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Hydrologic Inventory of the Weber River Study Unit

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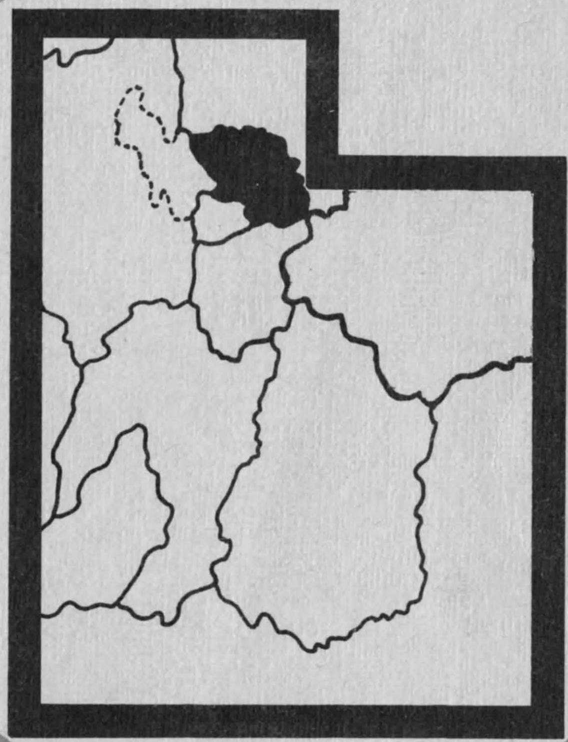

HYDROLOGIC INVENTORY
of the
WEBER RIVER STUDY UNIT

DEVELOPING A STATE WATER PLAN - UTAH STATE UNIVERSITY - UTAH DIVISION OF WATER RESOURCES

HYDROLOGIC INVENTORY
OF THE
WEBER RIVER STUDY UNIT

By
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Utah Division of Water Resources   Utah Water Research Laboratory

cooperating

Utah Water Research Laboratory
College of Engineering
Utah State University
Logan, Utah

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The overall effort has been coordinated by the General Hydrology and Water Supply work group, which consists of representatives from various state and federal agencies concerned with water resources planning and development. The representatives include: Roland Palmer and James Christensen, Utah Division of Water Resources; John Steele, U. S. Bureau of Reclamation; Creighton Gilbert, U. S. Soil Conservation Service; and Frank Haws and Gaylord Skogerboe, Utah Water Research Laboratory.

Frank W. Haws
Roland W. Jeppson
A. Leon Huber

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INTRODUCTION

Purpose and Scope of Study

The 1963 Utah State Legislature authorized the Utah Water and Power Board (now the Utah Division of Water Resources) to develop a state water plan in order to give coordination and direction to the activities of all state and federal agencies concerned with Utah's water resources. To facilitate the development of this plan, a proposal was submitted through the State Planning Coordinator in the Governor's Office to the Urban Renewal Administration of the Housing and Home Finance Agency. Funding was approved effective May 19, 1966, under the Urban Planning Assistance Program authorized by Section 701 of the Housing Act of 1954, as amended. Matching funds for the necessary land use and hydrologic investigations have been provided by the Utah Division of Water Resources and the Utah Water Research Laboratory.

A better understanding of the state's water resources, the way in which the water resources are being used, and the opportunities for further water conservation is an essential foundation in the development of a water plan. This understanding can be obtained only by careful study of each stream basin using recognized hydrologic techniques. Such a study must be designed to account for the water which appears as runoff, to isolate opportunities for improvement in water management, and to indicate opportunities for increasing the effective supply by eliminating nonproductive uses. Water planning must be based upon a reasonably good appraisal of the water supply and its quality at points within the system. In addition, since any proposed change in the place or type of water use will have an effect upon the total hydrologic system, this effect must be appraised before any possible development plan can be recommended.

The effort required to inventory the land and water resources throughout the state has necessitated a division of the workload. This division among numerous agencies and individuals has required that certain guidelines be prepared to insure compatability in the end products. This is particularly essential since the inventory data will also be used later for testing various water management possibilities. The general outline for the land use and water resources inventories follows.

1. Review existing land use data for each hydrologic area and determine its adequacy for meeting the needs of the water planning program.

2. Conduct field land-use surveys for those areas where inadequate information is available in order to delineate the various land use categories for each hydrologic area and subarea. Summarize the acreage data for use in the water budget studies.

3. For each subarea, determine the quantity and quality of runoff. Also, assemble and prepare for computer processing relevant available data regarding the hydrology and climate of each area, together with appropriate maps and charts.

4. Investigate relationships between precipitation and runoff with respect to both time and space. In this regard, factors influencing runoff, such as physiography, geology, vegetative cover, slope, elevation, and aspects are evaluated.

5. Estimate all major depletions from the flow system of the area.

6. Prepare water budgets which account for the time and spatial distribution of the total water resources within each hydrologic subarea.

The work reported herein was conducted as a portion of the contractual agreement between the Utah Division of Water Resources and the Utah Water Research Laboratory. The hydrologic basin described in this report is the Weber River study unit, shown in Fig. 1. A map of the basin depicting the drainage net along with cities and major highways is presented in Fig. 2. The Weber study unit is the drainage area in Utah tributary to the Weber River.

Sources of Data

Data collected and analyzed by various local, state, and federal agencies have been used extensively through-

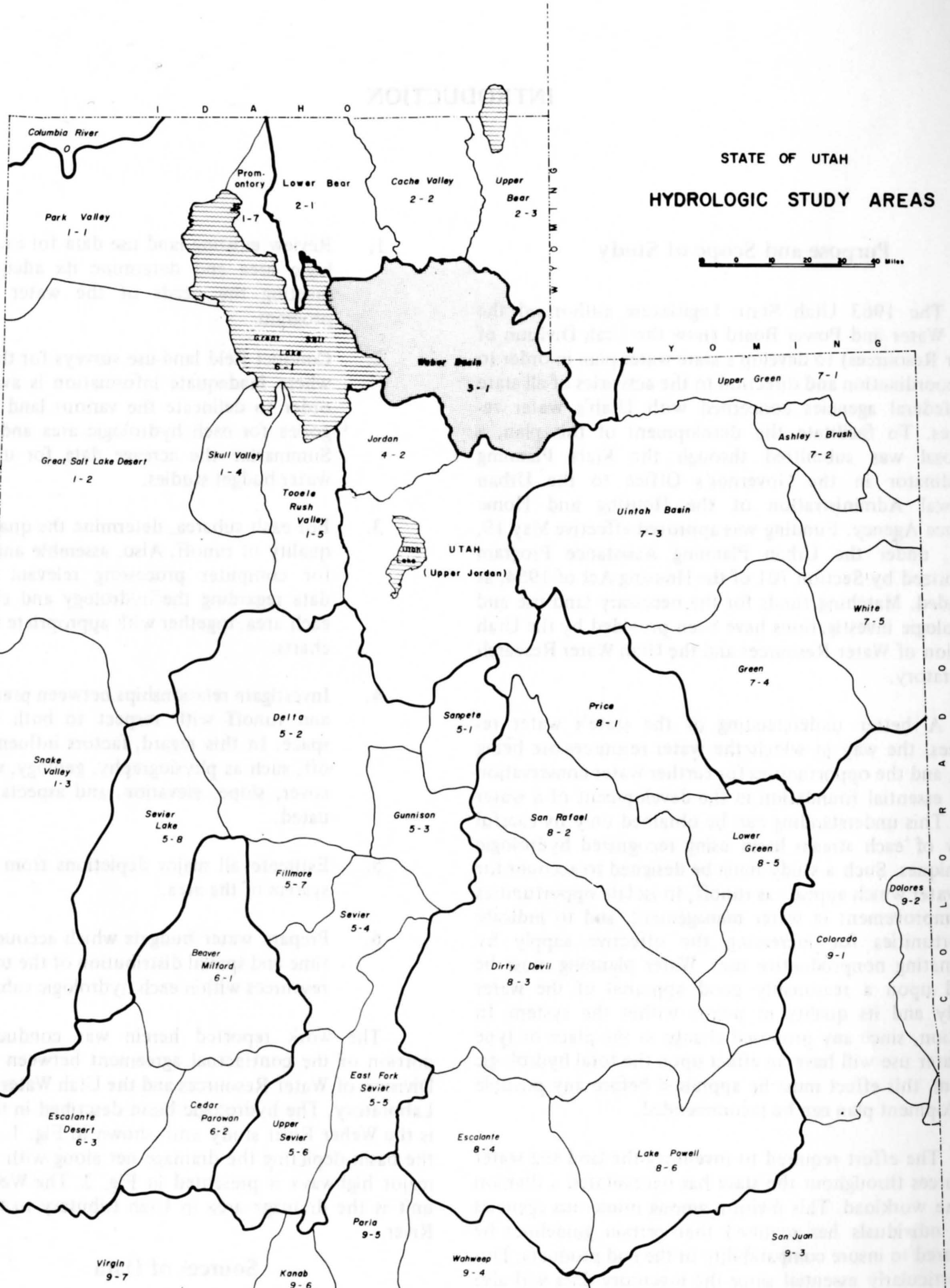
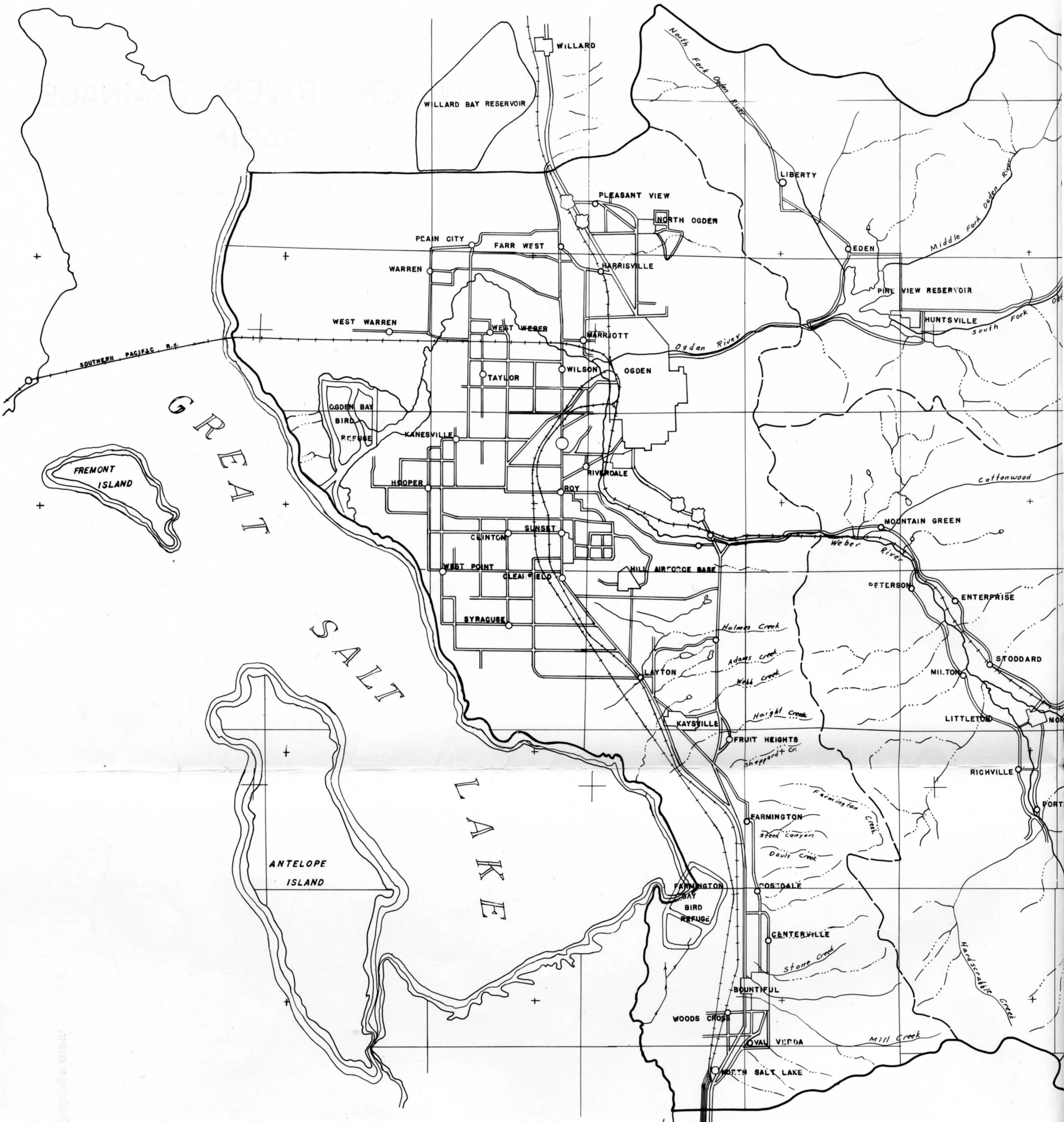
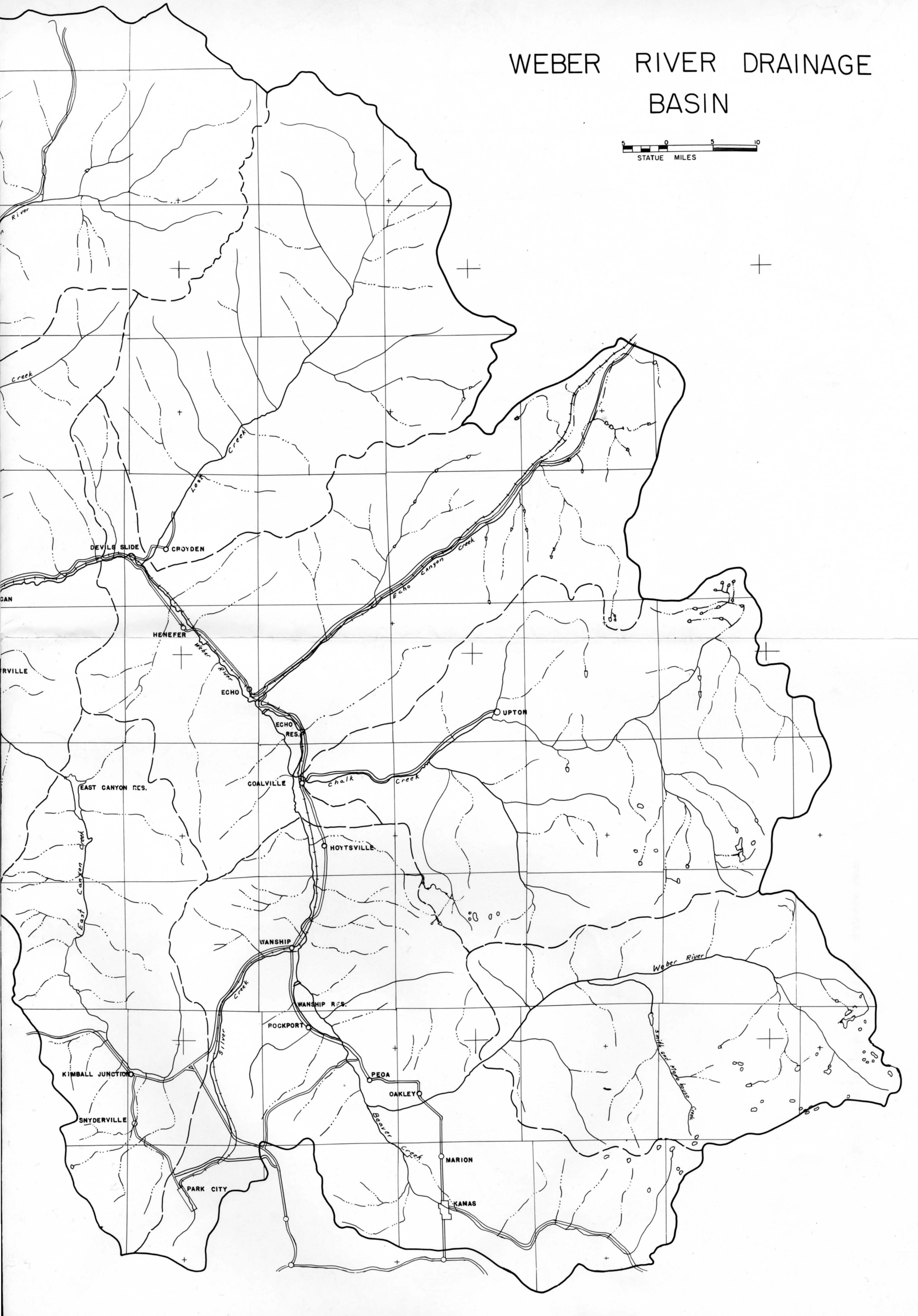


Figure 1. Location map of Weber River study unit.



WILLARD
WILLARD BAY RESERVOIR
North Fork Ogden River
LIBERTY
PLEASANT VIEW
NORTH OGDEN
EDEN
Middle Fork Ogden River
PLAIN CITY
FARR WEST
WARREN
HARRISVILLE
PINE VIEW RESERVOIR
HUNTSVILLE
South Fork
WEST WARREN
WEST WEBER
MARRIOTT
Ogden River
SOUTHERN PACIFIC R.R.
TAYLOR
WILSON
OGDEN
GREAT SALT LAKE
OGDEN BAY BIRD REFUGE
KANESVILLE
FREMONT ISLAND
HOOPER
RIVERDALE
ROY
Cottonwood
MOUNTAIN GREEN
CLINTON
SUNSET
Weber River
WEST POINT
CLEARFIELD
HILL AIRFORCE BASE
PETERSON
ENTERPRISE
SYRACUSE
Holmes Creek
STODDARD
LAYTON
Adams Creek
Webb Creek
MILTON
KAYSVILLE
Haight Creek
LITTLETON
FRUIT HEIGHTS
Sheppard Cr.
RICHVILLE
Farmington Creek
FARMINGTON
Steed Canyon
Davis Creek
ANTELOPE ISLAND
FARMINGTON BAY BIRD REFUGE
COSTDALE
CENTERVILLE
Stone Creek
Hardscrabble Creek
BOUNTIFUL
WOODS CROSS
VAL VERDA
Mill Creek
NORTH SALT LAKE


WEBER RIVER DRAINAGE BASIN
5 0 5 10
STATUE MILES
River
Creek
Lost Creek
DEVILS SLIDE
CROYDEN
HENEFER
Weber River
ECHO
ECHO RES.
Echo Canyon Creek
UPTON
COALVILLE
Chalk Creek
EAST CANYON RES.
East Canyon Creek
HOYTSVILLE
WANSHIP
Silver Creek
WANSHIP RES.
ROCKPORT
Weber River
Smith and Moorehouse Creek
KIMBALL JUNCTION
SNYDERVILLE
PEOA
OAKLEY
Beaver Creek
MARION
KAMAS
PARK CITY

out this report. The cooperation and assistance given by these agencies has been helpful.

The only new data collected for this study are the land use surveys conducted during the summers of 1966 and 1968 by the Utah Water Research Laboratory and the Utah Division of Water Resources.

Numerous streamflow gaging stations are maintained by the U.S. Geological Survey (USGS) within the Weber River drainage area. The runoff records for these stations are reported in the water supply papers covering the Great Basin. Additional records were obtained from Ogden City and from the Weber River Water Users Assocation. Diversion Records were obtained from Weber River and Ogden River commissioner reports filed in the State Engineer's Office and from private canal company records.

Most temperature and precipitation data acquired for the study are reported in publications of the Environmental Science Service Administration (ESSA). Additional precipitation data were obtained from the snow survey reports of the Soil Conservation Service (SCS).

Physiographic information was obtained from topographic maps prepared by the USGS. USGS reports and the geologic map prepared by the Utah Geological and Meteorological Survey (Utah State Land Board, 1963, 1964) indicate geologic data.

Hydrologic Study Area

Theoretically, a hydrologic budget can be prepared for any area regardless of shape or size, but the accuracy in evaluating the inflow and outflow items in a water budget can be improved if the area chosen is bounded by natural drainage divides. If the budget is being prepared to aid planners and developers, the most appropriate geographic unit is the river basin. Within such a system the surface and subsurface water supplies are connected and continuous. Every upstream use has some effect on the quality and quantity of water available farther downstream. Surface and underground waters can be studied together so that optimum utilization can be accomplished.

After selecting the proper geographic unit for which a water budget is to be prepared, the next step is to itemize all inflow - outflow items that can be measured directly. This involves an analysis of the existing records of meteorological and hydrologic measuring stations within the study unit. Inflow items that are usually measured consist principally of precipitation, river inflow, and canal inflow, while the measured outflow items usually available are river and canal outflows.

In every watershed there is usually a significant portion of the flow into or out of the area that cannot be measured directly. The use of various techniques to estimate this budget item is the third phase of developing a water budget. The largest single item in this category is evapotranspiration, which is water returned to the atmosphere by evaporation from either open bodies of water, soils, or vegetative cover. Evapotranspiration is most commonly estimated by equations which include various climatic factors such as temperature and length of growing season. Other indirect methods for estimating evapotranspiration rates includes correlation with parameters and soil moisture available to the plants.

Changes in storage in any given watershed usually are small when compared to the total budget, and over a period of several years the credits and debits to changes in storage tend to balance. However, when preparing budgets that extend over one year or only one month, it is usually necessary to account for the change in storage occurring between the beginning and the end of the period.

The usefulness of a water budget or hydrologic inventory depends upon the accuracy with which each of the individual components can be measured. Admittedly, the data are limited, and this permits the separate evaluation of each of the items of supply and disposal. The problem of determining precipitation amounts in regions of appreciable variation in elevation, cover, geologic, and climatic factors is self-evident. Likewise, filling in data gaps in surface runoff measurements in order to estimate these quantities has inherent limitations. The estimation of evapotranspiration quantities requires a knowledge of acreage of each water-consuming cultural class together with an appropriate unit value of annual use.

Although any increment of time can be used in preparing water budgets, mean annual data are most commonly used in preparing water budgets. In this budget, long-time averages are used to determine the water balance on a yearly basis. This is a useful tool to indicate the deficiencies or surpluses within an area and to establish estimates of the relative magnitudes of the various items in the budget. The mean annual water budget readily can be supplemented with frequency of occurrence information. The frequency analysis can reveal the probability of occurrence of such factors as precipitation, runoff, and temperatures, thereby expanding the utility of the water budget, particularly for planning purposes. This information enables planners to anticipate, or specify, risks involved in the projects they propose.

Mean monthly data provide another time increment for which water budgets can be prepared. Since a year is a true cyclic period, it is possible, by dividing the year into smaller time increments, such as months, and analyzing each time increment, to determine those periods during the year when surpluses and deficiencies occur. A mean annual surplus may have little meaning if there is no storage within the watershed to augment supplies during periods of deficiency in natural flows. As with mean annual budgets, a frequency of occurrence study is a helpful adjunct to the monthly budget.

In addition to time distribution studies of water, it is also necessary to study space or geographic distribution of water. This can be done in a gross manner by subdividing the study unit into smaller hydrologic subareas and preparing budgets for each subarea. The relative importance of each subarea to the total hydrologic system of the basin is then examined.

As increments of time and/or area are diminished, the inherent errors in measurement result in greater error in computing the water budget. Also, storage changes become more important since there is a greater likelihood of storage changes not balancing. Thus, it must be recognized when preparing water budgets that the advantages of smaller increments of time and area in delineating the occurrence and variation of hydrologic events, also result in greater chances of error in the computed magnitude of such events.

Budgets for Weber River study unit

The Weber River study unit was subdivided into nine smaller units or subareas. The hydrologic subareas were determined by location of river gaging stations, which provided good measurement of significant inflow and outflow items. Hydrologic budgets, both mean annual and mean monthly, were prepared for each subarea for the time base 1931 to 1960.

Hydrologic subareas

River gaging stations of runoff were used as division points to subdivide the total area into smaller sub-water sheds. Nine subdivisions, as shown on Fig. 3, have been made to represent the following areas:

1. Weber River above the measuring station at Oakley, Utah.
2. Weber River above the measuring station at Coalville and below the measuring station at Oakley.
3. Chalk Creek above the gaging station at Coalville.
4. Weber River above the measuring station at Devils Slide and below the measuring station at Coalville.
5. Lost Creek above the measuring station at Croyden.
6. East Canyon Creek above the measuring station at East Canyon Dam.
7. Weber River above the measuring station at Gateway and below the measuring station at Devils Slide.
8. Ogden River above the measuring station in Ogden Canyon immediately below Pineview Dam.
9. All the area between the shore lines of Great Salt Lake (4205 elevation), the top of the Wasatch Range and below the gaging stations in Ogden and Weber Canyons and between the county boundaries which separate Davis and Salt Lake County on the south and Weber and Box Elder Counties on the north.

Topography

Proceeding eastward from the shore of Great Salt Lake toward the Wasatch Mountains lies that flat fertile lake plain formed by the alluvial deposits of ancient Lake Bonneville. Several terraced benches mark the different lake levels while near the mouth of Weber Canyon lies the Weber River delta.

Rising abruptly from the valley floor are the rugged Wasatch Mountains which extend in a nearly north-south direction separating the flat valley lands from the rolling hills and mountain valleys on the interior of the hydrologic unit. The interior of the unit consists of narrow valleys between low rolling hills. The southeast corner of the unit rises again to meet the high mountain peaks marking the beginning of the Uintah Mountains and dividing the surface drainage into the Bear River, Weber River, Jordan River, and Colorado River systems.

The major tributaries to the Weber River are Beaver Creek, Chalk Creek, Lost Creek, East Canyon Creek, and Ogden River. Ogden River is the largest tributary and joins the Weber River in the valley area just before the rivers terminate in the Great Salt Lake. The Ogden River drains what was once an arm of the old Lake Bonneville and is now made up of three branches which traverse the Ogden Valley and meet at the head of narrow Ogden Canyon. The canyon is short and the river soon emerges onto the valley floor where it meets the Weber River.

The water resources of an area are affected by the topography. The altitude of the mountains is related to the extraction of water from moving air masses and the steepness and aspect of the slopes are related to the runoff. The topography of the Weber River study unit is indicated by shaded contours in Fig. 4a.

Elevation is one of the most significant physiographic factors affecting the hydrology of an area. Since elevation has a very significant effect on both temperature and precipitation, elevation plays an important role in defining the water system. For example, increased elevations usually result in increased precipitation and lower temperatures, thereby resulting in increased snowfall and lower potential consumptive use rates. Thus, the percent of precipitation occurring as runoff is increased. Since temperature is a limiting factor in the types of agricultural crops that can be grown in an area, elevation is oftimes the cause for the type of agriculture in an area. The effect of elevation on the combination of precipitation and temperature results in dramatic effects on the type of native vegetation found on mountain watersheds.

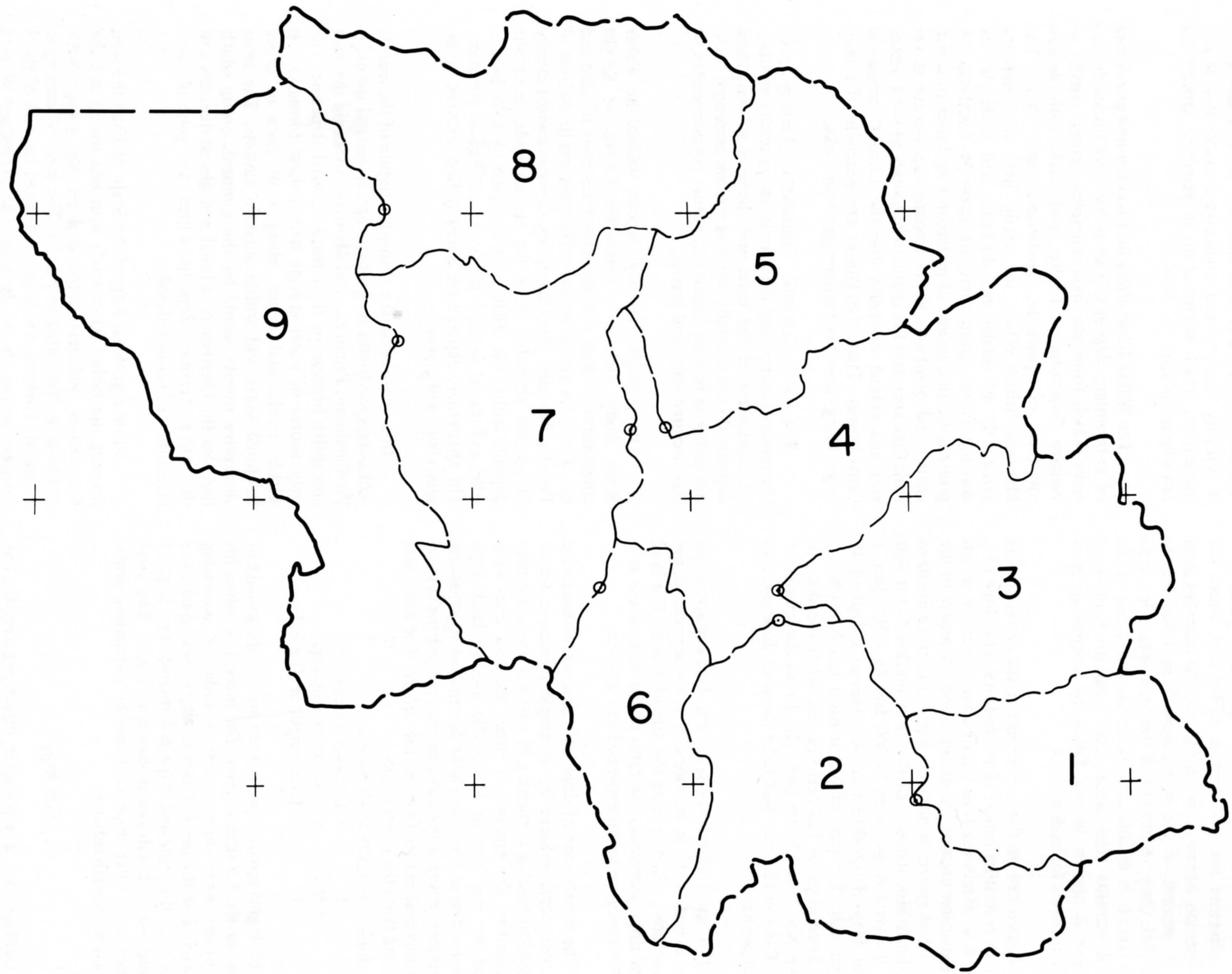


Figure 3. Hydrologic subareas in the Weber River drainage area.

Within the Weber River drainage area, the elevation varies from 4100 feet above mean sea level at the Great Salt Lake to 11,200 feet at the high Uintah peaks. The mean elevation for this area is 6,700 feet. From the area-elevation curves shown in Fig. 4b. The quartiles show that 50 percent of the area ranges from 5,900 feet to 7,450 feet. Only 16 percent of the total area is less than 5,000 feet; it is in this area, however, that most of the cultural pursuits take place. The areal distribution of elevation is shown in the figure by comparing area-elevation curves for each subarea.

Stream bed profiles are an important physiographic factor in evaluating runoff characteristics. The slope of a stream bed affects the time distribution of runoff, which is of particular importance during floods. A profile of the Weber River system is shown in Fig. 5. From the divide in the Uintah Mountains until the river reaches Great Salt Lake the river drops from 11,000 feet to 4,200 feet, a vertical drop of 6,800 feet in 140 miles or a slope of 48 feet per mile. The part of Weber River in subarea No. 1 has a mean slope of 125 feet per mile while the slope in subarea No. 7 is 23 feet per mile. From the mouth of Weber Canyon to Great Salt Lake the river slope averages 10 feet per mile.

The areal distribution of the land-surface slope within a watershed is an index of the steepness of the drainage area, which affects the rate of runoff. The land surface slope represents the ratio of the vertical rise in a unit horizontal direction expressed as a percent.

The distribution of slope with area was obtained for each hydrologic subarea by a simple technique which consisted of placing a square grid over a topographic map and counting the number of times the grid lines were crossed by the contour lines. The average land slope within each square was similarly determined by counting the number of times the contour lines crossed the vertical and horizontal center lines of the square. The slope was computed from the relationship:

Land slope $= 1.571\ DN/L$ where,

D = Contour interval

N = Number of crossings

L = Total length of all grid lines

Each grid square represents an area on the ground of approximately 3.6 square miles. The individual values for each square were then ranked in order of increasing magnitude and the percent area having slopes equal to or greater than the indicated slope determined. The slope of the land for each subarea is shown in Fig. 6. The areal distribution of land slope is shown by comparing slope-area curves for each subarea.

Geology

Geology has a significant effect on runoff. The disposition of precipitation falling on the area is partly determined by the absorptive character of the mantle rock or regolith. Nonabsorptive coverings result in rapid runoff and high flood flows. Absorptive coverings produce late season flows. The basal structure is also important if it is highly fractured and conducive to water storage and movement, which would result in perennial springs and late season streams.

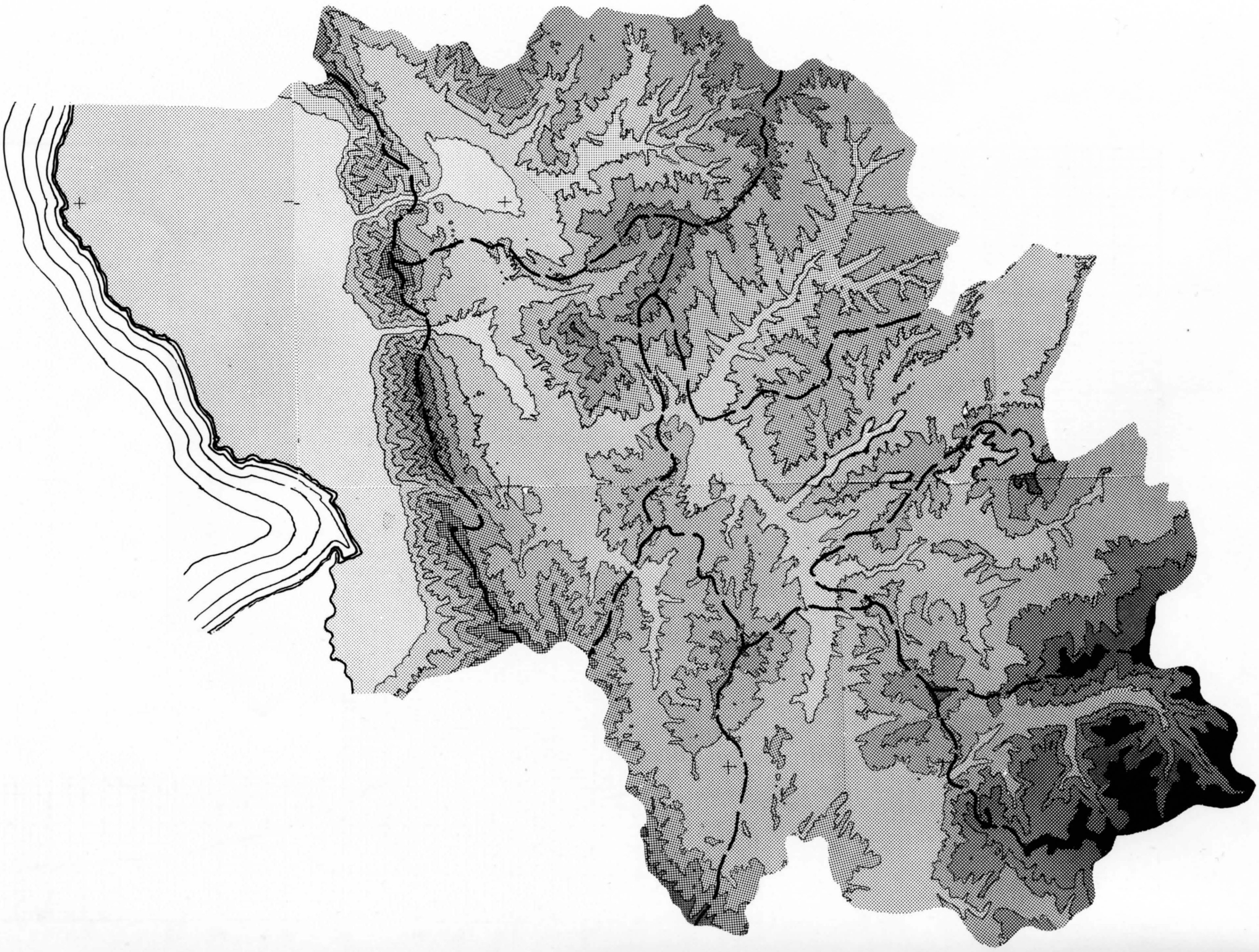
The Weber River study unit is composed principally of sedimentary deposits. The oldest (Paleozoic) formations which form the basal complex consist chiefly of massive limestone, dolomite, and shale with various mixtures of quartzite, sandstones, and chert. The Mesozoic rocks within the study unit are composed principally of sandstone, siltstone, and shale. In the Wasatch front region there are some Pre-Cambrian deposits consisting mainly of metamorphosed rock of schist, gneiss, and quartzite. Some igneous rocks occur in the Park City area near the southern boundary of the drainage area and extend westward into the Little Cottonwood Canyon area. These formations are generally of a later origin being classed as Tertiary granitoid rocks.

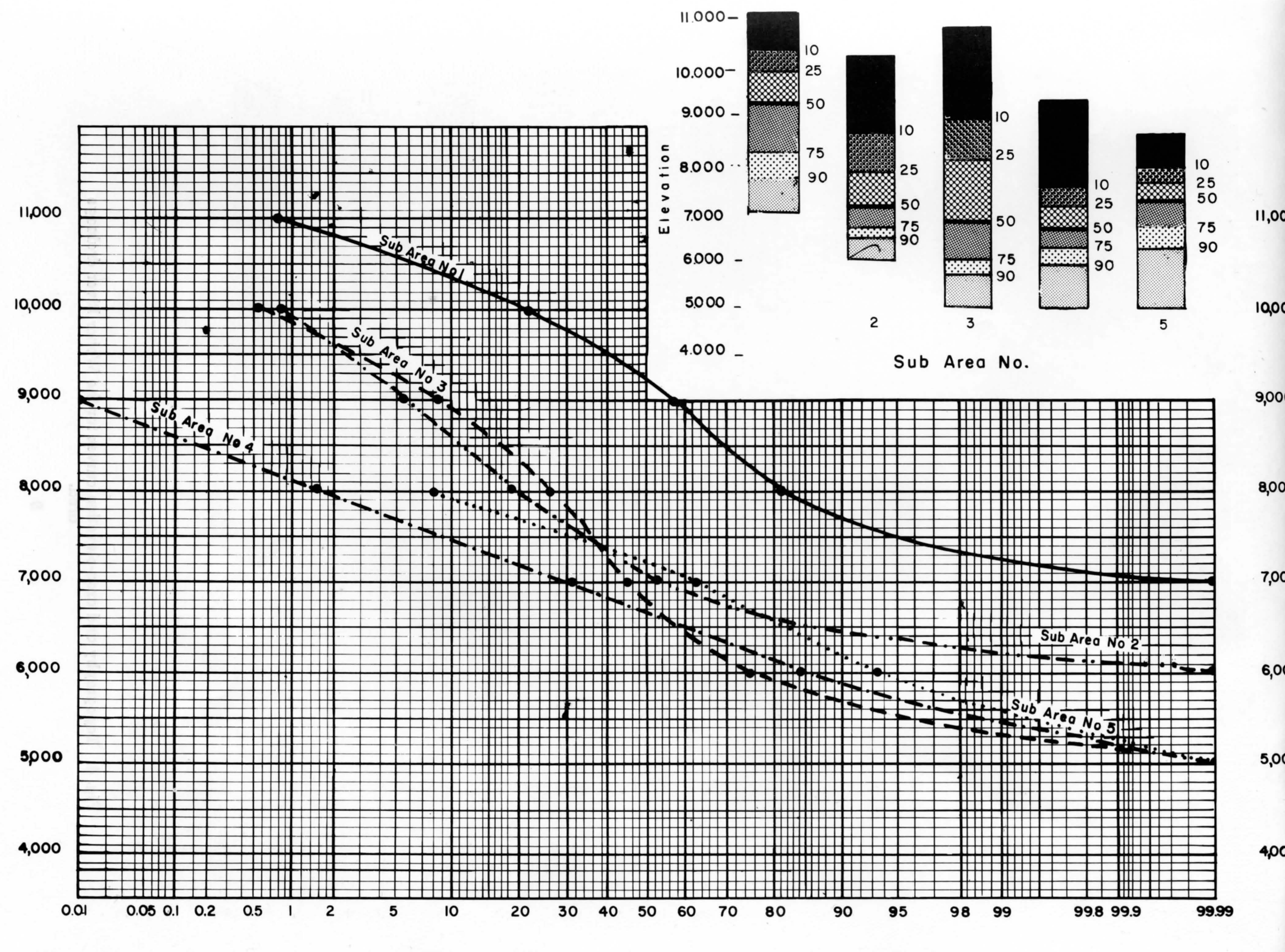
The later Cenozoic formations (Tertiary and Quaternary) composing the mantle are generally weathered expressions of the basal unit. Because of this, these deposits do not generally occur as massive cemented rocks but rather as broken fragments, porous conglomerates, or fine textured sands and gravels.

The principle Tertiary deposit within the Weber River study unit is a formation known as Knight conglomerate which contains minor amounts of sand and silt. There are also extensive tuffaceous and limey beds of Tertiary deposits. The Quaternary deposits consist chiefly of alluvial deposits along the stream beds, lacustrine deposits within the valley once occupied by Lake Bonneville, and glacial deposits in the areas of highest elevation. The Quaternary deposits are generally fine textured sands, silts, clays, and gravels.

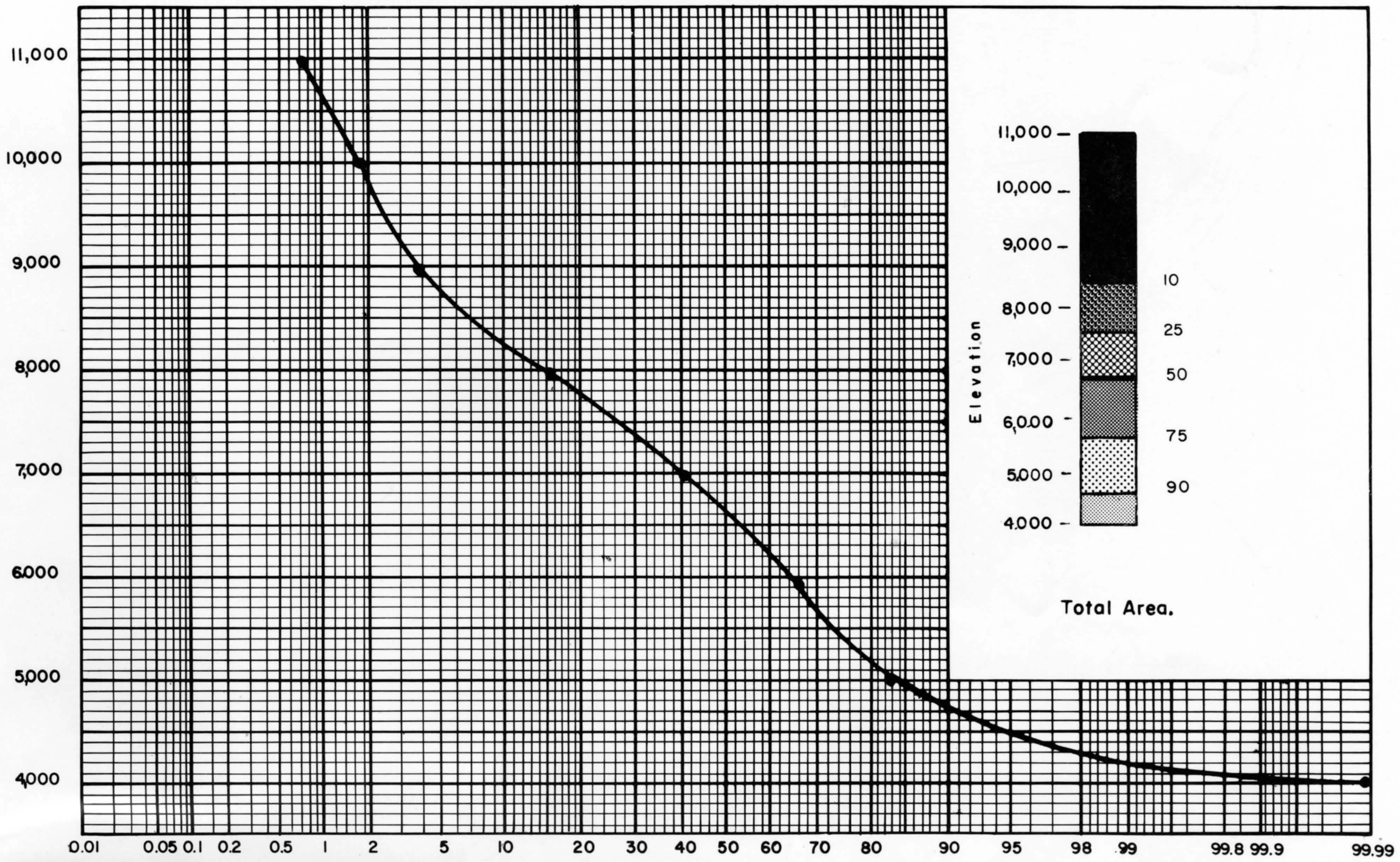
In a broad sense the absorptive nature of the mantle rock correspondswith its geologic age. In general the older Pre-Cambrian, Paleozoic, and Mesozoic rocks are the least absorptive because of their massive, solid structure. The only source of water storage within these formations is within cracks and seams, along fault lines or other fractured areas and within solution caverns. The most absorptive mantle would be the Cenozoic group which includes the Quaternary alluvial and glacial deposits and the older Tertiary deposits which are generally uncemented or unconsolidated.

From a geologic map of the State of Utah the area forming the Weber River study unit was traced and the four major undifferentiated geologic age groups were outlined, as illustrated in Fig. 7a. The area of each type of mantle covering was then determined for each of the 9 subareas within the study unit. The percentage of area covered by each of the geologic types was arranged in a bar graph to show the areal distribution of mantle

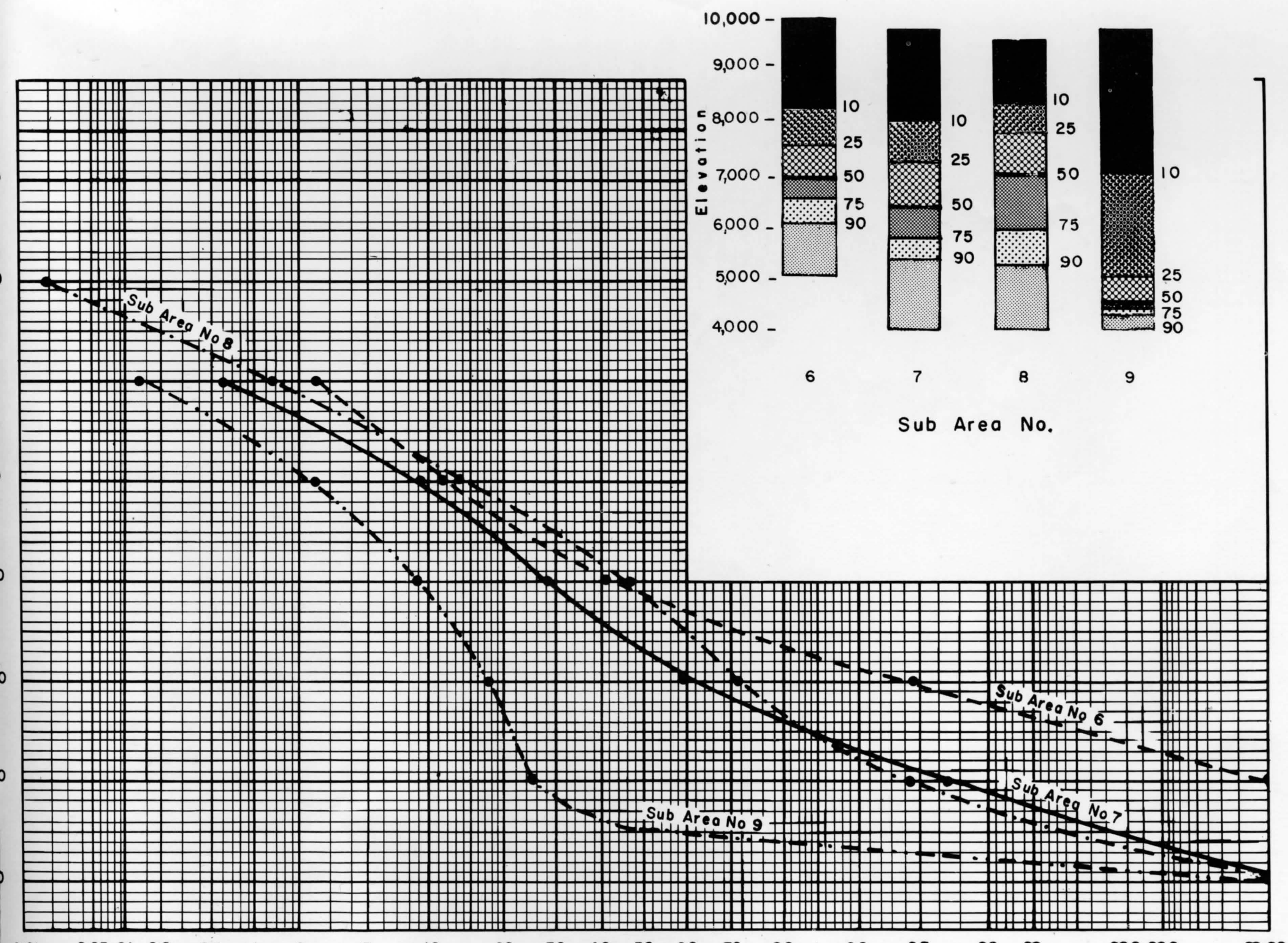




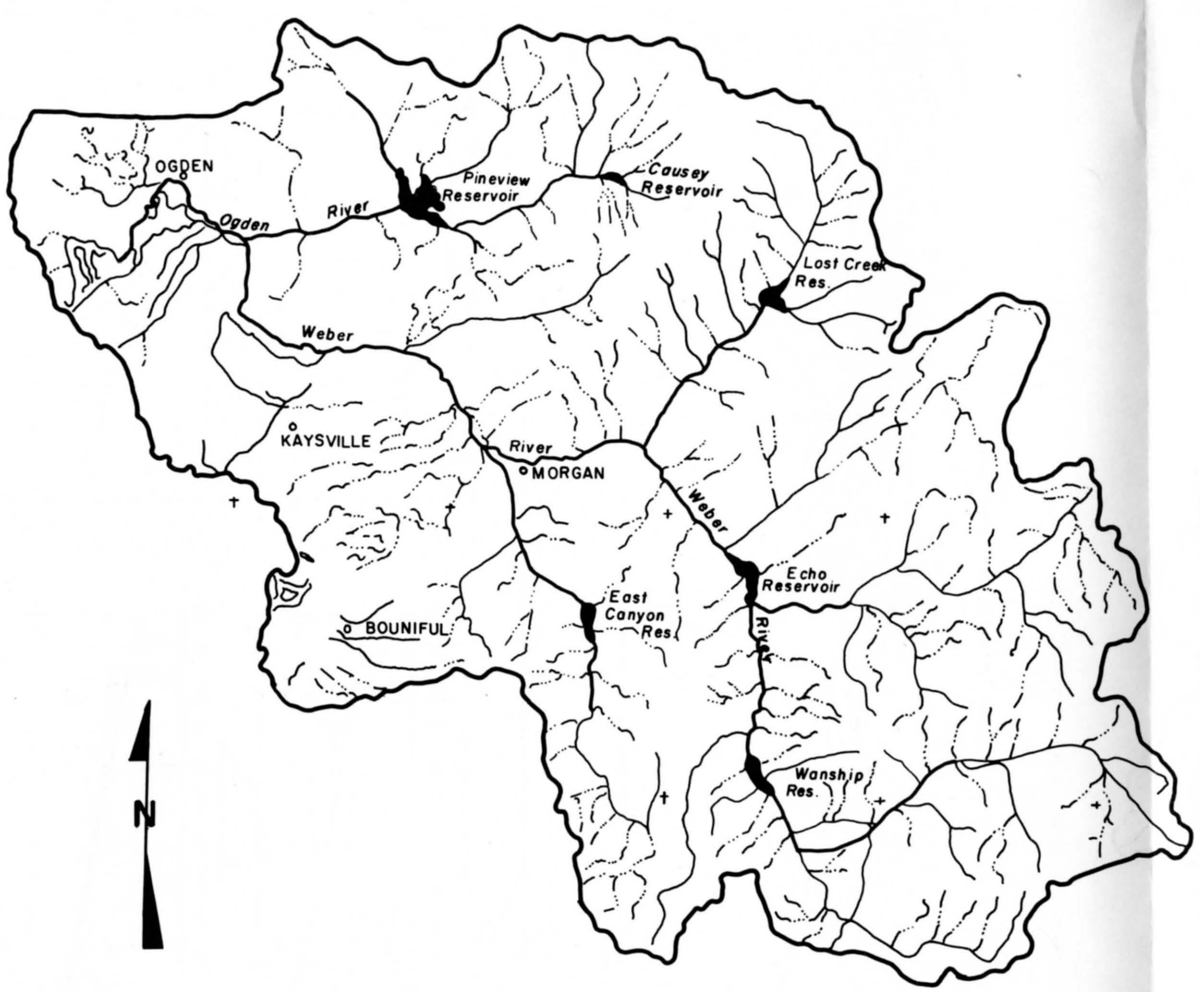
Elevation
11.000
10.000
9.000
8.000
7.000
6.000
5000
4.000
10
25
50
75
90
2
3
5
Sub Area No.
Sub Area No 1
Sub Area No 3
Sub Area No 4
Sub Area No 2
Sub Area No 5
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99



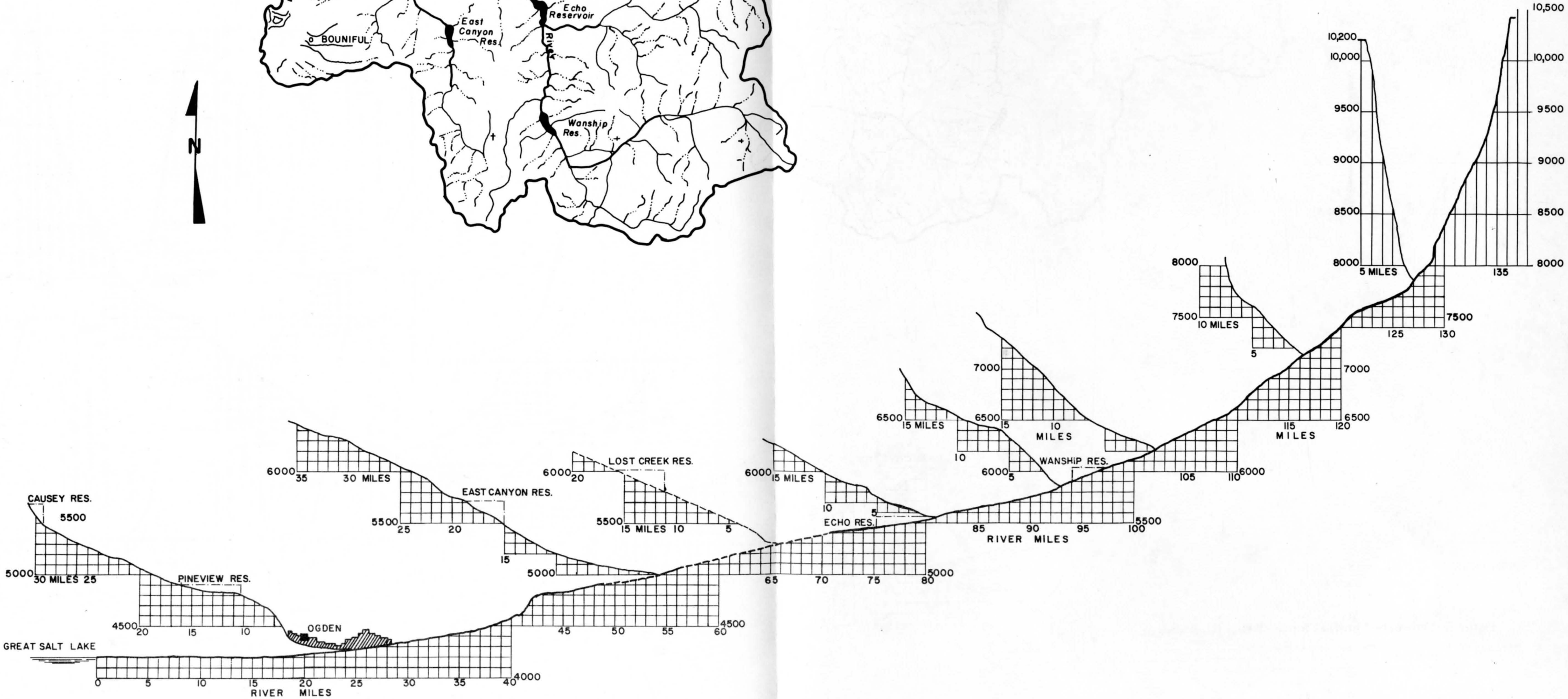
11,000
10,000
9,000
8,000
7,000
6000
5,000
4,000
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
Elevation
11,000
10,000
9,000
8,000
7,000
6,0.00
5,000
4.000
10
25
50
75
90
Total Area.



10,000
9,000
8,000
7,000
6,000
5,000
4,000
Elevation
10
25
50
75
90
6
7
8
9
Sub Area No.
Sub Area No 8
Sub Area No 6
Sub Area No 7
Sub Area No 9
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99



OGDEN
Ogden
River
Pineview Reservoir
Causey Reservoir
Lost Creek Res.
Weber
KAYSVILLE
River
MORGAN
Weber
Echo Reservoir
River
East Canyon Res.
BOUNIFUL
Wanship Res.
N



CAUSEY RES.
5500
5000
30 MILES 25
PINEVIEW RES.
4500
20
15
10
OGDEN
GREAT SALT LAKE
0
5
10
15
20
25
30
35
40
4000
RIVER MILES
6000
35
30 MILES
5500
25
20
EAST CANYON RES.
15
5000
45
50
55
60
4500
6000
20
LOST CREEK RES.
5500
15 MILES
10
5
65
70
75
80
5000
6000
15 MILES
10
5
ECHO RES.
6500
15 MILES
10
6000
5
6500
15
10
MILES
7000
WANSHIP RES.
85
90
95
100
5500
RIVER MILES
105
110
6000
115
MILES
120
6500
7000
8000
7500
10 MILES
5
125
130
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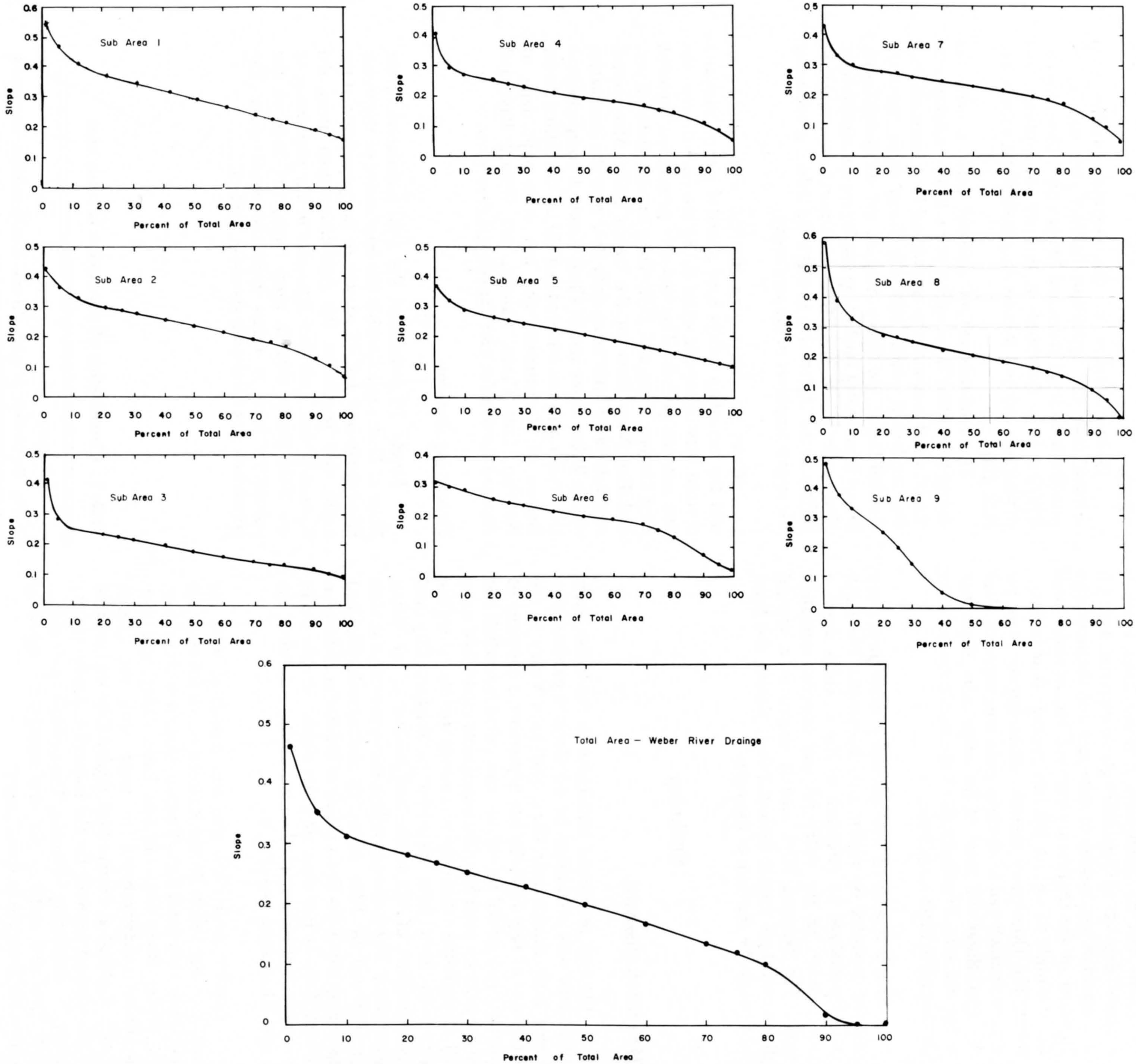


Figure 6. Area-slope distribution for hydrologic subareas in the Weber River drainage area.

covering, (Fig. 7b). This chart will reveal at a glance those areas which contain the greatest amount of absorptive mantle rock. Area 1, which is located in the high mountains near the headwaters of Weber River, contains extensive deposits of Quaternary glacial material. Area 1 is in a region of high rainfall or snowpack and the absorptive character of the Quaternary material retains water from the snowmelt to sustain the late summer flow in Weber River. The Quaternary material which occurs along the stream channels and in the lake plain area supports all of the agricultural and most of the other cultural pursuits within the area. Practically all of the usable groundwater also occurs in these formations.

