10-1965

Central Utah Project Ultimate Phase: Inventory of Available Data

Bureau of Reclamation

CENTRAL UTAH PROJECT ULTIMATE PHASE

INVENTORY OF AVAILABLE DATA

OCTOBER 1965

Bureau of Reclamation, Region 4
Central Utah Projects Office, Provo, Utah
Palmer B. DeLong, Project Manager

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ULTIMATE PHASE

INVENTORY OF AVAILABLE DATA

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Bureau of Reclamation, Region 4
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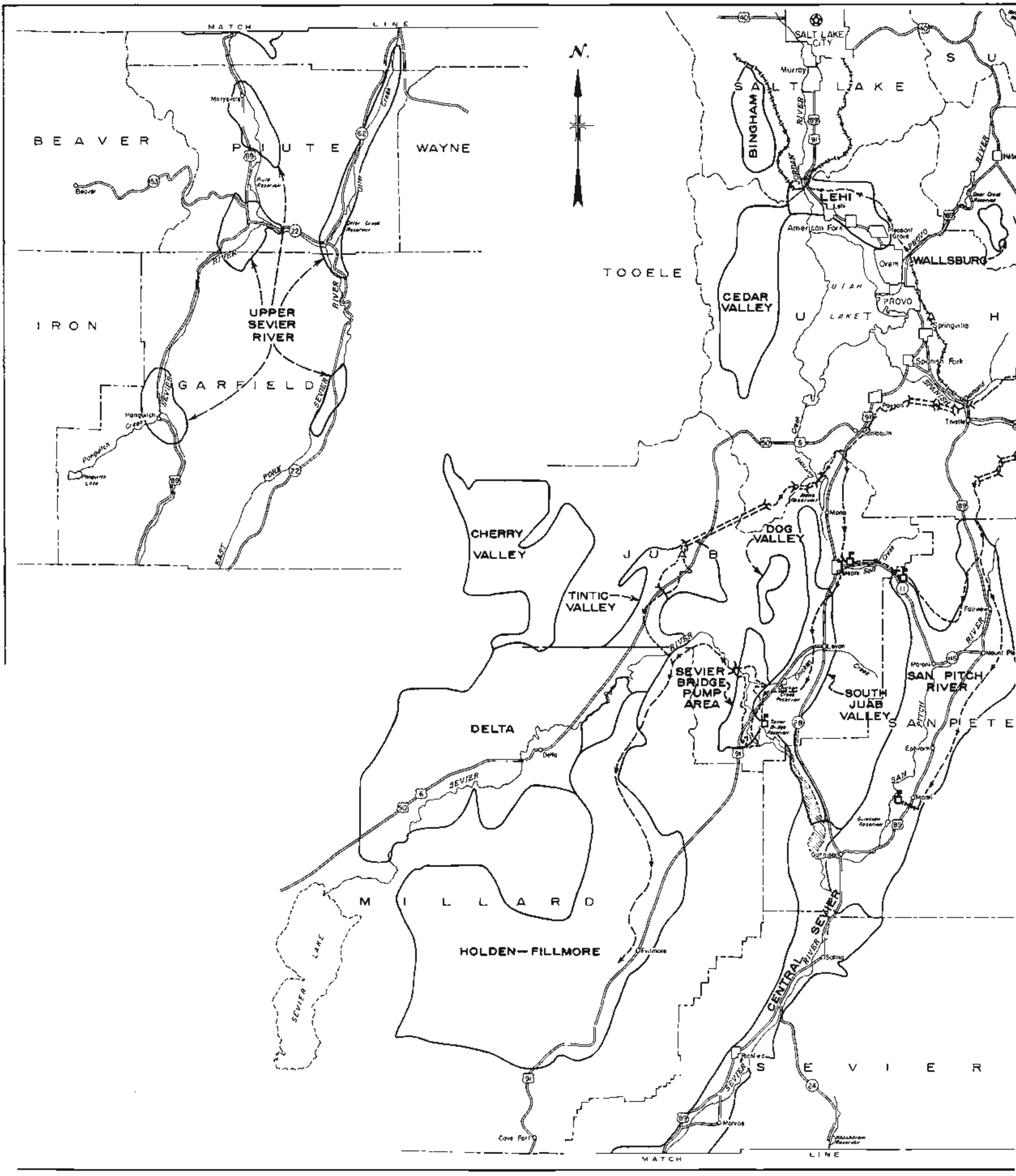
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BINGHAM
LEHI
Murray
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Pleasant Grove
Orem
PROVO
WALLSBURG
TOOELE
CEDAR VALLEY
UTAH LAKE
UTAH
Springville
Spanish Fork
Payson
Santaquin
Thistle
Mona
DOG VALLEY
CHERRY VALLEY
JUAB
TINTIC VALLEY
Nephi
Fairview
Levan
SEVIER BRIDGE PUMP AREA
SOUTH JUAB VALLEY
SAN PITCH RIVER
SANPETE
Mount Pleasant
Moroni
Ephraim
Manti
Gunnison
DELTA
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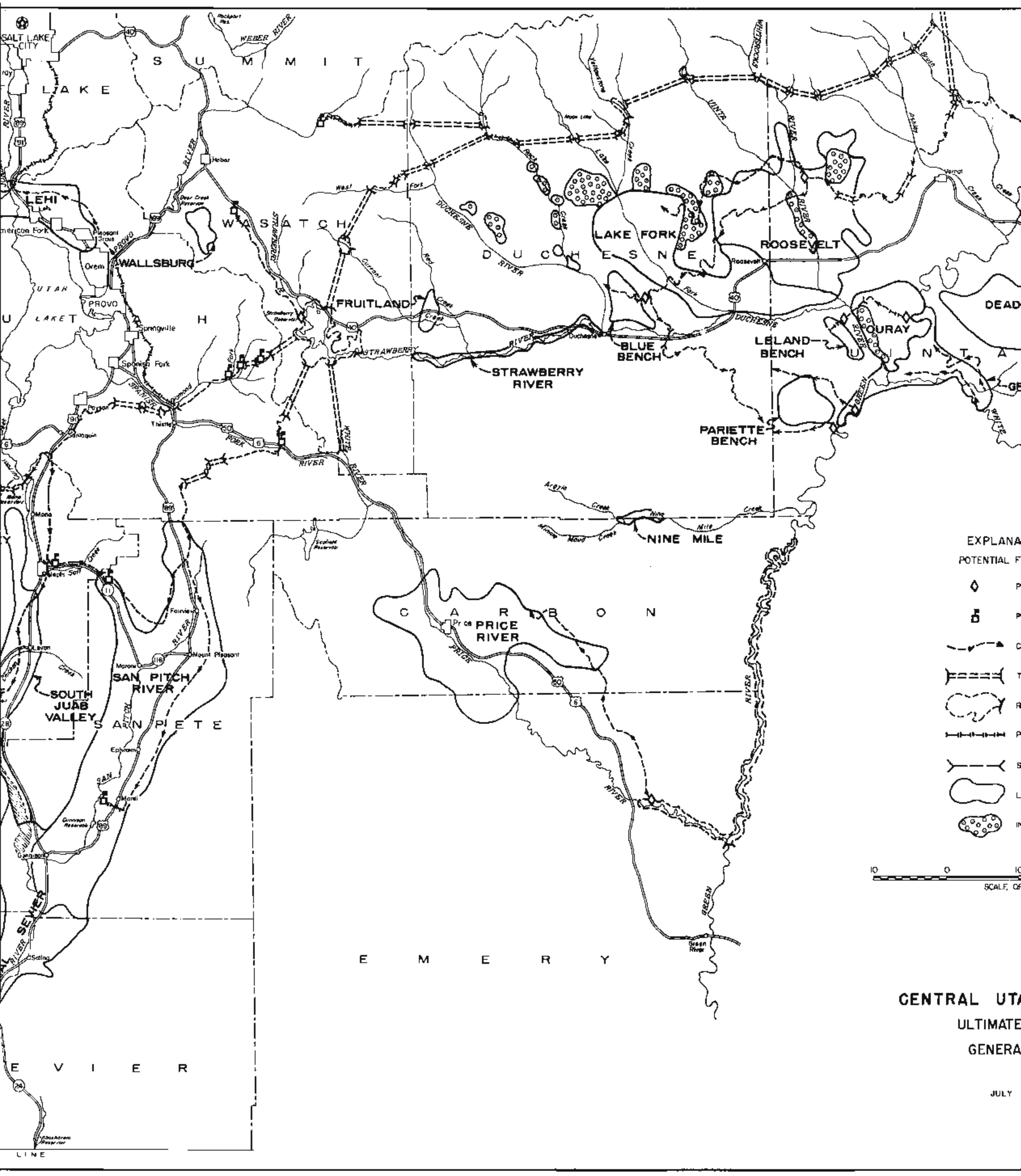
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LELAND BENCH
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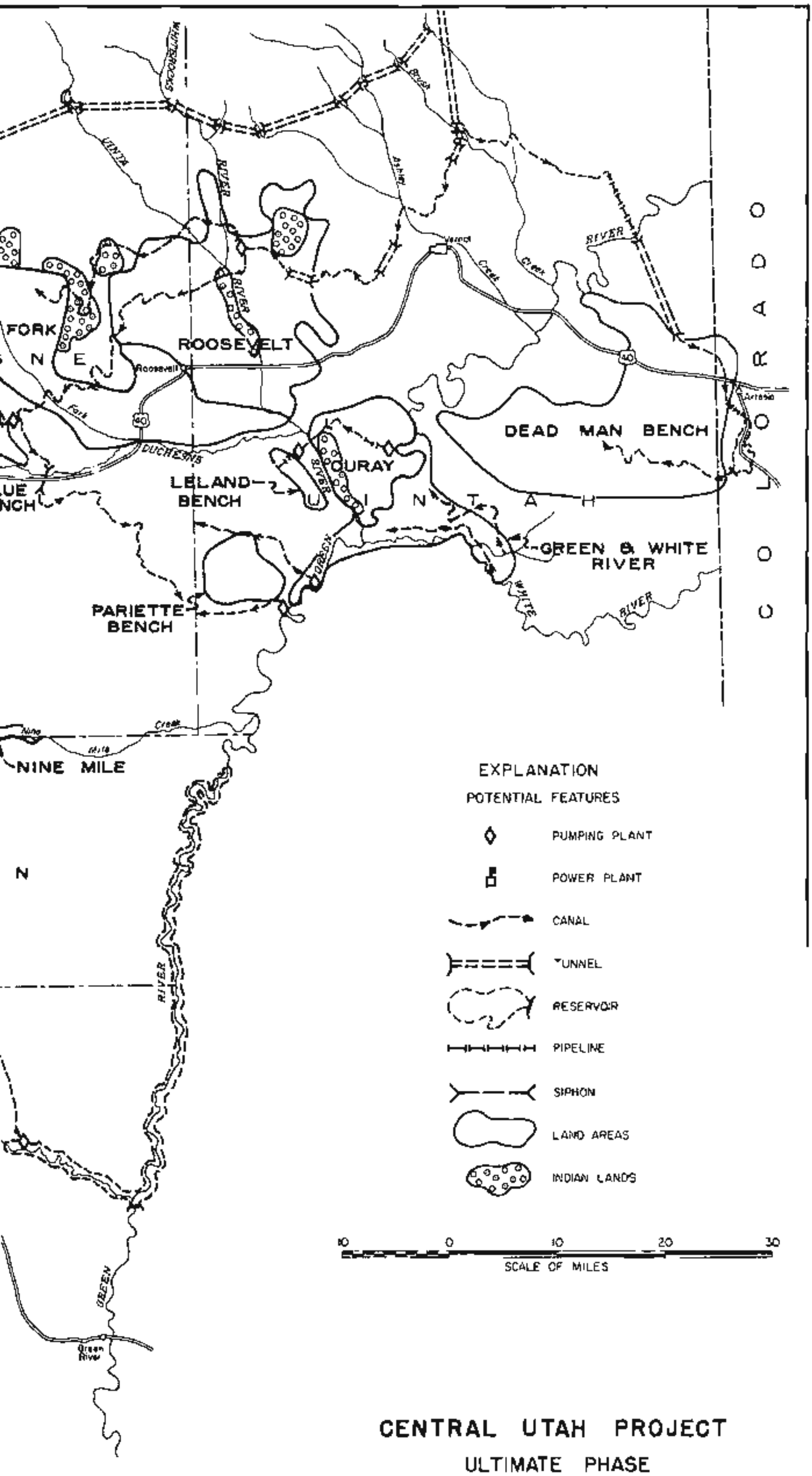

CENTRAL UTAH PROJECT

ULTIMATE PHASE

GENERAL MAP

JULY 1964

289-418-12

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CHAPTER I

GENERAL DISCUSSIONS

Introduction

The plan for the Central Utah project involves a diversion of water from streams in the Uinta Basin in the Upper Colorado River Basin to the closed Bonneville Basin in Central Utah and other associated water resource developments in both basins. Construction of the initial phase of the project was authorized by the Colorado River Storage Project Act of April 11, 1956 (70 Stat. 105). The initial phase has been divided into four units. Three of these, the Vernal, Jensen, and Upalco units, are developments in the Uinta Basin. The fourth, or the Bonneville unit, involves a diversion from the Uinta Basin to the Bonneville Basin and related developments in both basins. Construction is essentially completed on the Vernal unit and will commence this year on the Bonneville unit. Definite plan studies are underway on the Upalco and Jensen units.

The ultimate phase will expand on the initial phase development. Although plans are not yet definitely formulated, its purpose will be to increase the transbasin diversion to the Bonneville Basin and to provide water for replacement and additional use in the Uinta Basin. Water for the Uinta Basin will be provided by developments on streams originating in the basin and from the Green River either by pumping or by gravity flow through a tunnel heading at the existing Flaming Gorge Reservoir. Various alternatives will be considered for water sources, sites of storage and conveyance facilities, and places and nature of use. The principal facilities and irrigation service areas that are being considered for the ultimate phase are shown on the frontispiece map.

One part of the ultimate phase, designated as the Uintah unit, has been segregated for separate study, as it could be constructed and operated independently of other parts of the project. A feasibility report on this unit is scheduled for completion on July 1967. The unit will include storage developments on local streams (not shown on frontispiece map) to provide supplemental water for lands presently irrigated from the Uinta and Whiterocks Rivers in the Uinta Basin.

This report has been prepared as a means of bringing together all of the available data that may be useful in outlining and conducting an orderly investigation of the ultimate phase as a whole. A preliminary appraisal report on the ultimate phase scheduled for completion in 1968 will facilitate the selection of the optimum justifiable scheme of development.

Needs for the Project

The Central Utah project offers Utah one of the most practicable opportunities to use the major part of its share of Colorado River water as apportioned by the Upper Colorado River Compact of 1948. Water is the limiting factor in the future progress of the Central Utah area. The area's continued natural resource development and economic and population growth are assured with the water the project would make available. Without such expanded water supplies a rigid ceiling would be imposed on Central Utah's future growth. In the Bonneville Basin where the water requirement is the greatest, undeveloped water supplies are the shortest.

Utah officials and informed citizens generally recognize that the State's potential for economic growth and development is limited by its water supply. They look to the Central Utah project as the only means of providing large amounts of additional water to the most highly developed part of the State where population growth and industrial development are continuing at a rate far above the average for the State and the Nation.

Dry farming cannot be practiced successfully in most of the project area because of the limited rainfall during the growing season. Most of the readily available local water sources are already fully developed. It is anticipated that by the time water is made available by the ultimate phase the municipal and industrial requirement of the area will be far in excess of available local supplies. In fact, the municipal and industrial demand may be great enough to utilize much of the water developed by the project.

Climate

The ultimate phase area generally has a temperate, semiarid climate with relatively warm summers and cold winters that is usually satisfactory for irrigated agriculture. The Bonneville Basin with lower elevations has higher precipitation and temperatures with longer growing seasons than the Uinta Basin area. The climate in both basins varies considerably from place to place according to elevation. Temperatures are lower and the growing seasons shorter in and near the mountain valleys than on the lower elevations of the basin floors.

Climatological data at a number of stations in the project area are tabulated on the following page. The four stations--Altamont, Duchesne, Roosevelt, and Vernal--are representative of conditions in the Uinta Basin area. The Price Game Farm station is representative of the Price area. The remaining stations are representative of conditions that exist on the Bonneville Basin floor from Salt Lake City south to Milford.

Climate limits the variety of crops that can be successfully produced in the Uinta and Price River Basins to alfalfa, small grains, silage corn,

Ultimate Phase of the Central Utah Project
Summary of Climatological Data through December 1962

Location of station	Sta. elev. (ft. above sea level)	Years of precip. record	Precipitation (inches) Ave. annual	Ave. growing season	Annual extremes High	Annual extremes Low	Years of temp. record	Temperature Ave. annual	Extremes High	Extremes Low	Average annual growing periods (days) Frost-free (32°F)	Season
Bonneville Basin												
Beaver	5860	46	11.35	6.06	21.20	5.82	33	47.2	102	-34	106	142 May 11-Sep 30
Delta	4759	21	7.60	3.03	12.87	3.32	21	50.2	106	-25	145	170 Apr 23-Oct 9
Elberta	4690	60	9.90	5.03	14.95	5.18	54	50.2	109	-28	133	194 Apr 17-Oct 27
Fillmore	5250	70	14.04	4.99	21.28	6.72	69	52.4	115	-23	152	176 Apr 25-Oct 17
Levan	5300	72	13.22	4.54	26.22	7.20	69	49.4	104	-28	135	150 May 3-Oct 12
Milford	5028	55	8.00	2.98	13.17	5.06	45	49.0	104	-22	120	153 May 3-Oct 3
Nephi	5133	56	14.75	7.47	22.34	7.21	19	51.7	106	-18	134	200 Apr 11-Oct 28
Oak City	5075	48	11.60	4.70	19.05	6.59	45	52.4	108	-25	138	178 Apr 26-Oct 21
Panguitch	6720	34	9.41	5.56	15.21	5.44	31	43.5	97	-38	71	106 Jun 1-Sep 14
Piute Dam	5900	47	8.14	4.40	14.73	4.54	36	48.8	101	-32	134	154 May 6-Oct 6
Provo	4470	72	12.87	5.55	21.82	6.94	50	49.3	108	-35	146	193 Apr 10-Oct 19
Richfield Radio KSVC	5300	44	8.01	3.29	13.00	1.82	43	49.5	104	-28	122	148 May 8-Oct 3
Salt Lake City	4220	28 2/	13.90	6.65	18.79	9.36	28 2/	51.1	106	-30	166	202 Apr 8-Oct 27
Tooele	4820	65	15.48	6.64	24.41	9.93	64	51.5	102	-14	169	209 Apr 8-Nov 3
Average	5180	51	11.31	5.06	18.50	6.08	43	49.7	105	-27	134	170 Apr 27-Oct 14
Price River Basin												
Price Game Farm	5580	35	9.24	4.82	19.55	4.47	31	49.6	108	-31	150	178 Apr 26-Oct 19
San Pitch River Basin												
Manti	5585	62	11.93	4.28	18.94	7.08	62	47.7	110	-27	130	158 May 7-Oct 12
Moroni	5525	49	9.69	3.43	20.72	5.64	44	47.3	107	-30	116	147 May 11-Oct 5
Average	5555	56	10.81	3.86	19.83	6.36	53	47.5	109	-29	123	153 May 9-Oct 9
Uinta Basin												
Altamont (Mt. Emmons)	6100	23	7.52 1/	4.56	12.76	3.66	25	44.8 1/	98	-32	116	170 Apr 25-Oct 12
Duchesne	5515	56	9.07	3.93	15.70	4.60	53	44.6	99	-43	120	164 Apr 28-Oct 9
Roosevelt	5094	22	7.53	3.98	13.94	4.14	19	46.7	105	-32	136	176 Apr 19-Oct 12
Vernal	5280	61	7.97	4.25	14.78	4.62	61	44.0	103	-38	119	184 Apr 21-Oct 22
Average	5497	41	8.02	4.18	14.30	4.26	40	45.0	101	-36	123	174 Apr 23-Oct 14

1/ Average determined from 10-year period, 1953-1962, as previous years' record not available.
2/ Salt Lake Airport record only.

and pasture. In the Bonneville Basin areas the more favorable climate permits the production of a wide variety of crops including berries, deciduous fruits, and canning crops.

Population

The combined 1960 population of the 19 counties included in the ultimate phase project area totaled 786,083 which is about 88 percent of the population of Utah. About 85 percent of the people of this area reside in the industrialized Salt Lake, Weber, Utah, and Davis Counties. The population of these four counties increased from 341,503 in 1940 to 665,530 in 1960, a gain of about 95 percent over 1940 as compared to a 37 percent increase for the Nation as a whole. The combined population of the 15 rural counties of the area (Beaver, Carbon, Duchesne, Emery, Garfield, Juab, Millard, Morgan, Piute, Sanpete, Sevier, Summit, Tooele, Uintah, and Wasatch) declined from 128,249 in 1940 to 120,553 in 1960, reflecting the movement of people from rural communities to urban centers. The population of the 19 counties involved is shown at 20-year intervals in the following table.

	Population			
County	1900	1920	1940	1960
Beaver	3,613	5,139	5,014	4,331
Carbon	5,004	15,489	18,459	21,135
Davis	7,996	11,450	15,784	64,760
Duchesne	1/	9,093	8,958	7,179
Emery	4,657	7,411	7,072	5,546
Garfield	3,400	4,768	5,253	3,577
Juab	10,082	9,871	7,392	4,597
Millard	5,678	9,659	9,613	7,866
Morgan	2,045	2,542	2,611	2,837
Piute	1,954	2,770	2,203	1,436
Salt Lake	77,725	159,282	211,623	383,035
Sanpete	16,313	17,505	16,063	11,053
Sevier	8,451	11,281	12,112	10,565
Summit	9,439	7,862	8,714	5,673
Tooele	7,361	7,965	9,133	17,868
Uintah	6,458	8,470	9,898	11,582
Utah	32,456	40,792	57,382	106,991
Wasatch	4,736	4,625	5,754	5,308
Weber	25,239	43,463	56,714	110,744
Total	232,607	379,437	469,752	786,083

1/ Organized from part of Wasatch County in 1915, and a portion of Uintah County was annexed in 1917.

Public Facilities

In general, the project area is well served with essential public facilities. The Bonneville Basin is served by various railroad lines extending from Salt Lake City in almost every direction. Major highways also traverse the Bonneville Basin area. Though no railroads enter the Uinta Basin, the area is well served by a major transcontinental highway. The Price River area is served by a mainline railroad and a transcontinental highway. Branch highways are plentiful, and bus and truck lines on regular schedules reach all parts of the project area. Several transcontinental airlines make regularly scheduled stops at Salt Lake City, and feeder lines serve the larger communities in the area.

Telephone and telegraph facilities are available in all parts of the area. Electric power is provided to the Bonneville and Price River Basins, through the interconnected Utah Power & Light Company system and by several small municipal power systems in the Bonneville Basin. The Uinta Basin is supplied by the Utah Power & Light Company and by the Moon Lake Electric Association, an REA cooperative.

Most of the communities within the project area have private municipal water systems, generally supplied from nearby mountain streams and springs. Some of the larger cities, having exhausted their local supplies, have drilled wells and have reached out great distances to obtain water to supplement the local sources. Modern water purification or chlorination and sewage disposal plants are found in most of the larger communities.

Good educational facilities are located throughout the project area, consisting of several universities and numerous up-to-date elementary, junior high, and high schools.

Industrial Development

Agriculture has generally been the basic industry in the overall project area and is mainly centered around livestock production with its attendant feed crops, although diversified crops are successfully grown in the Bonneville Basin. Since about 1940 industrial expansion and growth have been pronounced in the highly industrialized areas of Salt Lake, Davis, Weber, Utah, and Carbon Counties where agriculture is no longer the predominant industry. This industrial development is mostly related to the mineral and agricultural products of the region and to national defense and space exploration.

Production at the Kennecott Copper Corporation's mine in Salt Lake Valley has a higher value than any other open-pit copper mine in North America. The copper is concentrated, smelted, and electrolytically refined at plants near Salt Lake City. Gold, silver, molybdenite, selenium, and other metals are also produced in significant quantities at the Kennecott mine. Iron and steel are produced by U.S. Steel's Geneva plant near Provo, one of the largest fully integrated steel plants west of the Mississippi River. Several manufacturing plants using locally produced steel and copper are operating in the area.

Various transportation and service industries have helped make Salt Lake City and Ogden major trade and distribution centers in the mountain west. In addition, a number of processing plants for agricultural products are prevalent, and plants which produce chemicals, stone, glass, paint, and clay products are located in the area. In the Salt Lake, Davis, and Weber County areas are such important defense and space exploration installations as the Chemical Propellant Division of Hercules Powder Company, Sperry Utah Engineering Laboratories of Sperry Rand Corporation, Litton Industries, Hill Air Force Base, and Marquardt Aircraft Corporation.

Business in the Uinta Basin has been stimulated by local oil discoveries near Vernal and Roosevelt and by phosphate and potash developments in recent years and also by development of the important Rangely oil field in Colorado, about 50 miles east of Vernal.

Coal mining in Carbon County is responsible for Utah's ranking as tenth in the Nation in coal production and first among the states west of the Mississippi River. Coal constitutes the major industry in the Price River Basin. Carbon dioxide is mined from wells near Wellington from which dry ice is manufactured, and substantial quantities of natural gas are mined in the area around Price. A missile base at Green River, about 60 miles southeast of Price, serves as an operational testing and proving base.

A substantial source of income to the project area is provided through recreation and tourism. Recreation is primarily in the form of fishing, hunting, camping, boating, water-skiing, and winter sports on the nearby streams, lakes, and mountains. Some of the Nation's most scenic attractions are in or easily accessible to the Central Utah project area. These attractions include national monuments, lakes, streams, and beautiful mountain scenery. Tourism has developed into an important industry and is increasing in volume each year.

Natural Resources

Utah and the immediate surrounding areas have greater quantities of mineral wealth--fuels, metals, and chemicals--than any other comparable area known. Discoveries of additional natural resources are still being made, but those already known assure continued industrial growth in the area. Future water resource development is essential for the full utilization of the area's natural resources and to create opportunities for industrial growth and agricultural expansion throughout the area.

Coal production in Utah is greater than the combined production of the other 10 western states. Large reserves are concentrated primarily in eastern Utah with the largest deposits in Carbon County in the vicinity of Price. Coal reserves in Utah have been estimated to be about 100 billion tons. Utah and the surrounding area contain about 35 percent of all the coal reserves of the United States and about 17 percent of all the reserves of the world. Utah coal is considered the highest quality bituminous coal on the western market. It is low in ash and moisture, extremely low in sulphur, and highly volatile with a high heat value.

Some of the Nation's largest deposits of oil shale lie undeveloped in eastern Utah. The deposits are saturated with an estimated 100 billion barrels of petroleum, an amount approximately five times the present estimated oil reserves of the entire United States. Geologists have labeled Uinta Basin as one of the leading potential oil fields.

Utah ranks first among the states in uranium ore production used in the manufacture of the atomic bomb and in nuclear powerplants. Vanadium, becoming increasingly important, is found and produced in connection with the uranium ores. Vast deposits are located in eastern Utah where radium and molybdenum are also found. Beryllium is also becoming more important for use in alloys, and large quantities of ore are found in the vicinity of Delta; this constitutes an important new potential industry.

Substantial supplies of natural gas are being discovered and mined in Utah. About 50 million cubic feet per day are being produced and delivered through an 18-inch pipeline from the area around Price to Utah County.

Vast reserves of carbon dioxide gas have been located in Carbon County. It is processed into dry ice and is used in the manufacture of carbonated beverages and in the mining industry as an explosive.

One of the few known national reserves of helium gas is located near Woodside in the Price River Basin. Near Vernal are found the greatest known deposits of thinly covered phosphate rock in the free world, which provides a basis for an extensive fertilizer industry. About 80 percent of the world's gilsonite is produced in the area. Iron ore mined near Cedar City and coke produced from Carbon County coal form the basis for steel production in Utah County.

Substantial reserves of low grade copper, lead, zinc, and manganese are found in the area and gold and silver are mined, usually as byproducts of other materials. Minerals found in the area, in addition to those previously mentioned, include potash, magnesium, sulphur, gypsum, salt, limestone, bituminous sandstone, and clays.

Water constitutes a valuable natural resource in the Central Utah project area, and development of most of the other resources is largely dependent upon the available water supplies. Most of the easily accessible water resources have been appropriated, thus large-scale development will require the importation of additional water. Another important natural resource is manpower which is available in large numbers to supply new industries badly needed in the area.

The Central Utah project area has significant and diversified recreational potential. The terrain which varies from colorful desert to scenic alpine mountains with their crystal-clear streams, glacial lakes, and winter snows provides a natural setting for a great variety of outdoor recreation. Some areas are ideally located and could be readily adapted to winter sports of all kinds. Some of the best deer hunting available is to be found in this area, and elk are also present in significant numbers. This could be a fisherman's paradise with the great variety of game and fish and the choice between lake and stream fishing. The mountains contain campground and wilderness areas for camping, picnicking, swimming, boating, and water-skiing. One of the most common forms of recreation is to leisurely ride through parts of the area and enjoy the delightful scenery.

CHAPTER II

RESERVOIR SITE INVENTORY

Potential Storage Sites

Storage of irrigation water in the area has been essential since colonizers found it necessary to conserve early spring runoff for late-season use. A continuous search has been conducted for years by various groups to find the most adequate storage sites.

Individuals, State agencies, and Federal agencies have been active in locating sites. The Utah Water and Power Board and the Utah State Engineer's office have been the principal State agencies and the Bureau of Reclamation and the Soil Conservation Service the more prominent Federal agencies. Some information was recorded and has been preserved of various sites as they were located. The biennial reports of the State Engineer, the 1951 Central Utah project planning report, and various other published and unpublished studies have yielded information on potential storage sites in the ultimate phase area of the Central Utah project. All of the known potential storage sites have been evaluated for this inventory report.

It is apparent from the meager information available that many of the sites located are alternative to each other and would be eliminated in any selected plan. Diversion works and waterways for collection and distribution of storage water will be necessary and must be considered for each storage site. Tabulations have been prepared for the sites selected in this report, and when available the following information has been included: locations, topographic maps, geologic and materials data, area-capacity curves, and cost-capacity curves.

The potential storage sites have been grouped for report purposes according to the natural basin or drainage area in which they are located. Five different areas with the maps for each area are included as follows.

1. Uinta Basin drainage area	Drawing No. 289-418-9
2. Utah Lake and Great Salt Lake drainage areas	Drawing No. 289-418-7
3. Sevier and San Pitch River drainage areas	Drawing No. 289-418-6
4. Price and San Pitch River drainage areas	Drawing No. 289-418-29
5. Nine-mile drainage area	Drawing No. 289-418-29

The location of each potential reservoir site selected for further study is shown on the maps on the following pages. Available data for each site are listed in the tabulation following the map on which the site is shown. The potential reservoir sites for this report were selected by field observations or studies of available topographic maps. The available data were classified as follows for each potential site.

Topography

The topography when available for the various sites is shown on quadrangle sheets prepared by the U.S. Geological Survey or topographic maps of the sites prepared by State or Federal agencies. The available maps with the scales to which they are drawn are listed in the tabulations. The quadrangle scales and contour intervals vary with the sheet and include scales of 1 to 125,000, 1 to 62,500, and 1 to 24,000 feet. Contour intervals range from 20 to 200 feet in elevation. Federal or State topographic maps have scales ranging from 1 inch equals 50 feet to 1 inch equals 1,000 feet, and the contour intervals range from 5 to 25 feet of elevation.

Datum for the dam site elevations varies and is based on approximate elevations taken from quadrangle sheets or elevations determined from Geological Survey level or Geodetic Survey bench marks. Horizontal control has been established usually by local triangulation nets.

Geology and materials

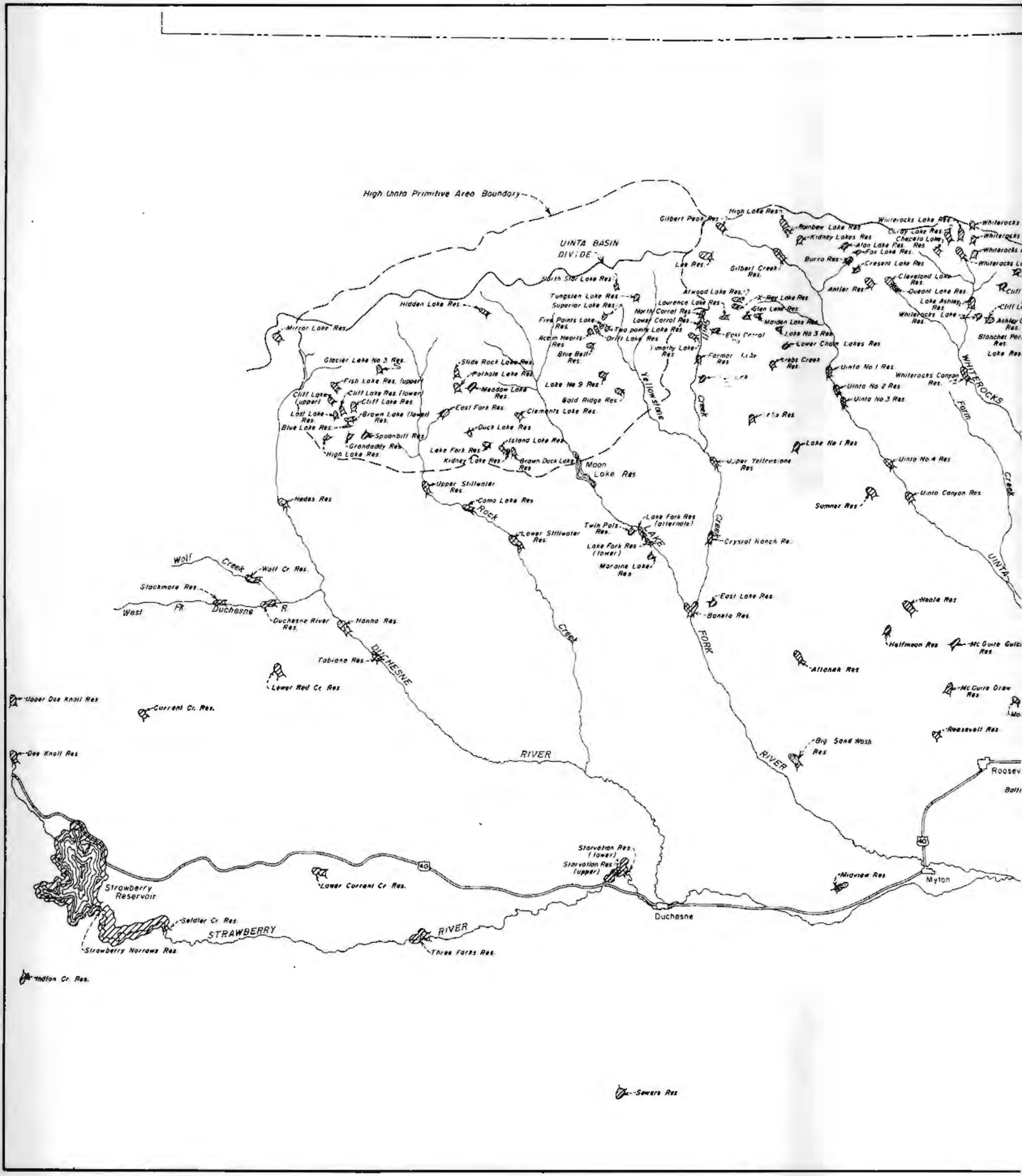
The geologic and materials information shown was obtained either from field observation of the sites or from general knowledge of the area. Detailed investigations have not been completed of these potential storage sites.

Area capacity curves

Area capacity curves were prepared for part of the storage sites from Bureau of Reclamation topographic maps. Some curves were also obtained from State Engineer records.

Future investigations

Design and estimate information presented in this report was obtained from any source available. Data concerning the various storage sites range from fair to inadequate. Additional information would be required to prepare satisfactory estimates. This would be obtained during the plan formulation period.



High Uinta Primitive Area Boundary
UINTA BASIN DIVIDE
Gilbert Peak Res
High Lake Res
Rainbow Lake Res
Kidney Lakes Res
Whiterocks Lake Res
Alan Lake Res
Fox Lake Res
Burro Res
Cresent Lake Res
Lee Res.
Gilbert Creek Res.
Cleveland Lake Res.
Antler Res
North Star Lake Res
Tungsten Lake Res
Superior Lake Res
Atwood Lake Res.
X-Ray Lake Res
Laurence Lake Res
Glen Lake Res
North Carral Res
Lower Carral Res
Maiden Lake Res
Lake No 3 Res
Five Points Lake Res.
Two points Lake Res
Drift Lake Res
Lower Chain Lakes Res
Hidden Lake Res
Mirror Lake Res.
Blue Bell Res.
Timothy Lake Res
Farmer Lake Res
Krebs Creek Res
Uinta No 1 Res
Whiterocks Canyon Res.
Uinta No 2 Res
Uinta No 3 Res
WHITEROCKS
Farm
Glacier Lake No 3 Res.
Slide Rock Lake Res.
Pothole Lake Res
Meadow Lake Res.
Lake No 9 Res
Bald Ridge Res
Fish Lake Res. (upper)
Cliff Lake Res (lower)
Cliff Lake (upper)
Cliff Lake Res
Lost Lake Res.
Brown Lake (lower) Res.
Blue Lake Res.
Spoonbill Res
Grandaddy Res
High Lake Res.
East Fork Res
Clements Lake Res
Duck Lake Res
Island Lake Res
Lake Fork Res
Kidney Lake Res
Brown Duck Lake Res
Moon Lake Res
Yellowstone
Creek
Lake No 1 Res
Upper Yellowstone Res
Uinta No 4 Res
Uinta Canyon Res
Sumner Res
Upper Stillwater Res.
Como Lake Res
Rock
Hades Res
Lake Fork Res (alternate)
Twin Pots Res.
Lake Fork Res (lower)
Moraine Lake Res
LAKE
Lower Stillwater Res.
Crystal Ranch Res
UINTA
Wolf Creek
Wolf Cr Res.
Stockmore Res.
West Fk Duchesne R
Duchesne River Res.
Hanna Res.
East Lake Res
Bonela Res
Neale Res
FORK
Halfmoon Res
Mc Guire Gulch Res
Tabiona Res
DUCHESNE
Lower Red Cr. Res
Allanek Res
Mc Guire Draw Res
Upper Doe Knoll Res
Current Cr. Res.
Roosevelt Res
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Big Sand Wash Res
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Strawberry Reservoir
Lower Current Cr Res.
40
Midview Res
Mytan
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Soldier Cr Res.
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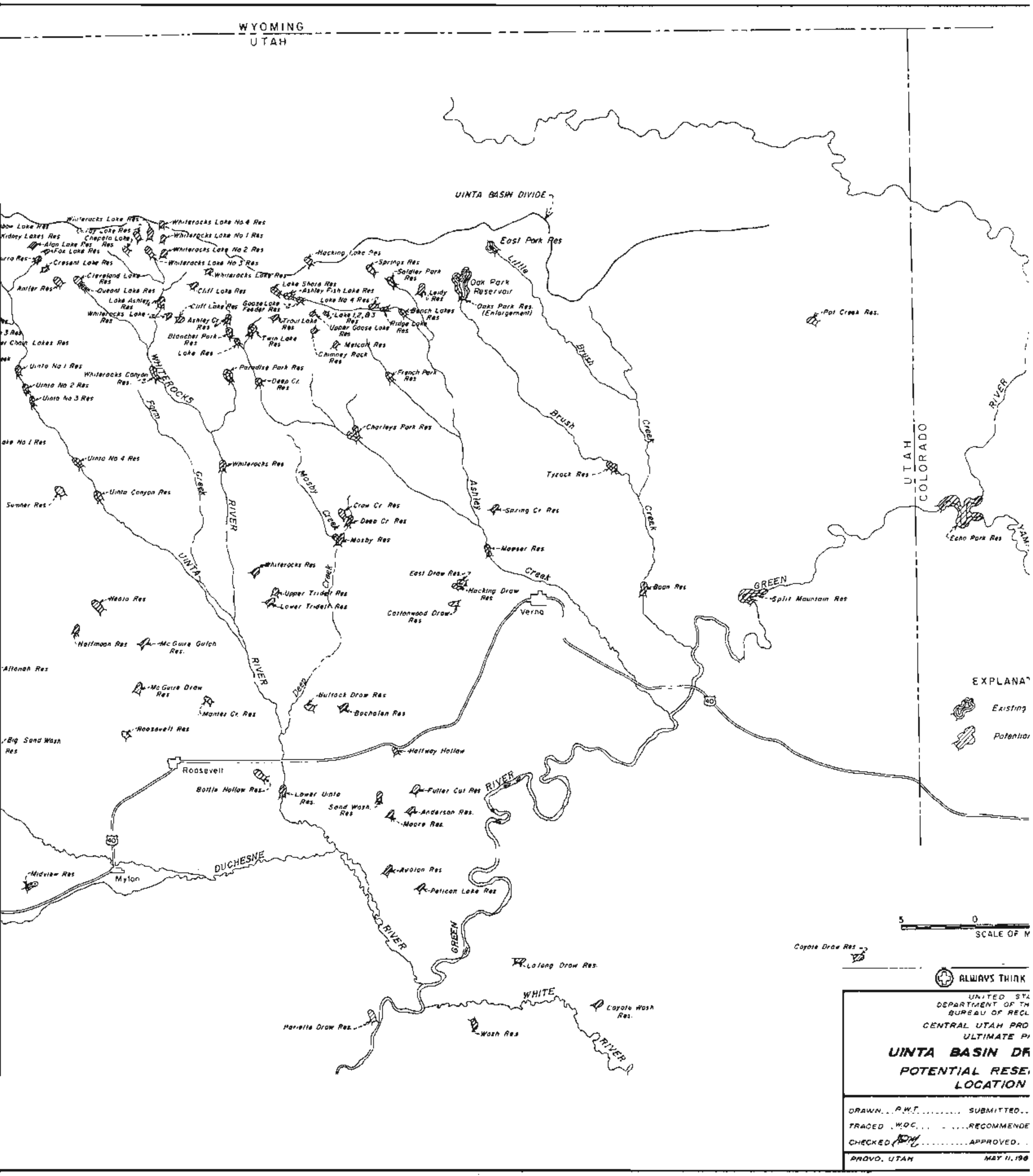
RIVER
Strawberry Narrows Res.
Three Forks Res.
Indian Cr. Res.
Sowers Res


WYOMING
UTAH
UINTA BASIN DIVIDE
East Park Res
Oak Park Reservoir
Oaks Park Res. (Enlargement)
Pot Creek Res.
Whiterocks Lake Res
Whiterocks Lake No 4 Res
Whiterocks Lake No 1 Res
Whiterocks Lake No 2 Res
Whiterocks Lake No 3 Res
Kidney Lakes Res
Alan Lake Res
Fox Lake Res
Chepeta Lake Res
Cresent Lake Res
Cleveland Lake Res
Antler Res
Queant Lake Res
Lake Ashley Res
Whiterocks Lake Res
Cliff Lake Res
Goose Lake Feeder Res
Ashley Cr Res
Blanchet Park Res
Lake Res
Twin Lake Res
Trout Lake Res
Upper Goose Lake Res
Hacking Lake Res
Springs Res
Soldier Park Res
Leidy Res
Lake Shore Res
Ashley Fish Lake Res
Lake No 4 Res
Lake 1, 2, & 3 Res
Ridge Lake Res
Bench Lakes Res
Metcalf Res
Chimney Rock Res
French Park Res
Paradise Park Res
Deep Cr. Res
Uinta No 1 Res
Uinta No 2 Res
Uinta No 3 Res
Whiterocks Canyon Res
Charleys Park Res
Uinta No 4 Res
Uinta Canyon Res
Whiterocks Res
Sumner Res
Tyzack Res
Spring Cr Res
Crow Cr Res
Deep Cr Res
Mosby Res
Maeser Res
Whiterocks Res
East Draw Res
Hacking Draw Res
Boon Res
Split Mountain Res
Echo Park Res
Upper Trident Res
Lower Trident Res
Cottonwood Draw Res
Neola Res
Halfmoon Res
McGuire Gulch Res.
Altonah Res
McGuire Draw Res
Montes Cr. Res
Bullock Draw Res
Bocholen Res
Roosevelt Res
Big Sand Wash Res
Halfway Hollow
Roosevelt
Vernal
Bottle Hollow Res
Lower Uinta Res.
Sand Wash Res
Fuller Cut Res
Anderson Res.
Moore Res.
Avalon Res
Pelican Lake Res
Midview Res
Myton
Coyote Draw Res
Lafang Draw Res.
Coyote Wash Res.
Pariette Draw Res.
Wash Res
WHITEROCKS
Farm Creek
RIVER
UINTA RIVER
Mosby Creek
Deep Creek
Ashley Creek
Little Brush Creek
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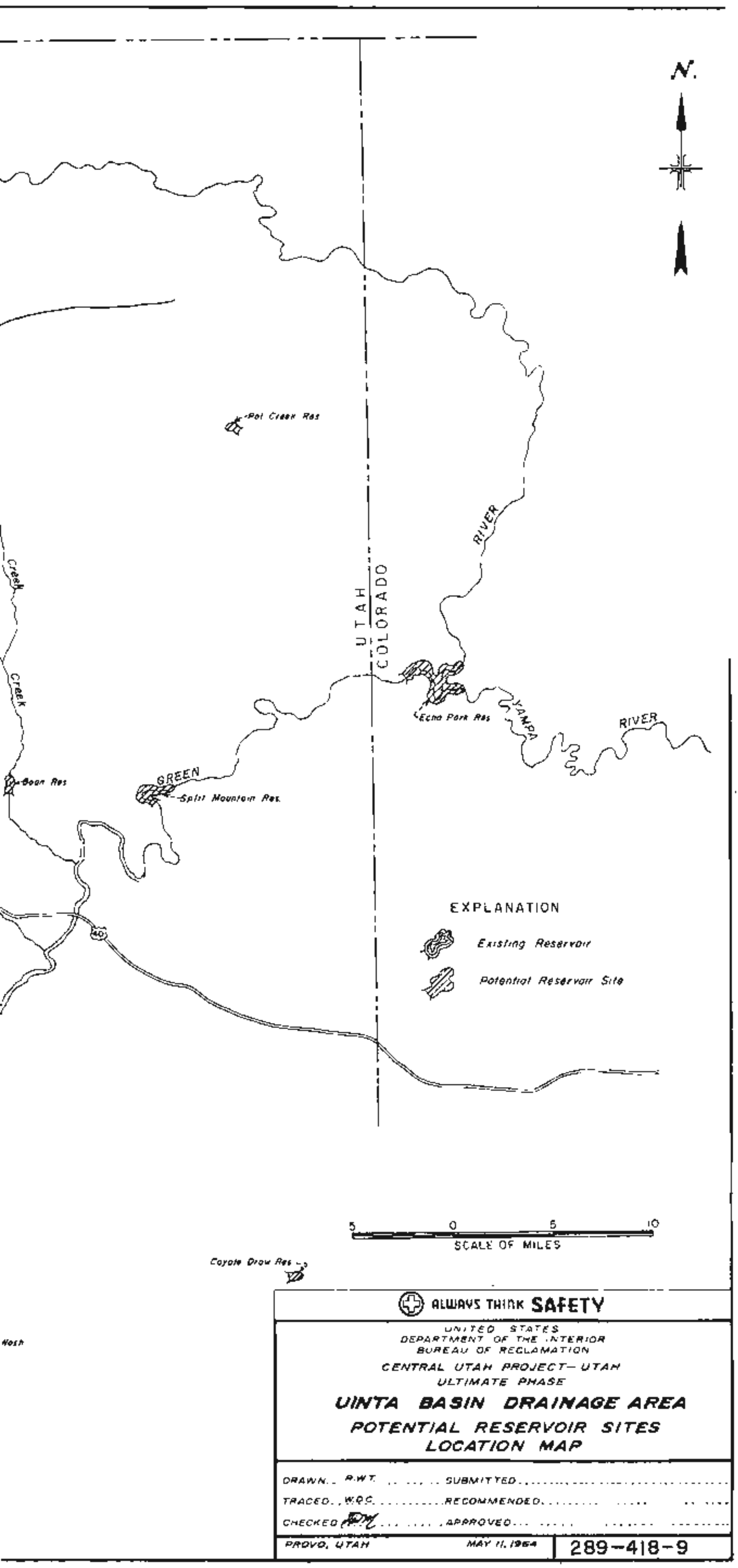
MAY 11, 196


N.
Pot Creek Res
RIVER
UTAH
COLORADO
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Echo Park Res
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GREEN
Boan Res
Split Mountain Res.
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EXPLANATION
Existing Reservoir
Potential Reservoir Site
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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT—UTAH
ULTIMATE PHASE
UINTA BASIN DRAINAGE AREA
POTENTIAL RESERVOIR SITES
LOCATION MAP
DRAWN R.W.T. SUBMITTED
TRACED W.D.C. RECOMMENDED
CHECKED APPROVED
PROVO, UTAH
MAY 11, 1964
289-418-9

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Ge t
Upper Doe Knoll Dam and Reservoir	On headwaters of the Strawberry River	Sec. 34, T1S, R12W, USB&M	1" = 500', CI = 25', 66PT-418-513	No
Doe Knoll Dam and Reservoir	Upper tributary of the Strawberry River	Sec. 22, T2S, R12W, USB&M	1" = 1000', CI = 25', 66PT-418-512, Nov. 25, 1959	No
Indian Creek Dam and Reservoir	On Indian Creek, a tributary to the Strawberry River	Sec. 35, T8S, R6E, SLB&M	1" = 100', 66PT-418-95 (Damsite) 1947	
Strawberry Narrows Dam and Reservoir	At Narrows below existing Strawberry Dam	SW¼, Sec. 3, T4S, R11W, USB&M		
Soldier Creek Dam and Reservoir	On Strawberry River	Sec. 16, T4S, R10W, USB&M	(Reservoir) 1" = 1000', CI = 5', 66-418-19 through 30 (Damsite) 1" = 100', CI = 5', 66-418-42 and 43. Borrow Area "B" and "C": 1" = 400', CI = 5', 66-418-836 and 837	G- G- 2
Currant Creek Dam and Reservoir	On Currant Creek, a tributary to the Strawberry River	Sec. 6, T2S, R10W, USB&M	Damsite: 1" = 100', CI = 5', 66PT-418-133 and 134 1/	2
Lower Currant Creek Dam and Reservoir	On Currant Creek, a tributary to the Strawberry River	SW¼, Sec. 30, T3S, R8W, USB&M		
Lower Red Creek Dam and Reservoir	On Red Creek, a tributary to the Strawberry River	Sec. 22, T1S, R9W, USB&M	660A-404-27 1940 1" = 100', CI = 5'	No
Three Forks Dam and Reservoir	Strawberry River	Sec. 17, T4S, R7W, USB&M		
Starvation Dam and Reservoir (Lower site)	On the Strawberry River	Sec. 27 and 28, T3S, R5W, USB&M	1" = 50', CI = 2', 66PT-418-905 through 920, 942 through 948, and 923 (24 sheets) 660A-418-150 (USGS) 1-12,000	GM GM
Mirror Lake Dam and Reservoir	Mirror Lake to Duchesne River	Sec. 34, T4N, R9W, USB&M		
Hades Dam and Reservoir	On Duchesne River	Sec. 26, T2N, R9W, USB&M		
Stockmore Dam and Reservoir	On the West Fork of the Duchesne River	Sec. 30, T1N, R9W, USB&M	1" = 500', CI = 10', 66PT-418-16 1943	No
Wolf Creek Dam and Reservoir	On Wolf Creek, a tributary to the West Fork of the Duchesne River	Sec. 21, T1N, R9W, USB&M	1" = 200', CI = 10', 66-418-121	No
Duchesne River Dam and Reservoir	On West Fork of the Duchesne River	Sec. 27, T1N, R9W, USB&M		
Hanna Dam and Reservoir	On the Duchesne River	Sec. 4, T1S, R8W, USB&M	1" = 500', CI = 10', 66PT-418-136 and 137; 1" = 50', CI = 5'; 66PT-418-138 through 149, 66-418-165, 169, and 81	
Tabiona Dam and Reservoir	On the Duchesne River	Sec. 14, T1S, R8W, USB&M	66-418-215, 1" = 500', CI = 10'	
Upper Cliff Lake Dam and Reservoir (Lodge Lake)	West Fork Fish Creek to Rock Creek to Duchesne River	Sec. 20, T3N, R8W, USB&M		
High Lake Dam and Reservoir (High)	West Fork Fish Creek to Rock Creek to Duchesne River	Sec. 31 and 32, T3N, R8W, USB&M		
Grandaddy Dam and Reservoir (Fish Lake)	Grandaddy Lake to West Fork Rock Creek to Duchesne River	Sec. 33, T3N, R8W, USB&M		
Blue Lake Dam and Reservoir	West Fork Rock Creek to Duchesne River	Sec. 28 and 33, T3N, R8W, USB&M		
Cliff Lake (Lower) Dam and Reservoir	Fish Creek to West Fork Rock Creek to Duchesne River	Sec. 21 and 28, T3N, R8W, USB&M		
Lost Lake Dam and Reservoir	West Fork Fish Creek to Duchesne River	Sec. 29, T3N, R8W, USB&M		
Brown Lake Dam and Reservoir (Lower)	West Fork Rock Creek to Duchesne River	Sec. 28, T3N, R8W, USB&M		
Spoonbill Lake Dam and Reservoir	West Fork Rock Creek to Duchesne River	Sec. 34, T3N, R8W, USB&M		
Glacier Lake No. 3 Dam and Reservoir	Glacier Lake to Fish Creek to Rock Creek to Duchesne River	Sec. 11, T3N, R8W, USB&M		
Fish Lake Dam and Reservoir (Upper)	Fish Creek to Rock Creek to Duchesne River	Sec. 17, T3N, R8W, USB&M		
Slide Rock Lake Dam and Reservoir	East Fork of Rock Creek to Duchesne River	Sec. 10, T3N, R7W, USB&M		

Potential Reservoir Sites
Uinta Basin Area

	Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
13	None	None	No number 9-23-59	2,600 AF Oct. 1959	USBR 30' Quad Series - Strawberry Valley
12, Nov. 25, 1959	None	None	66-418-1174 9-22-59	12,000 to 25,000 AF Jan. 1959	USBR 30' Quad Series - Strawberry Valley
e) 1947					USBR 30' Quad Series - Strawberry Valley
			66-418-509		USBR 30' Quad Series - Strawberry Valley
, 66-418-19 through 5', 66-418-42 and 43. 400', CI = 5',	G-66 G-40 5/	5/	66-418-202	870,000 AF (Feasibility)	5/ See report D&E 113 for references Site to be constructed under Bonneville unit to estimated capacity 66-D-15 30' Quad Series - Strawberry Valley
6PT-418-133 and 134	2/	2/	66-418-530	15,500 AF (Feasibility)	1/ Currant Creek pipeline and tunnel portal - 66PT-418-130 and 132 Borrow Area "A" = 66-418-828, Borrow Areas "A", "B", "C", "D", and "E" 1" = 1000', CI = 10', 66-418-1269 66-D-17 Ref. drawing 2/ Feasibility report on materials for Currant Creek Dam, Feb. 1951; Currant Creek Dam site earth materials investigation, Borrow Area "A" Feb. 1951; Preliminary Geology Report of the Currant Creek Dam and Reservoir sites, G-59, SLC, Utah. For further references see report D&E-123. 30' Quad Series - Strawberry Valley
			66-418-532		USBR 7.5' Quad Series - Fruitland
I = 5'	None	None	66-418-535		(Upper site) 660A-418-22 and 28 - located Sec. 16, T1S, R9W, USB&M by the State Engineer of Utah
					From 22nd Biennial Report of the State Engineer Est. 32,000 AF - $2,451,838 - Drager, 1920 - USBR - Lower White River
through 920, 942 s) 660A-418-150	GM-197 GM-81	See Geology	66-418-2418	162,800 AF Oct. 1962	Site to be constructed under Bonneville unit to estimated capacity USBR 30' Quad Series - Duchesne
					From 22nd Biennial Report of the State Engineer. Feasibility doubtful. 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer 33,770 AF storage - Great Basin Power Company USGS
6 1943	None	None	66-418-526 -529		USBR
	None	None	66-418-511		USBR - at coordinates N780,000, E2,159,000
					From 22nd Biennial Report of the State Engineer Feasibility doubtful
36 and 137; 1" = 50', 49, 66-418-165, 169,			66-404-647 1-6-50	500 to 22,000 AF	USBR
	None	None	66-418-531		USBR
					From 22nd Biennial Report of the State Engineer Reconnaissance made 686 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer Reconnaissance made and on file in State Engineer's Office and USGS 625 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer Reconnaissance made and on file in State Engineer's Office and USGS 382 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Reconnaissance made and on file in State Engineer's Office and USGS 257 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer Reconnaissance made and on file in State Engineer's Office and USGS 287 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer Reconnaissance made and on file in State Engineer's Office and USGS 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer USGS 343 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer USGS 1256 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer USGS 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer USGS 395 AF Other sites: Fish Lake (Lower), Sec. 21, T3N, R8W, USB&M Fish Lake (Middle), Sec. 16, T3N, R8W, USB&M 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of the State Engineer Est. made and on file in State Engineer's Office and USGS 68 AF 30' Quad Series - Hayden Peak

Central Utah Project
Ultimate Phase - Utah

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-capacity curve Drawing No.	Cost-curve Price
Pothole Lake Dam and Reservoir	East Fork of Rock Creek to Duchesne River	Sec. 15, T3N, R7W, USB&M					
Meadow Lake Dam and Reservoir	East Fork Rock Creek to Duchesne River	Sec. 14, T3N, R7W, USB&M					
Duck Lake Dam and Reservoir	East Fork to Rock Creek to Duchesne River	Sec. 35, T3N, R7W, USB&M					
East Fork Dam and Reservoir	On Rock Creek to Duchesne River	Sec. 21, 27, and 28, T3N, R7W, USB&M	660A-404-36				
Upper Stillwater Dam (Feasibility site)	On Rock Creek tributary to Duchesne River	Sec. 20, T2N, R7W, USB&M	1" = 400', CI = 10', 66-418-120 1/	2/	2/	66-418-504 1-7-49	Feas at 25 DPR Dwg.
Como Lake Dam and Reservoir	Rock Creek to Duchesne River	Sec. 26, T2N, R7W, USB&M					
Lower Stillwater Dam and Reservoir (Rock Creek Dam	On Rock Creek to Duchesne River	Sec. 5 and 8, T1N, R6W, USB&M	1" = 50', 56 PT-418-24 through 31, 66-418-203, 1" = 500', CI = 10'			66-418-203	
Sowers Creek Dam and Reservoir	Sowers Creek to Antelope Creek to Duchesne River	Sec. 4, T6S, R5W, USB&M	1" = 400', CI = 5'; 1" = 50', CI = 2', 660A-404-37				
Hidden Lake Dam and Reservoir	Lake Fork River to Duchesne River	Sec. 24, T4N, R7W, USB&M					
Clements Lake Dam and Reservoir	On Clements Creek a tributary to Lake Fork to Duchesne River	Sec. 29, T3N, R6W, USB&M				66-418-577	
Lake Fork Dam and Reservoir	Brown Duck Creek to Lake Fork River to Duchesne River	Sec. 1, T2N, R7W, USB&M					
Kidney Lake Dam and Reservoir	On Brown Duck Creek to Lake Fork to Duchesne River	Sec. 6, T2N, R6W, USB&M					
Island Lake Dam and Reservoir	On Brown Duck Creek, a tributary of Lake Fork to Duchesne River	Sec. 6, T2N, R6W, USB&M				66-418-573 Sep. 1931	
Brown Duck Lake Dam and Reservoir (Lake No. 1)	On Brown Duck Creek, tributary to Lake Fork to Duchesne River	Sec. 5, T2N, R6W, USB&M				66-418-572 Sep. 1931	
Lake Fork Dam and Reservoir (Lower)	Lake Fork to Duchesne River	Sec. 3 and 10, T1N, R5W, USB&M					
Lake Fork Dam and Reservoir (Alternate)	Lake Fork to Duchesne River	Sec. 10, T1N, R5W, USB&M					
Twin Potts Dam and Reservoir	Below Moon Reservoir on Lake Fork Creek to Duchesne River	Sec. 34, T2N, R5W, USB&M				66-418-599 Sep. 1931	
Moraine Lake Dam and Reservoir	Lake Fork to Duchesne River	Sec. 11, T1N, R5W, USB&M					
Bluebell Dam and Reservoir	On a small tributary of the Yellowstone Creek to Lake Fork to Duchesne	Sec. 31, T4N, R5W, USB&M				66-418-574 Sep. 1931	
Ace of Hearts Dam and Reservoir	West Fork Yellowstone Creek to Lake Fork to Duchesne River	Sec. 30, T4N, R5W, USB&M					
Drift Lake Dam and Reservoir	A tributary of Yellowstone Creek to Lake Fork to Duchesne River	Sec. 30, T4N, R5W, USB&M				66-418-576 Sep. 1931	
Superior Lake Dam and Reservoir	Headwaters of Yellowstone Creek to Lake Fork to Duchesne River	Sec. 20, T4N, R5W, USB&M					
Five Points Lake Dam and Reservoir (Lake No. 8)	A tributary to Yellowstone Creek to Lake Fork to Duchesne River	NE¼, Sec. 29, T4N, R5W, USB&M				66-418-575 Sep. 1931	
Two Points Lake Dam and Reservoir	West Fork Yellowstone Creek to Lake Fork to Duchesne River	Sec. 29, T4N, R5W, USB&M					
North Star Lake Dam and Reservoir	North Star Lake to Yellowstone Creek to Lake Fork Creek to Duchesne River	Sec. 9, T4N, R5W, USB&M					
Tungsten Lake Dam and Reservoir	West Fork Yellowstone Creek to Lake Fork Creek to Duchesne River	Sec. 15, T4N, R5W, USB&M					
Lake No. 9 Dam and Reservoir	Yellowstone Creek to Lake Fork River to Duchesne River	Sec. 8, T3N, R5W, USB&M					
Bald Ridge Dam and Reservoir	Small tributary to Yellowstone Creek to Lake Fork to Duchesne River	Sec. 16, T3N, R5W, USB&M					
Timothy Lake Dam (Lakes Nos. 10, 11, and 12) and Reservoir	Swift Creek, a tributary to Yellowstone River	SE¼, Sec. 29, T4N, R4W, USB&M				1/66-418-583 66-418-584 66-418-585	
Farmers Lake Dam and Reservoir (Miller)	Swift Creek, a tributary of Yellowstone Creek	Sec. 5 and 6, T3N, R4W, USB&M 1/				66-418-579 Sep. 1931 1/	

	Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
					From 22nd Biennial Report of State Engineer Reconnaissance estimate made and on file in State Engineer's Office and USGS An alternate damsite entitled Pothole Lake (Lower), Sec. 15, T3N, R7W - 74 AF 153 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Reconnaissance estimate made and on file in State Engineer's Office and USGS 804 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer USGS 374 AF 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Estimated by USGS 557 AF 30' Quad Series - Hayden Peak
1/	2/	2/	66-418-504 1-7-49	Feasibility est. at 29,500 AF DPR DC-1's 1961 Dwg. 66-D-16	1/ Damsite topography: 1" = 100', CI = 5', 66PT-418-165 through 169 Aug. 1948 2/ Preliminary Geological Report of Upper Stillwater Dam site G-62, CUP, Utah, Mar. 1950 For further references see D&F report No. 122, USBR 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Hayden Peak
, 66-418-203, 1" =			66-418-203		USBR 30' Quad Series - Hayden Peak
= 2', 660A-404-37					From 22nd Biennial Report of State Engineer Est. 465 AF - $80,832 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Reconnaissance made and on file in State Engineer's Office and USGS Est. 690 AF 30' Quad Series - Hayden Peak
			66-418-577		Reference drawing No. 66-418-192 Feb. 1942 USBR 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Est. 468 AF 30' Quad Series - Hayden Peak
					USBR 30' Quad Series - Hayden Peak
			66-418-573 Sep. 1931		USBR 30' Quad Series - Hayden Peak
			66-418-572 Sep. 1931		From 22nd Biennial Report of State Engineer Plans and specifications filed in State Engineer's Office Surveyed - Est. 468 AF Lake No. 1 (Brown Duck Lake) USBR 30' Quad Series - Hayden Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful Est. 650 AF 30' Quad Series - Duchesne
			66-418-599 Sep. 1931		USBR 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Plans and specifications filed in State Engineer's Office Est. 670 AF 30' Quad Series - Duchesne
			66-418-574 Sep. 1931		USBR 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
			66-418-576 Sep. 1931		USBR 30' Quad Series - Gilbert Peak
					USBR 30' Quad Series - Gilbert Peak
			66-418-575 Sep. 1931		From 22nd Biennial Report of State Engineer Reconnaissance estimate made and on file in State Engineer's Office, made by USGS Est. 150 AF 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Reconnaissance estimate made and on file in State Engineer's Office and USGS 300 AF 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
			1/66-418-583 66-418-584 66-418-585		1/ Alternate sites USBR 30' Quad Series - Gilbert Peak
			66-418-579 Sep. 1931 1/		1/ Alternate sites - Sec. 31 and 32, T4N, R4W, USB&M; area-capacity curve 66-418-580, Sep. 1931 USBR 30' Quad Series - Gilbert Peak

Central Utah Project
Ultimate Phase - Utah

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area- c Draw
North Carrol Dam and Reservoir	On Swift Creek, a tributary to Yellowstone Creek	SE¼, Sec. 21, T4N, R4W, USB&M	1" = 100', CI = 5', 66PT-418-381, Nov. 1955			66-4 Nov.
Lower Carrol Dam and Reservoir	On Swift Creek, a tributary of the Yellowstone Creek	NW¼, Sec. 28, T4N, R4W, USB&M				66-4 Sep.
East Carrol Dam and Reservoir	On Swift Creek, a tributary of the Yellowstone Creek	SE¼, Sec. 28, T4N, R4W, USB&M	1" = 100', CI = 5', 66PT-418-380, Nov. 1955			66-4 Sep. 66-4 Nov.
Deer Lake Dam and Reservoir	On a small tributary of Swift Creek, a tributary of the Yellowstone Creek	E½, Sec. 8, T3N, R4W, USB&M				66-4
Upper Yellowstone Dam and Reservoir	On Yellowstone Creek to Lake Fork to Duchesne River	Sec. 9 and 10, T2N, R4W, USB&M	1" = 400', CI = 10', 66PT-418-185, 186, and 187	1/		66-4
Crystal Ranch Dam and Reservoir (Lower Yellowstone)	On Yellowstone Creek to Lake Fork to Duchesne River	Sec. 4, T1N, R4W, USB&M	1" = 400', CI = 5', 987PT-418-18 and 19, June 1963 1" = 300', CI = 10', 66-418-59	1/		987- 2/66-4 66-4 Oct.
East Lake Dam and Reservoir	Yellowstone Creek to Lake Fork to Duchesne River	Sec. 28, T1N, R4W, USB&M				
Boneta Dam and Reservoir	On Lake Fork tributary to Duchesne River	Sec. 32, T1N, R4W, USB&M	1" = 500', CI = 10', 987PT-418-17, Nov. 21, 1962	"Appendices for Uinta Basin Report" by Charles A. Prescott, 1943 (only general)		Aug. No. assi
Upalco Dam and Reservoir (Big Sand Wash)	On Big Sand Wash	Sec. 21, T2S, R3W, USB&M	66-P-827W, 66-418-826, 66-418-825			66-4 Jan.
Lake Dam and Reservoir	West Fork Dry Gulch to Lake Fork River to Duchesne River	Sec. 25, T3N, R4W, USB&M				
Lake No. 1 Dam and Reservoir	Dry Gulch to Lake Fork River to Duchesne River	Sec. 4, T2N, R3W, USB&M				
Altonah Dam and Reservoir	Offstream site tributary to Uinta River	Sec. 16, T1S, R3W, USB&M	1" = 500', CI = 10', 66PT-418-34 and 35, Nov. 1942	1/		66-4
Midview Dam and Reservoir	An offstream site of the Duchesne River	Sec. 35 and 36, T3S, R3W, USB&M				66-4 July
Lee Dam and Reservoir	On Gilbert Creek, a tributary of Uinta River	Sec. 33, T5N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-170, 1946			
Gilbert Peak Dam and Reservoir	On Gilbert Creek, a tributary of Uinta River	Sec. 22, T5N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-100			66-4
Gilbert Creek Dam and Reservoir	On Gilbert Creek, a tributary of Uinta River	E½, Sec. 32, T5N, R3W, USB&M	1" = 500', CI = 10', 66PT-418-18	Visual observation only 1/		66-4 No d
High Lake Dam and Reservoir	Kidney Lakes Basin, a tributary to the Uinta River	Sec. 20, T5N, R3W, USB&M	1" = 1000', CI = 10', 66PT-418-24	Visual observation in memo. of 9-1-46 & 9-63		66-4 4-30
Rainbow Lake Dam and Reservoir	Kidney Lakes Basin, a tributary to the Uinta River	Sec. 20, T5N, R3W, USB&M	1" = 1000', CI = 10', 66PT-418-24			66-4
Kidney Lakes Dam and Reservoir (Lakes Nos. 6 and 7 Dam)	Kidney Lakes Basin, a tributary to the Uinta River	Sec. 28, T5N, R3W, USB&M	1" = 1000', CI = 10', 66PT-418-24	Visual observation in memo. of Sep. 1963		Jan. No. assi
Alan Lake Dam and Reservoir	Shale Creek to Uinta River	Sec. 25, T5N, R3W, USB&M				
Fox Lake Dam and Reservoir	Headwaters of the Uinta River	Sec. 36, T5N, R3W; Sec. 31, T5N, R2W, USB&M 1/	1" = 500', CI = 10', 66PT-418-20			Sep. No m
Crescent Lake Dam and Reservoir	Headwaters of the Uinta River	Sec. 6, T4N., R2W, USB&M				66-4 Aug.
Burro Dam and Reservoir	On Shale Creek, a tributary to the Uinta River	Sec. 36, T5N, R3W, USB&M	1" = 500', CI = 10', 66PT-418-21	Visual observation in memo. of 9-1-46		66-4
Atwood Lake Dam and Reservoir	Atwood Basin, a tributary to the Uinta River	Sec. 14, T4N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-101 and 102	Visual observation only 1/		66-4
X-Ray Lake Dam and Reservoir	Atwood Basin, a tributary to the Uinta River	Sec. 11, T4N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-101 and 102			66-4
Maiden Lake Dam and Reservoir	Atwood Basin, a tributary to the Uinta River	Sec. 24, T4N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-102	Visual observation in memo. of Sep. 1963		66-4 12-1

	Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
			66-418-607 Nov. 11, 1955		USBR 30' Quad Series - Gilbert Peak
			66-418-581 Sep. 1931		USBR 30' Quad Series - Gilbert Peak
			66-418-587 Sep. 1931 66-418-608 Nov. 11, 1955		USBR 30' Quad Series - Gilbert Peak
			66-418-578		USBR 30' Quad Series - Gilbert Peak
87	1/		66-418-644	18,000 to 137,000 AF Oct. 1963	1/ "Preliminary Geologic Report of the Yellowstone Dam Site", No. G-61, Jan. 1950 USBR 30' Quad Series - Gilbert Peak
1963	1/		987-418-26 2/66-418-524 66-418-564 Oct. 1963	30,000 to 60,000 AF Sep. 1963 No. not assigned	1/ "Reconnaissance Geological Report of Crystal Ranch Dam and Reservoir Site", G-129, Region 4, SLC, Utah, June 1951 2/ Lower Yellowstone USBR 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Duchesne
962	"Appendices for Uinta Basin Report" by Charles A. Prescott, 1943 (only general)		Aug. 1963 No. not assigned	10,000 to 20,000 AF July 1963 No. not assigned	USBR 30' Quad Series - Duchesne
			66-418-636 Jan. 1949	4,000 to 12,000 AF Dec. 1958	USBR 30' Quad Series - Duchesne
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Enginner 190 AF 30' Quad Series - Gilbert Peak
1942	1/		66-418-602	12,500 to 24,000 AF July 1958	1/ "Reconnaissance Geological Report, Altonah Dam and Reservoir Sites", G-131, Region 4, SLC, Utah, Sep. 1959 USBR 30' Quad Series - Duchesne
			66-418-513 July 1938		Existing reservoir - USBR 30' Quad Series - Duchesne
					USBR 30' Quad Series - Gilbert Peak
			66-418-512		USBR 30' Quad Series - Gilbert Peak
	Visual observation only 1/		66-418-503 No date	7,600 to 35,700 AF Oct. 1963	1/ "Geological Reconnaissance of Dam Sites", Sep. 1946, USBR, CUP USBR 30' Quad Series - Gilbert Peak
	Visual observation in memo. of 9-1-46 & 9-63		66-418-507 4-30-48	500 to 2,500 AF Oct. 1963	USBR 30' Quad Series - Gilbert Peak
			66-418-551		USBR 30' Quad Series - Gilbert Peak
	Visual observation in memo. of Sep. 1963		Jan. 1964 No. not assigned	800 to 2,450 AF Oct. 1963	USBR 30' Quad Series - Gilbert Peak
					From 22nd Biennial Report of State Engineer Est. 106 AF USGS 30' Quad Series - Gilbert Peak
			Sep. 1963 No number	5,000 to 15,000 AF Apr. 1964	1/ Axis A-A is in Sec. 31, T5N, R2W; Sec. 36, T5N, R3W, USB&M. Axis B-B is in Sec. 30 and 31, T5N, R2W, USB&M. 30' Quad Series - Gilbert Peak
			66-418-591 Aug. 1931		30' Quad Series - Gilbert Peak
	Visual observation in memo. of 9-1-46		66-418-538	1,600 to 6,050 AF Oct. 1963	USBR 30' Quad Series - Gilbert Peak
	Visual observation only 1/		66-418-537	1,400 to 5,700 AF Oct. 1963	1/ "Water Supply of the Uinta Basin, Utah, and Its Utilization", dated 1943. "Lakes and Reservoirs on the Headwaters of the Uinta, Whiterocks, and Lake Fork River", Uintah project, Utah, dated 1931 30' Quad Series - Gilbert Peak
			66-418-547	Jan. 1964 Range 425 to 940 AF (made from curves)	USBR 30' Quad Series - Gilbert Peak
	Visual observation in memo. of Sep. 1963		66-418-546 12-16-48	500 to 1,460 AF Oct. 1963	USBR 30' Quad Series - Gilbert Peak

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	A
Laurence Lake Dam and Reservoir	Atwood Basin, a tributary to the Uinta River	Sec. 22, T4N, R4W, USB&M	1" = 500', CI = 10', 66PT-418-101 and 102			
Glenn Lake Dam and Reservoir	Atwood Basin, a tributary to the Uinta River	Sec. 24, T4N, R4W, USB&M	1" = 500', CI = 5', 66PT-418-101 and 102			
Lake No. 3 Dam and Reservoir	Krebs Creek to Uinta River	Sec. 29 and 30, T4N, R3W, USB&M				
Lower Chain Lakes Dam and Reservoir	Chain Lake Basin, a tributary to the Uinta River	Sec. 32, T4N, R3W, USB&M	1" = 500', CI = 10', 66PT-418-98 and 99	Treated in a general way1/		
Krebs Creek Dam and Reservoir	Chain Lakes Basin, a tributary to the Uinta River	Sec. 6, T3N, R3W, USB&M	1" = 500', CI = 10', 66PT-418-99			
Uinta Nos. 1, 2, 3, and 4 Dam and Reservoir	On the Uinta River	1/No. 1, Sec. 11, T3N, R3W, USB&M	(Forest Service) 1" = 1000', CI = 25', 660A-418-161	Visual observation only. Memo. of Sep. 1946		
Uinta Canyon Dam and Reservoir	On Uinta River	Sec. 23, T2N, R2W, USB&M				
Sumner Dam and Reservoir (John Star)	John Star Flat, on Spring Branch to Cottonwood Creek to Duchesne River	Sec. 20, T2N, R2W, USB&M				
Neola Dam and Reservoir (Cottonwood Creek)	Tributary to the Uinta River	Sec. 26, 27, 34, and 35, T1N, R2W. USB&M	1" = 500', CI = 10', 66-418-180; 1" = 400', CI = 5', 987PT-418-22			
Half Moon Dam and Reservoir (Brown Draw)	Dry Wash 10 miles northwest of Roosevelt	Sec. 4, T1S, R2W, USB&M	1" = 500', CI = 10', Nov. 1955, 66-418-178 1/	"Preliminary Report of Geology of Dam Sites in the Uinta Basin & Ashley Valley", June 19432/		
McGuire Gulch Dam and Reservoir	Right Fork Cottonwood Creek to Duchesne River	Sec. 7, T1S, R1W, USB&M				
McGuire Draw Dam and Reservoir	Right Fork Cottonwood Creek to Duchesne River	Sec. 30, T1S, R1W, USB&M				
Roosevelt Dam and Reservoir (Hancock Dam)	Offstream site tributary to Uinta River	Sec. 7, T2S, R1W, & Sec. 12, T2S, R2W, USB&M	1" = 50', CI = 5', 70-418-5, 660A-404-25	"Prelim. Report of Damsites in the Uinta Basin and Ashley Valley", 1943		
Montez Creek Dam and Reservoir	Montez Creek, a tributary to the Uinta River	Sec. 36, T1S, R1W, USB&M	1" = 200', CI = 10', 66-418-158			
Cleveland Lake Dam and Reservoir	Tributary to Whiterocks to Uinta River	Sec. 9, T4N, R2W, USB&M	1" = 1000', CI = 10', 66PT-418-22, Aug. 1946			
Queant Lake Dam and Reservoir	Tributary to Whiterocks to Uinta River	Sec. 3/10, T4N, R2W, USB&M	1" = 1000', CI = 10', 66PT-418-22, Aug. 1946			
Antler Dam and Reservoir	West Fork Whiterocks Creek to Uinta River	Sec. 8, T4N, R2W, USB&M				
Ouray and Elbow Dam and Reservoir (Lake No. 10 Dam)	Whiterocks River to Uinta River	Sec. 30, T5N, R1W, USB&M				
Whiterocks Lake Dam and Reservoir	Whiterocks River to Uinta River	Sec. 29, T5N, R1W, USB&M				
Whiterocks Lake Dam and Reservoir	Whiterocks Lake to Whiterocks River to Duchesne River	Sec. 1, T4N, R1W, USB&M				
Cliff Lake Dam and Reservoir	Cliff Lake to Whiterocks River to Duchesne River	Sec. 11, T4N, R1W, USB&M				
Cliff Lake Dam and Reservoir	Whiterocks River to Uinta River	Sec. 22, T4N, R1W, USB&M				
Lake Ashley Dam and Reservoir	Headwaters of the Whiterocks River	Sec. 16 or 21, T4N, R1W, USB&M	Forest Service topography: 1" = 13,500', CI = 25'; Whiterocks Road, 119, June 1956			

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
		66-418-536	Jan. 1964 90 to 535 AF (made from curves)	USBR 30' Quad Series - Gilbert Peak
		66-418-544	Range: 760 to 2,240 AF Jan. 1964 (made from curves)	USBR 30' Quad Series - Gilbert Peak
				From 22nd Biennial Report of State Engineer Est. 250 AF USGS 30' Quad Series - Gilbert Peak
Treated in a general way1/		70-418-16 Mar. 1964	929 to 3,907 AF Mar. 1964	1/ Memorandum "Geological Reconnaissance of Dam Sites", September 1946 Data from Appendix (C), Design and Estimate Special Report, Lakes and Reservoirs on Headwaters of the Uinta, Whiterocks, and Lake Fork Rivers, Uintah project, Utah USBR 30' Quad Series - Gilbert Peak
		70-418-14 1-28-64	500 to 2,500 AF Mar. 1964	USBR 30' Quad Series - Gilbert Peak
Visual observation only. Memo. of Sep. 1946		Oct. 1963 No. not assigned	Dec. 1963 4,000 to 60,000 AF Prices: Oct. 1963	1/ Uinta No. 1 - in Sec. 11; Uinta No. 2 - in Sec. 13; Uinta No. 3 - in Sec. 24; Uinta No. 4 - in Sec. 9 and 10, T2N, R2W } Alternate axis 30' Quad Series - Gilbert Peak
				From 22nd Biennial Report of State Engineer Reconnaissance made Records on file at State Engineer's Office and USGS 12,480 AF 30' Quad Series - Gilbert Peak
		66-418-605 Sep. 1931		USBR and from 22nd Biennail Report of State Engineer Reconnaissance made Records on file at State Engineer's Office and USGS 2,750 AF 30' Quad Series - Gilbert Peak
		Sep. 1963 No. not assigned	1,000 to 5,000 AF Oct. 1963	USBR 30' Quad Series - Duchesne
"Preliminary Report of Geology of Dam Sites in the Uinta Basin & Ashley Valley", June 19432/		66-418-518, 519 (alternate site) Sep. 1963	1,000 to 4,000 AF Sep. 1963 No. not assigned	1/ USBR topog., Damsite: 1" = 50', 1963, No. 987PT-418-36 through 39 and 61 and 62 Feeder pipe: 1" = 50', 1963, No. 987PT-418-63 and 64 2/ Also "Reconnaissance Geology Report of the Half Moon Dam and Reservoir Sites", GM-77, Oct. 1963 30' Quad Series - Duchesne
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Duchesne
				USBR 30' Quad Series - Duchesne
"Prelim. Report of Damsites in the Uinta Basin and Ashley Valley", 1943		66-418-560 70-418-6 Oct. 1963	4,000 to 16,000 AF No. not assigned	USBR 30' Quad Series - Duchesne
		66-418-158		USBR 30' Quad Series - Vernal
		66-418-545 3-26-48	1,000 to 4,000 AF Oct. 1963	USBR 30' Quad Series - Gilbert Peak
		66-418-566 Mar. 1948	1,250 to 7,275 AF Oct. 1963 No. not assigned	USBR 30' Quad Series - Gilbert Peak
			460 AF	From 22nd Biennial Report of State Engineer Reconnaissance made Record on file in State Engineer's Office and USGS 30' Quad Series - Gilbert Peak
				From 22nd Biennial Report of State Engineer 30' Quad Series - Gilbert Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Gilbert Peak
				USBR 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Reconnaissance made Records on file in State Engineer's Office 620 AF - 16,650 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Reconnaissance made Records on file in State Engineer's Office Est. 550 AF 30' Quad Series - March Peak
				USBR 30' Quad Series - Gilbert Peak

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-cap curv Drawing
Whiterocks Lake Dam and Reservoir	Whiterocks River to Uinta River	Sec. 22, T4N, R1W, USB&M1/				
Whiterocks Canyon Dam and Reservoir (Whiterocks River Diversion Dam)	On Whiterocks River	Sec. 8 and 9, T3N, R1W, USB&M	Forest Service map, Whiterocks Road 119, R-4, Utah, Ashley NF, strip 31, 1:13,500, CI = 25'			No numb Apr. 19
Paradise Park Dam and Reservoir	Headwaters of Whiterocks River	E½, Sec. 7, T3N, R1E, USB&M				66-418- Aug. 19
Whiterocks Dam and Reservoir	On Whiterocks River	Sec. 7, T2N, R1E, USB&M	U.S. Forest Service Whiterocks Road 119, R-4, Utah, Ashley NF, strip 30, 1" = 13,500', CI = 25'			70-418- Aug. 19
Whiterocks Dam and Reservoir	On offstream site on a small tributary to the Whiterocks River	Sec. 16, T1N, R1E, USB&M				66-418-
Upper Tridell Dam and Reservoir	On a tributary to Whiterocks River	Sec. 27, T1N, R1E, USB&M				66-418-
Lower Tridell Dam and Reservoir	On a tributary to Whiterocks River	Sec. 27, T1N, R1E, USB&M				66-418-
Crow Creek Dam and Reservoir	On Crow Creek, a tributary of Uinta River	Sec. 26, T3S, R19E, SLB&M	1" = 400', CI = 5', 660A-418-23, 1946; 1" = 100', CI = 5', 660A-418-24, 1940			66-418-
Deep Creek Dam and Reservoir	On Deep Creek just below the confluence of Crow Creek	Sec. 26 and 27, T3S, R19E, SLB&M	1" = 400', CI = 10', 660A-404-33, 1912			
Mosby Dam and Reservoir	On Mosby Creek about 12 miles east and 4 miles north of Vernal	Sec. 34, T3S, R19E, SLB&M	1" = 400', CI = 5', 660A-418-21; 1" = 50', CI = 5', 660A-418-29			66-418-
Bochalen Dam and Reservoir	On Twin Cottonwood Wash, a tributary to the Uinta River	Sec. 27 and 28, T5S, R19E, SLB&M	1" = 400', CI = 5', 66PT-418-382, Nov. 1955	1/		2/66-418- 70-418- Oct. 19
Bullock Draw Dam and Reservoir	Deep Creek to Uinta River	Sec. 31, T1S, R2E, USB&M				
Lower Uinta Dam and Reservoir	On Uinta River	Sec. 35, T2S, R1E, USB&M	USBR 1" = 500', CI = 10', 70-418-2, Oct. 1963	1/		70-418- Oct. 19
Bottle Hollow Dam and Reservoir	Offstream site tributary to Uinta River	Sec. 21, 22, 27, & 28, T2S, R1E, USB&M	1" = 50', CI = 5', 70-418-9, Nov. 21, 1963	Memo to E. O. Larson, 3-31-39, by J. Neil Murdock (only general)		70-418- 66-418- Oct. 19
Sand Wash Dam and Reservoir	Dry Wash 6 miles east of Fort Duchesne	Sec. 25, T6S, R19E, SLB&M, 6 mi. east of Fort Duchesne	1" = 500', CI = 10', 66-418-104	1/		66-418-
Moore Dam and Reservoir	Red Wash to Duchesne River	Sec. 1, T7S, R19E, SLB&M				
Avalon Dam and Reservoir	On Dry Wash, a tributary to the Duchesne River	Sec. 25 and 26, T3S, R2E, USB&M	1" = 50', CI = 5', 66PT-418-59, June 1942	Appendices for Uinta Basin Report, 1943		70-418- Jan. 19
Fuller Cut Dam and Reservoir	An offstream site 9.5 miles southeast of Fort Duchesne	Sec. 29, T6S, R20E, SLB&M	1" = 50', CI = 5', 66PT-418-49 through 58			66-418-
Anderson Dam and Reservoir	An offstream site about 9 miles southeast of Fort Duchesne	Sec. 32, T6S, R20E, SLB&M				66-418-
Pelican Lake Dam and Reservoir	An offstream site, a tributary to the Duchesne River	Sec. 20, 21, 28, & 29, T7S, R20E, SLB&M	USBR 1" = 1000', CI = 5', 66PT-418-61, 63, and 65, May 1942	"Revised Uinta Basin Report Appendices" No. 123		70-418- Dec. 19
Halfway Hollow Dam and Reservoir	West Fork of Halfway Hollow, a tributary to Green River	Sec. 7, T6S, R20E, SLB&M	1" = 100', CI = 5', 66-418-406; 1" = 1000', CI = 10', 66-418-74 and 88	1/		70-418-
Blanchett Park Dam and Reservoir	Dry Fork, a tributary of Ashley Creek	Sec. 20, 21, 28, & 29, T1S, R18E, SLB&M	1" = 1000', CI = 10', 66PT-418-19, July 1946			66-418- Mar. 19
Lake Dam and Reservoir	Headwater Dry Fork to Lake Fork	Sec. 32, T4N, R1E, USB&M				
Twin Lakes Dam and Reservoir (Lake No. 7)	Dry Fork, a tributary to Ashley Creek	Sec. 21, T1S, R18E, SLB&M	1" = 1000', CI = 10', 66PT-418-19			66-418-
Goose Lake Feeder Dam and Reservoir (Elbow Lake)	South Fork of Ashley Creek	Sec. 18, T1S, R19E, SLB&M	1" = 400', CI = 5'; 1" = 100', CI = 2', 660A-404-37			

	Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
					From 22nd Biennial Report of State Engineer Feasibility doubtful 1/ Other Whiterocks Lake Dam sites located in: No. 1 Sec. 28, T5N, R1W No. 4 Sec. 21, T5N, R1W No. 2 Sec. 33, T5N, R1W No. 5 Sec. 29, T5N, R1W No. 3 Sec. 32, T5N, R1W 30' Quad Series - Gilbert Peak
.4, Utah,			No number Apr. 1964	50,000 AF Apr. 1964	USBR 30' Quad Series - Gilbert Peak
			66-418-600 Aug. 1931		USBR 30' Quad Series - Marsh Peak
.4, Utah,			70-418-1 Aug. 1963	Reconn. est. Sep. 1963 9,500 to 77,000 AF July 1963 prices	USBR 30' Quad Series - Marsh Peak
			66-418-556		USBR 30' Quad Series - Vernal
			66-418-559		USBR 30' Quad Series - Vernal
			66-418-558		USBR 30' Quad Series - Vernal
= 100',			66-418-527		USBR 30' Quad Series - Marsh Peak
					USBR 30' Quad Series - Marsh Peak
CI =			66-418-517		USBR 30' Quad Series - Marsh Peak
5	1/		2/66-418-612 70-418-8 Oct. 1963	6,220 to 15,700 AF Jan. 1964	1/ Preliminary Report of the Geology of Dam Sites in the Uinta Basin and Ashley Valley, June 1943 2/ Axis "A", 66-418-612, Sec. 29 and 32, T5S, R19E, Nov. 1955 30' Quad Series - Vernal
					From 22nd Bienniel Report of State Engineer Investigations made and cost estimates prepared Records on file in State Engineer's Office Est. 908 AF - $128,651 30' Quad Series - Vernal
1963	1/		70-418-4 Oct. 1963	Dec. 1963 2,000 to 8,000 AF Price Dec. 1963 No. not assigned	1/ "Preliminary Report of Geology of Dam Sites in the Uinta Basin and Ashley Valley", by G. D. Lassan, June 1943 30' Quad Series - Vernal
	Memo to E. O. Larson, 3-31-39, by J. Neil Murdock (only general)		70-418-13 66-418-603 Oct. 1963	Reconn. est. Dec. 1963 4,000 to 13,000 AF Prices Dec. 1963 No. not assigned	30' Quad Series - Vernal
	1/		66-418-555	1,000 to 15,000 AF Oct. 1963	1/ "Preliminary Report of Geology in the Uinta Basin and Ashley Valley", June 1943 30' Quad Series - Vernal
					From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Vernal
	Appendices for Uinta Basin Report, 1943		70-418-15 Jan. 1964	466 to 2,006 AF Mar. 1964	USBR 30' Quad Series - Vernal
			66-418-523		USBR 30' Quad Series - Vernal
			66-418-514		USBR 30' Quad Series - Vernal
, and	"Revised Uinta Basin Report Appendices" No. 123		70-418-12 Dec. 1963	6,500 to 60,500 AF Jan. 1964	USBR 30' Quad Series - Vernal
, CI =	1/		70-418-11	20,000 to 57,000 AF Dec. 1963	1/ "Preliminary Report of the Geology of Dam Sites in the Uinta Basin and Ashley Valley", 1943 USBR 30' Quad Series - Vernal
46			66-418-565 Mar. 1948	2,230 to 11,700 AF Oct. 1963	USBR 30' Quad Series - Marsh Peak
					From 22nd Biennial Report of State Engineer 30' Quad Series - Marsh Peak
			66-418-548	1,750 to 4,550 AF Oct. 1963	USBR 30' Quad Series - Marsh Peak
					From 22nd Biennial Report of the State Engineer Est. 432 AF - $22,227 } Two dams $46,809 } 30' Quad Series - Marsh Peak

Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-cap[acity] curv[e] Drawing
Trout Lake Dam and Reservoir	Trout Lake to Dry Fork to Ashley Creek	Sec. 24, T1S, R18E, SLB&M				
Deep Creek Dam and Reservoir	Dry Fork to North Fork Ashley Creek	Sec. 10, T2S, R18E, SLB&M				
Chimney Rock Dam and Reservoir	Chimney Rock Lake to Split Creek to North Fork Ashley Creek	Sec. 29, T1S, R19E, SLB&M				
Charleys Park Dam and Reservoir	North Fork Ashley Creek	Sec. 25, T2S, R19E, SLB&M				
Ashley Fish Lake Dam and Reservoir	South Fork to Ashley Creek	Sec. 7, T1S, R19E, SLB&M				
Lake Shore Dam and Reservoir (Dead Lake)	South Fork of Ashley Creek	Sec. 12, T1S, R18E, SLB&M	1" = 200', CI = 5', 660A-404-37			
Upper Goose Lake Dam and Reservoir	South Fork of Ashley Creek	Sec. 17, T1S, R19E, SLB&M	1" = 200', CI = 5', 660A-404-37			
Lake 1, 2, and 3 Dam and Reservoir	Lake to South Fork Ashley Creek	Sec. 16, T1S, R19E, SLB&M				
Metcalf Dam and Reservoir	East Fork to Dry Fork to Ashley Creek	Sec. 27, T1S, R19E, SLB&M				
French Park Dam and Reservoir	Black Canyon to Ashley Creek	Sec. 5, T2S, R20E, SLB&M				
Hacking Lake Dam and Reservoir	Hacking Lake to Ashley Creek	Sec. 32, T1N, R19E, SLB&M				
Springs Dam and Reservoir	Ashley Creek	Sec. 1, T1S, R19E, SLB&M				
Soldier Park Dam and Reservoir	On Ashley Creek above the confluence of Trout Creek	Sec. 5, T1S, R20E, SLB&M	1" = 500', 1943, 66PT-418-84			66-418-5[...]
Ridge Lake Dam and Reservoir	South Fork Ashley Creek	Sec. 18, T1S, R20E, SLB&M				
Leidy Dam and Reservoir (Trout Creek)	Trout Creek, a tributary to Ashley Creek	Sec. 9 and 10, T1S, R20E, SLB&M	1" = 1000', CI = 10', 66PT-418-15			66-418-5[...] Jan. 19[...]
Lake No. 4 Dam and Reservoir	Lake to South Fork Ashley Creek	Sec. 18, T1S, R20E, SLB&M				
Bench Lakes Dam and Reservoir (Upper and Lower)	South Fork to Ashley Creek	Sec. 20, T1S, R20E, SLB&M				
Spring Creek Dam and Reservoir	Spring Creek to Ashley Creek	Sec. 20, T3S, R21E, SLB&M				
Maeser Creek Dam	On Ashley Creek	Sec. 5, T4S, R21E, SLB&M	1" = 500', CI = 10', 325PT-418-64 through 69	Unpublished CUP Vernal unit definite plan geological report Dec. 1956	See Geology	325-418-[...] 7-9-48
East Draw Dam and Reservoir	Offstream site 5 miles west of Vernal, Utah	Sec. 13, T4S, R20E, SLB&M	1" = 500', CI = 10', 66PT-418-17			325-418-[...]
Hacking Draw Dam and Reservoir	Offstream site 5 miles west of Vernal	Sec. 13, T4S, R20E, SLB&M	1" = 500', CI = 10', 66PT-418-17			66-418-5[...]
Cottonwood Draw Dam and Reservoir	Offstream site 5 miles northwest of Vernal	Sec. 24, T4S, R20E, SLB&M	1" = 500', CI = 10', 66PT-418-17			66-418-5[...]
Oaks Park Dam and Reservoir	On Brush Creek, a tributary to the Green River	Sec. 1 and 12, T1S, R20E, SLB&M	1" = 50', CI = 2', 325-P-22, 9-12-42; 1" = 400', CI = 5', 66PT-418-437, Oct. 1946	1/		325-418-[...]
Tyzack Dam and Reservoir	On Brush Creek	Sec. 10, T3S, R22E, SLB&M	1" = 50', CI = 5', 450-P-4 (2 sheets); 1" = 500', CI = 10', 450-400-29 2/	Prelim. geology of Tyzack Dam site. Nov. 1945 Drill & test pit program, Tyzack Dam site, 1945	See Geology	Axis A 66-418[...] Axis B 66-418[...] Axis C 66-418[...]
Boan Dam and Reservoir	On Brush Creek 7 miles east of Vernal	Sec. 13 and 24, T4S, R22E, SLB&M	1" = 500', CI = 5 and 20', 66PT-418-12, Mar. 1943; 1" = 500', CI = 5' and 20', 66-418-176			66-418-5[...]
Pot Creek Dam and Reservoir	Pot Creek to Green River	Sec. 24, T1S, R24E, SLB&M				

roject
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ir Sites
Area

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Est. 80 AF USGS 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Estimate made and investigation made Records on file in State Engineer's Office Est. 313 AF - $28,580 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Est. 189 AF - $17,392 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak Est. 100 AF
				From 22nd Biennial Report of State Engineer Feasibility doubtful Est. 520 AF 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Reconnaissance made and records in State Engineer's Office Est. 234 AF - $36,402 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
		66-418-561		USBR 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Est. 450 AF USGS 30' Quad Series - Marsh Peak
		66-418-570 Jan. 1949	9,000 to 87,000 AF Oct. 1963	USBR 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak
Unpublished CUP Vernal unit definite plan geological report Dec. 1956	See Geology	325-418-136 7-9-48	25,200 AF Apr. 1948	USBR 30' Quad Series - Vernal
		325-418-135		USBR 30' Quad Series - Vernal
		66-418-522		USBR 30' Quad Series - Vernal
		66-418-534		USBR 30' Quad Series - Vernal
1/		325-418-153	Recon. est. Apr. 1964 10,000 to 16,000 AF Jan. 1964	1/ Unpublished report, CUP, Vernal unit, definite plan geology report, Dec. 1950 USBR 30' Quad Series - Marsh Peak
Prelim. geology of Tyzack Dam site, Nov. 1945 Drill & test pit program, Tyzack Dam site, 1945	See Geology	Axis A 66-418-675 Axis B 66-418-1020 Axis C 66-418-1021	4,000 to 15,000 AF 1/ Sep. 1963	1/ Cost capacity curve for Axis "A" 2/ Topography: 450PT-418-32 & 33 Scale 1" = 50', CI = 5' Damsite 450PT-418-34 Scale 1" = 500', CI = 10' Reservoir 3/ Alternate - Upper Big Brush Creek Reservoir Topography: 1" = 500', 1941, No. 66PT-418-43 USBR
'6		66-418-528		USBR 30' Quad Series - Jensen

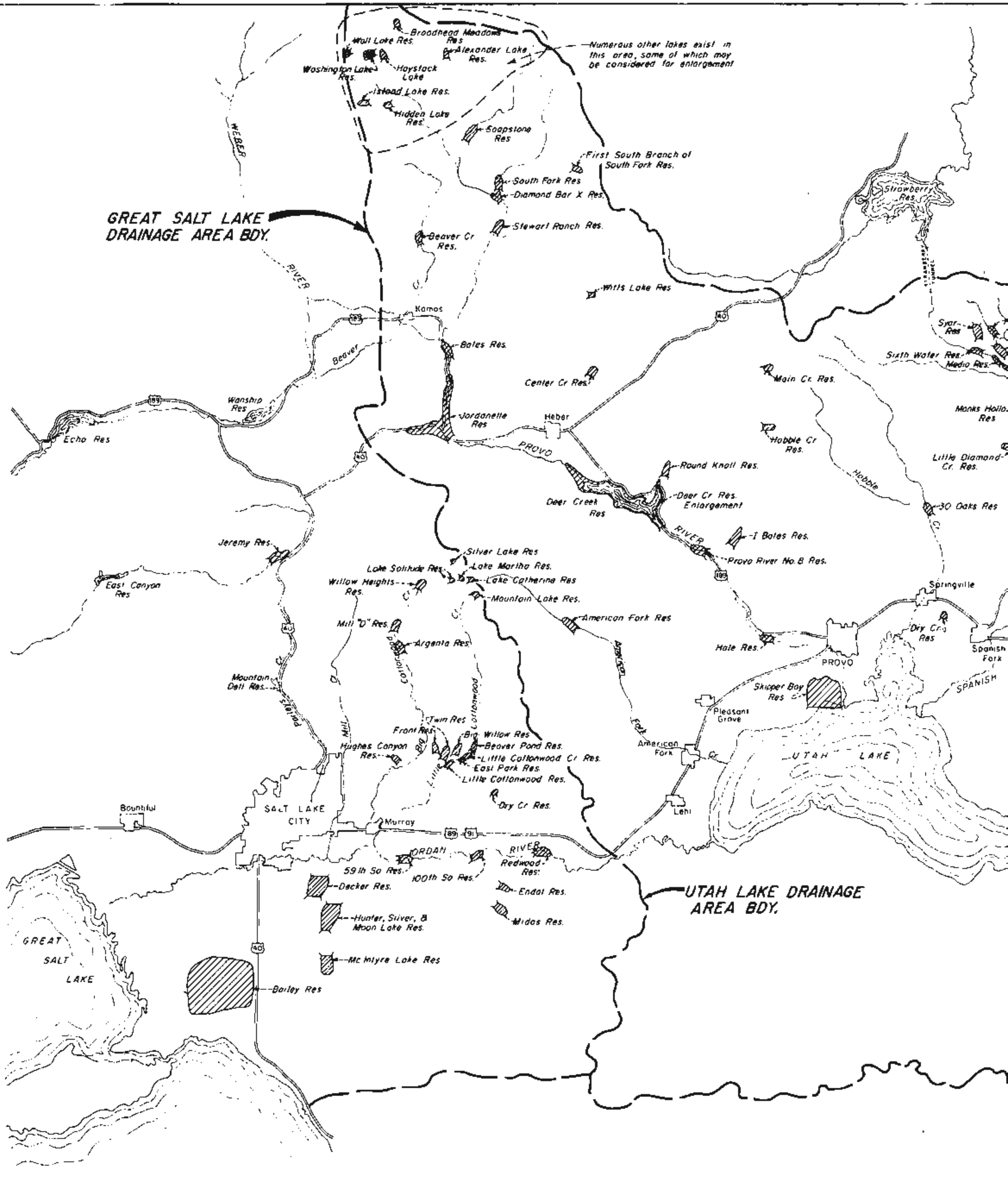
Pot Creek Dam: Alt. { Sec. 23 and 24, T1S, R24E, 1516 AF; Sec. 9 and 16, T1S, R24E }
From 22nd Biennial Report of State Engineer
Built 1910, failed 1927, not rebuilt 5505 AF

Central Utah Project
Ultimate Phase - Utah

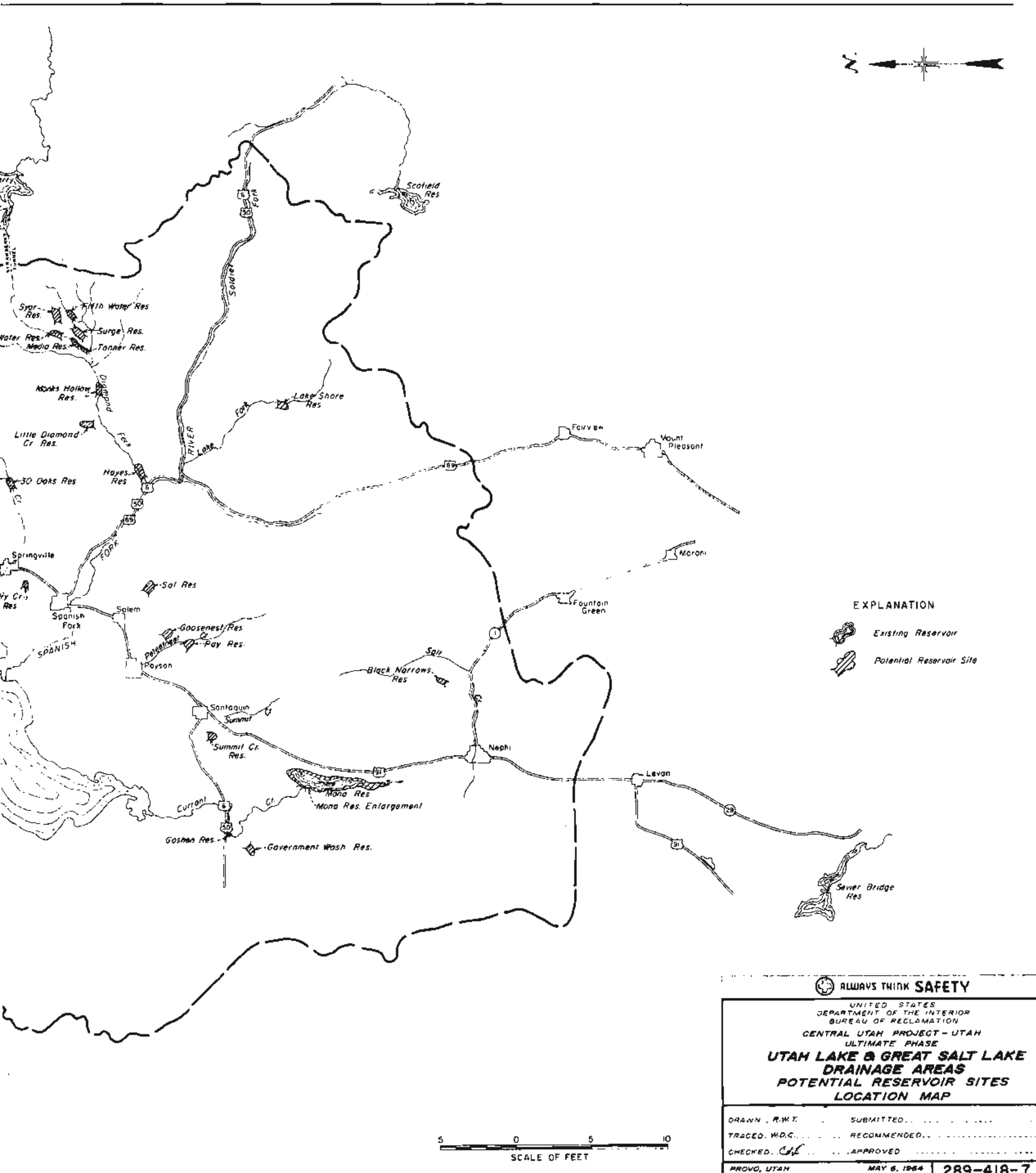
Potential Reservoir Sites
Uinta Basin Area

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area- c Draw
Echo Park Dam and Reservoir	Green River 3½ miles downstream from the confluence of the Yampa River	Sec. 20 and 29, T7N, R103W, Colorado B&M	1" = 200', CI = 5', 317PT-418-11 through 16; 1" = 50', CI = 5', 317PT-418-17 through 28			317-
Split Mountain Dam and Reservoir	Green River	Sec. 19 and 30, T4S, R24E, SLB&M	1" = 100', CI = 5', 592PT-418-6 through 8, 592-418-6 (1948)			
Pariette Dam and Reservoir	Pariette Draw to Green River	Sec. 14, T5S, R2E, USB&M				
Coyote Draw Dam and Reservoir	Coyote Wash to Green River	Sec. 19 or 20, T8S, R25E, SLB&M				
Coyote Wash Dam and Reservoir	Coyote Wash to White River to Green River	Sec. 5, T9S, R22E, SLB&M				
LaLong Draw Dam and Reservoir	LaLong Draw to White River to Green River	Sec. 21, T8S, R21E, SLB&M				
Wash Dam and Reservoir	Wash to White River to Green River	Sec. 12, T9S, R20E, SLB&M				
Ashley Creek Dam and Reservoir	Dry Fork to North Fork of Ashley Creek	Sec. 20 or 22, T1S, R18E, SLB&M				

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
		317-418-4		USBR 1 = 62,500 Topography of Dinosaur National Monument
				USBR
				From 22nd Biennial Report of State Engineer Plans and specifications filed in State Engineer's Office Est. 466 AF 30' Quad Series - Vernal
				From 22nd Biennial Report of State Engineer
				From 22nd Biennial Report of State Engineer
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Vernal
				From 22nd Biennial Report of State Engineer 30' Quad Series - Vernal
				From 22nd Biennial Report of State Engineer Feasibility doubtful 30' Quad Series - Marsh Peak



GREAT SALT LAKE DRAINAGE AREA BDY.
UTAH LAKE DRAINAGE AREA BDY.
Numerous other lakes exist in this area, some of which may be considered for enlargement
Broadhead Meadows Res
Wall Lake Res.
Alexander Lake Res.
Washington Lake Res.
Haystack Lake
Island Lake Res.
Hidden Lake Res.
Soapstone Res
First South Branch of South Fork Res.
South Fork Res
Diamond Bar X Res.
Stewart Ranch Res.
Beaver Cr Res.
Mills Lake Res
Strawberry Res.
Kamas
Bates Res.
Center Cr Res.
Wanship Res
Echo Res
Jordanelle Res
Heber
PROVO
RIVER
WEBER
Beaver
Syar Res
Sixth Water Res.
Main Cr. Res.
Monks Hollow Res
Hobble Cr Res.
Round Knoll Res.
Little Diamond Cr. Res.
Deer Creek Res
Deer Cr Res. Enlargement
Hobble
I Bates Res.
Provo River No. 8 Res.
30 Oaks Res
Jeremy Res.
East Canyon Res
Silver Lake Res
Lake Solitude Res
Lake Martha Res.
Lake Catherine Res
Willow Heights Res.
Mountain Lake Res.
American Fork Res
Springville
Mill "D" Res.
Argenta Res.
Dry Cr Res
Hale Res.
Spanish Fork
SPANISH
Mountain Dell Res.
Parleys
Cottonwood
American Fork
Skipper Bay Res
Pleasant Grove
Twin Res
Front Res.
Big Willow Res
Beaver Pond Res.
Hughes Canyon Res.
Little Cottonwood Cr Res.
East Park Res.
Little Cottonwood Res.
Dry Cr Res.
Mill
Big
Little
American Fork
UTAH LAKE
Lehi
Bountiful
SALT LAKE CITY
Murray
JORDAN RIVER
59th So Res.
100th So Res.
Redwood Res.
Decker Res.
Endal Res.
Hunter, Silver, & Moon Lake Res.
Midas Res.
Mc Intyre Lake Res
Bailey Res
GREAT SALT LAKE



EXPLANATION
Existing Reservoir
Potential Reservoir Site
Scofield Res
Syar Res.
Fifth Water Res
Surge Res.
Water Res.
Media Res.
Tanner Res.
Monks Hollow Res.
Little Diamond Cr. Res.
Lake Shore Res
Hayes Res
30 Oaks Res
Diamond
Fork
Soldier
Fork
RIVER
Lake
Fork
Fairview
Mount Pleasant
Moroni
Fountain Green
Springville
Spanish Fork
Salem
SPANISH
FORK
Sal Res
Goosenest Res
Pay Res.
Payson
Black Narrows Res
Salt
Cr.
Santaquin
Summit
Summit Cr. Res.
Nephi
Levan
Mona Res
Mona Res. Enlargement
Current
Cr.
Goshen Res.
Government Wash Res.
Sevier Bridge Res
5 0 5 10
SCALE OF FEET
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT - UTAH
ULTIMATE PHASE
UTAH LAKE & GREAT SALT LAKE
DRAINAGE AREAS
POTENTIAL RESERVOIR SITES
LOCATION MAP
DRAWN R.W.T.
SUBMITTED
TRACED W.D.C.
RECOMMENDED
CHECKED
APPROVED
PROVO, UTAH
MAY 6, 1964
289-418-7

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type
Black Narrows Dam and Reservoir	Pole Creek to Salt Creek to Currant Creek to Utah Lake	Sec. 28, T12S, R2E, SLB&M	1" = 200', CI = 5', 660A-418-1, 1939		
Government Wash Dam and Reservoir	(Kimball Creek) Government Wash to Currant Creek to Utah Lake	Sec. 21, T10S, R1W, SLB&M			
Goshen Dam and Reservoir	Current Creek on site of existing dam	NW¼, Sec. 15, T10S, R1W, SLB&M			
Mona Dam and Reservoir	On Currant Creek at the site of the existing dam	Sec. 7, T11S, R1E, SLB&M	1" = 50', CI = 1' and 5', 66PT-418-692, 693, and 695, Jan. 1962	Feasibility Geologic Report No. G-177, Region 4, SLC, Utah, Aug. 1962	See Geology
Summit Creek Dam and Reservoir	On Summit Creek, a tributary to Santaquin Creek	Sec. 2, 3, 10, and 11, T10S, R1E, SLB&M	1" = 400', CI = 2', 66-418-1496; 1" = 400', CI = 2', 66PT-418-690		
Pay Dam and Reservoir	On Peteetneet Creek, a tributary to Utah Lake	Sec. 34, T9S, R2E, SLB&M	1" = 400', CI = 10', 66PT-418-687 and 307		
Goosenest Dam and Reservoir	At the mouth of Bear Canyon, a tributary to Utah Lake	Sec. 22, 23, 26, and 27, T9S, R2E, SLB&M	1" = 50', CI = 5', 66-418-310; 1" = 400', CI = 10', 66PT-418-304 through 307		
Sal Dam and Reservoir	Near the mouth of Water Canyon, a tributary to Utah Lake	Sec. 17 and 18, T9S, R3E, SLB&M	1" = 400', CI = 10', 66PT-418-301 through 304		
Syar Dam and Reservoir	Summit of Rays Valley Road between Fifth and Sixth Water, a tributary to Diamond Fork	Sec. 17 and 18, T8S, R6E, SLB&M	1" = 50', CI = 2', 66PT-418-662 through 668, Sept. 1961	"Feasibility Geologic Report for Syar Dam & Powerplant Site" G-174, Region 4, SLC, Utah, Jan. 1962	See Geology
Sixth Water Dam and Reservoir	On Sixth Water Creek, a tributary to Diamond Fork	Sec. 13, T8S, R5E, SLB&M	1" = 50', Oct. 1961, 66PT-418-673 through 679, 66-418-1476	"Feasibility Geologic Report Sixth Water Dam & Powerplant Site" G-173, Region 4, SLC, Utah, Jan. 1962	See Geology
Surge Reservoir to Forks Powerplant	Offstream site between Fifth and Sixth Water, a tributary to Diamond Fork	NE¼, Sec. 25 and SW¼ Sec. 19, T8S, R5 and 6E, SLB&M	1" = 200', CI = 5', 66PT-418-107		
Media Dam and Reservoir	On Sixth Water, a tributary to Diamond Fork	Sec. 26, T8S, R5E, SLB&M	1" = 400', CI = 10', 66-418-1473		
Tanner Dam and Reservoir	On Sixth Water, a tributary of Diamond Fork	Sec. 26, T8S, R5E, SLB&M	1" = 400', CI = 10', 66-418-1473		
Fifth Water Dam and Reservoir	On Fifth Water Creek, a tributary to Diamond Fork	Sec. 19, T8S, R6E, SLB&M	Reservoir: 1" = 400', CI = 10', 66-418-1285 and 1286 2/; Dam: 1" = 50', CI = 5', 66PT-418-680 through 683 and 689	1/	See Geology
Monks Hollow Dam and Reservoir	On Diamond Fork	Sec. 32, T8S, R5E, SLB&M	State of Utah topography, 1940, 1" = 50', CI = 5', 66OA-418-15 (3 sheets) 1/	2/	2/
Little Diamond Creek Dam and Reservoir	On Little Diamond Creek	Sec. 1 and 36, T8 and 9S, R4E, SLB&M	660A-418-30 (1940), 1" = 50', CI = 5', (8 sheets); 660A-418-31 (1940), 1" = 400', CI = 5'; 660A-404-15 and 16, 1" = 400', CI = 5' 1/		
Hayes Dam and Reservoir	On Diamond Fork	Sec. 16 and 17, T9S, R4E, SLB&M	1" = 50', CI = 5', 66PT-418-349 through 355, 526, and 688 1/	2/	2/
Lake Shore Dam and Reservoir	Lake Fork to Soldier Creek to Spanish Fork River	Sec. 32, T10S, R5E, SLB&M			
30 Oaks Dam and Reservoir (Hobble Creek Dam)	Hobble Creek to Utah Lake	Sec. 32, T7S, R4E, SLB&M			
Dry Creek Dam and Reservoir (Big Hollow)	Big Hollow to Dry Creek to Utah Lake	Sec. 8, T8S, R3E, SLB&M			
Haystack Lake No. 2 Dam and Reservoir	Haystack Lake to Provo River	Sec. 7, T2S, R9E, SLB&M			
Broadhead Meadows Dam and Reservoir	Broadhead Meadows to Provo River	Sec. 16, T2S, R9E, SLB&M			

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Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
		66-418-646 Oct. 1949		From 22nd Biennial Report of State Engineer July 1, 1938 to June 30, 1940 Investigations made and cost estimate prepared Records on file in State Engineer's Office Est. 6,275 AF - $1,115,358 1,746 AF - $ 397,802 15' Quad Series - Moroni
				From 22nd Biennial Report of State Engineer July 1, 1938 to June 30, 1940 Investigation made and cost estimate prepared Records on file in State Engineer's Office Est. 318 AF - $90,389 15' Quad Series - Santaquin
		66-418-676 Jan. 1953		USBR 15' Quad Series - Santaquin
easibility eologic Report o. G-177, egion 4, SLC, tah, Aug. 1962	See Geology	66-418-1599 Mar. 3, 1962	Feasibility design at 55,000 AF	USBR Feasibility design drawing No. 66-D-35, 1962 15' Quad Series - Santaquin
				USBR 15' Quad Series - Santaquin
		No number Jan. 1962	6,000 to 22,000 AF Jan. 1962	USBR 15' Quad Series - Santaquin Peak
		66-418-1435 Nov. 1961	270 to 1,730 AF July 1958	USBR 7.5' Quad Series - Spanish Fork
		66-418-1436 Nov. 1961		Coordinates of dam axis N. 620,000 and E. 1,962,000 USBR 7.5' Quad Series - Spanish Fork Peak
Feasibility eologic Report or Syar Dam & owerplant Site" -174, Region 4, LC, Utah, Jan. 962	See Geology	66-418-1433 Nov. 16, 1961	Feasibility design1/ at 930 AF	1/ Feasibility design drawing No. 66-D-26 30' Quad Series - Strawberry Valley
Feasibility eologic Report ixth Water Dam Powerplant Site" -173, Region 4, LC, Utah, Jan. 962	See Geology	66-418-1495 Sep. 27, 1961	Feasibility design at 1,020 AF	USBR 30' Quad Series - Strawberry Valley
				USBR 30' Quad Series - Strawberry Valley
		No number Dec. 1962	1,000 AF	USBR 30' Quad Series - Strawberry Valley
		66-418-645 Mar. 1949		USBR 30' Quad Series - Strawberry Valley
1/	See Geology	No number Sep. 1961	2,500 AF 1961 est.	1/ Feasibility Geology Report "Fifth Water Dam and Powerplant Site," G-175 Region 4, SLC, Utah, Jan. 1962 2/ Reservoir topography prepared by the U. S. Forest Service USBR 30' Quad Series - Strawberry Valley
2/	2/	66-418-500 May 1946		1/ Reservoir topography: 1" = 400', CI = 5', 660A-418-16 (2 sheets) 2/ Monks Hollow Dam site, drill and test pit program, 1946 USBR 30' Quad Series - Strawberry Valley
		66-418-520 (Not in files)		USBR 1/ Topography by State Engineer 30' Quad Series - Strawberry Valley
2/	2/	66-418-680 Mar. 1953	Feasibility design at 51,500 AF Design drawing No. 66-D-24	1/ Reservoir topography: 66PT-418-605, 606, 608, 617, and 686, 1' = 400', Little Diamond Creek Reservoir site, 660A-404-31 (30' Quad Series - Strawberry Valley) 2/ "Earth Materials Investigation Data and Results of Laboratory Tests of Materials for the Proposed Hayes Dam", CTF, GP-52, April 1962
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful
		66-418-674 Mar. 1953	10,000 to 80,000 AF 3-27-53	From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Records on file in State Engineer's Office and USGS Reconnaissance made 7.5' Quad Series - Springville
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Plans and specifications filed in State Engineer's Office 7.5' Quad Series - Provo
				Alternate: Haystack Lake No. 1, Sec. 12, T2S, R8E, SLB&M From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 30' Quad Series - Hayden Peak
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 30' Quad Series - Hayden Peak

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type
Island Lake Dam and Reservoir (North Fork Lake No. 4)	Island Lake to North Fork to Provo River	Sec. 3, T2S, R8E, SLB&M			
Hidden Lake Dam and Reservoir	Hidden Lake to Provo River	Sec. 10 and 15, T2S, R8E, SLB&M			
Alexander Lake Dam and Reservoir	Alexander Lake to Provo River	Sec. 31, T2S, R9E, SLB&M			
Soapstone Dam and Reservoir	On Provo River	Sec. 5, T3S, R8E, SLB&M	1" = 400', CI = 5', 244-408-215 and 216, February 1952		
First South Branch of South Fork Dam and Reservoir	Campbell Hollow to South Fork to Provo River	Sec. 12, T4S, R7E, SLB&M			
South Fork Dam and Reservoir	On South Fork of Provo River	Sec. 14, T3S, R7E, SLB&M	Quad sheet, 30' series, 1:125,000		
Diamond Bar X Dam and Reservoir	On Provo River	Sec. 15, T3S, R7E, SLB&M	1" = 400', CI = 5', 244-408-217, Feb. 1952		
Stewart Ranch Dam and Reservoir (Twin Pine)	On Provo River	SE¼, Sec. 17, T3S, R7E, SLB&M	1" = 1000', CI = 10', 66PT-418-172; 1" = 200', 66PT-418-173; 1" = 400', CI = 5', 244-408-52, Jan. 1957		
Beaver Creek Dam and Reservoir	On Beaver Creek, a tributary to the Provo River	Sec. 19, T2S, R7E, SLB&M	Quad sheet, 30' series, 1 = 125,000		
Bates Dam and Reservoir	On Provo River	Sec. 36, T2S, R5E, SLB&M	1" = 400', CI = 5', 66PT-418-194 and 195, Aug. 1950 1/	Geology report 2/	See Geology
Jordanelle Dam and Reservoir	On Provo River	Sec. 31, T2S, R5E, SLB&M	Damsite: 1" = 100', CI = 5', 66-418-881 through 894; Reservoir: 1" = 400', CI = 5', 66-418-2276, 2317, 2327, 2331, 2338, 2349	GM-73 GM-74 Drill logs	GM-72
Witts Lake Dam and Reservoir	Lake Creek to Provo River	Sec. 10, T4S, R6E, SLB&M			
Center Creek Dam and Reservoir	On Center Creek, tributary to Provo River	Sec. 14, T4S, R5E, SLB&M	1" = 500', CI = 10', 66PT-418-511, Jan. 6, 1950		
Deer Creek Reservoir Enlargement	On Provo River	Sec. 5 and 6, T5S, R4E, SLB&M	1" = 200', CI = 5' 1/	See final construction report for existing dam	See final construction report for existing dam
Main Creek Dam and Reservoir	Main Creek to Round Valley Creek to Provo River	Sec. 11, T6S, R5E, SLB&M			
Hobble Creek Dam and Reservoir	On Little Hobble Creek, a tributary to Provo River	Sec. 7, T6S, R5E, SLB&M	1" = 50', CI = 5', 66PT-418-189 and 190, 1950	"Hobble Creek Res. Geologic Investigations"	See Geology
Round Knoll Dam and Reservoir	Tributary to Provo River	Sec. 4, T5S, R4E, SLB&M	1" = 200', CI = 5', 1.2R-36 and 37		
Provo River No. 8 Dam and Reservoir	Provo River	Sec. 24, T5S, R3E, SLB&M			
I. Bates Dam and Reservoir	South Fork to Provo River	Sec. 36, T5S, R3E, SLB&M			
Hale Dam and Reservoir	On Provo River	Sec. 12, T6S, R2E, SLB&M	1" = 50', CI = 1', 66PT-418-742 through 745		
Skipper Bay Dike	On Utah Lake north of Provo Boat Harbor	Sec. 28, 33, and 34, T6S, R2E; Sec. 3, 4, and 5, T7S, R2E, SLB&M	USGS Quad Sheet, 7½' series, 1 = 24,000	1/	1/
Howe Canyon Wash Dam and Reservoir	Howe Canyon Wash to Utah Lake	Sec. 1 and 2, T8S, R3W, SLB&M			
American Fork Dam and Reservoir	American Fork Creek to Jordan River	Sec. 7, T4S, R3E, SLB&M			
Wall Lake Dam and Reservoir	Wall Lake to Provo River	Sec. 30 and 31, T1S, R9E, SLB&M			
Washington Lake Dam and Reservoir	Washington Lake to Provo River	Sec. 6, T2S, R9E, SLB&M			

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 30' Quad Series - Coalville
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 30' Quad Series - Coalville
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 30' Quad Series - Hayden Peak
		No number 11-1-57	12,000 AF Oct. 1957	USBR 30' Quad Series - Coalville
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 30' Quad Series - Strawberry Valley
		No number 11-4-57	12,000 AF Oct. 1957	USBR 30' Quad Series - Coalville
		No number 11-6-57	12,000 AF Oct. 1957	USBR 30' Quad Series - Coalville
		66-418-567 2-17-49 No number 10-31-57	12,000 AF Oct. 1957	USBR 30' Quad Series - Coalville
		No number 11-4-57	12,000 AF Oct. 1957	USBR An alternate site entitled Lower Beaver Creek Reservoir 30' Quad Series - Coalville
Geology report 2/	See Geology	66-418-653 1-10-52	30,000 to 65,000 AF Prices: Oct.1958 3/	1/ Bates Dam site: 1" = 50', CI = 5', July 1950, 66PT-418-199 through 209 2/ Reconnaissance Geological Report of the Bates Dam and Reservoir site, G-76, Region 4, Salt Lake City, Utah, January 1951 3/ Also Upper Provo-Upper Weber complex curve, June 7, 1962; August 1959 cost study for 150,000 AF 30' Quad Series - Coalville
GM-73 GM-74 Drill logs	GM-72	66-418-2357	170,000 AF Feasibility estimate	USBR 7.5' Quad Series - Heber
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Plans and specifications filed in State Engineer's Office 30' Quad Series - Strawberry Valley
		66-418-1173 9-18-59	9,000 AF	USBR 30' Quad Series - Strawberry Valley
See final construction report for existing dam	See final construction report for existing dam	66-418-1748	150,000 AF Aug. 1959	1/ 66PT-418-533 through 541, 710, 746 through 760, 770, 860, and 862 through 872 USBR 7.5' Quad Series - Aspen Grove
				From 22nd Biennial Report of State Engineer July 1, 1938 to June 30, 1940 (State Engineer) Reservoir site infeasible 30' Quad Series - Strawberry Valley
"Hobble Creek Res. Geologic Investigations"	See Geology	66-418-571 May 1950	200 to 1,400 AF Prices 1957 No numbers	USBR 30' Quad Series - Strawberry Valley
		66-418-568	1,400 to 14,000 AF Oct. 1958	USBR Drawing No. 66-418-1106 shows damsite in sec. 4 30' Quad Series - Strawberry Valley
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Surveyed, no cost estimate Records in USBR, Larson, 1938 7.5' Quad Series - Bridal Veil Falls
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 7.5' Quad Series - Bridal Veil Falls
		66-418-1821 Aug. 1962	60 AF Feasibility design	USBR 7.5' Quad Series - Orem
1/	1/	66-418-1038 2/	25,000 AF Jan. 1959	1/ Provo Bay Geological Reports are available on a site south of Provo Boat Harbor 2/ Area-capacity curves for alternate sites - 66-418-1042, 1043- and 1041 7.5' Quad Series - Orem and Provo
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 7.5' Quad Series - Five-Mile Pass
				From 22nd Biennial Report of State Engineer July 1, 1938 to June 30, 1940 Reconnaissance made Records on file in State Engineer's Office 7.5' Quad Series - Timpanogos Cave
				Existing lake - Memorandum: "Upper Provo River Lakes Inspection - Central Utah Project", dated Oct. 10, 1962, to Project Manager from Chief, Engineering Division 30' Quad Series - Hayden Peak
				Existing lake - Memorandum: "Upper Provo River Lakes Inspection - Central Utah Project", dated Oct. 10, 1962, to Project Manager from Chief, Engineering Division 30' Quad Series - Hayden Peak

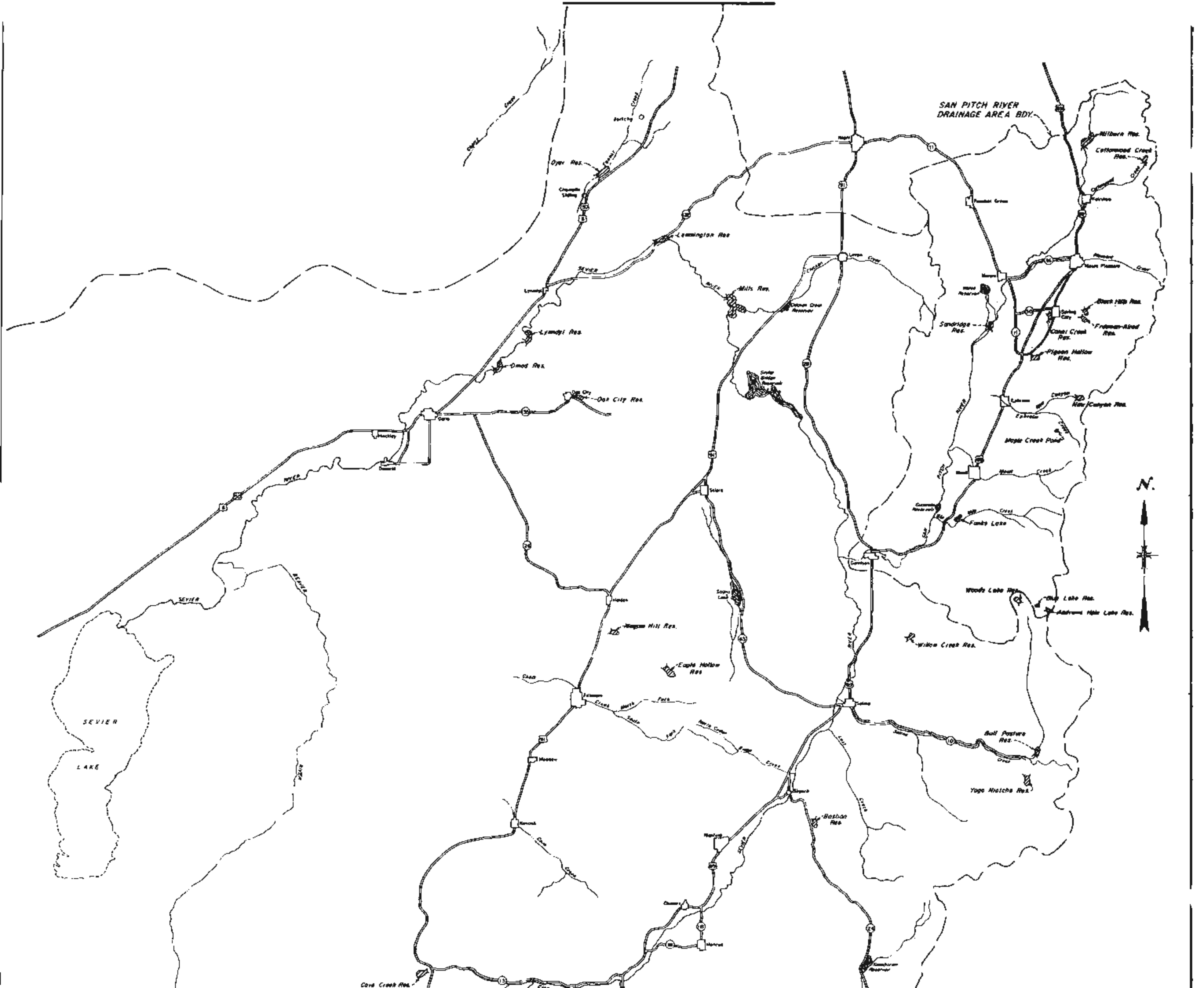
Potential reservoir sites
Great Salt Lake Drainage Basin

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-c... cu... Draw...
Mountain Lake Dam and Reservoir	Little Cottonwood Creek to Jordan River	Sec. 9, T3S, R3E, SLB&M				
Beaver Pond Dam and Reservoir	On Little Cottonwood Creek to Jordan River	Sec. 11, T3S, R1E, SLB&M	1" = 50', CI = 5', 1941, 660A-408-51 (10 sheets); 1" = 200', CI = 5', 1941, 660A-408-52 (2 sheets)[1]			66-41 7-14-
Little Cottonwood Creek Dam and Reservoir	On Little Cottonwood Creek	Sec. 2, T3S, R1E, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000			66-41 7-25-
East Park Dam and Reservoir	On Little Cottonwood Creek	Sec. 2, T3S, R1E, SLB&M	1" = 200', 660A-418-43, 1916			
Little Cottonwood Dam and Reservoir (Pepper Bridge)	Little Cottonwood Creek to Jordan River	Sec. 34, T2S, R1E, SLB&M				
Front Dam and Reservoir	Tributary to Great Salt Lake	Sec. 35 and 36, T2S, R1E, SLB&M[1]	1" = 100', CI = 5', 66PT-418-196, 197, and 198			66-41 8-8-5
Big Willow Dam and Reservoir	Little Willow Creek to Little Cottonwood Creek to Jordan River	Sec. 35, T2S, R1E, SLB&M				
Dry Creek Dam and Reservoir	On Dry Creek, tributary to Jordan River	Sec. 16, T3S, R1E, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000			66-41 7-25-
Lake Catherine Dam and Reservoir	Big Cottonwood Creek to Jordan River	Sec. 3, T3S, R3E, SLB&M				
Lake Martha Dam and Reservoir	Big Cottonwood Creek to Jordan River	Sec. 2, T3S, R3E, SLB&M				
Lake Solitude Dam and Reservoir	Big Cottonwood Creek to Jordan River	Sec. 34, T2S, R3E, SLB&M				
Silver Lake Dam and Reservoir (Hunter and Moon Lakes)	Hunter, Silver, and Moon Lakes to Jordan River	Sec. 24, T1S, R2W, SLB&M				
Willow Heights Dam and Reservoir	Big Cottonwood Creek to Jordan River	Sec. 22, T2S, R3E, SLB&M				
Argenta Dam and Reservoir	On Big Cottonwood Creek to Jordan River	Sec. 13, T2S, R2E, SLB&M	660A-418-3 and 4, Oct. 1924[1]	None	None	66-41 Feb.
Twin Dam and Reservoir	Offstream site in Cottonwood Canyon	Sec. 35 and 36, T2S, R1E, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000	None	None	None
Hughes Canyon Dam and Reservoir	Hughes Canyon to Big Cottonwood Creek to Jordan River	Sec. 13, T2S, R1E, SLB&M				
Jeremy Dam and Reservoir	On East Canyon Creek above East Canyon Reservoir	Sec. 2, T1S, R3E, SLB&M				66-4 June
Redwood Dam and Reservoir	On Jordan River 1 mile east of Riverton	Sec. 26, T3S, R1W, SLB&M				66-4 Feb.
Midas Dam and Reservoir	On a small tributary to the Jordan River	Sec. 17, T3S, R1W, SLB&M	1" = 200', CI = 2', 66PT-418-467 through 470	None	None	66-4 May
100th South Dam and Reservoir (South Jordan Dam)	On Jordan River	Sec. 11, T3S, R1W, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000			66-4 Mar.
59th South Dam and Reservoir	On Jordan River	N½, Sec. 14, T2S, R1W, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000			66-4 Mar.
Decker Dam and Reservoir	Great Salt Lake	Sec. 21, 22, 27, and 28, T1S, R1W, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000			No n 7-30
McIntyre Lake Dam and Reservoir	Jordan River drains and sloughs to Jordan River	Sec. 23, T1S, R2W, SLB&M				
Bailey Dam and Reservoir	North Point Consolidated Canal, Goggin Drain, Surplus Canal and Brighton Canal to Salt Lake	Sec. 15 through 22, 27 through 30, and 32 through 34, T1N, R2W, SLB&M	USGS Quad Sheet, 7.5' series, 1 = 24,000	See Materials	Embankment Materials Report on proposed Bailey dike & Reservoir, E. M. 24	No n 1959
Mill "D" Dam and Reservoir	On Big Cottonwood Creek	Sec. 7, T2S, R3E, SLB&M	1" = 200', CI = 10', 660A-418-2; 1" = 50', CI = 10', 660A-418-5[1]			Char 660A
Silver Lake Dam and Reservoir	Silver Lake to Big Cottonwood Creek to Jordan River	Sec. 35, T2S, R3E, SLB&M				
Endot Dam and Reservoir	A tributary to Jordan River	Sec. 9, 10, 15, and 16, T3S, R1W, SLB&M	1" = 200', CI = 2', 66PT-418-503, June 1958			

Utah project
phase - Utah

reservoir sites
ke Drainage Basin

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 7.5' Quad Series - Brighton
		66-418-633 7-14-50	1,040 AF 1950	Design drawing No. 66-418-311 1/ Topography by State Engineer USBR 7.5' Quad Series - Draper
		66-418-1045 7-25-57	3,400 AF 1959	USBR 7.5' Quad Series - Draper
				Drawing not in files State Engineer's Office 7.5' Quad Series - Draper
				From 22nd Biennial Report of State Engineer July 1, 1938 to June 30, 1940 Reconnaissance made 7.5' Quad Series - Draper
		66-418-638 8-8-50	400 to 600 AF Oct. 1958	1/ Located 5 miles east of Sandy and ½ mile south of Big Cottonwood Canyon 7.5' Quad Series - Draper
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Reconnaissance made 7.5' Quad Series - Draper
		66-418-1044 7-25-57		USBR 7.5' Quad Series - Draper
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Surveyed No cost est. Salt Lake City Corporation 7.5' Quad Series - Brighton
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Surveyed No cost est. Salt Lake City Corporation 7.5' Quad Series - Brighton
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 7.5' Quad Series - Brighton
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Kennecott Copper Corp. proposed to build one dam which will inundate 3 lakes 7.5' Quad Series - Magna
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Feasibility doubtful 7.5' Quad Series - Park City West
None	None	66-418-642 Feb. 1949	12,600 AF Dwg. 66-404-184W 1949	1/ Salt Lake City engineering topography 7.5' Quad Series - Mount Aire
None	None	None	1,370 AF Prices - Oct. 1959	USBR 7.5' Quad Series - Draper
				From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 Infeasible because reservoir site is too steep 7.5' Quad Series - Sugar House
		66-418-569 June 1947		USBR 7.5' Quad Series - Big Dutch Hollow (not in files)
		66-418-677 Feb. 1953	10,000 to 50,000 AF 4-2-53 No number	USBR 7.5' Quad Series - Midvale
None	None	66-418-1153 May 1958	500 to 6,000 AF 1958	USBR 7.5' Quad Series - Midvale
		66-418-679 Mar. 1953	10,000 to 50,000 AF 4-3-53 No number	USBR 7.5' Quad Series - Midvale
		66-418-678 Mar. 1953		USBR 7.5' Quad Series - Salt Lake City South
		No number 7-30-57		USBR 7.5' Quad Series - Salt Lake City South
				Kennecott Copper Corp. proposed to raise dam From 22nd Biennial Report of State Engineer July 1, 1938, to June 30, 1940 7.5' Quad Series - Magna
See Materials	Embankment Materials Report on proposed Bailey dike & Reservoir, E. M. 24	No number 1955	30,000 to 130,000 AF	USBR Found in manila folder "Magna Area Development" 7.5' Quad Series - Saltair
		Chart on 660A-418-2		1/ From Salt Lake City Engineering Dept. topography 7.5' Quad Series - Mount Aire
				From 21st Biennial Report of State Engineer July 1, 1936, to June 30, 1938 7.5' Quad Series - Brighton
				7.5' Quad Series - Midvale


