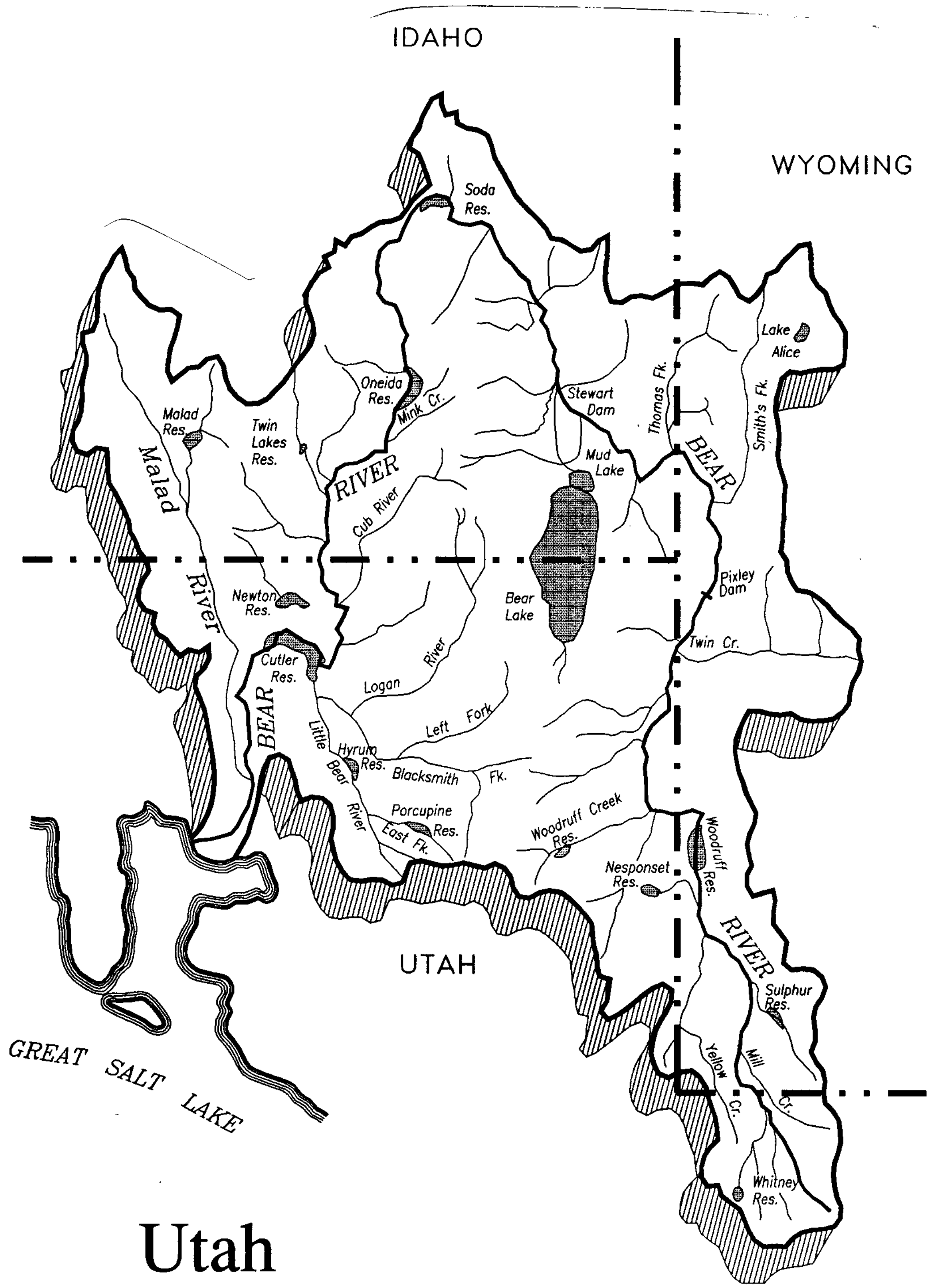

Utah
State Water Plan
Bear River Basin

January 1992

STATE OF UTAH
NATURAL RESOURCES
Division of Water Resources

State Water Plan

Bear River Basin

Utah Board of Water Resources
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January 1992

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State Water Plan ■ BEAR RIVER BASIN

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Section 1
FOREWORD

The Bear River Basin Plan is the first of eleven reports on river basins in Utah. The *January 1990 Utah State Water Plan (SWP)* covers the entire state, but in less specific terms. It presents a wide range of policies and guidelines for water planning, conservation, and development that will guide the individual basin planning process. Section 20 of the *SWP* will contain a summary of each river basin plan as it is written.

The Bear River Basin was placed first on the planning list mainly because of the relationship between the Bear River's water supply and the Wasatch Front's projected demand. Because 15-20 years are sometimes required to investigate and implement major water projects, work began early on the Bear River Basin Plan to avoid or minimize future water shortages.

River basin plans are not intended to be rigid "once-only" plans. Instead, they present flexible recommendations which recognize a need for continuous re-evaluation and change. Because changes will occur, it is realistic to expect them and provide an orderly process to accommodate them. Baseball's Casey Stengel is quoted as saying, "Making predictions is very difficult, especially about the future."

Historically, local water users have played an important role in planning, funding, and managing water projects. In addition to local efforts, state and federal agencies have been involved in various aspects of river basin planning and management. As water supply demands increase, activities at all levels of government must be more carefully coordinated and evaluated. The goal of the river basin plan is to help direct the orderly planning, conservation, development, protection, and preservation of Utah's water resources at the local level.

1.1 ACKNOWLEDGEMENT

The Board of Water Resources gratefully acknowledges the tireless efforts of the State Water Plan Coordinating Committee and Steering Committee in preparing this document. Work was lead by the planning staff of the Division of Water Resources, with valuable assistance from individual members of the coordinating committee. Efforts were highly professional and cooperative.

We also appreciate input from representatives of local, state, and federal cooperating entities, especially the local Bear River basin planning advisory group. Individuals from these entities provided a broad spectrum of expertise from a wide variety of interests.

And we extend a sincere thanks to the hundreds of people who attended meetings throughout the basin and provided oral and written comments to the Public Review Draft of the Bear River Basin Plan. Public input is imperative in the water planning process if a successful state water plan is to be obtained.

In endorsing this plan, as was the case with the **January 1990 State Water Plan,** we reserve the right to consider individual water projects on their own merits and may authorize a project which may not meet all the requirements of this plan. This basin plan is an important guide for water development in the Bear River Basin.

Clark J. Wall, Chairman

Clair C. Allen, Vice-Chairman

Roy P. Urie

George Buzianis

Wayne M. Winegar

Philip S. Knight

O. Eugene Johansen

Larry S. Ross

1.2 ABBREVIATIONS/ACRONYMS

Many names, titles, programs, organizations, legislative acts, measurements, and activities are abbreviated to reduce the number of words and simplify communications. A few commonly used abbreviations in the Bear River Basin Plan are listed in this section.

1.2.1 Federal Agencies

ASCS	Agricultural Stabilization and Conservation Service
BLM	Bureau of Land Management
BR(USBR)	Bureau of Reclamation
Corps	Corps of Engineers
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FS(USFGS)	Forest Service
FWS(USFWS)	Fish and Wildlife Service
GS(USGS)	Geological Survey
SCS	Soil Conservation Service

1.2.2 State and Local Organizations

BPAG	Basin Planning Advisory Group
BRWCD	Bear River Water Conservancy district

CEM	Comprehensive Emergency Management
DRC	Drought Response Committee
MCD	Multi-County Planning District
MWD	Metropolitan Water District
SLCWCD	Salt Lake County Water Conservancy District
UP&L	Utah Power and Light
USU	Utah State University
WBWCD	Weber Basin Water Conservancy District

1.2.3 Measurements

Ac	Acre
AF	Acre-feet
BOD	Biochemical Oxygen Demand
cfs	Cubic Feet per Second
Cu.Yd.	Cubic Yard
gpm	Gallon per Minute
kwh	Kilowatt Hour
MW	Megawatt
mg/l	Milligram per Liter
msl	Mean Sea Level
ph	Acidity
RVD	Recreation Visitor Day
TDS	Total Dissolved Solids
TSI	Tropic State Index
TSS	Total Suspended Solids
ug/l	Micrograms per Liter

1.2.4 Other

ATV	All-Terrain Vehicle
BMP	Best Management Practice
BMS	Best Management System
M&I	Municipal and Industrial
OM&R	Operation, Maintenance, and Replacement
RCC	Roller Compacted Concrete
WWTP	Wastewater Treatment Plant

Section 2 ■ CONTENTS

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Section 2
EXECUTIVE SUMMARY

The Bear River Basin Plan is presented in 19 sections. This executive summary is a synopsis or abstract of the other 18 sections which cover aspects of water resources in Utah's portion of the Bear River Basin. The following headings are titles of each of the sections summarized. The reader should study individual sections for more information.

FOREWORD

The **State Water Plan**, published in January 1990, provided the foundation and overall direction to establish and implement state water policies and recommendations. As part of the state water planning process, more detailed plans are prepared for each of the eleven hydrologic basins in the state. The Bear River Basin is the first of these. One goal of the river basin plan is to help strengthen the planning efforts at the local level. The plan is consistent with actions of the Bear River Development Task Force and intent of Utah's Bear River development legislation.

INTRODUCTION

Section 3 provides a general physical description of the Bear River Basin. The entire Bear River Basin covers 7,583 square miles, including portions of Wyoming, Idaho, and Utah. Of this total, 3,381 square miles are in Utah, including all of Rich and Cache counties and parts of Summit and Box Elder counties. The total river length is about 500 miles, beginning in the Uinta Mountains at elevations near 13,000 feet, and ending in the Great Salt Lake at an elevation of about 4,200 feet. Aspen and conifer forests cover about 27 percent of the basin; juniper, sagebrush, and other brush cover 37 percent; cropland about 20 percent; and the remaining 16 percent includes marshland, open water, residential, and other categories. Climate varies from 40 inches precipitation with harsh winters at higher elevations to nine inches and moderate temperatures at lower elevations.

Hampton Ford Station on the Bear River, 1872 - USGS

This section also includes general planning guidelines and organizational arrangements used in preparing the basin plan. The basin planning process provides opportunity for public involvement by state and federal agencies, as well as local governmental entities, organizations, and individuals.

DEMOGRAPHICS AND ECONOMIC FUTURE

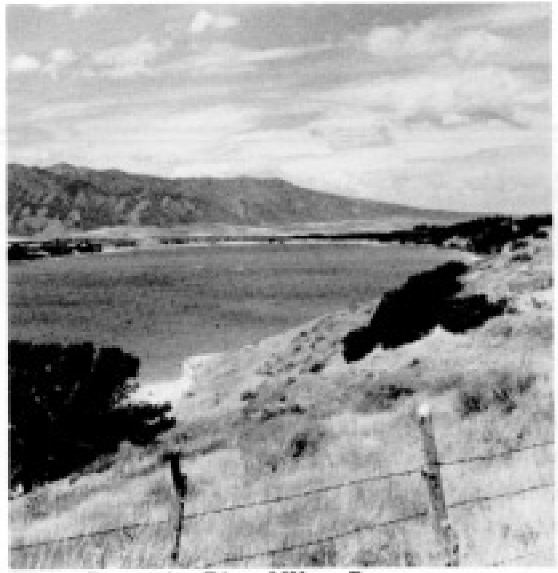
Population and economic aspects are discussed in Section 4. The 1990 census count of basin population within Utah was 108,393, including 70,183 in Cache County, 36,485 in Box Elder County, and 1,725 in Rich County. Logan and Brigham City, with populations of 32,762 and 15,644 respectively, account for more than 44 percent of the basin total. Of the next 10 largest cities, seven are in Cache County.

In terms of earnings, the basin's principal industry is manufacturing followed by government, retail trade, services, construction, and farming. The most important manufacturing industry is aerospace, followed by processing of agricultural products. The largest single employers are Thiokol in Box Elder County with 8,150 employees, and Utah State University in Cache County with 4,500.

The Bear River Basin population is projected to increase to 162,400 by the year 2020, including 107,200 in Cache County, 52,200 in Box Elder County, and 3,000 in Rich County. Employment in construction and manufacturing is expected to increase about 67 percent each by the year 2010.

WATER SUPPLY AND USE

Section 5 discusses historical flows, developable water supplies, present water uses, and interbasin water supply planning. About 1.5 million acre-feet of water has been developed for various uses in the Utah portion of the Bear River Basin. About 60 percent of this total is used for irrigation.


Hyrum Reservoir - Div. of Water Resources

Development of additional water is limited by the Amended Bear River Compact, existing Utah water rights, wide variations in annual runoff, and scarcity of favorable new reservoir storage sites. The average annual flow for the 1941-1990 period at the Bear River's lowest gaging station near Corinne is 1.232 million acre-feet. However, the practical limit for new depletions of water in Utah is estimated to be about 196,000 acre-feet per year. Annual estimated imports to the Bear River Basin near Brigham City, Utah, are 11,600 acre-feet. Annual estimated exports near Alexander, Idaho, are 23,000 acre-feet.

MANAGEMENT

In general, the water in the Bear River Basin is well-managed. Section 6 describes the existing water management systems in the basin for irrigation, municipal, industrial, and waterfowl uses and gives a brief discussion on the cloud seeding program. The Bear River is managed by court decrees, the Bear River Compact, and contracts with Utah Power &

Light Company. The UP&L operates Bear Lake for downstream irrigation and hydropower uses. Over 200 irrigation companies divert and use water in Utah. The 52 community water systems in the Utah portion of the basin provide culinary water to essentially all of the residents. Bear River water is managed for waterfowl use at the federal Bear River Migratory Bird Refuge, two state-owned waterfowl areas, and at nine privately-owned duck clubs.

REGULATION/INSTITUTIONAL CONSIDERATIONS

Section 7 discusses existing water rights, the Bear River Compact, the jurisdiction of land areas, and related problems. Any water development on the Bear River must conform to established water rights and the Amended Bear River Compact. The State Engineer is currently adjudicating water in the Bear River Basin.

The Bear River Compact was approved in 1958 and amended in 1980. An interagency, interstate commission was created to administer provisions of the compact. The 1980 amended compact provides for the protection of all prior rights applied to beneficial use as of January 1, 1976, and the protection of all rights granted under the 1958 compact. The 1980 amended compact also includes groundwater development in allocations, additional storage rights to all three states above Bear Lake, and allocation of the remaining water below Bear Lake between Utah and Idaho.

STATE AND FEDERAL WATER RESOURCES FUNDING PROGRAMS

Funding programs available for planning and development of water resources in the Bear River Basin, and a brief review of cost-sharing considerations, are discussed in Section 8. Most programs are available statewide. However, the Bear River Development Account established by the 1991 Utah Legislature is available only for basin water development and specifies the basis for cost-sharing. Over the last 40 years, at least $70 million in financial assistance has been provided by state and federal agencies for a wide variety of water activities and facilities in the Bear River Basin. Most communities in the basin have benefitted from these expenditures.

WATER PLANNING AND DEVELOPMENT

Section 9 describes potential water development alternatives for the Bear River Basin. Various considerations related to water development are discussed such as present water uses and supplies, future water needs, options for meeting needs, potential reservoir storage sites, environmental impacts, water quality assessment, costs, and economic and financial analysis. A suggested water development plan and implementation schedule are presented, and recommendations are included for additional activities needed to finalize and implement the plan.

The currently developed water supplies in the basin are slightly greater than the uses. While the Bear River Basin, as a whole, has sufficient public community water supplies to meet municipal and industrial (M&I) demands for the next 20 years, some individual systems are rapidly approaching their limits and will need new sources of water in the near future. Alternatives examined to meet future demands in and out of the basin include building reservoirs, increasing groundwater use, accelerating conservation/education, and transferring water rights.

Building storage reservoirs is considered the most practical alternative to develop large quantities of new Bear River water. In the lower Bear River, the Division of Water Resources has evaluated almost 40 potential reservoir sites. Sites included as potential projects in the Bear River Development Act are the Avon, Barrens, Honeyville, Hyrum Enlargement, Mill Creek, and Oneida Narrows. Environmental analyses and water quality assessments were conducted on all of these sites except the Oneida Narrows. Computer models were used to estimate yields from each individual reservoir as well as various combinations of reservoirs on the Bear River system in conjunction with the Willard Bay Reservoir.

Honeyville Site - Div. of Water Resources

An economic analysis was performed for these various projects to determine if the benefits will exceed the cost. Benefits were analyzed without regard to whom they accrue and costs were calculated without regard to who pays the cost. Four project alternatives are presented where benefits exceed costs.

On the basis of investigations, evaluations, and assumptions previously discussed, the division suggests the following water development plan: 1) enlarge Hyrum Reservoir, 2) connect the Bear River with a pipeline/canal to Willard Bay Reservoir, 3) provide conveyance and treatment facilities to deliver water to the Wasatch Front, and 4) build Honeyville Reservoir. The plan should be implemented in the order listed and will take an estimated 30-35 years to complete. Construction on any project cannot begin until all technical investigations are completed, contracts have been made for sale or lease of at least 70 percent of the water, permits have been obtained, an environmental mitigation plan has been prepared, and funds have been appropriated by the Legislature. If future needs do not develop as anticipated, the plan will be modified.

A financial analysis was performed on the suggested plan to separate costs of the project into categories and decide who should pay them. The Bear River Water Development Act stipulates that the state will own and finance construction of dams. Purveyors will finance and build distribution systems to convey water to their customers. Total project costs are estimated at about $270 million. Annual revenue to the state is nearly $8 million. Non-reimbursable costs are about $9 million.

Recommendations concerning future water planning and development are:

- obtain water sales agreements,
- continue a dialogue with Idaho on a joint Oneida Narrows Project,
- do detailed investigations of enlarging Hyrum Reservoir,
- investigate diversion of water from Blacksmith Fork to the Hyrum Reservoir,
- determine the interest of the U. S. Fish and Wildlife Service in a joint water development project.
- identify the most effective conveyance alternative for delivering Bear River water to Willard Reservoir,
- study alternatives for delivering water from the Hyrum Reservoir to Box Elder County and;
- protect the Honeyville and Hyrum Reservoir sites for future reservoir use.

AGRICULTURAL WATER CONSERVATION AND DEVELOPMENT

Section 10 describes the agricultural industry in the Bear River Basin, and discusses problems and potential solutions. Within the Utah portion of the basin, about 420,000 acres of land are cultivated, of which 301,700 acres are irrigated. The total consumptive use on the irrigated cropland, including rainfall, is estimated to be 535,600 acre-feet. The Bear River Canal Company operates the largest irrigation water delivery system in the basin, serving about 64,000 acres. The 12 largest irrigation companies deliver water to 48 percent of the irrigated land in the Utah portion of the basin.

The long-term trend in irrigated land in the Bear River Basin is nearly constant. This basin is one of the few places in the state where water and land are available for expansion. New irrigation projects, such as the South Cache and Bonneville Bench projects, are currently economically infeasible. Small, isolated acreage within areas served by existing irrigation systems could be irrigated if water was available. Also, an estimated 39,000 acres of existing irrigated cropland with occasional late season water shortage could use supplemental water.

In planning and evaluating future multipurpose water development projects in the Bear River Basin, consideration should be given to providing irrigation water for new lands and supplemental irrigation water for existing lands wherever water users are financially willing and able to participate.

DRINKING WATER SUPPLIES

Section 11 describes the present drinking water systems in the basin, discusses present and future problems, and presents estimated future water requirements. In the Utah portion of the Bear River Basin, 128 drinking water systems have been identified. Fifty-two of these systems are classified as "public, community" which serve at least 15 residences occupied year-round; 42 are "public, non-community" which serve at least 25 non-residents for 60 days or more; and 34 are "non-public" which do not meet the other criteria. Most public community water systems are owned and operated by a municipality, but a few are owned and operated by a private company or a state or federal agency.

Of the 52 public community water systems, nine are not approved by the Utah Division of Drinking Water, 10 systems are currently deficient in source capacity, and 9 systems are currently deficient in storage. These drinking water systems provided an estimated 51,170 acre-feet of water for residential and commercial use in 1990. The corresponding future requirement is estimated to reach 65,560 acre-feet per year by the year 2010.

A review of five state/federal funding programs shows that at least $30 million has been spent in 41 communities since 1970 to improve drinking water systems. The costs to install new facilities and improve existing facilities and anticipated costs to meet new federal requirements will be enormous. Continued state financial assistance will be needed.

WATER POLLUTION CONTROL

Data and information on existing levels of water pollution throughout the basin are presented in Section 12. Sources of pollution are identified, problems and solutions are discussed, and recommendations for control and improvement are given. An assessment and planning project is currently underway to better define problem areas, develop solutions, and implement a water quality management framework to protect and enhance the quality of the basin's surface and groundwater resources.

Most groundwater in the Bear River Basin is good quality. The quality of surface water, however, varies widely. The quality of surface water that enters Utah from Wyoming is considered to be good, but the quality deteriorates as the river flows downstream through the three states. In general, each tributary stream shows a similar pattern of downstream deterioration.

Of the 35 Utah communities below the Utah-Idaho state line, 15 have municipal wastewater treatment facilities. Several additional communities are contemplating constructing new sewage collection and treatment systems. The basin has 10 municipal and eight industrial permitted wastewater treatment facilities. In addition, a number of facilities do not discharge and are not required to obtain a permit. Other communities have recently received state and federal funds for planning, design, or construction of centralized wastewater collection and disposal systems. The estimated capital cost expenditure to meet current wastewater needs in the Bear River Basin is $346.5 million.

Bear River Flooding

Non-point source (NPS) pollution is a major contributor to water quality problems in the basin. Of the 21 Utah watersheds prioritized for water quality improvement under the NPS program, three are in the Bear River Basin, and all are in Cache County. Of the many agricultural impacts on water quality, animal waste from dairies and feedlots deserves special attention. The Little Bear River system is currently serving as a demonstration area for a river management pilot project to control water pollution. The project will determine the feasibility of implementing corrective measures and annual maintenance and preventive programs.

DISASTER AND EMERGENCY RESPONSE

Section 13 defines the organizational responsibilities for emergency response in the Bear River Basin, concentrating mainly floods and drought, the two most common water-related emergencies. Other emergency situations are also briefly considered.

Flooding is common in the basin, but because damages have been moderate, it has not been a major local problem. Most of the damages from floods are from erosion and sediment deposition. Primarily, agricultural land and property have been damaged. Most of the Bear River flood plain has a high water table, and construction of homes and other buildings within this zone has been limited. The most notable flood occurred when The Great Salt Lake reached a record high level in 1986. The lake inundated the Bear River Migratory Bird Refuge and other private and public facilities along its shoreline, and caused millions of dollars in damages. Droughts have occurred fairly frequently in the Bear River Basin. Because they are usually basinwide or statewide in nature, they have been dealt with in the past on a statewide basis. A drought response plan is in place to provide an effective means for the state to assess and respond to drought impacts. The immediate and primary responsibility for drought relief rests with local authorities of city and county governments. State action is taken only when local capabilities cannot cope with the needs. To prepare in advance for the difficult problems associated with droughts, each county and community should formulate its own drought response plan.

FISHERIES AND WATER-RELATED WILDLIFE

Fish and wildlife resources in the Bear River Basin are described in Section 14 along with a discussion of existing needs, alternatives solutions, and recommendations. The basin provides unusually good habitat for a wide variety of fish and wildlife. The Bear River Migratory Bird Refuge has national significance, and the state operates several waterfowl and wildlife management areas. Much of Utah's Class I trout fisheries, significant reaches of Class II streams, and a unique fishery in Bear Lake are within the basin.

Water quality problems in Hyrum, Newton, Cutler, and Mantua reservoirs, and the Bear River and Little Bear River in Cache Valley are of special concern to fish and wildlife. Several different efforts and programs are aimed at improving water quality in these areas, including the non-point source pollution program on the Little Bear River, watershed improvement plans, public information and education, and the water quality management plan.

When the Great Salt Lake rose to its record level in 1986, it inundated the Bear River Migratory Bird Refuge and caused extensive damage to facilities. As a part of a major restoration program, the Fish and Wildlife Service prepared an environmental assessment in 1991 which considered four alternatives. The preferred alternative includes enhancement of the existing refuge and a 38,200-acre expansion.

Water resource development actions in the basin have altered the natural flow patterns of some streams. Storage and diversion of streamflows reduce the natural flow during part of the year. In some cases, the stream is dewatered. Releases from storage also augment the natural flow during other times of the year, often during low flow periods. Planning for water projects should incorporate instream flow considerations as part of project operational criteria.

Riparian vegetation is critical for virtually all wildlife in the basin. Streambank stability and resistance to channel scouring are enhanced by healthy riparian communities. If those responsible for maintenance, improvement, and restoration would voluntarily restore and improve streambank vegetation whenever an opportunity occurs, the results could be significant.

RECREATIONAL ASPECTS OF WATER DEVELOPMENT

The purpose of Section 15 is to describe the Bear River Basin's leisure facilities and resources, identify problems and needs, and offer some recommendations. The section focuses on the water-related, outdoor recreational aspects of active and passive leisure activities. It also presents findings from the 1990 public meetings and telephone survey.

Access and immediacy to water is extremely important to the recreating public in Utah. Water-related activities usually rank in the top 12 outdoor recreation activities. Major water resources for recreation include Bear Lake, eight reservoirs, numerous small lakes and streams in the national forests, and vast marshes and wet areas along the shoreline of the Great Salt Lake.

Considerable acreage of land in the basin managed by state and federal agencies provide many opportunities for recreational use. Within Box Elder, Cache, and Rich counties the Forest Service administers over 460,000 acres of land with over 2,860 visitor-days of capacity on 33 units. The Bureau of Land Management administers a large area, mostly in western Box Elder County. The U. S. Fish and Wildlife Service manages the 65,000 acre Bear River Migratory Bird Refuge in Box Elder County. The Utah Division of Wildlife Resources administers four major waterfowl areas in Box Elder County.

The Utah Division of Parks and Recreation administers about 3,840 acres of park land in the three basin counties. The division administers 44,600 surface acres of fresh water plus the surface of Great Salt Lake, pursuant to the state boating law. At Bear Lake, the division administers about 906 land acres at seven locations around the lake, plus about 34,250 surface acres on the Utah portion of the lake. Hyrum State Park has approximately 260 acres of land and 440 surface acres of water. Willard Bay State Park has about 2,673 acres of land, including 344 acres in two marinas, and 4,420 acres of water surface. Visitation dropped about 50 percent from 1986 to 1991 at Bear Lake and Willard Bay state parks due primarily to lowering water levels.

A major outdoor recreation household survey to determine what kind of outdoor recreation is occurring, public meetings to update critical outdoor recreation issues and needs, and a survey of recreation-providing government agencies to determine their respective expenditures for outdoor recreation were completed by the Division of Parks and Recreation in 1990. These provided part of the data needed to update the State Comprehensive Outdoor Recreation Plan (SCORP). The results are summarized for the Bear River Basin in Section 15.

Nearly $5 million in grants from the Federal Land and Water Conservation Fund (LWCF) have been spent since 1965. Total value of projects with matching funds was nearly $10 million. Most have been city and county projects, and about 47 percent were in association with major water features. Bear Lake land acquisitions and development amounted to about $1.8 million of the LWCF grants. To meet growing recreational needs, a balanced funding and operational cost program will have to be realized, utilizing federal, state, local, and private funds.

FEDERAL WATER PLANNING AND DEVELOPMENT

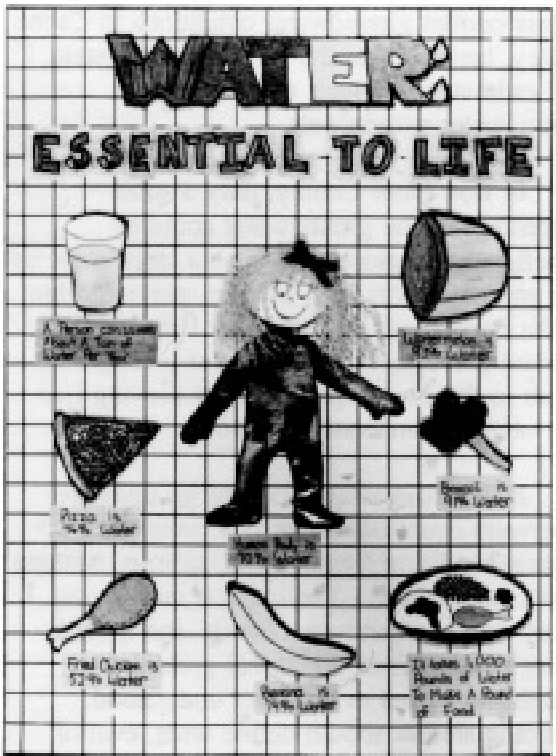
Section 16 describes past and expected future involvement of federal agencies in Bear River Basin water planning and development. Several federal agencies are actively involved in Bear River Basin planning, and several have been involved in planning and development for many years.

The Bureau of Reclamation and the Department of Agriculture have completed basinwide investigations. Hyrum Dam and Newton Dam were built by the Bureau of Reclamation many years ago. Irrigation improvements have been designed and built by the Soil Conservation Service in cooperation with other agencies and private local entities. The Department of Agriculture's water-related programs provide cost sharing and technical assistance. The Corps of Engineers recently conducted a flood reconnaissance study.

Federal programs most significant to the basin in the immediate future include the ongoing programs of the Department of Agriculture, the Environment Protection Agency's authority under the federal Safe Drinking Water Act and Clean Water Act, and the Fish and Wildlife Service's restoration and expansion plans for the Bear River Migratory Bird Refuge.

WATER CONSERVATION

Water conservation needs, issues, and alternatives are discussed in Section 17 along



KayCee Nielsen - 1991 Young Artists Water Education Poster Contest

with recommendations for conserving water. Two basic water conservation strategies are: (1) reduce demand by using supplies more efficiently, and (2) increase supplies by operating storage and delivery facilities more efficiently. The "wise use" of water requires involvement of both strategies.

The demand for more municipal and industrial water in the Bear River Basin is expected to increase by nearly 18,000 acre-feet by the year 2010. Agriculture use could increase by as much as 9,500 acre-feet if late season supplemental water is provided to existing irrigated cropland, and by another 18,000 acre-feet if water can be provided to non-irrigated cropland within the service area of existing irrigation systems. Additional water will be required for the expansion alternative of the Bear River Migratory Bird Refuge.

In terms of total foreseeable uses, it will be a long time before a limited water supply will necessitate a massive water conservation effort in the basin. Even though water supplies in the basin are generally plentiful, shortages already occur in some areas. Because of differing local circumstances, each area must be considered separately.

Water conservation methods and strategies available for use in the area include public information/education, institutionalizing water conservation, restricting water use, joint use of water supplies, landscaping and home water savings, pricing, reuse, and water measurement.

INDUSTRIAL WATER USE

Section 18 discusses industrial water use such as manufacturing of products, processing and washing operations, and commercial fish operations. Total industrial use in the basin is relatively small. Of the estimated 10,310 acre-feet of industrial use in the basin, about 80 percent is self-supplied; the remainder is from public supply systems. Almost all of the supply is from groundwater. Cache and Box Elder counties are attempting to attract new industries. Various estimates for additional industrial uses have been made, but they are not fully supported. One projection shows that if industrial water use grows at the same rate as the population in the next 20 years, it will increase from 10,310 acre-feet to 13,460 acre-feet. Updated information concerning future industrial water uses is needed.

GROUNDWATER

Groundwater conditions in the Bear River Basin, and important problems and issues, are described in Section 19. Groundwater is an important source of water for municipal, industrial, and agricultural uses. Of the 82,880 acre-feet of groundwater used in the basin in

1990, 60 percent was for municipal use, 27 percent for irrigation, and 13 percent for industrial use.

Groundwater reservoirs in the Bear River Basin are generally full. The recharge to groundwater in Cache County is estimated to be 170,000 acre-feet per year. The groundwater discharge is also estimated to be 170,000 acre-feet with 14 percent being pumped from wells, 49 percent discharging to streams and springs, and 37 percent owing to evaportranspiration. Box Elder County groundwater recharge is estimated to be 315,000 acre-feet per year. The discharge is estimated to be the same amount with one percent being pumped from wells, 67 percent discharging to streams, 32 percent going to evaportranspiration. Less than one percent leaves as subsurface outflow.

Cache County has a good supply of high quality groundwater for municipal use. A study made 20 years ago estimated an additional 75,000 acre-feet per year of groundwater could be withdrawn from Cache Valley aquifers without significantly impacting surface supplies. However, a study is currently underway with the U. S. Geological Survey to access current groundwater conditions in Cache Valley, better define the groundwater system, and estimate the effects of additional groundwater withdrawals.

In Box Elder County, only a small percentage of the groundwater could be beneficially developed, because a large share of the groundwater is high in salts, generally due to the impacts of the Great Salt Lake. Any marked decreases in groundwater levels could result in the poorer quality water moving into the inland groundwater reservoirs.

New withdrawals from the groundwater reservoirs could impact surface water by decreasing discharges to wells, springs, wetland areas, and streams. The impacts on existing water rights, groundwater levels, and surface water systems from additional groundwater withdrawals need to be better understood. Ongoing studies should define what level of new development can occur without significant interference with existing water rights.

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Section 3
INTRODUCTION

This section includes a general physical description of the Bear River Basin. It also includes some general planning guidelines and the organizational arrangements used in preparing the basin plan.

3.1 BACKGROUND

Through the Board of Water Resources and the Division of Water Resources (division), the state has a leadership role in water planning and development and coordinating the activities of other state and federal agencies involved. Formulation of basin plans fits within the state water policy framework, which includes regulation, conservation, development, protection of water quality, and management. Municipal and industrial (M&I), agricultural, fish and wildlife, and recreational uses are part of the planning. The interrelation of water resource demands and activities is recognized and incorporated.

The Bear River Basin Plan includes a description of significant water problems, options available to resolve them, and recommendations for future action. One main purpose of the plan is to identify problems which need early attention. Each recommendation in the basin plan addressing an identified need is consistent with the state water policies identified in the 1990 State Water Plan (SWP).

Previous water-related studies conducted by state and federal agencies in the Bear River Basin have provided important information on the basin resources and, in some cases, alternative water development plans. The studies used in preparing this report are listed by number at the end of each section, and are referenced in the narrative by the same number.

The Bear River Basin Plan is prepared at a reconnaissance level, giving a general assessment of problems and demands and identifying their location. Basin planning is a continuous process, and the plans are flexible to allow for future revisions. Water management, protection of water quality, and conservation needs are delineated, and all potential uses of streams are considered. It is intended that both the formulation of a plan and its implementation will provide for a balance of environmental, economic, social, and political factors.

Over the years, many water supply projects have been built by private individuals, non-profit irrigation companies, and incorporated municipalities. The state and the federal government have participated in basin water development. Substantial hydropower developments have been built and are being operated by Utah Power & Light Company (UP&L) and several municipalities. Future water development projects in the basin can be expected because of the quantity of undeveloped water available, the projected growth, and an increasing demand for water along the Wasatch Front where water is less plentiful.

3.2 DESCRIPTION OF BASIN

The Bear River Basin is unique in many ways. In order to better understand the problems, alternatives, and recommended actions, a brief description of the basin's physical characteristics is presented.

3.2.1 Drainage Area and Topography

While the basin encompasses parts of three states, the Bear River begins and ends in Utah. The river begins about 60 air miles east of Salt Lake City in the Uinta Mountains, and flows through parts of southwestern Wyoming and southeastern Idaho before returning to Utah and emptying into the Great Salt Lake. The total river length is approximately 500 miles. The basin covers about 7,583 square miles in the following portions in each state:

State	Area (Sq. Mi.)[2]
Utah	3,381
Wyoming	1,507
Idaho	2,695
Total	**7,583**

This report primarily discusses the portion of the basin within Utah, consisting of a small part of Summit County, all of Rich and Cache counties, and the eastern quarter of Box Elder County. These areas are as follows:

County	Area (Sq. Mi.)[5]
Summit	293
Rich	1,078
Cache	1,175
Box Elder	835
Total	**3,381**

References are made throughout this report to the upper and lower basins within Utah. In general, "upper" means Summit and Rich counties, and "lower" means Cache and Box Elder counties. This is a simple and convenient distinction for the reader, but it is not the same definition used in the Bear River Compact (See Section 7).

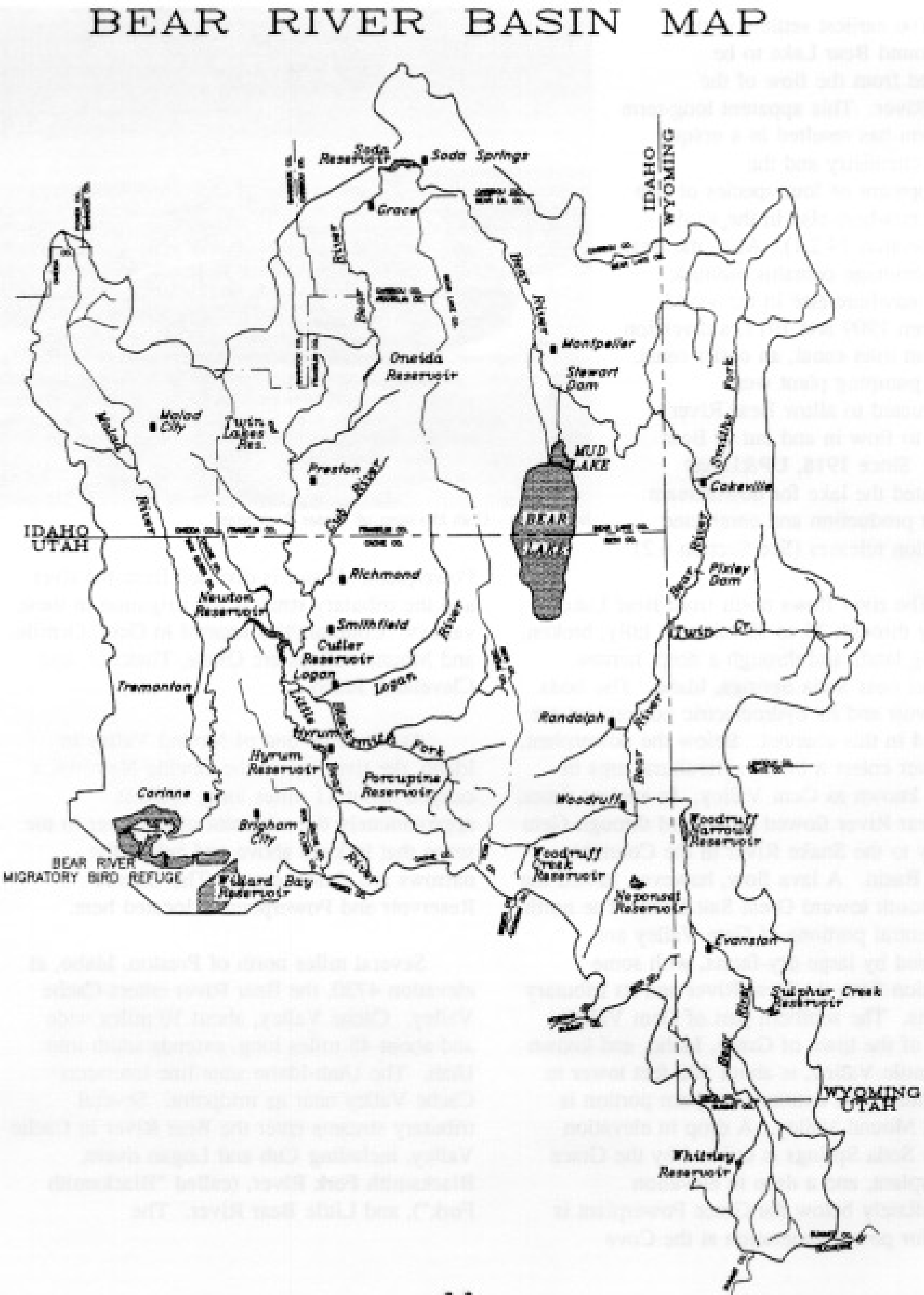
Although the Bear River Basin plan covers only the Utah portion, the following description encompasses the entire basin, as shown in Figure 3-1. It isn't possible to understand the hydrology of the river without considering the entire basin.

The headwaters are in the western end of the Uinta Mountain Range in Summit County, Utah, at elevations approaching 13,000 feet. In the upper reaches of the river, numerous small glacial lakes serve as catchment areas for the heavy snowfall and rain. About 25 miles downstream, near the Wyoming stateline, the river flow leaves the mountains and at elevation 7,000 feet enters a broad, gently-sloping valley about 10 miles wide.

This valley extends northward almost 100 miles, through Wyoming, Rich County, Utah, Wyoming again, and westward into Idaho at elevation 6,000 feet (approximately). Arable lands are common along this valley.

A few miles after the Bear River enters Idaho, it flows westward into the mid-portion of Bear Lake Valley. This valley is about 12 miles wide and 50 miles long, extending northward into Idaho and southward into Utah. The south end of the valley is inundated by Bear Lake, a feature of special importance to this report. The lake is 19 miles long, 7.5 miles wide, has 52 miles of shoreline, and covers a surface area of 110 square miles. The lake's

FIGURE 3-1


BEAR RIVER BASIN MAP
Soda Reservoir
Soda Springs
Grace
IDAHO
WYOMING
Bear River
Oneida Reservoir
Montpelier
Stewart Dam
Malad City
Twin Lakes Res.
Preston
MUD LAKE
Cokeville
IDAHO
UTAH
BEAR LAKE
Richmond
Pixley Dam
Newton Reservoir
Smithfield
Cutler Reservoir
Logan
Tremonton
Randolph
Hyrum
Hyrum Reservoir
Porcupine Reservoir
Corinne
Woodruff
Woodruff Narrows Reservoir
Brigham City
BEAR RIVER
MIGRATORY BIRD REFUGE
Willard Bay Reservoir
Woodruff Creek Reservoir
Neponset Reservoir
Evanston
Sulphur Creek Reservoir
WYOMING
UTAH
Whitney Reservoir

maximum depth is 208 feet, and it's total volume is 6.5 million acre-feet.

The earliest settlers in the area found Bear Lake to be isolated from the flow of the Bear River. This apparent long-term isolation has resulted in a unique water chemistry and the development of four species of fish found nowhere else in the world (See Section 14.2.1). Also, the Bear Lake drainage contains mollusk found nowhere else in the world. Between 1909 and 1918, a diversion dam, an inlet canal, an outlet canal, and a pumping plant were constructed to allow Bear River water to flow in and out of Bear Lake. Since 1918, UP&L has regulated the lake for downstream power production and contracted irrigation releases (See Section 6.2).


Bear Lake - Utah Division of Water Resources

The river flows north from Bear Lake Valley through 25 to 30 miles of hilly, broken, grazing lands and through a deep, narrow channel near Soda Springs, Idaho. The Soda Reservoir and its hydroelectric powerplant are located in this channel. Below the powerplant, the river enters a broad agricultural area in Idaho known as Gem Valley. In ancient times, the Bear River flowed northward through Gem Valley to the Snake River in the Columbia River Basin. A lava flow, however, turned the river south toward Great Salt Lake. The north and central portions of Gem Valley are occupied by large dry-farms, with some irrigation from the Bear River and its tributary streams. The southern part of Gem Valley, south of the town of Grace, Idaho, and known as Gentile Valley, is about 500 feet lower in elevation. The extreme southern portion is called Mound Valley. A drop in elevation below Soda Springs is utilized by the Grace Powerplant, and a drop in elevation immediately below the Grace Powerplant is used for power generation at the Cove Powerplant. Water is diverted from the river and the tributary streams for irrigation in these valleys. Communities located in Gem, Gentile, and Mound valleys are Grace, Thatcher, and Cleveland, Idaho.

At the south end of Mound Valley in Idaho, the river enters the Oneida Narrows, a canyon about 11 miles long. This is approximately the midpoint of the river in the sense that inflows above and below the narrows are almost equal. The Oneida Reservoir and Powerplant is located here.

Several miles north of Preston, Idaho, at elevation 4720, the Bear River enters Cache Valley. Cache Valley, about 10 miles wide and about 45 miles long, extends south into Utah. The Utah-Idaho state line intersects Cache Valley near its midpoint. Several tributary streams enter the Bear River in Cache Valley, including Cub and Logan rivers, Blacksmith Fork River, (called "Blacksmith Fork"), and Little Bear River. The

Bear River enters the Cache Valley from the northeast, runs rather sluggishly southward, and leaves the valley westward through a narrow two-mile gorge into Box Elder County. UP&L's Cutler Dam and its hydropower plant, the last hydropower plant on the Bear River, are located at the lower end of the gorge.

The Bear River then flows southwesterly through Box Elder County into Bear River Bay on the Great Salt Lake. The Bear River Bay is the largest contiguous natural freshwater bay in the United States. The Bear River Migratory Bird Refuge, a federally developed and operated waterfowl management area, is located in the north end of the bay.

The southwestern boundary of the Bear River Basin, as defined in this report and as shown on Figure 3-1, encloses the drainage area surrounding Bothwell, Thatcher, and Penrose (but not Blue Creek), the Public Shooting Grounds, the entire Bear River Migratory Bird Refuge, Willard Bay Reservoir, and the drainage area surrounding Willard and Perry.

3.2.2 Soils

The soils of the upper valleys in Rich and Summit counties have developed from alluvial sediments on flood plains, alluvial fans, and footslope areas at the base of the mountains. Quartzites and sandstones are the predominant parent material for the alluvium found in the upper valleys. Being so near the source of parent materials, the valley fill in the upper valleys consists mainly of coarse sands and gravels. In some places, however, the soils are made up of medium to fine textured topsoils overlying the more coarse-grained sand and gravels.

In Cache and Box Elder counties, valley soils have developed from sediments deposited in ancient Lake Bonneville. Much of the soil is medium to coarse-textured material, deposited at the edges of the valleys as fans. The lake terraces and finer materials, widely distributed on the broader interior floor of the valleys, were deposited during Bonneville and post-Bonneville times. As a result, a complex pattern of highly stratified soils exists.

In general, arable lands of the basin have good water transmission properties and adequate moisture-holding capacity which, with other favorable physical and chemical properties, make them well-suited for irrigated agriculture.

3.2.3 Climate

As elevations in the basin vary from 4,200 to 13,000 feet, precipitation also varies, from 9 inches to over 40 inches at higher elevations. So also does vegetation vary accordingly. Heavy alpine forests above about 8,000 feet give way to sagebrush, sparse grasses, and semi-desert conditions at low elevations. About one-fourth of the entire basin is forested, more than one-third is rangeland, and about one-fifth is cultivated. A detailed inventory of vegetative cover was made by the U.S. Department of Agriculture in 1978. For the Utah portion, the inventory is summarized in Table 3-1.

The Bear River Basin is typical of mountainous areas in the West, with wide ranges in temperature between summer and winter and day and night. The high mountain valleys experience long, cold winters and short, cool summers. The lower valleys are more moderate, with less variance between maximum and minimum temperatures. 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 average frost-free season (above 28° F.) varies from about 174 days at Corinne to 94 days at Woodruff.

In the higher valleys of Summit County south of Evanston, Wyoming, the growing season is much shorter.

TABLE 3-1
VEGETATIVE COVER ON UTAH PORTION OF BEAR RIVER BASIN

Type of Cover	Area (1000 ac.)	Percent of Total Area
Alpine, conifer, and aspen	585[a]	27.0
Mountain brush, juniper, sagebrush, greasewood	807[b]	37.3
Cropland	424[c]	19.6
Scattered native vegetation	118	5.5
Riparian, marshland, wet flats	101[d]	4.7
Open water	98	4.5
Residential, commercial, industrial	31	1.4
Total	12,164	100.0

Source: See Reference No. 2 (Tables V-1 and V-4).

[a]Includes 397,000 acres of aspen
[b]Includes 497,000 acres of sagebrush
[c]122,000 non-irrigated, plus 302,000 irrigated (Table 10-2).
[d]Includes Bear River Migratory Bird Refuge.

3.3 PLANNING PROCESS

To be flexible and accommodate changes in needs and circumstances, review and revision of the plan will be a continual process. This will provide opportunities for all state and federal agencies, as well as local government entities, organizations, and individuals, to present their concerns.

3.3.1 Steering Committee

The State Water Plan Steering Committee consists of the chairman and vice chairman of the Board of Water Resources, the executive director of the Department of Natural Resources, and the director and assistant director of the Division of Water Resources. The chairman of the Board of Water Resources is chairman of the Steering Committee. The Steering Committee guides plan development in regard to policy and resolution of issues, and approves the plan prior to official acceptance by the Board of Water Resources.

3.3.2 Coordinating Committee

To assure that all state agencies with specific water-related missions are involved, the following were invited by the director of the Division of Water Resources to participate on the State Water Plan Coordinating Committee:

- Department of Natural Resources
  - Division of Water Resources
  - Division of Water Rights
  - Division of Wildlife Resources
  - Division of Parks and Recreation
- Department of Environmental Quality
  - Division of Drinking Water
  - Division of Water Quality
- Department of Agriculture
- Office of Planning and Budget
- Utah Water Research Laboratory

Each of these organizations designated a representative to participate. Some of the agencies participating on the coordinating committee have policy boards, commissions, or councils whose support is important to the basin plan. Each agency has the responsibility to keep its board informed about the basin plans.

3.3.3 Cooperating State Agencies

Nine other state agencies with expertise or involvement in water resources were asked to be cooperating state agencies. These agencies meet and work with the State Water Plan Coordinating Committee on an ad hoc basis.

3.3.4 Cooperating Federal Agencies

Many federal agencies have water resource programs affecting the State Water Plan. Eleven were asked to cooperate in developing the State Water Plan. Important input for the Bear River Basin Plan has been furnished from these agencies.

3.3.5 Basin Planning Advisory Group

Many water management agencies, special interest groups, private organizations, and political entities have a major interest in a basin plan. In order to involve local participation in the early stages of the planning process, a local basin planning advisory group was formed. Twenty-eight local individuals with an interest in state water planning were invited to review and comment on succeeding draft documents, and to help coordinate local basin input throughout the plan formulation and revision phases. The Basin Planning Advisory Group (BPAG) represents many of the local governments, water-user organizations, and other interested parties (See 3.4.3).

3.4 PUBLIC INVOLVEMENT

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.

Bear River Commission - Utah Div. of Water Resources

3.4.1 Public Involvement Program - 1985

In the summer and fall of 1985, an extensive public involvement program in the lower Bear River Basin was conducted for the Division of Water Resources by the Utah Association of Conservation Districts. Through a series of questionnaires, personal interviews, and 25 public meetings, the opinions of 250 residents of Cache and Box Elder counties concerning potential water development were obtained and listed. The concerns expressed at that time by the public are summarized in Table 3-2. No attempt has been made to prioritize or rank the issues by order of importance. Further explanation and discussion are contained in the original public involvement report[4]

3.4.2 State Water Plan Public Review - 1989

Sixteen public meetings were held throughout Utah in March and April 1989 to obtain local input to the Public Review Draft of the State Water Plan. Two of these meetings were held in the Bear River Basin (Logan and Tremonton) in March 1989. Forty-six people attended these two meetings and participated in a discussion on the State Water Plan.

3.4.3 Advisory Review Draft - April 1990

During the first week of April 1990, an Advisory Review Draft of the Bear River Basin Plan was distributed to the advisory groups (BPAG and statewide), and to other local, state, and federal cooperating entities. The State Water Plan Steering Committee met with the local BPAG on April 4, 1990, for a brief orientation and an introduction to the Advisory Review Draft and the basin planning process. Division staff held nine meetings in May and June with 24 members of the BPAG to discuss the Advisory Review Draft and gather comments.

3.4.4 Advisory Review Draft, Revision #1 - May 1991

Comments received from the coordinating committee and local, state, and federal cooperating entities on the Bear River Basin Advisory Review Draft were reviewed and (as appropriate) incorporated into a revised Advisory Review Draft. The revised draft was distributed to the advisory review entities in May 1991. Division staff held five meetings in July with members of the BPAG to discuss the draft and obtain comments.

3.4.5 Public Review Draft - November 1991

Comments received on the revised Advisory Review Draft were incorporated into a Public Review Draft and distributed to the general public in November 1991. Seven public meetings were held in December 1991 to discuss and receive comment on the Public Review Draft. Thirty-four written comments were submitted for consideration in addition to 31 oral comments at the meetings. Appropriate comments have been incorporated.

3.5 REFERENCES

In addition to the references listed below, the Utah State Water Plan, January 1990, discusses statewide aspects of state water planning.

1. "Hydrologic Inventory of the Bear River Study Unit," Utah State University for Utah Division of Water Resources, February 1973.

2. "Summary Report, Water and Related Land Resources, Bear River Basin," Cooperative Study, U.S. Department of Agriculture in cooperation with the States of Utah, Idaho, and Wyoming, 1978.

3. "Water-Related Land Use Inventories, Bear River Basin," Utah Division of Water Resources, January 1991.

4. "Public Involvement Program Concerning Water Development in the Lower Bear River Basin," Utah Association of Conservation Districts, for Utah Division of Water Resources, January 1986.

5. "Land Resource Data," U.S. Department of Agriculture, 1976. (Part of Reference No. 2).

TABLE 3-2
MAJOR ISSUES AND/OR CONCERNS EXPRESSED BY RESIDENTS - 1985

* Local water needs should be satisfied before any water is exported from the basin.

* The Public Involvement Program (begun in 1985) will be futile unless public involvement is continued throughout the planning process.

* The unit cost to develop agricultural water from the Bear River may be higher than other sources.

* The fact that the Oneida Reservoir site is located in Idaho may present political problems.

* The construction of some of the reservoir sites will inundate existing facilities. These lost facilities need to be replaced.

* Hydropower benefits should be used to pay for the project, rather than going into the pocket of a private developer.

* All those who benefit from the project should be expected to pay a fair share of the cost.

* Would the project be owned and operated locally, by the state, or by a private party?

* Would Salt Lake County's municipal and industrial uses become the controlling element in the operation of the Bear River project?

* In dry years would the available water be re-allocated to reflect the needs of municipal and industrial uses ahead of local prior rights for agriculture?

* What are the environmental impacts?

* Will the repayment and cost-sharing arrangements be equitable for both local water users and users of exported water?

* What assurance do local residents have that dams and other structures will be adequately designed to preclude failure?

* How would construction be funded?

* What role will groundwater play in the development of Bear River water?

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Section 4
DEMOGRAPHICS AND ECONOMIC FUTURE

The 1990 population census of the basin within Utah is 108,393[1]. By the year 2010 the total is projected to be 140,850, an increase of 30 percent. The average annual rate of growth is about 1.3 percent. The employment pattern will probably change moderately, with manufacturing and construction gaining, while agriculture and government sectors decrease.

Jackson School

4.1 DEMOGRAPHICS

The 1990 population of 108,393 within Utah represents a 10-year increase of 16 percent. The comparative 1980 and 1990 populations are shown in Table 4-1.

TABLE 4-1
BEAR RIVER BASIN POPULATION WITHIN UTAH[1]

County	1980	1990[c]	Percent of 1990 Total
Box Elder[a]	33,500	36,485	33.7
Cache	57,700	70,183	64.7
Rich	2,150	1,725	1.6
Summit[b]	0	0	0
Total	93,350	108,393	100.0
Percent of Utah Population	6.3	6.3	

[a]Entire county. County population outside basin is only about 2 percent.
[b]No permanent homes in this portion of county.
[c]Final 1990 census figures.

