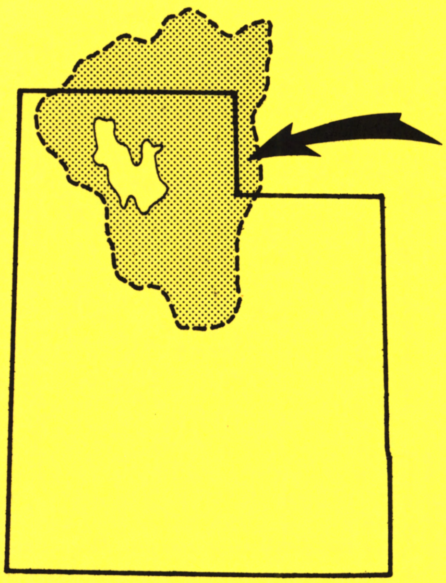
WATER-RESOURCES BULLETIN 10
1968

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
affiliated with
THE COLLEGE OF MINES AND MINERAL INDUSTRIES
University of Utah, Salt Lake City, Utah



DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE

and Chemical Characteristics of the Salt Lake Brine

Summary for Water Years
1960, 1961, 1964

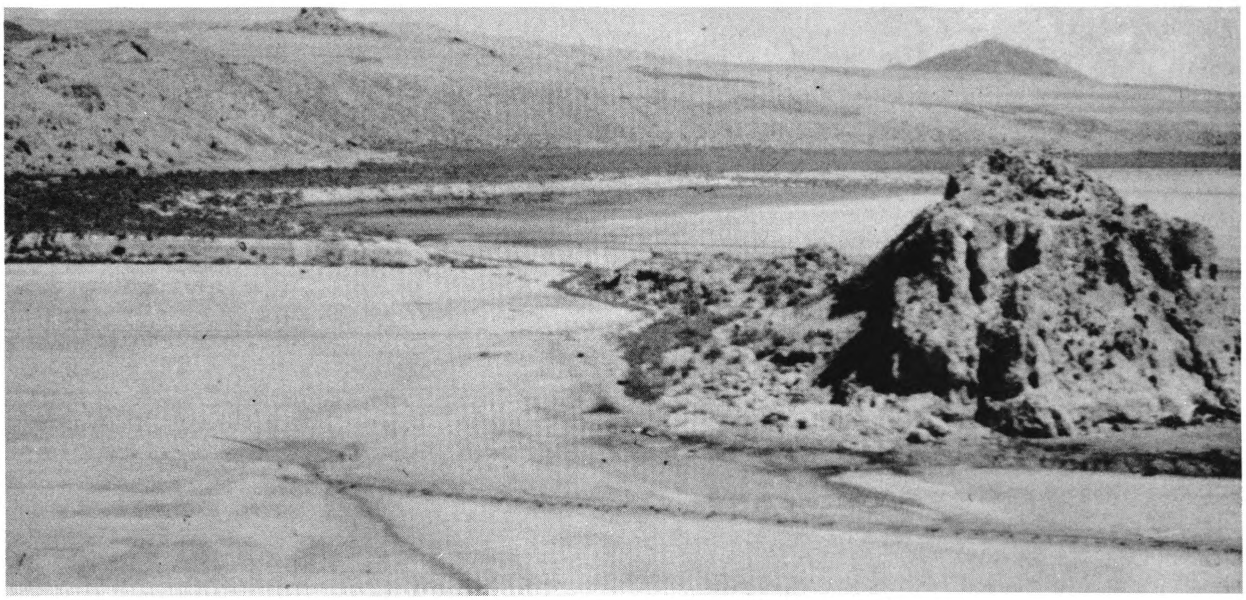
Prepared by
The United States Geological Survey
in cooperation with
The Utah Geological and Mineralogical Survey

Price $2.00

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE:

Summary for Water Years 1960, 1961, and 1964

by D. C. Hahl
Hydraulic Engineer, U.S. Geological Survey



View of a rock outcrop, seep area, pothole, and channel
at the northern end of Great Salt Lake.

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WATER-RESOURCES BULLETIN 10 • PRICE $2.00 • AUGUST, 1968

CONTENTS

	Page
Abstract	7
Introduction	7
Quality of Surface-Water Inflow to Great Salt Lake, 1964 Water Year	8
Bear River Drainage System	8
Weber River Drainage System	12
Jordan River Drainage System	12
Minor Drainage Systems	14
Davis County	14
Other Springs and Streams	14
Quality of Surface-Water Inflow to the Lake Area, 1964 Water Year	15
Bear River at Corinne	16
Weber River near Plain City	17
Jordan River at Salt Lake City	17
Comparison of Inflow to the Great Salt Lake and the Lake Area, 1960, 1961, and 1964 Water Years	19
Streamflow in the Bear and Weber Rivers	19
Inflow to the Lake and the Lake Area	20
Development of Surface-Water Inflow to Great Salt Lake	20
Effect of Upstream Reservoir Storage on the Lake Stage	22
Chemical Quality of Water Available for Development	23
A Fresh-Water Lake	26
Summary and Conclusions	27
References	28

ILLUSTRATIONS

Page

Frontispiece. Photograph of rock outcrop, seep area, pothole, and channel at the northern end of Great Salt Lake 1

Figure 1. Map of Great Salt Lake showing the 1964 data-collection sites, the boundary of the lake area, and the lakeshore . . . . pocket

2. Diagram showing site-location system 8

3. Map of the Bear River drainage system between Collinston and the Bear River Bridge 9

4. Graph showing comparative weighted-average dissolved-constituent concentrations for selected sites in the Bear River drainage system during the 1964 water year 11

5. Map of the Jordan River drainage system between Salt Lake City and Farmington Bay 13

6. Photograph of a spring on the west side of Promontory Mountains 14

7. Photograph of a rock outcrop at the northern end of Great Salt Lake 15

8. Photograph of a pothole spring containing clear water 15

9. Graph showing conductance-duration curve for the Bear River at Corinne, 1964 water year 17

10. Graph showing flow-duration curve for the Bear River at Corinne, 1964 water year 18

11. Graph showing mean water discharge and dissolved-solids concentration for the period indicated for the Bear River at Corinne, 1964 water year 19

12. Graph showing monthly minimum, mean, and maximum temperatures of the Bear River at Corinne, 1964 water year 19

13. Graph showing flow-duration curves, Bear River near Collinston 21

14. Graph showing percentage of water in the Bear River at Corinne containing dissolved-solids concentrations less than the values shown during the water years 1960, 1961, and 1964 23

15. Graph showing percentage of water in the Weber River near Plain City and the Jordan River at Cudahy Lane, near Salt Lake City containing dissolved-solids concentrations less than the values shown during the water years 1960, 1961, and 1964 23

16. Diagram for the classification of irrigation waters 24

17. Map of the eastern part of Great Salt Lake showing proposed dikes 25

TABLES

Page

Table 1. Summary of estimated inflow to Great Salt Lake by drainage system during the 1964 water year 10

2. Estimated weighted-average concentrations and loads of dissolved constituents entering Great Salt Lake during the 1964 water year 12

3. Estimates of water discharges and dissolved-constituent loads for the Bear River drainage system during the 1964 water year 12

4. Summary of estimated inflow to the lake area by surface-water unit during the 1964 water year. 16

5. Estimated weighted-average concentrations and loads of dissolved constituents in water discharged by surface-water units during the 1964 water year 16

6. Streamflow, in thousands of acre-feet, at selected gaging stations during the water years 1934-64 and 1960, 1961, and 1964 19

7. Summary of estimated inflow to Great Salt Lake during water years 1960, 1961, and 1964. 20

8. Summary of estimated dissolved-solids contributions by surface-water units to the lake area during the water years 1960, 1961, and 1964 22

9. Percentages of total water and dissolved solids contributed to the lake area by each unit during the water years 1960, 1961, and 1964 23

10. Discharge near the mouths of the Bear, Weber, and Jordan Rivers during the representative water years of high, low, and average discharge and the usable storage capacity of reservoirs in the drainage basins, in thousands of acre-feet 24

11. Analyses that represent specific dissolved-solids concentrations are shown along with some of the drinking-water standards recommended by the U.S. Public Health Service 26

12. Volume of water, in thousands of acre-feet, and dissolved-solids load, in thousands of tons, entering the eastern part of Great Salt Lake at the lakeshore during the water years 1960, 1961, and 1964 26

13. Volume of water, in thousands of acre-feet, and dissolved-solids load, in thousands of tons, from selected sources entering the lake area east of Great Salt Lake during the water years 1960, 1961, and 1964. 26

14. Chemical analyses of water from the Bear River, Weber River, Jordan River, and Davis County drainage systems 29

15. Chemical analyses of water from selected sites along the shore of Great Salt Lake 35

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE:

Summary for Water Years 1960, 1961, and 1964

by D. C. Hahl
Hydraulic Engineer, U. S. Geological Survey

ABSTRACT

The investigation of dissolved-mineral inflow to Great Salt Lake during the water years 1960, 1961, and 1964 was conducted during conditions of streamflow that were representative of the lowest and the average recorded during the water years 1934-64. The study conducted during the 1960 and 1961 water years was limited to defining surface-water inflow to the lake area. During the 1964 water year more detailed data were obtained on surface-water inflow at sites close to the lakeshore, as well as at sites used in the 1960-61 study. From these comparative data, estimates of inflow at the lakeshore were made for the 1960 and 1961 water years. During the 1964 water year, when inflow to the lake was probably representative of the 31-year average, about 1,700,000 acre-feet of water containing about 3,500,000 tons of dissolved solids entered the lake. During the 1961 water year, when inflow to the lake was about the lowest recorded during the 31-year period, about 800,000 acre-feet of water containing about 2,200,000 tons of dissolved solids entered the lake.

During years of average streamflow, about 500,000 acre-feet of water which might be developed for culinary use, passes the lowest sampling sites on the Bear and Weber Rivers. Also, more than 90 percent of the flow near the mouths of the Bear, Weber, and Jordan Rivers would be suitable for irrigation.

Sources of inflow could be selected to provide a water supply for a fresh-water lake east of Antelope Island. The supply would range from 300,000 acre-feet of water containing 800 ppm (parts per million) of dissolved solids during periods of low streamflow to 1 million acre-feet containing 500 ppm during periods of average streamflow.

INTRODUCTION

This report updates the study, which was started by the U. S. Geological Survey in 1959, of the dissolved-mineral inflow contributed by surficial sources to Great Salt Lake. The early phases of the study were summarized in a basic-data report by Hahl and Mitchell (1963); and an interpretive report by Hahl and Langford (1964), which was concerned principally with data collected during the 1960 and 1961 water years.1/

The fieldwork for this report was done in water year 1964 in cooperation with the Utah Geological and Mineralogical Survey. The purpose of the work was to refine the estimates of dissolved-mineral inflow by surficial sources to the lake made for the water years 1960 and 1961. Inflow to the lake was below average during those years. Furthermore, much of the data had been collected at sites that were several miles from the lake; consequently, Hahl and Langford (1964) restricted their discussion of inflow to the "lake area".2/

Inflow to the lake during the 1964 water year was about average, and it was possible to collect data at sites closer to the lake. These sampling sites were used to determine the "lakeshore" as used in this report. (See fig. 1 for the lakeshore and the boundary of the lake area.) The lakeshore is marked in most places by a change in topography from drifted sand beach or boulder strewn bluff to flat mud or sand lakebed, and in some places by the outer dikes of bird refuges. Below this shoreline, surface inflow is not contained in easily defined channels and is often affected by wind and brine movement.

This report includes determination of the dissolved-mineral inflow from surficial sources that crosses both the lakeshore and the boundary of the lake area. Some of the data for the 1964 study were collected at sites used during the earlier study; thus, based on data common to both studies, it was possible to include in this report a comparison of the inflow to the lake (as marked by the lakeshore) and to the lake area for the 3 water years 1960, 1961, and 1964.

Part of the data used in this report was collected by personnel of the U. S. Geological Survey engaged in studies of the water resources of Salt Lake County and of the Bear River basin. The U. S. Bureau of Sport Fisheries and Wildlife also provided assistance in the investigation.

1/ The water year covers a period from October 1 through September 30, and it is designated by the calendar year in which it ends. Thus, the year ending September 30, 1960, is called the 1960 water year.

2/ The "lake area" was defined by Hahl and Langford (1964, p. 7) as "that area occupied by the lake body and its surrounding shores, the outer perimeter of which is marked generally by the closest sampling points to the lake on the lake's tributaries."

Data were collected at 79 sites on tributaries and from springs around the lake. A complete list of sampling sites, along with the data collected, is given in tables 14 and 15, and the site locations are shown in figure 1.

The site-numbering system used in this report differs from that used in the basic-data report by Hahl and Mitchell (1963) even though a few of the sites sampled during the 1960-61 investigation were included in the 1964 sampling program. Therefore, only the sampling-site names can be used for cross reference. The names of only five former sampling sites, Black Slough, Blue Spring Creek, Salt Lake City sewage canal, Kennecott Drain, and Garfield Drain, were changed slightly, but these sampling sites remained at the same location.

Sampling sites listed in table 15 are located by a system based on the cadastral land-survey system of the Federal Government. By this system the State is divided into four quadrants by the Salt Lake Base and Meridian, and these quadrants are designated by the capital letters A, B, C, and D. A is the northeast quadrant, B is the northwest, C is the southwest, and D is the southeast. Numbers designating the township and range, follow the quadrant letter, and all these are enclosed in parentheses. The number after the parenthesis designates the section, and the lower case letters give the location of the well or sampling site within the section. The first letter indicates the quarter section, which is generally a tract of 160 acres, the second letter indicates the 40-acre tract, and the third letter indicates the 10-acre tract. Uncertainty of the land net in many areas bordering the lake prevents location of sites closer than the 40-acre tract. The location of a spring on the east side of the Promontory Mountains is used in figure 2 as an example of this location system.

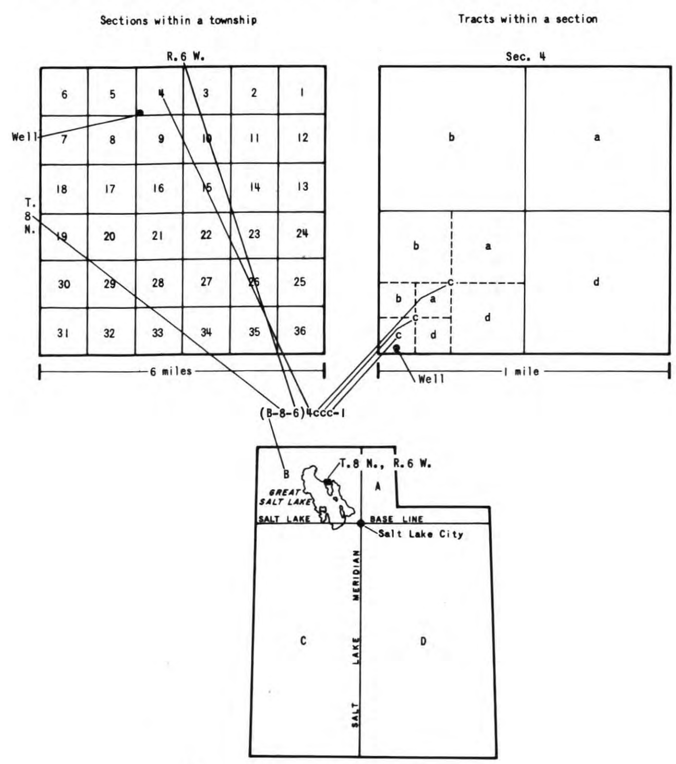

Figure 2. — Site-location system.

QUALITY OF SURFACE-WATER INFLOW TO GREAT SALT LAKE

1964 Water Year

Water entering Great Salt Lake at the lakeshore is divided into five drainage systems for this study. Each system includes surface water that is associated with the drainage from a river basin or that crosses a particular section of the lakeshore. These drainage systems along with a summary of their estimated inflow to Great Salt Lake during the 1964 water year are listed in table 1. The concentrations and loads of dissolved constituents in the water entering Great Salt Lake are shown by drainage system in table 2. The data in table 2 are computed from the data shown in tables 14 and 15.

Bear River Drainage System

The Bear River drainage system contributed about 1,400,000 tons of dissolved solids and about 900,000 acre-feet of water during the 1964 water year to the lake via Bear River Bay (table 1). Most of the water and dissolved solids came down the Bear River; however, Sulphur Creek near Corinne and the Public Shooting Grounds near Penrose together contributed about 30 percent of the load and 10 percent of the water leaving this drainage system. The water entering Bear River Bay was a sodium chloride type[3/] and contained a weighted-average concentration of about 1,120 ppm (parts per million) of dissolved solids (table 2).

The downstream part of the Bear River drainage system and its relation to Great Salt Lake is shown in figure 3. Line A-A marks the gap near Collinston through which all streamflow from the upper Bear River must pass to reach Great Salt Lake. Line B-B approximates the boundary of the lake area, and the line C-C is the lakeshore. From line C-C to line D-D the surface elevation drops only a few feet, and the intervening area (designated by the letter Y in fig. 3) is a flat bay floor, almost devoid of vegetation. This bay is open to Great Salt Lake through a 600-foot trestle in an otherwise solid fill represented by line D-D.

The inflow to Great Salt Lake across the lakeshore (line C-C) was calculated by measuring or estimating the inflow at sites 1-16 (fig. 1) on line B-B and adjusting the total for the effect in area Y due to evapotranspiration, ground-water inflow, and precipitation. The adjustment for the effect of area Y is shown in table 1 as the entry "Net change in shoreline marshes."

Daily data were collected for the inflow of the Bear River at Corinne, whereas monthly or less frequent data were collected at the other sites on line B-B

3/ Water type is determined by the cation and anion that have the greatest concentration expressed in equivalents per million. Multiple cations or anions are listed when the lesser ions have an equivalent per million value of at least three-fourths of that of the largest cation or anion value.