SAN PITCH RIVER
DRAINAGE AREA BDY.
Milburn Res.
Cottonwood Creek Res.
Dyer Res.
Leamington Res.
Mills Res.
Lynndyl Res.
Omad Res.
Oak City Res.
Sandridge Res.
Black Hills Res.
Fredman-Abed Res.
Canal Creek Res.
Pigeon Hollow Res.
New Canyon Res.
Maple Creek Pond
Funks Lake
Woods Lake Res.
Blue Lake Res.
Andrews Hole Lake Res.
Willow Creek Res.
Wagon Hill Res.
Eagle Hollow Res.
Bull Pasture Res.
Yogo Hiatcho Res.
Bastian Res.
Cove Creek Res.
SEVIER
RIVER
SEVIER LAKE
SAN PITCH RIVER
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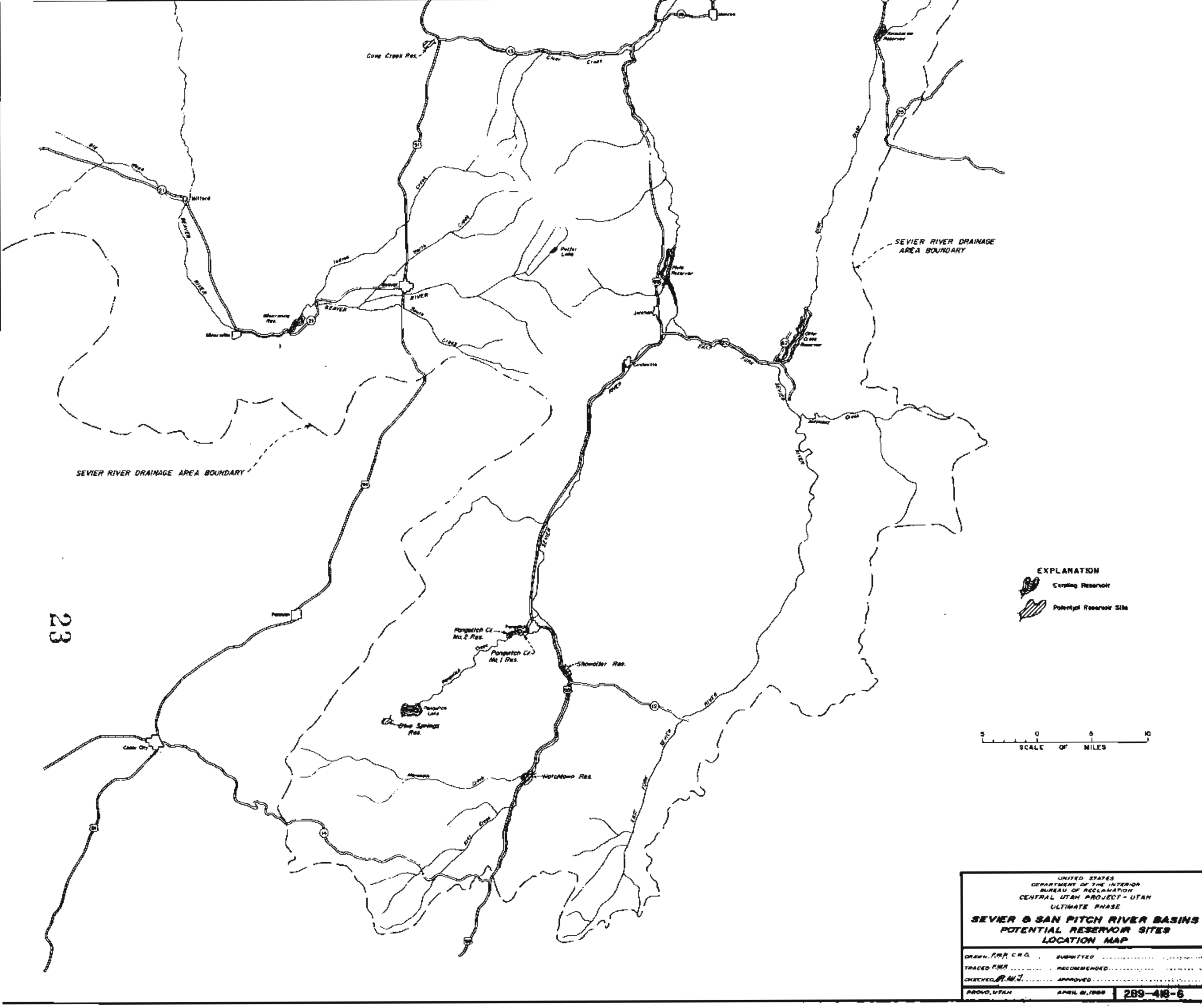
Cove Creek Res.
Clear Creek
Milford
BEAVER RIVER
Minersville
BEAVER RIVER
North Creek
Potter Lake
Piute Reservoir
Junction
Circleville
EAST FORK
Otter Creek Reservoir
SEVIER RIVER DRAINAGE AREA BOUNDARY
SEVIER RIVER DRAINAGE AREA BOUNDARY
SEVIER RIVER
Panguitch Cr. No. 2 Res.
Panguitch Cr. No. 1 Res.
Showalter Res.
Panguitch Lake
Blue Springs Res.
Hatchtown Res.
Cedar City
SEVIER RIVER
EAST FORK SEVIER RIVER
EXPLANATION
Existing Reservoir
Potential Reservoir Site
5 0 5 10
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT - UTAH
ULTIMATE PHASE
SEVIER & SAN PITCH RIVER BASINS
POTENTIAL RESERVOIR SITES
LOCATION MAP
DRAWN
SUBMITTED
TRACED
RECOMMENDED
CHECKED R.W.J.
APPROVED
PROVO, UTAH
289-418-6

Potential reservoir sites
Sevier River Basin

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-ca cur Drawin
Hatchtown Dam and Reservoir	Sevier River	Sec. 31, T36S, R5W, SLB&M				
Blue Springs Dam and Reservoir	Upper Mammoth Creek and Castle Creek to Sevier River	Sec. 7, T36S, R7W, SLB&M				
Showalter Dam and Reservoir	Sevier River	Sec. 14, T35S, R5W, SLB&M				
Panguitch Creek No. 1 Dam and Reservoir	Panguitch Creek to Sevier River	Sec. 29, T34S, R5W, SLB&M				
Panguitch Creek No. 2 Dam and Reservoir	Panguitch Creek to Sevier River	Sec. 32, T34S, R5W, SLB&M				
Cove Creek Dam and Reservoir	Cove Creek to Sevier River	Sec. 24, T25S, R7W, SLB&M				
Bastian Dam and Reservoir	Peterson Creek to Sevier River	Sec. 8 and 17, T23S, R1W, SLB&M				
Lost Creek Dam and Reservoir	North Fork Lost Creek to Sevier River	Sec. 21, T23S, R1E, SLB&M				
Woods Lake Dam and Reservoir	Woods Lake to Salina Creek to Sevier Creek	Sec. 15, T20S, R3E, SLB&M				
Bull Pasture Dam and Reservoir	Salina Creek to Sevier River	Sec. 23, T22S, R3E, SLB&M				
Yogo Niotche Dam and Reservoir	Yogo Creek to Salina Creek to Sevier River	Sec. 34, T22S, R3E, SLB&M				
Willow Creek Dam and Reservoir	Willow Creek to Sevier River	Sec. 27, T20S, R1E, SLB&M				
Yuba Dam and Reservoir	Sevier River	Sec. 1, T17S, R2W, SLB&M	1" = 200', 66-418-11, 1947; 1" = 400', CI = 10',1/ 660A-404-12 (10 sheets)			66-418 1959
Chicken Creek Dam and Reservoir	On Chicken Creek, a tributary to Sevier River	Sec. 20, T15S, R1W, SLB&M	1" = 400', CI = 10', 66PT-418-504 through 509			66-418 June 1
Mills Dam and Reservoir	Sevier River	Sec. 15, T15S, R2W, SLB&M				
Dyer Dam and Reservoir	Drainage from Tintic Mountains to Sevier River	Sec. 22, 26, and 27, T13S, R4W, SLB&M	1" = 1000', 66PT-418-42, 1947; 66-418-141, 1947; 66-418-257, 1948			66-418
Leamington Dam and Reservoir (Sevier Bridge)	Sevier River	Sec. 28, T14S, R3W, SLB&M				
Lynndyl Dam and Reservoir	Sevier River	Near intersection of sec. 3, 4, 9, and 10, T16S, R5W, SLB&M	1" = 200', CI = 10'	None	None	No num 6-6-55 Prepared USGS Qua
DMAD Dam and Reservoir	Sevier River	Sec. 26, T16S, R6W, SLB&M	1" = 400', 660A-418-131 through 134, June 1958 1/			
Eagle Hollow Dam and Reservoir	Pioneer Creek to Sevier River	Sec. 2, T21S, R3W, SLB&M				
Magpie Hill Dam and Reservoir	Pioneer Creek to Sevier River	Sec. 23, T20S, R4W, SLB&M				
Oak City Dam and Reservoir	Oak Creek to Sevier River	Sec. 32, T16S, R4W, SLB&M				

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logy type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
				From 22nd Biennial Report of State Engineer Est. 13,000 AF - $84,312 Guy Sterling,1916 Built and failed
				From 22nd Biennial Report of State Engineer Est. 5,000 AF - $40,390 Guy Sterling, 1916 15' Quad Series - Panguitch Lake
				From 22nd Biennial Report of State Engineer Est. 12,000 AF - $266,453 Guy Sterling, 1916
				From 22nd Biennial Report of State Engineer Reservoir site infeasible - no water available
				From 22nd Biennial Report of State Engineer Est. 370 AF - $37,949
				From 22nd Biennial Report of State Engineer
				From 22nd Biennial Report of State Engineer Reservoir site infeasible because all water in source is appropriated Failed, not rebuilt
				From 22nd Biennial Report of State Engineer
				From 22nd Biennial Report of State Engineer Est. 41 AF - $6,344
				From 22nd Biennial Report of State Engineer Reservoir site infeasible because all water in source is appropriated Est. 1,773 AF - $119,602
				From 22nd Biennial Report of State Engineer Reservoir site infeasible because all water in source is appropriated Est. 328 AF - $21,728
				From 22nd Biennial Report of State Engineer Feasibility doubtful
		66-418-1047 1959		1/ By F. W. Cottrell, Engineer for Consolidated Sevier Bridge Reservoir Co. 15' Quad Series - Scipio North
		66-418-1046 June 1959	30,000 to 50,000 AF June 1960	USBR
				USBR
		66-418-525	530,000 AF Recon. est., 1949	USBR 15' Quad Series - Lynndyl
				USBR
	None	No number 6-6-55 Prepared from USGS Quad Sheet	40,000 AF Jan. 1959	USBR 15' Quad Series - Oak City
				1/ U. S. Soil Conservation Service - by Gilbert P. Searle 15' Quad Series - Oak City
				From 22nd Biennial Report of State Engineer Est. 175 AF - $30,971
				From 22nd Biennial Report of State Engineer Est. 55 AF - $40,570 7.5' Quad Series - Holden
				From 22nd Biennial Report of State Engineer Est. 34 AF - $15,957 15' Quad Series - Oak City

Central Utah project
Ultimate phase - Utah

Potential reservoir sites
San Pitch River Basin

Feature	Drainage	Location: township and range	Topography Scale, CI Drawing No.	Geology type	Materials type	Ar D
Milburn Dam and Reservoir	San Pitch River	Sec. 12, T13S, R4E, SLB&M	1" = 500', CI = 10', 239PT-418-6[1]			
Cottonwood Creek Dam and Reservoir	Cottonwood Creek to the San Pitch River	Sec. 23, T13S, R5E, SLB&M				
Canal Creek Dam and Reservoir	Canal Creek to San Pitch River	Sec. 31, T15S, R4E, SLB&M				
Black Hills Dam and Reservoir	Oak Creek to San Pitch River	Sec. 26, T15S, R4E, SLB&M				
Freeman-Allred Dam and Reservoir	Tributary to San Pitch River	Sec. 35, T15S, R4E, SLB&M	Damsite: 1" = 50', CI = 2', 238,418-9;[1] Reservoir: 1" = 100', CI = 5', 238-418-8; 2380A-418-2[2]			[illegible] 5 2
Sandridge Dam and Reservoir	San Pitch River	T16S, R3E, SLB&M				
Pigeon Hollow Dam and Reservoir	Pigeon Hollow Creek to San Pitch River	Sec. 14, T16S, R3E, SLB&M				
New Canyon Dam and Reservoir	New Canyon Creek to Ephraim Creek to San Pitch River	Sec. 3, T17S, R4E, SLB&M				
Maple Creek Pond Dam and Reservoir	Maple Creek to Ephraim Creek to San Pitch River	Sec. 19, T17S, R4E, SLB&M				
Blue Lake Dam and Reservoir	South Fork Twelve-Mile Creek to San Pitch River	Sec. 12, T20S, R3E, SLB&M				
Andrews Hole Lake Dam and Reservoir	South Fork Twelve-Mile Creek to San Pitch River	Sec. 7, T20S, R4E, SLB&M				

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Utah

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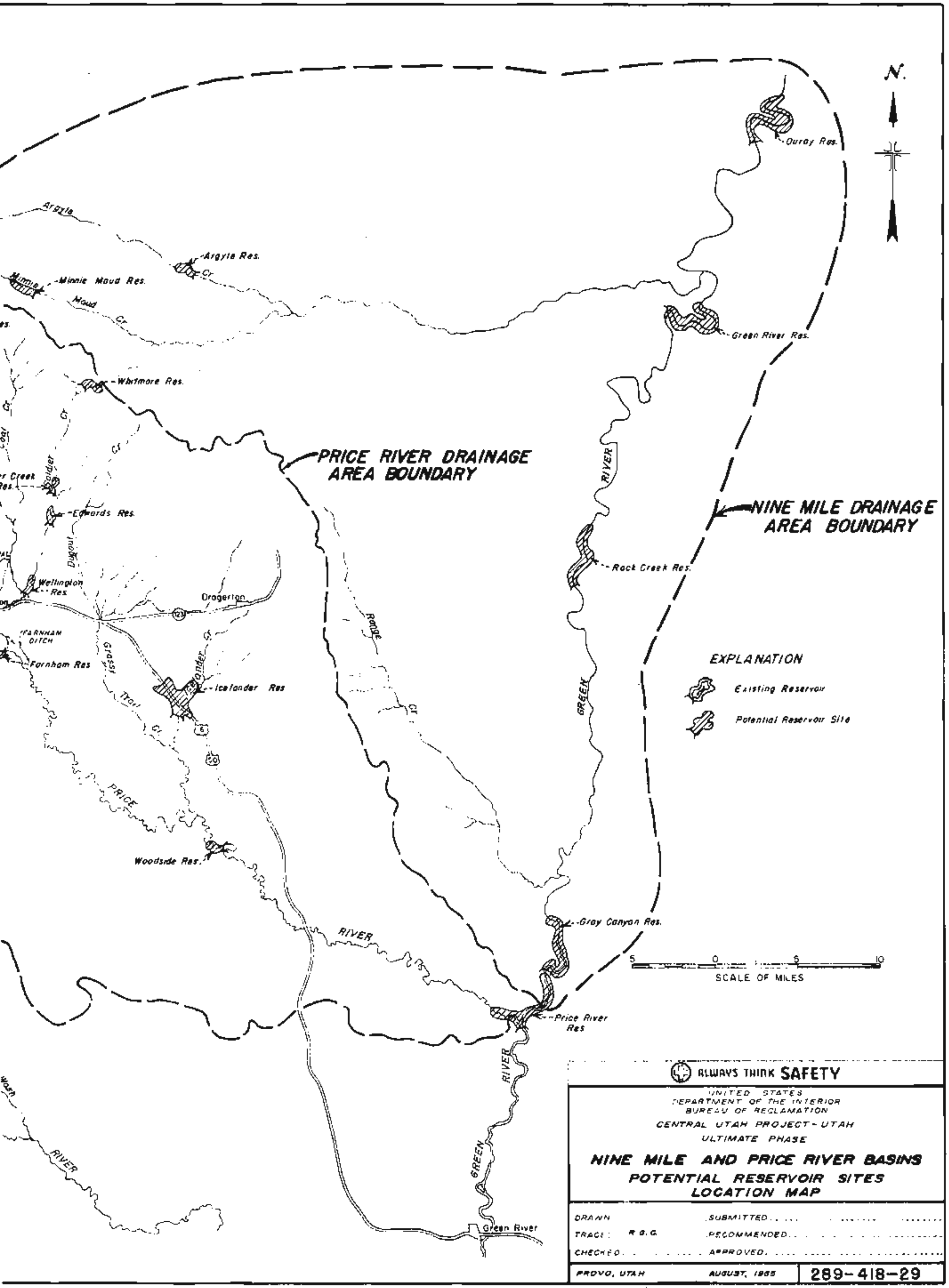
gy e	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
				From 22nd Biennial Report of State Engineer Est. 11,417 AF - $557,098 1939 USBR Nielsen 1/ Topography by USBR
				From 22nd Biennial Report of State Engineer Two est. - #9 Cottonwood - 86 AF - $37,613 #11 Cottonwood Creek - 32 AF - $19,268
				From 22nd Biennial Report of State Engineer Est. 67 AF - $78,761
				From 22nd Biennial Report of State Engineer Est. 120 AF USBR Larson 1935
		No number 5-13-49 238-418-43/	560 AF 650 AF No number	USBR report 1/ Topography by USBR 2/ Topography on water appropriation application by F. W. Cottrell, employed by State Engineer 3/ Preliminary estimate drawing with area-capacity curve
				From 22nd Biennial Report of State Engineer
				From 22nd Biennial Report of State Engineer Feasibility doubtful
				From 22nd Biennial Report of State Engineer Est. 160 AF - $85,891
				From 22nd Biennial Report of State Engineer Reservoir site infeasible Subterranean drainage of reservoir site
				From 22nd Biennial Report of State Engineer Est. 46 AF - $17,438
				From 22nd Biennial Report of State Engineer Est. 27 AF - $12,569

WHITE RIVER
White River Res.
Colton Res.
RIVER
PRICE
Scofield Res.
Richards Res
Gooseberry Cr
Mammoth Res.
Lower Gooseberry Res.
Beaver Cr
Gooseberry Res.
Gooseberry Lake
Huntington Res.
Cleveland Res
Rolfson Res.
Oman Res.
Gordon Cr
Serviceberry Creek Res.
Serviceberry Cr
Miller Cr
Argyle
Argyle Res.
Minnie Maud Res.
Maud Cr
Willow Creek Res.
Willow
Whitmore Res.
Price River Res.
Helper
SPRING GLEN CANAL
Soldier Creek Res.
Soldier Cr
Coal Cr
Edwards Res.
Price
WELLINGTON CANAL
CARBON CANAL
Wellington
Wellington Res
Dugout
Dragerton
FARNHAM DITCH
Farnham Res
Miller Res
Grassy Trail Cr
Icelander Res.
Icelander Cr
Desert Lake
PRICE
Woodside Res.
CLEVELAND CANAL
Huntington Cr.
Huntington
Cottonwood
Orangville
Castle Dale
Rock Canyon Cr
Buckhorn Wash
SAN RAFAEL RIVER
Ferron Cr
Ferron



N.
Argyle
Argyle Res.
Cr.
Minnie Maud Res.
Maud
Cr.
Ouray Res.
Green River Res.
Whitmore Res.
PRICE RIVER DRAINAGE AREA BOUNDARY
NINE MILE DRAINAGE AREA BOUNDARY
RIVER
Soldier
Edwards Res.
Wellington Res.
Dragerton
FARNHAM DITCH
Farnham Res.
Grassy
Trail
Cr.
Icelander
Icelander Res.
Range
Cr.
Rock Creek Res.
GREEN
EXPLANATION
Existing Reservoir
Potential Reservoir Site
PRICE
Woodside Res.
RIVER
Gray Canyon Res.
SCALE OF MILES
Price River Res.
RIVER
GREEN
Green River
RIVER
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT - UTAH
ULTIMATE PHASE
NINE MILE AND PRICE RIVER BASINS
POTENTIAL RESERVOIR SITES
LOCATION MAP
DRAWN
SUBMITTED
TRACED R.G.G.
RECOMMENDED
CHECKED
APPROVED
PROVO, UTAH
AUGUST, 1965
289-418-29

Potential reservoir sites
Price River Basin

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area-cap curv Drawing
Gooseberry Dam and Reservoir	Gooseberry Creek to Fish Creek to Price River	Sec. 19, T13S, R6E, SLB&M, 9 mi. east of Fairview, Utah	1" = 50', CI = 5', 1941; 1" = 400', CI = 10', 239PT-418-34	Field notes only in Geology section	See Geology	239-P-2
Mammoth Dam and Reservoir	Headwaters of Lower Gooseberry Creek to Fish Creek to Price River	Sec. 6, T13S, R6E, SLB&M	1" = 50', CI = 5'			239-418
White River Dam and Reservoir	On White River, a tributary to Price River	Sec. 31, T10S, R8E, SLB&M	1" = 1000', CI = 10', 239PT-418-35	Field notes only in Geology section	See Geology	239-418 2-23-55
Colton Dam and Reservoir	Price River below mouth of White River	Sec. 26, T11S, R8E, SLB&M				
Richards Dam and Reservoir	On Beaver Creek, a tributary to Price River	Sec. 15, T12S, R8E, SLB&M	1" = 500', CI = 25', 239PT-418-47	Field notes only in Geology section	See Geology	No numb 12-17-5
Willow Creek Dam and Reservoir	Willow Creek, a tributary to Price River	Sec. 10, T12S, R10E, SLB&M	1" = 50'; 1" = 200', CI = 5'			1. 239- 2. 239-
Helper Dam and Reservoir	Price River	Sec. 13, T13S, R9E, SLB&M				
Olsen Dam and Reservoir	Bob Wright Creek to Gordon Creek to Price River	Sec. 6, T14S, R8E, SLB&M				
Whitemore Dam and Reservoir	On Soldier Creek, a tributary to Price River	Sec. 33, T12S, R12E, SLB&M	1" = 500', CI = 25', 239PT-418-51	Field notes only in Geology section	See Geology	No numb 12-18-5
Soldier Creek Dam and Reservoir	On Soldier Creek to Price River	Sec. 36, T13S, R11E, SLB&M				
Edwards Dam and Reservoir	On Soldier Creek, a tributary to Price River	Sec. 12, T14S, R11E, SLB&M	1" = 500', CI = 25', 239PT-418-50	Field notes only in Geology section	See Geology	No numb 12-16-5
Wellington Dam and Reservoir	On Soldier Creek, a tributary to Price River	Sec. 35, T14S, R11E, SLB&M	1" = 500', CI = 25', 239PT-418-48	Field notes only in Geology section	See Geology	No numb 12-30-5
Serviceberry Dam and Reservoir	Serviceberry Creek to Miller Creek to Price River	Sec. 10, T15S, R8E, SLB&M				
Miller Creek Dam and Reservoir	Miller Creek to Price River	Sec. 22, T15S, R10E, SLB&M				
Farnham Dam and Reservoir	On Miller Creek to Price River	Sec. 21, T15S, R11E, SLB&M, 3.5 mi. SE of Wellington, Utah	1" = 1000', CI = 25', 239PT-418-53	Field notes only in Geology section	See Geology	No numb Dec. 19
Woodside Dam and Reservoir	Price River	Sec. 22, T17S, R13E, SLB&M				
Price River Dam and Reservoir	Green River	T16S, R19E, SLB&M				
Icelander Dam and Reservoir	Icelander Creek to Grassy Trail Creek to Price River	Sec. 8, T16S, R13E, SLB&M	1" = 1000', CI = 10', 1040PT-418-4			USBR Region

Geology type	Materials type	Area-capacity curve Drawing No.	Cost-capacity curve range Prices as of	Remarks
Field notes only in Geology section	See Geology	239-P-21T	6,000 to 17,500 AF July 1958	Reference drawing No. 239-418-6 USBR Gooseberry project report Jan. 1953
		239-418-1	Dec. 1949	USBR Gooseberry project report Jan. 1953
Field notes only in Geology section	See Geology	239-418-31 2-23-55	4,000 to 8,000 AF 1957	Two alternate sites - area-capacity curves for each 239-418-32 and 33 USBR 15' Quad Series - Soldier Summit
				Suggested site by Wayne Cahoon 15' Quad Series - Soldier Summit
Field notes only in Geology section	See Geology	No number 12-17-58	2,000 AF July 1958	USBR 15' Quad Series - Soldier Summit
		1. 239-418-29 2. 239-418-30		USBR
				From 22nd Biennial Report of State Engineer Feasibility doubtful 15' Quad Series - Castlegate
				From 22nd Biennial Report of State Engineer Feasibility doubtful 15' Quad Series - Soldier Summit
Field notes only in Geology section	See Geology	No number 12-18-58	1,000 AF July 1958	USBR 15' Quad Series - Wellington
				From 22nd Biennial Report of State Engineer Reservoir site infeasible No water 15' Quad Series - Wellington
Field notes only in Geology section	See Geology	No number 12-16-58	3,000 AF July 1958	USBR 15' Quad Series - Wellington
Field notes only in Geology section	See Geology	No number 12-30-59	3,000 to 6,000 AF Jan. 1959	Upper axis USBR 15' Quad Series - Wellington
				From 22nd Biennial Report of State Engineer Feasibility doubtful 15' Quad Series - Soldier Summit
				From 22nd Biennial Report of State Engineer Feasibility doubtful 15' Quad Series - Castlegate
Field notes only in Geology section	See Geology	No number Dec. 1958	6,000 AF July 1958	USBR 15' Quad Series - Wellington
				From 22nd Biennial Report of State Engineer Est. 14,000 AF - $400,000 USGS 15' Quad Series - Woodside
				Region 4 USBR
		USBR Region 4		USGS - 15' Quad Sheet - Woodside, Utah

Central Utah project
Ultimate phase - Utah

Potential reservoir sites
Nine-Mile Drainage Basin

Feature	Drainage	Location: township and range	Topography Scale: CI Drawing No.	Geology type	Materials type	Area- c Draw
Ouray Dam and Reservoir	On Green River	Sec. 18, T10S, R19E, SLB&M				
Rock Creek Dam and Reservoir (Desolation Canyon)	On Green River	Sec. 32, T14S, R17E, SLB&M				
Green River Dam and Reservoir	On Green River	Sec. 5, T12S, R18E, SLB&M				
Gray Canyon Dam and Reservoir	On Green River	Sec. 31 and 36, T18S, R16 and 17E, SLB&M				

l Utah project
e phase - Utah

l reservoir sites
e Drainage Basin

Geology type	Materials type	Area-capacity curve Drawing No.	Cost capacity curve range Prices as of	Remarks
				USBR 15' Quad Series - Nutters Hole
				From 22nd Biennial Report of State Engineer 300,000 AF 15' Quad Series - Flat Canyon
				From 22nd Biennial Report of State Engineer 1,500,000 AF 15' Quad Series - Nutters Hole
				USBR

CHAPTER III

WATER SUPPLY

Introduction

The water supply chapter contains a discussion of water resources, water requirements for irrigation, and water rights within the ultimate phase project area. These factors are considered for the Uinta Basin, the Sevier River Basin, and the Price River Basin. Irrigation requirements were essentially satisfied for the areas included in the Bonneville unit definite plan report of August 1964. Water may be diverted, however, to the Delta area in the Sevier River Basin as part of the Bonneville unit. This diversion may be made in lieu of providing water to full service lands in the Mosida and Mona-Nephi areas. If this should prove feasible, details will be included in a supplement to the Bonneville unit definite plan report. Most of the areas of the Bonneville unit will not be affected by the ultimate phase with the possible exception of the Mosids and Mona-Nephi areas. Therefore, a water supply discussion for the Bonneville unit areas is not included in this report. Areas to receive only municipal and industrial project water are discussed separately in Chapter VI, and include Utah, Salt Lake, Weber, Davis, Summit, and Morgan Counties.

Streamflow records for most stations have been developed for the 43-year period, 1920 to 1962. This period includes the extremely low runoff years of 1931, 1934, 1935, and 1961 as well as the exceptionally high runoff years of 1921, 1922, 1923, snd 1952. The variations in water supply found during this extended period should be representative of the range expected in future years.

An inventory of water rights in the ultimate phase area includes existing court decrees, agreements, adjudications, and approved or pending water right applications. For project facilities this inventory also includes applications owned by the government and additional applications and agreements that will be needed to guarantee a water supply for the operation of the ultimate phase of the Central Utah project.

Detailed water right abstracts for the streams in the ultimate phase area are included in the supporting data on file in the Central Utah Projects Office in Provo, Utah.

Uinta Basin

In the Uinta Basin, water supply data are included for Brush Creek, Ashley Creek, Whiterocks River, Uinta River, and Lake Fork. Data for

Duchesne River and its upper tributaries are included in the Bonneville unit report dated August 1964.

Water resources

Streamflow data and records at various points on Uinta Basin streams are summarized in the tables on the following pages. The locations of the gaging stations in the Uinta Basin are shown on the map on page 33.

Streamflow and canal diversion records by months are recorded in supporting data on file in the Central Utah Projects Office.

Quality of Water

Quality of water data for this study have been collected by the Bureau of Reclamation and adopted from the Geological Survey (Chemical Analyses of Surface Waters in Utah, October 1959 to September 1962) and from the Utah State Engineer (Bulletin No. 10). These data indicate the Uinta Basin streams to be of adequate quality for irrigation. The streams in their upper reaches contain low concentrations of dissolved solids, with increasing concentrations as the water flows downstream. The principal constituent is calcium bicarbonate with a small amount of sodium present. Assuming adequate drainage, the chemical concentrations are low enough that they should not present a hazard to the soils. Results of chemical analysis of water samples are also found in the supporting data.

Water requirements

Lands in the Uinta Basin were considered by areas in order to facilitate the determination of the theoretical unit irrigation water requirements. Climatological data were obtained from Weather Bureau stations located at Vernal, Roosevelt, Altamont, and Duchesne. Stations in the vicinity of the respective areas were used to determine the length of the growing season, frost-free period, effective precipitation, and other data pertinent to the determination of irrigation requirements. Climatological data from the four weather stations used are shown in the table on page 34.

Cropping Pattern

The cropping patterns expected to develop under project conditions are shown by areas in the table at the top of page 35.

Summary of stream gaging data - Uinta Basin
(Unit: 1000 acre-feet)

Gaging station	Drainage area (sq.mi.)	Period of record 1/	Average recorded flow	Annual runoff fo	
					Mi
				Average	Year
Lake Fork above Moon Lake near Mountain Home	78	1933-34, 1943-55	77.5	79.4 2/	1934
Brown Duck Creek near Mountain Home	15	1934, 1943-55	6.9	-	1934
Lake Fork below Moon Lake near Mountain Home	110	1921-34 (fragmentary), 1942-62	87.2	92.7 3/	1934
Yellowstone Creek below Swift Creek near Altonah	99	1950-55	86.9	96.4 2/	1934
Yellowstone Creek near Altonah	131	1945-62	94.8	103.3 2/	1934
Lake Fork near Upalco	418	1943-55	42.6 4/	-	1954
Uinta River below Gilbert Creek near Neola	33	1951-55	28.8	33.8 2/	1934
Uinta River above Clover Creek near Neola	132	1946-55	102.8	113.2 2/	1934
Clover Creek near Neola	9.5	1951-55	1.4	1.9 2/	1934
Uinta River near Neola	181	1948-60	122.0	135.0 2/	1934
Whiterocks River above Paradise Creek near Whiterocks	90	1946-55	71.2	77.2 2/	1934
Paradise Creek near Whiterocks	10	1947-55	5.1	5.2 2/	1934
Whiterocks River near Whiterocks	115	1900-03, 1909-10, 1913-62	89.7	86.5 2/	1934
Farm Creek near Whiterocks	22	1950-62	4.2	5.1 2/	1961
Deep Creek near Lapoint	75	1943-45, 1950-55	5.1	-	1954
Uinta River at Fort Duchesne	672	1900-20 (fragmentary), 1943-58	84.7	65.6 5/	1934
Ashley Creek below Trout Creek near Vernal	27	1944-54	17.5	17.8 2/	1934
South Fork of Ashley Creek near Vernal	20	1944-55	14.4	14.9 2/	1934
Ashley Creek near Vernal	101	1914-62	74.0	72.4 2/	1934
Mosby Canal near Lapoint	-	1955-62	2.4	-	1955
Dry Fork above Sinks near Dry Fork, Utah	48	1940-46, 1955-62	26.0	29.9 6/	1934
Dry Fork above Sinks excluding Mosby Canal	48	1940-62	26.0 7/	-	
North Fork of Dry Fork near Dry Fork, Utah	12	1947-62	4.4	4.9 2/	1934
East Fork of Dry Fork near Dry Fork, Utah	12	1947-62	5.8	6.4 2/	1934
East Fork of Dry Fork above Sinks near Dry Fork, Utah	9	1961-62	8.6	-	1961
Dry Fork below Springs near Dry Fork, Utah	102	1941-45, 1954-62	21.9	-	1959
Dry Fork at mouth near Dry Fork, Utah	118	1954-62	13.8	-	1959
Ashley Creek at the "Sign of the Maine" near Vernal	241	1940-62	87.9	89.9 8/	1959
Ashley Creek near Jensen	386	1947-62	38.4	-	1961
Oaks Park Canal near Vernal	-	1942-62	4.6	-	1955
Brush Creek above cave near Vernal	23	1947-54	12.3	12.1 9/	1934
Brush Creek near Vernal	82	1940-62	24.9	26.8 4/	1934
Little Brush Creek below East Park Reservoir near Vernal	20	1950-55	9.6	10.9 3/	1934
Little Brush Creek near Vernal	28	1946-52	14.3	12.5 10/	1934
Brush Creek near Jensen	255	1940-62	13.9	-	1959
Green River near Jensen	25,400	1947-60	3,212.0	-	1954
Green River near Ouray	35,500	1948-62	4,145.0	-	1961
Yellowstone Feeder Canal	-	1941-62	12.3	11.3 4/	1922

1/ Water years, not including records after 1962.
2/ Historical flow.
3/ Past modified flow.
4/ Present modified flow.
5/ Historical flow record of average annual runoff for period 1921-62.
6/ Past modified flow plus flows in Mosby Canal, 1955-62.
7/ Excludes Mosby Canal flows, 1955-62.
8/ Past modified flow minus flows of Oaks Park Canal, 1941-62.
9/ Past modified flow plus flows stored in Oaks Park Reservoir, 1947-54.
10/ Past modified flow record of average annual runoff for period 1920-60.

Note: Historical flow is the flow actually experienced at a gaging station or point of measurement. It is the total runoff of
of measurement as influenced by nature and the activities of man. It may be recorded or estimated.
Past modified flow is the historical and/or natural flow corrected to show for the period of study the man-made developm
beginning of the period of study.
Present modified flow is the historical and/or natural flow corrected to show the effect of the present man-made develop
the period of study.

ging data - Uinta Basin
00 acre-feet)

ord1/	Average recorded flow	Annual runoff for period of study (1920-1962) Average	Minimum Year	Minimum Quantity	Maximum Year	Maximum Quantity
5	77.5	79.4 2/	1934	33.4	1922	143.4
	6.9	-	1934	1.5	1952	12.1
tary),	87.2	92.7 3/	1934	39.1	1922	164.0
	86.9	96.4 2/	1934	33.4	1922	198.9
	94.8	103.3 2/	1934	39.1	1922	201.0
	42.6 4/	-	1954	13.1	1952	115.7
	28.8	33.8 2/	1934	8.5	1922	66.1
	102.8	113.2 2/	1934	42.9	1922	230.2
	1.4	1.9 2/	1934	0.1	1921	6.2
	122.0	135.0 2/	1934	54.1	1922	262.0
	71.2	77.2 2/	1934	23.9	1922	160.7
	5.1	5.2 2/	1934	1.2	1921	8.5
, 1913-62	89.7	86.5 2/	1934	30.4	1922	175.3
	4.2	5.1 2/	1961	1.9	1922	11.9
5	5.1	-	1954	2.6	1944	8.2
tary),	84.7	65.6 5/	1934	9.0	1922	217.0
	17.5	17.8 2/	1934	5.2	1921	39.0
	14.4	14.9 2/	1934	4.6	1921	28.0
	74.0	72.4 2/	1934	31.3	1921	129.0
	2.4	-	1955	1.2	1961	3.6
2	26.0	29.9 6/	1934	9.1	1921	57.3
	26.0 7/	-				
	4.4	4.9 2/	1934	1.4	1921	11.4
	5.8	6.4 2/	1934	1.2	1921-22	12.9
	8.6	-	1961	5.2	1962	12.0
2	21.9	-	1959	4.2	1944	48.3
	13.8	-	1959	1.7	1962	31.1
	87.9	89.9 8/	1959	42.8	1944	142.3
	38.4	-	1961	7.3	1952	93.2
	4.6	-	1955	2.4	1953	7.4
	12.3	12.1 9/	1934	4.9	1921	22.7
	24.9	26.8 4/	1934	12.2	1921	46.1
	9.6	10.9 3/	1934	3.2	1922	23.4
	14.3	12.5 10/	1934	2.4	1921	29.3
	13.9	-	1959	2.8	1962	30.9
	3,212.0	-	1954	2,056.0	1952	4,522.0
	4,145.0	-	1961	2,087.9	1952	6,424.6
	12.3	11.3 4/	1922	1.5	1947	20.4

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point of measurement. It is the total runoff of a drainage area above the point
ay be recorded or estimated.
iow for the period of study the man-made developments as they existed at the

› show the effect of the present man-made developments if they had existed over

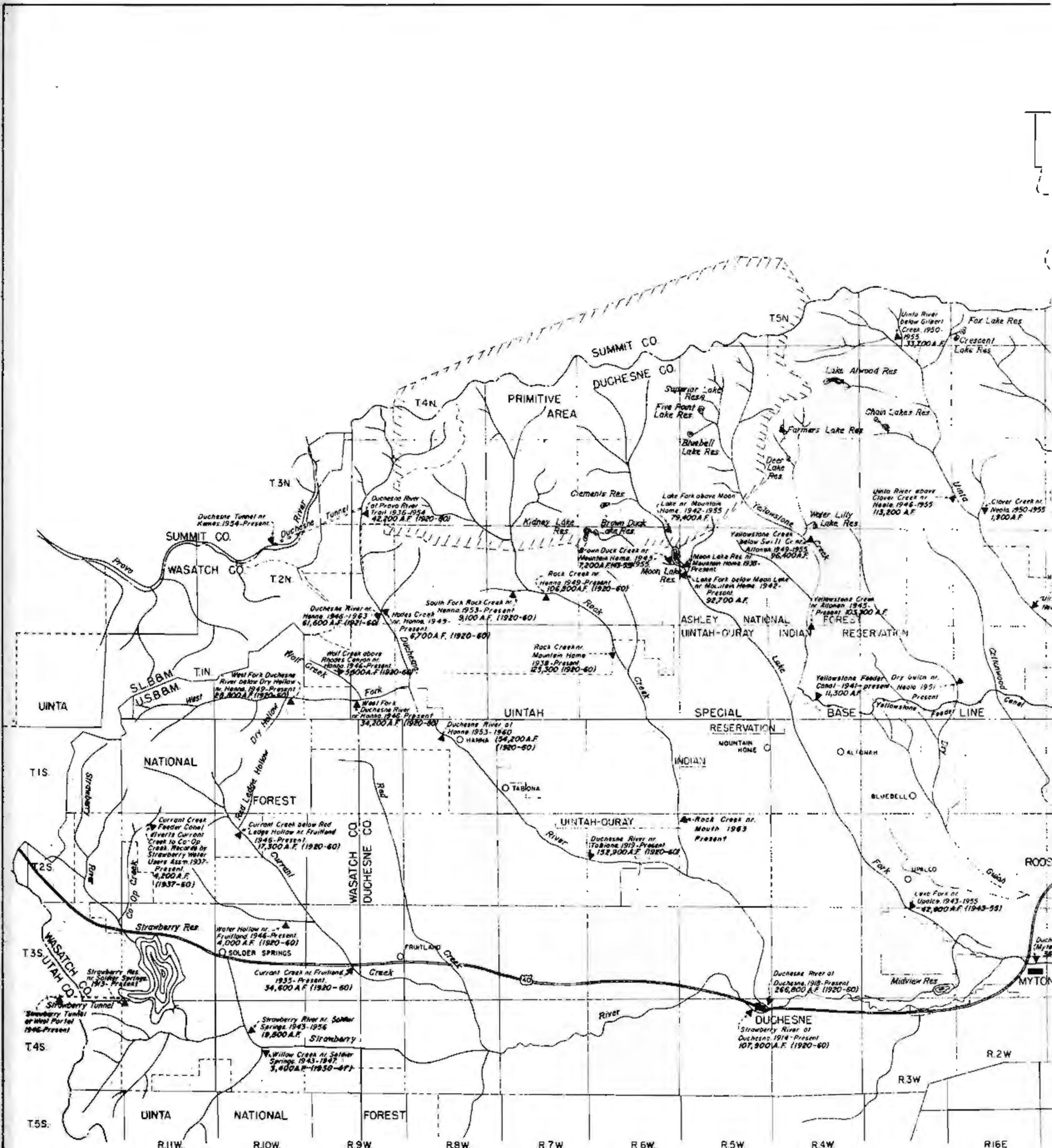
Annual streamflo
Unit: 1,(

Year	Little Brush Creek near Vernal (past mod.)	Little Brush Creek below East Park Reservoir near Vernal (past mod.)	Brush Creek above cave near Vernal (past mod.)	Brush Creek near Vernal (present mod.)	Ashley Creek at Strawberry aqueduct (past mod.)	Ashley Creek at Sign of the Maine (past mod.)	Cow Hollow at Strawberry aqueduct (histor-ical)	Black Canyon at Straw-berry aqueduct (histor-ical)	East Fork of Dry Fork near Dry Fork (histor-ical)	Three tribu-taries of East Fork of Dry Fork (histor-ical)	North Fork of Dry Fork near Dry Fork (histor-ical)	Flume Mill (tribu-tary to Dry Fork (histor-ical)	Dry Fork above sinks near Dry Fork (past mod.)	Pa Cree Whit (h
	1	2	3	4	5	6	7	8	9	10	11	12	13	
1920	20.4	16.5	16.2	36.3	35.0	127.0	1.0	2.6	9.8	9.2	7.2	.8	41.4	
21	29.3	23.2	22.7	46.1	49.5	175.8	1.5	3.7	12.9	13.1	11.4	1.1	57.3	
22	28.2	23.4	22.3	45.5	48.7	173.1	1.4	3.6	12.9	12.8	11.2	1.1	55.4	
23	20.5	17.5	18.2	41.4	38.8	142.1	1.2	2.9	10.7	10.2	8.2	.9	46.8	
24	9.2	8.1	10.3	21.3	21.9	65.9	.6	1.6	4.2	5.8	3.3	.5	21.0	
1925	8.4	8.0	9.2	21.1	22.4	69.1	.7	1.7	4.9	5.9	3.5	.5	24.3	
26	11.2	10.5	13.1	26.9	27.9	83.8	.8	2.1	5.8	7.4	4.8	.6	26.0	
27	15.7	12.5	13.5	31.3	33.1	112.3	1.0	2.5	8.1	8.7	5.9	.7	39.2	
28	17.1	13.6	16.4	32.8	33.6	110.6	1.0	2.5	8.3	8.9	6.6	.7	34.9	
29	20.3	16.6	16.6	37.8	37.3	135.6	1.1	2.8	10.2	9.8	7.6	.8	45.6	
1930	14.7	12.8	14.6	31.4	32.3	104.1	1.0	2.4	7.4	8.5	5.5	.7	35.6	
31	4.4	4.6	7.5	16.1	16.3	43.0	.5	1.2	2.1	4.3	2.0	.4	14.1	
32	14.7	11.8	12.9	28.5	28.4	98.8	.8	2.1	7.6	7.4	5.3	.6	34.1	
33	6.9	6.4	7.6	18.8	18.6	58.2	.6	1.4	3.9	4.9	2.6	.4	21.1	
34	2.4	3.2	4.9	12.2	12.0	30.3	.4	.9	1.2	3.1	1.4	.3	9.1	
1935	11.8	10.7	10.5	26.6	24.6	86.8	.7	1.8	6.3	6.5	4.6	.5	29.4	
36	5.3	4.4	6.3	15.0	16.0	44.0	.5	1.2	2.3	4.2	1.8	.4	15.0	
37	16.6	12.3	13.7	29.6	30.2	105.2	.9	2.2	8.1	8.0	5.6	.7	35.5	
38	14.7	12.4	12.7	30.9	29.6	105.4	.9	2.2	7.9	7.8	5.7	.7	36.8	
39	10.4	9.0	11.7	27.1	25.5	72.5	.8	1.9	4.5	6.7	3.8	.6	25.6	
1940	6.5	7.3	9.5	17.5	20.7	55.3	.6	1.5	3.5	5.4	2.8	.5	17.8	
41	16.5	14.3	15.6	31.9	34.3	125.2	1.0	2.5	9.5	9.0	7.1	.8	44.6	
42	18.2	15.3	16.8	40.9	36.7	122.4	1.1	2.7	9.3	9.7	7.5	.8	35.5	
43	7.6	8.7	10.1	20.0	21.8	74.6	.6	1.6	4.3	5.8	2.5	.5	21.9	
44	19.1	15.7	15.0	37.2	33.7	136.4	1.0	2.5	9.3	8.9	7.2	.8	42.2	
1945	9.5	8.3	9.1	22.5	22.2	75.2	.7	1.6	5.2	5.9	3.7	.5	23.6	
46	5.5	5.1	6.4	14.7	16.3	44.2	.5	1.2	2.8	4.3	1.5	.4	16.5	
47	20.6	14.5	17.3	41.2	34.0	130.3	1.0	2.5	11.8	9.0	7.7	.8	40.3	
48	10.8	9.5	11.0	25.1	23.4	74.4	.7	1.7	4.6	6.2	3.3	.5	25.5	
49	15.0	13.2	14.6	34.0	28.9	99.4	.9	2.2	6.9	7.6	4.8	.6	34.9	
1950	19.8	14.8	14.5	36.3	31.8	113.6	.9	2.4	7.2	8.4	6.2	.7	38.6	
51	9.3	8.2	9.1	19.7	21.1	71.1	.6	1.6	4.6	5.6	3.6	.5	23.5	
52	18.9	15.6	16.0	35.4	38.0	128.5	1.1	2.8	8.5	10.0	5.7	.8	44.5	
53	6.2	8.1	8.2	19.7	19.5	57.7	.6	1.4	3.2	5.1	3.1	.4	22.2	
54	5.5	6.0	7.9	16.4	17.3	54.4	.5	1.3	4.1	4.6	3.0	.4	16.4	
1955	4.1	5.1	7.8	14.4	18.1	50.0	.5	1.3	3.6	4.8	2.1	.4	16.9	
56	5.9	8.2	10.1	16.4	20.7	65.3	.6	1.5	5.7	5.4	4.1	.5	19.7	
57	11.6	11.1	9.7	27.9	26.0	89.6	.8	1.9	6.4	6.9	5.5	.6	31.8	
58	10.8	9.6	11.5	23.9	23.6	87.1	.7	1.8	6.8	6.2	6.4	.5	28.0	
59	5.3	4.9	6.3	15.9	14.8	39.8	.4	1.1	2.3	3.9	1.9	.3	15.2	
1960	3.2	5.4	7.2	12.6	15.3	43.7	.4	1.1	3.4	4.0	2.4	.3	17.5	
61		7.0	8.1	13.3	19.1	54.3	.6	1.4	3.4	5.0	2.2	.4	20.3	
62		16.9	17.8	36.3	37.1	127.7	1.1	2.8	10.5	9.8	7.9	.8	39.0	
Total	512.1	470.3	520.5	1,149.9	1,156.1	3,863.8	34.3	85.7	276.0	304.7	210.2	25.8	1,284.6	2
Average	12.5	10.9	12.1	26.7	26.9	89.9	.8	2.0	6.4	7.1-	4.9	.6	29.9	

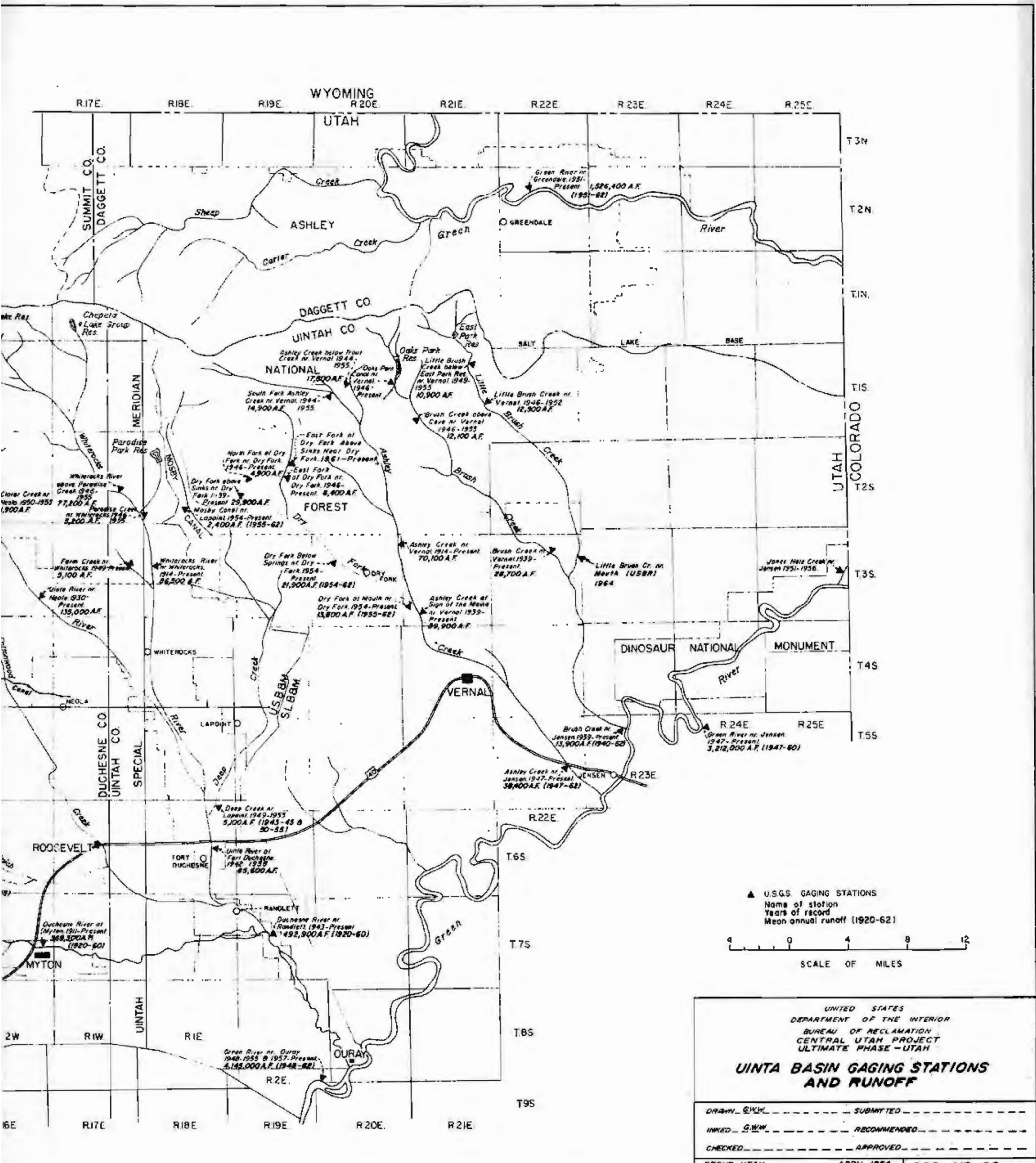
Annual streamflow in the Uinta Basin
Unit: 1,000 acre-feet

rth ork Dry near Fork stor- al)	Flume Mill (tributary to Dry Fork (historical)	Dry Fork above sinks near Dry Fork (past mod.)	Paradise Creek near Whiterocks (historical)	Whiterocks River above Paradise Creek (historical)	Whiterocks River near Whiterocks (historical)	Farm Creek near Whiterocks (historical)	Clover Creek near Neola (historical)	Uinta River above Clover Creek near Neola (historical)	Uinta River near Neola (historical)	Uinta River at Fort Duchesne (historical)	Yellowstone Creek below Swift Creek near Altonah (historical)	Hell Canyon at Strawberry aqueduct (historical)	Lake Fork below Moon Lake near Mountain Home (past mod.)
11	12	13	14	15	16	17	18	19	20	21	22	23	24
7.2	.8	41.4	7.0	81.8	90.6	5.7	2.4	115.5	137.4		103.0	3.4	98.9
1.4	1.1	57.3	8.5	151.2	165.8	11.4	6.2	214.8	245.4	190.9	182.0	6.3	156.2
1.2	1.1	55.4	8.4	160.7	175.3	11.9	6.1	230.2	262.0	217.0	198.9	6.7	164.0
8.2	.9	46.8	7.5	128.7	141.6	9.0	4.9	185.0	216.8	165.2	162.4	5.4	145.8
3.3	.5	21.0	4.2	49.9	57.0	3.5	.8	76.9	90.4	38.6	63.5	2.2	63.8
3.5	.5	24.3	4.4	63.3	72.2	4.0	1.1	93.8	112.7	36.7	77.8	2.8	87.8
4.8	.6	26.0	5.7	68.0	76.5	4.6	1.1	104.3	122.3	52.2	86.9	2.9	81.6
5.9	.7	39.2	6.7	97.8	109.0	5.8	2.4	143.4	167.6	70.7	119.4	4.2	119.7
6.6	.7	34.9	6.8	87.2	96.7	7.1	2.8	127.6	148.9	76.6	107.5	3.7	99.8
7.6	.8	45.6	7.3	114.3	126.5	7.6	3.9	164.2	193.2	136.1	141.3	4.8	132.6
5.5	.7	35.6	6.6	93.6	102.9	5.7	2.1	134.6	160.0	77.3	114.6	3.9	102.2
2.0	.4	14.1	2.7	38.3	45.0	2.5	.2	63.8	73.8	30.9	53.7	1.7	56.7
5.3	.6	34.1	5.8	84.9	95.5	6.3	2.8	119.4	146.5	73.1	102.4	3.6	106.8
2.6	.4	21.1	3.3	51.8	58.5	3.0	.7	78.3	96.2	23.6	68.1	2.2	59.6
1.4	.3	9.1	1.2	23.9	30.4	2.1	.1	42.9	54.1	9.0	33.4	1.2	39.1
4.6	.5	29.4	4.9	60.6	67.7	3.7	1.1	88.7	106.8	64.0	80.4	2.6	75.0
1.8	.4	15.0	2.5	55.3	64.2	3.1	.7	85.0	102.7	20.0	69.3	2.4	71.3
5.6	.7	35.5	6.2	85.8	96.7	6.8	3.1	122.5	147.7	57.7	90.6	3.7	104.7
5.7	.7	36.8	6.1	90.6	101.0	5.7	2.5	129.8	155.2	88.0	112.8	3.8	109.2
3.8	.6	25.6	5.1	66.4	74.7	4.2	.9	106.3	117.9	52.1	85.8	2.8	77.5
2.8	.5	17.8	3.9	44.0	51.2	3.0	.4	72.7	82.6	30.4	58.6	2.0	52.4
7.1	.8	44.6	6.9	107.7	119.1	7.5	3.6	155.5	183.0	112.4	133.3	4.5	123.0
7.5	.8	35.5	7.3	95.0	104.5	5.4	2.1	139.5	163.7	94.9	122.5	4.0	101.6
2.5	.5	21.9	4.2	61.2	69.7	4.3	.9	91.3	111.5	27.5	76.4	2.6	98.8
7.2	.8	42.2	6.8	107.0	120.5	6.9	3.8	157.1	188.9	149.4	137.8	4.6	116.3
3.7	.5	23.6	4.3	69.3	78.0	3.8	1.1	101.4	124.3	40.4	87.4	3.0	88.0
1.5	.4	16.5	3.8	49.6	55.2	3.4	.4	79.3	89.9	25.8	62.1	2.1	75.7
7.7	.8	40.3	5.7	101.2	111.1	7.1	3.3	133.8	174.3	99.0	121.5	4.2	105.2
3.3	.5	25.5	7.0	58.4	69.4	4.2	1.3	85.5	98.3	41.6	75.6	2.6	68.1
4.8	.6	34.9	4.5	86.4	93.8	5.3	2.3	123.6	152.9	85.5	104.6	3.6	107.5
6.2	.7	38.6	7.4	80.7	93.2	7.0	2.0	114.4	137.6	66.8	99.1	3.6	105.6
3.6	.5	23.5	3.5	69.3	73.0	4.4	1.2	89.7	114.6	28.9	80.9	2.8	90.5
5.7	.8	44.5	5.8	107.8	120.4	7.1	3.6	153.4	183.1	120.0	132.8	4.6	137.0
3.1	.4	22.2	5.0	53.2	63.4	3.0	.5	87.8	105.4	26.7	74.0	2.4	76.3
3.0	.4	16.4	3.4	50.6	57.9	3.3	.7	75.8	95.1	11.6	62.3	2.2	60.7
2.1	.4	16.9	2.6	54.7	60.3	3.1	.8	81.4	96.6	21.0	70.4	2.3	69.3
4.1	.5	19.7	3.9	58.9	67.2	3.2	1.5	83.7	111.8	26.4	71.5	2.6	95.0
5.5	.6	31.8	5.3	71.5	80.2	4.0	1.2	106.4	124.1	54.9	93.0	3.0	92.9
6.4	.5	28.0	4.7	82.9	92.3	6.1	2.5	119.6	140.6	70.8	100.7	3.5	90.8
1.9	.3	15.2	2.2	53.1	61.2	2.4	.4	82.2	100.7	14.4	68.0	2.3	68.7
2.4	.3	17.5	2.3	50.1	57.5	2.6	.6	77.4	99.9	17.0	65.3	2.2	68.8
2.2	.4	20.3	3.5	54.5	63.2	1.9	.6	86.2	92.8	13.7	69.5	2.4	51.5
7.9	.8	39.0	7.6	99.5	110.2	5.9	2.5	144.3	176.6	97.5	124.4	4.2	89.7
0.2	25.8	1,284.6	223.5	3,320.7	3,720.3	218.6	83.2	4,869.0	5,805.9	2,756.3	4,145.5	141.6	3,985.7
4.9	.6	29.9	5.2	77.2	86.5	5.1	1.9	113.2	135.0	65.6	96.4	3.3	92.7

Uinta River at Fort Duchesne (historical)	Yellowstone Creek below Swift Creek near Altonah (historical)	Hell Canyon at Strawberry aqueduct (historical)	Lake Fork below Moon Lake near Mountain Home (past mod.)	Green River near Jensen (historical)	Green River near Ouray (historical)	Year
21	22	23	24	25	26	
	103.0	3.4	98.9			1920
190.9	182.0	6.3	156.2			21
217.0	198.9	6.7	164.0			22
165.2	162.4	5.4	145.8			23
38.6	63.5	2.2	63.8			24
36.7	77.8	2.8	87.8			1925
52.2	86.9	2.9	81.6			26
70.7	119.4	4.2	119.7			27
76.6	107.5	3.7	99.8			28
136.1	141.3	4.8	132.6			29
77.3	114.6	3.9	102.2			1930
30.9	53.7	1.7	56.7			31
73.1	102.4	3.6	106.8			32
23.6	68.1	2.2	59.6			33
9.0	33.4	1.2	39.1			34
64.0	80.4	2.6	75.0			1935
20.0	69.3	2.4	71.3			36
57.7	90.6	3.7	104.7			37
88.0	112.8	3.8	109.2			38
52.1	85.8	2.8	77.5			39
30.4	58.6	2.0	52.4			1940
112.4	133.3	4.5	123.0			41
94.9	122.5	4.0	101.6			42
27.5	76.4	2.6	98.8			43
149.4	137.8	4.6	116.3			44
40.4	87.4	3.0	88.0			1945
25.8	62.1	2.1	75.7			46
99.0	121.5	4.2	105.2	4,057		47
41.6	75.6	2.6	68.1	3,060	3,982.5	48
85.5	104.6	3.6	107.5	3,408	4,825.9	49
66.8	99.1	3.6	105.6	4,097	5,461.3	1950
28.9	80.9	2.8	90.5	3,673	4,718.5	51
120.0	132.8	4.6	137.0	4,522	6,424.6	52
26.7	74.0	2.4	76.3	2,492	3,399.3	53
11.6	62.3	2.2	60.7	2,056	2,664.7	54
21.0	70.4	2.3	69.3	2,074	2,817.8	1955
26.4	71.5	2.6	95.0	3,404		56
54.9	93.0	3.0	92.9	4,377	5,592.7	57
70.8	100.7	3.5	90.8	3,156	4,338.5	58
14.4	68.0	2.3	68.7	2,194	2,811.9	59
17.0	65.3	2.2	68.8	2,392	3,115.8	1960
13.7	69.5	2.4	51.5		2,087.9	61
97.5	124.4	4.2	89.7		5,789.3	62
2,756.3	4,145.5	141.6	3,985.7	44,962	58,030.7	Total
65.6	96.4	3.3	92.7	3,212	4,145.0	Average



SUMMIT CO.
DUCHESNE CO.
PRIMITIVE AREA
T.5N.
T.4N.
T.3N.
T.2N.
T.1N.
T.1S.
T.2S.
T.3S.
T.4S.
T.5S.
SUMMIT CO.
WASATCH CO.
Provo
Duchesne River
Tunnel
Duchesne Tunnel nr Kamas 1954-Present
Superior Lake Res.
Five Point Lake Res.
Bluebell Lake Res.
Lake Atwood Res
Farmers Lake Res
Chain Lakes Res
Deer Lake Res
Fox Lake Res
Crescent Lake Res
Clements Res
Kidney Lake Res.
Brown Duck Lake Res.
Moon Lake Res.
Water Lilly Lake Res.
Yellowstone
Uinta
Rock
Creek
Lake
Fork
Wolf Creek
West Fork
Duchesne
ASHLEY NATIONAL FOREST
UINTAH-OURAY INDIAN RESERVATION
S.L.B.&M.
U.S.B.&M.
BASE LINE
UINTAH
SPECIAL
RESERVATION
INDIAN
UINTAH-OURAY
UINTA
NATIONAL
FOREST
WASATCH CO.
DUCHESNE CO.
Strawberry
Red
Dry Hollow
Red Ledge Hollow
Currant
Co Op Creek
Strawberry Res.
Strawberry Tunnel
WASATCH CO.
UTAH CO.
Currant Creek nr Fruitland 1935-Present 34,600 A.F. (1920-60)
Strawberry River nr Soldier Springs 1943-1956 19,800 A.F.
Willow Creek nr Soldier Springs 1943-1947 3,400 A.F. (1930-47)
Water Hollow nr Fruitland 1946-Present 4,000 A.F. (1920-60)
SOLDIER SPRINGS
FRUITLAND
HANNA
TABIONA
MOUNTAIN HOME
ALTONAH
BLUEBELL
UPALCO
River
Creek
40
Duchesne River at Duchesne 1918-Present 266,800 A.F. (1920-60)
DUCHESNE
Strawberry River at Duchesne 1914-Present 107,900 A.F. (1920-60)
Duchesne River nr Tabiona 1919-Present 132,900 A.F. (1920-60)
Duchesne River at Hanna 1953-1960 154,200 A.F. (1920-60)
Rock Creek nr Mouth 1963 Present
Midview Res
MYTON
ROOS
Dry Gulch
Cottonwood
Canal
Yellowstone Feeder
UINTA
NATIONAL
FOREST
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
R.4W.
R.3W.
R.2W.
R.16E.


WYOMING
UTAH
COLORADO
R.17E.
R.18E.
R.19E.
R.20E.
R.21E.
R.22E.
R.23E.
R.24E.
R.25E.
T.3N.
T.2N.
T.1N.
T.1S.
T.2S.
T.3S.
T.4S.
T.5S.
T.6S.
T.7S.
T.8S.
T.9S.
SUMMIT CO.
DAGGETT CO.
DAGGETT CO.
UINTAH CO.
DUCHESNE CO.
UINTAH CO.
ASHLEY
NATIONAL
FOREST
MERIDIAN
SPECIAL
UINTAH
U.S.B.&M.
S.L.B.&M.
DINOSAUR NATIONAL MONUMENT
Green River
Sheep Creek
Carter Creek
Ashley Creek
Brush Creek
Little Brush Creek
Dry Fork
Whiterocks
Uinta River
Deep Creek
Mosby Canal
Salt Lake Base
GREENDALE
VERNAL
JENSEN
LAPOINT
WHITEROCKS
NEOLA
DRY FORK
FORT DUCHESNE
RANDLETT
ROOSEVELT
MYTON
OURAY
Oaks Park Res.
East Park Res.
Paradise Park Res.
Chepeta Lake Group Res.
Green River nr. Greendale 1951-Present 1,526,400 A.F. (1951-62)
Ashley Creek below Trout Creek nr. Vernal 1944-1955 17,800 A.F.
Oaks Park Canal nr. Vernal 1946-Present
Little Brush Creek below East Park Res. nr. Vernal 1949-1955 10,900 A.F.
South Fork Ashley Creek nr. Vernal 1944-1955 14,900 A.F.
Little Brush Creek nr. Vernal 1946-1952 12,900 A.F.
Brush Creek above Cave nr. Vernal 1946-1955 12,100 A.F.
East Fork of Dry Fork Above Sinks Near Dry Fork 1961-Present
North Fork of Dry Fork nr. Dry Fork 1946-Present 4,900 A.F.
East Fork of Dry Fork nr. Dry Fork 1946-Present 8,400 A.F.
Dry Fork above Sinks nr. Dry Fork 1-39-Present 29,900 A.F.
Mosby Canal nr. Lapoint 1954-Present 2,400 A.F. (1955-62)
Ashley Creek nr. Vernal 1914-Present 70,100 A.F.
Brush Creek nr. Vernal 1939-Present 28,700 A.F.
Little Brush Cr. nr. Mouth (USBR) 1964
Jones Hole Creek nr. Jensen 1951-1956
Dry Fork Below Springs nr. Dry Fork 1954-Present 21,900 A.F. (1954-62)
Dry Fork at Mouth nr. Dry Fork 1954-Present 13,800 A.F. (1955-62)
Ashley Creek at Sign of the Maine nr. Vernal 1939-Present 89,900 A.F.
Whiterocks River nr. Whiterocks 1914-Present 96,500 A.F.
Farm Creek nr. Whiterocks 1949-Present 3,100 A.F.
Uinta River nr. Neola 1930-Present 135,000 A.F.
Brush Creek nr. Jensen 1959-Present 13,900 A.F. (1940-62)
Green River nr. Jensen 1947-Present 3,212,000 A.F. (1947-60)
Ashley Creek nr. Jensen 1947-Present 38,400 A.F. (1947-62)
Deep Creek nr. Lapoint 1949-1955 5,100 A.F. (1943-45 & 50-55)
Uinta River at Fort Duchesne 1942-1958 65,600 A.F.
Duchesne River nr. Randlett 1943-Present 492,900 A.F. (1920-60)
Duchesne River at Myton 1911-Present 359,300 A.F. (1920-60)
Green River nr. Ouray 1948-1955 & 1957-Present 4,145,000 A.F. (1948-62)
▲ U.S.G.S. GAGING STATIONS
Name of station
Years of record
Mean annual runoff (1920-62)
4 0 4 8 12
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE – UTAH
UINTA BASIN GAGING STATIONS AND RUNOFF
DRAWN G.W.W.
SUBMITTED
INKED G.W.W.
RECOMMENDED
CHECKED
APPROVED
PROVO, UTAH
APRIL 1964
289-418-28

Climatological data
Uinta Basin Weather stations

Weather Station	Mean temperature (°F)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Vernal	15.4	22.1	34.2	45.9	54.6	61.9	69.5	67.2	59.4	47.9	32.6	21.4	44.3
Roosevelt-Altamont	15.6	22.4	36.6	48.5	56.5	63.4	71.1	69.0	59.9	48.6	33.7	23.5	45.7
Duchesne	17.0	23.0	35.0	46.0	54.0	62.0	69.0	67.0	59.0	48.0	32.0	22.0	45.0

Weather Station	Mean precipitation (inches)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Vernal	0.55	0.49	0.65	0.93	0.73	0.72	0.54	0.80	0.67	0.88	0.50	0.76	8.22
Roosevelt-Altamont	0.50	0.36	0.52	0.59	0.49	0.72	0.34	1.01	0.58	0.91	0.50	0.63	7.15
Duchesne	0.58	0.54	0.73	0.61	0.87	0.81	0.97	1.27	0.84	0.97	0.42	0.67	9.28

Weather Station	Growing season			Frost-free period		
	From	To	No. of days	From	To	No. of days
Vernal	April 21	October 22	184	May 29	September 23	119
Roosevelt-Altamont	April 19	October 12	176	May 16	September 29	136
Duchesne	April 28	October 9	164	May 25	September 22	120

Cropping patterns
Uinta Basin

Crop	Percent of total: Vernal	Roosevelt-Altamont	Duchesne
Alfalfa	37	45	39
Pasture	26	35	41
Corn	9	5	2
Small grains	28	15	18
Total	100	100	100

Consumptive Use

Consumptive use is defined as the annual quantity of water in acre-feet per acre absorbed by the crops and transpired or used directly in the building of plant tissue together with that evaporated from the soil. It includes the water from all sources including precipitation, irrigation, and ground water. The Lowry-Johnson method was used in determining the length of the growing season, and the consumptive use was determined by use of the Blaney-Criddle method.