[1]Source: U.S. Bureau of Census and Utah Office of Planning and Budget.

The Utah Office of Planning and Budget prepared the projected population figures. These numbers were then used by the division as a basis for estimating water supply requirements in the Bear River Basin Plan. The 1990 census is the basis for all 1990 population figures. The basin population within Utah is considered to comprise Box Elder, Cache, and Rich counties, without any adjustment. The last two are entirely within the basin, but only the eastern portion of Box Elder County is.

Although more than three-fourths of Box Elder County's area lies outside the Bear River Basin, it includes only a few communities. The combined populations of Snowville, Howell, Grouse Creek, and Park Valley are less than 800, or only about two percent of the Box Elder County total. The 15 largest cities in the study area, with their 1990 census populations, are listed in Table 4-2.

The combined population of these 15 cities in 1990 constituted 77 percent of the basin population within Utah, and the two largest constitute almost 45 percent. Logan accounted for 47 percent of the Cache County population, and Brigham City accounted for 43 percent of the Box Elder County population.

Figure 4-1 shows the relative growth of the 15 cities since 1980. The apparent lack of growth in Brigham City, shown in Figure 4-1, is misleading. The U.S. Bureau of Indian Affairs, Intermountain Indian School, that operated since 1950 in Brigham City, was closed in the mid-1980s. The closure resulted in a significant loss of residents who had been included in the 1980 census. The Utah Office of Planning and Budget has estimated a net loss of 900 people from the closure. The school population was about 1,500,

TABLE 4-2
CITY POPULATIONS

City	1990 Population	County	Percent of Basin Total
Logan	32,762	Cache	30.2
Brigham City	15,644	Box Elder	14.4
Smithfield	5,566	Cache	5.1
Hyrum	4,829	Cache	4.5
Tremonton	4,264	Box Elder	3.9
N. Logan	3,768	Cache	3.5
Providence	3,344	Cache	3.1
Wellsville	2,206	Cache	2.0
Hyde Park	2,190	Cache	2.0
Richmond	1,955	Cache	1.8
Garland	1,637	Box Elder	1.2
Lewiston	1,532	Cache	1.4
Willard	1,298	Box Elder	1.2
River Heights	1,274	Cache	1.2
Perry	1,211	Box Elder	1.1

Source: U.S. Bureau of the Census and Utah Office of Planning & Budget[1].

FIGURE 4-1

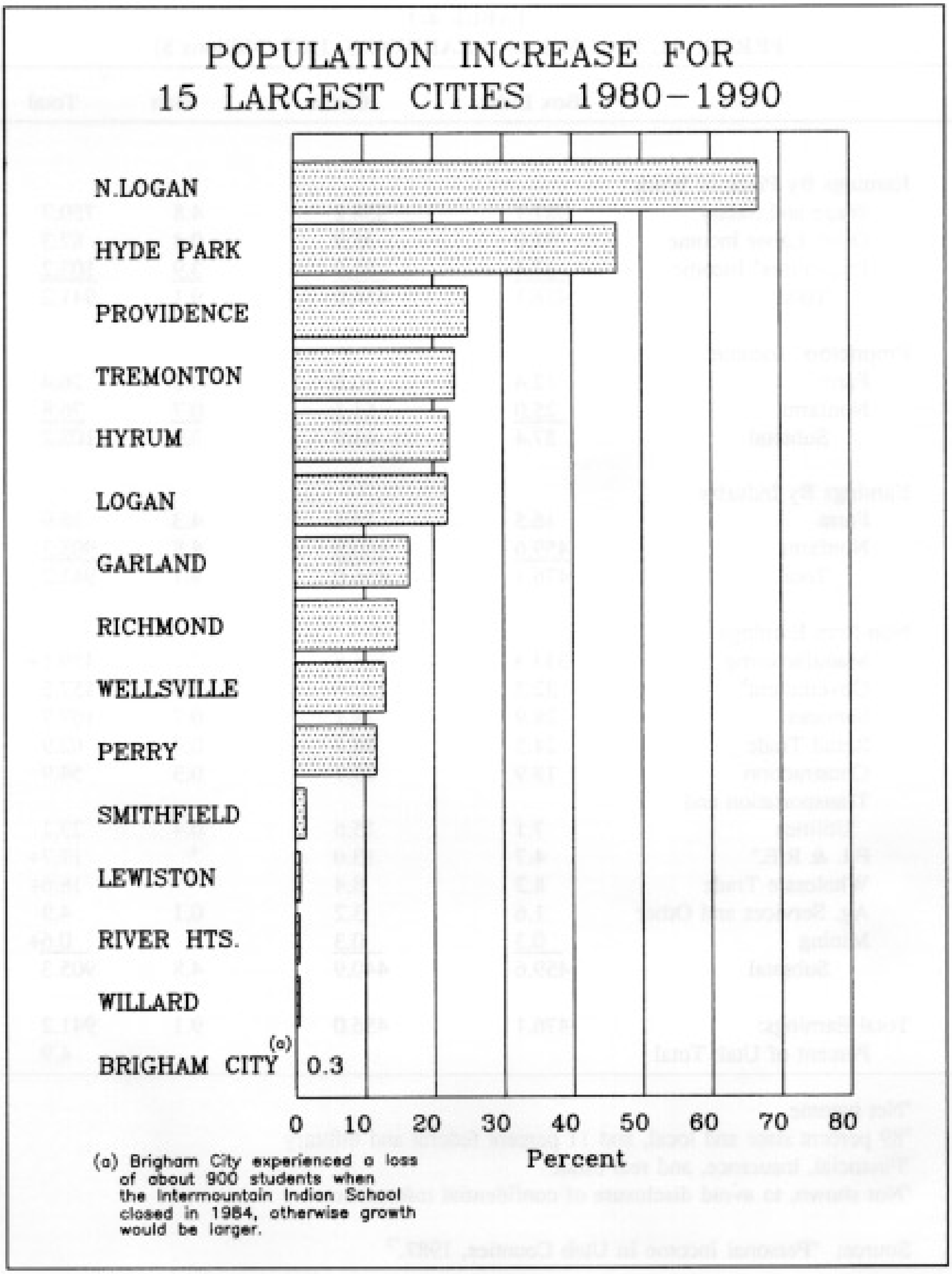
POPULATION INCREASE FOR
15 LARGEST CITIES 1980-1990
N.LOGAN
HYDE PARK
PROVIDENCE
TREMONTON
HYRUM
LOGAN
GARLAND
RICHMOND
WELLSVILLE
PERRY
SMITHFIELD
LEWISTON
RIVER HTS.
WILLARD
BRIGHAM CITY (a) 0.3
0 10 20 30 40 50 60 70 80
Percent
(a) Brigham City experienced a loss of about 900 students when the Intermountain Indian School closed in 1984, otherwise growth would be larger.

TABLE 4-3
PERSONAL INCOME AND EARNINGS, 1987 (Millions $)

	Box Elder	Cache	Rich	Total
Earnings By Place of Work				
Wage and Salary	387.7	358.2	4.8	750.7
Other Labor Income	51.0	35.9	0.4	87.3
Proprietors' Income	37.4	61.9	3.9	103.2
Total	476.1	456.0	9.1	941.2
Proprietors' Income[a]				
Farm	12.4	10.8	3.2	26.4
Nonfarm	25.0	51.1	0.7	76.8
Subtotal	37.4	61.9	3.9	103.2
Earnings By Industry				
Farm	16.5	15.1	4.3	35.9
Nonfarm	459.6	440.9	4.8	905.3
Total	476.1	456.0	9.1	941.2
Non-farm Earnings				
Manufacturing	333.3	125.8	[d]	459.1+
Government[b]	32.3	122.6	2.5	157.5
Services	28.9	78.1	0.7	107.7
Retail Trade	24.3	38.2	0.4	62.9
Construction	18.9	35.7	0.3	54.9
Transportation and Utilities	7.1	15.6	0.4	23.1
F.I. & R.E.[c]	4.7	13.0	[d]	17.7+
Wholesale Trade	8.2	8.4	[d]	16.6+
Ag. Services and Other	1.6	3.2	0.1	4.9
Mining	0.3	0.3	[d]	0.6+
Subtotal	459.6	440.9	4.8	905.3
Total Earnings:	476.1	456.0	9.1	941.2
Percent of Utah Total				4.9

[a]Net income
[b]89 percent state and local, and 11 percent federal and military
[c]Financial, insurance, and real estate
[d]Not shown, to avoid disclosure of confidential information

Source: "Personal Income In Utah Counties, 1987."[2]

including students, faculty, and other employees. A greeting card factory in Brigham City, with 159 employees, closed in the late 1980s. An estimated three-fourths of the people remained in Brigham City. The net population loss, including employees and families, was probably about 100. Without these two closures, the 1980-90 population growth would have been about 6.7 percent.

In terms of total earnings, the principal industry in Cache and Box Elder counties is manufacturing, followed by government, services, retail trade, construction, and farming. The principal industry in Rich County is farming. Personal income and earnings, by county, are shown in Table 4-3. The most important type of manufacturing in the basin is the aerospace industry, followed by the processing of agricultural products. The largest employers are Morton Thiokol in Box Elder County with 8,150 employees (1989)[2], and Utah State University in Logan with 4,500 (1991)[4].

Oregon. U.S. Highway 91, extending northward into Idaho, passes through Logan and Smithfield after leaving Interstate 15 at Brigham City. Three small airports, near Logan, Brigham City, and Tremonton, serve the area. Cache and Box Elder counties are serviced by the Union Pacific Railroad main line, with several spur lines located throughout the area.

4.2 POPULATION AND ECONOMICS

Estimates of future population used in this basin plan were made by the Utah Office of Planning and Budget[1]. Conclusions and recommendations are based on those projections, shown by county in Table 4-4. Employment projections by multi-county district (Box Elder, Cache, and Rich) are shown in Table 4-5. No subtraction has been made for the small population in western Box Elder County, which is outside the Bear River Basin.

TABLE 4-4
POPULATION PROJECTIONS

Year	Box Elder	Cache	Rich	Total
1990	36,485	70,183	1,725	108,393
2000	40,500	77,900	2,300	120,700
2010	46,300	91,900	2,600	140,800
2020	152,200	107,200	3,000	162,400
2025	55,100	114,900	3,200	173,200
2025/1990 Ratio	1.51	1.64	1.86	1.60

Source: Utah Office of Planning and Budget.[1]

Interstate 15, the major highway in the area, crosses Box Elder County in a north-south direction near Brigham City and Tremonton. Interstate 84 extends northwesterly from Tremonton to Boise, Idaho, and Portland, Oregon.

To estimate future water requirements of individual communities, population projections of communities were necessary. Community projections were made by the Utah Office of Planning and Budget, as shown in Section 11 (See Tables 11-8 through 11-10), and are consistent with county figures in Table 4-4.

TABLE 4-5
EMPLOYMENT PROJECTIONS
BOX ELDER, CACHE, AND RICH COUNTIES

Industry	1990	2000	2010	1990-2010 Increase (percent)
Agriculture	4,100	4,200	4,200	2.4
Mining	c	c	c	c
Construction	1,600	2,000	2,500	66.7
Manufacturing	16,700	21,700	27,100	67.3
TCPU[a]	800	1,000	1,100	37.5
Trade	7,400	8,600	10,300	39.2
FIRE[b]	900	1,100	1,300	44.4
Services	5,500	6,600	7,800	41.2
Government	10,100	10,800	12,500	23.8
Non-Farm Proprietors	6,900	7,200	8,500	23.2
TOTAL	54,100	63,200	75,400	39.4
Total for Non-Agricultural Wage and Salary Jobs	43,100	51,900	62,700	45.5

[a]Transportation, communication, and public utilities.
[b]Finance, insurance, and real estate.
[c]Probably less than 1/10 of 1%. Employment figure was 11 in 1987 (3/100 of 1%); shown in source publication as zero thereafter.

Source: Utah Office of Planning and Budget[1]

Employment in construction and manufacturing are expected to increase significantly (67 percent each) by 2010. All other sectors, except agriculture and mining, are expected to show significant growth, as shown in Table 4-5.

4.3 REFERENCES

In addition to the references below, statewide demographics and projected futures are discussed in the State Water Plan, January 1990.

1. "Economic and Demographic Projections, 1990," December, 1989; and final 1990 census figures, January 1991, Utah Office of Planning and Budget.

2. Utah Economic and Business Review, University of Utah Graduate School of Business. April 1989.

3. "Utah Agricultural Statistics, 1989," Utah Dept. of Agriculture, page 98.

4. Utah State University personnel office, February 22, 1991 (personal communications).

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Section 5
WATER SUPPLY AND USE

This section discusses historical flows, developable water supplies, present water uses, and interbasin water supply planning.

5.1 INTRODUCTION

The Bear River Basin is one of the few areas in the state where there appears to be an adequate developable water supply to meet existing and projected needs. The Bear River's average annual inflow to the Great Salt Lake is approximately one million acre-feet. Some of this water can be stored and developed to meet future needs.

5.2 WATER SUPPLY

Before considering how much of the water supply could be developed, it is helpful to review the streamflow records. Locations, amounts, and probabilities of basin water supplies are discussed on the following pages.

5.2.1 Historical Flows

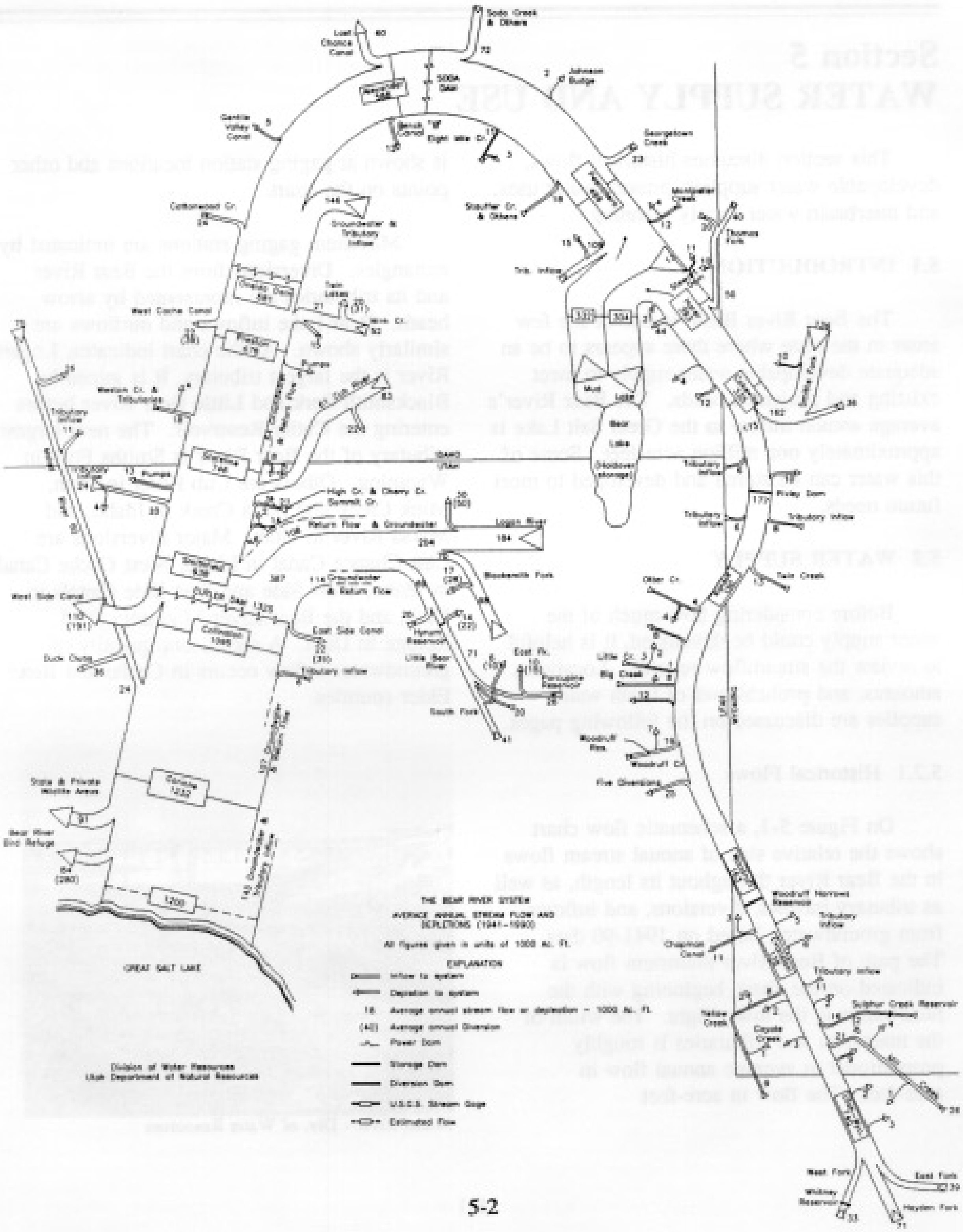
On Figure 5-1, a schematic flow chart shows the relative size of annual stream flows in the Bear River throughout its length, as well as tributary inflows, diversions, and inflows from groundwater, based on 1941-90 data. The path of Bear River mainstem flow is indicated on the chart, beginning with the headwaters at the lower right. The width of the mainstem and tributaries is roughly proportional to average annual flow in acre-feet. The flow in acre-feet is shown at gaging station locations and other points on the chart.

Mainstem gaging stations are indicated by rectangles. Diversions from the Bear River and its tributaries are represented by arrow heads. Bear Lake inflows and outflows are similarly shown. As the chart indicates, Logan River is the largest tributary. It is joined by Blacksmith Fork and Little Bear River before entering the Cutler Reservoir. The next largest tributary of the Bear River is Smiths Fork in Wyoming. Others are Cub River in Utah, Mink Creek and Soda Creek in Idaho, and Malad River in Utah. Major diversions are Last Chance Canal in Idaho, West Cache Canal in Idaho, West Side and East Side Canals in Utah, and the Bear River Migratory Bird Refuge in Utah. A significant quantity of groundwater inflow occurs in Cache and Box Elder counties.

Malad River - Div. of Water Resources

FIGURE 5-1

BEAR RIVER FLOW CHART



The stations above Bear Lake and on most of the tributary streams throughout the entire basin are operated by the U.S. Geological Survey (USGS). In cooperation with USGS, the Utah Power & Light Company (UP&L) operates and maintains most of the mainstem stations downstream from Bear Lake. Below the Corinne gage, a portion of the water is diverted into the Bear River Migratory Bird Refuge (See Figure 5-1).

A summary of key streamflow records is shown in Table 5-1. The main object of this table is to show flow characteristics along the Bear River, especially average annual runoff volumes. The Bear Lake outlet and inlet canals are included in order to show the effect of Bear Lake operations on downstream river flows. In all but extremely high runoff years, the entire flow of Bear River is diverted into Bear Lake. With the exceptions of these two canals, all of the streamflow records in Table 5-1 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 it enters the Great Salt Lake. The Harer, Idaho, Station was just above the canal diversion into Bear Lake. The station was operated by UP&L until removed from service in 1986. The Collinston, Utah, Station is immediately below the Cutler Dam and powerplant. This record, extending back to 1889, is the longest in the Bear River Basin, and one of the longest in Utah.

The 50-year interval of 1941-90 is a representative base period for streamflow averages and other hydrologic computations. Weather cycles with both extremely high and extremely low years are included in this period (See Figure 5-2).

Another important flow characteristic, in addition to average annual volume, is low flow. The frequency of occurrence of low flows, the degree to which they approach zero, the duration, and the season(s) when they occur, are all significant environmentally as well as for water supply and recreation. In Table 5-2, low-flow records are shown for five mainstem locations and six tributary streams. These 11 records were selected as being somewhat representative of the entire basin. Only four of the gaging stations are entirely free of the effects of upstream storage or diversions (Big Creek, High Creek, Logan River, and Blacksmith Fork).

Blacksmith Fork - Div. of Water Resources

Recorded instantaneous minimums alone do not convey the true picture of low-flow conditions. The lowest average day is probably more meaningful, or even the lowest average month. To give a better perspective, both of these properties are shown in Table 5-2, along with the long-term annual average. For example, the difference between lowest day, lowest month, and average year-round flow is not very great for Logan River and Blacksmith Fork, and also for Bear River at the Utah-Wyoming state line. But for the Bear River above and below Woodruff Narrows Reservoir and at the Idaho-Utah State line, and Woodruff Creek below the reservoir, the difference is much greater. For comparison, the extremely low flows for 1977 and average year-round flows are shown in Table 5-2.

TABLE 5-1
STREAM GAGING RECORDS[a]

Gaging Station on Bear River[a]	Drainage Area (square miles)	Period of Record	Instantaneous Extremes Minimum (cfs)	Instantaneous Extremes Maximum (cfs)	Average Annual Runoff 1941-90 (1,000 acre-feet)
Near UT-WY State Line	172	1942-90	12	2,980	139.9[b]
Near Randolph, UT	1,616	1943-90	2	3,630	160.1
At Harer, ID	2,839	1913-86	26	5,140	393.1
Rainbow Inlet Canal near Dingle, ID	N.A.	1922-90	0	4,420	304.0
Bear Lake Outlet Canal near Paris, ID	-	1922-90	1	2,010	332.0
Below tailrace, at Oneida, ID	4,455	1921-90	3	5,480	681.3
At ID-UT State Line	4,881	1970-90	48	4,870	746.4[b]
Near Collinston, UT	6,267	1889-1990	6[c]	12,700	1,094.7
Near Corinne, UT	7,029	1949-57 1963-90	72	14,770	1,232.0[b]

[a]Except the Bear Lake outlet and inlet canal gaging stations, which are not on Bear River.
[b]Part of record estimated by correlation with another station.
[c]Minimum day. See Table 5-2.

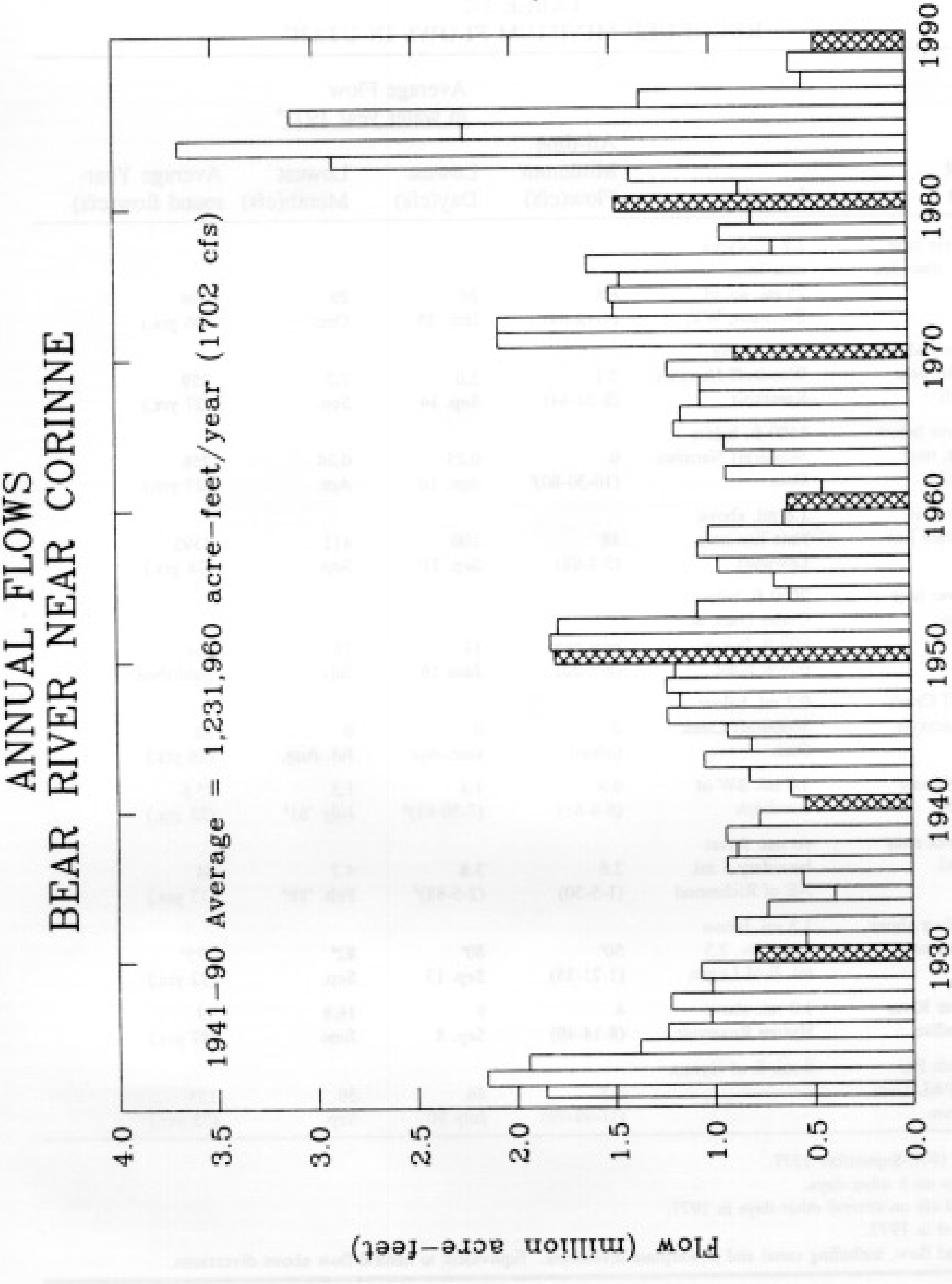
Figure 5-2 is a bar chart of annual runoff at the Corinne gage for a 70-year period extending back to 1921. The greatest runoff year was 1984, and the smallest was 1934.

TABLE 5-2
RECORDED MINIMUM FLOWS IN UTAH[a]

Gaging Station	Location	All-time Minimum Flow(cfs)	Average Flow in water year 1977[a]: Lowest Day(cfs)	Lowest Month(cfs)	Average Year-round flow(cfs)
Bear River near UT-WY state line	2.8 mi.above state line, 25 mi. so. of Evanston, WY.	6.8 (4-12-84)	20 Dec. 25	29 Dec.	196 (46 yrs.)
Bear River above Reservoir, near Woodruff	5 mi. above Woodruff Narrows Reservoir	0.1 (8-24-64)	3.0 Sep. 14	7.2 Sep.	259 (27 yrs.)
Bear River below reservoir, near Woodruff	1100 ft. below Woodruff Narrows Dam	0 (10-30-80)[b]	0.25 Apr. 10	0.34 Apr.	256 (27 yrs.)
Bear River at UT-ID state line	1.8 mi. above state line near Lewiston	48 (5-1-88)	100 Sep. 11[c]	411 Sep.	1395 (18 yrs.)
Bear River near Collinson	2000 ft. below Cutler Dam, & 800 ft. below power plant	near zero (8-5-20)	11 June 16	15 July	not published
Woodruff Creek below reservoir	0.2 mi. below Woodruff Creek Dam	0 (often)	0 Dec.-Apr.	0 Jul.-Aug.	32 (16 yrs.)
Big Creek near Randolph	5.2 mi. SW of Randolph	0.9 (8-4-61)	1.1 (7-30-61)[d]	1.5 July '61[d]	15.6 (23 yrs.)
High Creek near Richmond	At nat. forest boundary 5 mi. NE of Richmond	2.6 (1-5-50)	3.8 (2-5-88)[d]	4.7 Feb. '88[d]	34 (17 yrs.)
Logan River above State Dam near Logan	1.3 mi. below canal div. 2.5 mi. E of Logan	50[e] (1-21-35)	80[e] Sep. 13	82[e] Sep.	275[e] (92 yrs.)
Little Bear River near Paradise	1.0 mi. above Hyrum Reservoir	4 (8-14-40)	9 Sep. 8	16.8 June	99 (49 yrs.)
Blacksmith Fk. above UP&L Dam near Hyrum	6 mi. E of Hyrum	4.7 (11-28-79)	46 July 30	50 Sep.	133 (75 yrs.)

[a]October 1976-September 1977.
[b]Also zero on 6 other days.
[c]Also 100 cfs on several other days in 1977.
[d]No record in 1977.
[e]Combined flow, including canal and powerplant diversions. Equivalent to natural flow above diversions.

FIGURE 5-2


ANNUAL FLOWS
BEAR RIVER NEAR CORINNE
1941-90 Average = 1,231,960 acre-feet/year (1702 cfs)
Flow (million acre-feet)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Time (years)
1930
1940
1950
1960
1970
1980
1990

5.2.2 Supply Available for Development

The amount of water that can be developed is limited by the following:

(1) Amended Bear River Compact
(2) Existing Utah water rights
(3) Wide variation in annual runoff
(4) Scarcity of feasible and environmentally acceptable storage sites

Because of these limitations, it is difficult to quantify the exact amount of new water supply that will be developed in the future.

(1) Amended Bear River Compact - In Section 7.2, the Amended Bear River Compact of 1980 is discussed in detail, with an explanation of the permanent allocations agreed on by Wyoming, Utah, and Idaho. Above Stewart Diversion Dam, there are allocations to all three states. But below Stewart Dam (the "Lower Division"), only Idaho and Utah are involved.

In the upper basin (above Stewart Diversion Dam), some further development became allowable under the amended compact. The additional development was defined in terms of new annual storage and annual depletion. For Utah, these allowable amounts were 35,000 acre-feet of storage and 13,000 acre-feet of depletion. The remaining portions of these allowances at the present time are 17,000 acre-feet of storage and 6,314 acre-feet of depletion. In addition, water can be stored upstream when Bear Lake is full and spilling, but this water is not reliable since it may be available only once every 10 to 20 years. By compact definition, the Bear Lake Valley in Rich County is in the "Lower Diversion."

Below Stewart Dam, where the margin of potential development is large, the allocation formula provides for equitable development in both Idaho and Utah. Also, the compact makes provision that the water supply would be shared in accordance with a set of priority rights (See Table 7-1 in Section 7). For example, with development in both states reaching a total annual depletion of 550,000 acre-feet, Utah's share of depletions under the Compact would be 350,000 acre-feet.

2) Existing Utah water rights - Any future development, whether private, state, or federal, must recognize and make careful provision for existing water rights. One of the largest and most significant water rights in relation to potential development of the lower Bear River is that of the Bear River Migratory Bird Refuge. With adequate new reservoir storage, the average historical use of about 280,000 acre-feet/year could be increased to meet late summer needs. This is discussed further in Section 14.

The most important water rights affecting present operations are those held by UP&L. These rights affect not only the operation of Bear Lake, but also the entire length of Bear River from Bear Lake down to Cutler Dam.

(3) Wide variation in runoff - Because of the wide variations in annual flow volume, dependable water supplies are no greater than the lowest recorded year, plus some level of acceptable shortage, plus carryover storage (from one year to another).

Figure 5-2 shows annual flows of the Bear River near Corinne. In the 1941-90 base period, the maximum was 3,666,000 acre-feet in 1984, and the minimum was 442,700 acre-feet in 1961. Other comparisons are shown in Table 5-3 on the following page.

A statistical probability study based on a 1941-90 period of analysis for the same gaging station indicates a 90-percent probability that the annual flow volume in any random year will be 601,400 acre-feet or greater. Also, there is a 75-percent probability that it will be 793,900 acre-feet or greater (under present conditions of development).

TABLE 5-3
RUNOFF COMPARISONS FOR BEAR RIVER (SEE FIGURE 5-2)

Annual runoff[a] (acre-feet)	Number of years this runoff was exceeded[b]
400,000	50
500,000	48
600,000	46
700,000	39
800,000	37
900,000	34
1,000,000	29
1,250,000	16
1,500,000	11
(Average) 1,231,960	17
(Average) 1,065,000	25

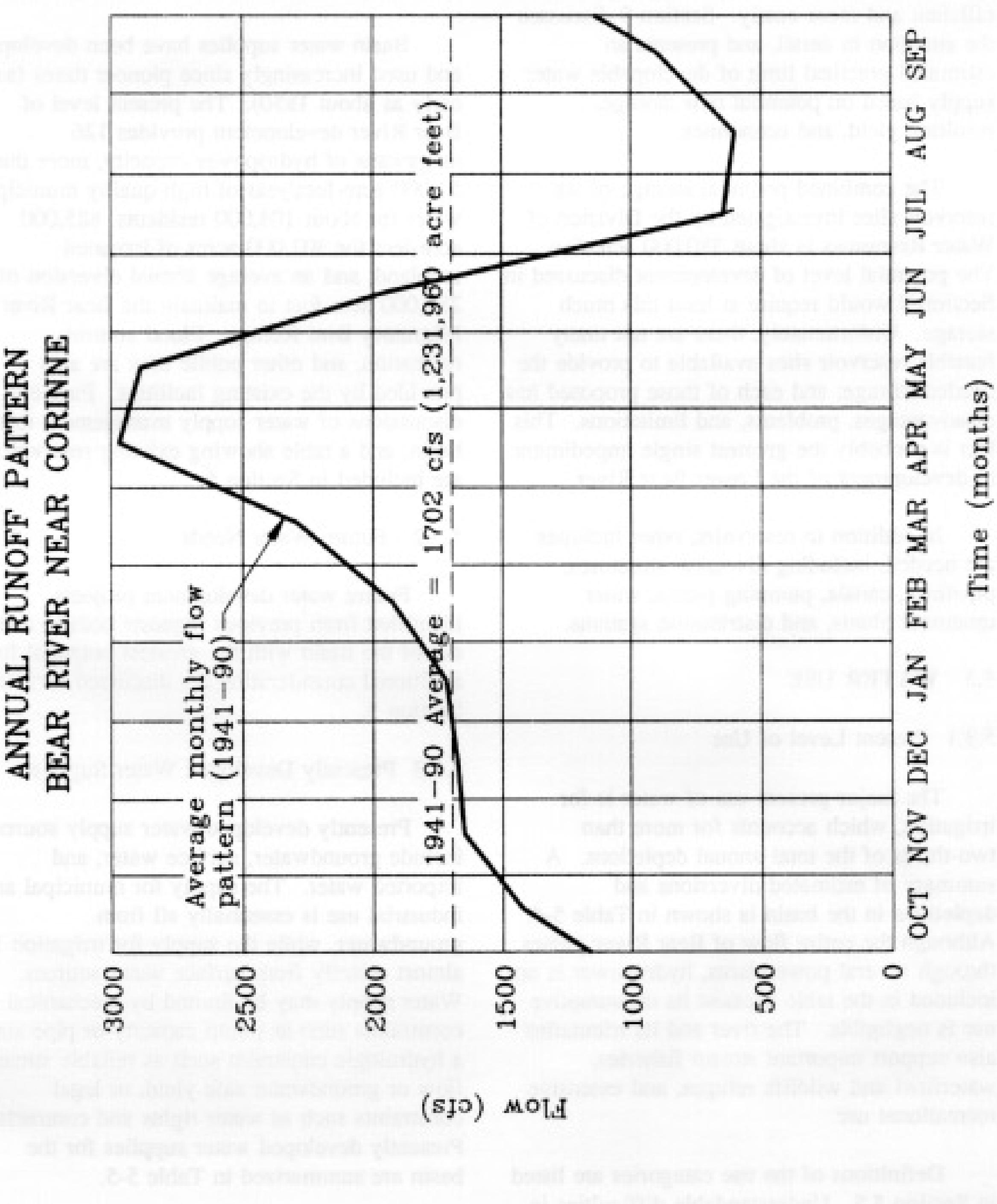
[a]Bear River near Corinne
[b]Based on 50 years of record (1941-90)

When Idaho develops its share of Bear River water in accordance with the amended compact, the remaining downstream flow at Corinne available for development in Utah will be less by the amount of Idaho's depletion. For example, if Idaho's development were to result in a depletion of 125,000 acre-feet/year, the remaining water available for development in Utah would be about 476,000 acre-feet (for a year of 90-percent probability). After subtracting 280,000 acre-feet for the approximate amount presently being used at the Bear River Migratory Bird Refuge leaves about 196,000 acre-feet/year available for development in Utah (in terms of depletion).

The runoff pattern at Corinne during a typical year (using average monthly values) is shown on Figure 5-3. About 60 percent of the annual flow occurs during the snowmelt season of April, May, and June, because the flow originates primarily from snowfall in the mountains. But in the heavy demand period of July, August, and September, streamflows typically decrease to their lowest levels of the year. This late-summer pattern illustrates why new reservoir storage will be needed to develop a significant new water supply.

<u>(4) Storage and other facilities needed</u> - Of the four limiting factors named earlier, the limitation imposed by reservoir storage requirements is probably the most severe. First, the amount of storage needed for the scale of development referred to above (196,000 acre-feet) is large. A computer model study[2] compared the potential storage available at presently known reservoir sites and the storage needed to supply projected needs. The study indicates, for example, that development of a new water supply in Utah with diversions of 250,000 acre-feet/year (and

FIGURE 5-3


ANNUAL RUNOFF PATTERN
BEAR RIVER NEAR CORINNE
Flow (cfs)
3000
2500
2000
1500
1000
500
0
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
Time (months)
1941–90 Average = 1702 cfs (1,231,960 acre feet)
Average monthly flow pattern (1941–90)

depletions of about 100,000 acre-feet) would require approximately 400,000 acre-feet of active storage capacity. Further increments of development beyond this level would require proportionately larger increments of storage, each of which would be hydrologically less-efficient and more costly. Section 9 discusses the situation in detail, and presents an estimated practical limit of developable water supply based on potential new storage, resulting yield, and economics.

The combined potential storage of six reservoir sites investigated by the Division of Water Resources is about 380,000 acre-feet. The potential level of development discussed in Section 9 would require at least this much storage. Unfortunately, there are not many feasible reservoir sites available to provide the needed storage; and each of those proposed has disadvantages, problems, and limitations. This fact is probably the greatest single impediment to development of the Lower Bear River.

In addition to reservoirs, other facilities are needed, including diversion structures, pipelines, canals, pumping plants, water treatment plants, and distribution systems.

5.3 WATER USE

5.3.1 Present Level of Use

The major present use of water is for irrigation, which accounts for more than two-thirds of the total annual depletions. A summary of estimated diversions and depletions in the basin is shown in Table 5-4. Although the entire flow of Bear River passes through several powerplants, hydropower is not included in the table because its consumptive use is negligible. The river and its tributaries also support important stream fisheries, waterfowl and wildlife refuges, and extensive recreational use.

Definitions of the use categories are listed in Section 5.5. Understandable difficulties in defining and estimating uses by these or any other set of categories result from confusing terminology and complex inter-relationships between uses, supply sources, and ownership of water systems. Detailed discussions of specific uses are included in other sections.

Basin water supplies have been developed and used increasingly since pioneer times (as early as about 1850). The present level of Bear River development provides 126 megawatts of hydropower capacity, more than 51,000 acre-feet/year of high-quality municipal water for about 108,000 residents, 885,000 acre-feet for 302,000 acres of irrigated cropland, and an average annual diversion of 280,000 acre-feet to maintain the Bear River Migratory Bird Refuge. Flood control, recreation, and other public uses are also provided by the existing facilities. Further discussions of water supply management in the basin, and a table showing existing reservoirs, are included in Section 6.

5.3.2 Future Water Needs

Future water development projects identified from previous requests both in and out of the basin with the greatest potential for additional consideration are discussed further in Section 9.

5.3.3 Presently Developed Water Supplies

Presently developed water supply sources include groundwater, surface water, and imported water. The supply for municipal and industrial use is essentially all from groundwater, while the supply for irrigation is almost entirely from surface water sources. Water supply may be limited by mechanical constraints such as pump capacity or pipe size, a hydrologic constraint such as reliable stream flow or groundwater safe yield, or legal constraints such as water rights and contracts. Presently developed water supplies for the basin are summarized in Table 5-5.

TABLE 5-4
ESTIMATED PRESENT WATER USE (acre-feet/year)

County	Irrigation	Municipal[a]	Industrial	Reservoir Evaporation	At Bird Refuge[b]
			Diversions[c]		
Cache	377,100	31,930	9,270	-	
Box Elder	343,700	15,900	1,020	-	280,000
Rich	153,300	3,340	20	-	
Summit	11,500	0[d]	0	-	
Total	885,600	51,170	10,310	___	280,000
			Depletions[e]		
Cache	229,800	10,630[f]	2,320[f]	15,400	
Box Elder	192,800	5,290[f]	250[f]	1,500	84,000
Rich	106,600	1,110[f]	10	63,700[g]	
Summit	6,400	0	0		
Total	535,600	17,030	2,580	80,600	84,000

[a]Consists of residential and commercial (no industrial).
[b]The Bear River Migratory Bird Refuge.
[c]"Diversions" means the volume of water diverted from streams (or pumped from groundwater) for the uses indicated.
[d]At campgrounds only.
[e]"Depletions" for irrigation means the water consumed by crops, including that which is supplied by rainfall. During the growing season, as much as one-fourth of the total consumptive use may be supplied by average rainfall. For the other four categories, depletions are estimated as consumed portion of diversions, excluding any rainfall.
[f]Based on an approximate portion of diversions: 1/3 for municipal and 1/4 for industrial (See Ref. No. 5).
[g]Including Bear Lake (portion within Utah).

5.4 INTERBASIN WATER SUPPLY PLANNING

Neither imports nor exports in the Bear River Basin are significantly large. At present there is only one of each.

The Ogden-Brigham Canal imports water diverted from the Ogden River to irrigation companies and communities as far north as Brigham City. The average annual amount imported in recent years (1985-89) is 11,600 acre-feet. Return flows and streamflow from this area go directly into the Great Salt Lake.

TABLE 5-5

PRESENTLY DEVELOPED WATER SUPPLIES[7]

SOURCE	DESCRIPTION	DIVERSIONS (Acre-feet/Year) Box Elder	Cache	Rich	Basin Total
Groundwater	Public Supply Well and Springs	18,500	43,100	3,400	65,000
	Private Domestic and Stock Wells	2,900	1,900	100	4,900
	Self-Supplied Industrial Wells	900	7,400	0	8,300
	Irrigation Wells	6,000	13,300	3,000	22,300
Subtotal		28,300	65,700	6,500	100,500
Surface Water	Irrigation Supply	304,000	352,000	142,400	798,400
	Public Supply for Residential Use	0	500	0	500
	Public Supply for Golf Course	400	0	0	400
	Supply to Wet/Open Areas	418,000	32,700	7,300	458,000
	Reservoir Evaporation Losses	1,500	15,400	[b]63,700	80,600
	Supply to Sub-irrigated Pasture/Grass Hay	22,100	11,800	7,900	41,800
Subtotal		746,000	412,400	221,300	1,379,700
Imported Water		[a]11,600	0	0	11,600
TOTAL		785,900	478,100	227,800	1,491,800

[a]Irrigation supply from Weber County
[b]Includes 62,200 for Utah portion of Bear Lake

Inflows to Willard Reservoir, on the extreme southern boundary of the basin, do not constitute an import because the water is pumped back to the south for uses in the Weber River drainage basin.

The only export from Bear River Basin occurs in the area of Alexander, Idaho, where the Bear River flows within a few miles of the hydrologic boundary. Because the basin divide is very low and flat, two canals in the area are able to carry diverted flows from the Bear River to irrigated lands west of the divide. Also, irrigation runoff near the surface water divide may feed groundwater aquifers which flow to the Portneuf River outside the basin. The maximum annual export possible with existing canal capacities is 60,000 acre-feet/year, but the actual amount is much less.

The Idaho Department of Water Resources has estimated approximately 7,600 acres were irrigated outside the basin with Bear River water in 1976. If an estimated 3.0 acre-feet/acre were diverted, annual export would be about 23,000 acre-feet.

Plans for diverting water out of the basin for various purposes have been proposed in the past. With the exception of the canals near Alexander, no plans have been implemented. The most significant and likely future export will be to meet Wasatch Front M&I needs (See Section 9).

5.5 DEFINITIONS AND CATEGORIES OF WATER USE

Irrigation - Water used for irrigation of cropland as identified in the Bear River Land Use Inventory (See Table 10-2). Residential lawn and garden uses are not included.

Municipal - Consists of the sum of "residential" and "commercial" uses, which are not usually identified separately in available records of water use. It is recognized that "municipal" is really a term for supply, but it is used for convenience.

Residential - Water used for residential household purposes and residential lawn and garden watering. Municipal irrigation of parks and golf courses is included here.

Commercial - Water used by hotels, motels, restaurants, office buildings, retail sales stores, educational institutions, churches, hospitals, and government and military facilities.

Industrial - Water used to manufacture products such as steel, chemical, and paper products. It includes petroleum refining for processing, washing, and cooling operations. In the Bear River Basin, meat packing, dairies, cheese factories, egg plants, and other food processing enterprises are included. Gravel washing and ready-mix concrete operations are also included. Estimated use for all of the above is included, whether the water is self-supplied or from a public system.

Public Water Supply - Water supplied to either private or publicly owned community systems which serve at least 15 service connections or 25 individuals at least 60 days per year. Water from public supplies is used for residential, commercial, and industrial purposes, including irrigation of publicly owned areas.

Secondary Systems - Pressurized lawn and garden irrigation systems using untreated water for irrigation of lawns, gardens, and publicly owned open areas.

Private, Domestic, and Stock - Water used from private wells or springs for individual homes, usually in rural areas not accessible to public water supply systems.

Wet and Open Water Areas - Includes lakes, reservoirs, rivers, wet areas used for aquatic wildlife refuge, and areas inundated or partially inundated adjacent to lakes, reservoirs, and rivers.

Culinary Supply - Water meeting all applicable safe drinking water requirements suitable for residential and commercial use.

Bird Refuge - Water diverted to the Bear River Migratory Bird Refuge and used to provide waterfowl habitat.

5.6 REFERENCES

In addition to the references listed below, the Utah State Water Plan, January 1990, discusses statewide aspects of water supply and use, including interbasin water supply planning.

1. "Summary Report, Water and Related Land Resources, Bear River Basin," Cooperative Study, U.S. Department of Agriculture in cooperation with the States of Utah, Idaho, and Wyoming, 1978.

2. "Results from Bear River Model," unpublished memorandum by David Cole, Utah Division of Water Resources, Dec. 20, 1989.

3. Bear River Compact as Amended. Public Law 96-189, 96th Congress. Feb. 8, 1980.

4. "Overview of the Proposed Lower Bear River Water Development Plan", Utah Division of Water Resources, December 1988.

5. "Wasatch Front Total Water Management Study," U.S. Bureau of Reclamation and Utah Division of Water Resources, February 1990.

6. U.S. Geological Survey Water Resources Data for Utah.

7. "Present Water Supplies, Uses and Rights - Bear River Development;" Hansen, Allen and Luce, Inc. For Utah Division of Water Resources, June 1991.

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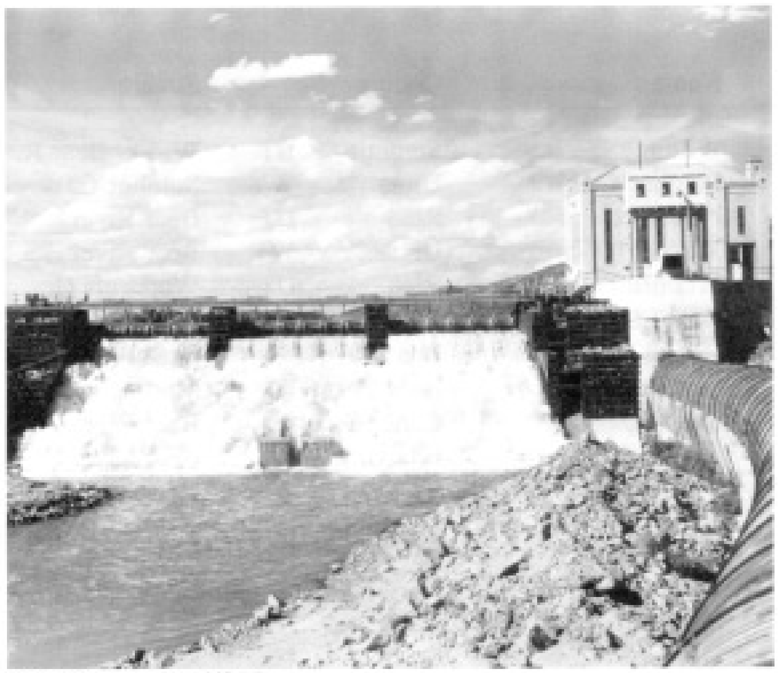
Section 6
MANAGEMENT

This section describes the existing water management systems in the basin for irrigation, municipal, industrial, and waterfowl use. The cloud seeding program is discussed, management organizations are listed, and a general recommendation is made.



Grace Dam, 1950 - UP&L

6.1 INTRODUCTION

For purposes of this report, "management" is defined as the responsibility for control, augmentation, and use of a water supply, including storage and release, diversion, distribution, and treatment. Management for water quality, fisheries, conservation, and groundwater use, are covered in other sections of this report. Most of the local management of water supplies throughout the Bear River Basin consists of irrigation management, in terms of water supply quantities as well as numbers of managing entities. The most common entities are mutual irrigation companies. A few of the larger companies are listed.

6.2 OVERALL MANAGEMENT OF THE BEAR RIVER SYSTEM

The Bear River is not managed as an entire stream system on a unified basis, although provisions of the Bear River Compact are the basis for all river operations in the three states. The major operator is Utah Power & Light Co. (UP&L). However, UP&L has no operations in the upper basin above Bear Lake. Below Bear Lake, flows of the mainstem are regulated by UP&L for its own use and others. Under a set of contracts, court decrees, and the Bear River Compact, UP&L operates Bear Lake and the river downstream, not only for hydropower generation but also for irrigation and to some extent for flood control and recreation. A series of three mainstem dams and seven hydroelectric power plants provide UP&L with a mainstem generating capacity of nearly 117 megawatts. These and other existing reservoirs and power plants in the basin are listed for reference in Tables 6-1 and 6-2. In Table 6-1, about 9 megawatts of capacity is for non-UP&L powerplants. Power plant locations are shown in Figure 6-1.

Above Bear Lake, river flows are managed almost entirely for irrigation. Mainstem storage regulation is provided by Woodruff Narrows Reservoir near the Wyoming-Utah state line below Evanston, so

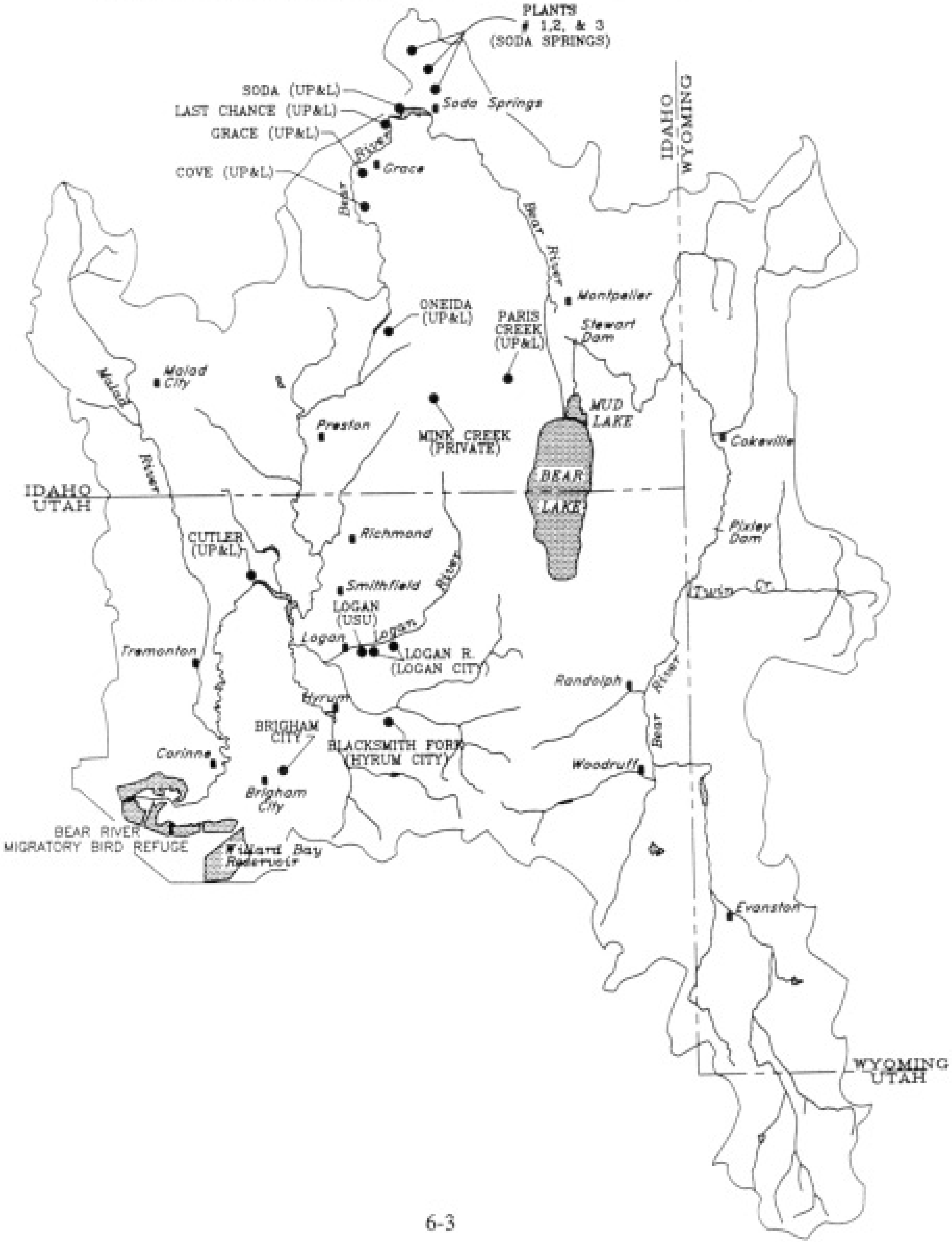
TABLE 6-1
EXISTING RESERVOIRS IN BEAR RIVER BASIN[2,a]
(in downstream order)

Name	County		Stream	Owner or Operator	Total Storage (acre-feet)
Whitney	Summit	UT	W. Fk. Bear R.		4,700
Sulphur Creek	Uinta	WY	Sulphur C.		19,800
Neponset[b]	Rich	UT	Bear River		6,900
Woodruff Narrows	Uinta	WY	Bear River	[c]	57,300
Woodruff Creek	Rich	UT	Woodruff C.		4,100
Bear Lake[b]	Rich	UT	Bear River	UP&L	1,452,000[b]
	Bear Lake	ID	Bear River		
Montpelier	Bear Lake	ID	Montpelier C.		4,050
Soda Point	Caribou	ID	Bear River	UP&L	15,500
Oneida Narrows	Franklin	ID	Bear River	UP&L	11,500
Twin Lakes[b]	Franklin	ID	Mink Creek		14,000
Glendale	Franklin	ID	Worm Creek		11,000
Strong Arm	Franklin	ID	Battle C.		4,500
Treasureton	Franklin	ID	Battle Creek		7,000
Porcupine	Cache	UT	E.Fk. Little B.R.	[e]	12,800
Hyrum	Cache	UT	L. Bear R.	USBR[f]	18,800
Newton	Cache	UT	Newton Creek	USBR[g]	5,600
Cutler	Box Elder	UT	Bear River	UP&L	17,000
Mantua	Box Elder	UT	Box Elder C.	Brigham City	7,560
Daniels	Oneida	ID	L. Malad R.	[h]	11,900
Deep Creek	Oneida	ID	Deep Creek		5,400
Devil Creek	Oneida	ID	Devil C.		4,450
St. Johns	Oneida	ID	Davis C.		4,450

[a]With storage capacities greater than 4,000 acre-feet.
[b]Off-channel.
[c]Woodruff Narrows Reservoir Co.
[d]Off-channel location. Includes 31,000 acre-feet in Mud Lake.
[e]Porcupine Reservoir Co.
[f]Operated by South Cache Water Users Association.
[g]Operated by Newton Water Users Association.
[h]Owned and operated by St. John Irrigating Co.