Area 9 is covered with extremely deep Quaternary material deposited by ancient Lake Bonneville. The depth can be visualized by reference to Fig. 8 which shows a cross section of the valley fill and adjacent mountain range. The Wasatch fault area is shown as a vertical displacement of several thousand feet, placing this basal rock below the alluvium of the valley.

Economy

Historical background

The first permanent settlements in the Weber River study unit were established by the Mormon pioneers who began their exodus into Great Salt Lake Valley in the latter part of July 1847. By late September, a company of pioneers had settled on the site now called Bountiful; and in the next six years Mormon immigrants established some 20 communities within the area which stretches along the mountain front from Bountiful to Brigham City and includes most of the fertile land known as the Weber River delta. The mountain valleys began to receive settlers in 1859 and by 1863 about 28 new communities had sprung up along the flood plains of the Weber and Ogden Rivers. Thus in less than 20 years nearly 50 new towns and cities had been planted within the boundaries of the Weber River study unit (Fig. 9).

Growth within the area was stimulated with the coming of the Union Pacific Railroad which followed the immigrant trail down Echo Canyon, made new trails along the Weber River into the Salt Lake Valley, and then proceeded northwestward to unite with the Central Pacific Railroad at Promontory. Ogden City was selected as the western terminal for the railroad and grew rapidly under its stimulating influence. The railroad made migration easier and many of the new immigrants stayed to make their homes in or near Ogden.

The railroad and favorable climatic conditions contributed to the growth potential in the East Shore area. Fertile soil and an adequate water supply produced a wide variety of crops and the export industry provided by the railroad produced money and more industry. By 1940 Ogden ranked high as a center for railroading, grain handling, food manufacturing, jobbing, and financing. Natural industries included textile factories, meat packing businesses, canning factories, sugar factories, and others.

Pioneer farmers in the mountain valleys soon learned that the agriculture in this area was limited principally to small grains and forage crops. Livestock and dairying have flourished in this region, however, and mining has enjoyed success in places like Coalville and Park City.

The establishment of national defense industries during World War II brought a new influx of workers into the area and much of the agricultural land succumbed to the residential needs. Hill Air Force Base, the Utah General Depot, the Ogden Arsenal, and the Naval Supply Depot were among the leading employers during this time. Many other non-military federal agencies have established offices in the Ogden area to make the federal government the largest employer in the area today.

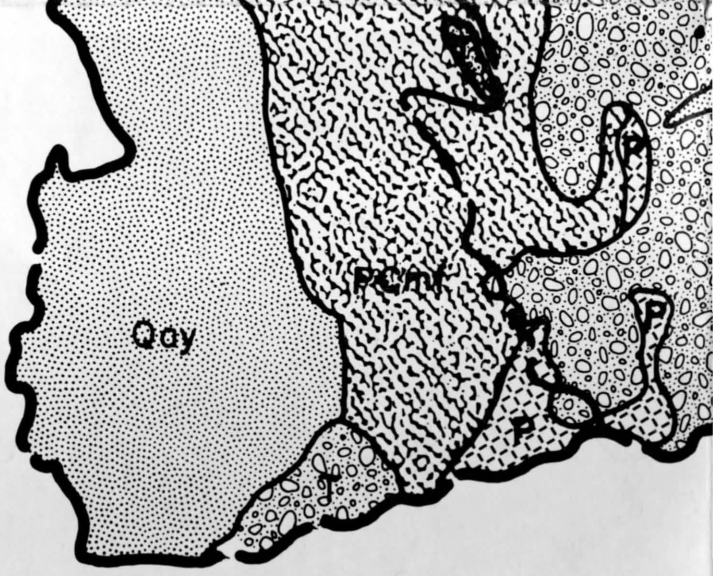
Water has always been plentiful in the study area, and the mountain valleys have provided several adequate storage sites to provide water during low river flows in the late summer periods. The first storage projects included East Canyon Dam, and Echo Dam on the Weber River, and Pine View Dam on the Ogden River. Many small reservoirs were built at an early date near the headwaters of the Weber River and of Chalk Creek. A comprehensive river basin plan was initiated in 1949 by the United States Bureau of Reclamation and has since built dams at Wanship, Lost Creek, Causey, and Willard Bay; and enlarged the dams at East Canyon and Pine View.

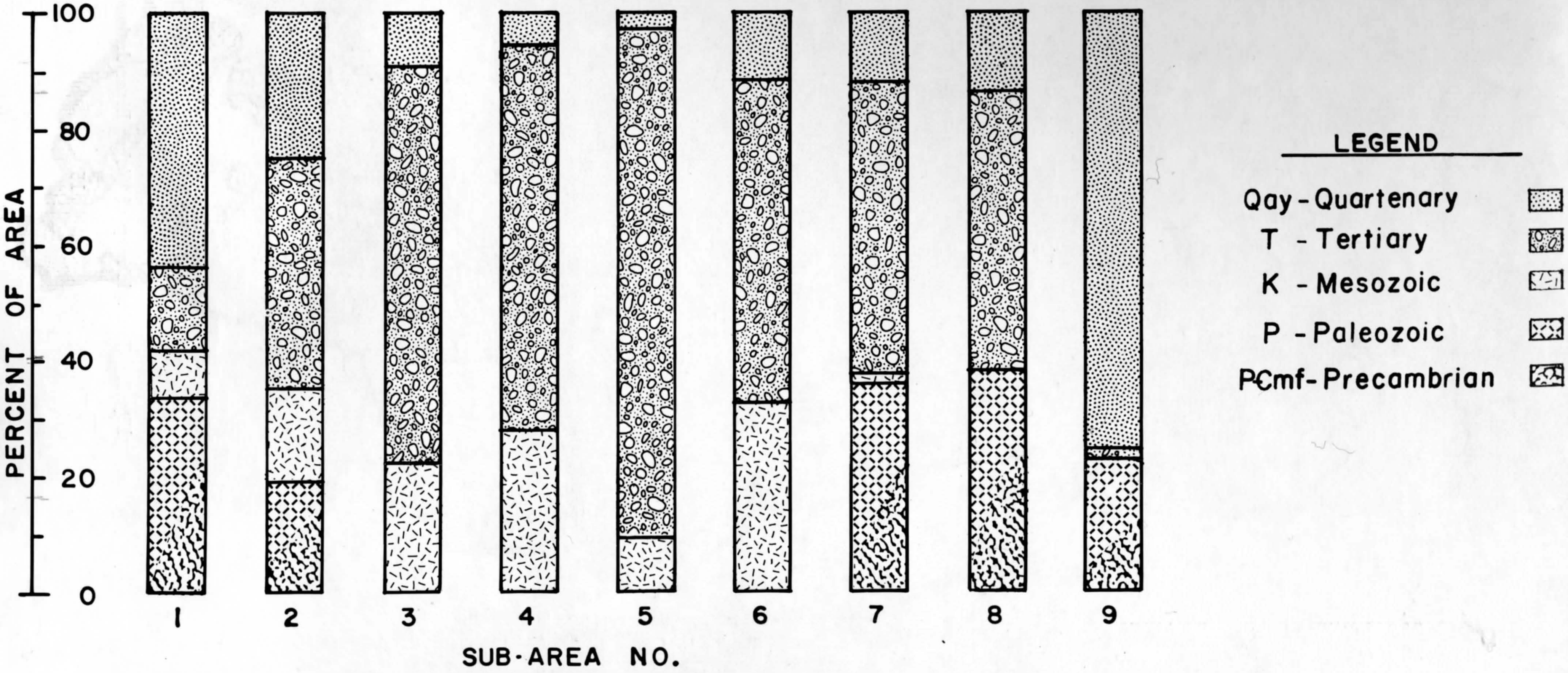
Present day situation

Nearly 20 percent of the total population of the State of Utah resides within the boundaries of the Weber River study unit and 95 percent of the population of the study unit resides in the East Shore area along the Wasatch Front. Less than 3 percent of the population of the East Shore area is rural farm, the bulk of the population lives in urban type residential areas. The population classification is shown in Table 1.

Table 1. Classification of population in study area.

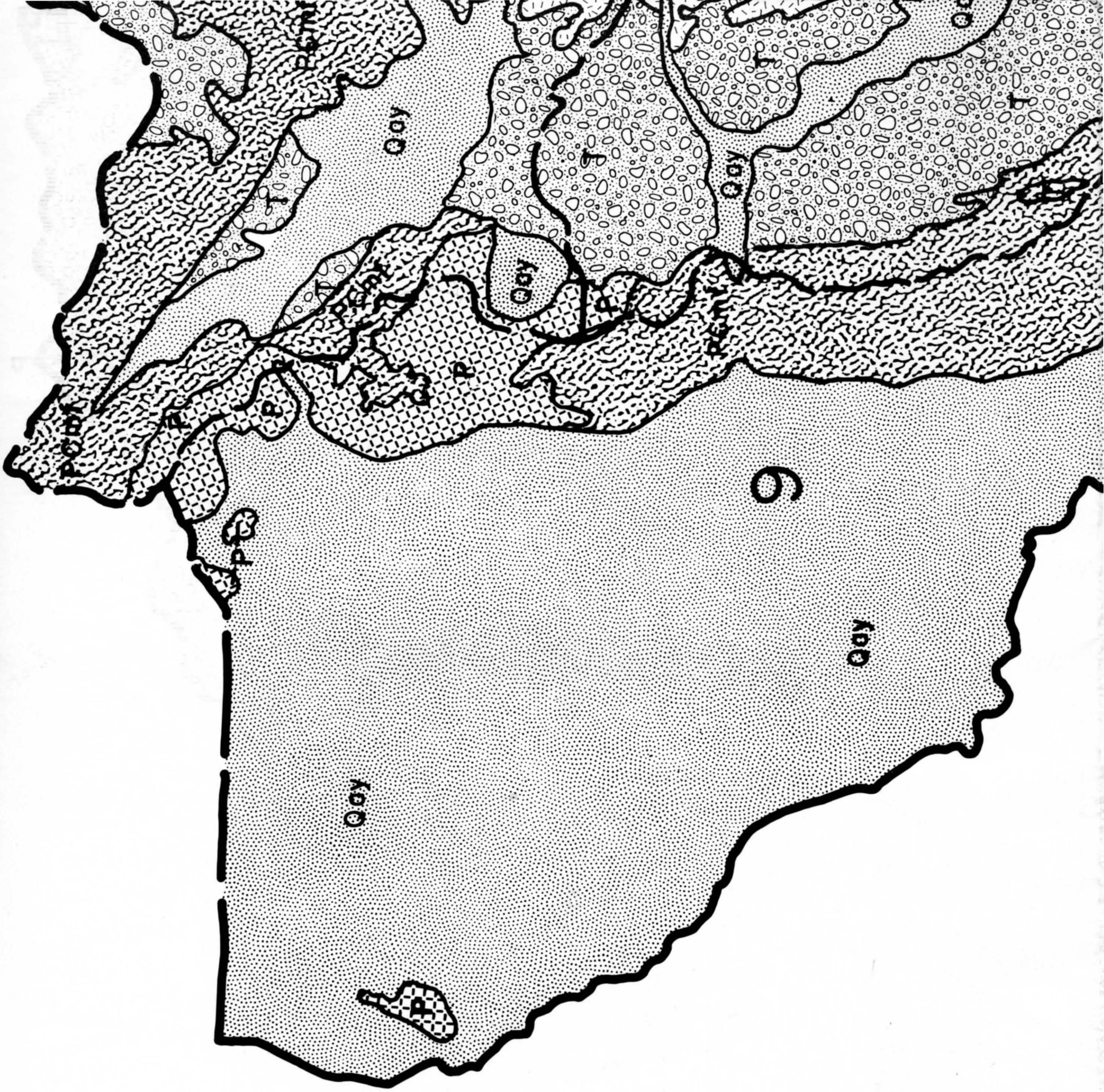
County	1960 Population	Density	% Urban	% Non-farm rural	% Farm rural
Weber	110,744	201.7	86.8	10.3	2.9
Davis	64,760	241.6	80.0	16.4	3.6
Morgan	2,837	4.7	——	62.2	37.8
Summit	5,673	3.1	——	79.9	20.1
Total	184,014	74.7	80.4	15.4	4.2


Qay
PCmf
P
T

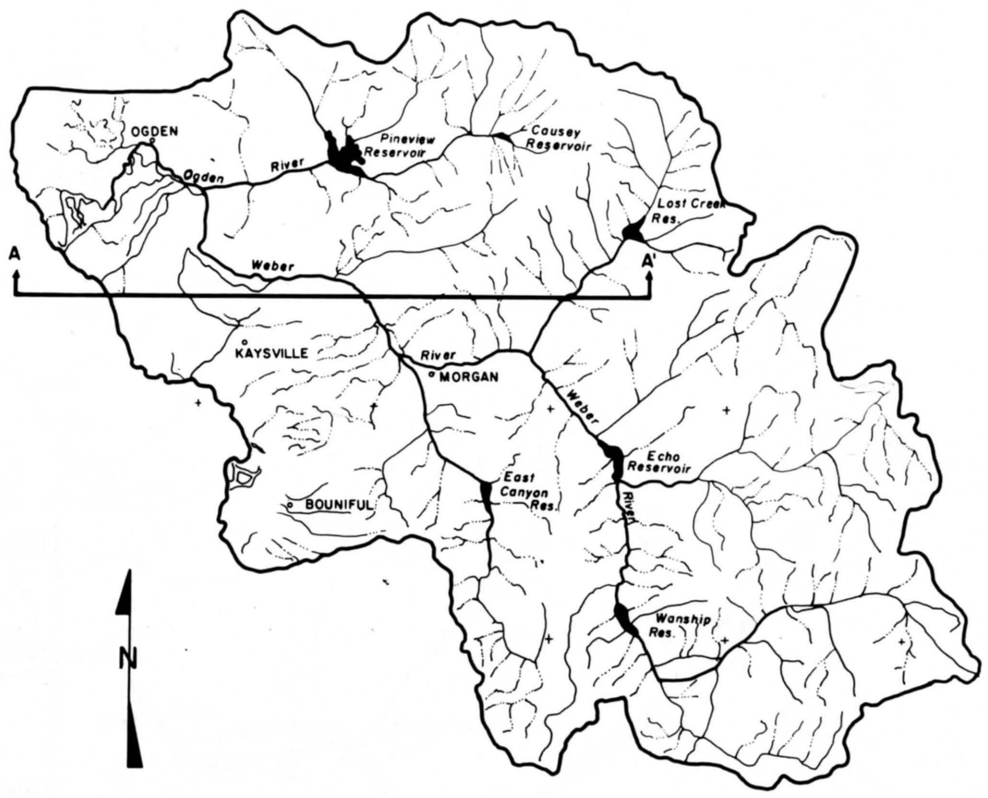

PERCENT OF AREA
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
SUB-AREA NO.
LEGEND
Qay - Quartenary
T - Tertiary
K - Mesozoic
P - Paleozoic
PCmf - Precambrian

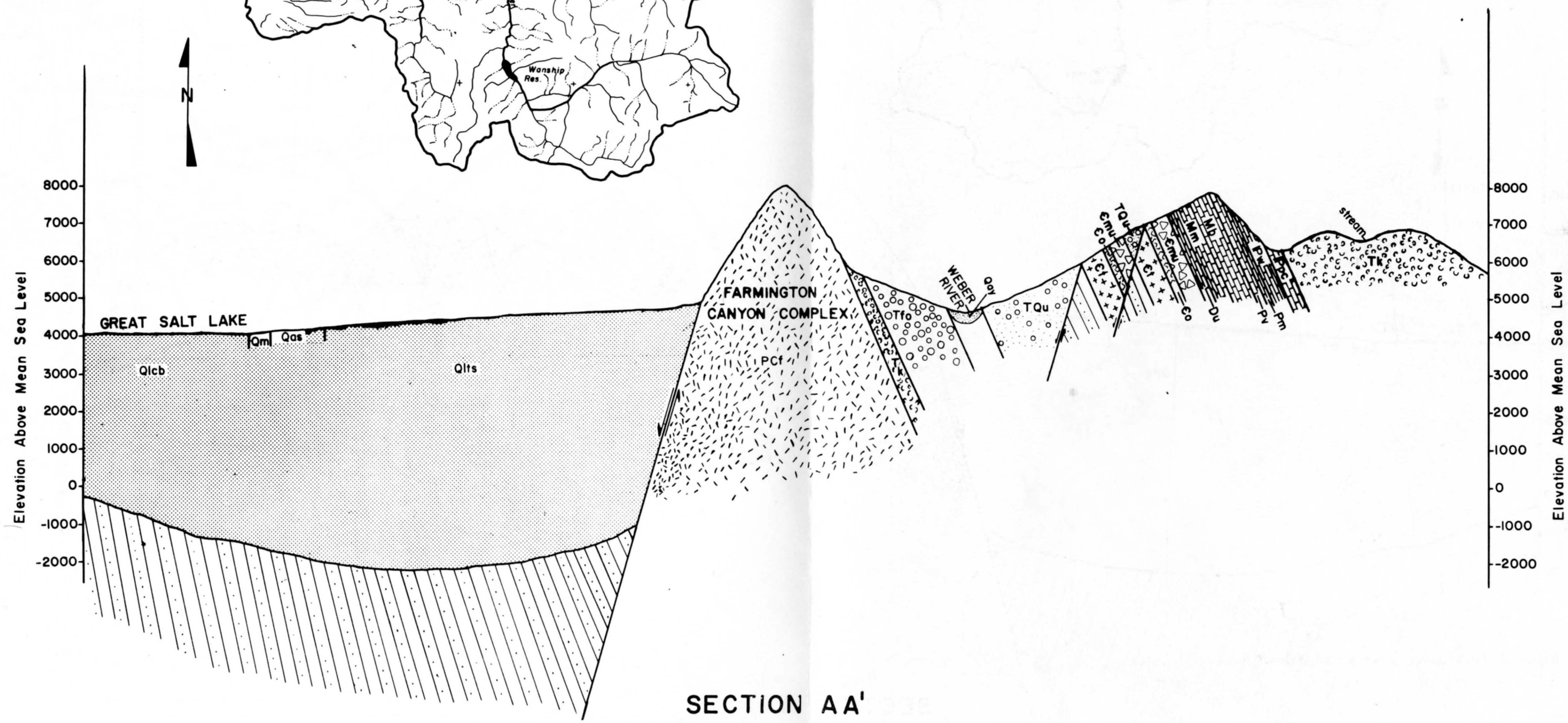

Qay
K
T
P
1
2
3
6

4
5
8
7
Qay



Qay


OGDEN
Ogden
River
Pineview Reservoir
Causey Reservoir
Lost Creek Res.
A
A'
Weber
KAYSVILLE
River
MORGAN
Weber
Echo Reservoir
East Canyon Res.
BOUNIFUL
River
Wanship Res.
N


8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
Elevation Above Mean Sea Level
GREAT SALT LAKE
Qm
Qas
Qlcb
Qlts
FARMINGTON CANYON COMPLEX
PCf
Tk
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WEBER RIVER
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Cf
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Du
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Tk
stream

SECTION AA'

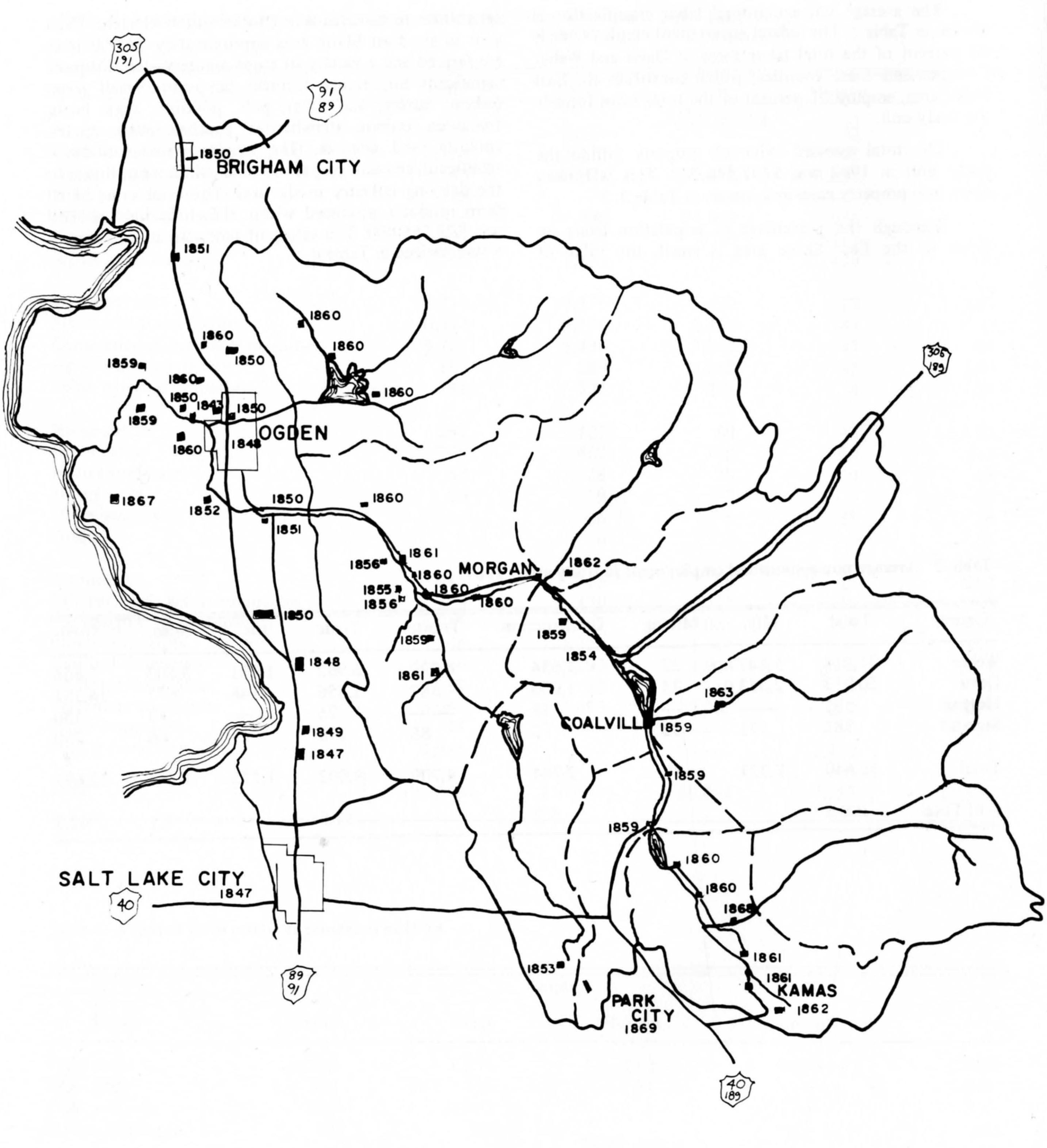


Figure 9. Dates of settlement for towns in the Weber River drainage area.

The average non-agricultural labor classification is shown in Table 2. The federal government employs nearly 43 percent of the total labor force in Davis and Weber Counties and these counties, which constitute the East Shore area, employ 97 percent of the total labor force in the study unit.

The total assessed value of property within the study unit in 1962 was $191,346,000. This is broken down into property class by counties in Table 3.

Although the percentage of population living on farms in the East Shore area is small, the value of agriculture to the area is not to be underestimated. Each year in the East Shore area approximately 74,000 acres are farmed and a variety of crops are harvested. Crops of significant importance include: hay, corn, small grains (wheat, barley, and oats), peas, potatoes, sugar beets, tomatoes, onions, strawberries, peaches, pears, apples, apricots, and cherries. The cropland also includes a significant amount of pasture land which contributes to the dairying industry in the area. The total value of all farm products produced within the study unit in 1959 was $23,555,000. The value of products in each county is summarized in Table 4.

Table 2. Average non-agricultural employment in study area - 1961.

County	Total	Mfg.	Mining	Construction	Transp.	Trade	Ins.	Misc.	Govt.
Weber	31,214	5,847	22	1,654	4,239	6,982	1,001	3,603	7,866
Davis	20,913	2,353	35	1,000	382	1,856	148	677	14,351
Morgan	532	---------	----	58	---------	76	---------	18	130
Summit	981	171	32	72	88	178	24	66	350
Total	53,640	8,371	89	2,784	4,709	9,092	1,173	4,364	22,697
% of Total	100.0			5.2		17.0		8.1	42.3

Table 3. Assessed values, by class, of property within the Weber River study unit - 1962.

Property Class	Total	Weber	Davis	Morgan	Summit
			1,000 dollars		
Residential real estate	13,429	8,314	4,771	32	312
Commercial & industrial real est.	6,168	5,477	636	11	44
Agricultural real estate	10,583	3,924	3,252	1,239	2,168
Unclassified real estate	115	8	19	---------	88
Residential buildings	64,618	36,930	25,809	686	1,193
Commercial and industrial bldg.	18,625	13,237	5,026	115	247
Agricultural buildings	2,265	1,639	257	139	230
Motor vehicles	15,319	9,176	5,190	323	630
Merchandise and fixtures	10,674	8,196	2,339	47	92
Commerical & industrial machinery	8,781	5,435	3,238	47	61
Agricultural machinery	582	289	182	32	79
Other personal property	896	571	278	8	39
Range cattle	297	122	60	43	72
Other cattle	748	402	148	56	142
Horses and mules	83	28	28	9	18
Sheep	50	9	7	9	25
Other animals	63	6	6	25	26
Poultry	9	4	-	--	5
Air lines	411	15	85	29	282
Bus, car, and express companies	359	129	131	30	69
Gas and pipe line companies	8,717	2,131	3,067	779	2,740
Power companies	5,306	3,223	1,344	280	459
Railroad companies	15,206	8,293	1,903	1,606	3,394
Telegraph companies	39	27	10	1	1
Telephone companies	6,051	3,075	2,066	282	628
Water companies	15	---------	---------	---------	15
Mining companies	1,946	---------	---------	1,430	516
Total	191,346	110,660	59,854	7,257	13,575

Table 4. Value of farm products produced in 1959.

	County				
Crop	Weber	Davis	Morgan	Summit	Total
Field crops	1,334	1,234	212	203	2,983
Vegetables	374	436	31	----	841
Fruit and nuts	556	382	1	----	939
Horticulture spec.	102	590	----	1	693
			1,000 dollars		
Dairy products	2,420	631	270	1,430	4,751
Poultry	2,530	736	15	1,639	4,919
Livestock	2,619	3,415	859	1.536	8.429
	9,935	7,424	1,387	4,809	23,555

DATA ASSEMBLY AND EVALUATION

Climate

Data network

Perhaps the two most important meteorologic elements forming the climate of any region are temperature and precipitation. Neither could be looked upon as independent variables since both are dependent upon solar radiation, topography, elevation, position upon the earth, and perhaps other undefined phenomena. Because of the complex system of interdependence, most meteorologic elements are treated as random variables and an understanding of the phenomena is derived by studying the historical occurrence of the variables.

The location of temperature and precipitation stations within and adjoining the Weber River study unit is shown in Fig. 10. A listing of these stations, including the periods of record, is given in Tables 5 and 6. The data used in this report consisted of monthly temperature and precipitation data. In cases where data for particular months were missing, correlation procedures were used to estimate the missing data and to test the consistency of the data, particularly for the stations having long periods of record. In preparing water budgets, the temperature and precipitation stations having consistent records were primarily used. There are a number of good weather stations located in the agricultural valleys of the Weber River study unit.

Temperature

Temperature is important in a hydrologic study for several reasons. First, temperature is a measure of molecular activity and hence a measure of the rate at which water is changed from a liquid phase to a gaseous phase. In the gaseous phase water is less manageable and is free to exit from the hydrologic area. (It is also in this state that water enters the hydrologic area and precipitates to form the source of all liquid water within the hydrologic unit.) Secondly, the growth processes of both plants and animals are highly dependent upon temperature, and life can exist only within a very narrow temperature range. To prevent this temperature from exceeding a lethal value, both plants and animals depend upon the cooling effect of evaporating water. At the lower extreme most plants die upon freezing or cease to grow and become dormant. Thus, temperature limits the growing season of plants and determines the consumptive use of water by plants. Temperature also stimulates growth in plants and determines the type of plants that can survive within an area.

Temperature is dependent upon intensity of solar radiation and hence varies with terrestrial latitude. Temperature also varies with the absorption characteristic of the earth's surface and the intervening atmosphere. In general, this means a change in temperature with elevation. For each 1,000 foot increase in elevation the mean annual temperature will decrease about 3°F. In the Weber River study area the high mountain valleys are thus cooler and have shorter growing seasons than the East Shore lake areas. The upper mountain valleys, for example, have an average growing season of about 95 days which is about 60 days shorter than the growing season in the lake shore area west of the Wasatch Mountains. The average summer temperature is about 6° cooler in the mountain valleys than in the lake shore area. The cropping pattern is, therefore, much different in the two areas, the mountain valleys being used primarily for forage crops and small grains while the East Shore valley area produces a wide variety of crops including truck vegetables and orchards.

Isotherms representing mean annual temperature are shown in Fig. 11 for the Weber River study unit. The records from the temperature stations shown in Fig. 10 formed the base in preparing the map of isotherms. Temperatures in adjoining areas were obtained by using a temperature lapse rate of -3° per 1,000 feet, which was used in preparing Fig. 11. The isothermal map gives a general portrayal of temperature variation in the Weber River study unit. As would be expected, the low isotherms of 20°F and 25°F occur near the peaks of the Wasatch Mountains. The high isotherms of 50° F occur in the lake shore areas of the Weber Delta.

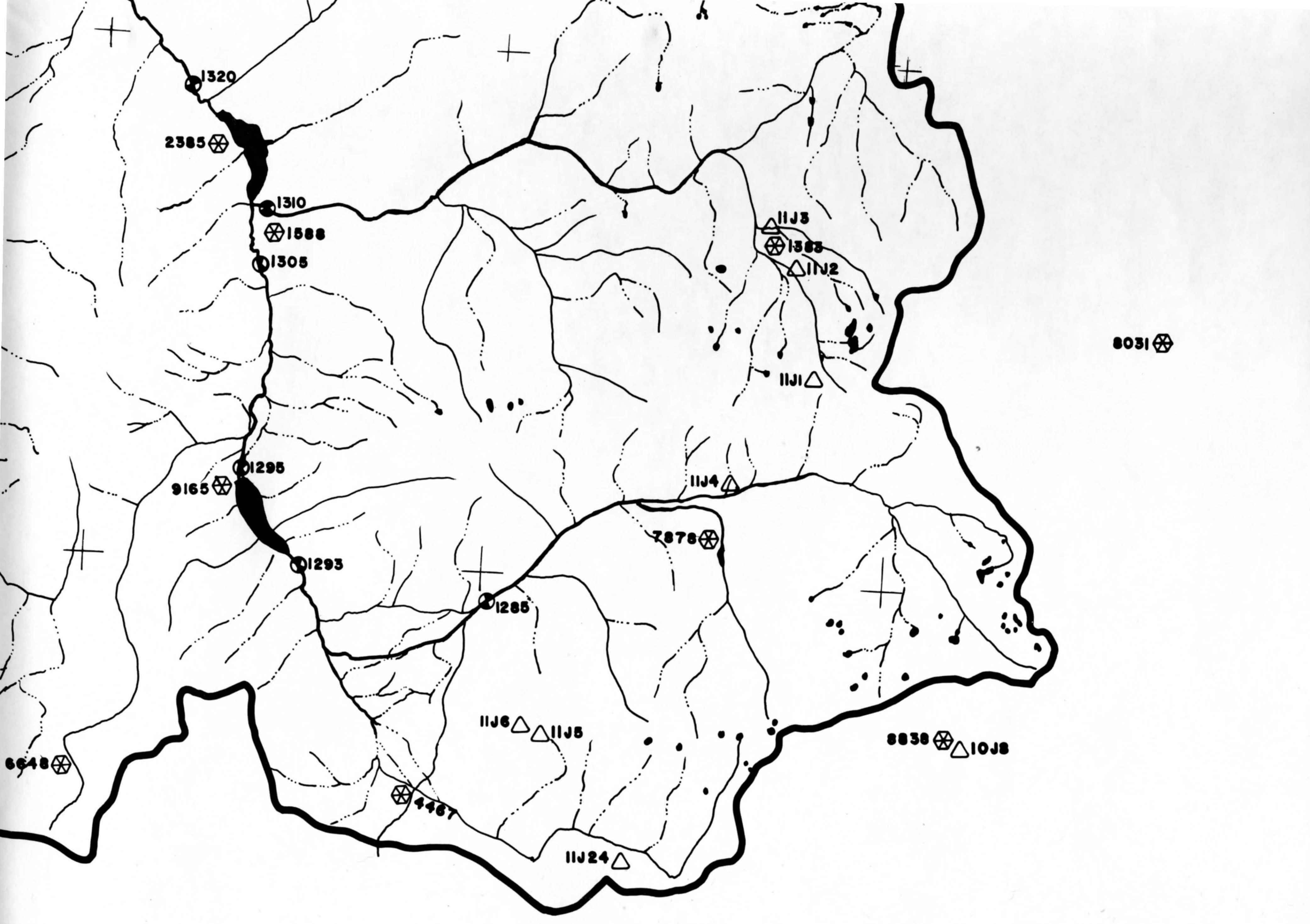
Knowing where temperature occurs is important, but knowing when temperature occurs is also important. Because temperature is dependent upon solar radiation, it can be expected that temperature will vary daily as the intensity of radiation varies from zero during the night to some maximum value during the daylight period. This variation will exhibit a periodic pattern except as altered by cloud cover or convection currents. Temperature will also vary seasonally as the angle of radiation changes with the earth's solar orbit. This variation will also exhibit some type of periodic pattern. No other true cycles of temperature change have been identified, although long-time changes in mean temperatures may occur as a result of man's activity upon the earth.

The seasonal or yearly change in temperature can be seen in the plots of mean monthly temperatures shown in Fig. 12. The curves are plotted from data collected at 13 stations within or near the study area. One can note that the curves are partly skewed with the minimum temperature occurring in January and the maximum in July or August. Shown also on the figure is the frequency with which temperatures will probably occur. The upper

Table 5. Precipitation and temperature measurement stations located in the Weber River study unit.

Station No.	Name of Stations	Elevation	Period of Record: Precipitation	Period of Record: Temperature
0072	Alta	8760	1960-61	
0497	Bear River Hyde Fork	10500	1947-63	
0603	Ben Lomond Power	5850	1955-68	
1222	Castle Rock	6445	1956-61	
1383	Chalk Creek 2	6335	1954-68	
1588	Coalville	5550	1908-68	1911-68
2243	Dry Breed Pond	8230	1955-68	
2294	East Canyon	5680	1955-68	
2385	Echo Dam	5500	1940-68	1943-68
2558	Enterprise	5330	1943-61	
2721	Farmington		1889-94	
			1900-68	1900-68
2722	Farmington R. S.	7450	1951-68	
2725	Farmington Rice	6800	1939-68	
4467	Kamas	6495	1951-68	1952-68
5115	Little Bear Upper	6550	1956-68	
5663	Mill Creek Ranger Station	8975	1955-68	
5826	Morgan	5070	1902-68	1915-68
6404	Ogden Pioneer P. H.	5564	1910-68	1892-68
6414	Ogden Sugar Factory	4280	1924-68	1930-68
6648	Park City	6970	1939-68	
6669	Parleys	7590	1952-68	
6869	Pineview Dam	4940	1913-68	1936-68
7318	Riverdale P. H.	4390	1914-68	1923-68
7499	Sagebrush Flat	6300	1956-68	
7846	Silver Lake	8740	1916-68	1937-68
7878	Smith & Morehouse	7600	1954-68	
7924	Snow Basin	6420	1958-62	
8031	Stillwater Camp	8550	1955-68	
8838	Trial Lake	9800	1952-68	
8885	Uinta	4830	1940-60	
9165	Wanship Dam	5950	1955-68	1955-68


1420
11J12
2721
2722
11J11
1350
1425
1430
1435
1345
2294
1440
Bountiful
1450
5663
6669
NJ15
11J14
7846
0072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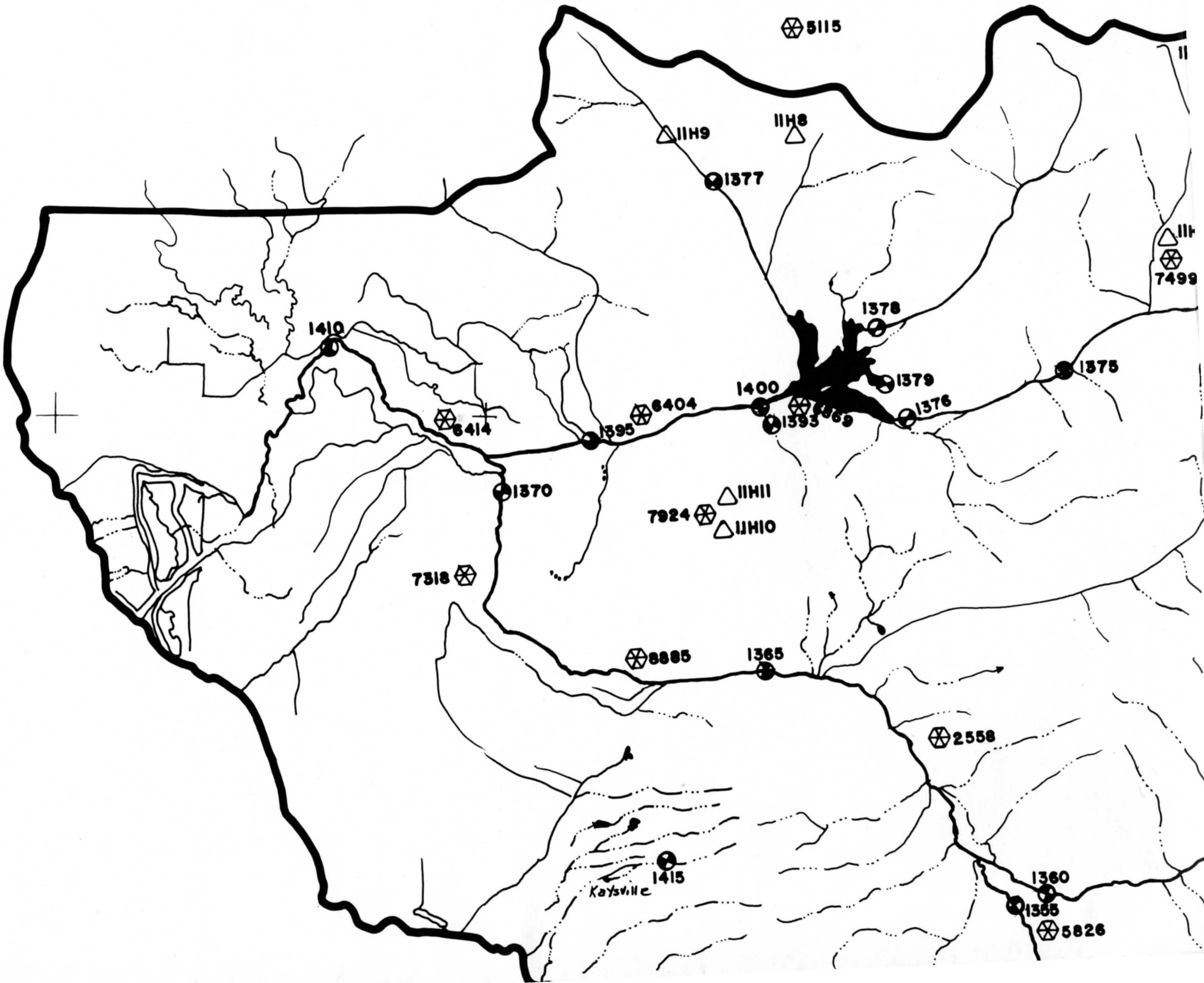
2385
1310
1588
1305
11J3
1383
11J2
11J1
8031
1295
9165
11J4
7878
1293
1285
11J6
11J5
8838
10J8
6648
4467
11J24

11 H12
H14
11H13
2243
15
1325
1335
1330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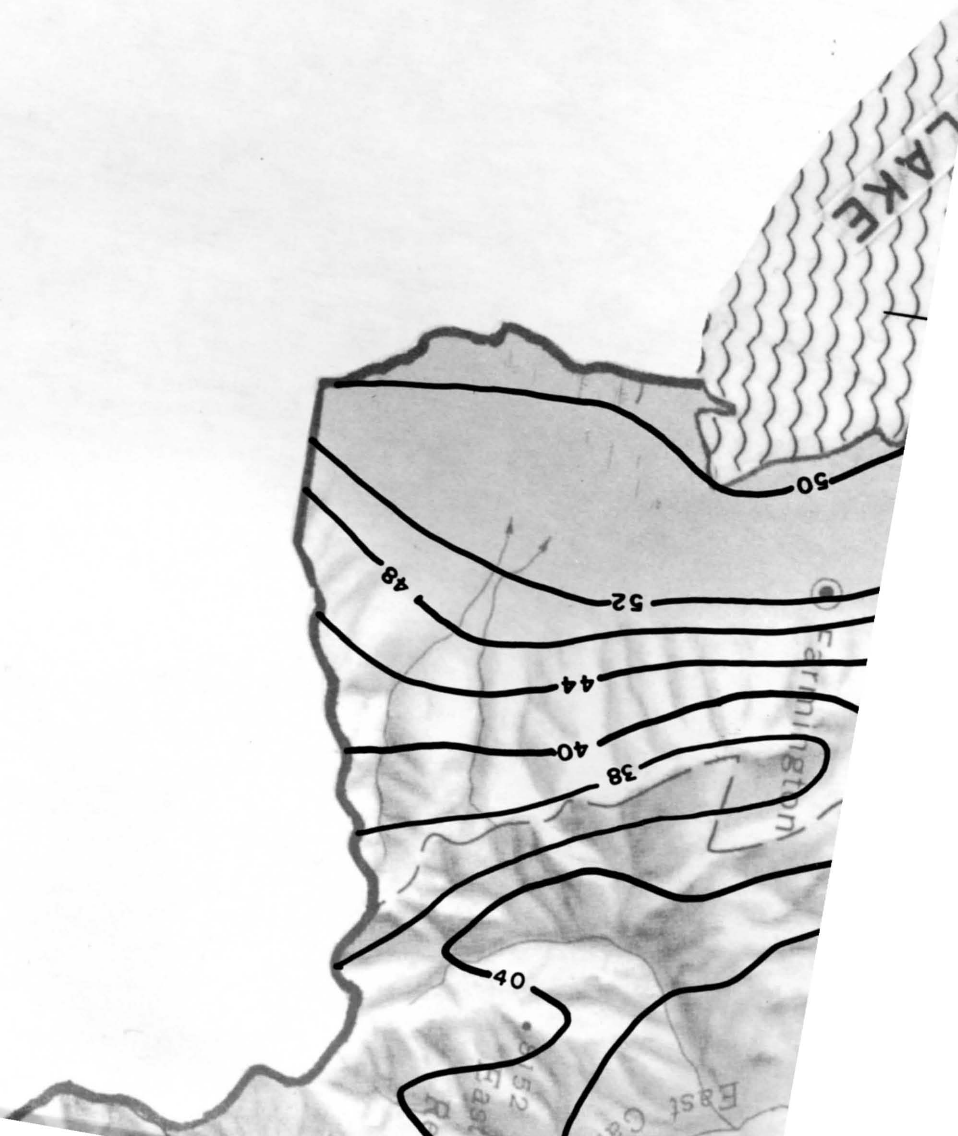
11H9
11H8
1377
7499
1378
1375
1379
1400
6404
1376
1393
1410
6414
1395
1370
11H11
7924
11H10
7318
8885
1365
2558
1415
Kaysville
1360
1355
5826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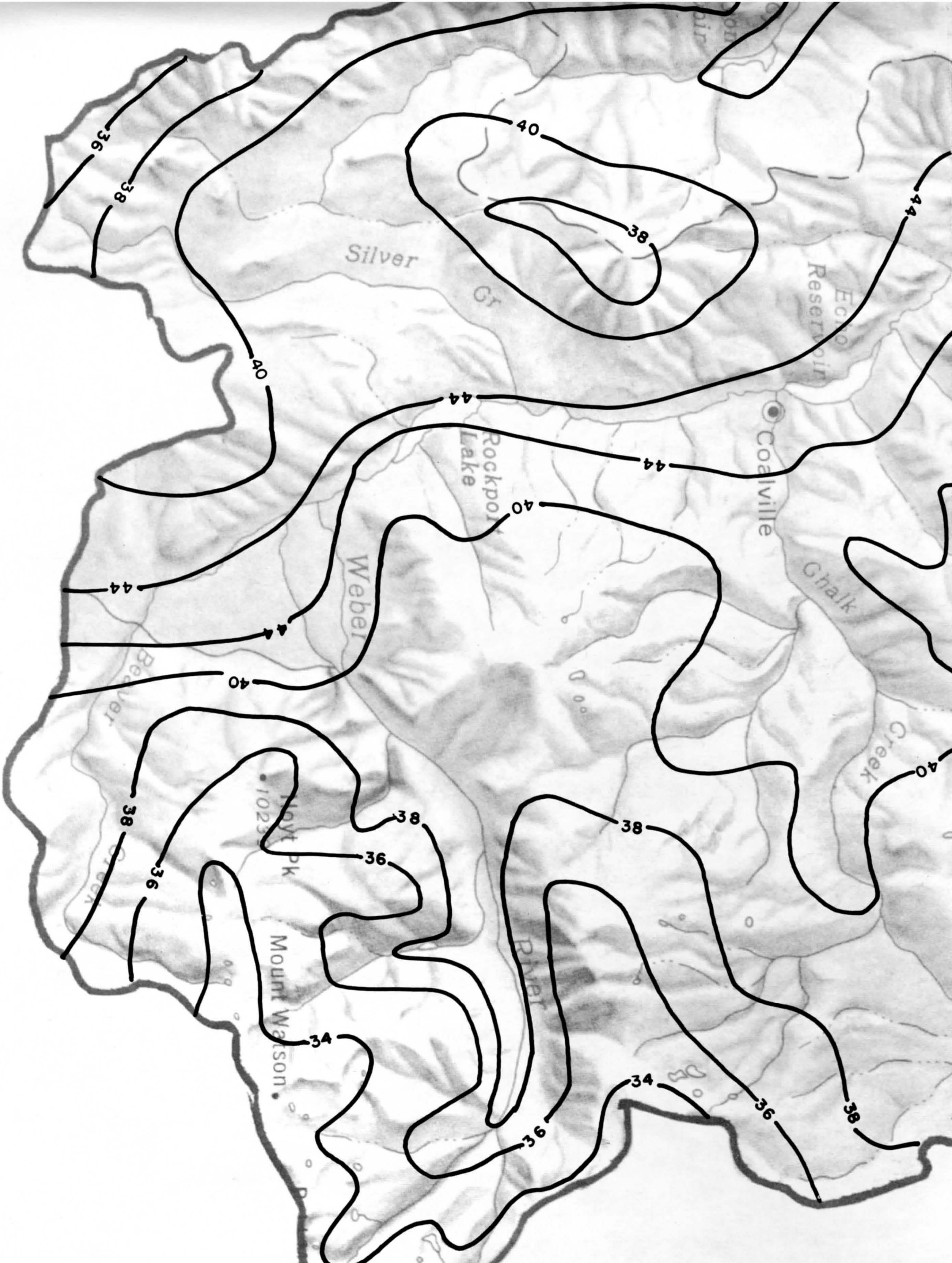
48
52
44
40
38
40
Farmington



Silver
Cr
Echo
Reservoir
Coalville
Rockport
Lake
Weber
River
Chalk
Creek
Beaver
Mount Watson
36
38
40
44
34

9275
Echo
Canyon
Creek
Fork
River
40
38
44


40
44
38
48
Br
Willard Peak
N Fk
Res
R
Ogden
OGDEN
Weber
36
52
50
Weber R
Salt Flats
4673
Mud
Flats
GREAT
SALT

Table 6. **Snow measurement stations located in or near to the Weber River study unit.**

Station No.	Name of Snow Course	Elevation	Period of Record
11H14	Beaver Cr. - Skunk Cr.	7150	1952-1968
11H 8	Ben Lomond Peak	8000	1951-1968
11H 9	Ben Lomond (lower)	5850	1954-1968
11H13	Dry Bread Pond	8230	1936-1968
11H12	Monte Cristo R. S.	8960	1930-1933, 1936-1968
11H10	Mt. Ogden	8600	1948-1968
11H15	Sagebrush Flat	6300	1953-1968
11H11	Snow Basin	6420	1942-1968
11J24	Beaver Cr. R. S.	7500	1931-1968
11J 1	Chalk Cr. No. 1	9100	1951-1968
11J 2	Chalk Cr. No. 2	8000	1951-1968
11J 3	Chalk Cr. No. 3	7500	1952-1968
11J12	Farmington Canyon (lower)	6950	1951-1968
11J11	Farmington Canyon (upper)	8000	1951-1968
11J14	Lamb's Canyon	6600	1935-1968
11J15	Parley's Canyon Summit	7600	1934-1968
11J 6	Redden Mine (lower)	8500	1930-1968
11J 5	Redden Mine (upper)	9000	1930-1968
11J16	Silver Lake Brighton	8725	1931-1968
11J 4	Smith and Morehouse	7600	1929-1968
10J 8	Trial Lake	9800	1931-1968

values, labeled 2.5, are the probable mean monthly temperatures, which will reoccur or be exceeded five times in every 200-year period. The lower values, labeled 97.5, are the probable temperatures which will reoccur or be exceeded 195 times in every 200-year period. It is to be noted that the variation in probable monthly temperatures is smallest for the month of July and largest for the month of January.

Mean annual temperatures for the 13 meteorological stations within or near the study unit are shown in Fig. 13 along with the associated frequency of occurrence distribution. The stations have been graphically ranked from left to right in order of increasing altitude, showing the inverse relationship of temperature and elevation.

Precipitation

Precipitation is the only source of water to replenish the supply on a given watershed. It is therefore important to know how this supply is distributed geographically throughout the watershed. It is also important to understand variations that occur with time and the probability factors associated with these variations.

Precipitation occurs when a saturated air mass moves into the hydrologic area and is cooled so that condensation can occur. Since the air at high elevations is generally cooler than the air near the land surface, it is to be expected that when the high mountain ranges deflect the moving air mass upward to cooler elevations, the greater mean annual precipitation would occur near the mountain peaks. In the Weber River study unit the mean annual precipitation ranges from 12 inches to near 50 inches with only 20 lateral miles separating these extremes.

The U.S. Weather Bureau (now the Environmental Sciences Service Administration, ESSA) has prepared isohyetal maps which portray the areal distribution of precipitation in the State of Utah. Isohyetal maps have been developed for normal annual precipitation, normal October-April precipitation, and normal May-September precipitation. The time base used in computing normals was 1931-1960, which corresponds with the time base presently being used by the World Meteorological Organization (WMO). From the isohyetal maps for the State of Utah, normal annual precipitation maps have been prepared for the Weber River study unit as shown in Fig. 14. The mean annual precipitation on the Weber River study unit amounts to 2,960,000 acre feet. Of this amount, less than 10 percent falls on the area below 5,000 feet elevation and only 16 percent falls on the area which drains into Ogden River. Nearly 75 percent of all the precipitation within the study area falls on land drained by the Weber River above the gaging station at Gateway near the mouth of Weber Canyon. From the published annual, October-April, and May-September isohyetal maps, the precipitation falling on each hydrologic subarea was determined. These values are shown in Table 7 for each subarea.

To display the variation of precipitation with time, the rainfall records from 10 weather stations in or near the Weber River study unit were analyzed. Fig. 15 illustrates the variation that occurs throughout the year and also the probable variation for each month of the year. The heavy line (50 percent probability) near the center of each of the series of bars represents the amount of precipitation occurring for that month one-half of the time, i.e., half of the years will have less than this amount of precipitation. The 5 percent bar indicates the amount of precipitation which will be exceeded 5 years (on the average) in a 100 year period. The 10, 25, 75, 90, and 95 percent bars also represent the amounts of precipitation that will probably be equaled or exceeded in the time period represented by the indicated level of probability.

Fig. 16 shows the frequency distribution of mean annual precipitation for the 10 weather stations. It should be noted that the annual precipitation at any level of probability shown on the figure bears no relationship to the sum of the mean monthly precipitation at the same probability level shown on the previous tables.

Before estimates of probable occurrence of any event can be obtained, it is necessary to determine the nature or kind of mathematical function which best fits the frequency distribution of the data. Often, because the data available are insufficient to determine the precise nature of the frequency distribution function, a "normalcy" must be assumed. In this study the monthly precipitation values of several stations were plotted on normal probability paper. The plots showed clearly that another distribution function which more nearly fits the data should be used. The incomplete gamma distribution function was selected because it characterizes a distribution function which contains zero values, as rainfall does on a weekly or monthly basis. To check the validity of fitting the precipitation data to the incomplete gamma distribution function, the rainfall was ranked and the results were compared to the results obtained from the assumed distribution. In almost all cases the results were very nearly alike.

The monthly distribution of precipitation as shown in Table 8 was obtained by proportioning the total precipitation as determined by the isohyetal maps on the basis of monthly precipitation records available in each subarea. Precipitation stations were chosen and weighted so as to give, in the judgment of the writers, a good representation of the area. Any change in the isohyetal maps would have to be reflected in similar changes in the table.

Table 7. Average precipitation falling on subareas within the Weber River study unit.

Subarea No.	Size Sq. Miles	Mean Annual Prec. Ac-ft.	Mean Annual Prec. Inches	October to April Ac-ft.	October to April Inches	May to Sept. Ac-ft.	May to Sept. Inches
1	163	280,970	32.32	187,520	21.57	93,450	10.75
2	268	311,160	21.77	210,540	14.73	100,620	7.04
3	253	282,150	20.91	188,370	13.96	93,780	6.95
4	280	280,750	18.80	182,630	12.23	98,120	6.57
5	228	240,890	19.81	157,710	12.97	83,180	6.84
6	155	217,990	26.37	158,970	19.23	59,020	7.14
7	300	421,440	26.34	310,080	19.38	111,360	6.96
8	310	402,920	24.37	296,280	17.92	106,640	6.45
9	505	525,200	19.50	370,870	13.77	154,330	5.73
TOTAL	2,462	2,963,470	22.57	2,062,970	15.71	900,500	6.86

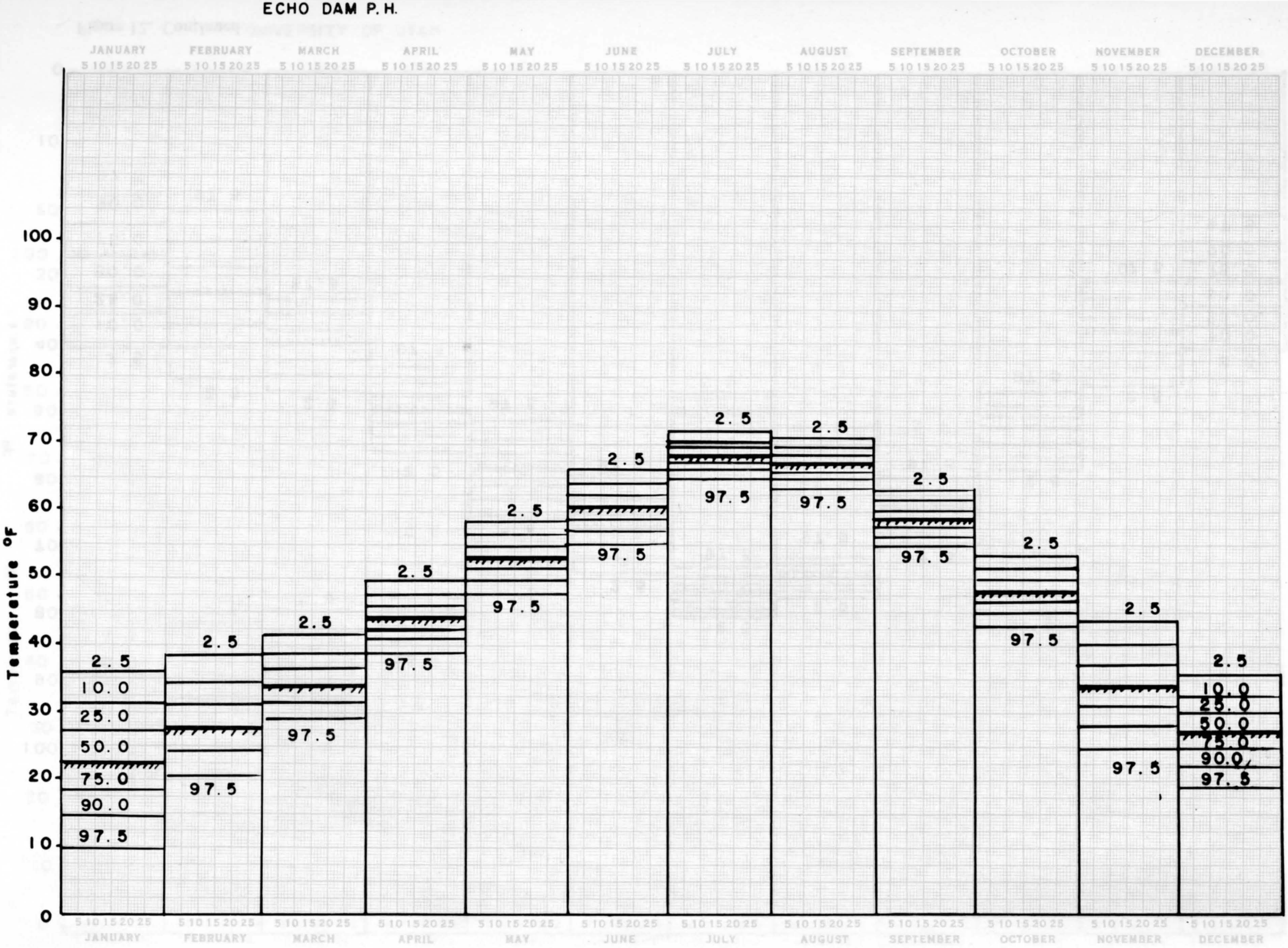
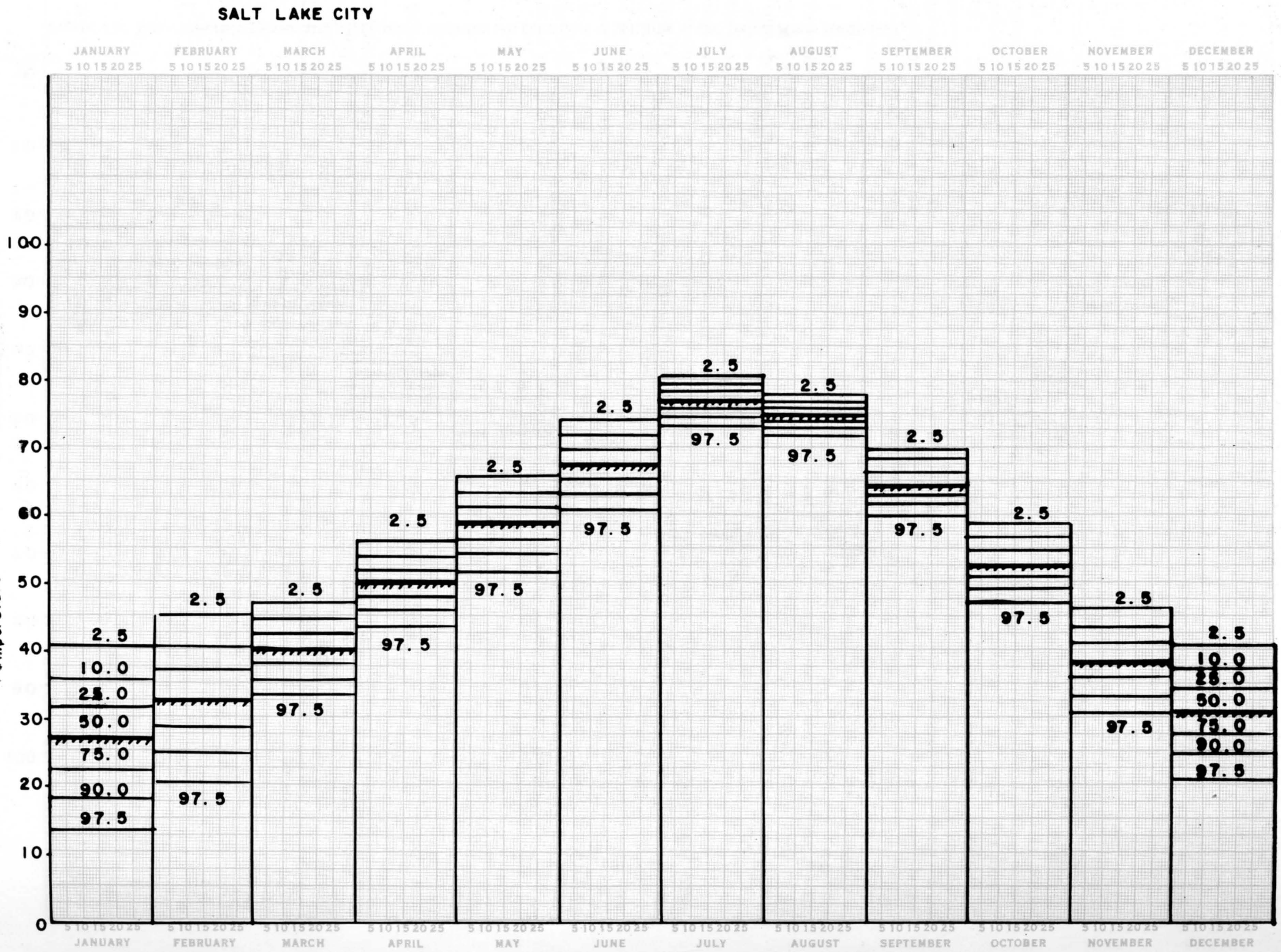


Figure 12. Mean monthly temperature frequency distribution for selected stations in the Weber River study unit.