In estimating the amount of water that would be supplied by precipitation, consideration was given to the effectiveness of single storms, carryover of winter precipitation in the form of soil moisture, and effective growing season precipitation. A conservative estimate of the net effective precipitation was considered as being 90 percent of the average precipitation occurring in the 10 driest growing seasons during the period of study.

Consumptive use water requirements minus effective precipitation gives the net amount of irrigation water that must be supplied to the crops by irrigation.

The average annual consumptive use, effective precipitation, and irrigation requirements are shown for each area in the table on page 36.

Farm Delivery Requirement

The farm delivery requirement is the amount of water consumptively used on the farm plus any water lost by seepage from farm ditches, deep percolation, and surface runoff. In general, it was estimated that the irrigation efficiencies would vary by land class as follows.

Land class	Farm irrigation efficiency (percent)
1	60
2	55
3	50

Summary of irrigation diversion requirements
Uinta Basin

	Duchesne	Vernal	Roosevelt-Altamont
	Annual requirement (acre-feet/acre) (Based on productive acreage1/)		
Consumptive use requirement	2.17	1.87	2.02
Effective precipitation	.22	.20	.20
Irrigation requirement	1.95	1.67	1.82
	(Based on irrigable acreage)		
Irrigation requirement	1.85	1.59	1.73
Farm losses	2/2.15	1.29	1.30
Farm delivery requirement		2.88	3.03
Conveyance loss	2/	.63	.62
Diversion requirement	3/4.00	4/3.51	5/3.65
	Monthly diversion requirement (acre-feet per acre)		
April	0.04	0.17	0.12
May	.52	.60	.50
June	.92	.71	.80
July	1.00	.81	.93
August	.88	.63	.70
September	.52	.42	.50
October	.12	.17	.10
Total	4.00	3.51	3.65

1/ The productive area is estimated at 95 percent of the irrigable area.
2/ Total loss includes farm irrigation and conveyance losses.
3/ Measured at Duchesne River.
4/ Measured at Steinaker Reservoir.
5/ Measured at Moon Lake.

Class 6W lands were not assigned an irrigation efficiency for project study because they will receive only their proportionate share of the natural streamflow under existing water rights and will not receive water from the project.

The weighted farm irrigation losses and farm delivery requirements are shown by areas in the table on page 36.

Diversion Requirements

Diversion requirements for a given area are influenced by the efficiency of the conveyance system. Conveyance losses occur in transit from the source of water supply to the farm headgate. They are comprised of evaporation from the canal water surface, transpiration by vegetation along the canal banks, seepage, and operational waste.

Seepage losses depend upon the wetted area, head, permeability of the soils traversed by the canal, and the length of the canal. The seepage losses may be estimated by using the Moritz Formula ($S = 0.2C \sqrt{Q/V}$) in which S is the loss in second-feet per mile of canal, Q is the discharge in second-feet, V is the velocity of flow in feet per second, and C is the depth of water in feet lost through the wetted area in 24 hours. The table on page 36 summarizes the estimated conveyance loss for each area in the Uinta Basin.

The average annual diversion requirements at appropriate points of diversion, based on irrigable acres for each area, are also summarized in the table on page 36.

Reservoir Evaporation Losses

To determine the net water available for project use, reservoir evaporation losses were determined for the proposed Starvation and Lake Fork Reservoirs and the existing Big Sand Wash and Moon Lake Reservoirs. Evaporation rates found at Utah Lake were applied to the Starvation Reservoir after adjustments were made for differences in climatological data. Big Sand Wash Reservoir evaporation rates were assumed to be the same as those at the Starvation site. The evaporation rates of Moon Lake Reservoir were measured for the summer months and estimated for the winter months. Evaporation rates at the Lake Fork Reservoir site were assumed to be the same as at Moon Lake Reservoir.

The table on the following page is a summary of the estimated evaporation rates at Moon Lake Reservoir and Big Sand Wash Reservoir.

Evaporation rates
(Unit--acre-feet per acre)

Month	Moon Lake Reservoir	Big Sand Wash Reservoir
October	0.19	0.21
November	.07	.08
December	.01	.02
January	.01	.02
February	.01	.03
March	.06	.14
April	.15	.30
May	.34	.44
June	.41	.53
July	.45	.58
August	.41	.52
September	.33	.39
Total	2.44	3.26

Operation studies

Preliminary operation studies were made of the Uinta Basin streams east of Rock Creek to determine the approximate amount of runoff which may be available for diversion from the Uinta Basin. These studies are summarized in the table on the following page. Criteria upon which the studies were based are listed below. It is realized these criteria may not be entirely valid due to economic or other factors which remain to be investigated in detail.

1. Flaming Gorge aqueduct will extend from Flaming Gorge Reservoir southward to Brush Creek, then westward to the Blue Bench north of Duchesne. Its location will be approximately the same as found in the 1951 report of the Central Utah project.

2. Land lying below the Flaming Gorge aqueduct will be supplied entirely from stream gains below the Strawberry aqueduct and from Flaming Gorge aqueduct.

3. Land lying either above the Flaming Gorge aqueduct or inaccessible to the aqueduct will be supplied from stream gains and bypasses from Strawberry aqueduct. The table on page 40 is a summary of these Uinta Basin lands and estimates of bypasses thereto.

Water supply at Strawberry aqueduct under ultimate phase
(Unit--1,000 acre-feet)

Stream	Average annual flow for period of study (1920-1962)			
	Flow at Strawberry aqueduct	Spills[1/]	Estimated bypass to irrigation[2/]	Estimated divertible flow
Little Brush Creek	3/ 10.9	1.6	1.0	8.3
Brush Creek	3/ 12.1	1.8	1.0	9.3
Ashley Creek	3/ 26.9	4.0		22.9
Cow Hollow	4/ .8	.1		.7
Black Canyon	4/ 2.0	.3		1.7
East Fork of Dry Fork	4/ 6.4	1.0		5.4
Three tributaries of East Fork of Dry Fork	4/ 7.1	1.1		6.0
North Fork of Dry Fork	4/ 4.9	.7		4.2
Flume Mill	4/ .6	.1		.5
Dry Fork	3/ 29.9	4.5	5.0	20.4
Paradise Creek	4/ 5.2	.8		4.4
Whiterocks River	4/ 77.2	11.6	2.4	63.2
Farm Creek	4/ 5.1	.8		4.3
Clover Creek	4/ 1.9	.3		1.6
Uinta River	4/ 113.1	16.9	5.3	90.9
Yellowstone Creek	4/ 96.4	14.5	44.0	37.9
Hell Canyon	4/ 3.3	.5	0	2.8
Lake Fork	3/ 92.7	13.9	5/ 45.3	33.5
Total	496.5	74.5	104.0	318.0

1/ Estimated to be 15 percent of the flow based on studies for initial phase of Strawberry aqueduct.

2/ A portion of this requirement would likely be able to be supplied from spills and could be reduced by that amount.

3/ Past modified.

4/ Historical.

5/ Includes 1,500 acre-feet for evaporation from Lake Fork Reservoir.

Estimated streamflow bypassed at Strawberry aqueduct to lands not served by Flaming Gorge aqueduct

Stream	Irrigable area (acres)1/	Annual requirement (acre-feet per acre)	Total annual requirement (acre-feet)	1,000 acre-feet (rounded to tenth)
Little Brush Creek	185	3.51	649	0.6
Dry Fork	868	3.51	3,047	2/5.4
Whiterocks River	644	3.65	2,351	2.4
Uinta River	1,440	3.65	5,256	5.3
Lake Fork and Yellowstone Creek	18,900 6,730	3.65 2.80	68,985 18,844	87.8
Total bypass				101.5

Note: Neither Brush nor Ashley Creeks will require streamflow bypasses at Strawberry aqueduct.

1/ All are class 1, 2, or 3 lands except for 6,730 acres of 6W Lake Fork area lands.

2/ Estimate includes Mosby Canal diversions of about 2,400 acre-feet annually from Dry Fork to Deep Creek area lands.

4. Spills at Strawberry aqueduct were estimated from studies made for the Bonneville unit, initial phase.

Water rights

Duchesne River

President Abraham Lincoln issued an executive order on October 3, 1861, establishing an Indian reservation in the Uinta Basin covering the drainage of the Duchesne River and its tributaries. Subsequent to the establishment of the reservation many acts and executive orders were made that affected the original reservation. The Indians had undisturbed possession of the reservation for some 40 years until the act of 1902 provided for the allotment of arable reservation lands to the public domain. In 1905 the United States Government opened the reservation to non-Indian land filings of 160 acres each, and as a result of this action Indian and non-Indian lands are everywhere interspersed. Some of the Indian lands also were later acquired by non-Indians. The original Indian lands, however, retained the original priority of their water rights regardless of present ownership. This priority dates back to October 3, 1861, the date the reservation was established.

The non-Indian settlers acquired secondary water rights under Utah State law by application to the State Engineer. The filing of water right applications began immediately after the opening of the reservation in 1905 and has continued to the present time. As a result, the rivers have been very greatly overappropriated, and the applications with late priority provide little or no water after the high runoff except in the cases where reservoirs have been constructed under their junior rights. The Indian diversions, in general, are located in the lower reaches of the rivers and the diversions of water by junior rights upstream soon left the Indian canals without sufficient water. As early as 1913 government officials realized a water adjudication was necessary on the Lake Fork, Whiterocks, and Uinta Rivers if sufficient water for the Indian land would be available for the lower diversions.

The Indians acquired first right to the use of the Duchesne River water, not only by diligence claims but also by applications to the Utah State Engineer beginning in 1905. The abstract attached to this report lists nine diligence claims for water to be used on 190 acres of Indian land. This abstract also shows that the first 17 perfected water right applications are owned by the Indians and cover 294.07 second-feet of water from the Duchesne River for use on 18,287.38 acres of land. This is ample evidence of the Indians' first right to the Duchesne River water.

An adjudication suit covering the water rights of Lake Fork, Uinta, and Whiterocks Rivers was started in the Federal Court in 1914. The basis for the claims by the Government in this suit was the decision in the United States Supreme Court known as the "Winters Decision" (Winters vs. United States--207 U. S. 564, 1908). The adjudication suit of Lake Fork, Uinta, and Whiterocks Rivers was bitterly opposed by the defendents and was continually in the courts until 1923, when, by stipulation, the District Court of the United States in and for the District of Utah established two decrees (Docket 4427 and 4418). These decrees gave the Uintah Indian Irrigation project lands the first right to all of the water in the three rivers covered by the decrees. The Duchesne River was specifically eliminated from the court decrees as it was thought then that the Duchesne River would supply ample water for all irrigation demands.

Docket 4427 was made for the Uinta River and its tributaries and guarantees the Indians the first and exclusive right under a priority that dates to October 3, 1861, to divert from the Uinta River and its tributaries into their canals a certain quantity of water for irrigation, domestic, culinary, and stockraising uses. The total land covered by the decree was 34,700.09 acres, and the permitted diversion requirement was 104,100.27 acre-feet or 498.88 second-feet. The decree limited the use to ". . . that which is needed for economical and beneficial use . . ." and defined the irrigation period from March 1 to November 1. It further limited the irrigation use to no more than 3 acre-feet of water per year for each acre of land irrigated, and no more than one-seventieth of a second-foot of water for each acre was to be diverted from the river at any one time. For the protection of the water rights described, the decree provided for a water commissioner to be appointed from time to time. The decree was dated March 16, 1923, and signed by Judge Tillman D. Johnson.

Natural lakes, high in the mountains, have been developed by a number of secondary water right interests as storage reservoirs. Six reservoirs are on the Uintah and five on the Whiterocks drainage. The water impounded in these reservoirs has proven to be of considerable benefit to their owners. The following table shows the owners, the names, and the active capacities of these reservoirs.

Existing Reservoirs, Uinta River system

Stream	Applicant or Owner	Reservoir	Active capacity (acre-feet)
Uinta River	Dry Gulch Irrigation Company	Fox Lake	1,100
		Crescent Lake	200
		Lake Atwood	750
		Upper Chain Lake	470
		Middle Chain Lake	130
		Lower Chain Lake	750
			3,400
Whiterocks River	Whiterocks Irrigation Company	Paradise Park	1,400
		Chepeta Lake	185
		Wigwam Lake	112
		Papoose Lake	80
		Mocassin Lake	103
			1,880

At the same time the court decree (Docket 4427) was made for the Uinta River, Docket 4418 was made for Lake Fork. This decree is similar to the one for the Uinta River. It states that the Indians have first right to the flow of Lake Fork and its tributaries and fixes these rights as follows.

Name of ditch or canal	Acres irrigated under each ditch	Water permitted to be diverted each season	
		Acre-feet	Second-feet
Lake Fork Extension	1,230.76	3,692.28	17.58
Lake Fork	9,701.43	29,104.29	138.59
Payne Lateral	493.20	1,479.60	7.05
Red Cap	8,751.75	26,255.22	125.03
Dry Gulch	4,871.57	14,614.71	69.60
Uteland	22.90	68.70	.33
Total	25,071.61	75,214.80	358.18

Docket 4418 limits the use of water to 3 acre-feet per year per acre for beneficial use and provides for a water commissioner to be appointed for Lake Fork. The decree was also signed by Judge Johnson and dated March 16, 1923.

The secondary users have developed several natural lakes high in the mountains as storage reservoirs to improve their water supply. Seventeen of these reservoirs are on Lake Fork tributaries. The water impounded in these reservoirs has proved to be of considerable benefit to the owners. The following table shows the owners, the names, and the active capacities of these reservoirs.

Existing reservoirs--Lake Fork River system

Applicant or Owner	Reservoir	Active capacity acre-feet
Farnsworth Canal and Reservoir Company	Kidney Lake	2,500
	Island Lake	1,000
	Brown Duck Lake	500
	Twin Potts	3,150
Dry Gulch Irrigation Company	Clement Lake	1,200
Farmers' Irrigation Company	Five Point Lake	500
	Drift Lake	200
	Bluebell Lake	380
	Superior Lake	400
	Farmers' Lake	803
	White Miller Lake	34
	Deer Lake	205
	Water Lily Lake	334
Brigham Timothy, et al.	Upper Timothy Lake Middle Timothy Lake Lower Timothy Lake	520
Hartman and Daniels	Milk Lake	184

During the investigation of the Moon Lake project, the non-Indian irrigation companies diverting water from Lake Fork and two companies diverting from the Uinta River formulated an agreement known as the Equalization Agreement, dated February 1935. By this agreement the numerous secondary water rights were evaluated, and methods of equalizing the distribution of water to each acre of land were agreed upon. The water rights owned by the participating companies were assigned to the Moon Lake Water Users' Association. Companies signing the agreement are listed as follows.

Dry Gulch Irrigation Company
Lake Fork Irrigation Company
Farmers' Irrigation Company
Farnsworth Canal and Reservpor Company
Lake Fork Western Irrigation Company
South Boneta Irrigation Company
Uteland Ditch Company
T. N. Dodd Irrigation Company
Monarch Canal and Irrigation Company

The Moon Lake project was constructed in 1938 by the Bureau of Reclamation to supplement the non-Indian water supply available under the secondary water rights. It provides supplemental irrigation water to approximately 75,256 acres of land in Duchesne and Uintah Counties. The project water supply is provided by Lake Fork and its principal tributary, Yellowstone Creek, and by the Duchesne River. Moon Lake Reservoir with 35,800 acre-feet of active capacity stores surplus spring flows of Lake Fork for release during the irrigation season to canals diverting from that river. The Yellowstone Feeder Canal, with a capacity of 88 second-feet, conveys Yellowstone Creek flows that are surplus to Indian rights to project land in the vicinity of Neola in the Uinta River drainage. Additional Lake Fork water is made available to Moon Lake project land by the Midview Exchange. Indian lands in the exchange area are supplied water from Duchesne River, and the Lake Fork water originally diverted to this area is used upstream on Moon Lake project lands.

Duchesne River water is delivered to the Midview Exchange area through the Duchesne Feeder Canal which diverts from the river about 5 miles downstream from Duchesne, Utah. The canal was originally constructed by private water users to irrigate about 1,500 acres having a water right from Duchesne River and was enlarged under the Moon Lake project. The enlarged canal, with an initial capacity of 200 second-feet, conveys the water 7 miles to a natural drainage which diverts a portion of the flow to the Midview Reservoir with an active capacity of 5,700 acre-feet. The remaining water flows into the Red Cap lateral which is about 8 miles long and serves Indian land originally irrigated from Lake Fork by the Red Cap Canal of the Uintah Indian Irrigation project. Midview lateral, 9 miles long and with an 80-second-foot capacity, delivers storage water from Midview Reservoir to Indian lands under the U. S. Dry Gulch Canal which originally diverted from Lake Fork.

Water rights for the Midview Exchange area include application No. 7781-a which covers the diversion of 175 second-feet from the Duchesne River for direct use in the area. Application No. 9104-a covers diversions from the Duchesne River of 11,570 acre-feet for storage in Midview Reservoir. The latter application allows the reservoir to be filled twice each year, once during the winter for early irrigation season use and again during the high spring flow. The above applications provide water for supplying 10,000 acres of land under the Midview Exchange.

The Midview Exchange is presently being operated on year-by-year agreements between the Moon Lake Water Users' Association and the Ute Indian Tribe. Negotiations leading to a permanent agreement whereby the operation and maintenance of the Midview Exchange would be assumed by the Ute Tribe have not been successful. Thus, the Midview Exchange was included in the Central Utah project plan in order to protect the water rights of the Moon Lake project. When the irrigable Indian lands with primary water rights on Duchesne River are fully developed, they will require part of the water presently being diverted to the Midview Exchange area. With the resulting decrease in exchange water and without Central Utah project the Indian lands in the Midview area would then require Lake

Fork water in lieu of the Duchesne River water, and the resulting shortages would accrue to the Moon Lake project lands.

Under the proposed Bonneville unit development the Midview Exchange lands will receive water from Starvation Reservoir, eliminating the necessity of recalling Lake Fork water to supply these lands. The Bonneville unit of the Central Utah project will not increase the water supply to the Moon Lake project as compared to the present supply, but it will insure the continued delivery of the present supply as development of the Indian lands on the Duchesne River proceeds. A diversion requirement of 4 acre-feet per acre was allowed at the Duchesne Feeder Canal heading for 10,000 acres of Midview Exchange land. An inventory of land resources indicates there is a maximum of about 7,500 acres of irrigable Indian land in the Midview Exchange area. The Indians are presently considering purchasing some non-Indian water right land now being served from the U. S. Dry Gulch Canal, thereby bringing the full 10,000 acres into irrigation under the Midview Exchange.

The Moon Lake Water Users' Association, with the help of the Utah Water and Power Board, has constructed the Big Sand Wash Dam on Big Sand Wash near Upalco, Utah. The reservoir has a total capacity of about 12,000 acre-feet and an active capacity of 10,800 acre-feet. Application No. 17978, owned by the Moon Lake Water Users' Association, appropriates the water for the Big Sand Wash Dam. This application covers 300 second-feet of water from Lake Fork and 30 second-feet from Sand Wash.

Consistent with the objectives of the Colorado River Compact, dated November 24, 1922, the Upper Colorado River Basin Compact of October 11, 1948, and the Colorado River Storage Project Act of April 6, 1956, which included the Flaming Gorge Dam and Reservoir as a unit and the Central Utah project as a participating project, Application No. 30414 to appropriate water from the Green River was filed with the State Engineer by the Bureau of Reclamation on August 7, 1958. This application covers the appropriation of 8,000 second-feet and 4,000,000 acre-feet of water from the Green River. As part of the water supply for the Central Utah project, this application proposes to divert 500,000 acre-feet of water annually, as needed, from Flaming Gorge Reservoir into an aqueduct to provide water for various purposes to lands and communities in the Uinta Basin and to replace water diverted from the Uinta Basin through the proposed Strawberry aqueduct for use in the Bonneville Basin. Application No. 30414 was approved by the State Engineer October 6, 1959.

On September 4, 1946, the Bureau of Reclamation filed Application No. 18043 with the State Engineer covering the appropriation of water for both the initial and ultimate phases of the Central Utah project. The application sought to appropriate 800,000 acre-feet of surplus water from lakes, streams, and proposed reservoirs in the Uinta Basin from Brush Creek on the east to Strawberry River on the west. This application covered all of the reservoirs and points of diversion along the collection system in the Uinta Basin and the distribution system and lands in the Bonneville Basin. Strawberry Reservoir was to be enlarged from its present active capacity of 270,000 acre-feet to an active capacity of 1,370,000 acre-feet. Approval of Application No. 18043 by the State Engineer was delayed at the request of the Bureau of Reclamation pending formulation of the project plan.

Shortly after Application No. 18043 was filed, the Governor of Utah withdrew the Uinta Basin streams, tributary to the Green River, from further appropriation of more than 5 second-feet. This withdrawal proclamation was made December 19, 1946. Since the withdrawal order was made, a great number of water right filings have been made on the Uinta Basin streams for flows of 5 second-feet or less. These applications have priority dates that are after Application No. 18043 and are unapproved. These applications are included in the abstract of water rights in the supporting data to this report in the Central Utah Projects Office in Provo, Utah.

An adjudication proceeding intended to define all surface and ground water rights in the Uinta Basin in Utah was ordered March 20, 1956, by the Fourth Judicial District Court in and for Duchesne County in Civil Action No. 3070. The area comprising this general determination proceeding included all of the water sources, both surface and underground, within the drainage area of the Green River and all of its tributaries below the confluence of Pot Creek and above the confluence of the Green River with the Colorado River but excluding therefrom the drainage area of the San Rafael River.

Pursuant to the court order the State Engineer has made field surveys in a major part of the Uinta Basin as a step in the preparation of his proposed determination of water rights. The adjudication has progressed very well, but it will be several years before it is completed. In the absence of an authoritative definition of water rights on the streams in the Uinta Basin, two committees have been organized to study the problems, one for the Duchesne River and one for Lake Fork and Uinta River. These committees include representatives of the Bureau of Indian Affairs, Ute Indian Tribe, Upper Colorado River Commission, Utah Water and Power Board, Bureau of Reclamation, and non-Indian land owners in the respective areas. The Duchesne River Area Study Committee was organized April 4, 1961, and the Lake Fork-Uintah Area Study Committee began May 29, 1963. One of the objectives of the committees was to make appropriate conclusions and recommendations pertaining to optimum Central Utah project development within the limits of available water supplies.

Water rights of Duchesne River are discussed in the "Duchesne River Area Study Committee Report" of April 1962 and in the "Bonneville Unit Definite Plan Report" of August 1964. The abstract was not available at the time the Bonneville Unit Definite Plan Report was printed.

In its final report made in April 1962 the Duchesne River Area Study Committee concluded that Indian lands along the Duchesne River totaled 20,705 acres and that non-Indian water rights on the Duchesne River that could be accepted as having priority over rights for the Central Utah project include water for the irrigation of 32,295 acres of land in the Uinta Basin. These Uinta Basin lands were made up of 20,295 acres along the Duchesne River, including lands served by the Taylor Canal, 10,000 acres under the Midview Exchange, and 2,000 acres irrigated under applications of 5 second-feet or less with priority dates after Application No. 18043. The study committee estimated that there were 8,000 acres of land presently irrigated under the Taylor Canal.

On December 23, 1963, a study was initiated with representatives from the State Engineer's office and the Bureau of Reclamation to reevaluate and tabulate the water rights and lands along the Duchesne River. The results of this study and a comparison tabulation of the Duchesne River Area Study Committee's recommended lands are shown in the table on the following page.

As can be seen in the table the net difference of land between the two studies is 1,520 acres. This was due to 2,304 additional acres brought under cultivation recently in the Taylor Canal area and a net increase of 216 acres in the other categories. It was found in the final tabulation that about 1,061 acres of land are presently irrigated without an approved water right. In the reevaluation study 25 new water right applications were written to cover 793 acres and 10 existing applications filed during 1956 were amended to include 268 acres of this land. The 25 new applications were filed with the State Engineer by the Central Utah Water Conservancy District, and all 35 applications will be recognized ahead of the Bonneville unit water rights. The table on page 49 includes the 25 new applications filed by the conservancy district and the 10 amended applications for lands presently irrigated without an approved water right.

New applications were prepared for filing in lieu of seeking approval of Application 18043 in anticipation that the Uinta Basin streams would be restored to new water right filings. Units included in the new filings are Bonneville, Upalco, and Uintah. An application was also prepared for Starvation Reservoir to supplement Application 18043 in the event adequate priorities were not obtained for these new project filings. Descriptions of the new Bureau of Reclamation applications follow.

Uintah unit application.--The purpose of this application is to appropriate up to 100,000 acre-feet of surplus water from the following sources: Gilbert Creek which is tributary to the Uinta River (at Gilbert Creek Dam site), Shale Creek which is tributary to the Uinta River (at Burro Dam site), Uinta River (at Uinta No. 1 Dam site), unnamed fork which is tributary to West Fork of Whiterocks River (at Queant Lake Dam site), Whiterocks River (at Middle Whiterocks Dam site), Twin Cottonwood

Summary of Duchesne River lands
and water rights
(Unit --acres)

		Duchesne River Study Committee's recommended acreages (used in studies)	Tabulation as of May 1965	Difference
I.	Indian ownership lands	20,705	20,705	0
II.	Non-Indian ownership lands			
	1. Lands along the Duchesne River (except Taylor Canal lands) with water rights before Bureau Application No. 18043	12,295	12,093	1/ -202
	2. Taylor Canal lands	8,000	10,304	+2,304
	3. Land along the Duchesne River with certificated water right applications after application No. 18043)		2/ 807	
	4. Lands in class 1, 2, 3, and 6W presently irrigated without an approved water right (25 new applications were filed on this land))		793	
	5. Other lands with elections or potential elections filed since application No. 18043)	2,000	550	+418
	6. Land in class 1, 2, 3, and 6W presently irrigated without an approved water right (old 5 c.f.s. filings to be amended for these lands))		268	
	7. Midview Exchange lands	10,000	10,000	0
	Total	53,000	55,520	+2,520

1/ The decrease in acreage was the result of abandoned water rights, Indian and non-Indian filings on same lands, and supplemental rights.

2/ Includes approximately 200 acres of land classified as 6st brush pasture land.

Recent water right applications with priority ahead of the Bonneville unit

Application No.	Property owner	Ditch	Flow (sec.-ft.)	Additional acreage (acres)
36542	Vernal Bromly	Murray White Canal	0.05	3
36543	D. L. Nielson	Gray Mountain	0.09	7
36544	Mrs. L. Felter	Pahcease Canal	0.36	22
36545	Olsen Brothers	Yannawards Ditch	0.24	14
36546	Hazel Hadden	Knight Ditch	0.11	7
36547	R. D. Broadhead	Broadhead Ditch	0.27	16
36548	Peatross Brothers	Gray Mountain	0.15	9
36549	T. L. Bishop	Gray Mountain	0.25	15
36550	K. J. Nielsen	Gray Mountain	0.18	11
36551	R. D. Broadhead	Jones Ditch	0.21	13
36552	Charles J. Moody	Jessop Thomas	0.33	19
36553	Charles Fabrizio	Fabrizio Ditch	0.15	9
36554	Milvin and Ruth Broadhead	West Rock Creek Ditch	0.23	13
36555	Merlin Broadhead	West Rock Creek	0.13	8
36556	Farm Creek Irrigation Co.	Farm Creek Canal	1.00	60
36557	Charles Fabrizio	Turnbow Ditch	0.30	18
36558	Vernon Moon	Turnbow Ditch	0.17	10
36559	Theron H. Robb	Shanks Ditch	0.53	32
36560	Wayne and Adrienne Strong	Shanks Ditch	0.24	14
36561	Olsen Brothers	Madsen Ditch	0.55	33
36562	Rhoades Canal Irrigation Co.	Rhoades Canal	0.36	22
36563	Ray and Erma Thomas	Hicken Ditch	0.34	21
36564	Clarence and Margaret Wright	Jones Ditch	0.25	14
36565	Leland and Carol Wright	Jones Ditch	0.17	10
36637	Rocky Point Ditch Co.	Rocky Point	6.55	393
28483	J. Willis Moon	Private	.57	34
28484	Ray Thomas	Hicken Ditch	.25	15
28485	Ray D. Broadhead	Jones Ditch	.12	7
28486	Clarence Wright	Jones Ditch	.22	13
28492	Theron Robb	Knight Ditch	.2	12
28532	Farm Creek Irr. Co.	Farm Creek Canal	.84	50
28533	Myrthon Moon	Jessup-Thomas	.60	36
28548	Ray D. Broadhead	Broadhead Ditch	.28	17
28549	Kenneth L. Wilkinson	Private	.17	10
28581	Rocky Point Ditch Co.	Rocky Pt. Ditch	1.13	74

Wash which is tributary to Uinta River (at Bochalen Dam site), West Fork of Halfway Hollow which is tributary to Halfway Hollow, tributary to the Green River (at Halfway Hollow Dam site), Whiterocks River (at Ouray Valley Canal Diversion Dam), Brown Draw which is tributary to Cottonwood Creek which is tributary to Dry Gulch which is tributary to Uinta River (at Half Moon Dam site), Uinta River (at Cedarview Canal Diversion Dam), Bottle Hollow which is tributary to Uinta River (at Bottle Hollow Dam site), and Uinta River (at Indian Bench Canal Diversion Dam). Alternate reservoirs proposed for this unit are described in the application.

Water appropriated under this application will be used as a supplemental or full supply on lands within the Uintah unit area and for other incidental uses.

Water appropriated by this application will be distributed by the existing canals and conduits to the extent possible, and new facilities will be constructed or existing features enlarged as necessary to serve the project requirements.

Ultimate phase Application No. 36645.--This application proposes to appropriate up to 1,400,000 acre-feet of water, including 800,000 acre-feet from Flaming Gorge Reservoir which is also covered by Application No. 30414. Under this application water from Flaming Gorge Reservoir would be released as needed into the Flaming Gorge aqueduct and from the aqueduct into the natural channels for direct irrigation and other uses within the Uinta Basin and for exchange water to replace up to 600,000 acre-feet of water diverted from lakes, streams, and proposed reservoirs along the potential Strawberry aqueduct. The application proposes uses such as domestic, municipal, irrigation, stock-watering, power, fish and wildlife, and recreational uses.

A restoration proclamation affecting all streams which drain into the Green River from the Uinta Basin including Little Brush Creek, Brush Creek, Ashley Creek, Uinta River, Yellowstone Creek, Lake Fork, Rock Creek, Duchesne River, and Strawberry River was signed by Governor George D. Clyde November 2, 1964. This proclamation was published in the Vernal Express, Uintah Basin Standard, Wasatch Wave, Salt Lake Tribune, and The Deseret News on November 19, 26, and December 3, 1964. The effective date of the proclamation was December 7, 1964.

During the publication period the Central Utah Water Conservancy District filed the 25 new applications covering existing uses of water on 793 acres of land along the Duchesne River system not covered by other established water rights. Twenty-four of these applications seek to appropriate less than 5 second-feet of water and, therefore, were accepted and processed by the State Engineer at the time of filing on November 19, 1964. They were given filing numbers from 36542 to 36565. The twenty-fifth application covers 6.55 second-feet of water and 393 acres of land under the Rocky Point Canal. This application was one of ten that were deposited with the State Engineer during the restoral publication period and by statute were considered at a hearing to establish their priority dates. The hearing was held in Duchesne, Utah, on December 21, 1964, and continued on December 22, 1964, in Salt Lake City, Utah.

A table showing the ten applications filed during the advertisement of the restoral order and the final order of priority assigned by the State Engineer is shown below. This order of priority is essentially in agreement with recommendations made at the hearing by the Bureau of Reclamation, Central Utah Water Conservancy District, and others.

No.	Applicant	Quantity	Source	Priority assigned
36637	Central Utah Water Conservancy District	6.55 c.f.s.	Duchesne River	11 a.m. 11-19-64
36638	U. S. Bureau of Reclamation	200,000 ac.-ft.	Duchesne & Strawberry Rivers (Starvation Reservoir)	12 noon 11-19-64
36639	U. S. Bureau of Reclamation	500,000 ac.-ft.	(Bonneville unit)	12 noon 11-19-64
36640	Dry Gulch Irrigation Co.	250 ac.-ft.	Lake Atwood	10:30 a.m. 11-27-64
36641	Dry Gulch Irrigation Co.	400 ac.-ft.	Fox Lake	10:30 a.m. 11-27-64
36642	U. S. Bureau of Reclamation	100,000 ac.-ft.	(Upalco unit)	11 a.m. 11-27-64
36643	Monarch Canal and Reservoir Co.	500 ac.-ft.	Dry Gulch Creek	8 a.m. 12-4-64
36644	U. S. Bureau of Reclamation	100,000 ac.-ft.	(Uintah unit)	9 a.m. 12-4-64
36645	U. S. Bureau of Reclamation	1,400,000 ac.-ft.	(Ultimate phase)	10 a.m. 12-4-64
36646	Uintah Power and Light Co.	96.62 c.f.s.	Uinta River	11 a.m. 12-4-64

After the State Engineer assigned the priorities the Uintah Power and Light Company filed a complaint with the District Court seeking to reverse the State Engineer's order of priorities and place the Uintah Power and Light Company's Application No. 36646 ahead of the Bureau of Reclamation's Uintah unit and ultimate phase Application Nos. 36644 and 36645.

Ashley Creek

The court decrees and water right applications on Ashley Creek are discussed in detail in the Vernal Unit Definite Plan Report, Appendix B, May 1957.

Dry Fork is a tributary of Ashley Creek and drains an area of about 118 square miles, most of which is located in the Ashley National Forest. The town of Dry Fork is located within this drainage area and about 12 miles northwest of Vernal. On Dry Fork about 6 miles above the town of Dry Fork is an area called the "Sinks" where most of the flow of the creek is lost into the ground.

Several attempts have been made in the past to divert water around the Sinks. The first attempt occurred in 1887 or 1888 when the pioneers living along the stream dug a ditch that skirted the Sink area. This attempt failed, however, when the diverted water disappeared into a hidden sink hole. Later, between 1894 and 1896, they tried to build a wooden flume over the Sink area. The flume leaked so badly that the water washed out the flume supports and it collapsed.

Planning for the Dry Fork project began in 1960 as a joint venture between the Soil Conservation Service and the Utah Water and Power Board. This proposed project is essentially another attempt to provide facilities to convey water past the Sinks area, along with a reservoir system in the headwaters to regulate the flows and a series of improvements along the creek to reduce and control the occasional flood threat. The project would be constructed under the following water right applications.

Direct flow Application No. 9126 is presently held by the Utah Water and Power Board, and it proposes to appropriate 75 second-feet of water from Dry Fork of Ashley Creek. The point of diversion is in the vicinity of the "Dry Fork above Sinks" gaging station. It is planned to use this application for constructing the Dry Fork Diversion Dam and the Dry Fork branch of the Dry Fork pipeline.

Storage rights that could be used for the proposed reservoirs of the Dry Fork project are Application Nos. 26535, 32742, and 8755. Application No. 26535 proposes to appropriate 5 second-feet and 250 acre-feet of water from the East Fork of Dry Fork for storage in Brownies Park Reservoir. The Uintah Water Conservancy District holds Application No. 32742 which proposes to store an additional 300 acre-feet in the same reservoir. Application No. 8755 was filed by the Ashley Valley Reservoir Company and proposes to store water in seven separate reservoirs including Chimney Rock Lake, Charlies Park, and Mill Fork. It proposes to appropriate 14 second-feet and 1,425 acre-feet. The Bureau of Reclamation has no objection to this project provided it does not reduce the water supply and consequently the repayment ability of the Vernal unit of Central Utah project.

Brush Creek

Two court decrees granting specific rights to the full and free use of specified amounts of the natural flows of Brush Creek have been given by the Fourth Judicial District Court of the State of Utah in and for Uintah County. The first decree, dated August 12, 1896, divided the natural flows of Brush Creek between four groups of water users. Division of natural flows was based upon the number of acres each group had under cultivation. This division, shown below, is still in effect.

Decree of August 12, 1896

Owner	Percent of flow
Burns Bench Canal	50
Burton ditch	22
Murray ditch	15
Small ditches above Sunshine Canal	13
Total	100

The second decree, dated November 13, 1930, granted to several individuals specified amounts of natural flow from Brush and Little Brush Creeks totaling 3.071 second-feet. This decree also granted a share of the excess flows of the two streams for irrigation purposes. The decree also provided sufficient water to the individuals for stockwatering and domestic purposes.

Since March 29, 1956, when the State Engineer was ordered by the Fourth Judicial District Court to make a general determination of the water rights of streams in the Uinta Basin, the hydrographic surveys of Brush Creek and its tributaries have been completed and the State Engineer certified to the courts on January 15, 1960, his proposed determination of all the rights to the use of water within the area of Brush Creek. At that time he submitted his "Priority Schedule of the Irrigation Water Rights on Brush Creek and Tributaries in Uintah County." This priority schedule has been developed into an abstract of water rights which is included in the supporting data in the Central Utah Projects Office.

The Bureau of Reclamation has water right Application No. 17558 to appropriate water from Brush Creek. The water appropriated in this application is for the supplemental irrigation of 3,500 acres of presently irrigated land and 1,500 acres of full service land included in the area of the Jensen unit. The application seeks to appropriate 30 second-feet and 10,000 acre-feet for direct flow use on the lands of the Jensen unit and for storage in a reservoir proposed at the Tyzack Dam site. Water stored in Tyzack Reservoir would be released at such times and amounts needed to supplement the natural flow of Brush Creek. Application No. 17558 has a priority date of April 23, 1946, and it was approved March 17, 1961.

An alternative plan for the Jensen unit would involve the pumping of water directly from the Green River to the lands described above. This could be accomplished by use of Application No. 30415 which is owned by the United States. The purpose of this application is to appropriate 50 second-feet of water to be pumped from the Green River into the existing Burns Bench and Murray Canals. This water would be used in exchange for water from Brush Creek which would be diverted into upper canals. Application No. 30415 has a priority date of August 7, 1958, and it was approved April 3, 1961.

Sevier River Drainage

The Sevier River is the longest river found entirely within the State of Utah. It rises in the south-central part of the State and flows generally northward for about 150 miles, then turns southwestward for about 60 miles and terminates in Sevier Lake. Since man came to the area most of the water is consumptively used on lands along the river, and very little water reaches the now dry Sevier Lake.

It is physically possible to convey project water by gravity into the lower Sevier River to supply land in the vicinity of the city of Delta, Utah. Exchanges could then be made to furnish a better water supply to the area upstream on the Sevier River.

Years of relatively low runoff during the past two decades combined with an increasing population are causing keen competition for the available water supply within the basin. This has resulted in the establishment of Sevier River Study Committee composed of water users'organizations and Government agencies. This committee is working toward increasing the water supply from existing sources, reducing losses, improving the efficiency of use, and obtaining additional water from sources outside the basin. The committee is endeavoring to organize a water conservancy district to continue this work and provide a higher degree of permanency than the present organization affords. Although not yet available, basic data obtained by the committee should be available to the Bureau of Reclamation at an early date.

Water resources of the San Pitch River, a major tributary of the Sevier River, are reported in greater detail in the basin-type report of the Price and San Pitch River Basins, December 1964, prepared by the Bureau of Reclamation.

Water resources

Runoff Records

The U. S. Geological Survey has maintained streamflow gaging stations at a number of locations within the Sevier River drainage including the San Pitch River Basin. The table on the following page summarizes the streamflow records of each of the gaging stations, and the location of the stations is shown on the map on page 56. Monthly streamflow and canal diversion records are included in the supporting data.

Summary of stream gaging data - Sevier River Basin
(Unit: 1000 acre-feet)

Gaging station	Drainage area (sq.mi.)	Period of record 1/	Average recorded flow	Annual runoff Average 2/	Annual runoff Year
Sevier River and its tributaries					
Sevier River at Hatch	340	1912-28, 1940-62	94.7	83.9	1960
Sevier River near Circleville	950	1913-22, 1924, 1925-27 (fragmentary), 1950-62	111.2	101.1	1956
Sevier River near Kingston	1,110	1915-62	94.6	89.2	1960
Antimony Creek near Antimony	26	1947-48, 1958-62	16.2	19.6	1959-6
East Fork of Sevier River near Kingston	1,260	1914-62	59.5	55.5	1934
Sevier River below Piute Dam near Marysvale	2,440	1911-12 (fragmentary), 1913-62	161.7	150.3	1956
Sevier River above Clear Creek near Sevier	2,700	1912-16, 1940-55	186.0	174.2	1957
Clear Creek at Sevier	169	1913-19, 1934-37 (fragmentary), 1938-39, 1941-57	21.7	20.8	1951
Clear Creek above diversions near Sevier	164	1958-62	16.9	-	-
Sevier River at Sevier	2,850	1918-29	244.5	198.6	1956
Sevier River near Sigurd	3,340	1912 (fragmentary), 1915-62	70.8	65.1	1954
Sevier River below Vermillion Dam	-	1934-61	21.7	21.7	1951
Salina Creek at Salina	298	1914-17 (fragmentary), 1918-19, 1943-55	14.0	16.8	1961
Sevier River below San Pitch River near Gunnison	4,880	1913-62	163.4	151.6	1935
Sevier River near Juab	5,120	1912-62	168.4	153.7	1961
Sevier River near Lynndyl	6,270	1915-19, 1943-62	142.3	131.2	1961
San Pitch River Basin					
Pleasant Creek near Mount Pleasant	16	1955-62	12.0	-	1961
Twin Creek near Mount Pleasant	6	1955-62	5.9	-	1961
Ephraim Creek near Ephraim	-	1941-62	18.0	-	1959
Twelve Mile Creek near Mayfield	60	1960-62	19.6	-	-
San Pitch River near Fairview (USBR)	-	1954-57 3/	12.8	-	1954
San Pitch River near Mount Pleasant (USBR)	-	1954-57 3/	7.3	-	1954
San Pitch River near Moroni (USBR)	-	1954-57 3/	12.9	-	1956
San Pitch River at Moroni (USBR)	-	1954-57 3/	7.7	-	1956
San Pitch River near Chester (USBR)	-	1954-57 3/	7.6	-	1956
Transmountain diversions from Colorado River Basin					
Fairview ditch near Fairview	-	1950-62	1.4	-	1961
Candland ditch near Mount Pleasant	-	1950-58	0.2	-	1955
Coal Fork ditch near Mount Pleasant	-	1950-58	0.3	-	1958
Twin Creek tunnel near Mount Pleasant	-	1950-58	0.2	-	1953
Spring City tunnel near Spring City	-	1950-62	2.0	-	1959
Black Canyon ditch near Spring City	-	1950-58	0.3	-	1953
Cedar Creek tunnel near Spring City	-	1950-58	0.4	-	1954
Reeder ditch near Spring City	-	1950-58	0.3	-	1953
John August ditch near Ephraim	-	1950-58	0.2	-	1950
Madsen ditch near Ephraim	-	1950-58	0.0	-	1950, 1955,
Ephraim tunnel near Ephraim	-	1950-62	3.4	-	1959
Larsen tunnel near Ephraim	-	1950-58	1.1	-	1954
Horseshoe tunnel near Ephraim	-	1950-58	0.6	-	1954

1/ Water year; does not include records after 1962.
2/ Historical flow.
3/ No records are available for winter months, November-February.

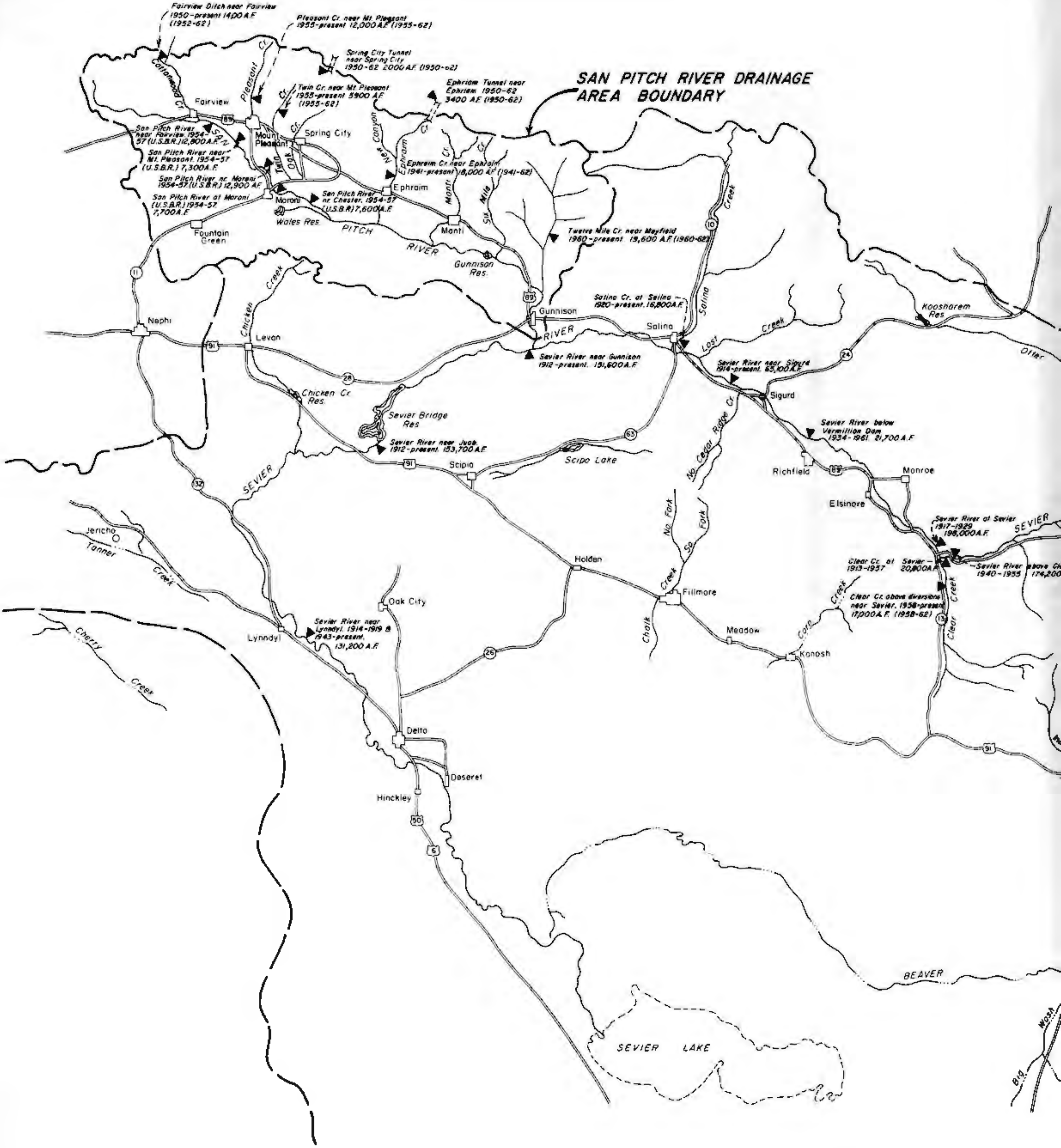
Note: Historical flow is the flow actually experienced at a gaging station or point of measurement. It is the total runoff c
measurement as influenced by nature and the activities of man. It may be recorded or estimated.
Past modified flow is the historical and/or natural flow corrected to show for the period of study the man-made develop
of the period of study.
Present modified flow is the historical and/or natural flow corrected to show the effect of the present man-made develo
period of study.

ata - Sevier River Basin
acre-feet)

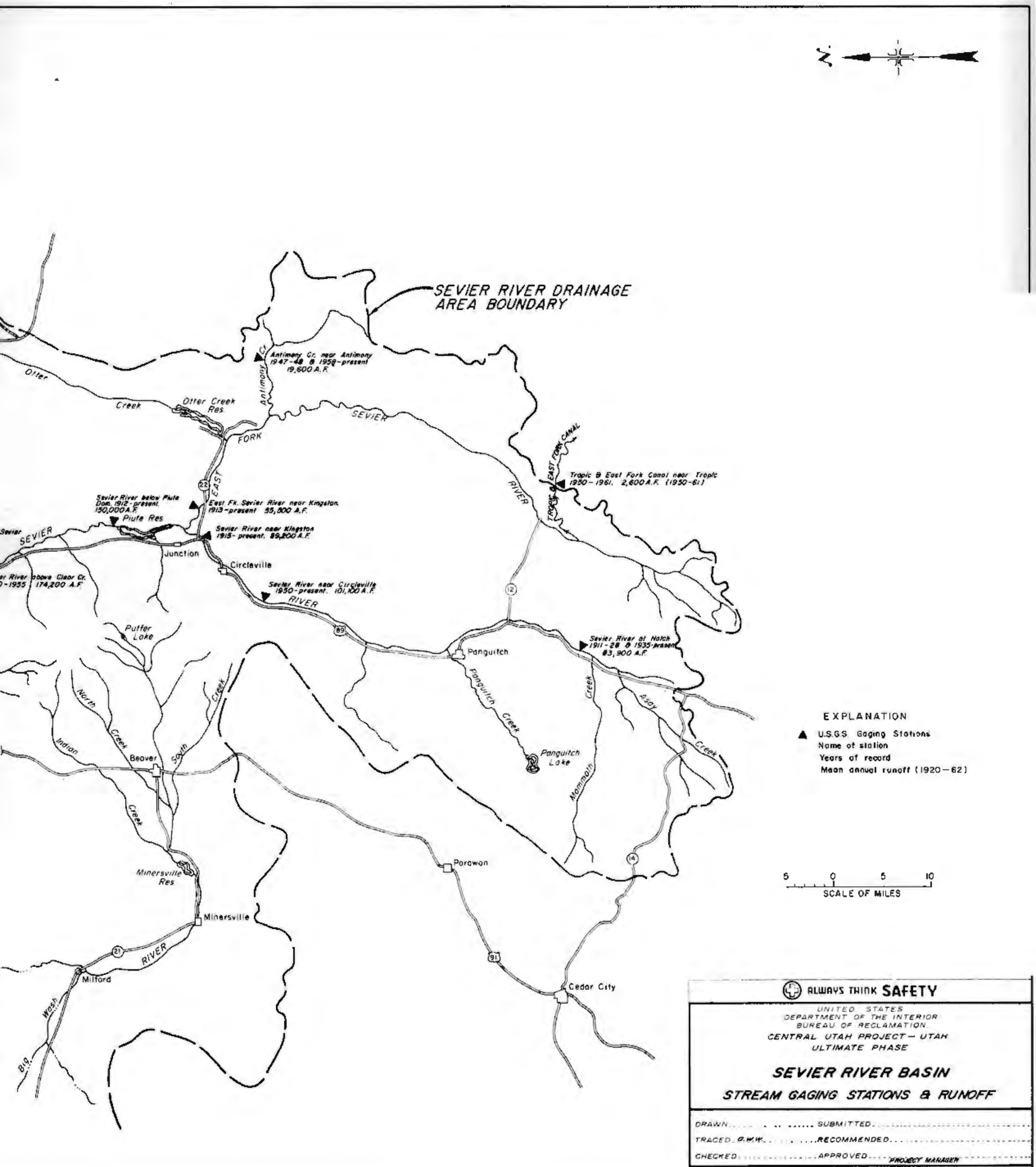
	Average recorded flow	Annual runoff for period of study (1920-1962)				
		Average2/	Minimum		Maximum	
			Year	Quantity	Year	Quantity
	94.7	83.9	1960	37.8	1922	226.6
27	111.2	101.1	1956	42.0	1922	280.9
-62						
	94.6	89.2	1960	36.8	1922	259.7
	16.2	19.6	1959-60	12.2	1922	36.7
	59.5	55.5	1934	27.3	1922	145.9
,	161.7	150.3	1956	72.7	1922	411.9
	186.0	174.2	1957	89.6	1922	462.5
gmen-	21.7	20.8	1951	6.6	1952	35.9
1-57						
	16.9	-	-	-	-	-
	244.5	198.6	1956	111.1	1922	489.8
915-62	70.8	65.1	1954	30.5	1922	306.0
	21.7	21.7	1951	1.4	1942	83.0
,	14.0	16.8	1961	2.1	1922	61.2
	163.4	151.6	1935	62.6	1922	455.6
	168.4	153.7	1961	68.2	1923	435.1
	142.3	131.2	1961	74.2	1923	305.5
	12.0	-	1961	7.9	1957	16.1
	5.9	-	1961	4.1	1957	8.8
	18.0	-	1959	9.0	1962	28.4
	19.6	-	-	-	-	-
	12.8	-	1954	6.7	1957	19.1
	7.3	-	1954	4.6	1957	10.8
	12.9	-	1956	5.3	1957	25.3
	7.7	-	1956	4.5	1957	10.9
	7.6	-	1956	2.0	1957	13.6
	1.4	-	1961	0.6	1957	2.5
	0.2	-	1955	0.1	1952	0.6
	0.3	-	1958	0.2	1952	0.7
	0.2	-	1953	0.1	1952	0.5
	2.0	-	1959	1.3	1962	3.3
	0.3	-	1953	0.2	1952	0.5
	0.4	-	1954	0.2	1952	0.7
	0.3	-	1953	0.1	1958	0.5
	0.2	-	1950	0.2	1951	0.3
	0.0	-	1950, 1954, 1955, 1958	0.0	1956	0.1
	3.4	-	1959	2.4	1962	6.1
	1.1	-	1954	0.7	1952	2.3
	0.6	-	1954	0.4	1952	1.0

of measurement. It is the total runoff of a drainage area above the point of
orded or estimated.
r the period of study the man-made developments as they existed at the beginning

the effect of the present man-made developments if they had existed over the



Fairview Ditch near Fairview 1950-present 1400 A.F. (1952-62)
Pleasant Cr. near Mt. Pleasant 1955-present 12,000 A.F. (1955-62)
Spring City Tunnel near Spring City 1950-62 2000 A.F. (1950-62)
Twin Cr. near Mt. Pleasant 1955-present 5900 A.F. (1955-62)
Ephriam Tunnel near Ephriam 1950-62 3400 A.F. (1950-62)
SAN PITCH RIVER DRAINAGE AREA BOUNDARY
San Pitch River near Fairview 1954-57 (U.S.B.R.) 12,800 A.F.
San Pitch River near Mt. Pleasant 1954-57 (U.S.B.R.) 7,300 A.F.
San Pitch River nr. Moroni 1954-57 (U.S.B.R.) 12,900 A.F.
San Pitch River at Moroni (U.S.B.R.) 1954-57 7,700 A.F.
San Pitch River nr. Chester 1954-57 (U.S.B.R.) 7,600 A.F.
Ephraim Cr. near Ephraim 1941-present 18,000 A.F. (1941-62)
Twelve Mile Cr. near Mayfield 1960-present 19,600 A.F. (1960-62)
Salina Cr. at Salina 1920-present 16,800 A.F.
Sevier River near Gunnison 1912-present 151,600 A.F.
Sevier River near Sigurd 1914-present 65,100 A.F.
Sevier River near Juab 1912-present 153,700 A.F.
Sevier River below Vermillion Dam 1934-1961 21,700 A.F.
Sevier River at Sevier 1917-1929 198,000 A.F.
Clear Cr. at Sevier 1913-1957 20,800 A.F.
Clear Cr. above diversions near Sevier 1958-present 17,000 A.F. (1958-62)
Sevier River near Lynndyl 1914-1919 & 1943-present 131,200 A.F.
Fairview
Mount Pleasant
Spring City
Ephraim
Moroni
Wales Res.
Fountain Green
Manti
Gunnison Res.
Gunnison
Nephi
Levan
Chicken Cr. Res.
Sevier Bridge Res.
Scipio
Scipio Lake
Salina
Sigurd
Richfield
Monroe
Elsinore
Koosharem Res.
Holden
Fillmore
Meadow
Kanosh
Oak City
Lynndyl
Jericho
Delta
Deseret
Hinckley
SAN PITCH RIVER
SEVIER RIVER
SEVIER
BEAVER
SEVIER LAKE
Cottonwood Cr.
Pleasant Cr.
Twin Cr.
Oak Cr.
Nebo Canyon
Ephraim Cr.
Manti Cr.
Six Mile Cr.
Salina Creek
Lost Creek
Chicken Creek
No. Cedar Ridge Cr.
No. Fork
So. Fork
Chalk Creek
Corn Creek
Clear Creek
Tanner Creek
Cherry Creek
Otter
Big Wash


N
SEVIER RIVER DRAINAGE AREA BOUNDARY
Antimony Cr. near Antimony 1947-48 & 1958-present 19,600 A.F.
Antimony Cr.
Otter Creek
Otter Creek Res.
EAST FORK
SEVIER RIVER
EAST FORK CANAL
TROPIC &
Tropic & East Fork Canal near Tropic 1950-1961. 2,600 A.F. (1950-61)
Sevier River below Piute Dam. 1912-present. 150,000 A.F.
Piute Res.
East Fk. Sevier River near Kingston. 1913-present 55,500 A.F.
Sevier River near Kingston 1915- present. 89,200 A.F.
SEVIER
Junction
Circleville
Sevier River above Clear Cr. -1955 174,200 A.F.
Sevier River near Circleville 1950-present. 101,100 A.F.
RIVER
Puffer Lake
Panguitch
Sevier River at Hatch 1911-28 & 1935-present 83,900 A.F.
Panguitch Creek
Panguitch Lake
Mammoth Creek
Asay Creek
North Creek
South Creek
Indian Creek
Beaver
Minersville Res.
Minersville
Parowan
RIVER
Milford
Big Wash
Cedar City
EXPLANATION
U.S.G.S. Gaging Stations
Name of station
Years of record
Mean annual runoff (1920-62)
5 0 5 10
SCALE OF MILES
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT – UTAH
ULTIMATE PHASE
SEVIER RIVER BASIN
STREAM GAGING STATIONS & RUNOFF
DRAWN .... SUBMITTED ....
TRACED G.W.W. .... RECOMMENDED ....
CHECKED .... APPROVED .... PROJECT MANAGER
PROVO, UTAH MAY 1963 289-418-17

Quality of Water

Quality of water analyses for irrigation are available from publication of the State Engineer (Bulletin No. 10) and the Geological Survey (Chemical Analyses of Surface Waters in Utah, October 1959 to September 1962). Additional quality of water samples are now being collected throughout the drainage basin by the Department of Agriculture, but the analyses are not yet available to the Bureau of Reclamation. A record of chemical analyses is also found in the supporting data.

Water requirements

The Sevier River Basin was divided into areas to facilitate the determination of the theoretical unit irrigation requirements. Climatological data were obtained from Weather Bureau stations at Delta, Panquitch, and Richfield. Stations located in the vicinity of the respective areas were used to determine the length of growing season, frost-free period, effective precipitation, and other data pertinent to the determination of irrigation requirements. Climatological data used are shown in the table on page 59.

Cropping Patterns

The cropping patterns by areas expected to develop under project conditions is shown below.

Sevier River Basin
Cropping patterns anticipated under Central Utah project

Crop	Percent of total		
	Panguitch	Richfield	Delta
Alfalfa (hay)	35	38	11
Alfalfa (seed 1st and 2nd crops)			57
Pasture	53	30	2
Sugar beets		6	5
Corn	2	5	5
Small grain	10	21	20
Total	100	100	100

Diversion Requirements

The derivation of average monthly diversion requirement per irrigable acre for each area at appropriate points of diversion is included in the table on the following page.

Summary of irrigation diversion requirements
Sevier River area

	Panguitch	Richfield	Delta
	Annual requirement (acre-feet per acre)		
	(Based on production acreage)1/		
Consumptive use requirement	1.29	1.85	1.98
Effective precipitation	0.26	0.18	0.16
Ground water contribution			0.44
Irrigation requirement	1.03	1.67	1.38
	(Based on irrigable acreage)		
Irrigation requirement	0.98	1.59	1.31
Farm losses	0.98	1.46	1.07
Farm delivery requirement	1.96	3.05	2.38
Conveyance loss	0.65	0.76	0.42
Diversion requirement2/	2.61	3.81	2.80
	Monthly diversion requirement (acre-foot per acre)		
April			0.12
May		0.41	0.77
June	0.78	0.96	0.69
July	0.89	0.98	0.61
August	0.66	0.89	0.41
September	0.28	0.57	0.14
October			0.06
Total	2.61	3.81	2.80

1/ The productive area is estimated at 95 percent of the irrigable area.
2/ Measured at Sevier River.

Reservoir Evaporation Losses

Reservoir evaporation losses were determined for Piute, Otter Creek, and Sevier Bridge Reservoirs. The evaporation rates of Piute Reservoir were measured for the summer months in most of the years taken into consideration. Winter months and missing records were estimated by correlation with evaporation rates on Utah Lake. All three reservoirs appear to have similar evaporation characteristics. Piute Reservoir evaporation rates were therefore applied to Otter Creek and Sevier Bridge Reservoirs after differences in climatological data were taken into account. It is estimated that Otter Creek's evaporation rates would be 95 percent of the rates at Piute Reservoir, and Sevier Bridge Reservoir would be 105 percent of the Piute Reservoir rates.

Climatological data
Sevier River Basin

Weather station	Mean temperature (°F.)												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Panguitch	22.7	26.7	34.0	42.8	50.1	57.8	64.1	62.7	55.8	45.5	33.6	25.8	43.5
Richfield	28.4	32.7	40.2	48.2	56.5	64.6	71.6	69.9	61.7	50.8	37.7	30.8	49.4
Delta	24.8	31.3	39.3	49.5	58.3	65.9	76.1	74.5	64.3	51.8	36.7	29.9	50.2

Weather station	Mean precipitation (inches)												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Panguitch	0.58	0.57	0.71	0.63	0.61	0.52	1.40	1.51	0.89	0.93	0.48	0.58	9.41
Richfield	.63	.65	.83	.69	.78	.55	.80	.78	.52	.64	.56	.58	8.01
Delta	.56	.59	.89	.83	.83	.67	.24	.41	.38	1.06	.51	.63	7.60

Weather station	Growing season			Frost-free period		
	From	To	No. of days	From	To	No. of days
Panguitch	June 1	September 14	106	June 19	August 29	71
Richfield	May 4	October 1	151	May 27	September 18	115
Delta	April 17	October 21	188	May 7	September 30	147

Estimated evaporation rates at Piute, Otter Creek, and Sevier Bridge Reservoirs are summarized in the following table.

Measured and estimated evaporation rates
Sevier River Basin
(Unit--feet)

Month	Evaporation rate		
	Estimated		Measured and estimated
	Otter Creek 1/	Sevier Bridge Reservoir 2/	Piute 3/
January	0.04	0.04	0.04
February	.05	.06	.05
March	.19	.21	.20
April	.34	.38	.36
May	.48	.54	.51
June	.61	.67	.64
July	.59	.65	.62
August	.50	.56	.53
September	.42	.46	.44
October	.27	.29	.28
November	.09	.10	.10
December	.04	.04	.04
Total	3.62	4.00	3.81

1/ Estimated to be 95 percent of the evaporation rate of Piute Reservoir.

2/ Estimated to be 105 percent of the evaporation rate of Piute Reservoir.

3/ Measured values were taken from climatological data reports of the U. S. Weather Bureau. Missing records were estimated by correlation with the evaporation rates of Utah Lake. Pan evaporation factor of 0.70 was used to convert pan evaporation to lake evaporation.

Water rights

More than 40 court decrees have been rendered on suits concerning water right on the Sevier River system. The three most important ones are entitled "Deseret Irrigation Company and Leamington Canal Company vs. Samuel McIntyre, et al."; "Richfield Irrigation Canal Company, et al. vs. Circleville Irrigation Company, et al."; and "Richlands Irrigation Company, Inc. vs. Westview Irrigation Company, Inc., et al." A decree of the first mentioned case was rendered by Judge E. V. Higgins in 1901 and on the second by Judge C. W. Morse in 1906. These two decrees were largely the result of stipulations between committees and representatives of water users. The third case has come to be known as the Cox Decree and was rendered November 30, 1936.

The Cox Decree is a result of an adjudication of the Sevier River system and takes into full consideration the previous decrees, agreements, stipulations, statements of claims, the survey of records and files, and an examination by the State Engineer and the Court. Prior to the completion of the Cox decree, the State prepared a "Proposed Determination of Water Rights on the Sevier River System" and submitted it to the Court for use in the case. The State Engineer's proposed determination of water rights contains a tabulation of rights to February 1926. Except for storage rights decreed to the Piute Reservoir and Irrigation Company and the Sevier Bridge Reservoir Company, the Cox Decree divided the Sevier River system into two zones, A and B. This was done for the more efficient distribution and use of the water. Zone A included all rights above the dam of the Vermillion Canal Company situated in Sevier County, and Zone B included all rights below the dam of the Vermillion Canal Company. The two zones are independent as far as primary, second class, third class, and fourth class rights are concerned. Zone A has no commitments to bypass water within their direct flow rights to Zone B.

The priority of the primary rights along the river in Zone A starts at the head of the river and proceeds downstream by reaches to Vermillion Dam. Each canal in a reach receives a prorated share up to its water right of the water available. The second, third, and fourth class rights are filled after all primary rights are filled and the priorities start at Vermillion Dam and proceed upstream by reaches. No third class rights receive water until all second class rights are filled, and no fourth class rights receive water until all third class rights are filled.

Any water in excess of direct flow rights is termed "summer storage water" which, together with the "winter storage water" in excess of stock watering requirements, makes up the storable flows. This water is subject to distribution between Piute Reservoir and Sevier Bridge Reservoir. This distribution is outlined on page 186 of the Cox Decree. Any of the stockholders of Piute Reservoir can, if they so desire, store their summer flows in Piute Reservoir. This water, however, cannot be carried over from year to year because the decree states that if there is any such water in the reservoir on October 1 it becomes summer storage water and is to be distributed between Sevier Bridge Reservoir and Piute Reservoir. The quantity of storable winter and summer flows is determined monthly so that each reservoir will have its rightful storage under any runoff pattern.

Chapters II, III, and IV of the Cox Decree cover the rights of the independent users which do not divert directly from Sevier River.

Water rights in the San Pitch River Basin are also defined in the 1936 Cox Decree. Recent litigation includes the San Pitch River Basin; however, the State Engineer has not published notices calling for statements of water users' claims. The adjudication is to update the 1936 decree and define any additional water rights acquired since the decree was issued.

Since the San Pitch River Basin receives water from the San Rafael and Price River Basins, it is affected by pending general water right adjudication proceedings in those basins.

Essentially all surface water in the San Pitch Basin is presently appropriated. Only during periods of exceptionally high runoff does San Pitch River water reach the Sevier River, and then it is required to meet downstream rights. Most of the applications filed since 1936 have been made to appropriate ground water for domestic use or for supplemental irrigation.

Price River Basin

Water resources

The Price River Basin water sources are also presented in detail in the Price and San Pitch River Basins report of December 1964. Only a summary of the resources is included in this chapter.

The watershed of the Price River Basin ranges from 5,500 feet to 12,300 feet above mean sea level and is characterized by glaciated mountain slopes, steep canyons, a relatively impervious bedrock, and a comparatively shallow soil mantle. Consequently the runoff is rapid, contributing to occasional destructive floods and wide seasonal fluctuations in streamflow. Runoff reaches its high stages in May or June, falls off rapidly, and is quite low in the late summer months.

The Geological Survey has maintained streamflow gaging stations at a number of locations within the Price River basin. Flows at these stations were used along with snow survey data to estimate flows at other locations. A summary of streamflow is found in the table on the following page, and the Map on page 64 gives the location of the gaging stations within the drainage area. Records of streamflow and canal diversions by months are included in the supporting data.

Quality of Water

Price River water samples collected by the Geological Survey, the State Engineer, and the Bureau of Reclamation indicate that the water from the headwaters downstream to the Carbon Canal heading below Helper is of good quality for irrigation. Below this point, however, the base flow consists principally of return flow, and the high dissolved solids concentration limits its use to the high salt tolerant crops. Results of the analyses of the samples are found in the supporting data.

Below the confluence of the Price River and Gordon Creek and after the point of major diversion, the instream water is unfit in terms of quality for municipal purposes and for industrial purposes, except perhaps for coal washing and cooling.

