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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
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U. S. DEPARTMENT OF THE INTERIOR
Geological Survey

# Water Utilization Ship Creek near Anchorage, Alaska

Jesse L. Colbert
Tacoma, Washington
May, 1951 -



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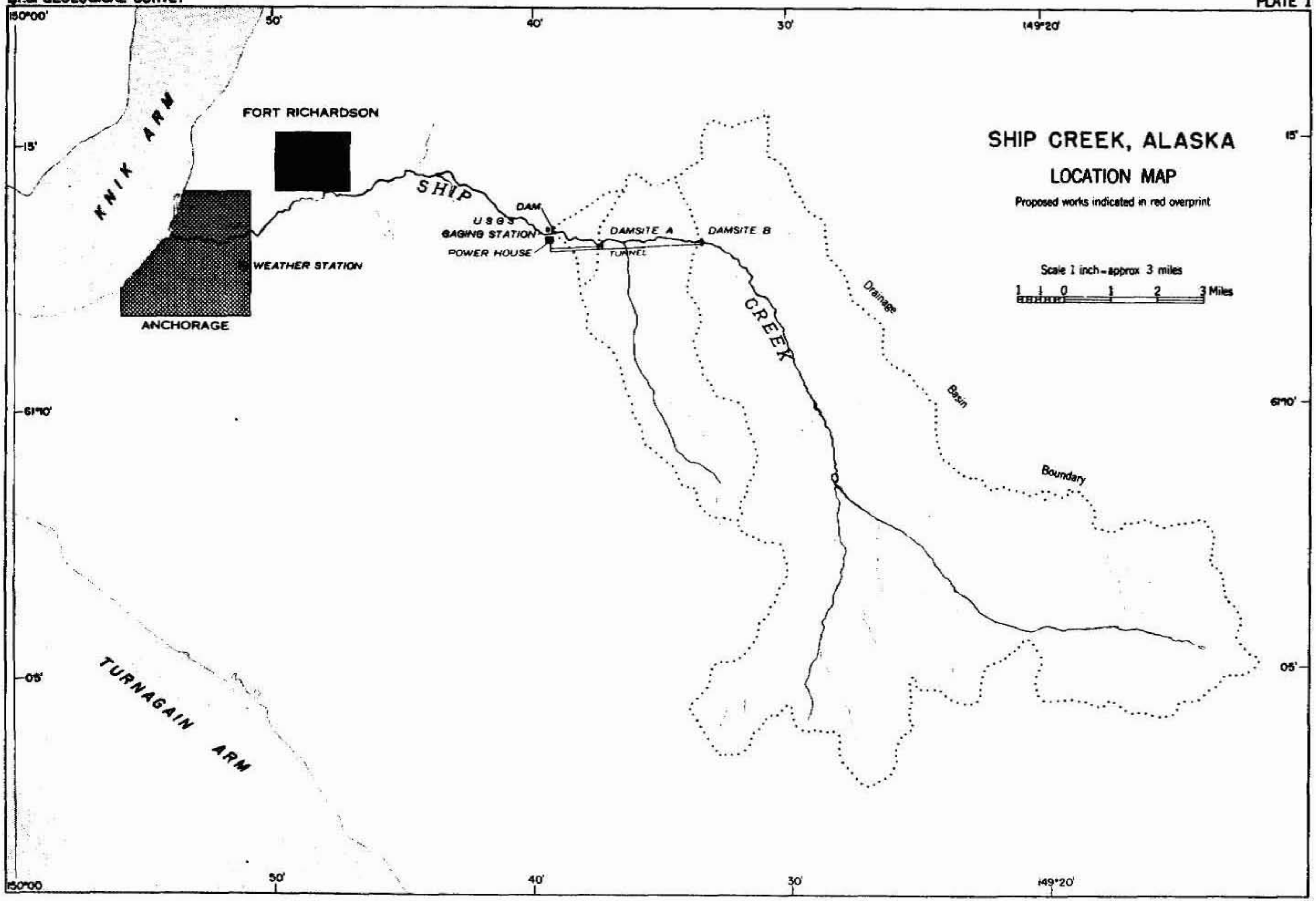
## ILLUSTRATIONS


SHIP CREEK, ALASKA
LOCATION MAP
Proposed works indicated in red overprint
Scale 1 inch = approx 3 miles
1
0
1
2
3 Miles
FORT RICHARDSON
KNIK ARM
ANCHORAGE
WEATHER STATION
SHIP
CREEK
DAM
USGS
GAGING STATION
POWER HOUSE
DAMSITE A
DAMSITE B
TUNNEL
Drainage
Basin
Boundary
TURNAGAIN ARM
150°00'
50'
40'
30'
149°20'
15'
61°10'
05'

## SUMMARY

Ship Creek drains an area in the Chugach Mountains, flows westward through Anchorage, and empties into Knik Arm. It emerges from the mountains 10 miles east of Anchorage and above that point has a drainage area of 90 square miles. Stream flow records for the 4 year period, 1947 through 1950, show a mean flow of 156 second-feet with a variation from 114 second-feet for 1950 to 198 second-feet for 1949. The monthly distribution of flow has considerable variation with about one-fifth of the runoff in the 6 month period December to May, and about one-half the runoff in the 3 month period, June, July, and August. Storage is therefore required for regulation and most effective use of the streamflow. There is no natural storage in the basin. Storage possibilities and power developments are not favorable. Two possible sites are considered in this report, one at mile 1.0 and one at mile 3.5. Development at the former site would produce 3200 and 2800 KW for 50 percent and 90 percent of the time while development at the latter would produce 5000 and 4400 KW for 50 percent and 90 percent of the time.

Ship Creek is not a glacier fed stream and thus is free from glacial silt and offers a good source of municipal and industrial water supply. The natural flow is sufficient to supply present demands and it is believed that with the development of storage demands created by any foreseeable expansion of Anchorage and the surrounding area can readily be met.

## INTRODUCTION

Purpose and Scope: The purpose of this report is to present the results of investigations concerning the utilization of Ship Creek, as a potential source of power and of municipal and industrial water supply. The data presented will serve as a basis for the classification of public lands involved as to their value for power and storage purposes.

The investigations included the mapping by plane table methods of a 7.3 mile section of Ship Creek to show possible dam sites, reservoir sites, and the stream gradient; a study of stream flow records from 1947 through 1950; the study of pertinent climatological records; and geologic examination of two possible dam sites.

Acknowledgments: The author is indebted to Mr. Charles Tryk, City Engineer of Anchorage; Mr. Charles Wilson, Superintendent of Anchorage Public Utilities; and Mr. Bud Tout of the Alaska Railroad for furnishing valuable information relative to water supply problems in Anchorage and vicinity.

Maps and Aerial Photographs: Ship Creek was mapped from the Fort Richardson water supply diversion dam, located 10 miles east of Anchorage, upstream for 7.3 miles during the 1948 and 1949 field seasons by G. C. Giles and C. B. Shaw. Mapping was on a field scale of 1:20,000 with a contour interval of 20 feet. Horizontal control was based upon stadia traverses, and vertical control upon a U. S. Army bench mark on the floor of the boiler room at the diversion dam. Datum for this bench mark is mean sea level. The resulting map, entitled "Plan and Profile, Ship Creek, Alaska," has been published as a regular stream survey in three colors on a scale of 1:24,000 (1" = 2000 ft.) on one sheet, and a copy is included as plate 3 of this report. From the starting point to mile 3.5 the topography was completed to 250 feet or more above stream level. Beyond mile 3.5 the topography was completed to the 1300 foot contour. Copies of the map are on file at 410 Federal Building, Tacoma, Washington, or may be purchased from Distribution Section, Geological Survey, Denver Federal Center, Denver, Colorado at a cost of 10¢ each.

Fourteen plane table bench marks were established during the mapping, descriptions and elevations of which are included as an appendix to this report or copies may be obtained from the office of the U. S. Geological Survey, 410 Federal Building, Tacoma 2, Washington.

The Ship Creek basin, see plate 1, is covered by the Anchorage, Knik and Raven Glacier quadrangles prepared by the U. S. Army. These maps are on a scale of 1:62,500. The Raven Glacier quadrangle has a contour interval of 100 feet while the other two have a 50 foot interval. They are published by the Army Map Service, Washington, D. C. Alaska Map 25, "Seward to the Matanuska Coal Fields," covers the entire region. This map, published by the U. S. Geological Survey, has a scale of 1:250,000 and a contour interval of 200 feet.

The Anchorage and Ship Creek areas have been covered by aerial photography. A list of photographs of these areas is as follows:

| AAF TRIMETROGON PHOTOGRAPHY | | | | |
|---|---|---|---|---|
| Final Index Sheet | Project | Roll | Flight or Mission | Exposures |
| 1 | 41 | | 12B | 33-39 |
| 1 | 2011 | 1 | 34 | 1-5 |
| 1 | 2011 | 2 | 35 | 1-4 |
| 1 | 2011 | 2 | 34 | 1 |
| 2 | 41 | 1 | 39X | 56-62 |
| 2 | 41 | 1 | 39X | 41-45 L & V |
| 2 | 41 | 1 | 40X | 80-81 L & R |
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| 3 | 41 | | 12B | 1-5 |
| 3 | 41 | | 12 | 23 |
| 4 | 15B | | 46 RS, M7M 44 | 128 |
| 4 | 15B | | 46 RS, M7M 44 | 190 |
| 4 | 15B | | 46 RS, M7M 44 | 46 |
| 5 | 15B | | 72 RS 8M 42 | 85-87 |
| 5 | 15B | | 72 RS 8M 54 | 61-64 & 70-74 |
| 5 | 15B | | 72 RS 8M 42 | 39 |

L, V, and R refer to left, vertical, or right exposures for tri-lens photographs.

## GEOGRAPHY

Ship Creek rises in the Chugach Mountain Range which lies east of Anchorage. These mountains do not exceed 5,000 feet in altitude in the Ship Creek basin. Timber line is about 1800 feet with thick alder brush above this for a few hundred feet. Slopes are covered with grass and weeds above the brush line. Soil cover throughout the valley ranges from unconsolidated glacial material in the upper reaches to exposed consolidated rock in a canyon section in the foothills.

Although there are many glaciers in the high lands of this range, there are no glaciers within the Ship Creek basin nor are there any lakes. The flow is built up by the many unnamed creeks that drain the steep slopes of the Chugach Range. This twisting network of creeks

Ship Creek valley, from point on road to Ski Bowl 4.3 miles from junction with road to diversion dam and about one mile north of Dam Site B. This view shows most of the reservoir site area above Dam Site B. (Photo J-48-90, August 20, 1948).

gradually develops into the main stream which is about 24 miles long. The stream flows in a northwesterly direction to a wide turn to the west 15 miles upstream from Anchorage. The last $1\frac{1}{4}$ miles of the channel in the mountains is through a steep-sided rocky canyon. One possible dam site has been selected in this section. Ship Creek emerges from the mountains about 10 miles east of Anchorage and continues its generally westward course through the brushy, comparatively low land north and east of Anchorage to where it empties into Knik Arm at the head of Cook Inlet.

The gradient or profile of Ship Creek, as shown on plate 3, is fairly steep throughout. The first mile of the mapped section has a fall of 160 feet, and the following mile is somewhat flatter having a fall of 115 feet. The steepest section comes in the next half mile with a fall of 115 feet. From this point on the gradient decreases to an average fall of 67 feet per mile.