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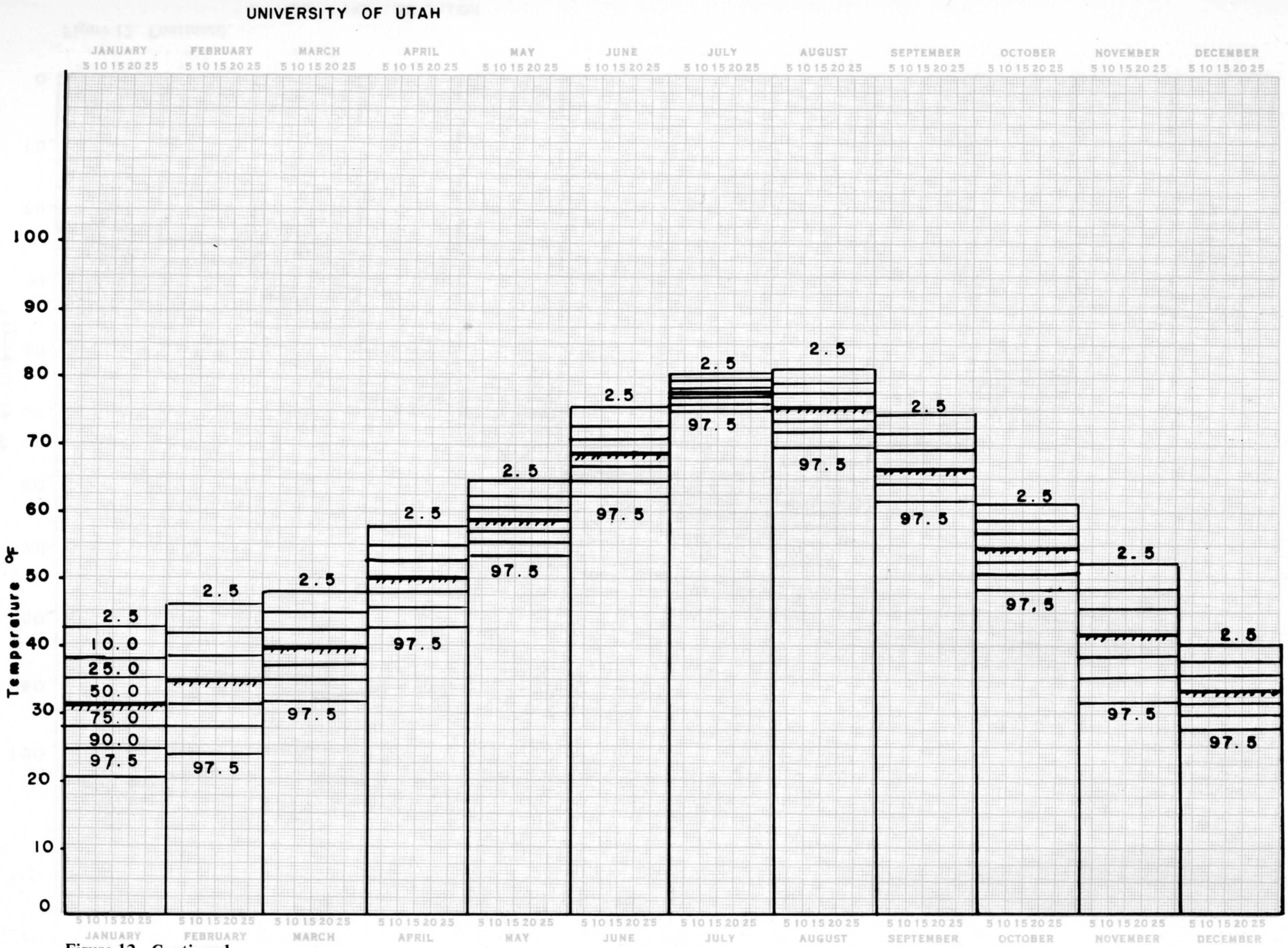

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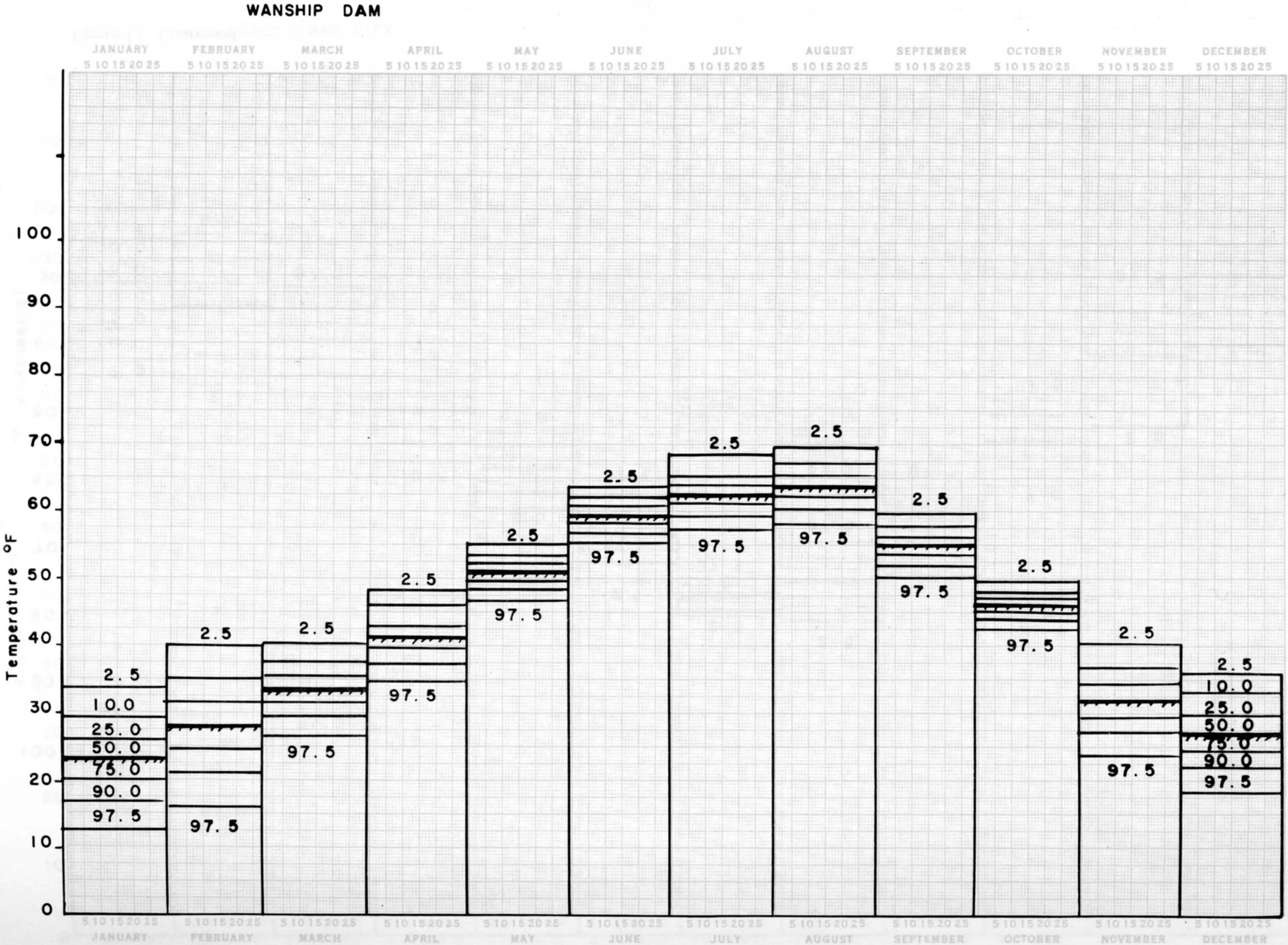


Figure 12. Continued.

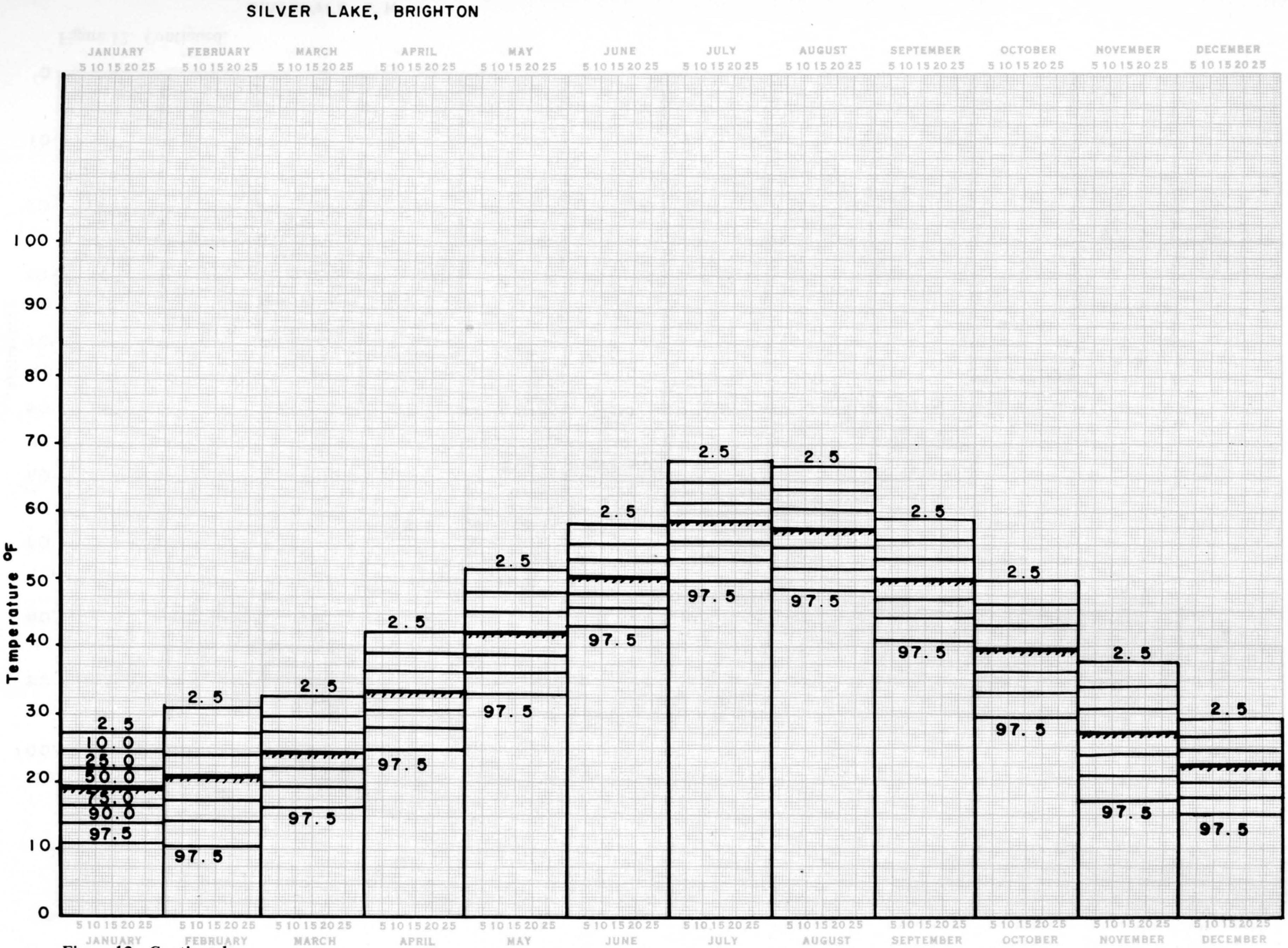


Figure 12. Continued.

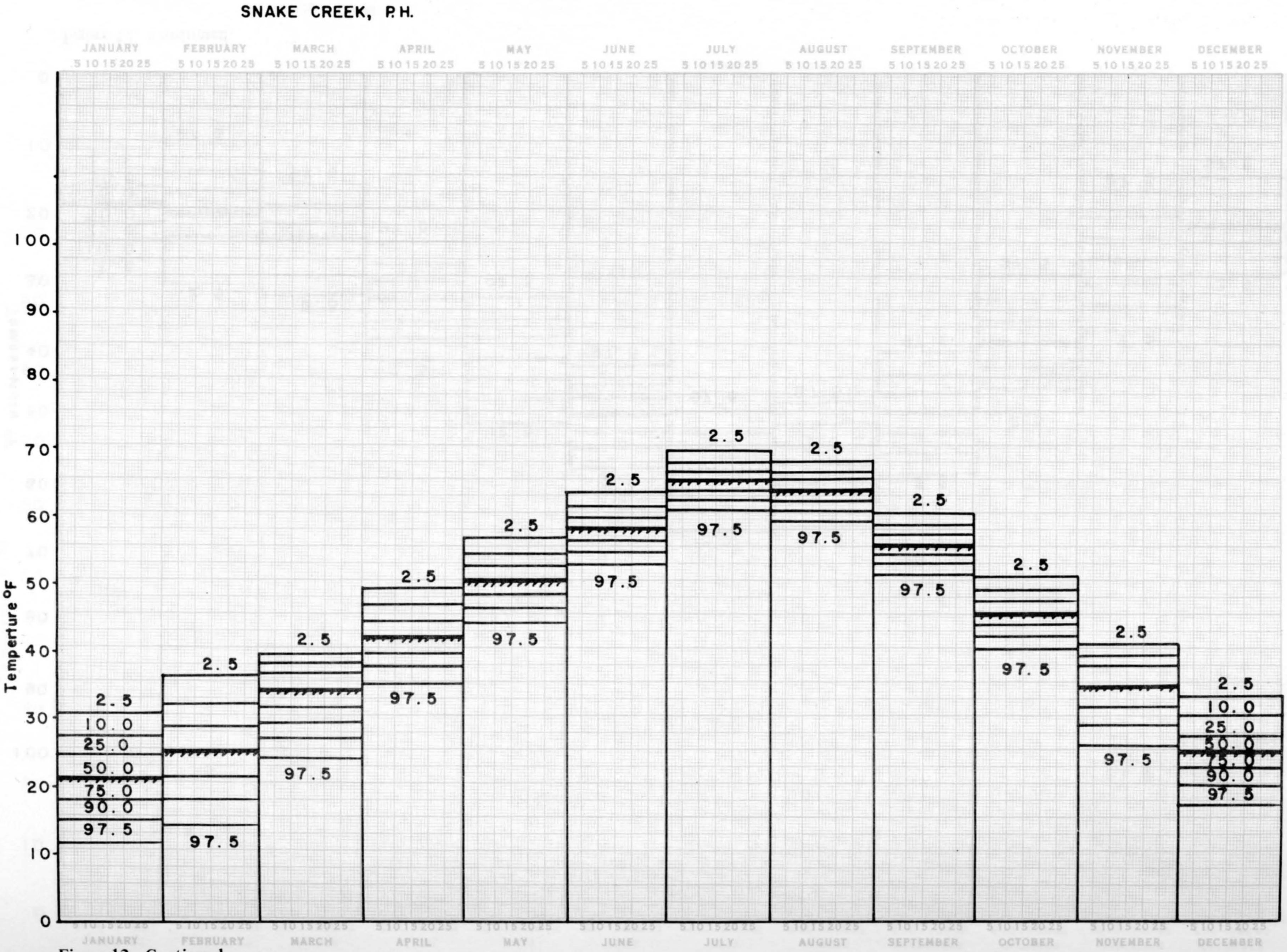
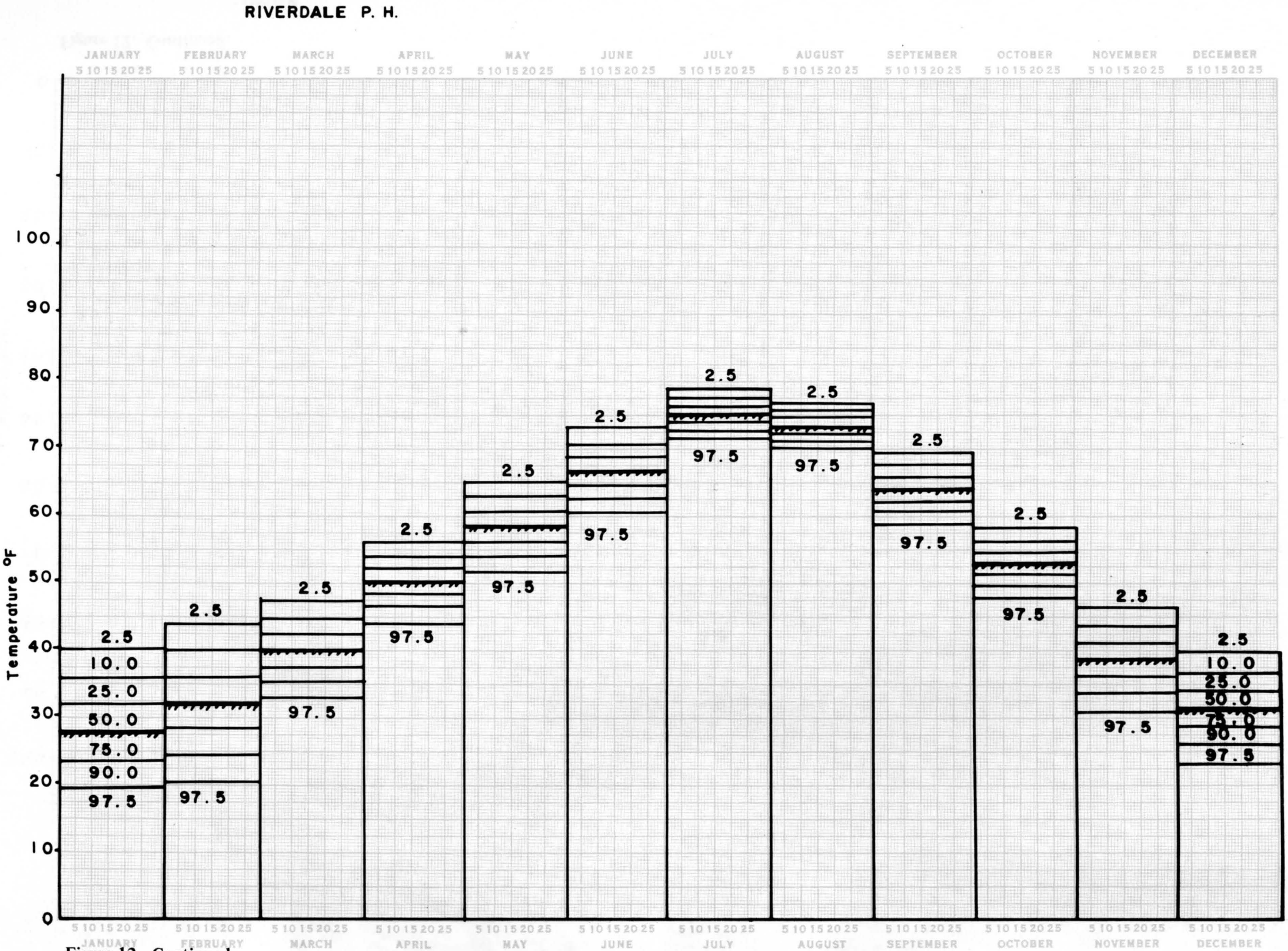


Figure 12. Continued.



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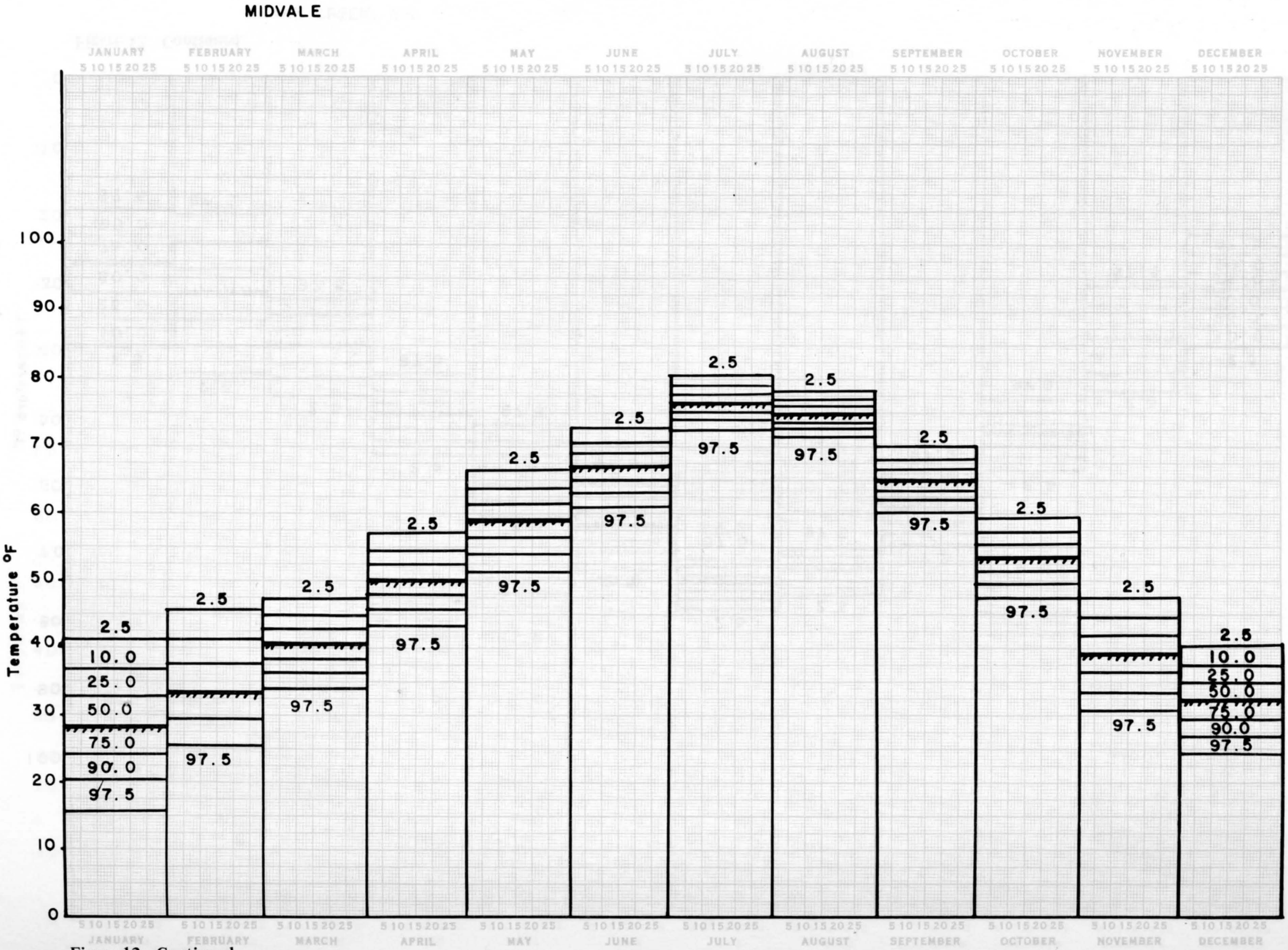

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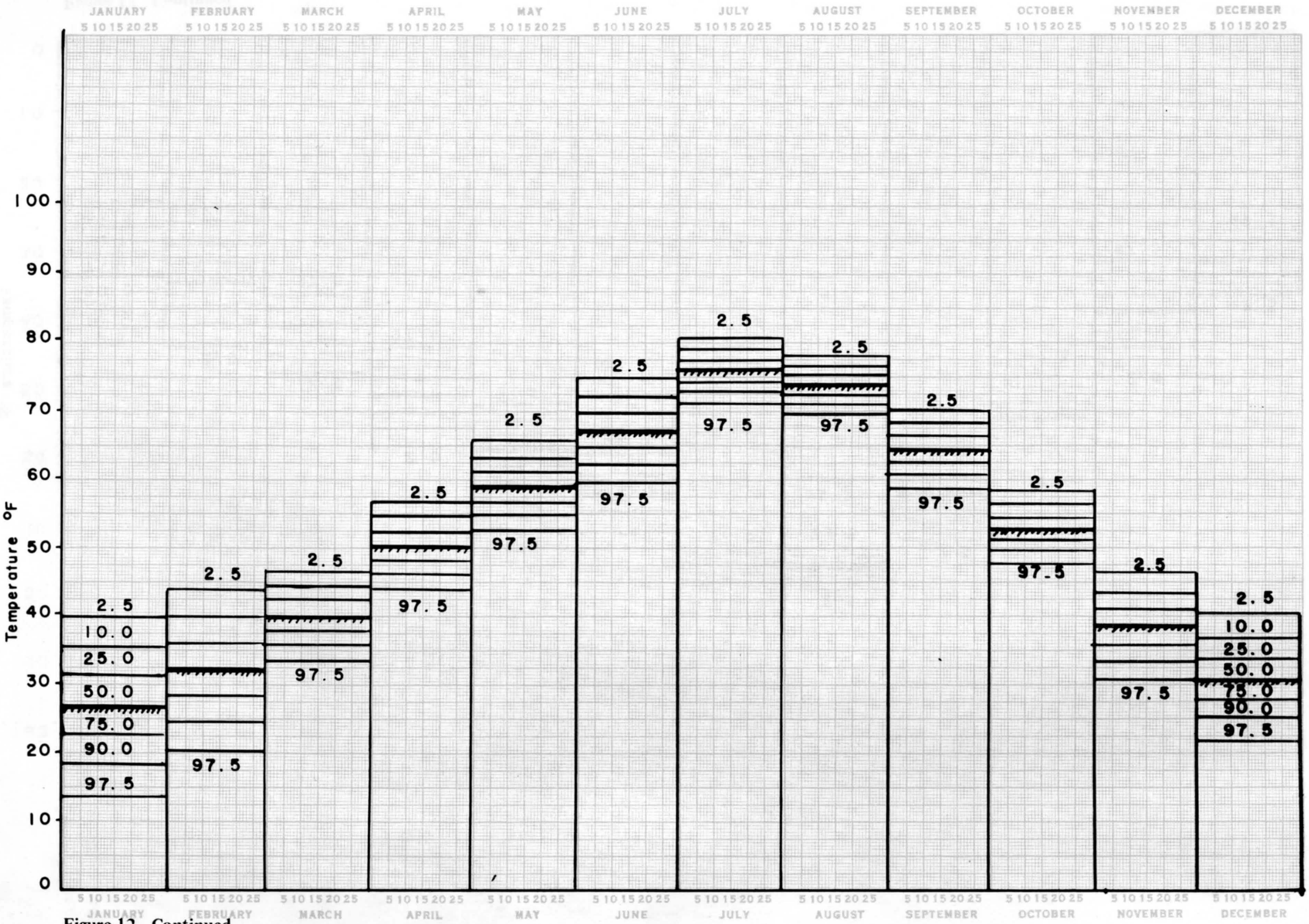
OGDEN



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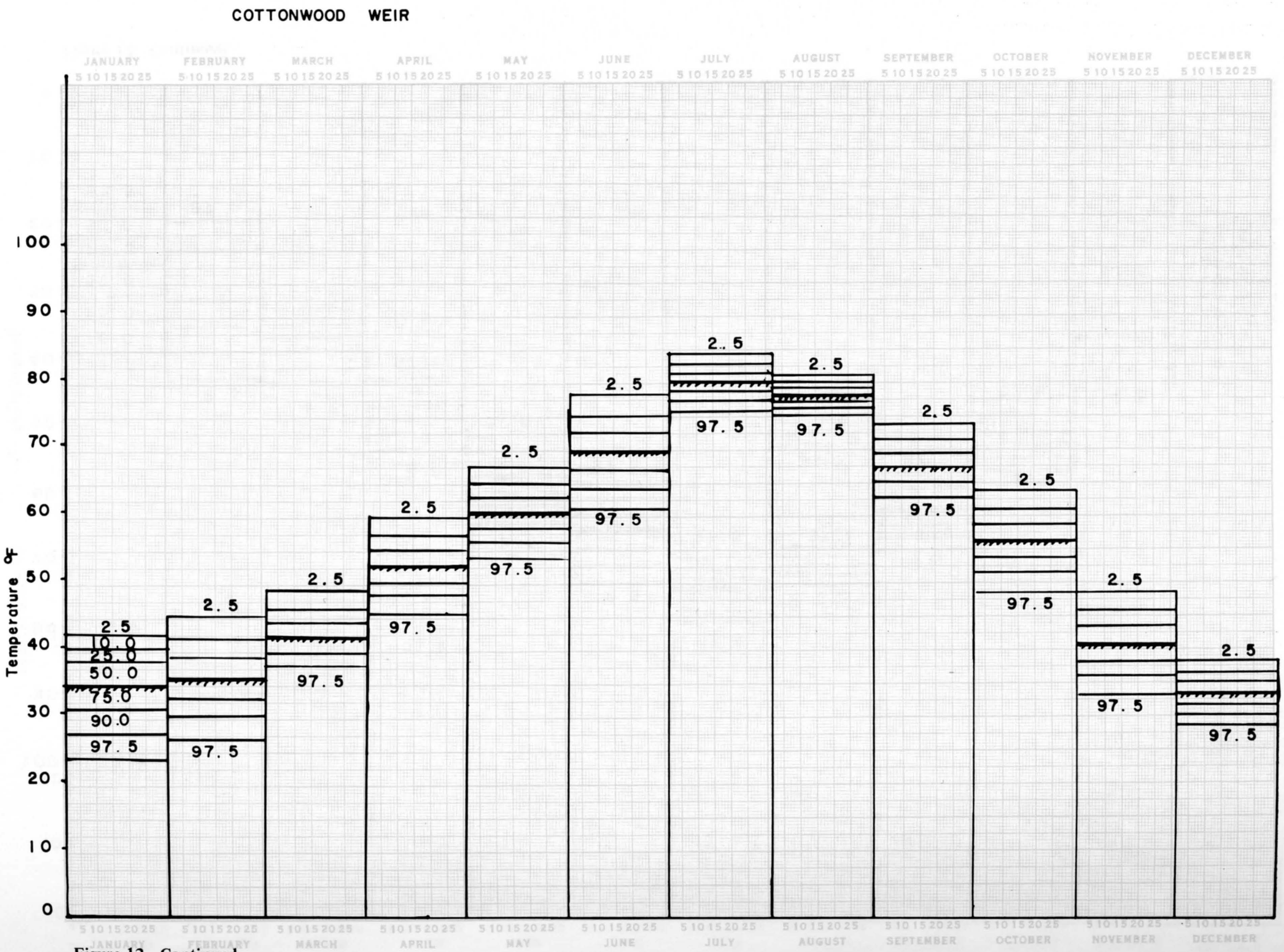

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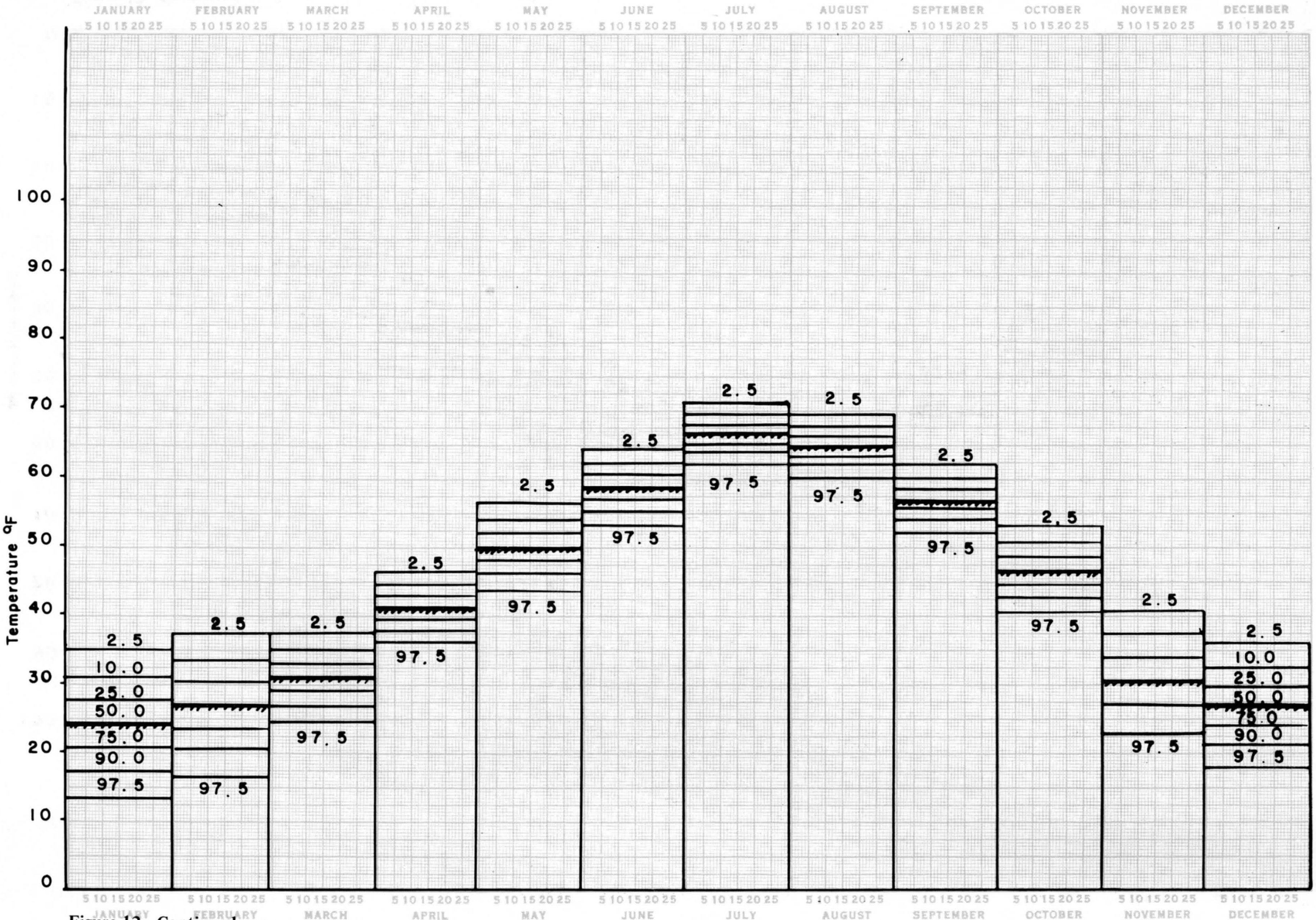
KAMAS



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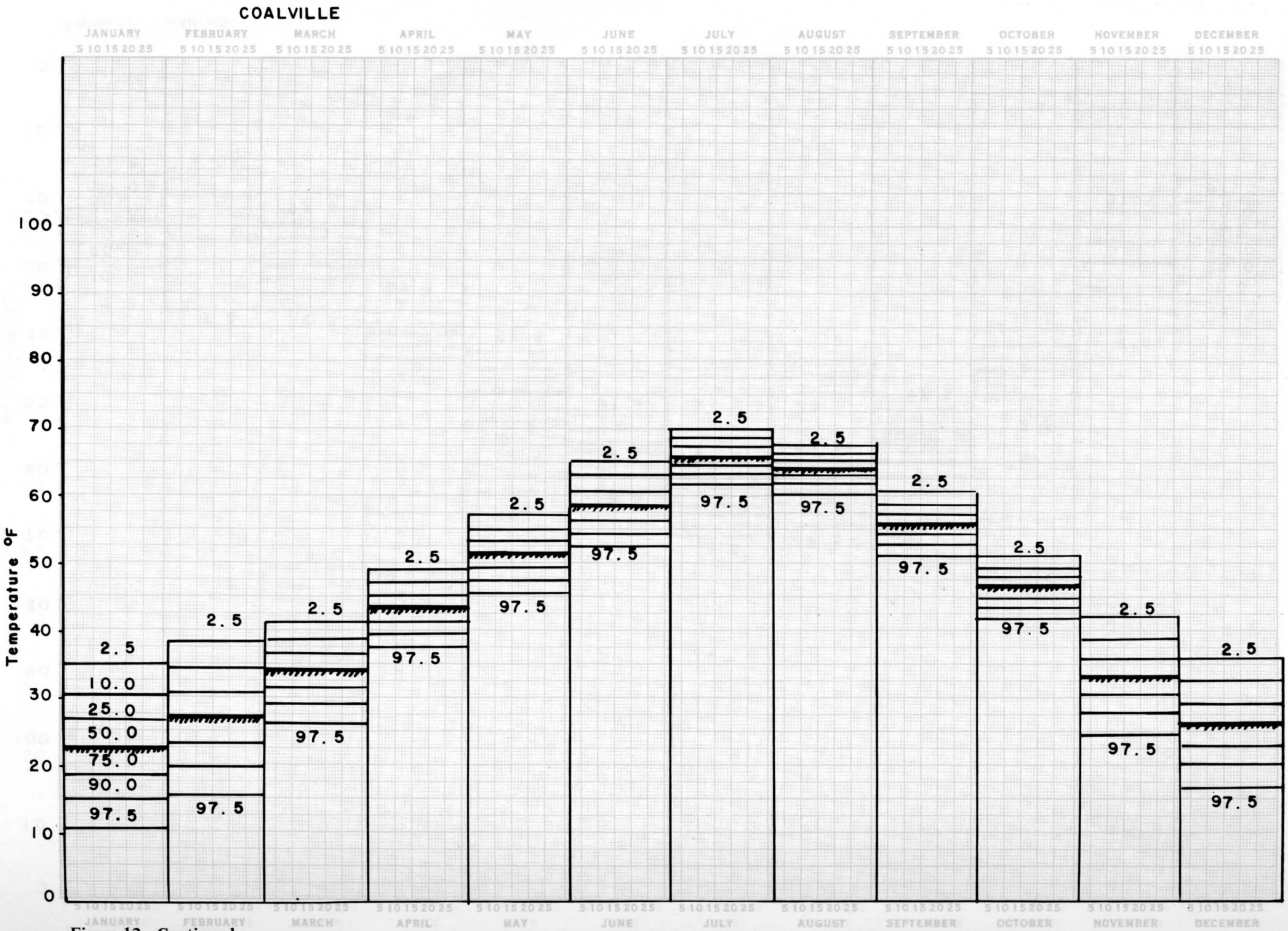

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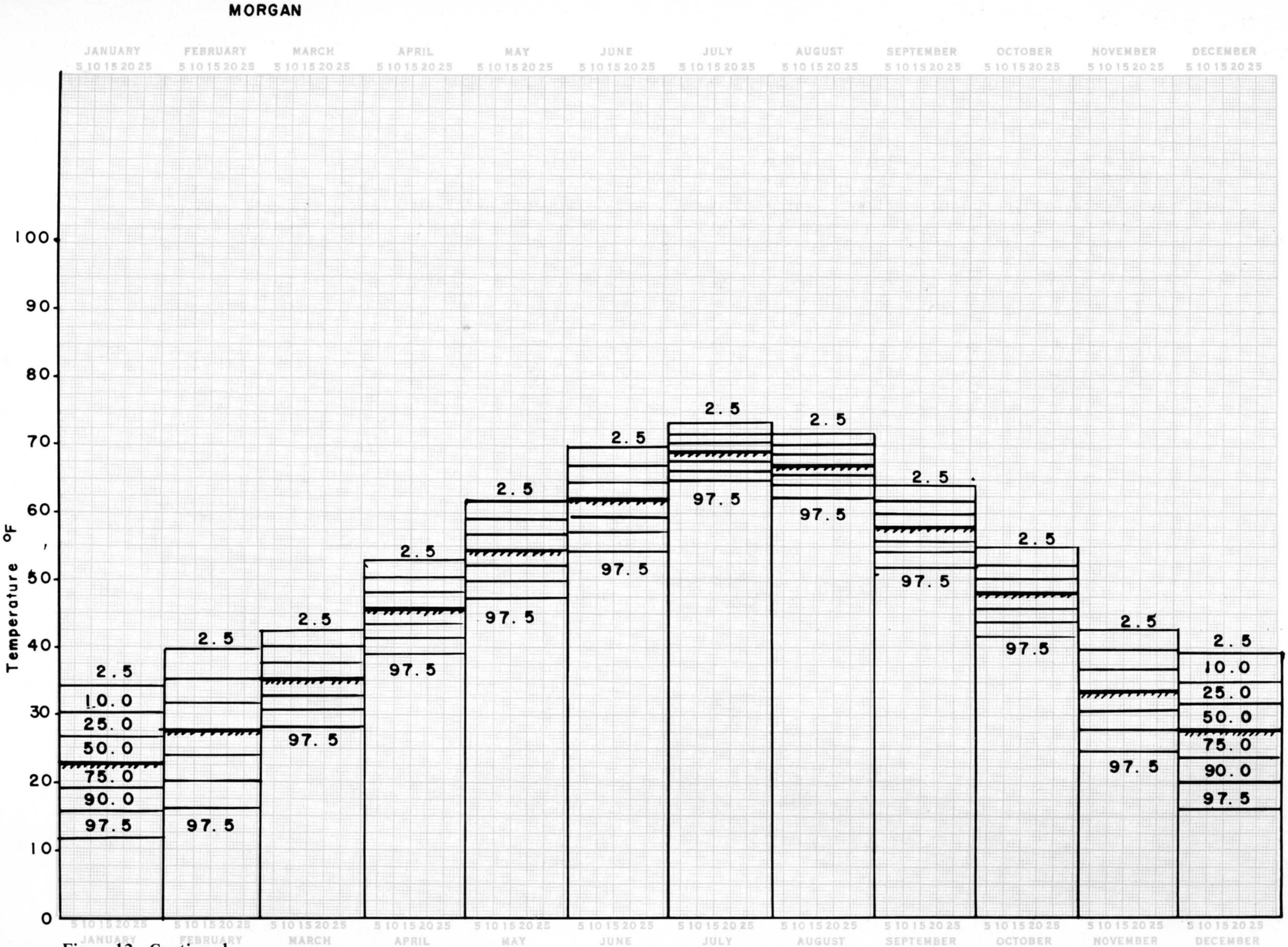

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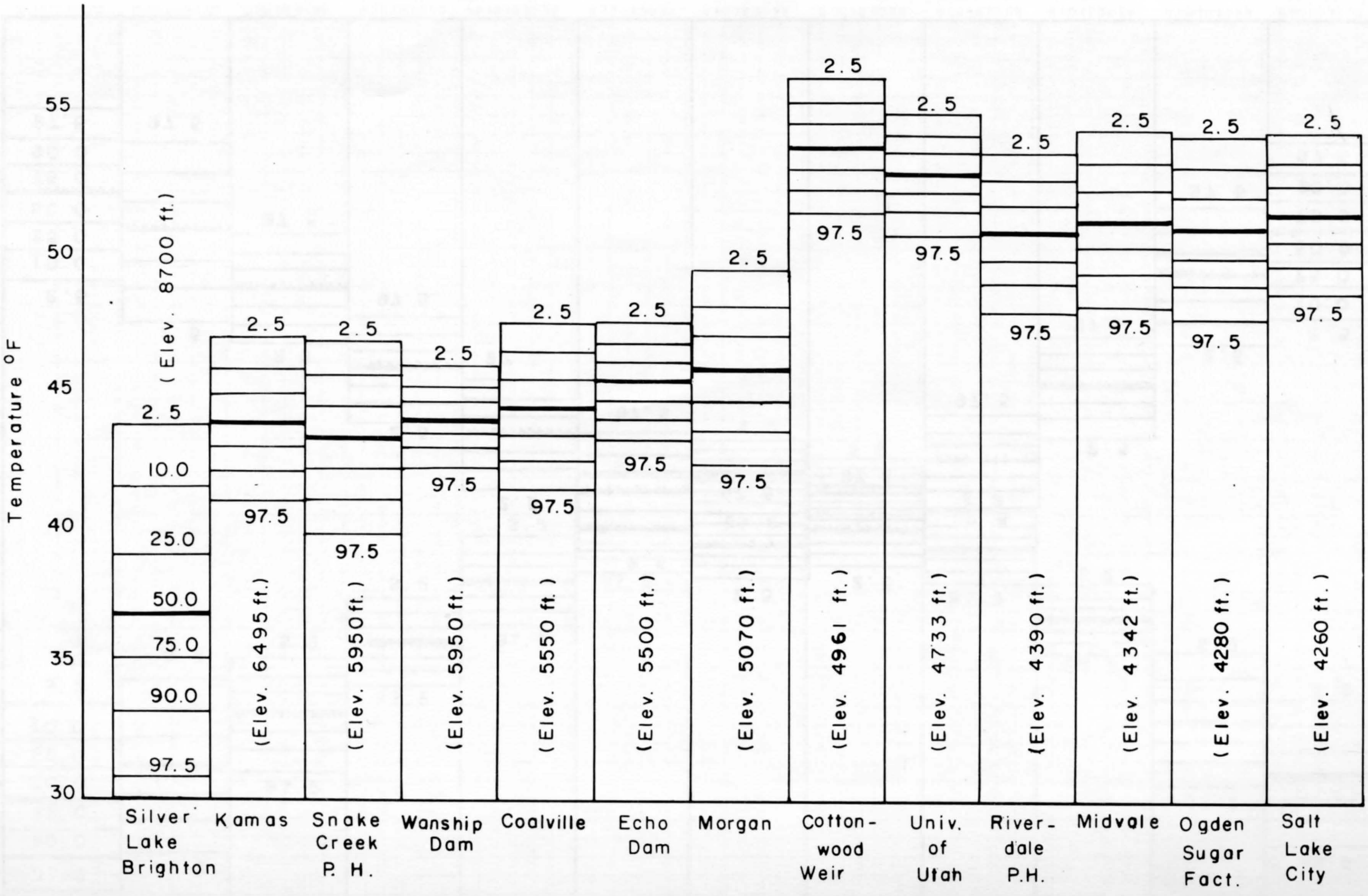
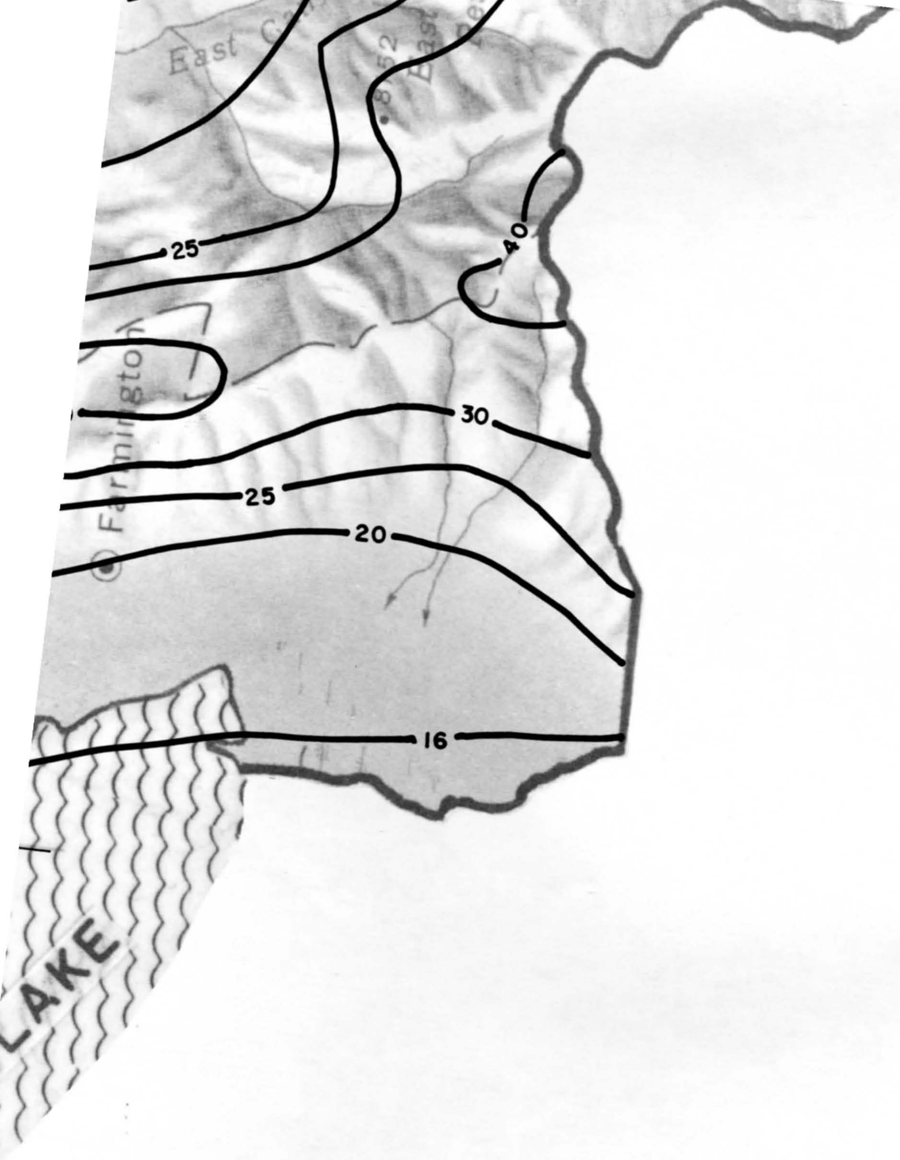
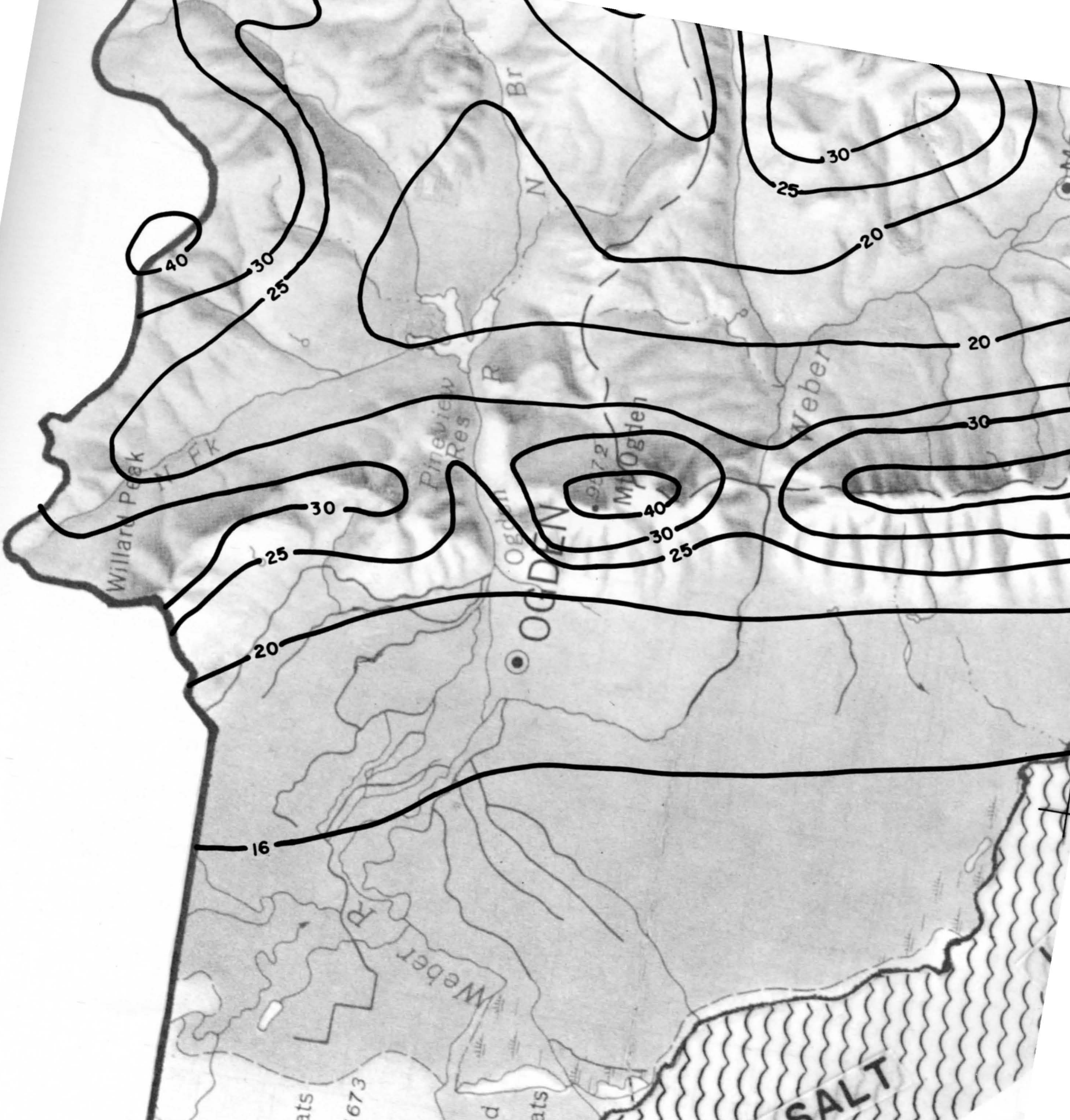


Figure 13. Mean annual temperature frequency distribution for selected stations in the Weber River study unit.


East
25
40
Farmington
30
25
20
16
LAKE


Silver
Gr
Echo
Reservoir
Rockport
Lake
Coalville
Weber
Chalk
Creek
Beaver
Creek
Hoyt Pk
10239
Mount Watson
River
40
30
25
20
16


River
Lost Creek
Echo Canyon
9275
8308
16
20
25
30



40
30
25
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16
Br
N
Willard Peak
N Fk
Pineview Res
R
Ogden
9572
Mt Ogden
OGDEN
Weber
Weber R
Salt Flats
4673
Mud Flats
GREAT
SALT

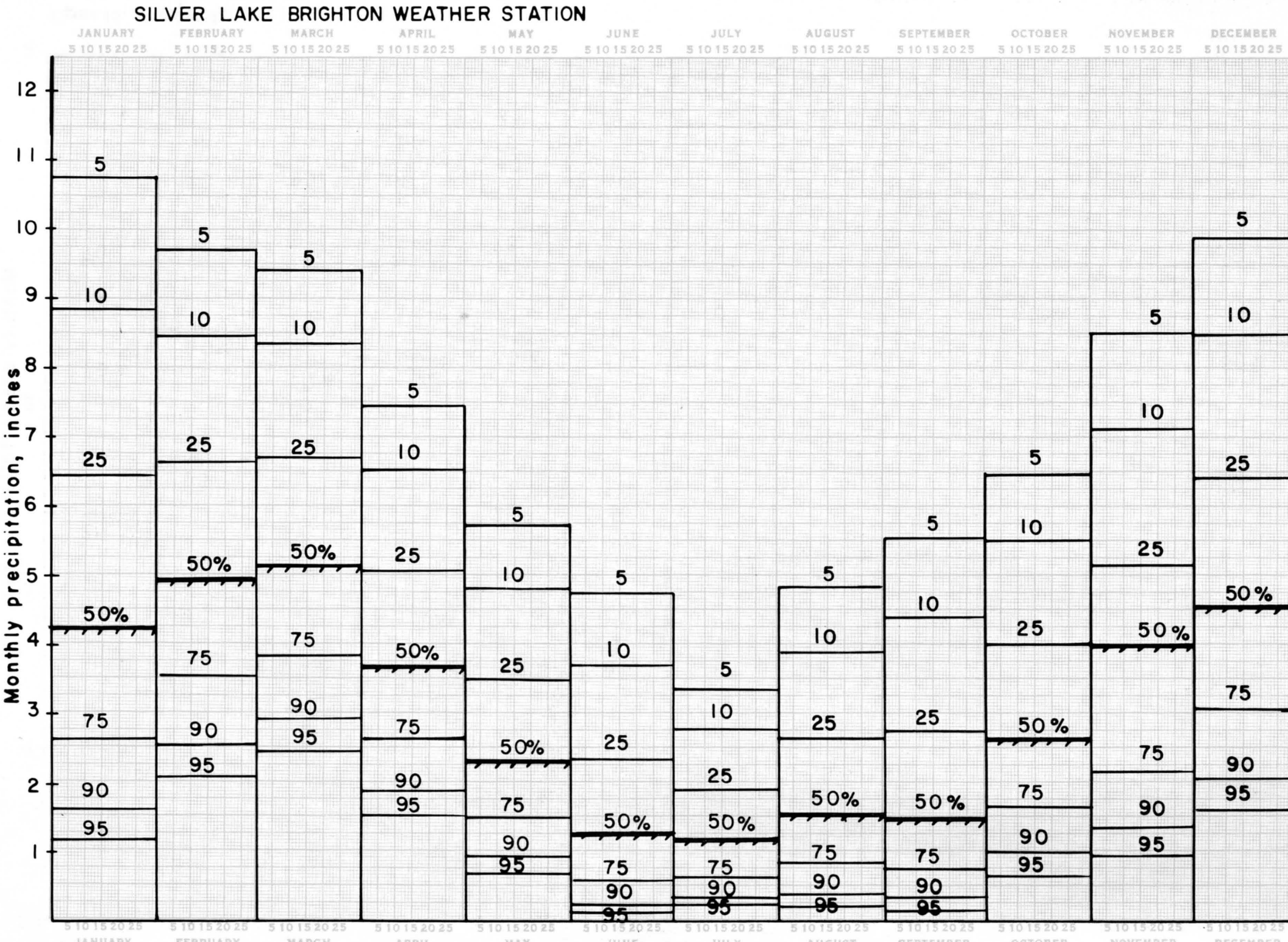
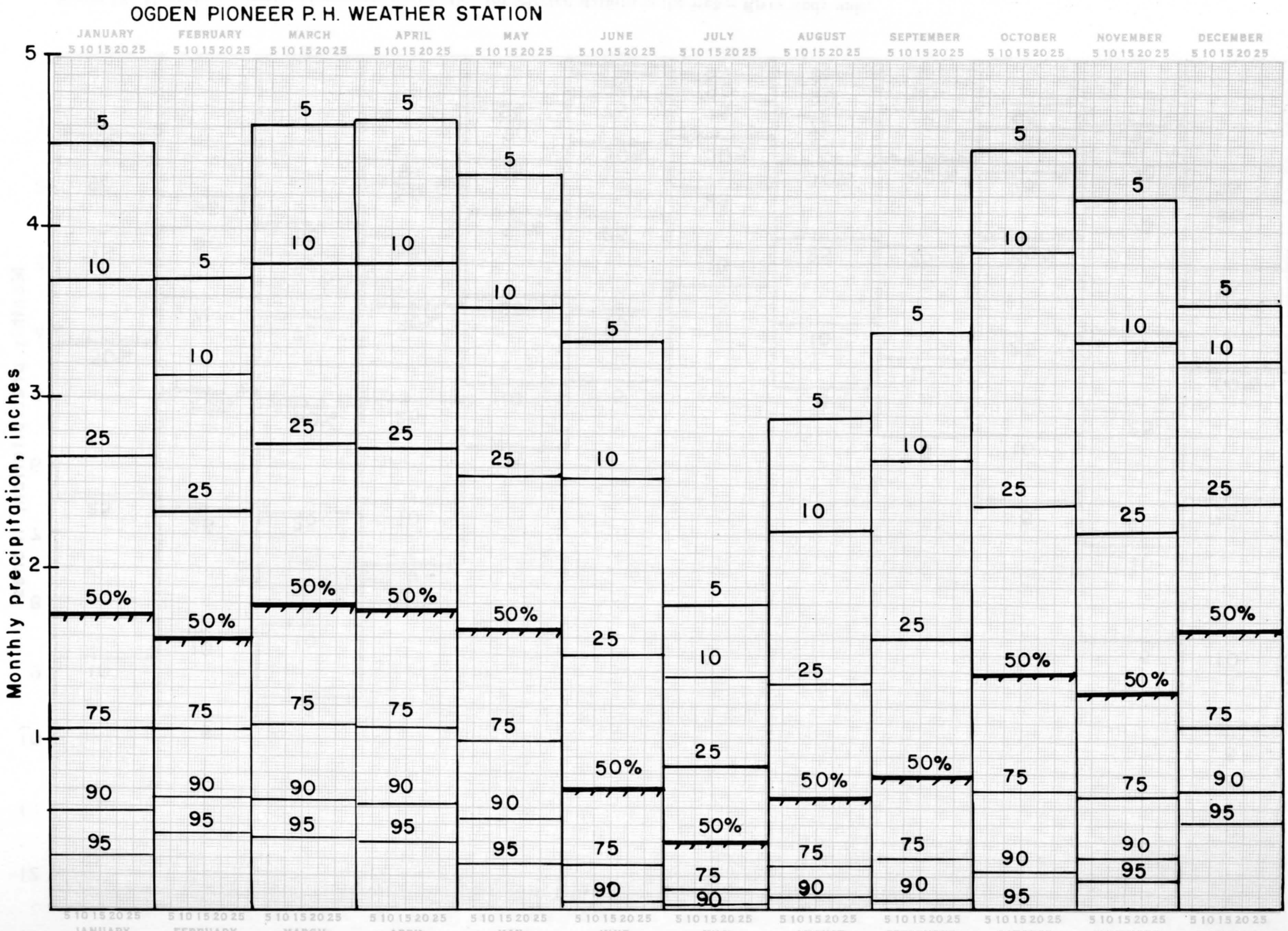


Figure 15. Monthly precipiation frequency distribution for selected stations in the Weber River study unit.