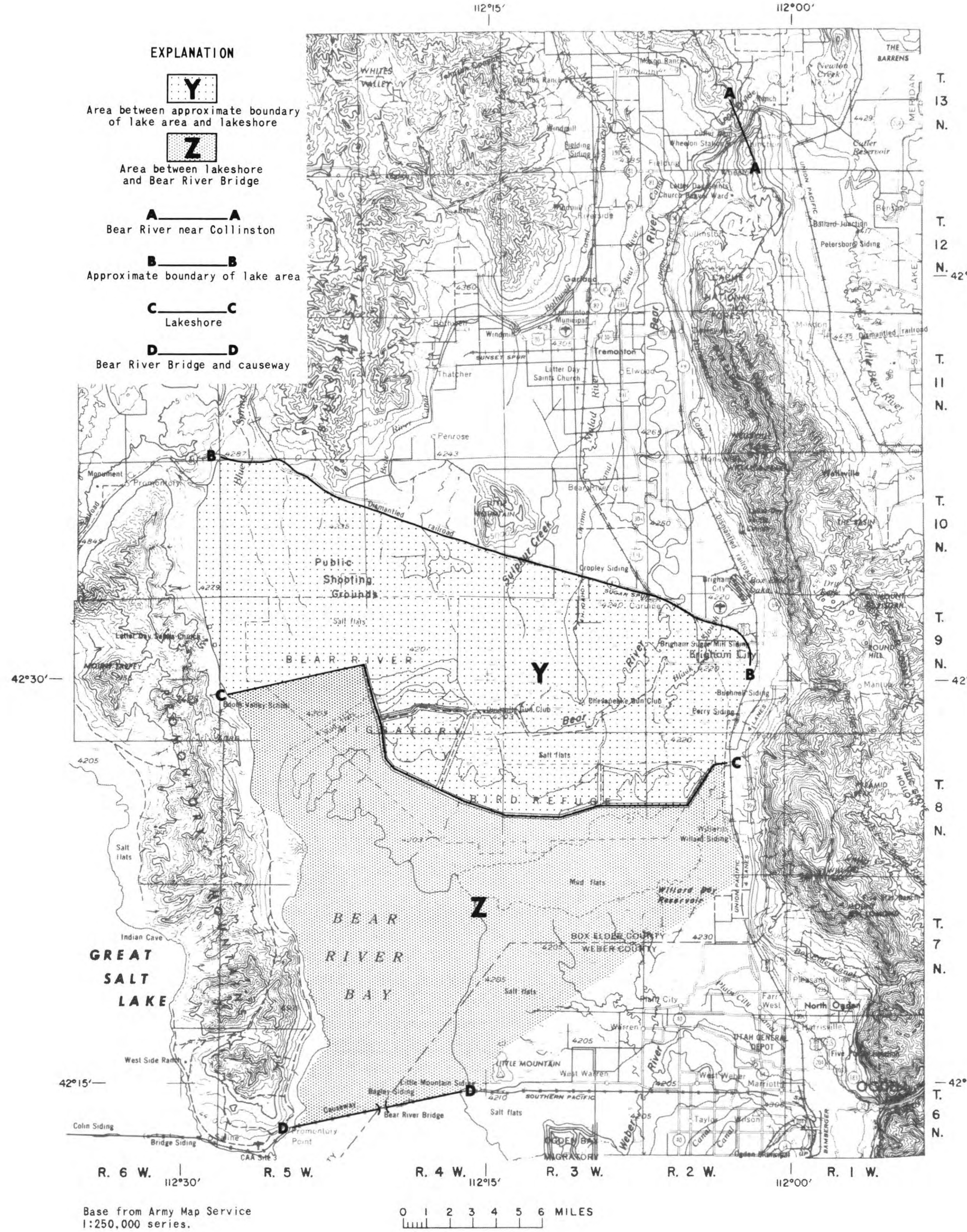

Figure 3. — Map of the Bear River drainage system between Collinston and the Bear River Bridge.

(table 14). During the 1964 water year the volume of water in the Bear River at Corinne was about six times greater than the combined volume of all other streams, canals, and springs that cross line B-B. The load of dissolved solids contributed by the Bear River at Corinne, however, was only about 1.5 times greater than the combined load of the other sources in the Bear River drainage system. During the period July-September 1964, the volume of water and the dissolved-solids load of the Bear River at Corinne were equal to or less than the combined volume and load of other sources in the system.

Most of the flow crossing line B-B enters the Bear River Migratory Bird Refuge where over 65,000 acres of open water and hydrophytic vegetation account for tremendous water loss. Adjacent to the refuge, phreatophytes and mudflats cause additional water loss. As a result, area Y of figure 3 significantly affects the inflow to Great Salt Lake. This effect had to be computed because it was not possible to measure the discharge through the dozen spill boxes which discharge water from the bird refuge.

The chemical quality of the water changes significantly between line A-A and line D-D. At line A-A the water is a magnesium calcium bicarbonate type as determined from data in Hahl and Mitchell (1963) and Connor, Mitchell, and others (1958); at lines B-B and C-C a sodium chloride bicarbonate type; and at D-D a sodium chloride type. The change in water type is expressed in terms of weighted-average annual concentration in figure 4 by showing the concentration of ions on the horizontal scale and the concentration of dissolved solids on the vertical scale. For example, the four points marked "a" in figure 4 represent the weighted-

Table 1. — Summary of estimated inflow to Great Salt Lake by drainage system during the 1964 water year

Streamflow: Estimated unless otherwise indicated; a, daily discharge or pumpage record available.
Dissolved solids (thousands of tons): Calculated from data in tables 14 and 15.

Drainage system	Source	Streamflow (thousands of acre-feet)	Dissolved solids	
			Tons per acre-foot	Thousands of tons
Bear River	Canals crossing State Highway 83, near Corinne	23	0.78	18
	Bear River at Corinne	a 936	.82	768
	Black Slough at U.S. Highway 30, near Brigham City	22	2.4	53
	Sulphur Creek at State Highway 83, near Corinne	51	2.9	148
	Public Shooting Grounds near Penrose	47	5.5	258
	Blue Spring Creek at Promontory Road, near Howell	4	6.0	24
	Miscellaneous drains and canals	5	1.4	7
	Net change in shoreline marshes	-175	-	112
	Subtotal	913	-	1,388
Weber River	Weber River near Plain City	a 312	0.38	119
	Sloughs and drains in lower Weber River delta	100	.7	70
	Net change in shoreline marshes	-14	-	11
	Subtotal	398	-	200
Jordan River	Treated sewage from West Bountiful plant, near Woods Cross	a 1	3	3
	Jordan River at Cudahy Lane, near Salt Lake City	a 90	1.31	118
	Salt Lake City sewage canal at Cudahy Lane, near Salt Lake City	a 39	2.9	113
	Surplus Canal at Cohen Flume, near Salt Lake City	a 88	1.38	121
	Goggin Drain near Magna	a 37	2.3	85
	North Point Canal below Goss Flume, near Salt Lake City	a 11	1.5	16
	Kennecott Drain near Magna	a 58	4.9	284
	Lee Creek near Magna	3	96	288
	Garfield Drain near Magna	1	9.0	9
	Net change in shoreline marshes	-47	-	35
	Subtotal	281	-	1,072
Davis County	Miscellaneous streams	50	0.4	20
	Treated sewage effluent, three plants in Davis County	a 13	1	13
	Miscellaneous springs	1	7	7
	Subtotal	64	-	40
Other springs and streams	Bear River Bay	10	16	160
	Antelope Island	4	3	12
	Tooele Valley	4	24	96
	Stansbury Island	1	4	4
	Stansbury Island to Kelton	4	20	80
	Locomotive Springs area	22	4.1	90
	Locomotive Springs area to Hansel Valley	1	105	105
	Hansel Valley	2	9	18
	Rozel Point	1	7	7
	Westside Promontory Point	2	4	8
	Storm runoff from Great Salt Lake Desert	35	7.5	262
	Subtotal	86	-	842
Great Salt Lake	Total (rounded)	1,700	-	3,500

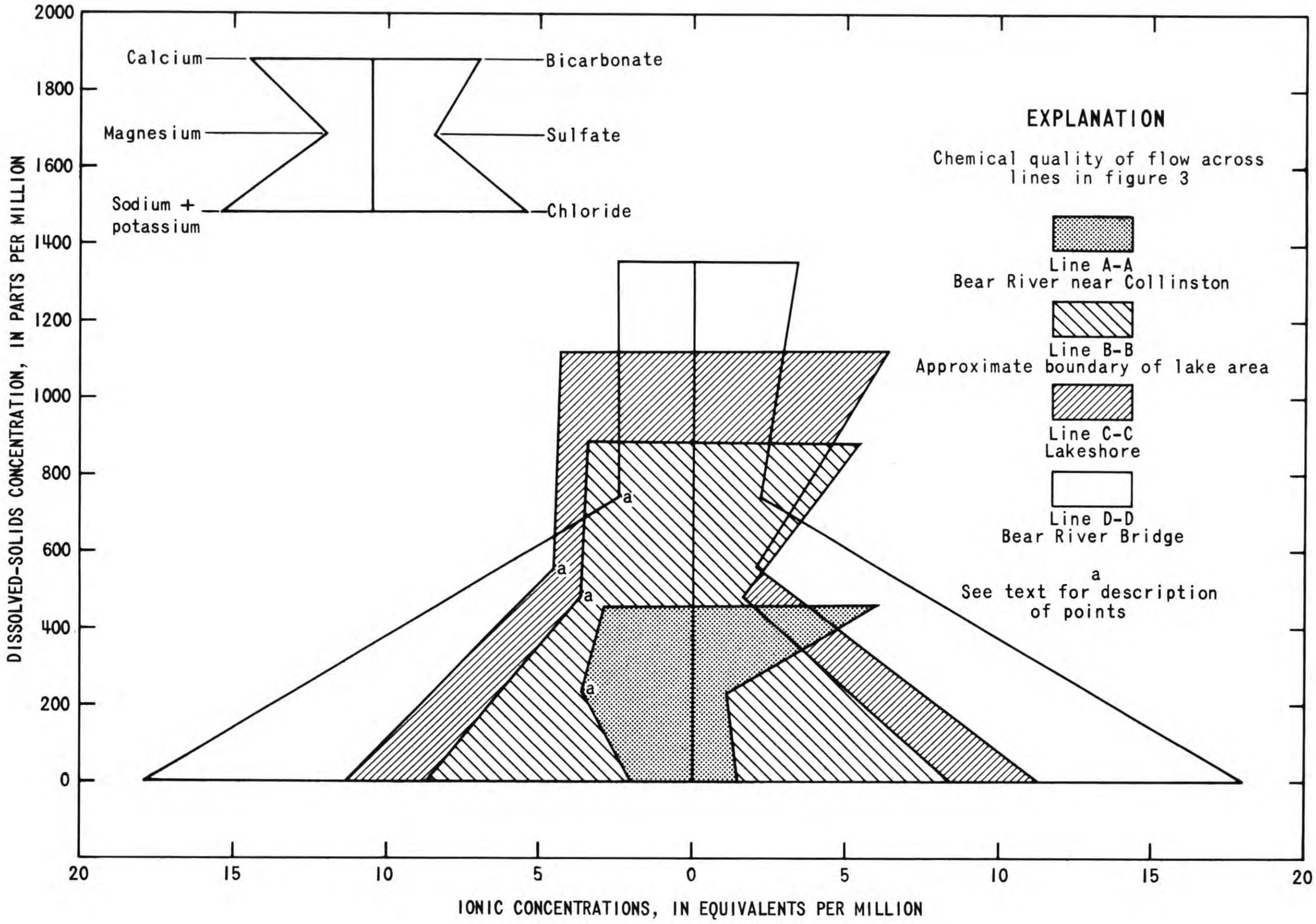

Figure 4. — Comparative weighted-average dissolved-constituent concentrations for selected sites in the Bear River drainage system during the 1964 water year.

average concentration of magnesium ions in the water at the four lines during the 1964 water year. At line A-A there were 3.6 epm (equivalents per million) of magnesium in water of about 460 ppm dissolved solids; at line B-B about 3.7 epm in about 880 ppm; at line C-C about 4.5 epm in about 1,120 ppm; and at line D-D about 2.4 epm in about 1,360 ppm. Estimates of the annual discharge and dissolved-solids load that cross the four lines in the Bear River drainage system are compared in table 3. The overall change in load shows an actual increase in sodium and chloride ions and a decrease in magnesium, calcium, and bicarbonate ions.

The slight increase in discharge across line B-B as compared to line A-A indicates that inflow to the area downstream from line A-A exceeds evapotranspiration. The major change in dissolved constituents in the area downstream from line A-A is an increase in sodium and chloride ions and an increase in dissolved solids due to inflow from saline springs and return flow from irrigated areas.

The decrease in discharge across lines C-C and D-D as compared to upstream lines indicates that evapotranspiration in areas Y and Z (fig. 3) exceeds inflow to those areas. This concept is supported by the increased quantity of dissolved solids in the waters moving downstream across lines B-B, C-C, and D-D (table 3). The increase in dissolved solids in area Z, however, is accompanied by the precipitation of calcium and magnesium carbonates, which probably results from the change in environment as water flows from area Y to area A. The bird refuge, which constitutes most of area Y, contains an abundant flora and fauna that probably maintain a large amount of gas dissolved in the water. The lower bay, which constitutes most of area Z, is so flat that the water spreads in a sheet over about 75 square miles. This increases the water-air interface so greatly over that in the refuge that the dissolved gases now equilibrate with those in the air. Thus, with the probable increase in water temperature in the lower bay, gases, including carbon dioxide, are lost from the water. This loss in carbon dioxide results in the precipitation of calcium and magnesium carbonates.

Table 2. — Estimated weighted-average concentrations and loads of dissolved constituents entering Great Salt Lake during the 1964 water year

Sodium: Includes potassium (K).
Bicarbonate: The figures shown as load are bicarbonate reported as carbonate (CO_3).
Dissolved solids: Computed or taken from table 14.

Drainage system	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids
	Concentration, in parts per million						
Bear River	87	55	260	387	103	404	1,120
Weber River	57	20	52	266	43	55	370
Jordan River	152	123	683	282	586	1,070	2,810
Davis County	-	-	-	-	-	-	460
Other springs and streams	-	-	-	-	-	3,840	7,200
Weighted average	-	-	-	-	-	-	1,500
	Load, in thousands of tons						
Bear River	109	68	323	237	128	502	1,388
Weber River	31	11	28	71	23	30	200
Jordan River	58	47	261	54	224	409	1,072
Davis County	-	-	-	-	-	-	40
Other springs and streams	-	-	-	-	-	449	842
Total tons (rounded)	-	-	-	-	-	-	3,500

Weber River Drainage System

The Weber River drainage system contributed about 200,000 tons of dissolved solids and about 400,000 acre-feet of water to the lake during the 1964 water year (table 1). Water leaving this drainage system was a calcium sodium bicarbonate type and contained a weighted-average concentration of about 370 ppm of dissolved solids (table 2). The Weber River drainage system is one of the smallest contributors of dissolved solids to Great Salt Lake. However, it is the second largest contributor of water. Thus, if potential development of fresh-water inflow to the lake is considered, the Weber River is the most important source of inflow.

The relation of the downstream part of the Weber River drainage system to the lakeshore cannot be represented simply on a map. Water from the Weber River is diverted to areas north and west of Ogden, and most of the return flow is consumed in marshes at the southeast margin of Bear River Bay. Other water is diverted as far south as Bountiful and Woods Cross, with some return flow entering via the Jordan River drainage system. About 25 percent of the flow from the Weber River drainage system is through a diverse system of drains and sloughs which cross the lakeshore between Little Mountain and Syracuse. These drains are estimated to carry about 33 percent of the dissolved-solids load contributed to the lake by this drainage system. Evapotranspiration in the Ogden Bay Migratory Bird Refuge and Howard Slough was responsible for a loss of about 14,000 acre-feet of water and a gain of about 11,000 tons of dissolved solids in the flow from the Weber River drainage system. These values were computed from data from Christiansen (1964) and are entered as "Net change in shoreline marshes" in table 1.

Jordan River Drainage System

The Jordan River drainage system contributed about 1,000,000 tons of dissolved solids and about 300,000 acre-feet of water to the lake during the 1964 water year (table 1). Water leaving the drainage system was of a sodium chloride type and contained a weighted-average concentration of about 2,800 ppm of dissolved solids (table 2). This drainage system was the second largest contributor of dissolved-solids load and the third largest contributor of water to the lake.

Flow from the Jordan River drainage system enters the lake through diverse water courses, but data collected during the 1964 water year enabled definition of the discharge approximately along line A-A in figure 5. A summary of the data in table 14 that were used to compute surface flow across this line is shown in table 1.

The major contributors of water in this drainage system were the Jordan River and the Surplus Canal, which carried a combined flow of about 180,000 acre-feet of water and about 240,000 tons of dissolved solids (table 1). The major contributors of dissolved solids were Lee Creek and Kennecott Drain, which carried a combined flow of about 570,000 tons of dissolved solids and about 60,000 acre-feet of water.

Table 3. — Estimates of water discharges and dissolved-constituent loads for the Bear River drainage system during the 1964 water year

Sodium: Includes potassium (K).

Site	Discharge (thousands of acre-feet)	Thousands of tons						
		Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate as carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids
Inflow crossing line A-A near Collinston	1/ 1,032	79	63	66	250	76	73	632
Inflow crossing line B-B	1,088	103	66	296	229	118	445	1,276
Inflow crossing line C-C	913	109	68	323	237	128	502	1,388
Outflow crossing line D-D at Bear River Bridge	800	54	33	446	107	113	694	1,480

1/ Measured.

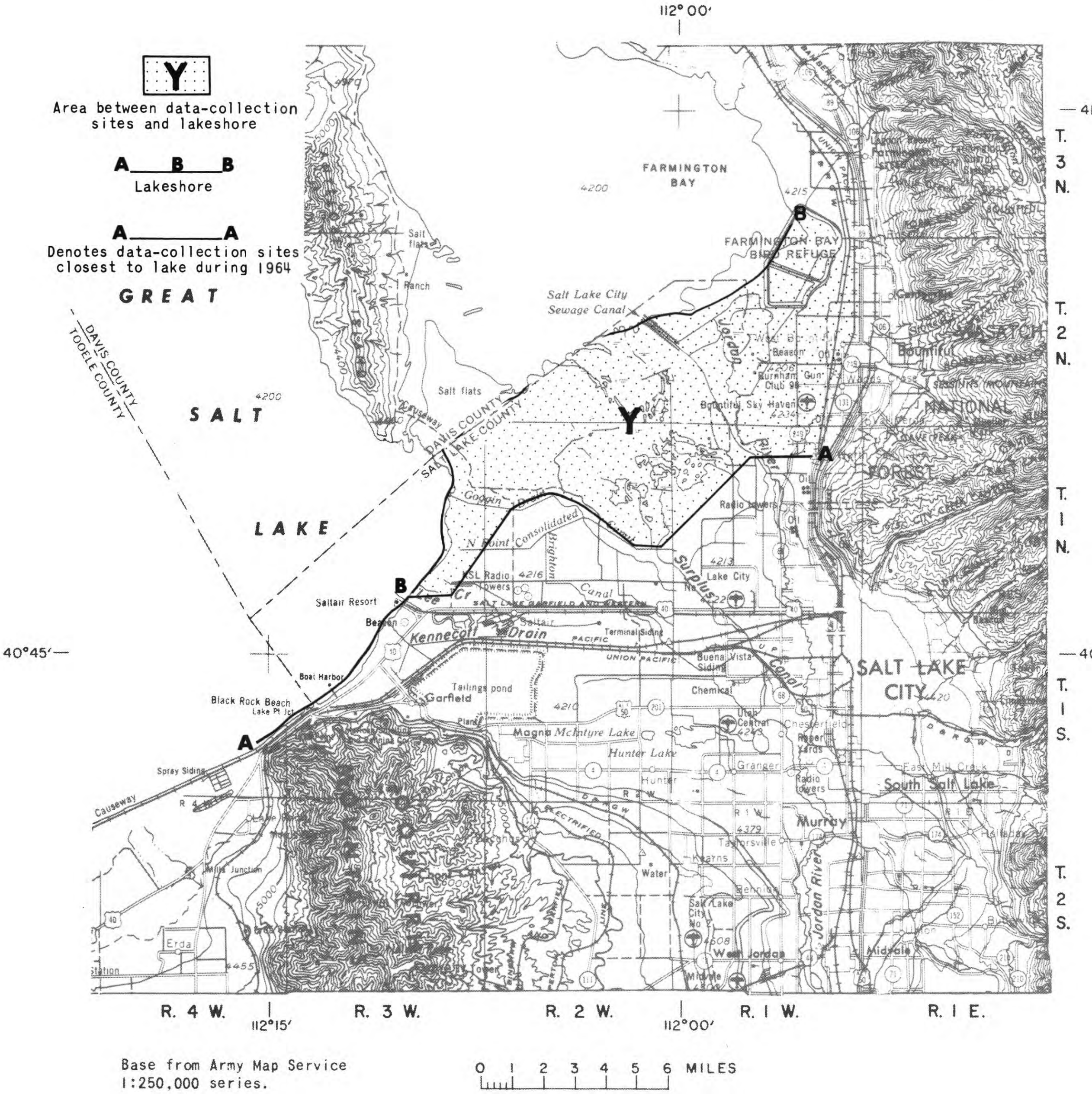

Figure 5. — Map of the Jordan River drainage system between Salt Lake City and Farmington Bay.