Anchorage is the only city in the immediate vicinity of Ship Creek. This city, the largest in Alaska, has an estimated 15,000 residents within the city limits and a considerable population that has grown up in the adjacent area for an estimated total of about 30,000. During World War II the population made an upward spurt and since the war it has continued to grow. A large part of this growth was due to the development of Fort Richardson Army Base, three miles to the northeast. The Alaska Railroad is the principal industry of the city and will continue to be a major factor in the future of Anchorage. The railroad runs from Seward to Fairbanks, a distance of 470 miles, and crosses Ship Creek 1/4 mile from the mouth. Another port, Whittier, also serves as a terminal point for the line. The local airfield, Merrill Field, is considered the busiest in the territory. Airlines operating from Merrill Field serve the Kenai Peninsula, Cook Inlet points, Alaska Peninsula, Bristol Bay, Nome, Kuskokwim River, Fairbanks and Prince William Sound. Pan American Airlines, though not operating directly to Anchorage, connects with Anchorage by Pacific Northern Airlines from Juneau. Northwest Airlines operates directly from Seattle to Anchorage. The latter two lines operate from Elmendorf Field, which is an Army field. A commercial airport, capable of handling the large planes and located a few miles southwest of the city, is nearing completion.

The Glenn Highway links Anchorage with the Richardson Highway at Glenn Allen which in turn connects with Valdez, Fairbanks, and the Alaskan Highway. Thus Anchorage is well served by overland routes, ocean transportation, and by air.

A gravel road extends from Anchorage to the diversion dam on Ship Creek. This road is all within Fort Richardson. Above the dam there is a road called Pioneer Road, which runs parallel to and about 1/2 mile north of the creek for about 4 miles, terminating at the Tenth Rescue Squadron trail cabin. Due to steep grades it can only be traveled by four wheel drive vehicles and then only in dry weather. A recreation area called The Ski Bowl is located in the Ship Creek basin 5 miles northeast from the diversion dam, and is reached by a road branching from the road to the dam.

The areas of the Ship Creek drainage basin at several points as measured on the Raven Glacier, Anchorage, and Knik Quadrangles are shown in the following table:

| LOCATION | AREA IN SQ. MILES | PERCENT OF TOTAL |
|---|---|---|
| Upstream from Diversion Dam | 90.3 | 100.0 |
| " " Mile 1.0, Dam Site A | 89.2 | 98.7 |
| " " Mile 3.5, Dam Site B | 75.1 | 83.1 |

## GEOLOGY

A geological examination of parts of the Ship Creek valley and the proposed dam sites was made by E. Dobrovolny of The Engineering Geology Branch of the Geological Survey in August 1950, and a report[1]

[1] Preliminary report on the geology of two dam sites on Ship Creek near Anchorage, Alaska. E. Dobrovolny, December 1950

prepared. This report gives a preliminary evaluation of the dam sites but further geological examination is necessary as well as for possible tunnel routes. Dam site surveys on a scale of 1:4800 should be made to facilitate more detailed geological investigations.

At the lower dam site the exposed rock is hard and of a probable high compressive strength. Joints are numerous but these are tight and can be sealed. Horizontal contact between consolidated rock and glacial till occurs about 100 feet above the water surface of the stream. Superficial indications show the till to be tough, resistant, and impervious.

The same tough impervious till will form the abutments of a dam at the upper dam site. The depth to consolidated rock is not known, but the rock will have properties similar to the exposed rock at the lower dam site.

The valley is wide and U-shaped above the upper dam site near Mile 3.5 and narrow and V-shaped on downstream to its place of emergence from the mountains at the diversion dam. The geology of the Anchorage vicinity is further described in a report by the Geological Division of the Geological Survey.[2]

[2] Dobrovolny, E., Miller, Robert D., and Cooley, Maurice, Descriptive Geology of Anchorage and Vicinity, Alaska, Engineering Geology Branch, Denver, Colorado, June, 1950

<u>Climatology</u>: Weather records for the Anchorage vicinity are nearly complete as far back as 1916. During the period of record the observation station was moved several times. All of these moves, however, were within the representative area so the records may be regarded as continuous. In the later years of the record, the observation station has been at Merrill Field, just east of Anchorage.

A study of the precipitation data, shown in table 1, shows a variation in annual precipitation from a minimum 6.78 inches in 1931 to a maximum of 19.57 in 1917. The annual values shown in the table are for the water year, October 1 to September 30. This arrangement has been used so as to be comparable with stream flow records. The mean precipitation for the period of record, 1917-1950, is 14.45 inches. The spring months of March, April, and May are the driest of the year as only 10 percent of the precipitation occurs during this quarter. April contributes less than 3 percent of the total. Precipitation during the five month period, June through October, amounts to nearly 70 percent of the annual total. August and September are the two wettest months, accounting for 36 percent of the yearly precipitation. The mean monthly values for precipitation and also temperature are shown graphically in figure 1.

The snowfall, shown in table 2, averages 61.3 inches annually, varying from a minimum of 29.9 inches in 1935 to a maximum of 111.4 inches in 1949. Snowfall values are not available for the extreme dry year of 1931. In general, the four month period, November through February, accounts for three fourths of the annual snowfall. During the period of record, snowfall has never been recorded in July or August and only once in June, which was in 1949, when 0.4 inches fell. The winter snowfall accumulates until the rising temperatures of April and May begin the melting of this stored moisture. This explains the very high runoff in May and June even though neither of these months has very much precipitation. It must be remembered that these data are for the Anchorage vicinity and that conditions in the upper levels of the Ship Creek drainage basin will differ to some extent.

The annual snowfall at Anchorage during the period of record, as well as Index of Wetness, is shown graphically in figure 2.

Monthly and annual values of temperature at Anchorage are shown in table 3. A study of this table shows that the climate is characterized by cool summers and cold winters. Only July escapes the possibilities of freezing weather. Over a 26 year period there was an average of 204 days when the minimum temperature was 32 degrees or colder. Figure 3 [/] shows a temperature comparison of Matanuska, Alaska, with the average of three midwestern cities for a 29 year period.

[/] Lawrence, Fred F., "Preliminary Report on Water-Power Resources of Little Susitna River and Cottonwood Creek, Alaska," U. S. Geological Survey, p. 11, 1949.

Matanuska's weather station is about 35 miles northeast of the Anchorage weather station. The monthly mean temperatures for November through March are all below freezing with a monthly mean of 12.3 degrees in January, the coldest month. The monthly means of the two stations differ by only a degree or two and the overall annual mean for Matanuska is only one degree higher than Anchorage's 34.8 degrees. It is obvious from a study of these temperatures that the design of any development on Ship Creek will be influenced by the temperature.

Table 1

PRECIPITATION IN INCHES
AT ANCHORAGE, ALASKA

| Year a/ | Oct | Nov. | Dec | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual a/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1916 | - | - | - | - | .98 | .01 | T | 1.65 | 0.96 | 0.86 | 3.41 | 2.54 | - |
| 17 | 6.43 | 0.99 | 0.67 | 1.65 | 0.87 | 0.66 | 0.13 | 0.91 | 0.70 | 2.45 | 1.54 | 2.57 | 19.57 |
| 18 | 1.67 | 0.98 | 0.07 | 0.80 | 1.02 | 0.31 | 1.01 | 0.55 | 0.21 | 1.19 | 3.49 | 2.16 | 13.46 |
| 19 | 1.14 | 0.75 | 1.40 | 0.90 | 0.10 | 0.15 | 0.23 | 0.14 | 0.24 | 3.01 | 3.42 | 2.63 | 14.11 |
| 20 | 1.89 | 1.44 | 3.49 | 1.55 | 2.01 | 0.25 | 0.28 | 0.05 | 0.55 | 1.99 | 3.43 | 1.10 | 18.03 |
| 1921 | 0.53 | 0.89 | 0.43 | 1.00 | 0.50 | 0.66 | 0.25 | 0.23 | 0.80 | 2.09 | 3.08 | 2.68 | 13.14 |
| 22 | 3.01 | 0.03 | 1.11 | 1.41 | 0.49 | 0.66 | 0.66 | 0.13 | 0.58 | 3.60 | 1.33 | 1.61 | 14.62 |
| 23 | 0.73 | - | 0.16 | 1.61 | 0.79 | 0.78 | 0.35 | 0.08 | 0.61 | 1.70 | 0.89 | 5.09 | - |
| 24 | 1.72 | 1.03 | 0.52 | 0.30 | 0.08 | 0.21 | 0.57 | 0.55 | 0.50 | 0.79 | 3.60 | 3.82 | 13.69 |
| 25 | 1.64 | 0.21 | 0.49 | 0.81 | 0.10 | 0.45 | 0.25 | 0.09 | 0.72 | 0.97 | 2.07 | 3.54 | 11.34 |
| 1926 | 2.44 | 1.47 | 1.06 | 0.89 | 0.15 | 0.77 | 0.16 | 0.05 | 0.03 | 1.26 | 2.51 | 2.38 | 13.17 |
| 27 | 1.89 | 0.49 | 1.23 | 0.76 | 0.95 | - | 0.69 | 0.34 | 1.06 | 0.47 | 3.46 | 3.69 | - |
| 28 | 1.10 | 0.49 | 0.91 | 0.60 | 1.96 | 1.07 | 0.43 | 0.13 | 0.89 | 2.28 | 3.12 | 2.54 | 15.52 |
| 29 | 1.34 | 1.55 | - | - | - | - | - | - | - | 3.12 | 1.96 | 2.72 | - |
| 30 | - | - | 0.17 | 0.47 | 0.34 | 1.61 | 0.36 | 0.82 | 0.37 | 2.38 | 3.68 | 1.96 | - |
| 1931 | 0.26 | 0.44 | 0.18 | 0.30 | 0.20 | 0.09 | 0.01 | 0.30 | 0.21 | 1.47 | 0.82 | 2.50 | 6.78 |
| 32 | 2.06 | 1.43 | 2.10 | 1.17 | 1.51 | T | 0.08 | 0.35 | 0.31 | 1.65 | 4.76 | 3.59 | 19.01 |
| 33 | 1.81 | 0.93 | 0.89 | 0.80 | 0.61 | 0.60 | 0.39 | 0.80 | 0.53 | 0.19 | 1.35 | 2.84 | 11.74 |
| 34 | 1.61 | 2.37 | 0 | 0.94 | 0.46 | 1.18 | 0.25 | 2.00 | 0.75 | 1.33 | 5.91 | 1.34 | 18.14 |
| 35 | 1.14 | 0.04 | 1.82 | 0.80 | 0.91 | 0.46 | 0.54 | 0.44 | 0.16 | 2.58 | 2.16 | 1.63 | 12.68 |

Table 1
Cont'd.