Summary of stream gaging data
Price River Basin
(Unit - 1,000 acre-feet)

Gaging station	Drainage area (sq. mi.)	Period of record 1/	Average recorded flow	Ann
				Average
Gooseberry Creek near Fairview	8	1960-62	6.2	2/7.8
Gooseberry Creek near Scofield	16	1931, 1941-62	13.5	2/13.6
Price River above Scofield Reservoir near Scofield	62	1931-32 (frag.), 1939-62	32.9	2/33.9
Price River near Scofield	163	1944-62	50.4	3/51.9
Price River near Soldier Summit	53	1938-39 (frag.), 1940-62	13.9	2/14.4
Price River near Heiner	455	1935-62	79.2	5/86.5
Price River near Helper	530	1905-06, 1908-34	104.4	4/91.2
Price River near Wellington	850	1950-58	54.6	-
Price River at Woodside	1,500	1909 & 1911 (frag.) 1910, 1947-62	70.7	-
Green River at Green River	40,600	1895-98, 1904-62	4,709.3	2/4,359.8

1/ Water year; does not include records after 1962.
2/ Historical flow.
3/ Past modified flow.
4/ Historical flow record of average annual runoff for period 1920-34 only.
5/ Past modified flow plus or minus the change in content of Scofield Reservoir plus estimated

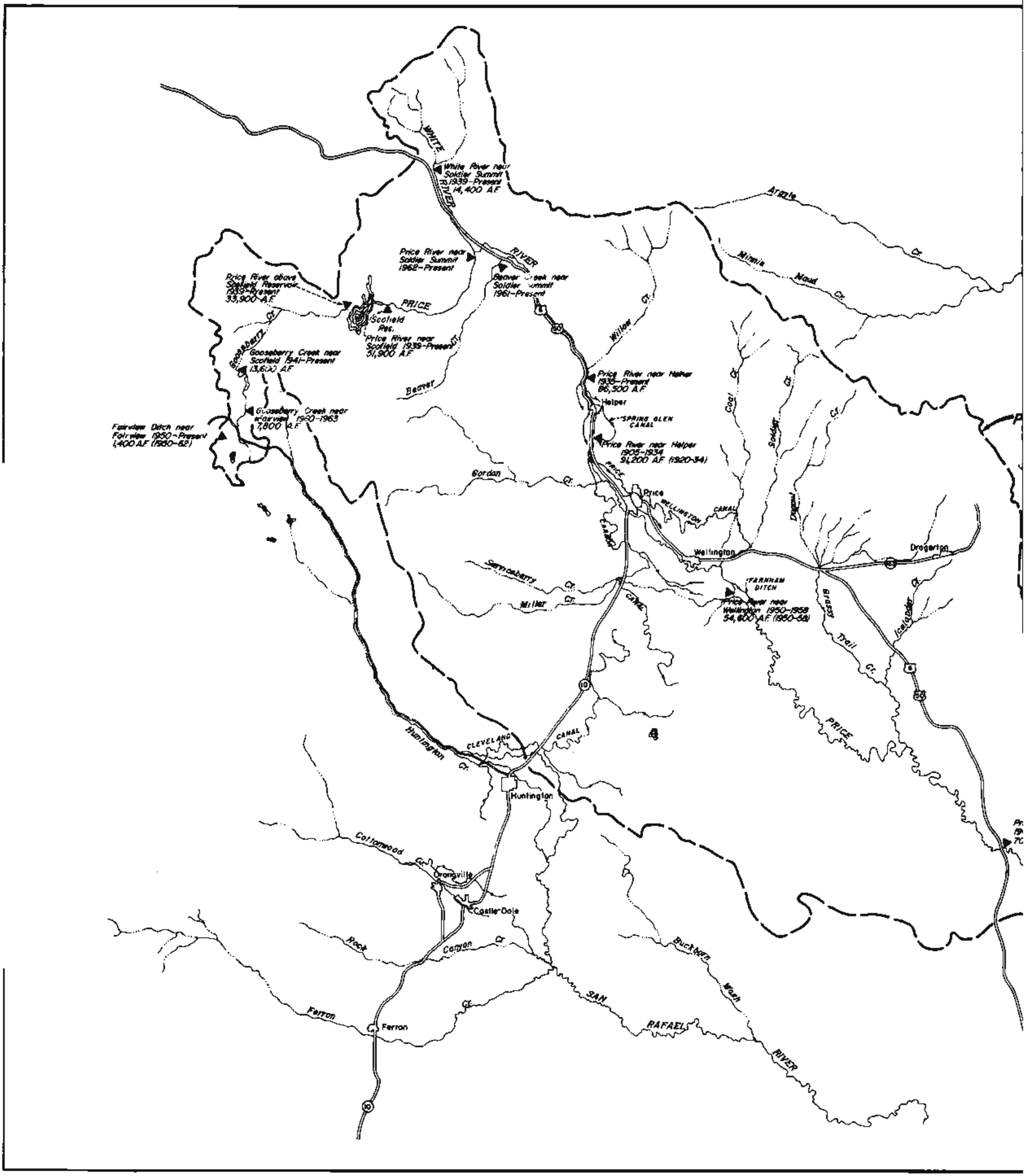
Note: Historical flow is the flow actually experienced at a gaging station or point of measurement. area above the point of measurement as influenced by nature and the activities of man. It ma
Past modified flow is the historical and/or natural flow corrected to show for the period of they existed at the beginning of the period of study.
Present modified flow is the historical and/or natural flow corrected to show the effect of t they had existed over the period of study.

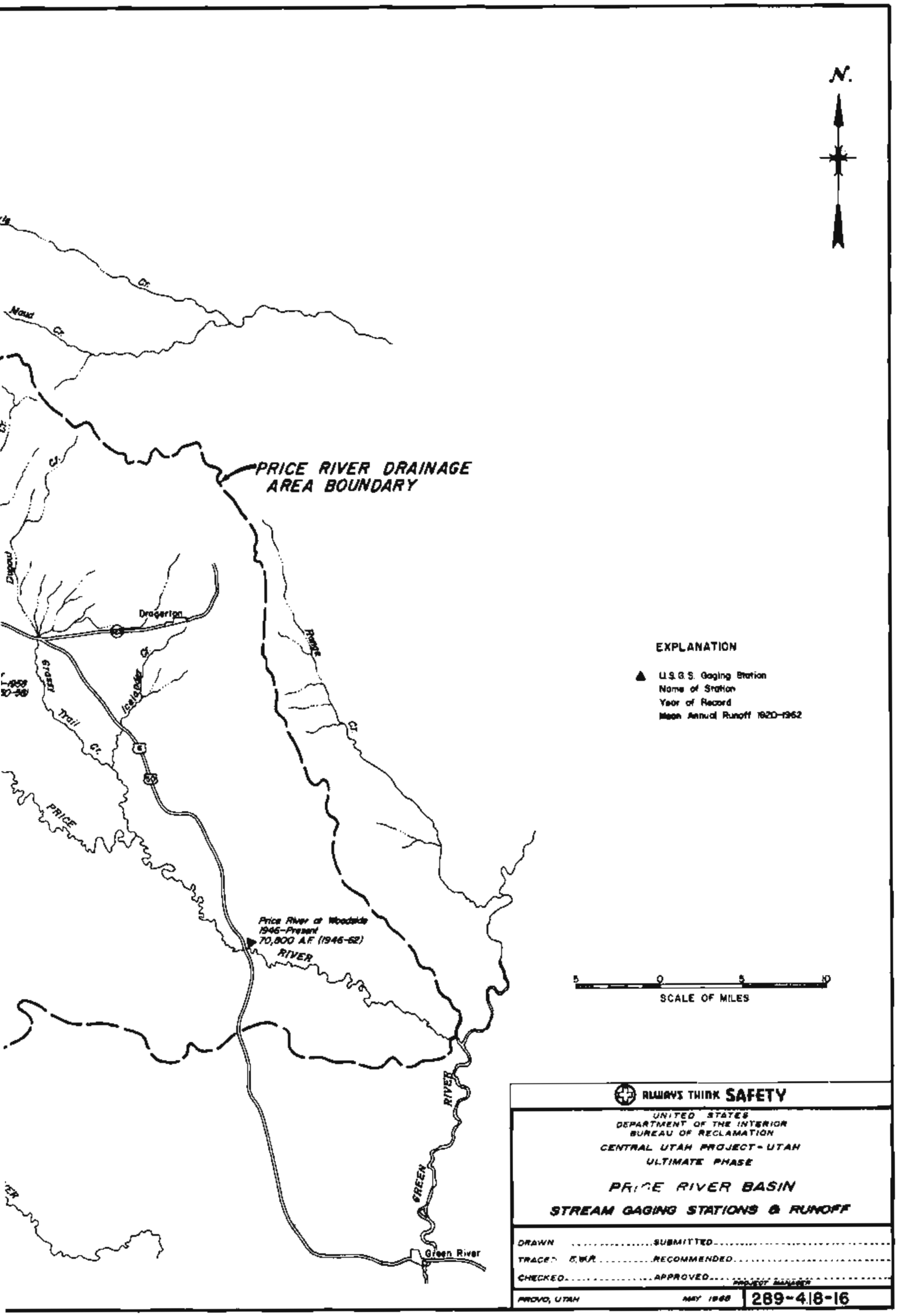
gaging data
Basin
re-feet)

Average recorded flow	Annual runoff for period of study (1920-62)				
		Minimum		Maximum	
	Average	Year	Quantity	Year	Quantity
6.2	2/7.8	1961	3.1	1952	17.4
13.5	2/13.6	1961	5.4	1952	29.5
32.9	2/33.9	1961	10.8	1952	78.0
50.4	3/51.9	1961	16.4	1952	124.3
13.9	2/14.4	1934	6.2	1952	333.3
79.2	5/86.5	1961	20.9	1952	252.9
104.4	4/91.2	1934	26.4	1952	198.3
54.6	-	1956	15.5	1952	208.8
70.7	-	1960	23.4	1952	247.8
4,709.3	2/4,359.8	1934	1,306.6	1921	7,206.0

34 only.
d Reservoir plus estimated evaporation from Scofield Reservoir.
n or point of measurement. It is the total runoff of a drainage
activities of man. It may be recorded or estimated.
to show for the period of study the man-made developments as

ed to show the effect of the present man-made developments if


WHITE RIVER
White River near Soldier Summit 1939–Present 14,400 A.F.
Argyle Cr.
Minnie Maud Cr.
Price River near Soldier Summit 1962–Present
RIVER
Beaver Creek near Soldier Summit 1961–Present
Price River above Scofield Reservoir 1939–Present 33,900 A.F.
PRICE
Scofield Res.
Price River near Scofield 1939–Present 51,900 A.F.
Gooseberry Cr.
Gooseberry Creek near Scofield 1941–Present 13,600 A.F.
Beaver Cr.
Willow Cr.
Price River near Helper 1935–Present 86,500 A.F.
Helper
SPRING GLEN CANAL
Gooseberry Creek near Fairview 1960–1963 7,800 A.F.
Fairview Ditch near Fairview 1950–Present 1,400 A.F. (1950-62)
Price River near Helper 1905–1934 91,200 A.F. (1920-34)
Coal Cr.
Soldier Cr.
Gordon Cr.
PRICE
Price
WELLINGTON CANAL
Carbon
Wellington
Dragerton
Serviceberry Cr.
Miller Cr.
FARNHAM DITCH
Price River near Wellington 1950–1958 54,600 A.F. (1950-58)
Grassy Trail Cr.
Icelander Cr.
CANAL
PRICE
Huntington Cr.
CLEVELAND CANAL
Huntington
Cottonwood Cr.
Orangeville
Castle Dale
Rock Canyon Cr.
Ferron Cr.
Ferron
SAN RAFAEL RIVER
Buckhorn Wash


N.
PRICE RIVER DRAINAGE AREA BOUNDARY
Dragerton
Grassy Trail Cr.
Icelander Cr.
Range Cr.
Naud Cr.
Cr.
PRICE
RIVER
Price River at Woodside
1946-Present
70,800 A.F. (1946-62)
GREEN RIVER
Green River
EXPLANATION
U.S.G.S. Gaging Station
Name of Station
Year of Record
Mean Annual Runoff 1920-1962
5 0 5 10
SCALE OF MILES
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT - UTAH
ULTIMATE PHASE
PRICE RIVER BASIN
STREAM GAGING STATIONS & RUNOFF
DRAWN .... SUBMITTED ....
TRACED E.W.R. .... RECOMMENDED ....
CHECKED .... APPROVED ....
PROJECT MANAGER
PROVO, UTAH
MAY 1966
289-418-16

Water requirements

Consumptive use requirements for the Price River Basin were developed by the Soil Conservation Service. Farm irrigation efficiencies and conveyance efficiencies computed by the Bureau of Reclamation for the Emery County project were used for the Price River area where applicable. The irrigation diversion requirements developed under these criteria are summarized in the following table.

Summary of irrigation diversion requirements
Price River Basin

	Annual requirement (acre-feet per acre) (based on productive acreage)1/
Consumptive use requirement	2.24
Effective precipitation	.20
Irrigation	2.04
	(Based on irrigable acreage)
Irrigation requirement	1.94
Farm losses	1.79
Farm delivery requirement	3.73
Conveyance loss	.67
Diversion requirement	2/4.40

	Monthly diversion requirement (acre-feet per acre)
April	0.15
May	.62
June	1.14
July	1.14
August	.76
September	.48
October	.11
Total	4.40

1/ The productive area is estimated at 95 percent of the irrigable area.

2/ Measured at Price River.

Reservoir Evaporation Losses

To determine the net water available for project use, reservoir evaporation losses were determined for Scofield Reservoir. The evaporation rates for Scofield Reservoir were measured by a Class A Weather Bureau evaporation pan operated at Scofield Dam during the summer months and estimated for the winter months. The average evaporation rates are summarized as follows.

Evaporation rate--Scofield Reservoir

Month	Evaporation rate (feet)
January	0.01
February	.01
March	.08
April	.18
May	.35
June	.48
July	.51
August	.42
September	.33
October	.23
November	.05
December	.01
Total	2.66

Water rights

Decreed Rights on Price River

Water rights on Price River and tributaries were adjudicated in the Seventh Judicial District Court of Utah in 1902 and 1910, with a correction issued in 1914. The combined effect of these decrees is a listing of rights by classes according to priorities, with the primary right being first class. The irrigation rights are defined in terms of acres irrigated and specify a duty of 1 second-foot for each 60 acres. The decrees provide that the various classes of rights are entitled to the water shown in the decree and that none of the secondary classes are entitled to water until the requirements of the preceding classes have been fully satisfied.

The total rights decreed directly from Price River by classes for irrigation and industrial use are summarized in the following table.

Class	Irrigation		Industrial	Total
No.	Acres	Sec.-ft.	(sec.-ft.)	(sec.-ft.)
1	4,137.5	68.95	2.094	71.04
2	854.0	14.23	.70	14.93
3	4.0	.07	.24	.31
4	7.0	.11	.24	.35
5	22.0	.37		.37
6	6.0	.10		.10
7	6.0	.10	.228	.33
Total	5,036.5	83.93	3.502	87.43

Many tributaries to Price River were included in the "First," "Second," and "Not Classified" classes of rights from the decree. There is one known right initiated by use prior to the decree but not mentioned therein. This is a diligent use of the Gooseberry-Cottonwood Irrigation Company of

Fairview, Sanpete County. Under this right the company maintains a 1,900 acre-foot reservoir on the headwaters of Gooseberry Creek and diversion works through which reservoir water and divertible natural flows of Gooseberry Creek are diverted out of Gooseberry Creek Basin. The transbasin diversion right was recently determined to be 3,020 acre-feet annually by a decree of the District Court; however, the Price people have served notice that they will appeal to a higher court to have the amount reduced.

Tripartite Contract

The Tripartite Contract was executed between the United States of America, the Carbon Water Conservancy District, and the Price River Water Conservation District on October 11, 1943. The principal purposes of the contract were to define the relative application rights of the three parties to the waters of the Price River system, to agree to the construction of a new dam to replace the unsafe original Scofield Dam built by the Price River Water Conservation District, to convey to the United States certain rights-of-way and interests in reservoir lands, and to define the size of the land holdings and the price at which land may be sold.

Included in the contract were provisions allowing the United States to build storage and diversion works on the Price River system at a point or points above the confluence of Cabin Hollow Creek and Gooseberry Creek for use within or outside of the Price River Basin.

The water users in the Price River Basin have vigorously opposed any action which might lead to the export of water out of the basin. The State Engineer is presently taking the lead in negotiating an agreement between the Sanpete County interests and the Price River interests regarding the diversion and use of water.

CHAPTER IV

GROUND WATER

Introduction

This chapter contains an inventory of ground water as a source of existing water and a potential water supply for the Central Utah project. Ground water consists of water occurring below the ground surface in confined or unconfined water-bearing strata. Some ground water has been used in Utah for many years for irrigation, municipal, and industrial purposes. Overdevelopment of ground water in some areas has resulted in the restriction of use due to the lowering of the water table. High development costs and infringement on existing water rights have discouraged extensive ground water development. Use has been restricted primarily to areas of inadequate surface streamflow and areas of economically accessible ground water.

Detailed ground water investigations have not been completed for the areas of the ultimate phase. Some reconnaissance data are available for portions of the area; however, no firm interpretations have been made of these basic data. Thus detailed studies will be required prior to the formulation of a definite project plan to determine the amounts of ground water available in each area, the rate at which it can be withdrawn, and the relationship between ground water and other sources of supply.

Overdevelopment of ground water results in a reduction of water tables, a decrease in the quality of water, and an increase in development costs. Lowering of water levels also involves additional costs. The trend of local court decisions regarding well interference is that the new developments assume the cost of replacement water or of increased pumping lifts to existing wells. Pumping lifts of new wells also become significantly greater as development progresses. Full development of ground water would necessitate the use of poorer quality water that may involve desalinization for culinary and many industrial uses. Equalization of pressures must be maintained between areas to prevent the migration of poorer water into better water areas. Shallow ground waters are generally of lower quality and more expensive to recover.

Ground water recharge is essential to assure a supply for continued usage. Water tables are recharged primarily from infiltration of precipitation, seepage from surface waters and streams, and from irrigation. Extensive population development and industrial expansion, such as along the Wasatch Front, cause a reduction in ground water recharges from all three of these major sources. Thus available ground water for development in the Wasatch Front area is actually decreasing rather than increasing.

Estimates of ground water shown in this report have been taken primarily from published papers or reports of other agencies. These estimates, although often optimistic, are used since they are the only ones available and they must be subsequently substantiated by adequate investigations. Detailed ground water investigations will continue for the project area and will be incorporated in the plan formulation estimates on a continuing basis as they become available throughout the planning period.

Wasatch Front Summary

The areas along the Wasatch Front are the most significant in the ultimate phase, both from the standpoint of present ground water use and of potential development. Thus a summary of these areas is presented for ready reference.

Approximately 65,000 acre-feet of ground water could be developed in the Wasatch Front areas in addition to the 215,000 acre-feet that are now withdrawn. The additional development, however, would involve a major reduction of water levels and the utilization of ground water of substandard quality with accompanying higher development costs. Most of this unused ground water, amounting to about 50,000 acre-feet, would be obtained from Jordan Valley. The natural ground water discharge in Utah and Juab Valleys is largely tributary to the overexploited surface water resource; thus most of the ground water is fully appropriated. It was assumed that about 5,000 acre-feet could be salvaged in Goshen Valley and about 10,000 acre-feet in Utah Valley between Utah Lake and Jordan Narrows.

The following table is a summary of the existing wells along the Wasatch Front with withdrawals for 1963 and 1964 and the potential increase that may be developed. The estimated increases are average annual yields subject to variations necessary to provide carryover storage for use in drought periods.

Ground water summary--Wasatch Front

Area	Approximate no. wells as of Dec. 1962 1/	No. wells completed in 1963 (diameter) Less than 6 in.	More than 6 in.	Withdrawals from wells 1963 1/ (ac.-ft.)	1964 2/ (ac.-ft.)	Reconnaissance appraisal of potential increase (ac.-ft.)
Jordan Valley	9,000	24	19	110,000		50,000
Northern Utah Valley	3,000	6	7	50,000	47,000	10,000
Southern Utah Valley	1,600	13	14	25,000	20,000	0
Goshen Valley				11,000	9,200	5,000
Northern Juab Valley	120	0	1	17,000	16,000	0
Total				213,000		65,000

1/ Data taken from Cooperative Investigation Report No. 2 by Utah Water and Power Board and USGS.

2/ Advanced data received from USGS by telephone.

Discussion by areas

The ground water discussion is presented by individual valleys or areas as shown on the map on the following page. Most of the published ground water information is contained in basic data reports by the U.S. Geological Survey. Information presented, when available, includes past investigations, major problems of ground water development, water quality, and preliminary estimates of perennial ground water yields.

Jordan Valley

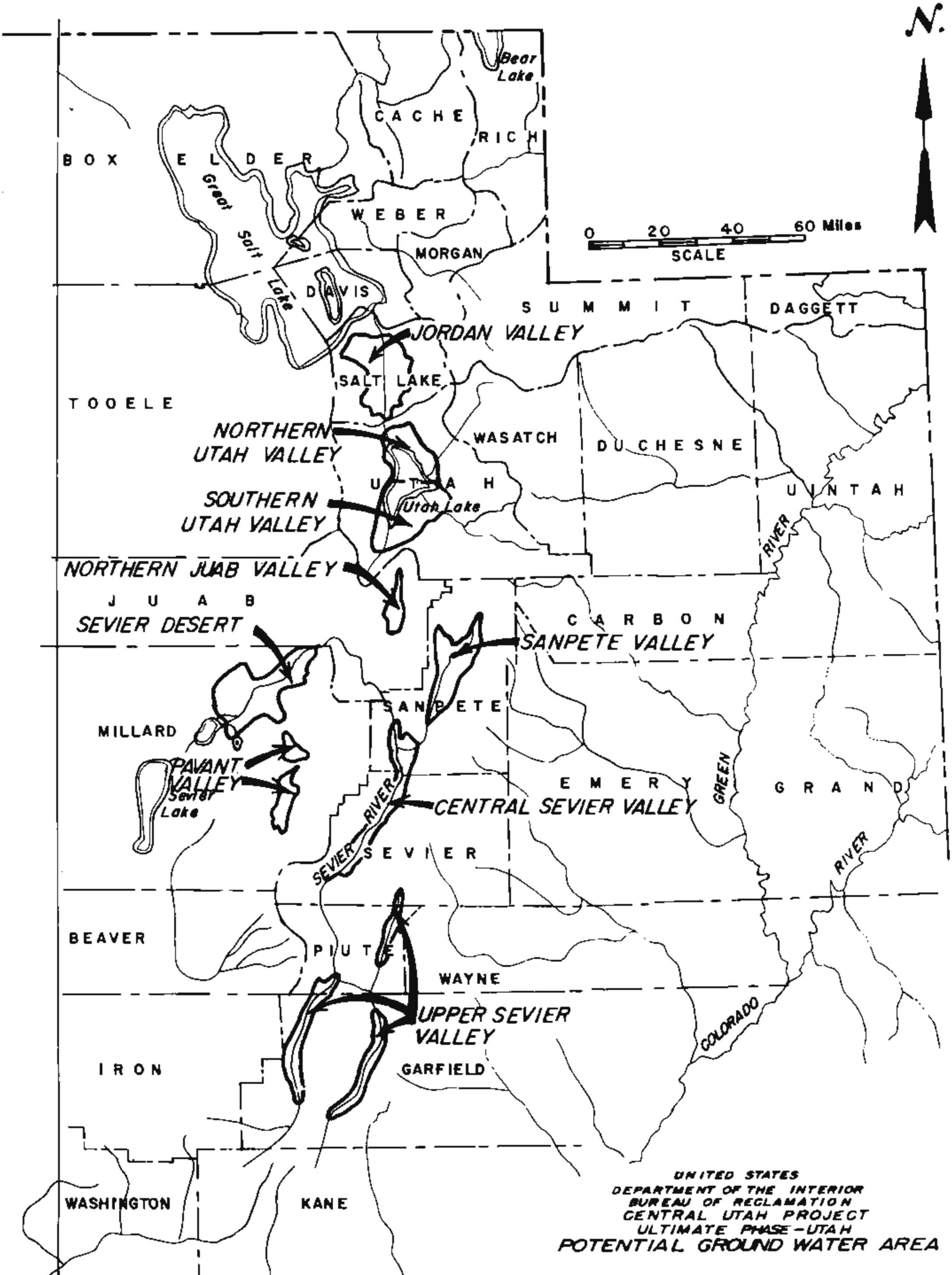
Jordan Valley occupies the central part of Salt Lake County and is drained by Jordan River. For report purposes the valley has been divided into six ground water districts as follows: East Bench, East Lake Plains, Cottonwoods, Southeast, West Slope, and Northwest Lake Plainsdistricts. Some of these districts are further divided into subdistricts as shown on the map on page 72.

About 9,000 wells are being operated in Jordan Valley, and in 1963 the discharge totaled approximately 110,000 acre-feet. The 1963 estimated well discharge is summarized below by districts for various uses.

Ground water discharge--Jordan Valley
(Unit--acre-feet)

Use of water	East Bench district	East Lake Plains district	Cottonwoods district	Southeast district	West Slope district	Northwest Lake Plains district	Total (rounded)
Industry	789	3,659	1,500	87	25	31,000	37,100
Public supply	5,232	4,023	15,600	300	641	2,898	28,600
Irrigation	1,350	0	1,300	100	4,251		7,000
Air conditioning	200	700	0	20			900
Domestic and stock, and fish and fur culture	100	10,000	12,000	100	5,000	10,000	37,200
Total (rounded)	7,700	18,400	30,400	600	9,900	43,900	110,000

Water level trends from 1952 to 1963 indicate that the discharge in three of the ground water districts (Cottonwoods, Southeast, and West Slope) exceeded the recharge. Smaller declines in other districts suggest that discharges and recharges are more nearly in equilibrium.


N.
0 20 40 60 Miles
SCALE
BOX ELDER
CACHE
RICH
Bear Lake
Great Salt Lake
WEBER
MORGAN
DAVIS
SUMMIT
DAGGETT
JORDAN VALLEY
SALT LAKE
TOOELE
NORTHERN UTAH VALLEY
WASATCH
DUCHESNE
UTAH
Utah Lake
SOUTHERN UTAH VALLEY
UINTAH
RIVER
NORTHERN JUAB VALLEY
JUAB
SEVIER DESERT
CARBON
SANPETE VALLEY
SANPETE
MILLARD
PAVANT VALLEY
Sevier Lake
EMERY
GREEN
GRAND
SEVIER RIVER
CENTRAL SEVIER VALLEY
SEVIER
RIVER
BEAVER
PIUTE
WAYNE
UPPER SEVIER VALLEY
IRON
GARFIELD
COLORADO
WASHINGTON
KANE
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE-UTAH
POTENTIAL GROUND WATER AREA

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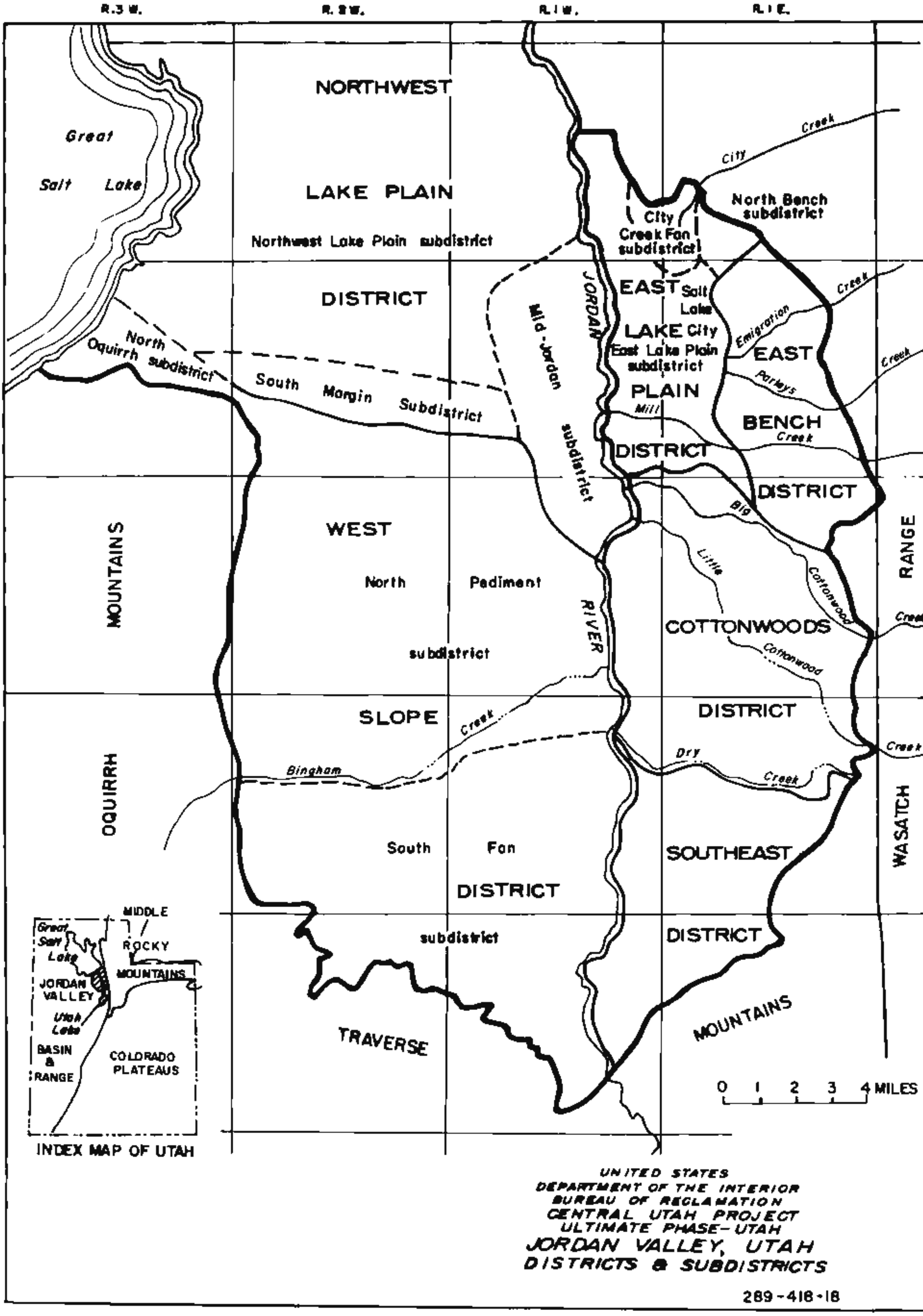

R.3 W.
R.2 W.
R.1 W.
R.1 E.
T. 1 N.
T. 1 S.
T. 2 S.
T. 3 S.
T. 4 S.
Great Salt Lake
NORTHWEST
LAKE PLAIN
Northwest Lake Plain subdistrict
DISTRICT
North Oquirrh subdistrict
South Margin Subdistrict
Mid-Jordan subdistrict
JORDAN RIVER
City Creek
City Creek Fan subdistrict
North Bench subdistrict
EAST Salt Lake City
LAKE
East Lake Plain subdistrict
PLAIN
DISTRICT
Emigration Creek
EAST
Parleys Creek
BENCH
Mill Creek
DISTRICT
Big Cottonwood
Little Cottonwood
COTTONWOODS
Cottonwood
DISTRICT
Creek
WEST
North Pediment
subdistrict
SLOPE
Creek
Bingham
Dry Creek
Creek
South Fan
DISTRICT
subdistrict
SOUTHEAST
DISTRICT
MOUNTAINS
OQUIRRH
MOUNTAINS
RANGE
WASATCH
TRAVERSE
MOUNTAINS
0 1 2 3 4 MILES
Great Salt Lake
JORDAN VALLEY
Utah Lake
MIDDLE ROCKY MOUNTAINS
BASIN & RANGE
COLORADO PLATEAUS
INDEX MAP OF UTAH
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE-UTAH
JORDAN VALLEY, UTAH
DISTRICTS & SUBDISTRICTS
289-416-18

Data on both the piezometric surface and on the chemical quality of water indicate that the Cottonwoods district supplies a major part of the ground water to the East Lake Plains district and Mid-Jordan subdistrict. Thus, a decline of water levels in the Cottonwoods district will eventually affect the East Lake Plains district and the Mid-Jordan subdistrict. These aforementioned districts yield the best quality water in Jordan Valley; consequently, they are among the most heavily developed districts at the present time.

An estimate of the additional ground water that can be developed in Jordan Valley without respect to quality of water can be made based on the average annual ground water inflow of 180,000 acre-feet into the Jordan River. It is significant that only a part of the ground water originates from the aquifers that are possible of economic development; namely, the deep, generally confined aquifers.

The developable portion of this inflow is estimated as follows. The inflow as indicated by the variation of the chemical quality of water along the Jordan River and its tributaries is largely from the shallow water tables. The recharge to the shallow water tables is from precipitation and irrigation and canal seepage. This recharge occurs on the valley areas exclusive of the deep water table areas which recharge the confined (artesian) aquifers. The shallow water table recharge area is about 208,000 acres (269,000 minus 61,300--total valley area minus the area of deep water table). Assuming an average of 12 inches of precipitation during the nongrowing season and a 25 percent infiltration factor, the recharge to the shallow water tables from precipitation is 208,000 x 12/12 x 0.25 = 52,000 acre-feet, rounded to 50,000 acre-feet.

The recharge to the shallow water tables from the irrigation of 50,000 acres of land and from canal seepage is estimated by assuming the deep percolation losses and canal seepage to be 30 percent of the quantity diverted (4 acre-feet per acre). Thus, 50,000 x 4 x .30 = 60,000 acre-feet.

As indicated by the foregoing computations, the total annual ground water inflow to the Jordan River originating from the shallow water tables would be 110,000 acre-feet. This leaves about 70,000 acre-feet originating from deep ground water sources, including an indeterminate amount of underflow through the Jordan Narrows and saline water rising along fault zones. Some part of this 70,000 acre-feet, however, could presumably be salvaged from wells by lowering the water levels drastically so as to curtail this leakage. It is assumed that 50,000 acre-feet could be recovered.

A large part of the water thus salvaged would be of poorer quality than that presently developed. This can be expected because the high quality areas have now been subjected to more extensive development and are nearing the limit compatible with the long-term sustained yield.

It will, therefore, be necessary in the future to exploit the areas yielding a poorer quality of water. Also, as the valley approaches full development, the water level must be lowered in those aquifers with poorer quality water to control migration of the poorer quality water and consequent deterioriation of the better quality water. Therefore, the ultimate development of ground water on a firm sustained yield basis will involve increasingly greater costs because of the requirement for desalinization. Other physical factors will also increase costs, such as higher pumping lifts resulting from lowered water levels and the necessity to utilize less competent aquifers, requiring greater drawdown to produce a unit of water.

A reduction of recharge to the deep aquifers will occur and, in fact, has already taken place to some extent because of the urbanization of the recharge areas. The infiltration characteristics of these recharge areas, located on the high Lake Bonneville and Provo benches, are being changed by the construction of houses and paved streets, driveways, walks, etc. The resulting reduction in infiltration from precipitation has already been great enough to cause serious storm runoff control problems in the urban areas of Salt Lake County.

The entrant streams of Jordan Valley are as yet unregulated, and when future storage is provided and increased surface flow diversions are made above the mouths of the canyons, the recharge to the deep aquifers will be further reduced by reducing the flow of these streams over the recharge zones. This forthcoming reduction in recharge has not been taken into account in the foregoing estimate of available ground water.

The legal aspects should be considered in the planning of any large-scale ground water development. Two categories of problems are involved. One concerns the right of an appropriator to pressure or water level. The second is concerned with the situation where ground water is tributary to fully appropriated surface streams and to springs.

The courts in Utah have leaned toward recognizing a right to pressure or water level as a part of the right to a given quantity of water. This doctrine places a serious block in the way of any large-scale ground water development in an area such as Jordan Valley. More than 95 percent of the total wells in Jordan Valley are small wells of less than 6 inches in diameter, many of which are flowing wells. About 125 are large-diameter wells that produce about two-thirds of the 110,000 acre-feet now discharged by wells.

A large-scale ground water development made over a period of a few years would cause a drastic lowering of water tables in the presently heavily developed areas. This would bring about considerable litigation that could delay the project and greatly increase its cost if the courts find that replacement and damages were justified.

Northern Utah Valley

A 60 percent increase in well discharge in northern Utah Valley has been shown during the 16 years ending in 1964. During this period the water levels have declined from 5 to 15 feet, which may be attributed in part to the increased well discharge since the precipitation has been only slightly below normal. Ground water withdrawals in northern Utah Valley and the purposes of use are tabulated below for the past 3 years.

Ground water withdrawals
(Unit--acre-feet)

Use	1962	1963	1964
Irrigation	= 35,000	1/36,000	29,600
Industrial	= 7,000	9,800	9,000
Public supply	= 5,000	3,300	5,200
Domestic, stock, and irrigation	= 1,200	2/400	2,500
Total (rounded)	49,000	50,000	47,000

1/ Includes some stock and domestic use.
2/ Includes only domestic use.

Considerable hydrologic evidence indicates that the natural ground water discharge in most of northern Utah Valley is tributary to Utah Lake and the Jordan River. The waters of Utah Lake and the Jordan River are fully appropriated, and the ground water discharge into Utah Lake is thus, in effect, fully appropriated.

Additional ground water development would further lower the ground water levels and reduce the natural ground water discharge into Utah Lake. A general reduction in these water levels in the vicinity of Utah Lake of 10 to 60 feet would, depending upon the locality and the depth of aquifer, lower the piezometric surface below the level of the lake and halt ground water discharge into the lake.

Some evidence suggests ground water underflow from Utah Valley to Jordan Valley under the Jordan Narrows, but the existence of any substantial underflow has not been conclusively demonstrated. Further investigations will be made to determine if a flow exists.

It is possible that ground water could be developed in Utah Valley between Utah Lake and the Jordan Narrows without depleting Utah Lake. The piezometric surfaces in this part of the valley suggest that the ground water discharges into the Jordan River above the Narrows and possibly some flows under the Narrows. It may be possible to intercept this water before it reaches the area of pollution with saline water and salvage that portion that enters Jordan Valley. It is assumed for this study that about 10,000 acre-feet might be developed from this portion of Utah Valley.

Southern Utah Valley

Southern Utah Valley is considered to include the Springville-Santaquin district and the Goshen district to conform with published U.S. Geological Survey literature and data.

Springville-Santaquin district.--The amount of ground water withdrawals in the Springville-Santaquin district and its use for the years 1963 and 1964 are shown below. Records of use for previous years are not available for this district.

Use	(Unit--acre-feet) 1963	1964
Irrigation	10,400	8,100
Industrial	400	600
Public supply	800	900
Domestic, stock, and irrigation	13,400	10,100
Total (rounded)	25,000	20,000

The ground water level trends in this district appear to be largely influenced by precipitation which would indicate that recharge and discharge are about at equilibrium. The piezometric surface contours indicate that the ground water moves toward Utah Lake. It would thus appear that the natural ground water discharge from the deep (confined) aquifers must be into Utah Lake. Ground water development would thus cause some depletion of the water supply of the lake.

A number of fresh water spring areas occur at locations distant from the lake, which springs are supplied by natural ground water discharge. These springs would be reduced by additional ground water development. The spring flows are used for irrigation with the surplus flows entering the lake largely during the nonirrigation season.

Ground water in the Springville-Santaquin district cannot be considered as a source of new water, and therefore it offers no potential for large-scale ground water development. Some quality of water problems would also develop with a major increase in ground water production.

Goshen district.--A considerable expansion of ground water production has occurred in this district since 1962. Records are available in the Goshen district of ground water withdrawals and use for 1963 and 1964 as follows.

Use	(Unit--acre-feet) 1963	1964
Irrigation	10,800	9,200
Industrial	30	30
Public supply	10	10
Domestic, stock, and irrigation	140	140
Total (rounded)	11,000	9,400

Long-term water level records are not available in this district. Therefore, the general ground water trends are not known. The ground water contours indicate, however, that pumping is producing a ground water trough which in turn indicates a significant decline of water levels has been caused by this short period of pumping.

The ground water contours indicate a flow toward Goshen Bay. Some evidence indicates that this lakeward flow is being largely dissipated in the valley bottom by evapotranspiration. Studies in progress indicate that 4,000 to 8,000 acre-feet may be presently discharged via this route. It is possible that some part of this loss could be salvaged. Water level records are too short, and the present extensive development has not been in operation long enough to show a definite trend. Although it is possible that the capacity of the present development is already approaching this limiting discharge, it is assumed for this study that 5,000 acre-feet remain to be developed and that there is no significant leakage into the lake.

The water being produced varies in chemical quality from well to well. Much of it is not suitable for domestic use but is being used for irrigation and stock water. A strong possibility exists that if the recharge is exceeded the quality will deteriorate. Two factors would contribute to this deterioration. One is the probability of recirculation because of the essentially unconfined state of the aquifer which will allow recharge from irrigation deep percolation. The second is the possibility of drawing water in from the aquifers under the valley floor which produce a poor quality of water.

Northern Juab Valley

The discharge from wells in the northern Juab Valley ranged from 800 acre-feet in 1951 to 17,000 acre-feet in 1963. Bureau of Reclamation studies made in connection with the 1964 Bonneville Unit Definite Plan Report included a reconnaissance inventory of ground water pumpage for the period 1951 to 1961. These ground water withdrawals were tabulated separately for the Nephi fan and Mona areas and are summarized below. This pumped water represents about 80 to 90 percent of the total ground water withdrawals used for irrigation.

(Unit--acre-feet)

Year	Nephi fan area	Mona area	Total
1951	800		800
1952	800		800
1953	800		800
1954	5,400		5,400
1955	4,600	1,000	5,600
1956	4,800	1,800	6,600
1957	2,700	1,300	4,000

(Unit--acre feet)(Continued)

Year	Nephi fan area	Mona area	Total
1958	3,900	1,800	5,700
1959	7,900	2,100	10,000
1960	9,500	2,000	11,500
1961	11,300	1,800	13,100

The U.S. Geological Survey inventory of combined pumpage from about 120 wells in northern Juab Valley during 1963 and 1964 is shown below. More than 80 percent of the wells discharge less than 10 gallons per minute.

	(Unit--acre-feet)	
Use	1963	1964
Irrigation	17,000	15,500
Industrial		50
Public supply		
Domestic and stock	100	100
Total (rounded)	17,000	16,000

The water levels have shown a decline since 1951 in spite of above normal precipitation. This decline results from increased pumping, particularly in the Nephi fan area as shown in the above tabulation. Natural ground water discharge is from springs and evapotranspiration. The largest natural discharge is from springs at Burraston Pond which provide the principal source of supply for the Mona Reservoir.

For all practical purposes it appears that the ground water resources in northern Juab Valley are fully appropriated. Some water could be salvaged by curtailing evapotranspiration losses, but the necessary lowering of the piezometric surface in the valley bottom would undoubtedly affect the Burraston Springs and some wells which would involve replacement of the flows thus lost.

Generally the quality of the ground water in the vicinity of Nephi is such that it is not suitable for human consumption without desalinization although it is used for irrigation.

The Nephi fan aquifers present a unique opportunity for utilization as a storage reservoir for surface water from the Central Utah project. Existing or new wells could be employed as recharge wells in the off-peak season and as discharge wells in the peak season.

Sevier River Areas

The only available source of ground water data on the Sevier River is from the U.S. Geological Survey ground water studies which have been conducted since 1957 as part of a basinwide investigation outlined by the Sevier River Study Committee. Although final interpretive reports have not yet been published, the ground water data herein presented were taken from USGS basic data reports, study committee annual progress reports, the 1964 ground water conditions annual report, and news releases.

The ground water discussion of the Sevier River is presented in the three following areas.

Central Sevier Valley.--The Central Sevier Valley includes the Salina and Richfield areas. Ground water is available in the alluvial deposits throughout the valley under both artesian and water table conditions and is divided into five ground water basins. Ground water occurs under water table conditions at the upper end but is under pressure in the centers and at the lower end of the basins. The valley fill consists of gravel, sand, silt, and clay which reach a maximum thickness exceeding 800 feet. About 50 percent of the fill is permeable gravel and sand which yields water readily to wells and springs.

During a 1963 ground water pumpage inventory, the USGS measured a total of 16,000 acre-feet discharging from wells, of which 10,000 acre-feet was used for irrigation. Of the total discharge, 14,000 acre-feet was from flowing wells and 2,000 acre-feet from pumped wells. The report further indicated that the discharge from wells has not changed significantly in the past 5 years and that the long-time trends in ground water levels are due primarily to changes in precipitation.

Discharge from springs and drains is another source of water supply to the area from the ground water resource. It is estimated that ground water issuing via these channels averages approximately 95,000 acre-feet annually, of which 73,000 acre-feet is contributed by springs and 22,000 acre-feet by drains.

At the annual meeting of the Sevier River Basin Study Committee on February 19, 1964, Francis T. Mayo of the State Engineer's Office presented data representing conclusions of the ground water studies made to date in the Sevier River Basin. The key points of his conclusions, with respect to the Central Sevier Valley, are as follows.

1. That approximately 1,500,000 acre-feet of ground water are in permeable materials in the five separate basins in the central Sevier Valley.

2. That the surface water and ground water in these basins are interconnected.

3. That ground water discharge and recharge are in balance.

4. That about 100,000 acre-feet is consumed locally by phreatophytes of low economic value.

5. That about 35,000 acre-feet of ground water could be developed annually in the first three basins by wells and drains without greatly affecting the flow of the Sevier River.

In analyzing the foregoing conclusions which were made by the Geological Survey and the State Engineer's Office, the following observations are presented.

1. That the development of a significant amount of ground water, such as 35,000 acre-feet annually, would materially upset the present ground water recharge-discharge balance unless an extensive drainage system were constructed in the area.

2. Drainage construction to reduce ground water use in the phreatophytes area would

    a. Eliminate many acres of pasture with fair to good economic value.

    b. Create many economic problems for individual landowners because of established land use economy.

    c. Require a detailed drainage investigation to determine the physical possibilities of water development through drainage.

    d. Require an economic study to determine the feasibility of abandoning pasture lands and developing water through control of water tables.

    e. Be difficult to determine the differential in evapotranspiration between the present high water table and the proposed controlled water table in the areas presently covered by phreatophytes.

3. If drainage were attempted by wells, there would be a definite depletion of the ground water aquifers which in turn would reduce the ground water contribution to the stream for downstream use. Thus, some of the pumped water would have to be turned back into the stream as replacement water.

Upper Sevier Valleys.--The Upper Sevier River Basin includes four main valleys--Panguitch, Circle, East Fork, and Grass Valleys. Most of the available ground water in the valleys occurs in the alluvial deposits under both artesian and water table conditions. The USGS has estimated that about 1,000,000 acre-feet of ground water is in storage in the water-bearing materials.

About 300 wells occur in the valleys, of which more than half are in Grass Valley and most are less than 4 inches in diameter. The U.S. Geological Survey indicates that in 1963 the total discharge from these wells amounted to about 3,600 acre-feet and that the annual discharge has not changed materially in the past 5 years. About 2,300 acre-feet was used for irrigation, and the remaining was used for domestic and public supply. About 1,300 acre-feet of the irrigation water was discharged from flowing wells and about 1,000 acre-feet was pumped.

Long-term fluctuations of water levels in the various valleys were generally similar during the past 20 years. Water levels were higher during the 1940's, a relatively wet period, but declined during the 1950's, a relatively dry period except for 1952 and 1958 when the flow was above normal.

Although it would be physically possible to develop some ground water in this area, the problems are much the same as have been outlined for the central Sevier Valley. No additional ground water supplies are anticipated at present for the Upper Sevier Valleys.

Sevier Desert.--Ground water occurs in unconsolidated deposits under both water table and artesian conditions. Water table conditions occur along the eastern margin of the Sevier Desert near the Canyon Mountains where the water-bearing materials become unconfined with a decrease in the quantity of fine-grained lake deposits above the Provo level of old Lake Bonneville (approximately 4,800 feet above m.s.l.). This aquifer is considered a major source of ground water where wells are drilled upslope from the Provo stage of Lake Bonneville.

Two artesian aquifers underlie the Sevier Desert--the shallow artesian and the deep artesian aquifers. The shallow aquifer has a depth range of 50 to 500 feet below land surface. These artesian aquifers are a very important source of water supply in this area.

Recharge to the aquifers occurs principally along the east side of the valley near the Canyon Mountains. Ground water that enters the recharge areas along the east side of the valley moves westward, under a hydraulic gradient, toward the topographically low-lying area south and west of Delta.

Ground water is discharged both by natural means and by wells. Natural discharge occurs in the low-lying area south of Delta and is principally by seeps. Ground water from the shallow aquifer is discharged by upward diffusion in a few areas located south and west of Delta. Most of this flow, which is very minor in magnitude, is intercepted and discharged through the shallow drainage system constructed throughout the area. Wells penetrate both the water table and artesian aquifers--the smaller discharge wells are flowing and the large discharge wells are pumped. Wells drilled in the mountain front aquifer of the Leamington-Lynndyl and Oak City districts constitute an important source of irrigation water in these districts.

The shallow and deep artesian aquifers are tapped by all wells in the Delta district. Only a few wells in the Leamington-Lynndyl and Oak City districts tap these aquifers. The deeper aquifer is not penetrated by any wells in the Oak City district. Ground water that is withdrawn from these aquifers is used for industry, public supply, and irrigation. The following shows that withdrawals from pumped wells have increased from 1,500 acre-feet in 1951 to 24,800 acre-feet in 1963. Flowing well discharge over the same period has decreased from 3,000 to 1,400 acre-feet. It is estimated that the area containing flowing wells has been reduced by one-half since 1951.

Annual withdrawals from pumped wells in the Sevier Desert

Year	Acre-feet
1951	1,500
1952	3,000
1953	2,000
1954	4,000
1955	3,500
1956	5,000
1957	5,000
1958	8,600
1959	14,400
1960	15,300
1961	18,100
1962	19,800
1963	24,800
1964	26,200

Discharge of ground water by wells always causes a lowering of water levels in an aquifer. Water levels in both the artesian and water table aquifers have declined steadily since 1951 with the increasing number of wells that have been drilled each year. Since 1955 a steady decrease in precipitation has been shown in the recharge area for these aquifers. This steady decrease reflects a more rapid decline in water levels since 1955.

Ground water withdrawals increased only 3,500 acre-feet during the early period (1951-57), and water levels in all aquifers generally declined from 0 to 5 feet. With the larger increase in pumping from 1958 through 1963, water levels generally declined an additional 0 to 13 feet. Water levels declined only 3 feet during 1964 with a small increase in pumping over 1963; however, there was also an increase in precipitation during 1964.

A ground water reservoir that contains water of good quality appears to underlie the Sevier Desert area. This reservoir is surrounded on all sides and beneath by water of a poorer quality. Canal recharge from the Central Utah Canal affects the ground water quality to the east of the reservoir, particularly in the shallow aquifer. The poor quality of water which surrounds the remainder of the reservoir is unsuitable for irrigation.

Three major problems would materialize with further ground water development in the Sevier Desert: (1) legal problems, (2) water quality problems, and (3) economic problems. The magnitude of these problems would become greater with increased pumpage from the ground water reservoir and a resulting continual decline in the water level.

The increase in both the number of large-diameter pumping wells and the quantity of ground water pumped since 1951 has not caused any apparent major legal problems. These problems usually result from the "drying up" of flowing wells and the lowering of water levels in nearby small-diameter pumping wells. The area in which flowing wells existed prior to 1951 is estimated to have been reduced to half by 1963.

Water quality problems would result from the migration of poorer quality ground water into the areas of better quality as water levels are continually lowered by increased pumping in the areas of better quality. Economic problems would result from increased pumping lifts that would be required to bring ground water to the surface.

It is estimated, however, that an additional 5,000 acre-feet per year from the deep aquifer in the Oak City district can be developed in the Sevier Desert without developing further legal, water quality, or economic problems. This estimate was made after calculating the quantity of ground water moving through an inflow section east of Delta during March of 1964. The deep artesian aquifer underlying the Oak City district is not presently penetrated by wells. This aquifer is not recharged by seepage from the Central Utah Canal and is more permeable in this district than it is farther west near Delta.

More detailed studies are required to determine what portion of the present (1963-64) magnitude of ground water withdrawal can be continued on a firm yield basis.

<u>Sanpete Valley</u>

The geology of Sanpete Valley is favorable for ground water development. The valley fill consists of permeable material capable of receiving and transmitting water. Ground water occurs both in unconfined and confined conditions. Certain of the underlying consolidated formations are also capable of receiving and transmitting water.

Under existing conditions a considerable ground water yield is within the valley. Most of the yield occurs through natural avenues as springs and seeps while a lesser amount has been developed through the installation of artesian and pumped wells. The total ground water yield for an average year has been estimated to be 50,000 acre-feet, of which about 13,000 acre-feet is developed from wells.

The quality of the underground water is generally good for both irrigation and human consumption with the possible exception of the water from some of the consolidated aquifers.

In planning and investigating, those concerned with development of a water supply from ground water sources must consider the fact that ground water discharge, both natural and artificial, from aquifers in the San Pitch River Basin is either tributary to the San Pitch River or is consumed by evapotranspiration. No evidence is available to suggest any loss of ground water by subterranean routes to points outside of the basin. Development and consumptive use of ground water thus deplete the flow of the San Pitch River. Water may be salvaged by reducing nonbeneficial use by phreatophytes in the lower portions of the basin, which water could be exchanged for ground water developed elsewhere in the basin from the deep or confined aquifers.

A reduction in nonbeneficial use would require a lowering of the water tables in the phreatophyte areas to levels that would allow the eradication of phreatophytes and the substitution of a more beneficial vegetation of either irrigated or dryland varieties with a lower consumptive use. One such program could provide for the development of suitable lands to a more efficient and beneficial use of water and for maintaining the poorer lands in a nonirrigated state. An alternative program would be to maintain all of the drained lands as nonirrigated lands so as to reduce the losses to a minimum. Either of these programs could require the Government to purchase these lands to be maintained in a dry state. The quantity of water thus salvaged annually would represent the quantity of ground water that would be available for development from the confined aquifers without depleting the flow of the San Pitch River. The salvaged water could return to the San Pitch River in exchange for ground water developed and used elsewhere in the basin.

The investigation program needed to determine the quantity of additional ground water that could be developed would include the ground water studies, surface water studies, drainage studies, and land classification and agronomic studies.

Pavant Valley

Ground water occurs in unconsolidated deposits under water table and artesian conditions and in basalt under water table conditions. Water table aquifers in the unconsolidated deposits are located principally along the eastern margin of the valley, near the mountains, where the water-bearing materials become unconfined. This unconfined condition exists because of a decrease in the quantity of fine-grained lake deposits above the Provo level of old Lake Bonneville. This aquifer is not extensively developed along the eastern margin of the valley and is therefore considered as an unimportant source of water for wells. Water table aquifers in the basalt near Flowell and Kanosh are, however, important sources of water for irrigation.

Two artesian aquifers underlie Pavant Valley; however, they will be referred to as one unit because there is not sufficient data available to warrant separate discussions and most of the wells are developed in both aquifers. These aquifers provide the bulk of the ground water that is discharged from wells in Pavant Valley.

Recharge to the aquifers occurs principally along the east side of the valley near the Canyon Mountains and the Pavant Range. Aquifer recharge is derived from precipitation, from seepage losses in streams and canals, from infiltration of unconsumed irrigation water, and from underflow which moves from bedrock in the mountains into the permeable valley fill. Ground water that enters the recharge area along the eastern margin of the valley moves westward under a hydraulic gradient toward the basalt ridge on the west side of the valley. Water level contours indicate that ground water continues to move westward beneath the basalt ridge.

Discharge of ground water in Pavant Valley occurs both by natural means and by wells. Natural discharge occurs in the topographically low-lying area along the east side of the basalt ridge. Evapotranspiration and both nonartesian and artesian springs are the means by which ground water is naturally discharged. Several hot springs appear in the low-lying area; however, this water is derived from a source other than the presently developed aquifers.

Underflow beneath the basalt ridge is also considered as natural discharge. A "Sink" area appears near Flowell where the piezometric gradient increases rapidly to the northwest. Here the depth to water also increases and surface drainage is better than in shallow water table areas to the south. The emergence of several large springs just east of Clear Lake, about 10 miles northwest of Flowell, appears to be the outlet for ground water moving into the "Sink" area.

Wells withdraw ground water from both water table and artesian aquifers in Pavant Valley. Discharge from both flowing and pumped wells for the past 18-year period is tabulated on the following page and is shown graphically on page 87 .

A sharp increase occurred in the number of large discharge irrigation wells developed since 1949 which has caused a steady decrease in flowing well discharge.

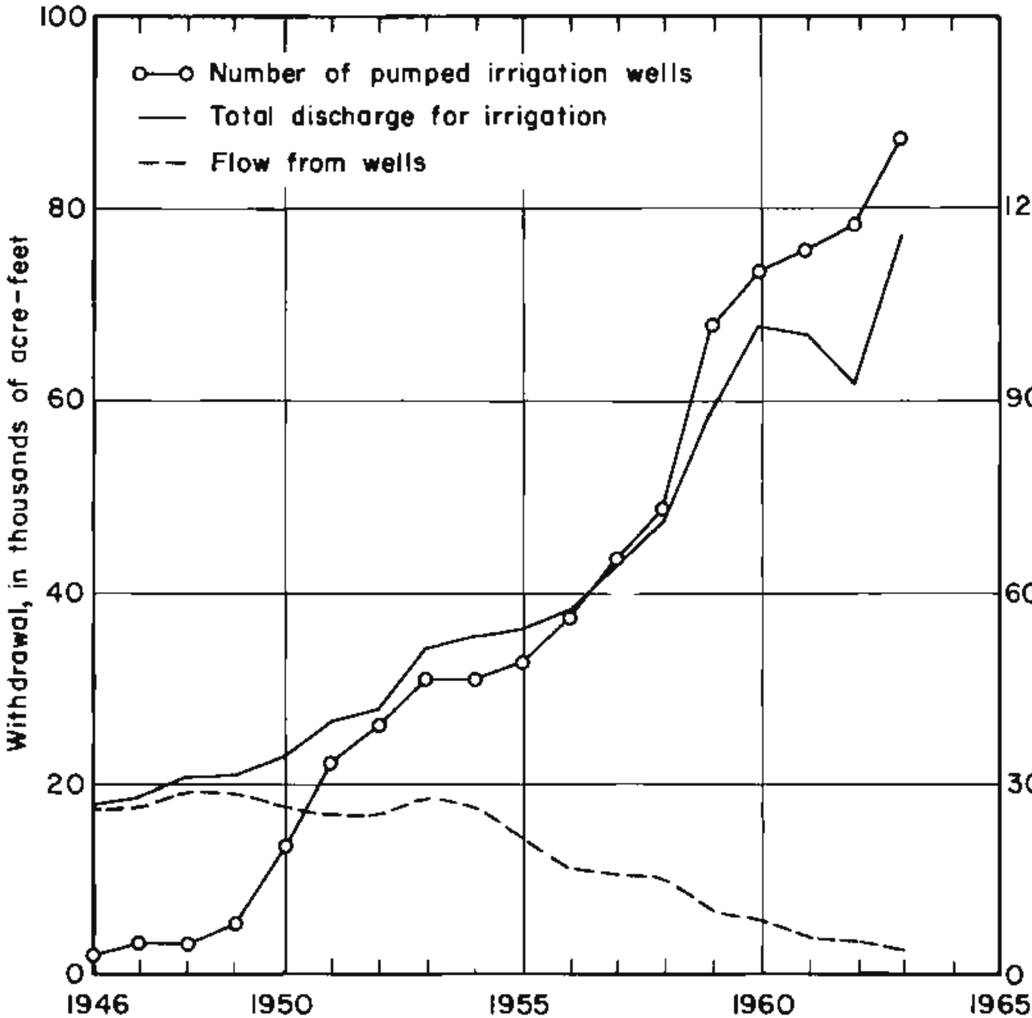
Discharge from wells (estimated) and number of wells in Pavant Valley, 1946-63

Year	Discharge (acre-feet) Flowing wells	Pumped wells	Total	Number of pumped irrigation wells	Total number of wells in valley
1946	17,300	400	17,700	3	343
1947	17,400	1,000	18,400	5	349
1948	19,400	1,200	20,600	5	361
1949	18,600	2,200	20,800	8	367
1950	17,600	5,100	22,700	20	400
1951	16,500	9,800	26,300	33	415
1952	16,600	10,800	27,400	39	424
1953	18,700	15,100	33,800	46	445
1954	17,500	17,900	35,400	45	451
1955	14,400	21,600	36,000	49	466
1956	11,000	27,000	38,000	56	485
1957	10,200	32,300	42,500	66	498
1958	10,000	37,000	47,000	73	507
1959	6,300	53,300	59,600	101	522
1960	5,900	61,400	67,300	110	532
1961	4,500	61,800	66,300	113	535
1962	3,600	58,200	61,800	117	540
1963	2,700	77,000	79,700	133	542

Water levels in both the artesian and water table aquifers have declined steadily since 1949 with the increasing number of wells that have been drilled each year. Since 1948 a steady decrease in precipitation has been apparent in the recharge areas for these aquifers. This steady decrease would normally cause a decline in water levels without pumping from wells; therefore, the combined effects of decreased precipitation and increased pumpage caused a more rapid water level decline than if normal precipitation had continued.

Prior to 1950 withdrawals were nearly constant. During this early period (March 1946 to March 1950) water levels also remained nearly constant. In some cases water levels rose during this early period, which corresponds to the above-normal precipitation from 1945 to 1947. With an increase in pumping which started in 1950 and has continued through 1964, water levels have declined more than 40 feet (maximum decline is between Fillmore and Flowell).

Recharge waters which are derived from the principal streams entering Pavant Valley consist of 200 to 250 p.p.m. total dissolved salts and less than 20 p.p.m. chloride. Wells in the upper parts of the alluvial



Graph showing relation of number of pumped irrigation wells and total discharge to discharge from flowing wells in Pavant Valley, 1946-63.

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fans (above the Central Utah Canal) yield water of similar composition but contain a greater amount of total dissolved salts. Ground water that is discharged from wells located lower on the fans (below the Central Utah Canal) carries more dissolved salts and in particular contains a much larger proportion of sodium, chloride, and sulphate ions. This poorer quality ground water obtained lower on the fans reflects recharge by seepage from the Central Utah Canal into the upper portion of the artesian aquifers. Wells and springs near the western margin of the valley and those in the southern portion yield sodium chloride and sulphate waters ranging from 1,000 to 8,000 p.p.m.

CHAPTER V

PROJECT LANDS AND DRAINAGE

Land Inventory

General

An inventory has been made of all the available land classification data for the potential land areas in the ultimate phase of the Central Utah project. Data presented herein were obtained from various methods, including reconnaissance-type surveys, land use surveys, and estimates or secondary survey information obtained from all sources available. The bulk of the classification data presented has been obtained from two major surveys; namely, the Colorado River investigation and the Colorado River-Great Basin survey.

The Colorado River investigation was made by the Bureau of Reclamation under the direction of E. R. Fogarty during the period of 1933 to 1936. It is a reconnaissance-type survey of lands along the Colorado River and its tributaries and includes the Uinta Basin and the Price River Basin as part of this report. The nonirrigated lands were separated into arable and nonarable categories, and the arable land was classified as either class 1 or class 2. Irrigated lands were merely designated as arable or meadow. Since aerial photographs were not available for this survey, horizontal control was established on 18 x 24-inch sheets of detail paper by use of a planetable and alidade. The scale used on these sheets was 1,000 feet equals 1 inch, and an average of about one 5-foot hole per section was dug to examine the soil and subsoil.

The Colorado River-Great Basin survey was a cooperative effort by the Utah Agricultural Experiment Station and the Bureau of Reclamation. Some previous cooperative classification by the Bureau of Chemistry and Soils and the Utah Agricultural Experiment Station was projected into this survey. The work, completed in 1939 and 1940, was restricted to lands within the Great Basin and is of a reconnaissance type. Part of the work was done on aerial photographs with a scale of 4 inches per mile, and the balance was done on planetable sheets with a scale of either 1,000 feet or 2,000 feet to the inch. On the average two to three 5-foot holes were dug per section to examine the soil and aid in the classification. Irrigated and nonirrigated arable land was separated into classes 1, 2, and 3, and the nonarable land was placed in class 6.

Recent land classification surveys made by the Bureau of Reclamation since 1940 are available for a few of the areas. Some specifications used in these surveys are of a higher grade than those used in reconnaissance land classification. Pending the completion of a detailed drainage investigation, however, the recent land classification surveys must be considered of a reconnaissance type. The land use surveys and estimates used in this study to obtain the reported acreages were prepared by the Bureau of Reclamation.

A summary of the land classification data is presented in the table on the following page by the individual areas, showing the date, type, and source of survey and the land classes when available. These previous surveys were sufficient for the purpose for which they were intended; however, they are inadequate for a detailed study. Prior to the preparation of a definite plan report, a detailed land classification will be completed for those areas selected in that particular plan. The estimated land shown in the table includes the approximate area that would be covered in a detailed classification. Locations of the various areas are shown on the map on page 92 .

Areas

A brief description of the potential land areas considered for this report is contained in the following paragraphs. Each area is discussed separately as to the location, type of survey, acreage, and soil characteristics.

Deadman Bench Area

Deadman Bench includes an area beginning on the south side of the Green River a few miles east of Ouray, Uintah County, and extends east into Colorado about 3 or 4 miles at the Moffat and Rio Blanco County line. A survey of this area was made by the Bureau of Reclamation in connection with the Colorado River investigation of lands in the Upper Colorado River Basin. Under this survey there were found to be around 70,000 acres of arable, nonirrigated land.

The lands occur in broad, gently sloping valleys on terrain characterized by narrow ridges and valleys on high elevation undulating bench lands, on moderately sloping alluvial fans, and on gently sloping river terraces. The soils are alluvial, having textures that range from medium to light, and are deepest in the broader valleys and shallowest on the elevated benches and in the narrow valleys. Their salinity content is low, but there are definite indications of sodic conditions in some areas. The soils are underlain by generally impermeable saline shale and sandstone although intervening gravelly substrata show in some localities.

Green and White Rivers Area

The Green and White Rivers area lies adjacent to and southwest of the Deadman Bench area on the east side of the Green River. It extends about 10 miles up the White River from the confluence of the Green and

Unit: Acres

Central Utah project
Inventory of po

Basin and area	Date classified	Type of survey	Source of classification	Class 1	Class 2
Uinta Basin					
Deadman Bench	1938	Reconnaissance	Colorado River Inv. USBR		
Green and White Rivers	1935	Reconnaissance	Colorado River Inv. USBR		
Uintah					
Roosevelt	1962-1963	Reconnaissance	Bureau of Reclamation		20,000
Ouray	1963	Reconnaissance	Bureau of Reclamation		2,000
Lake Fork	1962	Reconnaissance	Bureau of Reclamation		12,000
Leland Bench	1933-1936	Reconnaissance	Colorado River Inv. USBR		
Pariette Bench	1933-1936	Reconnaissance	Colorado River Inv. USBR		
Blue Bench	1933-1936	Reconnaissance	Colorado River Inv. USBR		
Fruitland	1933-1936	Estimate	Colorado River Inv. USBR		
Strawberry	1956	Reconnaissance	Bureau of Reclamation		600
Nine Mile	1933-1936	Estimate	Colorado River Inv. USBR		
Subtotal					34,600
Bonneville Basin					
Wallsburg	1950	Land use survey	Bureau of Reclamation		
Bingham	1939-1940	Reconnaissance	Colo. River-Great Basin USBR		
Lehi	1948	Recon. and estimate	Bureau of Reclamation	3,000	8,000
Cedar Valley	1939-1940	Reconnaissance	Colo. River-Great Basin USBR	2,000	
Cherry Valley	1939-1940	Reconnaissance	Colo. River-Great Basin USBR		
Dog Valley	1939-1940	Reconnaissance	Colo. River-Great Basin USBR		
South Juab Valley	1939-1940	Reconnaissance	Colo. River-Great Basin USBR	4,000	2,000
Tintic Valley	1939-1940	Reconnaissance	Colo. River-Great Basin USBR		
Holden-Fillmore	1939-1940	Reconnaissance	Colo. River-Great Basin USBR	18,000	5,000
Subtotal				27,000	15,000
Sevier River					
Upper Sevier River					
East Fork	1964	Reconnaissance	Bureau of Reclamation		
Koosharem and Otter Creek	1964	Reconnaissance	Bureau of Reclamation		
South Fork	1964	Reconnaissance	Bureau of Reclamation		
Below Piute Reservoir	1964	Reconnaissance	Bureau of Reclamation		
Subtotal Upper Sevier River					
Central Sevier	1939-1940, 1964	Reconnaissance	Colo. River-Great Basin USBR		
Sevier Bridge Pump	1939-1940	Reconnaissance	Colo. River-Great Basin USBR		
Delta	1928, 1939-1940, 1964	Recon. and detailed	Bureau of Reclamation	17,000	40,000
Subtotal				17,000	40,000
San Pitch River	1939-1940, 1960-1961	Reconnaissance	Colo. River-Great Basin USBR and SCS		
Price River	1957	Land use survey	Bureau of Reclamation		
Subtotal				44,000	89,600
Indian lands	1960-1964	Indian survey	Water right claims, Uintah and Ouray Indian Reservation, Utah, E. L. Decker		
Ouray Valley					
Rock Creek					
Little Valley					
Towanta Flat					
Bluebell Benches					
Mud Springs					
Uintah Bottoms					
Deep Creek					
Subtotal					
TOTAL				44,000	89,600

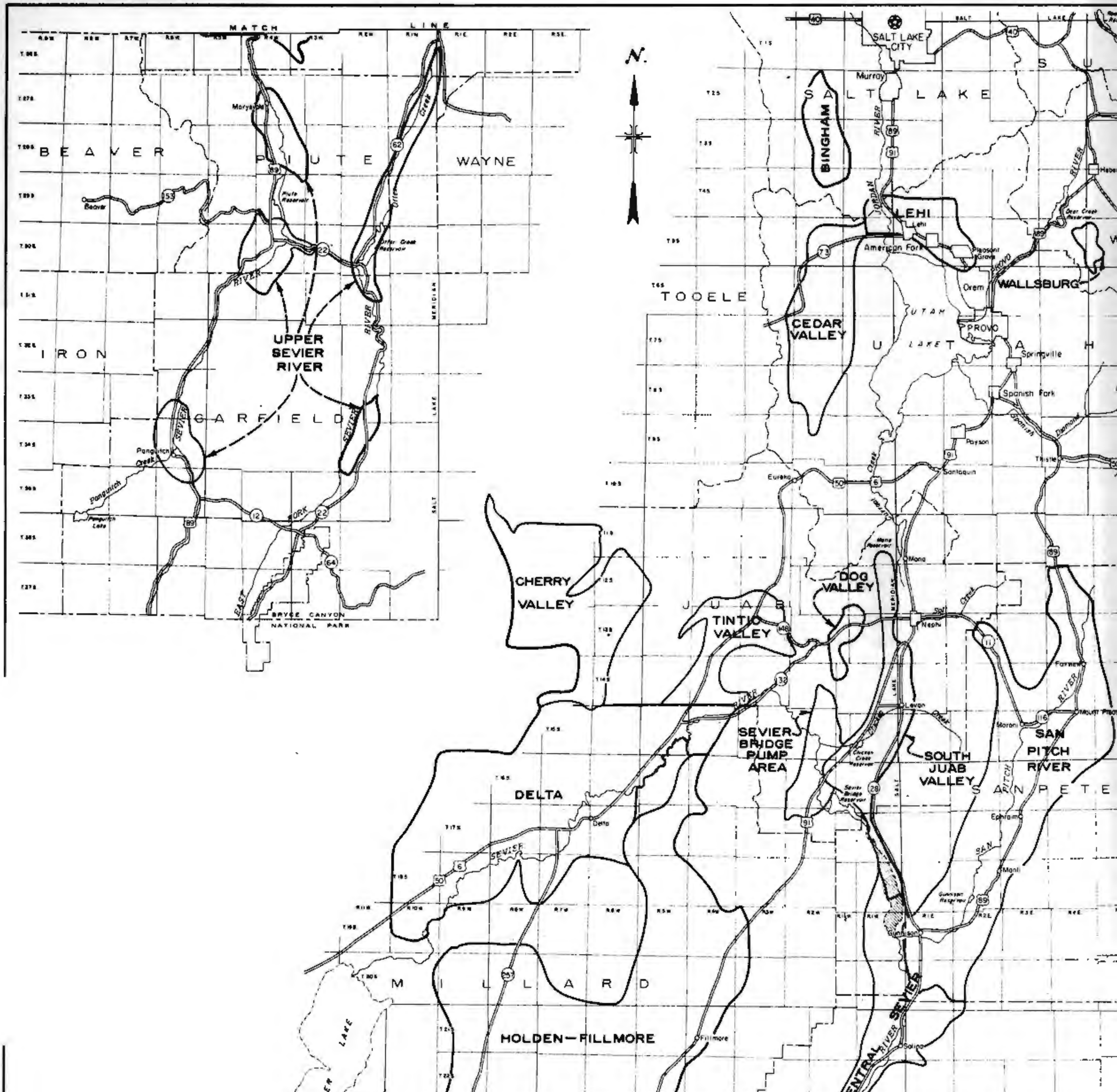
1/ Total 1, 2, 3, and irrigated pasture combined.
2/ Irrigated lands were detailed in 1964 and part of the nonirrigated lands.
3/ Includes group 1 Indian land, designated by E. L. Decker.