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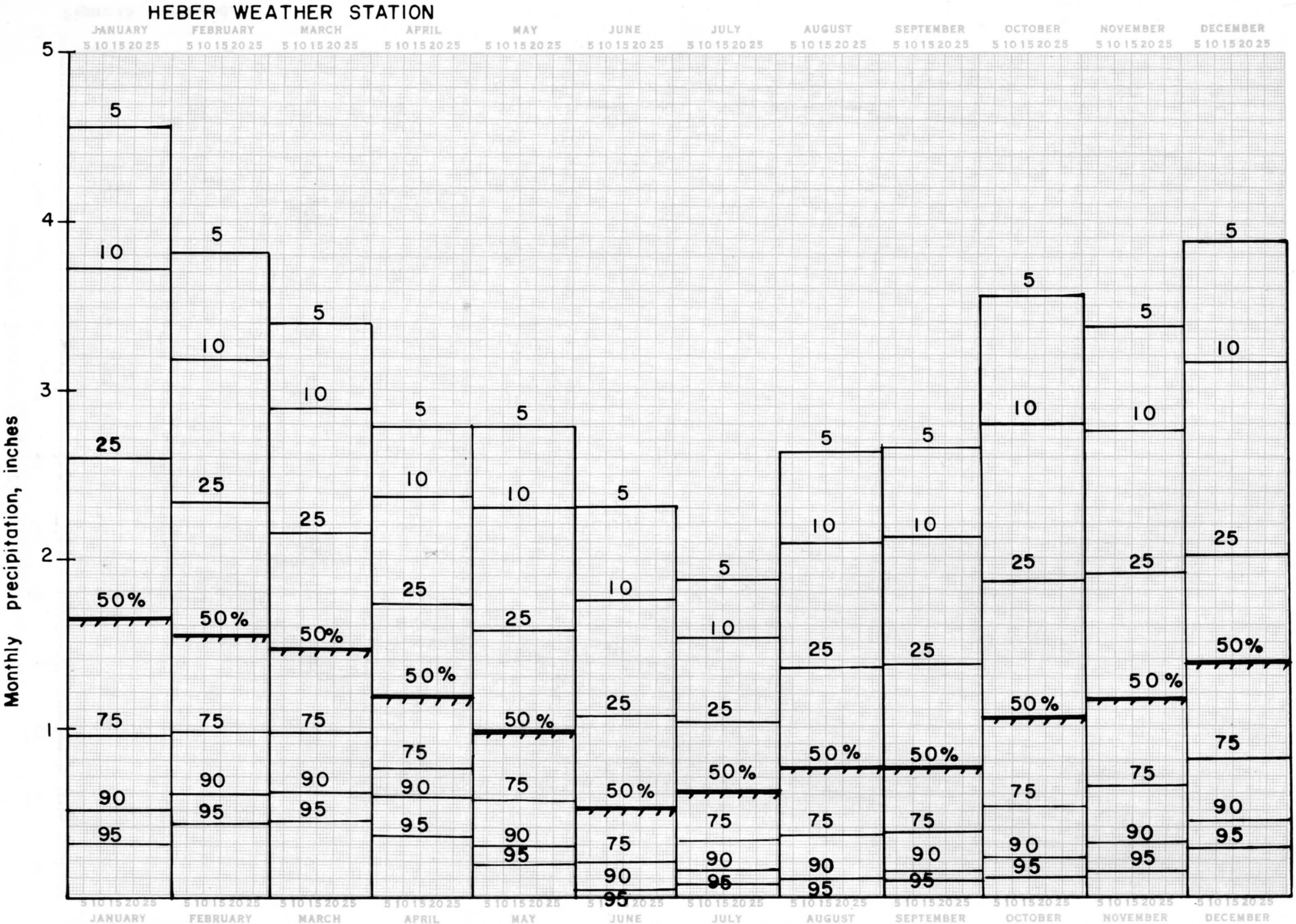

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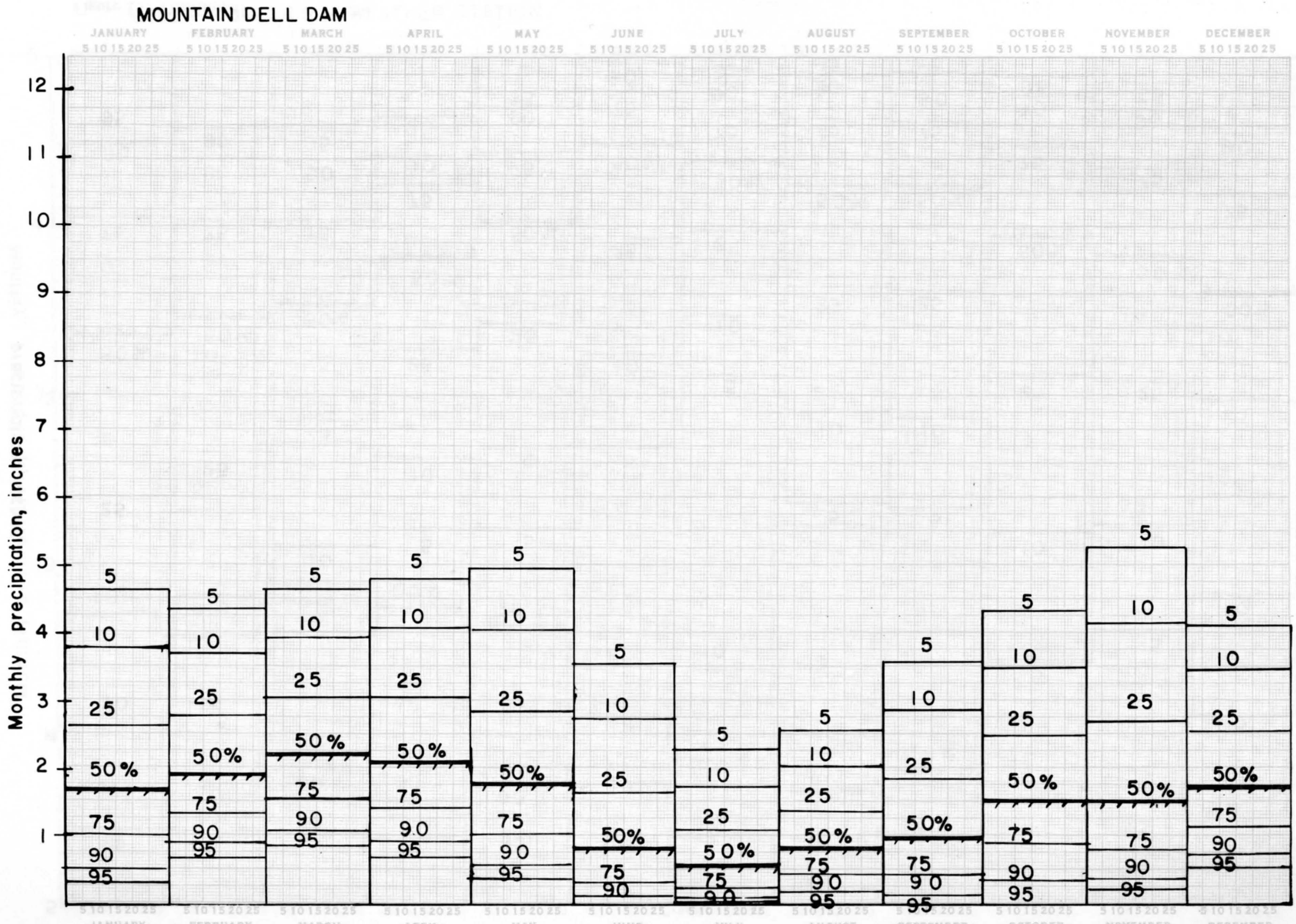

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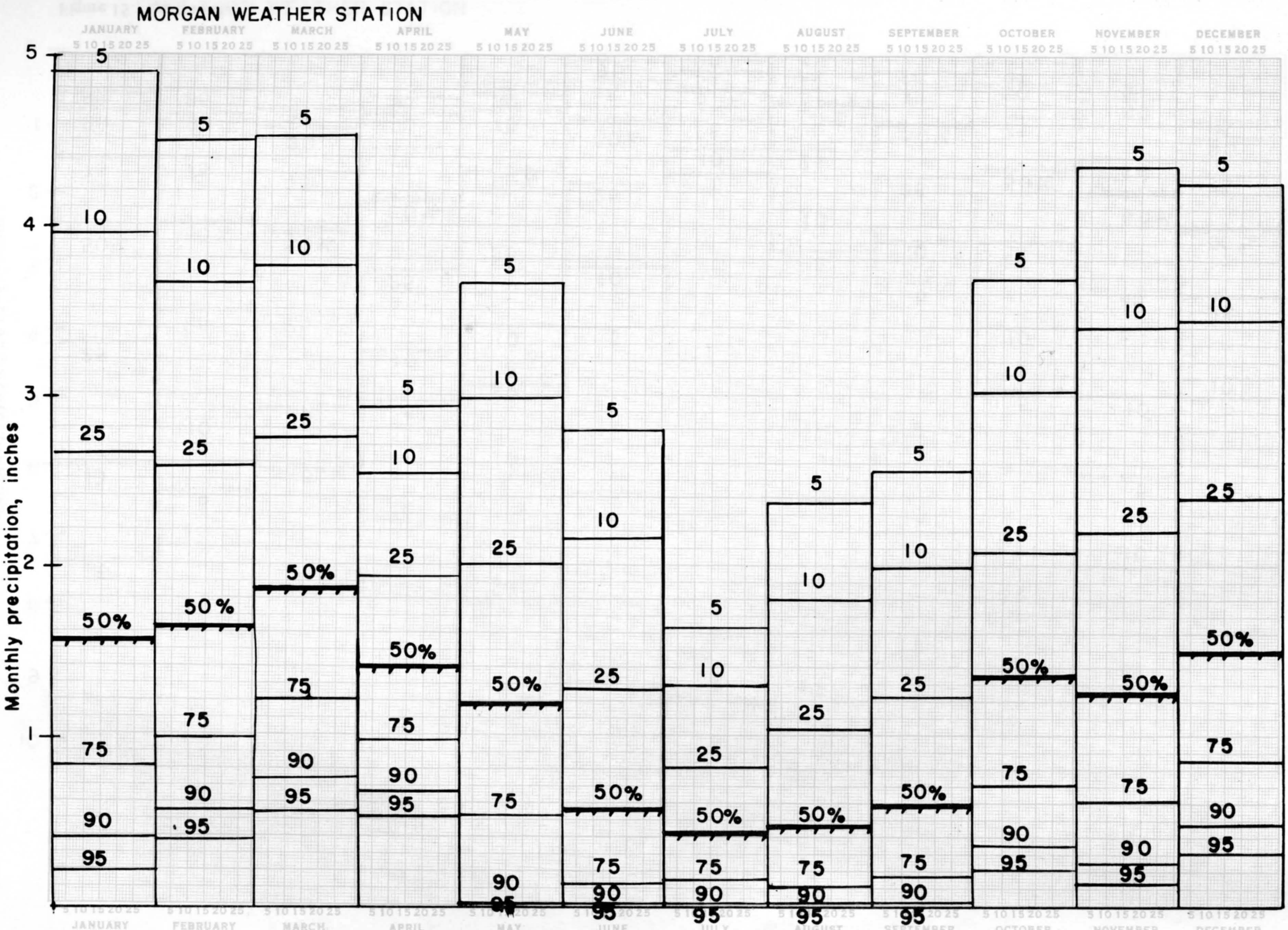

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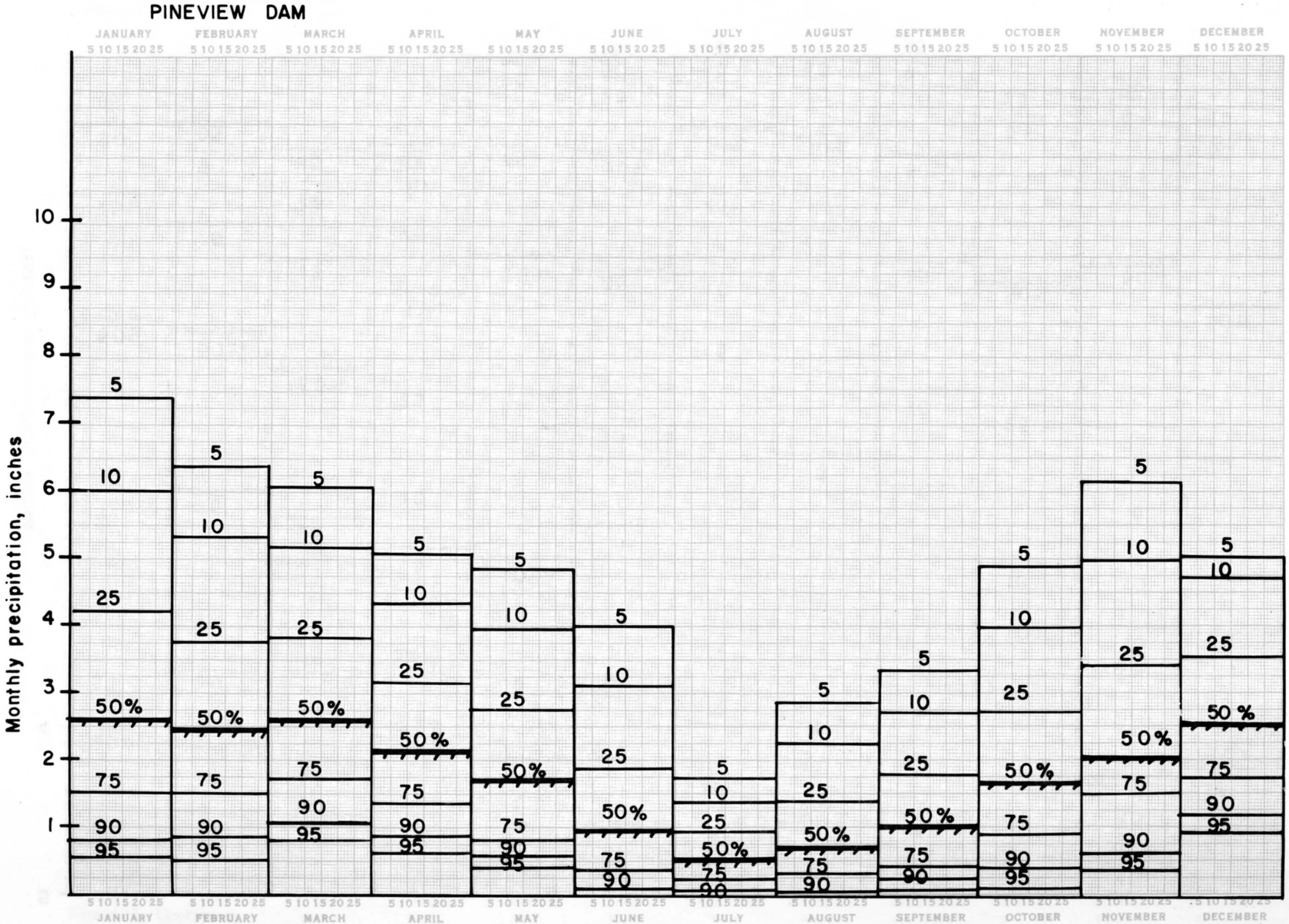
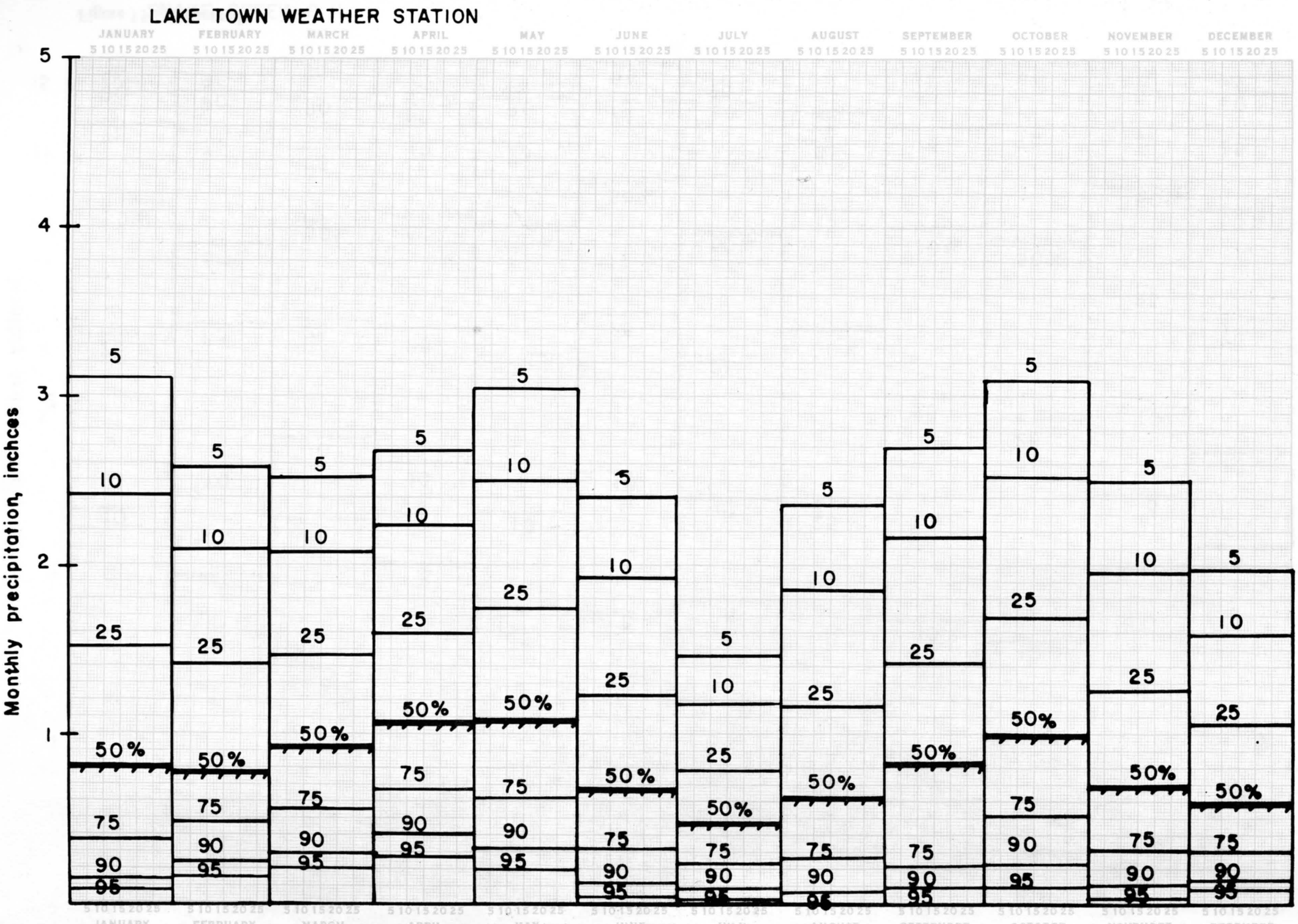


Figure 15. Continued.



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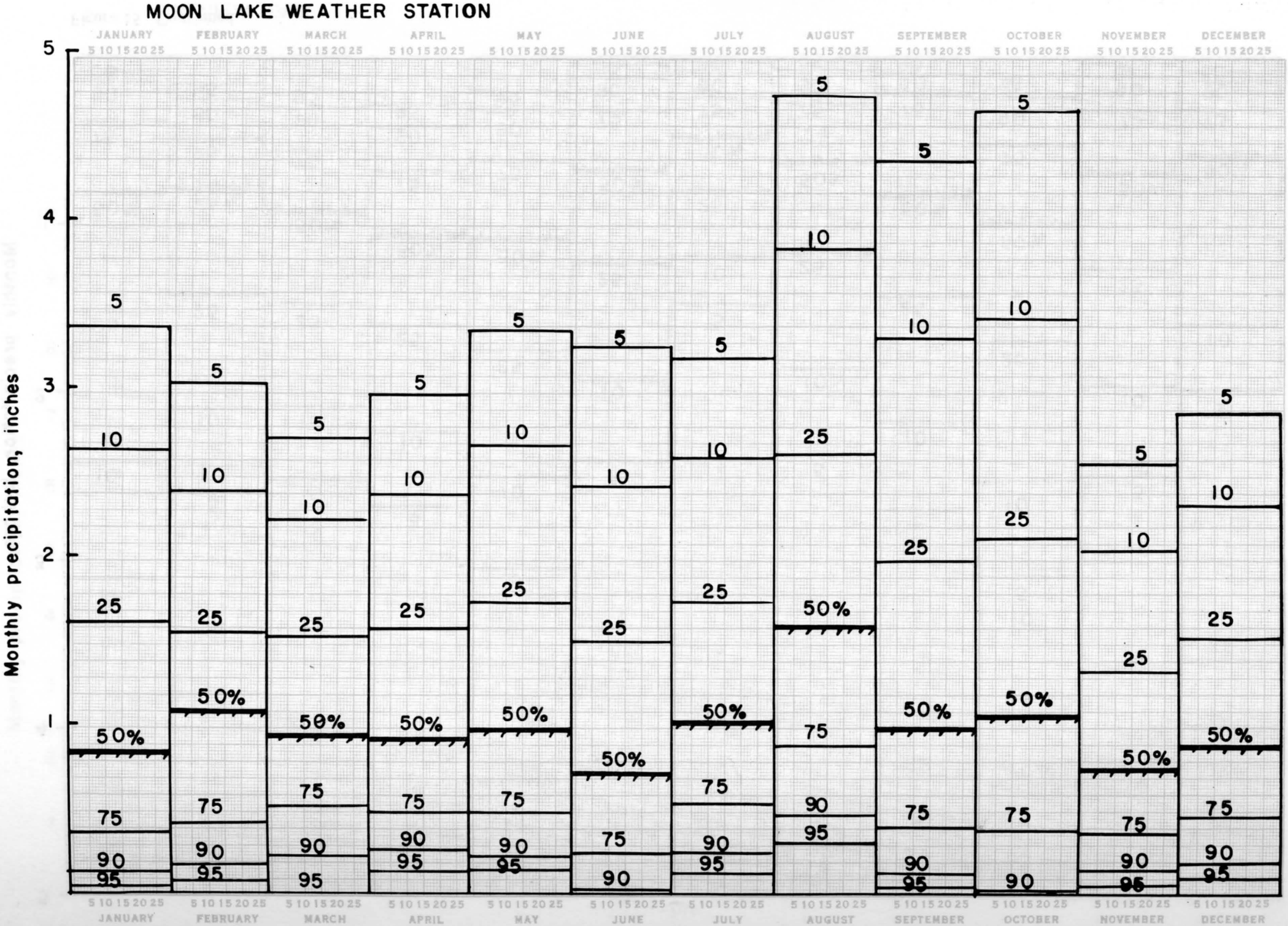

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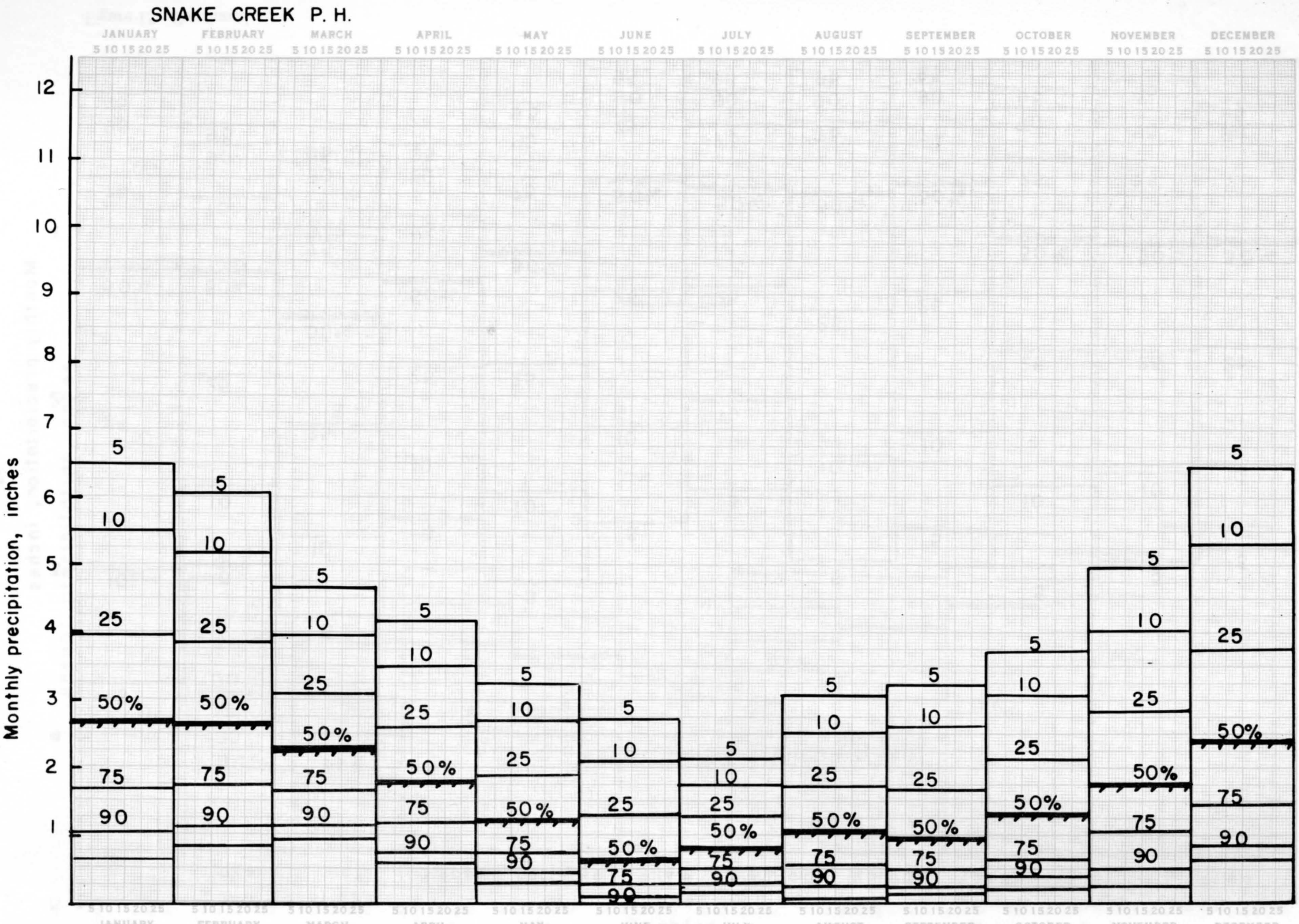

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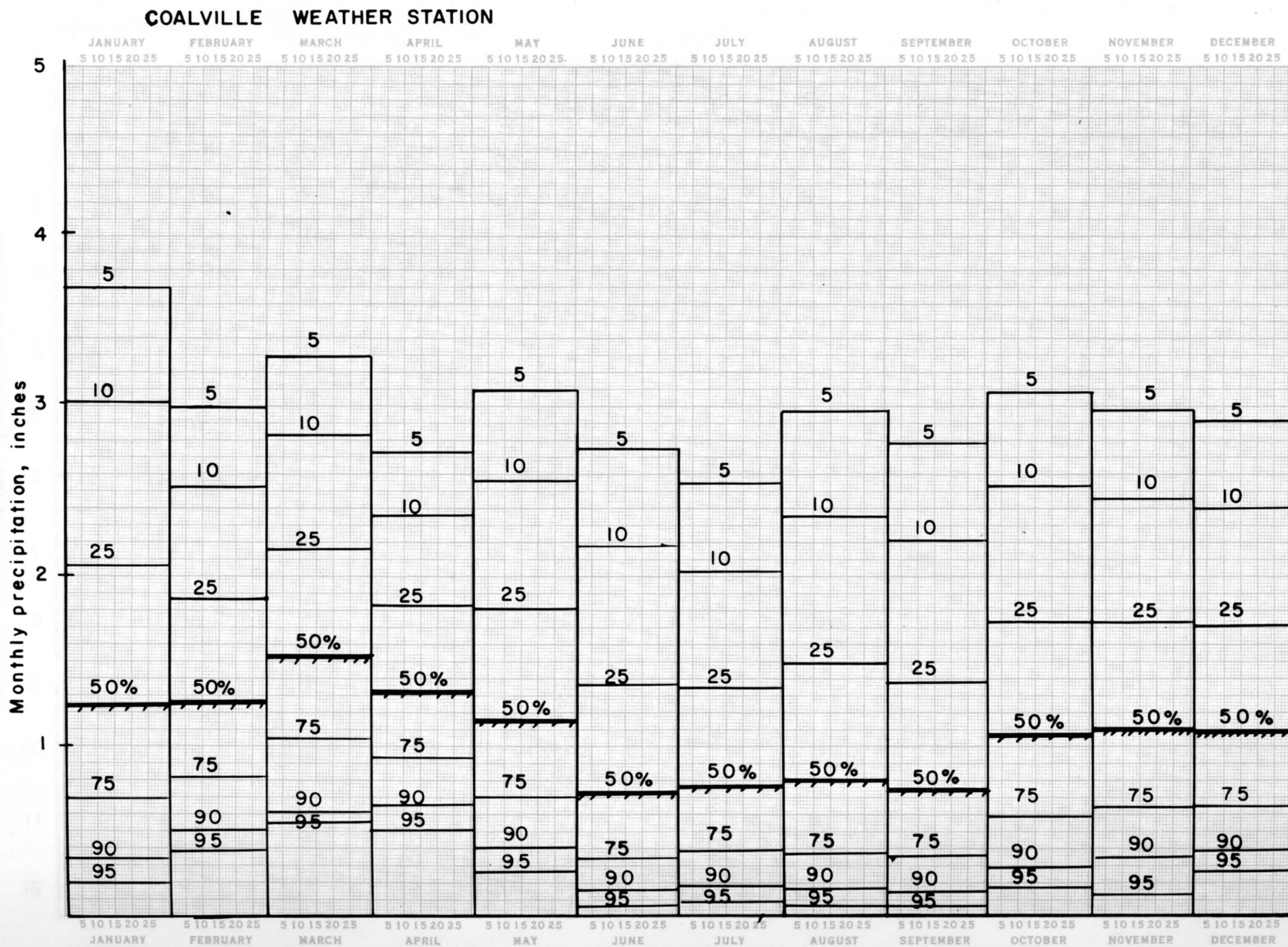


Figure 15. Continued.

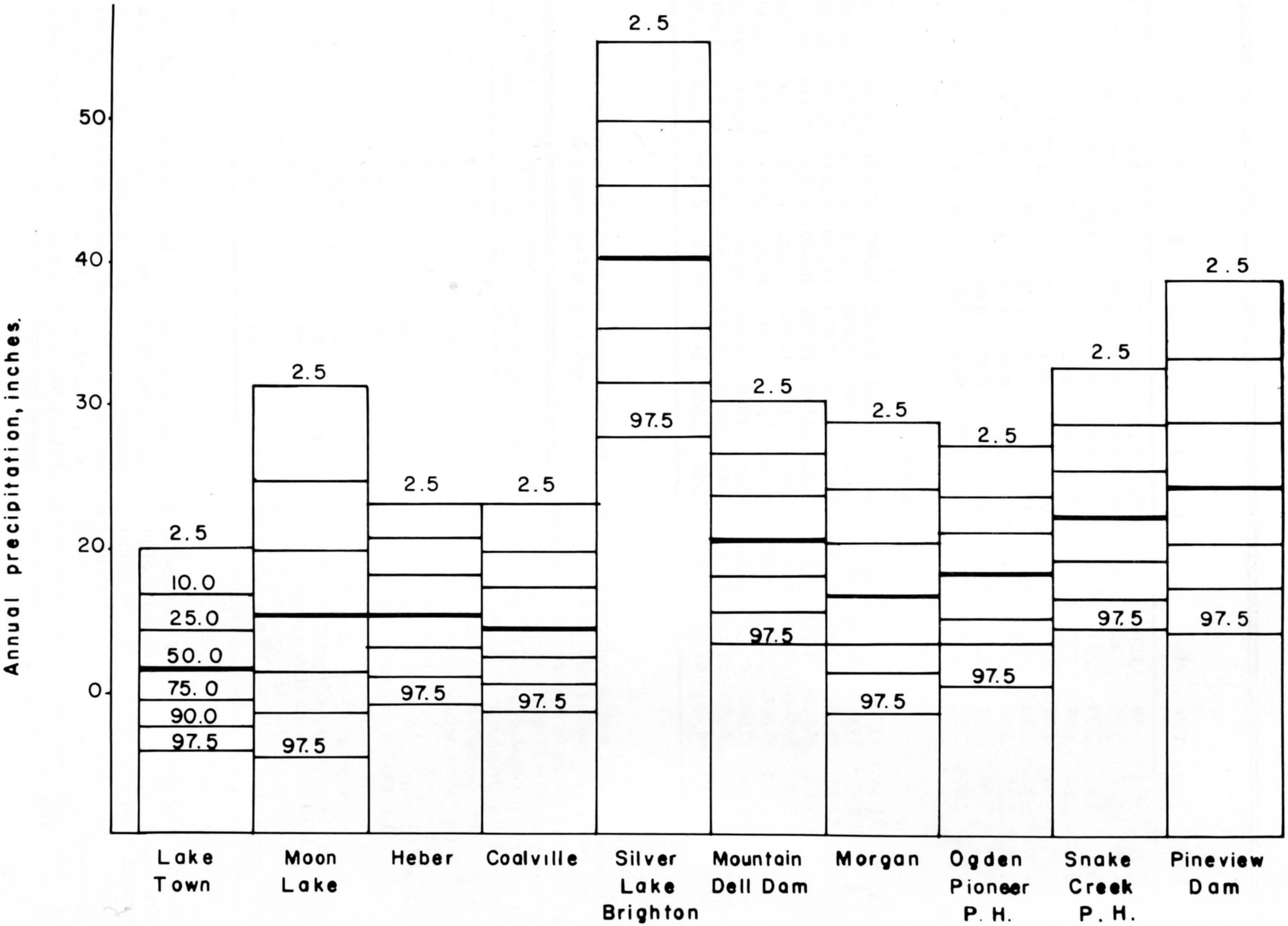


Figure 16. Annual precipitation frequency distribution for selected stations in the Weber River study unit.

Table 8. Monthly distribution of total precipitation on Weber River study unit.

Area No.	Total	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						inches							
1	32.32	3.42	3.59	3.70	3.33	2.70	2.10	1.41	2.37	2.17	2.06	2.85	2.62
2	21.77	2.16	2.28	2.44	1.91	1.99	1.46	0.95	1.39	1.25	1.53	2.05	2.36
3	20.91	1.82	2.29	2.51	2.43	1.96	1.62	0.87	1.22	1.28	1.39	1.82	1.70
4	18.80	1.66	1.98	2.23	1.85	1.75	1.37	1.02	1.16	1.27	1.36	1.62	1.53
5	19.79	1.93	2.03	2.37	2.09	2.07	1.35	0.87	1.14	1.41	1.27	1.56	1.72
6	26.37	2.94	3.10	3.32	2.85	2.17	1.47	0.90	1.33	1.27	1.73	2.43	2.86
7	26.34	2.72	3.01	3.27	2.88	2.29	1.67	0.59	1.13	1.28	2.05	2.67	2.78
8	24.31	2.76	2.83	3.29	2.69	2.09	1.37	0.47	0.94	1.58	1.57	2.31	2.47
9	19.50	2.01	2.01	2.17	2.22	1.92	1.35	0.46	0.90	1.10	1.55	1.90	1.91
						acre-ft							
1		29,700	31,240	32,220	28,950	23,440	18,230	12,230	20,610	18,890	17,930	24,760	22,760
2		31,730	33,520	35,900	28,200	29,310	21,420	13,890	20,480	18,380	22,380	30,180	34,730
3		26,660	33,770	36,950	35,700	28,880	23,940	12,830	17,910	18,880	20,430	26,770	24,950
4		25,930	30,870	35,020	29,050	27,350	21,430	15,940	18,070	19,800	21,330	25,470	23,830
5		24,500	25,650	29,990	26,330	26,120	17,100	11,090	14,460	17,920	16,100	19,730	21,710
6		24,920	26,330	28,080	24,170	18,370	12,510	7,580	11,210	10,730	14,670	20,560	24,230
7		43,610	48,280	52,540	46,220	36,880	26,880	9,380	18,130	20,400	32,820	42,900	44,680
8		50,410	51,760	60,090	49,300	38,150	25,180	8,660	17,260	27,790	28,740	42,210	45,280
9		55,480	55,440	59,960	61,500	53,030	37,200	12,650	24,770	30,510	42,750	52,860	52,760

Snow. In the higher areas of the Weber River study unit approximately 65 percent of the total annual precipitation occurs in the form of snow and accumulates in the snow pack to melt in the spring and feed the streams and rivers of the study area. The depth of snow and its water content is currently (1964) being measured at 21 snow courses during the winter and early spring months. While these snow courses were not established to give representative samples of snow depth over large areas of the basin, the data from the snow courses in and adjacent to the study unit have been used to develop maps showing the water accumulation in snow pack near the first of each of several months. Fig. 17 shows the average water content of the snow in the Weber River study unit on April 1. A depth area analysis from this map indicates that 1,271,000 acre feet of water are stored as snow during the average year on April 1. Table 9 shows the amount of water in storage as snow on April 1 for each subarea within the study unit.

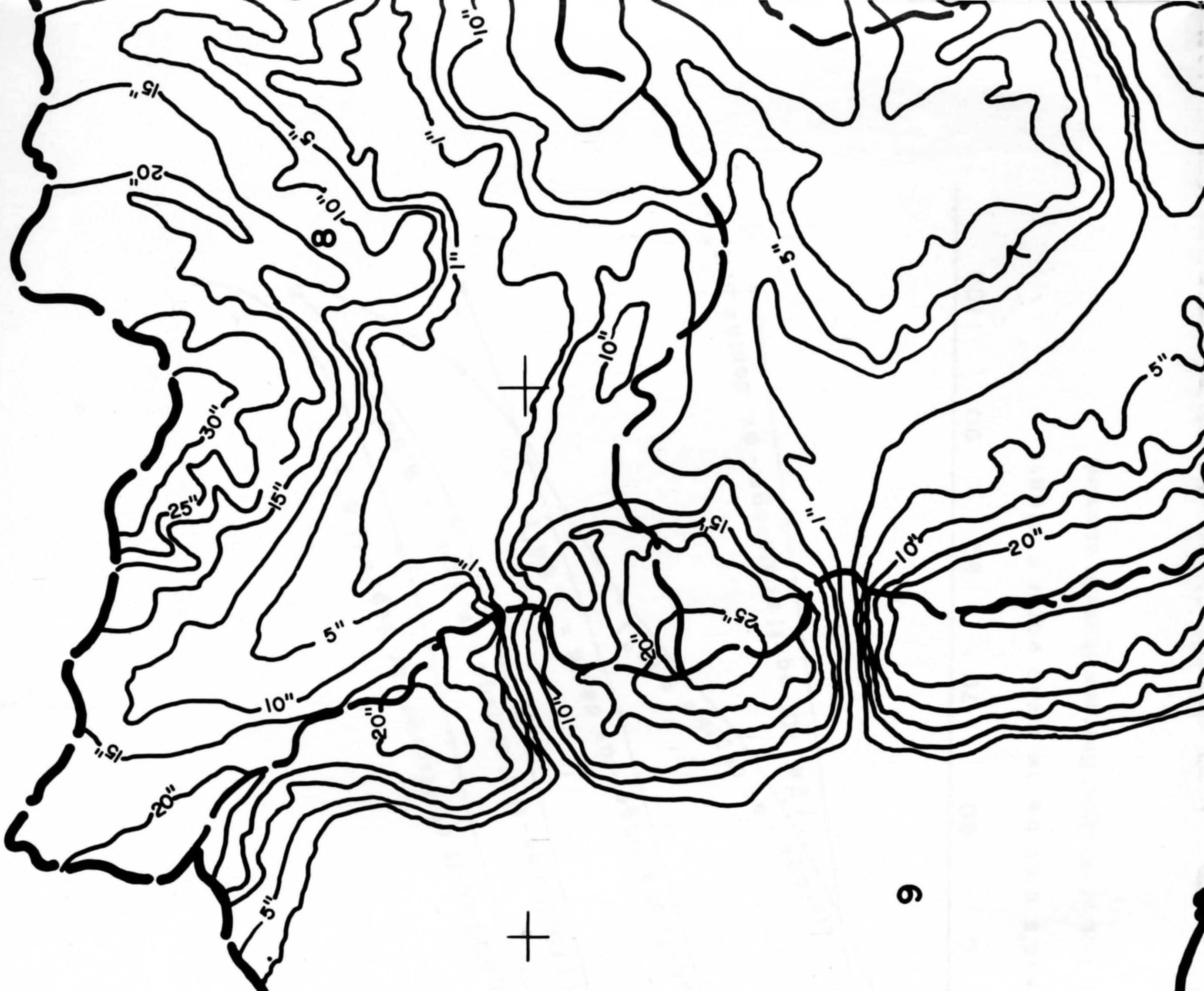
Table 9. Average amount of water in storage as snow on April 1, Weber River study unit.

Subarea No.	Size Square Miles	Water Content of Snow ac. - ft.	Equivalent Depth Inches
1	163	189,320	21.7
2	268	147,160	10.3
3	253	131,140	9.7
4	280	71,350	4.8
5	228	119,420	9.8
6	155	115,500	13.9
7	300	171,420	10.7
8	310	199,700	12.1
9	505	125,612	4.7
TOTAL	2,462	1,270,600	9.7

To investigate further how snow accumulates during the winter and early spring months, the water content of the snow in relation to the percent area within a watershed was analyzed. Fig. 18 shows this relationship for a small watershed within subarea 8 which drains the land area above the gaging station on the south fork of Ogden River near Huntsville. Fig. 19 shows a similar set of curves for subarea No. 1. By comparing these curves for consecutive months the manner in which the snow accumulates can be seen. For January 1 and February 1 the water content shows a linear relation with the percent of the watershed area below the point. By the first of March some snow has melted at the lower areas, and is accumulating rapidly in the higher areas.


N
1"
5"
10"
15"
20"
25"
30"

6
2
3
5"
10"
15"
20"
25"
30"
35"


1"
5"
10"
15"
20"
25"
30"
8
9

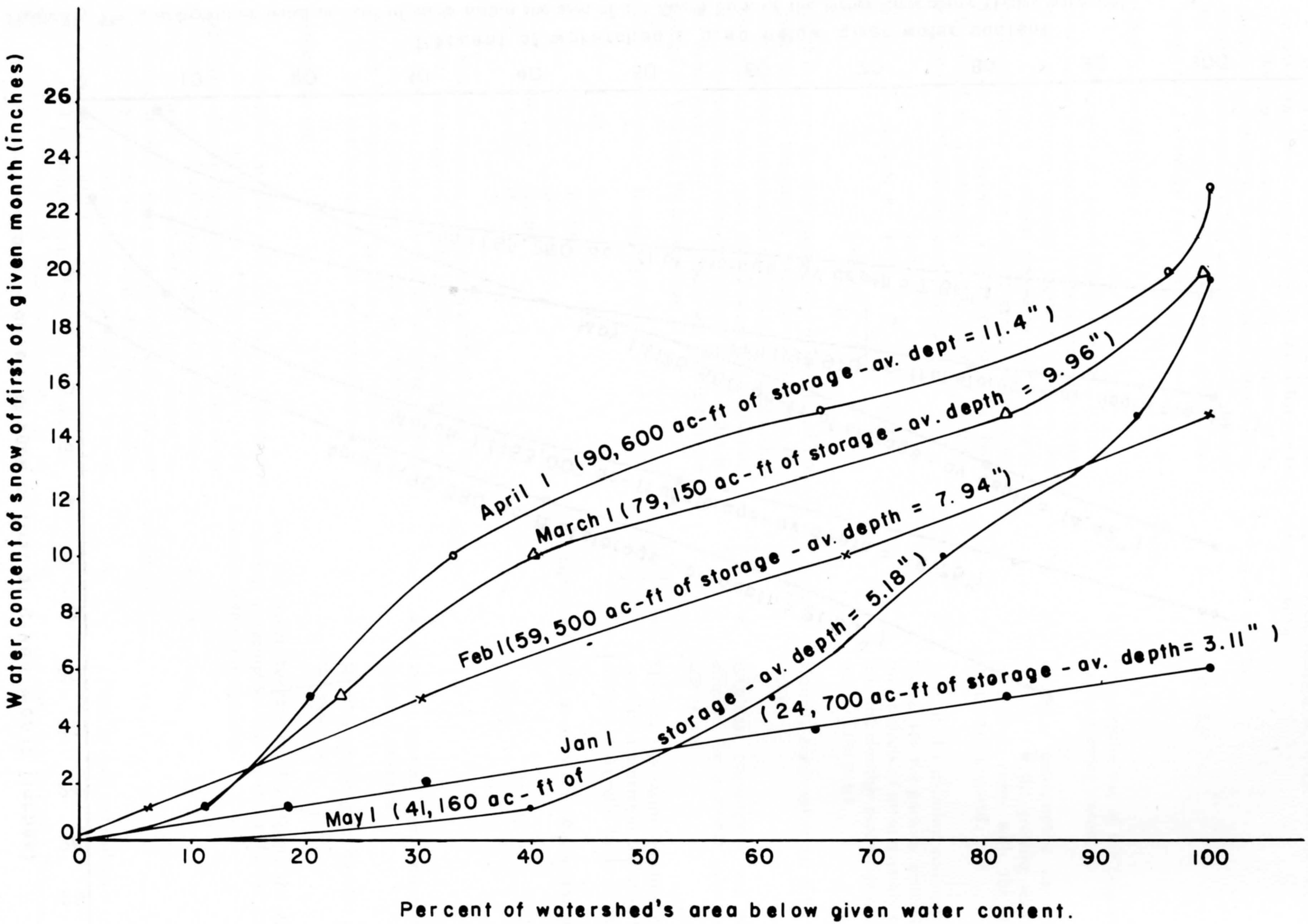


Figure 18. The distribution of water content of snow within the South Fork of the Ogden River near Huntsville watershed.

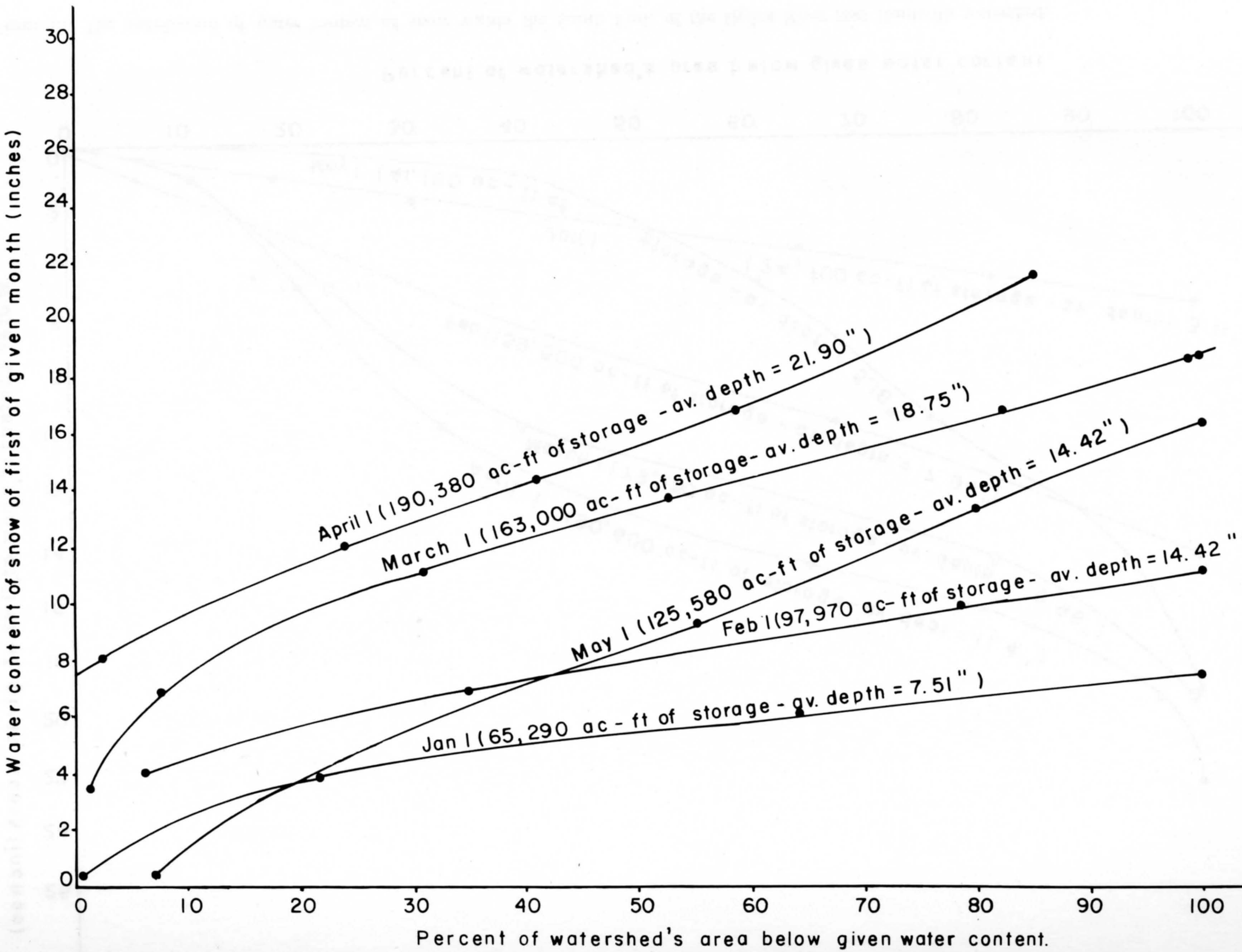


Figure 19. The distribution of water content of snow within the area of the South Fork of the Weber River above Oakley watershed.

The variability of the snow pack from year to year for two snow courses is given in Fig. 20. These bar graphs were developed assuming that the water content of the snow for the months given followed a normal distribution. While this assumption is not completely valid, a plot of the data from both these snow courses revealed that assumption of normalcy was not greatly in error.

Classification of climate

The climate of a region is determined by a complex combination of meteorological elements including temperature, precipitation, humidity, sunshine, cloudiness and wind. Climate is generally classed as arid, semi-arid, sub-humid, humid, or wet, depending upon the effectiveness of the precipitation. This effectiveness has been determined by Thorthwaite on the basis of an index computed from the following relationship:

$$\text{P.E. index} = 115 \sum_{i=1}^{i=12} \left(\frac{P_i}{T_i - 10} \right)^{10/9}$$

where P = mean monthly precipitation in inches, and T = mean monthly temperature in degrees Fahrenheit. Because a precise determination of climatic classification has little practical value, mean annual values of precipitation and temperature were used to compute the PE index in the Weber River study unit. Climate was classified on the basis of the following PE index values:

PE index	Humidity province
0-16	Arid
16-32	Semi-arid
32-64	Sub-humid
64-128	Humid
over 128	Wet

From iso-maps of precipitation and temperature the PE index was computed and the humidity provinces within the study area were isolated as shown in Fig. 21. Since the PE index is directly proportional to precipitation and inversely proportional to temperature, the magnitude of the PE index increases rapidly with increased elevation.

Consumptive use

The bulk of the water which exits from a hydrologic unit is through the processes of evapotranspiration and evaporation. Accounting for this water is one of the major problems associated with a water budget. One of the more useful methods used to estimate the amount of evapotranspiration, U, from an hydrologic area is the one developed by Blaney and Criddle. The Blaney-Criddle formula, which is used throughout the world, can be used in areas for which little data are available, or it can be used in areas for which considerable data are available. More accurate estimates of evapotranspiration can be made for the areas having the better basic data. The Blaney-Criddle formula is represented by the following simple equations.

$$u = kf$$

$$U = \sum fk = KF$$

where,

U = Consumptive use of the crop in inches for the growing season,

K = Empirical consumptive use crop coefficient for the growing season. This coefficient varies with the different crops being irrigated,

F = Sum of the monthly consumptive use factors for the growing season (sum of the products of mean monthly temperature and monthly percentage of daylight hours of the year),

u = Monthly consumptive use of the crop in inches,

k = Empirical consumptive use crop coefficient for a month (also varies by crops), and

f = Monthly use factor (product of mean monthly temperature and monthly percentage of daylight hours of the year).

The equation for the monthly consumptive use factor, f, is

$$f = (tp)/100$$

where

t = Mean monthly air temperature in degrees Fahrenheit.

p = Monthly percentage of daylight hours in the year.

For the water budgets in this report, the empirical monthly consumptive use crop coefficient has been computed from the equation

$$k = k_t k_c$$

where

k_t = a climatic coefficient which is related to the mean air temperature, t, and

k_c = a coefficient reflecting the growth stage of the crop.

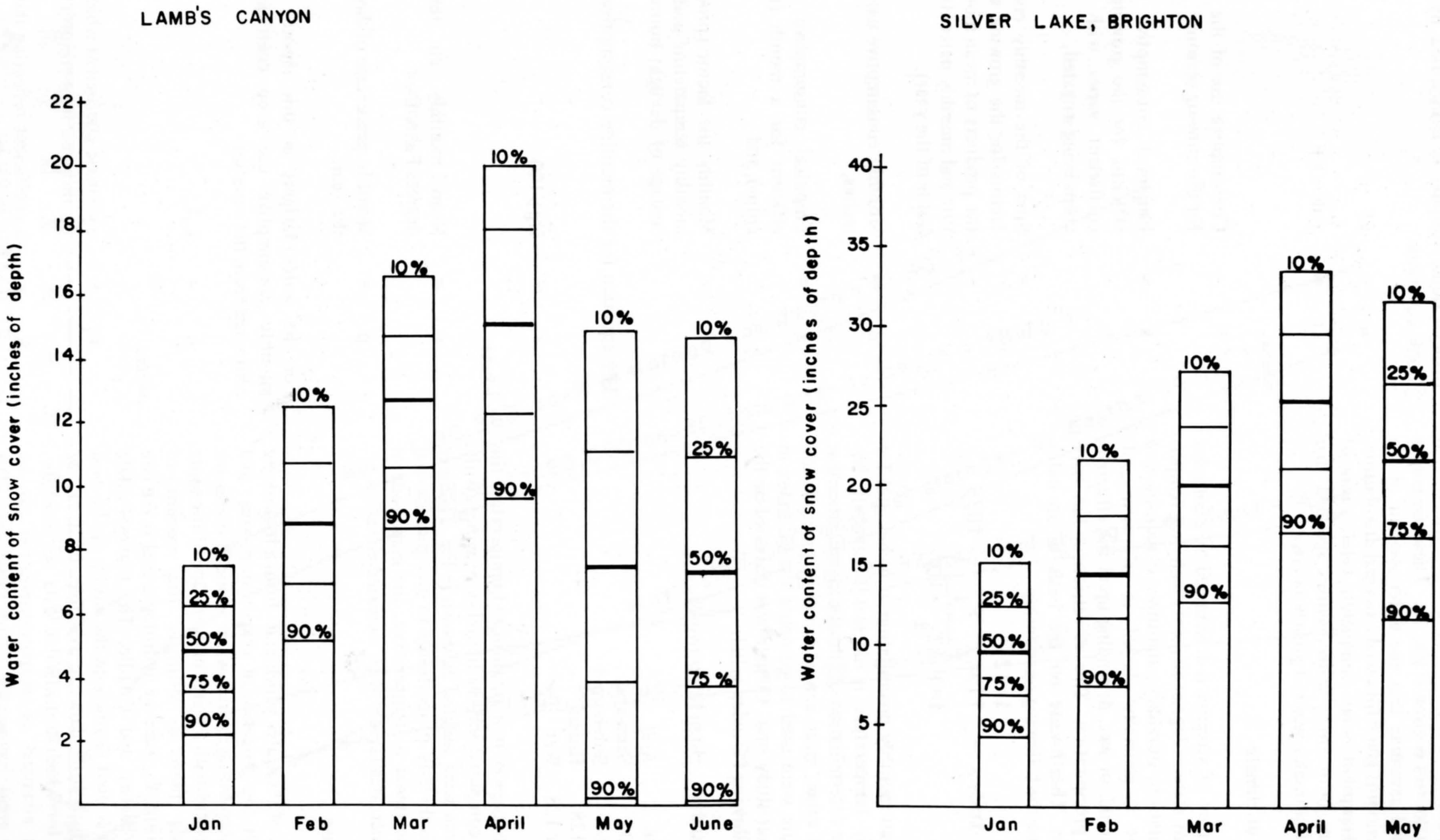
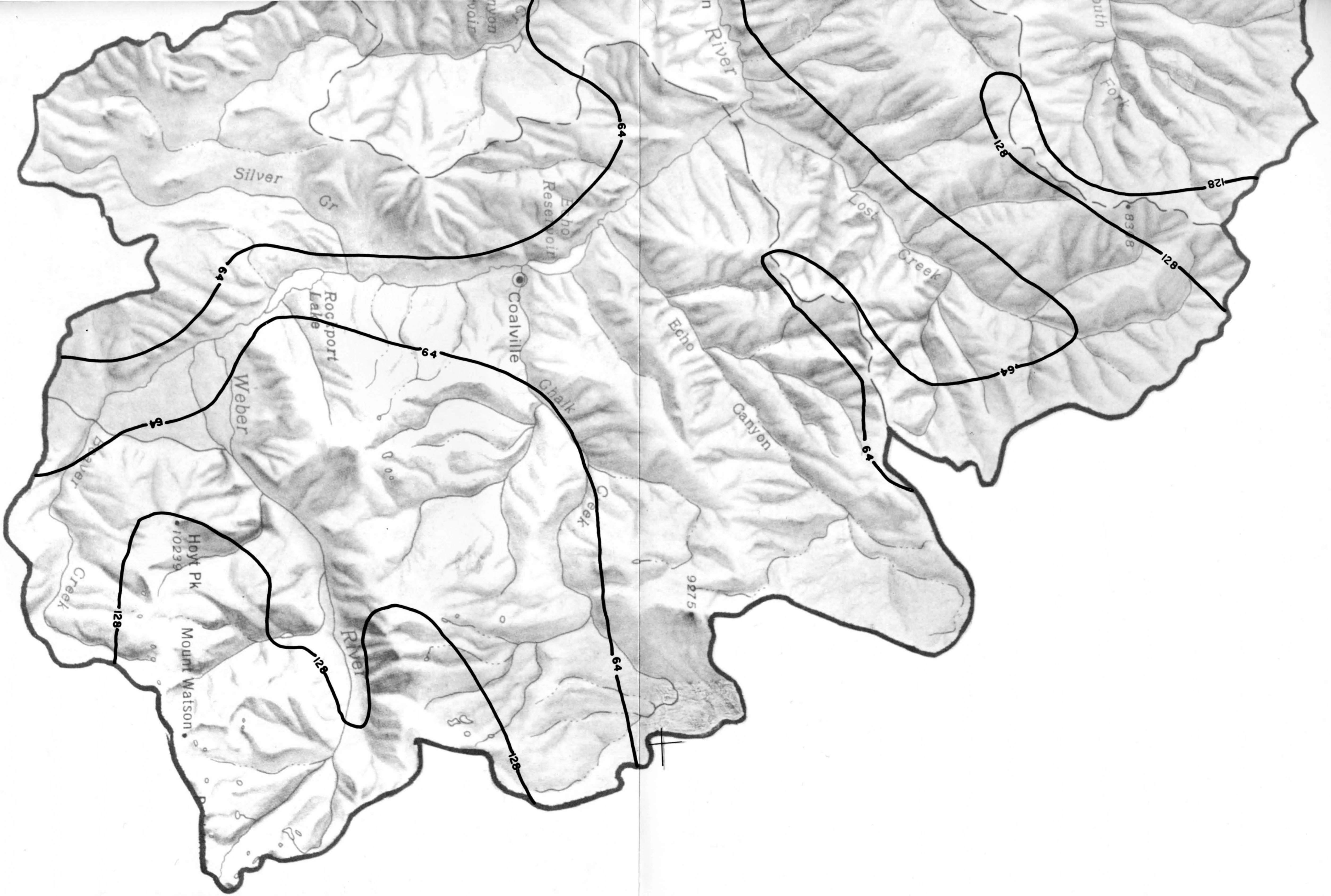


Figure 20. Frequency distribution of April 1 water content at various snow courses in the Weber River study unit.