PRECIPITATION IN INCHES
AT ANCHORAGE, ALASKA

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual a/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1936 | 3.01 | 1.50 | 0.47 | 0.17 | 0.58 | 0.88 | 0.37 | 0.06 | 0.38 | 1.57 | 1.51 | 0.52 | 11.02 |
| 37 | 5.13 | 2.40 | 1.05 | 0.83 | 0.43 | 0.14 | 1.50 | 0.50 | 0.47 | 0.51 | 2.44 | 2.03 | 17.43 |
| 38 | 3.33 | 1.15 | T | 0.05 | 0.12 | 0.94 | T | 0.50 | 1.75 | 0.50 | 0.85 | 1.75 | 10.94 |
| 39 | 1.95 | 1.71 | 0.34 | 0.57 | 0.65 | 0.51 | 0.09 | 0.71 | 1.43 | 1.56 | 4.20 | 3.92 | 17.64 |
| 40 | 3.98 | 0.37 | 0.90 | 0.47 | 0.13 | 0.36 | 0.28 | 0.49 | 0.63 | 0.96 | 2.47 | 5.14 | 16.18 |
| 1941 | 3.19 | 1.27 | 1.55 | 1.30 | 0.73 | 0.44 | 1.40 | 0.64 | 2.62 | 1.88 | 0.23 | 0.89 | 16.14 |
| 42 | 1.43 | 1.02 | 0.33 | 0.35 | 0.79 | 0.45 | 0.81 | 0.25 | 0.68 | 1.83 | 3.59 | 3.41 | 14.94 |
| 43 | 2.36 | 0.17 | 0.77 | 1.14 | 0.28 | 0.39 | 0.17 | 0.64 | 1.20 | 2.54 | 3.27 | 3.97 | 16.90 |
| 44 | 0.47 | 1.27 | 1.39 | 1.29 | 0.47 | 0.44 | 0.23 | 0.51 | 0.86 | 2.53 | 4.01 | 2.50 | 15.97 |
| 45 | 1.20 | 0.33 | 1.08 | 0.36 | 1.13 | 1.23 | 0.34 | 1.27 | 1.62 | 1.49 | 3.38 | 2.70 | 16.63 |
| 1946 | 2.32 | 0.59 | 0.13 | 0.51 | 1.22 | 0.32 | 0.18 | 1.23 | 0.74 | 0.97 | 1.69 | 1.24 | 11.14 |
| 47 | 0.80 | 1.39 | 0.97 | 0.96 | 0.12 | 0.47 | 0.33 | 0.57 | 0.30 | 1.27 | 2.58 | 4.28 | 14.04 |
| 48 | 0.89 | 1.23 | 0.68 | 1.04 | 0.43 | 0.67 | 0.08 | 0.03 | 0.42 | 3.28 | 1.86 | 2.34 | 12.95 |
| 49 | 1.75 | 1.37 | 0.50 | 2.13 | 0.69 | 1.05 | 0.82 | 0.41 | 2.94 | 1.26 | 1.80 | 2.45 | 17.17 |
| 50 | 1.25 | 0.62 | 1.45 | 0.83 | T | 0.29 | 0.04 | 0.10 | 1.89 | 0.97 | 0.92 | 1.07 | 9.43 |
| No. of Values | 33 | 32 | 33 | 33 | 34 | 33 | 34 | 34 | 34 | 35 | 35 | 35 | 30 |
| Mean | 1.98 | 1.00 | 0.86 | 0.87 | 0.64 | 0.56 | 0.39 | 0.52 | 0.83 | 1.67 | 2.61 | 2.60 | 14.45 |
| Percent of mean annual | 13.7 | 6.9 | 5.9 | 6.0 | 4.4 | 3.8 | 2.6 | 3.5 | 5.7 | 11.5 | 18.0 | 18.0 | 100.0 |
| Maximum | 6.43 | 2.40 | 3.49 | 2.13 | 2.01 | 1.61 | 1.50 | 2.00 | 2.94 | 3.60 | 5.91 | 5.14 | 19.57 |
| Minimum | 0.26 | 0.03 | 0.00 | 0.05 | T | T | T | 0.03 | 0.03 | 0.19 | 0.23 | 0.52 | 6.78 |

a/ For water year, October 1 to September 30.

MONTHLY AND ANNUAL SNOWFALL IN INCHES
AT ANCHORAGE, ALASKA

Table 2

| Year b/ | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May a/ | Annual b/ | Percent of mean annual |
|---|---|---|---|---|---|---|---|---|---|---|
| 1916 | - | - | - | - | 8.5 | T | T | T | - | - |
| 17 | 6.5 | 8.0 | 9.1 | 30.5 | 11.0 | 11.5 | 0.5 | 5.5 | 82.6 | 135 |
| 18 | 13.0 | 18.8 | 1.8 | 17.2 | 19.0 | 5.7 | 12.6 | T | 88.1 | 144 |
| 19 | 10.6 | 16.0 | 17.0 | 17.0 | 2.1 | 2.5 | T | 0 | 65.7 | 107 |
| 20 | 4.6 | 28.1 | 29.5 | 8.6 | 21.3 | 7.0 | 5.1 | 0 | 104.2 | 170 |
| 1921 | 1.0 | 14.5 | 11.9 | 22.9 | 9.8 | 7.8 | 0.2 | T | 68.1 | 111 |
| 22 | 1.0 | 0.9 | 26.2 | 26.0 | 7.6 | 11.2 | 5.5 | 0 | 78.4 | 128 |
| 23 | T | 7.0 | 3.0 | 16.8 | 11.6 | 7.1 | 2.0 | 0 | 47.5 | 77 |
| 24 | 0 | 15.8 | 9.2 | 5.3 | 1.0 | 2.4 | 8.8 | 0 | 42.5 | 69 |
| 25 | 9.2 | 3.0 | 8.5 | 13.2 | 1.4 | 6.3 | 2.0 | 0 | 43.6 | 71 |
| 1926 | - | - | - | - | 2.9 | - | 0 | 0 | - | - |
| 27 | - | 1.0 | 18.0 | 5.2 | 12.0 | - | 3.0 | 0 | - | - |
| 28 | 4.0 | 7.2 | 11.7 | 9.5 | 21.5 | 22.0 | 0 | 0 | 75.9 | 124 |
| 29 | - | 9.8 | - | - | - | - | - | - | - | - |
| 30 | - | - | 2.0 | 4.7 | 6.5 | 11.0 | 0 | 0 | - | - |
| 1931 | 0.2 | 6.4 | 0.5 | - | - | - | 0 | 0 | - | - |
| 32 | T | 9.5 | 28.3 | 17.0 | 19.0 | T | 1.5 | 0 | 75.3 | 123 |
| 33 | 6.5 | 12.0 | 12.0 | 14.0 | 9.0 | 9.0 | 2.0 | 0 | 64.5 | 105 |
| 34 | 16.0 | 22.5 | 0 | 9.5 | 6.5 | 12.5 | 2.5 | 0 | 69.5 | 113 |
| 35 | 3.0 | 1.5 | 2.5 | 8.0 | 9.5 | 3.4 | 2.0 | 0 | 29.9 | 49 |

MONTHLY AND ANNUAL SNOWFALL IN INCHES
AT ANCHORAGE, ALASKA

Table 2
Cont'd.

| Year b/ | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May a/ | Annual b/ | Percent of mean annual |
|---|---|---|---|---|---|---|---|---|---|---|
| 1936 | 1.3 | 2.0 | 2.2 | 3.4 | 7.5 | 10.0 | 6.8 | 0 | 33.2 | 54 |
| 37 | 0 | 12.5 | 11.0 | 2.0 | 4.5 | 1.5 | 12.7 | 0 | 44.2 | 72 |
| 38 | 0 | 22.0 | T | 2.5 | 2.0 | 15.0 | T | 0 | 41.5 | 68 |
| 39 | 0 | 17.5 | 4.5 | 14.7 | 7.0 | 7.0 | T | T | 50.7 | 83 |
| 40 | 18.2 | 13.8 | 15.5 | 6.5 | T | 7.0 | 0 | 0 | 61.0 | 99 |
| 1941 | 15.0 | 6.9 | 15.4 | 19.0 | 3.2 | 5.0 | 6.0 | 0 | 70.5 | 115 |
| 42 | 3.5 | 10.8 | 1.5 | 1.7 | 8.9 | 4.4 | 2.0 | 0 | 32.8 | 54 |
| 43 | 8.6 | 2.1 | 7.6 | 12.0 | 3.3 | 2.4 | 3.1 | T | 39.1 | 64 |
| 44 | T | 6.8 | 14.4 | 24.6 | 6.8 | 8.1 | 0.7 | 0 | 61.4 | 100 |
| 45 | T | 7.0 | 17.5 | 5.0 | 18.8 | 8.1 | 1.8 | 7.8 | 66.0 | 108 |
| 1946 | 6.1 | 8.2 | 1.9 | 9.4 | 19.0 | 5.8 | 1.9 | 0 | 52.3 | 85 |
| 47 | 0.4 | 17.9 | 16.7 | 11.1 | 1.3 | 7.1 | T | 1.7 | 56.5 | 92 |
| 48 | 3.7 | 11.5 | 14.9 | - | 8.1 | 14.0 | T | 0 | - | - |
| 49 | 7.8 | 10.4 | 11.1 | 36.1 | 12.4 | 12.9 | 16.4 | 3.9 | 111.4 | 182 |
| 50 | 7.3 | 8.2 | 25.9 | 13.6 | T | 4.9 | T | T | 59.9 | 98 |
| No. of Values | 30 | 32 | 32 | 30 | 33 | 31 | 34 | 34 | 28 c/ | |
| Mean | 4.9 | 10.6 | 11.0 | 12.9 | 8.6 | 7.5 | 2.9 | 0.6 | 61.3 | |
| Percent of mean annual c/ | 8.3 | 18.0 | 18.6 | 21.9 | 14.6 | 12.7 | 4.9 | 1.0 | - | |
| Maximum | 18.2 | 28.1 | 29.5 | 36.1 | 21.5 | 22.0 | 16.4 | 7.8 | 111.4 | |
| Minimum | 0 | 0.9 | 0 | 1.7 | T | T | 0 | 0 | 29.9 | |

a/ June to Sept. omitted. No recorded values of snowfall in July or Aug. during period of record; June had only one measurable value, 0.4 inch in 1949; and Sept. only one measurable value, 0.4 inch in 1947, and a trace registered in nine years.

b/ For water year, October 1 to Sept. 30. c/ Mean of annual values.

Table 3

MEAN MONTHLY AND ANNUAL TEMPERATURES (°F)
AT ANCHORAGE, ALASKA

| Year a/ | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual a/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1916 | - | - | - | - | 12.4 | 18.5 | 36.7 | 42.0 | 50.0 | 54.6 | 53.9 | 46.2 | - |
| 17 | 37.6 | 18.0 | 7.7 | 8.4 | 17.2 | 23.6 | 31.8 | 44.0 | 51.8 | 55.0 | 55.3 | 46.4 | 33.1 |
| 18 | 33.3 | 15.2 | - 9.2 | 12.0 | 12.7 | 15.8 | 31.5 | 42.4 | 52.6 | 57.2 | 54.1 | 50.5 | 30.7 |
| 19 | 35.6 | 15.6 | 12.8 | 7.1 | 18.0 | 20.1 | 35.2 | 43.9 | 53.1 | 59.3 | 55.6 | 49.1 | 33.8 |
| 20 | 34.2 | 16.8 | 10.6 | 2.1 | 29.4 | 18.4 | 27.8 | 41.2 | 51.8 | 54.5 | 52.0 | 45.2 | 32.0 |
| 1921 | 31.6 | 19.7 | 12.4 | 4.4 | 11.8 | 25.2 | 33.9 | 44.4 | 54.0 | 55.3 | 55.6 | 46.7 | 32.9 |
| 22 | 35.4 | 19.0 | 12.8 | 12.8 | 14.7 | 17.0 | 33.7 | 43.6 | 52.4 | 55.9 | 53.6 | 44.6 | 33.0 |
| 23 | 39.0 | 22.5 | 11.6 | 8.2 | 21.4 | 22.4 | 36.5 | 46.2 | 53.1 | 59.5 | 59.2 | 48.8 | 35.7 |
| 24 | 41.8 | 26.8 | 11.4 | 15.4 | 18.2 | 31.8 | 29.0 | 46.2 | 54.6 | 56.6 | 55.2 | 45.6 | 36.0 |
| 25 | 29.6 | 26.6 | 10.6 | 0.7 | 11.8 | 24.6 | 35.2 | 46.4 | 50.6 | 56.9 | 56.1 | 50.5 | 33.3 |
| 1926 | 41.8 | 28.8 | 17.7 | - | 22.0 | 37.0 | 40.5 | 48.9 | 58.6 | 59.0 | 57.0 | 51.4 | - |
| 27 | 39.8 | 28.8 | 15.1 | 14.6 | 22.9 | - | 28.4 | 45.1 | 53.9 | 58.7 | 54.5 | 46.4 | - |
| 28 | 32.0 | 12.6 | 14.2 | 18.8 | 24.2 | 21.3 | 35.4 | 45.8 | 54.2 | 56.2 | 54.6 | 45.0 | 34.5 |
| 29 | 35.3 | 25.8 | - | - | - | - | - | - | - | 56.1 | 55.8 | 53.4 | - |
| 30 | 39.1 | 29.3 | 11.3 | 14.0 | 7.5 | 23.2 | 34.9 | 45.0 | 51.6 | 56.4 | 58.6 | 48.6 | 35.0 |
| 1931 | 35.2 | 23.6 | 26.8 | 24.8 | 26.4 | 26.0 | 38.8 | 46.0 | 56.2 | 58.0 | 58.2 | 49.4 | 39.1 |
| 32 | 26.0 | 27.0 | 13.3 | 4.2 | 9.4 | 28.4 | 38.0 | 43.9 | 51.4 | 56.6 | 54.0 | 45.4 | 34.0 |
| 33 | 37.5 | 15.2 | 14.4 | 3.3 | 15.4 | 21.0 | 35.3 | 45.4 | 51.2 | 57.5 | 54.2 | 45.4 | 33.0 |
| 34 | 27.9 | 25.2 | - 0.2 | 6.2 | 27.6 | 24.0 | 37.4 | 45.4 | 52.4 | 55.0 | 55.1 | 49.0 | 33.7 |
| 35 | 37.0 | 24.2 | 17.8 | 14.9 | 27.6 | 21.4 | 36.2 | 45.1 | 52.3 | 57.4 | 54.3 | 47.7 | 36.3 |