FIGURE 6-1

HYDROELECTRIC POWER PLANTS



that irrigation diversions can be made downstream.

To manage the mainstem flows, UP&L has developed facilities which enable the company to regulate (and use as a reservoir) the top 1.4 million acre-feet of Bear Lake's 6.5-million acre-foot storage volume. To do this, it was necessary to divert the flow of Bear River into Bear Lake, because it does not flow in under natural conditions. Between 1909 and 1918, the Stewart Diversion Dam, the Rainbow Inlet Canal, the Outlet Canal, and the Lifton Pumping Plant were built. The pumping plant was needed to lift water from the lake into the Outlet Canal, which returns the water to the Bear River. Operation of these facilities provides UP&L with controlled storage in Bear Lake through a maximum range of 21.65 feet, which represents 1,452,000 acre-feet of storage.

In accordance with a series of contracts, UP&L provides water for irrigation diversions along the Bear River in Idaho and Utah from Bear Lake down to Cutler Reservoir. The irrigation companies which divert from Bear River under contract with UP&L are given in Table 6-3.

6.3 MANAGEMENT OF IRRIGATION SYSTEMS

The existing network of irrigation companies in the basin is extensive. Those irrigation companies listed in Tables 6-4, 6-5, and 6-6 are only the largest of about 205 local companies using the water sources indicated. Although there are small areas irrigated from groundwater (particularly in Cache County), irrigation in the Bear River basin is essentially by surface water.

TABLE 6-2
EXISTING HYDROELECTRIC POWER PLANTS IN BEAR RIVER BASIN[3&4]

Plant	Stream	Owner	Static Head (feet)	Installed Capacity (kilowatts)
Soda	Bear River	UP&L	79	14,000
Last Chance	Last Chance Canal	UP&L	40	1,500
Grace	Bear River	UP&L	526	33,000
Cove	Bear River	UP&L	98	7,500
Oneida	Bear River	UP&L	145	30,000
Cutler	Bear River	UP&L	127	30,000
Mink Creek	Mink Creek	Private	430	3,075
Paris Creek	Paris Creek	UP&L	346	650
Logan City	Logan River	Logan City	213	2,000
Logan (State)	Logan River	USU	30	450
Logan City	Logan River	Logan City	99	1,400
Soda Springs #1	Soda Creek	Soda Springs City	50	120
Soda Springs #2	Soda Creek	Soda Springs City	20	50
Soda Springs #3	Soda Creek	Soda Springs City	84	400
Hyrum City	Blacksmith Fork	Hyrum City	76	400
Brigham City	Box Elder C.	Brigham City	580	1,200
TOTAL				125,745

TABLE 6-3
IRRIGATION CONTRACTS WITH UP&L[5]

Company	Date of Contract	Amount
IDAHO		
Last Chance Canal Company (24,000 ac.)	1919[a]	20,000 ac-ft+ supplemental
Thatcher Irrigation Company (1,700 ac.)	1989	Variable
West Cache Canal Company (15,000 ac.)[b]	1919	12,000 ac-ft
Twin Lakes Irrigation Company (12,500 ac.)	1961	5,000 ac-ft
Cub River Irrigation Company (22,300 ac.)[b]	1916	20,000 ac-ft
Individual Pumping Contracts (19 contracts)	1989	Variable
UTAH		
Bear River Canal Company (64,000 ac.)	1912	900 cfs
Individual Pumping Contracts (57, all in Cache County)	1989	Variable

[a]Original contract revised in 1984.
[b]Includes land in Utah and Idaho

Management of an irrigation water supply typically includes these responsibilities:

- Planning, construction, and operation of reservoir storage, diversion dams, and delivery systems.
- Conveyance of streamflow diversions and storage releases to irrigated cropland in accordance with water rights.
- Prevention of conveyance losses, excessive return flows, and illegal water use.
- Collection of revenues from water users to meet operation, maintenance and replacement (OM&R) expenses and repay capital costs.
- Continuous, long-term operation and maintenance of project facilities.

6.3.1 Above Evanston

Irrigated land areas above Evanston, Wyoming, are mostly within Wyoming. The main tributaries are Mill Creek, Sulphur Creek and Yellow Creek. Each is managed essentially for the irrigation of pasture and hay. For the most part, managing entities above Evanston are private ranches, of which only a few are in Utah. Within Utah (Summit County), the irrigated area is 2,650 acres, as shown in Table 10-2, which is a detailed breakdown of irrigated land by counties.

6.3.2 Below Evanston, Above Bear Lake

Wyoming's irrigated land in the Bear River Basin is within the two counties, and is above Bear Lake (See Figure 3-1). Most of the Uinta County portion is situated above Evanston, Wyoming.

Uinta County, Wyoming
27,000 acres (approximately)

Lincoln County, Wyoming
33,000 acres (approximately)

Idaho has about 22,000 acres of land irrigated by diversions from the Bear River and its tributaries above Stewart Diversion Dam. Also, about 13,000 acres of land in Idaho is irrigated by streams flowing directly into Bear Lake, mostly along the northwest shoreline.

The remaining 73,400 acres of irrigated land above Bear Lake is within Utah's Rich County, where water supplies are managed by at least 35 irrigation companies or other entities. Storage regulation for management of water supplies in Utah is provided by the following five reservoirs.

Woodruff Narrows	**57,300 AF**
Neponset	**6,900 AF**
Woodruff Creek	**4,200 AF**
Birch Creek	**2,260 AF**
Little Creek	**980 AF**

About 15 companies manage flows diverted from the mainstem of Bear River. About 20 companies (or private entities) manage water supplies diverted from tributary streams. A few of the larger companies are listed for reference in Table 6-4.

6.3.3 Irrigated Land in Idaho

Within Idaho's portion of the Bear River Basin, the estimated 190,000 acres of irrigated land (See Table 10-1) is managed by at least 90 irrigation companies. The Idaho area of main interest for this report is below Oneida Dam in Franklin County (Idaho). About 12 irrigation companies manage the water supply in Franklin County. Several of the canals and irrigation systems in this area extend beyond the state line into Utah. Oneida Dam and Reservoir is operated for hydropower generation only. Eleven storage reservoirs on five tributary streams are operated for irrigation. The seven largest provide a combined storage capacity of 46,150 acre-feet (Table 6-1).

Cache County - Div. of Water Resources

6.3.4 Cache County, Utah

In Cache County, an average annual water supply of about 377,100 acre-feet for nearly 120,000 acres of irrigated land is managed by more than 70 irrigation companies. Possibly as much as 8,000 acres are irrigated with groundwater. Because the irrigation systems are numerous and complex, they are grouped in Table 6-5 by subareas, in clockwise order around Cache Valley.

TABLE 6-4
RICH COUNTY IRRIGATORS[1,8]

Company	Water Source	Irrigated Area (acres)
Randolph & Woodruff Canal Co.	Bear River	10,200
Randolph & Sage Creek Canal Co.	Bear River	8,580
Beckwith-Quinn-West Side Canal Co. (a.k.a. Beckwith-Quinn Canal Co.)	Bear River	5,650
Chapman Canal Deseret Livestock Co. (a.k.a. Chapman Canal Co.)	Bear River and Saleratus Creek	5,030
Crawford-Thompson Irrigation Co.	Bear River	4,050
Utah Woodruff Narrows Reservoir Co.	Bear River	2,200[a]
Woodruff Irrigation Co.	Woodruff Creek	4,840
Randolph Irrigation Co.	Big Creek	3,400
Rich County Otter Creek Irrigation Co.	Otter Creek	1,380
Meadowville Canal Co.		1,190[b]
Laketown Irrigation Co.	Laketown Creek	1,090
Hodges Irrigation Co.	Swan Creek	1,000
Little Creek Reservoir Co.	Little Creek	1,000
Others (not listed)		23,440
Total		73,400

[a]Supplies supplemental irrigation water to about 30,000 acres of land irrigated by other companies listed in this table.
[b]Meadow, Jebo, and Tuff creeks.

Irrigation management in Cache County is enhanced by the operation of three reservoirs. Porcupine, Hyrum, and Newton reservoirs provide 37,000 acre-feet of storage (See Table 6-1). No irrigation reservoir storage on the Logan River, Blacksmith Fork, or in the Smithfield- Richmond area. This requires irrigation companies to rely on natural stream flows and/or groundwater.

6.3.5 Malad River in Idaho

The Malad River joins the Bear River in Box Elder County, Utah. Because of poor water quality below the Idaho-Utah state line, most of the land irrigated from the Malad River is in Oneida County, Idaho. About 10 irrigation companies serve more than 15,000 acres in Oneida County. Four reservoirs provide about 26,000 acre-feet of water storage.

6.3.6 Box Elder County, Utah

Table 10-2 shows 105,800 acres of irrigated land in the Box Elder County portion of the Bear River Basin. Included in this total is a significant area of subirrigated pasture; approximately 11,070 acres. More than 1,600 acres of other land are irrigated from local groundwater, and another 7,200 acres of land

TABLE 6-5
CACHE COUNTY IRRIGATORS[1&8]

Company	Irrigated Area (acres)
Lewiston/Clarkston Area	
Cub River Irrigation Co. (Utah only)	14,600
West Cache Irrigation Co. (Utah only)	11,250
Newton Water Users Assoc.	2,600
Richmond/Smithfield Area	
Richmond Irrigation Co.	8,380
Smithfield Irrigation Co.	2,900
Logan River Area	
Logan & Northern Irrigation Co.	3,340
Logan, Hyde Park, & Smithfield Canal Co.	2,810
Benson Irrigation Co.	2,650
Blacksmith Fork Area	
Nibley-Blacksmith Fork Irrigation Co.	2,800
Hyrum - Blacksmith Fork Irrigation Co.	2,400
Little Bear River/Wellsville Area	
Hyrum - Mendon - Wellsville Irrigation Co.	7,090
Porcupine Highline Canal Co.	2,870
Wellsville East Field Irrigation and Canal Co.	2,780
Others (not listed)	53,430
Total	119,900[a]

[a]See Table 10-2

are partially or completely served by water from the Weber River Basin.

More than 100 irrigation companies or private entities manage the 343,700 acre-feet/year of water supply. Most of these irrigators receive their water from the Bear River Canal Company, the largest irrigation company in the entire Bear River Basin. It provides water to 64,000 acres or more. Its system consists of 120 miles of canals and laterals, supplying irrigation water to sub-companies, small groups, and individual farmers. Fifty-three of the largest companies irrigate a total of 21,600 acres, and the remaining area of 42,400 acres is irrigated by numerous individual farmers and small groups of irrigators. The Bear River Canal Company's diversion is at Cutler Reservoir. Some of Box Elder

County's many irrigation systems are listed in Table 6-6.

6.4 MANAGEMENT OF MUNICIPAL AND INDUSTRIAL WATER SYSTEMS

There are 52 community water systems in the Utah portion of Bear River Basin, which provide water of culinary quality to essentially all of the basin's 108,000 residents. These systems are managed for the most part by the communities or by mutual non-profit water companies. Management consists of development of a source, construction and maintenance of some type of conveyance facilities, water purification treatment (if needed), periodic sampling, compliance with other Utah Department of Environmental Quality requirements, distribution to local users, collection of revenues, repayment of capital costs, and payment of operation, maintenance, and replacement costs. These management responsibilities must be carried out in such a way that the water system complies at all times with specified public health regulatory standards enforced by the Utah Drinking Water Board. Sections 11

TABLE 6-6
BOX ELDER COUNTY IRRIGATORS[1]

Company	Irrigated Area (acres)
Bear River Canal Co. (and subgroups)	64,000
Water Imported from Ogden & Weber Rivers	
Pineview Water System	2,300
Cook-Porter Group	530
Others (not listed)	70
Subtotal (approx.)	2,900
Local Streams, Local Groundwater, and Imported Flow[a]	
Box Elder Creek Water Users Assoc.	1,200
Willard Water Co.	1,170
North Field Irrigation Co.	750
Perry Irrigation Co.	420
North Willard Irrigation Co.	200
West Field Stream	200
Mantua Irrigation Co.	710
Cold Springs Dam & Irrigation Co.	340
North String Irrigation Co.	200
Others (not listed)	33,710
Subtotal (approx.)	38,900
Box Elder County Total	105,800

[a]Imported flow in addition to that identified in second group.

and 18 discuss in detail the present use of municipal and industrial water, as well as future needs.

6.5 MANAGEMENT OF WATERFOWL AREAS

The Bear River Migratory Bird Refuge is managed by the U.S. Fish and Wildlife Service. The water supply source for the bird refuge is the Bear River. Existing facilities allow flows of the Bear River to be diverted into the managed area and released to the Great Salt Lake. By maintaining somewhat stable levels of fresh water in the ponds through part of the year, with a healthy growth of marsh vegetation, the refuge has for many years supported great numbers of waterfowl with food and nesting protection. In addition to the Bear River Migratory Bird Refuge, two state-managed waterfowl areas are near Great Salt Lake. The Salt Creek State Waterfowl Management Area is six or seven miles southwest of Tremonton. The State Public Shooting Grounds area is closer to Great Salt Lake on the south. Each area includes 3 or 4 large fresh-water ponds, some of which are controlled by levees. The water supply for both state-managed areas is Salt Spring, west of Tremonton, and other springs further south. Management objectives are to maintain an optimum, stable water surface in the ponds, and promote a maximum of vegetation. Both are managed by the Utah Division of Wildlife Resources.

Also, nearly 20,000 acres of marshland and ponds along the shoreline of Great Salt Lake in Box Elder County are managed by nine privately owned duck clubs. The names and sizes of these clubs are shown in Table 6-7. Water control facilities in these areas are believed to be minimal or non-existent.

TABLE 6-7
PRIVATELY OWNDED DUCK CLUBS

Name of Club	Acreage Managed[6]	Location
Bear River Club	9,600	Bear River Delta
Chesapeak Duck Club	2,900	Bear River Delta
Duckville Club	1,200	Bear River Delta
Knudson's Duck Club	3,000	West of Brigham
Pioneer Duck Club	1,200	South of Corinne
Sagebrush Club	1,000	West of Corinne
Sweet Grass Gun Club	156	South of Corinne
Widgeon Club	160	South of Corinne
Willard Bay Gun Club	320	Willard Bay
Total	19,536	

6.6 CLOUD SEEDING

Winter cloud seeding for augmentation of mountain snowpack is an accepted program in the water supply management community. Some projects in the Western United States have been operated continuously for more than 30 years. This relatively long experience indicates that increases of 5-20 percent in seasonal precipitation can be achieved.

In the Bear River Basin, a winter cloud seeding program that began in the fall of 1988 is continuing. The operational period is November 15 to April 15 each year. Costs are shared by the state and local governments. The estimated increase in precipitation has been about 1.48 inches, or approximately 12 percent.[7] (Note: these percentages relate to the cloud seeding year, not an average year. Thus, in a below-normal year of 70 percent precipitation, for example, a 12-percent increase would raise the annual total only to 78 percent of normal). Additional runoff resulting from cloud seeding operations does not necessarily correspond with additional precipitation, because watershed conditions and other factors are involved. Although the amount of augmented runoff in the Bear River Basin is difficult to quantify with accuracy, the results have been adequate to justify the continuing costs. The probable cost of additional runoff is about $2 to $5/acre-foot. The UP&L has conducted cloud seeding in the Thomas and Smiths Fork drainages (upstream from Bear Lake) periodically since 1961. In most cases, full use of the additional runoff can be achieved only by expanded storage regulation.

Summer rainfall augmentation during the agricultural growing season is more complex, and the record of operational experience is shorter. Nevertheless, researchers in this field consider the prospects to be favorable. Because of the large area of cropland in the Bear River Basin, and particularly the dry cropland, summer rainfall augmentation could be especially valuable. During six consecutive years (1976-81), an experimental summer cloud seeding program was conducted in the Bear River Basin. The objective was to investigate the possibility of increasing summer rainfall (June - September) and suppressing hail. Further research is needed to better evaluate average capability, seasonal dependability, and probable costs.

6.7 MANAGEMENT PROBLEMS AND NEEDS

Within the limits of existing facilities for streamflow regulation, the Bear River Basin is well managed. Improvements, however, are encouraged wherever possible. The Bear River Basin Plan does not suggest any change in existing management organizations, although additional organizations may be necessary in the future as new Bear River development occurs. Where new project operations would affect existing operations or facilities, new operating agreements to protect each party may be required.


Cloud Seeding Research Aircraft - Div. of Water Resources

Managers of public water supply systems in the basin have several difficult problems to resolve in the next few years, including expansion of systems for new population growth, replacement of deteriorating facilities, and adjustment to more stringent public health standards. Section 11 discusses these in more detail.

The most pressing management needs at the Bear River Migratory Bird Refuge are to repair the flood damage created by several years of extremely high lake levels in the early 1980s, and to re-establish the vegetation. The U.S. Fish and Wildlife Service is currently addressing these needs. Water supply needs of the refuge are discussed in Section 14.

6.8 RECOMMENDATIONS

Utah Power & Light Company, irrigation companies, municipal and industrial water users, waterfowl and wildlife agencies, and other water management entities in the Bear River Basin should continue to operate and manage their respective systems to obtain efficient use of existing water resources with minimum interference to other systems and users.

Continuous communication and cooperation between water management entities is a strong influence toward greater efficiency of use and protection against potential shortages. Therefore, more emphasis on both communication and cooperation is encouraged and recommended.

6.9 REFERENCES

In addition to references listed below, Section 6 of the Utah State Water Plan, January 1990, discusses management of water in Utah, and four issues concerning ways to improve water resource management.

1. "Irrigation Conveyance Systems," Working Paper for Bear River Basin Type IV Study, U.S. Dept. of Agriculture, April 1976.

2. "Existing and Potential Reservoirs," Working Paper for Bear River Basin Type IV Study, U.S. Department of Agriculture, February 1976.

3. "Summary of Bear River Operation," Utah Power and Light Co. (Carly Burton), February 19, 1988.

4. "Wasatch Front Total Water Management Study," U.S. Bureau of Reclamation and Utah Division of Water Resources. February 1990.

5. Letter from Utah Power and Light Co. (Carly Burton). June 21, 1990.

6. Letter from U.S. Fish and Wildlife Service (Clark D. Johnson, Assistant Field Supervisor), June 4, 1990.

7. "Summary of Operations (1991 water year) and Evaluation of A Cloud-Seeding Program In Northern Utah (Box Elder, Cache, and Rich Counties)," North American Weather Consultants, August 1991.

8. "Water Companies in Utah," Utah Division of Water Rights, 1990.

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Section 7
REGULATION/INSTITUTIONAL CONSIDERATIONS

This section discusses existing water rights, the Bear River Compact, the jurisdiction of land areas within the basin, and several problems or concerns relating to water rights.

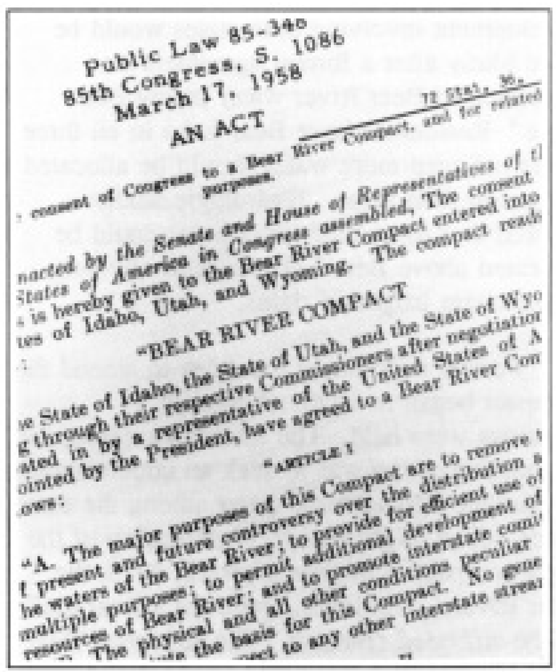
7.1 WATER RIGHTS

The State Engineer is presently adjudicating water rights in Box Elder County to define both surface and groundwater rights that are held for various uses under decrees, claims, and applications. A completion date is expected to be several years in the future. Proposed determinations are complete 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 to established water rights as well as to the Amended Bear River Compact.

7.2 BEAR RIVER COMPACT

In order to develop storage reservoirs above Bear Lake and protect the water users below the lake without the threat of litigation, a compact for sharing of the Bear River was negotiated by the states of Idaho, Utah, and Wyoming, with final agreement on February 4, 1955. This compact was ratified by the legislatures of Idaho, Utah, and Wyoming. The United States Congress gave its legislative consent, and the president signed it on March 17, 1958.

To administer its provisions, the compact created the Bear River Commission, an interstate agency composed of 10 commissioners. Three commissioners represent each signatory state, and one additional commissioner, who serves as chairman without vote, represents the United States of America.


Public Law 85-340
85th Congress, S. 1086
March 17, 1958
AN ACT

72 Stat. 38.

consent of Congress to a Bear River Compact, and for related purposes.

nacted by the Senate and House of Representatives of tl
States of America in Congress assembled, The consent
is hereby given to the Bear River Compact entered into
tes of Idaho, Utah, and Wyoming. The compact reads

"BEAR RIVER COMPACT

e State of Idaho, the State of Utah, and the State of Wyo
g through their respective Commissioners after negotiatior
ated in by a representative of the United States of A
ointed by the President, have agreed to a Bear River Con
ows:

"ARTICLE I

"A. The major purposes of this Compact are to remove t
f present and future controversy over the distribution a
he waters of the Bear River; to provide for efficient use of
multiple purposes; to permit additional development of
resources of Bear River; and to promote interstate comi
The physical and all other conditions peculiar
the basis for this Compact. No gene
to any other interstate strea

The commission has hired an engineer-manager to manage the basin states' interests in each yearly distribution of Bear River water. The division of water under the compact is among states (or separate sections thereof); and each state administers water apportioned to it in accordance with its own state law.

The 1958 compact provided for apportionment of direct flows on Bear River and its tributaries among separate sections of the states above Bear Lake, as well as establishing and limiting additional storage above Bear Lake. The 1958 compact also reserved a portion of the storage capacity in Bear Lake for primary use by (and protection of) irrigation uses and rights downstream from Bear Lake; and provided that water delivery between Idaho and Utah would be based on priority of rights without regard to state boundary lines.

The 1958 compact did not divide between Idaho and Utah either the direct flow or storable water below Bear Lake, and did not consider groundwater. State water officials in Utah and Idaho believed that a major water development involving both states would be more likely after a formal agreement on allocation of Bear River water below Bear Lake.[4] Residents above Bear Lake in all three states believed more water should be allocated for use in their areas. Hydrologic studies showed that some additional water could be allocated above Bear Lake without affecting downstream irrigation rights.

Formal negotiating meetings to amend the compact began in 1970. A total of 17 meetings were held. The intent in creating the negotiating group was to seek an understanding of possible allocation of water among the three states which might lead to modification of the 1958 compact. On December 22, 1978, the Bear River Commission approved a final draft of the amended compact. The Amended Bear River Compact[1] was ratified by the legislatures of Idaho, Utah, and Wyoming during the 1979 legislative sessions. The U.S. Congress gave its legislative consent, and the President made it effective by adding his signature on February 6, 1980.

The Amended Bear River Compact provides for the protection of all prior rights applied to beneficial use as of January 1, 1976, and the protection of all rights granted under the 1958 compact. The compact also includes groundwater development in the allocations, additional storage rights to all three states above Bear Lake, and allocation of the remaining water below Bear Lake between Idaho and Utah. Table 7-1 is a tabulation of the compact allocations.

7.3 WATER-USER AND WATER DEVELOPMENT ORGANIZATIONS IN BASIN

Several types of local water development and management entities are found in the basin, each intended for particular purposes and associated with distinctive enabling legislation.[3]

Mutual Irrigation Companies are the most common water development and management entities in the basin. They are formed under the Utah corporation code, and the majority of them are non-profit. In general, stockholders are granted the right to a quantity of water proportional to the number of shares they hold. Assessments are levied similarly.

Mutual Non-profit Water Companies are similar to mutual irrigation companies in that water users must be stockholders, and assessments are levied according to the number of shares. Most residents of the Bear River Basin are served by mutual non-profit water companies and city water departments.

Water Conservancy Districts are created under Title 73, Chapter 9 of the Utah Code. They are established by the district court in response to a formal petition, and are governed by a board of directors appointed by the governor for multi-county districts and by the county commission for single county districts. Water conservancy districts have very broad powers, including that of constructing and operating water systems, levying taxes, and contracting with the federal government. These districts may include incorporated and unincorporated areas.

TABLE 7-1
AMENDED BEAR RIVER COMPACT OF 1980[1]
ALLOCATION OF WATER (acre-feet)

Upper and Central Divisions (above Stewart Dam)

	Idaho	Utah	Wyoming	Total
Storage--original	1,000	17,750	17,750	36,500
Storage--additional[a]	4,500	35,000	35,000	74,500
Depletion--additional (including groundwater)	2,000	13,000	13,000	28,000
Bear Lake Spills	6%	47%	47%	100%

Lower Division (based on depletion, including groundwater)

	Idaho	Utah	Total	Cumulative Total
First right	125,000		125,000	125,000
Second right		275,000	275,000	400,000
Third right	75,000	75,000	150,000	550,000
All remaining water	30%	70%	100%	

[a]This storage is not allowed when Bear Lake is below elevation 5,911.00.

City Water Departments are agencies established by municipalities to provide water service to residents. City ordinances and Titles 10 and 11 of the Utah Code provide the legal framework for operation.

Water Improvement Districts are established under Title 73, Chapter 7 of the Utah Code to accomplish goals of water development, financing, and management similar to those of water conservancy districts and metropolitan water districts. Their activities are confined to unincorporated areas within a single county.

Special Service Districts may be established by resolution to provide various services (including water) within a county or municipality. The powers of special service districts are similar to those of water improvement districts. A service district may be governed by an administrative control board (which may be either appointed or elected), but the governing authority of the county or municipality retains final control and supervisory authority.

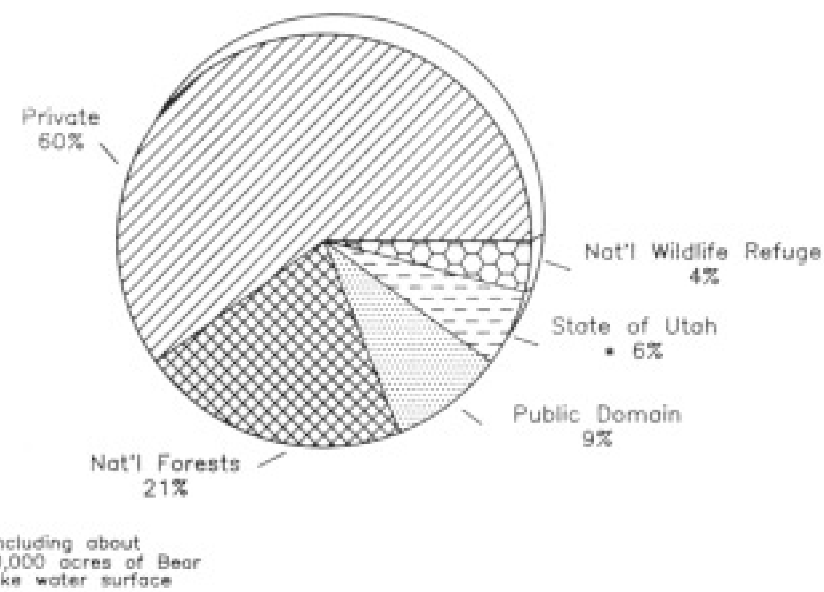
7.4 REGULATORY AGENCIES AND LAND JURISDICTION

State, federal, and local entities having major roles in the regulation and institutional aspects of water use throughout Utah are described in the State Water Plan. They are not repeated here. Also, the specific responsibilities of each are very similar in all river basins of the state. They include public drinking water requirements, water pollution control, distribution of water in accordance with legal water rights, restrictions on construction within or near stream channels, required procedures to develop wells and pump groundwater, and many other activities which have application in the Bear River Basin. Uses and management of water are discussed in Sections 5, 6, 11, and 12 of this report.

Privately owned land accounts for 60 percent of the Bear River Basin in Utah, a higher percentage than in most other basins of the state. The remaining 40 percent includes national forest, public domain managed by the Bureau of Land Management, and state jurisdiction, as shown in Figure 7-1.

FIGURE 7-1

LAND JURISDICTION
BEAR RIVER BASIN IN UTAH [2]



7.5 PROBLEMS AND NEEDS

On the Bear River below Bear Lake, a water right issue needing resolution involves the distribution of water to users. The parties to the Bear River Compact need to adopt a common method for determining the natural flow of the river, so that possible disputes about such determinations can be avoided.

The river commisioners distribute water according to the river's natural flow as measured at various points These measurements determine how much water each user gets from the natural flow, and how much money each user must pay to compensate UP&L for any lost power revenues due to depletions by junior right holders. UP&L has expressed its concern that these users are diverting and consuming water which the company is entitled to use for hydropower generation.

In 1989, UP&L executed 57 contracts in Utah and 19 in Idaho, which provide for delivery of Bear Lake storage water to individual users. As a major water user on the river, UP&L has requested the State Engineers in Idaho and Utah to determine if there is any unauthorized use of Bear River water, and if so, to enforce the laws of the state.

7.6 RECOMMENDATIONS

The State Engineer offices in Utah and Idaho, in consultation with the Bear River Commission and with input from UP&L, should review alternatives for determining the natural flow of the Bear River below Bear Lake at strategic points, and adopt a common method in order to improve distribution of water to users.

7.7 REFERENCES

In addition to references listed below, Section 7 of the State Water Plan, January 1990, discusses the regulation of water in Utah in detail, including six policy issues concerning regulation and institutional problems.

1. Bear River Compact as Amended. Public Law 96-189, 96th Congress. Feb. 8, 1980.

2. "Hydrologic Inventory of the Bear River Study Unit," Utah State University for Utah Division of Water Resources, February 1973.

3. "State of Utah Water--1982," Utah Division of Water Resources, 1982.

4. "Proposed Revisions to the Bear River Compact," Utah Division of Water Resources, October 1976.

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Section 8
STATE AND FEDERAL WATER RESOURCES FUNDING PROGRAMS

This section discusses funding programs available for planning and development of water resources in the Bear River Basin. Cost-sharing considerations are also reviewed.

8.1 INTRODUCTION

Section 8 of the State Water Plan identifies current sources of funding for water resource activities. The program purpose and the responsible agency for each are also described. Most of the programs are uniformly available throughout the state. For convenient reference, Table 8-1, a table of state funding programs, and Table 8-2, a corresponding table of federal funding programs that apply to the Bear River Basin, are included in this section.

Much of the early funding for water resource planning and development in the Bear River Basin has been private for single-purpose projects such as hydropower, irrigation, and municipal supply. Since about 1970, however, significant amounts of public funding have been expended in the basin, especially for municipal water supply improvement and wastewater treatment.

8.2 SETTING

Funding for water developments in the Bear River Basin has been from a wide range of sources, both public and private. Public funding has been both state and federal.

For many years, the Board of Water Resources has been extensively involved in the planning and development of water resources in the Bear River Basin. Through financial assistance by the board and other entities, and with design and construction support from the Division of Water Resources, two major and two smaller water storage dams have been built. In addition, 10 gravity irrigation systems have been converted to sprinklers or otherwise improved, approximately 28 irrigation conveyance systems have been improved, and 41 community drinking water systems have been enlarged or upgraded. The two major storage dams are Woodruff Narrows on the Bear River near the Utah-Wyoming state line, and Porcupine, on the East Fork of Little Bear River near Paradise, Utah. The first dam mentioned is operated and maintained by the

Porcupine Reservoir - Div. of Water Resources

TABLE 8-1
STATE OF UTAH FUNDING PROGRAMS

Administering Entity and Program	Type of Funds	Purposes	Agency Contact
Board of Water Resources			
Revolving Construction Fund	Loans	Small irrigation and culinary projects	Division of Water Resources
Cities Water Loan Fund	Loans	Municipal culinary water systems	
Conservation & Development Fund	Loans	Large water improvement projects	
Bear River Development Account	Special	Develop Bear River surface water	
Community Impact Fund Board			
Permanent Community Impact Fund	Grants & Loans	Schools, roads, medical, water	Division of Community Development
Disaster Relief Board Fund	Grants	County or municipal flood repair	
Community Dev. Block Grants Policy Board			
Community Dev. Block Grants Program	Grants	Improved living environment for small communities and counties	Division of Community Development
Drinking Water Board			
Financial Assistance Program	Loans	Drinking water facilities	Division of Drinking Water
Water Quality Board			
Wastewater Treatment Facilities Financial Assistance Program	Loans	Wastewater treatment facilities	Division of Water Quality
Federal Construction Grants	Grants	Wastewater treatment facilities	
Utah Soil Conservation Commission			
Agricultural Resource Development Loan	Loans	Improvement of cropland and non-federal rangeland	Utah Department of Agriculture
Priority Watershed Program	Grants	Watershed improvements	
Board of Parks and Recreation			
Land & Water Conservation Fund	50-50 Cost-sharing Grants	Swimming and boating facilities, and other recreation activities	Division of Parks and Recreation
Wildlife Board			
Dingle-Johnson Sport Fish Restoration Act	Grants	To restore or develop fish habitat	Division of Wildlife Resources

TABLE 8-2
FEDERAL FUNDING PROGRAMS

Administering Agency	Program	Type of Funds	Purpose
Department of Agriculture			
Agricultural Stabilization and Conservation Service	Agricultural Conservation Program	Grants	Soil, water, and energy conservation
	Emergency Conservation Program	Grants	Rehabilitation of farmland damaged by wind, floods, or other natural disasters
	Conservation Reserve Program	Grants	Reduce erosion and maintain wetlands
Farmers Home Administration	Rural Development	Grants, Loans	Water supply and wastewater disposal
	Resource Conservation & Development	Loans	Multiple purpose water and related-land conservation and other facilities
Soil Conservation Service	Watershed Protection & Flood Prevention	Grants	Flood control, water supply, wildlife, and recreation facilities
	Resource Conservation & Development	Grants	Multiple purpose water and related-land conservation and other facilities
Department of the Army			
Corps of Engineers	Civil Works	Grants	Flood control, water supply, navigation, and recreation-related developments
	Continuing Authorities Program	Grants	Flood control and protection
	Emergency Activities	Grants	Flood control and protection
Department of the Interior			
Bureau of Reclamation	Investigations Program	Loans	Water storage/delivery, related purposes
	Loan Programs	Loans	Small multiple-purpose water developments
Department of Housing and Urban Development	Community Develop. Block Grant Program	Grants	Water resources planning, development
Economic Development Administration	Public Works and Economic Development	Grants, Loans	Water and related planning, development
Fed. Emergency Management Agency	Presidential Declared Disaster	Grants	Flood damage mitigation
	Flood Plain Management	Grants	Acquisition of structures in flood plains

TABLE 8-3
PAST FUNDING FOR WATER-RELATED IMPROVEMENTS IN BEAR RIVER BASIN, 1948-91

Funding Entity and/or Funding Program	Amount ($1,000) Grants	Amount ($1,000) Loans	Time Period
Utah Board of Water Resources			
Revolving Construction Fund		8,031	1948-91
Cities Water Loan Fund		6,252	1976-90
Conservation & Development Fund		3,874[a]	1980-88
Utah Water Quality Board	11,192	12,012[b]	1984-90
Utah Board of Parks & Recreation			
Land & Water Conservation Fund	2,226		1965-90
Community Impact Fund Board			
Permanent Community Impact Fund	484	643	1985-90
Disaster Relief Board Fund	346[c]		1983-86
Community Development Block Grants	1,279		1982-90
Utah Drinking Water Board		2,371	1983-90
Utah Soil Conservation Commission	83	3,307	1976-90
U.S. Department of Agriculture			
Farmers Home Admin.	2,635	6,572	1970-90
Agric. Stabiliz. & Conserv. Service	1,719		1980-90
Resource Conserv. & Develop. (SCS)	2,045		1980-90
U.S. Bureau of Reclamation	4,871	368	1980-90
Total	26,880	43,430	

[a] Including $828,000 of 1991 bond funding.
[b] A very small portion of this amount is grants.
[c] Funds available from legislature only after a disaster declaration by governor.

Source: Data from agency files, obtained by letters and telephone.

Woodruff Narrows Reservoir Company, and the second by the Porcupine Reservoir Company. The smaller reservoirs are Birch Creek and Woodruff Creek in Rich County.

Other public funding for water-related facilities in the Bear River Basin has been extensive. Although the list of expenditures identified in Table 8-3 is not entirely complete, it is illustrative of the wide range and general magnitude of funding sources. It indicates that at least $70 million in financial assistance has been provided by state and federal agencies in the Bear River Basin. The various funding sources in Table 8-3 cover a wide range of activities and facilities. Most of the communities throughout the basin have benefitted substantially from these expenditures.


Woodruff Narrows Reservoir - Div. of Water Resources

Future funding needed in the basin for purposes identified in Tables 8-1 and 8-2 can probably be obtained under existing programs. Existing programs are available to help cities or water-use entities with immediate needs.

In contrast, the future Bear River development proposed in Section 9 is wider in scope, covering a larger area (and areas outside the basin). It will provide for a full range of water uses, and meet needs that are more long-term than immediate. Also the cost is much greater, which would be shared by several entities and public sectors. In order to meet the special financing arrangements needed to provide the development funding and create an equitable, acceptable cost sharing formula, the 1991 General Session of the Utah Legislature enacted legislation which appropriated $2 million in a Bear River Development Account. The appropriation is to be used by the Division/Board of Water Resources, when released by the Legislature, to help develop the surface waters of the Bear River. The account consists of monies appropriated by the Legislature and future revenue received from the sale of water or power from authorized projects.

The division is authorized to develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature, to own and operate the facilities constructed, and to market the developed waters.

8.3 COST SHARING

Cost sharing is the dividing of financial obligations and risk associated with funding a project, where concepts of up-front financing and cost recovery (or repayment) are considered. The guiding principle of cost-sharing programs is to promote economic efficiency in the use of scarce resources. This principle holds that those who benefit from a project should pay its full cost. Federal, state and local governments often choose, however, to provide a subsidy in the form of grants, or low or no-interest loans, to encourage water conservation or quality improvements.

Funding programs listed in Tables 8-1, 8-2, and 8-3 require the sharing of up-front costs by project sponsors. Loans may be awarded for 100 percent of a project's cost only under hardship or other extreme circumstances. Grants for 100 percent of cost are not likely to be considered. Sponsors of small projects may make in-kind contributions in lieu of cash when approved by the funding agency. The portion of a project's costs to be funded by the local project sponsor is set by the agency's policy board, generally on a case-by-case basis. For loans, the interest rate and repayment period are also set by the agency's board after reviewing the sponsor's repayment ability[1].

When public purposes (such as recreation, fish and wildlife, and flood control) are included as part of a multipurpose water development project, state or federal funds may be (or have been) used to cover 100 percent of the costs.

In the 1991 Bear River Development Act,[2] the Utah Legislature specified the basis for cost sharing in future development of the Bear River by the state (See Section 9.1.3). Table 8-4 shows the intended basis. Under the act, repayment is set at 50 years or less, and the rate is to be set by the Board of Water Resources.

TABLE 8-4
COST SHARING SPECIFIED UNDER BEAR RIVER DEVELOPMENT ACT[2]

Percent to be Paid by Direct Beneficiaries			
Construction and Allocated Costs	Environmental Mitigation	Operation and Maintenance	Repair and Replacement
Municipal & Industrial	100	100	100
Agriculture	25	100	100
Hydropower	100	100	100
Recreation[a]	0	0	0
Fish & Wildlife[a]	0	0	0
Flood Control[a]	0	0	0

[a]To be paid by the state.

8.4 RECOMMENDATIONS

Sponsors of water conservation and development projects should make initial inquiries about financial assistance through appropriate local entities (such as the Bear River Resource Conservation and Development organization, Bear River Association of Governments, and Bear Lake Regional Commission). It is usually more effective to make initial contacts through local individuals (such as board and commission members) to obtain endorsement of the project, and coordinate funding requests with various state and federal programs.

8.5 REFERENCES

1. "Economics of the State Water Plan, Background Paper," Utah Division of Water Resources, January 1992.

2. Bear River Development Act, Title 73, Chapter 26, *UCA*, 1953, amended.

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Section 9
WATER PLANNING AND DEVELOPMENT

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

9.1 INTRODUCTION

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

9.1.1 Setting

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

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

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

In 1981, the Woodruff Narrows Reservoir was enlarged to a total capacity of 57,300 acre-feet. New compact storage in the amount of 18,000 acre-feet per year, with an annual depletion limitation of approximately 6,700 acre-feet, was allocated for the enlargement project. Therefore, of the additional increment of development permitted by the amended compact, only 17,000 acre-feet can yet be stored each year, and about 6,300 acre-feet more can be depleted within Utah. More information is given in Section 7.

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

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

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

9.1.2 Authority and Legislative History

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

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

9.1.3 Bear River Development Act - 1991[5]

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

Water developed by projects authorized by this act, except water reserved for wildlife or public recreation, shall be made available by contracts exclusively to the following entities: Bear River Water Conservancy District, 60,000 acre-feet; Salt Lake County Water Conservancy District, 50,000 acre-feet; Weber Basin Water Conservancy District, 50,000 acre-feet; and municipalities, water companies, and any water conservancy district in Cache County, 60,000 acre-feet. The act also directs the division to allocate project costs according to the following purposes: municipal and industrial, agriculture, hydropower, recreation, fish and wildlife, and flood control.


Below Cutler Reservoir - Div. of Water Resources

9.1.4 1992 Legislation[6]

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

9.2 PRESENT WATER USES AND SUPPLIES

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

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

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

9.2.1 Box Elder County

Box Elder County has significant agricultural activity and a growing industrial base. The non-agricultural industries and the public water systems rely totally on groundwater. The groundwater resources of the county are limited, primarily from a quality standpoint. The water resources originating in the county are relatively limited when compared to the other counties in the study area. The Bear River, that flows through the eastern part of the county, and is the largest river entering the Great Salt Lake. The Bear River with Bear Lake storage water provides approximately 67 percent of the water for irrigated land in the Bear River Valley. Water used for open/wet areas includes the Bear River Migratory Bird Refuge and other private and state waterfowl areas at the mouth of the Bear River. Present use by category is depicted in Figure 9-1.

9.2.2 Cache County

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

FIGURE 9-1

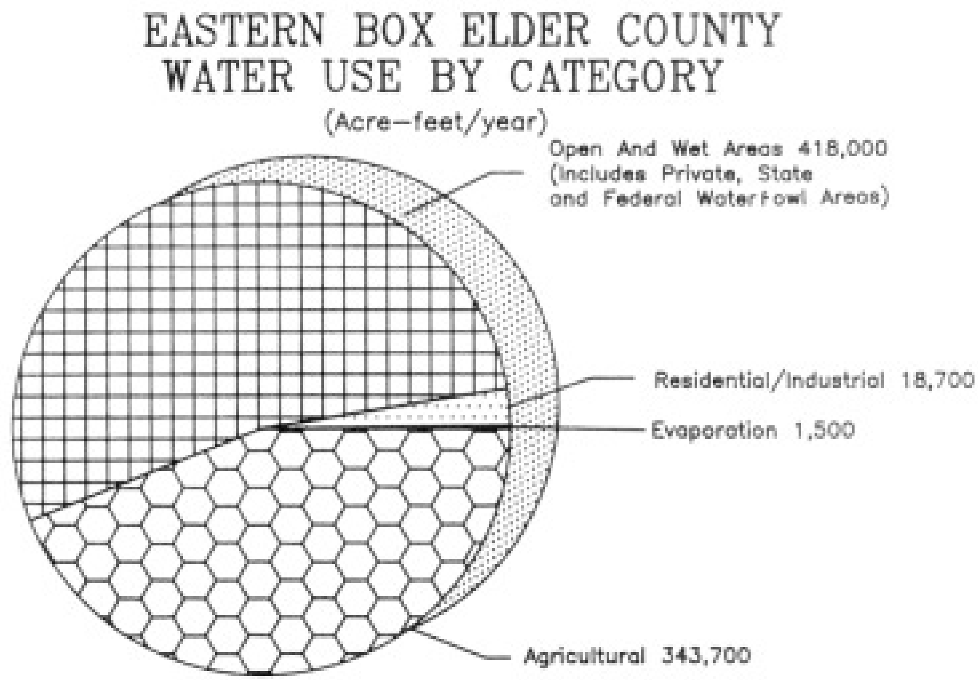
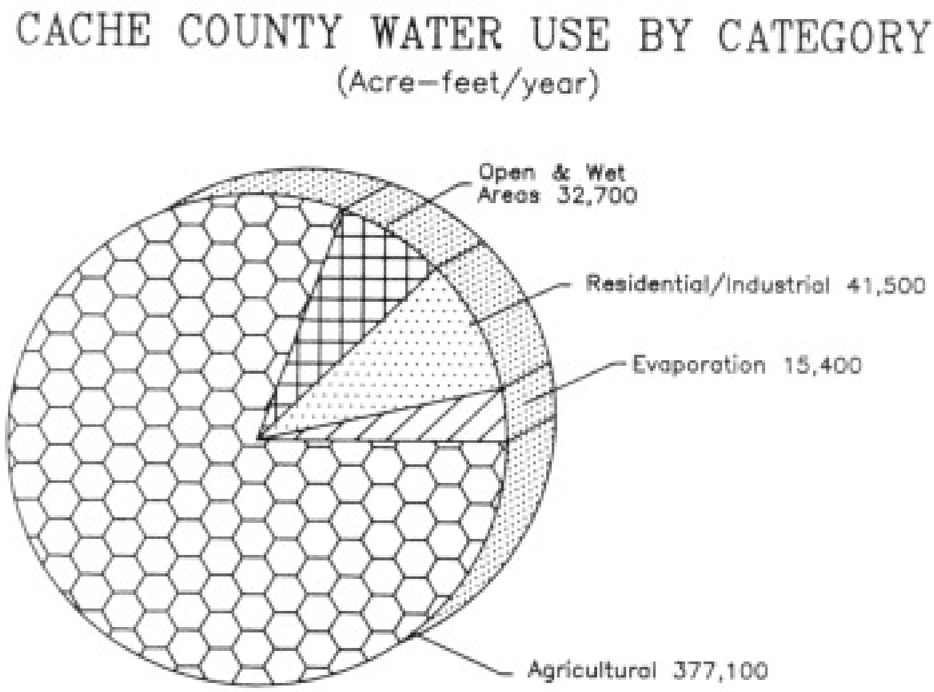


FIGURE 9-2



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

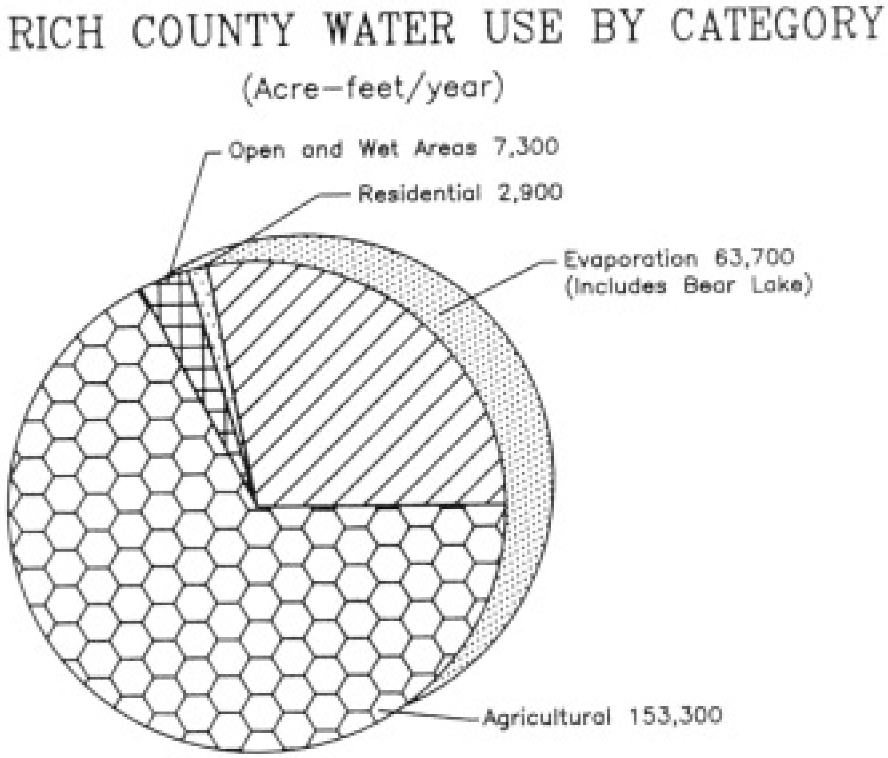
9.2.3 Rich County

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

9.3 FUTURE WATER NEEDS

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

FIGURE 9-3



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

9.3.1 Box Elder County

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

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

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

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

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

9.3.2 Cache County

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

Agriculture - Development of the South Cache Irrigation Project (See Section 10.4.1) in Cache County which would bring new lands under irrigation, was found to be economically infeasible under current conditions. However, an estimated 1,500 acres of non-irrigated cropland within the service area areas of several large irrigation systems could be irrigated if 5,000 acre-feet of water were available in the existing canals. Approximately 25,000 acres of irrigated cropland with a late season water shortage could use up to 6,000 acre-feet of supplemental water.

9.3.3 Rich County

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

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

9.3.4 Export to Wasatch Front[3]

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

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

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

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

9.4 ALTERNATIVES FOR MEETING NEEDS

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

9.4.1 Building Reservoirs

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

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

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

9.4.2 Groundwater Use

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

9.4.3 Conservation/Education

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

9.4.4 Water Rights Transfer

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

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

9.4.5 Bear River Water Conservancy District

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

TABLE 9-3

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

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

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

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

9.5 POTENTIAL STORAGE SITES

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

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

9.5.1 Avon

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

9.5.2 Barrens

The Barrens Reservoir site is located approximately five miles west of Smithfield, Utah, immediately to the west of the town of Amalga. The area is known as "The Barrens" because of the relatively barren ground encompassed by the area. Because the groundwater is shallow in the dish-shaped drainage and the soils are alkaline, limited agricultural activity has occurred in the region. The area drains into the Clay Slough, which is an arm of Cutler Reservoir. Several springs and flowing wells are located within the proposed reservoir area. The reservoir would be an off-stream storage facility with a limited drainage area contributing runoff water to the reservoir. Water to fill the reservoir must be brought to the site through either the West Cache Canal or a pump station on the nearby Bear River. A major power transmission line crosses the reservoir basin, and an industrial sewage lagoon facility is situated inside the proposed reservoir basin. The balance of the

TABLE 9-4

POTENTIAL RESERVOIR DATA SUMMARY[3]

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

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

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

9.5.3 Honeyville

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

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

9.5.4 Hyrum Dam Enlargement

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

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

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

9.5.5 Mill Creek

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

9.5.6 Oneida Narrows

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

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

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

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

9.5.7 North Eden

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

9.6 ENVIRONMENTAL ANALYSIS

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

9.6.1 Impacts

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

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

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

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

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

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

9.6.2 Mitigation

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

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

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

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

9.7 WATER QUALITY ASSESSMENT

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

Box Elder County - Div. of Water Resources

9.7.1 Reservoir Modeling

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

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

9.7.2 Treatment Requirements

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

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

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

9.8 ECONOMIC ANALYSIS

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

9.8.1 Benefits and Costs

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

9.8.2 Wasatch Front M&I

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

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

TABLE 9-6									
PREDICTED WATER QUALITY SUMMARY FOR PROPOSED RESERVOIRS[3]									
CE-Qual- Model								Steady State Model	Bluegreen Model[b]
Water Quality[a] Parameters	Min DO (mg/l)	OP (mg/l)	N:P	Max Algae (g C/L)	Period of Peak Algae	Avg. TDS (mg/l)	Avg. TSS (mg/l)	Avg. Annual TP (mg/l)	
Avon	>4.5	1-6	>16	0.06	fall	<200	0-18	0.026	BG
Mill Creek	>2.5[c]	5-10	>16	0.18	summer	300-350	0-18	0.036	BG
Willard	0.0[d]	2-10	≥16	0.16	fall	480	15-20	0.084	BG
Barrens	>6.5	<5	>16	0.52	spring	450-550	40	0.091	*
Hyrum	>6.0[e]	20-40	>16	0.60	fall	<250	10-40	0.102	*
Honeyville	>2.0	5-25	<16[f]	1.50	summer-fall	400-500 >750 in fall	50-100	0.183	BG

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

TABLE 9-7				
SUMMARY OF ECONOMIC ANALYSIS ($ IN MILLIONS)[4]				
Project Description	Costs	Benefits	Net Benefits	Benefit Cost Ratio
Willard Bay[a], Honeyville, Mill Creek, and Groundwater	260.3	284.7	24.4	1.09
Willard Bay[a], Honeyville, and Groundwater	239.5	265.8	26.3	1.11
Willard Bay[a], Honeyville, Hyrum, and Groundwater	253.6	269.3	15.7	1.06
Mill Creek Reservoir	35.0	44.3	9.3	1.26

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

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

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

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

9.8.3 Recreation

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

9.8.4 Hydropower

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

9.8.5 Box Elder County M&I

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

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

Project costs for delivering replacement water to Box Elder County are small. It is assumed that the Bear River Water Conservancy District will proceed with its groundwater pumping project (See Section 9.4.5) with or without the Bear River development project.

9.8.6 Cache County M&I

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

9.8.7 Flood Damage Reduction

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

9.8.8 Irrigation

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

9.8.9 Bird Refuge

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

9.9 WATER DEVELOPMENT PLAN AND IMPLEMENTATION SCHEDULE

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

9.9.1 Water Development Plan

The plan includes: 1) enlarging Hyrum Reservoir, 2) connecting the Bear River with a pipeline and/or canal from a point somewhere below Cutler Dam to Willard Bay Reservoir, 3) providing conveyance and treatment facilities to deliver water to the Wasatch Front, and 4) building Honeyville Reservoir.