Willard Peak
N Fk
Salt Flats
4673
32
Mud
Flats
GREAT
SALT
LAKE
Weber R
Pineview
Res
Ogden
R
N
Br
OGDEN
9572
Mt Ogden
128
64
Weber
Farmington
Morga
8152
East Ca
Rese
Canyon



Silver
Cr
Echo Reservoir
Coalville
Rockport Lake
Weber
River
Chalk
Creek
Echo
Canyon
Lost
Creek
Fork
River
Creek
Hoyt Pk
10239
Mount Watson
9275
64
128

The climatic coefficient, k_t, is computed from the equation

$$k_t = 0.0173t - 0.314$$

Crop growth stage curves have been developed by the Soil Conservation Service (1964) for a variety of crops and phreatophytes. These curves were used in obtaining monthly values of k_c.

Since the seasonal consumptive use factor, F, is a function of meteorology and geography, and is independent of the crop, a map of iso-F values is valuable in showing the climatic potential for agriculture. Such a map is shown in Fig. 22a for the Weber River study unit, where the season used in computing F was taken as the time period between the 50 percent probability of obtaining a temperature of 32°F in the spring and in the fall. The minimum seasonal consumptive use factor, F, for a number of crops is listed in Table 10. A comparison of Fig. 22 with Table 10 indicates the climatic potential for growing the various crops in any particular subarea.

Table 10. Minimum F values required to mature crops within the Weber River study unit.

Crops	F
alfalfa	full season
beans	25
corn	35
corn silage	20-35
grain, fall	30-35
grain, spring	25
pastures	full season
peas	20
potatoes	20-32
small truck	20
sugar beets	30-40
tomatoes	30-35
orchards	full season

Fig. 22b shows how the average seasonal "F" factor is distributed by subareas within the study unit. It can readily be seen that area No. 9, the East Shore area west of the Wasatch Mountains, is the only area capable of producing a variety of agricultural crops. With the exception of a small amount of corn silage produced in areas 7 and 8, the only crops produced in the rest of the study unit are pastures, grasses, alfalfa, and small grians.

The crop coefficients, "k," for the various crops grown in the study unit are shown in Table 11. Also shown are the potential unit use of water in inches for the same crops. Actual crop water use will vary through the area as the length of growing season and availability of water varies.

Table 11. Crop coefficients and potential unit water use value in the Weber River study unit.

Crop	Crop Coefficient "k"	Unit Use--Inches
alfalfa	0.85	.85 F
beans	0.70	17.5
corn	0.80	28.0
corn silage	0.80	16.0 - 28.0
grain, fall	0.80	24.0 - 28.0
grain, spring	0.80	20.0
pastures	0.80	0.80 F
peas	0.80	16.0
potatoes	0.70	14.0 - 22.4
small truck	0.65	13.0
sugar beets	0.70	21.0 - 28.0
tomatoes	0.70	21.0 - 24.5
orchards	0.65	0.65 F

Monthly "F" values have been computed for each subarea using the daytime hours shown in Table 12 and the average temperature shown in Table 13. These "F" values are shown in Table 15. Crop coefficients, k, have been estimated for each subarea from data presented by Criddle, et al. (1962) in Technical Publication No. 8 of the State Engineer's Office and are shown in Table 15. The product of "F" and "K" or the monthly unit water use for the various crops grown in each subarea is shown in Table 16.

Evaporation from open bodies of fresh water such as lakes and rivers is difficult to measure. Estimates are sometimes made using the measured evaporation from a Weather Bureau evaporation pan, but the correction factor to apply to each month's total pan evaporation is often not known. One of the few inflow-outflow studies conducted to determine lake evaporation in the Weber River study unit was that of Christiansen (1964) and Lee (1964). These studies were made in the Howard Slough area west of Ogden, Utah. Lee's determinations of monthly evaporation were compared with computed "F" values at the Ogden Sugar Factory, extrapolated to include the missing winter months, and a coefficient "k" computed. These coefficients, shown in Table 17 were used to compute the unit monthly evaporation from open fresh water in each subarea throughout the study unit as shown in Table 18.

In nearly every hydrologic area water is consumed by non-commercial native vegetation which grows beside or in the water courses and uses water in excess of the

Table 12. Monthly percentage of daytime hours in the Weber River study unit.

Subarea No.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.71	6.70	7.25	8.97	10.06	10.12	10.27	9.57	8.39	7.73	6.68	6.47
2	6.71	6.70	7.25	8.97	10.06	10.12	10.27	9.57	8.39	7.73	6.68	6.47
3	6.69	6.69	8.32	8.98	10.08	10.14	10.29	9.58	8.39	7.72	6.67	6.45
4	6.69	6.69	8.32	8.98	10.08	10.14	10.29	9.58	8.39	7.72	6.67	6.45
5	6.69	6.69	8.32	8.98	10.08	10.14	10.29	9.58	8.39	7.72	6.67	6.45
6	6.70	6.70	8.32	8.97	10.07	10.13	10.28	9.57	8.39	7.73	6.68	6.39
7	6.68	6.69	8.32	8.98	10.09	10.15	10.30	9.58	8.39	7.72	6.67	6.45
8	6.67	6.68	8.32	8.99	10.10	10.16	10.31	9.59	8.39	7.71	6.66	6.43
9	6.69	6.69	8.32	8.98	10.08	10.14	10.29	9.58	8.39	7.72	6.67	6.45

Table 13. Mean monthly temperature for cultivated portion of subareas within the Weber River study unit.

Month \ Area No.	1	2	3	4	5	6	7	8	9
January	21.2	23.2	22.4	22.1	22.4	23.0	22.4	19.1	25.9
February	23.9	27.3	27.5	27.5	27.6	28.2	27.6	26.8	31.6
March	27.5	32.0	34.1	36.9	35.3	33.3	35.3	32.4	39.8
April	36.4	40.9	42.7	43.5	45.9	41.0	45.9	45.4	50.1
May	44.4	49.8	51.8	52.3	53.7	50.8	53.8	55.0	58.7
June	52.4	58.5	57.9	58.9	60.9	59.1	60.9	62.3	66.6
July	60.0	65.0	66.4	67.4	68.8	63.6	68.8	71.5	75.2
August	57.8	64.2	64.1	65.1	66.8	64.2	66.8	68.3	74.8
September	50.9	55.7	56.2	57.2	58.0	55.2	58.0	60.4	64.0
October	41.8	46.3	46.8	47.2	48.0	46.1	48.0	49.2	52.7
November	27.1	31.1	33.1	33.1	34.2	32.2	34.2	32.6	38.5
December	23.8	26.7	26.5	26.7	27.3	27.5	27.3	24.8	30.7

Table 14. Mean monthly F values for cultivated portion of subareas within the Weber River study unit.

	1	2	3	4	5	6	7	8	9
Oct.	3.23	3.58	3.62	3.65	3.71	3.57	3.71	3.80	4.07
Nov.	1.81	2.08	2.21	2.21	2.28	2.15	2.28	2.18	2.57
Dec.	1.54	1.73	1.71	1.72	1.76	1.76	1.76	1.60	1.98
Jan.	1.42	1.56	1.50	1.48	1.50	1.54	1.50	1.28	1.74
Feb.	1.60	1.83	1.84	1.84	1.85	1.89	1.85	1.59	2.12
Mar.	2.29	2.66	2.84	2.82	2.94	2.77	2.94	2.70	3.31
April	3.27	3.67	3.84	3.88	4.12	3.67	4.12	4.09	4.50
May	4.47	5.01	5.22	5.27	5.42	5.11	5.42	5.55	5.92
June	5.30	5.92	5.88	5.98	6.18	5.98	6.18	6.33	6.75
July	6.16	6.68	6.84	6.94	7.08	6.53	7.08	7.37	7.74
Aug.	5.53	6.14	6.14	6.24	6.40	6.14	6.40	6.55	7.17
Sept.	4.27	4.67	4.72	4.80	4.87	4.63	4.87	5.07	5.37
Annual	40.89	45.53	46.36	46.83	48.11	45.74	48.11	48.11	53.24

Table 15. Estimated Blaney-Criddle coefficient, K, for various use categories within the Weber River study unit.

Crop	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Area 1						
Pasture	0.07	0.11	0.14	0.16	0.25	0.76	0.84	0.73	0.42	0.14	0.10	0.06
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 2						
Alfalfa	0.09	0.14	0.20	0.26	0.39	0.86	0.93	0.81	0.52	0.23	0.10	0.07
Pasture	0.10	0.14	0.20	0.25	0.38	0.81	0.87	0.76	0.49	0.23	0.11	0.08
Grain	0.08	0.13	0.19	0.37	0.55	0.89	0.98	0.49	0.28	0.18	0.09	0.06
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	.135	1.30	1.20	0.85	0.44
Water	0.38	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 3						
Alfalfa	0.09	0.15	0.20	0.27	0.42	0.86	0.94	0.82	0.54	0.24	0.10	0.07
Pasture	0.10	0.15	0.20	0.26	0.40	0.81	0.88	0.77	0.51	0.24	0.10	0.08
Grain	0.08	0.14	0.20	0.37	0.44	0.89	0.98	0.57	0.30	0.20	0.09	0.06
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24

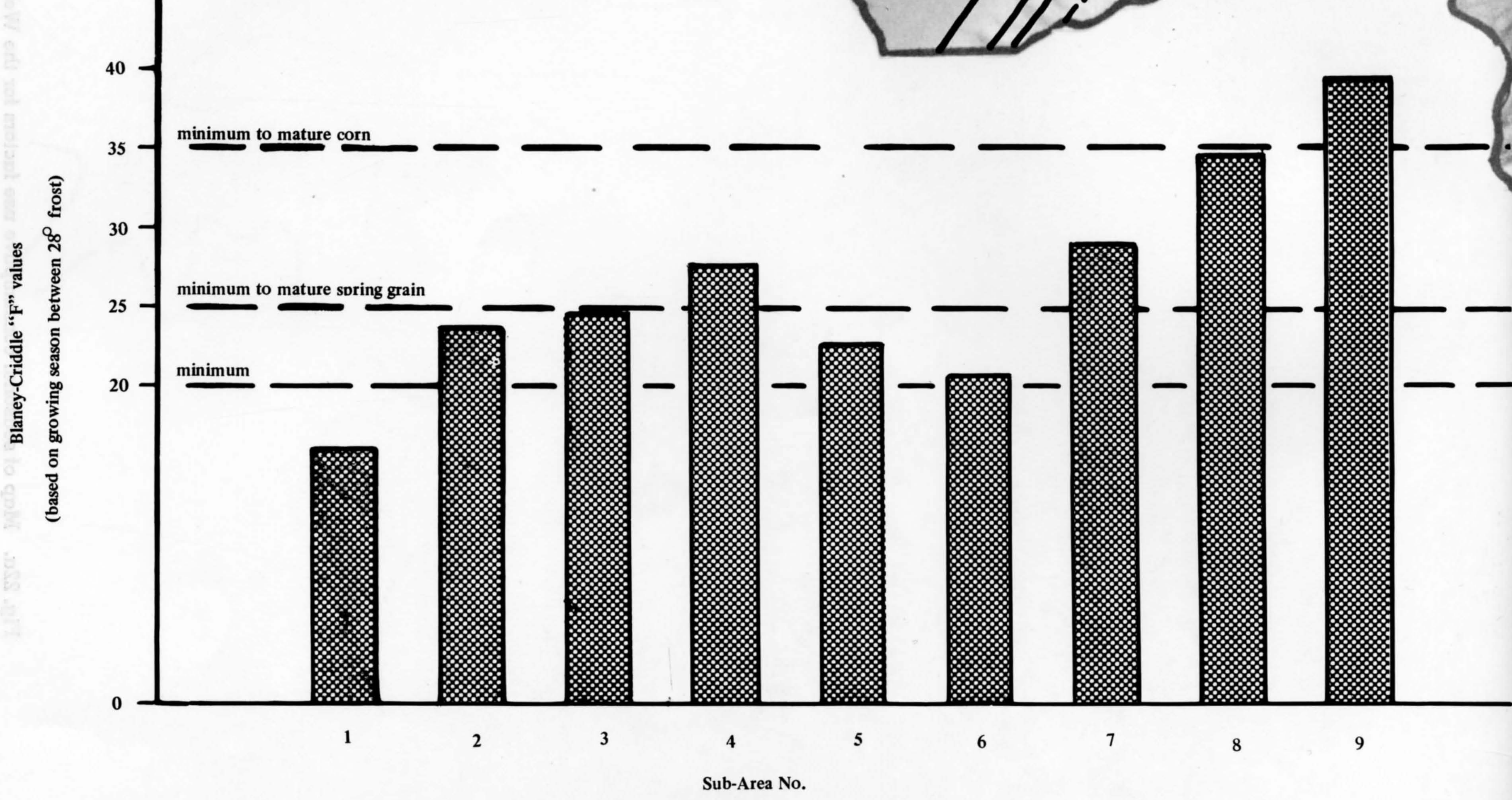
Table 15. Continued.

Crop	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Area 4						
Alfalfa	0.10	0.16	0.23	0.30	0.50	0.88	0.95	0.83	0.57	0.28	0.12	0.07
Pasture	0.09	0.16	0.23	0.29	0.48	0.83	0.89	0.78	0.54	0.27	0.13	0.08
Grain	0.09	0.15	0.28	0.42	0.63	0.97	0.95	0.50	0.28	0.19	0.11	0.06
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 5						
Alfalfa	0.09	0.14	0.20	0.26	0.39	0.86	0.93	0.81	0.52	0.23	0.10	0.07
Pasture	0.10	0.14	0.20	0.25	0.38	0.81	0.87	0.76	0.49	0.23	0.11	0.08
Grain	0.08	0.13	0.19	0.37	0.55	0.89	0.98	0.34	0.30	0.19	0.09	0.06
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 6						
Alfalfa	0.08	0.13	0.18	0.23	0.31	0.84	0.92	0.80	0.49	0.19	0.08	0.06
Pasture	0.09	0.14	0.18	0.23	0.30	0.79	0.86	0.75	0.47	0.19	0.09	0.07
Grain	0.07	0.12	0.17	0.36	0.55	0.89	0.98	0.33	0.28	0.17	0.07	0.05
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 7						
Alfalfa	0.11	0.18	0.24	0.33	0.56	0.89	0.96	0.84	0.59	0.30	0.14	0.08
Pasture	0.12	0.18	0.24	0.32	0.53	0.83	0.90	0.79	0.56	0.29	0.14	0.09
Orchard	0.24	0.28	0.31	0.36	0.49	0.67	0.71	0.65	0.51	0.35	0.26	0.22
Grain	0.10	0.17	0.23	0.43	0.61	0.86	0.96	0.65	0.24	0.18	0.13	0.07
Corn	0.10	0.17	0.23	0.42	0.51	0.79	0.97	0.95	0.25	0.19	0.13	0.07
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 8						
Alfalfa	0.12	0.19	0.26	0.35	0.63	0.91	0.97	0.85	0.62	0.34	0.16	0.08
Pasture	0.13	0.19	0.25	0.34	0.60	0.85	0.91	0.80	0.59	0.33	0.16	0.09
Orchard	0.25	0.29	0.32	0.37	0.53	0.69	0.72	0.65	0.52	0.37	0.27	0.22
Grain	0.11	0.18	0.25	0.46	0.67	0.97	0.92	0.72	0.33	0.24	0.15	0.07
Corn	0.11	0.18	0.25	0.45	0.61	0.92	1.00	0.92	0.65	0.24	0.15	0.07
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
						Area 9						
Alfalfa	0.20	0.26	0.35	0.55	0.80	0.97	1.02	0.91	0.72	0.47	0.26	0.16
Pasture	0.20	0.26	0.34	0.52	0.75	0.91	0.96	0.85	0.68	0.45	0.26	0.16
Orchard	0.29	0.32	0.37	0.48	0.62	0.72	0.75	0.69	0.58	0.44	0.32	0.27
Grain	0.19	0.25	0.33	0.53	0.84	0.98	0.79	0.13	0.21	0.39	0.24	0.15
Corn	0.19	0.25	0.33	0.45	0.61	0.92	1.00	0.92	0.65	0.39	0.24	0.15
Beans	0.19	0.25	0.33	0.37	0.41	0.53	0.70	0.81	0.21	0.39	0.24	0.15
Peas	0.19	0.25	0.33	0.53	0.70	0.92	0.98	0.13	0.21	0.39	0.24	0.15
Potatoes	0.19	0.25	0.33	0.43	0.54	0.76	0.84	0.77	0.63	0.39	0.24	0.15
Sm. Truck	0.19	0.25	0.33	0.39	0.45	0.59	0.69	0.80	0.21	0.39	0.24	0.15
Sugar Beets	0.19	0.25	0.33	0.43	0.57	0.81	0.90	0.80	0.59	0.41	0.24	0.15
Tomatoes	0.19	0.25	0.33	0.46	0.58	0.82	0.86	0.77	0.59	0.39	0.24	0.15
Phreatophytes	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
High WT Grasses	0.20	0.35	0.51	0.65	0.77	0.90	1.00	0.95	0.75	0.55	0.31	0.18
Water	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.47	0.24

Table 16. Unit water use, U, for irrigated crops in Weber River study unit.

Crop	Avg. Growing Season	April	May	June	July	Aug	Sept	Oct	Total
			Area No. 1						
Pasture	June 13 to Sept 5	----	----	1.62	5.05	4.70	0.57	----	11.9
			Area No. 2						
Alfalfa	May 23 to Sept 13	----	0.59	4.20	6.21	5.83	1.74	----	18.6
Pasture	May 23 to Sept 13	----	0.58	4.08	5.81	5.46	1.66	----	17.6
Grain	May 1 to Aug 18	----	2.76	5.27	6.55	2.99	----	----	17.6
			Area No. 3						
Alfalfa	May 18 to Sept 7	----	1.52	4.53	6.57	5.78	0.94	----	19.3
Pasture	May 18 to Sept 7	----	1.45	4.35	6.16	5.46	0.90	----	18.3
Grain	May 1 to Aug 20	----	2.87	5.23	6.70	3.48	----	----	18.3
			Area No. 4						
Alfalfa	May 12 to Sept 20	----	1.74	4.90	6.66	5.68	2.53	----	21.5
Pasture	May 12 to Sept 20	----	1.68	4.60	6.25	5.37	2.40	----	20.3
Grain	Apr 22 to Aug 22	1.20	3.32	5.80	6.59	3.09	----	----	20.0
			Area No. 5						
Alfalfa	May 27 to Sept 10	----	0.30	4.08	6.44	6.02	1.44	----	18.3
Pasture	May 27 to Sept 10	----	0.30	3.96	6.02	5.70	1.36	----	17.3
Grain	May 1 to Aug 12	----	2.98	5.50	6.94	2.18	----	----	17.6
			Area No. 6						
Alfalfa	May 28 to Sept 5	----	0.20	3.83	5.88	5.83	0.71	----	16.5
Pasture	May 28 to Sept 5	----	0.20	3.65	5.55	5.46	0.68	----	15.5
Grain	May 1 to Aug 5	----	2.81	5.32	6.40	1.12	----	----	15.6
			Area No. 7						
Alfalfa	April 23 to Sept 9	0.43	3.69	5.62	6.58	5.18	0.96	----	22.5
Pasture	April 23 to Sept 9	0.42	3.52	5.25	6.23	4.86	0.92	----	21.2
Grain	April 13 to Aug 26	1.00	3.31	5.31	6.09	4.33	----	----	20.0
Corn	April 23 to Sept 9	0.40	2.82	4.88	6.87	6.08	1.24	----	22.3
Orchard	April 23 to Sept 9	0.41	3.04	4.20	4.96	4.03	0.80	----	17.4
			Area No. 8						
Alfalfa	April 18 to Sept 13	1.04	4.27	6.01	7.15	5.57	1.45	----	25.5
Pasture	April 18 to Sept 13	0.98	4.05	5.70	6.71	5.24	1.36	----	24.0
Grain	April 18 to Aug 16	0.94	3.72	6.14	6.78	2.43	----	----	20.0
Corn	April 26 to Sept 13	0.29	3.11	5.32	7.37	6.22	1.73	----	24.0
Orchard	April 18 to Sept 13	0.86	3.22	4.37	5.09	4.00	1.10	----	18.6
			Area No. 9						
Alfalfa	April 11 to Oct 19	1.57	4.85	6.62	7.97	6.60	3.97	1.28	32.8
Pasture	April 11 to Oct 19	1.51	4.62	6.28	7.35	6.31	3.81	1.25	31.1
Grain	April 1 to Aug 1	2.15	4.97	6.62	6.11	0.15	----	----	20.0
Corn	April 11 to Sept 22	1.28	3.61	6.21	7.74	6.60	2.56	----	28.0
Orchard	April 11 to Oct 19	1.31	3.73	4.93	5.73	4.95	3.11	1.12	24.9
Beans	May 21 to Aug 17	----	0.78	3.58	5.42	3.18	----	----	13.0
Peas	Apr 29 to July 22	0.16	4.14	6.21	5.49	----	----	----	16.0
Potatoes	May 2 to Sept 8	----	2.99	5.13	6.50	5.52	0.90	----	21.0
Small Truck	May 5 to Aug 29	----	2.23	3.98	3.32	3.47	----	----	13.0
Sugar Beets	April 11 to Oct 19	1.23	3.37	5.54	6.97	5.74	3.17	0.81	26.8
Tomatoes	April 22 to Sept 27	0.49	3.43	5.54	6.66	5.52	2.85	----	24.5


Willard Peak
Salt Flats
4673
Weber R
OGDEN
Mud Flats
GREAT SALT LAKE
Mt Ogden
9572
Weber
Morgan
Farmington
East Canyon
8152
East Canyon Reservoir
40
35
30
25
20
17
15


Blaney-Criddle "F" values
(based on growing season between 28° frost)
minimum to mature corn
minimum to mature spring grain
minimum
0
20
25
30
35
40
1
2
3
4
5
6
7
8
9
Sub-Area No.

Silver
Cr
Rockport
Lake
Coalville
Weber
River
Chalk
Creek
Echo
Canyon
Lost
Creek
Creek
Hoyt Pk
10239
Mount Watson
9275
9308
20
17
15
12

normal precipitation. In the Weber River study unit these "water-loving" plants (phreatophytes) consist mainly of cottonwoods, willows, salt grass, and marshy plants such as cattails, tule, rushes, etc. To determine the influence of these plants on the water budget for the study unit, unit monthly water use has been determined as shown in Table 19 from "k" values suggested by Blaney and Muckel (1955) and used by Lee (1964).

Table 17. Coefficients, k, for estimating water use by open bodies of water and phreatophytes in the Weber River study unit.

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Open fresh water [a]	0.28	0.50	0.74	0.94	1.10	1.18	1.25	1.17	0.94	0.68	0.34	0.24
Marshy plants, tules, cottonwoods, willows [b]	0.48	0.71	0.94	1.15	1.30	1.35	1.40	1.35	1.30	1.20	0.85	0.44
Salt grass, 1 foot WT [b]	0.20	0.35	0.51	0.65	0.70	0.90	1.00	0.95	0.75	0.65	0.31	0.18

[a] Adapted from Lee, 1964.

[b] After Blaney-Muckel, 1955.

Table 18. Unit water loss from open fresh water in the Weber River study unit.

Area No.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1	0.40	0.80	1.69	3.07	4.92	6.25	7.70	6.47	4.01	2.20	0.62	0.37	38.50
2	0.44	0.92	1.97	3.45	5.51	6.99	8.35	7.18	4.39	2.43	0.71	0.42	42.76
3	0.42	0.92	2.10	3.61	5.74	6.94	8.55	7.18	4.44	2.46	0.75	0.42	43.53
4	0.41	0.92	2.09	3.65	5.80	7.06	8.68	7.30	4.51	2.48	0.75	0.41	44.06
5	0.42	0.93	2.18	3.87	5.96	7.29	8.85	7.49	4.58	2.52	0.78	0.42	45.29
6	0.43	0.95	2.05	3.45	5.62	7.06	8.16	7.18	4.35	2.43	0.73	0.42	42.83
7	0.42	0.93	2.18	3.86	5.96	7.29	8.85	7.49	4.58	2.52	0.78	0.42	45.28
8	0.36	0.80	2.00	3.84	6.11	7.47	9.21	7.66	4.76	2.58	0.74	0.38	45.91
9	0.49	1.06	2.45	4.23	6.51	7.97	9.68	8.39	5.05	2.77	0.87	0.48	49.95

Table 19. Unit water loss from natural phreatic vegetation where water supply exceeds precipitation in the Weber River study unit.

Area No.	Jan.	Feb.	Mar.	Apr.	May	June	(Inches) July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1													
2				----	1.52	7.99	9.35	8.29	2.63	----			29.79
3				----	2.63	7.94	9.58	8.29	1.43	----			29.87
4				----	4.19	8.07	9.72	8.42	4.16	----			34.56
5				----	0.92	8.34	9.91	8.64	1.90	----			29.71
6				----	0.64	8.07	9.14	8.29	1.00	----			27.14
7				1.11	7.05	8.34	9.91	8.64	1.90	----			36.95
8				.88	7.22	8.55	10.32	8.84	2.86	----			39.67
9 [a]				3.28	7.70	9.11	10.84	9.68	6.98	2.99	----	----	50.58
9 [b]				1.85	4.14	6.08	7.74	6.81	4.03	1.62	----	----	32.27

[a] cottonwoods, willows, marshy plants, tules

[b] salt grass pasture, shallow water tules

Streamflow

Data network

Streamflow measurements have been collected for most of the rivers and creeks in the Weber River study unit. Although some of these measurements only cover a year or two, they are valuable in assessing the water resources within the area. The location of stream gaging stations is shown in Fig. 10. A listing of these stations, including the period of time for which measurements were collected, is given in Table 20. Those stations which reflect near natural flow conditions not affected by man's works, are flagged with an asterisk. Out of a total of 33 gaged stations, 15 are classed as "resource" stations and reflect natural flow conditions. Some of the streamflow records in the Weber River study unit have been extended by correlation with adjacent stations.

The mean (1931-60) monthly and annual runoff for the gaging stations in this study unit is listed in Table 21.

Geographic distribution

The mean annual runoff, or water yield map for the Weber River study unit, is shown in Fig. 23. The physical characteristics of many small watersheds within the study unit were used in accordance with the correlation techniques reported by Bagley, Jeppson, and Milligan (1964) in developing the water yield map. By measuring the area between adjacent water yield lines, and multiplying by the average depth for each area, the surface runoff can be determined for any watershed. Any value of surface runoff developed from Fig. 23 represents the mean annual flow for the 1931-1960 time base. The water yield map has been used to determine the distribution of yield with land area for each subarea as shown in Fig. 24.

For the entire Weber River study unit the total mean annual yield is approximately 7 inches. Mean annual precipitation for the same period amounts to approximately 23 inches. This means that about 16 inches of water or nearly 72 percent of the total precipitation is consumed on the watershed without producing measurable runoff. Mean annual yield figures for each subarea are shown in Table 22. Monthly distribution of yield is shown in Table 23.

Not all of the runoff that occurs naturally on a watershed is easily manageable. Water yield from low lying areas may be sporadic and occur only in the spring after heavy rain or excessive snow melt, and thus not be readily retained in reservoirs for later summer use. Fortunately, most of the yield comes from the higher elevation areas above 7,000 feet. This means that a relatively small part of the watershed produces the water used on the entire watershed. From Fig. 24 it can be seen that 10 percent of the land area in the Weber River study unit has a yield value in excess of 19 inches and that 50 percent of the land area produces over 82 percent of the total yield.

Time variation

Time variation of streamflow can be expressed in a number of ways. The long-time changes which occur over a period of many years can be sensed by a plot of running averages of annual streamflow. A probabilistic format is more useful in expressing time variations of annual or monthly flows. Frequency distributions, similar to those prepared for temperature and precipitation have been developed to evaluate the probability of occurrence of runoff at a stream gaging station. Daily variations in flow can be utilized in developing flow duration curves or high- and low-flow sequence curves.

Running averages

A long cyclic period of runoff is difficult to detect because the available historical record of the event is too short. It is doubtful, with present knowledge, if true long-time cycles actually exist. An analysis of the historical record may, however, be of some value in indicating present trends. By plotting 5-year running averages of runoff for several resource gaging stations within the Weber River study unit the trends indicated in Fig. 25 are noted. It would appear that in subarea 1 the flow of Weber River at Oakley is in a downward trend, while the other stations reveal no trend, or as in the case of Chalk Creek, a slightly upward trend. In as much as management practice on the watershed has a marked effect on the amount of runoff it would be difficult to place a meaning on "long-time" trends which may appear with such short-time records. It may be noted that the plot of average precipitation, which is the source of runoff, does not indicate a downward trend.

Frequency distributions

There is value in knowing the probability that certain annual flows could recur in a given year. This would not in any way be a prediction that the flow would occur but only a way of assessing the risk involved in making decisions based on certain design flows. This type of information is even of greater use when applied to mean monthly flows. Runoff frequency distributions for annual flows at several gaging stations within the Weber River study unit are shown in Fig. 26. Frequency distributions on a monthly basis for the several gaging stations are shown in Fig. 27. The probabilities represent the volume of runoff that would be equaled or exceeded. Frequencies of 5, 10, 25, 50, 75, 90, and 95 percent were computed by ranking the data. The 1 and 99 percent frequencies were obtained by extrapolation using a quadratic equation based upon Lagrange's formula. Since these extreme frequencies were obtained by extrapolation, considerable inaccuracy may exist. The upper value in each frequency distribution, which is 1 percent, is the runoff which will be exceeded, on the average, once in a 100 year period. The lower value, which represents 99 percent, is the runoff which would probably be exceeded 99 times in a 100 year period.

Table 20. Stream gaging stations located in the Weber River study unit.

Station No.	Name of Stream Gage	Period of Record
1275 *	Weber River above Smith & Morehouse Creek, near Oakley, Utah	1947
1280 *	Smith and Morehouse Creek near Oakley, Utah	1947
1285 *	Weber River near Oakley, Utah	1905-1968
1293	Weber River near Peoa, Utah	1958-1968
1295	Weber River near Wanship, Utah	1951-1955, 1958-1960
	Silver Creek near Wanship, Utah	1942-1946
1305	Weber River near Coalville, Utah	1928-1968
1310 *	Chalk Creek at Coalville, Utah	1928-1968
1320	Weber River at Echo, Utah	1928-1960
1325 *	Lost Creek near Croydon, Utah	1922, 1923, 1942-1968
1330	Lost Creek at Devils Slide, Utah	1922-1933
1335	Weber River at Devils Slide, Utah	1906-1955
1345 *	East Canyon Creek near Morgan, Utah	1932-1968
1350 *	Hardscrabble Creek near Porterville, Utah	1942-1968
1355	East Canyon Creek below diversions, near Morgan, Utah	1952-1955
1360	Weber River near Morgan, Utah	1951-1955
1365	Weber River at Gateway, Utah	1891, 1892, 1895, 1896-1899 1921-1968
1370	Weber River at Ogden, Utah	1952-1958
1375 *	South Fork Ogden River near Huntsville, Utah	1922-1968
1376	South Fork Ogden River at Huntsville, Utah	1960-1968
1377 *	North Fork Ogden River near Huntsville, Utah	1960-1968
1378	Middle Fork Ogden River near Huntsville, Utah	1959-1968
1379	Spring Creek at Huntsville, Utah	1959-1968
1393 *	Wheeler Creek near Huntsville, Utah	1959-1968
1395	Ogden River near Ogden, Utah	1905-1912, 1932-1959
1400	Ogden River below Pine View Dam, near Ogden, Utah	1938-1960
	Ogden River at powder mill near Ogden, Utah	1890, 1898
1410	Weber River near Plain City, Utah	1905-1968
1415 *	Holmes Creek near Kaysville, Utah	1950-1968
1420 *	Farmington Creek above diversions, near Farmington, Utah	1950-1968
1425 *	Ricks Creek above diversions, near Centerville, Utah	1950-1968
1430 *	Parrish Creek above diversions, near Centerville, Utah	1950-1968
1435 *	Centerville Creek above diversions, near Centerville, Utah	1950-1968
1440 *	Stone Creek above diversions, near Bountiful, Utah	1950-1968
1450	Mill Creek at Mueller Park, near Bountiful, Utah	1950-1968

Flow-duration

The flow-duration curve is a cumulative frequency curve (integral of the frequency diagram) that shows the percent of time during which specified discharges were equaled or exceeded in a given period (Searcy, 1959). The flow-duration curve does not represent the chronological sequence of flows. Consequently, it is not possible to determine from the curve whether the lowest or highest flows occurred in consecutive periods or were scattered throughout the record.

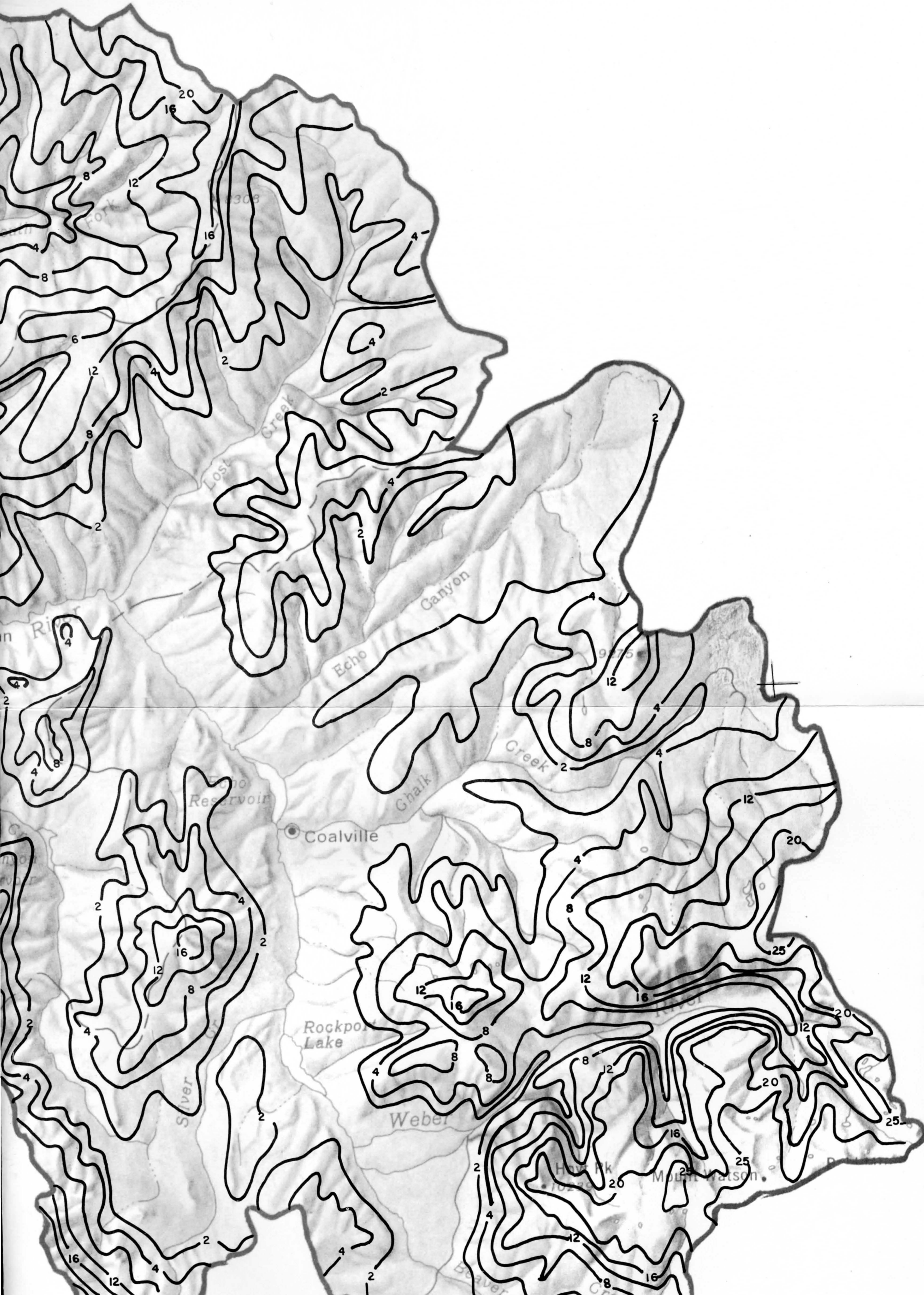
Flow-duration curves are useful for determining the probability of future streamflows. Also, the shape of the curve can be used in evaluating general watershed characteristics. If the curve has been developed from a sufficiently long period of record, the flow-duration curve may be considered a probability curve and used to estimate the percent of time that a specified discharge will be equaled or exceeded in the future.

A streamflow record integrates the effects of climate, topography, and geology. The flow-duration

Table 21. Mean annual runoff for stream in the Weber River study unit.

Gaging Station	yrs. of record	Mean Annual Runoff (1932-1963)	Mean Annual Runoff (1931-1960)
		ac-ft	
Weber R. ab. Smith & Morehouse Cr. nr. Oakley		69,360	
Smith and Morehouse Cr. nr. Oakley		37,160	
Weber River nr. Oakley		140,320	140,430
Weber River nr. Peoa			
Weber River nr. Wanship		130,630	
Silver Creek near Wanship		4,590	
Weber River near Coalville		136,060	136,750
Chalk Creek near Coalville		40,310	40,750
Weber River at Echo		190,640	
Lost Cr. near Croydon		19,890	
Lost Cr. near Devils Slide		36,270	
Weber R. at Devils Slide		241,370	
East Canyon Cr. nr. Morgan		35,130	37,970
Hardscrabble Cr. nr. Porterville		20,510	
East Canyon Cr. bel. div. nr. Morgan		43,160	
Weber River near Morgan		290,540	
Weber River at Gateway		359,520	371,610
Weber River at Ogden		205,200	
South Fork Ogden River nr. Huntsville		76,300	77,330
South Fork Ogden River at Huntsville		62,820	
North Fork Ogden River nr. Huntsville		33,330	
Middle Fork Ogden River at Huntsville		27,650	
Spring Cr. at Huntsville		7,500	
Wheeler Cr. nr. Huntsville		6,090	
Ogden River nr. Ogden		160,820	
Ogden R. below Pine View Dam nr. Ogden		55,140	
Ogden R. at Powder Mill nr. Ogden			
Weber River near Plain City		351,940	367,870

GREAT SALT LAKE
Salt Flats
4673
Mud Flats
Weber R
OGDEN
Ogden
Mt Ogden
Willard Peak
Weber
East Canyon



Lost Creek
Echo Canyon
Chalk Creek
Echo Reservoir
Coalville
Rockport Lake
Weber River
Silver Creek
Beaver Creek
Mount Watson

Table 22. **Water yield by subareas in the Weber River study unit.**

Subarea	Yield inches	Yield ac-ft.
1	16.48	138,689
2	4.45	54,821
3	3.13	41,448
4	2.39	36,860
5	3.36	40,527
6	4.77	39,240
7	7.23	107,527
8	12.99	196,958
9	6.44	68,628
Total	6.65	724,698

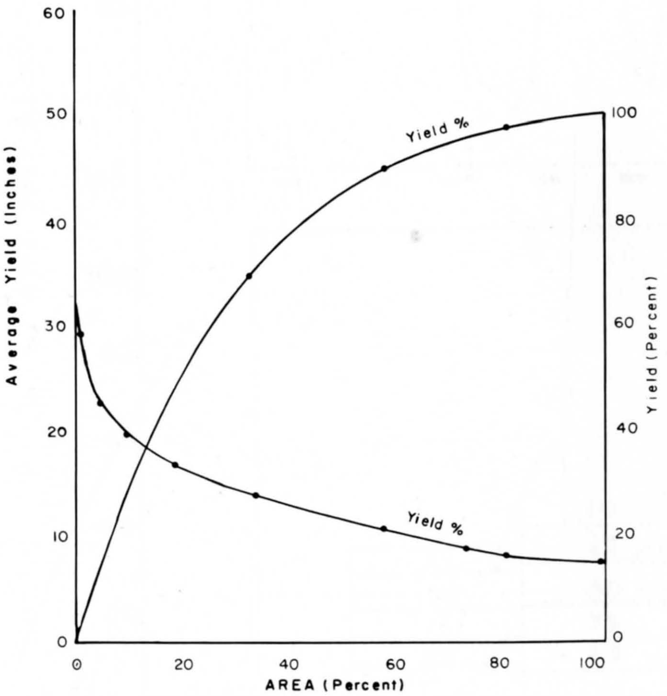


Figure 24. Distribution of yield with land area for the Weber River study unit.

curve, which is obtained from the distribution of streamflow both in time and magnitude, is affected by the hydrologic and geologic characteristics of the drainage area. Consequently, such a curve can be used to study the characteristics of a drainage basin or to compare one basin with another. A flow-duration curve having a continual steep slope denotes a highly variable stream whose flow is largely from direct runoff, whereas a curve with a flat slope reveals either surface or groundwater storage, which tends to equalize the flow. The slope of the lower end of the duration curve represents the characteristics of the perennial storage in the drainage basin; a flat slope at the lower end indicates a large amount of storage; and a steep slope indicates a negligible amount. Streams whose high flows come largely from snowmelt tend to have a flat slope at the upper end (Searcy, 1959).

Daily discharge records were used in developing flow-duration data and curves. The flow-duration curves for some of the gaging stations are shown in Fig. 28.

High- and low-flow sequence

In the preceding section, flow-duration curves were described which illustrated the percent of time that flow rates of a given magnitude can be expected to occur at a station.

Analysis of high- and low-flow sequence portrays streamflow records in such a manner that frequency and magnitude of flow for consecutive days is obtained. The analysis yields high-flow and low-flow frequency data using the high and low flows respectively, averaged over specified intervals of time. The high and low flows converge as the time period is increased and coincide at 365 days where the variations represent the frequency distribution of annual runoff.

High- and low-flow sequence curves have been prepared for some gaging stations using frequencies of 3, 10, 25, 50, 75, 90, and 97 percent. The high- and low-flow sequence curves for these stations are shown in Figs. 29 and 30. Under the assumption that the historic record is a good indication of future streamflows, the curves provide an estimate of the average high and low flows that might be expected for any particular time period and probability level.

Relationship to precipitation

Relationships between precipitation and runoff are extremely important. The greatest use of such relationships in the intermountain region is forecasting the summer water supply from snow survey measurements in the mountains. The forecasts are of tremendous economic importance, particularly to agriculturists. The forecasting process is usually complicated by the control works constructed by man and the many diversions from the system. Thus, predictions of spring and summer runoff along a major stream requires considerable analysis. The

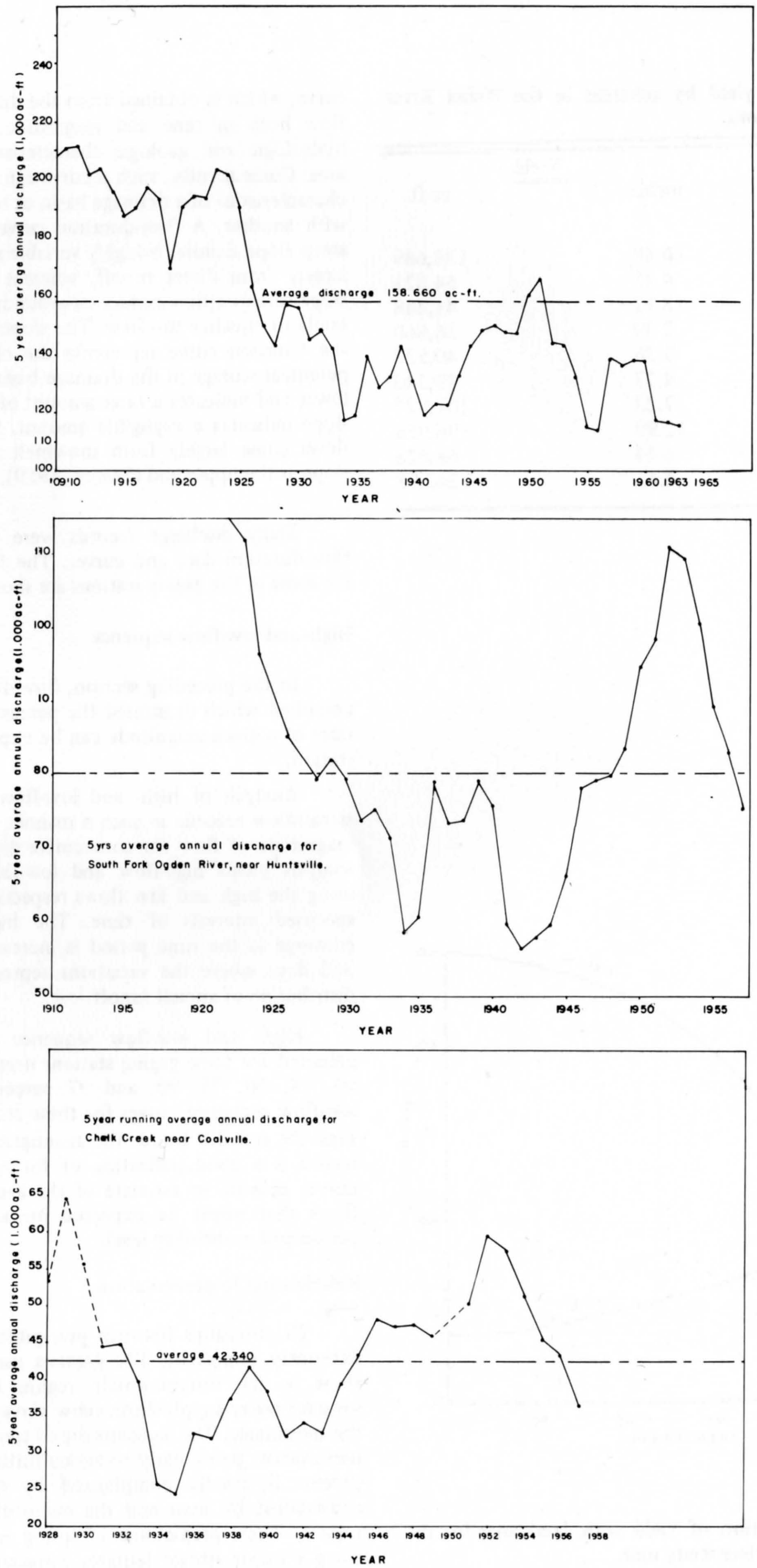


Figure 25. Running averages of runoff for selected gaging stations in the Weber River study unit.

Table 23. Distribution of mean annual and mean monthly yield for subareas in the Weber River study unit.

Area	Yield	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	138,689	4,188	3,733	3,402	2,881	3,245	3,596	8,072	39,996	46,149	12,466	6,702	4,259
2	54,821	1,215	4,322	4,327	4,160	3,986	8,567	9,366	8,903	4,145	1,991	2,016	1,823
3	41,448	926	1,114	1,068	1,059	1,050	1,613	5.944	14,729	8,627	2,712	1,541	1,065
4	36,860	1,398	1,700	2,218	2,293	2,260	3,834	8,841	7,637	5,010	625	166	878
5	40,527	826	1,207	1,007	1,017	1,152	1,927	7,854	18,237	4,003	1,463	1,022	812
6	39,240	1,353	1,755	1,655	1,692	1,735	3,214	6,322	9,124	6,687	2,211	1,970	1,522
7	107,527	3,504	3,435	3,753	3,257	4,197	10,080	24,421	26,767	13,572	5,713	5,022	3,806
8	196,958	3,450	2,806	4,068	4,779	6,052	17,698	54,935	60,728	21,430	9,520	6,471	5,021
9	68,628	1,242	1,366	3,418	3,802	2,313	3,967	15,167	23,821	8,908	2,416	1,139	1,057

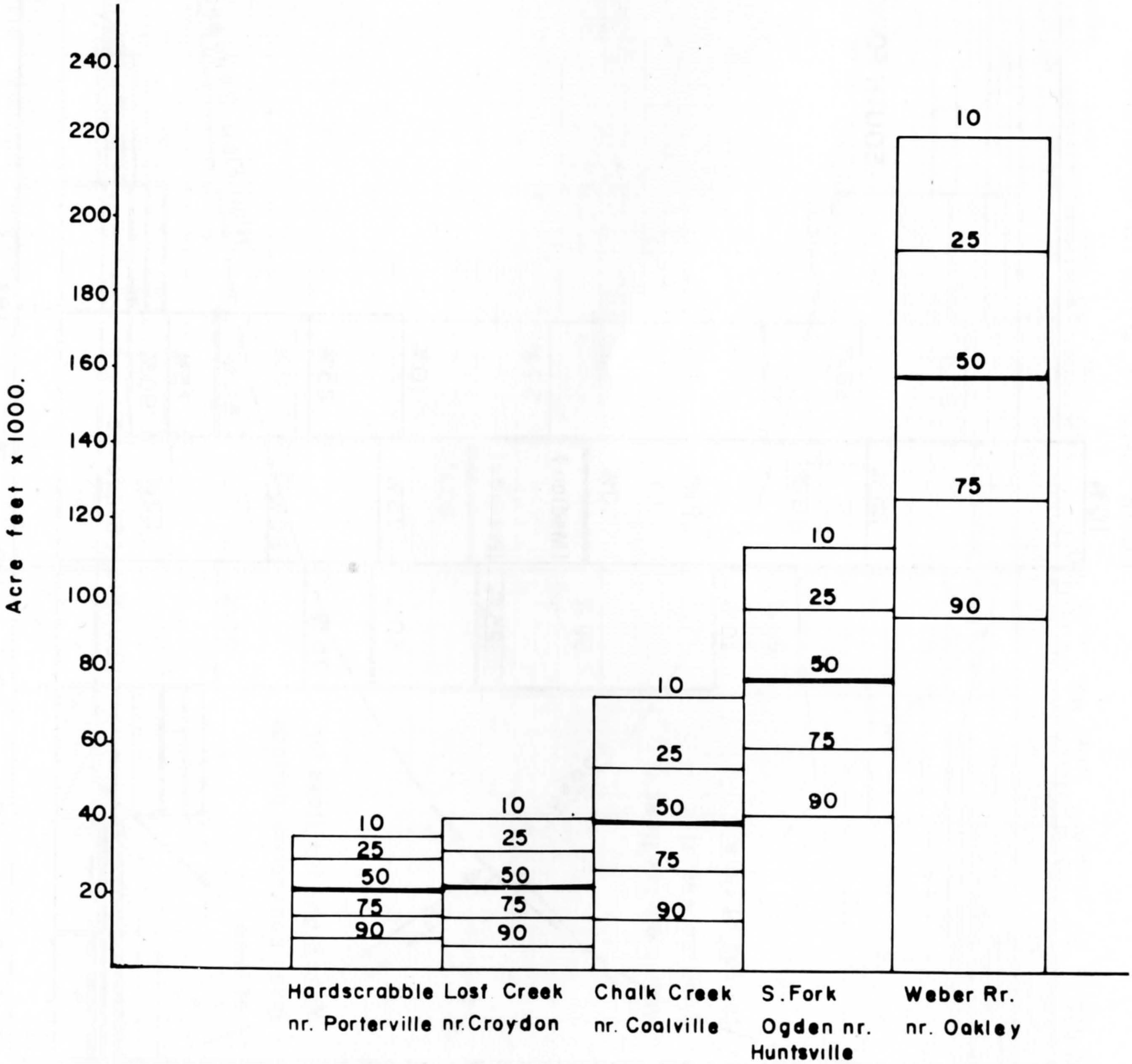


Figure 26. Mean annual runoff frequency distribution for selected stations in the Weber River study unit.

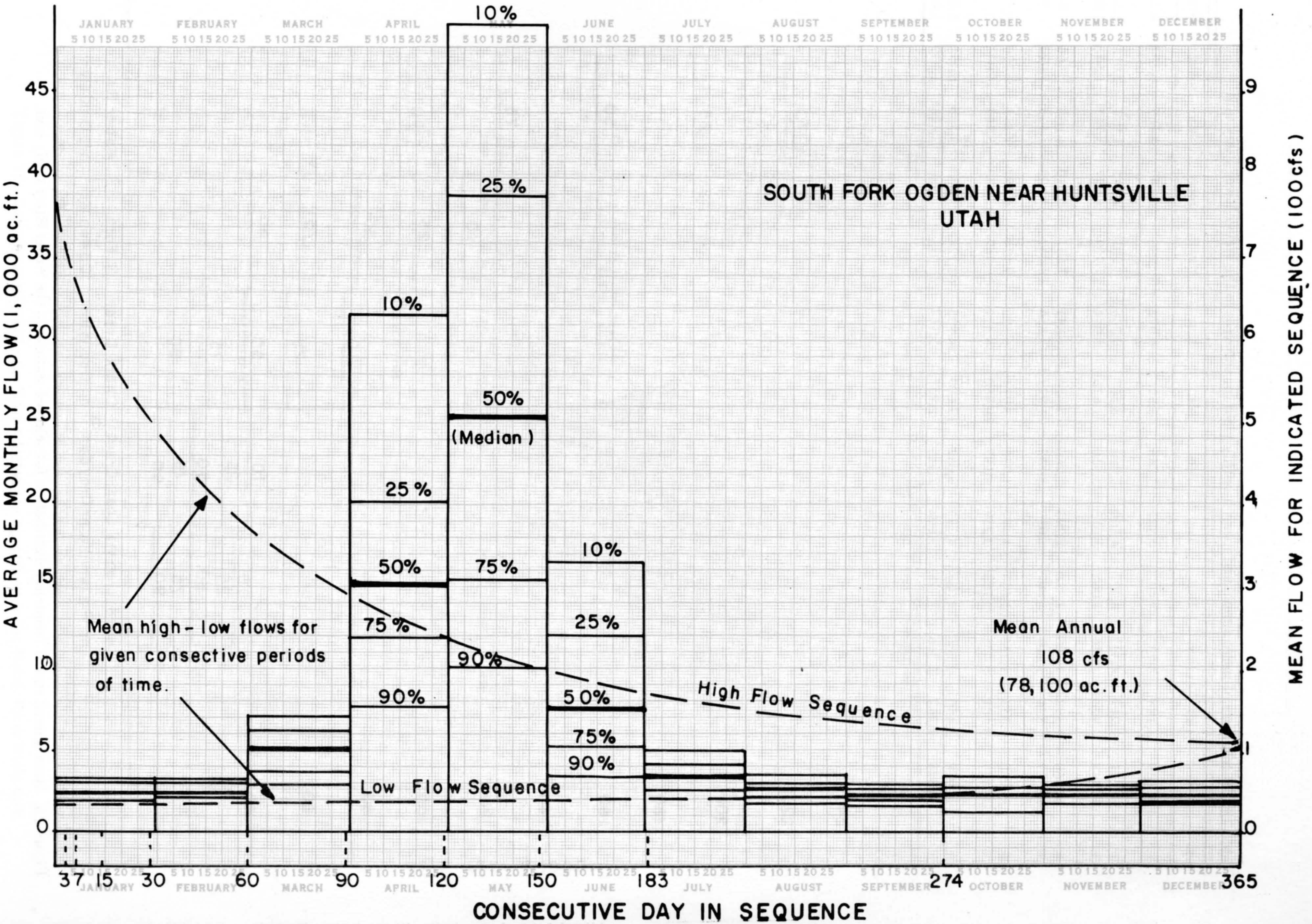


Figure 27. Mean monthly runoff frequency distribution for selected stations in the Weber River study unit.