MEAN MONTHLY AND ANNUAL TEMPERATURES ($^{o}F$)
AT ANCHORAGE, ALASKA

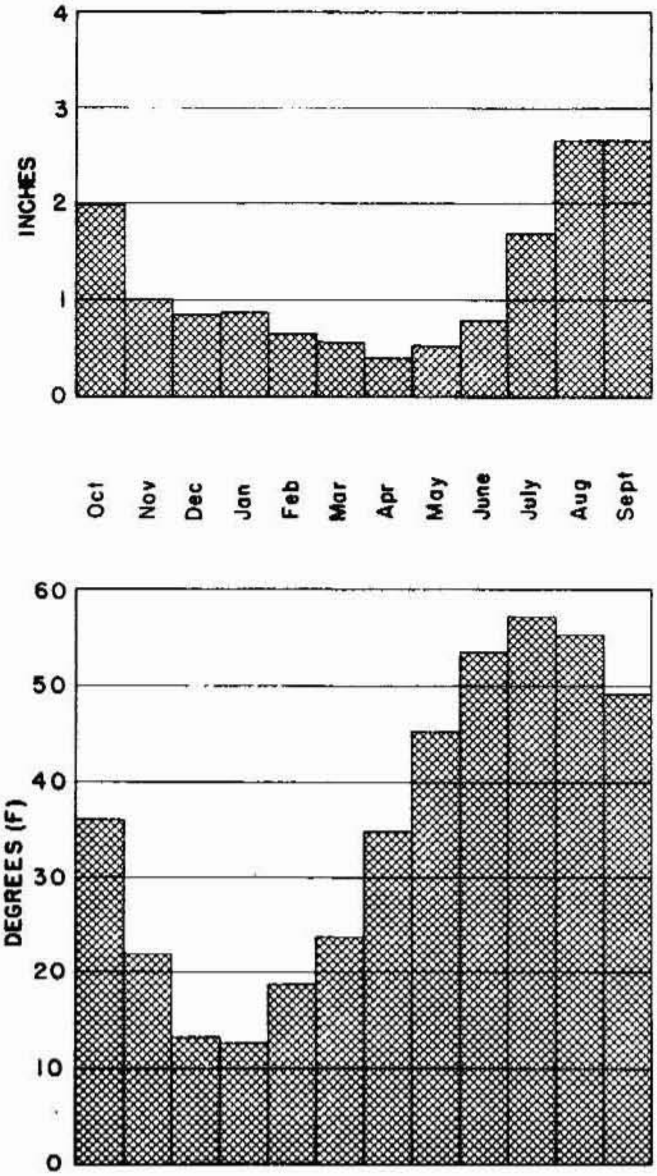
Table 3
Cont'd.

| Year a/ | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual a/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1936 | 32.8 | 23.2 | 17.2 | 17.9 | 14.8 | 21.8 | 34.9 | 45.2 | 59.0 | 61.1 | 58.5 | 46.8 | 36.1 |
| 37 | 42.1 | 30.2 | 11.6 | 22.0 | 12.6 | 25.2 | 35.2 | 45.6 | 54.8 | 58.0 | 54.6 | 48.8 | 36.7 |
| 38 | 41.6 | 26.4 | 11.8 | 12.2 | 17.0 | 25.4 | 40.9 | 45.6 | 52.4 | 56.2 | 57.3 | 50.1 | 36.4 |
| 39 | 41.2 | 21.8 | 19.0 | 13.2 | 19.0 | 20.4 | 35.1 | 43.7 | 52.8 | 56.5 | 53.2 | 46.6 | 35.2 |
| 40 | 29.6 | 17.9 | 20.4 | 20.9 | 23.1 | 24.8 | 41.6 | 48.0 | 55.1 | 57.8 | 55.6 | 47.4 | 36.8 |
| 1941 | 36.3 | 23.8 | 21.8 | 15.0 | 27.8 | 32.0 | 40.4 | 46.4 | 55.4 | 57.0 | 59.2 | 48.4 | 38.6 |
| 42 | 32.6 | 19.4 | 17.8 | 24.0 | 30.0 | 25.5 | 38.7 | 50.8 | 55.4 | 57.3 | 55.5 | 51.4 | 38.2 |
| 43 | 37.6 | 15.8 | 4.4 | 9.8 | 22.0 | 23.6 | 34.8 | 46.2 | 54.6 | 55.9 | 53.6 | 46.0 | 33.7 |
| 44 | 36.4 | 28.1 | 22.4 | 14.6 | 25.8 | 20.6 | 31.9 | 45.0 | 54.4 | 56.2 | 55.4 | 47.0 | 36.5 |
| 45 | 36.8 | 22.5 | 17.3 | 22.6 | 21.5 | 23.6 | 31.8 | 42.4 | 52.4 | 57.3 | 54.2 | 46.6 | 35.7 |
| 1946 | 34.8 | 12.4 | 13.0 | 15.8 | 17.8 | 15.9 | 32.8 | 44.8 | 53.7 | 58.4 | 53.2 | 47.4 | 33.3 |
| 47 | 39.4 | 17.2 | 5.0 | -1.0 | 18.4 | 30.3 | 36.1 | 46.6 | 53.4 | 59.6 | 55.2 | 47.2 | 33.9 |
| 48 | 36.1 | 27.6 | 22.7 | 18.0 | 12.0 | 19.8 | 31.4 | 46.2 | 53.9 | 56.2 | 53.2 | 45.6 | 36.1 |
| 49 | 35.8 | 14.2 | 5.8 | 12.6 | 6.0 | 29.4 | 31.4 | 44.8 | 50.6 | 56.0 | 54.8 | 49.8 | 32.6 |
| 50 | 35.2 | 26.1 | 6.9 | 5.1 | 7.5 | 27.5 | 35.2 | 45.1 | 53.1 | 56.7 | 58.0 | 48.8 | 33.8 |
| No. of Values | 34 | 34 | 33 | 32 | 34 | 33 | 34 | 34 | 34 | 35 | 35 | 35 | 31 |
| Mean | 36.1 | 22.0 | 13.0 | 12.3 | 18.4 | 23.8 | 35.0 | 45.2 | 53.4 | 57.0 | 55.4 | 47.8 | 34.8 |
| Maximum | 42.1 | 30.2 | 26.8 | 24.8 | 30.0 | 37.0 | 41.6 | 50.8 | 59.0 | 61.1 | 59.2 | 53.4 | 39.1 |
| Minimum | 27.9 | 12.4 | - 9.2 | - 1.0 | 6.0 | 15.8 | 27.8 | 41.2 | 50.0 | 54.5 | 52.0 | 44.6 | 30.7 |

a/ For water year, October 1 to September 30.