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

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

9.9.2 Implementation Schedule

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

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

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

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

9.10 FINANCIAL ANALYSIS

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

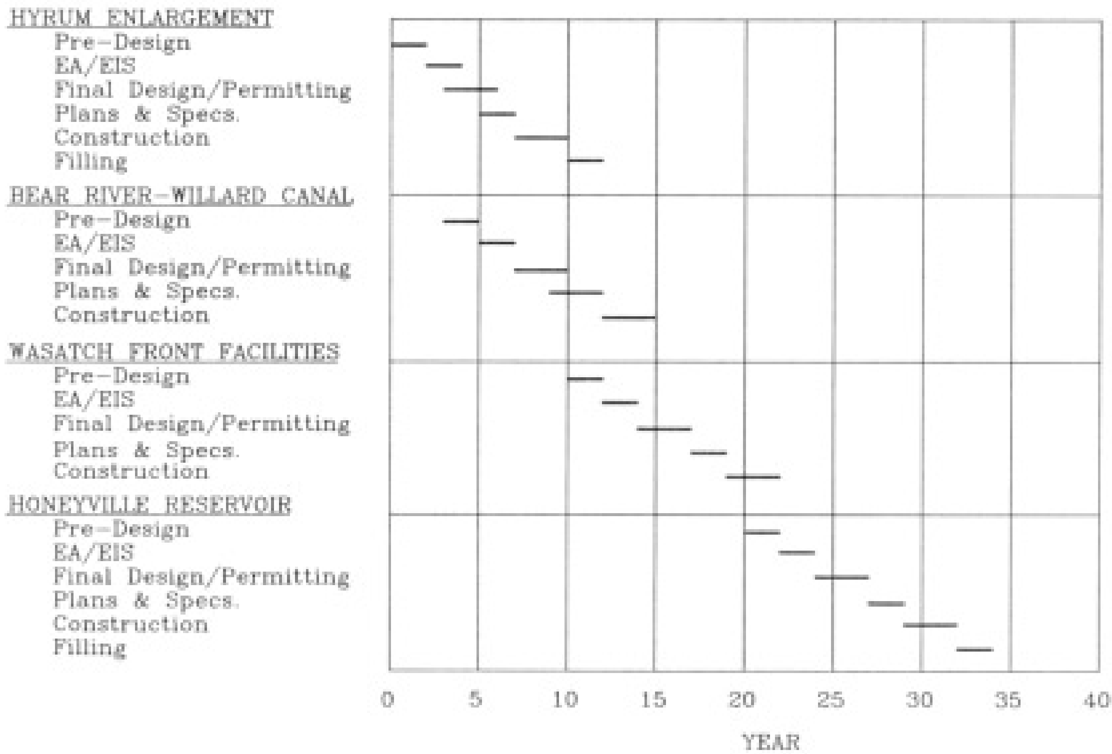
The analysis focused on allocating joint costs or, in other words, project costs that contribute to more than one purpose. In addition, the amount of the payment required to return all state funds invested in project facilities other than flood and recreation was calculated. Table 9-8 shows how project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

9.10.1 Cost Allocation

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

FIGURE 9-4

BEAR RIVER WATER DEVELOPMENT PLAN
IMPLEMENTATION SCHEDULE



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

9.10.2 Cost Recovery

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

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

9.11 RECOMMENDATIONS

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

TABLE 9-8							
FINANCIAL ANLYSIS OF HONEYVILLE, HYRUM, WILLARD BAY RESERVOIR AND GROUNDWATER[4]							
Purpose	Separable Cost ($)	Share of Joint Cost ($)	Total Cost ($)	Annual AF Delivered	Annual Total Cost per AF ($)	Annual Revenue to State ($)	Present Worth of Non-reimbursable Cost ($)
Wasatch Front M&I	173,000,000	52,808,000	225,808,000	100,000	239	7,198,000	0
Box Elder M & I	156,000	5,073,000	5,229,000	16,000	22	298,000	0
Cache M & I	34,000	1,234,000	1,268,000	3,500	25	73,000	0
Irrigation	614,000	1,218,000	1,832,000	13,000	23	18,000a	913,000
Bird Refuge	0	15,637,000	15,637,000	30,500			0
Recreation	4,000,000	2,925,000	6,925,000				6,925,000
Hydropower	7,900,000	3,661,000	11,561,000			215,000	0
Flood Reduction	0	998,000	998,000				998,000
Total	185,704,000	83,554,000	269,258,000	163,000		7,802,000	8,836,000

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

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

9.11.1 Water Sales Agreements

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

9.11.2 Oneida Narrows Joint Reservoir Project

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

9.11.3 Hyrum Reservoir Investigation

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

9.11.4 Blacksmith Fork Water Diversion

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

9.11.5 Bird Refuge Joint Project

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

9.11.6 Bear River to Willard Reservoir Conveyance System

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

9.11.7 Hyrum Reservoir to Box Elder County Conveyance System

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

9.11.8 Protection of Potential Reservoir Sites

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

9.12 REFERENCES

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

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

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

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

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

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

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

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Section 10
AGRICULTURAL WATER CONSERVATION AND DEVELOPMENT

This section describes the agricultural industry in the Bear River Basin. It also discusses proposed solutions to the problems and needs of the area.

10.1 INTRODUCTION

Agriculture is an important industry in the study area. Within the Utah portion of the basin, about 420,000 acres are cultivated land, of which 301,700 are irrigated (13.9 percent of basin area). Beef cattle, sheep, and dairying are the largest sources of total farm income.

Investigations of several of the most favorable areas for potential irrigation showed that they are economically infeasible. The only new irrigation development feasible at this time are small acreages within areas served by existing irrigation systems. The investigations are described in this section, but no significant new irrigation is proposed.

10.2 SETTING

Within the entire Bear River Basin, approximately 550,000 acres of cropland are being irrigated, with a little over half located in

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Utah, and the remainder in Wyoming and Idaho. About half of the basin total is irrigated from the Bear River mainstem, and half from tributary streams. A breakdown by state and county of surface-irrigated cropland is shown in Table 10-1. A detailed listing of irrigated crops in each county is shown in Table 10-2.

Annual depletion of water from irrigated cropland is estimated to be approximately 1,020,000 acre-feet from the entire basin[1] and 535,600 acre-feet within Utah (See Table 5-4). These figures refer to total crop consumptive use, including that supplied directly by rainfall during the growing season.

physical and chemical properties, make them desirable for irrigated agriculture. This is evidenced by nearly a century of sustained irrigation on much of the arable area, and successful dry farming on most of the remainder.

The Bear River Canal Company operates the largest irrigation water delivery system in the basin. The company's West Side and Hammond East Side canals divert from Cutler Dam, and serve about 64,000 acres of land in Box Elder County. These canals carry natural flows of Bear River and substantial amounts of

TABLE 10-1
IRRIGATED CROPLAND BY COUNTIES
BEAR RIVER BASIN

County	Area (acres)
Summit[a]	2,700
Rich	73,400
Cache	119,800
Box Elder[a]	105,800
Utah Total	301,700[2]
Idaho Total	190,000[3]
Wyoming Total	60,000[3]
Basin Total	552,000 (rounded)

[a]Portion of county within Bear River Basin.

During the average growing season, May-September precipitation provides only about one-fourth of the crop consumptive use requirement. Thus, irrigation is necessary for most crops. The average frost-free season is especially short in the upper basin, severely limiting agricultural opportunities.

The arable lands generally have good water transmission properties and adequate moisture-holding capacity which, with other favorable

Bear Lake water delivered under contract with UP&L. Other irrigation systems diverting from the Bear River have acquired lesser amounts of Bear Lake water by contracts with the power company, as discussed in Section 6.

Irrigation companies in the Bear River Basin are numerous. About 170 of them are within Utah. Section 6 lists the largest companies in each county. Table 10-3

TABLE 10-2
IRRIGATED CROPLAND BY CROP[2]
BEAR RIVER BASIN

Crop	Box Elder	Cache	Rich	Summit	Total
	(Acres, by County)				
Fruit	2,470	183	97	0	2,750
Other Horticulture	0	20	21	0	41
Grain	35,227	34,348	2,016	0	71,591
Corn	12,858	8,911	0	0	21,769
Vegetables	2,095	313	0	0	2,408
Alfalfa	19,990	39,592	9,150	0	68,732
Grass Hay	2,000	2,996	50,206	194	55,396
Grass/Turf	461	24	0	0	485
Pasture	9,970	19,145	5,549	2,461	37,125
Fallow	7,894	4,401	197	0	12,492
Idle Overgrown	1,764	2,923	123	0	4,810
Surface Subtotal	94,729	112,856	67,359	2,655	277,599
Pasture	11,068	6,958	3,056	0	21,082
Grass Hay	0	0	3,021	0	3,021
Subsurface Subtotal	11,068	6,958	6,077	0	24,103
Total Irrigated	105,797	119,814	73,436	2,655	301,702

shows the 12 largest, along with their water source and the county in which they operate. These 12 represent 48 percent of the basin's irrigated land in Utah.

10.3 PROBLEMS, NEEDS, AND ISSUES

A wide range of water-related agricultural problems, needs, or issues in the Bear River Basin are discussed in the following paragraphs.

10.3.1 Irrigated Cropland Conversion

Utah's growing population tends to increase the overall demand for land and water. Often this results in a loss of good agricultural land and/or the water used for irrigation. Agriculture has been responsible for much of the existing water development, and thus controls a large supply of relatively low-cost water and land that is attractive to new developments. Transfer of water rights from agriculture to other uses is not uncommon, and occurs on a willing buyer/willing seller basis.

TABLE 10-3
LARGEST UTAH IRRIGATION COMPANIES[4]
BEAR RIVER BASIN

Name of System	County	Water Source	Area Irrigated (Acres)
Bear River Canal Co.	Box Elder	Bear River	64,000
Cub River Irrigation Co.	Cache	Cub & Bear R.	14,600[a]
West Cache Canal Co.	Cache	Bear River	11,200[a]
Randolph & Woodruff Canal Co.	Rich	Bear River	10,200
Randolph & Sage C. Canal Co.	Rich	Bear River	8,600
Richmond Irrigation Co.	Cache	Local streams and wells	8,400
Hyrum-Mendon-Wellsville Irrigation Co.	Cache	L. Bear River	7,100
Beckwith-Quinn Canal Co.	Rich	Bear River	5,600
Chapman Canal Co.	Rich	Bear River	5,400
Woodruff Irrigation Co.	Rich	Woodruff C.	4,800
Crawford-Thompson Canal Co.	Rich	Bear River	4,100
Randolph Irrigation Co.	Rich	Big Creek	3,400

[a]Utah portion of irrigated area.

The long-term trend in total irrigated land in the Bear River Basin is nearly constant, with any increase or decrease being minor. Increments of new irrigated land approximately compensate for losses to residential use.

Changes in land use, such as suburban residential expansion, often displace agriculture. In the past, the irrigated cropland base stayed at about the same level, and even increased as various water development projects came on line. Now, however, development of new lands appears to be close to an end because of the high cost of any new water supplies and the poor economic market for agriculture. The Bear River Basin is one of the few places in the state that has enough water and arable land to allow agricultural expansion.

10.3.2 Ability to Pay Water Costs

Farming has undergone fundamental changes in recent years that have resulted in many farmers leaving the farm entirely, or relying on off-farm employment. On the whole, however, these changes are a result of national and international political and economic restructuring. Farmers in the Bear River Basin who have survived the continuing farm crisis have done so by becoming adept at increasing efficiency and productivity, and by taking full advantage of government conservation and commodity programs. In general, Bear River farmers cannot afford to pay the full development cost of water (including storage) for new irrigation projects without financial subsidies or other incentives.

Crop budgets indicate farmers can afford to pay from $10 to $20 an acre for water for low-value crops such as hay, and up to $100 an acre for high-value crops such as fruit.

10.3.3 Irrigation Water Supply and Management

In the Box Elder portion of the Bear River Basin, approximately 61 percent of the irrigated land is served by the Bear River Canal Company. In general, this portion has an adequate water supply. On the remaining 39 percent of land, served by many smaller irrigation companies and individual systems, the supply is not always adequate, and late-season shortages are common. As many as 8,000 acres of irrigated land with a late season water shortage could use up to 2,000 acre-feet of supplemental water. Other problems include seepage losses from conveyance systems, vegetation along conveyance systems, and deficient diversion structures.

Cache County is served by about 70 irrigation companies, many of which have similar problems, including a need for better structural facilities. For example, the Porcupine Canal Company has had problems with canal seepage loss. Some of the needed canal lining has been done, but much remains. The Richmond Irrigation Company, because of water shortages, has been able to serve only part of the acreage it could otherwise serve. Approximately 25,000 acres of irrigated land in Cache County with a late season water shortage could use up to 6,000 acre-feet of supplemental water.

In Rich County, the main problem is a shortage of late-season irrigation supply; not because of inadequate supply in the Bear River mainstem but because of low flow in tributary streams. This is especially true in low runoff years, and particularly in the Randolph area, where there is only 980 acre-feet of tributary water storage. Approximately 6,000 acres of irrigated land in Rich County could use up to 1,500 acre-feet of supplemental water. Other problems are deficient structures, canal vegetation, and inefficient water management.

The Bear River Basin in Summit County has only two irrigation systems. The general condition of these systems is good, but there are high seepage losses.

10.3.4 Water Conservation

Opportunities for more efficient use of irrigation water exist through wise management, allocation, and conservation. More than 74 percent of water depletions in the Utah portion of Bear River Basin result from irrigation (See Table 5-4). Because of this, an improvement in irrigation efficiencies would impact the largest volume of water.

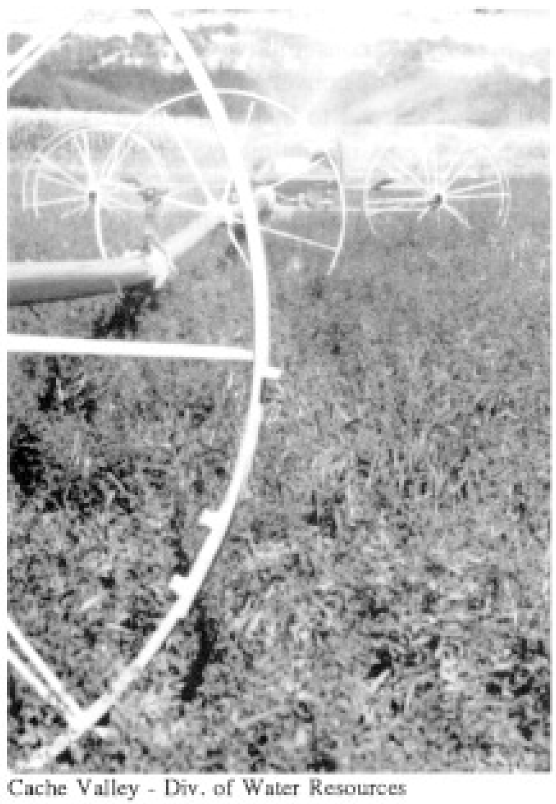

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TABLE 10-4
SPRINKLER IRRIGATION

	Sprinkler Irrigated Area (acres)	Percent of all Irrigated Land in County[a]
Box Elder[b]	9,000	10 or less
Cache	70,000	60 or more
Rich	11,000	15 or more
Total	90,000	30

[a] Rough Estimates based on judgment of specialists familiar with area.
[b] Bear River Basin portion

One possibility is conversion to sprinkler irrigation, which allows controlled, uniform application and reduces waste from over-irrigation. This practice generally reduces diversions at the head of a system, although it may increase the consumptive use of water by crops. Because of convenience and economic incentives, the trend to install sprinkler irrigation systems is continuing, especially in Cache County. About 30 percent of the total irrigated area is now sprinkler irrigated, as shown in Table 10-4.

Better onfarm management of irrigation water by scheduling the timing and amount of water for optimum plant growth, and improvements in farming methods, could increase crop yields and farm income. Losses in existing systems could be reduced by lining or piping canals through excessive seepage areas and high-failure hazard areas, constructing better diversion dams, providing control structures to reduce operating losses, and installing measuring devices to coordinate water deliveries and demands more closely.

10.3.5 Use of Saved Water

The perceived right to use water saved by conservation practices has statewide application. This issue is discussed in the State Water Plan, January 1990. In the Bear River Basin, it will become more of an issue, as it now is in other Utah basins, when water supplies become more fully used.

In some areas of the basin, the downstream water user depends on return flow from upper users to provide significant portions of the water supply. Irrigation return flows from Rich County, Utah, and from Wyoming and Idaho lands return to the mainstem and are re-diverted downstream in Cache and Box Elder counties. Likewise, return flows from Cache County become part of Box Elder County's total water supply.

10.3.6 Watershed Management

Watershed management is the protection, conservation, and use of all the natural resources to keep the soil mantle productive and in place; and to assure that the water yield meets the existing and potential requirements. If not properly protected, watershed lands are readily damaged by erosion, flood, sediment, and fire. This discussion is limited to watershed treatment measures such as:

1. Livestock and wildlife grazing management.

2. Vegetation improvement, coordinated with grazing management.

3. Structural measures, such as contour trenching, debris basins, gully control, and stream channel stabilization, in conjunction with vegetation improvement and grazing management.

Erosion - In the Bear River Basin, large quantities of suspended sediment enter the mainstem flow from a few tributary streams. Some of these streams, are Bridger Creek, Twin Creek, and Smiths Fork in the upper basin, and Deep Creek, Battle Creek, Weston Creek, Five Mile Creek, and Mink Creek in northern Cache Valley in Idaho. Some of the erosion occurring in most of these tributary watersheds is natural, but most of it is largely man-caused from activities such as livestock overgrazing, mining, and construction. Sediment produced from this erosion is deposited in reservoirs, stream channels, canals, ditches, and on irrigated land and urbanized areas. It reduces reservoir storage capacity and the efficiency of irrigation conveyance systems. Much of the phosphorus carried by the tributary streams to the Bear River is derived from runoff and erosion of the land.

Better management is bringing some improvements, but full correction will take many years. Channel degradation and headcutting have been severe in some cases. Extremely heavy runoff in the early 1980s has accelerated the erosion in many streams.

Erosion also occurs on dry cropland in the basin, especially where slopes are steep and density of vegetation is low. Damages to agricultural land from thunderstorms are usually in the form of erosion and sediment. Flooding along the river plains inundates cropland and pasture, damages irrigation systems, and disrupts rural road systems. Flood problems are more fully discussed in Section 13.

Water Quality - Non-point source pollution from agricultural activities are components of the basin's overall water quality problem. Return flow from irrigated lands, animal wastes, and agricultural chemicals contribute to pollution of the Bear River, so reduction of non-point source pollution/sediment is complex and difficult. Section 12, "Water Pollution Control," discusses these problems and overall water quality.

Specific Watershed Conditions - The entire Bear River drainage system has been subdivided into six watershed areas by the U.S. Geological Survey. For planning purposes, those within Utah have been further divided into 16 smaller watershed units by the Soil Conservation Service (SCS). These are shown on Figure 10-1 and listed in Table 10-5. The SCS has identified work needed in these watersheds to solve a variety of problems. They have extensively studied the Clarkston watershed. It is estimated that 27 percent of the rangeland in these Utah watersheds is in excellent or good condition, with the remaining 73 percent rated as fair or poor. The Little Bear River and Cornish watersheds in Cache County are currently prioritized for non-point source water quality projects by the Departments of Environmental Quality and Agriculture (See Section 12).

10.4 POTENTIAL NEW IRRIGATION DEVELOPMENT

Most potentially irrigable land in the basin is presently non-irrigated cropland. The locations of eight such areas in Cache and Box Elder counties are identified on Figure 10-2. Small, selected portions of areas No. 1 and 6 were studied in detail in 1989-90 at the request of local agricultural organizations. Neither of the two was found to be economically feasible for new irrigations.[6 & 7] The two studies are described in the following paragraphs. The cost of new reservoir storage, pumping and conveyance facilities precludes most potential irrigation development throughout the basin.

FIGURE 10-1

MAJOR WATERSHEDS OF THE
BEAR RIVER AND TRIBUTARIES
WITHIN UTAH

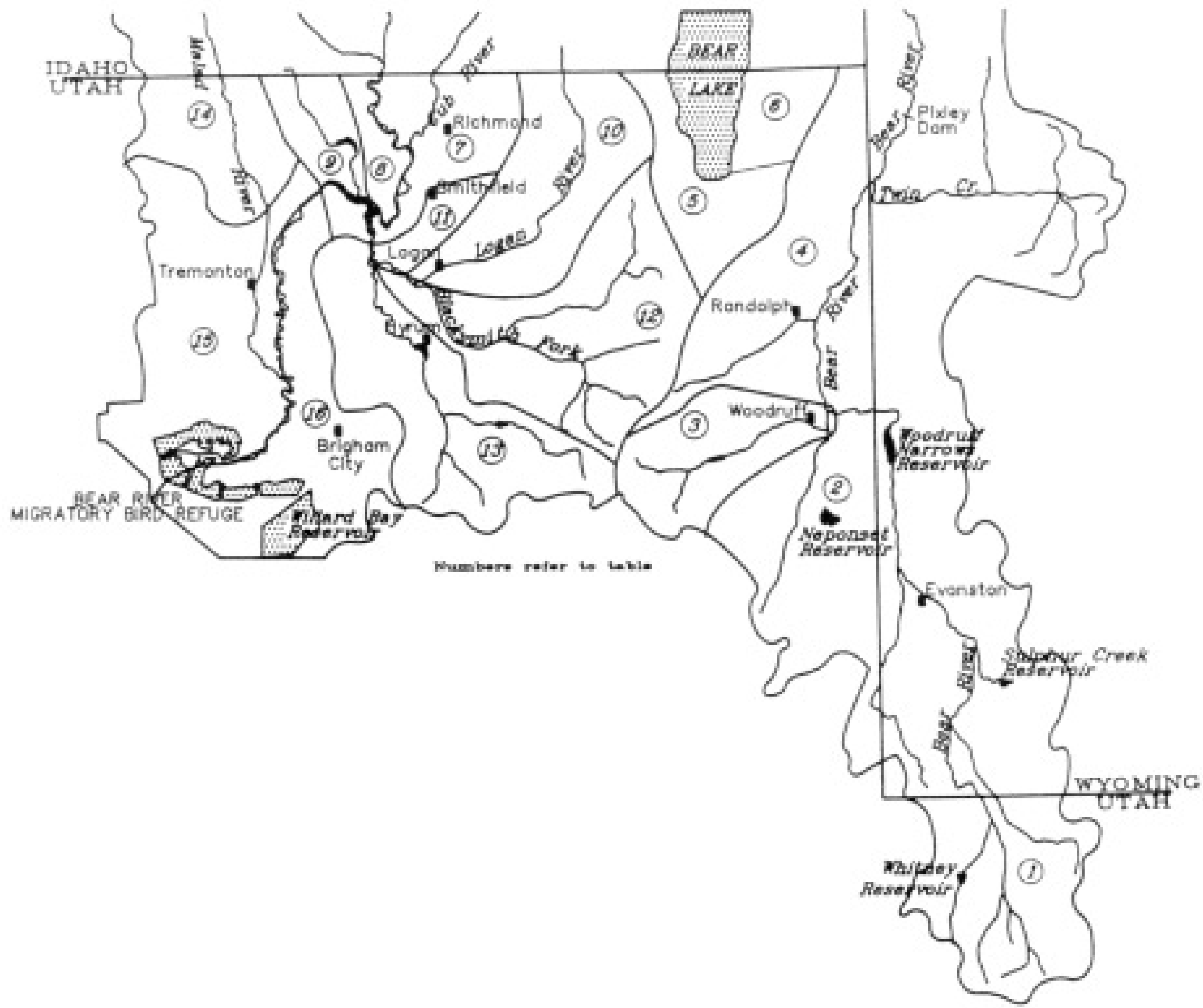


TABLE 10-5
UTAH WATERSHEDS, BEAR RIVER BASIN

Basin and Watershed	Area (Acres)	Potential Feasible Watershed Project Identified
Upper Bear River	707,705	
1 Uinta Mountains	161,474	
2 Upper Rich	241,214	
3 Woodruff Creek	89,975	X
4 Lower Rich	215,042	X
Bear Lake	169,711	
5 Bear Lake	124,971	X
6 East Shore	44,740	X
Middle Bear	175,969	
7 Cub River	90,084	X
8 Cornish	37,119	X
9 Clarkston	48,766	X
Logan/Little Bear	576,671	
10 Logan River	114,516	
11 Smithfield	50,064	X
12 Blacksmith Fork River	214,080	X
13 Little Bear River	198,011	X
Lower Bear	414,276	
14 Washakie	70,311	X
15 Bear River Valley	225,107	X
16 Wellsville Mountain	118,858	X
GRAND TOTAL	2,044,332	

Watersheds are located by number on Figure 10-1.
Source: "Watersheds of Utah," Soil Conservation Service.

Although irrigation of the above areas is not feasible, small, isolated tracts of non-irrigated cropland are within service areas of existing canal systems which could be irrigated if enough water were available.

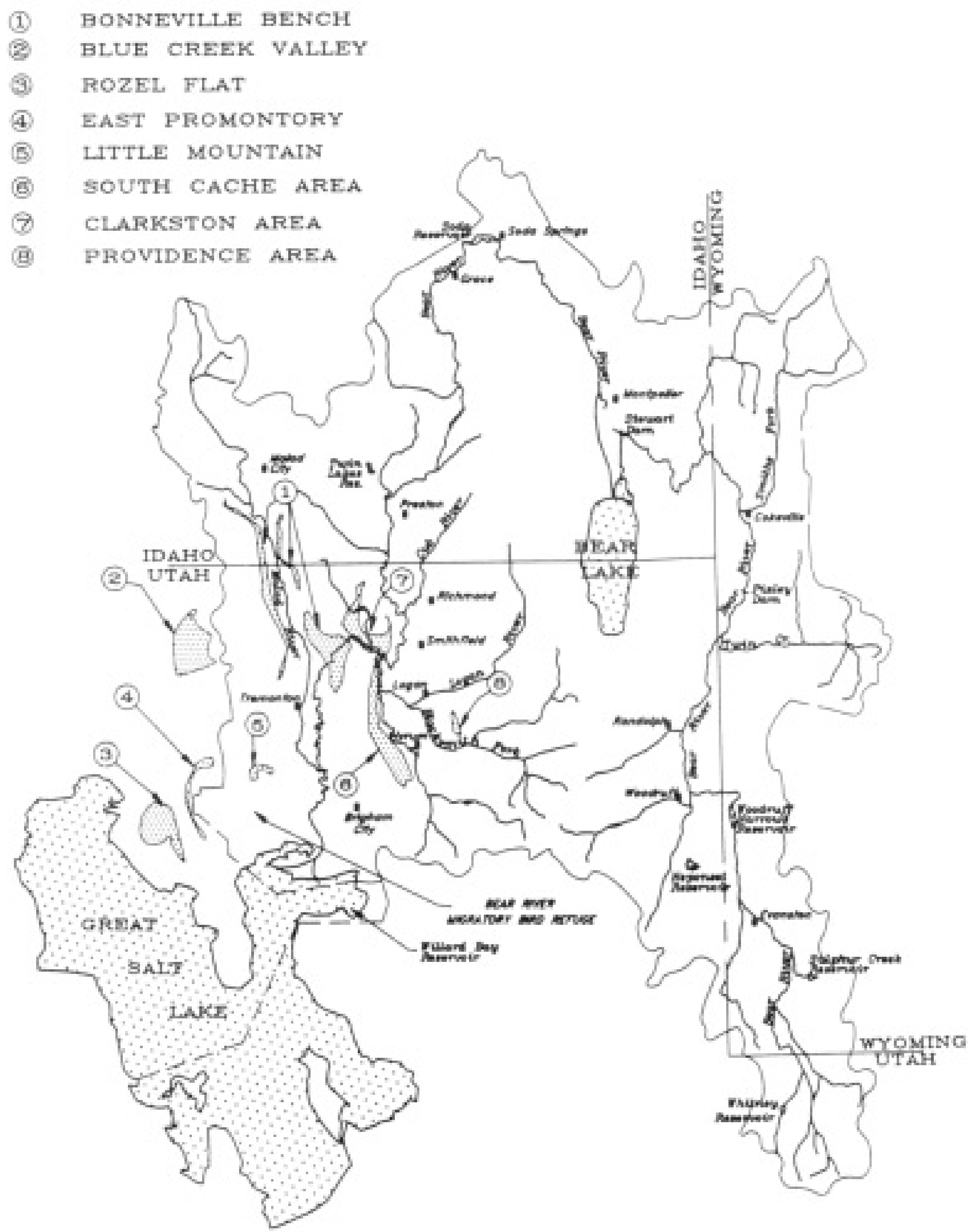
About 18,000 acre-feet of additional water would provide irrigation to these tracts, including an estimated 3,200 acres in Box Elder County and 1,500 acres in Cache County.

10.4.1 South Cache Project

The Division of Water Resources received a request in April 1986 from the Bear River

FIGURE 10-2

POTENTIALLY IRRIGABLE LANDS LOWER BEAR RIVER BASIN



RC&D (Resource Conservation and Development) Committee to investigate the potential "South Cache Project." The local Cache County RC&D Committee wished to sponsor the project. Several studies dating back to 1976[5] have investigated various aspects of this project.

With adequate water storage and conveyance facilities, the project could potentially serve any of the lands above the existing Wellsville-Mendon Canal, from the town of Paradise to Cutler Reservoir (See Figure 10-3). Table 10-6 shows that about 14,000 acres of land could potentially be irrigable. The present cropland areas shown in Table 10-6 were obtained from an extensive land-use inventory by the division. Because of a limited water supply and conveyance costs, the location with greatest potential for irrigation development is the 4,000 acres on Sterling Bench near Hyrum (Figure 10-3). Most of this land is privately owned.

In response to the 1986 request, the division completed a preliminary feasibility study of sprinkler irrigation of 4,000 acres on Sterling Bench[6] (See Figure 10-3). Reservoir storage would be needed. Avon Reservoir, on the Little Bear River near Avon, would provide a water supply of 12,000 acre-feet/year. The Avon reservoir site was investigated separately. A gravity conveyance system could be either an earth-lined canal or a large pipeline. Each has advantages, but less cost is the over-riding advantage of a canal.

The cost of the South Cache Project, including reservoir storage, is about $22.4 million. Benefits for the project would consist solely of increased net income to farmers, resulting from the conversion of dry cropland to irrigated cropland. Comparison of annual benefits with annual equivalent costs shows the project would be infeasible.[6]

10.4.2 Bonneville Bench Project

The Division of Water Resources has re-evaluated this potential project in response to a request from the Bear River Water Conservancy District and the Bear River Agricultural Water Development Committee. The preliminary feasibility report was completed in December 1990 [7]. The study found the project to be economically infeasible. The division completed an investigation of this project in 1981 that showed the same conclusion.[8]

Figure 10-4 shows three segments of potentially irrigable land in northeastern Box Elder County. These were the land areas considered for possible irrigation in the Bonneville Bench Project Study.[7] About 34,000 acres of land in the three segments is suitable for irrigation. Most of the land is presently dry-farmed, with crops consisting almost entirely of hay and grain. The land is all privately owned. Table 10-7 gives a detailed breakdown of the land according to land capability classes and elevation bands. Elevation is crucial because water would have to be pumped from Cutler Reservoir (with a normal water surface elevation of 4,407 feet), or an existing canal, or the proposed Washakie Reservoir. About 21,700 acres of Class 2, 3, and 4 land are within a 100-foot pump lift.

In scaling the project to an optimum economic size, a portion of Segment 1 surrounding the town of Plymouth was selected as most suitable (See Figure 10-5). Soils are good, slopes are gentle, and the land is close to Cutler Reservoir. Of the 10,025 acres in Segment 1 (See Table 10-7 and Figure 10-4), a project service area of about 5,800 acres was studied in more detail. This is the area shown on Figure 10-5. Its present use is 87 percent dry-farmed, 6 percent irrigable rangeland, 5 percent presently irrigated, and 2 percent residential. The area consists of Class 2, 3, and 4 land: 1,784; 1,497; and 2,521 acres, respectively.

FIGURE 10-3

POTENTIALLY IRRIGABLE LAND SOUTH CACHE AREA

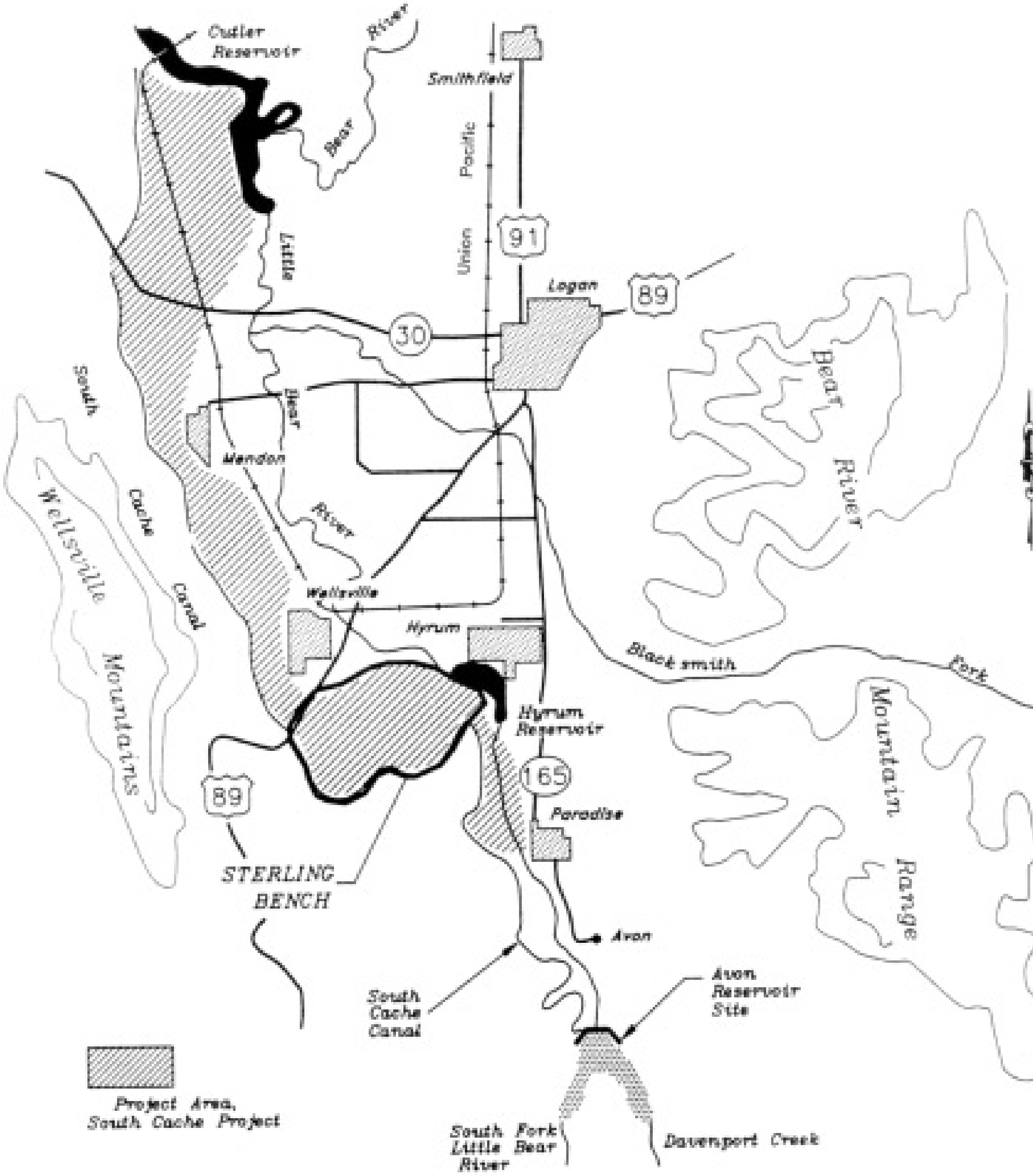


FIGURE 10-4

POTENTIALLY IRRIGABLE LAND
EASTERN BOX ELDER COUNTY

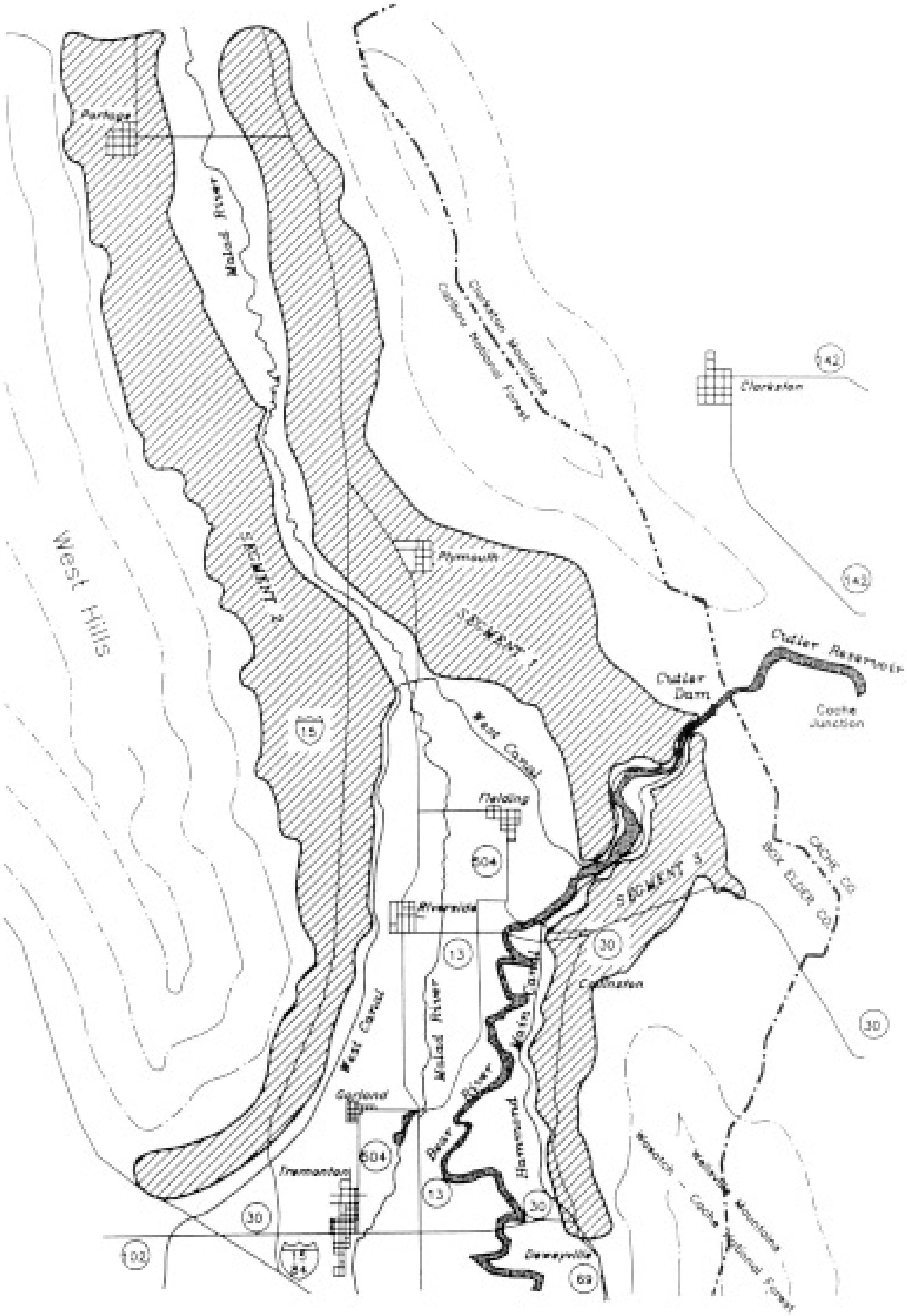


TABLE 10-6
LAND USE SUMMARY FOR POTENTIALLY IRRIGABLE LAND
SOUTH CACHE PROJECT[6]

	Irrigable acres
Dry Grain	6,144
Alfalfa	5,288
Idle/Fallow/Pasture	1,562
Rangeland (less than 10% slope)	717
Rangeland (between 10% & 20% slope)	526
TOTAL	14,237

Four alternative water supply arrangements were evaluated, three of which were referred to above. They were: (1) pumping from the existing West Side Canal; (2) pumping from Cutler Reservoir; (3) pumping from the potential Washakie Reservoir; and (4) extending West Cache Canal in Cache County by about 30 miles. This last alternative would irrigate only 4,500 acres. Construction costs for the alternatives (without any storage cost) varied from $12.2 million to $20.0 million, with Alternative 4 being the highest cost, and Alternative 3 being the lowest. After adding an estimated reservoir cost to each, based on a unit cost per acre-foot of storage, total construction costs were increased to a minimum of $19.3 million or a maximum of $24.2 million.[7]

An economic analysis of the four alternatives resulted in a comparison between estimated annual benefits and annual equivalent costs. Alternative No. (2) (pumping from Cutler Reservoir), is the best economically, but none of the four is feasible. If associated reservoir costs are added, the project benefit to cost ratio is reduced even more. The project is less feasible now than it was in 1981. Costs have risen while the benefits associated with conversion of dry farming to sprinkler irrigation have remained relatively unchanged.

10.4.3 Dry Cropland Within Existing Irrigation Systems

Non-irrigated (dry) croplands are within areas served by existing irrigation systems which, if water were available, could be irrigated with a minimum investment in new facilities. Most of the lands are lower in elevation than the existing water supply and could be irrigated by gravity flow directly from the existing system. Some land is slightly higher in elevation than the existing water supply and would require pumping.

In Box Elder County, approximately 2,200 acres of non-irrigated cropland are within the service area of the Bear River Canal Company system. An additional 1,000 acres of dry cropland immediately above the upper canals could be irrigated with a small pump lift. This land would be economical to irrigate, according to current estimates, if water were available in the existing canals. Up to 13,000 acre-feet of water would be required.

FIGURE 10-5

POTENTIALLY IRRIGABLE LAND
BONNEVILLE BENCH AREA
(PLYMOUTH SEGMENT)

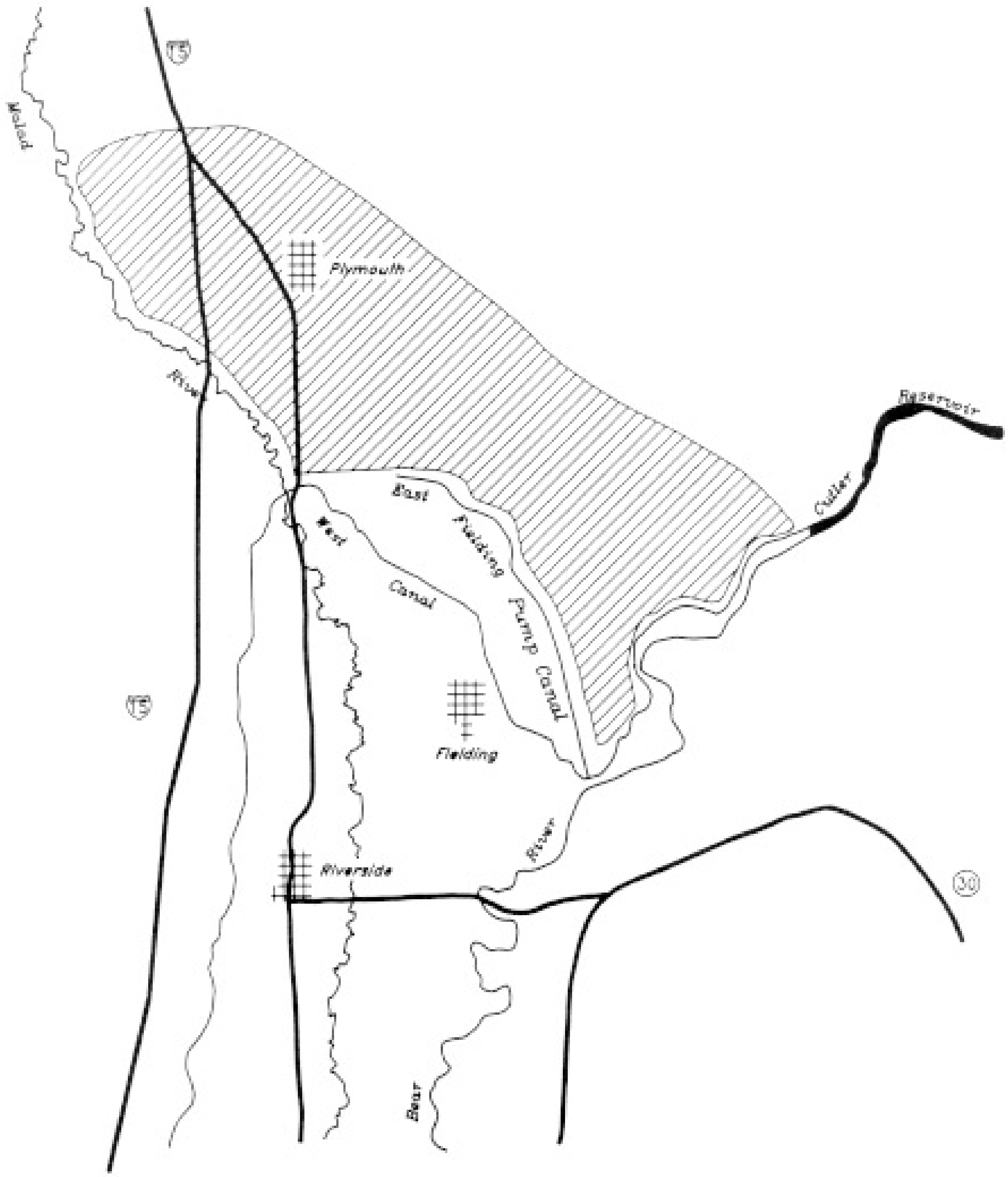


TABLE 10-7
POTENTIALLY IRRIGABLE LAND
BONNEVILLE BENCH PROJECT
BOX ELDER COUNTY[7]

LCC[a]	Acres, by Land Capability Unit (LCC) Below Elevation 4,500	Elevation 4,500 to 4,800	Total
Segment 1			
2	2,646	1,745	4,391
3	1,552	366	1,918
4	5,827	983	6,810
Sub Total	10,025	3,094	13,119
Segment 2			
2	3,119	891	4,010
3	4,022	1,306	5,328
4	2,564	4,735	7,299
Sub Total	9,705	6,932	16,637
Segment 3			
2	320	362	682
3	1,292	792	2,084
4	370	1,018	1,388
Sub Total	1,982	2,172	4,154
TOTAL	21,712	12,198	33,910

[a] Land capability classes 1 through 4 are considered suitable for the production of commonly cultivated crops. The risk of soil damage or use limitations becomes progressively greater from Class 1 to Class 4.

In Cache County, an estimated 2,200 acres of non-irrigated cropland are within the service areas of several large irrigation systems. Approximately 1,500 acres of this land would be economical to irrigate if water were available. This would require up to 5,000 acre-feet of water. There may be other dry cropland which could be irrigated by pumping directly from canals.

In Rich County, probably less than 500 acres of non-irrigated cropland are within the service areas of existing irrigation systems. Little, if any, of this land would be feasible to irrigate.

10.5 ECONOMIC AND FINANCIAL CONSIDERATIONS

An economically feasible, single-purpose, major irrigation project has not been identified in the Bear River Basin. In the intermountain area, most new major irrigation projects in the last 30 years have been part of multipurpose plans funded by the federal government, with repayment based on ability of irrigators to pay. Benefit/cost ratios have been favorable for the entire plan, but not necessarily for each project purpose.

10.6 RECOMMENDATIONS

The following recommendations relate to discussions in Section 10.3. Some of these recommendations are intended for future rather than immediate implementation.

10.6.1 New Irrigation Development

Although the Bonneville Bench Irrigation Project in Box Elder County and the South Cache Irrigation Project in Cache County are currently economically infeasible, small acreages of non-irrigated croplands within the areas served by existing irrigation systems may be economical to irrigate. In planning and evaluating future multipurpose water storage development projects in the Bear River Basin, the Division of Water Resources should consider options to provide irrigation water for new lands, where agricultural water users are willing and able to participate.

The Utah Department of Agriculture should facilitate the growing of high value crops in project areas, and should pursue alternate crop research and marketing avenues.

10.6.2 Irrigation Water Management

The Soil Conservation Commission, the Division of Water Resources, and other appropriate agencies should continue to provide technical and financial assistance to irrigation companies in the basin to upgrade existing facilities and increase irrigation efficiencies.

Some irrigated croplands in the Bear River Basin could use supplemental irrigation water to extend cropping seasons and supplement supplies in time of drought. While these needs may not justify projects themselves, projects built for other purposes could also serve this agricultural need. When considering new multipurpose water storage projects in the Bear River Basin, the Division of Water Resources should evaluate the possibility of allocating water for supplemental irrigation purposes.

10.6.3 Watershed Management

The Soil Conservation Commission, in conjunction with the Soil Conservation Service and the local soil conservation districts, should periodically re-evaluate the potential for small watershed projects under P.L. 566 (See Table 10-5).

The Soil Conservation Commission and the Bear River Resource Conservation and Development Committee should continue to provide technical and financial assistance to ranchers to improve range conditions on watersheds, reduce sediment runoff from range and cropland, and reduce stream channel erosion.

The Utah Department of Agriculture, Department of Environmental Quality, and Division of Water Resources should continue to coordinate river basin and watershed planning efforts, particularly for the Newton Reservoir, Little Bear River, and Cornish watersheds, in order to maximize the use of available resources.

10.7 REFERENCES

In addition to the references listed below, attention is directed to Section 10 of the Utah State Water Plan, January 1990, where Utah's agricultural industry and four statewide agricultural, water-related issues are discussed in detail.

1. "Summary Report, Water & Related Land Resources, Bear River Basin," U.S. Department of Agriculture Cooperative Study, 1978.

2. "Water-Related Land Use Inventories, Bear River Basin," Division of Water Resources, January 1991.

3. "Hydrologic Inventory of The Bear River Study Unit," Utah Water Research Laboratory, Utah State University, February 1973.

4. "Irrigation Conveyance Systems," Bear River Basin Type IV Study, U.S. Dept. of Agriculture, 1976.

5. "South Cache Project," Preliminary Feasibility Report, Utah Division of Water Resources, September 1976.

6. "South Cache Project, Preliminary Feasibility Report Update," Utah Division of Water Resources, November 1990.

7. "Bonneville Bench Project Update," Preliminary Feasibility Report, Utah Division of Water Resources, December 1990.

8. "Bonneville Bench Irrigation Project," Preliminary Feasibility Study, Utah Division of Water Resources, May 1981.

9. "Present Water Supplies, Uses and Rights - Bear River Development," Hansen, Allen and Luce, Inc. June 1991.

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Section 11
DRINKING WATER SUPPLIES

This section describes the present drinking water systems in the basin, discusses present and future problems, and presents estimated future water requirements.

11.1 INTRODUCTION

In the Utah portion of the Bear River Basin, an estimated 51,170 acre-feet of water was provided for residential and commercial use in 1990. The corresponding future requirement is estimated to reach 65,560 acre-feet/year by the year 2010.

As used in this report, "drinking water" is defined as approximately synonymous with residential and commercial use, which means water that is used (or is available for use) as a culinary supply inside homes. It is supplied through a pipeline distribution system, and the quality is typically the highest available in the locality, because of treatment or because of pure natural sources. Most water systems are owned and operated by a municipality, but in a few cases the owner/operator is a private company, or is a state or federal agency. Regulatory categories of systems are defined in Section 11.2.

In addition to drinking water, the systems provide water for many inside and outside uses. Some examples are residential lawn and garden watering, car washing, swimming pools, public parks and streets, fire protection, commercial enterprises, and schools. Some industrial uses are supplied from municipal water systems in the basin, as noted in Tables 11-8 through 11-10. However, in this section, industrial water use has been purposely subtracted. Industrial water is discussed separately in Section 18.

Residential Water - Div. of Water Resources

The quality of present supplies is reasonably good, consisting almost entirely of groundwater. Approximately 88 percent of the basin's Utah residents are served by water systems that are approved by the state of Utah. Nine systems, however, are not fully approved and need to be upgraded. Other problems include (1) several communities needing new supplies immediately but without a good available local source, (2) many communities with a need to expand and upgrade their systems, and (3) a need for all systems to meet the new and stringent standards imposed by the Safe Drinking Water Act.

11.2 SETTING

In Box Elder, Cache, Rich, and Summit counties, 128 drinking water systems have been identified. They are classified as follows and listed in Table 11-1.

-52 systems serve at least 15 residences that are occupied year-round. These are referred to as "Public, Community" Systems.

-42 systems serve at least 25 non-resident individuals for 60 days or more per year. These are referred to as "Public, Non-community" systems. Examples of this type include campgrounds, restaurants, and commercial establishments.

-34 systems do not meet the above two criteria. They are classified as "Non-public" systems, not legally subject to regulation under the provisions of federal and state Safe Drinking Water regulations.

The state agency responsible for regulating and monitoring "public" drinking water systems is the Division of Drinking Water. By action of the 1991 Utah Legislature, effective July 1, 1991, the Department of Environmental Quality was created, and the Bureau of Drinking Water/Sanitation was elevated to the Division of Drinking Water.

TABLE 11-1
DRINKING WATER SYSTEMS, BEAR RIVER BASIN (1990)

Size and Category	Box Elder	Cache	Rich	Summit	Total
Public, Community Systems					
More than 3,000 people	2	5	0	0	7
800 - 3,0000	7	7	0	0	14
25 - 800 people	15	11	5	0	31
Total	24	23	5	0	52
Public, Non-Community Systems					
State parks and campgrounds	2	10	2	8	22
Other systems	2	10	7	1	20
Total	4	20	9	9	42
Non-Public Systems					
State parks and campgrounds	2	9	0	0	11
Other systems	10	8	5	0	23
Total	12	17	5	0	34
Total	40	60	19	9	128

Source: Data from Utah Division of Drinking Water

11.2.1 Present Water Use

At 421 gallons per day, per capita use in the Bear River Basin is high, compared to the state average of 284. The per capita use is probably high because of lawn and garden watering, farm and dairy use, stock watering, and other non-culinary uses supplied from community water systems. Although several of the largest water systems exceed the state average, per capita use in 21 of the 52 water systems is less than the state average.

The 1990 level of residential and commercial water use is listed by county in Table 11-2. Definitions of these and other water uses are presented in Section 5.

11.2.2 Water Treatment and State Approval

The 52 public community water systems are served by about 110 springs and 70 wells. One community (North Logan) can be served in part by a surface source. Current treatment methods used on the above sources vary, as follows:

Springs with chlorination	**71**
Springs without chlorination or other treatment	**39**
TOTAL	**110**
Wells with chlorination	**31**
Wells without chlorination or other treatment	**39**
TOTAL	**70**
Surface water with complete treatment	**1**

Official ratings of the 52 public community water systems by the Utah Department of Environmental Quality are summarized in Table 11-3.

TABLE 11-2
PRESENT LEVEL OF RESIDENTIAL AND COMMERCIAL WATER USE

County	Water Systems (number)	1990 Level of Use (AF/year)
Box Elder	40	15,900
Cache	60	31,930
Rich	19	3,340
Summit	9	Negligible[a]
TOTAL	128	51,170

[a]Only in campgrounds and parks. See Table 11-1

TABLE 11-3
RATINGS OF PUBLIC COMMUNITY WATER SYSTEMS[1]

Official Rating	Box Elder	Cache	Rich	Total
"Approved"	17	21	5	43
"Not Approved"	3			3
"Corrective Action Required"	4	2	0	6
Total	24	23	5	52

Note: Public non-community and non-public systems are not rated.

11.2.3 System Improvements

Occasional repair, replacement, enlargement, or upgrading of each system is necessary to maintain the level of service expected. The improvements cover a wide range of facilities, but they consist mainly of new wells, storage tanks, and pipelines. Some communities have sometimes paid for these improvements without outside help, but most have made use of public funding programs. Specific funding programs are identified in Tables 8-1 and 8-2. The programs most widely used currently for improvement of drinking water systems are listed below, along with the entity or agency controlling each fund.