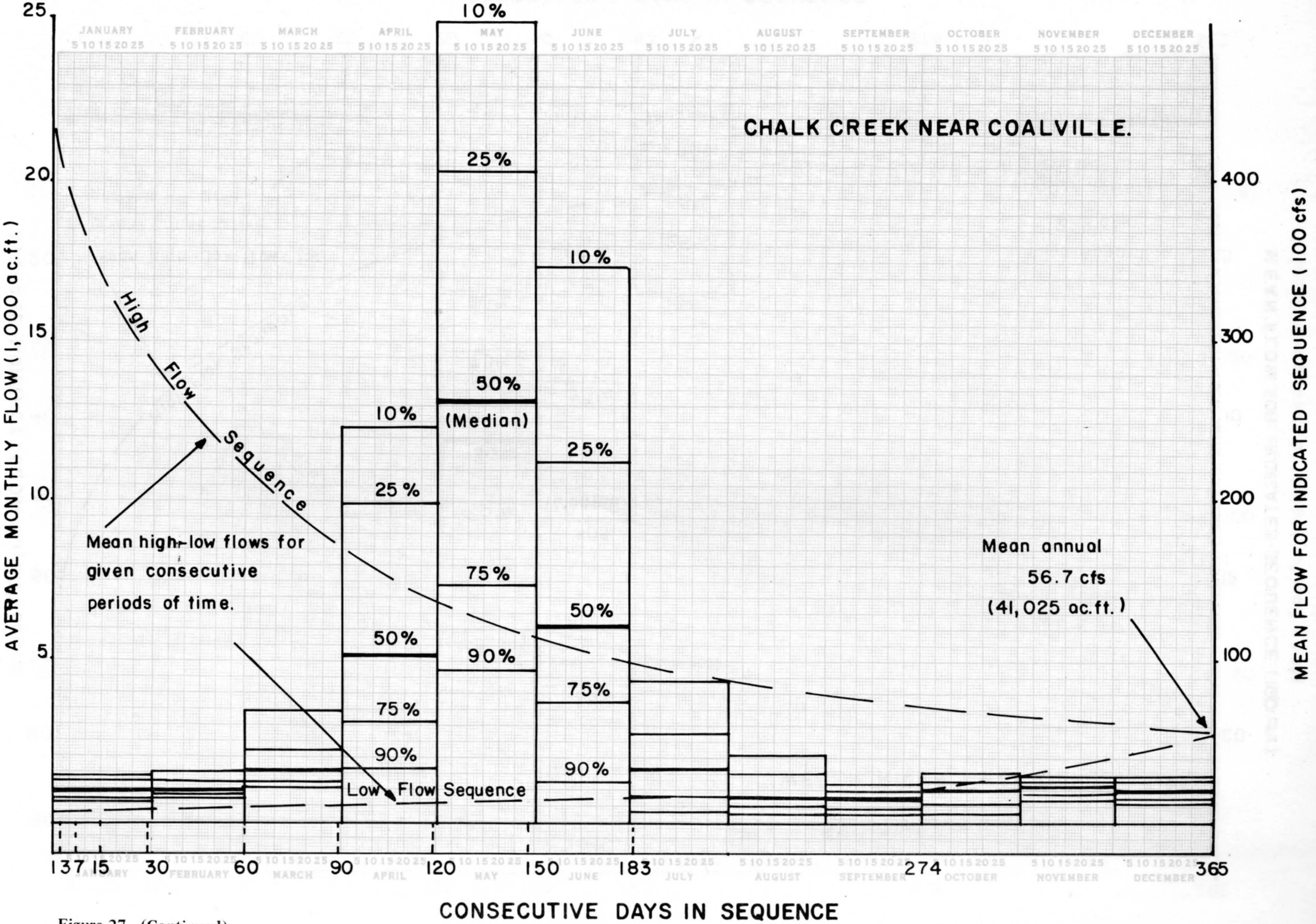


Figure 27. (Continued)

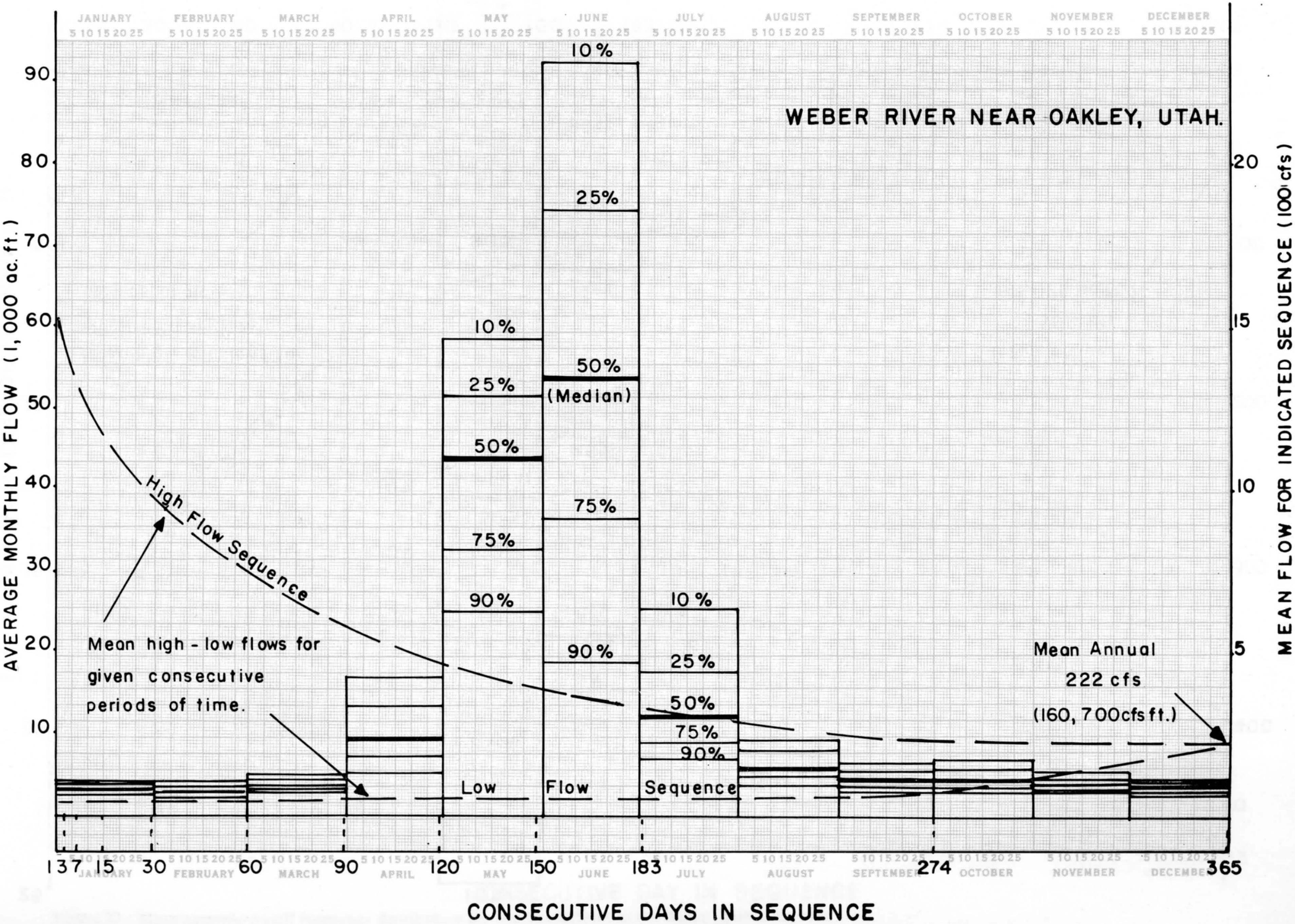
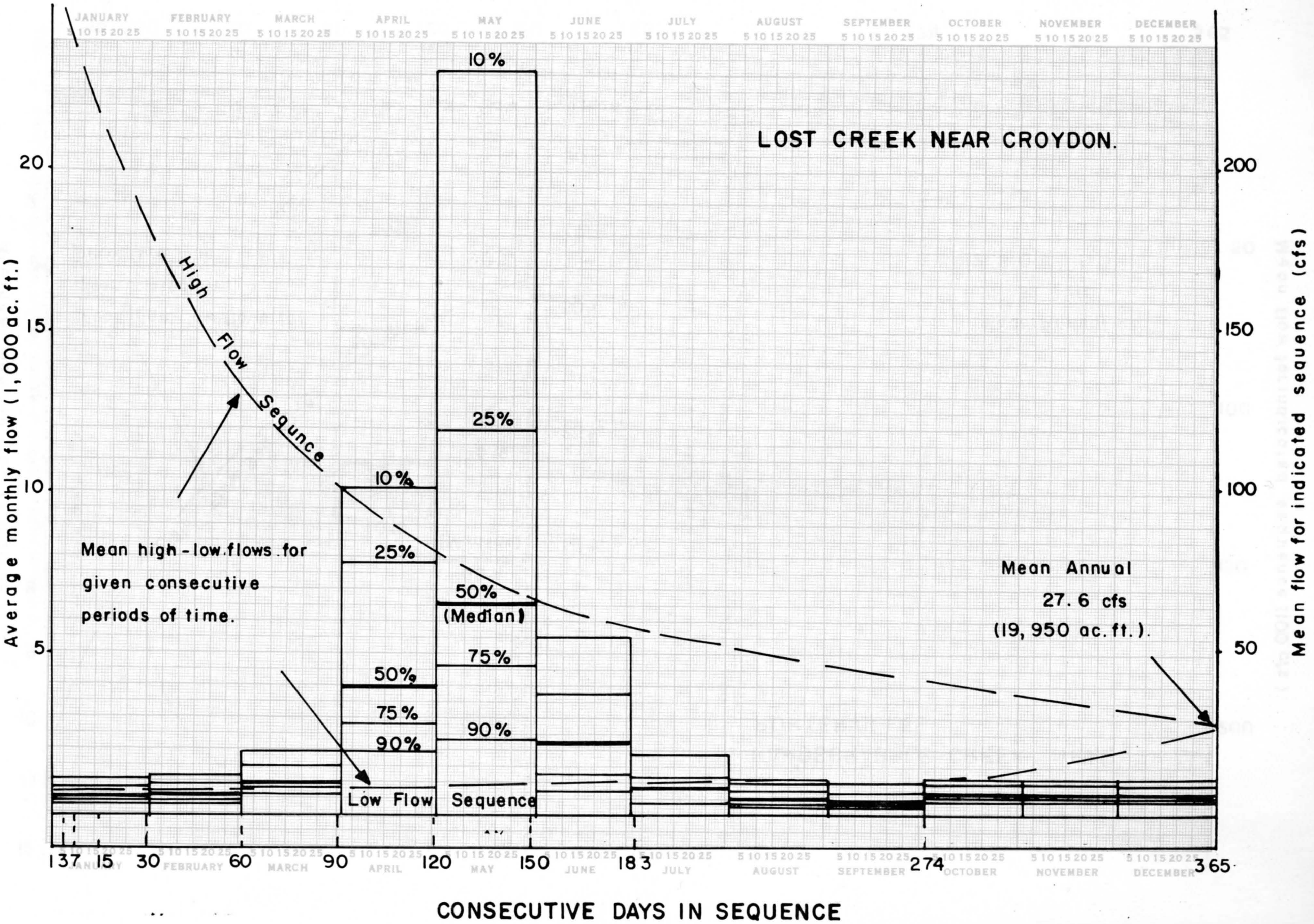


Figure 27. (Continued)



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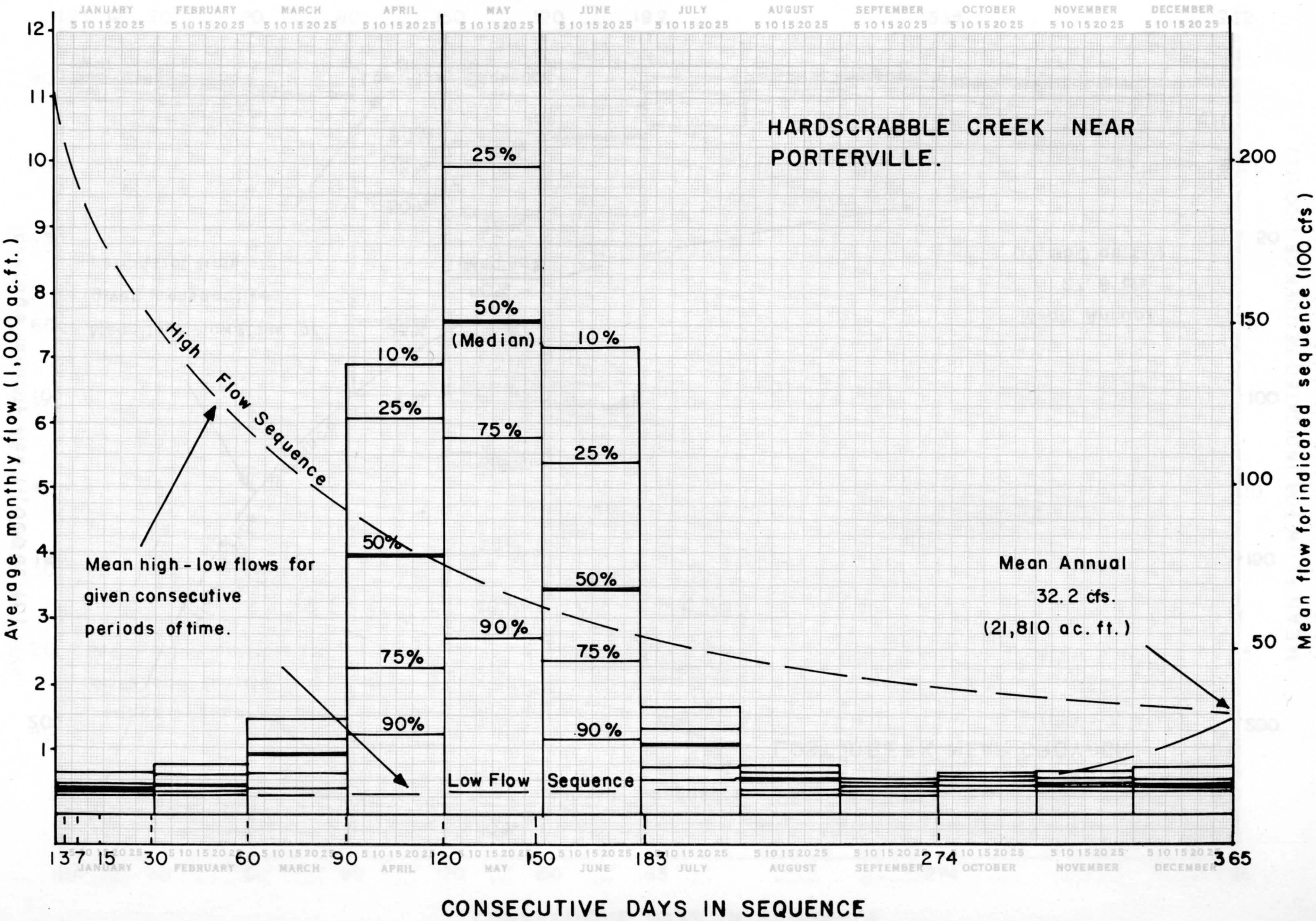

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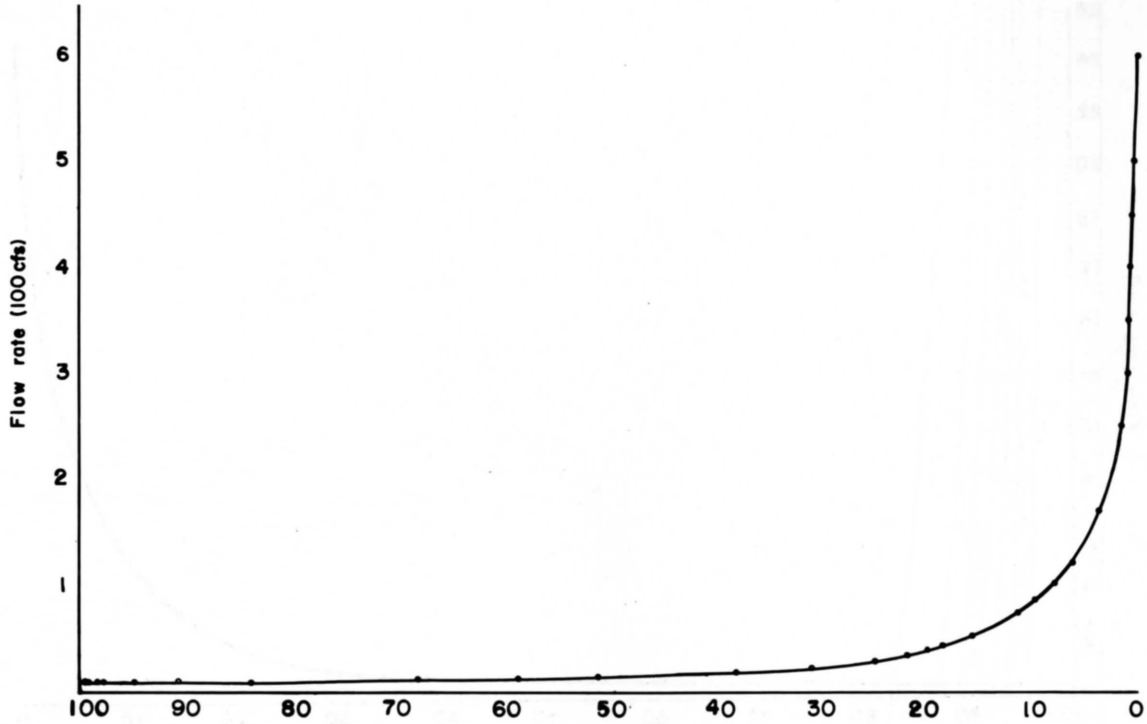
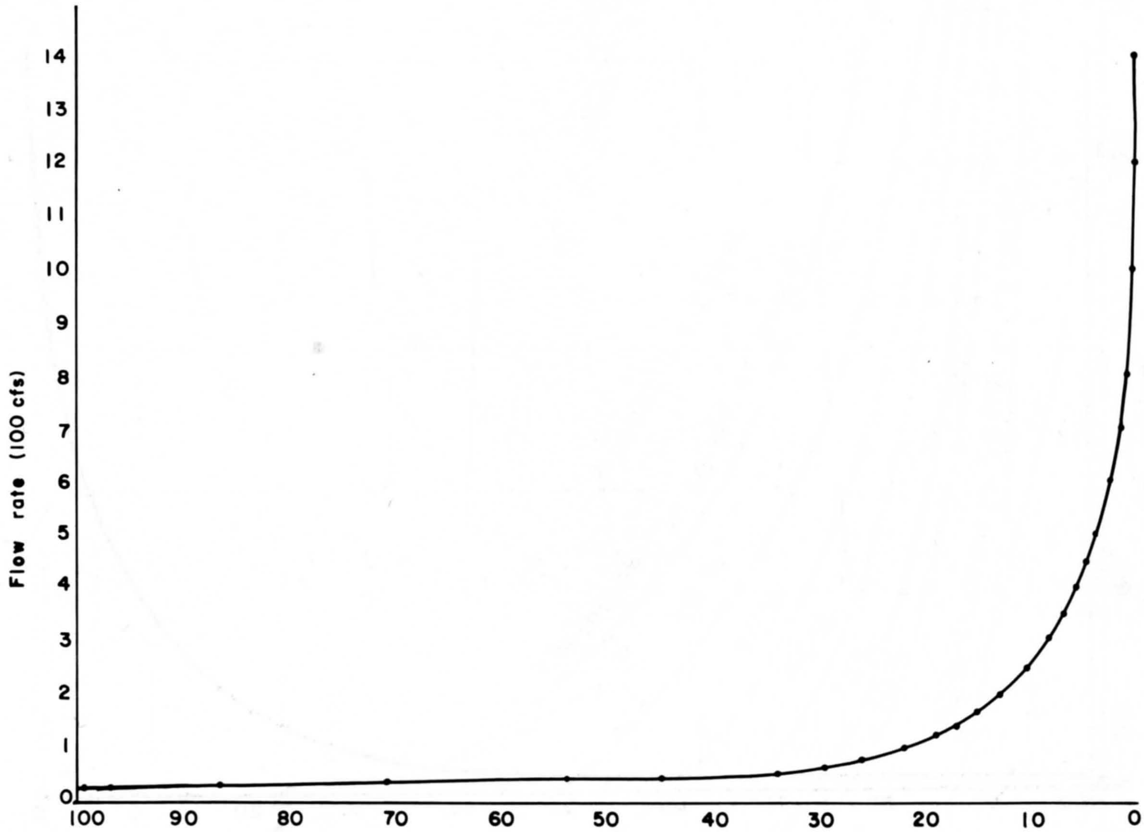
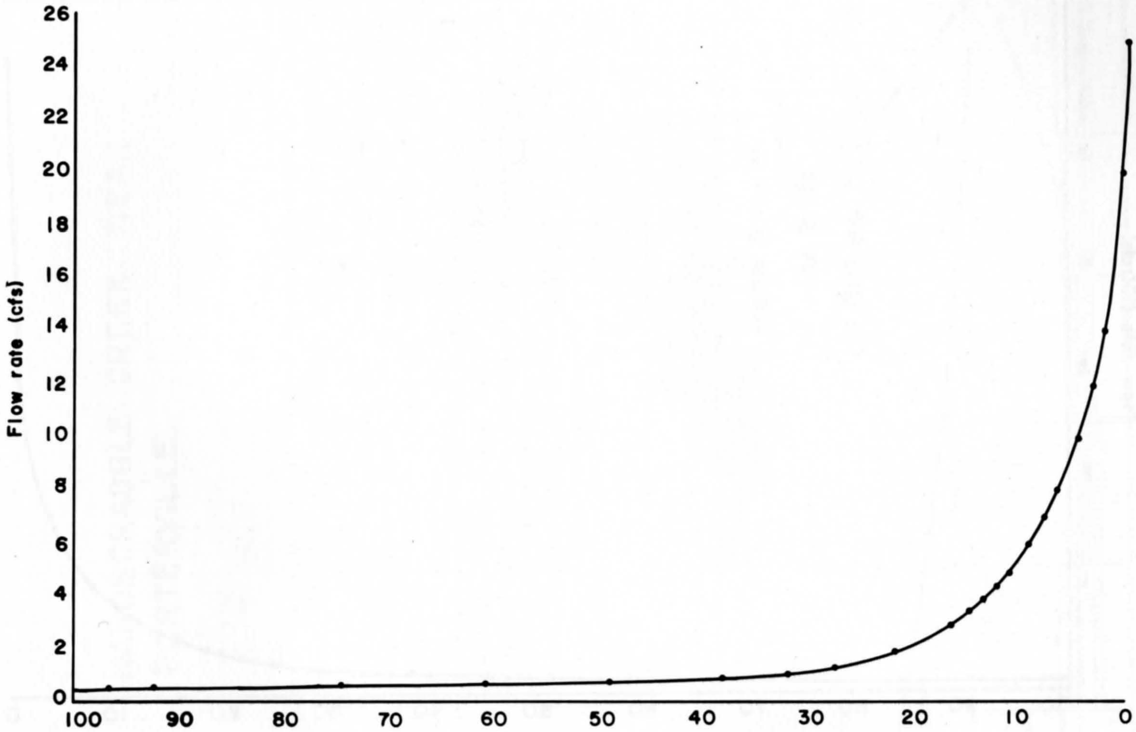


Flow-duration curve for Lost Creek near Croydon.

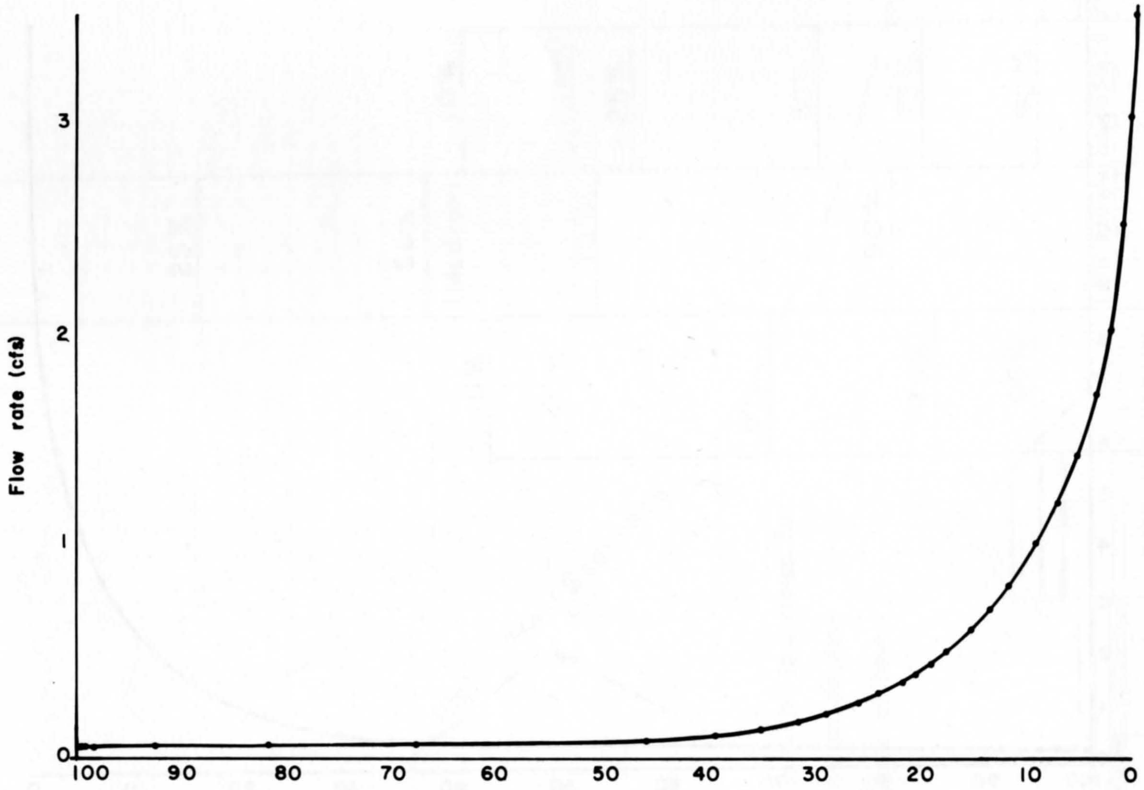


Flow-duration curve for South Fork Ogden River near Huntsville.

Figure 28. Flow duration curves for selected stations in the Weber River study unit.



Flow-duration curve for Weber River near Oakley.



Flow-duration curve for Hardscrabble Creek near Porterville.

Figure 28. Continued.

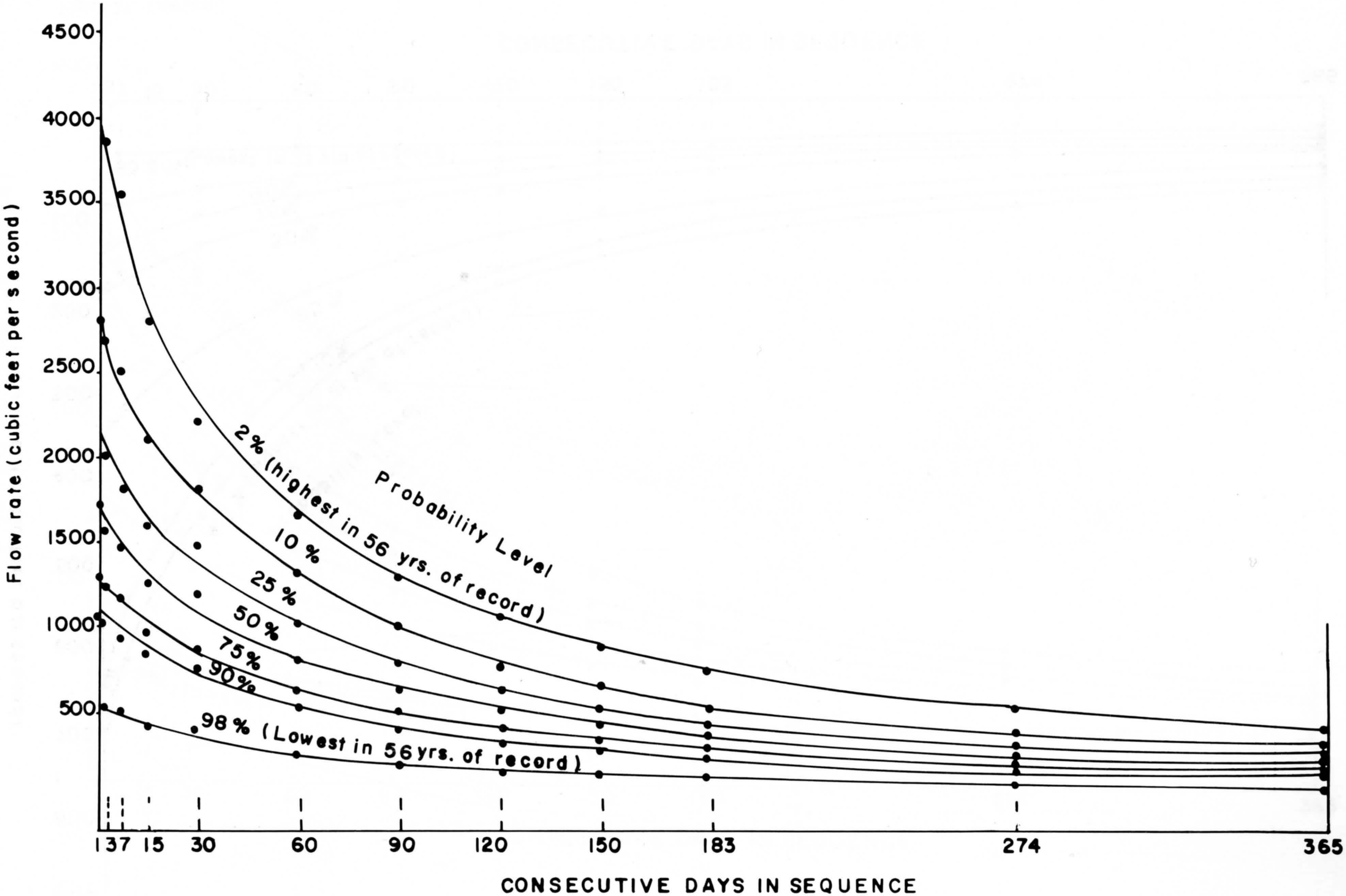


Figure 29. High-flow sequence curves for selected stations in the Weber River study unit.

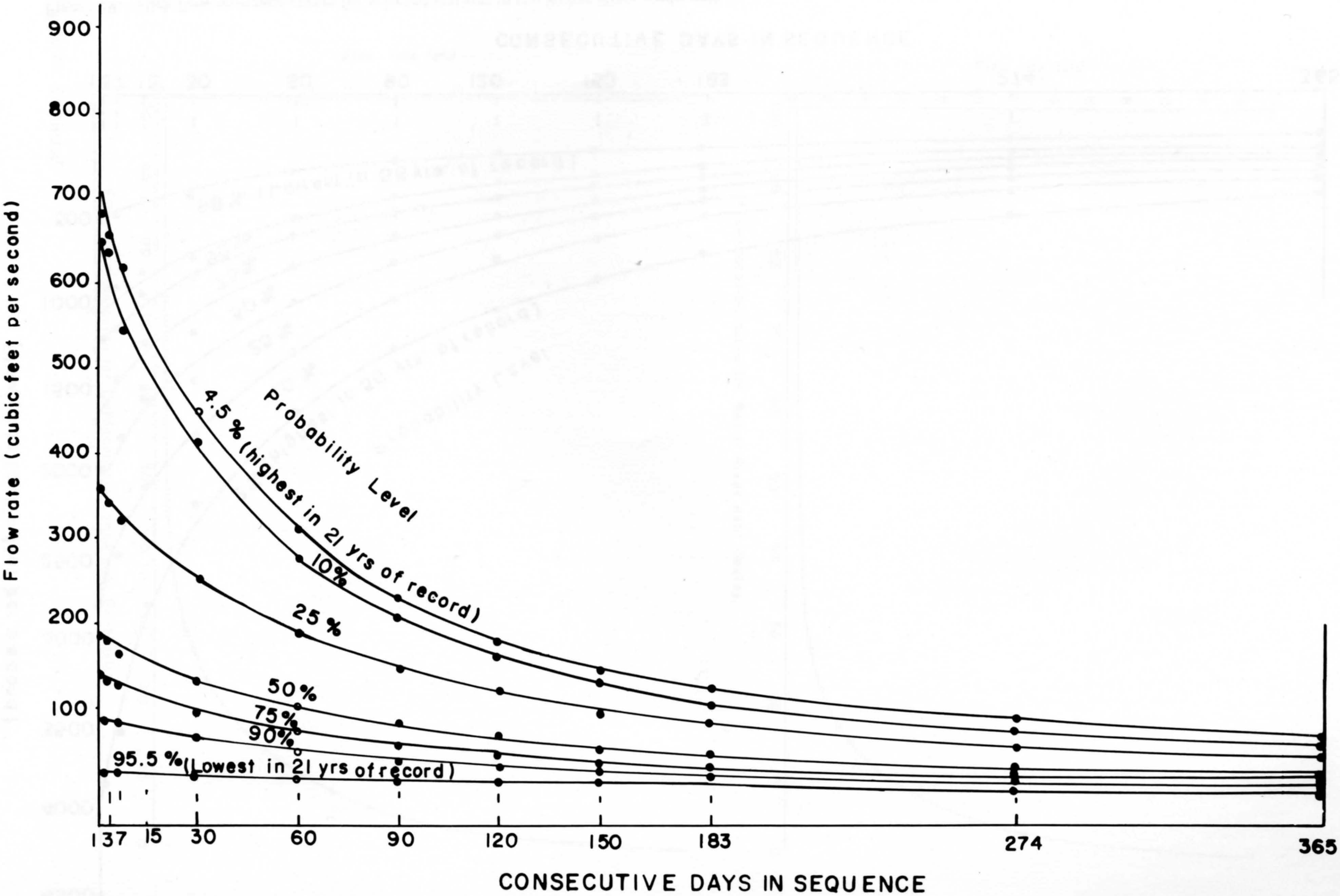


Figure 29. Continued.

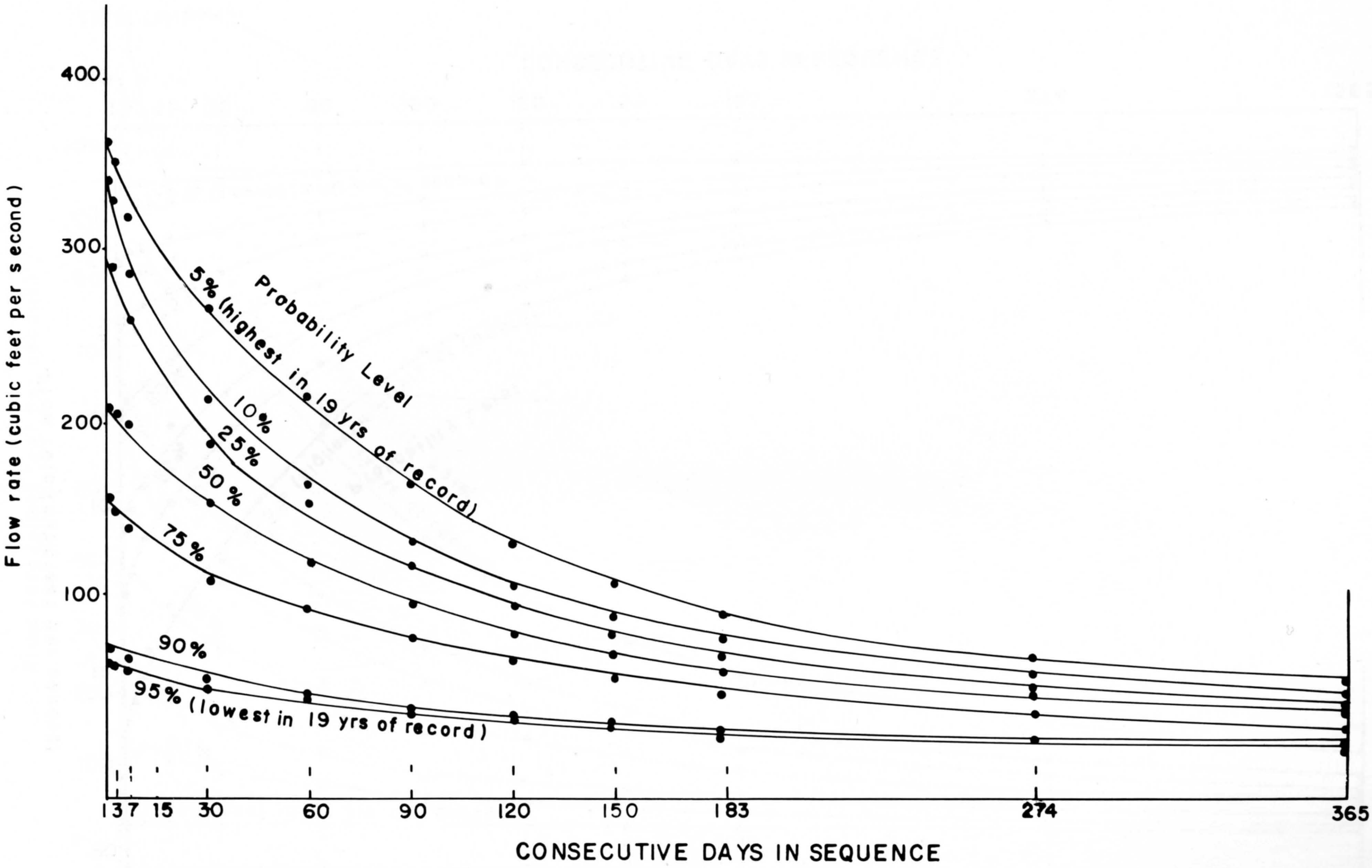


Fig. 29. Continued.

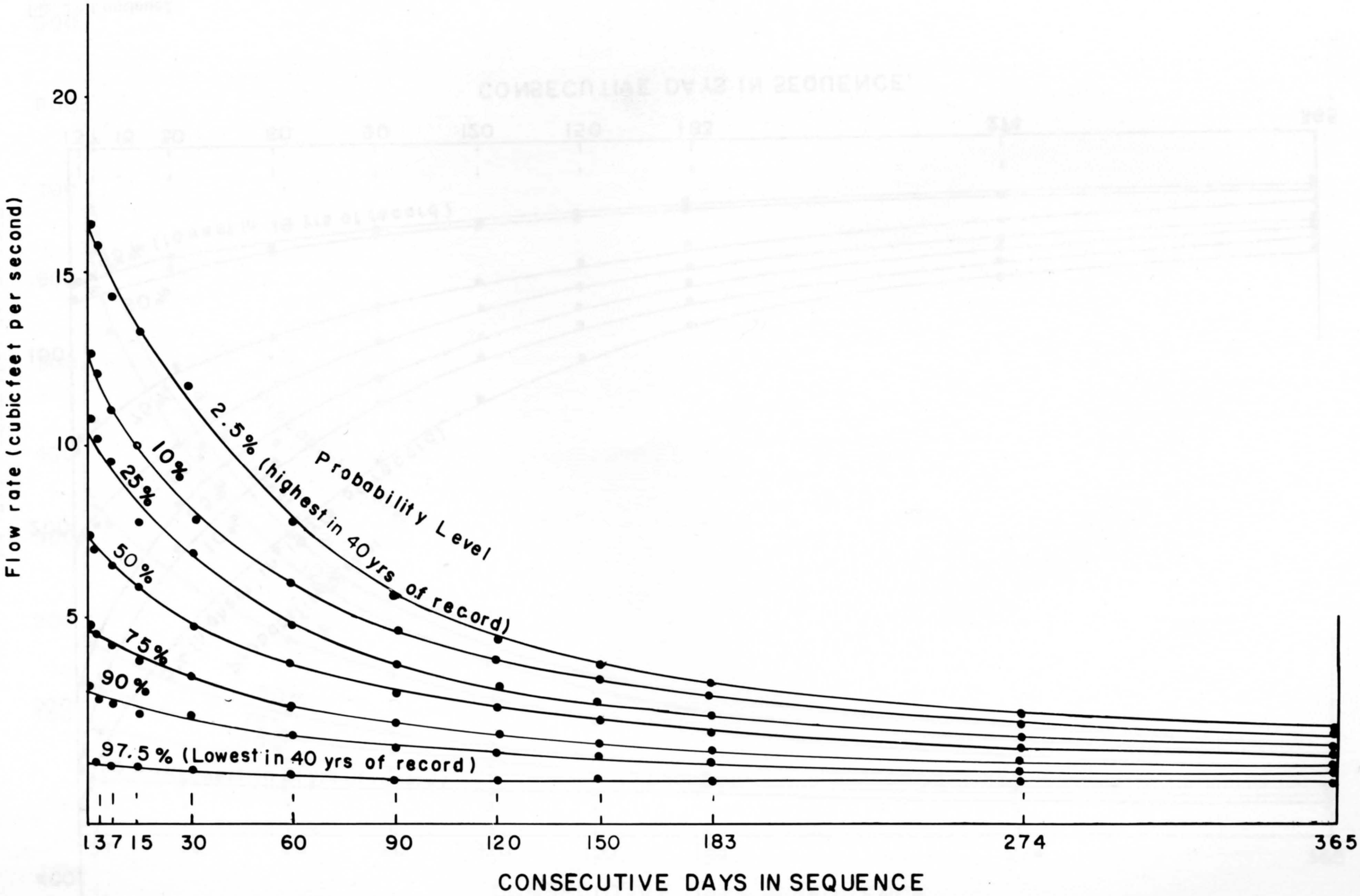


Fig. 29. Continued.

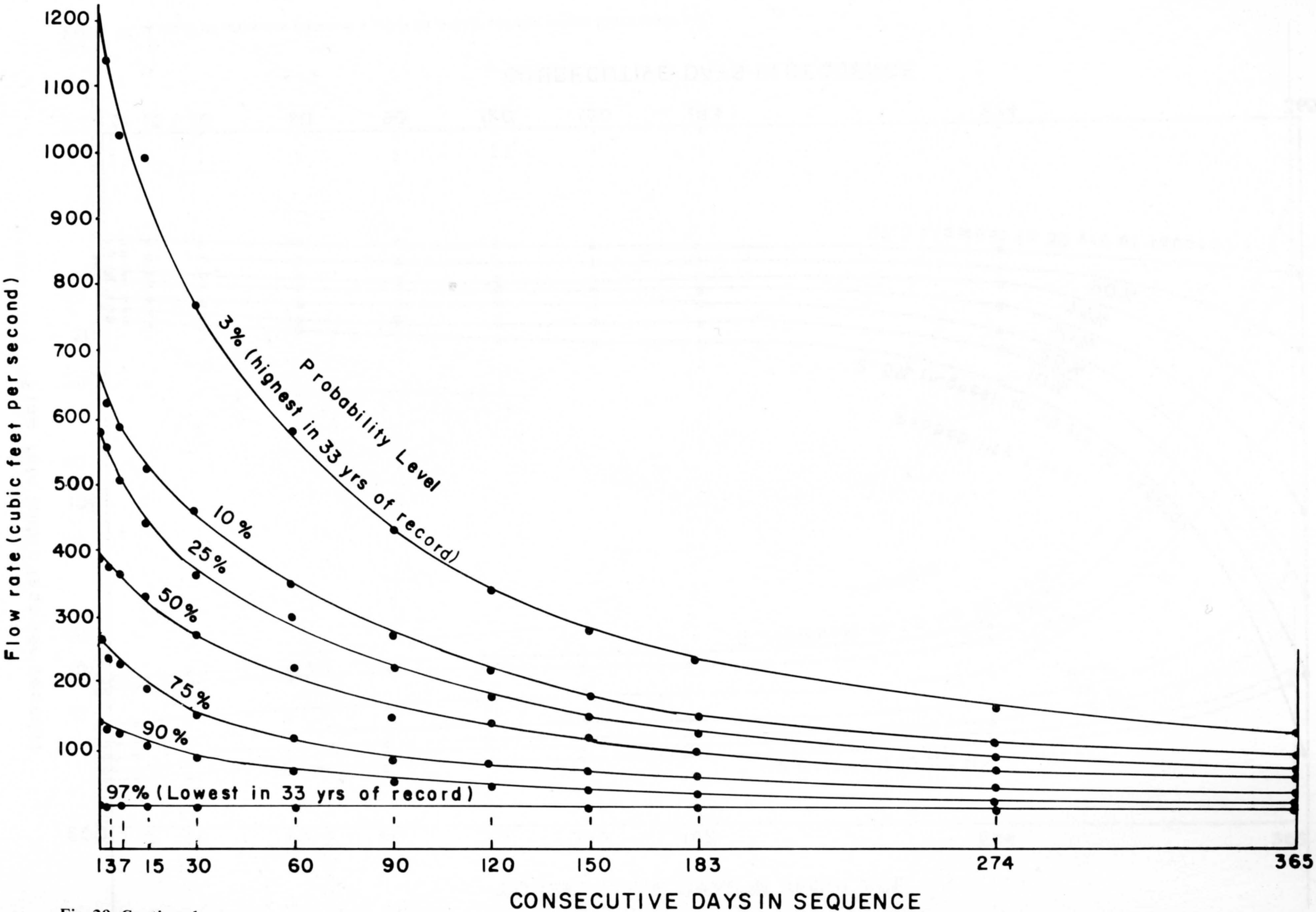


Fig. 29. Continued.

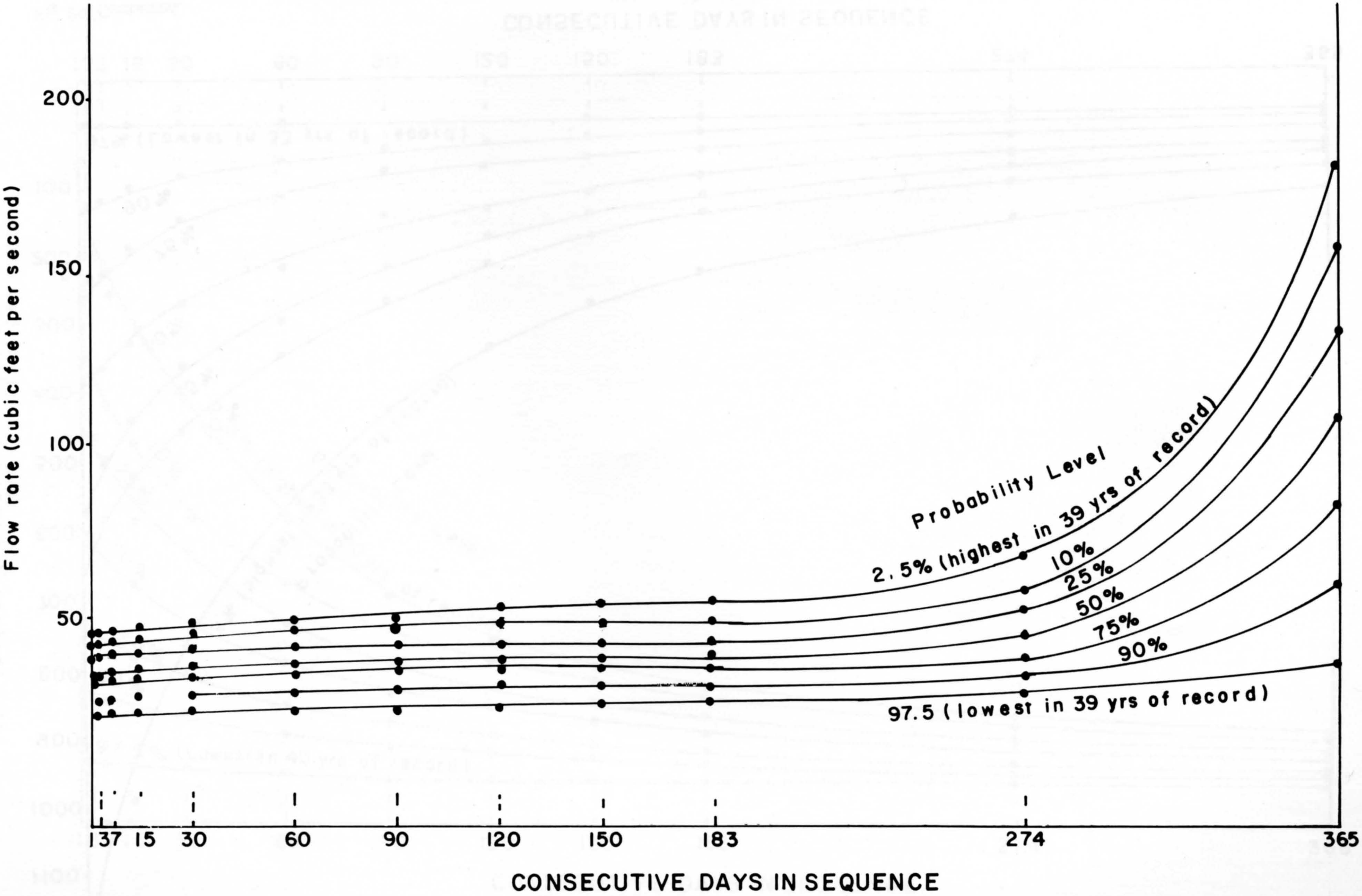


Figure 30. Low-flow sequence curves for selected stations in the Weber River study unit.

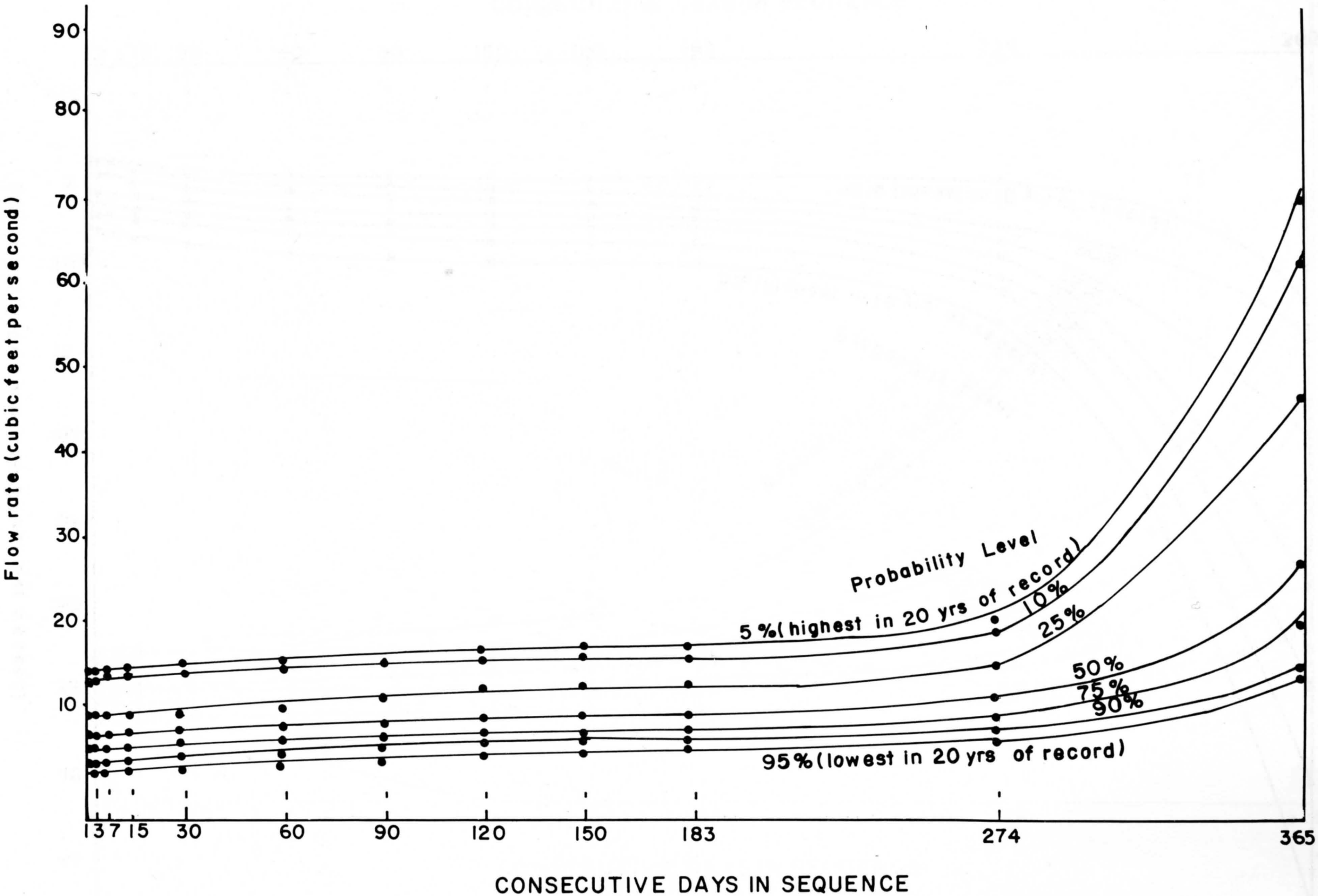


Figure 30. Continued.

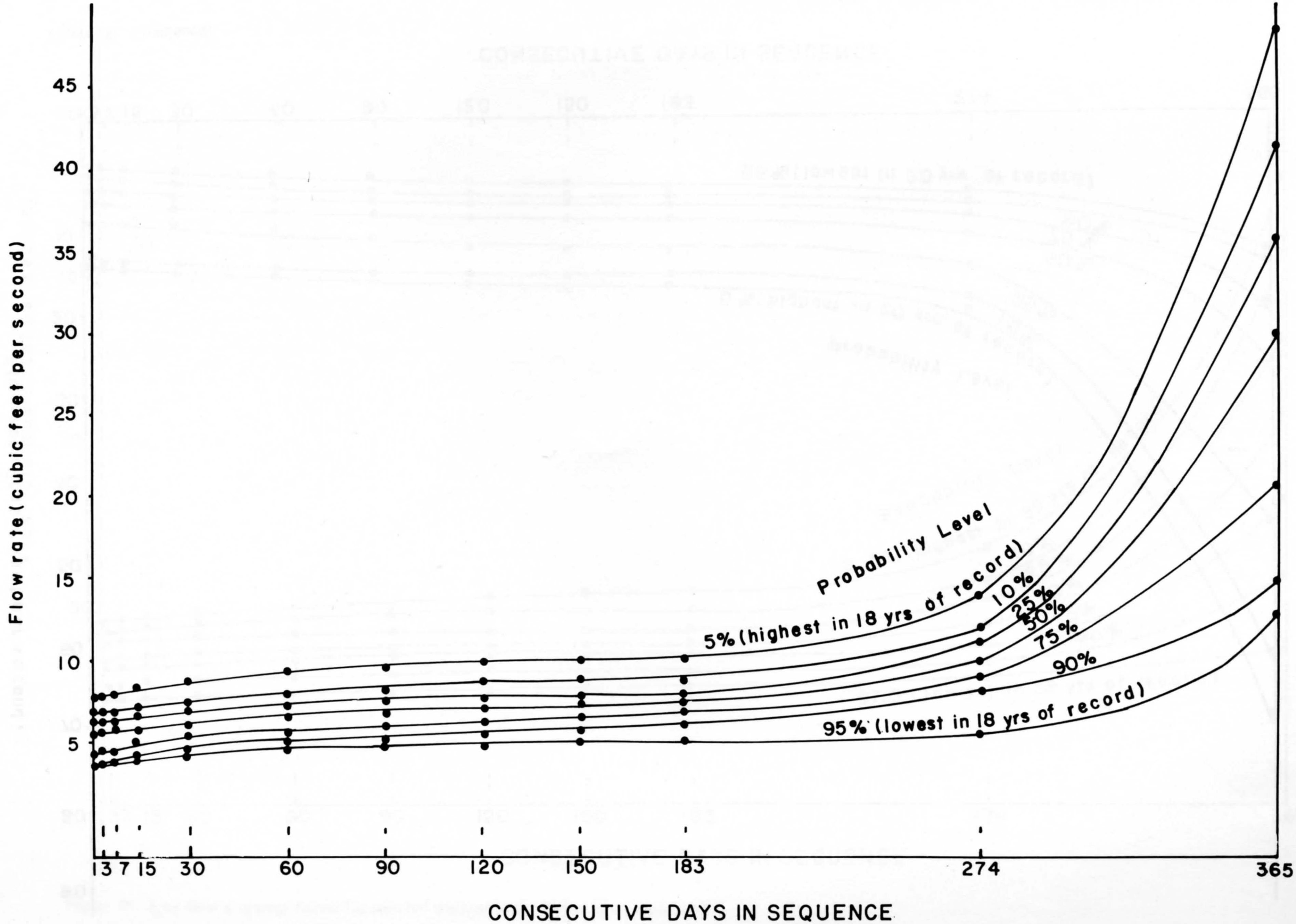
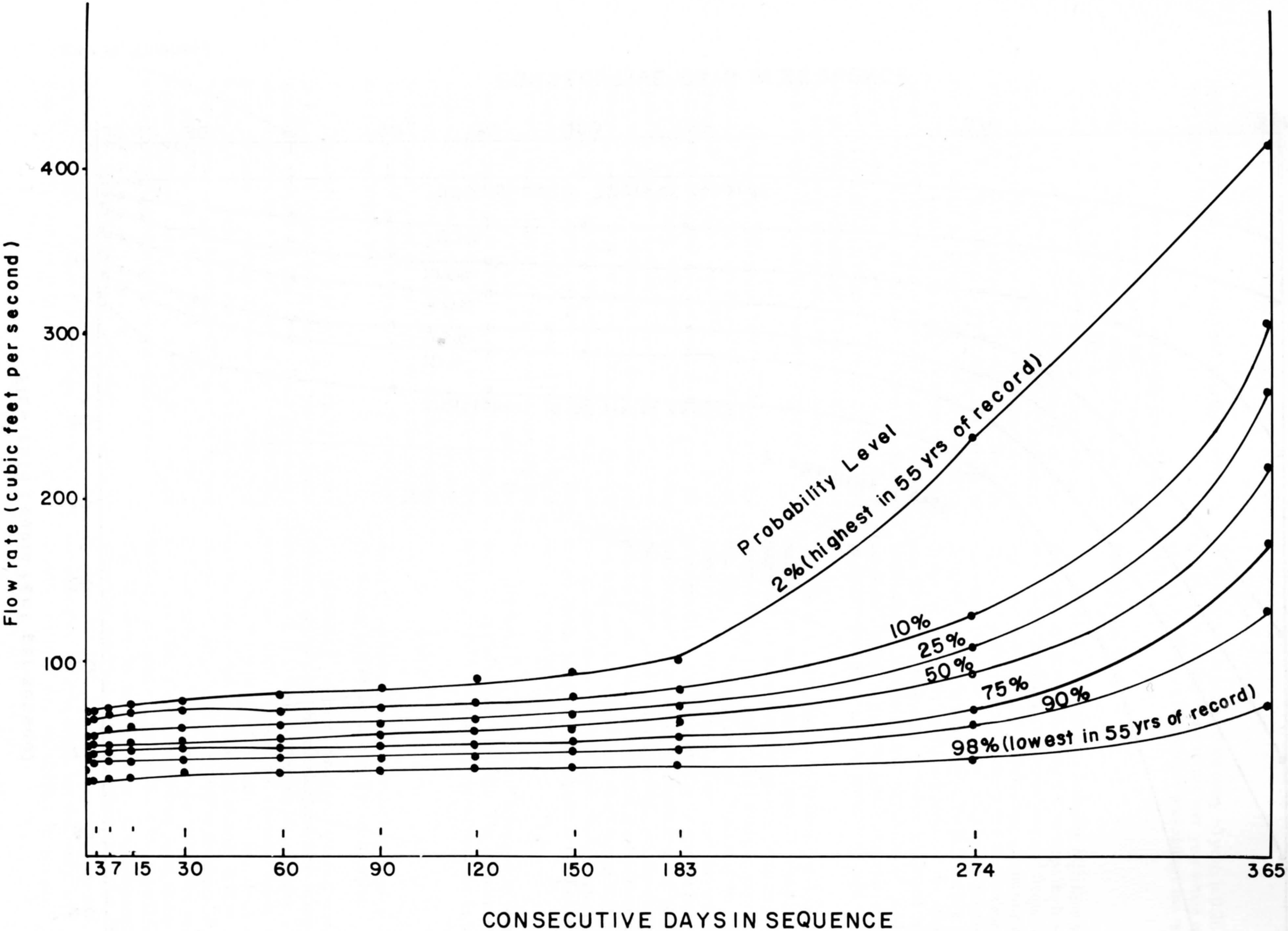


Figure 30. Continued.



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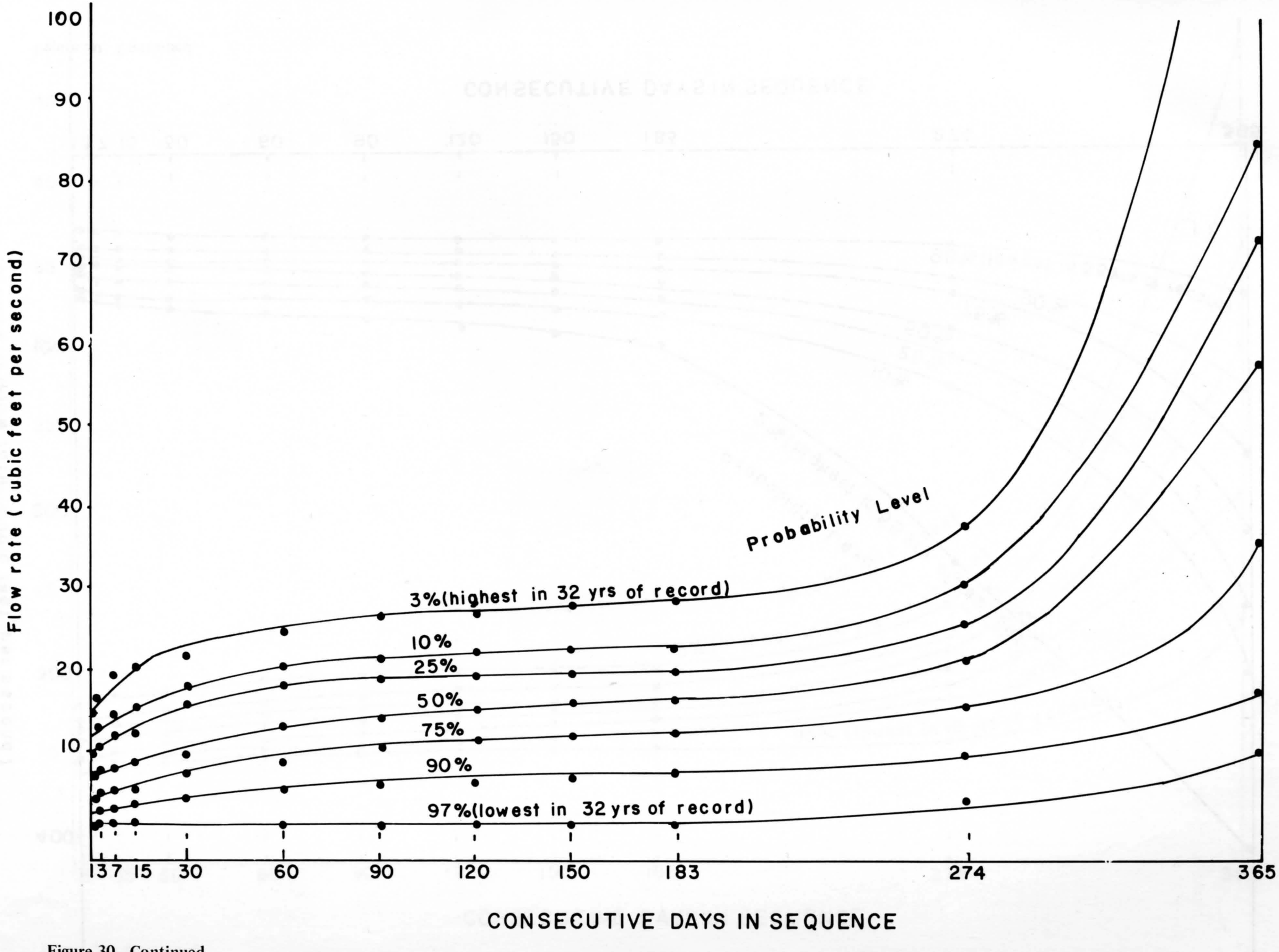


Figure 30. Continued.

analysis is constantly being improved, thereby resulting in more accurate predictions.

The runoff-precipitation relationship for a drainage area serves as another indicator of watershed characteristics. Also, by comparing such relationship as the ratio of runoff (R) to precipitation (P) and the difference between these quantities (P-R) between watersheds provides some insight into the "reasonableness" of these quantities. The difference between runoff (R) and precipitation (P) reflects the amount of evaporation and evapotranspiration occurring on the watershed. The ratio of these two parameters (R/P) reflects the effects of watershed elevation, temperature, and possible storm activity. For example, a very high elevation (relatively speaking) watershed would be expected to catch considerable snowfall. Because of the high elevation, the expected temperatures would be low, thereby allowing a dense snowpack (provided considerable snowfall did occur) and the expected evapotranspiration rates would be less than for nearby lower watersheds. As a consequence, a high ratio of runoff to precipitation would be expected.

In studying relationships between precipitation and runoff, it must be borne in mind that both quantities are susceptible to large error. The areal distribution of precipitation (isohyetal map) is normally established for mountain watersheds with only a few stations being available. The limited amount of data is supplanted with relationships developed between the available records and elevation, aspect, type of storm activity, and possibly other variables if the data warrant. The runoff records are a measure of the surface outflow from a watershed. The accuracy of runoff records is expected to be roughly 5 percent. Usually there are no data available regarding the amount of subsurface outflow from a watershed. The ratio of subsurface outflow to surface outflow may, in some cases, be nearly zero, yet for some watersheds, the subsurface outflow may exceed the surface outflow. Consequently, if two watersheds which might be expected to have similar ratios of runoff to precipitation should vary considerably, then the amount of subsurface outflow might first be suspected.

The ratio of runoff to precipitation (R/P) is shown in Fig. 31, on a probability basis for two watersheds within the Weber River study unit–subarea No. 1 and a part of subarea No. 8 (South Fork of Ogden River). The mean elevation of subarea No. 1 is nearly 2,000 feet higher than the mean elevation of the other watershed. From the curve it can be seen that 50 percent of the time 55 percent of the precipitation falling on area No. 1 results in runoff whereas in the South Fork watershed only 30 percent of the precipitation results in runoff.

The ratio of runoff to precipitation tends to increase with the "wetness" of the year as indicated by the upward slope of the curve. For example, on the South Fork of Ogden River the ratio of runoff to precipitation in the dry year occurring once every 10 years is 0.265 (90 percent probability) while in the wet year which occurs once every 10 years (10 percent probability) the ratio is 0.47.

Frequency of floods

A flood is defined as a relatively high-flow which may endanger life and property if it overtops the banks of the stream. Determining the magnitude and frequency of large flow rates is one of the first steps in designing works to minimize the risks and damage due to flooding. The maximum flow rate for which a hydraulic structure is designed is called the design flood. Proper selection of the design flood requires careful evaluation of the economic and human consequences of failure combined with a knowledge of frequencies and magnitudes of floods. An economic design is one for which the cost of flood protection does not exceed the probable damage.