Central Utah project - Ultimate phase
Inventory of potential land

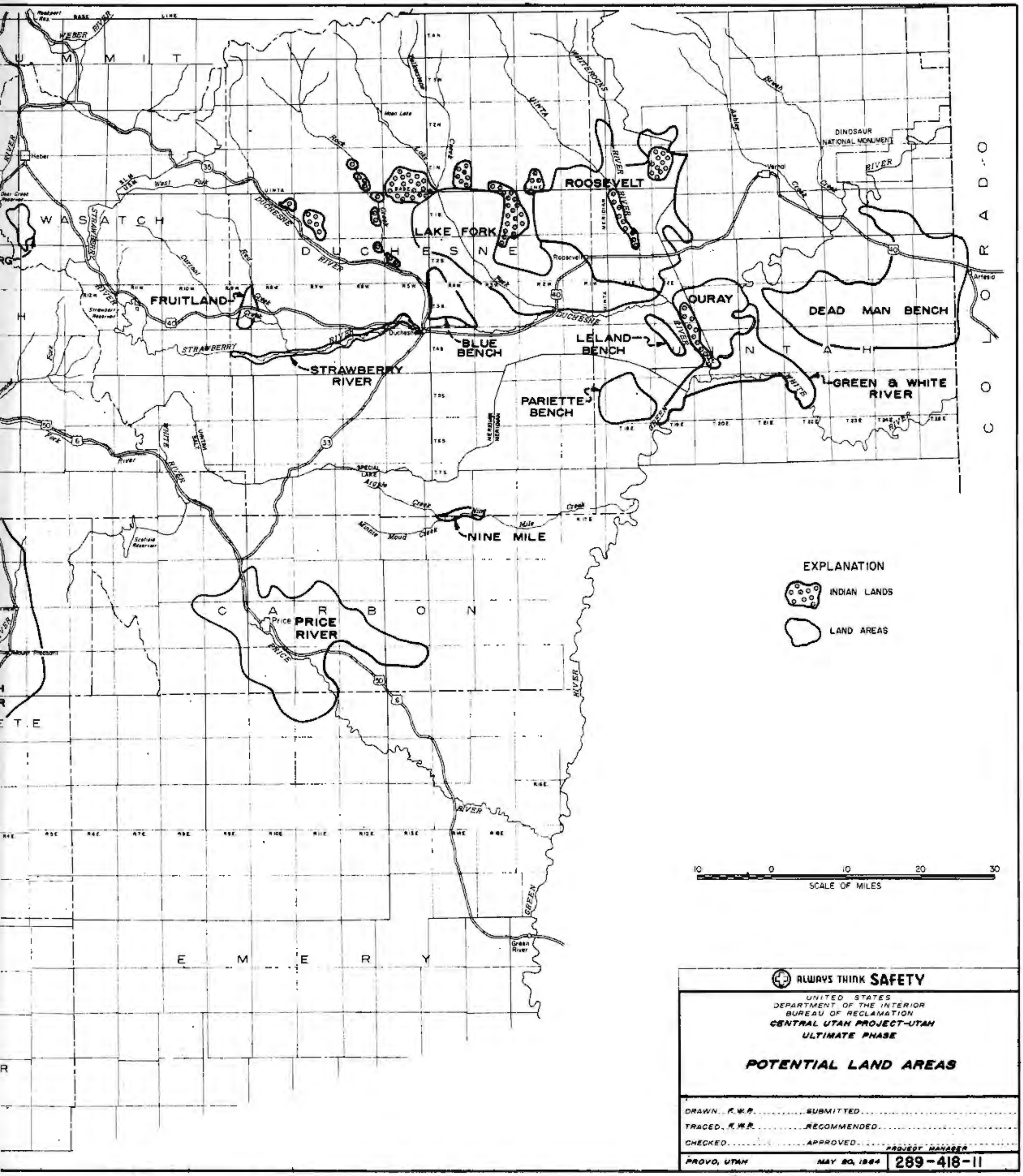
Irrigated: Class 1	Irrigated: Class 2	Irrigated: Class 3	Irrigated: Not classified and class 6	Irrigated: Sub-total	Nonirrigated: Class 1	Nonirrigated: Class 2	Nonirrigated: Class 3	Nonirrigated: Subtotal	Estimated land	Total
					10,000	60,000		70,000		70,0
			1,000	1,000	2,000	19,000		21,000		22,0
	20,000	19,000	12,000	51,000 3/		7,000	3,000	10,000 3/	8,000	69,0
	2,000	1,000		3,000 3/		5,000	5,000	10,000 3/	1,000	14,0
	12,000	27,000	15,000	54,000 3/					7,000	61,0
						3,000		3,000	5,000	8,0
					1,000	10,000		11,000		11,0
					3,000	11,000		14,000		14,0
			1,000	1,000					1,000	2,0
	600	700	700	2,000						2,0
			1,000	1,000						1,0
	34,600	47,700	30,700	113,000	16,000	115,000	8,000	139,000	22,000	274,0
			3,000	3,000						3,0
					3,000	7,000	14,000	24,000		24,0
3,000	8,000	9,000	4,000	24,000					6,000	30,0
2,000				2,000	12,000	41,000	6,000	59,000		61,0
					1,000	23,000	14,000	38,000		38,0
					3,000	7,000		10,000		10,0
4,000	2,000	2,000		8,000	18,000	29,000	25,000	72,000		80,0
					5,000	23,000	2,000	30,000		30,0
18,000	5,000			23,000	28,000	86,000	27,000	141,000		164,0
27,000	15,000	11,000	7,000	60,000	70,000	216,000	88,000	374,000	6,000	440,0
			5,000	5,000					30,000	35,0
			10,000	10,000					15,000	25,0
			21,000	21,000					30,000	51,0
			4,000	4,000					10,000	14,0
			40,000	40,000					85,000	125,0
			62,000 1/	62,000 1/	2,000	17,000	8,000	27,000		89,0
					3,000	5,000		8,000		8,0
17,000	40,000	3,000		60,000	5,000	19,000	29,000	53,000		113,0
17,000	40,000	3,000	102,000	162,000	10,000	41,000	37,000	88,000	85,000	335,0
			106,000	106,000	6,000	25,000	3,000	34,000		140,0
			17,000	17,000	2,000	23,000		25,000		42,0
44,000	89,600	61,700	262,700	458,000	104,000	420,000	136,000	660,000	113,000	1,231,0
								2,400		2,4
								1,100		1,1
								1,400		1,4
								10,500		10,5
								6,500		6,5
								1,900		1,9
								3,700		3,7
								1,500		1,5
								29,000		29,0
44,000	89,600	61,700	262,700	458,000	104,000	420,000	136,000	689,000	113,000	1,260,0

April 1965

Nonirrigated			Estimated		Area to be
ss 2	Class 3	Subtotal	land	Total	classified
,000		70,000		70,000	100,000
,000		21,000		22,000	60,000
,000	3,000	10,000 3/	8,000	69,000	150,000
,000	5,000	10,000 3/	1,000	14,000	30,000
			7,000	61,000	111,000
,000		3,000	5,000	8,000	12,000
,000		11,000		11,000	23,000
,000		14,000		14,000	18,000
			1,000	2,000	4,000
				2,000	4,000
				1,000	2,000
,000	8,000	139,000	22,000	274,000	514,000
				3,000	7,000
,000	14,000	24,000		24,000	32,000
			6,000	30,000	40,000
,000	6,000	59,000		61,000	104,000
,000	14,000	38,000		38,000	165,000
,000		10,000		10,000	13,000
,000	25,000	72,000		80,000	105,000
,000	2,000	30,000		30,000	73,000
,000	27,000	141,000		164,000	600,000
,000	88,000	374,000	6,000	440,000	1,139,000
			30,000	35,000	45,000
			15,000	25,000	30,000
			30,000	51,000	55,000
			10,000	14,000	20,000
			85,000	125,000	150,000
,000	8,000	27,000		89,000	150,000
,000		8,000		8,000	17,000
,000	29,000	53,000		113,000 2/	420,000
,000	37,000	88,000	85,000	335,000	737,000
,000	3,000	34,000		140,000	170,000
,000		25,000		42,000	217,000
,000	136,000	660,000	113,000	1,231,000	2,777,000
		2,400		2,400	2,400
		1,100		1,100	1,100
		1,400		1,400	1,400
		10,500		10,500	10,500
		6,500		6,500	6,500
		1,900		1,900	1,900
		3,700		3,700	3,700
		1,500		1,500	1,500
		29,000		29,000	29,000
,000	136,000	689,000	113,000	1,260,000	2,806,000



MATCH LINE
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
UPPER SEVIER RIVER
Marysvale
Piute Reservoir
Otter Creek Reservoir
Beaver
Panguitch
Panguitch Creek
Panguitch Lake
EAST FORK
SEVIER RIVER
BRYCE CANYON NATIONAL PARK
N.
SALT LAKE CITY
Murray
SALT LAKE
BINGHAM
LEHI
Lehi
American Fork
Pleasant Grove
Orem
WALLSBURG
PROVO
Springville
Spanish Fork
Payson
Santaquin
Thistle
Eureka
TOOELE
CEDAR VALLEY
UTAH LAKE
UTAH
JORDAN RIVER
Deer Creek Reservoir
Heber
Mona Reservoir
Mona
DOG VALLEY
Nephi
JUAB
TINTIC VALLEY
CHERRY VALLEY
SEVIER BRIDGE PUMP AREA
Levan
Chicken Creek Reservoir
Sevier Bridge Reservoir
SOUTH JUAB VALLEY
SAN PITCH RIVER
Moroni
Mount Pleasant
Fairview
Ephraim
Manti
Gunnison Reservoir
Gunnison
SANPETE
DELTA
Delta
SEVIER RIVER
MILLARD
SEVIER LAKE
HOLDEN—FILLMORE
Fillmore
Cove Fort
CENTRAL SEVIER RIVER
Salina
Richfield
Monroe
Koosharem Reservoir
SEVIER
MATCH LINE


ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT–UTAH
ULTIMATE PHASE
POTENTIAL LAND AREAS
DRAWN F.W.R.
SUBMITTED
TRACED F.W.R.
RECOMMENDED
CHECKED
APPROVED
PROJECT MANAGER
PROVO, UTAH
MAY 20, 1964
289-418-11
EXPLANATION
INDIAN LANDS
LAND AREAS
SCALE OF MILES
ROOSEVELT
LAKE FORK
FRUITLAND
BLUE BENCH
STRAWBERRY RIVER
LELAND BENCH
OURAY
DEAD MAN BENCH
GREEN & WHITE RIVER
PARIETTE BENCH
NINE MILE
PRICE RIVER
DINOSAUR NATIONAL MONUMENT
WASATCH
DUCHESNE
UINTAH
CARBON
EMERY
COLORADO
Heber
Duchesne
Roosevelt
Vernal
Price
Green River

White Rivers near Ouray, Uintah County. The remainder of the area lies in a narrow strip along the east side of the Green River extending to the mouth of Willow Creek.

A land survey was made of this area by the Bureau of Reclamation in connection with the Colorado River investigation, showing about 22,000 acres of arable land, 1,000 acres of which was irrigated. Most of the arable land was found in small areas or blocks, either along the rivers and streams or above them on the low benches and terraces. The soils are mostly medium-textured alluvium. Their salinity content is low except in small areas where the surface layers have accumulated some soluble salts. These could be readily leached from the soils upon irrigation.

The elevation of the Green and White Rivers area averages around 4,500 to 4,600 feet. The growing season is similar to that of Ouray, 167 days from April 23 to October 6.

Roosevelt Area

The Roosevelt area is located in northeastern Utah in Duchesne and Uintah Counties and lies on both sides of the Uinta River. The land extends from the town of Randlett to Whiterocks and includes 69,000 acres which are either irrigated or arable. A reconnaissance-type land classification of these and other lands in the Uinta Basin was made by the Bureau of Reclamation in 1962-63.

The lands occur on terrain characterized by narrow ridges and valleys, on high elevated undulating bench lands, on moderately sloping alluvial fans, and on gently sloping river terraces. The soils are alluvial, having textures that range from fine to coarse, and are deepest in the valleys and shallowest on the elevated benches.

Salinity is a problem in much of the area due to unfavorable subsurface conditions, lack of drains, and poor management. The soils are usually underlain by impermeable saline shale and sandstone although intervening gravelly substrata show in some localities.

The elevation of the Roosevelt area ranges from 4,990 feet at Fort Duchesne to over 5,600 feet at Whiterocks. The growing season averages 159 days, from May 3 to October 8, at Fort Duchesne, to around 157 days, from May 8 to October 11, at Neola.

Ouray Area

The Ouray area comprises land east of the Uinta and Duchesne Rivers and west of the Green River. The confluence of the Duchesne and Green Rivers near the town of Ouray marks the southern boundary. It is roughly triangular in shape and extends approximately 12 miles northward from its apex at this confluence of the two streams.

A land classification survey of this area was made in 1963 by the Bureau of Reclamation showing a total of about 14,000 acres of arable land in this area, of which about 3,000 acres are presently irrigated.

The lands occur on moderately sloping alluvial fans, old alluvial benches, and on low stream terraces and foot slopes. The alluvial soils making up the gently sloping fans have been deposited from the adjacent mountains upon the deep layers of shale of the Uintah formation. The glacial outwash, deposited over the uneven shale surface of the bench lands, consists primarily of water-rounded quartzitic rocks and boulders over which a layer of finer alluvial material has been deposited. Soils on the benches have been formed from these materials. The soil textures are generally medium to coarse. Many of the surface soils on the low stream terraces are sandy and have been shifted considerably by wind action.

The salinity content is generally low in the nonirrigated areas but rather high on the inadequately drained irrigated lands. The elevation of Ouray area ranges from 4,600 to 4,900 feet. The growing season at Ouray averages 167 days, extending from April 23 to October 6.

Lake Fork Area

The Lake Fork area is located in northeastern Utah in Duchesne County and lies on both sides of the Lake Fork River. The city of Roosevelt is on the southeastern extremity, and the lands about 4 miles northwest of Mountain Home make up the northwest boundary. The lands cover approximately 61,000 acres which are either irrigated or arable. A land classification of the area was made by the Bureau of Reclamation in 1963.

The lands occur on terrain characterized by narrow ridges and valleys, on elevated undulating bench lands, on moderately sloping alluvial fans, and on gently sloping river terraces. The soils are alluvial, having textures that range from medium to coarse. The salinity content is low on the bench lands, but there are definite indications of sodic conditions in some areas. The soils are underlain by cobble, cemented by calcium carbonate on the higher bench lands over impermeable saline shale and sandstone. Intervening gravelly substrata show in some localities.

The elevation of the Lake Fork area ranges from 5,100 to 6,100 feet. Roosevelt has an average growing season of 176 days, extending from April 19 to October 12, while Altamont's average growing season is 170 days, between April 25 and October 12.

Leland Bench Area

Leland Bench is an area bounded on the north and east by the Duchesne River. The area is about 3 miles wide and extends west about 5 miles and south about 6 miles from the confluence of the Duchesne and Uinta Rivers. A survey was made of this area in connection with the Colorado River investigations of lands in the Upper Colorado River Basin. Under this survey 8,000 acres of arable nonirrigated land were designated.

Leland Bench is a series of old alluvial benches deposited over the uneven shale surface and consists primarily of water-rounded quartzitic rocks and boulders over which a layer of finer alluvial material has been deposited. Soils on the benches have been formed from these materials. The soils are medium to fine textured and have developed under the influence of a semiarid continental or inland climate. They are only moderately matured, showing slight horizontal development, fairly well defined lime zones, and are rich in mineral plant nutrients.

Some saline conditions occur in these soils which could probably be readily alleviated by irrigation. The soils are underlain by generally impermeable shale and layers of calcium carbonate. Large cobble and rock, cemented by calcium carbonate, are near the surface at the edges of the bench, thus restricting natural drainage.

The elevation of the Leland Bench area ranges from 5,100 to 5,200 feet. The growing season at the town of Ouray averages 168 days, from April 23 to October 10.

Pariette Bench Area

Pariette Bench area in Uintah County lies about 12 miles west of Ouray. It is bordered on the south by the west Tavaputs Plateau and begins about 5 miles southeast of Pleasant Valley. The Green River flows about 4 miles to the southeast of the area. A survey of this area was made by the Bureau of Reclamation in connection with the Colorado River investigation, showing about 11,000 acres of arable, nonirrigated lands. The lands occur in fairly large blocks on low benches dissected by stream action. The soils are alluvial, having textures that range from medium to coarse. Their salinity content is moderate to low. The soils are usually underlain by impermeable saline shale although intervening flat, platy, gravelly substrata show in some localities.

The elevation of the Pariette Bench area ranges from 5,000 to 5,200 feet. The growing season recorded at the town of Ouray averages 168 days, from April 23 to October 10.

Blue Bench Area

The Blue Bench area extends north approximately 10 miles from the city of Duchesne and averages about 5 miles in width. The Duchesne River forms the western boundary of the area for about 6 miles above Duchesne.

A survey was made of this area by the Bureau of Reclamation in connection with the Colorado River inventory of lands in the Upper Colorado

River Basin. An estimated 14,000 acres of arable land were surveyed during this investigation.

The Blue Bench is made up largely of a series of mesas of different levels. The soils on the lower mesas are typical mesa soils. The surface soils are mostly loams and sandy loams. A heavy lime layer is encountered at depths ranging from 18 to 42 inches in scattered areas. In the northern part the soils are distinctly recent alluvial sands and sandy loams derived largely from the red sandstone which borders the area.

In the southeastern part of the area the bench narrows rapidly. With the exception of some deep gulches and a few narrow ridges, the relief varies from lightly rolling topography to even gentle slopes. The salinity content is low in this area with very few drainage problems.

The elevation of Blue Bench ranges from 5,800 to 6,000 feet. The growing season at Duchesne City averages 164 days, from April 28 to October 9.

Fruitland Area

Fruitland is a small area adjacent to the town of Fruitland in western Duchesne County and is about 25 miles west of Duchesne City along U.S. Highway 40. An estimated 2,000 acres of arable land occur in this area, of which 1,000 acres are irrigated. An inspection survey was made of this area in connection with the Colorado River investigation.

The lands occur in small blocks on terrain characterized by rolling hills and contrasting slopes. The soils are medium textured, alluvial material deposited over substrata of sandstone and shale. Their salinity content is moderate to high in the poorly drained low-lying areas.

The elevation of Fruitland is about 6,500 to 6,600 feet. It is estimated that Fruitland has an average growing season of 135 days.

Strawberry River Area

The lands of this area lie along the Strawberry River beginning at the city of Duchesne and extending upstream approximately 30 miles to near the Duchesne-Wasatch County line. A land classification of this area was made by the Bureau of Reclamation in 1956 in which about 2,000 acres were designated as arable.

The arable lands occur in narrow strips on either side of the Strawberry River where the canyon becomes broad enough to permit cultivation. The soils have been derived from stream deposits and are medium to coarse in texture. The salinity of these soils is relatively low except near Duchesne where the lands flatten out and are inadequately drained.

The elevation varies from 5,500 feet at Duchesne to 6,800 feet at the upper extremities. The growing season varies from 164 days at Duchesne to about 130 days at the higher elevations.

Nine Mile Area

The Nine Mile area is located in southern Duchesne County along Nine Mile and Minnie Maud Creeks. Water from these creeks flows into the Green River. The arable lands lie in long narrow strips adjacent to these creeks at the base of the high West Tavaputs Plateau. About 1,000 acres of irrigated land are in this area.

The lands occur in narrow strips along Minnie Maud and Nine Mile Creeks where the canyons widen sufficiently to make cultivation permissible. The alluvial soils have been deposited by streams that have cut deep into the surrounding mountains. These soils are mainly medium textured with a low salinity content.

The elevation in this area ranges from around 5,500 to 7,000 feet with an estimated 100- to 120-day growing season. The growing season varies depending on elevation.

Wallsburg Area

The Wallsburg area is located in Wasatch County surrounding Wallsburg, Utah, south of Deer Creek Reservoir. Entrance into the area is via U.S. Highway 189 between Provo and Heber.

No land classification survey of the area has been made. Acreage estimates for the inventory studies were made from a land use survey conducted by the Bureau of Reclamation in 1950. The survey indicated a total of 3,000 acres of irrigated and estimated arable land in the area.

Soils of the Wallsburg area have developed primarily from alluvial outwash material eroded from the sedimentary deposits of the surrounding mountains and transported into place by local streams. Most of these soils are underlain by gravel, cobble, and boulders. The alluvial fans produced by local streams contain the bulk of the arable land. Textures of the soils range from sandy loams to clay loams. The salinity in the area is low with few problems due to drainage.

The elevation of the Wallsburg area ranges from 5,800 to 6,000 feet. The growing season averages around 137 days.

Bingham Area

The Bingham area is on the east slope of the Oquirrh Mountains in Salt Lake County about 11 miles southwest of Salt Lake City. The Bingham branch of the Denver and Rio Grande Western Railroad and Utah Highway

No. 48 from Salt Lake City to the Bingham Copper Mines crosses the area. A survey of this area was made in connection with the Colorado River-Great Basin survey. A total of 24,000 acres of nonirrigated arable land were found.

The major portion of the Bingham area is made up of broad gentle slopes interrupted frequently by low terraces that correspond to the stationery levels of the prehistoric Lake Bonneville. Above these pediment slopes and adjacent to the mountains are steeper alluvial fans and rough hills. The textures range from medium to fine, going from the higher to lower regions within the area. The natural drainage of the area is good except for those finer-textured soils where, under irrigation, the need for artificial drainage may develop. The topsoils are relatively free from alkali although some of the subsoils contain concentrations of soluble salts.

The general elevation of the Bingham area is 4,700 to 5,100 feet. The growing season is estimated at about 190 days.

Lehi Area

The Lehi area includes those lands north of Utah Lake extending to the Salt Lake County line on the north, the Wasatch Mountains on the east, and across the Jordan River to the Lake Mountains on the west.

The soils were formed primarily from lacustrine deposits. Rivers and other entrant streams have deposited coarser materials over the lacustrine sediments, resulting in more favorable textures. The soils of the area are generally medium to fine textured. The arable lands are for the most part free of excessive concentrations of salinity and alkalinity.

About 24,000 acres of land are irrigated in this area and about 6,000 acres are nonirrigated arable lands. The Bureau of Reclamation made a reconnaissance classification of part of the area in 1948. Since then an estimate was made by the Bureau of the remainder of the area.

The elevation of the land ranges from about 4,500 to 5,100 feet. The growing season of the area averages 187 days, from April 12 to October 16.

Cedar Valley Area

This area is situated in Cedar Valley immediately west of Utah Lake and is separated from the lake by the low Lake Mountains. The valley is enclosed and has no drainage outlet. Drainage water collects on and is evaporated from the valley floor at a low spot designated as the "Sinks."

A survey of Cedar Valley lands was made by the Bureau of Reclamation as part of the Colorado River-Great Basin survey. According to this survey, the valley has approximately 61,000 acres of arable land.

The structural basin was filled primarily with alluvium from the surrounding mountains, but present topography and parent material of the soils are principally a result of the action of ancient Lake Bonneville. Light silt loams of open structure and uniform profiles constitute the major part of the more gently sloping fans and plains. The land of low gradient has somewhat restricted drainage conditions and contains moderate to excessive amounts of alkali.

The elevation of the arable lands of the valley varies from 4,850 to 5,300 feet. The average growing season for the area is from May 5 to October 15 or 164 days.

Cherry Valley Area

Cherry Valley area is located in Juab County except for one small portion extending into Tooele County. The Sheeprock and Simpson Mountains lie to the north of the area. The West Tintic Mountains and the rolling sand dunes to the south of these mountains separate this area from the Delta and Tintic Valley areas. This area was classified by the Utah Agricultural Experiment Station and the Bureau of Reclamation in conjunction with the Colorado River-Great Basin survey. About 38,000 acres were considered arable in this survey.

The area is made up of badly eroded alluvial fans, bench lands, and nearly flat, lacustrine plains extending south from the northwest corner through the Cherry Valley area. Textures of the soils range from coarse to medium on the alluvial fans and bench lands to rather fine textures on the lacustrine plains. Moderate to heavy accumulations of saline salts are characteristic of much of the area, especially the bottom lands.

The general elevation of the Cherry Valley is 4,600 to 4,800 feet. The growing season for the area has not been established, but for this study it has been assumed at 170 days, from April 23 to October 9, the same as the Delta area.

Dog Valley Area

Dog Valley is a small isolated valley about 10 miles west of Nephi. Utah Highway No. 132, which crosses the area, is the only public-maintained road. The Utah Agricultural Experiment Station and the Bureau of Reclamation Colorado River-Great Basin survey designated 10,000 acres of land in the area as arable.

This area is a small structural valley formed during the general uplift of the East Tintic Mountains which also isolate it from adjacent areas. The valley fill is made up of alluvial and colluvial deposits of debris from these mountains. The general topography is slightly undulating adjacent to the main drainageways and rolling to rough throughout the rest of the area due to erosion. The soils are generally coarse textured with structures usually open and readily penetrable to water.

The salinity of the Dog Valley area is low due to the character of the parent material and generally good drainage conditions. The elevation of the area extends from 5,500 to 5,600 feet. The growing season has not been established, but for this study it has been assumed at 170 days, from April 23 to October 9, the same as the Delta area.

South Juab Area

The South Juab area is located in the southern section of Juab County and the southwestern section of Sanpete County and is situated geographically near the center of the State of Utah. Levan on the north and Fayette on the south are the two towns located within the area. A survey was made in conjunction with the Colorado River-Great Basin survey which designated 80,000 acres as arable.

The lands of the South Juab area are long narrow strips formed on coalesced alluvial fans that extend from the foothills down both sides of the valley and extend out and over the lacustrine deposits of the valley floor. The soils of the valley floor are fine textured while those of the alluvial fans are of a medium to coarse texture. The alluvial soils have adequate natural drainage characteristics. The lands range in elevation from 4,900 to 5,200 feet above sea level and the growing season averages 200 days.

Tintic Valley Area

The Tintic Valley area in Juab County includes those lands from Jericho south to Juab-Millard County line about 2 miles north of Leamington. The area was included in the Colorado River-Great Basin survey accomplished by the Bureau of Reclamation in conjunction with the Utah Agricultural Experiment Station. Under this survey 30,000 acres were considered arable.

The soils generally are fairly uniform and coarse textured with some areas exhibiting slight to moderate lime development. Sporadic accumulations of saline salts occur within the area.

The elevation of the Tintic Valley area averages 5,300 feet. The growing season has not been established, but for this study it has been assumed at 170 days, the same as the Delta area.

Holden-Fillmore Area

The Holden-Fillmore area is west of the Canyon and Pavant Mountain ranges and east and south of the Delta area. Holden, Fillmore, and Kanosh are three towns located in this area and U.S. Highway 91 runs through the area.

The area comprises alluvial fans reaching toward the valley floor from the Pavant Mountain range. The alluvial fans are medium in texture and usually show good drainage and little or no alkali. The lacustrine plains in the valley floor are excessively alkaline, generally very fine textured, and have inadequate drainage outlets.

The land was classified in connection with the Colorado River-Great Basin survey, resulting in about 164,000 arable acres.

The elevation of the Holden-Fillmore area averages 5,200 feet with an average growing season of 176 days, extending from April 25 to October 17.

Upper Sevier River Area

The Upper Sevier area is composed of four separate, small areas and includes those arable lands between the Koosharem Reservoir in Sevier County to the Otter Creek Reservoir in Piute County, the East Fork of the Sevier River in Garfield County, the South Fork of the Sevier River in Garfield and Piute Counties, and below the Piute Reservoir to below Marysvale in Piute County.

An estimated 125,000 arable acres are in the Upper Sevier area. These figures are based upon a crop census of the area since no formal land survey has been made.

The long narrow valleys are made up of alluvial deposits from the Sevier River and mountain streams. These alluvial soils are medium textured except in the valley floors where they are medium to fine. Because of the general grade and good natural drainage, salinity is not a problem in most of the area.

The elevation of the Upper Sevier area has a wide range with 6,720 feet at Panguitch and 5,900 feet at Piute. The average growing season at Panguitch extends from June 1 to September 14 with 105 days and at Piute May 6 to October 6 or 154 days.

Central Sevier Area

The Central Sevier area is contained in the long Sevier River Valley, having an average width of 5 or 6 miles, and is bounded on the west by the Pavant Range and on the east by the Sevier and Wasatch Plateaus. This area extends north and east from Joseph about 67 miles to Gunnison. The Sevier River meanders the full length of the valley and is joined at Gunnison by the San Pitch River from Sanpete Valley. About 89,000 acres of arable land, most of which is under present crop land, are in this area. The area was included in the Colorado River-Great Basin survey.

The valley is made up of alluvial deposits from the surrounding hills. The soils of the alluvial fans as a whole are medium to coarse in texture, show little profile development, and usually exhibit a soft crumb structure. The salinity of the area is generally low except in areas adjacent to the Sevier River. Here better drainage practices could alleviate much of the problem. The elevation of the Central Sevier area averages about 5,300 feet with a 150-day growing season.

Sevier Bridge Pump Area

The Sevier Bridge pump area is between the Sevier River and the Canyon Mountains. The area lies between Levan and Scipio along U.S. Highway No. 91. Since this area is higher in elevation than the Sevier River, pumping of irrigation water will be required either from Sevier Bridge Reservoir or from the river. As with other areas in the vicinity, a survey of the lands was made by the Bureau of Reclamation and the Utah Agricultural Experiment Station as part of the Colorado River-Great Basin survey, showing about 8,000 acres of arable land.

This area was formed by alluvial and colluvial deposition, principally from formations of sandstone and limestone, from the mountains to the west. The eastern edge of the area is rough and badly eroded. The southern portion is a broad, gently sloping expanse of alluvial fans separated by low rolling hills from the northern part which is composed of a narrow valley and a narrow bench. The soils range in texture from light silt loams to sandy loams and exhibit uniform profiles except on the low rolling hills where the soils contain excessive amounts of rock and gravel and have a pronounced compact lime zone showing varying degrees of cementation.

The elevation of the Sevier Bridge pump area ranges from 5,000 to 5,200 feet. The growing season is estimated to be about 200 days.

Delta Area

The Delta area is in the northeastern part of Millard County in west-central Utah. Delta is the largest commercial center of the area and is served by the Los Angeles-Salt Lake branch of the Union Pacific Railroad and U.S. Highway No. 6. The Colorado River-Great Basin survey originally covered all of the Delta area. In 1964 a detailed land classification was made of part of the area by the Bureau of Reclamation. A combination of these surveys shows a total of 113,000 acres of arable land, 60,000 acres of which are presently irrigated. The old Colorado River survey was used only for the lands not included in the recent classification.

Great depths of alluvium were initially deposited on the floor of this large valley by the Sevier River and local streams from the adjacent hills. The mantle of fine material laid down by the ancient lake covers nearly the entire area. Migratory sand dunes make up the southern portion of the area north of the Sevier River where they extend to the foothills. The alluvial fans on the western side of the valley have coarse-textured soils, generally uniformly calcareous profiles, and moderate to excessive amounts of alkali. Sandy soils, usually containing appreciable amounts of gravel, are characteristic of the Lynn Bench in the Delta area. The soils of the desert floor are finer, varying from light silt loam to clay, and have a high concentration of alkali.

The elevation of the Delta area is from 4,700 to 4,800 feet with an average growing season of 170 days.

San Pitch River Area

The San Pitch River area is in Sanpete Valley in the center of the State of Utah, extending north about 50 miles from Gunnison. The San Pitch River and its tributaries flow through this valley. The area was included in the Colorado River-Great Basin survey by the Utah Agricultural Experiment Station and the Bureau of Reclamation. Under this survey 140,000 acres were considered arable.

Broad alluvial fans and slopes of low gradient extend from the foothills to the flood plains of the San Pitch River except for some steeper fans on the west and the more rolling terrain in the north. The upper portions of the alluvial fans are very rocky and gravelly. The central and outer portions of the fans are free from gravel or rock, show medium textures, and due to good drainage are relatively free from alkali. The very gently sloping central portion of the valley along the San Pitch River varies, with textures ranging from sand to slowly permeable clay, structures from single grain to massive, and little to excessive alkali.

The general elevation of the San Pitch River Basin is 5,500 to 5,600 feet with an average growing season of 165 days, from May 12 to October 3.

Price River Basin Area

The Price River Basin is located in the east-central part of the State of Utah, mostly in Carbon County. U.S. Highway No. 50 runs through the area and Price City is its largest community. The lands included lie adjacent to the Price River and those areas which could be reached through canal systems diverted from the river. Some small creeks and streams flowing into Price River have adjacent lands which are included. The old Colorado River survey included this area and designated about 42,000 acres of land as arable.

Soils of the area are principally alluvial. The arable lands were developed primarily from alluvial material derived from sandstone, limestone, and shale deposited as gently sloping fans extending from the foothills to the valley floor. This alluvial material varies in depth from several inches to about 60 feet. The residual soils, formed in place through weathering of shale material, are shallow and of low quality. The soils of the area are generally of medium texture. They have moderate permeability, good available moisture capacity, and a relatively low content of salinity and alkalinity.

The average elevation of the Price River Basin area is 5,500 to 5,600 feet. The average growing season at Price is from April 26 to October 19 or 178 days.

Indian Lands

Indian lands included in the ultimate phase are situated in eight small areas in the Uinta Basin. Estimated acreages of these areas have been obtained from a report entitled "Preliminary Report, Proposed Participation in Central Utah Project by Uintah and Ouray Indian Reservation, Utah," by E. L. Decker dated July 5, 1960, revised October 1, 1961. This report shows a total of 29,000 acres of nonirrigated land contained in the eight areas.

Drainage Inventory

The drainage inventory includes a summary of existing and anticipated drainage conditions that are available for the potential land areas. Drainage investigations conducted to date are also presented and future investigations listed that may be required for ultimate phase development. A complete evaluation of project drainage conditions is not possible because of the lack of available information.

Bonneville unit lands have not been included in this drainage inventory. A detailed drainage investigation was included in the 1964 definite plan report for all areas except the Sevier River area. Additional studies have also been made in 1964 and 1965 in the Provo Bay area to firm up the drainage plan and cost estimate as presented in the 1964 definite plan report of the Bonneville unit. A report of detailed investigations of these two areas will be included in a supplement to the Bonneville Unit Definite Plan Report scheduled for completion in 1966.

Detailed drainage investigations have also been initiated but not completed by the Bureau of Reclamation on the Uintah unit of the ultimate phase. The other potential areas considered in this report have not been investigated in detail by the Bureau of Reclamation and the drainage conditions presented were obtained from any available sources, including observations and cursory studies completed by other agencies. No drainage information is available for some of the areas considered.

A detailed drainage investigation will be required on all areas selected for the ultimate phase development. The scope of these investigations will vary for each of the areas according to the differences in depth to water table, type of subsurface material, depth to and type of barrier zones, size of irrigated area, topography, and water supply.

Areas

Drainage conditions are discussed briefly below for each of the potential land areas. The information, when available, is presented in the following order: existing drainage conditions, potential conditions with ultimate development, drainage investigations to date, and future investigations required.

Deadman Bench Area

No irrigation exists on the lands of this area and there are no known water tables at present. The shallow soil over shale and sandstone in much of the area will be conducive to numerous drainage problems under potential development. No reports of drainage investigations are available.

Green and White Rivers Area

Approximately 1,000 acres of presently irrigated land on the bottom lands along the rivers are believed to have some drainage deficiencies. Additional development may increase the drainage problems on these river bottom lands and could produce new problems on the bench lands that have shallow alluvial soils over shale. Detailed drainage investigations will be required prior to project development.

Roosevelt Area

High water tables occur on about 40 percent of the 51,000 acres of presently irrigated non-Indian land. Approximately three-fourths of the high water table land is situated on cobble-covered benches and river terraces which have generally shallow soils overlying the cobble. The high water table bench and terrace lands are not considered drainage deficient because of the stable pasture-livestock economy established there. This economy indicates adequate natural drainage capacity under existing conditions and use. Any potential drainage deficiency under ultimate development has not yet been determined. Approximately 6,000 acres of the irrigated high water table lands are considered either presently or potentially drainage deficient. These lands are located in the valleys and on the benches with deeper soil over cobble. These lands were classified as drainage deficient but may be reclaimed, if feasible, to an arable class. The feasibility of draining them has not yet been determined.

Under potential development most of the bench and terrace lands may not require artificial subsurface drainage. It is anticipated, however, that the drainage deficiency existing in the valley lands may spread to adjacent irrigable lands with an additional water supply. It will therefore be necessary to provide project drainage for the present potentially deficient lands that are deemed feasible of drainage under a project plan.

A detailed drainage investigation was about half completed in 1963 in this area by the Bureau of Reclamation. This study will be completed in 1966 and will be reported in detail in the forthcoming Uintah Unit Feasibility Report. No prior drainage investigations have been made of the Roosevelt area.

Ouray Area

The 1963 land classification of the Ouray area shows about 3,000 acres of presently irrigated land, of which approximately 1,300 acres were designated as definitely drainage deficient. The drainage problems are located primarily in the central part of the area in a 3-mile by 3-mile triangular shaped area in the valley north of Pelican Lake. Minor problems exist on the north bench and in a small area below Pelican Lake.

Additional irrigation water provided by potential development would aggravate the existing drainage problems on presently irrigated land. New drainage problems would probably be created on a substantial part of the full service lands. Both presently irrigated and new lands will probably have some drainage requirement. The magnitude of the requirement will depend somewhat on the type of irrigation used. Both surface and sprinkler irrigation should be considered on new lands because of the complex combination of soil, topographic, and subsurface characteristics in part of the area. The sprinkler systems will create fewer drainage problems than surface irrigation. The combination of adverse soil, topographic, and subsurface characteristics that produce drainage deficiencies in parts of the area may preclude drainage reclamation.

No specific drainage investigations were made prior to 1963. Detailed drainage investigations have been initiated on this area and will be completed by the Bureau of Reclamation and will be reported, with the Roosevelt area, in the Uintah Unit Feasibility Report.

Lake Fork Area

In the Lake Fork area about 54,000 acres are presently irrigated and approximately 40 percent of this acreage has a shallow water table condition. As in the Roosevelt area, approximately 80 percent of the high water table lands are situated on cobble-covered benches and produce meadow pasture and hay which are part of a stable pasture-livestock economy. The shallow water tables are a benefit to this type of economy, and these lands are not considered to be drainage deficient. Drainage of these lands is presently considered neither desirable nor feasible in view of their established land use. The balance of the shallow water table lands primarily in the valleys and on parts of the North Myton Bench is considered drainage deficient, but part may be correctible to an arable class under ultimate development if future investigations prove drainage to be feasible. Supplemental water to be supplied to this area by the Upalco unit, Central Utah project, initial phase, will be about 0.36 acre-foot per acre but is not expected to alter the present stable drainage status of the area.

No drainage requirements are anticipated under potential development for the lands with shallow cobble which support a pasture-livestock economy. Drainage may be required for the remainder of the lands with deeper soils and correctible drainage deficiencies under ultimate phase development.

A reconnaissance land classification was made in 1962 and 1963 for the Upalco unit in which drainage-deficient land was placed in a class commensurate with the percent productivity. It was assumed that no drainage would be provided for the Upalco unit, thus a large part of these lands were placed in class 6. No formal drainage investigations were made in connection with the land classification since only small amounts of supplemental water will be provided under the Upalco unit. Prior to ultimate phase development a full-scale drainage investigation will be required. The presently drainage-deficient lands may be placed in a higher class if future investigations show drainage to be feasible as part of the ultimate phase.

Leland Bench Area

No presently irrigated lands and no known water tables exist on Leland Bench. Potential development with addition of irrigation water will probably create drainage problems because of the shallow depth of alluvial material over shale and the complex topographic conditions. Formal drainage investigations have not been conducted in the area.

Pariette Bench Area

As on the Leland Bench no presently irrigated lands are in this area and it is not known if ground water tables are present. Drainage problems are anticipated because shallow soils and lands in the area are in relatively large blocks and irrigated slopes would be long. The area has not been investigated for drainage characteristics.

Blue Bench Area

The Blue Bench area north of Duchesne contains no known ground water tables and no irrigation is presently practiced. The alluvial soils of this area are generally shallow to cobble and are often underlain at shallow depths by hardpan layers and at greater depths by shale material. Drainage problems are anticipated under these conditions with potential development. Formal drainage investigations have not been conducted in this area but will be required prior to development.

Fruitland Area

Approximately half of the small Fruitland area, or about 1,000 acres, is presently irrigated; however, little is known about the present drainage conditions. Some drainage problems are anticipated with potential development.

Strawberry River Area

The land classification of 1956 designated about 2,000 acres as irrigated. About 300 acres are considered to have high water tables. Additional drainage problems are anticipated with potentail development. Detailed drainage investigations have not been conducted in this area.

Nine Mile Area

Nine Mile is a small area containing about 1,000 acres of irrigated land, but little is known about the present drainage conditions or the ground water tables. Under further development many drainage problems are anticipated.

Wallsburg Area

Approximately 3,000 acres of land are irrigated in the Wallsburg area, including about 700 acres with high ground water tables. The established and stable livestock-pasture economy is well adapted to these conditions; hence no actual drainage deficiency exists. The natural drainage capacity of lands in this area is sufficient to assure continued good drainage status under the established economy with an additional water supply. No formal drainage investigations have been conducted in the area and only reconnaissance investigations will be required.

Bingham Area

No lands are presently irrigated in the Bingham area. The natural drainage is assumed to be good due to the deep, medium-textured soils and the favorable topography. The natural drainage is assumed to be adequate under potential development. Drainage problems are anticipated, however, on lower-lying irrigated lands adjacent to the eastern edge of the Bingham area. Project drainage will be required to protect these lower lands. Limited drainage investigations have been conducted by the Bureau on these lower lands, but no investigations have been made on the Bingham area.

Lehi Area

Approximately 24,000 acres of land in this area are presently irrigated, including about 4,500 acres with high ground water tables. Most of the high water table lands are located on the lower elevations adjacent to Utah Lake and are beneficially used for pasture production. The

1957 annual drainage report on the Provo River project estimated about 1,500 acres of project land affected by high ground water tables, most of which are located between the towns of Pleasant Grove and Lehi. About 850 acres were being drained through individual farm effort in cooperation with the Soil Conservation Service. No organized drainage program exists in the area.

Under ultimate development an increased water supply will probably aggravate the present drainage problems and may create additional deficiencies. The lands on higher elevations have better natural drainage capacity and will require less attention. Limited drainage investigations have been made of the area by the Bureau, including 33 water table observation wells drilled in 1960 and observed until March 1963. Soil Conservation Service personnel have helped farmers with drainage problems on an individual farm basis. No large-scale drainage investigations have been made.

Cedar Valley Area

Cedar Valley is a closed basin and the surface runoff collects in the low central part of the valley where it evaporates. The only drainage deficiencies evident are in the topographic lows. About 2,000 acres are presently irrigated around the periphery of the valley from surface sources, and a considerable area of unknown acreage is irrigated by pumping from ground water wells. The impact of this ground water development on the water table behavior in the area is also unknown.

The lack of natural outlets for surface and subsurface water will create a major problem to the lower portions of the valley. Full-scale irrigation development would increase the amount of valley low land submerged by the collection of runoff and surface waste. This would require detailed drainage investigations prior to development.

Cherry Valley Area

No lands are presently irrigated in Cherry Valley. No drainage investigations have been conducted and the depths to ground water tables are unknown. Drainage problems are anticipated with development due to fine textures of the soil and the relatively flat topography.

Dog Valley Area

Dog Valley is a small valley containing no presently irrigated land. Depths to ground water tables are unknown since drainage investigations have not been made of this area; however, some drainage problems are anticipated with development.

South Juab Area

Approximately 8,000 acres are presently irrigated in the South Juab area. No drainage investigations have been conducted; thus little is known of the depths to ground water tables or other drainage conditions. No drainage problems are anticipated on alluvial fan soils around the periphery of the valley. Deficiencies will probably occur on the valley floor with development. These will be determined by future detailed investigations.

Tintic Valley Area

No lands are presently irrigated in Tintic Valley. Little is known about the drainage conditions or ground water tables since no drainage investigations have been conducted in the area, but some drainage problems are anticipated with irrigation development.

Holden-Fillmore Area

The 1939-40 land survey indicated about 164,000 acres of arable land in this area, of which about 23,000 acres are presently irrigated. The arable land is situated primarily on the alluvial fans along the east side of the valley. The fans have good natural drainage except at the toes where the soil is thin over lacustrine deposits of the valley floor. It is estimated that about 5,000 acres of presently irrigated land may have high water tables. Some potentially arable land lies on the valley floor, and high water tables and highly alkaline conditions are evident on these fine-textured lacustrine soils. With irrigation development it is anticipated that a comprehensive drainage system will be required for the valley floor lands. The natural drainage capacity will probably be adequate on most of the alluvial fans.

Upper Sevier Area

A reconnaissance survey made by the Bureau of Reclamation in 1964 shows approximately 40,000 acres of irrigated land along the Upper Sevier River. Of this amount about 10,000 acres are surface irrigated or subirrigated pasture land, most of which has a high ground water table.

It is anticipated that under ultimate development drainage will have to be provided for part of these high water table lands and for some lands adjacent to the high water table area. Lands on the alluvial fans of the valley slopes will be relatively free of drainage problems.

No drainage investigations of this area are available at the present time. The U.S. Department of Agriculture, including the Soil Conservation Service, Economic Research Service, Forest Service, and other Federal and State cooperative agencies are currently conducting an investigation of the Sevier River Basin for inventory purposes. Results of this investigation are not yet available except for some irrigated and high water table acreages and crop use. The report is scheduled for completion in 1966.

Central Sevier Area

Of the 62,000 acres of irrigated land in the area, about 12,000 acres are pasture land, generally with fluctuating high water tables containing varying amounts of soluble salts. These drainage-deficient lands are confined primarily to the valley floors. Lands on the sloping alluvial fans have good natural drainage capacity. Utah Agricultural Experiment Station Bulletin No. 333, January 1949, reports 10 drainage districts organized in the valley from 1916 to 1924 containing a total of 21,000 acres, but only 16,000 acres were provided with drains. Two of the districts installed no drains, two districts were dissolved, two are inactive, leaving only four active districts.

Additional drains may be required on the low lands with further development, but the alluvial fans are not expected to require artificial subsurface drainage. No detailed drainage investigations are available for this area. The U.S. Department of Agriculture report scheduled for 1966 on the Sevier River Basin should provide some useful information.

Sevier Bridge Pump Area

This area contains no presently irrigated lands. Depths to water tables are unknown and no evident drainage deficiencies exist. It is doubtful that major drainage problems would accompany ultimate development; however, detailed drainage investigations will be required.

Delta Area

Approximately 60,000 acres of land in this area are irrigated with an inadequate water supply. A long history of drainage problems exists for these lands due primarily to extremely flat surface gradients with little or no natural drainage capacity. According to Experiment Station Bulletin No. 333, approximately 81,000 acres are within four drainage districts, of which about 47,000 acres have regularly participated in bond payments. About 21,000 acres in the districts have been abandoned because of water shortages, salinity, drainage deficiencies, or other reasons for which tax payments became delinquent.

About 600 miles of closed drains were installed from 1914 to 1918 after the drainage districts were organized. Most of these drains were effective during the first few years but later became inoperative due to faulty design or construction, lack of maintenance, and in some cases drains were purposely plugged to conserve water in the low water years during the 1930's. During the 1940's and early 1950's the area received a better than average water supply which again created many drainage problems. As a result, during this period approximately 250 miles of open drains were installed or rehabilitated. Although this amount of artificial drainage appeared to maintain reasonable crop production, it is believed that there still exists a sizable drainage deficiency in the area during good water years. The past 10 years in the Delta area represent a dry cycle during which the existing drainage facilities have been adequate for controlling ground water levels.

Additional drainage problems are anticipated with ultimate development, particularly on lands not now adequately drained. Artificial subsurface drainage of the lands is possible but will require adequate investigation, design, construction, and good maintenance practices in order to effectively control the water tables and provide the proper leaching of salts from the soils.

The Bureau of Reclamation began initial phase drainage investigations in 1964 in the area. These investigations are scheduled for completion in 1966. Some research on drainage has been done by other agencies, but it is limited to local areas and is incomplete.

San Pitch River Area

Drainage characteristics and requirements are reported in more detail in the Price and San Pitch River Basins report of December 1964. The Colorado River-Great Basin survey of the area shows about 106,000 acres of irrigated land, of which about 64,000 acres have favorable natural drainage conditions and about 42,000 acres have drainage deficiencies of varying degrees. The drainage-deficient lands are located on the low area along the valley bottom and on the lower edges of the alluvial fans near the transition zone between the fans and the valley bottom. Valley bottom lands between Ephraim and Manti are usually inundated during the early spring runoff. These lands tend to be saline with salinity increasing toward the south end of the valley.

Ultimate phase development with increased water use would not seriously affect present drainage-deficient lands. Higher water tables would be maintained for a longer period and at a higher level. The drainage-deficient area would probably be expanded as the high water table extends to adjacent areas.

Drainage of much of the valley bottom land would not be practicable because of the lack of gradients and outlets. The productive wet meadow lands, however, complement the livestock economy of the San Pitch River Basin. Detailed investigations will be required to determine the extent to which drainage would be feasible.

Price River Area

The Price River area drainage discussion is also included in the Price and San Pitch River Basin report.

The old Colorado River survey designated about 17,000 acres as irrigated land. Since that survey the irrigated acreage has been reduced to about 13,200 acres, of which about 600 acres have drainage deficiencies and consequently are affected by salt accumulations.

The drainage-deficient lands are usually in small scattered tracts at the foot of alluvial slopes where water accumulates from higher irrigated lands. Seepage water from irrigation canals and ditches also contributes to the water tables. These lands are used primarily as wet meadow pasture and produce low-value salt or wire grass. Drainage of these small areas would be difficult and would upset the present land use pattern and practices.

CHAPTER VI

MUNICIPAL AND INDUSTRIAL WATER

Introduction

The availability and cost of municipal and industrial water appear to be major factors in determining the future rate and extent of growth and industrial expansion in Utah. Municipal and industrial requirements have expanded rapidly in the past two decades as a result of population increase, industrial expansion, the discovery and development of natural resources, and commercial growth. This increase has been especially pronounced along the Wasatch Front including Salt Lake, Davis, Weber, and Utah Counties and is rapidly depleting water supplies to the extent that some systems presently experience shortages in dry years. Other systems have only a small reserve of water for future growth. Limited opportunities exist to extend local supplies by installing regulation storage, developing additional ground water, converting irrigation supplies to municipal and industrial use, and other local developments. The remaining undeveloped supplies appear inadequate when compared to mounting requirements. Without substantial quantities of additional water supplies a rigid ceiling will eventually impose itself upon the growth and resource development of the state.

Continued future expansion appears to be dependent upon the Central Utah project since it is the most promising source of water to satisfy the growing requirements. The Bonneville unit of the Central Utah project will provide 79,000 acre-feet of municipal and industrial water for delivery along the Wasatch Front from Salt Lake City on the north to Nephi on the south. This water should be available by about 1975 to supplement local supplies until ultimate phase water can be developed. The ultimate phase would provide larger quantities of water to a greater part of the State, including counties in Uinta and Bonneville Basins.

The Bureau of Economic and Business Research, College of Business, University of Utah, has recently made a study of population trends and projected water requirements in Utah and adjacent areas for the Bureau of Reclamation. It was made as a basis for sound estimates of future population and other factors that affect municipal and industrial water requirements. The study is preliminary and will be reviewed and updated in the near future before it is finalized. The study develops population figures and municipal and industrial water requirements for the year 1960 and projections for the years 1980, 2000, and 2020.

Population Growth

Population projections made by the University of Utah evaluated such economic factors as location, availability of natural resources, and the tendency toward population concentration in urban or metropolitan areas. Projected growth is based on the assumption that adequate supplies of water will be available at a reasonable price. In making population projections, economists at the University analyzed historic trends of each county before applying the above economic factors. The results of this study for 19 counties in the potential ultimate phase area are shown on the following page. Numerically, Salt Lake, Weber, Utah, and Davis Counties show the largest projected growth, but percentage increases from 1960 to 2020 are greatest in Uintah, Davis, Salt Lake, and Utah Counties. New developments in oil, oil shale, phosphate, and an ever-increasing tourist business are expected to be the major stimulants in Uintah County. Continued industrial growth, closely following the historic pattern, is expected to account for increases in Salt Lake, Utah, Davis, and Weber Counties. The other 14 counties, with the exception of Carbon, will be stimulated by various types of small industry but for the most part will remain rural rather than urban, depending on an agricultural base. Carbon County is expected to grow in direct relationship to the coal industry. Utilization of coal for electric generation will be a major growth factor.

The projections indicate an average annual increase of 1.8 percent over the 1960 to 2020 period for the state which appears within reason when compared to the recent increase rate of about 2.6 percent per year. It should be recognized the projection data are preliminary and will be reviewed and adjusted periodically, especially as new developments occur.

A further projection and extension of population was made by Region 4 economists. In this study estimates made by the University of Utah were projected to the year 2050 using the 1980 to 2020 growth rate for each county. Population estimates were also made for 1970, 1990, and 2010 in an effort to show a decade growth pattern from 1960 to 2050. To make the data more pertinent hydrologically, population figures were developed for each river basin and subbasin on a county basis. A summary of this study is shown on page 117.

Bureau of Reclamation economists also estimated additional population growth resulting from development of specific and significantly new industrial expansion not adequately covered in the University of Utah study. The increase in specific developments included extraction of oil from the shale beds in Uintah County, increased coal industry for thermoelectric plants in the Carbon-Emery area and the Kaiparowits area in Kane County, and the production of marketable phosphate rock in Uintah County.

The estimated additional population associated with new industries for each county involved is shown on page 118.

University of Utah study
Potential Ultimate phase area - 1960 population and projected population data for years 1980, 2000, and 2020

County	1960 population	Projected population 1980	2000	2020	Percent increase 1960-2020
Beaver	4,331	4,705	5,145	5,653	31
Carbon	21,135	28,759	48,644	53,525	153
Davis	64,760	116,015	171,634	232,870	260
Duchesne	7,179	7,923	8,937	9,748	36
Emery	5,546	7,985	11,589	15,499	179
Garfield	3,577	4,376	6,225	7,615	113
Juab	4,597	5,925	7,093	8,116	76
Millard	7,866	8,871	9,570	10,060	28
Morgan	2,837	3,865	4,849	5,786	104
Piute	1,436	1,383	1,545	1,637	14
Salt Lake	383,035	633,332	893,315	1,157,698	202
Sanpete	11,053	11,645	12,713	13,451	22
Sevier	10,565	12,869	15,635	18,711	71
Summit	5,673	9,309	11,573	13,688	141
Tooele	17,868	29,100	37,144	43,428	143
Uintah	11,582	16,006	54,485	72,681	528
Utah	106,991	162,168	237,329	318,078	197
Wasatch	5,308	6,988	9,067	11,088	109
Weber	110,744	176,934	252,482	320,833	190
Total	786,083	1,248,158	1,798,974	2,320,165	195 (ave.)

Summary of population projection by river basin and counties without ma

Basin and county	1960	1970	1980	1990	2000
Colorado River Basin					
Green River Subbasin					
Green River Sub-subbasin					
Carbon County					
Duchesne County	100	100	100	100	200
Emery County	1,600	1,900	2,300	2,700	3,300
Uintah County	8,200	9,700	12,000	26,300	44,700
Total	9,900	11,700	14,400	29,100	48,200
San Rafael River Sub-subbasin					
Emery County	2,600	3,100	3,900	4,500	5,700
Price River Sub-subbasin					
Carbon County	21,100	24,000	28,800	36,000	48,600
Emery County	700	800	1,000	1,200	1,500
Utah County					
Wasatch County			100	100	100
Total	21,800	24,800	29,900	37,300	50,200
Duchesne River Sub-subbasin					
Duchesne County	7,100	7,400	7,800	8,100	8,700
Uintah County	3,000	3,500	4,000	6,000	9,000
Wasatch County					
Total	10,100	10,900	11,800	14,100	17,700
Bonneville Basin					
Sevier River Subbasin					
Beaver County	4,300	4,500	4,700	4,900	5,100
Garfield County	1,700	1,900	2,300	2,800	3,600
Juab County	3,600	4,100	4,800	5,100	5,900
Millard County	7,900	8,200	8,900	9,100	9,600
Piute County	1,400	1,400	1,400	1,400	1,600
Sanpete County	11,000	11,200	11,500	11,800	12,500
Sevier County	10,500	10,900	12,800	13,600	15,400
Total	40,400	42,200	46,400	48,700	53,700
Provo-Jordan Subbasin					
Juab County	500	500	600	600	600
Salt Lake County	383,000	490,000	633,300	740,000	893,200
Sanpete County	100	100	100	200	200
Utah County	107,000	132,000	162,200	192,000	237,300
Wasatch County	5,300	6,000	6,900	7,700	9,000
Total	495,900	628,600	803,100	940,500	1,140,300
West Desert Subbasin					
Juab County	500	500	500	600	600
Tooele County	17,900	23,000	29,100	32,000	37,100
Total	18,400	23,500	29,600	32,600	37,700
Weber River Subbasin					
Davis County	64,800	85,000	116,000	140,000	171,600
Morgan County	2,800	3,200	3,900	4,200	4,800
Summit County	5,500	7,000	9,100	9,900	11,300
Weber County	110,700	140,000	176,900	210,000	252,500
Total	183,800	235,200	305,900	364,100	440,200
Total all basins	782,900	980,000	1,245,000	1,470,900	1,793,700

ies without major resource development (rounded)

Year					
2000	2010	2020	2030	2040	2050
200	200	200	300	300	300
3,300	3,800	4,500	5,300	6,200	7,300
44,700	47,100	54,700	60,900	69,800	80,700
48,200	51,100	59,400	66,500	76,300	88,300
5,700	6,300	7,400	8,900	10,500	12,400
48,600	50,000	53,500	62,500	73,000	85,200
1,500	1,600	2,000	2,300	2,700	3,200
100	100	200	200	200	200
50,200	51,700	55,700	65,000	75,900	88,600
8,700	9,000	9,500	9,900	10,500	11,100
9,000	13,000	17,000	21,000	24,000	28,000
17,700	22,000	26,500	30,900	34,500	39,100
5,100	5,300	5,700	5,900	6,200	6,500
3,600	3,900	4,400	4,900	5,900	7,100
5,900	6,200	6,800	7,400	8,000	8,800
9,600	9,700	10,100	10,400	10,700	11,000
1,600	1,600	1,600	1,700	1,800	1,900
12,500	12,800	13,200	13,700	14,200	14,600
15,400	16,300	18,500	24,700	22,300	24,500
53.700	55.800	60.300	68.700	69.100	74.400
600	700	700	700	800	800
893,200	1,000,000	1,157,700	1,355,000	1,583,000	1,812,000
200	200	200	300	300	400
237,300	272,000	318,100	382,000	454,000	526,000
9,000	9,800	10,900	12,200	13,800	15,500
1,140,300	1,282,700	1,487,600	1,750,200	2,051,900	2,354,700
600	600	600	700	700	700
37,100	39,000	43,400	47,900	53,000	58,500
37,700	39,600	44,000	48,600	53,700	59,200
171,600	198,000	232,900	277,000	337,000	392,000
4,800	5,000	5,800	6,400	7,100	7,900
11,300	12,200	13,300	14,600	16,100	17,800
252,500	285,000	320,000	379,000	441,000	501,000
440,200	500,200	572,000	677,000	801,200	918,700
1,793,700	2,009,400	2,312,900	2,715,800	3,173,100	3,635,400

Population projection for specific industrial development

	Uintah County		Coal industry	
Year	Oil shale development	Phosphate production	Carbon-Emery Counties	Kane County
1960		500		
1970	25,000	1,000		4,000
1980	40,000	12,000		8,000
1990	40,000	15,000		19,000
2000	50,000	16,000	6,000	21,000
2010	50,000	17,000	11,000	21,000
2020	50,000	20,000	11,000	21,000
2030	60,000	20,000	21,000	21,000
2040	70,000	31,000	25,000	25,000
2050	80,000	32,000	32,000	25,000

The projected population data in the above tabulation are believed to be more speculative than the base population projection and should be compared periodically with actual developments and adjusted as necessary.

Water Requirements

In projecting tentative future requirements for municipal and industrial water use, the University of Utah considered present water use, local resources, present and potential industrial and related economic development, and population trends. Briefly summarized, the procedure for making water requirement estimates was to project employment and population and apply unit water requirements to determine water needs. The water requirements were computed in two parts, industrial water requirements and nonindustrial water requirements. Industrial water requirements were computed by multiplying a modified current water use per employee by the projected employment for each industry. The current use per employee was modified for projections on the basis that labor productivity will increase at a rate faster than the anticipated decrease in water use per unit of product. Water use per employee was assumed to increase 20 percent by 1980, an additional 10 percent by the year 2000, and an additional 5 percent by 2020. Water requirements for nonindustrial purposes including households, parks, schools, commercial establishments, etc., were assumed to increase primarily with population and were projected on the basis of population. The 1960 per capita daily water use for each county was modified for the years 1980, 2000, and 2020. An increase in daily use was assumed of 20 gallons per capita by 1980, an additional 10 gallons per capita by 2000, and an additional 10 gallons per capita by 2020. While the above was the general rule, modifications were made to conform with near average use except for local situations. The projections assume reasonably priced water would be available in sufficient quantities to meet all requirements. It should also be noted that requirements are based on total intake needs and do not allow for potential reuse of water within the system.

A summary of projected water requirements, developed by the University of Utah, is included on the following page for 19 counties in the potential ultimate phase area. The requirements are also shown graphically on page 121 to illustrate the relative magnitude of expected use by area.

The nonindustrial annual use rate per capita varies from about 0.17 acre-foot to about 0.50 acre-foot, depending on the county. In general the rural areas have a higher use rate because of increased irrigation use, stockwatering, and possibly the absence of water meters. The average nonindustrial use rate for the area is expected to increase from about 0.23 acre-foot per capita in 1960 to about 0.29 acre-foot per capita in the year 2020. The combined municipal and industrial use rate varies widely by county because of wide differences in industrial uses. The average annual combined use rate for the area is expected to increase from about 0.5 acre-foot per capita in 1960 to about 0.6 acre-foot per capita in the year 2020.

In addition to water requirements for the base population projection, Bureau of Reclamation economists have estimated water requirements for industrial growth not adequately covered under the base projection. The estimated additional water requirements are shown below by area and industry.

Additional water requirements for specific industrial development
(Unit--acre-feet)

	Uintah County		Kane County	Carbon-Emery Counties
Year	Oil shale1/	Phosphate2/	Coal industry3/	Coal industry3/
1960		1,000		
1970	20,000	2,000	40,000	
1980	30,000	3,000	80,000	
1990	30,000	4,000	185,000	
2000	40,000	7,000	205,000	60,000
2010	40,000	11,000	205,000	105,000
2020	40,000	17,000	205,000	105,000
2030	50,000	26,000	205,000	205,000
2040	50,000	40,000	245,000	245,000
2050	60,000	62,000	245,000	310,000

1/ Water requirements computed at 0.75 acre-foot per capita per year for combined municipal and industrial use.

2/ Based on a total municipal and industrial water requirement of 3.5 acre-feet per 1,000 tons of marketable phosphate rock.

3/ Based on a water requirement of 1/4 acre-foot per capita per year and 20,000 acre-feet per mission kilowatts of installed capacity.

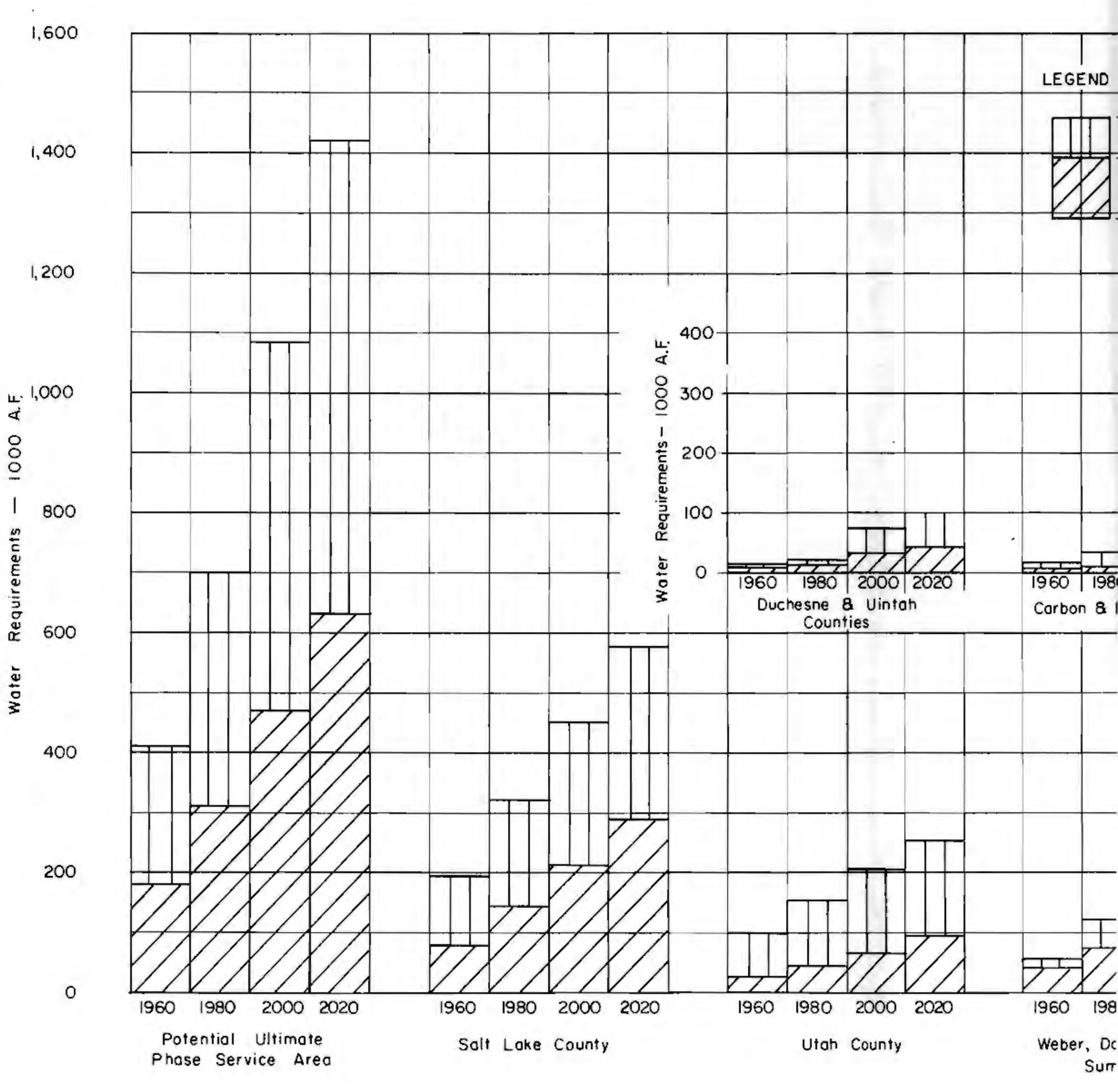
The water requirements should be reviewed periodically and revised as population changes occur or as water use rates change.