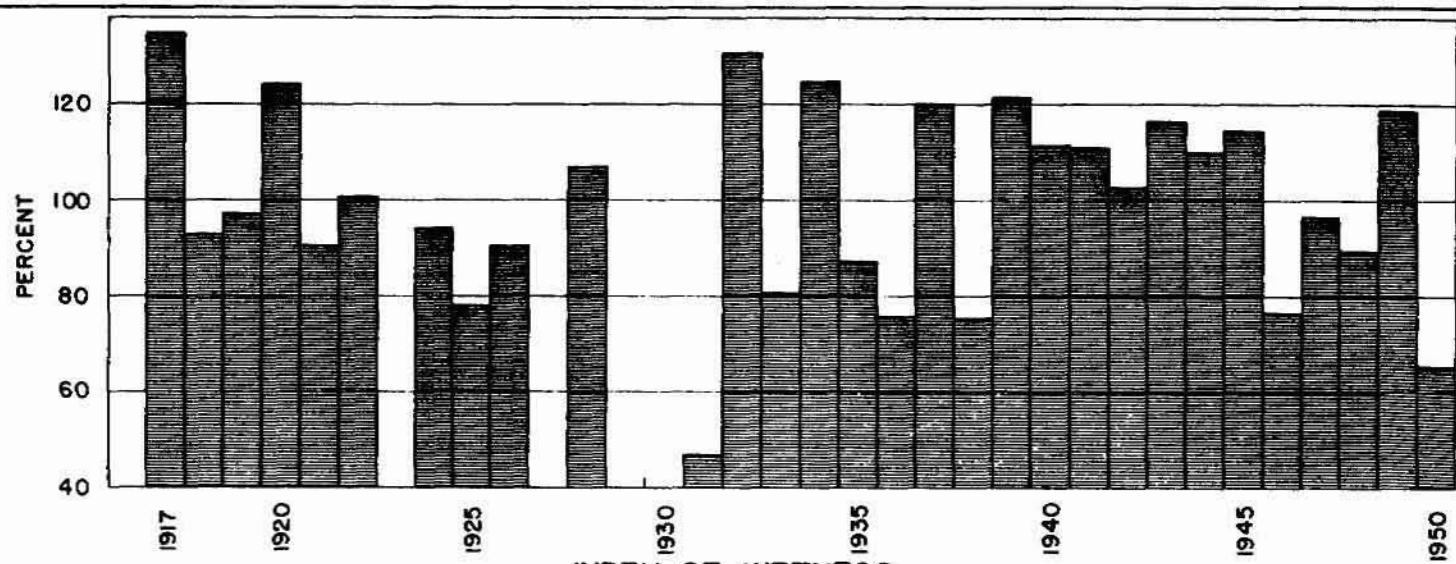
# MONTHLY DISTRIBUTION
# TEMPERATURE AND PRECIPITATION
## ANCHORAGE ALASKA

Mean Monthly Precipitation
34 years record 1917-1950

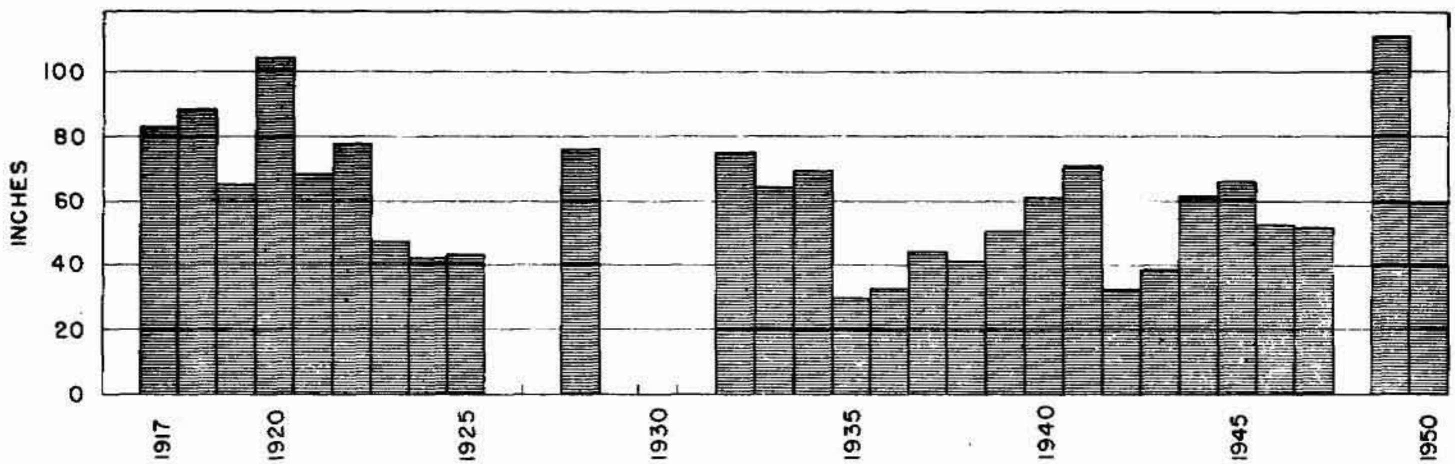



Mean Monthly Temperature
34 years record 1917-1950

GPO-87-81711




INDEX OF WETNESS
ANCHORAGE, ALASKA
Mean Annual Precipitation =14.5 inches



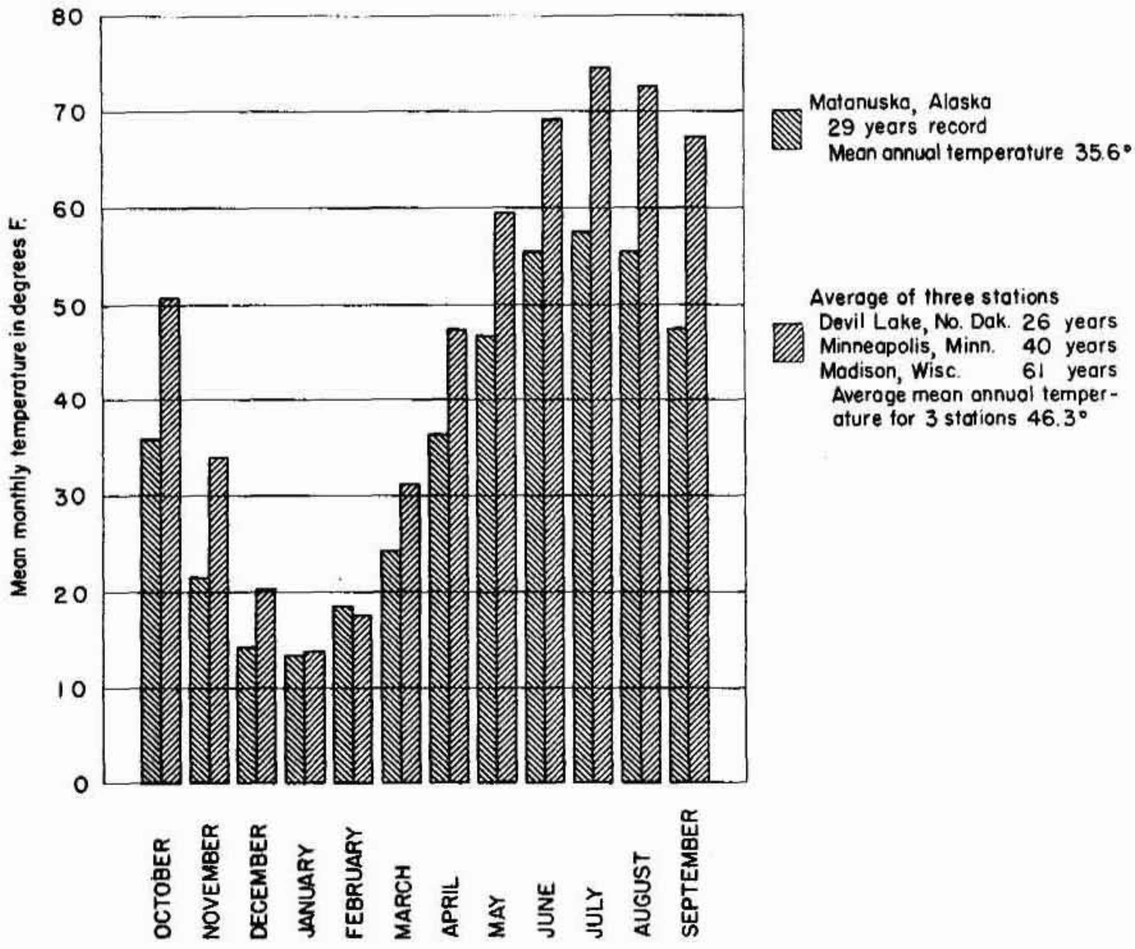

ANNUAL SNOWFALL
ANCHORAGE, ALASKA
Mean Annual Snowfall = 61.3 inches

U S GEOLOGICAL SURVEY

FIGURE 2

## TEMPERATURE COMPARISON

MATANUSKA VALLEY, ALASKA
WITH
NORTH CENTRAL UNITED STATES



Runoff: There is one gaging station on Ship Creek, located at the Fort Richardson diversion dam. It was established September 30, 1946, and operated with a staff gage until May 1, 1947, when a Stevens A-35 automatic water stage recorder was installed. Continuous records from this station are available from the time it was established.

The monthly runoff values for the period of record are listed in table 4 and are also shown graphically with precipitation and temperature values for this same period on figure 4. The mean discharge as shown in this table is 156 second-feet, which is equivalent to 113,000 acre-feet, or 23.46 inches runoff. The mean annual precipitation at the Anchorage station for the same four year period was 13.40 inches. This indicates that the precipitation in the drainage basin is much greater than that at Anchorage. The average precipitation at Anchorage for these four years was slightly less than the overall average of 14.45 inches, indicating that the runoff evidenced by the present period of record should be near normal.

An attempt was made to extend the runoff records back on the basis of the precipitation. This "synthetic runoff" record will not be dependable for obtaining a value for individual years but it will follow the trend of the runoff. The synthetic record indicates that there were 10 years when the runoff was less than the average for the years of actual record. The average of the actual discharges is slightly less than the synthetic average discharge for the 34 years for which precipitation records are available. This indicates the four year period to be slightly drier than average.

The annual values during this 4 year period varied from 9.43 inches in 1950 to 17.17 inches in 1949. The variation in this 4 year period was almost as great as the variation shown in the 30 annual values in table 1. Only one year had a lesser value than the 9.43 inches in 1950 and the 17.17 inches in 1949 was only exceeded in 6 years of the 30.

As above shown, the average runoff for the 4 years of record was 23.46 inches and the average precipitation for the same period was 13.40. The runoff at the gaging station was therefore 1.83 times the precipitation at Anchorage. This ratio, however, varied greatly from year to year as shown by the following tabulation.

| Water Year | Runoff inches | Precipitation at Anchorage, inches | Ratio of runoff to precipitation |
|---|---|---|---|
| 1946 - 1947 | 20.43 | 14.04 | 1.45 |
| 1947 - 1948 | 26.58 | 12.95 | 2.06 |
| 1948 - 1949 | 32.52 | 17.17 | 1.90 |
| 1949 - 1950 | 17.92 | 9.43 | 1.90 |

A comparison on the calendar year basis gives more consistent values as shown by the following values.

| Year | Runoff inches | Precipitation at Anchorage, inches | Ratio of runoff to precipitation |
|---|---|---|---|
| 1947 | 24.30 | 13.68 | 1.77 |
| 1948 | 24.92 | 13.77 | 1.81 |
| 1949 | 30.09 | 16.87 | 1.80 |
| | | | 1.79 |

The pronounced variation in the ratio between runoff and precipitation for the water years while the ratio for calendar years is very consistent is believed due to the fact that the last month of the calendar year, December, accounts for only 6% of the average annual precipitation. Year to year variations in the September precipitation would therefore have a more noticeable affect on the runoff for the water year than the year to year variation in December precipitation would have on the runoff for the calendar year. The figures shown above would indicate that the runoff at the gaging station would vary from 1.5 to 2.0 times the precipitation at Anchorage for the water year and over a period of several years would average about 1.75. A ratio of 1.5 applied to the Anchorage precipitation record should give a conservative figure for the Ship Creek runoff.

The maximum recorded flow was 1570 second-feet on June 21, 1949, and the minimum flow was 20 second-feet on February 20, 1949. The maximum monthly mean was 660 second-feet in June, 1949 and the minimum monthly mean was 26.5 second-feet in March, 1949. About 75 percent of the annual runoff occurs in the five month period, May through September while the precipitation during these months accounts for only 57 percent of the annual value.

A flow duration curve, figure 5, based on the 4 years available records shows the following:

| | |
|---|---|
| Q 95 = 30 second-feet | Q 90 = 33 second-feet |
| Q 50 = 105 second-feet | Q mean (39) = 156 second-feet |

The gaging station is at the downstream end of the survey and has a drainage area of 90.3 sq. miles. The drainage area above the dam site at Mile 1.0 is 99 percent and above the dam site at Mile 3.5 is 83 percent of the area above the gaging station. In the absence of other information, it is assumed that the runoff is proportional to the contributing drainage area, and therefore the runoff at Mile 3.5 is considered as 83 percent of that at the gaging station. It is very likely that the runoff is somewhat greater than 83 percent because of the higher mean altitude of the drainage area above Mile 3.5. Applying the 83 percent factor to the flow duration curve, the following values result for the dam site at Mile 3.5:

410 Federal Bldg.,
Tacoma 2, Wash.

April 18, 1952

Dear Sir:

Several months ago a report entitled, "Water Utilization, Ship Creek near Anchorage, Alaska" was sent to you. An error in the streamflow data used in this report has recently come to our attention. Table 4, Summary Of Monthly Mean Discharge In Second-feet, lists the observed values of streamflow at the gaging station. The diversion to Ft. Richardson is immediately above the gaging station. The monthly mean values of this diversion is shown in the following table.

Ship Creek Near Anchorage, Alaska
Summary of Monthly Mean Flow In Second-feet
Diverted to Ft. Richardson

| Water year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Yr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1947 | 4.4 | 4.7 | 4.7 | 4.6 | 4.7 | 4.5 | 4.3 | 4.3 | 4.3 | 5.0 | 4.7 | 4.6 | 4.6 |
| 1948 | 4.4 | 4.4 | 4.7 | 4.5 | 4.5 | 4.6 | 4.5 | 4.6 | 4.3 | 4.4 | 4.6 | 4.2 | 4.5 |
| 1949 | 4.5 | 4.7 | 5.0 | 5.0 | 4.9 | 5.0 | 4.9 | 4.6 | 4.4 | 4.4 | 4.4 | 4.4 | 4.7 |
| 1950 | 4.5 | 4.1 | 4.4 | 4.3 | 4.2 | 5.0 | 4.8 | 4.7 | 4.9 | 6.3 | 5.4 | 4.7 | 4.8 |

The values for the streamflow in the gaging station should therefore be increased by the amounts shown in the above table to obtain the adjusted flow at that point. Due to this error the first two sentences on page 18 should be changed to read as follows: "During the period of record, 1947 through 1950, the lowest recorded flow in Ship Creek was 25 second-feet on February 20, 1949, which is equivalent to 11,220 gallons per minute or 16.1 mgd. Three mgd of this flow is diverted to Ft. Richardson leaving 13 mgd available for Anchorage."