Cities Water Loan Fund
Board of Water Resources

Permanent Community Impact Fund
Community Impact Fund Board

Block Grants Program
Community Development Block Grants Policy Board

Financial Assistance Program
Drinking Water Board

Rural Development Program
U.S. Farmers Home Administration

As an indication of the approximate magnitude of improvements made through these programs, Tables 11-4, 11-5, and 11-6 have been prepared. They show that at least $30 million has been spent in 41 separate communities for this purpose since 1970. This figure is on the low side because it does not include projects that were self-funded by individual cities and towns. For example, Logan's self-funded improvements since 1970 have cost about $5 million, many times the amount shown for Logan in Table 11-5. The three tables show the total cost of projects for each community from the five funding programs referred to above, including the portion cost-shared by the community. It should be noted that these are heavy financial burdens for some of the smaller communities listed in the tables. Only about 14.4 percent of the total, or $4.4 million, consisted of grants. About $18.9 million of the total was for projects funded partially or entirely by the Board of Water Resources and the Drinking Water Board. Distribution of the total by counties was approximately as follows:

Box Elder	**32.2 %**
Cache	**58.4 %**
Rich	**9.4 %**
TOTAL	**100.0 %**

TABLE 11-4
PUBLIC WATER SYSTEM IMPROVEMENTS IN BOX ELDER COUNTY, 1970-91[a]

System	Cumulative Cost
Bear River City (Acme)	$ 273,000
Bothwell	79,000
Brigham City	1,179,000
Corinne	655,000
Deweyville	226,000
Elwood	320,000
Garland	1,186,000
Honeyville	595,000
Mantua	86,000
Perry	443,000
Plymouth	865,000
Portage	487,000
S. Willard	251,000
Thatcher/Penrose	870,000
Tremonton	1,525,000
W. Corinne	316,000
Willard	460,000
Total Costs	$9,816,000

[a]In addition to this table, improvements are planned for the Mantua and West Corinne water systems.

Data for the three tables came from files of the Utah divisions of Water Resources, Drinking Water, Community Development, and the U.S. Farmers Home Administration. Some minor double-counting probably appears in the figures, because two or more funding programs have been involved in about half of the projects. But, to the extent possible, reductions have been made in such cases, and any double-counting that remains is very small.

11.3 PROBLEMS AND NEEDS

This sub-section identifies needs which are immediate and long-term. A review of the current sources and storage capacities of the 52 public community water systems identified the following immediate needs.

1. Nine systems are currently deficient in storage and need enlargement.

2. Ten systems are currently deficient in source capacity and need to be increased.

3. Nine systems are not approved by the Utah Division of Drinking Water.

Specific locations of these needs are identified in Tables 11-8 through 11-13, which are described later.

11.3.1 Future Growth

In the next five years, the population of the study area is expected to grow by 5.7 percent (6,150 people). This is equivalent to about

TABLE 11-5
PUBLIC WATER SYSTEM IMPROVEMENTS IN CACHE COUNTY, 1970-91[a]

System	Cumulative Cost
Amalga	$260,000
Clarkston	820,000
Cornish	66,000
Cove Area (High Creek)	82,000
Hyde Park	975,000
Hyrum	4,166,000
Lewiston	1,166,000
Logan	88,000
Mendon	660,000
Millville	140,000
Newton	167,000
Nibley	901,000
N. Logan	2,375,000
Paradise	786,000
Providence	930,000
Richmond	354,000
Smithfield	2,190,000
Spring Creek Water Co.	60,000
Wellsville	1,630,000
Total Cost	$17,816,000

[a]In addition to this table, improvements are planned for the N. Logan, Riverside, and Cornish water systems. The Benson Water Improvement District is developing an entirely new water system.

TABLE 11-6
PUBLIC WATER SYSTEM IMPROVEMENTS IN RICH COUNTY, 1970-91[a]

System	Cumulative Cost
Garden City	$1,638,000
Laketown	76,000
Meadowville Spec. Service Dist.	50,000
Randolph	826,000
Woodruff	270,000
Total Cost	$2,860,000

[a]In addition to this table, further improvement of the Laketown system is being planned.

2,000 residences. The additional water demand of these 2,000 residences would be about 2,200 gallons per minute (peak day demand) and 2,900 acre-feet per year (average yearly demand).

Between 1990 and 2010, the basin's population is expected to increase by 30 percent (32,407 people). This represents approximately 10,000 residences. At present per capita use rates, the increased water requirement for this many new residents would be 14,400 acre-feet. The various means of meeting these needs (including conservation) are discussed in Section 11.4. Conservation is discussed in Section 17. Corresponding requirements for other future target dates are shown by counties in Table 11-7.

11.3.2 Current Deficiences

For individual communities, Tables 11-8 through 11-10 show estimated future water requirements compared with reliable water system capacities. The estimates of system capacity reflect the relationship between maximum annual delivery capacity of a system and the portion that is usable within the community's annual demand pattern. Although each system must be capable of meeting the maximum monthly and daily demands in the warmest part of summer, delivery at this rate during the remainder of the year would greatly exceed the demand. The annual usable portion of capacity, which falls within the yearly demand pattern, varies in accordance with how much lawn and garden use is included. The

TABLE 11-7
FUTURE WATER REQUIREMENTS FOR RESIDENTIAL AND COMMERCIAL USE

Item	Year	Box Elder	Cache	Rich	Total
Population[a]	1990	36,485	70,183	1,725	108,393
	2000	40,500	77,900	2,300	120,700
	2010	46,300	91,900	2,600	140,800
	2025	55,100	114,900	3,200	173,200
		Withdrawals/Diversions (AF/year)			
Water Use[b]	1990	15,900	31,930	3,340	51,170
	2000	17,660	35,330	3,560	56,550
	2010	20,180	41,610	3,770	65,560
	2025	24,020	51,990	4,320	80,330
1990 Per Capita Use					
	AF/Yr.	.436	.455	.516	.472
	Gal/Day	389	406	461	421

(Conversion: 1.0 AF/Yr = 892.7 Gal/Day)

[a]From Utah Office of Planning and Budget (Reference No. 2).
[b]Calculated from the population projections above and 1990 per capita use rates.

TABLE 11-8
RESIDENTIAL AND COMMERCIAL GROUNDWATER REQUIREMENTS/SUPPLY FOR BOX ELDER COUNTY

Public Community Water System	Population Served 1990	2000	2010	2025	1990 Per Capita Use (AF/Yr.)	Water Requirements (Acre-feet/year) 1990	2000	2010	2025	1991 Reliable System Supply Capacity
Brigham City	15,644	16,658	18,645	22,280	.605	9474	10,090	11,290	13,490	10,032
Tremonton	4,264	4,904	5,702	6,761	.350	1492[e]	1,720	2,000	2,370	1,584
Garland	1,637	1,835	2,104	2,498	.367	601	674	772	917	810
Willard	1,298	1,419	1,607	1,913[g]	.350	454	496	562	669	964
Perry	1,211	1,346	1,537	1,826	.209	253[f]	281	321	381	784
Honeyville	1,112	1,326	1,573	1,866	.401	446	532	631	748	1,127
W. Corinne Water Co.*	1,100	1,720	1,970	2,340	.198	218	242	277	329	218*
Riverside/N. Garland	1,000	1,110	1,270	1,510	.171	171	190	217	258	198
Thatcher/Penrose Co.	812	900	1,030	1,230	.214	174	190	220	260	576
Ukon Water Co.[a]	800	760	870	1,030	.114	91	101	115	137	131
Acme Water Co.[b]	750	812	948	1,124	.251	188	204	238	282	212
Mantua	665	777	911	1,080	.280	186	217	255	302	333
Corinne*	639	714	818	971	.117	75	140	160	200	75*
Elwood	575	711	863	1,028	.191	110	140	160	197	292
Bothwell Water Co.*	400	300	340	410	.232	93	100	120	140	93*
Deweyville	318	351	399	475	.318	101	111	127	151	128
Plymouth	267	296	337	401	.393	105	116	133	158	390
South Willard	225	250	290	340	.267	60	70	80	90	198
Portage	218	251	292	346	.280	61	70	82	97	335
Evans Water Co.	150	170	190	230	.436	65	74	83	100	65+
3 Trailer Courts[c]	260	260	260	260	.436	113	113	113	113	113+
Cedar Ridge Subd.[d]	50	60	65	80	.436	22	26	28	35	22+
Subtotal	33,395	36,703	41,760	49,692	.436	14,553	15,897	17,984	21,424	18,680
Other Water Systems	3,090	3,797	4,540	5,408	.436	1,347	1,763	2,196	2,596	1,350
County Total	36,485	40,500	46,300	55,100	.436	15,900	17,660	20,180	24,020	20,030

[a]E. Garland/Fielding
[b]Bear River City
[c]Willard/ S. Willard
[d]Tremonton

[e]In addition to this figure, Tremonton also provides 92 acre-feet of industrial water.
[f]In addition to this figure, Perry also provides 26 acre-feet of industrial water.
[g]Does not include 400 acre-feet of surface water.
+Reliable system supply capacity estimated to be equal to or greater than 1990 water requirements.
*Available data indicates present use is approximately equal to system capacity.

TABLE 11-9
RESIDENTIAL AND COMMERCIAL GROUNDWATER
REQUIREMENTS/SUPPLY FOR CACHE COUNTY

Public Community Water System	Population Served 1990	2000	2010	2025	1990 Per Capita Use (AF/Yr.)	Water Requirements Acre-feet/year 1990	2000	2010	2025	1991 Reliable System Supply Capacity
Logan	32,726	34,895	40,229	50,315	.465	15,245[a]	16,230	18,700	23,400	19,948
Smithfield*	5,566	6,147	7,207	8,976	.482	2,681	2,960	3,470	4,330	2,681*
Hyrum	4,829	5,640	6,809	8,470	.628	3,034[b]	3,540	4,280	5,320	4,542
North Logan	3,768	4,690	5,880	7,374	.206	777[c]	970	1,210	1,520	1,545[i]
Providence	3,344	3,908	4,719	5,870	.431	1,440	1,680	2,030	2,530	2,211
Wellsville	2,206	2,465	2,907	3,617	.618	1,363[d]	1,520	1,800	2,230	1,936
Hyde Park	2,190	2,564	3,099	3,855	.328	718	840	1,020	1,260	761
Richmond	1,955	2,259	2,711	3,372	.571	1,117	1,290	1,550	1,930	2,299
Lewiston	1,532	1,567	1,776	2,238	.446	684	700	790	1,000	1,449
River Heights	1,274	1,312	1,491	1,876	.378	482	500	560	710	1,508
Millville	1,202	1,513	1,909	2,400	.160	192	240	310	380	251
Nibley	1,167	1,618	2,184	2,850	.509	594[e]	820	1,120	1,450	1,012
Mendon*	684	805	976	1,215	.630	431	510	610	760	431*
Newton	659	707	818	1,022	.361	238	255	300	370	378
Clarkston	645	696	806	1,007	.260	168	180	210	260	705
Paradise	561	594	683	855	.130	73	80	90	110	88
Trenton	464	471	532	672	.343	159	160	180	230	230
Amalga*	366	411	485	604	.792	290[f]	330	380	470	557*
Cornish	205	208	235	296	.210	43[g]	44	49	62	97
Riverside Water Co.	88	98	115	140	.182	16	18	21	25	274
S.Cove Water Co.	63	70	82	100	.429	27	30	35	43	165
Goaslind Spg. Water Co.*	50	55	65	80	1.300	65	72	84	100	65*
High C. Water Co.*	35	39	46	60	.371	13	14	17	22	13*
Subtotal	65,615	72,732	85,764	107,264	.455	29,850	32,983	38,816	48,512	43,145
Other Water Systems	4,568[h]	5,168	6,136	7,636	.455	2,080	2,347	2,794	3,478	2080
County Total	70,183	77,900	91,900	114,900	.455	31,930	35,330	41,610	51,990	45,225

a) In addition, Logan provides 272 acre-feet for industrial use.
b) In addition, Hyrum provides 1,128 acre-feet for industrial use.
c) In addition, N. Logan provides 65 acre-feet for industrial use.
d) In addition, Wellsville provides 92 acre-feet for industrial use.
e) In addition, Nibley provides 2 acre-feet for industrial use.
f) In addition, Amalga provides 267 acre-feet for industrial use.
Total 1,869 acre-feet for industrial use.
g) In addition, Cornish provides 43 acre-feet for industrial use.
h) Included in this total are about 411 residents who will be served by a new water system under development by the Benson Water Improvement District. May be in operation in 1992.
i) Does not include 500 acre-feet of surface water.
*) Present data indicates that present use (including industrial) is approximately equal to system capacity.

TABLE 11-10
RESIDENTIAL AND COMMERCIAL GROUNDWATER REQUIREMENTS/SUPPLY IN RICH COUNTY

Public Community Water Systems	Population Served 1990	2000	2010	2025	1990 Per Capita Use (AF/Yr.)	Water Requirements (Acre-feet/year) 1990	2000	2010	2025	1991 Reliable System Supply Capacity
Garden City Residents	193	237	268	330						
Estimated visitors[a]	2537	2540	2600	2800						
Subtotal	2730	2777	2868	3130	.926	2529	2570	2650	2900	2689
Randolph	488	718	812	999	.197	96	141	160	197	345
Laketown[b]	261	305	345	425	.291	76	89	100	124	157
Woodruff	135	228	258	317	.311	42	71	80	99	188
Mtn. Meadow Park	59	60	60	60	.407	24	24	24	24	24
Subtotal	943	1,311	1,475	1,801	.252	238	325	364	444	714
Community System Subtotal	3,673	4,088	4,459	4,931		2,767	2,895	3,014	3,344	3,403
Other Water Systems										
Residents	589	752	857	1,069						
Estimated visitors[c]	1,691	1,875	2,127	2,800						
Subtotal	2,280	2,627	2,984	3,869	.252	573	665	756	976	575
Rich County										
Residents[d]	1,725	2,300	2,600	3,200						
Estimated visitors	4,228	4,415	4,727	5,600						
Total	5,953	6,715	7,327	8,800	.561	3,340	3,560	3,770	4,320	3,978

[a]This system serves a wide area extending from the state line to (and including) Sweetwater Park. This area is impacted by numerous non-resident visitors in the summer. The equivalent year-round population represented by the large annual temporary influx is estimated to be 2537. 6/

[b]Approximately 20 acre-feet of industrial use (meat-packing operation) is provided by this water system.

[c]Other Bear Lake area visitors are served by "non-community" systems. Included in this category are Rendezvous Beach State Park, South Bear Lake Water Users Co-op, other summer homes and cabins along the south and east lake shores, Bridgerland Village, and several Forest Service campgrounds. These water systems are estimated to serve 40% of the Rich County visitors at present, and 50% by the year 2025.

[d]The 1990 census data gives county and community populations. Projected populations for each were estimated by the Utah Office of Planning and Budget.

pattern for inside use only is more nearly uniform throughout the year. Considerable outside use requires proportionately more water in the summer and, therefore, a greater system capacity. These tables indicate that 10 systems are presently at the limit of their capacity: Tremonton, West Corinne, Corinne, Bothwell, Smithfield, Mendon, Amalga, Goaslind, High Creek, and Mountain Meadow Park. Some of these are in the process of developing new facilities.

Tables 11-11 through 11-13 show the existing storage capacity for each community water system, compared with future storage capacity needed as the community grows. Typically, the storage consists of one or more tanks of steel or reinforced concrete, and the tanks feed directly into the community's distribution lines. Tank sizes vary from less than 20,000 gallons to more than a million gallons each. Additional tanks are added as the system grows.

The volume of storage needed consists of a quantity for emergency fire-fighting operations, plus an ordinary reserve for residential use. The fire flow requirement is normally considered to be 750 gallons per minute for two hours, which is equal to 90,000 gallons. However, for larger communities the requirement is greater. For very small communities, the requirement is less. In Tables 11-11 through 11-13, fire-flow needs are as follows: For Logan and Brigham City; 2,500 gallons per minute (gpm) for four hours (or 600,000 gallons); for Smithfield, Hyrum, and Tremonton, 1,500 gpm for two hours (180,000 gallons); for all other communities except the smallest, 750 gpm for two hours (90,000 gallons); and for communities with less than 100 connections, 500 gpm for two hours (or 60,000 gallons).

The ordinary reserve for residential use is considered by the Utah Division of Drinking Water to be 400 gallons per connection for inside use only, and 800 gallons per connection when used outside for lawn and garden watering, as is common in these three counties. The "outside use factor" in the tables reflects these differences. A few communities, such as Paradise in Cache County, have a dual water system for outside use, so the community drinking water supply is used only inside. Other communities have a partial outdoor system for lawn and garden watering, which in some cases is just a local irrigation supply.

Thus, the 1990 computed storage requirement for Honeyville, for example, is 800 gallons per connection times 350 connections (equal to 280,000 gallons of ordinary reserve) plus 90,000 gallons for fire flow, or a total of 370,000 gallons. Honeyville's existing storage capacity is 435,000 gallons, so there is a reserve which will last until sometime after the year 2000. In computing future storage requirements, it is assumed that the number of connections will increase at the same rate as the population.

These computations indicate that nine community systems are in need of more storage now: Acme, Cornish, North Logan, Laketown, Mountain Meadow Park, Mantua, Portage, South Cove, and Goaslind Spring Water Company (Cove Area). However, none of these deficits is large, and plans are underway to correct most of the deficits.

Regulatory approval of a public community drinking water system is given when the system is officially recognized as meeting certain minimum public health standards. The Utah Department of Environmental Quality has approved all but nine of the 52 public community systems in the basin. As shown previously in Table 11-3, six are in a category called, "corrective action required," and three others are "not approved." Both of these categories are considered to be transitional rather than permanent. Full approval of the nine systems not presently approved is

TABLE 11-11
STORAGE CAPACITY NEEDED
FOR COMMUNITY WATER SYSTEMS IN BOX ELDER COUNTY

Water System	No. of Connections (1990)	Outside Use Factor (gal.)	Computed Storage Requirement (gallons)				Existing Storage (1991)
			1990	2000	2010	2025	
Brigham City	4687	800	4.35mg.	4.59mg.	5.07mg.	5.94mg.	6.5mg.
Tremonton	1724	770	1.51mg.	1.70mg.	1.95mg.	2.78mg.	2.37mg.
Garland	600	800	570,000	626,000	706,000	822,000	1.35mg.
W. Corinne	230	620	233,000	248,000	270,000	307,000	325,000
Willard	442	800	444,000	474,000	530,000	610,000	670,000
Perry	376	800	391,000	426,000	474,000	546,000	650,000
Honeyville	350	800	370,000	426,000	490,000	562,000	435,000
Riverside/N. Garland	238	800	280,000	298,000	330,000	378,000	375,000
Thatcher-Penrose	238	800	280,000	298,000	330,000	378,000	700,000
Acme Water Co.	278	620	262,000	276,000	307,000	350,000	200,000
Ukon Water Co.	256	600	244,000	260,000	285,000	321,000	270,000
Mantua	222	800	268,000	298,000	334,000	378,000	244,000
Corinne	232	480	201,000	215,000	234,000	258,000	300,000
Elwood	158	800	216,000	246,000	282,000	314,000	400,000
Deweyville	95	800	136,000	144,000	156,000	172,000	310,000
Bothwell Water Co.	94	400	98,000	102,000	108,000	116,000	165,000
Plymouth	100	800	140,000	148,000	164,000	180,000	150,000
S. Willard	86	800	129,000	137,000	148,000	164,000	140,000
Portage	81	800	125,000	134,000	146,000	164,000	122,000
Evans Water Co.	77	800	122,000	130,000	138,000	154,000	325,000
Cedar Ridge Subdivision	(25)						
3 Trailer Courts	(80)						

TABLE 11-12
STORAGE CAPACITY NEEDED
FOR COMMUNITY WATER SYSTEMS IN CACHE COUNTY

Water System	No. of Connections (1990)	Outside Use Factor (gal.)	Computed Storage Requirement (gallons) 1990	2000	2010	2025	Existing Storage (1991)
Logan	7145	720	5.74mg.	6.08mg.	6.91mg.	8.50mg.	7.5mg.
Smithfield	1580	560	1.06mg.	1.15mg.	1.33mg.	1.61mg.	2.45mg.
Hyrum	1219	620	936,000	1.06mg.	1.25mg.	1.51mg.	3.265mg.
N. Logan	1013	690	789,000	959,000	1.18mg.	1.46mg.	725,000[a]
Providence	950	800	850,000	978,000	1.16mg.	1.43mg.	1.63mg.
Wellsville	580	800	554,000	610,000	698,000	850,000	940,000
Hyde Park	578	750	524,000	600,000	705,000	855,000	725,000
Richmond	529	560	386,000	432,000	499,000	600,000	750,000
Lewiston	550	800	530,000	538,000	602,000	730,000	830,000
River Heights	393	800	404,000	414,000	458,000	554,000	500,000
Millville	294	800	325,000	386,000	464,000	562,000	336,000
Nibley	317	800	344,000	442,000	562,000	706,000	1,300,000
Mendon	236	800	279,000	312,000	360,000	425,000	600,000
Newton	218	480	195,000	202,000	220,000	252,000	250,000
Clarkston	190	800	242,000	254,000	280,000	328,000	500,000
Paradise	183	400	163,000	168,000	179,000	202,000	300,000
Trenton	140	800	202,000	204,000	219,000	252,000	220,000
Benson (new system)	125	800	190,000	200,000	215,000	246,000	(0)[b]
Amalga	114	800	181,000	192,000	211,000	240,000	230,000
Cornish	70	800	116,000	117,000	124,000	141,000	100,000[c]
Riverside Water Co.	25	800	80,000	82,000	86,000	92,000	100,000
S. Cove Water Co.	20	800	76,000	78,000	80,000	86,000	20,000
Goaslind Spg. Water Co.	14	800	71,000	72,000	74,000	78,000	20,000
High C. Water Co.	16	480	68,000	69,000	70,000	73,000	160,000

[a]A new one-million-gallon tank will be built within the next five years.
[b]New system (to be completed in 1993) will include a 300,000-gallon tank.
[c]Community has asked for state assistance to upgrade its water system.

TABLE 11-13
STORAGE CAPACITY NEEDED
FOR COMMUNITY WATER SYSTEMS IN RICH COUNTY

Water System	No. of Connections (1990)	Outside Use Factor (gal.)	Computed Storage Requirement (gallons)				Existing Storage (1991)
			1990	2000	2010	2025	
Randolph	180	800	234,000	302,000	330,000	386,000	900,000
Laketown	104	800	173,000	188,000	200,000	235,000	92,000[a]
Garden City	430	800	434,000	514,000	570,000	597,000	600,000
Woodruff	67	800	144,000	180,000	192,000	243,000	600,000
Mtn. Meadow Park	22	800	78,000				60,000

[a]Completion of new 250,000-gallon tank expected in 1992.

anticipated when the required items of improvement are complete. In the meantime, the need for reaching full approval is urgent.

11.3.3 Training and Certification

Training and certification of system operators is a continuing need. Certification is important because it requires a minimal level of training which helps to safeguard public health. Most of the current need is among the smaller communities. Eight of the nine systems not fully approved by the Utah Division of Drinking Water serve communities with less than 800 people. Recent legislation requires that community systems of 800 or less must have a certified operator.

11.3.4 New Federal Requirements

Additionally, new federal requirements for water quality may impact some systems significantly. Congress' 1986 Amendments to the Federal Safe Drinking Water Act resulted in more stringent requirements for the quality, monitoring, and treatment of public drinking water. Among other things, the amendments required:

1. That EPA set maximum contaminant levels (MCLs) for 83 specific contaminants and for any other contaminant in drinking water that may have any adverse effect upon the health of persons.

2. That EPA also set MCLs for 25 additional contaminants every three years.

3. That criteria be established for determining which surface water systems must install filtration.

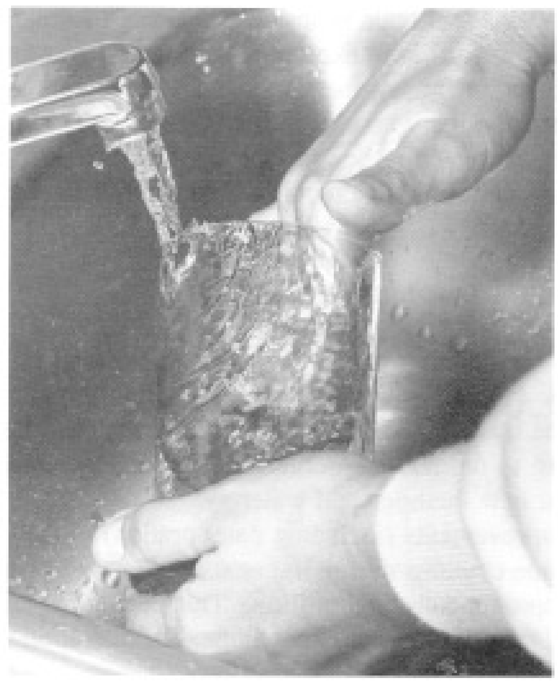
4. That a treatment technique regulation must be promulgated to require all public water systems to use disinfection.

The congressional mandates will require changes in Utah's drinking water rules. It is anticipated that by January 1993 the following rules may be adopted in the state:

Surface Water Treatment Rule - This rule decreases the allowable level of turbidity, changes disinfection requirements, and requires that groundwater sources be classified as groundwater or groundwater influenced by surface water.

Phase II Regulations - An additional 38 contaminants will be monitored.

Lead and Copper Rule - Provisions for the monitoring and treatment of lead and copper will be implemented.



If adopted, these regulations may impact public drinking water systems in the Bear River Basin. Monitoring costs will increase. Furthermore, since the region has a large number of culinary springs, and some of these springs may be surface-water influenced, construction of additional conventional, complete treatment plants may be necessary.

The EPA estimates that increased monitoring because of Phase II regulations should be less than $10 per household per year. If a water treatment system is required to meet standards, costs could be considerably more. For example, if a granular activated carbon system is installed to remove synthetic organic contaminants (i.e. pesticides), treatment costs could be anywhere from $40 to $600 per household per year, depending on the size of the system. If a conventional, complete treatment plant is constructed to treat a spring contaminated with surface water, costs could be greater than $50 per household per year.

Since monitoring has not yet begun, it cannot be said with any certainty how many systems will have to install additional treatment facilities. It is unlikely that synthetic organic contaminants will be a problem. However, some culinary springs in the Bear River Basin are suspected to be "surface water influenced" and additional treatment facilities may be required.

11.3.5 Deterioration of Facilities

In addition to new water supplies, most of the systems will need new distribution lines and other facilities to replace those that will be lost to normal deterioration. The total expense for new facilities and water system improvements (including deterioration) in the three counties during the next 25 years will be approximately $60 million. This cost is in addition to present expenditures for operation and maintenance.

Table 11-14 shows the number of leaks in recent years in systems for which a requested report was received in 1991. The significance of this information is the relationship between frequency of recurring leaks and general deterioration of a distribution system. Therefore, this data gives an indication of where heavy expenditures for replacement systems may be imminent. Also, there are doubtless many other communities with non-reported leakage problems in their distribution systems. The right-hand column in this table reduces the data to a comparative basis (leaks per 100 connections per year).

11.4 ALTERNATIVE SOLUTIONS OR ACTIONS

Problems and needs identified for consideration in Section 11.3 are (1) anticipated future growth of water requirements, (2) current deficiencies in system capacity, storage, and regulatory approval, (3) training and certification of system operators, (4) new federal requirements for water quality, and (5) replacement of aging facilities.

Actions to meet these needs, though difficult and expensive, are fairly obvious and straightforward for all but the first item. And actions by communities are already underway to solve present needs and deficiencies. Existing funding and technical assistance programs are available and being used to correct present deficiencies, train and certify operators, meet new federal requirements, and replace facilities. Since each community's circumstances are different, not all are being (or will be) met exactly the same; and every drinking water need must be resolved on a community basis.

Means for meeting future growth are more varied than the other four needs identified, and there are varying opinions on which would be best. Water conservation, further use of existing supplies, drilling of new wells, construction of new reservoirs, and inter-county transfers are all recommended. But none of these fit every community, and no community would employ all of them.

Most communities have a reserve capacity, some of which is necessary in meeting unusual demand periods, and some of which is presently a surplus. According to data in

TABLE 11-14
SUMMARY OF REPORTED LEAKS IN DISTRIBUTION SYSTEMS[a]

County	Supplier	No. of Connections	No. of Reported Leaks	Leaks/ 100 Conn./ Year
Box Elder	Acme	278	3	1.1
	Deweyville	95	1	1.0
	Elwood	158	4	2.5
	Mantua	222	2	0.9
	Perry	376	12	3.2
	Portage	81	1	1.2
	Riverside/N. Garland	238	2	0.8
	Thatcher/Penrose	238	5	2.1
	Willard	442	20	4.5
Cache	Amalga	114	6	5.3
	Hyde Park	578	6	1.0
	Millville	294	20	6.0
	N. Logan	1013	15	1.5
	Smithfield	1580	30	1.9
	Wellsville	580	25	4.3
Rich	(None reported)			

[a]No report from other communities.
Source: Utah Division of Drinking Water.

Table 11-8 through 11-10, of the 52 community water systems, 30 have enough current capacity to carry them beyond the year 2010 (at present per capita use rates); and 21 systems have enough to carry them beyond 2025. Lewiston, for example, would apparently still have a reserve capacity of 112 percent in 2025. The remainder, however, have little or no reserve capacity at the present time. As expected, systems without reserve capacity have the greatest need for new water supplies (or other solutions).

If new future water requirements are to be satisfied by conservation, which means that the present level of use would remain constant, the per capita use rate must drop drastically. For example, Table 11-7 shows a basin population of 140,800 in the year 2020. To maintain the 1990 water use at 51,170 acre-feet, an overall per capita use rate of 0.363 acre-feet/year would be necessary. This would be a drop of 33 percent. To maintain the present use rate to the year 2025 would require a drop of 37 percent. In communities with high use rates, these decreases are probably achievable, but in others the rate is already low. Twenty-one of the 52 community systems use less water per capita than the state average of 0.318 acre-feet/year. Ten communities are below 0.210. It would be difficult to reduce these much further. For the two largest cities, Logan and Brigham City, a present decrease to the state average would be 32 and 47 percent, respectively. To maintain their present levels of use to the year 2010 would require a future decrease of 18 to 16 percent in each case. In summary, the communities needing water the most are the very ones least able to meet their needs by water conservation alone. And communities with a large surplus have little incentive to conserve. This further emphasizes the concept that each community must be considered separately. Another reality is that public opinion is the major factor in water conservation. Conservation is discussed more fully in Section 17.

In many areas of the basin, communities can, with the State Engineer's approval, drill a new well and obtain a new water supply of good quality. Current groundwater supplies are assumed adequate to provide culinary water for most of the 32,400 additional residents anticipated by the year 2010. Small amounts of surface water will supply the remainder. To utilize the additional groundwater or to develop surface supplies, new facilities for storage, treatment, and distribution will also be needed.

Good quality groundwater is not available everywhere, however. In Box Elder County, for example, where about seven communities are currently needing more water, this is true. The remaining supply is quite limited and quite localized. A small amount of good-quality groundwater can still be developed along the eastern edge of the county. A larger quantity could probably be developed and imported from Cache Valley. The Bear River Water Conservancy District is currently investigating the potential of developing wells in Cache Valley and hope to deliver up to 7,000 acre-feet of additional M & I groundwater to Box Elder County by the year 2000. This inter-county transfer would require the building of a new pipeline conveyance system.

The other alternative for Box Elder County is to develop a surface water supply. If surface water is used, extensive water treatment will be necessary. The associated costs are high. Box Elder County could elect to develop a surface water supply unilaterally, or could to do so in cooperation with the state, or with other entities.

New reservoir construction for drinking water supplies will probably not be necessary in the immediate future, unless the State Engineer eventually requires the replacement of new groundwater development in Cache Valley with new surface water supplies.

The most likely means that will be utilized in meeting future drinking water requirements is a combination of conservation and new groundwater development. But the combination will vary from one community to another because of differing circumstances. The selection will reflect the local public opinion, and will generally be the easiest and least expensive option.

11.5 RECOMMENDATIONS

These recommendations relate directly to the immediate and long-term needs identified in Section 11.3.

11.5.1 Providing for Future Growth

System owners should: (1) continue to maintain and upgrade existing systems, including protection of each water source, (2) enlarge existing systems and/or build new systems to accommodate future growth in the basin; (3) and initiate public education programs to promote water conservation in each community.

11.5.2 Systems Not Fully Approved

The Utah Department of Environmental Quality should provide assistance to upgrade the nine public community systems not fully approved to achieve an "approved" status.

11.5.3 Systems Currently Deficient in Storage and Source Capacity

The owners/operators of nine systems currently deficient in storage capacity and the 10 systems deficient in source capacity should begin efforts to design, finance, and build the needed improvements.

11.5.4 Public Water Systems Operator Certification

The Utah Division of Drinking Water should encourage and assist operators of all public water systems to be trained and certified, with specific attention given to those nine systems not fully approved.

11.5.5 Financial Assistance Programs

The costs will be enormous to install new facilities and improve existing facilities along with anticipated costs to meet new federal requirements. Limited federal financial assistance is expected. Although the primary responsibility for implementation and funding of drinking water system improvements rests with the owners of each system, the financial assistance programs of the Drinking Water Board and the Board of Water Resources should be continued in order to assist with improvements.

11.6 REFERENCES

In addition to the references listed below, attention is directed to Section 11 of the Utah State Water Plan, January 1990, where more detail is given concerning drinking water supplies, and two related issues are discussed.

1. "Public Water Supply Information System" (computer data printout sheets). Utah Division of Drinking Water.

2. "1987 Baseline Projection," April 1987, "Economic and Demographic Projections, 1988," April 1988, and "Economic and Demographic Projections, 1990," Dec. 1989. Utah Office of Planning and Budget.

3. "Water Use Data for Public Water Supplies", Utah Division of Water Rights, Water User Reports No. 1-6, 1979-85.

4. "Bear River Water Development Study", Hansen, Allen, and Luce, Inc., Consultants/Engineers, and Valley Engineering, Inc., Feb. 1989, and "Conceptual Level Engineering Plan," Dec. 1989.

5. 1984 Community Water System Capital Facilities Needs Survey - Summary Report, University of Utah Bureau of Economic and Business Research for Utah State Dept. of Health, February 1985.

6. "Present Water Supplies, Uses, and Rights - Bear River Development"; Hansen, Allen, and Luce, Inc., for Utah Division of Water Resources, June 1991.

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Section 12
WATER POLLUTION CONTROL

This section presents data and information on existing levels of water pollution throughout the basin. Sources of pollution are identified, problems and solutions are discussed, and recommendations are given for control and improvement by responsible agencies.

12.1 INTRODUCTION

With some important exceptions, most groundwater in the Bear River Basin is good quality and suitable for culinary use with little or no treatment.[1] The major exception is in Box Elder county in areas near the Great Salt Lake. Essentially all of the municipal, industrial, and domestic water in the basin comes from high-quality groundwater sources. The quality of surface water, however, varies widely because of both 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, electrical conductivity, 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 warmer temperatures 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.

Ashley Anderson - Grand Prize Winner, 1990
Young Artists Water Education Poster Contest

12.2 SETTING

Chronic and occasionally serious wastewater discharges containing high biochemical oxygen demand (BOD) and coliform bacteria have occurred at some locations. Of the 35 Utah communities below Oneida Dam, 15 have municipal wastewater treatment facilities[1]. New or recently upgraded facilities are located in Hyrum, Brigham City, Tremonton, Logan, North Logan, River Heights, Smithfield, and Providence. Table 12 is a listing of current municipal treatment facilities for the basin, and the stream to which they discharge. Generally, most of these falcilities are in compliance with their discharge permit. Many additional communities are contemplating construction of sewage collection and treatment systems.

12.3 REGULATION

The 1991 Legislature created the Department of Environmental Quality, a new department of Utah state government that formerly was the Division of Environmental Health. Within the new department, several existing agencies are elevated to division status. The Division of Water Quality (formerly the Bureau of Water Pollution Control) is of special interest to this report.

The Utah Water Quality Board has the following responsibilities: (1) developing and updating regulations and policies, (2) enforcing water quality discharge limits and treatment standards, (3) classifying the waters of the state according to use, and (4) setting water quality standards, including numeric criteria. Numeric water quality criteria are used to calculate discharge limits for municipal and industrial discharges, to evaluate the impact of point and non-point source pollution, and to determine the achievement of beneficial uses. The use designations are defined by six major classes and nine sub-classes, shown in Table 12-2. The board's classification of streams, lakes, and reservoirs in the Bear River Basin is shown in Table 12-3. Some streams carry different classifications because of multiple uses and changing conditions in various reaches. For example, portions of the Little Bear River and its tributaries are classified as (3A) a cold water fishery, (3D) for waterfowl use, and (4) as a supply for agricultural uses. Porcupine and Hyrum reservoirs are classified (2B) for boating and water-skiing, (3A) cold water game fish and aquatic life, and (4) a source of water for agricultural uses. Cutler Reservoir is classified (2B), for boating and water-skiing (3B), warm water fishery and aquatic life (3D) waterfowl, and (4) a source of water for agricultural uses.

Tremonton Treatment Plant - Div. of Water Resources

TABLE 12-1
EXISTING MUNICIPAL AND INDUSTRIAL WASTEWATER DISCHARGES

Community/Industry	Receiving Stream
Richmond Lagoons	Cub River
Logan Lagoons (includes North Logan, Hyde Park, Providence, River Heights, and Smithfield)	Cutler Reservoir
Hyrum WWTP	Little Bear River
Wellsville Lagoon	Little Bear River
Bear River City Lagoons	Malad River
Brigham City WWTP[a] (includes Mantua)	Black's Slough
Tremonton WWTP[a] (includes Garland)	Malad River
Corinne Lagoons	Bear River
Con Agra	Wetlands on Great Salt Lake
Morton International	Blue Creek
NuCor Steel	Malad River
Gossner Foods	Cutler Reservoir
E.A. Miller	Little Bear River
Western Dairyman	Cutler Reservoir
Trout of Paradise	Little Bear River

[a]Wastewater treatment plant.

TABLE 12-2
USE DESIGNATIONS BY UTAH WATER QUALITY BOARD

Class 1 - Protected for use as a raw water source for domestic water systems.

Class 1A - Reserved (for future definition).

Class 1B - Reserved (for future definition).

Class 1C - Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Department of Health.

Class 2 - Protected for in-stream recreational use and aesthetics.

Class 2A - Protected for recreational bathing (swimming).

Class 2B - Protected for boating, water skiing, and similar uses, excluding recreational bathing (swimming).

Class 3 - Protected for in-stream use by beneficial aquatic wildlife.

Class 3A - Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.

Class 3B - Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.

Class 3C - Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.

Class 3D - Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.

Class 4 - Protected for agricultural uses including irrigation of crops and stockwatering.

Class 5 - Reserved (for future definition).

Class 6 - Waters requiring protection when conventional uses as identified in Sections 2.6.1 through 2.6.5 do not apply. Standards for this class are determined on a case-by-case basis.

TABLE 12-3
USE CLASSIFICATION OF WATER IN THE BEAR RIVER BASIN

STREAMS	
Bear River and tributaries, from Utah-Wyoming state line to headwaters (Summit County)	3A, 4
Bear River and tributaries in Rich County	3A, 4
Big Creek and tributaries, from Bear Lake to headwaters	2B, 3A, 4
Swan Creek and tributaries, from Bear Lake to headwaters	3A, 4
Swan Springs, tributary to Swan Creek	1C
All other tributaries to Bear Lake	3A, 4
Cub River and tributaries, from confluence with Bear River to state line	3B, 4
High Creek and tributaries, from confluence with Cub River to headwaters	3A, 4
Bear River from Utah-Idaho state line to Great Salt Lake	2B, 3B, 3D, 4
Birch Creek and tributaries, from confluence with Clarkston Creek to headwaters	3A, 4
Clarkston Creek and tributaries, from Newton Reservoir to headwaters	3B, 4
Newton Creek and tributaries, from Cutler Reservoir to Newton Reservoir	3B, 4
Blacksmith Fork and tributaries, from confluence with Logan River to headwaters	3A, 4
Logan River and tributaries, from Cutler Reservoir to headwaters	2B, 3A, 3D, 4
Little Bear River and tributaries, from Cutler Reservoir to headwaters	3A, 3D, 4

TABLE 12-3 (continued)
USE CLASSIFICATION OF WATER IN THE BEAR RIVER BASIN

STREAMS	
Malad River and tributaries, from confluence with Bear River to state line	3C
Box Elder Creek, from Brigham City Reservoir to headwaters	3A, 4
Box Elder Creek from confluence with Black Slough to Brigham City Reservoir	3C, 4
Perry Canyon Creek from U.S. Forest boundary to headwaters	3A, 4
Willard Creek, from Willard Bay Reservoir to headwaters	3A, 4
LAKES & RESERVOIRS - - SUMMIT COUNTY	
Whitney Reservoir	2B, 3A, 4
Ryder Lake	2B, 3A, 4
McPheters Lake	2B, 3A, 4
Lily Lake	2B, 3A, 4
Amethyst Lake	2B, 3A, 4
LAKES & RESERVOIRS - - RICH COUNTY	
Woodruff Creek Reservoir	2B, 3A, 4
Little Creek Reservoir	2B, 3A, 4
Birch Creek Reservoir	2B, 3A, 4
Bear Lake (Utah portion)	2A, 2B, 3A, 4
LAKES & RESERVOIRS - - CACHE COUNTY	
Tony Grove Lake	2B, 3A, 4
Pelican Pond	2B, 3B, 4
Porcupine Reservoir	2B, 3A, 4
Newton Reservoir	2B, 3B, 4
Hyrum Reservoir	2B, 3A, 4

TABLE 12-3 (continued)
USE CLASSIFICATION OF WATER IN THE BEAR RIVER BASIN

LAKES & RESERVOIRS - - BOX ELDER COUNTY	
Willard Bay Reservoir	1C, 2B, 3B, 3D, 4
Mantua Reservoir	2B, 3A, 4
Cutler Reservoir (including portion in Cache County)	2B, 3B, 3D, 4
NATIONAL BIRD REFUGE AND STATE WATERFOWL AREAS	
Salt Creek Waterfowl Management Area, Box Elder County	3C, 3D
Public Shooting Grounds Waterfowl Management Area, Box Elder County	3C, 3D
Harold Crane Waterfowl Management Area, Box Elder County	3C, 3D
Bear River Migratory Bird Refuge, Box Elder County	3B, 3D

12.4 PROBLEMS, NEEDS, AND ISSUES

Water quality problems in the Bear River Basin are complex and pervasive. This basin plan attempts to present only a general overview, and in some cases specific examples of problems. In general, water quality in the Bear River decreases as it flows downstream.

The Utah 1982 Clean Lakes Inventory and Classification Project[8] studied the following impoundments: Bear Lake, Cutler Reservoir, Newton Reservoir, Tony Grove Lake, Hyrum Reservoir, Porcupine Reservoir, and Mantua Reservoir. Those impoundments found to have critical or potential water quality problems, particularly from eutrophication and sedimentation, were Hyrum and Newton reservoirs and Bear Lake. Each is discussed on the following pages, along with specific reaches of the Bear River mainstem and tributaries.

12.4.1 Point Source Pollution

Point sources of water pollution are those which result from a discharge at a specific single location and are generally associated with discharges from municipal or industrial wastewater treatment facilities. Wastewater discharges must be permitted by the Water Quality Board, acting through the Division of Water Quality. State water pollution control regulations require, as a minimum, all persons discharging wastes into any of the waters of the state to provide treatment processes which will produce effluent meeting or exceeding Utah Secondary Standards. These standards stipulate that the arithmetic mean of effluent BOD (biochemical oxygen demand) and TSS (total suspended solids) over any 30-day period not exceed 25 mg/l; the geometric mean of effluent total and fecal coliform not exceed 2000/100 ml and 200/100 ml, respectively; and that effluent values for pH (acidity) be maintained between 6.5 and 9.0.

The three counties comprising the Bear River Basin in Utah currently have 10 municipal and eight industrial permitted wastewater treatment facilities. These include:

Municipal

Bear River Town Lagoons
Brigham City WWTP
Corinne City Lagoons
Perry City Lagoons
Tremonton City WWTP
Hyrum City WWTP
Lewiston City Lagoons
Logan City Lagoons
Richmond City Lagoons
Wellsville City Lagoons

Industrial

Con Agra - Land Application
Morton International Industrial WWTP
NuCor Steel Lagoons
Thiokol Industrial WWTP
Gossner Foods Lagoons
E.A. Miller Lagoons Treatment Plant/Lagoons
Western Dairyman's Cooperative Lagoons (Amalga)
Trout of Paradise

In addition, a number of facilities do not discharge and are not required to obtain a permit from the state. These include:

Bear Lake Special Service District Lagoons
Sweetwater Lagoons
Bear Lake State Park Lagoons
Willard Bay State Park Lagoons

Many areas of the Bear River Basin have high groundwater levels, inadequately sized septic tank/drainfield systems, residential lots of inadequate size to support on-site disposal systems, and systems located in soils of low percolation rates. Because of these conditions, some communities have recently received state and federal funds for planning, design, or construction of centralized wastewater collection and disposal systems. These communities include:

Smithfield City
Providence City
Hyde Park City
Willard City (planning only)
Bear Lake South Shore (planning only)

Major upgrades were completed recently at the Logan City Lagoons and Brigham City Wastewater Treatment Plant. In spite of these efforts, the capital cost expenditure to meet current wastewater needs in the Bear River Basin is estimated at $346.5 million (1990 dollars). The capital cost to meet the area's wastewater needs to the year 2008 is estimated to be $524.2 million (1990 dollars).

12.4.2 Non-point Source Pollution

"Non-point sources" (NPS) of water pollution are those not resulting from discharge at a specific single location (e.g., a pipeline outflow). NPS pollution is associated with natural sources and with human activities such as agriculture, construction, mining, recreation, urban runoff, channel modifications, and forest management. It is very difficult to control. NPS pollution is a major contributor to water quality problems in the Bear River Basin, and is recognized by the U.S. Congress as a major contributor nationwide. The 1987 Federal Clean Water Act (Section 319) established provisions to control NPS pollution.

In Utah, the Department of Environmental Quality has administrative responsibility for NPS pollution, with the Utah Department of Agriculture responsible for day-to-day program management. The Division of Water Quality in the Department of Environmental Quality has prepared an assessment report which describes the nature, extent, and effect of NPS pollution. The Utah Department of Agriculture has prepared a management plan, identifying measures ("best management practices") required and strategies for implementing NPS controls. Congress has asked each state to prepare these two reports. In connection with this responsibility, priorities have been set for NPS control efforts in Utah. As best management systems (BMS) are implemented in the future, and problem areas are controlled, the priority list will be updated and reviewed by the NPS Task Force. Present priorities are based on the following criteria:

1. Designated use of the stream
2. Degree of impairment
3. Population affected
4. Potential for improvement
5. Special considerations (i.e., local support)

Of 21 Utah watersheds prioritized for water quality improvement under this program, three are in the Bear River Basin, and all are in Cache County: Clarkston Creek, Little Bear River, and the Cornish watershed near Clarkston. Water quality problems in each of these areas are described in the following subsection. In each case, animal waste from dairies and feedlots is a problem that is presently impacting water quality. Many other agricultural impacts are apparent, but animal wastes deserve special attention in the Bear River Basin. Table 12-4 shows the relative impact of NPS pollution in the basin and the general sources of pollution.

12.4.3 Rich County

Minor water quality impairments in Rich County, include those in cold water fisheries because of temperature, turbidity, and, occassionally, amonia. The impairments result from natural sources, resource extraction, road construction, grazing, and channel modifications. Impacts from total phosphate are also contributed by agricultural activities and from municipal discharge at Evanston. Most contaminated input results from high water during early spring thaw, and from runoff that carries nutrients and sediments into streams from the terrestrial system.

TABLE 12-4
NON-POINT SOURCE POLLUTION IMPACTS
BEAR RIVER DRAINAGE[7]

Source Category	Major Impact	Moderate to Minor Impact (in stream miles)
Non-point Sources		
Agriculture		310
Resource extraction		52
Urban runoff		31
Construction		22
Hydro/habitat modification		11
Land disposal		9
Silviculture (forest management)		2
Other (natural)		629

12.4.4 Bear Lake

Although the present quality of Bear Lake is very good, the nutrient loading is critical because of the lake's unique chemistry. About 70 percent of the nutrients entering the lake come from the Bear River, which accumulates them from non-point sources upstream. The 30 percent from drainage areas directly tributary to Bear Lake includes wastewater from communities and recreation areas around the lake.

The following statement is from a 1989 Bear Lake water quality summary prepared for the Bear Lake Regional Commission [6].

"Over the last decade, a large amount of water quality data has been collected on Bear Lake. The total inorganic nitrogen data has been consistently around 20-40 ug/l* since 1982. Prior to that time, the concentrations were between 40-80 ug/l. Total nitrogen (the sum of all nitrogen components) appears to have a cyclic pattern, reaching highest average concentrations during the wet 1983, 1984 and 1985 time periods.

"Total and ortho-phosphate have both demonstrated an upward trend in concentration. This is especially evident since 1987. Concentrations of total phosphorus regularly exceed 15 ug/l.

"In response to decreased concentrations of nitrogen during 1987-1989 the phytoplankton appear to have decreased. The limnological data indicates that due to high concentrations of ortho-phosphate, nitrogen appears to be limiting the phytoplankton.

"The data for average pH (acidity) levels in the lake over the last decade shows a steady decrease in pH, especially since 1987. This decrease could account for the increased phosphate levels and the concurrent nitrogen limitation. Because the mechanism for pH reduction is unknown, every effort should be made to determine the cause and to adjust management plans accordingly.

"The production of phytoplankton has decreased during 1987, 1988 and 1989, with no surface concentrations exceeding 1.0 ug/l. This agrees with other data which suggests a decrease in nitrogen and phosphorus loading to Bear Lake during the current dry hydrologic cycle. The decrease in nutrient loading would result in decreased phytoplankton productivity. This level of production is the lowest observed over the last decade."

Although much of Bear Lake's nutrient loading is attributable to inflows from the Bear River, a return to natural conditions (with Bear River bypassing the lake) is not an option. UP&L is obligated by contract and under the Bear River Compact to prudently store spring runoff in Bear Lake and release the stored water during times of downstream irrigation demands. This operation is critical to the economy of the lower basin.

12.4.5 Mainstem of Bear River Above Cutler Dam

The Cache Valley segment of Bear River below Oneida Dam contains a substantial level of sediment from unstable stream channels and poor watershed conditions in some areas. Several tributaries, such as Battle Creek and Deep Creek, contribute great quantities of sediment to the Bear River. In addition, irrigation practices have resulted in severe erosion along some bench areas adjacent to the Bear River. Daily streamflow fluctuations from hydropower production at Oneida Dam tend to worsen the streambank instability and sediment problem which already exists. The fine sediment remains in suspension and some passes through Cutler Reservoir to the river below. Much of this sediment has settled out in Cutler Reservoir, as evidenced by its reduced storage capacity.

From the Idaho-Utah state line to Cutler Dam, problems identified are excessive bacteria counts, high ortho-phosphate and nitrate levels, high turbidity, and occasionally high BOD counts. The problems partially originate at cattle confinement and dairy areas from improper manure management practices, and in cropland areas from fertilizer application. Runoff into streams and canals in Cache Valley often carries animal wastes. Some dairy operations, especially those near the communities of Benson and Amalga, have discharged wash water as well as feedlot runoff into the Bear River or into contiguous backwaters and sloughs. Several dairies are located close enough to the river that cattle can walk into the water. In addition, it is suspected that there are some septic tanks presently discharging into the Bear River between Preston and Cutler Reservoir.

Rich County - Div. of Water Resources

Sedimentation and organic enrichment have an impact on the Bear River as described above. However, water quality data do not presently show toxicity problems.

Macroinvertebrate samples support the assumption that heavy metal or pesticide toxicities have not occurred at this location from April 1977 to November 1983. Water quality data did indicate stressful conditions for many species of aquatic organisms, with benthic communities consisting of species considered relatively intolerant to poor water quality but tolerant to sedimentation.

12.4.6 Cornish Watershed

The Cornish Watershed contains 37,100 acres, extending 21 miles north to south and six miles east to west. Cornish, Trenton, and Amalga are within the area. This watershed is bounded on the east by the Bear River, on the south by Cutler Reservoir, on the west by the Clarkston Creek Watershed, and on the north by the Utah/Idaho state line. The watershed lies on an east-facing slope with Little Hill and Big Hill on the west. Elevations range from 4,400 feet at Cutler Reservoir to 5,725 feet at the summit of Big Hill. The mean annual precipitation is 17 inches.

Within the watershed, numerous dairy operations inadequately handling livestock waste. Waste management plans and facilities are needed to reduce impacts from this source of pollution.

Most of the 5,000 acres of dry cropland and about 5,000 acres of rangeland within the watershed have highly erodible soils. The extent of erosion and sediment production has not been determined. Crop production on irrigated land in this area is higher than the average for the state. Application of chemical and organic fertilizers is a common practice. Present irrigation and fertilizer management practices and livestock waste management are resulting in an undesirable nutrient yield to the river system.

The adjoining reach of Bear River has been classified for secondary contact recreation, as a warm water fishery, for waterfowl use, and as a supply for agricultural uses. Generally, those parameters which exceed state standards as pollution indicators are total phosphorus and nitrogen. The beneficial use classification for the waters of Cutler Reservoir include: boating and water-skiing, warm water game fish and aquatic life, waterfowl and aquatic life, and agricultural irrigation and stock watering. Total suspended solids and total dissolved solids are excessive in incoming waters. Total phosphorus values exceed the state standards with a mean value of 0.11 mg/l. Cutler Reservoir is nitrogen-limited, and is eutrophic with a mean Trophic State Index of 73.53.

Present data is preliminary and does not quantify or identify specific problem sites. Additional data inventory and analysis work is necessary to allow for effective alternative development and benefit cost analysis. Water quality data specific to this watershed is needed to determine extent of impacts and to determine need for implementation of best management practices.

12.4.7 Clarkston Creek and Newton Reservoir

Water quality problems in Clarkston Creek include high turbidity from soil erosion, high phosphates, and occasional high BOD levels. Newton Reservoir problems have been identified as turbidity, low dissolved oxygen, high nutrients, and excessive algae and macrophyte growth. Newton Reservoir's water quality,[8] at four on-lake sample sites monitored in 1980, was well above the state standard of .025 mg/l for phosphorus as a pollution indicator. Nitrogen was below standards. Phosphorus was the limiting nutrient at all points during both sample dates, except for Clarkston Creek above the reservoir, which was nitrogen limited in August. Bicarbonate readings between 166 and 322 mg/l were indicative of hard water. All water temperatures were within the state standards for warm water fisheries (27°C). Iron concentrations reached as high as 3.88 mg/l. The standard is 1 mg/l. All other trace metals were within bounds. The reservoir stratified acutely with the development of anoxic hypolimnion at close to 10 meters. The waters are within standards for pH.

Following is a summary of biological information including plankton and fisheries gathered for Newton Reservoir during 1980. Fisheries present include yellow perch *(Perca flavescens)*, largemouth bass *(Micropterus salmoides)*, black crappie *(Pomoxis nigromoculatus)*, brown trout *(Salmo trutta)*, bluegill *(Lepomis macrochirus)*, carp *(Cyprinus carpioi)*, and Utah sucker *(Catostomus ardens)*. Phytoplankton present included the toxic pollution algae *Ceratium* and *Aphanizomenon*.