Between a part of line A-B-A (fig. 5) and the lakeshore at line B-B lies an area of farms, marshes, and wasteland designated by the letter Y in figure 5. The inflow to Great Salt Lake across the lakeshore (line A-B-B in fig. 5) was calculated by adjusting the flow across line A-B-A for the effect in area Y due to evapotranspiration, ground-water inflow, and precipitation. The adjustment for the effect of area Y is shown in table 1 as the entry "Net change in shoreline marshes." Evapotranspiration from the marshlands was computed from data from Harris (1964).

Minor Drainage Systems

Less than 10 percent of the surface inflow to Great Salt Lake enters via many small channels outside the three major drainage systems. This small volume of water, however, transports almost 25 percent of the dissolved-solids load that enters the lake.

Of the load delivered by the minor drainage systems in the 1964 water year, an estimated 150,000 tons were deposited on the land surface between the shoreline and the actual lake body. This occurred because insufficient water was discharged by some of the small channels to meet the demands of evaporation and still maintain flow as far as the brine's edge. Part of the deposited load, however, was moved toward the brine by rain and snowmelt.

Davis County

The Davis County drainage system contributed about 40,000 tons of dissolved solids and about 60,000 acre-feet of surface water to the lake during the 1964 water year (table 1). This system includes all the tributaries to Great Salt Lake that drain the west slope of the Wasatch Range between the Weber and Jordan River drainages. The system could be considered as part of the Weber River drainage system because diversions into Davis County from the Weber River constituted a significant part of the total discharge.

Water leaving the system was of the calcium sodium bicarbonate type, based on data collected by Hahl and Mitchell (1963), and contained a weighted-average concentration of about 460 ppm of dissolved solids (table 2).

Other Springs and Streams

The springs and streams drainage system contributed about 840,000 tons of dissolved solids and about 86,000 acre-feet of water to the lake during the 1964 water year (table 1). The water leaving the system was predominantly of the sodium chloride type and contained a weighted-average concentration of about 7,200 ppm of dissolved solids (table 2). Shoreline reconnaissances were made in August-September 1963 and in April 1964 to determine the quantity and quality of water from springs and streams that enter the lake from the Oquirrh Mountains westward around the lake to Promontory Point. The data collected during these trips are shown in table 15.

The trip of 1963 demonstrated the futility of sampling the innumerable seeps and some of the springs bordering the lake. Many springs issue over a 2-acre area with no distinct source of outflow, and the large shallow pools below some of the soggy outflow areas attest to a significant discharge that is unmeasurable by standard methods. During the 1964 trip, therefore, only the springs with a definite point of discharge were sampled.

Some springs lie at the base of alluvial fans. The dissolved-solids content of the water is usually between 1,000 and 3,000 ppm, and the discharge point is usually surrounded by dense vegetation. The density of the vegetation gradually diminishes due to an increase in the dissolved-solids content as the water flows over the lakebed. The photograph (fig. 6) shows a spring at the base of an alluvial fan at site 78 (table 15 and fig. 1). Water discharges from a large marsh area and flows across the dry lakebed into Great Salt Lake. The spring is thought to be the one mentioned by Stansbury (1853, p. 174).

Some seep areas are near or at the base of rock outcrops. Water from these seeps has a strong odor of hydrogen sulfide and usually contains more than 30,000 ppm of dissolved solids. The dark area in front of the rock outcrop in figure 7 is such a seep area. The springs at some of these outcrops yield water with temperatures exceeding 100° F.

Seven pothole springs were visited during the investigation and more are known to exist. These springs issue from holes that are 5-15 feet in diameter (fig. 7), 3-28 feet deep, and have vertical but rough walls (fig. 8). Gas rises from their depths and organic matter accumulates on the water surface. Figure 8 is a closeup view of one of the springs. Dissolved-solids concentrations of the water at the surface of these springs is from 25,000 to 90,000 ppm.

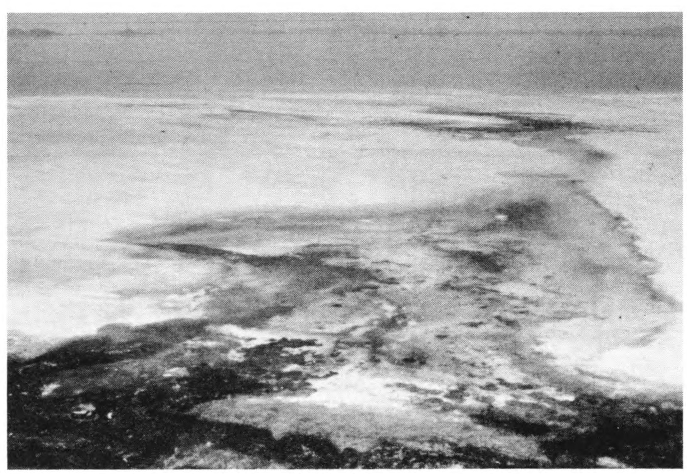

Figure 6. — A spring on the west side of Promontory Mountains. The water discharges from a large area (dark foreground) at the base of an alluvial fan and enters the brine near the center of the picture.

Many stream channels approach the lakeshore, but only a few reach the shoreline. From the appearance of vegetation and gravel in these channels, some obviously carry snowmelt runoff at least once during the year. Flow in the remainder of these channels seems to be dependent upon the pattern of summer storms in the area.

During the 1964 reconnaissance, Elmer Butler of the U. S. Geological Survey made computations of peak discharges from high-water marks, channel slopes, and apparent bed roughness during the period of flow. Although two such computations indicate peak discharges of about 50 cfs (cubic feet per second), most channels carried less than 10 cfs during their peak-flow period. The indirect measurement does not give an indication of the duration or total volume of flow.

An example of the force exhibited by inflow from the areas adjacent to the western shore of Great Salt Lake was observed later in 1964. During a cool wet spring, runoff from the mountains adjacent to the Great Salt Lake Desert filled normally moist sloughs and marshes to overflowing (Ray Piggott, oral communication, 1964). Then from June 5 to June 9, more than 1 inch of rain fell on the desert and more than 2 inches fell on the adjacent mountains. The resulting runoff was concentrated at the point of outflow from the desert to the lake and washed out a 4-foot diameter culvert in the Southern Pacific Co.'s service road west of Lakeside (point A, fig. 1). The duration of flow was about 3 weeks.

QUALITY OF SURFACE-WATER INFLOW TO THE LAKE AREA

1964 Water Year

Surface water entering the lake area is divided into six units based on source or type of inflow. The six

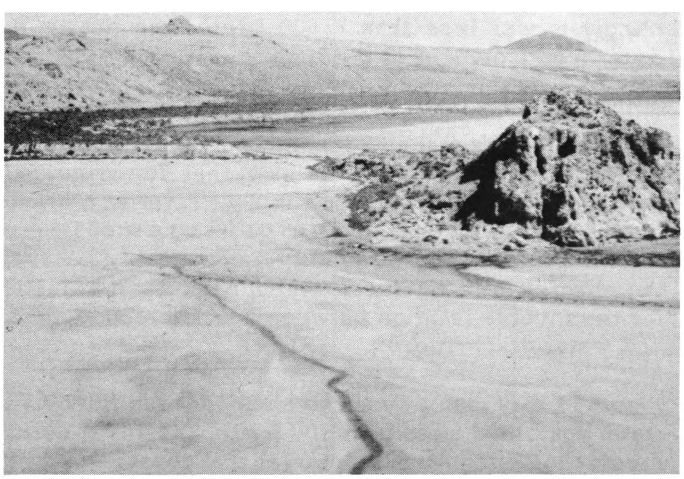

Figure 7. — A rock outcrop at the northern end of Great Salt Lake. Channel in foreground originates at pothole spring visible on exposed lakebed. Dark area in front of outcrop is seep area.

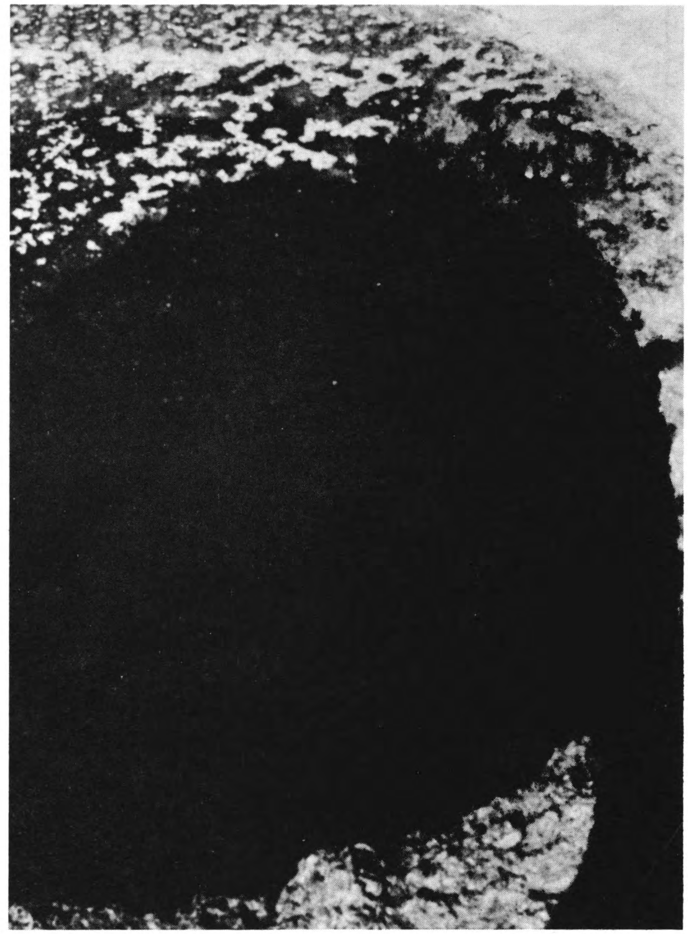

Figure 8. — Closeup view of pothole spring containing clear water. Note matter on water surface and the irregular vertical walls of the hole. This hole is about 28 feet deep and about 12 feet in diameter.

units are the Bear River unit, with sodium bicarbonate chloride type water; the Weber River unit, with calcium bicarbonate type water; the East Shore unit, with calcium bicarbonate type water; the Jordan River unit, with sodium calcium sulfate chloride type water; the springs around the lake unit, with sodium chloride type water; and the drains and sewage canals unit, with sodium chloride type water. Estimates of the dissolved-solids contributions by surface-water units to the lake area during the 1964 water year are summarized in table 4. Estimates of weighted-average concentrations and loads of dissolved constituents are shown in table 5.

Tables 4 and 5 show that the Bear River unit contributed the greatest load of dissolved solids, and with respect to the individual constituents, it was the largest single contributor of all constituents except sulfate. The drains and sewage canals unit was the principal contributor of sulfate. The water with the greatest concentration of dissolved solids was from springs around the lake unit and that with the least concentration was from the East Shore unit. These results of the 1964 water year study are identical to those for the 1960-61

Table 4. — Summary of estimated inflow to the lake area by surface-water units during the 1964 water year

Streamflow: Estimated unless otherwise indicated; a, daily discharge or pumpage record available.
Dissolved solids (tons per acre-foot): Calculated from data in tables 14 and 15.

Unit	Source	Streamflow (thousands of acre-feet)	Dissolved solids	
			Tons per acre-foot	Thousands of tons
Bear River	Bear River at Corinne	a 936	0.82	768
	Blue Spring Creek at Promontory Road, near Howell.	4	6.7	27
	Subtotal	940	-	795
Weber River	Weber River near Plain City	a 312	.38	119
	Sloughs and drains in the lower Weber River delta.	100	.7	70
	Subtotal	412	-	189
East Shore	Streams between Weber and Jordan River basins	50	.41	20
Jordan River	Jordan River plus Surplus Canal at Salt Lake City.	a 199	1.44	287
Springs around the lake	Locomotive Springs area near Snowville:			
	West Lake.	11	4.1	45
	Baker Springs Slough	4	3.4	14
	East Lake.	7	4.6	32
	Springs at abandoned salt plant south of Snowville:			
	Large spring	.7	100	70
	Small spring	.3	85	26
	Big Spring at Timpie.	5	11	55
	Miscellaneous springs	15	10	150
	Subtotal	43	-	392
Drains and sewage canals	Sewage from some communities between Salt Lake City and Ogden	a 13	1.0	13
	Salt Lake City sewage canal at Cudahy Lane, near Salt Lake City.	a 39	2.9	113
	Kennecott Drain near Magna.	a 58	4.9	286
	Garfield Drain near Magna	.8	11	9
	Miscellaneous drains.	15	3	45
	Subtotal	126	-	466
Lake area	Total (rounded)	1,800	-	2,200

water years (Hahl and Langford, 1964) except that during those years the Jordan River unit was the principal contributor of sulfate.

During the 1964 water year more than 80 percent of the surface water and about 55 percent of the dissolved-solids load that entered the lake area passed the sites at Bear River at Corinne; Weber River near Plain City; and Jordan River at Salt Lake City. The data collected at these three sites are discussed in greater detail below.

Bear River at Corinne

The Bear River delivered the largest volume of water to the lake area during the 1964 water year. Discharge data collected at the streamflow measuring site at Bear River near Corinne were used in conjunction with daily specific conductance data collected at a site on the Bear River at Corinne to develop the conductivity-duration curve shown in figure 9. The discharge does not change between the two sites; therefore, both are considered as having been collected at Corinne, and discharge data can be applied directly to the water-quality data. Figure 9 may be used to approximate the percentage of time that water of a certain chemical quality is available at the site during a water year. For example, assume that water having a dissolved-solids concentration of 900 ppm or less is required. The insert in figure 9 shows that at 900 ppm the specific conductance of the water is about 1,600 micromhos per centimeter. The conductivity-duration curve in figure

Table 5. — Estimated weighted-average concentrations and loads of dissolved constituents in water discharged by surface-water units during the 1964 water year

Sodium: Includes potassium (K).
Bicarbonate: The figures shown as load are bicarbonate reported as carbonate (CO_3).
Dissolved solids: Computed or taken from table 4.

Unit	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids
Concentration, in parts per million							
Bear River	58	35	129	324	54	176	620
Weber River	53	16	48	220	43	56	340
East Shore	53	16	26	210	34	33	290
Jordan River	115	58	167	233	337	241	1,060
Springs around lake	140	90	2,300	200	250	3,780	6,700
Drains and sewage canals	174	76	702	300	560	1,010	2,700
Weighted average	73	37	205	282	123	298	890
Load, in thousands of tons							
Bear River	74	45	165	204	69	225	795
Weber River	30	9	27	61	24	31	189
East Shore	4	1	2	7	2	2	20
Jordan River	31	16	45	31	91	65	287
Springs around lake	8	5	135	6	15	221	392
Drains and sewage canals	30	13	120	25	96	173	466
Total tons	177	89	494	334	297	717	2,200

9 shows that the conductivity of the water at the sampling site was less than 1,600 micromhos per centimeter for 71 percent of the time.

The flow-duration curve in figure 10 may then be used to determine the discharge for this particular time interval of 71 percent. It can be seen that for 71 percent of the time the discharge of the Bear River at Corinne is 400 cfs or greater. The percentages of time in figures 9 and 10 may be used interchangeably because the abscissas in figures 9 and 10 have been adjusted for the inverse relation between specific conductance and water discharge.

Figure 11 may then be used to show that the Bear River water contained more than 900 ppm of dissolved solids during the 29 percent time interval that covered the period from July to early October. During this period, the river carried only about 5 percent of the annual discharge. In other words, most of the year the river carries water of good chemical quality, but during the summer and early fall the river carries mostly seepage from ground-water aquifers and return flow from irrigation.

The discharge-weighted average concentration of dissolved solids in water in the Bear River at Corinne during the 1964 water year was about 600 ppm (table 15), and the water was a sodium bicarbonate chloride type. The monthly mean temperatures and temperature ranges of the Bear River at Corinne are shown in figure 12.

Weber River near Plain City

The Weber River delivered the second largest volume of water to the lake area during the 1964 water year, and the water had one of the smallest dissolved-solids concentrations of all the inflow.

Daily chemical data are not available to construct a conductivity-duration curve for the Weber River. However, sufficient data were collected to determine that the discharge-weighted average concentration of dissolved solids during the 1964 water year was about 280 ppm (table 14), and the water was a calcium bicarbonate type.

Jordan River at Salt Lake City

The Jordan River delivered the third largest volume of water to the lake area during the 1964 water year. The flow of water in the river is regulated except for the spring runoff from the Wasatch Range and storm-sewer effluent, which enter the river and cause short periods of increased flow and an associated decrease in dissolved-solids concentration. At other times, the dissolved-solids concentration of the river is controlled mainly by return flow from irrigated land and by water discharged as industrial waste.

The discharge-weighted average concentration of dissolved solids in the Jordan River at Salt Lake City during the 1964 water year was about 1,060 ppm, and the water was a sodium calcium sulfate chloride type. The data collected during the 1960, 1961, and 1964 water years, however, indicate that during the period from May to July the dissolved-solids concentration at times goes below 900 ppm.