In view of the importance of Ship Creek as a source of municipal water supply it is desired to call your attention to the above error at this time.

Very truly yours,

Arthur Johnson

Arthur Johnson, Reg. Hyd. Eng.
Water and Power Branch

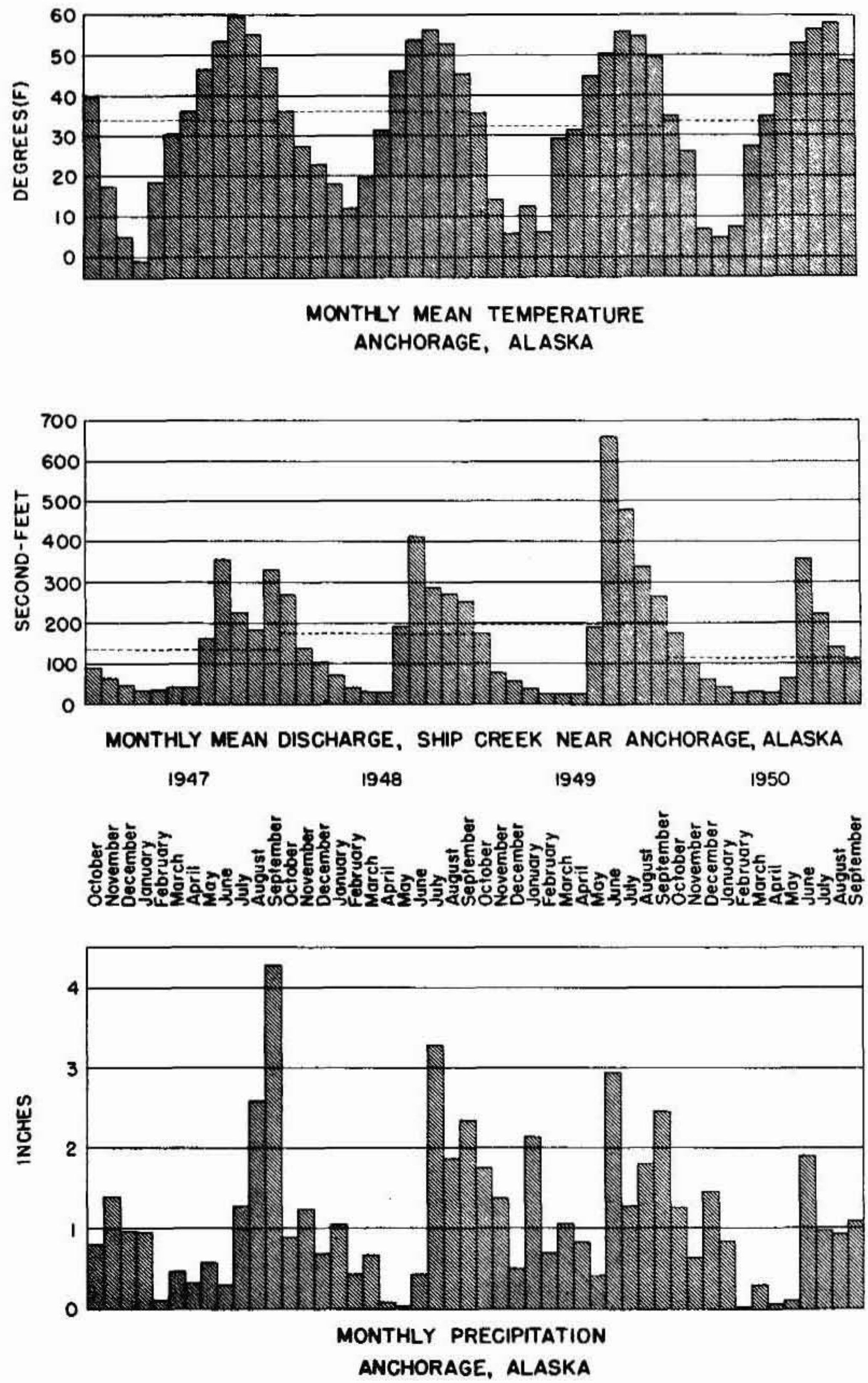
AJohnson:lcc

Note: The values in this table are observed values and should be increased by about 5 second-feet to adjust for diversions to Fort Richardson, which are made immediately above the gaging station. (Memo. from Arthur Johnson dated 4-8-50)

SHIP CREEK NEAR ANCHORAGE, ALASKA
SUMMARY OF MONTHLY MEAN DISCHARGE IN SECOND-FEET

Table 4

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1946-1947 | 92.4 | 67.4 | 49.1 | 37.1 | 38.6 | 43.1 | 42.2 | 163 | 356 | 227 | 183 | 331 | 136 |
| 1947-1948 | 269 | 139 | 106 | 72.9 | 41.7 | 33.7 | 32.0 | 192 | 413 | 287 | 271 | 254 | 176 |
| 1948-1949 | 175 | 78.3 | 58.9 | 40.5 | 28.6 | 26.5 | 27.7 | 189 | 660 | 478 | 338 | 266 | 198 |
| 1949-1950 | 177 | 99.1 | 62.8 | 45.3 | 30.5 | 31.3 | 30.3 | 64.5 | 356 | 222 | 141 | 109 | 114 |
| Maximum | 269 | 139 | 106 | 72.9 | 41.7 | 43.1 | 42.2 | 192 | 660 | 478 | 338 | 331 | 198 |
| Minimum | 92.4 | 67.4 | 49.1 | 37.1 | 28.6 | 26.5 | 27.7 | 64.5 | 356 | 222 | 141 | 109 | 114 |
| Mean | 178 | 96.0 | 69.2 | 49.0 | 34.8 | 33.6 | 33.0 | 152 | 446 | 304 | 233 | 240 | 156 |
| Mean runoff Acre-feet | 10,945 | 5,712 | 4,255 | 3,013 | 1,950 | 2,066 | 1,964 | 9,346 | 26,539 | 18,692 | 14,327 | 14,281 | 113,090 |
| Mean runoff Inches | 2.27 | 1.18 | 0.88 | 0.63 | 0.40 | 0.43 | 0.41 | 1.94 | 5.51 | 3.88 | 2.97 | 2.96 | 23.46 |
| Percent of mean annual | 9.7 | 5.0 | 3.8 | 2.7 | 1.7 | 1.8 | 1.7 | 8.3 | 23.5 | 16.5 | 12.7 | 12.6 | 100.0 |



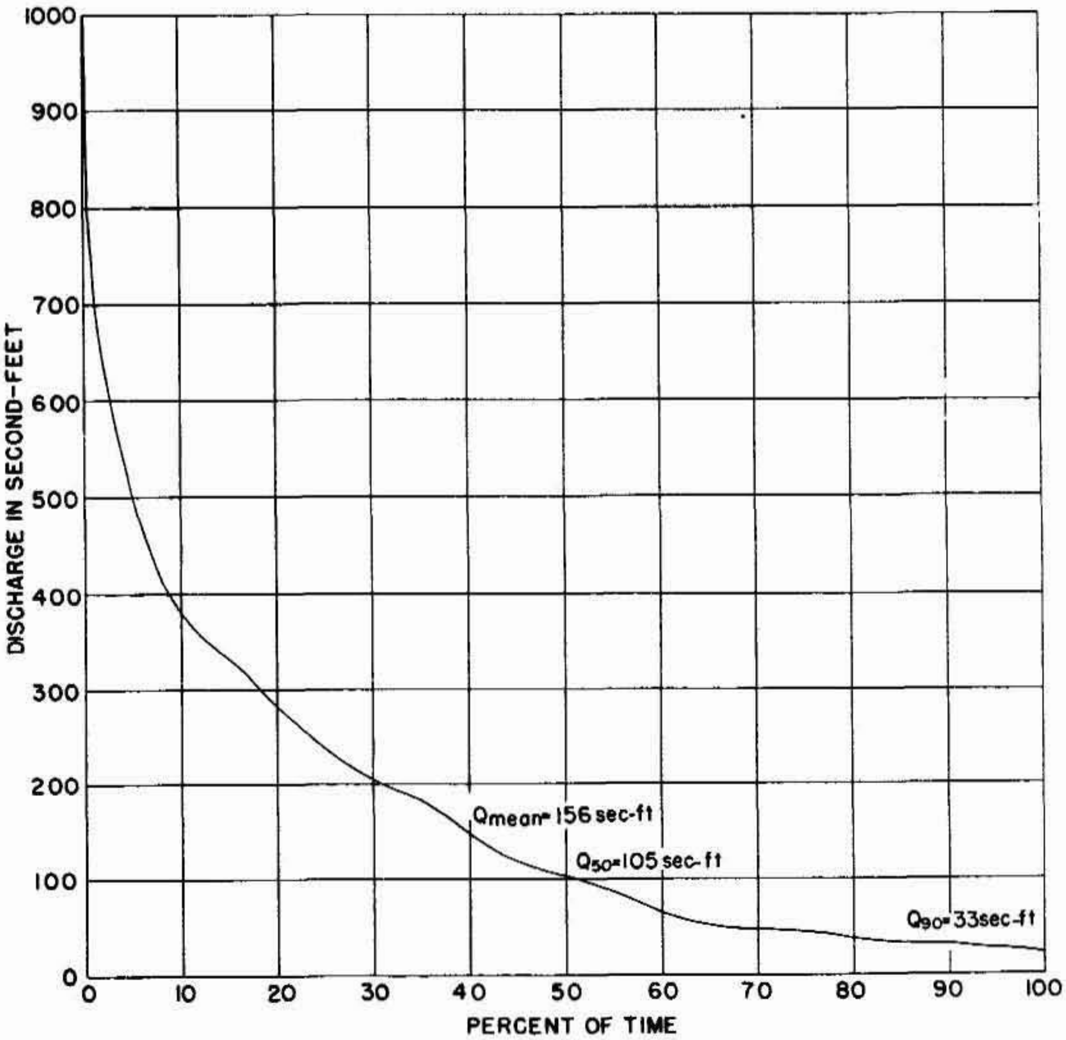

Mean annual values shown in dashed lines

GPO-87-81711

# DAILY FLOW DURATION CURVE

SHIP CREEK NEAR ANCHORAGE, ALASKA

OCTOBER 1, 1946 TO SEPTEMBER 30, 1950




GPO-87-81711

Q 95 = 25 second-feet Q 90 = 27 second-feet

Q 50 = 87 second-feet Q mean = 129 second-feet

These proportional runoffs have been used for the site at Mile 3.5 and the runoff at Mile 1.0 has been assumed the same as at the gaging station.

## WATER UTILIZATION

Present Use: Fort Richardson obtains its water supply by diversion from Ship Creek at a point 10 miles east of Anchorage. The diversion dam is only 10 feet high and the water is conveyed to Fort Richardson through a pipe line. The diversion structure includes a boiler installation which is used at times to warm the water slightly for better solution of the necessary chlorine. The amount of water diverted averages 4.6 second-feet or 3.0 mgd. This water is used for domestic purposes and for a steam plant.

Anchorage obtains its water supply by diversion from Ship Creek at the Fort Richardson dam and conveying it to the city through a pipe line. This pipe line was put into service in December, 1950. Prior to that time Anchorage obtained its water supply by pumping from Ship Creek at a point within the city limits located about one mile from the post office. The pumping plant has a capacity of 3.5 to 4.0 mgd.