Newton Reservoir was not surveyed during the 1975 Environmental Protection Agency National Eutrophication Survey. Based on 1980 data, the State Bureau of Water Pollution Control (now the Division of Water Quality), using the Carlson Trophic State Index (TSI), determined the reservoir to be eutrophic with a TSI of 67.7.

Current and potential non-point source problems at Newton Reservoir and agencies involved are:

Agriculture - North Cache Soil Conservation District
Chemicals, coliform, sediment, organics

Domestic Sewage - Local governments
Coliform, BOD, nutrients

Construction - Local governments
Sediment, oil, grease, litter, chemicals

Recreation - Local governments, state
Litter, sediment, oil, grease

12.4.8 Cub River, Logan River, and Blacksmith Fork

Problems in the Cub River are similar to those in the mainstem of the Bear River, including excessive bacteria counts, high ortho-phosphate and nitrate levels, high turbidity, and occasionally high BOD.

The Logan River drainage above the mouth of the canyon has excellent water quality; some problems of high coliform and orthophosphate have been observed on the lower segments of the river. Best management practices to alleviate the water quality problems of the Logan River include management of animal waste, continuation of range management, revegetation of urban land disturbances, protection and enhancement of the riparian corridor from the canyon mouth to Cutler Reservoir, and installation of toilet facilities at Franklin Basin, a recreation area at the headwaters.

High-quality mountain runoff enters the Blacksmith Fork through six main tributaries. With the exception of the lower end, water quality is excellent. Problems in the lower end include bacterial contamination, nutrients, and turbidity. Better management practices for this watershed would pertain to animal-waste handling, range management of the national forest areas, and contour and conservation tillage.

12.4.9 Little Bear River Watershed and Hyrum Reservoir

The Little Bear River drainage receives high quality mountain runoff. Two impoundments, Porcupine Reservoir and Hyrum Reservoir, store water for irrigation in southern Cache County and make possible a variety of recreational activities. The major water quality problem of the Little Bear River Watershed is the nutrient loading of Hyrum Reservoir and channel degradation between Porcupine and Cutler reservoirs. Animal waste from dairies and feedlots is a significant contribution of pollution to the Little Bear River. Periodic high concentrations of ortho-phosphate have been observed on the Little Bear River between Avon and Hyrum. Better management practices would include reducing erosion and controlling animal waste runoff. Additional sampling and research are needed to determine exact sources of nutrients before management practices are recommended to control the eutrophic state of Hyrum Reservoir.

The Little Bear River is a major source of sediment, phosphorus, and coliform to Hyrum Reservoir, Cutler Reservoir, and to the Bear River itself. For a selected period, from May 1984 to May 1985, water quality data from the Little Bear River at a point above the confluence with the Logan River was analyzed. Of the 13 samples collected, 11 exceeded the standard for phosphorus, five for nitrogen, six for biological oxygen demand, two for dissolved oxygen, and two for pH.

The Little Bear River system is currently serving as a demonstration area for a river management pilot project. Resources are being focused in this system through the Bear River Resource Conservation and Development (RC&D) Project. The program will determine the feasibility of implementing corrective measures and annual maintenance and preventive programs.

At least five resource problems within the Little Bear River Watershed impact water quality.

The first, and perhaps most obvious, is sediment production from the river channel between Porcupine Reservoir and Cutler Reservoir. The stability of this channel was severely impacted during the 1983 and 1984 flooding events. Still unstable, the channel yields significant amounts of sediment and nutrients to the system. An annual maintenance program is needed to encourage stream channel stability in a cost-effective manner. This program would also encourage and protect other beneficial uses of the stream corridor.

The second problem is inflow from tributary drainages on the lower west side of the watershed. These relatively small areas are dramatically affected by intense summer thunderstorms. During these events, rapid runoff develops inordinately high peak flows, significantly eroding the main and tributary channels. Treatment of these rapid runoff areas would modify the runoff characteristics and reduce sediment/nutrient loading impacts.

A third problem is the excessive amount of nutrient and coliform bacteria entering the system. A major portion of the river's riparian zone, used as pasture, is heavily grazed. Animal waste is a significant problem. Improved grazing and vegetation management, along with improved irrigation management, would reduce water quality impacts from these sources.

The fourth problem is in the upper watershed. Based on a Soil Conservation Service evaluation made in 1987, approximately five percent of the upper watershed (about 8,000 acres) would benefit from improved management, brush control, and some reseeding to reduce sediment yield. A significant amount of phosphorus is being contributed to the system from Davenport Creek and South Fork of Little Bear River. This phosphorus input occurs primarily during spring runoff. Grazing management, riparian zone protection and enhancement, and filter strip establishment would reduce phosphorus inputs.

A fifth problem is the shoreline of Hyrum Reservoir. The western shore of the reservoir is against steep and highly erosive bluffs. Wave action against the toe of the bluffs encourages major sloughing. Armoring the shoreline would protect the bluffs against this wave action.

Sediment and nutrient loading of Hyrum Reservoir is impairing the storage capacity, water quality, fishery, recreation, and aesthetics. An effort has already been initiated to increase the oxygen levels in the reservoir to improve its fishery values. Additional efforts are needed to reduce the remaining impacts.

The river channel between Hyrum Reservoir and Cutler Reservoir meanders through irrigated and naturally wet pastureland. Water quality in this reach is impacted by coliform bacteria, nutrients, and salinity.

12.4.10 Main Stem of Bear River Below Cutler Dam, Box Elder Creek, and Malad River

Water quality problems for the segment of the Bear River between Cutler Dam and the Bear River Migratory Bird Refuge are identified as excess levels of phosphates, high turbidity, high concentrations of total and fecal coliform, and occasional high TDS concentrations. Recommended management practices are those related to manure management and soil erosion. The Bear River below the confluence with the Malad River is characterized as moderate to poor in quality and physical habitat. Water temperature, total and fecal coliform, ammonia, boron, alkalinity, nutrients, hardness, TDS, and sulfates were all at, or near, levels considered undesirable. Concentrations of barium were frequently above the 50 mg/l maximum acceptable level for aquatic life, as shown in the Environmental Protection Agency's quality criteria for water, 1986. However, because of naturally high levels of sulfate and carbonate, the barium precipitated out of solution is virtually non-toxic. Low stream flows contributed to the unacceptable water quality and habitat conditions by higher water temperatures and decreasing dilution waters. Banks are stable and covered extensively with riparian vegetation, but plants and animals have few places to thrive because of hard clay bottoms, lack of rapids, high turbidity, total suspended solids, and harsh flow regimes.

The Box Elder Creek drainage includes several tributaries draining the steep slopes of the Wasatch Range from Brigham City to the Weber County line. Mantua Reservoir provides storage of irrigation water, water recreation, and wildlife habitat. One of the major water quality problems in this area is occasional flooding and sedimentation of the Ogden-Brigham Canal, with resultant flooding of orchards and homes. Before management practices are recommended in the Willard-Perry area, a feasibility study is needed to determine methods to reduce flooding. Proposed management practices for Mantua Reservoir include better management of animal waste to reduce nutrient loading.

The lower Malad River is too high in total dissolved solids for agricultural use. The major problems of the river include high TDS and turbidity. The most important source of TDS is Belmont Hot Springs, near Plymouth, Utah, with approximately 8,000 mg/l of TDS. Because mineral springs occur in the streambed, it would be difficult to control sources of these salts. Since the Malad River's salinity problem pervades the entire river, management practices to control salinity are not recommended at this time.

12.5 SOLUTIONS OR ACTIONS AVAILABLE

An assessment and planning project is currently underway to better define problem areas, develop solutions, and implement a water quality management framework to protect and enhance the quality of the basin's surface and groundwater resources. Planning and implementation actions are proceeding in some areas of the basin such as the Little Bear River Watershed. In the following sections, some general corrective approaches or actions for each portion of the basin (especially in relation to potential developments) are discussed, starting with the upper basin.

12.5.1 Rich County

The Bear River in Rich County is impaired for its current uses as a cold water fishery and for agriculture. River flows are stored during certain periods in Bear Lake. Nutrients and sediment have been identified as the major pollutants in this system. Since nutrients originate with human or animal wastes and from organic matter and sediments, proper pasture and riparian restoration and management would be very beneficial in this system. Beneficial county-wide nutrient control practices include irrigation water management, pasture management, and streambank protection.

12.5.2 Bear Lake

The Bear Lake Regional Commission has accepted the responsibility of coordinating all interagency activities for the improvement of Bear Lake. The Bear Lake Preservation Project, sponsored by the commission, is a cooperative effort to maintain the present quality by controlling or reducing the nutrient loading. The commission is attempting to reduce non-point source pollution to the Bear River upstream by encouraging erosion control and better livestock management practices. In the Bear Lake Basin itself, several sewage collection and treatment systems have been completed. One sewage collection system flows north from the state line to treatment lagoons near St. Charles, Idaho. Another flows south and east from the state line to treatment lagoons near Sweetwater Park. A system is needed to collect wastewater from the area around Laketown and the southeastern shore of Bear Lake.[5] In addition, both Sweetwater Park and Rendezvous Beach State Park have separate sewage collection and treatment systems (total containment lagoons).

12.5.3 Bear River in Cache Valley

The Utah Department of Agriculture lists the following general practices that would significantly improve water quality. Pollution sources that must be reduced or eliminated are agricultural (natural waste and fertilizer/ pesticide chemicals), septic tanks, and erosional sediment.

> County-wide - Animal waste and pasture management in areas where pollutants may enter groundwater.
>
> Newton Reservoir Watershed - Management practices intended to alleviate water quality problems are erosion control on the dry cropland west and north of Clarkston City, mechanical aeration to increase the dissolved oxygen level and fish habitat in Newton Reservoir, and manure management to keep animal wastes out of waterways.
>
> Blacksmith Fork River - Erosion control practices for stream channel protection and for stabilization.

12.5.4 Cornish Watershed Area

Excellent opportunities exist to treat agricultural non-point source pollution. Minimum tillage and/or other cultural and management practices can reduce erosion and sediment yield from dry cropland. Brush control and reseeding, along with management practices, can effectively reduce rangeland erosion. Irrigation water management is improving and will continue to do so, but targeted technical and financial assistance would help accelerate this process. The major effort and cost are in the management of livestock waste. Structural practices to handle large volumes of animal waste are expensive, but they can be very effective. Vegetative and management practices can also be effective and, in most cases, can help reduce the cost of animal waste management. Reductions in sediment and nutrient loading of the Bear River would increase fishery values, in the river and in Cutler Reservoir. Reduced sediment and nutrient loading of the reservoir would extend the reservoir life, improve fish and wildlife values, improve recreational values, and reduce health risks to water users.

The existing coordination of public information and education programs by the Extension Service, Utah Association of Conservation Districts, local soil conservation districts, and Utah departments of Agriculture and Environmental Quality has been important in the basin. Continuation of these programs will expand the public's awareness of water quality problems, and may build a stronger desire to participate in improvement activities. With public support and education, significant reductions in animal waste pollution of the Bear River can be achieved. Economic incentives will help even further.

12.5.5 Little Bear River

As part of the responsibility to prepare a management plan for controlling NPS pollution, the Utah Department of Agriculture's Environmental Quality Section has identified some best management systems (BMS) for areas targeted for priority consideration. The Little Bear River is one of these, and the following management and treatment actions were formulated as part of that effort.

To achieve significant protection and enhancement of water quality within the Little Bear River Basin, a sustained, well-managed, watershed maintenance program utilizing the combined capabilities of several organizations and agencies will be required. Through a process of problem identification, effective planning, and efficient practice implementation, existing programs and funds will be focused in a coordinated effort to assist local land owners and local organizations implement needed treatment measures.

Water quality improvement and protection and land enhancement in the Little Bear River system can be achieved by implementing a multi-faceted watershed management program. The Little Bear River Watershed has been approved as a "hydrologic unit area" by the SCS. A steering committee has been organized under the direction of the Blacksmith Fork Soil Conservation District to provide leadership and direction for project planning and implementation. A technical advisory committee was also organized to research all possible data, assemble, organize, and assist in plan development.

Financial support is being provided by local government entities, private sources, and existing state and federal programs. Other support is provided in the form of in-kind services and/or materials. Local, private, and county support is provided primarily as in-kind services such as labor, equipment, and/or materials.

Based on a watershed evaluation made by the Soil Conservation Service, about 8,000 acres of rangeland (five to six percent of the total rangeland) are eroding excessively and yielding large amounts of sediment to the river system. These areas have been identified and will be treated, utilizing existing state and federal assistance programs in support of local land owner initiatives. Improving rangeland management, along with some brush management, reseeding, fencing, and livestock water development, will effectively reduce sediment impacts on water quality. Treatment will consist of a combination of best management practices which are expected to reduce erosion, but also benefit wildlife and forage production needs, archaeological and historical values, and aesthetics.

At an estimated average cost of $30 per acre, the total treatment cost for the 8,000 acres of critical rangeland is expected to be approximately $240,000. Existing and special Agricultural Stabilization and Conservation Service (ASCS) cost-share program funds, Agricultural Resources Development Loan program funds, hydrologic unit area funds, EPA 319 funds, and other water quality program funds will be targeted to this effort.

The South Fork of the Little Bear River, Davenport Creek, Spring Creek, and the lower Little Bear River are also impacted by nutrient loading. In addition, the lower Little Bear River receives an excessive amount of coliform bacteria. Sediment loading also occurs from overland flow erosion. Enhancement of the riparian zone and animal waste management would effectively reduce the nutrient impacts. Establishment of riparian vegetative filter strips would catch and utilize sediment and nutrients resulting from overland flow. Pasture management, irrigation water management, fencing, and filterstrip improvement would effectively reduce nutrient impacts on the Little Bear River system. Streambank protection, flood protection, and improved fishery values are additional benefits from these activities.

12.6 RECOMMENDATIONS

These recommendations relate to the preparation of a water quality management plan for the Bear River Basin, and the planning and implementation of a non-point source water quality project on the Little Bear River.

12.6.1 Water Quality Management Plan

The Utah Division of Water Quality should prepare a Water Quality Management Plan for the Bear River Basin. Currently, water quality assessments and management strategies are being prepared by the Division of Water Resources in cooperation with the Department of Environmental Quality. This effort will provide a framework for continuing the effort to formulate a water quality management plan. This plan will assure protection of water quality to support designated beneficial uses.

12.6.2 Little Bear River Non-point Source (NPS) Water Quality Project

The Soil Conservation Service, the Utah Department of Agriculture, the Division of Water Quality, and other appropriate agencies should accelerate preparation and implementation of a Water Quality Management Plan for controlling NPS pollution for the Little Bear River watershed.

12. REFERENCES

In addition to references listed below, Section 12 of the Utah State Water Plan, January 1990, discusses water quality activities in the state and five water pollution control issues.

1. "Wasatch Front Total Water Management Study - Bear River Basin", U.S. Bureau of Reclamation and Utah Division of Water Resources, Preliminary Field Draft, August 1987.

2. "Water Quality management Studies for Water Resources in the Bear River Basin," Utah Water Research Laboratory (for Utah Division of Water Resources), January 1986.

3. "Reconnaissance Report, Bear River Basin Investigation, Idaho-Utah-Wyoming," Corps of Engineers, Draft Stage, February 1989.

4. "Wastewater Disposal Regulations Part II Standards of Quality for Waters of the State," Utah Department of Health, Revised by Action of Utah Water Pollution Control Committee April 21, 1988.

5. Telephone interview with Craig Thomas, Bear Lake Regional Commission, on March 13, 1990.

6. "Bear Lake 1989 Water Quality Summary," Ecosystems Research Institute, for Bear Lake Regional Commission. March 1990.

7. "State of Utah 305(b) Biennial Water Quality Report," Roy D. Gunnell, Utah Department of Health, October 1988.

8. "State of Utah Clean Lake Inventory and Classification," Utah Department of Health, April 1982.

9. "Bear River Basin Water Quality," Utah Department of Health, September 1989.

10. "Bear River Water Quality: Bioavailable Phosphorus Measurement, Sources, and Control," Utah Water Research Lab, December 1989.

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Section 13
DISASTER AND EMERGENCY RESPONSE

This section mainly discusses flood and drought response. It also briefly considers other emergency situations.

13.1 INTRODUCTION

Many types of emergency situations are water-related, varying all the way from disastrous flooding to extreme drought. Most are natural occurrences, but a few (such as oil spills in waterways) are man-caused. When any emergency situation arises, a pre-arranged response plan, maintained by the Utah Division of Comprehensive Emergency Management (CEM), provides a quicker and more effective response. Generally, the response plan emphasizes prevention of an emergency and, therefore, prevention of damages. But when an emergency does occur, the immediate need is for optimum control, mitigation of damages, and then repair. The state maintains a hazard mitigation team to provide coordination with local governmental authority. This team represents state agencies in hazard mitigation matters. The following paragraphs attempt to define the organizational responsibilities for emergency response in the Bear River Basin, concentrating mainly floods and drought, the two most common water-related emergencies.

13.2 FLOOD PROBLEMS IN BASIN

Flooding has been a common occurrence in the basin for many years. Because the resulting damages have been moderate, flooding has not been a major local problem. In a 1989 study, the Corps of Engineers estimated average annual damages from flooding, and analyzed structural control measures (see Ref. No. 1). Most of the damage from floods has been to agricultural land and property. Damages from thunderstorms are usually in the form of erosion and sediment deposition. Dry cropland areas in the Bear River Basin are most susceptible to this type of damage. Flooding along the river plains inundates cropland and pasture, damages irrigation systems, and disrupts rural road systems.

No single entity has sole authority for flood control management activities. Cities and counties have the necessary statutory authority to act, but at least six other organizations or officials also have some degree of authority and responsibility. Emergency response and hazard mitigation coordination authority rests with Utah CEM. Hazard mitigation planning is usually provided by the state hazard mitigation team following flood emergencies. Pre-emergency planning is also often conducted. Utah CEM maintains county preparedness plans.

Spring snowmelt flooding in the Bear River Basin periodically exceeds stream channel capacity, and overflows onto adjacent low lands. More serious damage occurs when heavy rain falls on frozen ground and/or a heavy snow pack. Severe flooding of this type has been experienced several times in Cache Valley.

Thunderstorms are common during the summer and fall months. These produce localized cloudburst flooding. The total volume of water produced by this type of storm is relatively small, although the instantaneous runoff rate is high. Damages from thunderstorms are usually in the form of erosion and sediment transport and deposition. Dry cropland areas in Box Elder County and Cache Valley are most susceptible to this type of damage.

Most of the Bear River flood plain has a high water table; thus, construction of homes and other buildings within this zone has been limited. Frequent flooding of these lands has also discouraged development, so they will probably remain agricultural. Floodplains subject to infrequent flooding have minor development presently, and are most likely to be developed in the future.

Flooding in Logan - SL Tribune

13.2.1 Bear River

The greatest opportunity in the basin at present to control the largest amount of potential annual flooding is at Bear Lake. UP&L's regulation of flows at Bear Lake has reduced the impact of flooding virtually every year on the mainstem of the Bear River below Bear Lake. Bear Lake is operated to provide an annual pre-runoff storage volume equal to twice the average annual runoff.

The reconnaissance study by the Corps of Engineers estimated damages on the Bear River between Oneida Narrows and Cutler Reservoir from historical floods. They are shown in Table 13-1. Due to the upstream regulation at Bear Lake, the flows and damages were less than natural runoff would have produced.

The following are brief descriptions of flood problems in some of the major tributaries of the Bear River.

13.2.2 Woodruff Creek

Flood damage has been primarily to diversion structures and pasture lands. Irrigation structures, farm roads, and fences have also been damaged. A few homes in Woodruff have been flooded.

13.2.3 Cub River

Flood damages have been principally to agricultural lands and irrigation facilities. Crops have been destroyed by long periods of inundation. Settlement pond embankments have been eroded. The flood problem along the last four miles of the river is related to its decreasing slope and its confluence with the Bear River.

TABLE 13-1
HISTORICAL FLOOD DAMAGES
ONEIDA NARROWS TO CUTLER RESERVOIR[1]

Year of Flood	Peak Flow (cfs)[a]	Damages At Time of Flood	Damages October 1990 Cost Index[b]
1952	3,999	$ 164,000	$ 806,000
1962	4,300	100,000	340,000
1971	3,960	175,000	441,000
1983	4,660	1,773,000	2,030,000

Note: 1986 was also high, with much of the runoff coming from Cache Valley tributaries. At the Bear River near Collinston gage, the peak was 12,700 cfs (Feb. 19, 1986).

[a]Flow at Oneida Narrows Reservoir.
[b]Indexed from October 1988 by a Factor of 1.062.

13.2.4 High Creek

Flood damages have consisted primarily of reduced crop yields. Irrigation facilities and rural roads have been eroded and blocked with sediment in some places.

13.2.5 Logan River

Floodwater has damaged campsites in Logan Canyon and homes within Logan City. Basements have been flooded and yards have been eroded. Downstream of the city, drainage and irrigation facilities have been damaged. County and farm roads have been overtopped. Railroad tracks have also been threatened.

13.2.6 Blacksmith Fork

Floodwater has affected the farming communities of Nibley and Millville. Several home basements have been flooded. County roads have been flooded and eroded, isolating some homes. Much of the agricultural damage resulted from extended inundation of farmlands, killing established crops. In some years, flooding has prevented the planting of some crops. Fences and irrigation facilities have been damaged.

13.2.7 Little Bear River

Flood problems have been mainly a reduction in crop yields. Due to prolonged inundation of some fields, plants have been destroyed, requiring that fields be reseeded. Roads have been eroded and culverts plugged. Erosion has occurred on croplands upstream of Hyrum Reservoir. Serious damage has occurred in the past to a private fish hatchery near Paradise.

13.2.8 Malad River

Flood damages along the Malad River have been mainly to meadow, pasture, rural roads, and major county and state highway crossings. The Tremonton-Garland sewage treatment plant has been affected by floods.

13.2.9 Great Salt Lake (Bear River Bay)

The most notable flooding problem in recent years has been the high level of the Great Salt Lake, which damaged shoreline facilities around the entire lake. During the 1986 runoff season, the lake reached an elevation of almost 4212 feet, the highest in 140 years of recorded history. This shoreline flooding essentially inundated the Bear River Migratory Bird Refuge, and caused millions of dollars in damage to other private and public facilities in Box Elder County. Monetary damage at the refuge is estimated to be about $4 million,[6] about $3 million at nine private duck clubs in Bear River Bay and the Harold Crane Waterfowl Management Area[6], and about $50,000[5] for repair of wastewater treatment plants and other facilities.

13.3 FLOOD DAMAGE REDUCTION

In the Bear River Basin, the following structural and non-structural alternatives would help reduce losses from flooding.

13.3.1 Forecasting

In general, reservoirs in the basin, including Bear Lake, are operated on a forecast basis to maximize summer storage. A secondary objective is to minimize spilling. Although forecasting information is available and used in managing the reservoirs, perhaps some operational changes could further reduce downstream flooding.

13.3.2 Control Structures

Some opportunities exist to provide additional reservoirs or other control structures such as dikes or detention basins to reduce peak flows. Potential storage reservoirs could include flood control as a project function to reduce local flood damage along the Bear River and its tributaries. The Corps of Engineers has made flood evaluation studies of the potential Mill Creek, Avon, Honeyville, and Oneida Narrows reservoir sites. Estimated annual potential flood reduction benefits for these reservoirs are $31,000, $122,000, $224,000 and $318,000 respectively, in 1988 dollars.

13.3.3 Stream Channel Capacity

Limited opportunity is available to restore stream channel capacity and thus reduce flooding. In a 1984 flood control study, the Corps of Engineers found that several improvements on a short stretch of the Logan River through Logan City were the only flood control measures that appeared to be eligible for assistance by the Corps at that time.

13.3.4 Upper Watershed Improvement

Rangeland and forestland conditions could be improved, thus reducing surface runoff, increasing infiltration, and retarding peak flows. The Soil Conservation Service has investigated a small watershed protection project under P.L. 566 for the Clarkston Creek watershed, but the project has not been funded. Measures for watershed improvement and flood protection in the Little Bear River drainage are proceeding under joint funding by USDA Hydrologic Unit Area and the non-point source pollution program.

13.3.5 Flood Plain Protection and Flood Insurance

Proper planning and regulation of future building construction would help prevent encroachment of inappropriate and expensive developments on the flood plains. Such action would not preclude other valuable uses of the floodplain, such as parks and golf courses.

As a protection against monetary losses when flood damage does occur, the National Flood Insurance Program is effective in areas where it is available. The Federal Emergency Management Agency (FEMA) has identified special flood hazard areas with flood insurance rate maps for 23 communities and two counties in the basin. Zoning and flood hazard reduction regulations have been adopted by 20 of these communities to direct future construction to minimize flood damage. A key benefit from local adoption of the floodplain standards has been the availability of flood insurance.

13.4 FLOOD CONTROL RECOMMENDATIONS

The following recommendations deal with reducing the damages from floods in the Bear River Basin through studies, projects, management, and regulations.

13.4.1 Flood Studies

In any future studies of water supply development in the Bear River Basin, it is recommended that consideration be given to flood control as a project purpose. The Corps of Engineers' three-state reconnaissance study of the Bear River Basin[1] covers most phases of potential project development.

13.4.2 Small Watershed Projects

Prevention is usually more cost-effective than damage repair and mitigation. Flooding can be significantly reduced by maintaining and protecting watershed vegetation and/or by building watershed flood storage. The Soil Conservation Commission, in conjunction with the Soil Conservation Service and the local soil conservation districts, should continue their practice of re-evaluating the potential for small watershed projects in the Bear River Basin.

13.4.3 Management

A cooperative study should be undertaken by the Division of Water Resources, Bureau of Reclamation, and appropriate local water users, to determine the potential for further regulation of flood flows in Hyrum, Newton, and Porcupine reservoirs. This recommendation is made while recognizing that the combined existing storage capacity of these three reservoirs is only 37,000 acre-feet, and the potential improvement in regulation is quite limited.

13.4.4 Flood Plain Zoning and Insurance

County and city governments should work through the state Community Assistance Program of the National Flood Insurance Program to evaluate flood hazard maps of identified flood plains, and enact appropriate zoning regulations to prevent further encroachment and thereby reduce the potential for flood damages. Most communities already have current maps and ordinances. In additional areas where national flood insurance can be made available by the adoption of the associated flood plain standards, these local governments should attempt to do so. Also, public education and promotion of flood awareness would be beneficial.

13.5 DROUGHT RESPONSE

In contrast to flooding, which tends to be more local in extent, drought is most often basinwide or statewide. Therefore, it has been dealt with in the past on a statewide basis. A drought response plan[2] has been prepared and is now in place to provide an effective means for the state of Utah to assess and respond to drought impacts. The plan came into being as a result of experience gained during the severe drought of 1976-1977. A drought in Bear River Basin would be dealt with as described below:

13.5.1 State Policy

The immediate and primary responsibility for drought relief rests with local authorities of city and county governments. State action is taken only when local capabilities cannot cope with existing or growing needs.

In the Bear River Basin, the most effective drought relief measures are probably the various actions taken by management organizations on a unilateral basis. Without such actions, water shortages would be much more severe. For example, UP&L's operation helps to alleviate drought by holdover storage in Bear Lake.

13.5.2 Drought Response Organization[2]

Although assisted by other groups, a Drought Response Committee (DRC) would represent the state in taking action and/or coordinating it. The DRC members are senior-level managers of the following state agencies or departments: Natural Resources, Environmental Quality, Agriculture, Community and Economic Development, and Office of Planning & Budget. The DRC is activated by a governor's proclamation. The governor also appoints the State Drought Coordinator, who serves as chairman of the DRC.

13.5.3 Drought Response Organization's Responsibilities

The primary responsibility for actions to conserve water and alleviate shortages would rest with the county and city governments of Box Elder, Cache, and Rich counties. When they determine that local capabilities can no longer cope with emerging needs and problems, the counties could request help from the state. Their request would be received through the State Drought Coordinator or the Governor. The DRC, in consultation with local authorities, would identify specific needs and coordinate available state resources to help. The Drought Review and Reporting Committee, activated earlier by the State Drought Coordinator, would have been aware of conditions in the Bear River Basin, and would have recommended activation of the DRC.

Task Forces for the responsibilities listed below would assist the DRC, as directed, by furnishing information and data on which to make decisions.

Municipal water and sewer systems
Agriculture
Commerce and tourism
Wildfire protection
Wildlife
Economic impacts

The Water Supply Availability Committee, constantly in existence, would have monitored the snowpack, precipitation, and streamflow in the previous months to be able to inform the State Drought Coordinator of the severity of the drought.

Through this response system, state resources would be made available to the local government authorities in the basin to assist them in coping with problems of the drought.

13.6 DROUGHT RESPONSE RECOMMENDATIONS

To prepare in advance for the difficult problems that must be solved in coping with a severe drought, each county and community should formulate its own drought response plan. To be effective, the plan must be workable, fair to all, and agreed on in advance. Eventually, most communities will face a severe drought situation. Advance preparation can reduce or minimize the turmoil and controversy which will otherwise occur.

13.7 OTHER EMERGENCY SITUATIONS

In addition to floods and droughts, other damaging situations may occur. Although much less common, they can occur quickly at any time, with little or no advance warning. Some examples that could be water-related include earthquakes, windstorms, snow- or earth-slides, dam failures or malfunction of spillway gates, contamination of drinking water sources by oil or chemical spills, and interruption of water supplies by various causes.

Potential problems are too many to consider each one separately, but the general approach is similar. The local authorities have the first responsibility, and as outside help is needed, state and federal resources are available. For most of these unusual occurrences, the state's Division of Comprehensive Emergency Management is prepared to step in and give whatever assistance is needed, and would contact appropriate federal agencies as needed. The Division of Water Quality has responsibility where hazardous spills occur.

13.8 REFERENCES

In addition to the references listed below, attention is directed to Section 13 of the Utah State Water Plan, January 1990, which discusses the potential for damage to water resources and related facilities, and addresses eight policy issues regarding floodwater control and management, and disaster and drought response.

1. "Reconnaissance Report, Bear River Basin Investigation, Idaho-Utah-Wyoming," U.S. Corps of Engineers, Feb. 1989. Revised December 1989.

2. "Drought Response Plan," Utah Division of Water Resources and Drought Response Committee, March 1990.

3. "Floods," Bear River Basin Cooperative Study, U.S. Department of Agriculture, April 1977.

4. "Wasatch Front and Central Utah Flood Control Study, Utah, Volume 2, 1984 Update and Potential Multiple Purpose Projects, Lower Bear River Basin," U.S. Corps of Engineers, September 1984.

5. "Reconnaissance Report, Great Salt Lake," U.S. Corps of Engineers, December 1986.

6. Informal Damage Estimate by U.S. Fish and Wildlife Service and Utah Division of Wildlife Resources, Telephone Conversation in October 1990.

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Section 14
FISHERIES AND WATER-RELATED WILDLIFE

This section describes the basin's fish and wildlife resources, discusses existing and potential needs, and presents recommendations.

14.1 INTRODUCTION

The basin has many important wildlife resources. The Bear River Migratory Bird Refuge has national significance, and the state operates several waterfowl and wildlife management areas. Large herds of deer and elk are present, as well as moose and antelope. The basin contains a substantial portion of Utah's Class I trout fisheries[1], significant reaches of Class II streams, and a unique fishery in Bear Lake. Many raptors, shorebirds, wading birds, song birds, small mammals, and other nongame wildlife species are present and enjoyed by people in the basin.

14.2 SETTING

The Bear River Basin provides unusually good habitat for a wide variety of wildlife and fish because of its large areas of forest, high mountain valleys, deep canyons, and clear mountain streams lakes and a large river delta. As an indication of the extent of fish and wildlife habitat, more than half of the total basin is covered with mountain-type vegetation (See Table 3-1).

Blacksmith Fork - Div. of Wildlife Resources

14.2.1 Varieties of Fish and Wildlife

Principal game fish found in the mountain streams, lakes, and reservoirs are several species of trout, mountain whitefish, kokanee salmon, channel catfish, black crappie, bass, yellow perch, and walleye. Other fish species present include bullhead, carp, Utah chub, Utah sucker, mountain sucker, and numerous dace and minnows. Four unique species native to Bear Lake are the Bonneville Cisco, the Bonneville Whitefish, the Bear Lake Whitefish, and the Bear Lake Sculpin.

Terrestrial habitat provides for big game such as deer, elk, moose, and pronghorn antelope; upland game such as pheasants, chukars, Hungarian partridge, sage grouse, forest grouse, doves, and rabbits; fur bearers such as beaver and muskrat; and many species of nongame wildlife, including several endangered species. Non-game wildlife includes raptors, shore birds, wading birds, song birds, and many small mammal species. More than 100,000 acres of marshland area and another 100,000 acres of open water provide habitat for nesting, staging, and wintering. The area is of hemispheric importance for waterbirds, and provides year-long habitat for numerous other birds and animals. The habitat includes public and private land. A more detailed inventory of species will be completed when site-specific studies are finished.

14.2.2 Agency Management

Primary responsibility for the protection and management of fish and wildlife populations in the Utah portion of the basin rests with two agencies: the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service (USFWS). The former has general responsibility throughout the entire basin and manages several special areas described in following paragraphs. These special areas cover approximately 40,000 acres. The second agency manages a major national waterfowl refuge, described and discussed later, and administers the requirements of federal acts relating to fish and wildlife, such as the Endangered Species Act of 1973.

Much of the basin's fish and wildlife are within national forest and public domain land, managed by the U.S. Forest Service and the U.S. Bureau of Land Management. The Forest Service area is 461,000 acres, and the BLM area is 187,000 acres, or about 30 percent of the entire basin (See Figure 7-1). The Utah Division of State Lands and Forestry also manages approximately 80,000 acres of scattered land tracts in the basin, some of which support fish and wildlife populations.

14.2.3 Special Management Areas

Several important refuges and other facilities for wildlife are located in the study area. The larger areas are described below. The existence of Bear Lake National Wildlife Refuge north of Bear Lake in Idaho is recognized. It is not discussed here, however, because this report is primarily concerned with Utah.

Bear River Migratory Bird Refuge - The Bear River Migratory Bird Refuge was developed in 1928 by the U.S. Fish and Wildlife Service (USFWS) to improve the existing natural habitat, and to alleviate periodic outbreaks of botulism which had killed thousands of waterfowl. The disease was associated with low flows of the Bear River. A system of dikes and ponds was built in the river delta area to encourage the spreading of fresh water and retention of open water surfaces, especially during low flow periods. Maintaining of adequate flow to these ponds is important to their effectiveness. Many thousands of birds use the refuge daily. The refuge area is regularly visited by 268 species of birds, 68 of which are known to nest there.[1] The refuge is considered to be of continental importance for waterfowl and non-game migrating species. It is the earliest designated waterfowl refuge in the United

West of Brigham City - Div. of Wildlife Resources

States, and is one of the largest. The USFWS has continued to operate and improve the refuge since its development.

The present refuge area covers about 65,000 acres, including 27,000 acres within five diked areas (units), 7,600 acres below the diked areas, and 30,400 acres above the five units. Most of this 30,400-acre area is in the northwest corner of the refuge (See Figure 14-1). Regulation of freshwater inflows to the ponds, and releases from them, were accomplished by a system of canals and control structures. A refuge headquarters, with about 10 buildings and a landing strip, was built near the extreme terminus of Bear River's old natural channel. A 14-mile road from Brigham City provided access to the refuge headquarters. The refuge headquarter facilities and much of the access road were destroyed by record-high levels of Great Salt Lake in the 1980s (See Section 14.3.2).

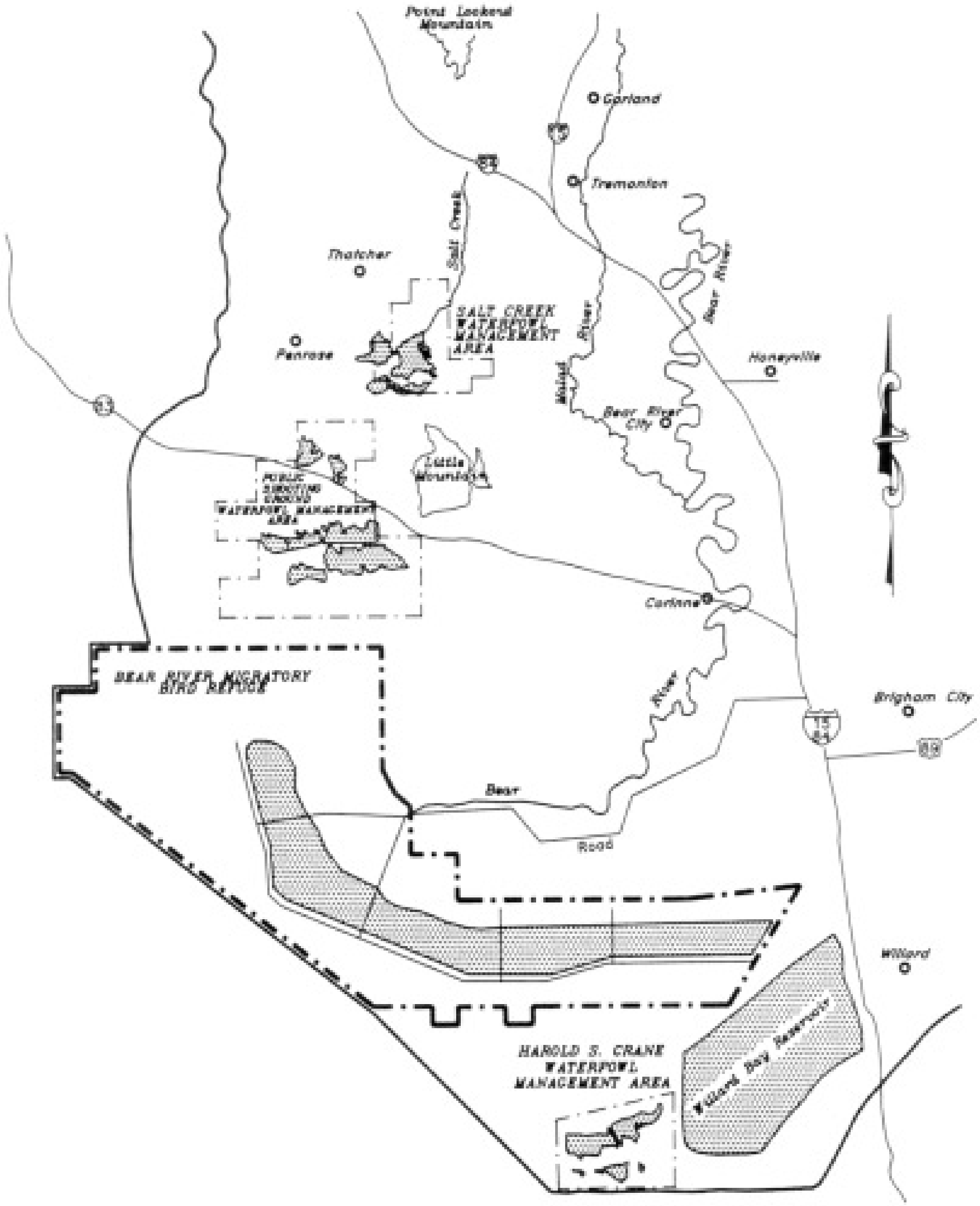
State-Managed Waterfowl Areas - The Utah Division of Wildlife Resources operates three waterfowl management areas in Box Elder County: Salt Creek, Public Shooting Grounds, and Harold S. Crane. These three, with a combined area of nearly 27,000 acres, along with about 50,000 acres of privately-owned marshland surrounding the federal refuge (including West Bear River and Willard Spur Bays), are extremely important for migratory birds. The value of these marshlands is inter-related with the refuge.

As shown on Figure 14-1, the Public Shooting Grounds Waterfowl Management Area is adjacent to the Bear River Migratory Bird Refuge on the north. The management area comprises about 13,000 acres[8], and includes nine lakes which are fed by several small streams and springs. Three of the four largest lakes are controlled by dikes. Outflows discharge into the federal bird refuge. An average of 6,500 ducks and geese are harvested by hunters here annually.

The Salt Creek Waterfowl Management Area, immediately northeast of the Public

FIGURE 14-1

MANAGED WATERFOWL AREAS EASTERN BOX ELDER COUNTY



Shooting Grounds, covers about 5,000 acres.[8] Several lakes or ponds within this area are fed by Salt Creek, springs, and return flow from irrigated land. The estimated annual hunter harvest is 8,000 ducks and geese.

The Harold S. Crane Waterfowl Management Area of about 8,600 acres[8] is situated southwest of Willard Bay Reservoir. The water supply for this area consists of releases from Willard Bay Reservoir, Weber River Basin springs, and return flows.

Private Waterfowl Areas - A combined area of 19,500 acres southwest of Corinne is managed by nine private duck clubs to provide habitat and hunting for their members. The specific clubs and areas are listed in Table 6-7.

Hardware Ranch Wildlife Management Area - In Cache County, the Utah Division of Wildlife Resources operates the Hardware Ranch Wildlife Management Area. This area of 19,000 acres,[1] located in Blacksmith Fork Canyon, provides winter feeding to more than 400 elk between December and March each year. Summer feeding range is adequate for elk and other big game in the basin, but winter range is not. The feeding program allows a continued existence for this herd, which otherwise might migrate toward valley agricultural lands. This area is also operated for the management of deer and other big game, and to provide public fishing access on the Blacksmith Fork and several tributaries.

14.2.4 Other Wildlife Habitat

Other significant water-related habitat includes the river itself, tributaries, reservoirs, lakes, marshland, wet meadows, other irrigated land, and big game winter habitat. Each of these habitat types occupies large areas of the basin, or many river miles, and supports great numbers and varieties of birds, mammals, fish, amphibians, mollusks, and other aquatic species. Although much of the total habitat is public land, half or more is probably privately-owned (See Figure 7-1).

In Cache County, the primary waterfowl habitat is on Cutler Reservoir and the adjacent marsh area. About 2,010 acres of bulrush and cattail and 2,220 acres of upland marsh plants are associated with the open water on this reservoir. Waterfowl hunter use in Cache County averages 13,300 hunter days, with a harvest of about 22,000 birds annually. The major part of this hunting activity occurs on Cutler Reservoir and surrounding waterfowl areas. Other hunting occurs on the various rivers and streams in the area. Several important rookeries exist within this area, including snowy and cattle egrets, great blue and black-crowned night herons, and white faced ibis. Local and regional recreationists spend numerous hours observing birds and other wildlife in this area.

The waterfowl habitat in Rich County supports breeding of 75 to 100 nesting pairs of Canada geese and several hundred ducks. This is also a staging area for Greater Sandhill Cranes during spring and fall migrations. Counts show nearly 1,000 cranes use the marshes along Bear River each fall. About 50 pairs of these cranes remain to nest in the area. Another important waterfowl area is Neponset Reservoir, with 1,043 acres. It is used by 20 to 30 pairs of nesting Canada geese. Hundreds of geese come to the area to molt each year. Several hundred ducks are also produced on the area. Round Valley, south of Bear Lake, contains 2,000 acres of waterfowl habitat which produces and supports good numbers of waterfowl and a few cranes. The area also provides hunting.[1]

The deer is the most numerous big game animal. Summer range is ample for these animals. Winter range, which is the key to overall carrying capacity, is in short supply. Four deer herd management units are within the basin. Winter range areas on these units is shown in Table 14-1, according to area available in normal winters and in critical winters, which is a constricted portion of the normal winter range. A portion of Blacks Fork Unit in Summit County within the basin has no deer winter range, because deer migrate south and east to winter. A small area in eastern Box Elder County lies within the basin, but it contains no significant winter range. An important winter range for moose is located on the upper Bear River within Utah and Wyoming. The area used by moose extends about three miles on either side of the Utah-Wyoming state line, mainly along the drainages. Moose move into the extensive willow-bottoms found along the streams to winter, and snow depth does not seem to seriously hamper their movement. They prefer a species of willow, identified as Drummond's willow, which is prevalent along the water courses in this area. The number of moose is growing, and they are increasingly seen in Cache and Rich County.[1] Antelope are often seen in the open sagebrush areas of the upper basin above Bear Lake.

TABLE 14-1
DEER WINTER RANGE IN BEAR RIVER BASIN[1]

Deer Herd Unit	Normal Winter Range	Critical Winter Range
	(acres)	
Unit 2 - Cache	186,957	50,200
Unit 3 - Mantua, Willard	25,366	8,928
Unit 4 - Wellsville	23,906	9,141
Unit 5 - Woodruff	143,466	24,460

14.2.5 Fisheries

Cold Water Fisheries - In the Utah portion of the Bear River Basin, an estimated 455 miles of stream length are classified as cold-water fisheries. Cold-water lakes, with about 50,000 surface acres (including Bear Lake), provide quality fishing opportunities. Some of the state's finest cold-water stream fisheries occur in lower Bear River Basin tributaries. In Cache County, 7.0 miles of the Logan River and 15.2 miles of the Blacksmith Fork River are Class I trout fisheries, which together represent 29.8 percent of the total miles of Class I stream fisheries in the state. Another 44.0 miles of Class II streams in Cache County are on the Logan River, Blacksmith Fork, Left Hand Fork of Blacks Fork, Little Bear River, and East Fork of Little Bear River. Class III stream fisheries are found throughout the basin in Box Elder (67.8 miles), Cache (193.2 miles) and Rich (134.3 miles) counties. Also, all of these stream complexes contain a complement of natural cold-water nongame fish species and amphibians that provide genetic and species diversity.

Warm Water Fisheries - The Bear River Basin in Utah has 160 stream-miles of warm-water fishery, and 7,460 surface acres. By the time the Bear River re-enters Utah in the north end of Cache County, water quality has been degraded to the point that a cold-water fishery is not supported, and a limited-value Class IV fishery for warm-water species exists. Although water releases from Cutler Dam fluctuate considerably, the Bear River downstream from Cutler Dam improves to a Class III fishery, supporting populations of channel catfish, black bullhead, largemouth bass, and occasional cold-water game species.

Flat Water Fisheries - Flatwater fisheries in the lower basin include warm-water fisheries in Cutler Reservoir, Hyrum Reservoir, Newton Reservoir, Mantua Reservoir, and cold-water fisheries in Porcupine Reservoir, Wellsville reservoir, and Bear Lake. Several small, high mountain lakes in the Wasatch National Forest also provide cold-water fisheries. Water quality in Hyrum, Newton, and Wellsville reservoirs is poor and declining, diminishing the reservoir's capacity to produce trout. Water quality in Bear Lake is good.

14.2.6 Instream Flows

In the larger Bear River Basin streams, some flow is maintained throughout the year. 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, with the exception of small reaches of Blacksmith Fork seasonally dewatered by hydroelectric developments. 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.

Recorded minimum flows are listed in Section 5 (See Table 5-2). Records are shown for mainstem and tributary streams, and high and low years. The data are intended to be representative of historical low flows within the study area. Long-term streamflow records show that annual minimums are normally in the winter, but in drought years like 1977 they have occurred in the late summer or early fall. Some of those which went to zero or near zero flows may have been natural, but most probably resulted from upstream storage regulation.

14.3 PROBLEMS AND NEEDS

Fish and wildlife professionals perceive the main problems and/or needs in the basin at present are: (1) deteriorated water quality in fishery streams, lakes, and reservoirs (especially Hyrum, Newton, and Mantua reservoirs); (2) restoration of waterfowl habitat damaged by high levels of Great Salt Lake; (3) protection of wetlands and other important habitat; (4) protection and improvement of riparian habitat and streambank stability; (5) maintenance and improvement of instream fishery flows and public access; and (6) cooperative planning and management of existing and future water development for the benefit and protection of fish and wildlife.

14.3.1 Water Quality

Where deteriorating quality occurs, it impairs the existing fishery and affects many bird species. Water quality problems of special concern are in Hyrum, Newton, Cutler, and Mantua reservoirs, and the Bear River and Little Bear River in Cache Valley. Although Bear Lake quality has been improved, and is currently good, continued monitoring and control are needed because of the intense and growing recreational use of the lake. Cutler Reservoir and the Bear River immediately above it could support many more bird species if there were aquatic insects and plants for them to eat. Sediment, nutrient runoff, and pesticides have combined to lower the water quality. If improved, the area could support many more fish-eating birds, ducks, and mammals. In Section 12, water quality problems throughout the basin are discussed in detail.

14.3.2 Bear River Migratory Bird Refuge

Between 1985 and 1988, water damage to refuge facilities was extensive. The Great Salt Lake rose to the highest level ever recorded (4211.85 feet) in 1986 and 1987, completely inundating the refuge area and covering the dikes with four feet of water. Before the lake dropped to normal levels again in 1989, wave action and ice had destroyed or severely damaged the headquarters buildings, dikes, canals, control structures, roadway, and much of the marsh-type vegetation so important to migratory birds. Section 14.4.2 describes current rehabilitation activities.

In addition to the recent damage, the refuge's effectiveness has always been somewhat impaired by a chronic annual shortage of river flow in the late summer and fall. A water supply to alleviate this deficit would represent a substantial improvement.

14.3.3 Other Important Habitat

Large areas of privately-owned wet meadows in the valleys of all three counties provide important habitat for ibis, snowy egret, sandhill crane, shorebirds, ducks, raptors, and many other species of birds and animals. The loss of any of this habitat would be significant to the above wildlife. Another valuable wildlife resource that would be a significant loss are the warm artesian springs which provide open water habitat during cold winters. These springs could be detrimentally affected by a lowered water table.

Although summer habitat is ample for deer and elk, areas of food supply and protection during winter is a critical limitation. The original, natural winter habitat, the basin's valley areas, is now occupied by cities and towns. As communities grow and expand into bordering foothill areas, the already limited winter habitat for big game is reduced even further. This fact is understandably of great concern to wildlife managers in the Bear River Basin, because the projected population growth indicates that this existing problem may become even more severe.

Hardware Ranch - Div. of Wildlife Resources

14.3.4 Instream Flows and Fishing Access

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, which improves streambank 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.

Water resource development actions in the basin have altered the natural yearly flow patterns of streams. The effect of the changes is a combination of good and bad. Storage and diversion of streamflows for a water supply reduce the natural flow during part of the year, and in several cases, such as Woodruff Creek and the lower end of Blacksmith Fork, the stream is sometimes dewatered. But releases from storage also augment the natural flows during other times of the year, most often July - September which is normally a low-flow period in the basin because of naturally declining streamflows. Low flows, dewatering, and some changes in seasonal pattern cause difficulties in maintaining a fishery. Not all peak flows are bad for wildlife. Some flooding stimulates and extends riparian systems.

Public access to streams is limited or precluded in some reaches as a result of private ownership. With increased future demand for public fishing opportunities (See Section 15), the available reaches will become more crowded, and the pressures for more public access will increase.

14.3.5 Riparian Vegetation

Riparian vegetation is critical for virtually all wildlife in the basin, as well as amphibians, mollusks, and many other aquatic species. For most of the latter group, there is very little knowledge available. Stream bank stability and resistance to channel scouring are enhanced by healthy riparian communities. Overall responsibility for maintenance, improvement, and restoration does not seem to rest with any one agency or local government. Corrective action is needed where stream banks are deteriorating, but funding for this purpose is often limited.

14.3.6 Future Development

With future population growth, recreational interest in the Bear River is expected to increase. This interest will create more demand for fishing and hunting and watchable wildlife opportunities, and at the same time will put additional pressure on the finite fish and wildlife resources present.

Projected growth in the basin and related nearby metropolitan areas (the Wasatch Front) will require additional development of water supplies. The 1991 Legislature directed that plans for such development proceed. Thus, it is expected that new reservoirs and other water supply structures will be built. In so doing, there is an accompanying need to minimize any harmful effects on fish and wildlife. Senate Bill 98, passed in general session by the 1991 Legislature, provided (among other things) that Bear River development project costs allocated to fish and wildlife are not reimbursable, and shall be paid entirely by the state (See Section 9).

14.3.7 Bear River Bay

The Bear River arm of Great Salt Lake is a nationally important wetland[2] area. Freshwater inflows to the saline lake create a unique environment that is critical to many species of shorebirds, waterfowl, and other migratory wildlife. The wetland ecosystem is maintained by high flows of freshwater in springtime. Any upstream water development plans should evaluate impacts on the inflow/timing regime to the Bear River Bay.

14.4 ALTERNATIVE SOLUTIONS OR ACTIONS

Some of the alternatives suggested for meeting future water needs in northern Utah may conflict with fish and wildlife needs. For instance, the development of a reservoir site may impact portions of highly valued stream fisheries and associated riparian systems. However, some of the needs for fish and wildlife can be met in concert with efforts to stabilize watersheds, improve water quality, and reduce peak flows in some streams. It continues to be important that wildlife planners and water resource planners work cooperatively on projects.

14.4.1 Water Quality

Several different efforts and programs discussed in Section 12 are aimed at improving water quality in the basin. Included are the

Bear Lake Regional Commission's coordination of activities for the improvement of Bear Lake, the program by Utah Department of Environmental Quality and Utah Department of Agriculture to reduce non-point source pollution of the Little Bear River, the public information and education programs maintained by several agencies and organizations to reduce animal waste pollution in the Bear River, watershed improvement plans by the Soil Conservation Service, and the water quality management plan by the Utah Department of Environmental Quality.

14.4.2 Bear River Migratory Bird Refuge

As part of a major rehabilitation program for the damaged bird refuge, the USFWS prepared an environmental assessment[3] which considered four alternatives. The preferred alternative proposed in the assessment is a 38,200-acre expansion of the refuge, combined with restoration and enhancement of the existing refuge. The other alternatives are (1) restoration and enhancement of the existing refuge area, (2) restoration only, and (3) no action. With preliminary internal approval, the USFWS is proceeding with studies to implement the preferred alternative.

Increases in late-season flows to the bird refuge could be provided by building upstream storage reservoirs. Previous studies and interagency discussions extending back to 1953 have resulted in various estimates of water requirements. The most recent are presented by the USFWS in its environmental assessment for the refuge. The amount of water needed varies according to the degree of restoration and enlargement and the future management plan. The assessment indicates the following water requirements for March-November, as compared with median flows in the Bear River near Corinne for 1932-83: (1) preferred alternative (expansion) would require 653,700 acre-feet, including 280,600 acre-feet from presently undeveloped storage; (2) enhancement alternative would require 567,200 acre-feet, including 238,100 acre-feet from new storage; and (3) restoration alternative would require 296,800 acre-feet, including 3,400 acre-feet from storage. Substantial portions of the requirement for the first two alternatives is for flushing the refuge ponds three times a year, in March, August, and November.

Comparisons between these requirements and historical river flows are shown graphically on Figure 14-2. Figure 14-2 shows, for example, that the preferred expansion alternative would require 214,490 acre-feet in August alone. This is a large quantity, about twice the storage content of the proposed Honeyville Reservoir. The effect of these refuge quantities on future M&I and other water requirements has not been determined, but apparently it is substantial.

14.4.3 Instream Flows and Fishing Access

Selected minimum flow requirements that may provide optimum fishery conditions are listed in Table 14-2. These were developed in 1977 by the Division of Wildlife Resources for the Division of Water Resources.[5]

Public access across private land involves several potential difficulties, such as crop damage, littering, interference with livestock, and gates left open. Various innovative solutions to these difficulties have been tried, with various degrees of success. The strongest influence for success is an honest desire among all parties concerned to reach a solution.