There are two approaches to obtaining flood information. The first approach is used in obtaining flow magnitude for structures and projects demanding recurrence intervals much longer than available records. For this case, two types of extreme floods may be used in selecting the design flood. They are the maximum probable flood, which is defined as the greatest flood that may reasonably be expected considering the pertinent physiographic and climatic factors, and the maximum possible flood, which is the greatest flood to be expected assuming complete coincidence of all factors that would produce maximum runoff (Chow, 1964). Evaluation of the maximum possible flood requires detailed consideration of the particular watershed.

Jeppson, et al. (1968), have developed an envelope curve for recorded floods in Utah. The equation of the envelope curve covering these recorded flood events is

$$Q_p = 3140\ A^{0.435}$$

where Q_p is the momentary peak discharge in cfs and A is the drainage area of the watershed in square miles.

Additional valuable flood information can be obtained by analyzing the recorded peak flows in order to determine their historical frequency distributions. These results may then be used to estimate floods with recurrence intervals of 50 years or less. Frequency distributions of nearly 300 gaging stations in Utah were evaluated by Jeppson, et al., (1968) to develop a 50 year iso-flood map and flood frequency curves for various portions of Utah. The flood frequency curve, along with the confidence intervals, for the Great Salt Lake Division (Fig. 32) were developed by linear and semi-log-arithmic orthogonal regression analyses (Jeppson and Huber, 1966) to relate the 2, 5, 10, and 25 year floods with the corresponding 50 year flood for the study unit. The resulting equation was transformed to eliminate their

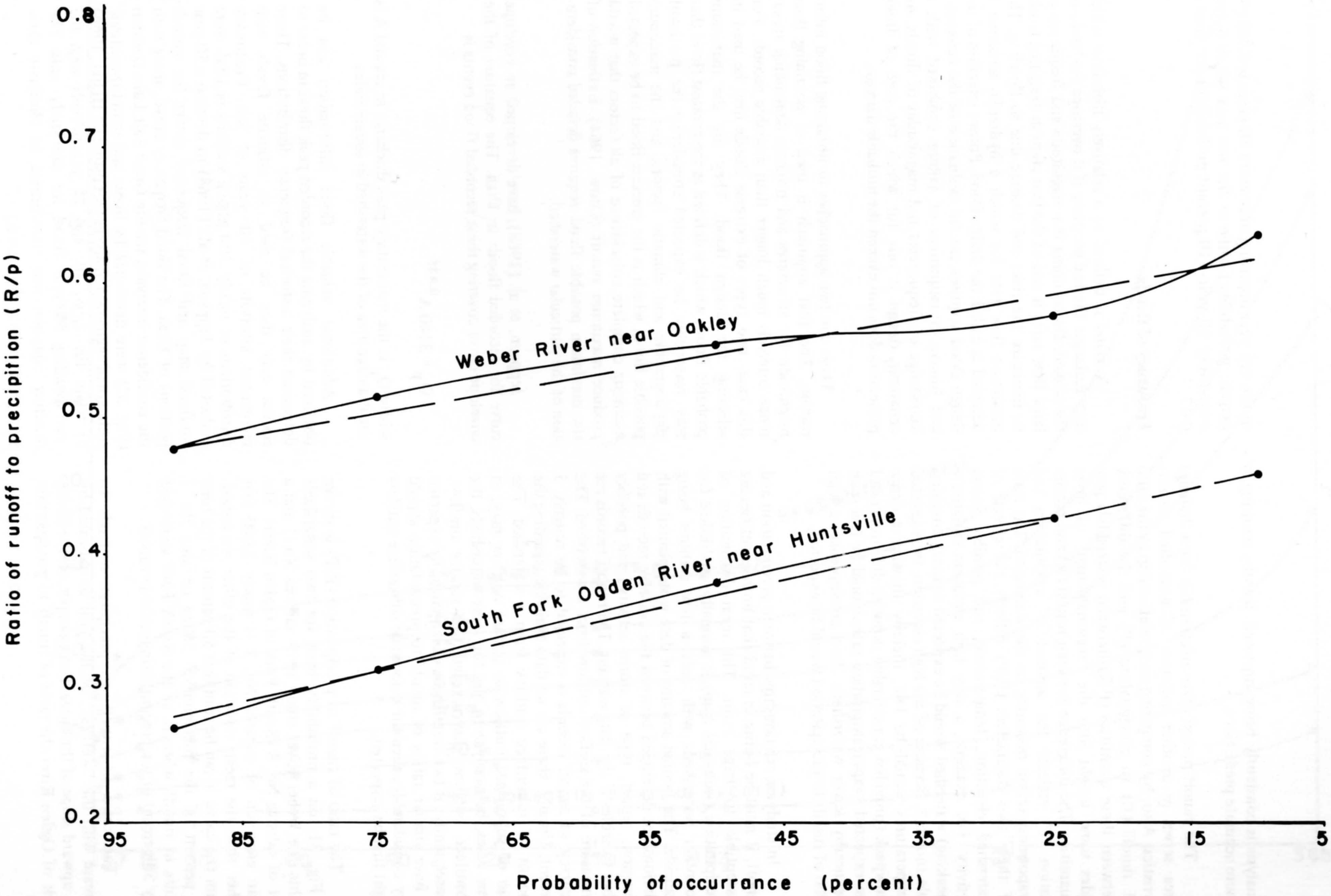


Figure 31. Ratio of runoff to precipitation at different probability levels for selected stations in the Weber River study unit.

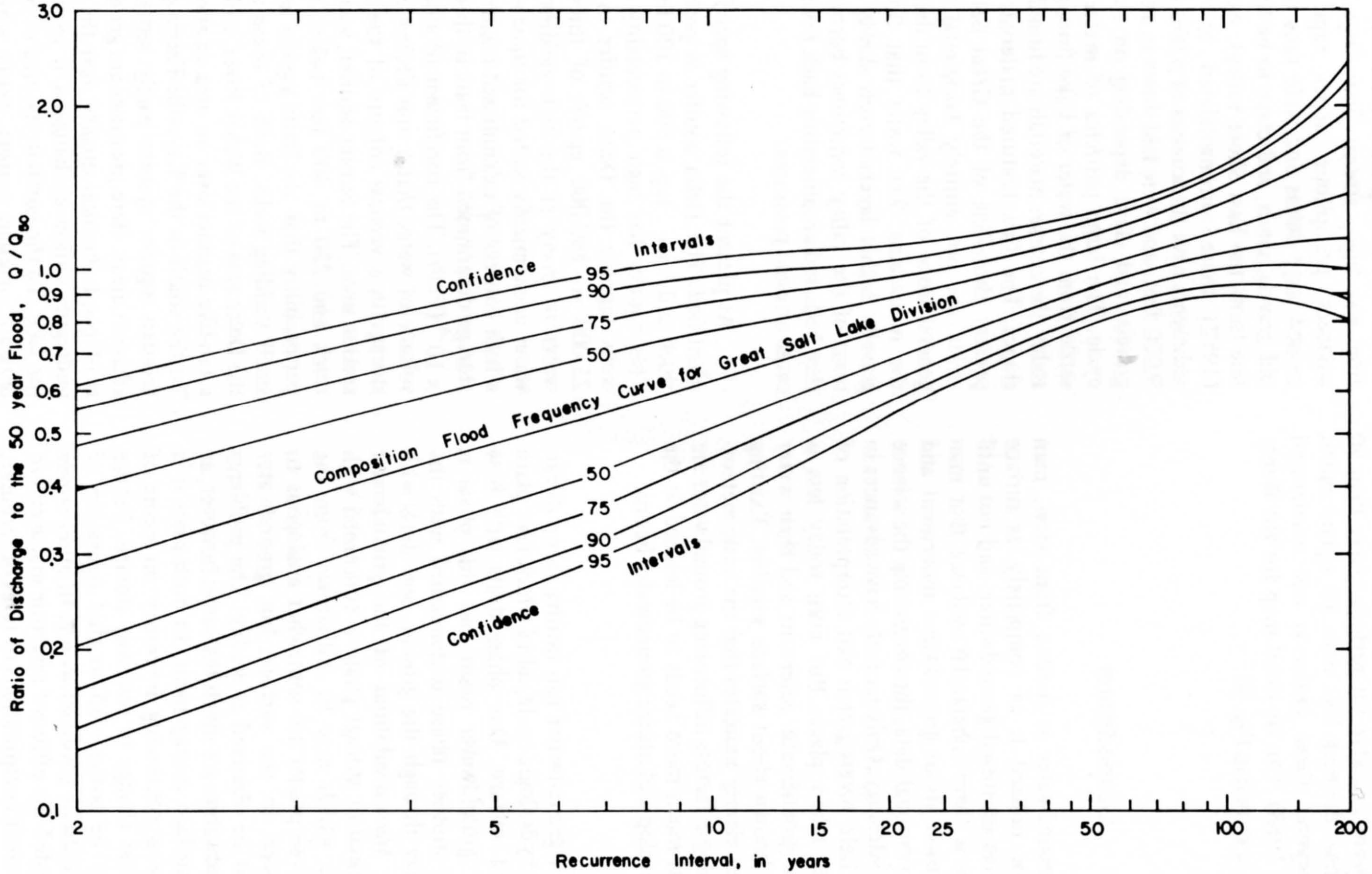


Figure 32. Composite flood frequency curve for Great Salt Lake Division. (Taken from Jeppson et al., 1969)

intercepts and to make their dependent argument be Q/Q_{50}. The confidence interval was calculated about the equation, depicting the relation between floods for various return periods, T, and the 50 year flood, Q_{50}. Confidence intervals for floods of greater than a 50 year return period were obtained by extrapolation. However, since few data were available for periods longer than 50 years, or for areas draining less than 10 square miles, extrapolation beyond these limits is not encouraged (Jeppson et al., 1968). The iso-flood map for the Weber River study unit is shown in Fig. 33.

Groundwater

Because groundwater is hidden from view, man generally has not utilized it as completely as surface supplies. Early man mystified groundwater, and not until the 19th century is there substantial evidence that man based his conclusion about groundwater movement and recharge on observational data, thus beginning the science of groundwater hydrology. Only recently have advances in the methods of field investigation and interpretation of groundwater data taken place. But even today less is known about our groundwater reservoirs and their water supplies than is known about surface supplies. Existing knowledge at least clearly indicates that the basic meteorologic and hydrologic factors influencing groundwater are complex and that much more needs to be learned in the future to fully develop and utilize groundwater basins.

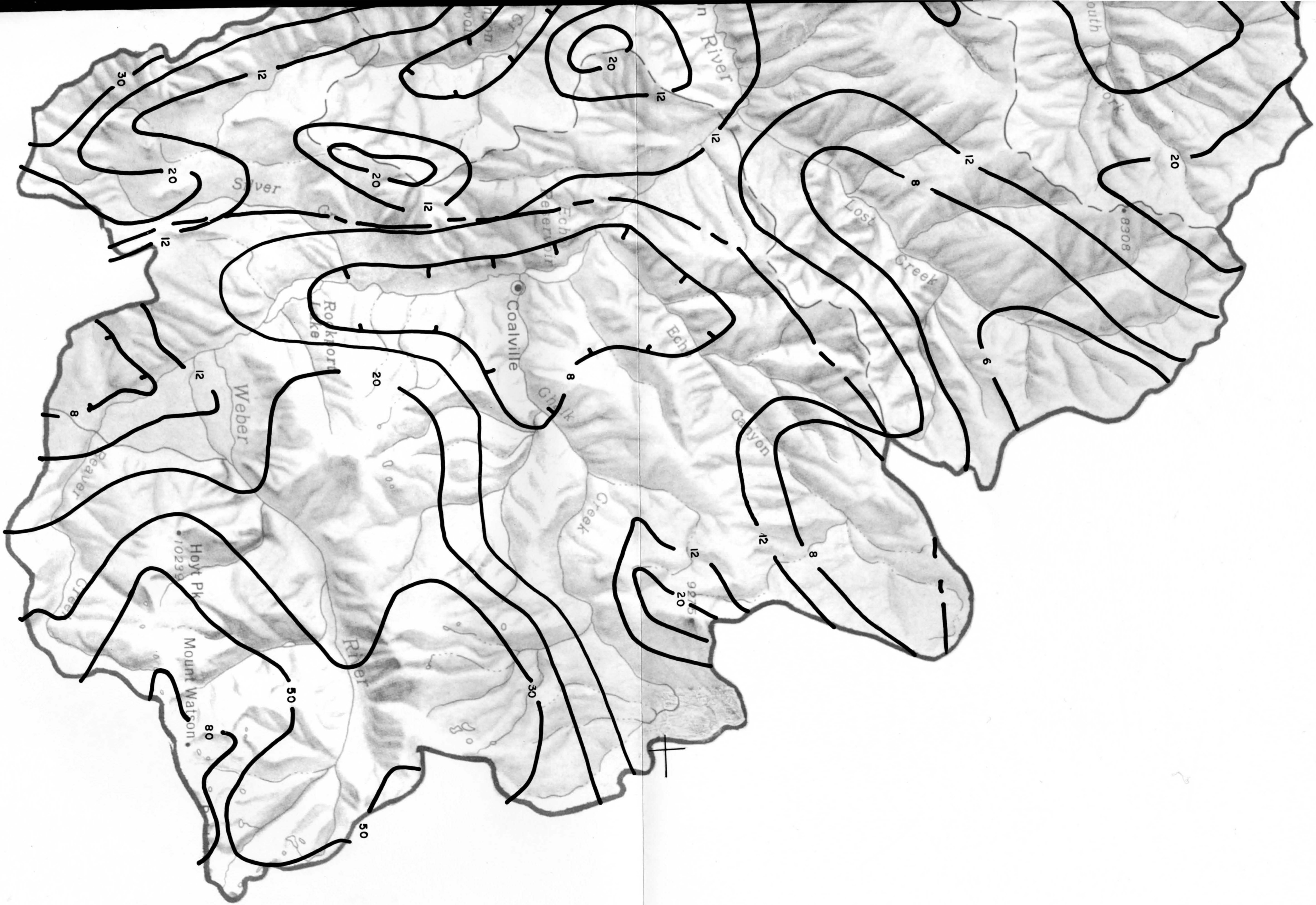
The study of groundwater can involve many different phases of the hydrologic cycle, all of which take place below the ground surface. One phase deals with how water enters the groundwater basin and this phase is termed recharge, another phase is concerned with the movement of water through the ground, and deals with permeabilities or transmissibilities of the groundwater formations. The final or storage phase is concerned with volumes of water which may be withdrawn from the aquifer. All of these phases are somewhat analogous to that which happens on the surface, but groundwater phenomena cannot be observed as readily. The problems of managing groundwaters are much the same, however, as the problems of surface management. In both cases it is necessary to have a continuing inventory on items of inflow, outflow and change in reservoir storage. Future needs should also be anticipated so that operation of reservoir storage could be governed wisely. In other words the basic data needed for efficient reservoir management are those which permit computations of rates of recharge, reservoir capacity, usable storage in the reservoir at all times, outflow or discharge from the reservoirs, and probability factors associated with the occurrence of such variables. Unfortunately present knowledge of the groundwater in the Weber Basin is not sufficient to completely satisfy these needs.

Groundwater aquifers at the East Shore area

The deep deposits in the valley area which extends east from the shore of Great Salt Lake to the Wasatch Mountains were formed during Pleistocene time by Lake Bonneville. During the Lake Bonneville period, precipitation was high, stream flow large, and erosion of the adjacent precipitous slopes rapid. This combination caused large deltas and wide fans containing deposits of old gravels, sands, and clays to be formed along the shore line (now the East Shore valley). According to Feth et al. (1952) these unconsolidated to weakly consolidated sediments have thicknesses of 6,000 to perhaps as much as 9,000 feet, and were laid down in alternate layers of sand, gravels, and clays depending on the particular weather cycle. The large particles of material were the first to settle from the water of Lake Bonneville, and, therefore, today the coarser materials are found nearer the mountain slopes. The fine textured materials are found near the present shore-line of the Great Salt Lake. The alluvial strata are not entirely horizontal but conform to the general slope of the valley from the lake upward toward the mountains. The water that finds its way into the gravelly higher layers travels slowly toward lower elevations of the valley sometimes becoming confined below clay beds and accumulating back toward the mountains to cause artesian pressures.

At present the following specific aquifers have been identified. The Delta aquifer is probably 50 to 150 feet thick and its top is 500 to 100 feet below the surface. This aquifer has high permeability (transmissibilities of wells tapping the Delta aquifer in general range from 25,000 to 190,000 gpd/ft of thickness) and furnishes water to many of the high yielding pumped wells. The water is chemically suited for most uses, but is hard, with a high content of calcium and magnesium. Coefficients of storage determined from tests in this aquifer averaged 6.9 x 10^{-4} (Feth). The coefficient of storage is defined as the volume of water that a unit decline in head releases from storage in a vertical column of the aquifer of unit cross section area. The Sunset aquifer, which is 50 to 250 feet thick and 250 to 400 feet below the surface, has less permeability than the Delta aquifer and therefore supplies small yielding wells. Both of these aquifers are beneath the Delta area of the Weber River, and extend westward in a fan-like manner over an area of about 130 square miles. To the south in the Kaysville-Farmington area there is an artesian aquifer system partly separated from those in adjacent areas. Here pressures are generally low. The water is of good chemical quality near the mountain front but undergoes cation exchange is it moves westward toward the lake. To the north in the area of North Ogden another separate artesian system exists which has the highest pressure in the East Shore area. Recharge is from the mountain front and the water is of excellent chemical character for all uses. The area extending from Ogden to Plain City is underlain by predominantly fine-grained materials. Yields are small and waters are of variable chemical character. The lenses defining separate aquifers

Willard Peak
N Fk
Pineview Res
Salt Flats
4673
Weber R
OGDEN
Ogden
Mt Ogden
9572
Mud Flats
GREAT SALT LAKE
Weber
N Br
Morgan
Farmington
East Canyon
8152
East Canyon Res
50
30
20
12
8



Coalville
Silver
Rockport
Weber
Chalk
Canyon
Creek
Lost
Creek
River
Hoyt Pk
10239
Mount Watson
8308
9275
30
20
12
8
6
50
80

are extremely complex, and recharge appears to be small. Further to the west and north is another area where yields are low, and waters are too high in sodium for irrigation.

Feth et al. (1966) estimated the amount of water stored in all aquifers to total 28,600,000 acre feet (Table 24). This amount, of course, does not represent the yield which can safely be withdrawn every year on the average without depleting the storage in the aquifers. A continuous safe yield, after lowering to minimum storage, must depend upon recharge. Through water budget computation and other means Feth estimated the annual recharge to the entire area to be 67,000 acre feet. Table 25 subdivides this water according to its origin.

It should be pointed out that evidence from four wells which penetrated the fills in the East Shore area to depths greater than 1,000 feet indicates that water below about 1,300 feet is highly mineralized with high sodium content and is, therefore, unsuitable for most purposes. There is also danger that this brackish water may encroach upon the existing fresh water aquifers if too much water is withdrawn lowering the pressure below some minimum value. Since, however, present pumpage (in 1954 the discharge from wells was about 25,000 acre feet) (Feth et al., 1966) has shown little or no effect on water levels, (the decrease in water levels can be accounted for by below normal precipitation) more water can be developed from the groundwater aquifer.

Table 24. Groundwater resources of the East Shore area. (Taken from Feth et al., 1966.)

Location	Area (sq-mi)	Water stored in zone 1,100 ft. thick (ac-ft)	Water obtainable by lowering artesian pressure 150 ft. (ac-ft)	Water obtainable by dewatering (ac-ft)
Weber River Delta area (Delta & Sunset aquifers)	130	12,400,000	75,000 to 200,000	250,000-500,000
Kaysville-Farmington area	34	2,600,000	est. not computed	90,000 [b]
North Ogden area	11	800,000	est. not computed	36,000 [b]
Subtotal	175	15,800,000		376,000
Ogden to Plain City area [a]	55	4,600,000	est. not computed	210,000
Western and northwestern areas [a] having cation exchanged waters	89	8,200,000	est. not computed	370,000
Total	319	28,600,000		956,000

[a] Chemical quality of water in this area, and dominance of fine-grained materials would materially strict development of water in storage.

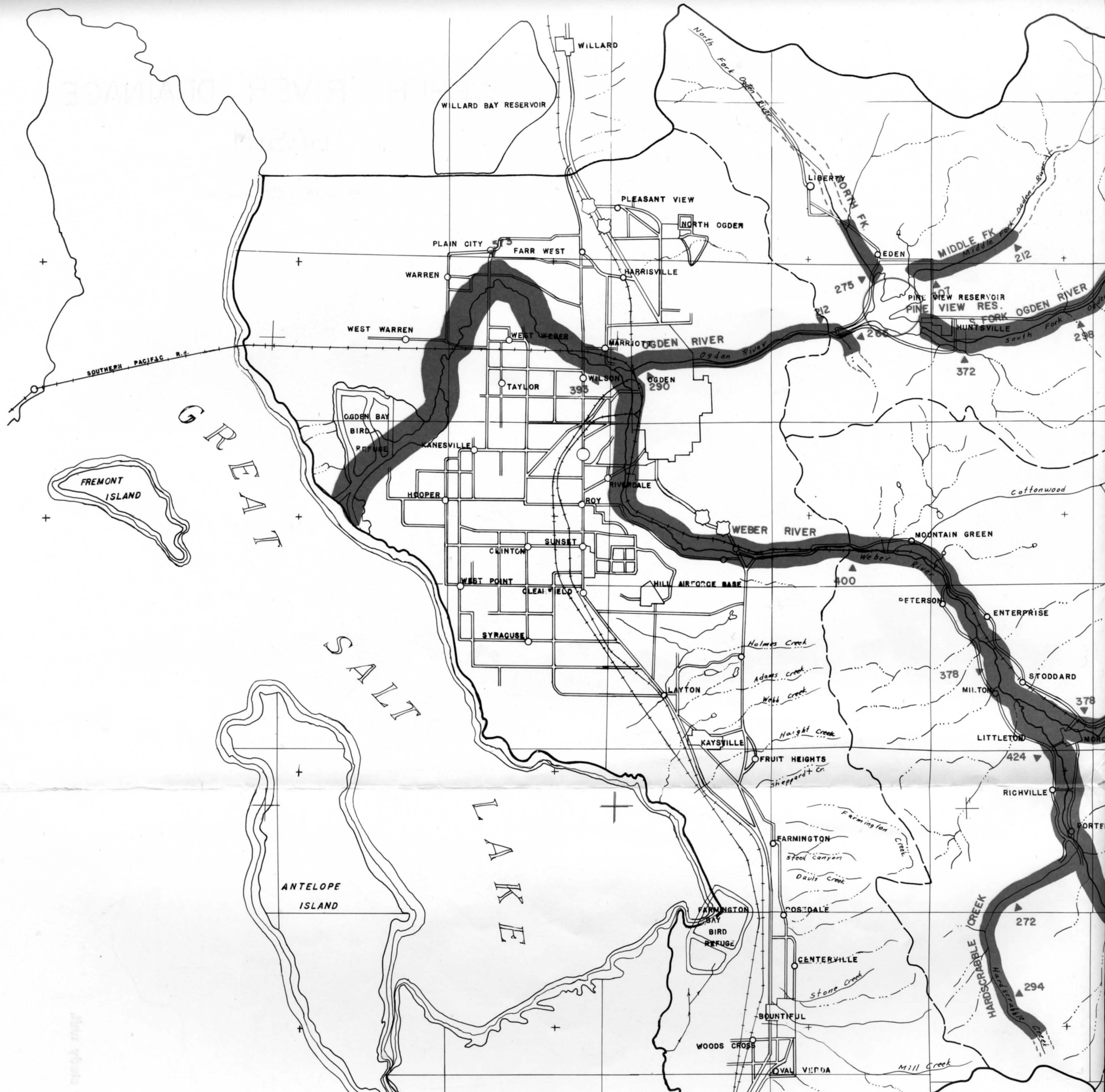
[b] These calculations have been made by using 25% as the specific yield of coarse-grained materials, ence they should be considered as maximum values.

Table 25. Annual quantities of water recharged to the acquifer of the East Shore area of the Weber River study unit.

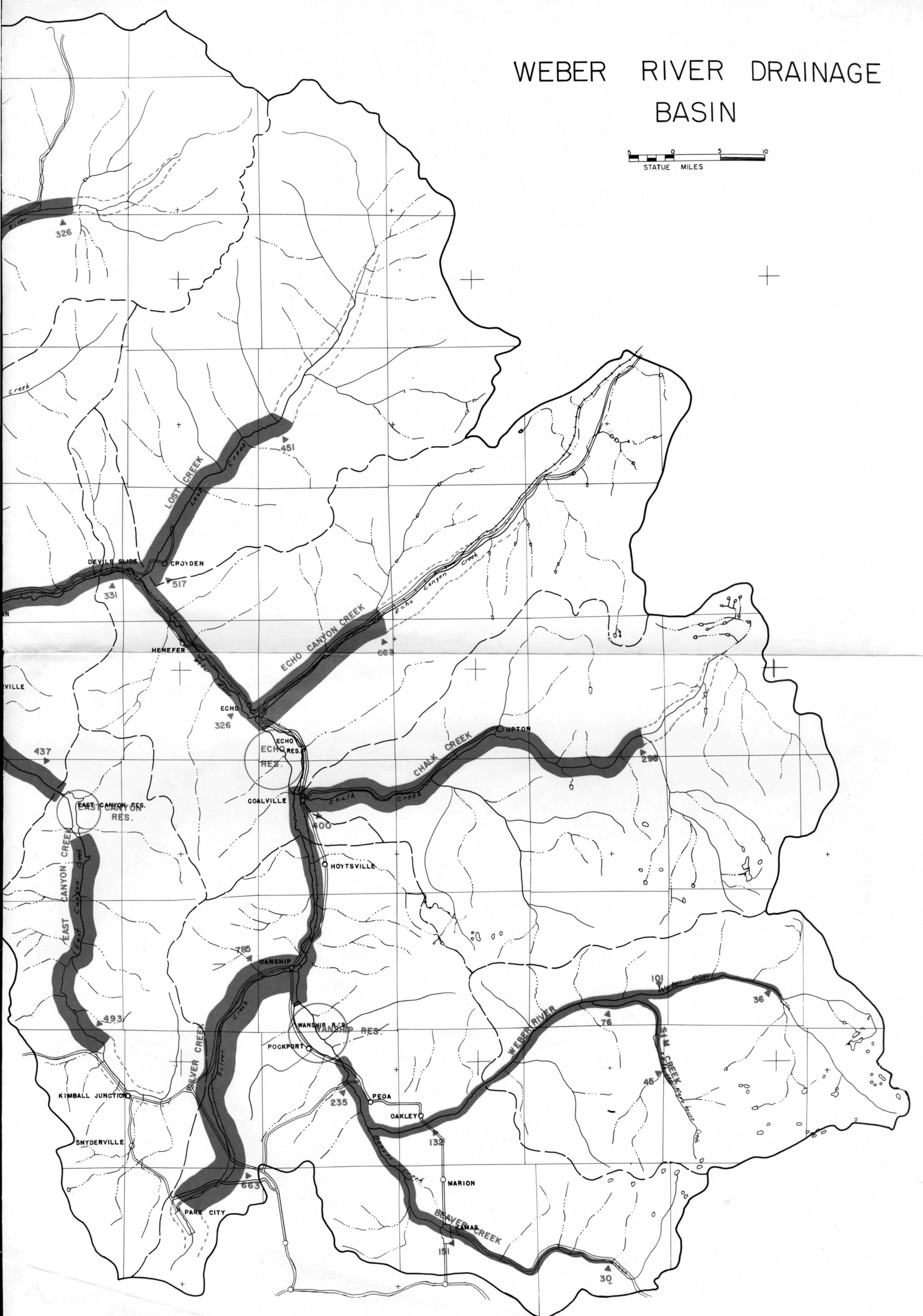
Source of recharge water	Annual recharge
Weber River	16,000
Ogden River	2,000
Mountain Front Streams	3,000
Subsurface front from the Mountain front	30,000
Infiltration of direct precipitation below 5,00 ft.	10,000
Irrigation seepage and canal losses	6,000
Total	67,000

Groundwater recharge possibilities

The principal recharge area for the aquifers in the East Shore area is along the Wasatch Mountain front where a belt of sand and gravel a few feet to a few thousand feet wide in a zone of complex faulting provides favorable areas where water may penetrate into the aquifers. The capacity of this zone to recharge the aquifers is evident west of the mouth of the Weber River where in a distance of 1 1/2 miles, 14,000 to 16,000 acre feet annually go into groundwater storage. The capacity of this zone to recharge the aquifer was demonstrated in a test conducted by the U.S. Bureau of Reclamation. In this test 2,170 acre feet of river water infiltrated through a 3 1/2 acre spreading basin in a 7 week period. This is an infiltration rate of 6.4 cfs per acre. At this rate the highest


WILLARD
WILLARD BAY RESERVOIR
North Fork Ogden River
LIBERTY
NORTH FK.
PLEASANT VIEW
NORTH OGDEN
PLAIN CITY
FARR WEST
HARRISVILLE
WARREN
EDEN
MIDDLE FK
Middle Fork Ogden River
212
275
207
PINE VIEW RESERVOIR
PINE VIEW RES.
S. FORK OGDEN RIVER
South Fork
HUNTSVILLE
296
WEST WARREN
WEST WEBER
MARRIOTT
OGDEN RIVER
Ogden River
SOUTHERN PACIFIC R.R.
372
TAYLOR
WILSON
393
OGDEN
290
GREAT SALT LAKE
OGDEN BAY BIRD REFUGE
KANESVILLE
FREMONT ISLAND
HOOPER
RIVERDALE
ROY
Cottonwood
WEBER RIVER
MOUNTAIN GREEN
Weber River
SUNSET
CLINTON
400
WEST POINT
HILL AIRFORCE BASE
CLEARFIELD
PETERSON
ENTERPRISE
SYRACUSE
Holmes Creek
378
STODDARD
Adams Creek
LAYTON
Webb Creek
MILTON
378
Haight Creek
LITTLETON
KAYSVILLE
FRUIT HEIGHTS
424
Sheppard Cr.
RICHVILLE
Farmington Creek
FARMINGTON
Steed Canyon
Davis Creek
ANTELOPE ISLAND
FARMINGTON BAY BIRD REFUGE
COSTDALE
272
CREEK
HARDSCRABBLE
CENTERVILLE
Stone Creek
294
Hardscrabble Creek
BOUNTIFUL
WOODS CROSS
VAL VERDA
Mill Creek
NORTH SALT LAKE

WEBER RIVER DRAINAGE BASIN



WATER BUDGETS

Water Related Land Use

In order to estimate the amount of water being returned to the atmosphere through the process of evaporation, the land-use pattern within the study area must be known. Some areas use more water than is supplied naturally from rainfall. These areas include irrigated farm lands, open water bodies, vegetated areas with high water table, and urban, municiple, or industrial areas. Sufficient knowledge about water use rates is available to reasonably estimate the amount of water evaporated when adequate water is available to the user.

The land within the Weber River study unit was mapped during the period 1963-1968 and the acreage determined for the following land-use classifications:

1. Irrigated cropland
2. Phreatophytes
3. Open, fresh water
4. Urban, municiple, and industrial including yards, roads, etc.
5. All other which includes dry native vegetation and barren wastes

Table 26 shows the acres of each class by subarea within this study unit.

Each major crop within the irrigated cropland was distinguished and measured by subareas as shown in Table 27. Non-agricultural vegetation was classed as native vegetation and separated into a wet or dry category depending upon the depth to water table. The amount of land in each of these two categories is shown by subarea in Table 28 and Table 29.

A detailed description of the method used to obtain the land use data as well as copies of the land use maps is contained in the publication, "Water Related Land Use in the Weber River Drainage Area," Haws (1970).

Water Budget Program

As has been previously stated a water budget is an attempt to obtain a balance between all incoming water supplies and all outgoing water supplies. When a monthly budget is desired and an attempt is made to trace some of the internal wanderings of the flow system such as surface and groundwater storage, snow melt, and canal diversions, the computations become numerous and complex. Because of this complexity, a digital computer program has been developed to facilitate computations. The flow chart illustrating the computational procedure is shown in Fig. 35.

Table 26. Distribution of water related land use within the Weber River study unit.

Area No.	Irrigated cropland	Phreatophytes	Open fresh water	Urban yards, roads, etc.	Barren Dry-crop Native Vegetation	Total
1	3,000	----	360	----	100,960	104,320
2	21,500	1,010	1,340	2,240	145,430	171,520
3	2,700	250	10	240	158,720	161,920
4	3,100	360	1,160	380	174,200	179,200
5	650	460	10	120	144,680	145,920
6	5,060	510	370	210	93,050	99,200
7	11,760	1,580	260	840	177,560	192,000
8	12,050	2,280	2,200	950	180,920	198,400
9	100,290	53,390	9,020	32,650	127,850	323,200
1-9	160,110	59,840	14,730	37,630	1,303,370	1,575,680

Table 27. Acres of irrigated cropland within the Weber River study unit.

Area No.	Alfalfa	Pasture	Grain	Corn	Peas	Potatoes	Sugar beets	Tomatoes	Other Truck	Orchard	Total
1	----	3,000	----	----	----	----	----	----	----	----	3,000
2	4,610	15,460	1,360	----	----	----	----	----	70	----	21,500
3	1,230	1,160	310	----	----	----	----	----	----	----	2,700
4	470	2,020	470	----	----	----	----	----	140	----	3,100
5	130	280	180	----	----	----	----	----	60	----	650
6	1,560	2,890	610	----	----	----	----	----	----	----	5,060
7	5,940	1,250	4,170	190	----	----	----	----	200	10	11,760
8	5,400	3,500	2,740	180	----	----	----	----	200	30	12,050
9	24,750	33,450	13,960	8,120	20	610	5,660	860	9,820	3,040	100,290
1-9	44,090	63,010	23,800	8,490	20	610	5,660	860	10,490	3,080	160,110

Table 28. Acres of wetland vegetation within the Weber River study unit.

Area No.	Cottonwoods, willows, etc.	Marsh land tules, rushes, etc. cattails	Wet pastures salt grass, high water table
1	----	----	----
2	980	30	----
3	250	----	----
4	360	----	----
5	460	----	----
6	510	----	----
7	1,580	----	----
8	2,280	----	----
9	14,490	10,000	30,480

In this particular computer program, the area which is being modeled is the irrigated agricultural and wet land area within the subbasin. The inflow into the model includes the gaged river inflow, ungaged inflow (yield) from the nonmodeled part of the subbasin, measured imports to the modeled area, groundwater recharge to the modeled area, and precipitation on the modeled area. The outflow from the model includes the gaged river outflow; the depletions due to agricultural transpiration, phreatophytes use, municiple and industrial use; plus exports from the area and any ungaged surface or underground outflow needed to balance the system. The computer program written in Fortran IV language for use on the Univac 1108 Computer is described by Hendricks et al. (1970).

Monthly budgets must consider the change in storage that occurs within the modeled area in order to

Table 29. Acres of dry land vegetation within the Weber River study unit.

Area No.	Mud, salt flats	Trees coniferous	Trees broad leaf	Sagebrush	Brushlands	Saltbush	Desert shrub	Total
1								100,960
2		7,930	48,160	54,940	38,670			149,700
3		5,650	51,130	40,240	61,550			158,570
4		----	7,410	110,690	38,160	15,520		171,780
5	5,320	9,640	46,770	47,080	31,370	4,320		144,500
6			44,470	12,980	35,290			92,740
7	3,610	3,610	27,160	65,820	79,020			179,220
8	2,310	3,410	38,800	17,230	120,980			182,750
9	50,910	----	----	24,750	76,090	----	18,000	169,750

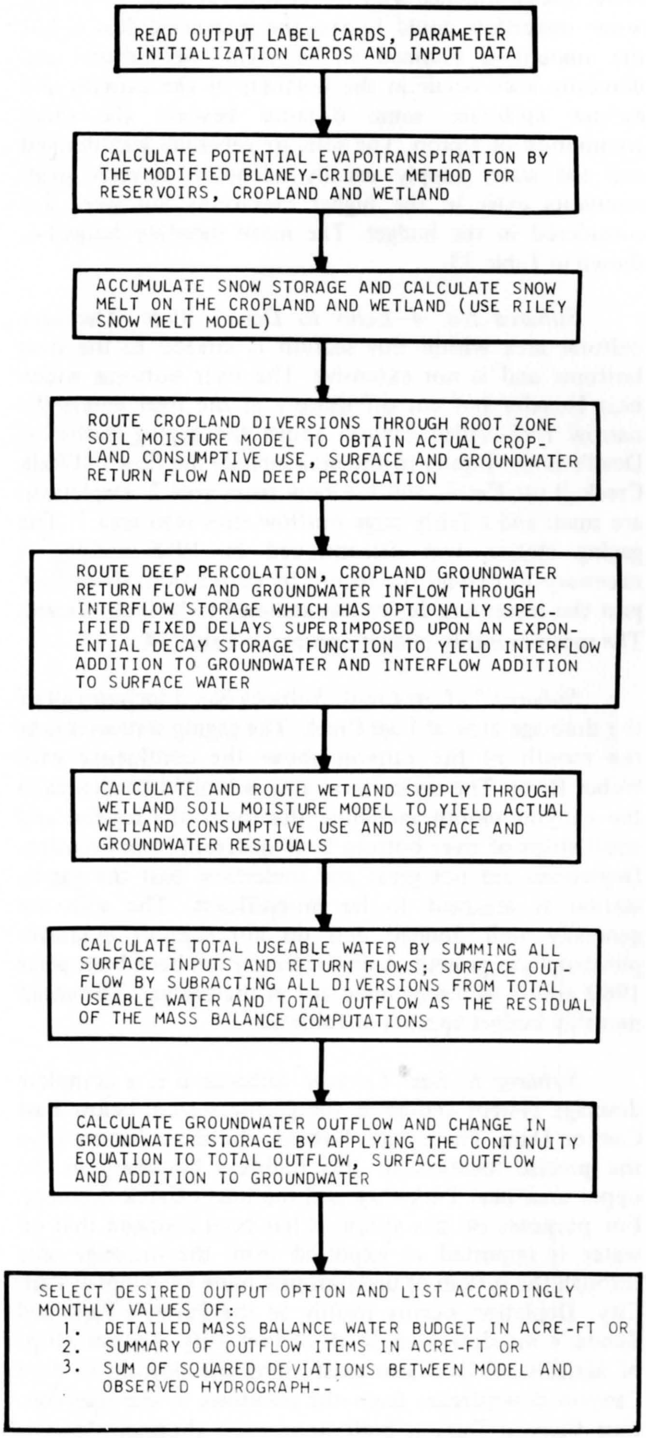


Figure 35. Flow chart of computational procedure in water budget program for Weber River study unit.

match the calculated outflow with the measured outflow. On a long time yearly basis the change in storage is generally zero and can be ignored. The storage facilities to be considered on a monthly basis include surface reservoirs, water stored temporarily as snow, water stored within the root zone soil, and water stored in underground reservoirs.

Actual records of water in storage at the beginning and end of the month are used to calculate change in storage in surface reservoirs. Water stored as snow is determined by assuming that all precipitation that occurs when the average temperature is at or below a given value is retained on the basin in the form of snow. The snow melt is assumed to occur when the temperature is at or exceeds a given value. These limiting temperatures are selected on the basis of judgment and are assigned to the subbasin before the computer program is run. The rate of snow melt is temperature dependent but is also dependent upon a coefficient pre-assigned by judgment. The formula for calculating snowmelt is as follows:

$$S_m + k\,(Tav. - 32)\,S_s$$

where

S_m = snowmelt during the month in acre feet
k = coefficient determined by judgment
Tav = average monthly temperature
S_s = snow in storage at beginning of the month in acre feet

Water that goes into the root zone soil in excess of that needed for plant transpiration is temporarily stored and later released either to deep groundwater, underground outflow from the subbasin, or surface flow available for wet land use. In this program water enters this temporary storage area when the root zone is saturated. Outflow from the temporary storage area occurs at a rate given by the following:

$$F = I_f\,(K_f)$$

where

F = outflow from temporary root zone storage
I_f = total amount of water in storage
K_f = coefficient determined by judgment

The program also provides that if the computed groundwater outflow is less than a given amount, the groundwater outflow will occur at a fixed minimum rate.

Water lost to the area through the process of evapotranspiration is calculated by the computer using the Blaney-Criddle formula and techniques reported earlier. The average monthly temperatures, the percentage of daylight hours and the crop coefficients are all read-in initially to the computer.

Water Budget Analyses

Summing all the inputs and outputs for each subarea gives the overall mean annual water budget as shown in Table 30. Using these figures and mean annual figures for water depletions, the flow diagram in Fig. 36 was drawn. The figure shows a sizable flow annually discharged into Great Salt Lake and that on-site uses and nonbeneficial uses account for almost 70 percent of the total water resource.

A flow diagram of a mean monthly budget is illustrated in Fig. 37. This diagram is used to indicate the "budgets within budgets" needed to balance the inflow-outflow items. Precipitation that occurs during the winter months does not immediately result in runoff. Water is held in storage on the watershed until the snowmelt period begins in early spring. Also, water that is diverted for agricultural use in excess of that depleted by the plants does not reappear in the streams until sufficient travel time has elapsed. Such changes in storage must be accounted for in any monthly budget.

Subarea No. 1–Weber River above Oakley. This area is principally a mountainous watershed with very little cultural activity taking place; however, indicators point to a summer home complex developing in the future. This may alter the present water balance. Present agricultural use is limited to pasture grasses in the canyon bottoms. Water may be diverted onto these pasture areas, but in general the precipitation on a mean monthly basis is sufficient to meet the consumptive demands. Because of the geologic structures at the gaging station, the underflow past the measuring device is assumed to be insignificant. The mean monthly budget for subarea 1 is shown in Table 31.

Subarea No. 2–Kamas Valley. Inputs to Kamas Valley include the Weber River which is gaged at Oakley and the ungaged inflow coming principally from Beaver Creek and Silver Creek. There is also some import into the area from Shingle Creek and Provo River through the Kamas-Washington canal. The soil moisture reservoir is generally considered to be full and overflowing. Water tables within inches of the ground surface exist over about 11,000 acres of the total 21,000 acres making up the valley floor. Depletion is, therefore, higher than would normally be expected for pasture lands in the same climatic environment without drainage problems.

Outflow from the valley in addition to vegetation depletion consists of water exported from the Weber River into the Weber-Provo canal, and an undetermined amount of groundwater seeping to the Provo River, and the flow of Ontario tunnel which is presumed to take water which would normally flow in the Silver Creek system. In addition, there may be an underflow passing the gaging station below the Rockport Reservoir into subarea No. 4. The mean monthly budget is shown in Table 32.

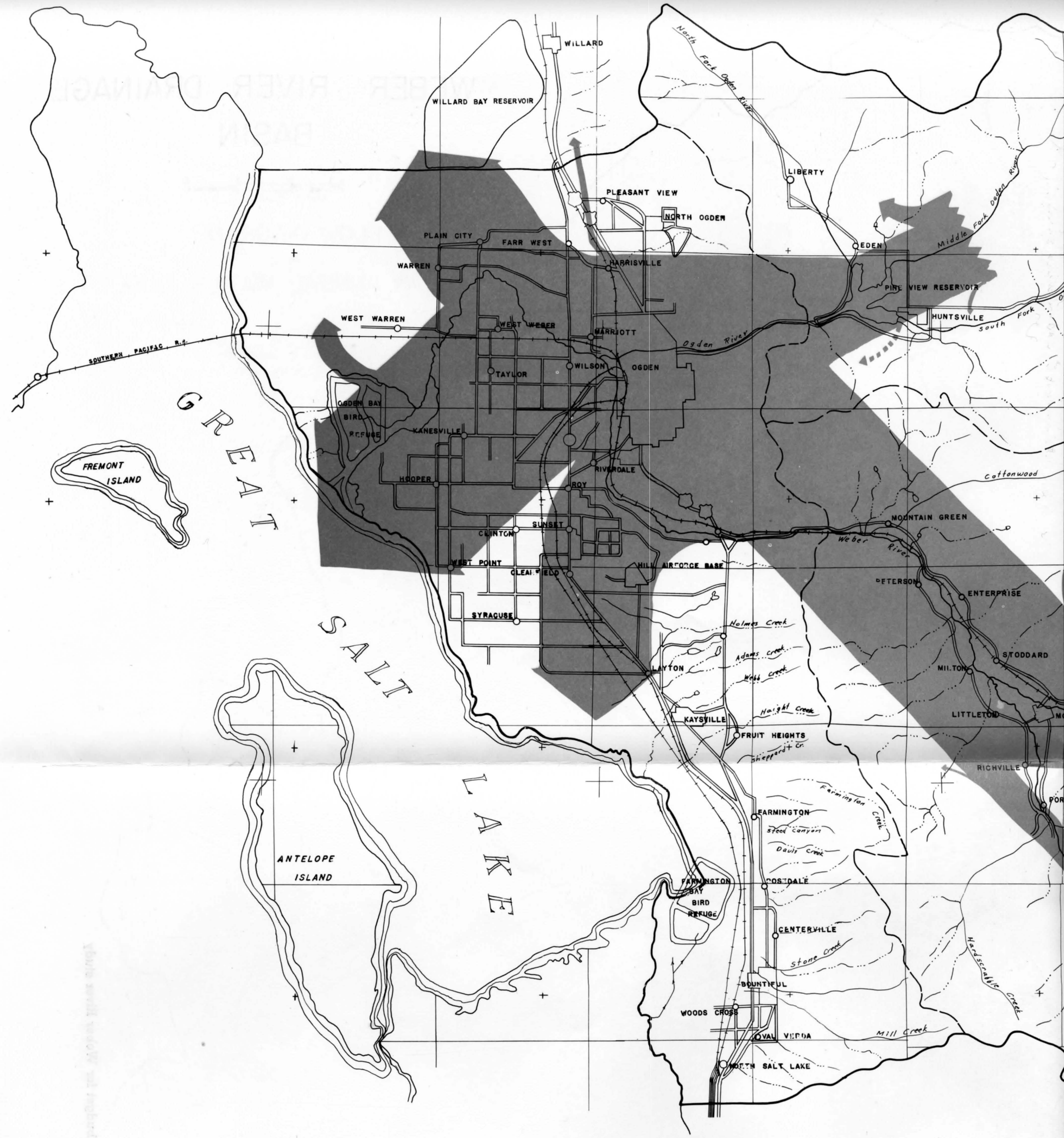
Subarea No. 3–Chalk Creek. Subarea 3 encompasses all of the drainage area of Chalk Creek above the gaging station at Coalville. The gaging station is located just above the confluence with Weber River at Echo Reservoir. Some underflow could bypass the measuring device, but the amount is assumed to be small. Agricultural and domestic uses occur in the bottoms of the canyon and extend upstream some distance beyond the small community of Upton. The soils are generally well drained and the water supply usually adequate. Several small reservoirs exist in the higher elevations but were not considered in the budget. The mean monthly budget is shown in Table 33.

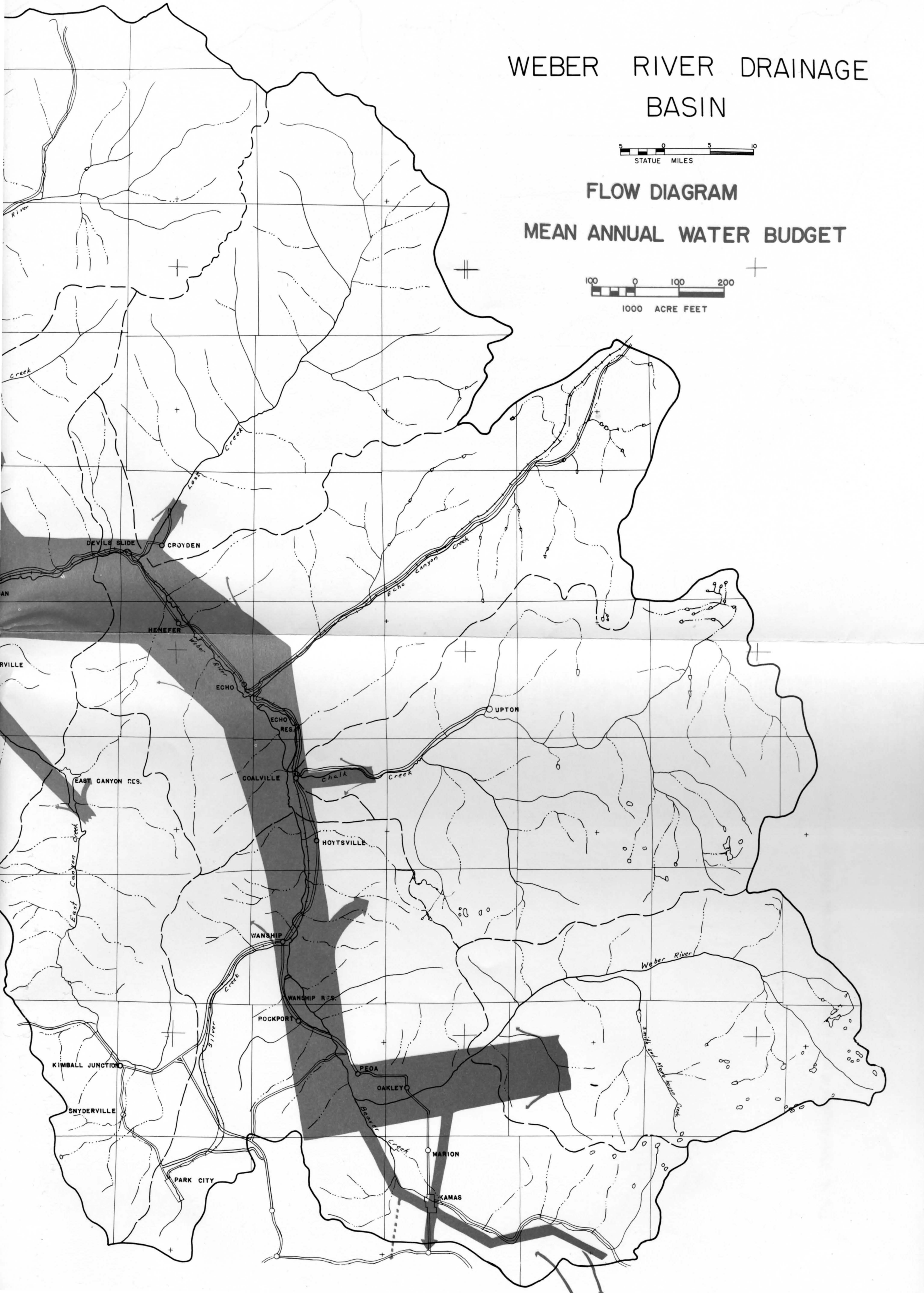
Subarea No. 4–Echo to Devil's Slide. The agricultural area within this section is limited to the river bottoms and is not extensive. The river bottoms widen near Henefer but cut off sharply as the river enters the narrow rock-walled canyon above the gaging station at Devil's Slide. Inputs to the area include the flow of Chalk Creek, Lost Creek, and the flow from area 2. Depletions are small and a fairly large outflow runs into area 7. The gaging station was discontinued in 1955 making it necessary to extend the record by correlation. Underflow past the measuring device was assumed to be insignificant. The mean monthly budget appears in Table 34.

Subarea 5–Lost Creek. Subarea No. 5 includes all of the drainage area of Lost Creek. The gaging station is near the mouth of the canyon above the confluence with Weber River. The agricultural area is limited to an area in the canyon mouth including the town of Croyden and small strips of river bottom land upstream from Croyden. Depletions are not great and underflow past the gaging station is assumed to be insignificant. The soils are generally well drained and do not support extensive phreatophyte growth. A new reservoir has been built since 1960 and is not accounted for in the budget. The mean monthly budget appears in Table 35.

Subarea 6–East Canyon. Subarea 6 is a complete drainage system ending at the gaging station below East Canyon Dam. There may, however, be some dispute as to the precise location of this drainage boundary in the upper area near Park City and the Silver Creek drainage. For purposes of this study, it has been assumed that no water is imported or exported from the drainage area through the system of underground mine workings at Park City. Depletion occurs mainly in the Parley's Park and Synder's meadow area north of Park City. Narrow strips of agricultural land also exist along the bottom of East Canyon downstream from the meadows to the reservoir. East Canyon Dam is built upon rock abutments and is assumed to block all underflow from the area. The mean monthly budget is shown in Table 36.

Subarea 7–Morgan. Subarea 7 is approaching the 5,000 foot elevation and consequently has higher mean temperatures than the previously described subareas. Inputs to the area include the outflow from area 4 and


WILLARD
WILLARD BAY RESERVOIR
North Fork Ogden River
LIBERTY
PLEASANT VIEW
NORTH OGDEN
PLAIN CITY
FARR WEST
EDEN
Middle Fork Ogden River
WARREN
HARRISVILLE
PINE VIEW RESERVOIR
HUNTSVILLE
South Fork
WEST WARREN
WEST WEBER
MARRIOTT
Ogden River
SOUTHERN PACIFIC R.R.
TAYLOR
WILSON
OGDEN
GREAT SALT LAKE
OGDEN BAY BIRD REFUGE
KANESVILLE
FREMONT ISLAND
RIVERDALE
HOOPER
ROY
Cottonwood
MOUNTAIN GREEN
SUNSET
CLINTON
Weber River
HILL AIRFORCE BASE
WEST POINT
CLEARFIELD
PETERSON
ENTERPRISE
SYRACUSE
Holmes Creek
STODDARD
Adams Creek
Webb Creek
LAYTON
MILTON
KAYSVILLE
Haight Creek
LITTLETON
FRUIT HEIGHTS
Sheppard Cr.
RICHVILLE
Farmington Creek
FARMINGTON
Steed Canyon
Davis Creek
ANTELOPE ISLAND
FARMINGTON BAY BIRD REFUGE
CENTERVILLE
Stone Creek
Hardscrabble Creek
BOUNTIFUL
WOODS CROSS
VAL VERDA
Mill Creek
NORTH SALT LAKE


WEBER RIVER DRAINAGE BASIN
5 0 5 10
STATUE MILES
FLOW DIAGRAM
MEAN ANNUAL WATER BUDGET
100 0 100 200
1000 ACRE FEET
River
Creek
Lost Creek
DEVILS SLIDE
CROYDEN
Echo Canyon Creek
HENEFER
Weber River
ECHO
ECHO RES.
UPTON
COALVILLE
Chalk Creek
EAST CANYON RES.
East Canyon Creek
HOYTSVILLE
WANSHIP
Silver Creek
WANSHIP RES.
ROCKPORT
Weber River
Smith and Morehouse Creek
KIMBALL JUNCTION
SNYDERVILLE
PEOA
OAKLEY
Beaver Creek
MARION
PARK CITY
KAMAS

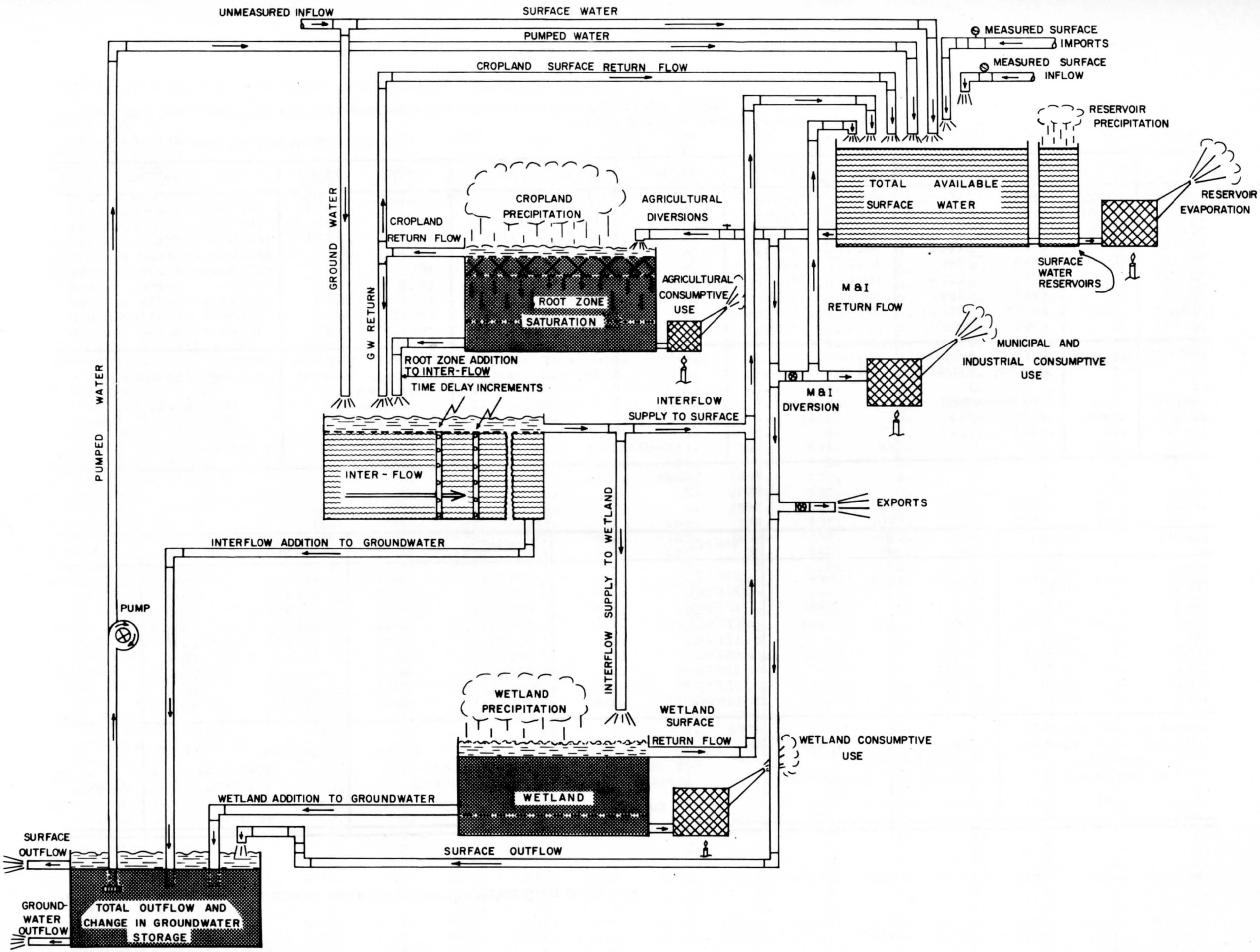


Figure 37. "Plumbing Diagram" of monthly water budget computational procedure.

Table 30. Summary of mean annual water budget for the Weber River study unit.