Ship Creek serves The Alaska Railroad which has its pumping plant very near to the city plant. The capacity of the railroad's installation is 2.5 mgd. The railroad's pumping plant serves all of the area within the city north of Ship Creek. These customers include two canneries during the fishing season, oil companies, the Army dock and the boats using those facilities, and others who ship their products on the railroad. In addition to the commercial demand, the residences in this area are also served by the railroad. It is planned that the railroad's distribution system in the area described will be turned over to the city in exchange for water to be furnished by the city.

The water supply for a gravel washing plant and a concrete products plant is also taken from the creek. There is no place on the creek where hydroelectric power has been developed. Salmon have been observed in the creek at least as far up as the diversion dam. It is not known if they proceed farther upstream, but the low dam would not obstruct their progress if their spawning areas were beyond that point.

Future Use: The development of hydroelectric power from Ship Creek is possible with the use of one or two dams. However, at this time it does not appear particularly attractive considering the size of the dams required and the comparatively small amount of power available. Irrigation of the area east of Anchorage and west of the Chugach Mountains in the vicinity of Ship Creek is possible from a topographic standpoint. No information is available concerning the soil condition or crop possibilities in this area. The Fort Richardson military reservation covers much of this area and thus renders the land unavailable for agricultural purposes. Water supply for Anchorage and adjoining communities and Fort Richardson appears to be the most likely future use for the waters of Ship Creek.

## STREAM REGULATION

Natural Storage: The rapid fall of the stream, the narrowness of the valley, and the absence of lakes results in no natural storage.

Developed Storage: The one dam, the Fort Richardson diversion dam, doesn't create any storage but is simply a diversion dam.

Undeveloped Storage: A study of the map of the stream valley, see plate 3, suggests two possible dam sites to develop storage on Ship Creek. These sites are at Mile 1.0 and Mile 3.5 and are hereafter referred to as Dam Site A and B respectively. Area and capacity curves and cross profiles of the dam sites are shown on figures 6 and 7. Tables showing areas and capacities for these dam sites follow.

RESERVOIR SITE
DAM SITE A, MILE 1.0

| Altitude of water surface (feet) | Area (acres) | Capacity (acre-feet) |
|---|---|---|
| 640 | 0 | 0 |
| 700 | 13 | 210 |
| 720 | 25 | 590 |
| 740 | 38 | 1,220 |
| 760 | 54 | 2,140 |
| 780 | 74 | 3,420 |
| 800 | 93 | 5,090 |
| 820 | 114 | 7,160 |
| 840 | 137 | 9,670 |
| 860 | 156 | 12,600 |
| 880 | 181 | 15,970 |
| 900 | 210 | 19,880 |
| 920 | 238 | 24,360 |
| 940 | 266 | 29,400 |
| 960 | 298 | 35,040 |
| 980 | 332 | 41,340 |
| 1,000 | 367 | 48,330 |

RESERVOIR SITE
DAM SITE B, MILE 3.5

| Altitude of water surface (feet) | Area (acres) | Capacity (acre-feet) |
|---|---|---|
| 1,040 | 0 | 0 |
| 1,060 | 3 | 30 |
| 1,080 | 13 | 190 |
| 1,100 | 28 | 600 |
| 1,120 | 55 | 1,430 |
| 1,140 | 96 | 2,940 |
| 1,160 | 149 | 5,390 |
| 1,180 | 208 | 8,960 |
| 1,200 | 296 | 14,000 |
| 1,220 | 392 | 20,880 |
| 1,240 | 472 | 29,520 |
| 1,260 | 575 | 39,990 |
| 1,280 | 714 | 52,880 |
| 1,300 | 838 | 68,400 |

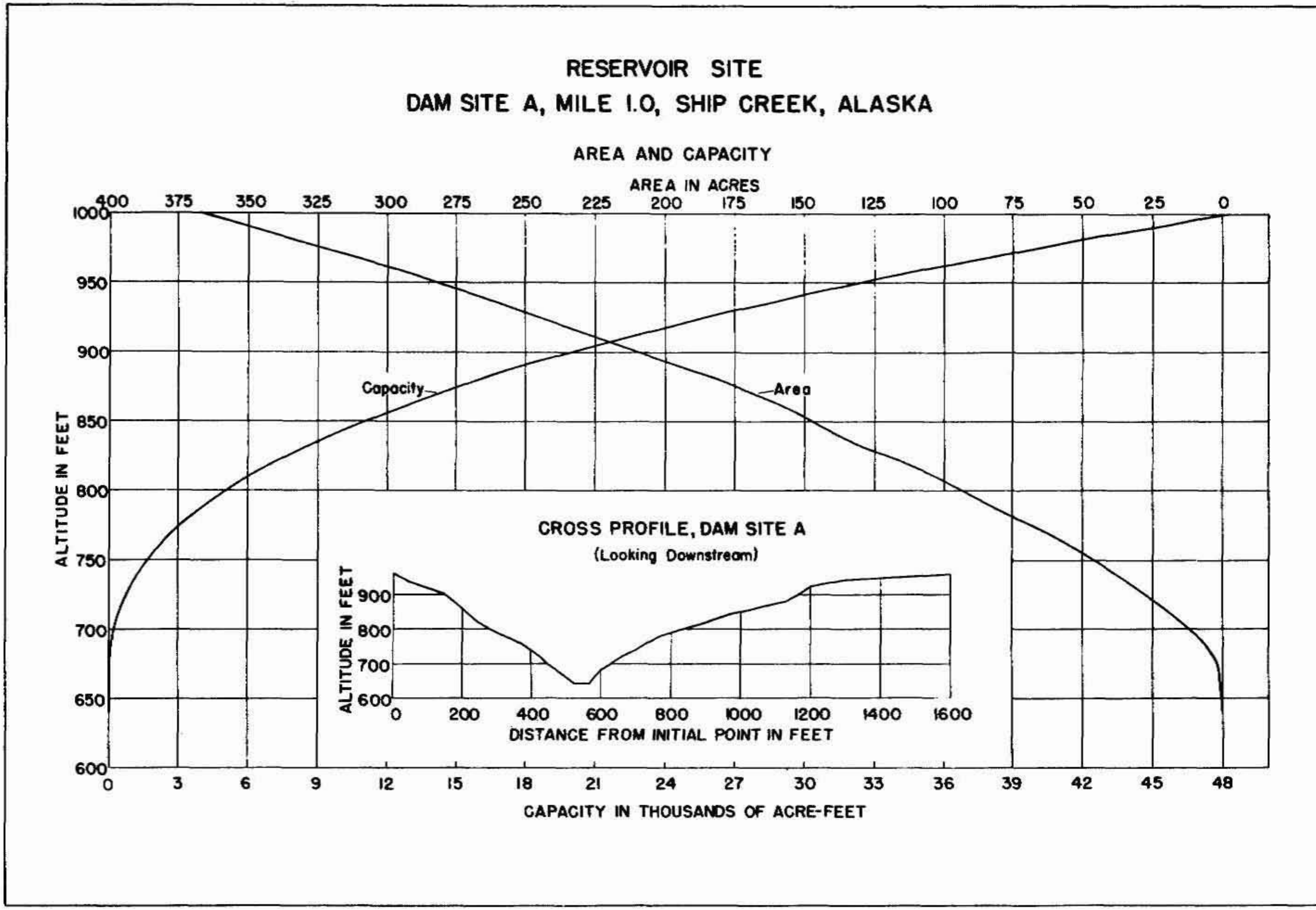
The mean flow for the period of record, 1947-1950, see table 4, was 156 second-feet, varying from a maximum monthly mean of 660 second-feet, to a minimum monthly mean of 26.5 second-feet. The six month period, November through April accounts for less than 20 percent of the annual runoff. June and July account for about 40 percent of the runoff and the four month period June through September accounts for 65 percent. With this variation in distribution throughout the year storage is necessary to regulate the flow for most effective use. The storage requirements for complete regulation, and the results obtainable with various storage capacities were determined from a study of the mass diagram, plate 8, showing the cumulative runoff during the 4 year period of record.

Regulation from year to year, and for the 4 year period, would have required the storage and maintained the flows as shown below.

| | DAM SITE A at MILE 1.0 a/ | | DAM SITE B at MILE 3.5 b/ | |
|---|---|---|---|---|
| Year | Storage Required (acre-feet) | Resulting Mean Flow (cfs) | Storage Required (acre-feet) | Resulting Mean Flow (cfs) |
| 1947 | 42,000 | 146 | 35,000 | 121 |
| 1948 | 38,000 | 170 | 31,500 | 141 |
| 1949 | 63,000 | 199 | 52,500 | 165 |
| 1950 | 24,500 | 107 | 20,000 | 89 |
| 1947-1950 | 47,500 | 156 | 39,500 | 130 |

a/ Runoff assumed to be the same as at gaging station.
b/ Runoff assumed to be 83 percent of that at gaging station.

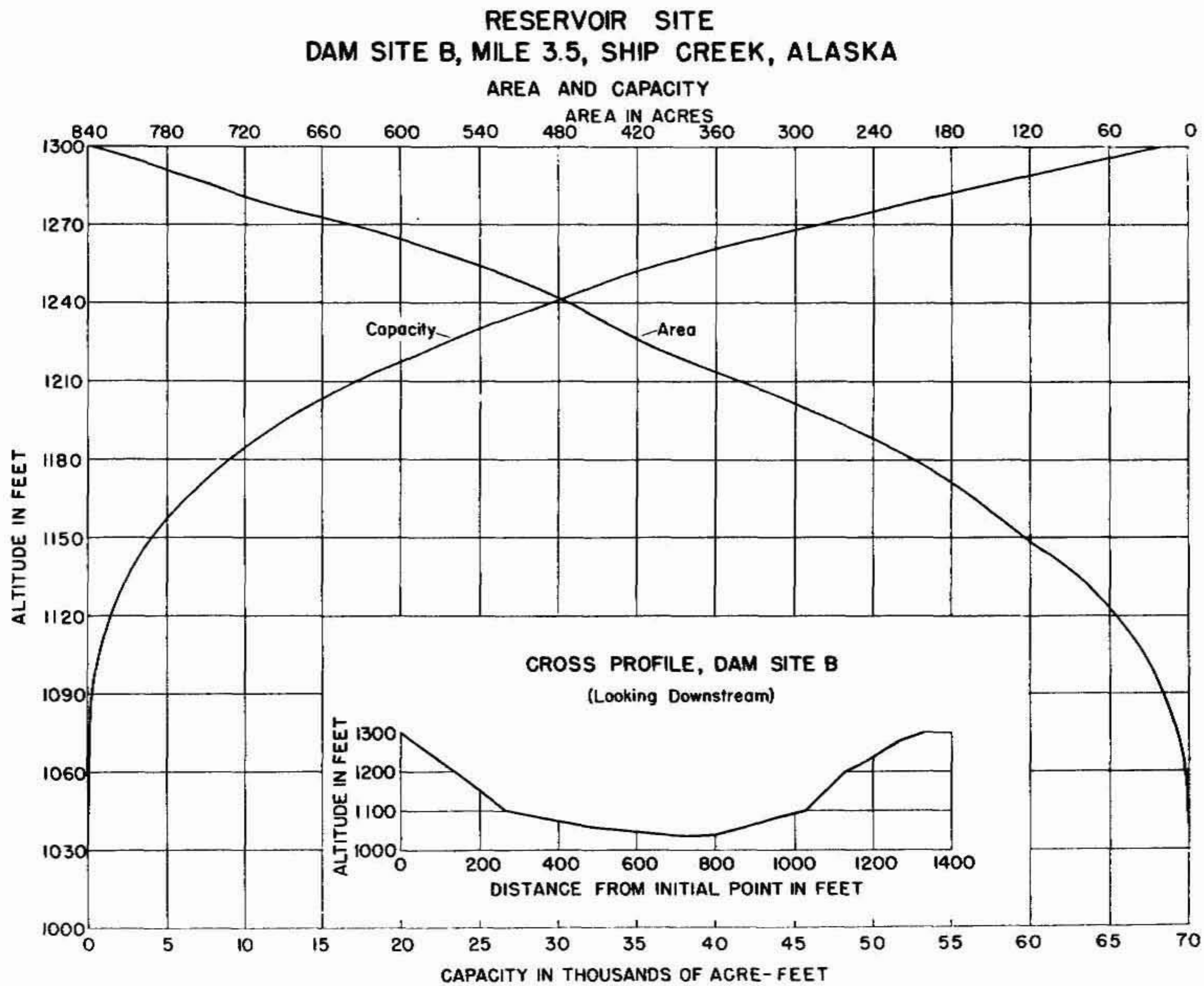
To maintain constant flow throughout the year withdrawal from storage would start in October or November and continue into April or May when the natural flow would exceed the demand and the reservoir would start to refill and would continue until October or November when withdrawal would again start.