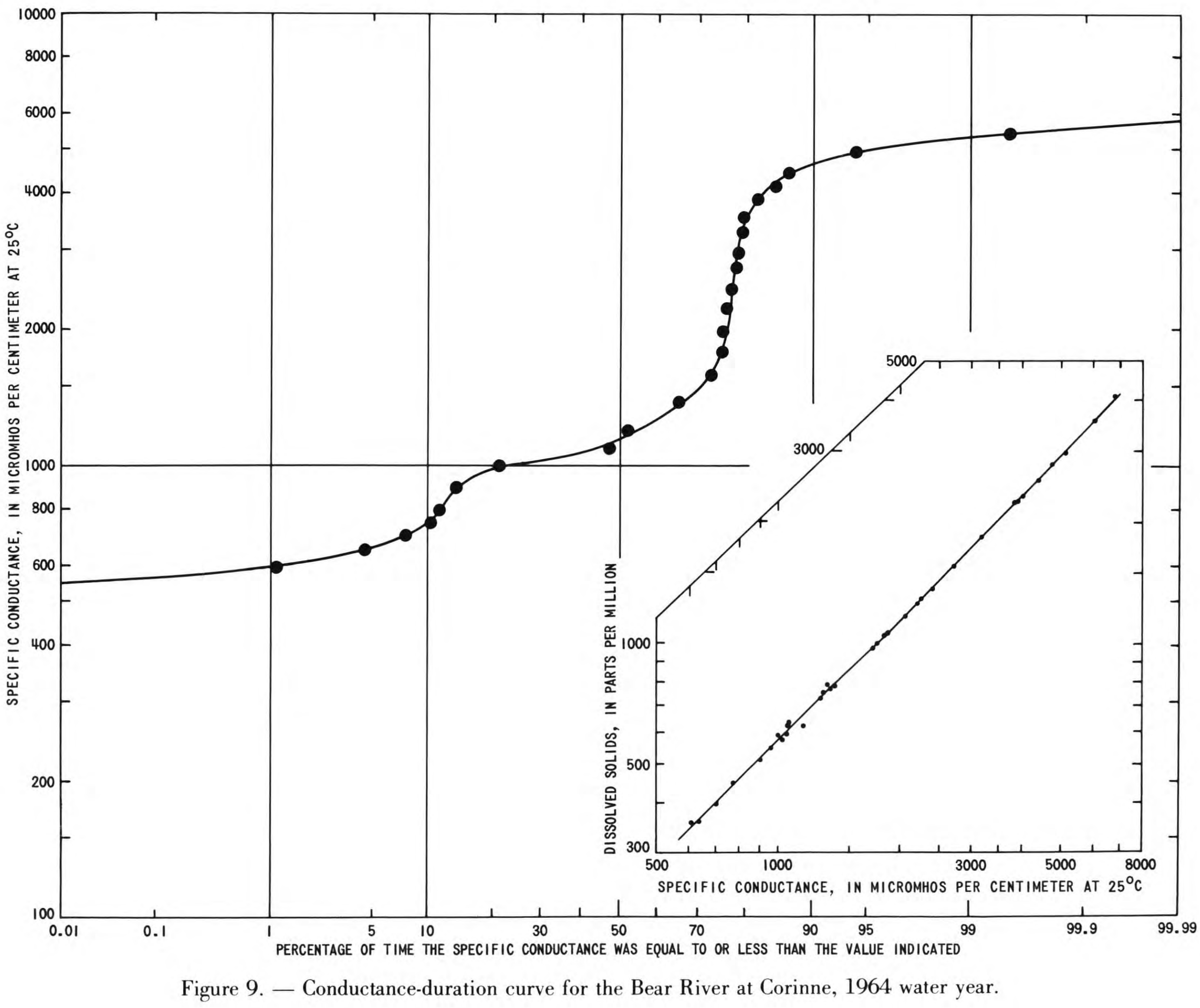

Figure 9. — Conductance-duration curve for the Bear River at Corinne, 1964 water year.

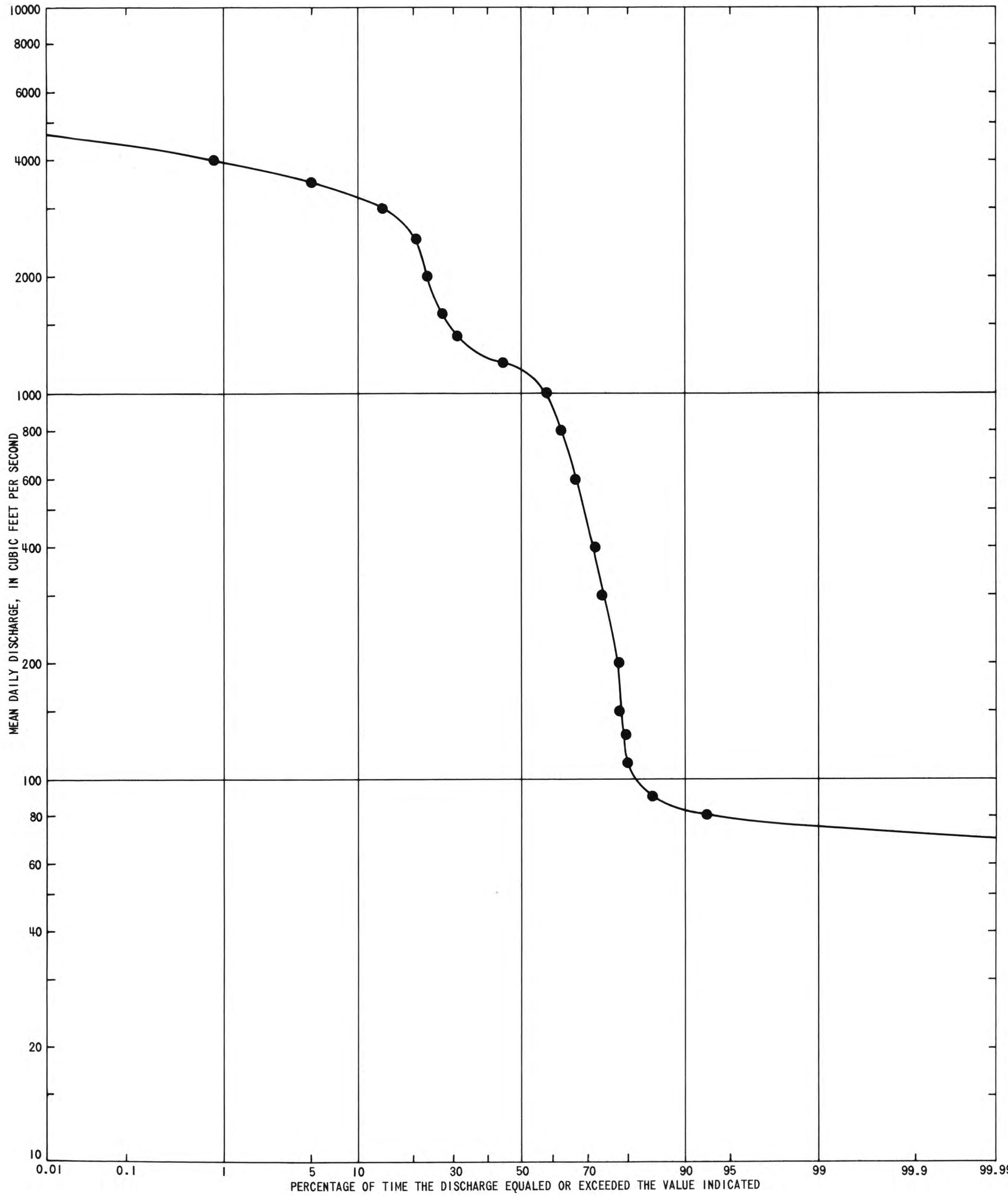

Figure 10. — Flow-duration curve for the Bear River at Corinne, 1964 water year.

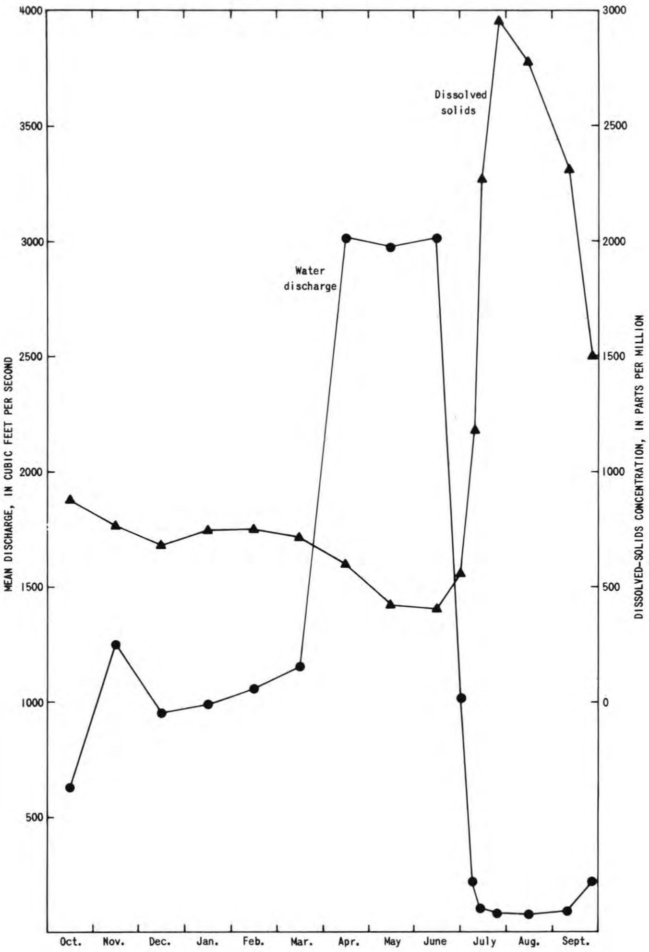

Figure 11. — Mean water discharge and dissolved-solids concentration for the period indicated for the Bear River at Corinne, 1964 water year.

Table 6. — Streamflow, in thousands of acre-feet, at selected gaging stations during the water years 1934-64 and 1960, 1961, and 1964

Site	1934-64			1960	1961	1964
	Minimum	Average	Maximum			
Bear River near Collinston	320	824	1,682	530	364	833
Weber River near Plain City	61	345	933	124	61	312

Streamflow in the Bear and Weber Rivers

Streamflow during the 1960, 1961, and 1964 water years at Bear River near Collinston and Weber River near Plain City ranged from about the lowest recorded to about average when compared with streamflow for the 1934-64 water years. Table 6 gives the 31-year average streamflow for the Bear River near Collinston and the Weber River near Plain City, along with the maximum and minimum annual streamflow for the period (U. S. Geol. Survey, 1960, 1961, 1962, 1963a, 1963b, 1964).

Figure 13 shows the duration of flow for the Bear River near Collinston for the 31-year period and for each of the water years 1960, 1961, and 1964. These four curves emphasize the range in streamflow represented by inflow during the 3-year period of study. The upper part of the curve for 1964 would have followed the 31-year curve more closely if an unusually large amount of reservoir space had not been available to store the excess spring runoff. The four curves represent streamflow ranging from the lowest recorded to about average, and it should be noted that the chemical data collected during the water years 1960, 1961, and 1964 are characteristic of the same range in streamflow.

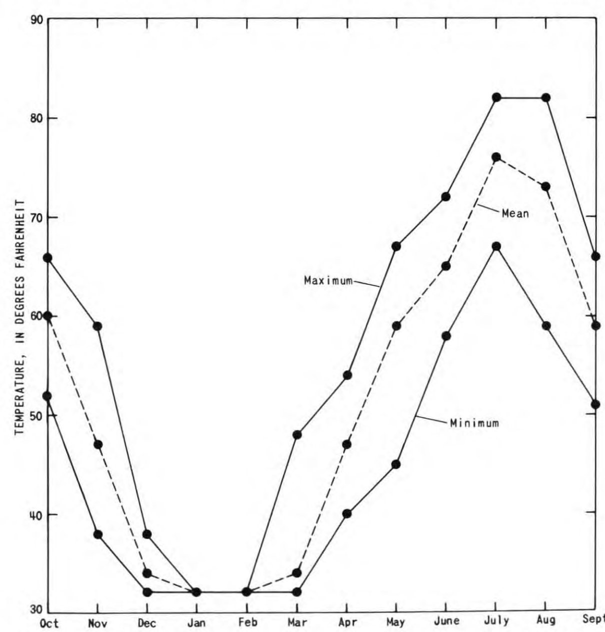

Figure 12. — Monthly minimum, mean, and maximum temperatures of the Bear River at Corinne, 1964 water year.

COMPARISON OF INFLOW TO GREAT SALT LAKE AND LAKE AREA

1960, 1961, and 1964 Water Years

The study of dissolved-mineral inflow to Great Salt Lake was conducted during 3 years in which the annual surface-water inflow to the lake varied widely. The following appraisal is based on a comparison of the annual volume of inflow during the study period with the average annual volume of inflow during a long period of recorded flow.

Unfortunately, the only streamflow measuring station in operation for a long period at the mouth of a major tributary to Great Salt Lake is Weber River near Plain City. However, record for the 1934-64 water years at Bear River near Collinston is applicable to the appraisal. Data from these two stations, which represent about 50 percent of the surface-water inflow to the lake area, are used as a gauge for all surface-water inflow to the lake.

Inflow to the Lake and the Lake Area

The inflow to the Great Salt Lake at the lakeshore and to the lake area[4/] are compared in tables 7 and 8 for the water years 1960, 1961, and 1964. The data for water year 1964 were taken from tables 1 and 4 of this report; the data for inflow to the lake area for water years 1960 and 1961 were adapted from Hahl and Langford (1964, p. 12); and the data for inflow at the lakeshore for water years 1960 and 1961 were estimated on the basis of the following relations:

1. Comparison of inflow to the lake area with inflow at the lakeshore for the 1964 water year.

2. Comparison of dissolved-solids inflow to the lake area for the water years 1960, 1961, and 1964.

3. Comparison of streamflow for the water years 1960, 1961, and 1964.

4. Coincidence in some areas of the boundary of the lake area with the lakeshore.

5. Computation of evapotranspiration from lakeshore marshlands flooded during each of the water years 1960, 1961, and 1964.

6. Comparison of rainfall records applicable to lakeshore marshlands for each of the water years 1960, 1961, and 1964.

4/ Figure 1 shows the lakeshore and the boundary of the lake area.

Inflow to Great Salt Lake at the lakeshore (table 7) ranged from a low of about 810,000 acre-feet of water carrying about 2,200,000 tons of dissolved solids in water year 1961 to about 1,700,000 acre-feet of water carrying about 3,500,000 tons of dissolved solids in water year 1964. This range in water and load was for inflow to the lake during a 3-year period which represents conditions of runoff ranging from the lowest recorded to about average during the 31-year period 1934-64.

Summaries of inflow to the lake area from surface units for the water years 1960, 1961, and 1964 are shown in table 9 as percentages of the total inflow for the respective year. The entries are computed from data in table 8. The Bear River unit contributed the greatest percentage of water and dissolved solids to the lake area during the 3 years. The Weber River and Jordan River units were either second or third in the percentage of water delivered, and the units comprised of drains and sewage canals and of springs were either second or third in the percentage of dissolved solids delivered.

DEVELOPMENT OF SURFACE-WATER INFLOW TO GREAT SALT LAKE

Proposed development that will use inflow to Great Salt Lake should be based on knowledge of the availability of the water and its suitability for the intended use. Consideration should also be given to the effect the development will have on inflow reaching the lake, because the role of Great Salt Lake as a recreational and mineral resource is dependent upon inflow. The volume of inflow, rather than the dissolved-solids load, is the factor important to the existence of the lake.

Table 7. — Summary of estimated inflow to Great Salt Lake during water years 1960, 1961, and 1964

Drainage system: Weber River, Davis County, springs and streams -- data for 1960 and 1961 taken from table 8 but adjusted for net loss from lakeshore marshlands. Bear River, Jordan River -- data for 1960 and 1961 taken from table 8 but adjusted for net loss from lakeshore marshlands and include estimates of streamflow and load for additional sources of water shown in table 1.

Water year 1964: Data entered from table 1.

Drainage system	Water year					
	1960		1961		1964	
	Streamflow (thousands of acre-feet)	Dissolved solids (thousands of tons)	Streamflow (thousands of acre-feet)	Dissolved solids (thousands of tons)	Streamflow (thousands of acre-feet)	Dissolved solids (thousands of tons)
Bear River	626	1,294	436	1,010	913	1,388
Weber River	188	133	80	75	398	200
Jordan River	269	814	204	650	281	1,072
Davis County	45	27	35	24	64	40
Springs and streams	70	560	60	480	86	842
Total to Great Salt Lake (rounded)	1,200	2,800	810	2,200	1,700	3,500

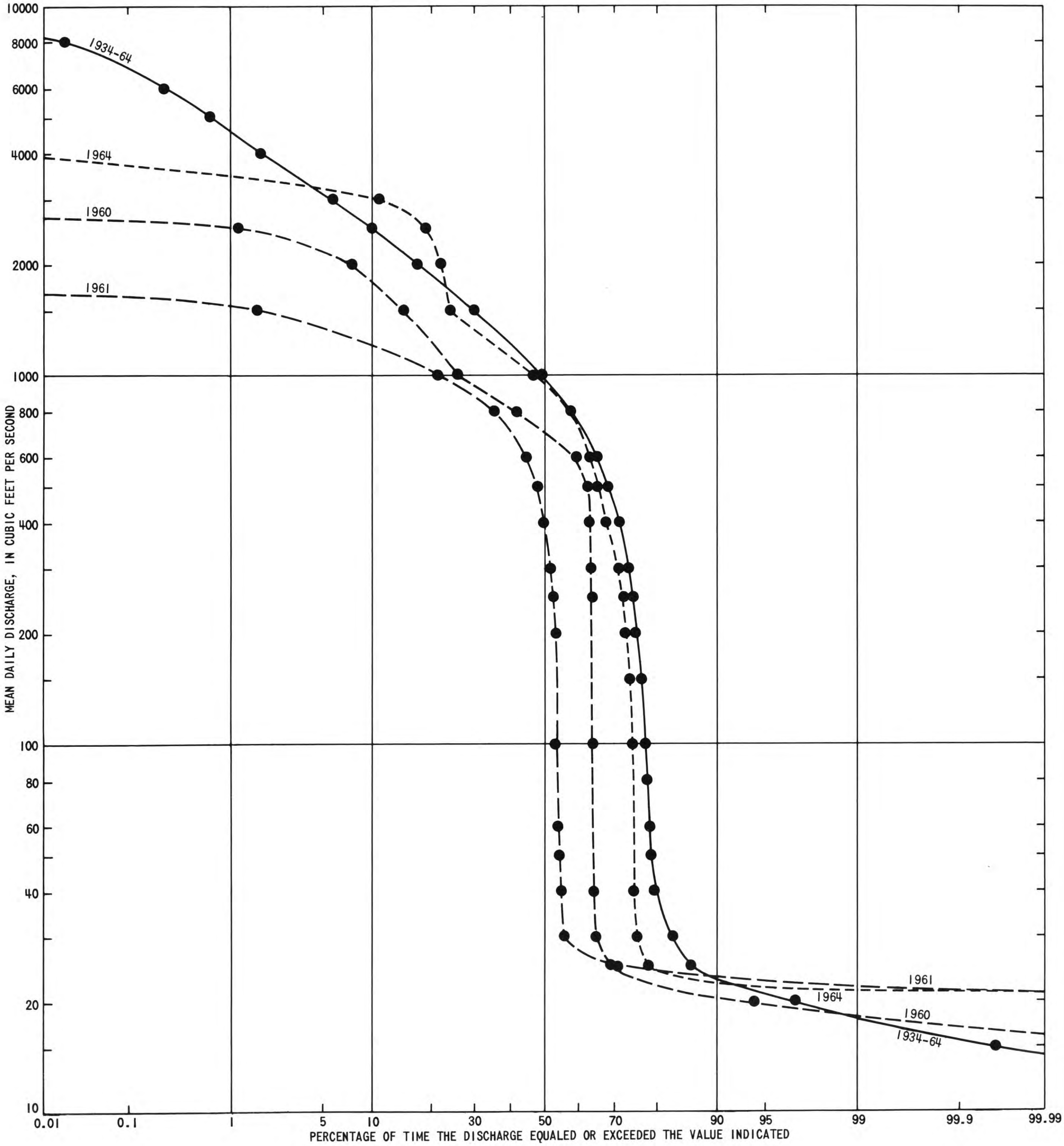

Figure 13. — Flow-duration curves, Bear River near Collinston.