14.4.4 Riparian Vegetation

In the interest of public good, there is a need for willing acceptance of responsibility by all concerned, without need for legal compulsion. If each agency, county, city, town, or private landowner directly or indirectly responsible for any portion of any stream would voluntarily restore and improve streambank vegetation whenever an opportunity occurs, the overall result could be significant.

FIGURE 14-2

WATER REQUIREMENTS vs. SUPPLY
BEAR RIVER MIGRATORY BIRD REFUGE

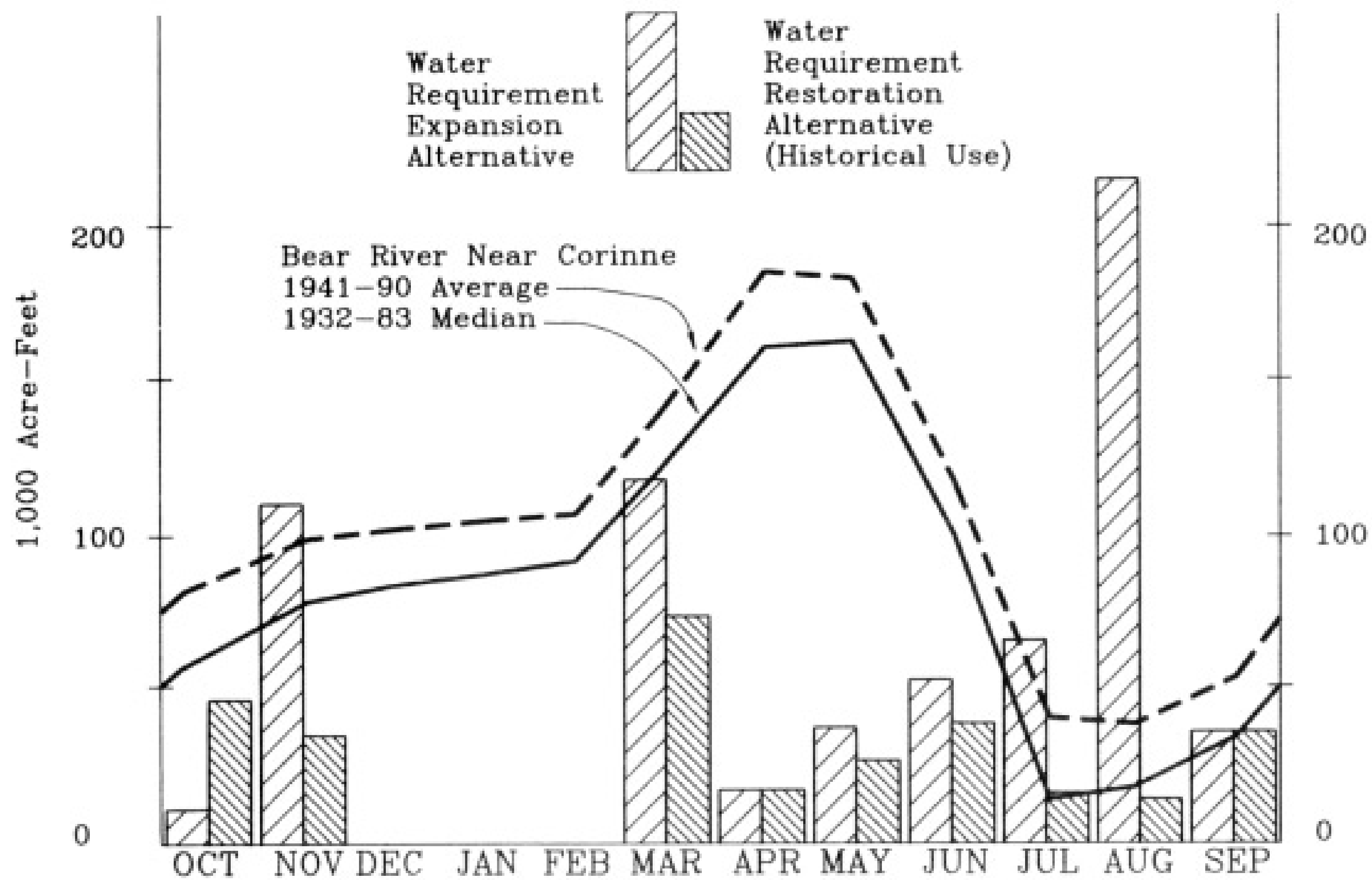


TABLE 14-2
MINIMUM FLOW REQUIREMENTS FOR SELECTED STREAMS, BEAR RIVER BASIN

Stream Location	Flow (cfs)
Bear River in Rich County	130
Logan River	75
Blacksmith Fork River	50
Little Bear River	30
Malad River at mouth	10

14.4.5 Future Development

Experience has shown that issues associated with fish and wildlife values versus water supply development can easily become polarized to a condition of bitter public controversy and lack of progress for either side. To avoid this, experience has also shown that full and early communication, with a desire to cooperate, can lead to a mutually beneficial consensus.

14.5 RECOMMENDATIONS

In consideration of the foregoing problems and needs, the following recommendations are offered.

14.5.1 Water Quality Improvement for Fisheries

The Division of Wildlife Resources should continue to work with the Division of Water Quality and others to identify water quality problems in reservoirs and streams which may be limiting to fisheries. Reservoir owners/operators should consider water quality for fisheries and other uses as an integral part of the reservoir operation. Structural solutions may include multilevel reservoir outlet structures to allow water temperature and quality to be adjusted, both in the reservoir and for downstream fishery releases.

14.5.2 Bear River Migratory Bird Refuge

The Fish and Wildlife Service should rehabilitate the refuge, so that it can again serve its purpose. State agencies should cooperate in this effort. The effect of an increased water supply to the refuge should be evaluated by the Division of Water Resources to determine the impacts this large increase in demand would have on other local water needs. The existing water right filing should be clarified by the Division of Water Rights in relation to other water rights.

14.5.3 Instream Flows And Fishing Access

Planning for water projects should incorporate instream flow considerations as part of project operational criteria. New projects should also make provision for adequate public access to fishing streams and other water-based attractions. Existing public access for both fishing and recreation should be maintained and improved as opportunities occur in future years.

14.5.4 Riparian Vegetation Protection

The Department of Natural Resources, other state agencies, and public and private land managers should continue to give special consideration to the protection and management of shoreline vegetation and stream banks in the Bear River Basin. This recommendation is particularly appropriate in areas owned and managed by state entities and along streams classified as Class I and II fisheries; and (where appropriate) for neotropical migrants, colonial nesting, and endangered species.

14.5.5 Future Development

In planning any new water developments in the basin, the Utah Division of Water Resources or any other planning entity should give consideration to multipurpose use. To adequately provide for these needs, consultation and input from fish and wildlife professionals should continue. Project features for fish and wildlife purposes should be completed concurrently with construction.

14.7 REFERENCES

In addition to the references listed below, attention is directed to Section 14 of the Utah State Water Plan, January 1990, where the values of fish and wildlife to the people of Utah and six related issues are discussed.

1. "Environmental Conditions Inventory," working paper for Bear River Basin Cooperative Study, Appendix I-IV, Utah Division of Water Resources, March 1977.

2. Letter from Assistant Field Supervisor, U.S. Fish and Wildlife Service, Salt Lake City, June 4, 1990.

3. "Restoration and Expansion of Bear River Migratory Bird Refuge," Environmental Assessment, U.S. Fish and Wildlife Service, October 1991.

4. "Bear River Investigations", Status Report, U.S. Bureau of Reclamation, June 1970.

5. "Environmental Enhancement Opportunities," U.S. Dept. of Agriculture, in cooperation with Idaho, Utah, & Wyoming, March 1977.

6. Letter from acting Director, Utah Division of Wildlife Resources, February 16, 1989.

7. Letter from Director, Utah Division of Wildlife Resources, June 7, 1990.

8. Utah Division of Wildlife Resources (8-20-91 telephone conversation with Tom Aldrich, Waterfowl Program Coordinator).

9. "Water-Related Land Use Inventories," Bear River Basin," Utah Division of Water Resources, January 1991.

Notes to Pages 14-1 and 14-9

1. Stream classes for fishery use are not equivalent to the stream classes defined in Section 12.
2. In this section, this term is used in the general sense to describe waterfowl habitat, rather than formally designed jurisdictional wetland.

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Section 15
RECREATIONAL ASPECTS OF WATER DEVELOPMENT

The purpose of this section is to describe the Bear River Basin's leisure facilities and resources, identify problems and needs, and offer some recommendations. This will focus on the outdoor recreational aspects of leisure defined here as the use of discretionary time--time not used in the pursuit of making a living. It includes both passive and active recreational activities: resident and non-resident tourism and educational aspects (recreation programs, interpretive programs, skill training, etc.) performed in an outdoor context--often water-related activity (streams, lakes, wetlands, rivers, reservoirs, and swimming pools).

The section also presents recent findings from the 1990 public meetings and telephone survey. The purpose for both was to determine issues, actions, and recreation needs in at least one location in each area of the state. Some resulting recommendations will also be tendered for consideration.

15.1 INTRODUCTION

Climatologically, Utah is one of the driest states. Access and immediacy to water, in all its natural and man-made settings, is extremely important to the recreating public in Utah. Water-related activities usually rank in the top 12 outdoor recreation activities; e.g., fishing, camping, picnicking, water play and sunbathing, powerboating, and swimming.[1]

Major water resources for recreation include Bear Lake (See description in Section 3), about eight reservoirs, numerous small lakes and streams in the Wasatch-Cache and Caribou National Forests, and vast marshland areas along the shoreline of Great Salt Lake.

New technologies and recreation equipment allow and encourage these water resources to be used in new and aggressive ways. Included in this category are highly maneuverable, high speed water craft (personal water craft--"Interdictor", jet skis, and wave jumpers), lightweight kayaks, personal floatable fishing platforms, lightweight cold-weather gear, portable water craft, ATVs, (all-terrain vehicles) under-water SCUBA (self-contained underwater breathing apparatus) gear, and remote-controlled water-ski craft. Institutionalized training programs and commercial programs help train recreators in the use of new technologies and equipment.

Youth programs in Utah aggressively train young men and women to use and enjoy leisure and outdoor recreation resources. The availability of public lands and waters further encourages use of Utah's outstanding outdoor recreation resources. Over 74 percent of the state is publicly owned by local, state, or federal agencies.[2] Comments received at recent public meetings and a review of literature indicate a symbiotic relationship between personal physical and mental health and the use and enjoyment of the outdoors; i.e., one can enjoy greater personal health by a robust outdoor recreation life-style - jogging, walking, biking, and generally enjoying the outdoors.

15.2 SETTING

Much of Utah's recreation planning is by multi-county planning district (MCD). The Bear River MCD comprises all of Box Elder, Cache, and Rich counties. Within this area, the U.S. Forest Service administers over 460,000 acres of land, with over 2,860 visitor-days of capacity on 33 units, including 22 campground units and 11 picnic areas.[4] The U.S. Bureau of Land Management also administers a large area; most of it, however, is in western Box Elder County. Some 65,000 acres of marshland contiguous to Great Salt Lake have been set aside as the Bear River Migratory Bird Refuge under the aegis of the U.S. Fish and Wildlife Service. The refuge is currently being re-built: a visitor's center is being proposed for information-interpretation, tours, scientific inquiry, and public education regarding the importance of wetlands and wildlife. The Utah Division of Wildlife Resources administers four major waterfowl areas. They are Locomotive Springs, Public Shooting Grounds, Salt Creek, and Harold S. Crane waterfowl management areas in Box Elder County.[5]

The Utah Division of Parks and Recreation (hereafter referred to as Division of Parks) administers about 3,840 acres of park land in the three basin counties. The Division of Parks also administers 44,600 surface acres of fresh water, plus the surface of Great Salt Lake, pursuant to the State Boating Law, Title 73-18-1 through 23, UCA, as amended.

At Bear Lake, the Division of Parks administers about 906 land acres at seven locations around the lake (See Figure 15-1), plus the surface acreage on the Utah portion of Bear Lake--about 34,250 surface acres when full. The lake bed is owned and administered by the Utah Division of State Lands and Forestry. Hyrum State Park (Figure 15-2) has approximately 260 acres of land and 440 surface acres of water administered under a Bureau of Reclamation lease. Willard Bay State Park (Figure 15-3) has about 2,673 acres of land, including 344 acres in two marinas, and 4,420 acres of water surface. Administration of this park is also under a Bureau of Reclamation lease.

15.2.1 Flatwater Recreational Use

One of the most attractive and heavily-used recreation areas in the basin is Bear Lake. A combination of state parks and private and commercially operated facilities provides a variety of summertime recreation activities for an estimated 500,000 visitors per year to the Utah portion of the lake.

The three units of Bear Lake State Park receive almost 300,000 visitors per year (when the lake level is up), about 97 percent of whom are from Utah. About two-thirds of these visits are at Rendezvous Beach, one-fourth at Bear Lake Marina, and the remainder near Cisco Beach on the east side of the lake. Visitors by counties is shown in Table 15-1. Data for the Cisco Beach area are not available.

Bear Lake Marina - Div. of Water Resources

FIGURE 15-1

BEAR LAKE STATE PARK PROPERTIES

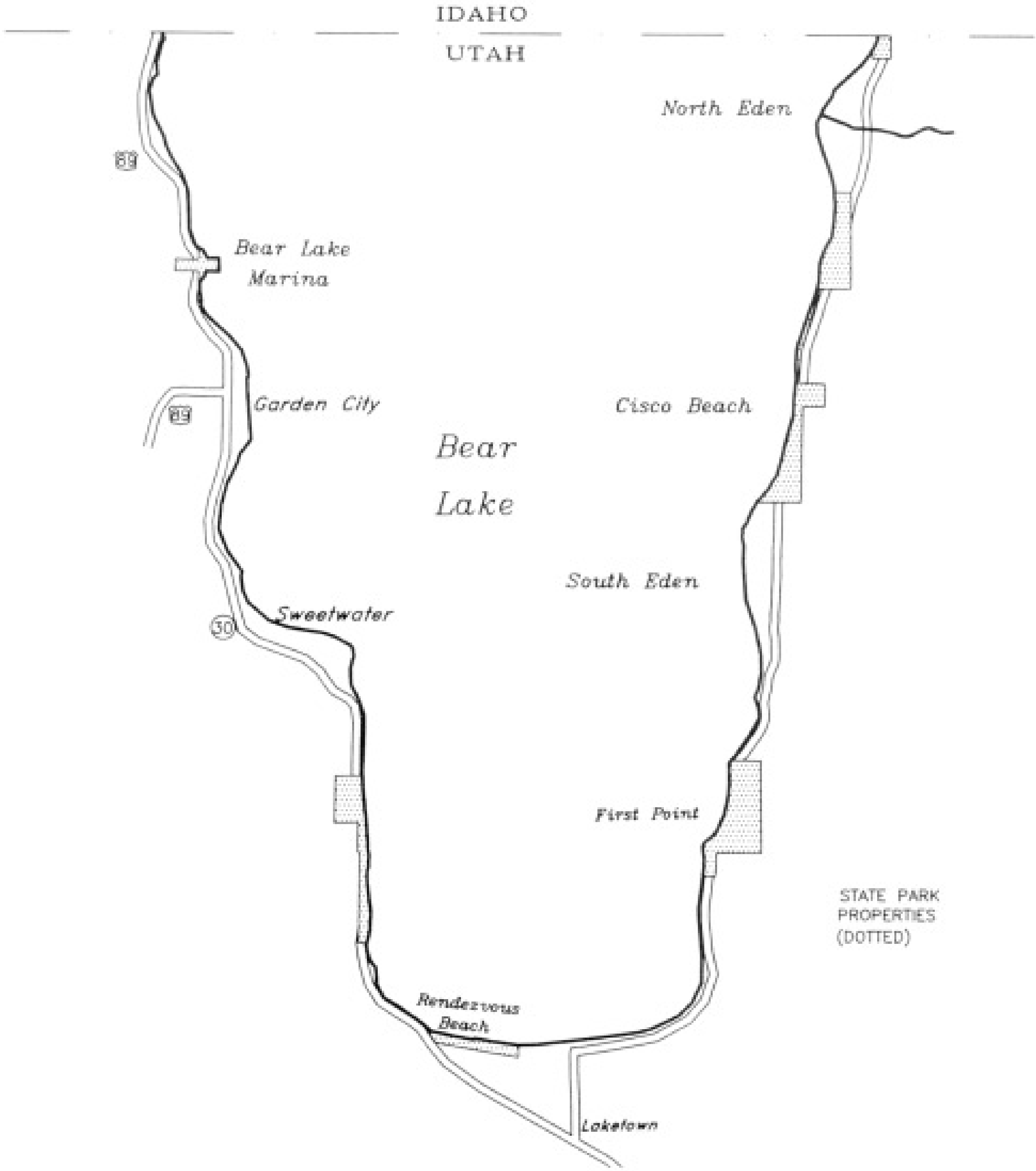
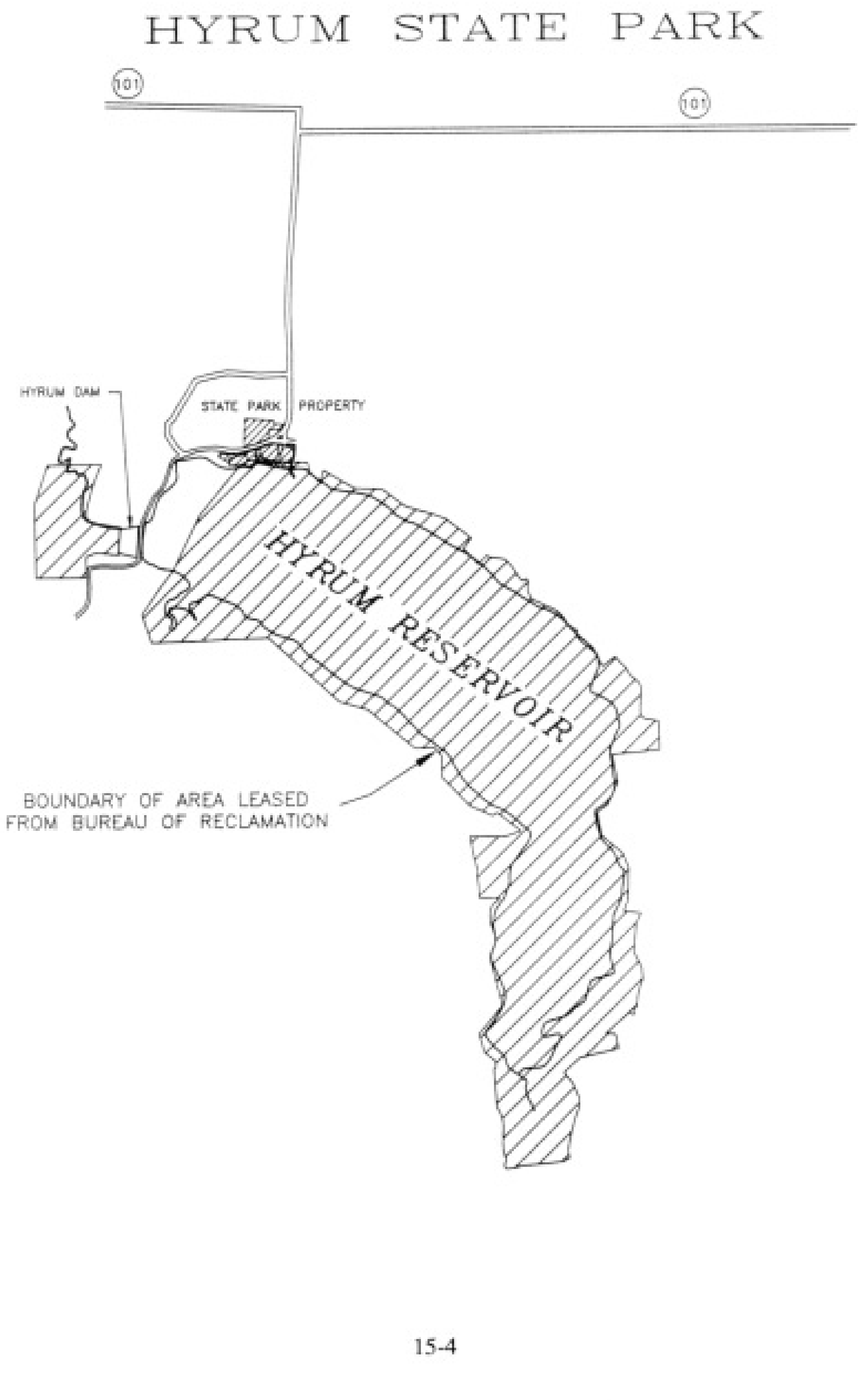


FIGURE 15-2



HYRUM STATE PARK
101
101
HYRUM DAM
STATE PARK PROPERTY
HYRUM RESERVOIR
BOUNDARY OF AREA LEASED FROM BUREAU OF RECLAMATION

FIGURE 15-3

WILLARD BAY STATE PARK

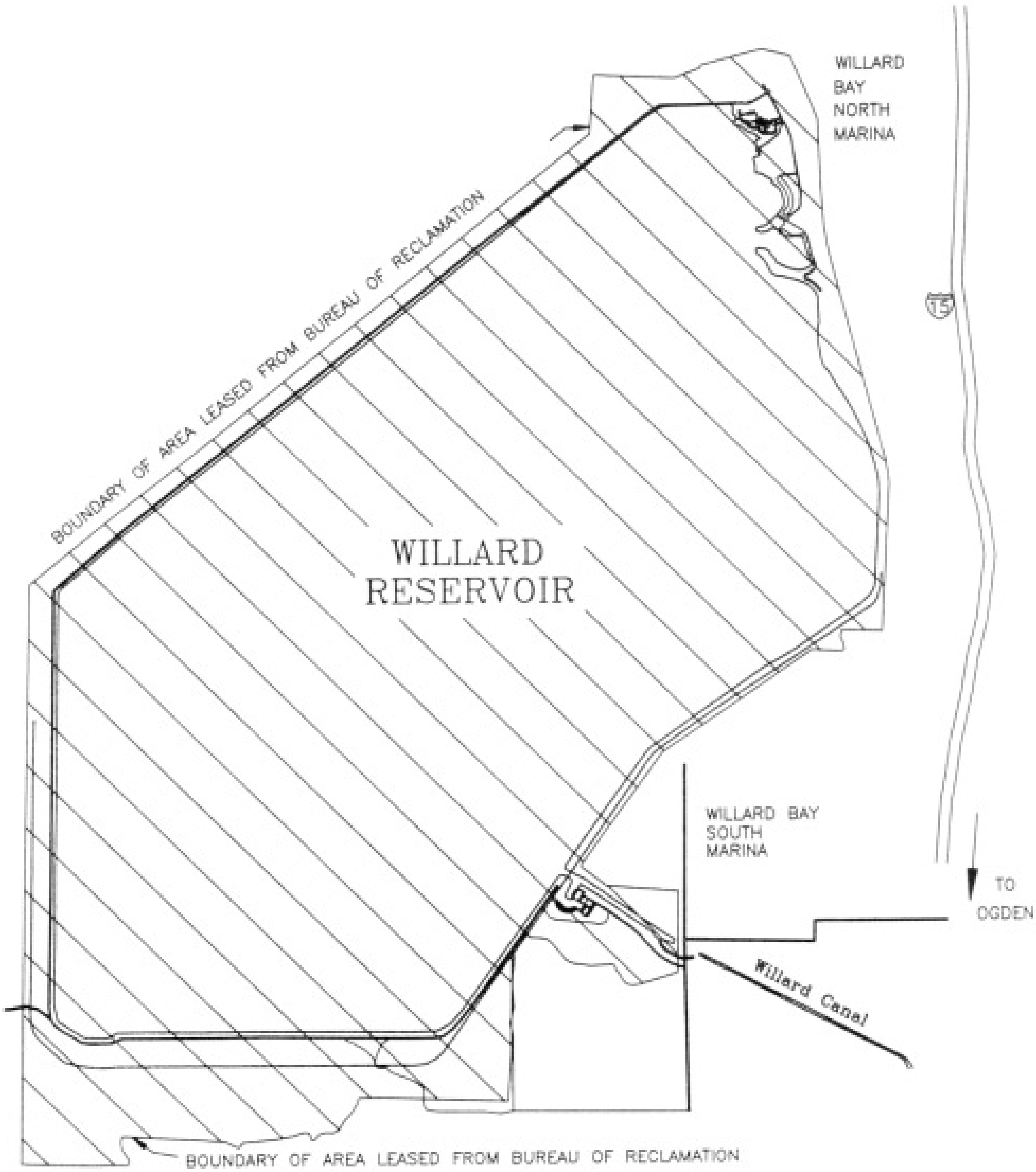


TABLE 15-1 ORIGIN OF VISITORS TO BEAR LAKE STATE PARK		
County	Rendezvous Beach (Percent)	Bear Lake Marina (Percent)
Salt Lake	68.0	41.4
Davis	16.8	10.3
Cache	a	19.0
Weber	9.0	2.6
Rich	a	6.0
Utah	5.0	a
Box Elder	a	2.6
Other Counties	1.2	12.6
Out-of-State	a	5.5
TOTAL	100.0%	100.0%

[a]Less than 1.0 percent

At Bear Lake, the water surface elevation has dropped more than 10 feet since 1986, due to the extended drought. As the water surface has dropped, so has the number of visitors at Bear Lake State Park, as shown by the following data:

Year	Visitation
1986	288,000
1987	224,700
1988	295,700
1989	259,500
1990	165,000
1991	163,300

Hyrum State Park has averaged over 188,000 visitor-days per year since 1985. The quality of fishing is critical to park use. During the fish-kill year of 1988, visitation dropped dramatically--over 25 percent. Quality fishing is returning now as a result of the kill. Most camping visitation at the park comes from the Wasatch Front. Day use is primarily local visitors. Only 10 percent of the visitors are from out-of-state, according to the park superintendent.

At Hyrum State Park, low water is not a dominant factor in visitation, as long as there is launching capability.

Year	Visitation	
1986	215,300	
1987	208,880	
1988	156,670	(decrease resulting from a planned fish-kill by Wildlife Resources)
1989	166,470	
1990	187,000	
1991	194,060	

At Willard Bay State Park, visitation is strongly influenced by the water level. A 55 percent drop in visitation from 1986 to 1989 is attributable to the lower water levels.

Fishing also dropped off--only small inflatables and small fishing boats are able to launch.

Year	Visitation
1986	422,500
1987	394,800
1988	235,220 (decrease as a result of northern Utah drought conditions)
1989	190,220
1990	223,000
1991	212,460

Private commercial concessions at Willard Bay State Park have been affected, with only limited services on weekends. The commercial waterslide was closed down and removed. According to the park manager, 80 percent of the use takes place at the north end of the park. Visitation comes primarily from the Wasatch Front. About nine percent is from out-of-state.

A cooperative resource enhancement program has been put into effect at the park. The Division of Wildlife Resources is helping to establish food and cover plots for upland game on 25 to 30 acres. These plots have been located near nature trails as a program or interpretive feature in the park. This development facilitates leisure activities of interpretation in the park. Implementing game management and fishery plans are important and worthy objectives of resource and park management.

15.2.2 Outdoor Recreation Survey

It is important to know what kind of outdoor recreation is occurring in the basin. A major outdoor recreation survey was completed in 1990[1] on a statewide basis. It provided part of the data needed to update the State Comprehensive Outdoor Recreation Plan (SCORP). In the Bear River Basin, 56 percent of the 500 random household questionnaires were returned, as shown in Table 15-2.

The first question asked in the survey was: "... what five (5) recreation activities do you most enjoy participating in as an individual?" (Activities selected from a standard list). Figure 15-4 indicates that a typical individual in the Bear River MCD would enjoy the 12 listed activities if the respondent participated without his or her family.

TABLE 15-2
QUESTIONNAIRES SENT AND RECEIVED

County	No. Sent	No. Returned	% Returned
Box Elder	150	88	59
Cache	200	115	58
Rich	150	78	52
TOTAL	500	281	56

Question number three (3) in the questionnaire asked: "... In order of preference, what five (5) recreation activities does your family as a whole most enjoy"? Developed camping becomes number one on the family chart (Figure 15-5); whereas, developed camping (camping in developed areas with services) was only number nine on the individual participation list. Picnicking, too, turns up high on the "family activity" list, but only number 11 on the individual list.

Family outdoor recreation activity is significant to development, design, and management decisions in terms of the types of activity and the magnitude or frequency of individual versus family/group activity. Park use information validates the importance of providing group-use facilities at recreation sites.

Question number five (5) asked: "... In my community, new opportunities/ facilities should be developed for the following recreation activities:" Swimming pools, improved fishing, ice rinks, golf, and bicycling paths led the list as noted in Figure 15-6.

The question in number six (6) was: "... In my community, existing opportunities/ facilities should be improved for (which of) the following recreation facilities?" (from an attached list). The response was led by requested improvements in developed camping areas, picnicking areas, fishing areas (access, number, and quality), swimming pools, bicycling paths, playgrounds, tennis courts, and walking paths, as shown on Figure 15-7. Some 24 priority needs are listed, from most needed (respondent's perception) to less needed. New swimming pools seemed to be a higher priority than improving existing pools. Bicycling paths and new and improved fishing opportunities rated about the same priority as swimming pools.

Question number seven (7) asked respondents to identify new facilities and opportunities needed on a statewide basis; i.e., outside the community or immediate area. Developed camping, picnicking, bicycling paths (and trails), improved fishing opportunities, and wildlife/nature study areas ranked high in the responses, as shown on Figure 15-8. The first three also ranked high as local needs (Question No. 6). Most of the above facilities/activities, along with hiking and ATV trials, can be incorporated into future water development areas.

15.3 LAND AND WATER CONSERVATION FUND GRANTS

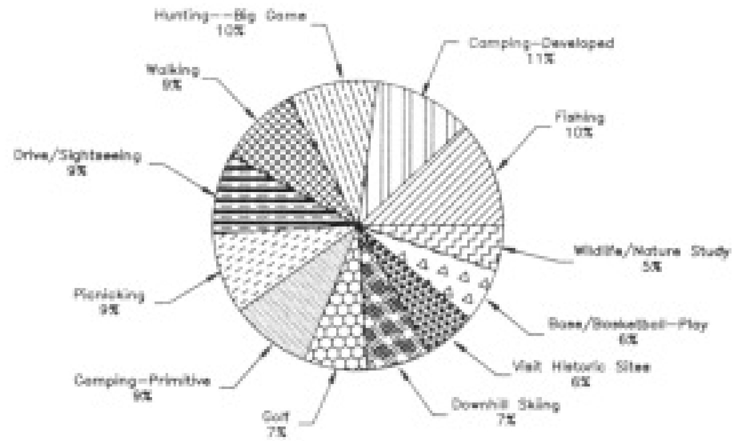
Funds for outdoor recreation acquisition and development in the basin have been made available from the Federal Land and Water Conservation Fund (LWCF). These funds are available as matching grants. As shown in Figure 15-9, nearly $5 million in federal grants has been spent since 1965. The total value of the projects, with matching funds, was nearly $10 million. Most have been city and county projects. Only seven of the 56 have been state projects, but they have been large ones. For example, Bear Lake land acquisitions and development amounted to about $1.8 million of the nearly $5 million in grants.

Not all of the above grants were for water-related recreation. Figure 15-10 shows the ratio. While some type of minor water feature on a site is nearly always preferable, about 47 percent of the projects were in association with major water features; e.g., Bear Lake, Newton Reservoir, Logan River. Water features are highly desired by park users for a variety of reasons, including near-community fishing, the usual presence of a variety of wildlife, visual amenities (reflective values, change, and visual relief from surroundings), the audio values of lapping and running water, and recreation opportunities such as swimming, sun bathing, beach play, fishing, boating, rafting, scuba, waterfowl hunting, ice skating, and so on.

A state park survey in 1986-87 indicated that water-related facilities/amenities were of utmost value when combined with beach resources such as shade trees, paths/trails, convenient parking, and good restrooms.[7]

FIGURE 15-4

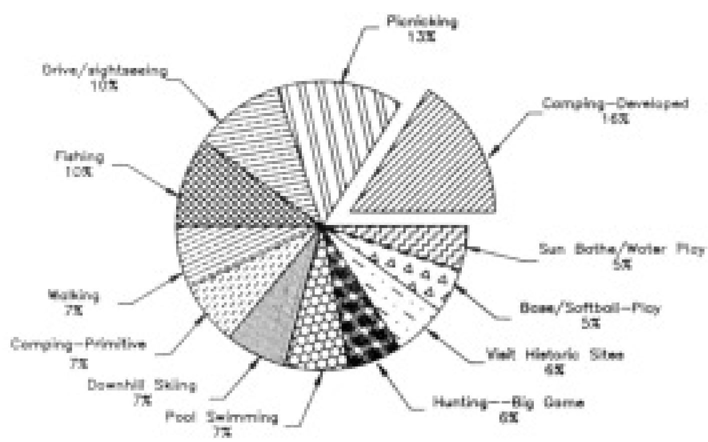
FAVORED INDIVIDUAL OUTDOOR RECREATION
Top Five Activities
(Summed frequency of all 5 top choices--not just number 1)
Bear River MCD--1990 Survey



Division of Parks & Recreation Survey
Question #1--Combined

FIGURE 15-5

FAVORED FAMILY OUTDOOR RECREATION
Top Five Activities
(Summed frequency of all 5 top choices--not just number 1)
Bear River MCD--1990 Survey



Division of Parks & Recreation Survey
Question #3--Combined

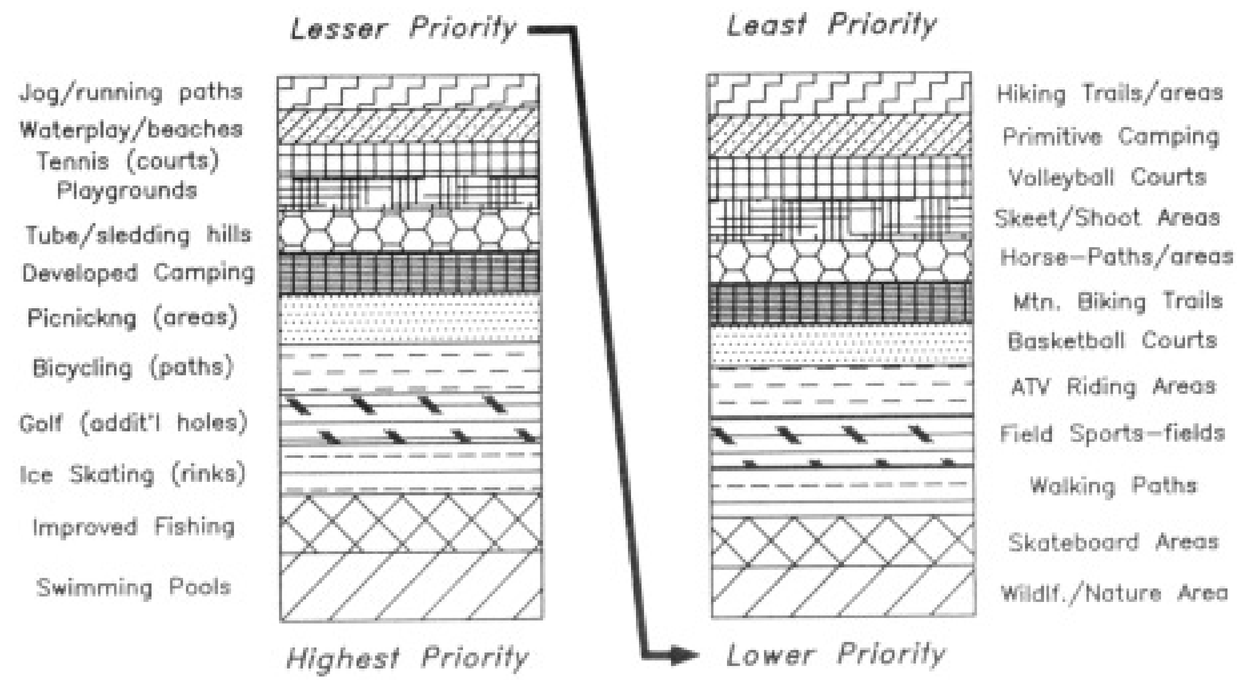
FIGURE 15-6

NEW COMMUNITY FACILITY NEEDS

Combined Top 5 Requests--Recreation

Question #5

Suggested Priority of Needed Outdoor Recreation Facilities



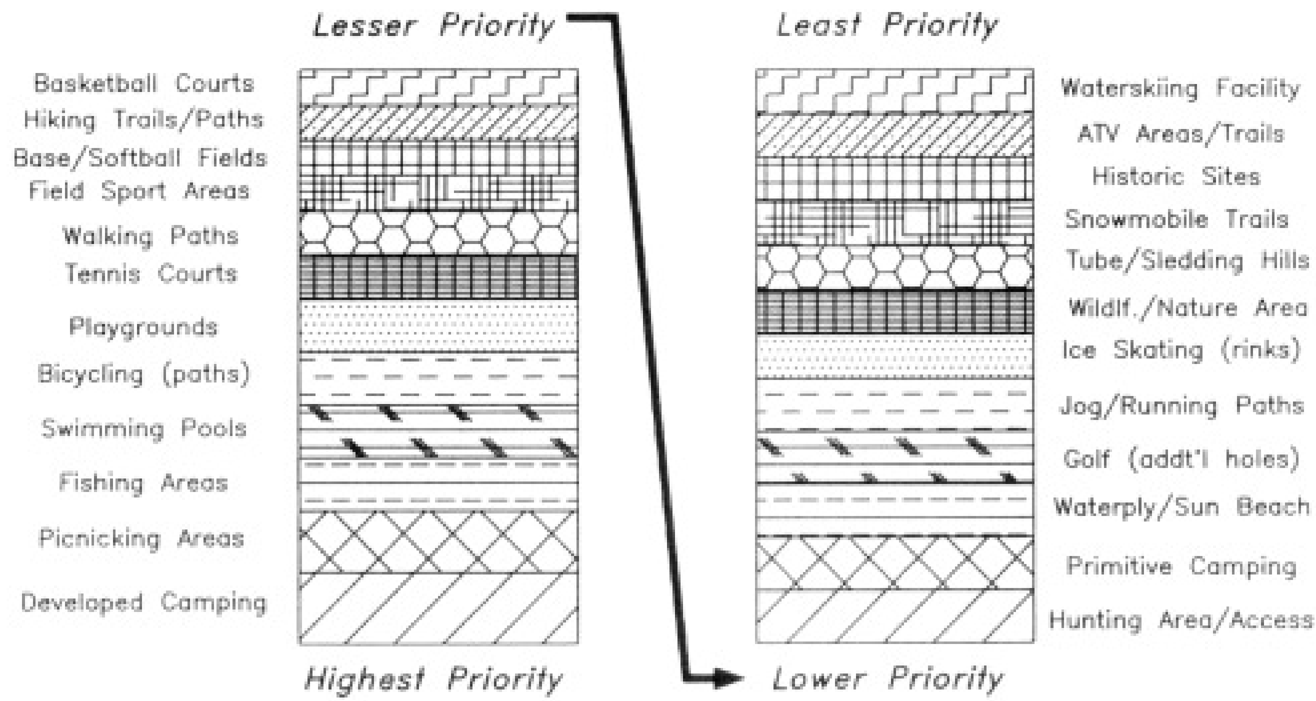
Bear River MCD--1990 Survey

FIGURE 15-7

EXISTING FACILITIES NEEDING IMPROVEMENT

Combined Top 5 Requests

Question #6--Community Recreation Facilities



Bear River MCD--1990 Survey

FIGURE 15-8

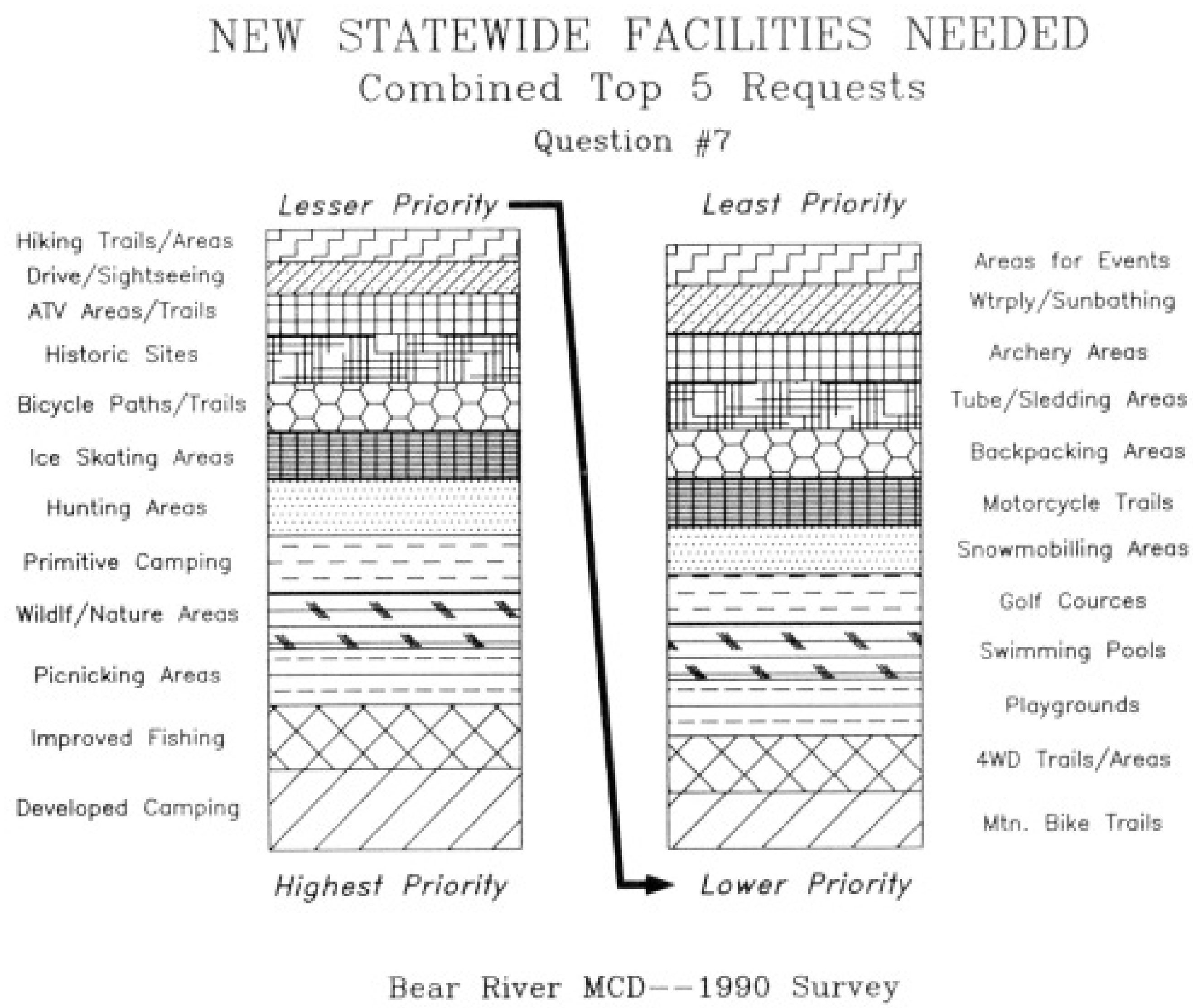

NEW STATEWIDE FACILITIES NEEDED
Combined Top 5 Requests
Question #7
Lesser Priority
Least Priority
Hiking Trails/Areas
Drive/Sightseeing
ATV Areas/Trails
Historic Sites
Bicycle Paths/Trails
Ice Skating Areas
Hunting Areas
Primitive Camping
Wildlf/Nature Areas
Picnicking Areas
Improved Fishing
Developed Camping
Areas for Events
Wtrply/Sunbathing
Archery Areas
Tube/Sledding Areas
Backpacking Areas
Motorcycle Trails
Snowmobilling Areas
Golf Cources
Swimming Pools
Playgrounds
4WD Trails/Areas
Mtn. Bike Trails
Highest Priority
Lower Priority
Bear River MCD--1990 Survey

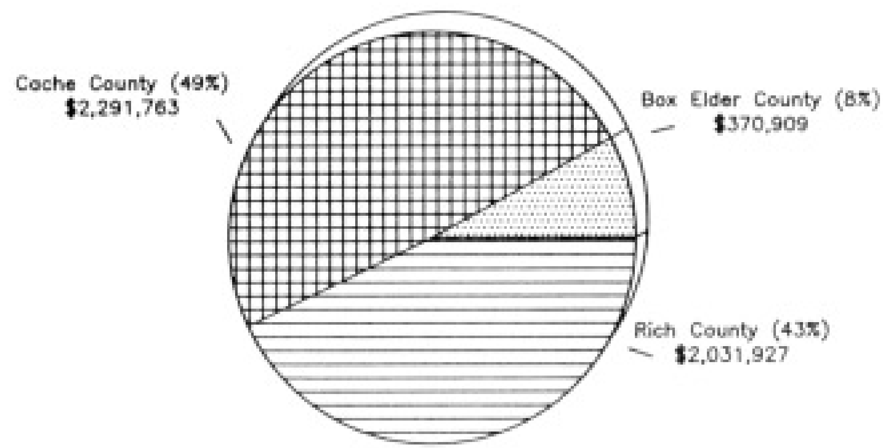
FIGURE 15-9

LAND AND WATER CONSERVATION FUND PROJECT GRANTS 1965–90

Box Elder, Cache and Rich Counties

Total Federal Grants = $4,694,600

(Total Value of Projects = ($9,389,200)



State Projects = 42% (mostly Rich Co.)

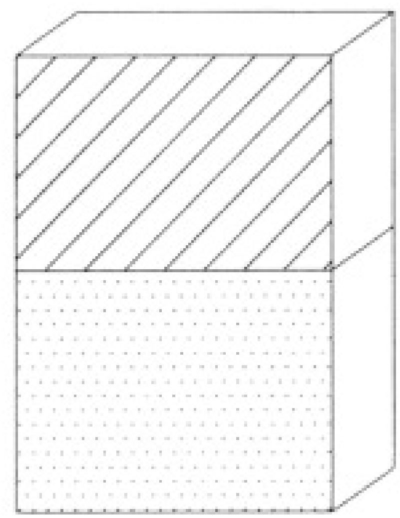
Total Number of LWCF Projects = 56 (7 State Projects)

FIGURE 15-10

LAND AND WATER CONSERVATION FUND
WATER–RELATED PROJECTS
Bear River MCD 1965–90

Source: Division of Parks & Recreation SCORP Analysis, 12/90

Orientation near water is a critical functional component and a highly–desired amenity for most outdoor recreation acquistitions and developments. (In–Park Users Survey, 1988)



88% of all water–related projects are located in Rich County in Bear Lake State Park––Marina and Rendezvous Beach units.

In general, water-related facilities near population centers have ranked high in priority for LWCF funding. Figure 15-10 shows that 47 percent of total federal grants since 1965 has been spent on water-related projects, most of which was at Bear Lake State Park. If proposed facilities provide a wide variety of year-round outdoor recreation activity, and are relatively convenient in terms of access, they have high priority under a procedure developed by the state of Utah to allocate the federal LWCF funding. The funding has been approximately $400,000 per year. There may be other aspects of outdoor recreation development along the Bear River (trails, bridging, signs, staging areas, handicapped facilities, etc.), for which the use of LWCF matching funds, as well as state River Enhancement Funds, may be appropriate (if funded by the State Legislature).


Willard Bay - Div. of Wildlife Resources

15.4 RECREATION NEEDS AND ISSUES

During the fall of 1990, statewide public meetings were held in at least every MCD in Utah. The purpose was to update critical outdoor recreation issues and needs identified during the period of 1985 to 1990. Approximately 11 issues were identified in surveys and public meetings in 1985-86. New issues and reiteration of old issues were discussed and ranked by meeting attendees. While commonalities were found among MCDs, significant differences were also discovered. Northern districts were more concerned about local and community needs for recreation facilities; whereas, southern and eastern districts were more focused on "tourism" and its economic benefits to their areas.

15.4.1 Logan SCORP Public Meeting

A Logan public meeting on September 18, 1990, enjoyed participation by farmers, academicians, the mayor of Logan, the Logan parks and recreation director, some graduate students from USU, and a representative for the "disabled population" in this area. Three state park staff members also attended. All 11 "old or previous issues" were presented. The group was asked to articulate additional "new or current issues." Then the guests were asked to vote or weight the issues so that the list of issues could be ranked. The resulting issues ranked as follows:

1. <u>The need for an ongoing or stable source of funding for recreation acquisitions and development.</u>

Adequate, continuous funding is needed to allow planning and plan implementation. Recreation planners also need to identify new sources of funding, such as a container or can tax, or a real estate transfer tax.

2. <u>The need to preserve and enhance public access to rivers, streams, and public lands.</u>

Examples were given regarding private closures of historically "open" private and public lands. They expressed a need for urban access to fishing and wildlife viewing areas, as well as safe, convenient and legal access.

3. Greater emphasis on providing outdoor recreation opportunities in urban and population center areas.

This includes planning and opportunities for fishing and viewing wildlife; the need for urban "primitive, wildland or natural" recreation resource developments and acquisitions (natural open spaces in community) mentioned in local surveys and identified with energy problems; locating outdoor recreational resources within the community context, or immediately thereto; and river and streamway enhancement.

4. Determine and promulgate the economic value of leisure, including outdoor recreation and tourism.

There was a great concern for generating valid and reliable data that documents the economic or quantified values of recreation, thus justifying budgets for acquisition and development.

5. The need to provide additional and improved access for the disabled.

There was a request to have the organization representing the disabled actually review plans and specifications. This would ensure that the disabled will not be precluded from utilizing outdoor recreation facilities and resources.

6. The need to further enable and support tourism and its attendant economic and social values in this area.

The group noted the importance of adequately funding and supporting outdoor recreational infrastructure to support and attract tourists into the area; e.g., renovate, repair and expand existing recreational facilities, and provide additional facilities and access, new trails and bikeways, recreation programs, and special events.

7. The need for comprehensive natural resource allocations.

The group noted the problem of fractionalized, ad hoc allocations of all natural resources, particularly water. Sometimes this may result in developing all water in an area before other needs are analyzed and other options are evaluated; e.g., water conservation, establishing growth policies, agricultural needs, total system impacts on wetlands, natural springs, wildlife populations, plant regimes, natural amenities, recreation, tourism, and so on. Irreversibility of change must be more thoroughly analyzed prior to exclusive development, deployment, and utilizations.

8. The need for improved interagency/ inter-institutional coordination and cooperation.

The group perceives agencies and institutions often at odds, or committing redundancies in planning and expenditures, or otherwise not communicating and cooperating. They see this as inefficient and ineffective. Comments were made that the Department of Natural Resources was seen working more closely than in the past on water, wildlife, and recreation matters. They complained regarding highway design and location, the lack of consideration for hike/bike lanes and turnoffs, and very poor signing for helping tourism and local businesses.

9. The need to accommodate and enhance health and fitness in our park and recreation/ community designs.

Use of all outdoor recreation facilities by those actively and purposely seeking to improve or maintain their health and physical/mental fitness is increasing. Examples are walking, jogging, swimming, playing, skating, biking, and otherwise aerobically exercising their bodies and refreshing their minds. These activities should be included in any facility design and management program for future and extant facilities; i.e., trails, paths, staging areas, rest room location, potable water fountains, signage, surface construction, maintenance, snow removal/trail grooming, fencing/gating, lighting, shading, and rest areas. Areas should be linked by paths, roads, trails, greenways, riverways, and linear open space corridors--they should be considered as systems, not isolated facilities.

The preceding suggests strong consideration of the following needs or issues in administration and development strategies for land and water developments in the Bear River Basin:

- more adequate funding methods for recreation facilities and assuring public access to water developments and along riverways;

- providing easy access from urban areas to water development sites (trails, paths, easements) and more immediate recreation developments closer to urban or population centers;

- assuring reasonable access for the disabled (paved trails, fishing piers, accessible day-use, and campgrounds);

- marketing facilities for tourism benefits -- professional staffing, programs, special events, and high quality facilities tourists expect;

- continuous coordination with other resource users, adherence to the NEPA process, consideration of free-flowing streams as well as impoundments, close agency coordination, water conservation, and environmental impacts.

15.4.2 Issues Prioritized by Government Agencies--Box Elder and Cache Counties.

Toward the end of 1990, all recreation-providing government agencies were surveyed to determine their respective expenditures for outdoor recreation. A listing of "recreation issues" in Box Elder and Cache counties resulted, ranging from "extremely important (5)" to "not at all important (1)" on a five point "Lickert Scale". The "very important (4)" and "extremely important (5)" recreation issues for Box Elder and Cache counties (circa November, 1990) are listed in Table 15-3.

TABLE 15-3
MOST IMPORTANT RECREATION ISSUES IN BOX ELDER AND CACHE COUNTIES, 1990

ISSUE	BOX ELDER	CACHE
1. Vandalism (law enforcement/education)	5	5
2. Liability Protection (insurance/plans)	4	5
3. Deteriorating Infrastructure	4	5
4. Improve Interagency Coordination	4	5
5. Access to Public Lands (stop closures)	5	4
6. Law Enforcement (assure health/safety)	5	4
7. Improve Environmental Education/Info	4	4
8. Need More Park Development(s)	4	4
9. Improve Private/Public Cooperation	4	4
10. Improve Environmental Quality	4	4
11. Promulgate Economic Values of Recreation	4	4
12. Provide More and Better Trails	4	3
13. Encourage More Volunteerism	3	4
14. Decisions on Wilderness Designations	3	4
15. Inadequate Recreation Funding	3	3

Source: Reference No. 8

Comparing public meeting issues and public agency perceptions demonstrates common concerns with differing priorities. Access to public recreation lands and waters is highly important to both groups. Provisions for the "disabled" are perceived as currently adequate, or at least not a high concern (federal and state laws prohibit architectural barriers, but effectiveness is questionable, according to advocates for the disabled). Resource and management coordination is also seen as a shared concern. Vandalism, facility deterioration, and potential tort liability is obviously a critical concern for resource and facility managers.

15.4.3 Budgets for Recreation

From FY 85 through FY 90, Cache County has shown a 60 percent increase in its recreation budget, or in adjusted dollars, a 30 percent increase in capital outlay and operational costs in the past five years. Box Elder and Rich counties did not report any recreation-related expenditures during this period, except for a major re-paving job along the east shore of Bear Lake (over $150,000) that benefitted agricultural, economic, and recreational interests. With the reduction of federal funding, cities and counties have had to take up the slack to meet population increases; i.e., an average of 1.4 percent per year, or about 22 percent from 1980 to 1990.[9]

To meet growing tourism and local recreational needs, a balanced funding and operational cost program will have to be realized, utilizing federal, state, local, and private funds. Currently, Bear Lake State Park has a total annual budget of about $266,000, Hyrum State Park about $125,000, and Willard Bay State Park $235,000. This makes a total of about $626,000 per year for the three state parks--coupled with perhaps another $125,000 in repairs and renovations by the northwestern regional maintenance crew of the Division of Parks and Recreation.