University of Utah study
Water requirement data for 1960 and projections for 19[illegible]
Unit: Acre-feet

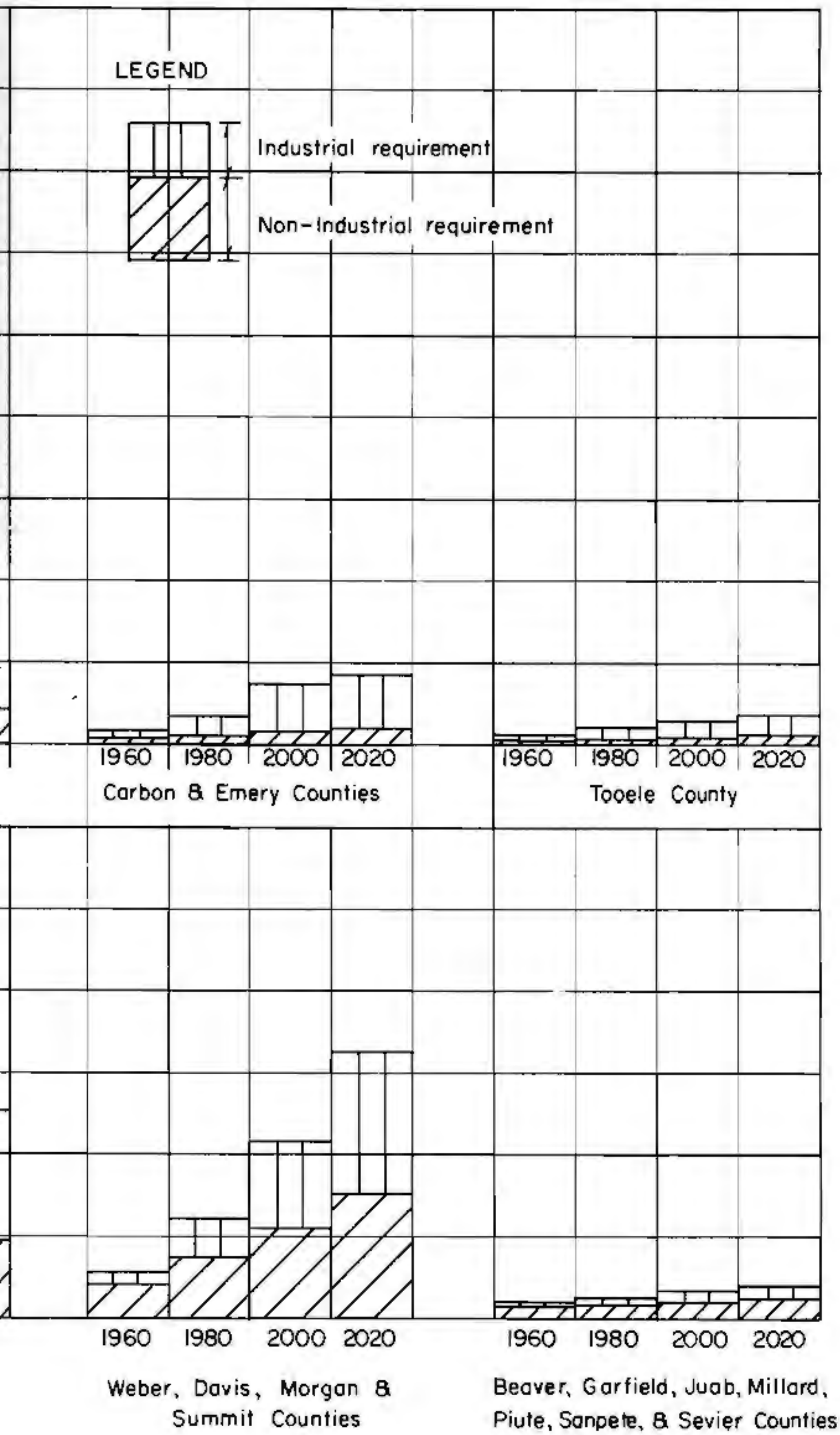
County	1960 Total M&I water	1960 Industrial water	1960 Nonindustrial water	1980 Total M&I water	1980 Industrial water	1980 Nonindustrial water	Total M&I water
Beaver	2,103	474	1,629	2,368	598	1,770	2,592
Carbon	12,656	7,498	5,158	24,305	16,635	7,670	54,770
Davis	18,103	6,948	11,155	48,727	25,477	23,250	88,713
Duchesne	2,146	281	1,865	2,624	386	2,238	3,109
Emery	4,400	3,242	1,158	8,482	6,639	1,843	17,110
Garfield	1,456	228	1,228	4,461	2,959	1,502	7,494
Juab	2,700	1,292	1,408	4,101	2,256	1,845	5,092
Millard	2,869	354	2,515	3,620	784	2,836	4,084
Morgan	1,256	159	1,097	1,876	382	1,494	2,468
Piute	424	18	406	458	52	406	546
Salt Lake	193,956	116,889	77,067	320,636	178,742	141,894	449,274
Sanpete	5,257	877	4,380	5,857	1,242	4,615	6,768
Sevier	5,215	857	4,358	6,735	1,426	5,309	8,435
Summit	3,195	476	2,719	5,330	868	4,462	6,670
Tooele	10,075	6,138	3,937	19,762	12,688	7,074	29,406
Uintah	9,684	3,672	6,012	16,653	8,346	8,307	69,321
Utah	98,074	71,430	26,644	153,688	109,741	43,947	205,751
Wasatch	3,438	1,687	1,751	5,064	2,759	2,305	5,780
Weber	32,986	7,297	25,689	66,059	21,041	45,018	119,025
Total	409,993	229,817	180,176	700,806	393,021	307,785	1,086,408

sity of Utah study
) and projections for 1980, 2000, and 2020
it: Acre-feet

	2000			2020		
nindustrial water	Total M&I water	Industrial water	Nonindustrial water	Total M&I water	Industrial water	Nonindustrial water
1,770	2,592	657	1,935	2,824	697	2,127
7,670	54,770	41,259	13,511	60,760	45,285	15,475
23,250	88,713	51,998	36,715	141,761	88,802	52,959
2,238	3,109	486	2,623	3,525	554	2,971
1,843	17,110	14,307	2,803	23,563	19,639	3,924
1,502	7,494	5,358	2,136	10,072	7,458	2,614
1,845	5,092	2,867	2,225	5,906	3,343	2,563
2,836	4,084	1,024	3,060	4,291	1,074	3,217
1,494	2,468	594	1,874	3,041	804	2,237
406	546	84	462	615	116	499
141,894	449,274	236,976	212,298	575,105	286,550	288,555
4,615	6,768	1,730	5,038	7,455	2,124	5,331
5,309	8,435	1,985	6,450	10,252	2,533	7,719
4,462	6,670	1,123	5,547	7,902	1,342	6,560
7,074	29,406	19,956	9,450	37,518	25,989	11,529
8,307	69,321	41,043	28,278	93,814	56,093	37,721
43,947	205,751	138,740	67,011	252,744	159,418	93,326
2,305	5,780	2,789	2,991	6,406	2,748	3,658
45,018	119,025	51,997	67,028	171,884	83,067	88,817
307,785	1,086,408	614,973	471,435	1,419,438	787,636	631,802



Water Requirements — 1000 A.F.
1,600
1,400
1,200
1,000
800
600
400
200
0
LEGEND
Water Requirements– 1000 A.F.
400
300
200
100
0
1960
1980
2000
2020
Duchesne & Uintah Counties
Potential Ultimate Phase Service Area
Salt Lake County
Utah County



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE-UTAH

PROJECTED WATER REQUIREMENTS
POTENTIAL ULTIMATE PHASE AREA
UNIVERSITY OF UTAH STUDY

289-418-27

Estimates of future water requirements are inherently uncertain, and time may prove them either too high or too low. The degree to which future needs can be met from sources other than Central Utah project is also uncertain. Increased requirements can be met to a limited extent by present supplies and local developments of surface and ground water. Some water now used for irrigation will likely become available for municipal and industrial use as residential and industrial developments spread into farmed areas. It is also expected water will be used more efficiently, and increased reuse will take place wherever practical. A cursory analysis to determine the extent increased requirements will depend on the ultimate phase was made considering the above factors. The analysis was made on a county or area basis and is summarized on the following page showing municipal and industrial water requirements, the present supply, the development from other sources, and the estimated amount required from the ultimate phase. The total anticipated ultimate phase municipal and industrial requirement is illustrated by the curve on page 124.

A brief description of the basis for the municipal and industrial estimates is presented in the following paragraphs for each county or area.

Salt Lake County

Salt Lake County is the most populous county in the State, and indications are that population and industrial growth will continue. The county presently uses about 47 percent of the total municipal and industrial water consumed in the 19-county ultimate phase area. Projections indicate the 1960 to 2020 increase in requirements for Salt Lake County to be about 380,000 acre-feet or about 37 percent of the total increase for the potential ultimate phase area.

Water supply studies to determine the adequacy of present supplies and local developments in meeting future municipal and industrial water requirements have been made by Berger Associates, Inc., and the Bureau of Reclamation.

Studies by Berger Associates, Inc.

Studies made by a private engineering firm, Berger Associates, Inc., are included in reports of 1962 and 1964 to the Salt Lake City Metropolitan Water District. These reports include considerable data regarding water supply, water rights, present facilities, etc., and include recommendations for local development to extend present water supplies. Since the studies were made for the Metropolitan Water District, only the water supply available to public systems and the public supply requirements were considered. The requirements were computed at a rate of 0.24 acre-foot per capita per year which has been the current use

Summary sheet

Municipal and industrial water requirements and water supply analysis

Unit: 1,000 AF

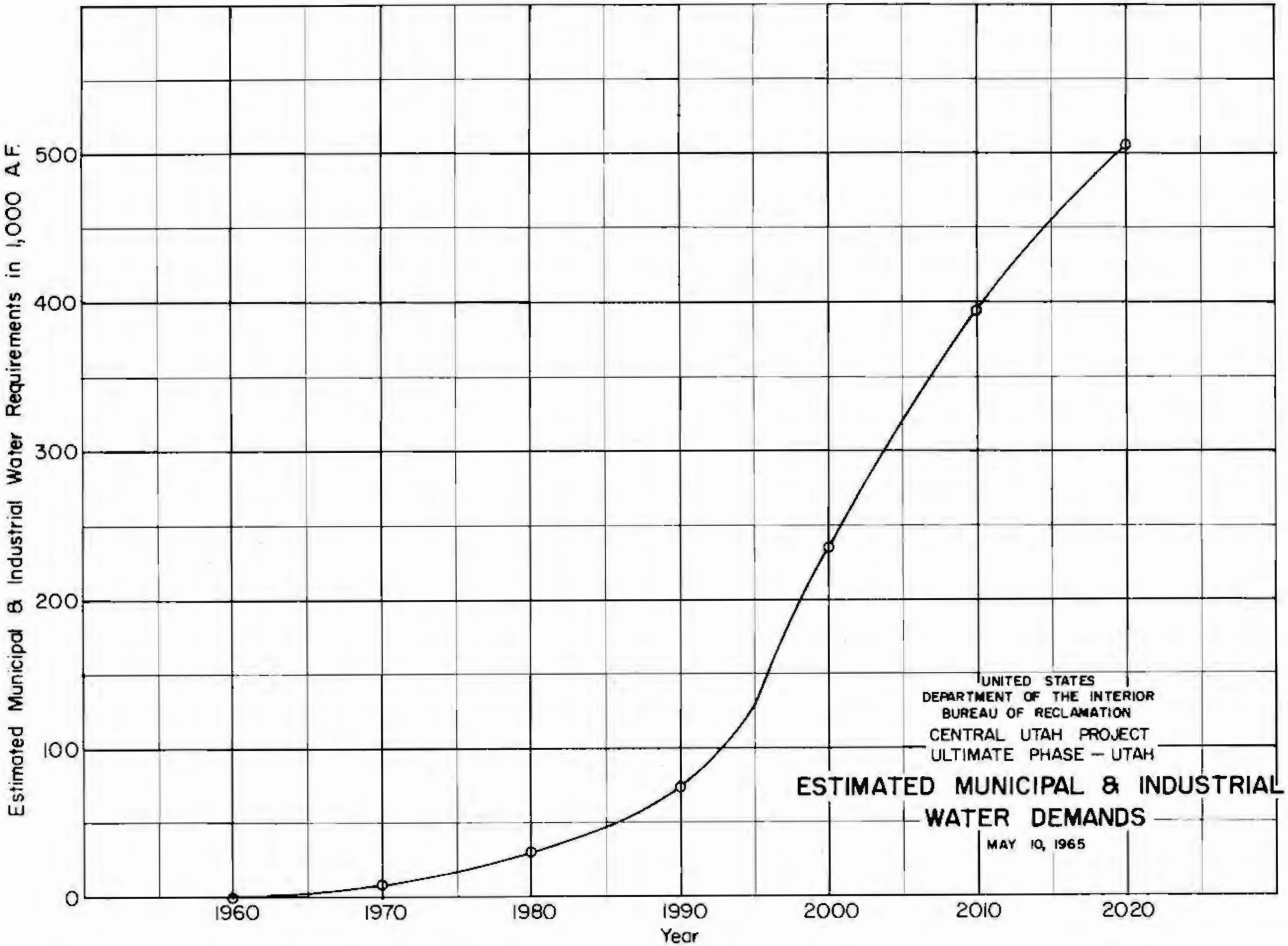
Year	Item	Salt Lake County	Utah County	Weber R. service area	Duchesne & Uintah County1/	Carbon & Emery County1/	Sevier R. area & Juab Cty.	Tooele County	Wasatch County	Total
1960										
	M&I water requirement	194	98	56	13	17	20	10	3	411
1980										
	M&I water requirement	321	154	122	53	33	28	20	5	736
	Present supply2/	194	98	56	13	17	20	10	3	411
	Local development3/	80	43	5	4	10	7	7	2	158
	Other development4/	0	0	39	4	0	0	0	0	43
	Increased reuse	22	2	22	6	3	1	3	0	59
	Bonneville unit	25	11	0	0	0	0	0	0	36
	Ultimate phase	0	0	0	26	3	0	0	0	29
2000										
	M&I water requirement	449	206	217	120	132	35	29	6	1,194
	Present supply2/	194	98	56	13	17	20	10	3	411
	Local development3/	120	43	5	8	10	8	8	3	205
	Other development4/	0	0	102	4	0	0	0	0	106
	Increased reuse	32	12	54	18	23	1	5	0	145
	Bonneville unit	64	25	0	0	0	2	0	0	91
	Ultimate phase	39	28	0	77	82	4	6	0	236
2020										
	M&I water requirement	576	253	325	155	189	41	38	6	1,583
	Present supply2/	194	98	56	13	17	20	10	3	411
	Local development3/	135	47	5	8	10	8	10	3	226
	Other development4/	0	0	106	4	0	0	0	0	110
	Increased reuse	58	19	90	27	34	2	7	0	237
	Bonneville unit	64	27	0	0	0	2	0	0	93
	Ultimate phase	125	62	68	103	128	9	11	0	506

1/ Requirements include industrial use anticipated over and above University of Utah projection.

2/ It was assumed the 1960 requirements could be adequately served by present supplies.

3/ Includes present local reserves and local increased supplies due to local development and irrigation conversion.

4/ Includes increased supplies developed by Bureau projects including Weber Basin project, Bear River project, and Jensen unit.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE – UTAH

ESTIMATED MUNICIPAL & INDUSTRIAL WATER DEMANDS

MAY 10, 1965

289–418–26

rate for the past several years. It is pointed out in the reports that should large industries be willing to pay the municipal rate for water, demands would increase accordingly and result in an increased depletion of existing supplies.

Three water supply studies were made by Berger Associates, Inc., to determine the maximum population which could be furnished a dependable water supply in the metropolitan service area (Salt Lake County population less 108,000 people presently supplied by wells and independent systems). The studies were based on coordinated use of all sources of water supply and indicate the increased yield associated with certain local development. The water supply for the studies included the portion of natural flow from mountain streams to which Salt Lake City has a right; estimated safe yield from wells owned or utilized by Salt Lake City, the Metropolitan Water District, and Salt Lake County Conservation District; existing rights of the Metropolitan Water District in the Provo River project and supplies made available by local regulation storage. Study No. 1 includes a 50,000-acre-foot reservoir on Dell Creek with variable reservation for flood control, a diversion conduit from Lambs Fork, and tunnels from Emigration and Mill Creeks. Study No. 2 includes a potential reservoir on Big Cottonwood Creek of 60,000-acre-foot capacity, a potential reservoir on Little Cottonwood Creek of 50,000-acre-foot capacity, increased use of mountain streams to which it is estimated Salt Lake City will acquire rights in the future, and the 50,000-acre-foot Little Dell Reservoir included in Study No. 1.

Study No. 3 uses the same data and facilities as Study No. 2 and 50,000 acre-feet of water annually from the Bonneville unit. Studies Nos. 1 and 2 cover the 1929-44 period, and Study No. 3 covers the 1921-63 period. Average annual yields from the various sources of water supply and the corresponding population supported are shown below.

(Unit--acre-feet)

Sources of supply	Average annual yield for period of study		
	Study No. 1 1/(550,000 population)	Study No. 2 1/(720,000 population)	Study No. 3 1/(930,000 population)
Mountain streams (direct)	71,400	68,200	80,900
Wells	13,600	16,900	17,200
Provo River project	44,300	58,100	54,500
Little Dell Reservoir	2,700	4,000	3,000
Big Cottonwood Reservoir		14,300	9,500
Little Cottonwood Reservoir		11,300	8,100
Central Utah project (Bonneville unit)			50,000
Total	132,000	172,800	223,200
Water supply unused or spilled			
Mountain streams and reservoirs	19,100	7,900	5,800
Deer Creek Reservoir	13,200	100	2,300

1/ Population supported based on 0.24 ac.-ft. per capita per year.

The period of critical water supply for the studies was the 1934-35 period which required considerable carryover storage to satisfy requirements. The tabulation below shows the contribution to water supply during the 1934-35 period as determined from the studies.

(Unit--acre-feet)

Source of supply	Average annual yield during 1934-35		
	Study No. 1	Study No. 2	Study No. 3
Mountain streams	50,500	50,100	55,800
Wells	8,000	9,000	9,000
Provo River project	47,500	34,700	34,300
Little Dell Reservoir	26,000	27,000	23,100
Big Cottonwood Reservoir		26,600	27,800
Little Cottonwood Reservoir		25,400	23,200
Central Utah project (Bonneville unit)			50,000
Total	132,000	172,800	223,200

The studies indicate the storage on the Cottonwood Creeks would increase the annual water yield by about 40,000 acre-feet, and the Bonneville unit would increase it by an additional 50,000 acre-feet. From the University of Utah population projection and considering about 100,000 people outside of the service area, the adequacy of the water supplies in meeting public supply requirements is shown below based on an annual use of 0.24 acre-feet per capita.

Study	Average yield (acre-feet)	Service area population	County population	Adequate supply to year
No. 1	132,000	550,000	650,000	1981
No. 2	172,800	720,000	820,000	1994
No. 3	223,200	932,000	1,030,000	2009

Bureau of Reclamation Studies

Water supply studies made to date involving Salt Lake and northern Utah Counties have been principally focused on public supply sources. These sources include Wasatch Front creeks, underground water, Provo River project water available to the Metropolitan Water District of Salt Lake City, Provo River water now used for irrigation that could be converted to municipal and industrial use in the future, and Bonneville unit water. It has been estimated that approximately 100,000 people in Salt Lake County and 69,000 people in northern Utah County receive water from small independent and rural systems that are in addition to the supply considered in the Bureau studies. A water supply study was also made for Utah Lake to assess the future impact on the lake of full conversion of irrigation to municipal and industrial use.

An analysis of industrial water requirements not supplied by public systems was made, and potential sources of nonpublic supply were considered only in a cursory manner. These are included following the public supply studies.

Public water supply studies.--Two sets of water supply studies have been completed to investigate (1) the effects of varying storage at Little Dell Reservoir for supplying Salt Lake County and (2) the effects of varying Jordanelle Reservoir storage for both northern Utah and Salt Lake Counties. In the discussion of various studies to follow, Little Dell Reservoir studies are for conditions of the present and near future (up to 1980 approximately) and include studies for storage reservoirs on Big and Little Cottonwood Creeks in addition to Little Dell Reservoir, and Jordanelle Reservoir studies are for the more distant future (from 1980 to 2035 approximately) with Little Dell Reservoir capacity set at 25,000 acre-feet of active capacity and full conversion of irrigation water to municipal and industrial use assumed.

Little Dell Reservoir.--The following possibilities were investigated along with Little Dell Reservoir storage: (1) modifications of facilities or operating criteria to extend local supplies, (2) potential development of regulation storage on Big and Little Cottonwood Creeks for presently unused flows, (3) coordinated use of local facilities and potential development with Bonneville unit, and (4) the effect of local development on the need for an additional aqueduct from Provo River into Salt Lake County. The studies were made on a monthly basis and are based on water supply data for the 1929 to 1935 period. This period was selected because it includes the period of lowest recorded runoff. Maximum water conservation and use were attempted by utilizing unregulated flows before drawing on ground water supplies or regulated sources.

Basic data developed by Berger Associates, Inc., and included in an engineering report to the Metropolitan Water District of Salt Lake City have been utilized as listed below.

Average annual water rights of Salt Lake City

Stream	Present rights (percent)	Estimated future rights (percent)
City Creek	100	100
Emigration Creek	99	100
Parley's Creek	87	87
Mill Creek	60	80
Big Cottonwood Creek	75	85
Little Cottonwood Creek	50	70

Water treatment facilities and capacities

Location	Design capacity (cfs)	Hydraulic capacity (cfs)
City Creek	23	31
Big Cottonwood Creek	50	65
Little Cottonwood Creek	155	232
Parley's Creek	50	62

Well data

Owner	Installed capacity (cfs)
Salt Lake City	98
Metropolitan District	11
County Conservancy District	38
Total	147

Monthly distribution of annual demand

Month	Percent	Month	Percent
Oct.	6.9	Apr.	6.4
Nov.	4.9	May	9.6
Dec.	4.9	June	14.0
Jan.	4.9	July	16.0
Feb.	4.2	Aug.	13.8
Mar.	4.8	Sep.	9.6
		Total	100.0

A summary of the water supply studies illustrating present conditions and potential local modifications and development is shown in the table on the following page. The summary gives a brief description of the water supply and facilities assumed for the particular plan. Also shown are the yield, water utilization, and the remaining unused supply.

The summary also shows the studies arranged into two plans with different sequences of development. Plan A starts with present conditions as illustrated by study 1 and considers in sequence the expanding of treatment facilities, the acquiring of additional water rights to the local streams, and the construction of Little Dell Reservoir, first to 25,000-acre-foot active capacity and then to 45,000 acre-feet. Plan B assumes Little Dell Reservoir would be constructed prior to expanding the treatment facilities or acquiring additional water rights. In this plan the capacity of the Salt Lake aqueduct is limited to 155 second-feet until the capacity of the Little Cottonwood treatment plant is enlarged in the seventh step of the sequence (study No. 6). A discussion of the studies follows.

Study No. 1 is based on present conditions. The water supply was limited by present water rights and design capacities of existing treatment

Summary of Salt Lak
Present conditi

Study number	1	2	3	4
Plan A sequence of development	1	2	3	4
Plan B sequence of development	1	2		
Facilities and water supply				
Mountain Dell Reservoir active capacity (AF)	3,000	3,000	3,000	3,00
Little Dell Reservoir active capacity (AF)				
Salt Lake aqueduct capacity (cfs)	155	155	175	17
Water rights	Present	Present	Present	Prese
Treatment facilities	Present	Present	Expanded	Expand
Yield of wells	1/	1/		
Yield (1000 AF)	96	108	112	11
Utilization of water supply, 1929-1935 average (1000 AF)				
Salt Lake County streams	52	53	53	6
Utilization of wells	11	13	13	1
Provo River project deliveries	33	42	45	4
Mountain Dell Reservoir releases	0	0	1	
Little Dell Reservoir releases	-	-	-	
Unused water supply, 1930-1935 average (1000 AF)				
Remaining Salt Lake County flow	24	23	23	1
Remaining Provo River project water	21	12	9	1

1/ In study No. 1 the supply available from wells was varied from 9000 acre-feet in the 1
other studies used 13,000 acre-feet from wells for all years.

Summary of Salt Lake County water supply studies
Present conditions and local development

2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	
2				7	8	9	10	3
3,000	3,000	3,000	3,000					
				25,000	25,000	45,000	45,000	25,0
155	175	175	175	175	175	175	175	1
Present	Present	Present	Future	Present	Future	Present	Future	Prese
Present 1/	Expanded	Expanded	Expanded	Expanded	Expanded	Expanded	Expanded	Prese
108	112	118	123	127	134	135	142	11
53	53	61	69	61	69	62	70	1
13	13	13	13	13	13	13	13	1
42	45	43	40	48	47	51	50	5
0	1	1	1	-	-	-	-	
-	-	-	-	5	6	9	9	
23	23	11	15	9	13	7	11	2
12	9	11	14	6	7	3	4	

ied from 9000 acre-feet in the low water years of 1931, 1934, 1935 up to 18,000 acre-feet in the other

8	9	10	11	12	13
8	9				
9	10	3	4	5	6
45,000	45,000	25,000	25,000	45,000	45,000
175	175	155	155	155	155
Present	Future	Present	Future	Present	Future
Expanded	Expanded	Present	Present	Present	Present
135	142	118	125	128	138
62	70	48	57	56	61
13	13	13	13	13	13
51	50	51	48	51	49
-	-	-	-	-	-
9	9	6	7	8	10
7	11	24	28	14	19
3	4	3	6	2	5

,000 acre-feet in the other years which it could be used. The facilities. Ground water use was varied from 9,000 acre-feet per annum in 1931, 1934, and 1935 up to 18,000 acre-feet in the other years. The monthly use of ground water varied from 2,000 acre-feet in years of low yield to 4,000 acre-feet in the other years. The yield of study No. 1 as indicated is 96,000 acre-feet per year. The remaining unused supply is relatively large and indicates the treatment facilities limit the yield. Study No. 2 is similar to the first, except that ground water use was about 13,000 acre-feet each year with a maximum monthly use rate of 4,000 acre-feet. The resulting yield was 108,000 acre-feet with the increase primarily attributable to increased use of water available from the Provo River project. This is made possible by the increased demand using more of the Provo River project water, leaving less holdover water in Deer Creek Reservoir, and consequently less spill from the reservoir during high runoff years.

Study No. 3 illustrates a yield of 112,000 acre-feet assuming the Salt Lake aqueduct would convey 175 second-feet and the Little Cottonwood treatment facility would be expanded to a capacity of 195 second-feet including 20 second-feet from Little Cottonwood Creek in the summer months. Study No. 4 is based on the assumption treatment facilities would be adequate to permit full use of the supply available within the demand pattern. New treatment facilities would be required on Emigration and Mill Creeks, and existing facilities would require expansion. The yield associated with this study is 118,000 acre-feet per year.

Study No. 5 is based on acquiring additional water rights as well as adequate treatment facilities. It indicates a yield of 123,000 acre-feet or an increase of 5,000 acre-feet attributable to conversion of water from irrigation use.

Studies Nos. 6, 7, 8, and 9 were made to determine the overall yield expected by including storage at Little Dell Reservoir subsequent to the previously mentioned improvements. Studies Nos. 6 and 7 are based on 25,000-acre-foot active storage capacity considering present and future water rights, respectively; and studies Nos. 8 and 9 are for 45,000-acre-foot active capacity assuming present and future water rights, respectively. The increase in yield for the smaller Little Dell Reservoir is about 9,000 acre-feet based on present water rights and about 11,000 acre-feet considering future rights. The 45,000-acre-foot reservoir would yield 17,000 to 19,000 acre-feet per year based on present and future rights, respectively.

Studies Nos. 10, 11, 12, and 13 were made for the second sequence of development and show the yield considering present treatment facilities with the modified ground water use and storage at Little Dell Reservoir. Studies Nos. 10 and 11 relate to a 25,000-acre-foot Little Dell Reservoir and indicate yields of 118,000 and 125,000 acre-feet for present and future water rights, respectively. The other studies relate to a 45,000-acre-foot Little Dell Reservoir and indicate corresponding yields of 128,000 and

133,000 acre-feet,respectively. The yield attributable to constructing Little Dell Reservoir prior to other development would be about 10,000 and 20,000 acre-feet, respectively, for a 25,000- and 45,000-acre-foot reservoir based on present water rights. Future water rights and regulation storage together would increase the yields by 17,000 and 25,000 acre-feet for the respective reservoir sizes.

Additional increases in yield under the sequence of Plan B would result by adding additional treatment facilities. The increase in yield associated with added treatment facilities can be found by comparing studies Nos. 3, 4, 5, or 6 with the corresponding studies Nos. 6, 7, 8, or 9.

The table on the following page is a summary comparing potential regulation storage in Salt Lake County at Little Dell, Big Cottonwood, and Little Cottonwood Creeks. The water supply and operating criteria for each study are essentially the same, making the studies comparable. The water supply is based on future local water rights with no capacity limitations at treatment plants. Salt Lake aqueduct capacity was assumed at 175 second-feet, and no Bonneville unit water was included. Ground water use was assumed at 13,000 acre-feet each year. Following a drawdown of the reservoirs, refilling up to within 5,000 acre-feet of capacity was made for flood control purposes in preference to using the flows directly. This criterion indicated that in most years 5,000 acre-feet is sufficient space to control surplus direct streamflow. In high runoff years, however, spilling occurred which could have been reduced by reserving more space for the spring runoff.

Capacity at Little Dell Reservoir was assumed in each study because of lower relative costs and the urgent need for flood control on that stream. It was also assumed storage at Big Cottonwood Creek would precede Little Cottonwood Creek regulation based on rough comparative cost estimates.

Increased yield attributable to various combinations of reservoir capacities can be obtained by comparing differences of yields from the table. The tabulated data do not include all possible combinations of storage but should suffice in giving direction for preliminary studies.

The table on page 133 includes results of certain studies from the previous table and parallel studies showing the use of 50,000 acre-feet of Bonneville unit water coordinated with local supplies and potential local development.

Studies No. 1-A, 2-A, and 3-A include the same facilities in Salt Lake County, but 2-A and 3-A reflect the use of Bonneville unit water. Study 2-A was based on delivery of 50,000 acre-feet of Bonneville unit water each year and as noted resulted in an average unused supply of

Summary of Salt Lake County water supply stu
Local regulation storage comparison without Bonne

Study number	1	2	3	
Facilities and water supply				
Little Dell Reservoir (active capacity - AF)	25,000	45,000	25,000	25,
Big Cottonwood Creek Reservoir (active capacity - AF)			25,000	50,
Little Cottonwood Creek Reservoir (active capacity - AF)				
Salt Lake aqueduct capacity	175	175	175	
Water rights	Future	Future	Future	Fut
Treatment facilities	Expanded	Expanded	Expanded	Expa
Yield (1000 AF)	134	142	145	
Utilization of water supply, 1929-1935 average (1000 AF)				
Salt Lake County streams	70	70	69	
Utilization of wells	13	13	13	
Provo River project deliveries	47	50	52	
Little Dell Reservoir releases	5	9	4	
Big Cottonwood Creek Reservoir releases	-	-	7	
Little Cottonwood Creek Reservoir releases	-	-	-	
Unused water supply, 1930-1935 average (1000 AF)				
Remaining Salt Lake County flow	13	11	8	
Remaining Provo River project water	7	4	2	

Lake County water supply studies
age comparison without Bonneville unit

2	3	4	5	6	7	8
5,000	25,000	25,000	45,000	45,000	25,000	25,000
	25,000	50,000	25,000	50,000	25,000	50,000
					25,000	50,000
175	175	175	175	175	175	175
uture	Future	Future	Future	Future	Future	Future
panded	Expanded	Expanded	Expanded	Expanded	Expanded	Expanded
142	145	152	151	159	150	163
70	69	68	68	68	68	59
13	13	13	13	13	13	13
50	52	53	53	53	53	53
9	4	5	7	8	4	4
-	7	13	10	17	6	17
-	-	-	-	-	6	16
11	8	7	8	7	7	1
4	2	0	0	0	0	0

Summary of Salt Lake County water supply studies
Local regulation storage with Bonneville unit

Study number	1-A	2-A	3-A	4-A	5-A	
Facilities and water supply						
Little Dell Reservoir active capacity (AF)	25,000	25,000	25,000	45,000	45,000	45
Big Cottonwood Creek Reservoir active capacity (AF)						25
Little Cottonwood Creek Reservoir active capacity (AF)						
Water rights	Future	Future	Future	Future	Future	Fu
Treatment facilities	Expanded	Expanded	Expanded	Expanded	Expanded	Exp
Salt Lake aqueduct capacity (cfs)	175	175	175	175	175	
Yield (1000 AF)	134	191	200	142	201	
Utilization of supply, 1929-1935 average (1000 AF)						
Salt Lake County streams	70	79	80	70	80	
Utilization of wells	13	13	13	13	13	
Provo River project deliveries	47	44	54	50	53	
Bonneville unit deliveries	-	50	48	-	47	
Little Dell Reservoir releases	5	5	5	9	8	
Big Cottonwood Creek Reservoir releases	-	-	-	-	-	
Little Cottonwood Creek Reservoir releases	-	-	-	-	-	
Unused supply, 1930-1935 average (1000 AF)						
Remaining Salt Lake County flow	13	5	3	11	4	
Remaining Provo River project water	7	9	0	4	0	
Required carryover in Jordanelle Reservoir (AF)	-	0	20,000	-	-	

studies
e unit

5-A	6-A	7-A	8-A	9-A	10-A	11-A
,000	45,000	45,000	25,000	25,000	25,000	25,000
	25,000	25,000	25,000	25,000	25,000	25,000
					25,000	25,000
ture	Future	Future	Future	Future	Future	Future
anded	Expanded	Expanded	Expanded	Expanded	Expanded	Expanded
175	175	175	175	175	175	175
201	151	204	145	202	150	206
80	68	73	69	77	68	78
13	13	13	13	13	13	13
53	53	53	52	53	53	53
47	-	48	-	49	-	49
8	7	9	4	4	4	4
-	10	8	7	6	6	5
-	-	-	-	-	6	4
4	8	2	8	3	7	1
0	1	0	2	0	0	0
-	-	0	-	0	-	0

14,000 acre-feet. Study 3-A was based on delivering the Bonneville unit water on a variable annual rate which would require additional regulation in Jordanelle Reservoir of about 20,000 acre-feet. The increase in yield over study No. 2-A is about 8,000 acre-feet per year. All other studies, Nos. 4-A and 5-A, 6-A and 7-A, etc., illustrate conditions without and with Bonneville unit for specific facilities. In these studies the Bonneville unit water deliveries were made on a variable basis; however, with the assumed storage in Salt Lake County little if any added carryover space would be needed in Jordanelle Reservoir.

A comparison of the two previous tables indicates only small increases in yields can be obtained by constructing local storage subsequent to Bonneville unit deliveries. The apparent reason is that as the demand increases more direct flow is usable under the demand curve. Increases in yields above that provided by a 25,000-acre-foot Little Dell Reservoir used in connection with Bonneville unit water are largely accounted for by the increase in carryover into the study period. It appears the benefits of local storage in Salt Lake County for storage above 25,000 to 50,000 acre-feet are relatively minor from a water supply standpoint. There may be value however in constructing joint storage for peaking purposes, emergency supplies, flood control, and recreation. Additional study would be required to investigate the possibilities of such joint use.

The table on the following page summarizes a series of studies made to determine the limiting water yield assuming the Salt Lake aqueduct as the only conveyance facility for delivering Provo River project water and Bonneville unit water into Salt Lake County.

Study No. 1 is based on present water rights and is the same as study No. 4 in the table on page 129. In this particular study the addition of Bonneville unit water would not add to the yield because the Salt Lake aqueduct was at the 175-second-foot capacity during 3 months of 1934, and in these same months local streamflow and Mountain Dell Reservoir were used to the full extent. Additional local water rights, additional local storage, or an additional aqueduct into Salt Lake County are required to increase the yield.

Study No. 2 is based on future water rights and is identical to study No. 5, in the table on page 129. As in study No. 1, Bonneville unit water would not increase the yield unless local storage or an additional aqueduct into Salt Lake County were constructed.

Study No. 3 was based on the same local supply as study No. 2 but included the addition of 25,000 acre-feet of storage at Little Dell Reservoir. The limiting overall annual yield assuming the capacity of Salt Lake aqueduct at 175 second-feet is 161,000 acre-feet per year including an average of 14,000 acre-feet of usable Bonneville unit water.

Summary of Salt Lake aqueduct capacity studies

Study number	1	2	3	4	5	
Facilities and water supply						
Mountain Dell Reservoir active capacity (AF)	3,000	3,000	0	0	0	
Little Dell Reservoir active capacity (AF)	0	0	25,000	25,000	45,000	2
Big Cottonwood Creek Reservoir active capacity (AF)	0	0	0	0	0	2
Little Cottonwood Creek Reservoir active capacity (AF)	0	0	0	0	0	2
Salt Lake aqueduct capacity (cfs)	175	175	175	200	175	
Water rights	Present	Future	Future	Future	Future	F
Treatment facilities	Expanded	Expanded	Expanded	Expanded	Expanded	Ex
Yield (1000 AF)	118	123	161	175	182	
Utilization of water supply, 1929-1935 average (1000 AF)						
Salt Lake County streams	61	69	73	74	73	
Utilization of wells	13	13	13	13	13	
Provo River project deliveries	43	40	54	54	54	
Bonneville unit deliveries	0	0	14	26	28	
Mountain Dell Reservoir releases	1	1	0	0	0	
Little Dell Reservoir releases	0	0	7	8	14	
Big Cottonwood Creek Reservoir releases	0	0	-	-	-	
Little Cottonwood Creek Reservoir releases	0	0	-	-	-	
Unused water supply, 1930-1935 average (1000 AF)						
Remaining Salt Lake County flow	14	19	10	7	6	
Remaining Provo River project water	10	12	0	0	0	
Required carryover in Jordanelle Reservoir (AF)			35,000	33,000	30,000	2

es

3	4	5	6
0	0	0	0
25,000	25,000	45,000	25,000
0	0	0	25,000
0	0	0	25,000
175	200	175	175
Future Expanded	Future Expanded	Future Expanded	Future Expanded
161	175	182	204
73	74	73	56
13	13	13	13
54	54	54	54
14	26	28	50
0	0	0	0
7	8	14	3
-	-	-	14
-	-	-	14
10	7	6	0
0	0	0	0
35,000	33,000	30,000	25,000

Study No. 4 is similar to the previous study except the Salt Lake aqueduct capacity assumed is 200 second-feet. The resulting annual yield is 175,000 acre-feet, including 26,000 acre-feet of usable Bonneville unit water.

In studies Nos. 5 and 6 consideration was given to additional storage in Salt Lake County, and these studies illustrate that about 75,000 acre-feet of peaking storage capacity in Salt Lake County would eliminate the need for a second aqueduct to deliver the Bonneville unit supply. Added carryover space in Jordanelle Reservoir of about 25,000 acre-feet would be required to permit flexibility of use.

Jordanelle Reservoir.--The capacity of Jordanelle Reservoir was varied in the following studies to determine the breakpoints in the ratio of storage capacity to firm municipal and industrial yield for 3-to 14-year holdover storage periods. Provo Reservoir Canal was considered as the most economical supplement to the Salt Lake aqueduct as a conveyance facility, and its entire capacity of 350 second-feet near Jordan Narrows or an enlargement was used in each study. The studies were made on a monthly basis and cover the period from 1929 to 1942. This period was selected because it includes the period of lowest recorded runoff. Maximum water conservation and use were attempted by utilizing unregulated flows before drawing on ground water supplies or regulated sources. All flows of the Wasatch Front creeks and Provo River and its imports from the Weber and Duchesne Rivers were considered available for satisfying losses and demands.

A summary of the water supply studies illustrating conditions with the active capacity used in the August 1964 definite plan report (150,000 acre-feet) and projections up to full use of all available water is shown in the tabulation on the following page. The summary shows the facilities assumed and their size for each particular plan. Also shown are the yield, water utilization, and incremental storage and yield.

The following assumptions were made in all six studies shown in the summary table. Treatment plants were assumed built to sufficient capacity to adequately treat all the supply. Conveyance facilities were assumed to be available to transport the water from Little Dell Reservoir and from Jordan Narrows to points of use in Salt Lake County. Northern Utah County would be served by a separate aqueduct diverting from Provo River. Little Dell Reservoir would store flows of Little Dell Creek and of Lambs Creek by means of the Lambs Creek diversion conduit. Ground water and local surface supplies were estimated at 22,000 acre-feet annually in northern Utah County and 42,000 acre-feet annually in Salt Lake County. Capacity of the Salt Lake aqueduct was assumed as 175 second-feet. Deer Creek Reservoir with 150,000 acre-feet of active storage would be available for storage of project water.

Summary of water supply studies with Jordanelle Reservoir

Study number	1	2	3	4	5	6
Facilities and water supply						
Little Dell Reservoir active capacity (ac.-ft.)	25,000	25,000	25,000	25,000	25,000	25,000
Jordanelle Reservoir active capacity (ac.-ft.)	150,000	210,000	335,000	445,000	530,000	625,000
Salt Lake aqueduct capacity (c.f.s.)	175	175	175	175	175	175
Provo Reservoir Canal capacity (c.f.s.)	350	450	500	525	525	525
Yield of wells and local surface supplies						
In Salt Lake County	42,000	42,000	42,000	42,000	42,000	42,000
In northern Utah County	22,000	22,000	22,000	22,000	22,000	22,000
Yield (1,000 ac.-ft.)						
Salt Lake County	371	389	405	416	424	430
Northern Utah County	86	91	95	99	100	102
Utilization of water supply (1,000 ac.-ft.)						
Period of study	1929-36	1931-36	1930-36	1930-36	1930-42	1929-42
Salt Lake County streams	112	106	108	106	116	120
Wells and local surface supplies						
In Salt Lake County	42	42	42	42	42	42
In Northern Utah County	22	22	22	22	22	22
Provo River plus imports	281	310	328	345	344	348
Incremental storage capacity required in Jordanelle Reservoir (1,000 ac.-ft.)		60	125	110	85	95
Incremental municipal and industrial yield (1,000 ac.-ft.)		23	20	15	9	8
Incremental storage capacity to firm municipal and industrial yield ratio		2.6:1	6.2:1	7.3:1	9.4:1	11.9:1

Study No. 1 is based on Jordanelle Reservoir capacity of 150,000 acre-feet. The carryover period for this study was from June 1933 to January 1936. Provo Reservoir Canal capacity of 350 second-feet was assumed.

Study No. 2 is based on Jordanelle Reservoir capacity of 210,000 acre-feet. The carryover period for this study was from June 1933 to January 1936. Provo Reservoir Canal capacity of 450 second-feet was assumed. By increasing the storage in Jordanelle Reservoir 60,000 acre-feet, an additional yield over study No. 1 of 23,000 acre-feet could be realized or an incremental storage capacity to firm municipal and industrial yield ratio of 2.6 to 1.

Study No. 3 is based on Jordanelle Reservoir capacity of 335,000 acre-feet. The carryover period for this study was from June 1930 to October 1935. Provo Reservoir Canal capacity of 500 second-feet was assumed. By increasing the storage in Jordanelle Reservoir 125,000 acre-feet, an additional yield over study No. 2 of 20,000 acre-feet could be realized or an incremental storage capacity to firm municipal and industrial yield ratio of 6.2 to 1.

Study No. 4 is based on Jordanelle Reservoir capacity of 445,000 acre-feet. The carryover period for this study was from June 1929 to January 1936. Provo Reservoir Canal capacity of 525 second-feet was assumed. By increasing the storage in Jordanelle Reservoir 110,000 acre-feet, an additional yield over study No. 3 of 15,000 acre-feet could be realized or an incremental storage capacity to firm municipal and industrial yield ratio of 7.3 to 1.

Study No. 5 is based on Jordanelle Reservoir capacity of 530,000 acre-feet. The carryover period for this study was from June 1929 to January 1941. Provo Reservoir Canal capacity of 525 second-feet was assumed. By increasing the storage in Jordanelle Reservoir 85,000 acre-feet, an additional yield over study No. 4 of 9,000 acre-feet could be realized or an incremental storage capacity to firm municipal and industrial yield ratio of 9.4 to 1.

Study No. 6 is based on Jordanelle Reservoir capacity of 625,000 acre-feet. This capacity represents about the maximum size of reservoir to fullycontrol the river and its imports. The carryover period for this study was from June 1929 to January 1941. Provo Reservoir Canal capacity of 525 second-feet was assumed. An increase in storage capacity of 95,000 acre-feet would yield an additional 8,000 acre-feet over study No. 5. The incremental storage capacity to firm municipal and industrial yield ratio between study No. 5 and study No. 6 would be 11.9 to 1.

<u>Utah Lake.</u>--The operation study of Utah Lake with Provo and Goshen Bays diked under conditions of full use of Provo River and its imports

for municipal and industrial use with Bonneville unit assumed in operation indicated that a firm annual yield of 205,000 acre-feet could be maintained. The effects of transforming the presently irrigated land adjacent to the lake in northern Utah County into homes, lawns, streets, business buildings, churches, parks, and industrial complexes in the way of increased runoff and return flows were assessed.

Industrial water supply studies.--Industrial water requirements in Salt Lake County are expected to increase from about 117,000 acre-feet per year in 1960 to about 287,000 acre-feet by 2020 or an increase of about 245 percent. The annual increase, if distributed uniformly over the 60-year pwriod, would be about 2,800 acre-feet per year.

Most of the water presently used for industrial purposes in Salt Lake County is developed independently. Sources of supply include streams emerging from the Wasatch Mountains, Jordan River, Utah Lake, and underground water developed by wells. Increased use in the near future will depend chiefly on water reserves, development of surplus flows and return flows to Jordan River, irrigation conversion, development of additional ground water, and the purchase of municipal water. The additional water for industrial use which can be developed from these sources has not been determined.

An investigation of water resources of Salt Lake County is presently underway as a joint effort of industrial users, municipalities and local districts, and State and Federal agencies; however, the investigation will not be completed for at least 3 years. When completed, the study will provide more reliable data with respect to the availability of surface and ground water which can be developed for municipal and industrial use in the area. Estimates of future water supply for industrial use have been made under population and water requirements subheading but should be used only as rough estimates and should be updated as additional data become available.

Surplus flow of the Jordan River was estimated by comparing recorded flows with estimated water requirements. The water requirements of the lower Jordan River were estimated by Karl Harris, Irrigation Engineer, Agricultural Research Service, Phoenix, Arizona. The requirements are included in Information Bulletin No. 13 published by the Utah State Engineer's Office and have been summarized on the following page.

Estimated water requirements for
lower Jordan area, Salt Lake County

Month	Requirement (cfs)				Total (1,000 ac.-ft.)
	Agri-culture	Game refuges	Industry1/	Total	
January			8	8	0.5
February			8	8	.5
March		370	8	378	23.4
April	27	370	8	405	24.3
May	27	200	8	235	14.6
June	27	200	8	235	14.1
July	27	200	8	235	14.6
August	20	150	8	178	11.0
September	20	86	8	114	6.8
October		31	8	39	2.4
November			8	8	.5
December			8	8	.5
Total					113.2

1/ Includes only the consumptive requirement of Utah Power & Light Company plants.

The water requirements have been compared with the flows of the Jordan River and Surplus Canal at 2100 South and the estimated inflow of Salt Lake City sewers. Comparisons are included below for average streamflow over the 1943 to 1962 period and for 1961 which is a low year approaching 1934 and 1935

(Unit--1,000 acre-feet)

Month	Jordan River and Surplus Canal 1942-63 average	Salt Lake City sewers	Lower Jordan River demands	Surplus flow	Shortages
October	19.0	2.8	2.4	19.4	
November	16.7	2.7	.5	18.9	
December	17.5	2.8	.5	19.8	
January	17.2	2.8	.5	19.5	
February	16.9	2.5	.5	18.9	
March	20.1	2.8	23.4		.5
April	20.4	2.7	24.3		1.2
May	25.5	2.8	14.6	13.7	
June	27.1	2.7	14.1	15.7	
July	18.2	2.8	14.6	6.4	
August	17.5	2.8	11.0	9.3	
September	18.9	2.7	6.8	14.8	
Total	235.0	32.9	113.2	156.4	1.7

(Unit--1,000 acre-feet)

Month	Jordan River and Surplus Canal 1961	Salt Lake City sewers	Lower Jordan River demands	Surplus flow	Shortages
October	15.1	2.8	2.3	15.5	
November	13.6	2.7	.5	15.8	
December	13.4	2.8	.5	15.7	
January	12.0	2.8	.5	14.3	
February	11.2	2.5	.5	13.2	
March	12.4	2.8	23.4		8.2
April	10.3	2.7	24.3		11.3
May	10.7	2.8	14.6		1.1
June	8.2	2.7	14.1		3.2
July	8.5	2.8	14.6		3.3
August	7.9	2.8	11.0		.3
September	8.7	2.7	6.8	4.6	
Total	132.0	32.9	113.2	79.1	27.4

The comparisons indicate about 80,000 acre-feet of surplus water on the lower Jordan River during a relatively low runoff year and about 156,000 acre-feet in an average year. There are, at the same time, substantial shortages noted in 1961 and minor shortages in an average year indicating seasonal and carryover regulation storage is required to increase the dependable yield. It is recommended regulation storage on the Jordan River be considered under ultimate phase to develop water for industrial use. Such storage could be used for flood control, recreation, and water quality control in addition to regulation.

Population and water requirements.--Population and water requirements for 1960 and projections for 1980, 2000, and 2020 were included in the University of Utah study and are tabulated below.

Salt Lake County population and water requirement data--
University of Utah study (figures rounded)

	1960	1980	2000	2020
Population	383,000	633,000	893,000	1,158,000
Nonindustrial water requirement (1,000 ac.-ft.)	77	142	212	288
Industrial water requirement (1,000 ac.-ft.)	117	179	237	287
Total municipal and industrial water requirement (1,000 ac.-ft.)	194	321	449	575

The study indicated 86,000 acre-feet of water delivered by public and rural domestic systems in 1960 indicating about 9,000 acre-feet of industrial water was delivered by public systems. Annual use per capita for nonindustrial requirements ranges from about 0.20 acre-foot in 1960 to 0.25-acre-foot in 2020. Public supply deliveries in 1960 were at an annual rate of about 0.225-acre-foot per capita. On the basis of the increasing nonindustrial requirements it appears annual public supply requirements will approach 0.28-acre-foot per capita by the year 2020.

The tabulation below shows the estimated public supply requirements and illustrates how such requirements may be supplied by presently available supplies, increased supplies made usable by local development, and Bonneville unit water. A remaining demand which may rely on ultimate phase development is also shown. It should be realized the local development assumed is for illustrative purposes only and should not be construed to represent or define local development. In addition all data, including requirements and potential supplies, should be reviewed periodically and adjusted as deemed appropriate.

Estimated public water requirements and
potential water supplies
Salt Lake County
(Unit--1,000 acre-feet)

	Year						
	1960	1970	1980	1990	2000	2010	2020
Nonindustrial requirement	77	109	142	176	212	250	289
Industrial requirement	9	13	17	20	25	29	34
Total public supply requirement	86	122	159	196	237	279	323
Present water supply	96	96	96	96	96	96	96
Increased supply, local development1/		26	38	38	38	38	38
Bonneville unit supply2/			25	62	64	64	64
Ultimate phase demand					39	81	125

1/ Assumes expansion of treatment facilities, conversion of water rights, and 25,000-acre-foot active capacity at Little Dell.

2/ Includes 50,000 acre-feet assumed available from Jordanelle and 14,000 acre-feet of presently available water made usable by importing Bonneville unit water.

Another tabulation is included on the following page to indicate projected industrial requirements. Remaining demands on the bottom line of the tabulation could likely be satisfied from increased municipal and industrial return flow and regulation storage on the Jordan River. An analysis of the future industrial supply has not been made at this time but should be made for inclusion into the 1966 supplemental definite plan report.

Estimated industrial water requirements
Salt Lake County
(Unit--1,000 acre-feet)

	Year						
	1960	1970	1980	1990	2000	2010	2020
Industrial requirement	117	148	179	208	237	263	287
Supplied from public systems	9	13	17	20	25	29	34
Remaining industrial requirement	108	135	162	188	212	234	253
Estimated present supply	120	120	120	120	120	120	120
Remaining demand		15	42	68	92	114	133

Utah County

Requirements for municipal and industrial water within Utah County have been rapidly increasing during the past two decades as a result of accelerating population growth, industrial expansion, and commercial development. Municipal and industrial water utilization for the county in 1960 was exceeded only by Salt Lake County and amounted to about 24 percent of the total use in the potential ultimate phase service area. Water requirement projections indicate Utah County's use will increase from 98,000 acre-feet in 1960 to about 253,000 acre-feet in 2020. In the year 2020 Utah County will use about 18 percent of the total municipal and industrial water consumption in the service area.

Water resources of Utah County consist of local streamflow, springs, ground water, and water delivered by the existing Strawberry Valley and Provo River projects. The water resources are currently nearing full utilization. Increased water use appears to depend on water reserves, conversion from irrigation use, and water imported under the Central Utah project.

Population and water requirements for 1960 and projections for 1980, 2000, and 2020 were included in the University of Utah study and are tabulated below.

Utah County population and water requirement data
University of Utah study (figures rounded)

	Year			
	1960	1980	2000	2020
Population	107,000	162,000	237,000	318,000
Nonindustrial water requirement (1,000 ac.-ft.)	26.6	43.9	67.0	93.3
Industrial water requirement (1,000 ac.-ft.)	71.4	109.7	138.7	159.4
Total municipal and industrial water requirement (1,000 ac.-ft.)	98.0	153.6	205.7	252.7

The study showed about 34,000 acre-feet of water delivered by public and rural domestic systems in 1960, indicating about 7,000 acre-feet of industrial water was delivered by public systems. Annual use per capita for nonindustrial requirements ranges from 0.25-acre-foot in 1960 to 0.29-acre-foot in 2020. Public supply deliveries in 1960 were at an annual rate of about 0.32 acre-foot per capita. On the basis of nonindustrial requirements, it appears public supply requirements would approach 0.37-acre-foot per capita per year by 2020. It is assumed, however, that more efficient use of water will take place and building lots will be smaller, thus offsetting increase in public requirements.

Utah County was considered in two parts in the Bonneville Unit Definite Plan Report. The area encompassing Provo and the municipalities to the north was considered North Utah County and the area south of Provo as South Utah County. The population and public supplied water requirements have been estimated for the two areas and are listed below.

Population and water requirement for Utah County

	1960	1980	2000	2020
South Utah County	27,000	37,000	52,000	68,000
Population				
Annual public water requirement (ac.-ft./capita)	.32	.32	.32	.32
Annual public water requirement (1,000 ac.-ft.)	8.70	11.80	16.60	21.80
North Utah County				
Population	80,000	125,000	185,000	250,000
Annual public water requirement (ac.-ft./capita)	.32	.32	.32	.32
Annual public water requirement (1,000 ac.-ft.)	25.60	40.00	59.20	80.00

It is estimated water reserves and local development will adequately serve the area until about 1975. Increased requirements beyond 1975 would depend primarily on water imported under Bonneville unit and ultimate phase of Central Utah project. The tabulation below derives potential demands on Central Utah project.

(Unit--1,000 acre-feet)

	Year					
	1975	1980	1990	2000	2010	2020
South Utah County						
Public supply requirement	11	12	14	17	19	22
Present supply and local conversion	11	11	11	12	12	12
Central Utah demand		1	3	5	7	10
North Utah County						
Public supply requirement	36	40	49	59	70	80
Present supply and local conversion	36	36	37	37	38	39
Central Utah demand		4	12	22	32	41

The industrial requirements which may require project water have been derived below. It is expected the requirements will be located primarily in North Utah County.

(Unit--1,000 acre-feet)
(Figures rounded)

	Year					
	1975	1980	1990	2000	2010	2020
Industrial water requirements	102	110	126	140	152	160
Independent industrial water requirements	94	102	118	132	144	152
Present supply and conversion	94	94	94	94	94	94
Remaining requirements		8	24	38	50	58
Estimated reuse		2	8	12	16	19
Central Utah demand		6	16	26	34	39

The demands for project water are rough estimates and will be revised as additional data are available or new trends develop. It was assumed the Bonneville unit water would be available in 1975 and would be initially needed the same year. Distribution of Bonneville unit water was assumed as contemplated in the definite plan report, 20,000 acre-feet to North Utah County and 7,500 acre-feet to South Utah County.

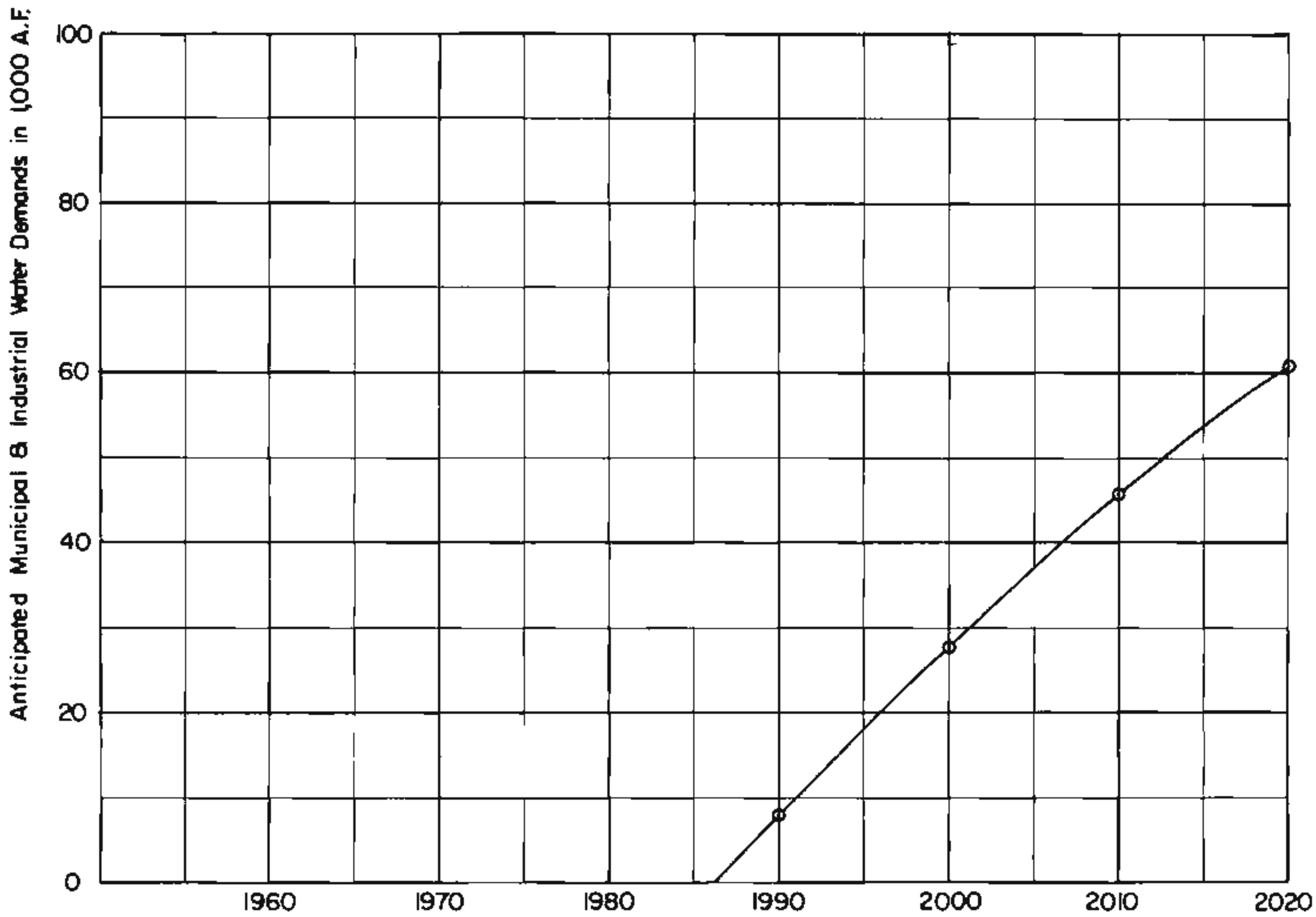
Central Utah project water requirements
Utah County
(Unit--1,000 acre-feet)

	1975	1980	1990	2000	2010	2020
South Utah County						
Public supply requirement		1	3	5	7	10
Bonneville unit		1	3	5	7	8
Ultimate phase						2
North Utah County						
Public supply requirement		4	12	22	32	41
Industrial requirement		6	16	26	34	39
Total		10	28	48	66	80
Bonneville unit		10	20	20	20	20
Ultimate phase			8	28	46	60

Depending on trends and the location of industry, it appears Bonneville unit water is adequate for South Utah County to about 2010. It appears North Utah County could require ultimate phase water prior to 1990. The total anticipated municipal and industrial requirement from the ultimate phase is illustrated by the curve on the following page for Utah County.

Davis, Weber, Morgan, and Summit Counties

Davis, Weber, Morgan, and Summit Counties have been considered jointly because they are all within the Weber River service area. The



UNITED STATES
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BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE-UTAH

MUNICIPAL & INDUSTRIAL WATER DEMANDS
UTAH COUNTY

MAY 10, 1968

289-418-25

four counties combined account for about 14 percent of the 1960 total municipal and industrial water consumption in the potential ultimate phase area. The anticipated use by 2020 is expected to approach 23 percent of the total for the entire service area, indicating above average growth is expected in the four-county area.

Expanding municipal and industrial water requirements are currently being met with ground water development and Weber Basin project supplies. It is anticipated the ground water will be fully developed in the near future and that increasing requirements will depend primarily on Weber Basin project supplies and irrigation conversion.

The Weber Basin project will provide about 60,000 acre-feet of municipal and industrial water for use in the area. The potential Bear River project currently being studied includes provisions to make about 22,000 acre-feet of water available to the area by 1975, and ultimately it is estimated about 68,000 acre-feet of Bear River project water could be delivered through various exchange agreements.

Population and water requirement data for 1960 and projections for 1980, 2000, and 2020 developed by the University of Utah are shown below for the four counties combined.

Projected population and water requirement data
(figures rounded)

	1960	1980	2000	2020
Population	184,000	306,000	441,000	573,000
Water requirements (1,000 ac.-ft.)				
Nonindustrial	41	74	111	151
Industrial	15	48	106	174
Total	56	122	217	325

Industrial water requirements increase at a rapid rate and account for about 60 percent of the total increase for the 1960 to 2020 period. Requirements tabulated above include total water intake needs and do not allow for reuse. It appears reasonable to assume a 50 percent return flow from increased nonindustrial use which could be used to meet industrial requirements not necessarily requiring high quality water. The table on the following page illustrates the use of return flow and derives the additional water supply required to meet increased demands during the 1960 to 2020 period after allowing for return flow.

Water requirements after allowing
for estimated usable return flow
(Unit--1,000 acre-feet)

	1960	1980	2000	2020
Nonindustrial requirement	41	74	111	151
Industrial requirement	15	48	106	174
Increased nonindustrial return flow		16	34	54
Remaining industrial requirement	15	32	72	120
Less 1960 supply	15	15	15	15
Remaining industrial requirement		17	57	105
2/3 remaining industrial requirement		12	38	70
Increased water requirement (Nonindustrial plus previous line)	1/42	86	149	221
Annual net use per capita (ac.-ft.)	0.23	0.28	0.34	0.39

1/ Includes 1,000 acre-feet public supplied industrial water.

The relatively high water requirements per capita in the four-county area reflect a projected industrial expansion which is higher than other counties.

The table below illustrates the adequacy of potential water supplies in meeting future requirements. Revisions will be considered as additional data become available.

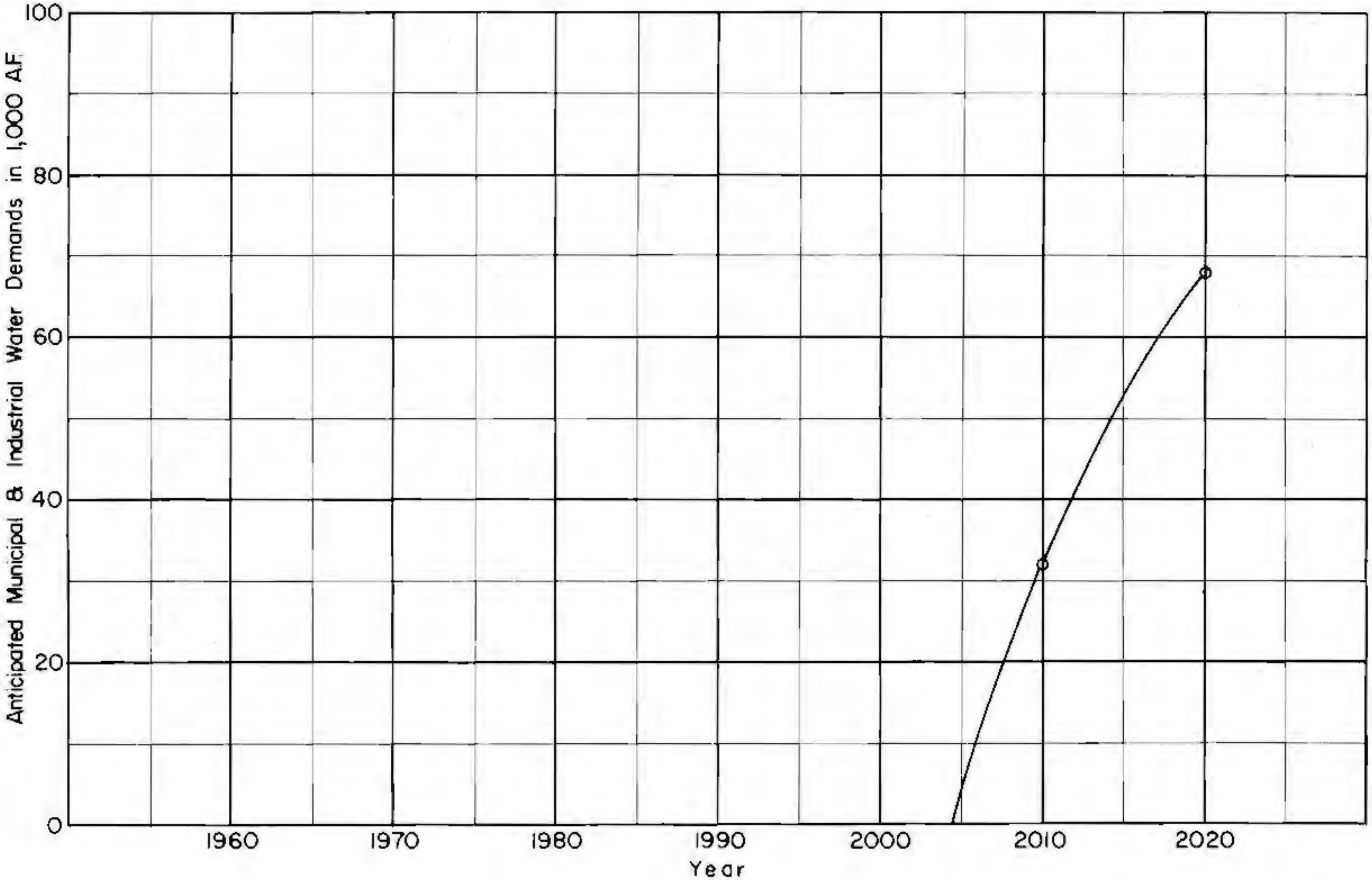
	1960	1970	1980	1990	2000	2010	2020
New water requirements		18	44	75	107	143	179
Weber Basin supply1/		14	38	38	38	38	38
Local development		4	5	5	5	5	5
Bear River project			1	32	64	68	68
Remaining demand						32	68

1/ Prior to 1960 about 22,000 acre-feet of Weber Basin project municipal and industrial water had been sold.

It appears the potential Bear River project would adequately supplement existing supplies to about the year 2000. In addition, irrigation conversion during the interim period and subsequent to 2000 would extend local supplies considerably. The total anticipated ultimate phase requirement for this area is illustrated on the following page.

Duchesne and Uintah Counties

The Uinta Basin, including Duchesne and Uintah Counties, has great potential for future growth because of the natural resources located in the area. Probably the greatest potential lies in the undeveloped oil shale deposits and the phosphate beds which cover large areas of Uintah County and extend into Duchesne County. Other potential growth is dependent on additional development of oil fields, timber industry, agriculture, recreation, and tourism.



UNITED STATES
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CENTRAL UTAH PROJECT
ULTIMATE PHASE-UTAH

MUNICIPAL & INDUSTRIAL WATER DEMANDS
DAVIS, WEBER, MORGAN, & SUMMIT COUNTIES

MAY 10, 1965

289-418-21

Based on the abundance of natural resources and other factors which influence growth and development, the population projection for Uintah County indicates it will experience the greatest percentage increase in population of any county within the Central Utah project area. The growth of Duchesne County is expected to be significantly below that of Uintah County.

Future growth and development in Uinta Basin are dependent on the availability of an adequate water supply to sustain growth. The water resources within the area, consisting of stream runoff and ground water, are currently being utilized for irrigation and municipal and industrial purposes. Additional local development is anticipated only in certain areas and will probably be undertaken as an integral part of the Central Utah project. The flows of Ashley Creek have been largely controlled and utilized by the recently completed Vernal unit of the Central Utah project. Other streams in the area are essentially utilized but will be developed further by constructing regulation storage under the Central Utah project. The Vernal unit of Central Utah project makes 1,600 acre-feet of water available for municipal and industrial purposes to the area around Vernal. Much of this water has already been used to supply current needs, and if the predicted growth of the area becomes a reality, the present municipal and industrial water supplies will become inadequate in a few years.

Future additional municipal and industrial water supplies appear to depend on acquiring irrigation water rights or obtaining water from the Central Utah project.

Population and water requirement data for 1960 and projections for 1980, 2000, and 2020 were included in the University of Utah study and are tabulated below.