Table 8. — Summary of estimated dissolved-solids contributions by surface-water units to the lake area during the water years 1960, 1961, and 1964

Streamflow: Estimated unless otherwise indicated.
Dissolved solids (tons per acre-foot): Calculated from data in tables 14 and 15 or in Hahl and Mitchell (1963)
Water years 1960 and 1961: Data entered from Hahl and Langford (1964, p. 12) except for revisions in entry for drains and sewage canals.
Water year 1964: Data entered from table 4.

Unit	Source	Water year 1960			Water year 1961			Water year 1964		
		Streamflow (thousands of acre-feet)	Dissolved solids: Tons per acre-foot	Dissolved solids: Thousands of tons	Streamflow (thousands of acre-feet)	Dissolved solids: Tons per acre-foot	Dissolved solids: Thousands of tons	Streamflow (thousands of acre-feet)	Dissolved solids: Tons per acre-foot	Dissolved solids: Thousands of tons
Bear River	Bear River at Bear River Migratory Bird Refuge, near Brigham City.	1/635	1.08	686	1/448	1.27	569	2/936	0.82	768
	Blue Spring Creek at Promontory Road, near Howell.	3	6	18	2	6	12	4	6.7	27
	Subtotal	638	-	704	450	-	581	940	-	795
Weber River	Weber River near Plain City	3/124	.47	58	3/61	.61	37	3/312	.38	119
	Sloughs and drains in the lower Weber River delta.	80	.8	64	30	.9	27	100	.7	70
	Subtotal	204	-	122	91	-	64	412	-	189
East Shore	Streams between Weber and Jordan River basins	30	.5	15	20	.6	12	50	.41	20
Jordan River	Jordan River plus Surplus Canal at Salt Lake City.	3/181	1.74	315	3/132	1.80	238	3/199	1.44	287
Springs around the lake	Locomotive Springs area near Snowville:									
	West Lake.	10	3.5	35	10	3.5	35	11	4.1	45
	Baker Springs Slough	6	2.6	16	6	2.6	16	4	3.4	14
	East Lake.	10	10	100	10	10	100	7	4.6	32
	Springs at abandoned salt plant south of Snowville:									
	Large spring	.7	100	70	.7	100	70	.7	100	70
	Small spring	.3	85	26	.3	85	26	.3	85	26
	Big Spring at Timpie.	5	11	55	4	11	44	5	11	55
	Miscellaneous springs	10	5	50	7	5	35	15	10	150
	Subtotal	42	-	352	38	-	326	43	-	392
Drains and sewage canals	Sewage from some communities between Salt Lake City and Ogden	3/15	4/1	15	3/15	4/1	15	3/13	1.0	13
	Salt Lake City sewage canal at Cudahy Lane, near Salt Lake City.	3/32	3.0	96	3/32	3.0	96	3/39	2.9	113
	Kennecott Drain near Magna.	4/50	4.7	4/235	4/30	5.3	159	3/58	4.9	286
	Garfield Drain near Magna	4/1	7.8	4/ 8	4/1	8	8	.8	11	9
	Miscellaneous drains.	10	3	30	7	4	28	15	3	45
	Subtotal	4/108	-	4/384	85	-	306	126	-	466
Total to lake area (rounded)		4/1,200	-	4/1900	820	-	1,500	1,800	-	2,100

1/ Estimated from streamflow records for gaging station at Collinston.
2/ Measured at gaging station Bear River near Corinne.
3/ Measured at gaging station or taken from pumpage records.
4/ Revised.

During the 3-year study, volume of surficial inflow to the lake ranged from 10 to 20 percent of the estimated volume of the lake, while the dissolved-solids load was less than 0.1 percent of the estimated load in the brine.

Effect of Upstream Reservoir Storage on the Lake Stage

The volume of inflow to Great Salt Lake is affected continually by upstream reservoir operation. During years of low runoff, usable storage in reservoirs is depleted because more water is used than is produced by rain and snow. For example, during the 1961 water year usable water in storage on the Weber River was reduced by about 19,000 acre-feet and on the Bear River by about 300,000 acre-feet. During years of average runoff, usable water in storage in reservoirs is increased because less water is used than is produced by rain and snow. For example, during the 1964 water year usable water in storage on the Weber River was increased by 9,000 acre-feet and on the Bear River by about 160,000 acre-feet.

The usable storage capacity of reservoirs during the 1964 water year in the Great Salt Lake basin was about 2,800,000 acre-feet. Table 10 shows data for 3 water years when high, low, and average amounts of streamflow reached the lake area (fig. 1) in each of its three major tributaries. During years of high runoff, the volume of water in the Bear and Weber Rivers that reaches the lake area exceeds the total storage capacity in those basins. During years of low runoff, inflow to the lake is reduced to only slightly more than the releases required to prevent stagnation in the bird refuges.

Proposed storage projects in the Bear River drainage would increase the storage capacity to about 2,000,000 acre-feet. This should be sufficient to completely regulate the flow of the Bear River for all except successive years of very high runoff.

Willard Bay Reservoir began filling in November 1964. This reservoir receives water from the Weber River and almost doubles storage in that drainage. However, several successive years of average runoff will still

Table 9. — Percentages of total water and dissolved solids contributed to the lake area by each unit during the water years 1960, 1961, and 1964

Unit	1960		1961		1964	
	Discharge	Load	Discharge	Load	Discharge	Load
Bear River	53	37	55	38	53	37
Weber River	17	6	11	4	23	9
East Shore	2	1	3	1	3	1
Jordan River	15	17	16	16	11	13
Springs around the lake	4	19	5	21	3	18
Drains and sewage canals	9	20	10	20	7	22
Total to lake area	100	100	100	100	100	100

provide considerable quantities of water that reach the lake area.

The Great Salt Lake recedes during successive years of low runoff, and as additional upstream storage is constructed, the low stages of the lake will be lower than those previously recorded. The relation of water quality to runoff observed during the 3 years of this study will probably hold for similar amounts of inflow even though the volume of upstream storage will change.

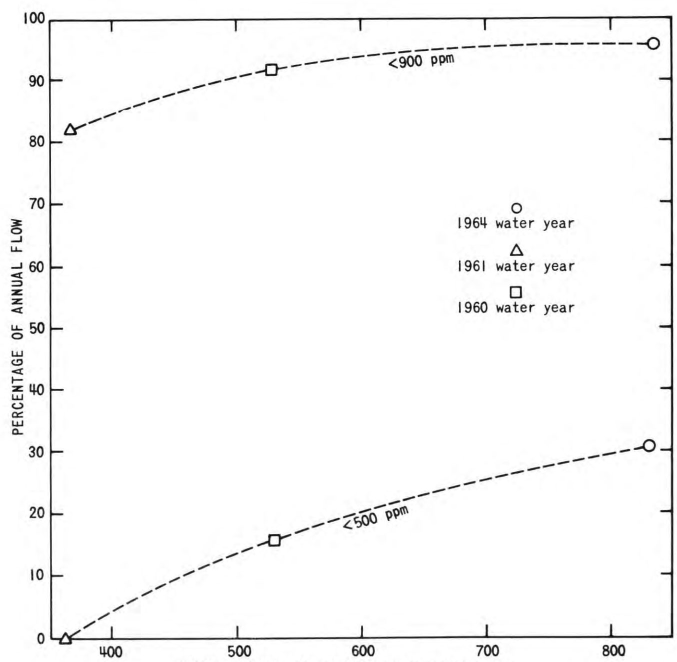

Figure 14. — Percentage of water in the Bear River at Corinne containing dissolved-solids concentrations less than values shown during the water years 1960, 1961, and 1964.

Chemical Quality of Water Available for Development

Chemical quality of the inflow to Great Salt Lake that is available for development was determined from data collected at the following sites: Bear River at Corinne, Weber River near Plain City, and Jordan River at Cudahy Lane, near Salt Lake City. Three-fourths of the water reaching Great Salt Lake passes these three sites, and use downstream from them is mostly as a water supply for marshlands.

Figures 14 and 15 show the range in annual flow for certain quantities of dissolved solids during the water years 1960, 1961, and 1964 in the Bear River, the Weber River, and the Jordan River. Between about 80 and 95 percent of the water in the Bear River contained less than 900 ppm of dissolved solids (fig. 14). During 1961 none of the water contained less than 500 ppm of dissolved solids, and during 1964 about 30 percent contained less than 500 ppm. Water in the Weber River never exceeded 900 ppm of dissolved solids; and about 50 percent during 1961 to about 95 percent during 1964 contained less than 500 ppm of dissolved solids (fig. 15). The volume of discharge of the Jordan River

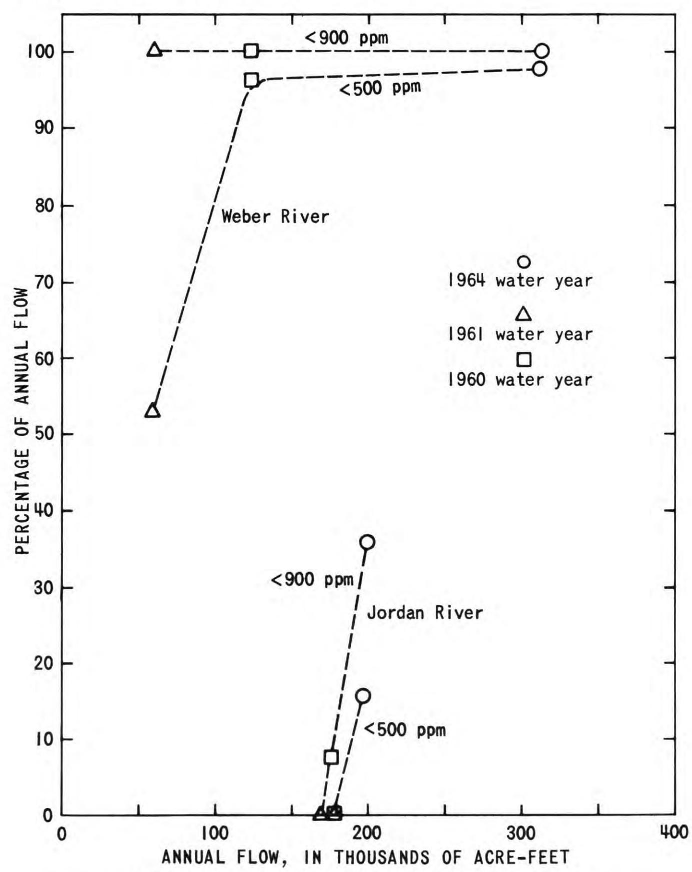

Figure 15. — Percentage of water in the Weber River near Plain City and the Jordan River at Cudahy Lane near Salt Lake City containing dissolved-solids concentrations less than the values shown during the water years 1960, 1961, and 1964.

varies little between years of low and average runoff, but the percentage of dilute water varies markedly (fig. 15). During 1961 none of the water contained less than 900 ppm of dissolved solids; however, during 1964 about 35 percent of the water contained less than 900 ppm of dissolved solids and only about 15 percent contained less than 500 ppm.

The chemical quality of the inflow to Great Salt Lake is compared in table 11 with drinking water standards recommended by the U. S. Public Health Service (1962, p. 7). The data in table 11 are for samples collected during the water years 1960, 1961, and 1964; and they represent specific water-quality conditions. The table indicates the percentage of time a dissolved-solids concentration occurred equal to or less than the concentrations shown. Water in the Bear River met the Public Health Service drinking water standards, as shown in table 11, about 12 percent of the time during the 1960, 1961, and 1964 water years. Water in the Weber River met the standards about 84 percent of the time. Water in the Jordan River, based on recorded conductivity data, met the standards about 5 percent of the time, although the analysis available represents only 3 percent of the time.

Data in tables 1 and 11 and in figures 14 and 15 suggest that about 500,000 acre-feet of water, which meets the recommended drinking-water standards passes the sites on the Bear and Weber Rivers during years of average streamflow.

Industrial water-quality requirements vary widely depending upon the use made of the water (American Water

Table 10. — Discharge near the mouths of the Bear, Weber, and Jordan Rivers during the representative water years of high, low, and average discharge and the usable storage capacity of reservoirs in the drainage basins, in thousands of acre-feet

Discharge: Measured at respective gaging stations -- Bear River near Corinne (1961 estimated), Weber River near Plain City, and Jordan River at Salt Lake City (includes discharge of Surplus Canal).
Usable storage capacity: As of August 1964. From Thomas and Harbeck (1956) and U. S. Geological Survey (1964).

Drainage basin	Discharge			Usable storage capacity
	1952 High	1961 Low	1964 Average	
Bear River	1,775	460	936	1,540
Weber River	933	61	312	272
Jordan River	477	132	199	980
Total (rounded)	3,200	650	1,400	2,800

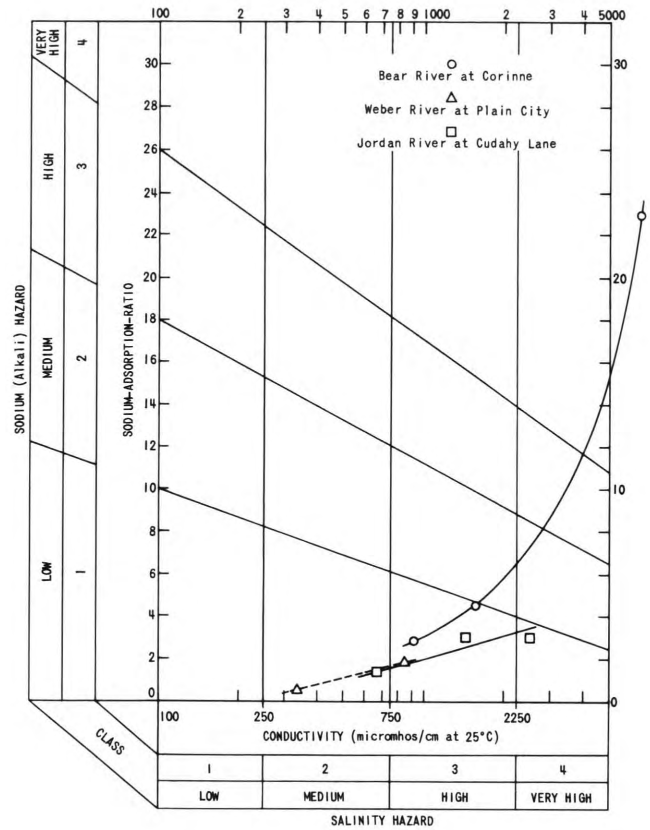

Figure 16. — Classification of irrigation waters.

Works Assoc., 1950). However, hardness is one property of water which universally receives attention. Data in table 11 indicate that most of the time water in the major tributaries to the lake is very hard and would require treatment to make the water suitable for industrial use.

The chemical quality of water is an indication of its usefulness for irrigation, but it should be considered together with soil characteristics, water management, crops to be grown, and regional climate. A system prepared by the U. S. Salinity Laboratory Staff (1954) classifies irrigation water by its salinity and sodium hazards, and the system is applicable to most soils found in semiarid regions. Data from table 11 are plotted according to this system in figure 16. Table 11 and figures 11 and 16 indicate that most water in the major tributaries near the lakeshore has a medium- to high-salinity hazard and a low-sodium hazard. Less than 10 percent of the annual flow presents a very high salinity hazard and a medium- to very high-sodium hazard; however, this 10 percent often is the only flow in the Bear and Jordan Rivers during the summer months. Most of the time water from the three rivers would present no sodium hazard but could present a salinity hazard to land and crops irrigated. However, with proper drainage and crop selection, the water is being used successfully for irrigation.

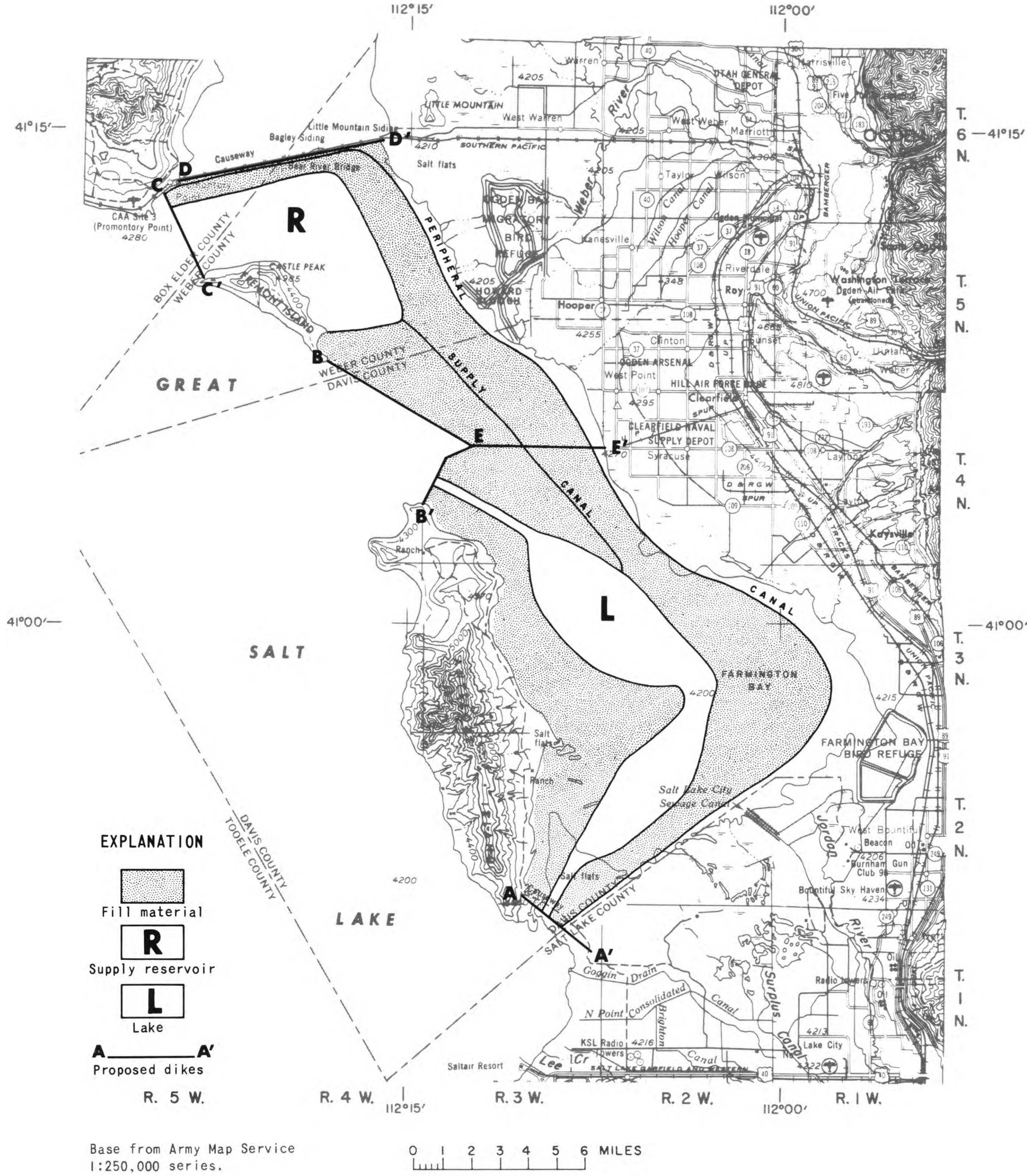

Figure 17. — Map of the eastern part of Great Salt Lake showing proposed dikes.