Golden Spike National Historic Monument serves over 200,000 visitors with a budget of about $597,000 per year. The Bear River MCD portion of the Wasatch-Cache National Forest expends an estimated 35 percent of its $2.3 million dollar budget in that area, or about $800,000 annually for about 1.2 million "recreation visitor days" (RVDs), which is about 25 percent of the total forest RVDs. Therefore, a major portion of outdoor recreation service expenditures is provided by the USFS, the state of Utah (state parks, Hardware Ranch, big game and fishery management programs), BLM, and U.S. Fish & Wildlife Service. Sawtooth National Forest also expends a significant amount, estimated at about $90,000 per year.[10]

15.4.4 Public Water Development Projects

Current surveys indicate that a typical public water development project should provide: (1) relatively convenient, safe, and legal access to the waters of the state; (2) natural amenities (trees, natural beaches, water play areas, preserve wetlands, and riverine environments); (3) trails (mostly muscle-powered, some motorized); (4) staging areas (parking, access control, solid waste containers, restrooms, potable water, boat ramps, signage, educational/interpretive signs and facilities, explanation of nature and cultural aspects); (5) reasonable management presence (law enforcement and recreational hosting); (6) commercial recreational opportunity (food, lodging, fuel, special services); and (7) areas for waterfowl, fisheries, upland game, and non-game wildlife to enhance the leisure experience and meet express desires of the public.

Facilities should be designed to include relatively inexpensive operation and maintenance, with reasonable revenue-generating potential to help defray management and maintenance expenses. Facilities should also encourage local and state economic activity from in-state and out-of-state facility users; e.g., provide well-designed and well-located highway signing, local information programs, host training, and comprehensive recreational programming for an entire region or area of the state in which the project is located.

In October, 1989, the Joint Gubernatorial/Legislative Bear River Development Task Force discussed projected financial arrangements associated with potential development of Bear River water supplies. The task force passed a motion recommending to the State Legislature that costs for recreation, fish and wildlife, flood control, and possibly riparian benefits become a public obligation. Subsequently, Senate Bill 98 was passed in general session by the 1991 State Legislature providing, among other things, that Bear River development costs allocated to recreation are not reimbursable and shall be paid entirely by the state. (See Section 9).

15.5 RECOMMENDATIONS

15.5.1 Future Recreation Demand

The size and growth rate of future demand for water-based recreation in the Bear River Basin should be determined by the Division of Parks and Recreation, and made available for plan formulation purposes.

15.5.2 New Recreational Facilities

The capability of existing facilities to meet future recreation demand should be determined by the Division of Parks and Recreation, so that the relative need for new facilities can be evaluated.

15.5.3 Upgrading Existing Recreational Facilities

Existing water-based recreational facilities should be maintained and upgraded by all responsible agencies to better serve the public.

15.5.4. Use of LWCF

The federal Land and Water Conservation Fund (LWCF) Program, guided by the State Comprehensive Outdoor Recreation Plan (SCORP), should continue to be used for future outdoor recreation acquisitions and development.

15.5.5 Funding for Future Recreational Development

New funding and cost-sharing arrangements for future recreational development should be explored, analyzed, and proposed by the Division of Parks and Recreation and other agencies.

15.5.6 Recreational Facility Deterioration

Vandalism, facility deterioration, and potential tort liability should be addressed more thoroughly by the Division of Parks and Recreation in future facility design and management.

15.6 REFERENCES

In addition to the references below, Section 15 of the Utah State Water Plan, January 1990, discusses three recreational issues with statewide significance.

1. "1990 Statewide Outdoor Recreation Household Survey," SAS Stat Analysis, Burns & Allred, Utah Division of Parks & Recreation.

2. "BLM Facts & Figures," U.S. Dept. of the Interior, 1988.

3. Bureau of Economic and Business Research. 1990 Statistical Abstract of Utah, January, 1990, p. 20.

4. "Wasatch-Cache National Forest Land & Resource Management Plan," U.S. Dept. of Agriculture. 1987, p. 11-5.

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Section 16
FEDERAL WATER PLANNING AND DEVELOPMENT

This section describes past, present and expected future involvement of federal agencies in Bear River Basin water planning and development.

16.1 INTRODUCTION

In recent years, the state of Utah has taken a more active role in the planning and development of local and regional water resources. In general, the federal role has been more dominant in the past, but the state is expected to prevail in the future. Federal financial assistance for a major water development is possible but less likely today than in previous years.[1&3] The cooperative participation of federal agencies, however, will continue to be very helpful to the state. Several federal agencies have major responsibilities for management and regulatory activities that are expected to continue indefinitely.

16.2 FEDERAL INVOLVEMENT IN THE BASIN

Several federal agencies are actively involved in Bear River Basin planning, and several have been involved for many years in planning and development. The U. S. Bureau of Reclamation and the U.S. Department of Agriculture have completed basin-wide investigations, and the three basin states (Utah, Wyoming, and Idaho) have completed numerous studies in connection with developing their state water plans. All of this has provided considerable information on the resources of the basin and, in some cases, alternative water development plans.

The Bureau of Reclamation (USBR), Corps of Engineers (Corps), Soil Conservation Service (SCS), Geological Survey (USGS), Environmental Protection Agency (EPA), Fish and Wildlife Service (FWS), Forest Service (FS), Federal Emergency Management Agency (FEMA), and Bureau of Land Managment (BLM), have been involved in studies or currently manage resources in the basin. The first two agencies are primarily development

Newton Reservoir - Div. of Water Resources oriented, with emphasis on relatively large projects, programs or areas. For the most part, SCS developments must be authorized by the U.S. Congress and sponsored by a state or local entity. The SCS has been, and continues to be, a service agency providing technical and financial assistance to the agriculture industry. The SCS projects do not need congressional approval. The USGS is mainly a data collection and research agency. The EPA has regulatory responsibilities, particularly in water quality. The FWS has jurisdiction over the Bear River Migratory Bird Refuge, in addition to responsibilities concerning threatened and endangered species. The FEMA provides flood insurance under a national program, and assists with repairing damages when they occur. The FS, BLM, and other federal agencies are involved with federal land or other resources which they each administer. The FS manages approximately 461,000 acres, and the BLM about 187,000 acres (See Figure 7-1).

Hyrum Dam on the Little Bear River, and Newton Dam, on Newton Creek, were designed and built by the USBR many years ago. They are operated and maintained by the South Cache Water Users Association and the Newton Water Users Association, respectively, but are still owned by the United States.

Extensive farm irrigation improvements in the Bear River Basin have been designed and built by the SCS in cooperation with other agencies and private local entities. A water quality improvement project for the control of non-point source pollution is underway on the Little Bear River, in cooperation with the Utah Departments of Environmental Quality and Agriculture. In addition, valuable hydrologic and agricultural data have been collected in previous basin investigations and are available for use.

The U.S. Department of Agriculture's water and water-related programs provide cost sharing and technical assistance. Cost sharing for individual and group irrigation facilities are provided through the Agricultural Stabilization and Conservation Service, grants and loans from the Farmers Home Administration, and technical assistance and grants provided by the SCS (See Tables 8-2 and 8-3).

The Bear River Resource Conservation and Development (RC&D) Program, sponsored by local government units, with technical and administrative support from the U.S. Department of Agriculture/SCS, has been involved in water development in the basin for many years. This is a cooperative program, with participation and funding provided from federal, state, and local sources, and with coordination essentially at the local level. A variety of projects and studies are supported by the RC&D Program.

In addition to the FWS, other federal agencies responsible for managing fish and wildlife resources in Rich, Cache, and Box Elder counties include the FS and the BLM.

The Corps of Engineers conducted a reconnaissance study in 1989 to determine if new reservoirs for flood control and related purposes were economically and environmentally justified. The report concluded that federal flood damage reduction projects were not implemented in the Bear River Basin because benefits were insufficient to qualify for Corps participation.[3]

16.3 PROSPECTS FOR FUTURE FEDERAL INVOLVEMENT

Federal programs most significant to the Bear River Basin in the immediate future are: (1) the EPA's authority under the Federal Safe Drinking Water Act and Clean Water Act, (2) FWS plans for rehabilitation and management of the Bear River Migratory Bird Refuge, and (3) at least eight ongoing farm programs of the Department of Agriculture.

Further comprehensive federal studies in the Bear River Basin and/or participation by the USBR, Corps, or SCS in future development would be welcomed, but neither appears to be likely at present. Should such participation happen, some form of cooperative cost sharing could significantly benefit basin residents and the state.

Undetermined water supply improvement for the Bear River Migratory Bird Refuge is expected to be part of any major lower basin water development project. Special studies and discussions with the FWS are expected to be the means of determining the type and extent of improvement to be provided. The FWS has expressed its wish to continue working with the state throughout the planning and implementation stages of development. As part of a nationwide agreement, the USBR is working with the FWS on water supply improvements for the bird refuge. The USBR has expressed a desire also to assist the state of Utah in the planning and development of the Bear River. The USBR and Division of Water Resources completed a joint water management study in 1990, that includes the Bear River Basin.[4]

In addition to rehabilitation and continued operation of the federal bird refuge, the FWS has other responsibilities mandated by the U.S. Congress. Two of the most significant laws are the Fish and Wildlife Coordination Act and the Endangered Species Act.

16.4 RECOMMENDATIONS

The Division of Water Resources and other state and local entities should continue to cooperate with federal agencies in planning, designing, funding, constructing, and operating of new and existing water supply projects in the Bear River Basin.

16.5 REFERENCES

In addition to references listed below, attention is directed to Section 16 of the Utah State Water Plan, January 1990, where a more detailed perspective is given of federal agencies with major water resources planning and development authority and responsibility.

1. "Assessment '87, A New Direction for the Bureau of Reclamation," USBR, September 1987.

2. "Summary Report, Water and Related Land Resources," Bear River Cooperative Study, U.S. Dept. of Agriculture, 1978.

3. "Bear River Basin Investigation," Reconnaissance Report, U.S.Corps of Engineers, February 1989. Revised December 1989.

4. "Wasatch Front Total Water Management Study" Final Report, U.S. Bureau of Reclamation and Utah Division of Water Resources, February 1990.

5. "Bear River Investigations," Status Report, U.S. Bureau of Reclamation, June 1970.

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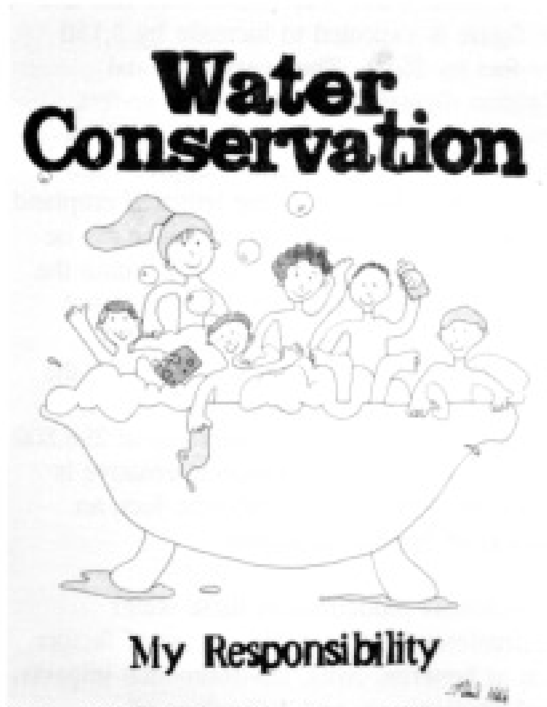
Section 17
WATER CONSERVATION

This section discusses water conservation needs, issues, and potential alternatives, and gives some recommendations for conserving water use.

17.1 INTRODUCTION

In the State Water Plan, water conservation is defined as "wise use," which is much wider in scope than merely reducing water consumption. To guide the management of its three revolving fund programs for water development projects, the Board of Water Resources has issued a policy statement on water conservation. The policy supports conservation and the wise use of water. It states that conservation will be examined as an alternative and a supplement to project proposals. Sponsors for projects are encouraged to prepare an effective conservation plan.

Significant water use reductions can be (and have been) achieved when people understand the reasons to conserve, especially in times of drought. It must be remembered, though, that reducing demand for water is unimportant if cost savings are not realized or the water cannot be stored and/or used for other desirable purposes.



Michael Hatch - Grand Prize Winner, 1988
Young Artists Water Education Poster Contest

Water conservation can be pursued through two strategies: (1) reducing the demand by using the existing supply more efficiently, and (2) increasing the supply by operating the storage and delivery facilities more efficiently (including the elimination of conveyance losses). Examples of (1) are restricted outside use, changes in landscaping, new and efficient plumbing, pricing, and water education. Examples of (2) are dual systems, re-use, water right transfers, and conjunctive use. Both of these strategies are valid in the Bear River Basin. Structural and non-structural measures apply to each. While opportunities exist to do much more in the basin, significant achievements in the wise use of water have been made. Storage reservoirs have been built, open delivery facilities have been lined or replaced with pipelines, and irrigation application efficiencies are being improved.

17.2 SETTING

The 1990 average annual diversion for municipal water in the Bear River Basin in Utah was 51,170 acre-feet. This amount is expected to increase by 14,390 acre-feet by the year 2010. The 1990 average annual diversion for industrial water was 10,310 acre-feet and this figure is expected to increase by 3,150 acre-feet by 2010. The average annual irrigation diversion was 885,600 acre-feet. This amount could increase by as much as 9,500 acre-feet if late season supplemental water is provided to existing irrigated cropland, and another 18,000 acre-feet if water can be provided to non-irrigated cropland within the service area of existing canals. Additional water for large irrigation projects is not anticipated. The historical water use for the restoration alternative for the Bear River Migratory Bird Refuge is estimated at 296,800 acre-feet, while the expansion alternative is estimated to require 653,700 acre-feet, an increase of 356,900 acre-feet.

Potential reductions in these water requirements involve a wide range of factors such as benefits, costs, environmental impacts, legal implications, and difficulties of implementation. For example, enhancement or expansion of the Bear River Migratory Bird Refuge requires more water, most of which would have to come from reservoir storage, and would most likely be in competition with other uses. Industrial water uses are so varied that it is difficult to make generalizations about conservation, except that the amount of total use (as well as any potential saving) is small. Potential conservation of municipal and irrigation water is discussed separately before considering specific methods and strategies.

17.3 NEEDS, ISSUES, AND ALTERNATIVES

The need for water conservation in the Bear River Basin is relative to all of the factors mentioned previously, as well as to geography and water quality. In terms of total foreseeable uses, it will be a long time before a limited water supply will necessitate a massive water conservation effort. But totals alone do not convey an accurate picture. Although water supplies in the basin are generally plentiful, shortages already occur in some areas, especially during droughts. Because of differing local circumstance, each area and the uses within that area must be considered separately. Also, in most cases, economics and water quality are the overriding factors. If this were not so, coastal states like California would have available to them the world's largest water supply: the Pacific Ocean.

17.3.1 Municipal Water Conservation

Conservation of municipal water appears to be an appropriate and feasible way of meeting part of the basin's future water requirements. Actual implementation, however, is somewhat complicated.

As discussed in Section 11, the 14,390 acre-feet per year of new water requirement to the year 2010 will most likely be met by a combination of actions. The alternative actions are water conservation, new wells, new reservoirs, and inter-county transfers. Each of the 52 community water systems has a different set of problems and circumstances, so the best means for meeting needs may not be the same for all.

The following figures show that if water conservation were to compensate for new developments, the overall per capita use must drop to 0.363 acre-feet per year.

Year	Population	Total Use (acre-feet/year)	Per Capita Use (acre-feet/year)
1990	108,393	51,170	.472
2010	140,800	51,170	.363

This per capita use rate is not unreasonable in relation to the statewide average of 0.318, but several difficulties are encountered. One is that the communities most in need of water are already practicing conservation and have low rates of per capita use. Communities with higher per capita use rates have plenty of water and little incentive to conserve. Communities with little or no reserve capacity are also hurt most by drought years (See Tables 11-8 through 11-10), while those with adequate surplus are almost unaffected by drought. If those communities with a high per capita use and large reserve capacity were to lower their use of water by practicing conservation, it would not help the communities presently in short supply. Very few pipelines connect communities. For example, reduction of use in Brigham City would not help Tremonton. Nevertheless, such sharing of supplies would be beneficial whenever possible, and is a wise use of water. This is occurring in Salt Lake County, where the Metropolitan Water District currently is sharing its surplus with the Salt Lake County Water Conservancy District.

Table 17-1 shows per capita use rates for public water systems. Water use rates are higher in the Bear River Basin than the state average, probably because of a large use by dairies and other commercial and industrial uses.

17.3.2 Irrigation Conservation

Of the 885,600 acre-feet of water per year diverted for irrigation, about 402,000 is consumed by crops (535,600, minus about 134,000 supplied by rainfall on irrigated land). Without reducing the irrigated area or supplying less water than the crops need, the 402,000 acre-feet is a minimum that probably couldn't be reduced further. The other 484,000 acre-feet either runs off the fields or seeps into the ground where most of it returns to the river downstream. Essentially, the only portion lost is evapotranspiration in riparian areas adjacent to the river and irrigated lands throughout the basin. In Rich County, these return flows enter the river and are stored in Bear Lake. In Cache County, they flow into Cutler Reservoir, and in Box Elder County they are diverted to the federal bird refuge or flow into the Great Salt Lake.

Irrigation diversions can be reduced by eliminating conveyance losses, such as canal seepage, and improving irrigation scheduling during each day of the growing season. Repairing canals and linings is a constant activity of irrigation companies. Sprinkler irrigation is one way to improve the scheduling process by applying the optimum amount of water on each crop at the optimum time. About one-third of the irrigated land in the basin is served by sprinklers, and conversion to this method is continuing. Although diversion requirements are usually reduced by sprinkler irrigation, consumptive use is often greater because of the larger, healthier plants associated with better crop yields. Some excess irrigation water beyond the actual consumptive use is necessary to prevent accumulation of harmful salts on the soil surface with evaporation.

TABLE 17-1
DRINKING WATER USE

County	1990 Per Capita Use[a] (gallons/ day)	(acre-feet/year)
Rich	501	.561
Cache	406	.455
Box Elder	389	.436
Basin Average	421	.472
State Average	284[b]	.318

[a]From Table 11-7
[b]For 1989

In view of these circumstances, substantial savings from conservation of irrigation water are not likely.

17.3.3 Conservation Methods and Strategies

A wide range of water conservation methods have been used in other areas and other states. The experience gained by using these methods can be helpful to others, although circumstances are always different. Their application in the Bear River Basin is discussed in the following paragraphs.

Public Information/Education - Because everyone is a water user, any significant gain in water conservation is an accumulation of individual attitudes and efforts. Therefore, public education is essential in conserving water. The degree of success will be in direct ratio to the public perception of conservation's need or importance. Every public agency or private organization concerned with planning, developing, or distributing water has a responsibility in this regard. Two examples of water conservation material currently being distributed to schools, water-user organizations, individuals (on request) in the Bear River Basin, and throughout the state, are shown on Figures 17-1 and 17-2. This material is part of a water education program by the Division of Water Resources. Other conservation objectives of the division's education program include water-efficient landscaping and gardening techniques ("Xeriscape"), conversion to more efficient hardware such as low-flush toilets, and a continuing communication with students in the elementary schools.

Institutionalizing water conservation - Effective water conservation requires cooperative effort by all segments of the public, especially individuals. The desired unity of effort can best be achieved through the organized leadership of public agencies and other social or political groups. Organized institutional conservation efforts are starting to occur in some areas of Utah, but apparently not in the Bear River Basin.

Restricting Water Use - To make enough water available for necessary household (and commercial) use during periods of severe drought like in 1977, the use of municipal water for lawn and garden watering and other outside uses has often been restricted. This has usually been referred to as "water rationing." One of the easiest restrictions to monitor and enforce is to prohibit outside use on certain days of the week, or to allow outside use on

FIGURE 17-1

Lawn Watering Guide

Lawn watering uses nearly half of the water around homes. Most of us tend to water too often and leave the sprinklers on too long.

Turf studies have shown that most lawns only need to be watered once every 3 or 4 days to stay healthy and green. Watering every day creates shallow roots. Watering infrequently develops deep roots and healthier turf. Grass roots grow deeper into the soil and become stronger with less watering. If grass does not spring back after being stepped on, it's time to water. Water only when needed.

Use the watering schedule as a guide. Your lawn may need more water when it's extra hot or less when it's cool. Water less when it rains. Avoid watering on windy days or midday when the evaporation level is the highest. Try to water during the early morning hours. Proper lawn watering can save a lot of water — and that saves you money. For more information on water conservation call (801) 538-7299.

Utah Division of Water Resources
1636 West, North Temple
Salt Lake City, Utah 84116

Determine your lawn watering needs.

1. Set 3 or more flat bottom cans or coffee mugs at various places on your lawn at least 4 feet from sprinkler head.
2. Turn on your sprinkler(s) for 15 minutes.
3. Measure the depth of water in each can with a ruler and determine the average water depth in the cans.
4. Match your sprinkler output with table below. Then water the number of minutes indicated.

	Water Depth in Cans	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
		Watering Time In Minutes								
SEASON	Spring (Water every 4 days)	52	34	26	20	17	13	10	9	6
	Summer (Water every 3 days)	69	69	52	41	35	26	21	17	13
	Fall (Water every 3 days)	104	51	39	31	26	19	15	13	10

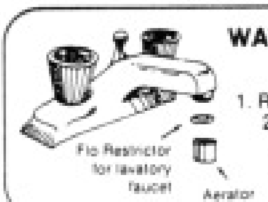
*Water through October 15 and again November 1st for Winter.
Note: If water begins to run off, stop and let it soak in a few minutes, then continue for the recommended time.
St. George / Dixie area - Add 10 minutes to watering times above.

FIGURE 17-2

PLEASE CONSERVE WATER!

Compliments of:

Utah Division of Water Resources
1636 W.N. Temple
Salt Lake City, Utah 84116
For more information call (801) 538-7200



WATER FLO RESTRICTOR
For Easy Shower
Installation:
1. Remove shower head from arm.
2. Insert flo restrictor with bevel facing shower head.
3. Reassemble shower head to shower arm.

WATER CONSERVATION REMINDERS:

1. FIX LEAKS: A dripping faucet can add up to a loss of 15 to 20 gallons per day. Faucet leaks are commonly caused by a worn washer. The few cents it takes to replace the washer is well worth the saving in precious water. A leaky toilet can waste up to 100 gallons a day. To detect one kind of toilet leak, drop some food coloring in the tank and wait about 15 minutes, without flushing. If the color has entered the bowl, there's a leak that should be fixed.
2. TOILETS: Toilets use about 40% of all water used in homes. Don't use the toilet to dispose of things that belong in the wastebasket. Most toilets use 5½ gallons per flush. You can reduce the amount of water used by weighting an empty plastic laundry or soap bottle with clean stones, fill with water, and place in the toilet tank, out of the way of the moving parts.
3. PERSONAL CLEANLINESS: Bathing and showering account for 30% of household water use. Short showers can consume less water than baths. Running the water while brushing your teeth or shaving can waste 10 gallons!
4. LAUNDRY AND DISHES: Dish and clothes washers account for 20% of home water consumption. Be sure to wash full loads only. When washing dishes by hand, use a sink stopper or dishpans full of suds and rinse water, not running water.
5. DRINKING WATER: Rather than running water until cool, keep a bottle of tap water in the refrigerator.

**By accepting this device, the consumer assumes all liability arising out of its installation and use the left or right side of the street, alternately. In the most severe cases, all outside use has been temporarily prohibited.

Corresponding restrictions on irrigators have also been imposed, but more frequently than on munimcipal users. The most common restriction is in accordance with water right priorities (first in time, first in right). Sometimes users receive a partial supply for each share of stock they own in an irrigation company.

The public has accepted these restrictions willingly, because they understand the necessity and realize the situation is temporary. But it is doubtful if the public would accept restrictions if they are perceived to be unnecessary, or are artificially contrived.

Joint Use of Water Supplies - Joint use (often called "conjunctive use") most often refers to surface water and groundwater. Where both are available as a water supply, groundwater can be allowed to accumulate during wet years, and then pumped in dry years to supplement surface water supplies. This is an excellent example of wise use, because it maximizes the available water supply.

Similarly, treated and untreated water can be used jointly to conserve high quality water for M&I use, as well as reduce costs. An auxiliary ("secondary," or "dual") water system to distribute untreated water for lawn and garden use allows a smaller system capacity of expensive, treated M&I water to suffice. A substantial portion of high-quality treated water in public water systems in the basin is customarily used for lawn and garden watering (See Section 11.4).

Several communities now have dual water systems for outside use. Among them are Paradise, Newton, Richmond, Smithfield, and Hyrum. Dual systems in a few other communities are under consideration. As high quality M&I water becomes more limited and expensive to treat, an increasing number of dual systems can be expected.

Landscaping and Home Water Savings - Reductions in per capita use of municipal water requires changes in personal habits and traditional practices inside and outside the home. This requires a mixed effort and a public perception of need. But a mixed effort can produce significant savings.

Inside, users can install water-saving toilets and shower heads, check plumbing for leaks, take shorter showers, use automatic dishwashers and washing machines only for full loads, and avoid having faucets run long periods for rinsing vegetables, dishes, and other items. Outside, users can avoid using a hose to clean driveways, letting water run to waste while washing a car, and improve landscaping practices. The Division of Water Resources teaches and encourages water conservation through creative landscaping (or "Xeriscaping"). The principles include limiting lawn areas, using plants and trees with low water requirements, irrigating only when needed, watering during morning or evening hours, and improving soils in shrub and garden areas by using mulches.

Pricing - Pricing policies are sometimes suggested as a means of reducing per capita water use. The change in per capita use in the Bear River Basin that would result from increasing water prices is unknown. The impact on the amount of water used would vary for each community water system. The rate increase would have to be substantial to be effective, according to general consensus. Such action, however, would require strong public support. For comparative purposes, rate schedules for several communities in the basin and in other Utah communities are shown in Table 17-2.

Reuse - No direct reuse or recycling of wastewater for drinking water use has been accepted 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 Bear River Basin, some direct reuse is already taking place. Approximately 1,400 acres of pasture and alfalfa are irrigated with water from the Logan City wastewater lagoon. The total use is approximately 4,100 acre-feet per year.

TABLE 17-2
RESIDENTIAL WATER RATES, 1985-86[4]

City	1990 Population	Monthly Base Rate	Minimum (gal.)	Rate (Per 1,000 gal.)	Cost for 30,000 gal.
Brigham City	15,644	$3.18	7,000	$0.254	$ 9.02
Tremonton	4,264	13.00[a]	15,000[a]	.60[a]	22.00
Garland	1,637	8.50	20,000	.50	13.50
Perry	1,211	9.50	15,000	.75	20.75
Corinne	639	8.40	12,000	.50	17.40
Plymouth	267	12.00	Unlimited	None	12.00
Logan	32,762	7.75[b]	3,000[b]	.45[b]	19.90
Hyrum	4,829	7.00	10,000	.25	12.00
N. Logan	3,768	5.25	1,000	1.00	34.25
Providence	3,344	7.00[e]	10,000[e]	.25[e]	12.00
Wellsville	2,206	7.50	35,000	.25	7.50
Richmond	1,955	9.40	10,000	.14	12.20
Nibley	1,167	9.00	15,000	.15	11.25
Newton	659	6.00	20,000	.08	6.80
Clarkston	645	12.91[d]	Unlimited	None	12.91
Trenton	464	17.85	700	.15	22.24
Randolph	488	10.00	15,000	.75	21.25
Woodruff	135	10.00	15,000	1.00	25.00
Laketown	261	8.00[f]	12,000[f]	.75[f]	21.50
Sandy	75,058	8.52	6,000[c]	.52	21.00
Bountiful	36,659	5.00	5,000	.73	17.38
Cedar City	13,443	14.00	10,000	.40	22.00
Vernal	6,644	4.20	8,000	1.10	28.40
Richfield	5,593	3.15	3,000	.25	8.90
Beaver	1,998	10.00	1,000	.30	18.70

[a]From city officials, 6-90.
[b]From Deseret News, 8-17-91.
[c]Minimum is 12,000 gal. in 60 days.
[d]Average fee.
[e]From Board of Water Resources Meeting, 12-21-90.
[f]From Board of Water Resources Meeting, 6-21-91.

Water Measurement - Accurate measurement of water encourages water conservation in several ways. Not only is each user assured of fair and equitable distribution and financial assessments, but it is also a more businesslike way to operate a system and provide records. Where users pay according to the quantity of water they actually use, there is a built-in tendency to conserve, whether the use is irrigation, municipal, or industrial. Most community water systems in the basin are metered. It may be practical, however, to meter all water systems.

17.4 RECOMMENDATIONS

The following recommendations relate directly to the discussions on various conservation methods described in Section 17.3.

17.4.1 Municipal Water Conservation

Each community should evaluate its own particular situation with regard to present supplies, present per capita use, anticipated future growth, and availability of new supplies. Then, a written water conservation plan should be prepared that will provide a good, long-term water supply at the optimum cost. For communities already in need, the plan should be designed to stretch their present supply until additional supplies are available. Until then, water use restrictions may be necessary. The new supply should allow a sufficient reserve capacity to manage in future drought periods. For communities with a current surplus, the plan should recognize this fortunate circumstance. In an orderly, unhurried way, they can implement conservation practices to accommodate anticipated future growth with the present surplus, and thus delay the expense of enlarging the present supply. The plan should also recognize the importance of maintaining an adequate reserve capacity.

17.4.2 Irrigation Conservation

Irrigation companies should also prepare a water conservation plan, after reviewing their own water supply situation. The plan should be designed to better the farmers and the company economically. To the extent allowable under current regulations for adjacent wet areas, canals should continue to be lined and maintained to reduce seepage losses. Conversion to sprinkler irrigation should be encouraged and supported whenever it is economically feasible. Further improvement of irrigation scheduling toward a goal of optimum water application at optimum times should be attempted.

17.4.3 Conservation Methods and Strategies

The methods and strategies in Section 17.3.3 with the most universal application in the Bear River Basin and recommended as being most likely to produce significant results are:

- public information/education
- landscaping and house water savings

Reasons for this recommendation are part of the description and discussion. Although less universal, the other methods can be very effective in particular communities with special conditions. Joint use of supplies should always be attempted whenever it is appropriate.

17.5 REFERENCES

In addition to the references listed below, Section 17 of the Utah State Water Plan, January 1990, discusses statewide water conservation related uses in more detail.

1. "Wasatch Front Total Water Management Study," Bureau of Reclamation and Utah Division of Water Resources, Joint Final Report, February 1990.

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Section 18
INDUSTRIAL WATER USE

18.1 INTRODUCTION

For this report, industrial water use is defined as water used in manufacturing of steel, chemicals, paper, and many other products. It includes processing, washing, and cooling operations, as well as employee use. In the Bear River Basin, meat packing, dairies, cheese, egg plants, and other food processing enterprises are included. Also included, to the extent they can be identified, are such activities as gravel washing and ready-mix concrete.

Total industrial use in the basin is relatively small, compared to more heavily populated counties along the Wasatch Front, i.e., Weber, Davis, and Salt Lake. About 80 percent of 1990 industrial use is self-supplied. The other 20 percent is from public supply systems. It is estimated and subtracted out from total public supply use in order to discuss industrial use separately. Almost all of the basin's industrial use is from groundwater.

No single agency or entity regulates the development or use of industrial water, although its use must conform to existing state laws for water rights, pollution control, and other regulations.

18.2 PRESENT USE

Table 18-1 shows a breakdown of estimated industrial uses in 1990, with a total of 10,310 acre-feet/year. The largest component is 7,400 acre-feet of self-supplied use in Cache County. This consists mostly of groundwater used for fish culture at two or more locations: Logan (Division of Wildlife Resources fish hatchery), Smithfield (commercial enterprise), and Providence (commercial). Another commercial fish operation near Paradise uses mostly surface water. The next largest portion is 2,451 acre-feet of industrial uses from public supplies. These uses include a major meat packing operation in Hyrum, a large cheese plant in Amalga, a dairy products plant in Wellsville, and several enterprises in Logan and North Logan (most of which are dairy or food processors). About half of the self-applied use in Box Elder County is at a large steel plant operation near Plymouth. Self-supplied use at Thiokol's aerospace operation near Howell is not included in Table 18-1,

NUCOR Plant Near Plymouth - NUCOR

TABLE 18-1
ESTIMATED INDUSTRIAL WATER USE IN THE BEAR RIVER BASIN

County and Community	Public Supply	Self-Supplied	Total	Estimated 1990 Depletions (AF/Year)[a]
	Estimated 1990 Diversions/Withdrawals[a] (AF/Year)			
Box Elder				
Perry	26			
Tremonton	92			
Total	118	900[b]	1,020	250
Cache				
Almaga	267			
Cornish	43			
Nibley	2			
Hyrum	1,128			
Wellsville	92			
Logan	272			
N. Logan	65			
Total	1,869	7,400[b]	9,270	2,320
Rich				
Laketown	20	0	20	10
Summit	0	0	0	0
Basin Total	2,007	8,300	10,310	2,580

[a]Estimated to be about 25 percent of diversions/withdrawals.
[b]At several locations.

because the operation and its industrial water supply lie outside the basin's hydrologic boundary. In Rich County, a meat packing plant in Laketown is the only significant industrial use.

Hydropower operations on the Bear River are extensive and long-standing. Utah Power and Light Company operates three hydropower dams and seven generating plants with a combined capacity of 117 megawatts, using Bear Lake for storage. Another seven megawatts of hydropower are generated at eight other power plants owned by cities and private entities. Although a non-consumptive industrial use, hydropower generation has altered natural flow patterns, with the main effect being in regulation and coordination of river flows.

18.3 PROBLEMS, ISSUES, AND FUTURE USE

At present, the most important issue with regards to industrial water use in the Bear River Basin is the coordination in water resource planning, waste treatment, and future industrial development. Industrial development could require moderate amounts of additional water. Both Cache and Box Elder counties are attempting to attract new industries for the improvement of employment and other economic benefits.

In contrast to residential and commercial water uses, which grow somewhat uniformly with population, future industrial use is impossible to predict. But that occurrence is not unlikely, and it could happen quickly.

Various amounts of future industrial use ranging from moderate to large have been estimated or recommended by consultants, water districts, and others. But at this time, none can be fully supported by factual, reliable information. One long-range projection by Box Elder County was in the range of 20,000 acre-feet/year. If industrial water use grows at the same rate as the population in the next 20 years, it will increase from 10,310 acre-feet to 13,460 acre-feet, as shown below.

Water quality of the existing supply for certain industries in Box Elder County is a major concern. The TDS (total dissolved solids) values in the water at one particular industrial site in Box Elder County have been measured at 1,525 mg/l, requiring considerable treatment to reduce the level to a usable level. Other industries have also experienced water quality degradation in some sources, making the water unusable without extensive treatment.

	1990 (acre-feet)	2010 (acre-feet)
Rich Co.	20	30
Box Elder Co.	1,020	1,290
Cache Co.	9,270	12,140
Total	10,310	13,460

18.4 RECOMMENDATIONS

The Bear River Association of Governments and appropriate local municipalities should develop and update inventories concerning present industrial water uses. Responsible local agencies should continue to estimate future industrial growth and make plans to supply needed water.

The Bear River Association of Governments should take the lead in evaluating the industrial water quality degredation in Box Elder County, and look for means of improvement.

18.5 REFERENCES

In addition to the references listed below, Section 18 of the Utah State Water Plan, January 1990, discusses six issues relating to industrial water use.

1. "Bear River Water Development Study," Hansen, Allen, and Luce, Inc., Consultant Engineers, and Valley Engineering Inc., February 1989.

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

3. Wasatch Front Total Water Management Study, Utah Division of Water Resources and U.S. Bureau of Reclamation, February 1990.

4. "Present Water Supplies, Uses, and Rights," Bear River and Wasatch Front, Hansen, Allen, and Luce, Utah Division of Water Resources, June 1991.

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Section 19
GROUNDWATER

Groundwater is an important source of water for municipal, industrial, and agricultural uses in the Bear River Basin. This section describes groundwater conditions in the basin.

19.1 INTRODUCTION

Groundwater has been developed in varying amounts in all valleys of the Bear River Basin. According to the USBR's "Bear River Investigations, Status Report," in 1970[1] there were over 3,430 wells in the Utah portion of the Bear River Basin. Figure 19-1 shows the general location of groundwater aquifers in the basin. An aquifer is defined as a water-bearing stratum of fractured or permeable rock, sand, and/or gravel. A groundwater reservoir can be defined as an aquifer that acts much like a surface reservoir, in that it spills and stores water as the level in the aquifer rises and lowers.

The groundwater reservoirs in the Bear River Basin are generally full. They are fed from precipitation and river flow at higher elevations, and they discharge water at lower elevations through wells, springs, and seeps. New withdrawals from these reservoirs could impact surface water by decreasing the discharge of flowing wells and springs, reducing water supply to wetland areas, and/or decreasing baseflow in streams. The impacts on existing water rights from future groundwater withdrawals, as well as the surface system, need to be understood to prevent future groundwater development from adversely affecting current users.

Estimates of present groundwater uses in the Bear River Basin are shown in Table 19-1. Water use refers to water that is withdrawn, but not necessarily consumed.

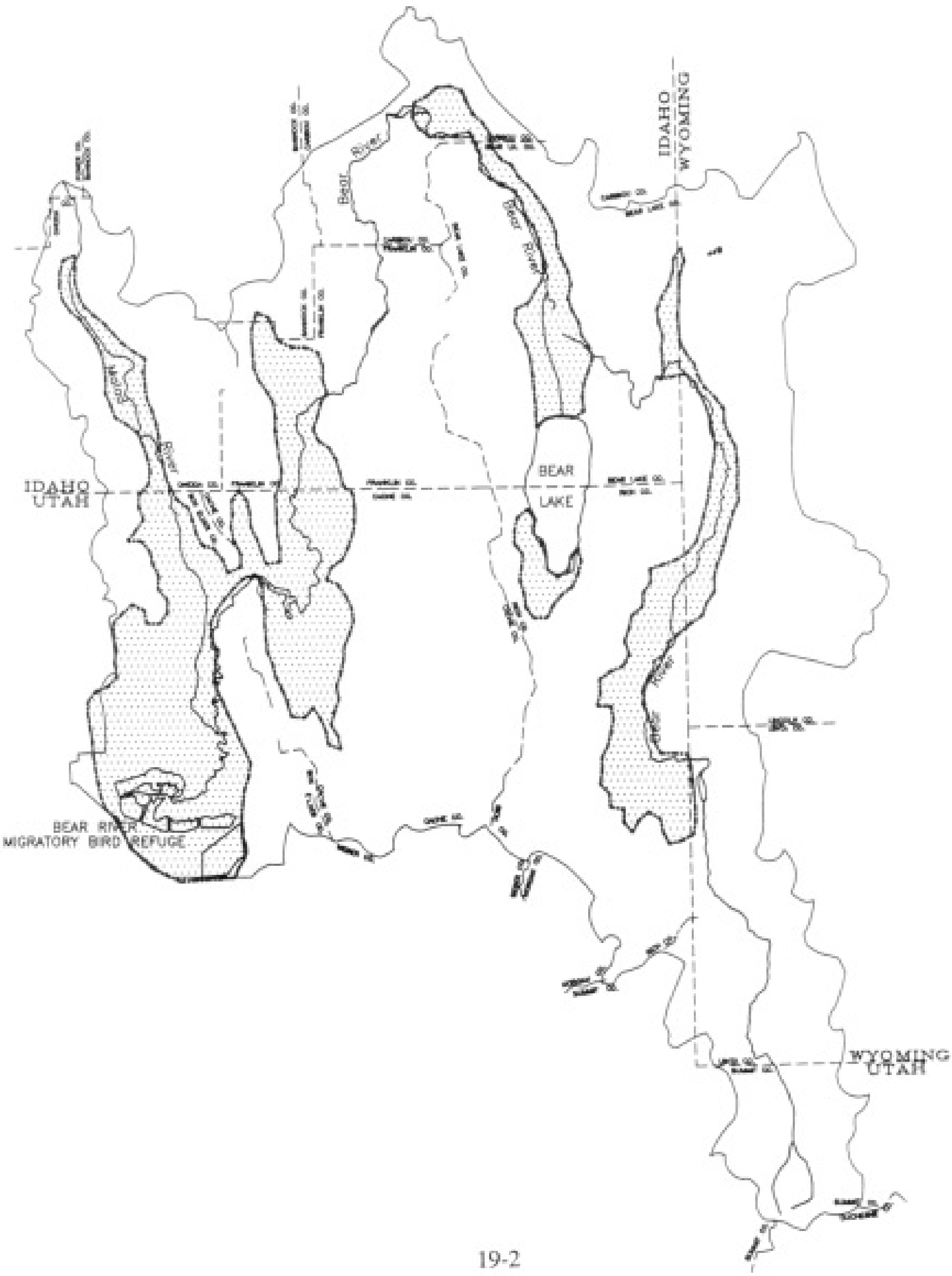
TABLE 19-1
PRESENT GROUNDWATER USE IN BEAR RIVER BASIN

Type of Use	1990 Average Annual Use (AF) Rich	Cache	Box Elder	Total
Residential/Commercial	3,340	31,430[a]	15,500[b]	50,270
Irrigation[2]	3,000	13,300	6,000	22,300
Industrial	20	9,270[2]	1,020[2]	10,310
Total	6,360	54,000	22,520	82,880

[a]500 acre-feet of surface water used for residential purposes in North Logan (See Table 11-9).
[b]400 acre-feet of surface water used for Brigham City Golf Course (See Table 11-8).

FIGURE 19-1

GENERAL LOCATIONS OF GROUNDWATER AQUIFERS IN BEAR RIVER BASIN



19.2 SETTING

Groundwater conditions in the Bear River Basin will be discussed in three parts: The upper basin (Rich and Summit counties), Cache County, and Box Elder County.

19.2.1 Upper Basin

The principal water-bearing deposits are limited to the flood plain area along the Bear River and along the southern part of Bear Lake.[3] The groundwater aquifers are mainly deep, alluvial deposits that consist of alternating layers of gravel, silt, and clay.

The adjacent mountain range area is underlain with clastic sedimentary rocks. These rocks are predominantly sandstone, quartzite, or shale, with some interbedded limestone or dolomite.[4] Wells in these aquifers generally have low yields. The yields vary from a few gallons per minute (gpm) to several hundred gpm in areas that are well fractured.

In the upper basin, the amount of groundwater use is small compared to the rest of the river basin. About 12 pumped wells are used for irrigation. The amount of water pumped is estimated to be 3,000 acre-feet/year.[5] At least five public water systems use groundwater--Randolph, Woodruff, Garden City, Laketown, and Bridgerland Village (west of Bear Lake). Total use for residential/commercial purposes is about 3,300 acre-feet/year. Groundwater use for other purposes, including livestock and for as many as 100 summer cabins in the mountains, is small by comparison.

19.2.2 Cache County

Although the entire drainage into Cache Valley is about 1,840 square miles (excluding the upstream Bear River drainage area), the valley itself occupies only about 660 square miles. About 300 square miles of this area extends north into Idaho. The Utah portion of Cache Valley covers the remaining 360 square miles.

Cache Valley is a structural basin bounded by faults on the east and west, and partly filled with sediments of Tertiary and Quaternary age. Strata of sand and gravel within these sediments make up the aquifers in this part of the basin. The adjacent mountain ranges are composed of carbonate sedimentary rocks which contain groundwater reservoirs. These reservoirs feed the numerous springs found along the edges of the valley.

BRWCD Test Well - Montgomery Engineers

The aquifers in Cache Valley consist of confined, semi-confined, unconfined, and perched types. At locations near the mountain front, aquifers are generally composed of coarse unconfined material. Groundwater in these regions is more easily recoverable than in other areas of the valley. At distances farther from the mountain front, layers of silt and clay begin to form confining layers that retard the upward movement of water.

Artesian conditions exist in approximately 200 square miles of the central part of the valley, and wells flow in an area of about 130 square miles. Pressure heads of most flowing wells are less than 40 feet, but heads as high as 62 feet have been measured. Depths to water are as much as 300 feet along the margins of the valley. Water table conditions exist near the edge of the valley and in a thin zone overlying the artesian areas in the central part of the valley. Perched groundwater exists in many locations in the valley.

The most productive aquifer system in Cache County is in the area along the east side of the valley between Smithfield and Hyrum. Yields to wells of as much as 3,500 gpm have been measured, and yields of 500 gpm or more are possible from most of the aquifer system.[6]

More than 2,400 wells and springs in Cache County supply water for irrigation, industrial, residential, and commercial uses.[7] In 1990, use from groundwater was about 13,300 acre-feet for irrigation, 9,300 acre-feet for industry, and 31,400 acre-feet for residential and commercial purposes.

The public water supply provides municipal use for 24 communities in the Utah portion of Cache Valley. The 1990 population of Cache County was 70,183. The valley has a good supply of high quality groundwater for municipal use. Public water systems supply much of the demand for dairies and meat packing industries.

Recharge to the groundwater system in Cache County occurs mainly within alluvial zones adjacent to the mountain front. Of the total calculated recharge, 47 percent originates as infiltration of precipitation that falls directly on the valley, or by infiltration directly from stream channels. Another 42 percent infiltrates from irrigation on croplands and other areas. The remaining 11 percent recharges the groundwater system by subsurface flow through faults, fractures, or solution channels. Total recharge to the Utah portion of Cache Valley is estimated to be 170,000 acre-feet per year.[8]

Groundwater discharge includes pumping from local wells, subsurface flow, seepage of water to streamflow, and evapotranspiration from high water table areas. Approximately 170,000 acre-feet of water is discharged annually in Cache County as shown in Table 19-2.

A 1990 report by the Bureau of Reclamation and Division of Water Resources (based on the 1971 USGS Study[6]) estimated that an additional 75,000 acre-feet/year of groundwater could be withdrawn from Cache Valley aquifers without significantly impacting surface supplies.[8] However, withdrawals of large quantities of groundwater will affect water rights and hydrodynamics of the groundwater system.

In an effort to gain a better understanding of current groundwater conditions, the Division of Water Resources and the Division of Water Rights have contracted with the U.S. Geological Survey to undertake a three-year cooperative study (to be completed in the fall of 1993) to:

1. Assess current conditions in Cache Valley in terms of recharge, movement, and discharge of groundwater, water levels, groundwater quality, and volumes of water in storage, and to document changes in conditions since the last study in Cache Valley in 1967-69;

2. Better define the groundwater system and how its components interact, with emphasis on groundwater/surface water interactions;

3. Estimate the effects of additional groundwater withdrawals in various geographic patterns, on water levels, streamflow, spring discharge, and evapotranspiration.

TABLE 19-2
GROUNDWATER DISCHARGE IN CACHE COUNTY[8]

	(acre-feet/year)	(percent)
Pumped from wells	24,000[a]	14
Discharge to streams and springs	83,000[b]	49
Losses to evapotranspiration	63,000	37
Subsurface outflow	Negligible	
Total	170,000	100

[a]For residential, commercial, industrial, irrigation, and livestock use (See Table 5-4).
[b]Including springs developed for residential/commercial use. Most community drinking water sources are springs (See Section 11.2.2).

Chemical analyses of water from the principal aquifers show it is of generally good quality. The quality has not changed significantly since 1941. Average TDS (total dissolved solids) values are less than 400 mg/L in the southern and eastern portions of the valley. The TDS values increase towards the west and north portions of the valley, with concentrations generally between 400-800 mg/l in the Benson, Newton, and Clarkston areas. Increases in TDS generally occur as the water moves from recharge areas near the mountains toward the discharge areas on the valley floor. Calcium, magnesium, and bicarbonate are the major chemical constituents present in the water.

19.2.3 Box Elder County

The Box Elder County portion of the basin is described as that portion east of the Promontory Mountains. The area covers about 800 square miles (See Section 3).

Like Cache Valley, the Box Elder County region is a structural basin into which the Bear River has deposited a delta.[9] Groundwater occurs in the sand and gravel beds of the delta and in the carbonate sedimentary bedrocks of the adjacent mountains.

Three main aquifers are within this area. The major one, from which most of the developed wells obtain their water, is a deep, confined aquifer. Unconfined and localized perched aquifers lie above the confined zones. Areas near the mountain front are typically unconfined or on the outer fringes of the confining system. The highest yielding wells penetrate the clastic geologic materials of these areas. Local perched aquifers are present in Box Elder County, but both the quantity and quality are highly variable. Therefore, little development of these zones has taken place.

Box Elder County is hydrologically complex. It is an area of transition, with cold, fresh groundwater at the upstream end (at higher altitudes) and generally warm, very saline groundwater at the downstream end near the Great Salt Lake. A wide range of hydrologic conditions exists through the area between.

Groundwater within the area is used for irrigation, public supply, livestock, and domestic use. Public supply provides municipal use for at least 22 communities in Box Elder County. The 1990 population of the entire county was 36,485. At present, all of the municipal water systems are supplied from springs and wells. Some of the distribution systems cover large rural areas because local groundwater is not always suitable for domestic use. According to a recent study, annual municipal and industrial use is 12,800 acre-feet and 3,500 acre-feet, respectively.[10]

Groundwater use for irrigation in Box Elder County occurs mainly in two areas: Brigham City-Perry and the "Bothwell Pocket," west of Tremonton. In the Brigham City-Perry area, moderate additional development of good quality groundwater is feasible. But in the Bothwell Pocket, additional development is marginal, and the

discharge by subsurface flow to springs, drains, or streams, and by evapotranspiration from high-water-table areas. As shown in Table 19-3, approximately 315,000 acre-feet of water is discharged annually in Box Elder County.

More information about the groundwater storage characteristics of Box Elder County is needed, but it appears that only a small percentage of stored water could be beneficially developed. This is because the outer fringes of the Great Salt Lake are highly saline. Any marked decreases in the groundwater levels could result in this poorer quality groundwater moving to inland groundwater reservoirs.

TABLE 19-3
GROUNDWATER DISCHARGE IN EASTERN BOX ELDER COUNTY[8]

	(acre-feet/year)	(percent)
Pumped from wells	4,000[a]	1
Discharge to streams	210,000[b]	67
Subsurface outflow	1,000	0.3
Evapotranspiration	100,000	32
Total	315,000	100

[a]For residential, commercial, industrial, irrigation and livestock use (See Table 5-4).
[b]Including springs developed for residential/commercial use. Most community drinking water sources are springs (See Section 11.2.2).

State Engineer has closed the area to further pumping. Sixty-four percent of recharge to the groundwater system in Box Elder County occurs from infiltration of precipitation, and infiltration directly from stream channels. Another 27 percent occurs from irrigation seepage, and nine percent from subsurface flow. Total recharge to Box Elder County is estimated to be 315,000 acre-feet per year.

Groundwater discharge occurs from the pumping of wells; seepage of water to the surface,

Chemical quality varies from "excellent" to "unfit for most uses" because of salinity. In general, the quality improves with distance from and elevation above the Great Salt Lake. Analyses show that dissolved solids vary from 88 to 122,000 mg/1, depending on location. Calcium, magnesium, and bicarbonate are the predominant ions in the water near the edges of the mountains.

19.3 PROBLEMS, NEEDS, AND ISSUES

Several important problems and issues related to groundwater have been identified. These problems and issues include:

1. Proposal to export groundwater from Cache Valley to Box Elder County,

2. Reduction of flow and pressure from flowing wells by increased groundwater use,

3. Urban development in recharge areas,

4. Protection of groundwater from contamination.

In October 1984, the governor issued an Executive Order that defined Utah's groundwater policy and directed the Department of Health to develop a protection strategy. Subsequently, a draft "Ground Water Quality Protection Strategy for the State of Utah" was published in June 1986.[11] This document is part of the State Water Plan by reference.

At present, about 50,270 acre-feet/year (or 98 percent) of the 51,170 acre-feet of residential and commercial water used in the basin (See Table 11-7) is from springs and wells, and this trend will probably continue. By the year 2010, the municipal and domestic requirement is expected to increase by nearly 14,000 acre-feet, with about the same percent expected to come from groundwater. Most of the increased use of groundwater will probably be in Cache Valley, where the supply of high-quality groundwater is greatest.

Currently, all of the industrial use in the basin (approximately 10,310 acre-feet/year) is from groundwater supplies. It is expected that groundwater for agriculture (about 22,300 acre-feet/year) will probably remain constant, but municipal and domestic use is expected to continue to increase.

19.4 RECOMMENDATIONS

To the extent a groundwater supply is available, and water quality remains good, groundwater development in Cache and Rich counties should continue to satisfy future high-quality needs. Ongoing studies should define what level of new development can occur without significant interference with existing water rights.

Cooperative development and distribution of surface water and groundwater supplies is recommended in order to meet the future growth of municipal and industrial requirements in the basin.

In Box Elder County, further development of groundwater for residential/ commercial use cannot be ruled out. Geophysical surveys and test-drilling might locate good quality groundwater. If available, these new sources can be developed to increase the fresh groundwater supplies of the lower Bear River area, where fresh water resources are somewhat limited. However, new wells must be approved by the State Engineer, who has closed some portions of Box Elder County to further groundwater development.

To safeguard groundwater supplies throughout the basin, all water resources and water user entities should cooperate and support the state's groundwater quality protection strategy.

19.5 REFERENCES

In addition to the references listed below, Section 19 of the Utah State Water Plan, January 1990, discusses the relationship of groundwater to the total water needs and presents recommendations on the groundwater issues.

1. "Bear River Investigations, Status Report," U.S. Bureau of Reclamation, June 1970.

2. "Bear River Development-Present Water Supplies, Uses & Rights" Hansen, Allen & Luce, Inc., June 1991.

3. "Hydrologic Inventory of the Bear River Study Unit," by Haws and Hughes, Utah State University for the Utah Division of Water Resources, February 1973.

4. "Multiobjective Interagency Study, Bear River Basin, Water and Related Land Resources," Utah Division of Water Resources, December 1976.

5. Based on several telephone interviews with experienced U.S. Soil Conservation Service engineers in Logan and Randolph, March 1991.

6. "Groundwater Resources of Cache Valley, Utah and Idaho," by Bjorklund and McGreevy, U.S. Geological Survey, for Utah Division of Water Rights, Technical Publication No. 36, 1971.

7. "Groundwater Conditions in Utah, Spring of 1990," by Herbert et. al, U.S. Geological Survey, in cooperation with Utah Division of Water Rights, Cooperative Investigations Report No. 30, 1990.

8. "Wasatch Front Total Water Management Study," Utah Division of Water Resources and U.S. Bureau of Reclamation, February 1990.

9. "Bear River Water Development Study" prepared for Bear River Water conservancy District and Tremonton City Corporation, by Valley Engineering, Inc. and Hansen, Allen and Luce, Inc., February 1989.

10. "Groundwater Resources of the Lower Bear River Drainage Basin, Box Elder County, Utah," by Bjorklund and McGreevy, U. S. Geological Survey, for the Utah Division of Water Rights, Technical Publication No. 44, 1974.

11. "Ground Water Quality Protection Strategy for the State of Utah," by Barnes and Croft, Utah Department of Health, June 1986.

State Water Plan ■ BEAR RIVER BASIN

Prepared by the State Water Plan Coordinating Committee

Department of Natural Resources - Division of Water Resources,
Division of Water Rights, Division of Wildlife Resources,
Division of Parks and Recreation

Department of Environmental Quality - Division of Drinking Water,
Division of Water Quality

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