Duchesne and Uintah Counties population and water requirement data (figures rounded)

	Year			
	1960	1980	2000	2020
Population	18,800	24,000	63,000	82,000
Nonindustrial water requirement (1,000 ac.-ft.)	7.9	10.6	30.9	40.7
Industrial water requirement (1,000 ac.-ft.)	3.9	8.7	41.5	56.6
Total water requirement (1,000 ac.-ft.)	11.8	19.3	72.4	97.3

In addition to water requirements developed in the mentioned study, Bureau of Reclamation economists have estimated water requirements for industrial growth not adequately covered under the base projection. Estimated additional water requirements for Uinta Basin are listed by decade on the following page.

Additional water requirements for specific
industrial development in Uinta Basin
(Unit--1,000 acre-feet)

Year	Oil shale	Phosphate	Total
1960	0	1	1
1970	20	2	22
1980	30	3	33
1990	30	4	34
2000	40	7	47
2010	40	11	51
2020	40	17	57
2030	50	26	76
2040	50	40	90
2050	60	62	122

The industrial development in Uinta Basin will likely be located considerable distance from existing municipalities and thus cannot rely on municipal return flows. It is estimated, however, about 20 percent of the industrial water could be reused. The tabulation below shows municipal and industrial water requirements after making allowance for reuse.

Total municipal and industrial water requirement for
Uinta Basin after allowing for estimated usable return flows
(Figures rounded)
(Unit--1,000 acre-feet)

	Year						
	1960	1970	1980	1990	2000	2010	2020
Nonindustrial requirement	8	9	11	19	31	37	41
Base industrial requirement	4	6	9	24	42	50	57
Additional industrial requirement	1	22	33	34	47	51	57
Total requirement	13	37	53	77	120	138	155
Estimated reuse	1	5	6	12	18	20	27
Net requirement	12	32	47	65	102	118	128

Present supplies were adequate to serve the 1960 requirements. Increased requirements beyond 1960 would rely on the Vernal unit supply and additional local development. The tabulation indicates the need for additional water supply by 1970 and points to the need for early construction of Jensen unit and ultimate phase to serve the area.

Estimated municipal and industrial water requirements
for Duchesne and Uintah Counties
(Unit--1,000 acre-feet)

	1960	1970	1980	1990	2000	2010	2020
Municipal and industrial requirement	12	32	47	65	102	118	128
Present supply	12	12	12	12	12	12	12
Local development and conversion		2	3	4	5	6	7
Vernal unit		2	2	2	2	2	2
Jensen unit and ultimate phase		16	30	47	81	98	107

It is currently estimated Jensen unit would develop about 4,000 acre-feet for municipal and industrial purposes; however, this could likely be increased if deemed necessary.

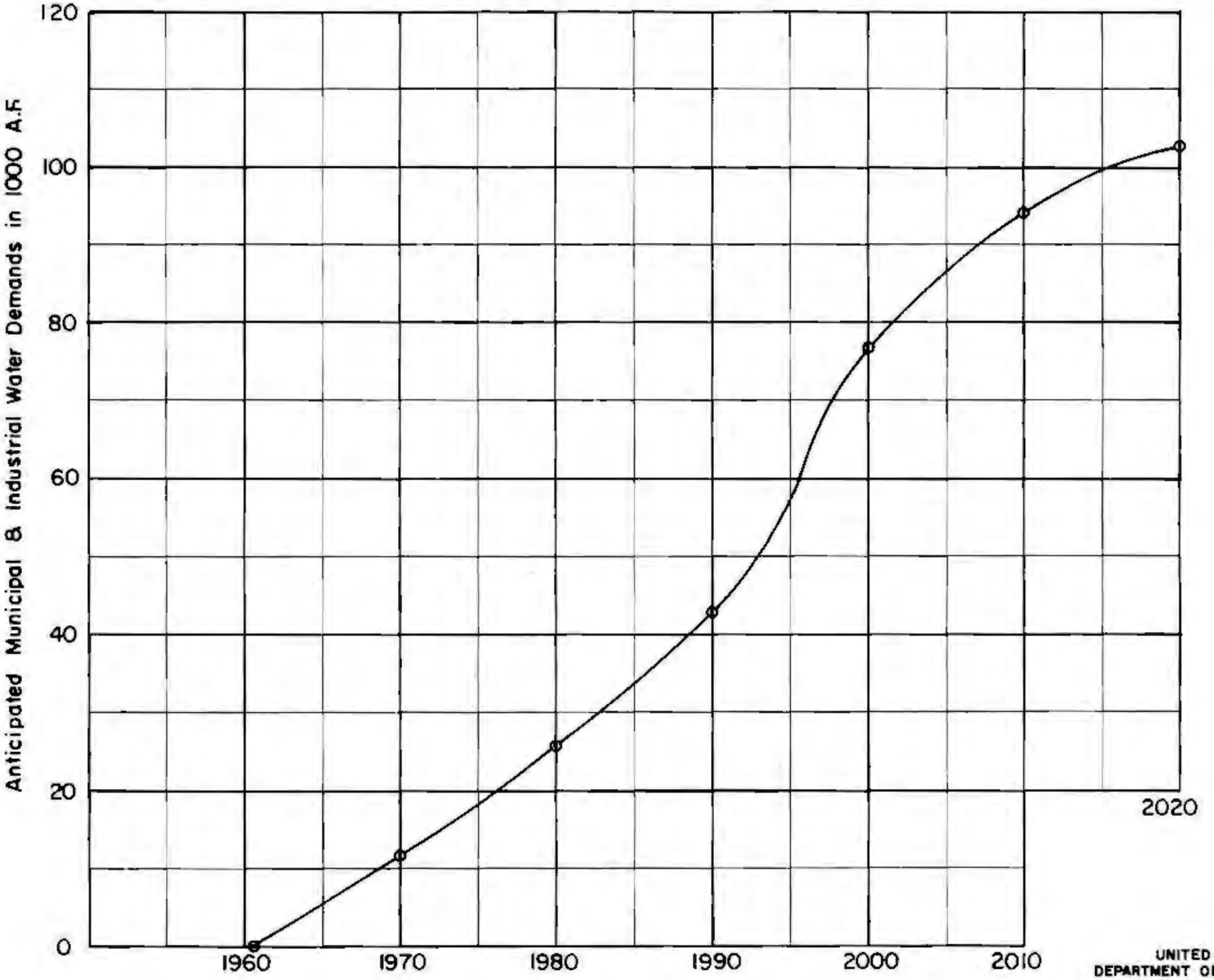
The curve on the following page illustrates the anticipated municipal and industrial requirement for the Uinta Basin area.

Carbon and Emery Counties

Future increases in municipal and industrial water requirements within Carbon and Emery Counties are principally dependent on expansion of coal mining and allied industries. The area contains vast deposits of good quality bituminous coal which is currently used in the steel industry, steam-electric generation, and for other purposes.

Expanded coal development will depend on a number of factors but one of the most important will be the availability of water. The water supply in the area is utilized to the extent that municipal and industrial users have periodically purchased stock in irrigation companies to obtain additional water.

Potential water development on the Price River and tributaries is discussed in a Bureau of Reclamation report, "Price and San Pitch River Basins, Utah," December 1964. The report points out the possibility of developing additional water on the lower Price River, part of which could be exchanged upstream to Scofield Reservoir. The development would include constructing storage at the Farnham site and possibly at the Woodside site to increase the annual water supply by about 40,000 acre-feet. The quality of water is questionable at the Farnham site and definitely is not suitable for municipal, irrigation, or most industrial uses at the Woodside site. In addition, the Woodside site is several miles from existing mines and industrial development. It was concluded in the report that some water could likely be developed at the Farnham site or other upstream sites but substantial increases in water supply will depend on importations into the basin. Possible sources of importation are the Green River and Strawberry Reservoir.



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ULTIMATE PHASE-UTAH

MUNICIPAL & INDUSTRIAL WATER DEMANDS
DUCHESNE & UINTAH COUNTIES

MAY 10, 1965

289-418-23

Population and water requirement data for 1960 and future projections from the University of Utah study are tabulated below for the two counties.

Carbon and Emery Counties
Population and water requirement data
(Figures rounded)

	Year			
	1960	1980	2000	2010
Population	26,700	36,700	60,200	69,000
Water requirements (1,000 ac.-ft.)				
Nonindustrial	6.4	9.6	16.3	19.4
Industrial	10.7	23.2	55.6	64.9
Total	17.1	32.8	71.9	84.3

Bureau of Reclamation economists have estimated additional water requirements for expansion not adequately covered in the University study. Estimated additional requirements are listed below by decade.

Year	(Unit--1,000 acre-feet) Additional industrial requirement
1990	
2000	60.0
2010	105.0
2020	105.0

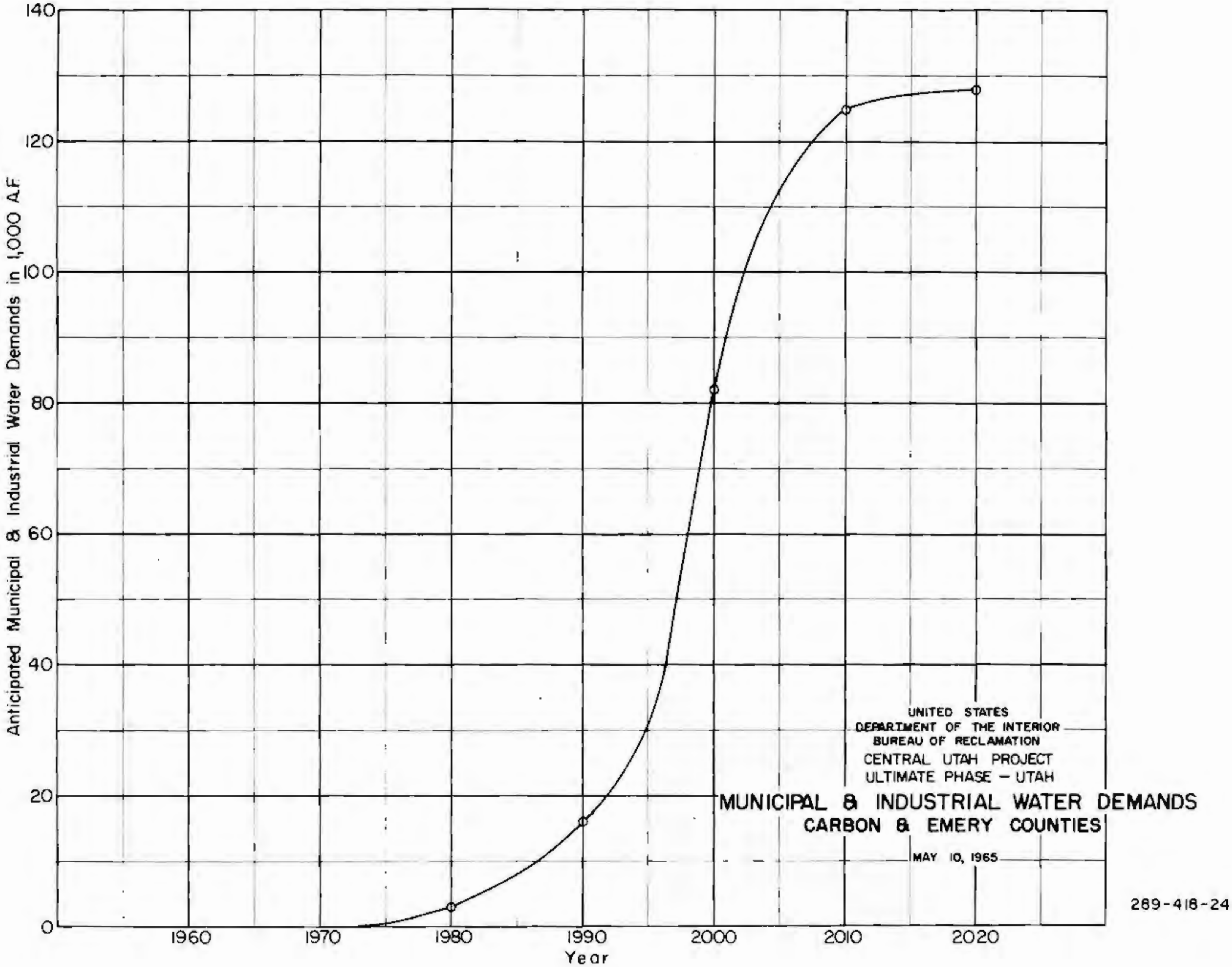
The industrial development will likely be located a considerable distance from municipalities and may be widely scattered, thus it is estimated only about 20 percent reuse could be realized.

The tabulation below derives the requirements which will likely depend on water developed by Central Utah project after allowing for estimated local development and reuse.

(Unit--1,000 acre-feet)

	1960	1970	1980	1990	2000	2010	2020
Total requirements	17	23	33	49	132	185	189
Present supply	17	17	17	17	17	17	17
Local development		5	10	10	10	10	10
Reuse		1	3	6	23	33	34
Central Utah project			3	16	82	125	128

Carbon and Emery Counties' anticipated municipal and industrial requirement from the ultimate phase is illustrated by the curve on the following page.


UNITED STATES
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CENTRAL UTAH PROJECT
ULTIMATE PHASE – UTAH
MUNICIPAL & INDUSTRIAL WATER DEMANDS
CARBON & EMERY COUNTIES
MAY 10, 1965
289-418-24
Anticipated Municipal & Industrial Water Demands in 1,000 A.F.
Year
0
20
40
60
80
100
120
140
1960
1970
1980
1990
2000
2010
2020

Sevier River Basin and Juab County

The counties comprising Sevier River Basin include Beaver, Garfield, Millard, Piute, Sanpete, and Sevier Counties. Juab County is included in this analysis because it is adjacent to the area and would likely be served water from the same conveyance system under Central Utah project.

Projected growth in Sevier River Basin and Juab County is primarily centered around agriculture but includes anticipated increases in light industries. Water resources in the area are essentially utilized at present for agricultural purposes. Increased municipal and industrial water supplies appear to depend on irrigation conversion or the importation of water under the Central Utah project.

Population and water requirement data for 1960 and future projections from the University of Utah study are tabulated below for Sevier River Basin and Juab County.

Population and water requirements
(Figures rounded)

	Year			
	1960	1980	2000	2020
Population	43,400	49,800	57,900	65,200
Water requirement (1,000 ac.-ft.)				
Nonindustrial	15.9	18.3	21.3	24.1
Industrial	4.1	9.3	13.7	17.3
Total	20.0	27.6	35.0	41.4

Usable return flow would be a comparatively small amount, due to the scattered nature of communities. It would likely be used for irrigation but additional municipal and industrial water could possible be diverted by exchange. Usable return flow is estimated to reduce demands on the project by about 20 percent.

It was assumed present water supplies and reserves would adequately serve the area until 1980, and only 80 percent of the increased demand beyond 1980 would require project water. Tabulated below are the estimated requirements which may depend on Central Utah project.

Potential Central Utah project
demand
(Unit--1,000 acre-feet)

Year	Demand
1980	
1990	2
2000	4
2010	7
2020	9

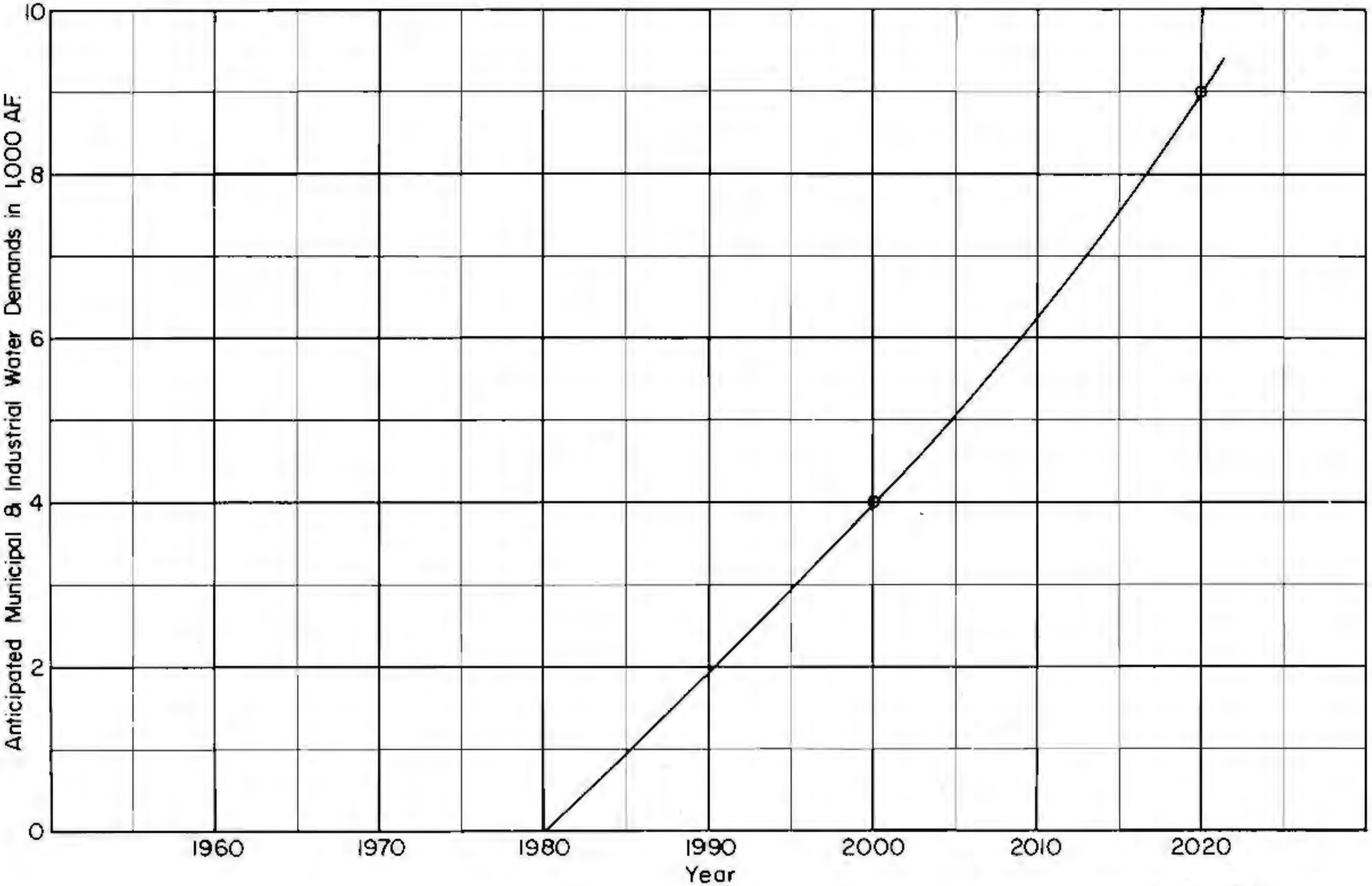
The municipal and industrial requirement for this area from the ultimate phase is illustrated by the curve on the following page.

Tooele and Wasatch Counties

Population and water requirement data for Tooele and Wasatch Counties compiled by the University of Utah have been tabulated below. The potential demand on ultimate phase for Tooele County will require additional investigation because of the distance involved in serving the area.

Population and water requirement data
(Figures rounded)

	Year			
	1960	1980	2000	2020
Population				
Tooele County	17,900	29,100	37,100	43,400
Wasatch County	5,300	7,000	9,100	11,100
Water requirements (1,000 ac.-ft.)				
Tooele County				
Nonindustrial	3.9	7.1	9.4	11.5
Industrial	6.1	12.7	20.0	26.0
Total	10.0	19.8	29.4	37.5
Wasatch County				
Nonindustrial	1.7	2.3	3.0	3.6
Industrial	1.7	2.8	2.8	2.8
Total	3.4	5.1	5.8	6.4



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
ULTIMATE PHASE — UTAH

MUNICIPAL & INDUSTRIAL WATER DEMANDS
BEAVER, GARFIELD, MILLARD, PIUTE, SANPETE, SEVIER & JUAB COUNTIES

MAY 10, 1965

289-418-22

CHAPTER VII

POWER

Introduction

Numerous potential hydroelectric and pumping developments may be associated with Central Utah project ultimate phase plans for developing and delivering water for irrigation, municipal, and industrial uses. Representative potential developments now recognized are summarized and described briefly in this chapter.

Power Requirements

Electric utilities in the United States have experienced a rate of growth such that they must plan and construct, on the average, one facility equal in size to the one in place every ten years. Rapid growth of this magnitude has been experienced in Utah and in the power market area of the Colorado River Storage project, comprising the States of Utah, Wyoming, Colorado, New Mexico, and southern Nevada. Federal Power Commission estimates of power requirements to be supplied by utilities in these areas are tabulated below to illustrate the continued rapid growth which may be expected.

	Power requirements			
	Peak demand (megawatts)		Energy requirements (million kw.-hrs.)	
Year	Utah	CRSP market area	Utah	CRSP market area
1955	507	2,515	2,637	13,518
1960	789	3,904	4,151	21,303
1970	1,445	7,258	7,710	39,966
1980	2,247	11,477	12,084	63,148

It is evident that large new sources of power generation must be planned and developed if the rapid growth forecast is to be met. Consideration should be given to various alternative sources of energy and sites for generation facilities.

There are large-scale resources of coal and oil shale in the Upper Colorado River Basin including areas of eastern Utah in the Central Utah project area. These resources are favorable to development of large mine-mouth fuel-electric powerplants. Some sites for mine-mouth plants are now being studied in connection with extra high voltage transmission to power-loads in California. In addition, the technology for nuclear-powered plants is advancing and forecasts have been made that this source of power will be competitive by 1970.

The bulk of the electrical power growth requirements will probably be met by large thermoelectric developments. These plants, however, operate best and most efficiently in a high plant factor base load operation. Hydroelectric plants are particularly adaptable to peaking operation since adjustments in generation can readily be made to meet load changes. A combination of thermoelectric and hydroelectric generation may most effectively and efficiently meet future anticipated load requirements. As loads increase in magnitude, pumped storage developments may be needed, involving pumping water to storage during off-peak hours of power use for release to generate power at the time of system peaks.

Potential hydroelectric resources in the project area should be investigated as a means of supplying part of the large amounts of power generation which will be required in future decades, as well as supplying power for project pumping plants. Particular consideration should be given to the utilization of hydroelectric resources for peaking operation.

Potential Hydroelectric Development

Potential hydroelectric developments are described under the general plan of water development with which they are associated or incidental to. Many of these developments are alternative to each other.

Comprehensive plan of 1951 authorizing report

This plan would divert south slope streams of the Uinta Range into a 90-mile-long Strawberry aqueduct at about 8,000 feet elevation. About 400,000 acre-feet would be diverted annually. The water would flow by gravity to the potential Strawberry Reservoir for storage. Releases from the reservoir would pass through Diamond Fork enroute to distribution in the Bonneville Basin. Water diverted from the Uinta Basin would be replaced and additional supplies developed by constructing the Flaming Gorge aqueduct for direct diversion from Flaming Gorge Reservoir to the Uinta Basin.

Diamond Fork Power System

The largest potential hydroelectric development associated with the authorizing report plan of 1951 is in the Diamond Fork area. The Diamond Fork power system as then presented included the following potential powerplants.

Powerplant	Nominal head (ft.)	Installed capacity (kw) Initial phase	Installed capacity (kw) Comprehensive plan1/	Average annual generation (million kw.-hrs.) Initial phase	Average annual generation (million kw.-hrs.) Comprehensive plan1/
Old West	329	9,000	9,000	46.6	46.6
Fifth Water	303		30,000		120.3
Hammock	1,460	40,000	160,000	240.2	789.7
Tanner	224	6,000	26,000	35.9	120.8
Castilla	400	6,000	6,000	48.3	48.3
Total	2/2,400	61,000	231,000	310.0	1,125.7

1/ Includes initial phase plan.
2/ Using average of Old West and Fifth Water heads.

The total average annual generation in excess of one billion kilowatt-hours representative of the potential of the Diamond Fork development with the water supply of the comprehensive plan of the 1951 report. The system, as indicated, would operate at an average annual plant factor of 55 percent. By utilizing daily regulating reservoirs and different conduit routings and powerplant sites in the same general area, peaking capacity could be added. Such changes were made in the initial phase plan adopted in the "Bonneville Unit Definite Plan Report," August 1964. It is expected that similar changes will be made in ultimate phase plans.

Potential ultimate phase powerplant sites in the Diamond Fork area are located at the outlet works of the potential Hayes and Monks Hollow dams.

Hayes Powerplant.--The Hayes Reservoir is planned for construction in the initial phase. A powerplant of 4,000-kilowatt capacity in the ultimate phase would produce about 14,000,000 kilowatt-hours annually with initial phase water distribution. The potential Hayes Powerplant supplants the Castilla Powerplant of earlier studies.

Monks Hollow Powerplant.--A peaking plant of 90,000 kilowatts and producing an average of 142,000,000 kilowatt-hours annually has been considered in past studies. The potential Monks Hollow Reservoir is not included in the initial phase plan.

Uinta Basin Powerplants

The comprehensive plan of development of the 1951 authorizing report included the Yellowstone and Whiterocks Powerplants. There are several other possible sites on tributary streams above the potential ultimate phase Strawberry aqueduct.

Yellowstone Powerplant.--This plant would be located at the outlet works of the potential Upper Yellowstone Dam on the Strawberry aqueduct.

The plant would utilize the head developed by the dam and the flows of Strawberry aqueduct from Little Brush Creek to Yellowstone Creek. Reconnaissance studies indicated that a plant of 11,000-kilowatt capacity would produce 40,000,000 kilowatt-hours.

Whiterocks Powerplant.--Located on the Whiterocks River at the diversion to the potential Strawberry aqueduct, this plant would develop a head of about 500 feet and an annual water supply of about 70,000 acre-feet. Preliminary studies showed that a plant of 7,000 kilowatts would produce 30,000,000 kilowatt-hours annually.

Other potential south slope Uinta powerplants.--Several other possible power sites are located at the diversions of Green River and Duchesne River tributaries to the potential Strawberry aqueduct. Preliminary estimates of these powerplants are summarized in the following tabulation.

Powerplant	Head (ft.)	Average annual water supply (ac.-ft.)	Capacity (kw.)	Average annual energy production (million kw.-hrs.)
Ashley	800	40,000	6,000	25
Dry Fork	2,000	22,000	8,000	34
Uinta	500	100,000	12,000	42
Upper Yellowstone1/	800	35,000	5,000	20
Lake Fork1/	600	65,000	7,000	30
Rock Creek1/	1,100	25,000	5,000	20

1/ Located in National Forest Wilderness area.

Green River Powerplants

Some alternative plans of water development involve direct diversion of water from the Green River. Large diversion dams compatible with power development would be required. Development of hydroelectric sites to provide power for extensive project pumping developments may also be economical. Several power sites have been recognized in past studies, including Echo Park, Split Mountain, and Gray Canyon. It should be noted that the Echo Park and Split Mountain sites are within the boundaries of the Dinosaur National Monument. Public Law 485, the authorizing act for the Colorado River Storage project and participating projects, states: "It is the intention of Congress that no dam or reservoir constructed under the authorization of the act shall be within any national park or monument." This may preclude any development at these two sites.

Echo Park

Echo Park Dam site is located on the Green River about 3 miles east of the Utah-Colorado state line and about 3 miles downstream from the confluence of the Yampa and Green rivers. Echo Park Powerplant would be located at the toe of the dam with an installed capacity of 200,000 kilowatts. Initially it would produce about 995,000,000 kilowatt-hours annually and with ultimate upstream depletions about 677,000,000 kilowatt-hours.

Split Mountain

Split Mountain Dam site is located on the Green River about 14 air miles east of Vernal, and the powerplant would be situated about 12 river miles downstream from the dam. With a capacity of 100,000 kilowatts the plant would produce about 710,000,000 kilowatt-hours annually under initial conditions and about 441,000,000 kilowatt-hours with ultimate upstream depletions.

Gray Canyon

Gray Canyon Dam would be located on the Green River about 4 miles upstream from the mouth of the Price River. Gray Canyon powerplant at the toe of the dam would have a capacity of 210,000 kilowatts. The plant would produce about 1,303,000,000 kilowatt-hours annually with initial conditions and 826,000,000 kilowatt-hours with ultimate upstream depletions.

An alternative to Gray Canyon Dam located downstream from the confluence of the Price and Green Rivers would have about the same power potential.

Other potential powerplants

The potential hydroelectric developments discussed in the preceding paragraphs are representative of the possibilities in the project area. Other alternative plans of water development, however, may include additional potential sites.

Alternatives involving diversion of water from Strawberry Reservoir to drainages other than Diamond Fork, including Tie Fork to Sanpete and Juab, Price River, or Daniels Creek to Provo River, may be considered. Potential power sites with the water supply involved and differences in elevation would be associated with such plans. In earlier studies planners have considered powerplant sites at Milburn and Nephi associated with one such plan.

Other powerplant possibilities could be associated with water distribution plans involving canal drops or regulating reservoirs. In early studies plants of this type were considered at Leamington and Sevier Bridge Reservoirs.

Pumped Storage Development

Numerous potential pumped storage sites are in the project area. The most favorable of these are considered to be in the Wasatch Front area due to proximity to powerloads. Development of large-scale mine-mouth fuel-electric plants in central and eastern Utah and construction of high voltage interregional transmission lines, however, may make potential developments of peaking power in other project areas attractive.

Development of peaking capacity with use of project water supply. as in the Diamond Fork area, is also a potentiality, possibly in combination with pumped storage. Other sites would probably have to be of the pure pumped storage class with self-contained water supply requiring only small amounts for makeup of losses and plant use.

Some pumped storage sites in the project area are described in the "Pumped Storage Investigations Preliminary Reconnaissance report," Region 4, March 1964.

Project Pumping

Cursory investigations indicate that project powerplants in the Central Utah project area would produce power in excess of the project pumping requirements. Extensive use of pumping is a potentiality in the various alternative plans of water development. Pumping plants now recognized are described briefly in the following paragraphs.

Comprehensive plan of 1951 authorizing report

Potential pumping plants included as part of the comprehensive plan of the 1951 report are the Blue Bench, Whiterocks-Neola, Altonah, Leota, and Holden plants. The Blue Bench plant would be located about 5 miles southwest of Upalco, Utah, and would pump water from the Flaming Gorge aqueduct to the Blue Bench during summer months for new land irrigation. The Whiterocks-Neola pumping plant would be located approximately $2\frac{1}{2}$ miles east of Whiterocks, Utah, and would pump water from the Flaming Gorge aqueduct to the Whiterocks-Neola Canal for irrigation. The Altonah pumping plant would pump replacement irrigation water from the Whiterocks-Neola Pump Canal about 9 miles southeast of Altonah, Utah, to lands above Mt. Emmons and Bluebell. The Leota pumping plant would be located north of the Leota Bottoms area, a flood plain of the Green River near Leota. Water would be pumped from the river via the service canal to lands too high to be reached by gravity flow from the river. The Bureau of Sport Fisheries and Wildlife is currently constructing a migratory bird refuge on lands that would be served by this plant which may preclude further development at this site. The Holden pumping plant, located about 7 miles northwest of Holden, Utah, would pump water from the Sevier Canal for irrigation of new lands in the vicinity of Holden and Fillmore. Details of the pumping plants follow.

Pumping plant	Blue Bench	Whiterocks-Neola	Altonah	Leota	Holden
Static lift (ft.)	414	558	167	20	255
Hydraulic capacity (c.f.s.)	293	275	120	35	240
Annual quantity pumped (ac.-ft.)	40,500	32,300	13,100	5,300	38,000
Installed capacity (kw)	16,000	23,000	2,800	115	9,000
Annual energy consumption (million kw.-hrs.)	45	30	5.6	0.2	15.7

Direct diversion from Green River plans

Several alternative plans of water development involving direct diversion of water from the Green River and export to the Bonneville Basin are potentialities. These could involve diversion from the Flaming Gorge Reservoir, the potential Echo Park or Gray Canyon Reservoir, or others. Extensive pumping could be associated with such developments.

The plants would operate near capacity a large part of the year. Pertinent data of these plants are given as follows to indicate somewhat the magnitude of pumping which may be required with the various potential plans of direct diversion from the Green River to the Bonneville Basin.

			Power requirements	
Pumping plant	Average head (ft.)	Hydraulic capacity (c.f.s)	Capacity (kw)	Annual energy (million kw.-hrs.)
Echo Park	133	1,800	31,100	190
Duchesne	286	1,800	61,600	406
Starvation No. 1	375	1,500	71,500	533
Starvation No. 2	410	1,500	65,000	583
Total	1,204		229,300	1,712

The same alternative plan, with greater scale of development than the 1951 comprehensive plan, would also include several pumping plants associated with water distribution in the Bonneville Basin. Data on these plants are shown in the following tabulation.

Pumping plant	Average head (ft.)	Amount pumped annually (ac.-ft.)	Power requirements Capacity (kw.)	Annual energy (million kw.-hrs.)
Sage Valley	200	21,300	2,500	5.5
Mona	306.5	42,860	24,300	16.8
Fayette No. 1	203.5	65,445	7,800	17.1
Fayette No. 2	61	14,220	500	1.1
Sevier Bridge	173	13,950	1,680	3.1
Holden-Fillmore No. 1	202	20,040	2,360	5.2
Holden-Fillmore No. 2	203	87,400	10,400	22.7
Holden-Fillmore No. 3	210	18,520	2,380	5.0
Total			51,920	76.5

The pumping plants listed above are somewhat representative of those possible with large-scale diversion from other points along the Green River for conveyance to the Bonneville Basin.

Unit pumping developments

Some potential pumping plants are located in the project area which could be developed as physically independent units separate from the large-scale development alternatives. Some of these which have been noted are described below.

Woodside Pumping Plant

With a dam on the Green River below the mouth of the Price River, water could be backed up nearly to Woodside at about elevation 4,600. Water could be pumped from such a reservoir to supply added water for municipal and industrial or supplemental irrigation use in the Price area or to supply new irrigation water to lands around Woodside. Pump lifts up to 1,300 feet, probably best served in a series of two or more lifts, would be involved. A plan developing 100,000 acre-feet would require about 20,000 kilowatts and 120,000,000 kilowatt-hours to supply the pump or pumps.

Pariette Pumping Plant

With direct diversion from the Green River near Ouray at about elevation 4,650 and a pump lift up to 150 feet, about 50,000 acre-feet of water could be pumped for new land irrigation in the Pariette Draw. This would require pumping plants with a total capacity of about 3,000 kilowatts and consuming about 7,000,000 kilowatt-hours annually.

Wonsits Pumping Plant

This plant would be located on the Green River about 10 river miles upstream from Ouray. Assuming a series of two or more lifts up to a total of 150 feet and pumping 100,000 acre-feet annually, about 6,000 kilowatts of pumping capacity using about 14,000,000 kilowatt-hours annually would be required. Some of the lands to be served are in the Hill Creek extension of the Uintah and Ouray Indian Reservation, and some are in the bird refuge being constructed by the Bureau of Sport Fisheries and Wildlife.

Ground Water Pumping Plants

Ground water resources will be studied and some pumping developments may be included as part of the project plan. Sufficient data are not available at present to detail such possible development.

Effect on Existing Powerplants

Existing hydroelectric powerplants in the project area which could be affected adversely or favorably by ultimate phase developments are tabulated below.

Powerplant	Owner	Installed capacity (kw.)	Approx. annual generation (million kw.-hrs.)
Yellowstone hydro	Moon Lake Electric Assoc.	900	6.5
Uintah hydro	Uintah Power and Light	1,200	9.0
Deer Creek	U.S. Bureau of Reclamation	4,950	27.0
Spanish Fork	Strawberry Water Users' Assoc.	1,450	10.5

Additional Data Required

Additional data required for the plan formulation studies involving potential hydroelectric and pumping plants include the following.

(1) Water supply operation studies to delineate the quantities available for hydroelectric generation or to be pumped at each potential site.

(2) Topographic maps equal to USGS 7.5' quadrangle series (1" = 2,000 ft. and 40-ft. contours) for some of the areas in the project not now available. As attractiveness of plans is indicated by reconnaissance studies, more detailed mapping will be required.

(3) Up-to-date estimates of the value of power in the project area, including peaking capacity as a function of plant factor.

(4) Current information on power market and selling rates.

(5) Up-to-date reconnaissance estimating data for construction costs of pumping plants, powerplants, switchyards and substations, transmission lines, tunnels, pipelines, penstocks, etc. This is particularly important in comparing alternative features such as pumping vs. gravity plans.

(6) Production and cost data on the powerplants which may be affected by the project.

CHAPTER VIII

AGRICULTURAL ECONOMY

Introduction

The economy of the area that may be served irrigation water from the ultimate phase of the Central Utah project is, with few exceptions, dependent upon agriculture. Although the type of agriculture practiced varies from place to place, particularly between high elevation counties with short growing seasons and lower elevation counties with longer growing seasons, the need for more water and better water regulation is a common denominator for all counties involved. To properly analyze the agricultural economy of the project area, it was necessary to obtain certain basic data on the factors influencing present agricultural conditions.

Climatological data

Weather data were obtained from Federal Government and State publications. Throughout all counties considered there are four distinct and well defined seasons with little overlapping. The data obtained and presented in the table on the following page indicate the elevation, the average annual precipitation, the average frost-free period, and the plant development units characteristic of each weather reporting station.

Farm types

Farm types utilizing a livestock enterprise as the major source of income dominate the project area. The number of farms by percent in each farm type as determined by the 1959 agricultural census for each county is shown in the table on page 171. It is not anticipated that significant changes in farm types will result from project construction.

Crop distribution

Hay crops and pasture are the principal crops grown with each area adjusting to its particular needs. Small grains are grown principally as a nurse crop in establishing alfalfa and pasture stands. Row crops are limited to areas with longer growing seasons and better water supplies. It is anticipated that row crops will become increasingly important in counties with climatical conditions suitable for their production when an adequate and regulated water supply is available. Crop distribution for each county is shown by percent in the table on page 172 . Data for this table were taken from the 1959 agricultural census.

Climatological data by counties--ultimate phase
Central Utah Project

County	Location of weather station	Elevation	Precipitation Annual	Precipitation April-September	Frost-free period (32°F.)	Growing season (28°F.)	Plant development units 1/
Emery	Castle Dale	5,600	7.62	4.56	127	153	3,460
Beaver	Beaver	5,860	11.77	6.06	104	142	3,080
Carbon	Price Game Farm	5,580	9.24	4.82	150	178	4,530
Duchesne	Duchesne	5,515	9.07	5.24	120	164	3,350
Garfield	Panguitch	6,720	9.41	5.56	71	106	2,260
Juab	Nephi	5,133	14.80	7.00	151	201	4,400
Millard (west)	Delta	4,759	7.70	3.80	146	170	4,120
Millard (east)	Fillmore	5,250	14.04	5.63	152	176	4,880
Piute	Piute Reservoir	5,900	8.14	4.40	134	154	3,970
Sanpete	Manti-Moroni	5,555	10.31	5.83	117	145	3,630
Sevier	Richfield	5,300	8.01	4.12	115	151	4,000
Tooele	Tooele	4,820	15.48	6.64	162	209	5,195
Uintah	Roosevelt-Altamont	5,300	7.00	3.90	126	173	2/ 3,990
Utah	Mosida	4,690	9.90	4.70	145	194	4,490
Wasatch	Heber	5,593	15.38	5.66	83	105	2,540

Source: Climatological Data of Utah--Annual Summaries, U.S. Weather Bureau.

1/ "Utah Heat and Moisture Indexes for Use in Land Capability Classification," U.S.D.A., Soil Conservation Service, Salt Lake City, Utah, 1954.

2/ Fort Duchesne.

Farm types by percent - Ultimate phase - C.U.P.

Farm type	Beaver	Carbon	Duchesne	Emery	Garfield	Juab	Millard	Piute	Sanpete
Cash grain	2					10	2		1
Other field crops	4	5			6		2	3	1
Vegetable farms									
Fruit farms									
Poultry farms	12			1		12	2	1	11
Dairy farms	24	4	26	4	4	7	7	21	18
Livestock farms	25	28	36	45	51	33	35	47	36
General farms	6	1	7	1		9	23	4	5
Miscellaneous farms	27	62	31	49	39	29	29	24	28
Total percent	100	100	100	100	100	100	100	100	100

Source: Agricultural census, 1959

e phase - C.U.P.

ard	Piute	Sanpete	Sevier	Tooele	Uintah	Utah	Wasatch
2		1	1	2		1	
2	3	1	2			1	
						1	
						5	
2	1	11	2	4	1	6	
7	21	18	11	10	8	9	34
5	47	36	50	28	37	21	32
3	4	5	7		4	6	9
9	24	28	27	56	50	50	25
0	100	100	100	100	100	100	100

Distribution of crops - Ultimate phase - C.U
(Percent of irrigated land)

Crops	Beaver	Carbon	Duchesne	Emery	Garfield	Juab	Millard	Piute	Sar
Row crops									
Corn (all purpose)	5.21	2.76	2.69	5.83	1.51	4.06	3.68	.32	1
Potatoes	5.04	.26	.04	.05	2.29	.02	.41	3.36	
Vegetables	.02		.01	.26		.02	.01		
Sugar beets		4.90		.13		.39	.37		2
Hay crops									
Alfalfa	50.70	42.66	23.55	34.81	34.89	42.19	42.44	42.38	42
Other hay	4.98	1.41	9.36	4.25	8.70	8.68	1.47	12.03	8
Alfalfa for seed		.02	1.63	.12		1.76	24.75	.09	
Small grains									
Wheat									
Winter	.60	.64	.32	1.96		4.60	2.80	.15	1
Spring	5.43	5.84	.92	2.50	.99	3.03	.99	.60	2
Oats	1.10	4.96	1.75	2.44	2.94	.42	.58	1.99	2
Barley	7.18	3.67	1.74	1.78	4.50	8.42	13.05	7.25	10
Other grain		.10	1.02	1.77	.07	.06	.38	.04	4
Orchards		.31	.07	.48	.26	.31	.03		
Pasture	19.74	32.47	56.90	43.62	43.85	26.05	9.04	31.79	23
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100

Source: Agricultural census, 1959

mate phase - C.U.P.
ted land)

rd	Piute	Sanpete	Sevier	Tooele	Uintah	Utah	Wasatch	All counties
8	.32	1.55	5.32	1.47	2.93	6.18		3.58
1	3.36	.03	.75	.19	.05	.59	.05	.59
1		.07	.05	.05	.02	4.90	.37	.80
7		2.68	5.77			3.00		1.36
4	42.38	42.58	37.98	35.09	33.17	27.63	41.41	34.99
7	12.03	8.23	2.66	16.11	3.72	9.26	15.15	6.72
5	.09	.34		3.39	1.10	.78	.04	4.25
0	.15	1.07	.01	.95	.35	1.72	.14	1.13
9	.60	2.93	2.23	1.34	1.42	5.42	.82	2.37
8	1.99	2.58	.67	1.24	2.50	1.91	1.65	1.77
5	7.25	10.08	16.30	8.91	2.93	15.39	6.48	8.48
8	.04	4.58	1.68	.14	.17	.62		1.04
3		.01	.04	.09	.05	6.21	.03	1.03
4	31.79	23.27	26.54	31.03	51.59	16.39	33.86	31.89
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Crop yields

Crop yields for the area were also obtained from the agricultural census and are shown by counties in the table on the following page. These yields are representative of counties as they are now and reflect the present short water supply. The increase in crop yields from project development should provide the basis for improving all phases of the agricultural economy in these counties.

Estimated Payment Capacity

The anticipated payment capacity of the water users has been determined on the basis of a full water supply and reduced to an acre-foot basis. Lands in need of only a supplemental supply will be expected to pay the same charges per acre-foot as land requiring a fully supply.

The anticipated payment capacity is based on long-term average prices received and paid by farmers. The indices are 250-265 (1910-14 = 100).

In the absence of detailed farm management data and farm budget analyses, it was necessary to arrive at payment capacities by more preliminary methods. Detailed studies have been made for the Bonneville unit which included studies in the counties of Duchesne, Wasatch, Summit, Utah, and Juab. These studies and county agricultural and weather data form the basis for payment capacity estimates of all counties included in the areas under consideration. Estimated payment capacities per acre and per acre-foot by county are shown in the table on page 175.

Irrigation benefits

Irrigation benefits are based upon increased production of goods and services associated with the increased water supply less the associated cost. Three types of tangible benefits are evaluated in monetary terms, direct, indirect, and public. Direct irrigation benefits are the increase in net farm income resulting from application of additional water. Indirect irrigation benefits result as agricultural products move through the channels of trade. These benefits are measured by profits arising from various economic activities resulting from an added increment of water. Public benefits insofar as they can be identified by monetary values are measures of improvement in the general welfare of an area not already included as direct or indirect. Items in this category would be increased tax base, settlement opportunity, and improvements in community facilities and services.

Procedure Used for Estimating Irrigation Benefits

Irrigation benefits have been estimated on the relationship of payment capacity to direct, indirect, and public benefits. This relationship

Average yields per acre of irrigated crops,
ultimate phase--Central Utah project

County	Corn (tons)	Winter wheat (bu.)	Spring wheat (bu.)	Oats (bu.)	Barley (bu.)	Alfalfa (tons)	Other hay (tcns)	Alfalfa seed (lbs.)	Potatoes (cwt.)	Sugar beets (tons)
Beaver	14.3	36	37	38	41	3.1	1.9		198	
Carbon	12.6	20	34	40	38	2.1	1.5	100	93	14.4
Duchesne	11.0	32	35	42	40	2.2	1.3	291	166	
Emery	10.7	27	29	33	32	2.3	1.3	142	121	14.1
Garfield	13.2		38	46	47	2.4	1.7		107	
Juab	15.0	31	33	49	52	2.5	1.0	164	336	10.8
Millard	16.2	33	36	48	49	2.0	1.8	264	268	12.8
Piute	10.0		41	38	57	2.3	1.3	69	135	
Sanpete	13.1	25	36	46	51	2.5	1.5	151	108	13.9
Sevier	15.2	12	54	53	65	3.5	1.5		142	14.3
Tooele	14.5	34	31	49	47	2.4	1.3	56	170	
Uintah	12.7	42	33	38	39	2.1	1.3	149	191	
Utah	16.0	40	51	60	56	3.6	1.5	198	159	19.4
Wasatch		39	46	70	68	2.8	2.0	600	114	

Source: Census of Agriculture, 1959

Estimated payment capacity per acre and per acre-foot by counties, ultimate phase--Central Utah project

County	Estimated payment capacity (per acre)	Estimated water requirement (ac.ft.)1/	Estimated payment capacity2/ (ac.ft.)
Beaver	$10.00	3.90	$2.00-3.50
Carbon	8.50	4.02	1.75-3.00
Duchesne	7.50	4.00	1.50-3.00
Emery	8.00	3.92	1.75-3.00
Garfield	6.00	2.61	1.75-3.00
Juab	13.00	3.08	3.75-5.00
Millard (Delta)	11.50	2.80	3.75-5.00
Millard (Fillmore)	11.50	4.13	2.25-3.50
Piute	7.50	4.15	1.75-3.00
Sanpete	11.00	3.68	2.50-4.00
Sevier	12.00	3.81	3.00-4.50
Tooele	9.00	4.20	1.75-3.00
Uintah	7.50	3.65	1.50-3.00
Utah	14.00	3.44	3.50-5.00
Wasatch	10.00	3.60	2.50-3.75

1/ At head of canal.
2/ Rounded to nearest $0.25.

was established using the results of a detailed study of irrigation repayment and benefits for the Bonneville unit of the Central Utah project. A ratio of benefits to payment capacity per acre was tabulated for thirteen different irrigation blocks. These blocks are believed to be representative of Utah in general. The climate, land class, and farm types are assumed to be comparable to the counties under consideration. Values used to project irrigation benefits were $8.10 of direct benefits for every dollar of payment capacity, $6.40 of indirect benefits, and $1 of public benefits. Benefits for each county in the ultimate phase were computed on the basis of this relationship and are shown in the table on the following page.

Additional Data Required

Detailed economic information will be required for all areas where project water may be delivered. As land classification progresses in these potential areas, farm management surveys will need to follow to obtain crop yields, land use, types of farms, livestock, plus all the other data obtained in contacts with the farmers. With this information as a basis, farm budgets will be prepared to determine irrigation payment capacity and benefits.

Gooseberry project (Sanpete County)

Preliminary studies have been made in the past in regard to the Gooseberry project in Sanpete County. A study was included in a 1953 report and also in a 1957 report. The comparative results of these two studies with emphasis on the economic aspects are summarized in the tables on pages 178 and 179.

Since these studies have been made, irrigation benefits have been reappraised (Garrison formula) throughout the Bureau. The basic information contained in the studies such as climate, crop yields, and farm sizes and types, however, has been considered in projecting payment capacity and benefits for Sanpete County.

Municipal and Industrial Water Benefits

At present, benefits are being measured for municipal and industrial water throughout the Bureau of Reclamation as the cost of the alternative single-purpose municipal and industrial project. Most everyone agrees that this procedure is not a true measure of the economic benefits of water for this purpose. Municipal and industrial water has a higher use than irrigation and as such should produce greater benefits; however, with the above method of determining benefits it does not always result in such a relationship. Based primarily upon the benefits determined for the

Estimated irrigation benefits by county--ultimate phase

County	Estimated payment capacity per acre	Estimated benefits per acre: Direct	Estimated benefits per acre: Indirect and public	Estimated benefits per acre: Total	Estimated water requirement acre-feet per acre 1/	Estimated direct benefits per acre-foot
Beaver	$10.00	$80.00	$74.00	$154.00	3.90	$19.00-24.00
Carbon	8.50	69.00	62.00	131.00	4.02	15.00-20.00
Duchesne	7.50	61.00	55.00	116.00	4.00	14.00-19.00
Emery	8.00	65.00	59.00	124.00	3.92	14.00-19.00
Garfield	6.00	49.00	44.00	93.00	2.61	16.00-21.00
Juab	13.00	105.00	96.00	201.00	3.08	32.00-37.00
Millard (Delta)	11.50	80.00	50.00	130.00	2.80	25.00-30.00
Millard (Fillmore)	11.50	93.00	85.00	178.00	4.13	20.00-25.00
Piute	7.50	60.00	48.00	108.00	4.15	15.00-20.00
Sanpete	11.00	89.00	81.00	170.00	3.68	22.00-27.00
Sevier	12.00	95.00	85.00	180.00	3.81	22.00-27.00
Tooele	9.00	73.00	67.00	140.00	4.20	15.00-20.00
Uintah	7.50	61.00	55.00	116.00	3.65	14.00-19.00
Utah	14.00	113.00	104.00	217.00	3.44	30.00-35.00
Wasatch	10.00	81.00	74.00	155.00	3.60	20.00-25.00

1/ At head of canal.

Gooseberry project benefit-cost ratio

Item	1953 report	1957 report
Benefits		
Irrigation - Direct	$135,300	$69,600
Indirect	72,800	21,300
Public		8,600
Recreation	6,100	4,800
Forest resources	2,700	
Fish and wildlife	-2,000	
Total	214,900	104,300
Costs		
Construction costs	5,189,000	2,088,000
Interest during construction	162,000	50,000
Interest after construction	553,000	
Less past investigations	1/	-85,000
Less present worth of salvage value	-114,000	
Net project investment	5,790,000	2,053,000
Average annual equivalent		
Project investment 1/	158,000	56,100
Annual operation and maintenance cost (irrigation)	10,300	5,600
Annual operation and maintenance cost (recreation costs)		700
Annual replacement costs (recreation)		1,700
Colorado River storage costs	29,400	2,700
Total	197,800	66,800
Benefit-cost ratio	1.09 to 1.00	1.56 to 1.00

1/ $2\frac{1}{2}$ percent for 100 years - factor 0.0273118.

Comparative economic data
Gooseberry project

Item	1953 report	1957 report
Irrigable area (acres)	16,400	3,630
Price level	1939-44	250/265
Kinds of farm budgets	Livestock and gen. 1 crop 100%	Livestock (wt. 70%) Grade A dairy (wt. 30%)
Size of farm	Livestock and gen. crop 70 ac. irrigated	Livestock 150 ac. irri. Grade A dairy 100 ac. irrig.
Net farm income	Livestock and gen. crop w/ $1,440--livestock and gen. crop w/o $855	Livestock w/ $7,225 Livestock w/o 4,757 Grade A w/ 8,568 Grade A w/o 5,259
Payment capacity per acre	Livestock and gen.crop w/ $2.39--livestock and gen. crop w/o $0.50	Livestock w/ $6.11 Livestock w/o 1.50 Grade A w/ 23.15 Grade A w/o 4.75
Recommended annual repayment total	$22,300	$18,000
Per ac.-ft. (rounded)	1.60	2.75
Direct irrigation benefits per acre	1/ 8.25	1/ 19.17
Indirect irrigation benefits per acre	1/ 4.44	1/ 5.87
Public irrig. ben. per acre		1/ 2.37
Total irrig. ben. per ac.-ft.	1/ 14.86	1/ 15.31
Net project investment	$5,790,000	$2,053,000
Total annual benefits	$197,800	$104,300
Benefit-cost ratio	1.09/1.00	1.56/1.00

1/ Adjusted for development.

initial phase of the Central Utah project, the municipal and industrial benefits are estimated to be $60 per acre-foot, further limited in plan formulation to $40 for a combination of repayment and alternative costs in the Bonneville Basin. In the Uinta Basin the limit for repayment and alternative costs is estimated at $30.

CHAPTER IX

POTENTIAL DEVELOPMENTS

General

This chapter has been prepared to briefly outline the general project objectives and describe some of the possibilities that may be considered in project plan formulation. One of the major considerations in developing the objectives is the size of the project and the relationships of the available water resources to the land and the people.

The potential project area occupies parts of 19 counties in central Utah. The lands are separated by the Wasatch range into two major drainage basins, the Bonneville Basin and the Upper Colorado River Basin. A preliminary estimate of the potential arable and irrigated lands tabulated for this report shows a total of 1,194,000 acres in 26 separate areas. About 865,000 acres, or over 72 percent of the total land area, are located in the Bonneville Basin. The 1960 census shows a total of 786,083 people in the 19 counties included in the project with 740,641, or 94 percent of the total population, residing in the Bonneville Basin. An estimated 2,500,000 acre-feet of streamflow is available for use within the project area, with less than 1,000,000 acre-feet or about 40 percent available in the Bonneville Basin to serve over 72 percent of the project land and over 94 percent of the total population.

A primary objective of the ultimate phase of the Central Utah project is to collect the available water and distribute it more uniformly to areas of need in an effort to develop and beneficially utilize to the economic limit the following: (1) Utah's apportioned share of the Upper Colorado River water, (2) the surface water supplies of the Bonneville Basin streams within the area, and (3) ground water supplies in the project area. Maximum use of Colorado River water would require serving the needs within the Upper Colorado River Basin and then conveying the excess water to areas of need in the Bonneville Basin.

Water requirements of the Upper Colorado River Basin portion of the project could be supplied from the following sources: control of local streams, diversions from Flaming Gorge Reservoir, and pumping directly from Green River. Sources of additional water supply to Bonneville Basin include: further control of local streams, transbasin diversion from the Upper Colorado River Basin, and development of ground water. Transbasin diversions could be accomplished by intercepting tributaries at a high elevation and conveying the water to the Bonneville Basin by gravity or by pumping from Green River to elevations high enough to divert through the Wasatch range.

Some potential developments of each basin indicated on the map on the following page are discussed below.

Upper Colorado River Basin

Uinta Basin

Strawberry Reservoir is by far the most inexpensive storage known in the Uinta Basin and under ultimate development would be enlarged for long-term carryover storage for water that would be diverted from the Uinta Basin to the Bonneville Basin. An aqueduct extending eastward from Strawberry Reservoir would intercept flows of as many streams along the south flank of the Uinta Mountains as is economically feasible. Diversion dams and some reservoirs for seasonal regulation will be required on the intercepted streams. A tunnel and aqueduct would divert water from Flaming Gorge Reservoir that would be used to replace exported supplies and add to the existing supplies in the area from Brush Creek to Duchesne River. This would be supplemented wherever feasible by pumping directly from Green River.

Obtaining the maximum utilization of water resources will require close coordination and balance among the various water sources and collection and distribution facilities.

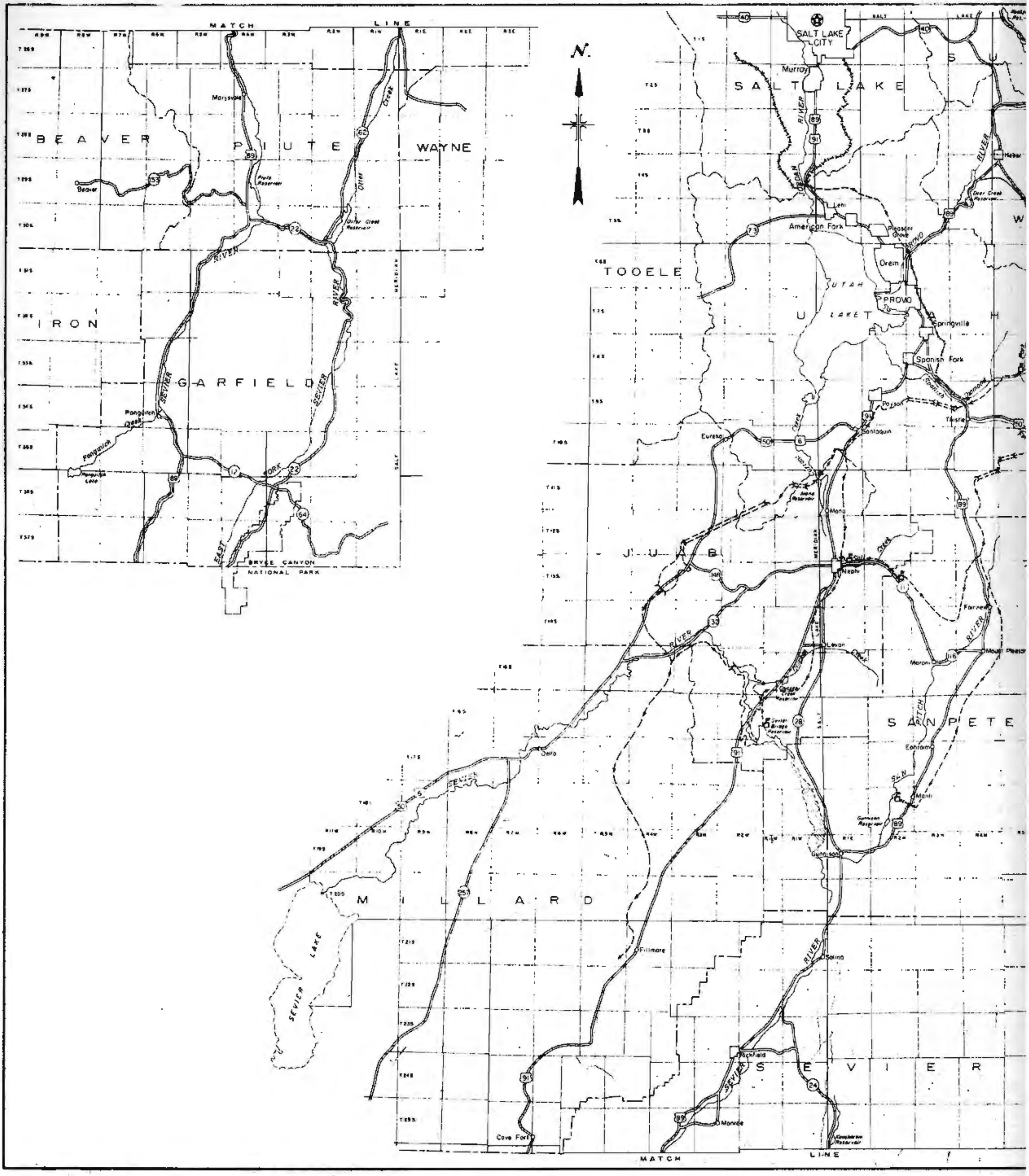
Possibilities in the Uinta Basin would include serving Leland and Pariette Bench areas from Flaming Gorge aqueduct or by pumping directly from Green River. The Deadman Bench area of the potential Juniper project could also be served from Flaming Gorge aqueduct as an alternative to service from Juniper Reservoir.

Price River Basin

Future requirements of the Price River Basin could be met by diversions from Strawberry Reservoir or by pumping directly from Green River. The pumping alternative would reserve some additional water in Strawberry Reservoir for transbasin diversion to Bonneville Basin.

Bonneville Basin

Several possible service areas exist in the Bonneville Basin. Since the quantity of water available for transbasin import is limited, extensive studies will be required in the selection of the most feasible areas of use to receive project water. Municipal and industrial requirements are increasing rapidly and could consume a large share of the available project water. The most economical use of the total water supply will



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BEAVER
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GARFIELD
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Panguitch
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BRYCE CANYON NATIONAL PARK
SALT LAKE CITY
Murray
SALT LAKE
TOOELE
American Fork
Orem
PROVO
UTAH LAKE
Springville
Spanish Fork
Santaquin
Eureka
Mona
JUAB
Nephi
Levan
Fairview
Mount Pleasant
Moroni
SANPETE
Ephraim
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MILLARD
Fillmore
Salina
Richfield
SEVIER
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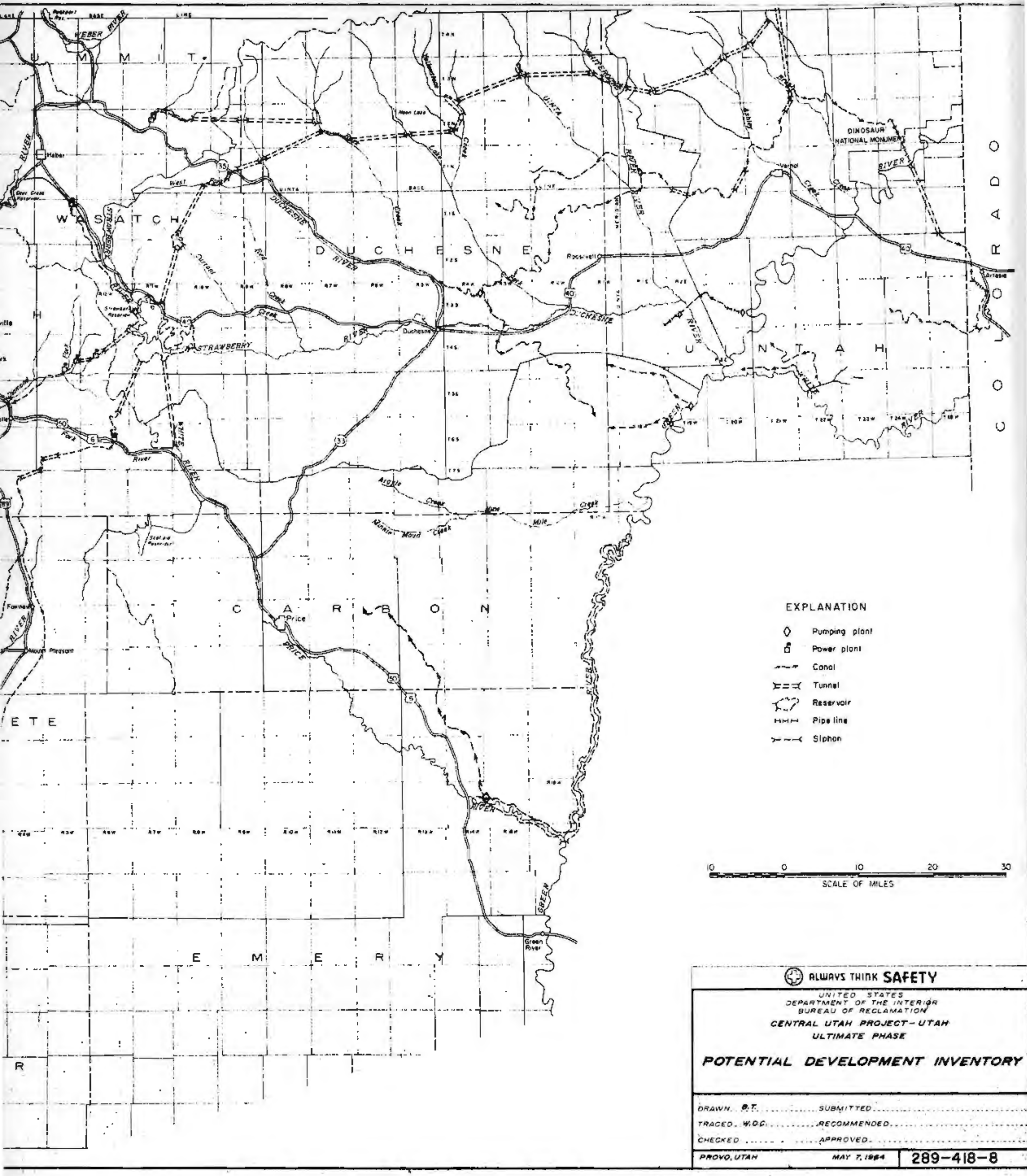
WEBER RIVER
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DUCHESNE
UINTAH
CARBON
EMERY
Heber
Roosevelt
Vernal
Duchesne
Price
Mount Pleasant
Green River
DINOSAUR NATIONAL MONUMENT
STRAWBERRY
DUCHESNE RIVER
PRICE RIVER
GREEN RIVER
COLORADO
EXPLANATION
Pumping plant
Power plant
Canal
Tunnel
Reservoir
Pipe line
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DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT-UTAH
ULTIMATE PHASE
POTENTIAL DEVELOPMENT INVENTORY
DRAWN B.T. SUBMITTED
TRACED W.O.C. RECOMMENDED
CHECKED APPROVED
PROVO, UTAH
MAY 7, 1964
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require close correlation between local surface and ground water supplies and transbasin imports. Long and costly aqueducts and canals, together with terminal storage or peaking reservoirs, will be required to accomplish the distribution of imported water.

Because of the limited water supply, priority of service will go to the presently irrigated areas with insufficient water supplies. Thus, it is anticipated that much of the available project irrigation water may be needed in Sevier and San Pitch Basins. Several alternative routes from Strawberry Reservoir to these areas of service are available and need to be explored. One route is to follow the Bonneville Unit Wasatch aqueduct route down Spanish Fork Canyon then on to the terminal storage at Dyer Reservoir site or some alternative storage site on the lower Sevier River. A second route would be to tunnel south from Strawberry Reservoir and extend an aqueduct to the upper San Pitch River thence down Salt Creek to Nephi and on to the lower Sevier River. A third route would be to continue the second route from the upper San Pitch River on to the lower Sevier River via Gunnison.

Studies will be required to determine the extent to which imported water delivered to the lower Sevier River could replace present supplies which could then be used upstream on the Sevier River. Ground water availability and use are presently being studied and will need to be correlated with the use of imported water.

Population growth and industrial expansion have an important influence on future water requirements of any area. The population and related industrial developments are expanding rapidly in the Bonneville Basin area, especially north of Payson. The number of people in Salt Lake and Utah Counties increased 82 percent from 1940-60. This rate of growth is more than three times that of the Nation as a whole and is expected to continue at a relatively high rate. Therefore, it is anticipated that the municipal and industrial water demand will far exceed the local supplies available. Since project water will be limited to Utah's share of the Colorado River water, the municipal and industrial allocation may be increased and the irrigation water decreased correspondingly.

Determining the extent of the municipal and industrial demand and correlating the local sources of supply with imported supplies will require extensive study. Various methods exist of serving project water to areas of need and will be considered. Part of the water can be exchanged through delivery to Utah Lake and withholding Provo River flows as in the Bonneville unit plan. The remaining quantity available through this means is limited, however. Additional supplies can be delivered directly to Provo River from Strawberry aqueduct or Strawberry Reservoir. From there, delivery could be made to Weber and Davis Counties (Ogden) by exchange on Weber River or diversion to Salt Lake and Utah Counties directly. An alternative for delivery of these additional supplies is via an aqueduct from Hayes Reservoir along the foot of the mountains to Provo River.

Fish and wildlife, recreation, flood control, water quality control, and area redevelopment requirements will be given proper consideration in the formulation of project plans in both basins.

CHAPTER X

FUTURE INVESTIGATIONS

Detailed investigation of the ultimate phase of the Central Utah project has only recently begun. Cursory studies were made for inclusion in the 1951 Central Utah project report and have not been expanded to the present time. This inventory report is concerned primarily with the compilation and presentation of existing data that will assist with future studies rather than a discussion of recent findings.

Extensive investigations of the project will be required to facilitate the formulation of an adequate plan prior to the preparation of a feasibility report. A preliminary appraisal report is scheduled for completion in FY 1966, and a feasibility report is due in FY 1967 for the Uintah unit portion of the ultimate phase. Several years will be required to complete the investigations necessary for these reports and for the selection of the optimum plan of development. Every available plan will be investigated thoroughly.

The limiting factor in plan formulation will be the amount of water available for project use. Utah's proportionate share of the Upper Colorado River water constitutes the major part of the project water supply. Detailed studies will be required to determine the water supply that will be available for project development.

The land inventory of this report shows considerable potential acreage in need of irrigation water. In fact, the land in the project area requiring irrigation is far in excess of the available water. If the requirement for municipal and industrial water continues at the present accelerated rate, by the time project water becomes available practically all of the water supply may be used for that purpose, leaving but little for irrigation use.

Municipal and industrial water requirements will depend primarily upon future population increases and industrial expansion. Several studies have been made recently of population projections with related water requirements and no doubt other similar studies will be made in the future. Extensive investigations will be necessary to determine the future municipal and industrial water requirements of the project area.

A project as large as the ultimate phase will require many features for the collection, storage, and distribution of project water. Detailed surveys will be required of these features for designs and cost estimates. Detailed land classification and drainage surveys will be necessary of all land areas considered for a project water supply. Other required investigations include continued ground water studies to determine to what extent ground water would be available to supplement the surface water supply, financial analyses to determine the feasibility of the project, and a thorough study of the existing water rights.

Close coordination should be maintained between the initial phase and the ultimate phase of the Central Utah project. The project plan should be flexible so as to incorporate any new or refined data as it becomes available through continued investigations.

A cooperative program with Federal, State, and local agencies that has been initiated should be encouraged to include the findings of their investigations in the plan formulation and to provide information for their reports.