Table 11. — Analyses that represent specific dissolved-solids concentrations are shown along with some of the drinking-water standards recommended by the U. S. Public Health Service

[Numbers in parentheses in column headings are drinking-water standards recommended by the U.S. Public Health Service (1962)]

Percentage of time: Indicates the period during the 3 water years, 1960, 1961, and 1964, in which the concentration was equal to or less than that shown; e, estimated.
Fluoride: Maximum or minimum recorded in occasional analysis and not determined for the specific analyses shown; optimum concentration determined by average maximum daily air temperature at Salt Lake City Airport.

Site	Date of collection	Percentage of time	Parts per million						Specific conductance (micromhos/cm at 25°C)	Sodium-adsorption ratio
			Sulfate (250)	Chloride (250)	Fluoride (0.9)	Nitrate (45)	Dissolved solids (500)	Total hardness as $CaCO_3$		
Bear River at Corinne	Nov. 23, 1959	69	63	280	-	3.9	862	344	1,540	4.6
	Sept. 19-20, 1960	99.96	261	1,950	0.4	1.8	4,040	593	6,780	23
	May 1-15, 1964	12	51	128	.3	.2	505	258	902	2.9
Weber River near Plain City	May 25, 1964	1e	24	26	.3	2.3	200	134	330	.6
	Aug. 18, 1964	84e	36	98	.7	17	500	286	842	1.9
Jordan River at Cudahy Lane, near Salt Lake City	June 6, 1960	12e	289	200	-	.3	897	426	1,420	3.1
	Oct. 17, 1960	99e	742	350	.8	7.8	1,820	993	2,560	3.1
	June 18, 1964	3e	99	71	.3	2.5	407	242	682	1.4

A Fresh-Water Lake

Almost 90 percent of the surface water entering Great Salt Lake passes through the openings represented by lines B-E-B' and C-C' in figure 17. Proposals have been made (Burns and others, no date) to separate the part of Great Salt Lake east of these lines from the main body of the lake with a system of dikes and thereby create a fresh-water lake east of the lines. The purpose of this lake would be to gain use of dilute inflow prior to its mixing with the brine.

If dikes were extended along lines A-A', B-E-B', and C-C' (fig. 17) and the natural drainage allowed to accumulate behind these dikes, the inflow to this fresh-water lake probably would be represented by data shown in table 12. During the 1960, 1961, and 1964 water years, the volume of inflow would have been as small as 700,000 acre-feet containing about 1,600 ppm of dissolved solids to as large as 1,600,000 acre-feet containing about 1,000 ppm. This water would contain predominantly sodium and chloride ions (table 2).

In such a large shallow lake, uniform quality of water probably would never exist. Sections of the lake would reflect the quality of specific sources of inflow, and these sections would shift position in the lake as a result of storm pattern and wind direction. Water temperature of this shallow lake would tend to follow air temperature. Evaporation losses would be high, and wind-driven waves and ice could cause damage to lakeshore structures.

Table 12. — Volume of water, in thousands of acre-feet, and dissolved-solids load, in thousands of tons, entering the eastern part of Great Salt Lake at the lakeshore during the water years 1960, 1961, and 1964

[Data obtained from tables 7, 14, and 15 and Hahl and Mitchell (1963)]

Source	1960		1961		1964	
	Volume	Load	Volume	Load	Volume	Load
Bear River drainage	630	1,290	440	1,010	910	1,390
Weber River drainage	190	130	80	80	400	200
Davis County drainage	40	30	40	20	60	40
Jordan River drainage, east of Antelope Island	180	410	150	350	170	430
Springs, east side Antelope Island	10	80	10	80	10	80
Total	1,050	1,940	720	1,540	1,550	2,140
Weighted average dissolved-solids concentrations, in parts per million	1,360		1,570		1,010	

Table 13. — Volume of water, in thousands of acre-feet, and dissolved-solids load, in thousands of tons, from selected sources entering the lake area east of Great Salt Lake during the water years 1960, 1961, and 1964

[Data obtained from table 14 and Hahl and Mitchell (1963)]

Source	1960		1961		1964	
	Volume	Load	Volume	Load	Volume	Load
Bear River near Corinne	300	320	210	270	640	520
Weber River near Plain City	170	100	60	40	370	170
Miscellaneous from Davis County area	30	20	30	20	30	20
Total	500	440	300	330	1,040	710
Weighted average dissolved-solids concentrations, in parts per million	650		810		500	

Another proposal includes the dikes along lines A-A' B-E-B', and C-C' and two additional ones, line E-E' (the route of the Syracuse Road to Antelope Island) and line D-D' (the existing dike between Little Mountain and Promontory Point augmented by a control on flow beneath the Bear River Bridge). Selective filling is proposed in order to form two lakes (R and L in fig. 17) and a peripheral canal. The areas to contain the lakes are to be dredged to increase the depth to surface-area ratio. Area R would act as a supply reservoir to area L and the peripheral canal would facilitate removal of undesired water from the system. This plan would allow water-quality control in both lakes and provide for a constant lake-surface elevation in area L.

Table 13 presents the quality of inflow to the proposed fresh-water lakes from selected sources at the boundary of the lake area (fig. 1), which had an annual average dissolved-solids concentration of 900 ppm or less. The volumes shown have been adjusted to allow for existing downstream use. During the water years 1960, 1961, and 1964 the volume of inflow ranged from 300,000 acre-feet of water containing about 800 ppm of dissolved solids in 1961 to about 1,000,000 acre-feet containing about 500 ppm in 1964. Comparison of the quality of the water at the boundary of the lake area (table 13) with water at the lakeshore (table 12) indicates a deterioration in chemical quality when water passes through the intervening marshlands. Therefore, selection of inflow at the boundary of the lake area is an important part of this two-lake proposal.

The volume and quality of water available are important considerations for any system used to supply a fresh-water lake. However, the water quality of inflow to a lake does not represent the water quality to be expected in the lake. The water quality of the lake will be determined by the interplay of climatic differences, ground-water inflow, upstream developments, and water management.

SUMMARY AND CONCLUSIONS

Inflow to Great Salt Lake is difficult to measure at its point of contact with brine in the lake because the lake stage fluctuates continually with season and wind. Also, as inflow crosses the wide band of mud and sand surrounding the lake, it is not contained in well-defined channels. Therefore, inflow reaching Great Salt Lake during the 1964 water year was defined as that flow crossing the lakeshore and discharging onto the flats surrounding the lake.

The study conducted during the 1960 and 1961 water years was limited to interpreting data collected at sites upstream from the lakeshore and, therefore, that study only defined flow reaching the lake area. More detailed data were obtained during the 1964 water year, both at sites used during the 1960-61 study and at points close to the lakeshore. The 1964 data on inflow to the lake area and to the lakeshore permitted estimates of inflow to the lake (at the lakeshore) to be made for the 1960 and 1961 water years. The volume of water reaching the lake area during the 3 years of study was about the same as that reaching the lakeshore, but the dissolved-solids content of the water reaching the lakeshore was much greater.

During the 1964 water year, which was probably representative of the average inflow conditions during the period 1934-64, about 1,800,000 acre-feet of water containing about 2,200,000 tons of dissolved solids entered the lake area and about 1,700,000 acre-feet of water containing about 3,500,000 tons of dissolved solids passed the lakeshore. During the 1961 water year, which was representative of the lowest recorded inflow conditions, about 800,000 acre-feet of water containing about 1,500,000 tons of dissolved solids entered the lake area and about 800,000 acre-feet of water containing about 2,200,000 tons of dissolved solids passed the lakeshore.

The Bear River drainage system contributed more than 50 percent of the water and about 40 percent of the dissolved solids that entered Great Salt Lake during the 1964 water year. The Weber River drainage system contributed the second largest volume of water, but the Jordan River drainage system and the springs and streams drainage system were, respectively, the second and third largest contributors of dissolved solids. The volume of water from the Davis County drainage system was about three-fourths as large as that from the springs and streams, but the dissolved-solids load was only about one-twentieth of their load.

With the exception of water from the Weber River and Davis County drainage systems, which was of the calcium sodium bicarbonate type, water crossing the lakeshore contained mostly sodium and chloride ions.

Much of the water entering Great Salt Lake is suitable for irrigation or meets the inorganic chemical standards recommended by the U.S. Public Health Service (1962) for drinking water. Water in the Bear River at Corinne met Public Health Service standards for drinking water supply 12 percent of the time, and water in the Weber River near Plain City met the standards 84 percent of the time. More than 90 percent of the flow during the 1964 water year at the Bear River at Corinne, Weber River at Plain City, and Jordan River at Cudahy Lane, near Salt Lake City was suitable for irrigation.

A proposed fresh-water lake east of a line between Antelope Island and Promontory Point, which would be supplied from selected sources of inflow at the boundary of the lake area, would have had an estimated 300,000 to 1,000,000 acre-feet of water available to it during the water years 1961 and 1964, respectively. This inflow would have had an estimated dissolved-solids content of 800 and 500 ppm, respectively.

In order to provide data from which a long-term estimate of loads entering the Great Salt Lake could be computed, the following additional work is needed:

1. During periods of low and average streamflow, a more detailed study should be made of the surface-water inflow from the Weber River, Davis County, and springs and streams drainage systems in order to refine the inflow estimates given in this report.

2. During a period of high streamflow, a study should be made of all inflow to the lake.

3. A study should be made of the ground-water inflow to the area below the lakeshore.

4. A study should be made of the climatology of the lake area.

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Table 14. — Chemical analyses of water from the Bear River, Weber River, Jordan River, and Davis County drainage systems

[Numbers in parentheses are site numbers in figure 1]

Mean discharge: e, estimated; m, discharge measured.
Sodium: Concentrations reported include potassium except when a dash or a value is shown in the potassium column.

Date of collection	Temperature (°F)	Mean discharge (cfs)	Parts per million												Specific conductance (micromhos/cm at 25°C)	pH
			Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$		
BEAR RIVER DRAINAGE SYSTEM																
(1) Corinne Canal at State High 83, near Corinne																
Aug. 23, 1963	71	54e	-	-	-	-	-	-	81	90	-	585	360	-	987	-
Nov. 18	-	6e	-	-	-	-	-	-	104	158	-	739	330	-	1,250	-
July 17, 1964	75	55e	-	-	-	-	-	-	58	86	-	483	-	-	859	-
Aug. 18	73	58e	-	-	-	-	-	-	70	92	-	545	330	-	920	-
Sept. 15	-	53e	-	-	-	-	-	-	74	98	-	535	324	-	917	-
(2) Central Canal at State Highway 83, near Corinne																
Aug. 23, 1963	72	18e	-	-	-	-	-	-	-	-	-	571	-	-	966	-
July 17, 1964	77	35e	-	-	-	-	-	-	53	84	-	459	-	-	866	-
Aug. 18	76	11e	-	-	-	-	-	-	66	90	-	512	322	-	883	-
Sept. 15	-	10e	-	-	-	-	-	-	71	92	-	508	318	-	870	-
(3) Bear River at Corinne																
Oct. 1-5, 10-17, 24-31, 1963 1/	59	682	16	56	44	163	16	368	67	250	0.6	788	322	20	1,380	8.0
Oct. 6-9	64	325	-	-	-	731		396	100	1,120	-	2,220	420	95	3,840	7.7
Oct. 18-23	60	679	-	-	-	189		368	78	240	-	746	310	8	1,290	7.9
Nov. 1-10	50	1,200	-	-	-	134		360	80	165	-	620	320	25	1,060	7.7
Nov. 11-24	48	1,320	-	-	-	188		388	92	245	-	778	350	32	1,380	7.9
Nov. 25-30	41	1,170	-	-	-	267		392	110	365	-	990	370	48	1,750	7.8
Dec. 1-3	37	654	-	-	-	317		416	109	450	-	1,170	400	59	2,050	7.9
Dec. 4-8	38	1,110	-	-	-	148		348	90	180	-	608	310	25	1,160	8.1
Dec. 9	36	236	-	-	-	358		416	97	515	-	1,260	390	49	2,210	7.9
Dec. 10-16	33	921	-	-	-	182		400	79	245	-	762	360	32	1,350	8.0
Dec. 17-22	34	1,270	-	-	-	130		380	80	155	-	586	330	18	1,060	7.9
Dec. 23, 1963-Mar. 10, 1964 2/	32	976	16	85	33	99	9.7	372	54	155	2.0	630	348	43	1,070	8.2
Mar. 11-31	36	1,260	-	-	-	159		3/ 372	59	218	-	745	328	23	1,280	8.3
Apr. 1-3	45	1,990	-	-	-	167		393	60	225	-	784	340	18	1,330	8.2
Apr. 4-30	49	3,170	-	-	-	106		312	49	145	-	587	280	24	1,000	8.0
May 1-15	53	3,020	-	-	-	106		310	51	128	-	505	258	4	902	7.5
May 16-31	64	2,940	-	-	-	57		257	27	76	-	358	222	11	639	7.7
June 1	66	2,500	10	54	19	54		246	33	68	.3	356	215	13	610	7.8
June 2-3	66	1,380	11	54	27	111		276	36	158	.2	547	246	20	963	7.8
June 4-30	64	3,160	11	55	22	62		268	35	75	.3	398	228	8	704	7.8
July 1-4	72	1,030	-	-	-	128		300	35	176	-	567	252	6	1,020	7.8
July 5-6	74	315	-	-	-	301		316	56	455	-	1,050	306	47	1,880	7.8
July 7-8	76	118	-	-	-	515		322	65	782	-	1,540	314	50	2,720	7.9
July 9	77	133	-	-	-	743		332	86	1,140	-	2,260	354	82	3,920	7.9
July 10-31	78	86.1	-	-	-	1,090		370	102	1,670	-	2,960	395	92	5,140	7.9
Aug. 1-31	73	79.6	-	-	-	900		380	128	1,370	-	2,780	420	108	4,790	7.8
Sept. 1-23	60	93.1	-	-	-	741		395	94	1,130	-	2,310	405	81	4,030	8.0
Sept. 24-25	57	257	-	-	-	565		400	97	845	-	1,820	392	64	3,180	7.9
Sept. 26-30	53	220	-	-	-	394		388	83	585	-	1,350	374	56	2,400	7.9
Weighted average 1964 water year 4/	-	1,290	-	58	35	123		324	53	168	-	604	288	24	1,050	-
(4) Black Slough at U.S. Highway 30, near Brigham City																
Aug. 23, 1963	71	-	-	-	-	-	-	-	109	156	-	796	360	-	1,320	-
Nov. 18	38	34.1m	-	-	-	-	-	-	88	928	-	1,900	386	-	3,340	-
Dec. 12	39	16.3m	-	-	-	-	-	-	93	870	-	1,920	488	-	3,300	-
Jan. 31, 1964	39	14.9m	-	-	-	-	-	-	77	610	-	1,420	444	-	2,450	-
Feb. 21	40	15.0m	-	-	-	-	-	-	83	960	-	2,040	480	-	3,520	-
Mar. 20	34	14.1m	-	-	-	-	-	-	62	595	-	1,420	412	-	2,420	-
Apr. 10	51	75.1m	-	-	-	-	-	-	58	790	-	1,560	300	-	2,790	
May 8	52	73.9m	-	-	-	-	-	-	94	1,580	-	2,770	400	-	4,870	-
June 11	72	42.6m	10	52	49	615		264	59	985	0	1,920	330	113	3,320	7.9
July 16	77	15.5m	-	-	-	-	-	-	50	-	-	1,390	-	-	2,520	-
Aug. 18	79	1.9m	-	-	-	-	-	-	52	65	-	449	310	-	743	-
Sept. 15	-	9.1m	-	-	-	-	-	-	32	40	-	309	240	-	534	-
Weighted average 1964 water year 4/	-	30e	-	-	-	-	-	-	75	886	-	1,780	365	160	3,120	-
(5) Brigham City treated sewage effluent at Brigham City																
Aug. 23, 1963	-	1.5e	-	-	-	-	-	-	42	100	-	539	244	-	891	-
Mar. 20, 1964	50	2.6	-	-	-	102	12	-	-	125	57	542	-	-	903	-
Aug. 18	71	1.9	-	-	-	115	9.2	-	-	83	35	428	-	-	795	-