Subarea	Watershed Precipitation (inches)	Watershed Precipitation (acre-feet)	Watershed on Site Use (inches)	Watershed on Site Use (acre-feet)	Yield to Valley Area (inches)	Yield to Valley Area (acre-feet)	River Inflows (acre-feet)	Surface Imports (acre-feet)	Precipitation on Valley Area Oct-Sept (acre-feet)	Precipitation on Valley Area May-Sept (acre-feet)
	INFLOWS									
01	32.48	273,280	16.00	134,590	16.48	138,689	0	0	7,691	2,558
02	22.00	270,770	17.55	215,950	4.45	54,821 [a]	140,378	4,698	40,394	13,074
03	20.97	277,770	17.84	236,320	3.13	41,448	0	1,182	4,376	1,453
04	18.93	275,400	16.54	238,540	2.39	36,860	220,417	1,177	5,354	1,955
05	19.83	239,300	16.47	198,770	3.36	40,527	0	0	1,587	548
06	26.62	206,860	21.85	167,620	4.77	39,240	0	0	11,133	3,226
07	27.23	404,800	20.00	297,270	7.23	107,527	288,490	0	16,643	4,931
08	24.68	374,100	11.69	177,150	12.99	196,958	0	0	28,813	7,631
09	18.89	201,240	12.45	132,610	6.44	68,628	559,879	0	323,956	96,535
Total	23.15	2,523,530	16.50	1,798,820	6.65	724,698			439,947	131,911

Subarea	Cropland Consumptive Use Oct-Sept (acre-feet)	Cropland Consumptive Use May-Sept (acre-feet)	Cropland Net Consumptive Use Oct-Sept (acre-feet)	Cropland Net Consumptive Use May-Sept (acre-feet)	Wetland Consumptive Use Oct-Sept (acre-feet)	Wetland Consumptive Use May-Sept (acre-feet)	Municiple and Industrial Use (acre-feet)	Total Depletions Oct-Sept (acre-feet)	Total Depletions May-Sept (acre-feet)	Net Depletions Oct-Sept (acre-feet)	Net Depletions May-Sept (acre-feet)	Exports (acre-feet)	Outflow Surface (acre-feet)
	OUTFLOWS												
01	4,846	4,246	-2,021	1,962	1,155	881	0	6.001	5.127	-1.690	2.569	0	140,378
02	45,240	39,150	4,999	27,363	8,250	6,208	150	53,640	45.466	13.246	32.392	33,577	153,076 [b]
03	5,398	4,657	1,400	3,329	809	615	50	6.257	5.306	1.881	3.853	0	40,748
04	6,413	5,465	2,830	4,153	5,313	4,028	0	11.726	9.493	6.372	7.538	0	252,081
05	1,209	1,024	281	704	1,343	1,047	0	2.552	2.071	965	1.623	0	39.562
06	11,338	9,779	1,794	7,012	2,628	2,017	0	13.966	11.796	2.833	8.570	0	36,408
07	24,910	20,867	10,524	16,605	5,511	4,375	120	30.541	25.328	13.898	20.397	9.889	372.229
08	30,049	25,412	9,039	19,847	16,133	12,526	50	46.232	37.972	17.419	30.341	16,703	162,819
09	264,277	204,520	97,971	154,496	234,805	176,793	27,588	526,670	402.454	202.714	305.919	18,662	407,069
Total	396,680	315,120	126,817	235,471	275,947	208,490	27,958	697,585	545.013	257.638	413.202	---	---

[a] Ground water yield from Park City Mines - 9,977

[b] Groundwater from mines at Park City and ground water flow to Provo River from Beaver Creek - 12,970

Table 31. Mean monthly water budget for subarea no. 1 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 1-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
UNMEASURED INFLOW	I	4188.	3733.	3402.	2881.	3245.	3596.	8072.	39996.	46149.	12466.	6702.	4259.	138689.
UNMEASURED SURFACE IN		4188.	3733.	3402.	2881.	3245.	3596.	8072.	39996.	46149.	12466.	6702.	4259.	138689.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR PRECIPITATION	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR EVAPORATION	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RES STORAGE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	1460.	987.	0.	2447.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	0.	2472.	777.	0.	0.	0.	0.	3249.
M AND I RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
USEABLE SURFACE WATER		4188.	3733.	3402.	2881.	3245.	3596.	10544.	40773.	46149.	13926.	7689.	4259.	144386.
EXPORTS	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I DIVERSION		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I NET USE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	0.	0.	0.	2175.	1699.	133.	4007.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	0.	0.	0.	685.	535.	42.	1262.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	1490.	1164.	91.	2745.
CROPLAND PRECIPITATION	I	438.	605.	557.	725.	762.	787.	707.	575.	447.	300.	502.	460.	6867.
SNOW STORAGE ADDED	O	0.	605.	557.	725.	762.	787.	0.	0.	0.	0.	0.	0.	3437.
ACCUM SNOW STORAGE		0.	0.	605.	1162.	1887.	2650.	3437.	550.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	0.	0.	2887.	550.	0.	0.	0.	0.	3437.
ROOT ZONE SUPPLY		438.	0.	0.	0.	0.	0.	3595.	1125.	447.	985.	1038.	502.	8129.
CROPLAND P.C.U.		153.	41.	27.	32.	56.	103.	188.	335.	1047.	1325.	1037.	502.	4846.
RZ SUPPLY-P.C.U.		284.	-41.	-27.	-32.	-56.	-103.	3407.	790.	-600.	-340.	0.	0.	3283.
ACCUM SOIL MOISTURE	I-O	0.	284.	243.	216.	184.	128.	25.	940.	940.	340.	0.	1.	1.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	153.	41.	27.	32.	56.	103.	188.	335.	1047.	1325.	1037.	502.	4846.
INTERFLOW ADDED		0.	0.	0.	0.	0.	0.	2493.	790.	0.	0.	0.	0.	3282.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	177.	91.	298.
ACCUM INTERFLOW	I-O	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.	2062.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	0.	2493.	790.	0.	30.	177.	91.	3580.
WETLAND PRECIPITATION	I	52.	73.	67.	87.	91.	94.	85.	69.	54.	36.	60.	55.	824.
SNOW STORAGE ADDED	O	0.	73.	67.	87.	91.	94.	0.	0.	0.	0.	0.	0.	412.
ACCUM SNOW STORAGE		0.	0.	73.	139.	226.	318.	412.	66.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	0.	0.	346.	66.	0.	0.	0.	0.	412.
TOTAL SUPPLY TO WL		52.	0.	0.	0.	0.	0.	2924.	925.	54.	66.	237.	146.	4404.
POTENTIAL WETLAND CU		66.	18.	11.	12.	24.	51.	92.	148.	188.	231.	194.	120.	1155.
TSWL-WL PCU		-13.	-18.	-11.	-12.	-24.	-51.	2832.	777.	-134.	-165.	43.	26.	3249.
ACCUM WL SOIL MOIST	I-O	130.	117.	98.	87.	75.	51.	0.	360.	360.	226.	61.	104.	130.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	66.	18.	11.	12.	24.	51.	92.	148.	188.	231.	194.	120.	1155.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	0.	2472.	777.	0.	0.	0.	0.	3249.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	4188.	3733.	3402.	2881.	3245.	3596.	10544.	40773.	46149.	11751.	5990.	4126.	140379.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		4188.	3733.	3402.	2881.	3245.	3596.	10544.	40773.	46149.	11751.	5990.	4126.	140379.
GAGED SURFACE OUTFLOW		4188.	3733.	3402.	2881.	3245.	3596.	10544.	40773.	46149.	11751.	5990.	4126.	140378.
DIFFERENCE (COMP-GAGED)		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.

Table 32. Mean monthly water budget for subarea no. 2 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 2-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	4188.	3733.	3402.	2881.	3245.	3596.	10544.	40773.	46149.	11751.	5990.	4126.	140378.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	935.	1640.	1057.	648.	418.	4698.
UNMEASURED INFLOW	I	1215.	4322.	4327.	4160.	3986.	8567.	9366.	8903.	4145.	1991.	2016.	1823.	54821.
UNMEASURED SURFACE IN		994.	3535.	3539.	3403.	3261.	7008.	7661.	7283.	3391.	1629.	1649.	1491.	44844.
GROUNDWATER INFLOW		221.	787.	788.	757.	725.	1559.	1705.	1620.	754.	362.	367.	332.	9977.
RESERVOIR STORAGE		2207.	2392.	2145.	2112.	2347.	2216.	1991.	3306.	4725.	4257.	3214.	2485.	2485.
RESERVOIR PRECIPITATION	I	106.	142.	163.	150.	158.	169.	132.	138.	101.	66.	96.	87.	1508.
RESERVOIR EVAPORATION	O	181.	52.	31.	32.	68.	146.	256.	409.	518.	619.	533.	326.	3171.
CHANGE IN RES STORAGE	O	-278.	185.	-247.	-33.	235.	-131.	-225.	1315.	1419.	-468.	-1043.	-729.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	153.	7859.	13726.	9036.	5819.	3650.	40241.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	0.	3364.	710.	0.	0.	0.	0.	4074.
M AND I RETURN FLOW		9.	6.	6.	3.	4.	10.	12.	19.	23.	27.	24.	15.	158.
USEABLE SURFACE WATER		7601.	9571.	9472.	8549.	8712.	12984.	23826.	59298.	67817.	27672.	17950.	12675.	266127.
EXPORTS	O	100.	400.	500.	400.	200.	400.	2800.	11214.	13095.	3128.	886.	454.	33577.
M AND I DIVERSION		18.	9.	9.	6.	8.	18.	24.	38.	46.	54.	48.	30.	308.
M AND I NET USE	O	9.	3.	3.	3.	4.	8.	12.	19.	23.	27.	24.	15.	150.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	223.	11471.	20035.	13189.	8493.	5327.	58738.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	70.	3612.	6309.	4153.	2674.	1677.	18497.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	153.	7859.	13726.	9036.	5819.	3650.	40241.
CROPLAND PRECIPITATION	I	2562.	3422.	3941.	3619.	3816.	4084.	3189.	3332.	2436.	1594.	2329.	2096.	36419.
SNOW STORAGE ADDED	O	0.	3422.	3941.	3619.	3816.	4084.	0.	0.	0.	0.	0.	0.	18882.
ACCUM SNOW STORAGE		0.	0.	2361.	6302.	9921.	13736.	10693.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	1061.	0.	0.	0.	7128.	10693.	0.	0.	0.	0.	0.	18882.
ROOT ZONE SUPPLY		2562.	1061.	0.	0.	0.	7128.	13951.	6944.	8745.	5748.	5003.	3773.	54916.
CROPLAND P.C.U.		1718.	446.	290.	307.	452.	1032.	1845.	4114.	9501.	11563.	9185.	4787.	45240.
RZ SUPPLY-P.C.U.		844.	615.	-290.	-307.	-452.	6096.	12106.	2830.	-755.	-5816.	-4181.	-1014.	9676.
ACCUM SOIL MOISTURE	I-O	3.	847.	1462.	1172.	865.	413.	6509.	11770.	11770.	11014.	5198.	1017.	3.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	1718.	446.	290.	307.	452.	1032.	1845.	4114.	9501.	11563.	9185.	4787.	45240.
INTERFLOW ADDED		0.	0.	0.	0.	0.	0.	6846.	2830.	0.	0.	0.	0.	9676.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACCUM INTERFLOW	I-O	5184.	5236.	5560.	5667.	5583.	5489.	6311.	7063.	7063.	7063.	6571.	5908.	5184.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	0.	7048.	3695.	2.	0.	0.	0.	10745.
WETLAND PRECIPITATION	I	174.	232.	267.	245.	258.	277.	216.	226.	165.	108.	158.	142.	2467.
SNOW STORAGE ADDED	O	0.	232.	267.	245.	258.	277.	0.	0.	0.	0.	0.	0.	1279.
ACCUM SNOW STORAGE		0.	0.	160.	427.	672.	930.	724.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	72.	0.	0.	0.	483.	724.	0.	0.	0.	0.	0.	1279.
TOTAL SUPPLY TO WL		174.	72.	0.	0.	0.	483.	7989.	3921.	167.	108.	158.	142.	17616.
POTENTIAL WETLAND CU		339.	124.	54.	59.	108.	220.	372.	605.	826.	977.	844.	551.	5079.
TSWL-WL PCU		-166.	-52.	-54.	-59.	-108.	262.	7616.	3316.	-658.	-869.	-686.	-409.	8134.
ACCUM WL SOIL MOIST	I-O	544.	378.	326.	272.	213.	105.	368.	3166.	3166.	2508.	1638.	952.	544.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	339.	124.	54.	59.	108.	220.	372.	605.	826.	977.	844.	551.	5079.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	0.	3364.	710.	0.	0.	0.	0.	4074.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	1454.	2606.	0.	0.	0.	0.	4060.
INTERFLOW TO GW		169.	463.	680.	841.	819.	737.	750.	756.	752.	854.	1030.	1056.	8909.
TOTAL GW ADDED		169.	463.	680.	841.	819.	737.	2204.	3362.	752.	854.	1030.	1056.	12968.
OUTFLOW + CHANGE IN GW	R	5445.	7233.	7498.	6872.	6976.	11087.	20993.	36631.	30668.	7897.	6339.	5435.	153076.
GW OUTFLOW		1083.	1088.	1090.	1092.	1090.	1127.	1050.	1148.	1106.	976.	1072.	1048.	12970.
CHANGE IN GW STORAGE		-914.	-625.	-410.	-251.	-271.	-390.	1154.	2214.	-354.	-122.	-42.	8.	-2.
SURFACE OUTFLOW		5276.	6770.	6818.	6031.	6157.	10350.	18788.	33269.	29916.	7044.	5309.	4379.	140107.
GAGED SURFACE OUTFLOW		5276.	6770.	6818.	6032.	6157.	10351.	18787.	33269.	29916.	7043.	5309.	4378.	140106.
DIFFERENCE (COMP-GAGED)		0.	-0.	-0.	-1.	-0.	-1.	1.	0.	0.	1.	-0.	1.	1.

Table 33. Mean monthly water budget for subarea no. 3 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 3-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	214.	395.	228.	186.	159.	1182.
UNMEASURED INFLOW	I	926.	1114.	1068.	1059.	1050.	1613.	5944.	14729.	8627.	2712.	1541.	1065.	41448.
UNMEASURED SURFACE IN		926.	1114.	1068.	1059.	1050.	1613.	5944.	14729.	8627.	2712.	1541.	1065.	41448.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR PRECIPITATION	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR EVAPORATION	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RES STORAGE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	1386.	2625.	0.	0.	0.	4011.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	427.	757.	450.	291.	1450.	992.	679.	5046.
M AND I RETURN FLOW		3.	2.	1.	1.	2.	3.	4.	8.	11.	5.	3.	5.	48.
USEABLE SURFACE WATER		929.	1116.	1069.	1060.	1052.	2043.	6705.	16787.	11949.	4395.	2722.	1908.	51734.
EXPORTS	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I DIVERSION		6.	4.	2.	2.	4.	6.	8.	14.	18.	14.	10.	10.	98.
M AND I NET USE	O	3.	2.	1.	1.	2.	3.	4.	6.	7.	9.	7.	5.	50.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	0.	2023.	3831.	2333.	1615.	1086.	10888.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	0.	637.	1206.	735.	509.	342.	3429.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	1386.	2625.	1598.	1106.	744.	7459.
CROPLAND PRECIPITATION	I	266.	348.	326.	348.	437.	480.	464.	376.	310.	166.	232.	244.	3998.
SNOW STORAGE ADDED	O	0.	348.	326.	348.	437.	0.	0.	0.	0.	0.	0.	0.	1459.
ACCUM SNOW STORAGE		0.	0.	171.	496.	845.	1282.	500.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	178.	0.	0.	0.	782.	500.	0.	0.	0.	0.	0.	1459.
ROOT ZONE SUPPLY		266.	178.	0.	0.	0.	1262.	964.	1013.	1516.	901.	741.	586.	7426.
CROPLAND P.C.U.		194.	50.	29.	32.	63.	130.	243.	506.	1120.	1422.	1072.	537.	5398.
RZ SUPPLY-P.C.U.		72.	127.	-29.	-32.	-63.	1132.	721.	506.	396.	-521.	-332.	49.	2028.
ACCUM SOIL MOISTURE	I-O	473.	545.	673.	644.	612.	549.	1277.	1277.	1277.	1277.	756.	424.	473.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	194.	50.	29.	32.	63.	130.	243.	506.	1120.	1422.	1072.	537.	5398.
INTERFLOW ADDED		0.	0.	0.	0.	0.	405.	721.	506.	396.	0.	0.	0.	2028.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	1598.	1106.	744.	3449.
ACCUM INTERFLOW	I-O	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	405.	721.	506.	396.	1598.	1106.	744.	5477.
WETLAND PRECIPITATION	I	25.	33.	31.	33.	41.	45.	44.	35.	29.	16.	22.	23.	378.
SNOW STORAGE ADDED	O	0.	33.	31.	33.	41.	0.	0.	0.	0.	0.	0.	0.	138.
ACCUM SNOW STORAGE		0.	0.	16.	47.	80.	121.	47.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	17.	0.	0.	0.	74.	47.	0.	0.	0.	0.	0.	138.
TOTAL SUPPLY TO WL		25.	17.	0.	0.	0.	524.	812.	542.	425.	1614.	1128.	767.	23471.
POTENTIAL WETLAND CU		52.	21.	8.	9.	16.	33.	55.	92.	134.	164.	137.	88.	809.
TSWL-WL PCU		-27.	-4.	-8.	-9.	-16.	490.	757.	450.	291.	1450.	992.	679.	5046.
ACCUM WL SOIL MOIST	I-O	258.	231.	227.	219.	210.	194.	258.	258.	258.	258.	258.	258.	258.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	52.	21.	8.	9.	16.	33.	55.	92.	134.	164.	137.	88.	809.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	427.	757.	450.	291.	1450.	992.	679.	5046.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	923.	1112.	1067.	1058.	1048.	2037.	6697.	14750.	8100.	2048.	1097.	812.	40748.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		923.	1112.	1067.	1058.	1048.	2037.	6697.	14750.	8100.	2048.	1097.	812.	40748.
GAGED SURFACE OUTFLOW		923.	1112.	1067.	1058.	1048.	2037.	6697.	14750.	8100.	2048.	1097.	812.	40749.
DIFFERENCE (COMP-GAGED)		0.	0.	0.	0.	0.	-0.	0.	-0.	0.	-0.	-0.	0.	-1.

Table 34. Mean monthly water budget for subarea no. 4 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 4-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	7025.	9089.	8892.	8107.	8357.	14556.	33474.	66154.	41631.	10153.	7155.	5824.	220417.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	214.	395.	228.	186.	154.	1177.
UNMEASURED INFLOW	I	1398.	1700.	2218.	2293.	2260.	3834.	8841.	7637.	5010.	625.	166.	878.	36860.
UNMEASURED SURFACE IN		1398.	1700.	2218.	2293.	2260.	3834.	8841.	7637.	5010.	625.	166.	878.	36860.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		15600.	17249.	19828.	21754.	24261.	32598.	49328.	63504.	62245.	43301.	25596.	16068.	16068.
RESERVOIR PRECIPITATION	I	103.	113.	107.	113.	111.	138.	111.	122.	94.	76.	100.	63.	1254.
RESERVOIR EVAPORATION	O	223.	67.	37.	37.	83.	204.	330.	521.	634.	780.	656.	406.	3978.
CHANGE IN RES STORAGE	O	-468.	1649.	2579.	1926.	2507.	8337.	16730.	14176.	-1259.	-18944.	-17705.	-9528.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	1915.	786.	763.	505.	438.	4407.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
USEABLE SURFACE WATER		24372.	26435.	28429.	30304.	32400.	42585.	74694.	124849.	110787.	73311.	50757.	32547.	651469.
EXPORTS	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I DIVERSION		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I NET USE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CROPLAND DIVERSIONS		120.	0.	0.	0.	0.	0.	0.	2970.	1567.	1520.	1007.	872.	8056.
AMOUNT TO ROOT ZONE		43.	0.	0.	0.	0.	0.	0.	1055.	556.	540.	358.	310.	2861.
CROPLAND RETURN FLOW		77.	0.	0.	0.	0.	0.	0.	1915.	1011.	980.	649.	562.	5195.
CROPLAND PRECIPITATION	I	295.	324.	306.	324.	318.	396.	318.	349.	270.	218.	285.	180.	3583.
SNOW STORAGE ADDED	O	0.	324.	306.	324.	318.	0.	0.	0.	0.	0.	0.	0.	1271.
ACCUM SNOW STORAGE		0.	0.	159.	464.	788.	1106.	122.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	165.	0.	0.	0.	985.	122.	0.	0.	0.	0.	0.	1271.
ROOT ZONE SUPPLY		338.	165.	0.	0.	0.	1380.	440.	1404.	826.	758.	643.	489.	6444.
CROPLAND P.C.U.		251.	72.	34.	35.	75.	183.	297.	662.	1293.	1606.	1245.	659.	6413.
RZ SUPPLY-P.C.U.		87.	93.	-34.	-35.	-75.	1197.	143.	742.	-467.	-848.	-602.	-170.	30.
ACCUM SOIL MOISTURE	I-O	366.	453.	545.	511.	476.	401.	1598.	1741.	2453.	1986.	1138.	536.	366.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	251.	72.	34.	35.	75.	183.	297.	662.	1293.	1606.	1245.	659.	6413.
INTERFLOW ADDED		0.	0.	0.	0.	0.	0.	0.	30.	0.	0.	0.	0.	30.
GW RETURN FLOW		77.	0.	0.	0.	0.	0.	0.	0.	224.	218.	144.	125.	788.
ACCUM INTERFLOW	I-O	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.	4000.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		77.	0.	0.	0.	0.	0.	0.	30.	224.	218.	144.	125.	818.
WETLAND PRECIPITATION	I	43.	47.	44.	47.	46.	57.	46.	50.	39.	32.	41.	26.	517.
SNOW STORAGE ADDED	O	0.	47.	44.	47.	46.	0.	0.	0.	0.	0.	0.	0.	184.
ACCUM SNOW STORAGE		0.	0.	23.	67.	114.	160.	18.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	24.	0.	0.	0.	142.	18.	0.	0.	0.	0.	0.	184.
TOTAL SUPPLY TO WL		120.	24.	0.	0.	0.	199.	64.	81.	263.	249.	185.	151.	24807.
POTENTIAL WETLAND CU		79.	29.	12.	13.	25.	57.	90.	151.	227.	279.	231.	143.	1335.
TSWL-WL PCU		41.	-5.	-12.	-13.	-25.	142.	-26.	-71.	36.	-30.	-46.	8.	1.
ACCUM WL SOIL MOIST	I-O	316.	357.	353.	341.	328.	303.	445.	419.	348.	385.	354.	309.	317.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	79.	29.	12.	13.	25.	57.	90.	151.	227.	279.	231.	143.	1335.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	8652.	9186.	8601.	8550.	8139.	9987.	25366.	58375.	46975.	28490.	24154.	15607.	252081.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		8652.	9186.	8601.	8550.	8139.	9987.	25366.	58375.	46975.	28490.	24154.	15607.	252081.
GAGED SURFACE OUTFLOW		8652.	9186.	8601.	8550.	8139.	9987.	25366.	58375.	46975.	28490.	24154.	15607.	252082.
DIFFERENCE (COMP-GAGED)		-0.	-0.	-0.	0.	-0.	0.	0.	0.	-0.	-0.	-0.	-0.	-1.

Table 35. Mean monthly water budget for subarea no. 5 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 5-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
UNMEASURED INFLOW	I	826.	1207.	1007.	1017.	1152.	1927.	7854.	18237.	4003.	1463.	1022.	812.	40527.
UNMEASURED SURFACE IN		826.	1207.	1007.	1017.	1152.	1927.	7854.	18237.	4003.	1463.	1022.	812.	40527.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR PRECIPITATION	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR EVAPORATION	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RES STORAGE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	241.	136.	1062.	527.	59.	0.	45.	2070.
M AND I RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
USEABLE SURFACE WATER		826.	1207.	1007.	1017.	1152.	2168.	7990.	19299.	4530.	1522.	1022.	857.	42597.
EXPORTS	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I DIVERSION		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I NET USE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	0.	1164.	915.	460.	273.	223.	3035.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	0.	367.	288.	145.	86.	70.	956.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	797.	627.	315.	187.	153.	2079.
CROPLAND PRECIPITATION	I	59.	73.	81.	90.	95.	111.	98.	97.	63.	41.	53.	66.	928.
SNOW STORAGE ADDED	O	0.	0.	81.	90.	95.	0.	0.	0.	0.	0.	0.	0.	266.
ACCUM SNOW STORAGE		0.	0.	0.	81.	171.	266.	72.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	0.	194.	72.	0.	0.	0.	0.	0.	266.
ROOT ZONE SUPPLY		59.	73.	0.	0.	0.	305.	169.	464.	351.	186.	139.	136.	1884.
CROPLAND P.C.U.		43.	13.	7.	8.	14.	32.	67.	122.	261.	324.	207.	110.	1209.
RZ SUPPLY-P.C.U.		16.	60.	-7.	-8.	-14.	273.	103.	342.	90.	-139.	-67.	26.	675.
ACCUM SOIL MOISTURE	I-O	126.	142.	202.	195.	188.	174.	306.	306.	306.	306.	168.	100.	126.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	43.	13.	7.	8.	14.	32.	67.	122.	261.	324.	207.	110.	1209.
INTERFLOW ADDED		0.	0.	0.	0.	0.	140.	103.	342.	90.	0.	0.	0.	675.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	797.	627.	315.	187.	153.	2079.
ACCUM INTERFLOW	I-O	700.	700.	700.	700.	700.	700.	700.	700.	700.	700.	700.	700.	700.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	140.	103.	1139.	717.	315.	187.	153.	2754.
WETLAND PRECIPITATION	I	42.	52.	57.	64.	67.	79.	69.	69.	45.	29.	38.	47.	659.
SNOW STORAGE ADDED	O	0.	0.	57.	64.	67.	0.	0.	0.	0.	0.	0.	0.	189.
ACCUM SNOW STORAGE		0.	0.	0.	57.	121.	189.	51.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	0.	138.	51.	0.	0.	0.	0.	0.	189.
TOTAL SUPPLY TO WL		42.	52.	0.	0.	0.	357.	223.	1208.	762.	344.	225.	200.	28220.
POTENTIAL WETLAND CU		80.	31.	12.	13.	23.	51.	87.	146.	235.	286.	236.	144.	1343.
TSWL-WL PCU		-37.	21.	-12.	-13.	-23.	306.	136.	1062.	527.	59.	-11.	56.	2070.
ACCUM WL SOIL MOIST	I-O	465.	428.	449.	437.	424.	400.	465.	465.	465.	465.	465.	454.	465.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	80.	31.	12.	13.	23.	51.	87.	146.	235.	286.	236.	144.	1343.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	241.	136.	1062.	527.	59.	0.	45.	2070.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	826.	1207.	1007.	1017.	1152.	2168.	7990.	18135.	3615.	1062.	749.	634.	39562.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		826.	1207.	1007.	1017.	1152.	2168.	7990.	18135.	3615.	1062.	749.	634.	39562.
GAGED SURFACE OUTFLOW		826.	1207.	1007.	1017.	1152.	2168.	7990.	18135.	3615.	1062.	749.	634.	39562.
DIFFERENCE (COMP-GAGED)		0.	0.	0.	0.	0.	0.	-0.	0.	0.	-0.	0.	-0.	-0.

Table 36. Mean monthly water budget for subarea no. 6 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 6-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
UNMEASURED INFLOW	I	1353.	1755.	1655.	1692.	1735.	3214.	6322.	9124.	6687.	2211.	1970.	1522.	39240.
UNMEASURED SURFACE IN		1353.	1755.	1655.	1692.	1735.	3214.	6322.	9124.	6687.	2211.	1970.	1522.	39240.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		10195.	11303.	12274.	13366.	14321.	16239.	21766.	24977.	24676.	19207.	14221.	10613.	10613.
RESERVOIR PRECIPITATION	I	45.	63.	74.	76.	80.	86.	74.	56.	38.	23.	34.	51.	699.
RESERVOIR EVAPORATION	O	75.	23.	13.	13.	29.	63.	107.	174.	218.	252.	222.	135.	1325.
CHANGE IN RES STORAGE	O	-418.	1108.	971.	1092.	955.	1918.	5527.	3211.	-301.	-5469.	-4986.	-3608.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	2266.	4890.	2955.	1906.	1179.	13195.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	124.	2988.	655.	172.	0.	0.	0.	3938.
M AND I RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
USEABLE SURFACE WATER		11936.	11990.	13019.	14028.	15152.	17681.	25515.	33692.	36546.	29613.	22895.	16839.	248906.
EXPORTS	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I DIVERSION		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I NET USE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	0.	3307.	7137.	4313.	2862.	1721.	19340.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	0.	1041.	2247.	1358.	901.	542.	6090.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	2266.	4890.	2955.	1961.	1179.	13250.
CROPLAND PRECIPITATION	I	612.	856.	1008.	1034.	1093.	1169.	1004.	764.	519.	316.	468.	700.	9544.
SNOW STORAGE ADDED	O	0.	856.	1008.	1034.	1093.	1169.	0.	0.	0.	0.	0.	0.	5160.
ACCUM SNOW STORAGE		0.	0.	497.	1505.	2539.	3559.	2222.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	360.	0.	0.	73.	2506.	2222.	0.	0.	0.	0.	0.	5160.
ROOT ZONE SUPPLY		612.	360.	0.	0.	73.	2506.	3226.	1805.	2766.	1675.	1370.	1242.	15634.
CROPLAND P.C.U.		431.	121.	77.	76.	129.	266.	460.	1081.	2410.	2831.	2264.	1193.	11338.
RZ SUPPLY-P.C.U.		181.	239.	-77.	-76.	-56.	2240.	2767.	724.	357.	-1156.	-895.	50.	4296.
ACCUM SOIL MOISTURE	I-O	631.	812.	1051.	974.	897.	841.	2633.	2633.	2633.	2633.	1476.	581.	631.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	431.	121.	77.	76.	129.	266.	460.	1081.	2410.	2831.	2264.	1193.	11338.
INTERFLOW ADDED		0.	0.	0.	0.	0.	448.	2767.	724.	357.	0.	0.	0.	4296.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	55.	0.	55.
ACCUM INTERFLOW	I-O	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.	3000.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	448.	2767.	724.	357.	0.	55.	0.	4351.
WETLAND PRECIPITATION	I	57.	80.	94.	96.	102.	109.	94.	71.	48.	29.	44.	65.	890.
SNOW STORAGE ADDED	O	0.	80.	94.	96.	102.	109.	0.	0.	0.	0.	0.	0.	481.
ACCUM SNOW STORAGE		0.	0.	46.	140.	237.	332.	207.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	34.	0.	0.	7.	234.	207.	0.	0.	0.	0.	0.	481.
TOTAL SUPPLY TO WL		57.	34.	0.	0.	7.	682.	3067.	796.	405.	29.	99.	65.	33460.
POTENTIAL WETLAND CU		78.	30.	13.	13.	25.	49.	80.	141.	233.	270.	232.	140.	1303.
TSWL-WL PCU		-21.	4.	-13.	-13.	-18.	633.	2988.	655.	172.	-240.	-133.	-75.	3938.
ACCUM WL SOIL MOIST	I-O	62.	41.	44.	32.	19.	1.	510.	510.	510.	510.	270.	136.	61.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	78.	30.	13.	13.	25.	49.	80.	141.	233.	270.	232.	140.	1303.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	124.	2988.	655.	172.	0.	0.	0.	3938.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	1741.	687.	745.	662.	831.	1442.	3749.	5408.	4733.	6093.	5812.	4505.	36408.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		1741.	687.	745.	662.	831.	1442.	3749.	5408.	4733.	6093.	5812.	4505.	36408.
GAGED SURFACE OUTFLOW		1741.	687.	745.	662.	831.	1442.	3749.	5408.	4733.	6093.	5812.	4505.	36408.
DIFFERENCE (COMP-GAGED)		-0.	0.	-0.	0.	-0.	-0.	0.	0.	-0.	-0.	-0.	-0.	-0.

area 6. The agricultural and domestic uses center principally in the Morgan Valley. Depletions are not high, however, being only 10 percent of the total available supply. The outflow is gaged at the Gateway station and is assumed to include all flow with no underflow bypassing. In addition, at the gaged outflow at Gateway additional water is exported through the Gateway tunnel at the Stoddard diversion. This export is a recent event involving only the last three years of the mean period. The mean monthly budget is shown in Table 37.

Subarea 8–Ogden Valley. Subarea 8 includes all of the drainage area above the gaging station at Pine View Reservoir. The high elevation mountains enclosing the valley yield a sizable amount of water to the area. Part of the valley floor is below 5,000 feet elevation but depletions are not high. An artesian aquifer exists under the valley floor. This underground basin is recharged by sources in the subarea and most of the yield from the underground basin is piped directly into area 9. The mean monthly budget for the subarea is shown in Table 38.

Subarea 9–East Shore area. Subarea 9 contains most of the cultural water consuming activities within the entire Weber River drainage system. Mean temperatures are highest, growing season is longest and the water demand, the greatest. Inputs to the area include the flow of Weber River at Gateway and the flow of Ogden River at Pine View Reservoir. In addition, there is an ungaged flow from the mountain front streams and precipitation on the cropped areas. Depletions from the area are high and include sizable amounts to nonbeneficial vegetation. Numerous wells tap the large underground reservoir although the amount of water withdrawn is not large. Some water is exported to the Bear River System and municiple and industrial uses are heavy. All other outflow from the subarea goes into Great Salt Lake and is lost to the atmosphere by evaporation. The mean monthly budget is shown in Table 39. Flow diagrams of mean annual water budgets for each subarea are shown in Fig. 38.

Table 37. Mean monthly water budget for subarea no. 7 Weber River study unit.

ITERATION 0

WATER BUDGET-SUBAREA 7-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	10393.	9873.	9346.	9212.	8970.	11429.	29115.	63783.	51708.	34583.	29966.	20112.	288490.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
UNMEASURED INFLOW	I	3504.	3435.	3753.	3257.	4197.	10080.	24421.	26767.	13572.	5713.	5022.	3806.	107527.
UNMEASURED SURFACE IN		3504.	3435.	3753.	3257.	4197.	10080.	24421.	26767.	13572.	5713.	5022.	3806.	107527.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR PRECIPITATION	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR EVAPORATION	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RES STORAGE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PUMPED WATER		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE RETURN FLOW		0.	0.	0.	0.	0.	0.	147.	4155.	5005.	4326.	3276.	2730.	19640.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
M AND I RETURN FLOW		7.	3.	2.	2.	4.	6.	10.	15.	12.	22.	19.	12.	114.
USEABLE SURFACE WATER		13904.	13311.	13101.	12471.	13171.	21515.	53693.	94720.	70297.	44644.	38283.	26660.	415771.
EXPORTS	O	273.	348.	316.	284.	197.	444.	350.	769.	1541.	1973.	2062.	1332.	9889.
M AND I DIVERSION		14.	6.	4.	4.	8.	12.	20.	30.	30.	44.	38.	24.	234.
M AND I NET USE	O	7.	3.	2.	2.	4.	6.	10.	15.	18.	22.	19.	12.	120.
CROPLAND DIVERSIONS		0.	0.	0.	0.	0.	0.	214.	7220.	8920.	7563.	5516.	3985.	33418.
AMOUNT TO ROOT ZONE		0.	0.	0.	0.	0.	0.	67.	2274.	2809.	2382.	1737.	1255.	10523.
CROPLAND RETURN FLOW		0.	0.	0.	0.	0.	0.	147.	4946.	6111.	5181.	3779.	2730.	22895.
CROPLAND PRECIPITATION	I	1196.	1392.	1519.	1558.	1499.	1607.	1352.	1343.	1009.	470.	813.	627.	14386.
SNOW STORAGE ADDED	O	0.	0.	1519.	1558.	1499.	0.	0.	0.	0.	0.	0.	0.	4577.
ACCUM SNOW STORAGE		0.	0.	0.	410.	1496.	719.	0.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	1109.	472.	2276.	719.	0.	0.	0.	0.	0.	0.	4577.
ROOT ZONE SUPPLY		1196.	1392.	1109.	472.	2276.	2326.	1420.	3616.	3818.	2852.	2550.	1882.	24910.
CROPLAND P.C.U.		919.	308.	138.	162.	325.	692.	1498.	2248.	5207.	6547.	4761.	2150.	24955.
RZ SUPPLY-P.C.U.		276.	1084.	970.	310.	1952.	1634.	-78.	1368.	-1388.	-3695.	-2210.	-268.	-45.
ACCUM SOIL MOISTURE	I-O	0.	276.	1360.	2331.	2641.	4592.	6226.	6148.	7516.	6128.	2433.	222.	0.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-45.	-45.
ACTUAL CROPLAND C.U.	O	919.	308.	138.	162.	325.	692.	1498.	2248.	5207.	6547.	4761.	2104.	24910.
INTERFLOW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	791.	1106.	855.	503.	0.	3255.
ACCUM INTERFLOW	I-O	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.	6350.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	0.	0.	791.	1106.	855.	503.	0.	3255.
WETLAND PRECIPITATION	I	188.	218.	238.	244.	235.	252.	212.	211.	158.	74.	128.	98.	2257.
SNOW STORAGE ADDED	O	0.	0.	238.	244.	235.	0.	0.	0.	0.	0.	0.	0.	718.
ACCUM SNOW STORAGE		0.	0.	0.	64.	235.	113.	0.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	174.	74.	357.	113.	0.	0.	0.	0.	0.	0.	718.
TOTAL SUPPLY TO WL		188.	218.	174.	74.	357.	365.	212.	1002.	1264.	929.	630.	98.	3897 2.
POTENTIAL WETLAND CU		335.	125.	52.	54.	102.	226.	390.	640.	972.	1181.	981.	601.	5659.
TSWL-WL PCU		-148.	93.	122.	20.	255.	139.	-178.	362.	293.	-252.	-350.	-503.	-147.
ACCUM WL SOIL MOIST	I-O	0.	0.	93.	215.	235.	490.	629.	451.	813.	1106.	854.	504.	1.
WETLAND DEFICIT		-148.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-148.
ACTUAL WETLAND C.U.	O	188.	125.	52.	54.	102.	226.	390.	640.	972.	1181.	981.	601.	5511.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OUTFLOW + CHANGE IN GW	R	13617.	12957.	12781.	12183.	12966.	21059.	53109.	86701.	59806.	35064.	30667.	21319.	372230.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SURFACE OUTFLOW		13617.	12957.	12781.	12183.	12966.	21059.	53109.	86701.	59806.	35064.	30667.	21319.	372230.
GAGED SURFACE OUTFLOW		13617.	12957.	12781.	12183.	12966.	21059.	53109.	86701.	59806.	35064.	30667.	21319.	372229.
DIFFERENCE (COMP-GAGED)		0.	0.	0.	0.	0.	0.	-0.	-0.	-0.	0.	0.	0.	1.

Table 38. Mean monthly water budget for subarea no. 8 Weber River study unit.

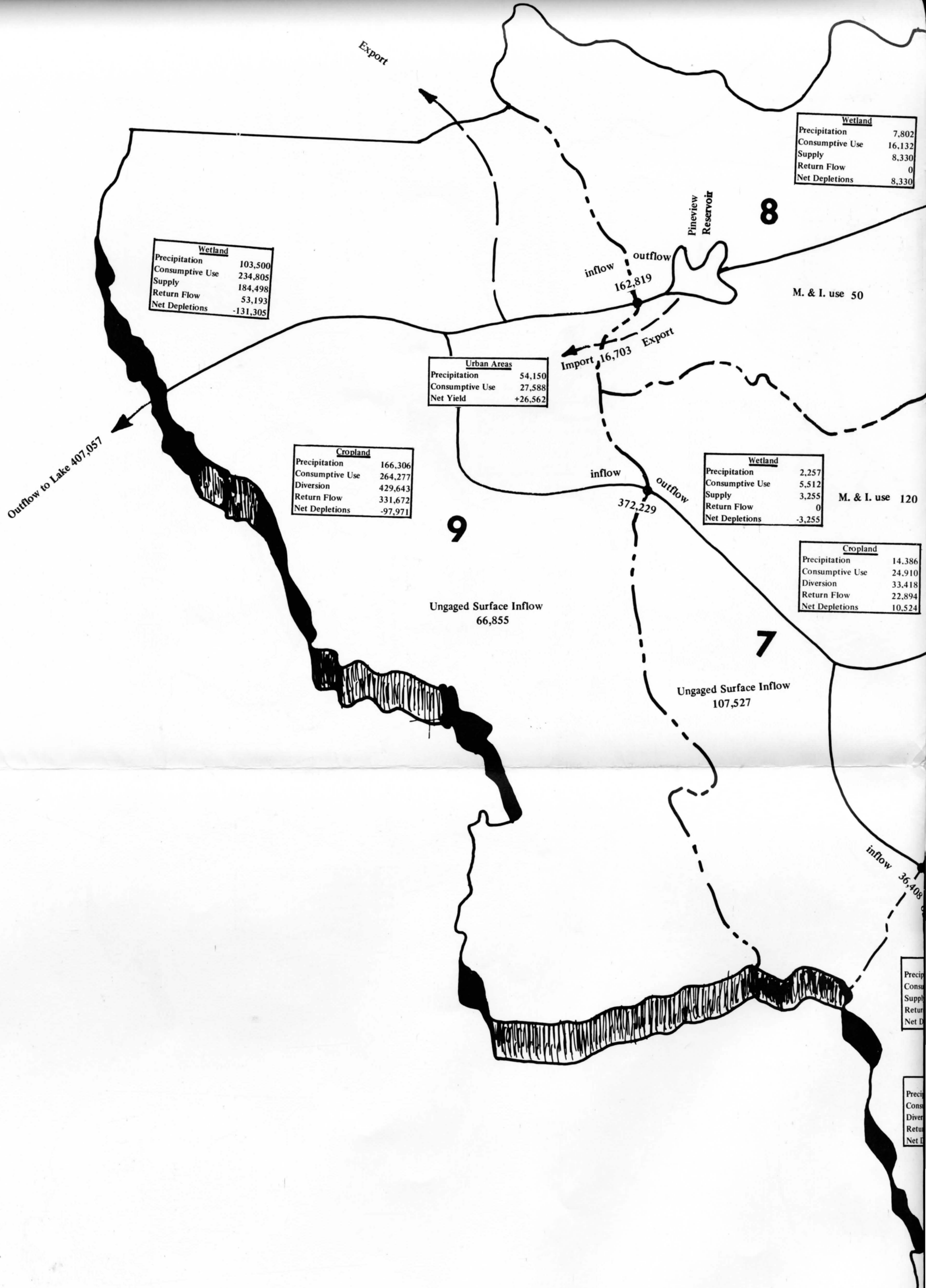
ITERATION 0 — WATER BUDGET-SUBAREA 8-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
UNMEASURED INFLOW	I	3450.	2806.	4068.	4779.	6052.	17698.	54935.	60728.	21430.	9520.	6471.	5021.	196958.
UNMEASURED SURFACE IN		3450.	2806.	4068.	4779.	6052.	17698.	54935.	60728.	21430.	9520.	6471.	5021.	196958.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		10270.	9365.	8539.	7769.	7966.	11326.	31158.	44298.	40569.	29897.	19365.	12382.	12382.
RESERVOIR PRECIPITATION	I	246.	362.	387.	433.	444.	515.	422.	327.	215.	73.	148.	248.	3820.
RESERVOIR EVAPORATION	O	501.	143.	74.	69.	174.	388.	739.	1187.	1451.	1788.	1487.	924.	8926.
CHANGE IN RES STORAGE	O	-2112.	-905.	-826.	-770.	197.	3360.	19832.	13140.	-3729.	-10672.	-10532.	-6983.	0.
PUMPED WATER		1262.	1123.	1157.	1142.	1013.	1091.	1062.	1270.	1363.	1568.	1535.	1356.	14942.
SURFACE RETURN FLOW		1875.	330.	473.	430.	431.	3984.	11423.	13020.	10752.	647.	195.	0.	43560.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	576.	1996.	2981.	0.	0.	0.	0.	5552.
M AND I RETURN FLOW		0.	2.	1.	1.	2.	3.	4.	6.	7.	10.	7.	5.	48.
USEABLE SURFACE WATER		18715.	14749.	15377.	15254.	15537.	31445.	80429.	108302.	76614.	50598.	36766.	25071.	488858.
EXPORTS	O	1262.	1123.	1157.	1142.	1013.	1091.	1062.	1363.	2092.	2184.	1826.	1388.	16703.
M AND I DIVERSION		3.	4.	2.	2.	4.	6.	8.	12.	14.	19.	14.	10.	98.
M AND I NET USE	O	3.	2.	1.	1.	2.	3.	4.	6.	7.	9.	7.	5.	50.
CROPLAND DIVERSIONS		2737.	482.	691.	627.	629.	5815.	16674.	19004.	15694.	5455.	4745.	3780.	76333.
AMOUNT TO ROOT ZONE		862.	152.	218.	197.	198.	1831.	5251.	5984.	4942.	1718.	1494.	1190.	24037.
CROPLAND RETURN FLOW		1875.	330.	473.	430.	431.	3984.	11423.	13020.	10752.	3737.	3251.	2590.	52296.
CROPLAND PRECIPITATION	I	1356.	1989.	2129.	2380.	2441.	2832.	2320.	1798.	1185.	402.	814.	1366.	21011.
SNOW STORAGE ADDED	O	0.	0.	2129.	2380.	2441.	0.	0.	0.	0.	0.	0.	0.	6950.
ACCUM SNOW STORAGE		0.	0.	0.	2129.	4509.	6602.	2311.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	347.	4292.	2311.	0.	0.	0.	0.	0.	6950.
ROOT ZONE SUPPLY		2218.	2140.	218.	197.	546.	8955.	9882.	7782.	6127.	2120.	2308.	2556.	45048.
CROPLAND P.C.U.		1256.	365.	138.	164.	359.	735.	1620.	3699.	6042.	7295.	5553.	2912.	30138.
RZ SUPPLY-P.C.U.		962.	1775.	80.	34.	186.	8220.	8262.	4083.	85.	-5175.	-3246.	-356.	14910.
ACCUM SOIL MOISTURE	I-O	0.	962.	2737.	2817.	2851.	3037.	8687.	8687.	8687.	8687.	3512.	267.	0.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-89.	-89.
ACTUAL CROPLAND C.U.	O	1256.	365.	138.	164.	359.	735.	1620.	3699.	6042.	7295.	5553.	2823.	30049.
INTERFLOW ADDED		0.	0.	0.	0.	0.	2569.	8262.	4083.	85.	0.	0.	0.	14999.
GW RETURN FLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	3091.	3056.	2590.	8736.
ACCUM INTERFLOW	I-O	9900.	7147.	5159.	3725.	2689.	1941.	3971.	9900.	9900.	9782.	9900.	9900.	9900.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		0.	0.	0.	0.	0.	0.	1943.	3801.	0.	2469.	1456.	517.	10186.
WETLAND PRECIPITATION	I	257.	377.	404.	451.	463.	537.	440.	341.	225.	76.	154.	259.	3982.
SNOW STORAGE ADDED	O	0.	0.	404.	451.	463.	0.	0.	0.	0.	0.	0.	0.	1317.
ACCUM SNOW STORAGE		0.	0.	0.	404.	855.	1251.	438.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	0.	0.	66.	813.	438.	0.	0.	0.	0.	0.	1317.
TOTAL SUPPLY TO WL		257.	377.	0.	0.	66.	1350.	2820.	4142.	225.	2545.	1610.	776.	53140.
POTENTIAL WETLAND CU		430.	154.	58.	57.	120.	246.	452.	789.	1270.	1567.	1273.	790.	7207.
TSWL-WL PCU		-173.	223.	-58.	-57.	-54.	1104.	2369.	3353.	-1046.	978.	337.	-14.	6961.
ACCUM WL SOIL MOIST	I-O	2286.	2113.	2300.	2242.	2185.	2131.	2300.	2300.	2300.	1254.	2232.	2300.	2286.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-148.
ACTUAL WETLAND C.U.	O	430.	154.	58.	57.	120.	246.	452.	789.	1270.	1567.	1273.	790.	7207.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	576.	1996.	2981.	0.	0.	0.	0.	5552.
WETLAND ADDITION TO GW		0.	36.	0.	0.	0.	359.	373.	373.	0.	0.	269.	0.	1409.
INTERFLOW TO GW		2753.	1987.	1435.	1036.	748.	540.	390.	281.	203.	504.	1600.	2073.	13549.
TOTAL GW ADDED		2753.	2023.	1435.	1036.	748.	899.	762.	654.	203.	504.	1869.	2073.	14958.
OUTFLOW + CHANGE IN GW	R	5934.	4675.	5266.	5608.	5660.	13014.	31228.	43009.	17085.	11979.	11149.	8227.	162835.
GW OUTFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN GW STORAGE		1491.	900.	278.	-106.	-265.	-192.	-300.	-616.	-1160.	-1064.	334.	717.	16.
SURFACE OUTFLOW		4443.	3775.	4988.	5714.	5925.	13207.	31527.	43625.	18245.	13043.	10816.	7511.	162820.
GAGED SURFACE OUTFLOW		4443.	3775.	4988.	5714.	5925.	13207.	31527.	43625.	18245.	13043.	10816.	7511.	162819.
DIFFERENCE (COMP-GAGED)		-0.	0.	0.	0.	-0.	-0.	0.	0.	0.	0.	-0.	-0.	1.

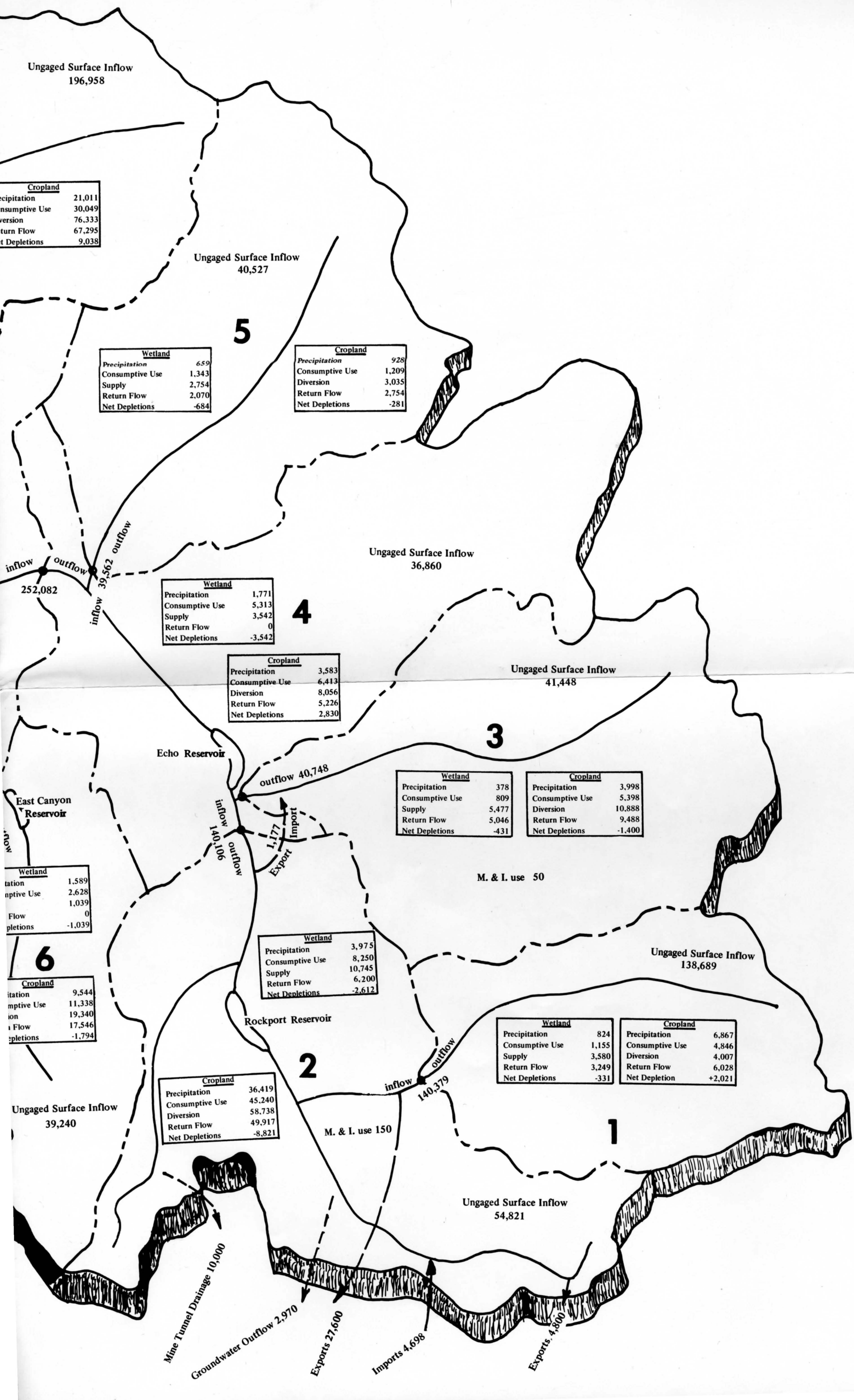
Table 39. Mean monthly water budget for subarea no. 9 Weber River study unit.

ITERATION 0 — WATER BUDGET-SUBAREA 9-WEBER BASIN

ITEM--YEAR MEAN		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
MEASURED INFLOW	I	19595.	18203.	19242.	19323.	20101.	35801.	86048.	132365.	80955.	51648.	45080.	31518.	559879.
MEASURED IMPORTS	I	0.	0.	0.	0.	0.	0.	0.	93.	729.	516.	291.	32.	1761.
UNMEASURED INFLOW	I	1242.	1365.	3418.	3802.	2313.	3967.	15167.	23728.	8179.	1800.	848.	1025.	66855.
UNMEASURED SURFACE IN		1242.	1365.	3418.	3802.	2313.	3967.	15167.	23728.	8179.	1800.	848.	1025.	66855.
GROUNDWATER INFLOW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
RESERVOIR STORAGE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRECIP ON URBAN AREAS	I	4625.	5007.	5505.	6150.	4435.	5878.	6313.	5388.	4190.	1442.	2639.	2476.	54150.
RESERVOIR EVAPORATION	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RES STORAGE	O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PUMPED WATER		2280.	1740.	1740.	1740.	1510.	1740.	1740.	2539.	2539.	2539.	2539.	2539.	25185.
SURFACE RETURN FLOW		3984.	4062.	5225.	4853.	4957.	7622.	12852.	19065.	20916.	21795.	19617.	16225.	147174.
GROUNDWATER TO SURFACE		0.	0.	0.	0.	0.	20822.	7123.	0.	0.	0.	0.	0.	27946.
M AND I RETURN FLOW		1497.	222.	265.	349.	345.	956.	1919.	2543.	4372.	3413.	3351.	2180.	21412.
USEABLE SURFACE WATER		39224.	30500.	35495.	36217.	33562.	76786.	131163.	195720.	121880.	83253.	74366.	55995.	904361.
EXPORTS	O	490.	0.	0.	0.	0.	0.	79.	1391.	2848.	5431.	5297.	3126.	18662.
M AND I DIVERSION		3000.	800.	600.	700.	900.	2000.	4000.	6000.	9000.	9000.	8000.	5000.	49000.
M AND I NET USE	O	1503.	578.	335.	351.	555.	1044.	2081.	3457.	4628.	5587.	4649.	2820.	27588.
CROPLAND DIVERSIONS		29146.	11859.	15255.	14167.	14472.	22252.	37520.	55555.	61059.	63626.	57268.	47364.	429643.
AMOUNT TO ROOT ZONE		9178.	3734.	4804.	4461.	4557.	7007.	11815.	17526.	19227.	20036.	18034.	14915.	135295.
CROPLAND RETURN FLOW		19968.	8125.	10451.	9706.	9915.	15245.	25705.	38129.	41832.	43590.	39234.	32449.	294348.
CROPLAND PRECIPITATION	I	14207.	15377.	17216.	18887.	13522.	18051.	19388.	16547.	12870.	4429.	8106.	7605.	166306.
SNOW STORAGE ADDED	O	0.	0.	17216.	18887.	13522.	0.	0.	0.	0.	0.	0.	0.	49725.
ACCUM SNOW STORAGE		0.	0.	0.	12567.	31454.	28849.	0.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	4648.	0.	16228.	28849.	0.	0.	0.	0.	0.	0.	49725.
ROOT ZONE SUPPLY		23385.	19111.	9452.	4461.	20785.	53907.	31203.	34073.	32097.	24465.	26140.	22520.	301601.
CROPLAND P.C.U.		14432.	5455.	2738.	3025.	4804.	9889.	19414.	34913.	48028.	55617.	41256.	24706.	264277.
RZ SUPPLY-P.C.U.		8953.	13557.	6714.	1435.	15981.	44018.	11790.	-840.	-15930.	-31152.	-15116.	-2186.	37324.
ACCUM SOIL MOISTURE	I-O	379.	9332.	22983.	29702.	31138.	47119.	65603.	65503.	54763.	48833.	17681.	2565.	379.
CONS. USE DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL CROPLAND C.U.	O	14432.	5455.	2738.	3025.	4804.	9889.	19414.	34913.	48028.	55617.	41256.	24706.	264277.
INTERFLOW ADDED		0.	0.	0.	0.	0.	25534.	11790.	0.	0.	0.	0.	0.	37324.
GW RETURN FLOW		9984.	4062.	5226.	4853.	4957.	7622.	12852.	19065.	20916.	21795.	19617.	16225.	147174.
ACCUM INTERFLOW	I-O	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.	13000.
INTERFLOW TO SURFACE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTERFLOW SUPPLY TO WL		9384.	4062.	5226.	4853.	4957.	33156.	24642.	19065.	20916.	21795.	19617.	16225.	184498.
WETLAND PRECIPITATION	I	3842.	9570.	10714.	11754.	8478.	11234.	12066.	10298.	8010.	2757.	5045.	4733.	103500.
SNOW STORAGE ADDED	O	0.	0.	10714.	11754.	8478.	0.	0.	0.	0.	0.	0.	0.	30946.
ACCUM SNOW STORAGE		0.	0.	0.	7821.	19575.	17954.	0.	0.	0.	0.	0.	0.	0.
SNOW MELT	I	0.	0.	2893.	0.	15099.	17954.	0.	0.	0.	0.	0.	0.	30946.
TOTAL SUPPLY TO WL		18826.	13532.	8118.	4853.	15057.	62345.	36709.	29363.	28925.	24552.	24662.	20957.	287998.
POTENTIAL WETLAND CU		14987.	6321.	2463.	2545.	4744.	10208.	17043.	27103.	38326.	46288.	39869.	25207.	234805.
TSWL-WL PCU		3838.	7511.	5655.	2307.	10312.	52137.	19666.	2260.	-9401.	-21736.	-15207.	-4249.	53193.
ACCUM WL SOIL MOIST	I-O	11806.	15544.	23256.	28911.	31218.	41531.	62400.	62400.	62400.	52999.	31263.	16056.	11806.
WETLAND DEFICIT		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACTUAL WETLAND C.U.	O	14987.	6321.	2463.	2545.	4744.	10208.	17043.	27103.	38326.	46288.	39869.	25207.	234805.
WETLAND SURFACE OUTFLOW		0.	0.	0.	0.	0.	20822.	7123.	0.	0.	0.	0.	0.	27946.
WETLAND ADDITION TO GW		0.	0.	0.	0.	0.	10445.	12542.	2260.	0.	0.	0.	0.	25247.
INTERFLOW TO GW		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GW ADDED		0.	0.	0.	0.	0.	10445.	12542.	2260.	0.	0.	0.	0.	25247.
OUTFLOW + CHANGE IN GW	R	4308.	16201.	17901.	19510.	16780.	51239.	100366.	122395.	46434.	2657.	1262.	-2034.	407119.
GW OUTFLOW		5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	7.	62.
CHANGE IN GW STORAGE		-2285.	-1745.	-1745.	-1745.	-1515.	8700.	10797.	-284.	-2544.	-2544.	-2544.	-2546.	0.
SURFACE OUTFLOW		6588.	17941.	19541.	21350.	18290.	52534.	89564.	122574.	48973.	5196.	3801.	505.	407056.
GAGED SURFACE OUTFLOW		6588.	17941.	19541.	21350.	18290.	52534.	89564.	122574.	48973.	5196.	3801.	505.	407057.
DIFFERENCE (COMP-GAGED)		-0.	0.	0.	-0.	-0.	0.	-0.	0.	0.	0.	-0.	-0.	-1.



Export
Wetland
Precipitation 7,802
Consumptive Use 16,132
Supply 8,330
Return Flow 0
Net Depletions 8,330
Pineview Reservoir
8
inflow
outflow
162,819
M. & I. use 50
Wetland
Precipitation 103,500
Consumptive Use 234,805
Supply 184,498
Return Flow 53,193
Net Depletions -131,305
Urban Areas
Precipitation 54,150
Consumptive Use 27,588
Net Yield +26,562
Import 16,703
Export
Outflow to Lake 407,057
Cropland
Precipitation 166,306
Consumptive Use 264,277
Diversion 429,643
Return Flow 331,672
Net Depletions -97,971
inflow
outflow
372,229
Wetland
Precipitation 2,257
Consumptive Use 5,512
Supply 3,255
Return Flow 0
Net Depletions -3,255
M. & I. use 120
Cropland
Precipitation 14,386
Consumptive Use 24,910
Diversion 33,418
Return Flow 22,894
Net Depletions 10,524
9
Ungaged Surface Inflow
66,855
7
Ungaged Surface Inflow
107,527
inflow
36,408



Ungaged Surface Inflow
196,958
Cropland
Precipitation 21,011
Consumptive Use 30,049
Diversion 76,333
Return Flow 67,295
Net Depletions 9,038
Ungaged Surface Inflow
40,527
5
Wetland
Precipitation 659
Consumptive Use 1,343
Supply 2,754
Return Flow 2,070
Net Depletions -684
Cropland
Precipitation 928
Consumptive Use 1,209
Diversion 3,035
Return Flow 2,754
Net Depletions -281
Ungaged Surface Inflow
36,860
inflow
outflow
252,082
39,562 outflow
inflow
Wetland
Precipitation 1,771
Consumptive Use 5,313
Supply 3,542
Return Flow 0
Net Depletions -3,542
4
Cropland
Precipitation 3,583
Consumptive Use 6,413
Diversion 8,056
Return Flow 5,226
Net Depletions 2,830
Ungaged Surface Inflow
41,448
3
Echo Reservoir
outflow 40,748
Wetland
Precipitation 378
Consumptive Use 809
Supply 5,477
Return Flow 5,046
Net Depletions -431
Cropland
Precipitation 3,998
Consumptive Use 5,398
Diversion 10,888
Return Flow 9,488
Net Depletions -1,400
East Canyon Reservoir
inflow 140,106
outflow
1,177 Export
Import
M. & I. use 50
Wetland
Precipitation 1,589
Consumptive Use 2,628
Supply 1,039
Return Flow 0
Net Depletions -1,039
6
Wetland
Precipitation 3,975
Consumptive Use 8,250
Supply 10,745
Return Flow 6,200
Net Depletions -2,612
Ungaged Surface Inflow
138,689
Cropland
Precipitation 9,544
Consumptive Use 11,338
Diversion 19,340
Return Flow 17,546
Net Depletions -1,794
Rockport Reservoir
Wetland
Precipitation 824
Consumptive Use 1,155
Supply 3,580
Return Flow 3,249
Net Depletions -331
Cropland
Precipitation 6,867
Consumptive Use 4,846
Diversion 4,007
Return Flow 6,028
Net Depletion +2,021
2
inflow
outflow
140,379
Cropland
Precipitation 36,419
Consumptive Use 45,240
Diversion 58,738
Return Flow 49,917
Net Depletions -8,821
Ungaged Surface Inflow
39,240
M. & I. use 150
1
Ungaged Surface Inflow
54,821
Mine Tunnel Drainage 10,000
Groundwater Outflow 2,970
Exports 27,600
Imports 4,698
Exports 4,800

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