Table 14. — continued

Date of collection	Temperature (°F)	Mean discharge (cfs)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Specific conductance (micromhos/cm at 25°C)	pH
		Parts per million														
BEAR RIVER DRAINAGE SYSTEM--Continued																
(6) Hammond West Branch Canal at U.S. Highway 30, near Corinne																
Aug. 23, 1963	72	20e	-	-	-	-	-	-	-	-	-	558	-	-	945	-
(7) Sulphur Creek at State Highway 83, near Corinne																
Aug. 23, 1963	75	18e	-	-	-	-	-	-	158	1,050	-	2,300	465	-	3,990	-
Oct. 17	52	165m	-	-	-	-	-	-	114	815	-	1,860	428	-	3,260	-
Nov. 15	56	117m	-	-	-	-	-	-	205	855	-	2,080	510	-	3,460	-
Dec. 12	33	114m	-	-	-	-	-	-	202	990	-	2,350	580	-	3,920	-
Jan. 31, 1964	31	32.1m	-	-	-	-	-	-	164	980	-	2,280	600	-	3,830	-
Feb. 21	32	25.7m	-	-	-	-	-	-	206	1,140	-	2,580	595	-	4,320	-
Mar. 19	49	27.7m	-	-	-	-	-	-	208	1,230	-	2,720	575	-	4,470	-
Apr. 10	54	27.4m	-	-	-	-	-	-	403	1,250	-	2,910	480	-	4,700	-
May 8	49	28.3m	-	-	-	-	-	-	444	1,250	-	3,030	500	-	4,930	-
June 11	66	97.8m	21	88	60	643		462	204	900	2.3	2,170	465	86	3,670	8.0
July 17	74	46.7m	-	-	-	-	-	-	178	950	-	2,150	400	-	3,720	-
Aug. 18	78	66.5m	-	-	-	-	-	-	147	745	-	1,800	416	-	3,070	-
Sept. 15	-	81.7m	-	-	-	-	-	-	134	790	-	1,890	438	-	3,210	-
Weighted average 1964 water year 4/	-	70e	-	-	-	-	-	-	195	926	-	2,180	485	-	3,680	-
(8) Hull Lake in Public Shooting Grounds, near Penrose																
Nov. 15, 1963	48	35e	-	-	-	-	-	-	514	2,850	-	5,550	630	-	9,140	-
Dec. 12	35	30e	-	-	-	-	-	-	764	4,200	-	8,530	977	-	13,400	-
Apr. 10, 1964	51	75e	-	-	-	-	-	-	615	1,780	-	3,930	520	-	6,320	-
May 7	56	20e	-	-	-	-	-	-	621	2,550	-	5,040	620	-	8,330	-
June 11	66	250e	-	-	-	-	-	-	437	1,450	-	3,170	420	-	5,270	-
Sept. 15	-	(5)	-	-	-	-	-	-	576	3,070	-	6,300	690	-	10,200	-
Weighted average 1964 water year 4/	-	40e	-	-	-	-	-	-	530	2,100	-	4,400	540	-	7,100	-
(9) Pintail Lake in Public Shooting Grounds, near Penrose																
Nov. 15, 1963	-	15e	-	-	-	-	-	-	145	1,000	-	2,200	520	-	3,740	-
Dec. 12	35	10e	-	-	-	-	-	-	291	1,540	-	3,330	710	-	5,490	-
Apr. 10, 1964	52	15e	-	-	-	-	-	-	286	1,480	-	2,920	515	-	4,940	-
May 7	54	15e	-	-	-	-	-	-	365	1,820	-	3,670	610	-	6,010	-
June 11	66	15e	-	-	-	-	-	-	165	1,400	-	2,760	450	-	4,700	-
Aug. 18	77	(5)	-	-	-	-	-	-	399	3,270	-	6,220	444	-	10,200	-
Sept. 15	-	(5)	-	-	-	-	-	-	459	2,930	-	6,000	808	-	9,610	-
Weighted average 1964 water year 4/	-	10e	-	-	-	-	-	-	250	1,400	-	2,900	580	-	4,900	-
(10) Widgeon Lake in Public Shooting Grounds, near Penrose																
Nov. 15, 1963	48	20e	-	-	-	-	-	-	267	1,310	-	2,840	510	-	4,780	-
Dec. 12	34	15e	-	-	-	-	-	-	586	2,750	-	5,710	910	-	9,010	-
Apr. 10, 1964	53	20e	-	-	-	-	-	-	540	1,650	-	3,440	540	-	5,590	-
May 7	56	20e	-	-	-	-	-	-	494	1,850	-	3,820	550	-	6,190	-
June 11	66	20e	-	-	-	-	-	-	401	1,380	-	3,040	420	-	5,070	-
Aug. 18	-	(5)	-	-	-	-	-	-	1,390	6,250	-	12,300	844	-	18,800	-
Sept. 15	-	(5)	-	-	-	-	-	-	1,010	5,330	-	10,800	1,100	-	16,500	-
Weighted average 1964 water year 4/	-	15e	-	-	-	-	-	-	460	1,900	-	4,000	630	-	6,400	-
(11) Drainage ditch, (B-10-4)7cda, near Penrose																
Nov. 15, 1963	44	0.5e	-	-	-	-	-	-	95	645	-	1,550	528	-	2,630	-
Apr. 10, 1964	43	.5e	-	-	-	-	-	-	117	-	-	2,160	-	-	3,690	-
May 7	51	.1e	-	-	-	-	-	-	164	-	-	2,480	-	-	4,150	-
June 11	64	1.5e	-	-	-	-	-	-	63	104	-	522	310	-	887	-
(12) Drainage ditch, (B-10-4)7cdb, near Penrose																
Apr. 10, 1964	45	0.5e	-	-	-	-	-	-	175	-	-	1,980	-	-	3,290	-
May 7	50	.5e	-	-	-	-	-	-	139	-	-	1,810	-	-	3,020	-
Aug. 18	70	4.0e	-	-	-	-	-	-	94	175	-	791	408	-	1,310	-
Sept. 15	-	1.0e	-	-	-	-	-	-	115	220	-	862	432	-	1,460	-
(13) Drainage ditch, (B-10-5)12dad, near Penrose																
Nov. 15, 1963	44	2.5e	-	-	-	-	-	-	85	200	-	794	368	-	1,350	-
Apr. 10, 1964	45	2.0e	-	-	-	-	-	-	116	-	-	1,620	-	-	2,800	-
May 7	73	.5e	-	-	-	-	-	-	214	-	-	2,250	-	-	3,740	-
Aug. 18	75	1.0e	-	-	-	-	-	-	66	112	-	572	352	-	980	-
Sept. 15	-	1.0e	-	-	-	-	-	-	73	128	-	-	342	-	1,010	-
(14) Drainage ditch, (B-10-5)12dac, near Penrose																
Nov. 15, 1963	45	2.0e	-	-	-	-	-	-	73	148	-	646	328	-	1,070	-
May 7, 1964	52	.1e	-	-	-	-	-	-	250	-	-	3,720	-	-	5,930	-

Table 14. — continued

Date of collection	Temperature (°F)	Mean discharge (cfs)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Specific conductance (micromhos/cm at 25°C)	pH
		Parts per million														
BEAR RIVER DRAINAGE SYSTEM--Continued																
(15) Drainage ditch, (B-10-5)12cad, near Penrose																
Nov. 15, 1963	50	1.0e	-	-	-	-	-	-	79	1,340	-	2,830	610	-	4,430	-
Dec. 12	33	1.0e	-	-	-	-	-	-	79	1,290	-	2,570	570	-	4,230	-
Mar. 19, 1964	49	1.0e	-	-	-	-	-	-	81	1,220	-	2,480	600	-	4,060	-
Apr. 10	48	1.5e	-	-	-	-	-	-	72	-	-	2,520	-	-	4,080	-
May 7	53	1.5e	-	-	-	-	-	-	82	-	-	2,470	-	-	4,070	-
June 11	62	6.0e	-	-	-	-	-	-	51	316	-	802	310	-	1,410	-
Aug. 18	75	2.0e	-	-	-	-	-	-	69	742	-	1,540	478	-	2,770	-
Sept. 15	-	1.0e	-	-	-	-	-	-	67	570	-	1,270	438	-	2,280	-
Weighted average 1964 water year[4]	-	1.5e	-	-	-	-	-	-	60	610	-	1,500	410	-	2,600	-
(16) Blue Spring Creek at Promontory Road, near Howell																
Oct. 16, 1963	59	4.2m	-	-	-	-	-	-	350	2,200	-	4,220	510	-	7,170	-
Mar. 19, 1964	32	10e	-	-	-	-	-	-	434	2,200	-	4,670	595	-	7,430	-
Apr. 10	45	11.0m	-	-	-	-	-	-	354	1,950	-	3,850	510	-	6,400	-
Apr. 24	45	9.0m	-	-	-	-	-	-	400	2,300	-	4,670	600	-	7,550	-
May 7	45	17.8m	-	-	-	-	-	-	362	1,900	-	3,820	430	-	6,400	-
June 11	56	2.5m	26	136	96	2,330		628	612	3,290	4.7	6,740	735	220	10,800	8.1
Sept. 15	-	.1e	-	-	-	-	-	-	395	2,440	-	4,920	454	-	8,140	-
Weighted average 1964 water year[4]	-	5e	-	-	-	-	-	-	448	2,430	-	4,940	580	-	8,050	-
(17) Bear River at Bear River Bridge, near West Warren																
Oct. 25, 1963	49	250e	-	-	-	-	-	-	377	2,400	-	4,790	750	-	8,040	-
Nov. 14	45	1,000e	-	-	-	-	-	-	275	2,100	8.1	3,810	560	-	6,550	-
Dec. 5	33	500e	-	-	-	-	-	-	174	855	-	1,880	418	-	3,290	-
Mar. 19, 1964	32	800e	-	-	-	-	-	-	188	1,220	-	2,600	500	-	4,300	-
Apr. 9	48	3,500e	-	-	-	-	-	-	74	380	-	852	232	-	1,570	-
June 12	63	3,500e	13	20	34	221		[6]176	56	330	.2	779	188	44	1,380	8.5
July 15[7]	78	150e	-	-	-	-	-	-	10,100	74,300	-	139,000	-	-	132,000	-
Weighted average 1964 water year[4]	-	1,100e	-	-	-	-	-	-	104	638	-	1,360	280	-	2,360	-
WEBER RIVER DRAINAGE SYSTEM																
(18) Weber River near Plain City																
Nov. 15, 1963[8]	51	147	10	74	24	63	7.3	306	43	92	8.1	477	283	32	812	7.4
Dec. 17	40	211	-	-	-	49		262	36	65	3.3	376	240	25	642	8.1
Jan. 31, 1964	40	283	-	-	-	38		178	86	51	3.4	356	228	82	574	7.7
Feb. 21	40	290	7.4	58	18	38		242	27	50	3.2	332	216	18	544	7.5
Mar. 20	39	372	-	-	-	47		258	35	60	2.9	350	232	20	616	7.7
Apr. 10	45	732	-	-	-	30		202	31	36	1.4	268	184	18	450	7.7
May 8	47	1,140	-	-	-	-	-	-	37	43	3.1	290	184	-	479	-
May 25[9]	56	1,200	8.3	38	9.2	16	2.1	146	24	26	2.3	200	134	14	330	7.5
June 12	54	2,280	8.8	51	13	24		202	26	27	1.5	234	180	14	408	7.8
July 17	75	40	-	-	-	86		327	44	112	14	541	296	28	927	7.5
Aug. 18	69	65	-	-	-	74		314	36	98	17	500	286	28	842	7.6
Sept. 16	-	63	-	-	-	75		318	44	113	-	558	302	41	915	7.7
Weighted average 1964 water year[4]	-	430	-	52	15	32	-	208	32	41	2.9	283	190	20	478	-
DAVIS COUNTY DRAINAGE SYSTEM																
(19) North Davis County treated sewage effluent at Syracuse																
Mar. 20, 1964	47	13.8	-	-	-	214	25	-	-	200	32	948	-	-	1,500	-
Aug. 18	71	15.5	-	-	-	117	12	-	-	105	31	552	-	-	997	-
(20) Central Davis County treated sewage effluent near Farmington																
Mar. 20, 1964	46	2.3	-	-	-	121	24	-	-	110	39	688	-	-	1,120	-
Aug. 18	66	2.8	-	-	-	112	14	-	-	75	34	536	-	-	945	-
(21) South Davis County treated sewage effluent at West Bountiful																
Mar. 20, 1964	49	4.6e	-	-	-	171	10	-	-	230	56	844	-	-	1,350	-
Aug. 18	69	5.1e	-	-	-	136	7.9	-	-	111	50	560	-	-	994	-
JORDAN RIVER DRAINAGE SYSTEM																
(22) Jordan River at Salt Lake City (includes Surplus Canal at Salt Lake City)																
Nov. 5, 1963	53	198	18	152	75	209		184	515	320	6.1	1,430	690	539	2,100	6.8
Dec. 12	42	183	20	143	76	204		[10]244	458	305	8.6	1,400	670	470	2,010	8.5
Jan. 15, 1964	36	169	22	150	80	199		248	477	305	6.6	1,410	702	499	2,030	7.5
Feb. 20	45	175	21	139	66	197		294	381	285	11	1,300	620	379	1,860	7.5
Mar. 20	50	187	23	143	77	209		304	413	310	11	1,380	672	423	2,050	7.6
Apr. 18	49	205	17	120	56	179		262	320	260	7.6	1,100	530	315	1,630	7.5

Table 14. — continued

Date of collection	Temperature (°F)	Mean discharge (cfs)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Specific conductance (micromhos/cm at 25°C)	pH
			Parts per million													
JORDAN RIVER DRAINAGE SYSTEM--Continued																
(22) Jordan River at Salt Lake City (includes Surplus Canal at Salt Lake City)--Continued																
June 18, 1964	52	717	11	64	31	88		165	166	117	4.2	567	286	151	921	7.4
July 14	62	201	18	127	65	197		285	361	278	11	1,260	582	348	1,870	7.5
Aug. 17	64	341	20	124	64	216		296	380	285	6.4	1,270	575	332	1,890	7.8
Aug. 28	60	303	18	141	72	220		302	395	326	10	1,420	648	400	2,100	8.2
Weighted average 1964 water year[4]	-	275	17	115	58	167		233	337	241	7.2	1,060	526	334	1,630	-
(23) North Point Consolidated Canal below Goss Flume, at Salt Lake City																
Sept. 11, 1964	64	51	13	122	69	221		284	389	300	8.8	1,320	586	353	1,930	8.2
(24) Surplus Canal at Cohen Flume, near Salt Lake City																
Oct. 14, 1963	59	160	-	-	-	-	-	-	-	-	-	-	-	-	2,030	-
Nov. 19	45	181	-	-	-	-	-	-	-	-	-	-	-	-	2,130	-
Dec. 13	38	98	-	-	-	-	-	-	-	-	-	-	-	-	2,090	-
Jan. 15, 1964	33	69	-	-	-	-	-	-	-	-	-	-	-	-	2,140	-
Feb. 20	36	47	-	-	-	-	-	-	-	-	-	-	-	-	1,990	-
Mar. 5	40	44	-	-	-	-	-	-	-	-	-	-	-	-	2,030	-
Mar. 18	-	88	-	-	-	-	-	-	-	-	-	-	-	-	1,970	-
Mar. 25	45	53	-	-	-	-	-	-	-	-	-	-	-	-	2,030	-
Apr. 17	56	82	-	-	-	-	-	-	-	-	-	-	-	-	1,990	-
May 19	55	335	-	-	-	-	-	-	-	-	-	-	-	-	893	-
May 26	55	380	-	-	-	-	-	-	-	-	-	-	-	-	603	-
June 22	52	331	10	63	25	80		154	152	105	3.8	527	260	134	854	7.6
June 25	63	214	-	-	-	-	-	-	-	-	-	-	-	-	887	-
July 16	76	105	-	-	-	-	-	-	-	-	-	-	-	-	1,870	-
July 23	74	151	-	-	-	-	-	-	-	-	-	-	-	-	1,950	-
July 29	74	98	-	-	-	-	-	-	-	-	-	-	-	-	1,940	-
Aug. 17	69	113	-	-	-	-	-	-	-	-	-	-	-	-	1,900	-
Aug. 24	74	51	-	-	-	-	-	-	-	-	-	-	-	-	1,920	-
Sept. 23	60	137	5.1	92	75	208		200	385	302	.6	1,180	540	376	1,830	7.6
Weighted average 1964 water year[4]	-	122	-	-	-	-	-	-	-	-	-	-	-	-	1,590	-
(25) Salt Lake City sewage effluent at Cudahy Lane, near Salt Lake City																
Jan. 15, 1964	50	44.5	-	-	-	-	-	-	-	-	-	-	-	-	2,680	-
Feb. 20	52	49.7	-	-	-	-	-	-	-	-	-	-	-	-	4,620	-
Mar. 20	58	55.4	-	-	-	551	25	-	-	765	5.3	2,000	-	-	3,370	-
June 22	65	66.6	16	134	64	548		402	497	668	2.5	2,020	600	270	3,210	7.4
July 23	76	65.7	-	-	-	-	-	-	-	-	-	-	-	-	2,650	-
Aug. 17	76	54.9	22	112	41	290		216	217	480	1.9	1,470	450	273	2,460	7.3
Weighted average 1964 water year[4]	-	53.4	16	134	64	548		402	497	668	2.5	2,130	600	270	3,210	-
(26) Jordan River at Cudahy Lane, near Salt Lake City																
Oct. 14, 1963	58	87	-	-	-	-	-	-	-	-	-	-	-	-	1,700	-
Nov. 19	42	39	21	140	71	203		234	445	295	13	1,340	640	448	2,010	7.0
Nov. 27	-	71	-	-	-	-	-	-	-	-	-	-	-	-	2,100	-
Dec. 13	38	97	21	147	70	215		229	455	320	13	1,380	656	468	2,050	7.2
Jan. 15, 1964	36	103	20	141	78	196		226	491	280	8.5	1,380	672	487	2,010	7.8
Feb. 20	40	117	21	135	69	182		286	362	280	10	1,260	618	383	1,900	7.6
Mar. 11	43	128	-	-	-	-	-	-	-	-	-	-	-	-	2,050	-
Mar. 17	47	134	-	-	-	-	-	-	-	-	-	-	-	-	1,900	-
Mar. 20	48	104	21	136	69	202		301	372	300	8.0	1,310	624	377	1,960	7.4
Mar. 24	46	138	-	-	-	-	-	-	-	-	-	-	-	-	1,920	-
Apr. 16	56	117	-	-	-	-	-	-	-	-	-	-	-	-	1,740	-
Apr. 17	52	119	17	112	50	153		252	293	210	11	998	484	277	1,490	7.4
Apr. 23	50	119	-	-	-	-	-	-	-	-	-	-	-	-	1,660	-
Apr. 30	58	157	-	-	-	-	-	-	-	-	-	-	-	-	1,500	-
May 6[11]	48	173	12	89	34	75	6.2	242	146	120	3.8	649	362	164	1,020	7.5
May 21	51	285	-	-	-	-	-	-	-	-	-	-	-	-	464	-
May 28	49	216	-	-	-	-	-	-	-	-	-	-	-	-	444	-
June 4	57	196	-	-	-	-	-	-	-	-	-	-	-	-	730	-
June 18	55	206	9.5	61	22	50		179	99	71	2.5	407	242	95	682	7.6
June 30	67	156	-	-	-	-	-	-	-	-	-	-	-	-	773	-
July 23	77	98	18	109	61	186		268	332	250	12	1,130	522	302	1,680	7.4
July 27	69	107	-	-	-	-	-	-	-	-	-	-	-	-	1,660	-
July 30	74	82	-	-	-	-	-	-	-	-	-	-	-	-	1,700	-
Aug. 7	72	96	-	-	-	-	-	-	-	-	-	-	-	-	1,640	-
Aug. 17	72	90	19	112	61	192		287	349	242	7.8	1,130	530	295	1,730	7.8
Aug. 26	69	86	-	-	-	-	-	-	-	-	-	-	-	-	1,640	-
Sept. 9	66	123	-	-	-	-	-	-	-	-	-	-	-	-	1,710	-
Sept. 14	68	120	17	119	69	194		276	355	282	10	1,250	580	354	1,850	8.1
Sept. 22	58	125	-	-	-	-	-	-	-	-	-	-	-	-	1,880	-
Sept. 24	58	132	-	-	-	-	-	-	-	-	-	-	-	-	1,870	-
Weighted average 1964 water year[4]	-	124	16	109	53	149	-	240	296	213	7.2	961	490	293	1,510	-

Table 14. — continued

Date of collection	Temperature (°F)	Mean discharge (cfs)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Specific conductance (micromhos/cm at 25°C)	pH
			Parts per million													
JORDAN RIVER DRAINAGE SYSTEM--Continued																
(27) South Davis County treated sewage effluent near Woods Cross																
Aug. 19, 1964	64	1.5e	-	-	-	573	17	-	-	870	35	1,880	-	-	3,270	-
Mar. 20	56	2.0	-	-	-	659	20	-	-	970	100	2,160	-	-	3,680	-
(28) Goggin Drain near Magna																
Oct. 14, 1963	64	4.0	-	-	-	-	-	-	-	-	-	-	-	-	5,320	-
Nov. 20	37	1.4	6.9	128	272	3,080		416	1,460	4,450	4.8	9,790	1,440	1,100	14,600	7.4
Dec. 13	32	.6	11	194	561	6,110		627	2,730	9,010	5.2	19,100	2,790	2,280	27,100	7.9
Feb. 18, 1964	33	.5	2.4	143	356	4,540		387	1,810	6,720	2.7	14,200	1,820	1,500	20,800	7.8
Apr. 9	46	1.5	-	-	-	-	-	-	-	-	-	-	-	-	26,900	-
Apr. 17	59	5.8	14	140	158	1,600		361	920	2,280	10	5,340	1,000	704	8,280	7.4
May 5	54	56	-	-	-	-	-	-	-	-	-	-	-	-	3,300	-
June 11	55	262	9.8	75	36	140		185	210	190	3.6	766	336	184	1,230	7.3
June 24	61	316	-	-	-	-	-	-	-	-	-	-	-	-	1,010	-
July 13	74	9.3	-	-	-	-	-	-	-	-	-	-	-	-	4,980	-
July 23	79	2.6	-	-	-	-	-	-	-	-	-	-	-	-	8,970	-
Aug. 17	68	142	19	130	66	258		300	402	345	4.8	1,380	595	349	2,090	7.9
Aug. 24	66	104	-	-	-	-	-	--	-	-	-	-	-	-	1,900	-
Sept. 10	59	28	-	-	-	-	-	--	-	-	-	-	-	-	2,990	-
Sept. 11	61	12	6.5	124	136	971		300	660	1,450	2.8	3,650	870	624	5,570	7.9
Sept. 26	54	7.9	-	-	-	-	-	-	-	-	-	-	-	-	5,550	-
Weighted average 1964 water year4/	-	51.3	10	120	74	360		260	500	480	3.0	1,680	604	390	2,800	-
(29) Lee Creek near Magna																
Oct. 14, 1963	69	4.0m	-	-	-	-	-	-	-	-	-	-	-	-	45,500	-
Nov. 19	47	3.6m	-	-	-	-	-	-	-	-	-	-	-	-	11,600	-
Dec. 13	36	1.0m	-	-	-	-	-	-	-	-	-	137,000	-	-	139,000	-
Jan. 15, 1964	24	-	-	-	-	-	-	-	-	-	-	-	-	-	106,000	-
Feb. 20	38	-	-	-	-	-	-	-	-	-	-	-	-	-	37,300	-
Mar. 19	42	29m	-	-	-	-	-	-	-	-	-	-	-	-	28,800	-
Mar. 20	43	29m	-	-	-	-	-	-	-	-	-	-	-	-	19,900	-
Apr. 9	61	1.7m	-	-	-	-	-	-	-	-	-	-	-	-	103,000	-
Apr. 17	64	1.4m	-	-	-	-	-	-	-	-	-	-	-	-	113,000	-
May 14	53	2.1m	-	-	-	-	-	-	-	-	-	-	-	-	136,000	-
June 22	57	20m	9.6	189	1,930	28,500		208	4,890	46,100	32	86,100	8,430	8,260	96,000	8.2
July 23	85	4.2m	-	-	-	-	-	-	-	-	-	-	-	-	158,000	-
Aug. 17	76	14m	-	-	-	-	-	-	-	-	-	-	-	-	163,000	-
Sept. 11	68	3.2m	18	114	4,400	22,300		385	9,780	39,900	12	84,300	18,400	18,000	85,300	7.8
(30) Kennecott Drain near Magna																
Oct. 14, 1963	62	108	-	-	-	-	-	-	-	-	-	-	-	-	4,730	-
Nov. 19	49	76	72	277	109	923		142	736	1,600	7.4	4,080	1,140	1,020	6,190	6.5
Dec. 13	41	71	31	265	92	883		270	701	1,420	7.4	3,820	1,040	819	5,540	8.0
Jan. 15, 1964	38	53	48	299	119	1,070		67	807	1,880	14	4,830	1,240	1,180	6,940	6.6
Feb. 20	42	77	32	285	117	836		152	797	1,450	11	4,100	1,190	1,070	5,770	7.7
Mar. 11	48	75	-	-	-	1,040		56	1,040	1,790	-	4,810	1,400	1,350	6,810	6.0
Mar. 19	39	213m	20	339	107	1,370		151	859	2,300	5.3	5,490	1,280	1,160	8,020	7.1
Mar. 19	43	204m	-	-	-	-	-	-	-	-	-	-	-	-	8,190	-
Mar. 19	43	204m	23	339	118	1,420		127	907	2,380	5.3	5,670	1,330	1,230	8,250	6.6
Mar. 20	45	141m	-	-	-	-	-	-	-	-	-	-	-	-	16,000	-
Mar. 20	47	156m	15	335	202	2,320		138	932	3,980	4.7	8,400	1,660	1,550	12,400	7.1
Mar. 21	43	101	-	-	-	5,980		123	1,550	10,000	-	19,600	2,820	2,720	27,700	6.7
Mar. 24	46	97	-	-	-	1,800		73	838	3,020	-	6,630	1,280	1,220	9,850	6.6
Apr. 9	35	70	42	261	102	930		45	731	1,620	11	4,380	1,070	1,030	6,470	6.0
Apr. 16	52	65	-	-	-	-	-	-	-	-	-	-	-	-	6,330	-
Apr. 18	55	53	57	212	107	1,140		(12)	793	1,860	10	4,400	970	-	6,610	4.4
May 19	73	40	-	-	-	-	-	-	-	-	-	-	-	-	7,330	-
June 18	62	147	23	240	77	889		142	612	1,480	7.6	3,630	915	799	5,510	6.9
July 23	76	77	26	216	117	902		301	605	1,490	4.3	3,710	1,020	773	5,550	7.7
Aug. 3	78	74	-	-	-	-	-	-	-	-	-	-	-	-	4,690	-
Aug. 17	71	96	22	168	96	711		304	507	1,120	4.7	2,880	815	566	4,440	8.0
Aug. 25	66	78	-	-	-	-	-	-	-	-	-	-	-	-	3,990	-
Sept. 10	61	97	-	-	-	-	-	-	-	-	-	-	-	-	3,670	-
Sept. 11	63	108	17	136	97	496		304	471	762	3.6	2,250	740	491	3,390	7.8
Sept. 22	60	111	-	-	-	-	-	-	-	-	-	-	-	-	8,680	-
Weighted average 1964 water year4/	-	80.2	40	230	100	950		170	700	1,500	10	3,610	985	846	5,800	-

Table 14. — continued

Date of collection	Temperature (°F)	Mean discharge (cfs)	Parts per million												Specific conductance (micromhos/cm at 25°C)	pH
			Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$		
JORDAN RIVER DRAINAGE SYSTEM--Continued																
(31) Garfield Drain near Magna																
Oct. 14, 1963	71	0.6	-	-	-	-	-	-	-	-	-	-	-	-	25,500	-
Nov. 5	67	1.9	71	277	97	1,330		(13)	2,760	2,430	16	6,360	1,090	-	18,200	1.7
Nov. 19	61	.7	-	-	-	-	-	-	-	-	-	-	-	-	19,300	-
Dec. 13	58	1.0	-	-	-	-	-	-	-	-	-	-	-	-	18,600	1.7
Jan. 15, 1964	52	1.1	-	-	-	-	-	-	-	-	-	-	-	-	19,300	1.7
Feb. 20	59	.8	-	-	-	-	-	-	-	-	-	-	-	-	18,400	1.8
Mar. 20	75	11	-	-	-	-	-	-	-	-	-	-	-	-	7,360	3.7
Apr. 18	61	.7	-	-	-	-	-	-	-	-	-	-	-	-	19,800	-
May 6	66	1.0	-	-	-	-	-	-	-	-	-	-	-	-	17,700	-
May 29	65	2.2	-	-	-	-	-	-	-	-	-	-	-	-	10,400	-
June 18	81	2e	36	427	94	1,340		(14)	1,800	2,250	3.0	5,600	1,450	-	11,100	2.0
July 23	83	.4	-	-	-	-	-	-	-	-	-	-	-	-	9,170	7.2
Aug. 17	80	.6	-	-	-	-	-	-	-	-	-	-	-	-	8,960	8.2
Sept. 11	90	12	16	232	100	1,440		236	441	2,450	7.4	5,260	990	796	7,950	7.6

1/ Analysis includes 0.13 ppm boron and 0.4 ppm fluoride.
2/ Analysis includes 0.13 ppm boron and 0.3 ppm fluoride.
3/ Includes 6 ppm carbonate.
4/ Chemical data estimated for periods of missing record; represents 100 percent of streamflow.
5/ No discharge from lake.
6/ Includes 8 ppm carbonate.
7/ High stage of Great Salt Lake caused brine to reach sampling site; not included in chemical weighted averages.
8/ Analysis includes 0.15 ppm boron, 0.7 ppm fluoride, and 0.00 ppm manganese.
9/ Analysis includes 0.03 ppm boron and 0.3 ppm fluoride.
10/ Includes 13 ppm carbonate.
11/ Analysis includes 0.15 ppm boron, 0.3 ppm fluoride, and 0.00 ppm iron.
12/ Hydrogen ion (H^+) concentration 1 ppm; note pH.
13/ Hydrogen ion (H^+) concentration 47 ppm; note pH.
14/ Hydrogen ion (H^+) concentration 14 ppm; note pH.

Table 15. — Chemical analyses of water from selected sites along the shore of Great Salt Lake

Location: In order starting at Promontory Point and moving clockwise around Great Salt Lake.
Discharge: Measurements based on cross sectional area and surface-velocity measurements or on computation of flow over weirs; a, no measureable flow; b, current-meter measurement; e, estimated.

Site number in figure 1	Location and sampling site		Date of collection	Discharge (cfs)	Parts per million: Sulfate (SO_4)	Parts per million: Chloride (Cl)	Parts per million: Dissolved solids (residue on evaporation at 180°C)	Parts per million: Hardness as $CaCO_3$ (calcium, magnesium)	Specific conductance (micromhos/cm at 25°C)	Density (grams/ml at 20°C)	Temperature (°F)
		BOX ELDER COUNTY									
32	(B-7-5)22ca	Spring.	10-16-63	0.1	-	-	2,390	-	4,170	-	62
33	22cd	Seep area	10-16-63	(a)	-	10,200	18,900	2,680	27,500	1.008	67
34	22bd	Spring.	10-16-63	.1	-	-	3,900	-	6,650	-	64
35	22ba	Stream below confluence of discharge from two springs	10-16-63	.6	-	5,890	11,600	1,460	17,500	1.003	70
36	22ba	Seep area	10-16-63	(a)	-	-	5,050	1,480	8,600	-	65
37	15cc	do.	10-16-63	(a)	-	-	6,130	-	10,100	1.000	69
38	15cc	Outlet to manmade pool east of road .	10-16-63	.2	-	2,200	3,860	700	6,770	-	65
39	15cb	Pothole spring, 3 feet deep	10-16-63	.7	-	13,000	24,600	3,110	34,400	1.011	77
40	15cb	Spring.	10-16-63	.1	-	-	2,110	-	3,700	-	62
41	15cb	Largest of five springs in seep area.	10-16-63	(a)	-	4,180	7,890	874	12,800	1.001	55
42	15bb	Spring.	10-16-63	.1e	-	610	1,320	345	2,350	-	60
43	15bb	do.	10-16-63	.1e	-	-	1,230	-	2,140	-	60
44	(B-9-5)32bc	do.	10-16-63	.1	-	1,640	3,140	400	5,490	-	69
		DAVIS COUNTY									
45	(B-3-3)27bb	Spring.	4-20-64	.1	-	260	628	-	1,130	-	67
46	(B-4-3)32ba	Large spring area, composite of 11 springs.	4-20-64	1.5	-	650	1,380	-	2,260	-	65
		TOOELE COUNTY									
47	(C-2-5)1bb	Sixmile Creek near Grantsville. . . .	4-22-64	7.4b	-	10,000	18,800	-	26,800	1.009	-
48	(C-1-6)26ba	Surface runoff near Solar Salt Plant.	9-24-63	.4	-	11,800	22,600	2,490	32,300	1.011	62
49	(B-1-6)13ad	Seep area	9-24-63	(a)	-	-	3,240	-	5,570	-	66
50	13aa	Largest outlet north of seep area . .	9-24-63	(a)	-	-	2,360	-	4,110	-	67
51	12aa	Seep area	9-24-63	(a)	-	1,100	2,200	380	3,770	-	69
52	1ac	Shallow pool at seep area	9-24-63	(a)	-	1,520	2,890	460	4,960	-	74
		Four Pools Spring:									
53	(B-2-6)25ca	Northernmost in series of four pools at seep area	9-24-63	(a)	-	1,690	4,140	625	5,820	1.000	78
54	25ca	Southernmost in series of four pools at seep area	9-24-63	(a)	-	-	13,300	1,400	20,400	1.004	86
55	(C-1-7)25ad	Stream at Dolomite Plant fed by springs.	9-11-63	.9	-	8,680	15,900	1,240	24,500	1.006	80
56	25ac	Spring.	9-11-63	.4	-	-	14,800	-	22,800	1.006	76
57	15ac	do.	9-11-63	.1e	-	-	11,800	-	18,800	1.003	87
58	15ba	do.	9-11-63	1.0	-	6,780	12,900	1,020	20,200	1.004	78
59	9cb	Big Spring at U.S. Highway 40	9-11-63	6.0	-	4,420	8,510	684	13,800	1.001	70
		Timpie Springs Waterfowl Management Area:									
60	9ab	West part upper lake.	9-11-63	2	-	4,970	9,000	718	14,700	1.002	76
61	10bb	East part upper lake.	9-11-63	1.5	-	5,490	9.860	718	16,000	1.002	72
62	3bc	Lower lake.	9-11-63	.7	930	12,200	21,900	1,380	31,400	1.012	73
63	(B-2-9)25ca	Pool inside cave.	8-26-63	(a)	-	356	940	270	1,680	-	57
		BOX ELDER COUNTY									
64	(B-11-11)6cd	Stream at abandoned Western Pacific Railroad bridge fed by springs . . .	4-23-64	.1	-	15,200	26,600	-	37,100	1.015	46
65	(B-14-8)2ccd	Deep Creek at U.S. Highway 30S, near Snowville.	8-27-63	5	-	218	746	322	1,290	-	67
		Locomotive Springs area:									
66	(B-11-10)10cb	West lake at south dike.	8-27-63	10	-	2,150	3,600	980	6,120	-	79
			4-24-64	23	108	1,600	2,950	550	4,740	-	43
67	(B-12-10)35dc	Baker Springs slough at diversion dam	8-27-63	12	-	1,220	2,480	520	4,050	-	72
			4-24-64	1	103	1,400	2,590	570	4,140	-	44
68	(B-11-10)13ba	East lake at south dike.	8-27-63	9	138	2,100	3,480	540	5,950	-	75
			4-24-64	11	126	1,700	3,310	580	5,300	-	47
69	(B-11-9)2cc	Pothole spring, 28 feet deep.	8-27-63	.2	-	43,700	79,500	5,730	94,100	1.050	-
70	2cc	Interconnected pothole springs, 26, 14, and 6 feet deep.	8-27-63	.9	-	-	89,200	-	103,000	1.058	-
71	10aa	Pothole spring, 6 feet deep	8-27-63	.1	-	28,100	50,900	4,130	66,200	1.030	64
		Hansel Valley:									
72	(B-11-8)2cb	Stream about 5 miles downstream from spring.	4-24-64	1.0	442	14,300	26,100	2,020	35,800	1.012	49
73	12ca	Stream, middle distributary.	4-24-64	1.5	182	4,230	7,860	680	12,700	1.000	47
74	12dc	Stream, east distributary.	4-24-64	1.5	222	4,690	8,430	660	13,700	1.001	47
75	(B-9-7)2ac	Flowing well.	8-28-63	.4	-	88	371	208	667	-	-
76	(B-9-6)32dd	At ranch.	8-28-63	1.5	-	1,410	2,620	620	4,700	-	-
77	(B-8-6)4ccc-1	Flowing well.	8-28-63	.3	-	625	1,290	230	2,390	-	-
78	21ca	Stream below large spring area. . . .	8-28-63	.3	-	730	1,490	250	2,760	-	-
79	21ca	Stream below small spring area. . . .	8-28-63	.1	-	-	1,590	-	2,860	-	-

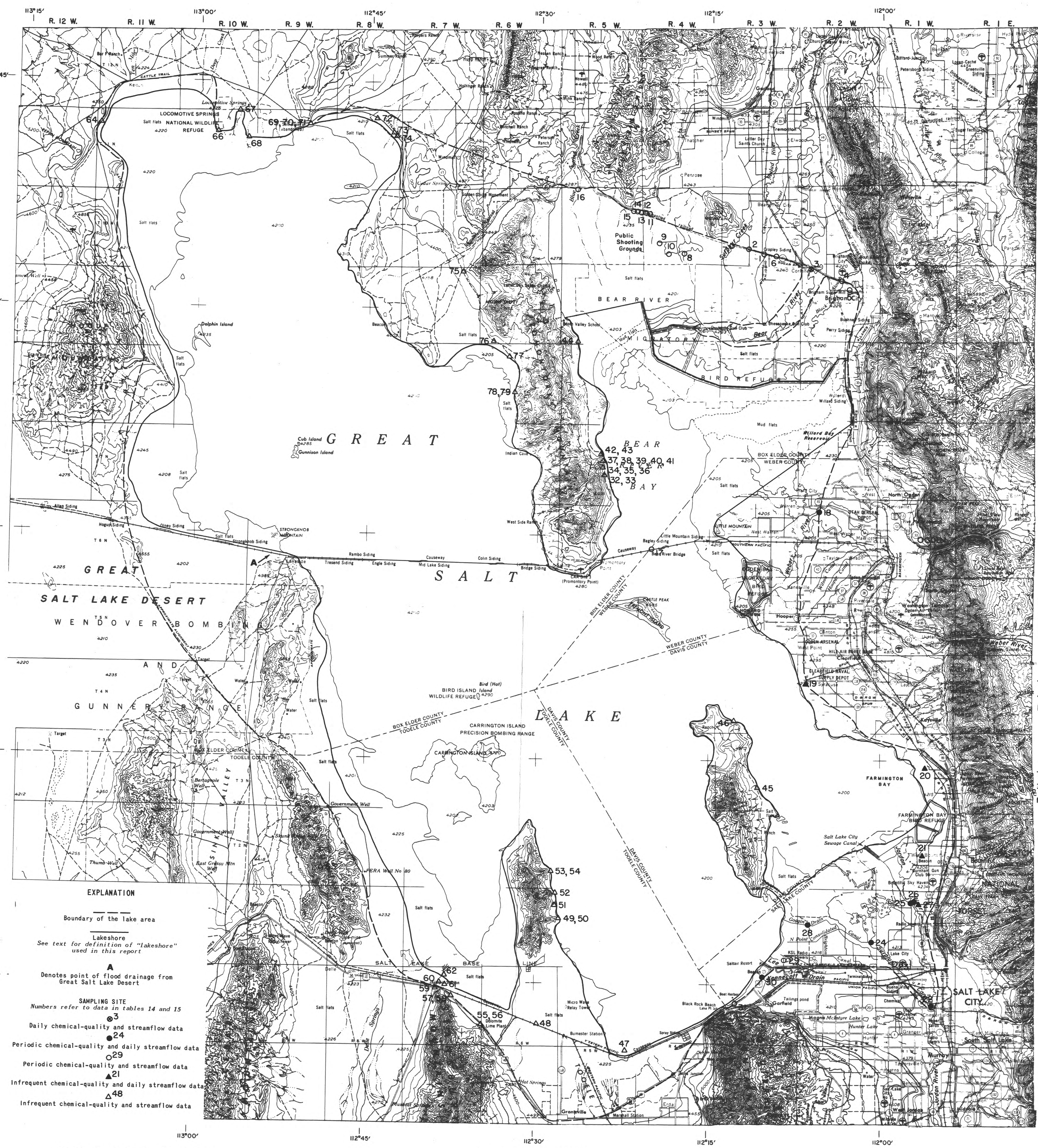

Figure 1. — Map of Great Salt Lake showing the 1964 data-collection sites, the boundary of the lake area and the lakeshore.

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

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The survey is enjoined to cooperate with all existing agencies to the end that the geological and mineralogical resources of the state may be most advantageously investigated and publicized for the good of the state. The *Utah Code, Annotated, 1953 Replacement Volume 5, Chapter 36, 53-36-2,* describes the Survey's functions.

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DIRECTORS:

William P. Hewitt, 1961-
Arthur L. Crawford, 1949-1961