U S GEOLOGICAL SURVEY

FIGURE 6

GPO-S-F80




U S GEOLOGICAL SURVEY

FIGURE 7

GPO-8-FSO

It seems very impractical to attempt complete regulation of Ship Creek because such large dams would be required. A dam 250 feet high at dam site B would be necessary for complete regulation. A dam that high would have a crest length of 1,310 feet. At dam site A, a dam 350 feet high having a crest length of 1,800 feet would not completely regulate the flow.

Assuming an active storage capacity of 20,000 acre-feet, for example, and analyzing each dam site on that basis would result in the following regulated flow.

| | DAM SITE A, MILE 1.0 | DAM SITE B, MILE 3.5 |
|---|---|---|
| Q95 | 102 cfs | 90 cfs |
| Q90 | 103 | 90 |
| Q50 | 118 | 103 |
| Qmean | 156 | 129 |

MUNICIPAL WATER SUPPLY

In an attempt to determine the consumption of water of various business establishments and residences, pilot meters were installed by the city water department in several places throughout the city. The results of this metering failed to establish any usable value for a per capita consumption as the demands were so divergent. They did serve to show that more water was being used at various places than had been believed. Water consumption during the months of peak demand, February through April, is quite high because of bleeding of pipe lines by consumers to prevent freezing. The month with the greatest consumption in 1947 was March when approximately 410 gallons per capita per day were used. The estimated population for 1947 was 9,000. The foregoing figures on consumption and population would corrected to according memo from Arthur Johnson dated 4-8-57 J.F. 4-15-57

result in a demand of 3.7 mgd.

During the period of record, 1947 through 1950, the lowest recorded flow in Ship Creek was ~~20~~ 25 second-feet on February 20, 1949 which is equivalent to ~~8,975~~ 11,220 gallons per minute or ~~12.9~~ 16.1 mgd. Three mgd of this flow is diverted to Fort Richardson leaving ~~ten~~ 13 mgd available for Anchorage. This appears to be adequate to supply all demands at the present time. However, lower flows and longer periods of low flow may be experienced. On the basis of past records of stream flow and precipitation, it is reasonable to assume that there will always be some flow in the creek. If there is further expansion in Anchorage or if nearby communities such as Mountain View, Spenard, or Eastchester were to be included in a distribution system with Anchorage, a greater and more dependable supply should be developed.

The required storage and resultant regulated supply could be achieved with a dam at dam site A. For example, a dam 100 feet high would develop 1,220 acre-feet of storage which would provide a constant flow during a four month low water period of 3.3 mgd in addition to the natural flow. A 150 foot dam would develop 4,250 acre-feet of storage which would provide a flow of 11.6 mgd in addition to natural flow throughout the same four month period. Thus the additional 50 feet in the height of the dam would increase the available flow fourfold.

The two foregoing examples indicate that the natural flow in Ship Creek along with the development of a small amount of storage should prove adequate for all demands in the foreseeable future.

## WATER-POWER

<u>Developed Power:</u> There is no developed water-power on Ship Creek at this time.

<u>Undeveloped Power:</u> The determination of the optimum design is not possible at this time with the information available. However, an illustrative plan of development with the data at hand is given to show how much power would be available under certain conditions. Insofar as possible it is based on practical considerations as to the size of dams, capacities of reservoirs and stream flow.

A plan of development for each of the two dam sites referred to in the section, Stream Regulation, is described in the following paragraphs. These plans both assume that the available flow would be that resulting from the development of 20,000 acre-feet of usable storage and that the power house would be at the mouth of the canyon at an altitude of 500 feet. The potential power has been computed using the formula $KW = 0.068\ Q\ H$ in which

$KW$ = kilowatts
$Q$ = flow in second-feet
$H$ = head available between mean reservoir level and power house site

The foregoing formula is based on an overall efficiency factor of 80 percent.

### Dam Site A (Mile 1.0)

A dam 300 feet high, with maximum flow line at altitude 940 feet, would develop 29,400 acre-feet of storage. Using 20,000 acre-feet would require a maximum draw down of 102 feet or down to altitude 838 feet. The mean altitude of the reservoir would be at 898, with a resulting mean head at the power house of 398 feet. Conveying the water from the dam to a power house at the mouth of the canyon would require a tunnel approximately 3/4 mile in length and a penstock approximately 1/2 mile in length. The tunnel entrance would be below the minimum draw down elevation and consequently would at times of full reservoir be subject to a static head of slightly over 100 feet. The foregoing assumes that the tunnel would have only enough gradient to provide the necessary flow and the main drop would be in the penstock. The length of penstock could be reduced by using a steeper gradient for the tunnel which in turn would require that the tunnel would have to be built to withstand increasingly greater pressure as it approached the penstock.

Potential power at undeveloped site, Mile 1.0, Dam Site A, (Head, 398 feet)

| | Flow in second-feet | | | Kilowatts | | |
|---|---|---|---|---|---|---|
| | 95 per cent of time | 90 per cent of time | 50 per cent of time | 95 per cent of time | 90 per cent of time | 50 per cent of time |
| Natural flow .. | 30 | 33 | 105 | 812 | 893 | 2840 |
| Regulated flow. | 102 | 103 | 118 | 2760 | 2790 | 3190 |

Dam Site B, (Mile 3.5)

A dam 200 feet high, with maximum flow line at altitude 1240 feet, would develop 29,500 acre-feet of storage. Using 20,000 acre-feet would require a maximum draw down of 58 feet or down to altitude 1182 feet. The mean altitude of the reservoir would be at 1216 feet with a resulting mean head at the power house of 716 feet. Conveying the water from the dam to a power house at the mouth of the canyon would require a tunnel approximately 2-3/4 miles in length and a penstock approaching 1 mile in length. The tunnel entrance would be below the minimum draw elevation and consequently subject to a static head of slightly over 60 feet. As in the previously described development the length of penstock could be shortened by increasing the tunnel gradient which in turn would result in the tunnel being subject to increasingly greater pressure as it neared the penstock.

Potential power at undeveloped site, Mile 3.5, Dam Site B, (Head, 716 feet)

| | Flow in second-feet | | | Kilowatts | | |
|---|---|---|---|---|---|---|
| | 95 per cent of time | 90 per cent of time | 50 per cent of time | 95 per cent of time | 90 per cent of time | 50 per cent of time |
| Natural flow | 25 | 27 | 87 | 1220 | 1310 | 4240 |
| Regulated flow | 90 | 90 | 103 | 4380 | 4390 | 5010 |

It is recognized that there are various other possible schemes of development, using different heights of dams, reservoir capacities, diversion methods, power house locations, etc. The basic data presented in this report will enable such studies to be made by those interested. The foregoing illustrative plans of development will serve to show the magnitude of the potential power available from Ship Creek and the problems to be encountered in developing it.

APPENDIX

Plane Table Bench Marks

The initial elevation for the following bench marks was a mark on the floor of the boiler room at the Ft. Richardson diversion dam. The elevations listed were determined with plane table and aliddade, using stadia distances and vertical angles. The markers referred to in the following descriptions are aluminum plates 6" square showing the following information.-

PLANE TABLE
BENCH MARK
U.S.
GEOLOGICAL SURVEY
ELEVATION
_____FEET

PLEASE DO NOT DISTURB THIS MARK

---

Ft. Richardson diversion dam, boiler room door, 10 feet southwest of, at No. 4 manhole, bronze tablet grouted in concrete stamped "493" 492.8

Ft. Richardson diversion dam, 0.6 mile upstream from along dim trail on right bank of Ship Creek; about 100 feet above stream level, 40 feet north of top of steep canyon wall, 14" spruce tree, copper nail and washer in root on west side. Aluminum plate on tree, stamped, "667". 666.7

Ft. Richardson diversion dam, 1.1 miles upstream from along dim trail on right bank of Ship Creek; 350 feet upstream from mouth of creek entering on left bank, about 100 feet above stream level, 40 feet north of trail and 50 feet north from top of steep canyon wall, 12" spruce tree, copper nail and washer in root on north side. Aluminum plate on tree, stamped "761" 761.5

Ft. Richardson diversion dam, 1.9 miles upstream from along Ship Creek, on left bank, about 100 feet upstream from small stream entering on right bank and 1300 feet upstream from tributary entering on left bank; in group of poplar trees in flat area at bend in creek; 9" spruce tree, copper nail and washer in root. Aluminum plate on tree stamped "754". 755.0

Ft. Richardson diversion dam, 3.2 miles upstream from, on right bank of Ship Creek; 0.3 mile downstream from mouth of creek entering on right bank and which flows past the Tenth Rescue Squadron cabin; about 115 feet above stream level, and 300 feet north of creek; on point of ridge at top of stee; slope; 15" spruce tree, copper nail and washer in root. Aluminum plate on tree stamped "1107". 1107.4

Ft. Richardson diversion dam, 3.5 miles upstream from along Ship Creek; at mouth of creek entering on right bank and which flows past Tenth Rescue Squadron cabin located 0.8 miles north therefrom; large boulder, standard plane table bench mark tablet grouted in top of, stamped, "1-S-1948,1050." 1050.1

Ft. Richardson diversion dam, 4.3 miles upstream from, along Ship Creek; 0.8 mile upstream from mouth of creek entering on right bank and flowing past Tenth Rescue squadron cabin; 1.4 miles southeast from said cabin, on right bank of creek, between two small tributaries entering on right bank, 1250 feet upstream from one and 500 feet downstream from the other; 400 feet southwest from Old Mail Trail, large rock at east end of small island; standard plane table bench mark grouted in top of, stamped, "2-S-1948,1122" 1122.1

Ft. Richardson diversion dam, 6.0 miles upstream from along Ship Creek; 2.8 miles southeast from Tenth Rescue Squadron cabin along Old Mail Trail; 1.2 miles along trail from when it crosses the second of two small streams entering on right bank; small ridge 500 feet north of Ship Creek; 12" spruce tree on east slope of ridge 15 feet north of trail; copper nail and washer in root. Aluminum plate on tree stamped "1245" 1245.4

Ft. Richardson diversion dam, 7.4 miles upstream from along Ship Creek; 3.8 miles southeast from Tenth Rescue Squadron Cabin along Old Mail Trail and 1000 feet south from trail; on right bank of creek 700 feet upstream from old log cabin; 18" spruce tree, copper nail and washer in root. Aluminum plate on tree, stamped "1306". 1305.9

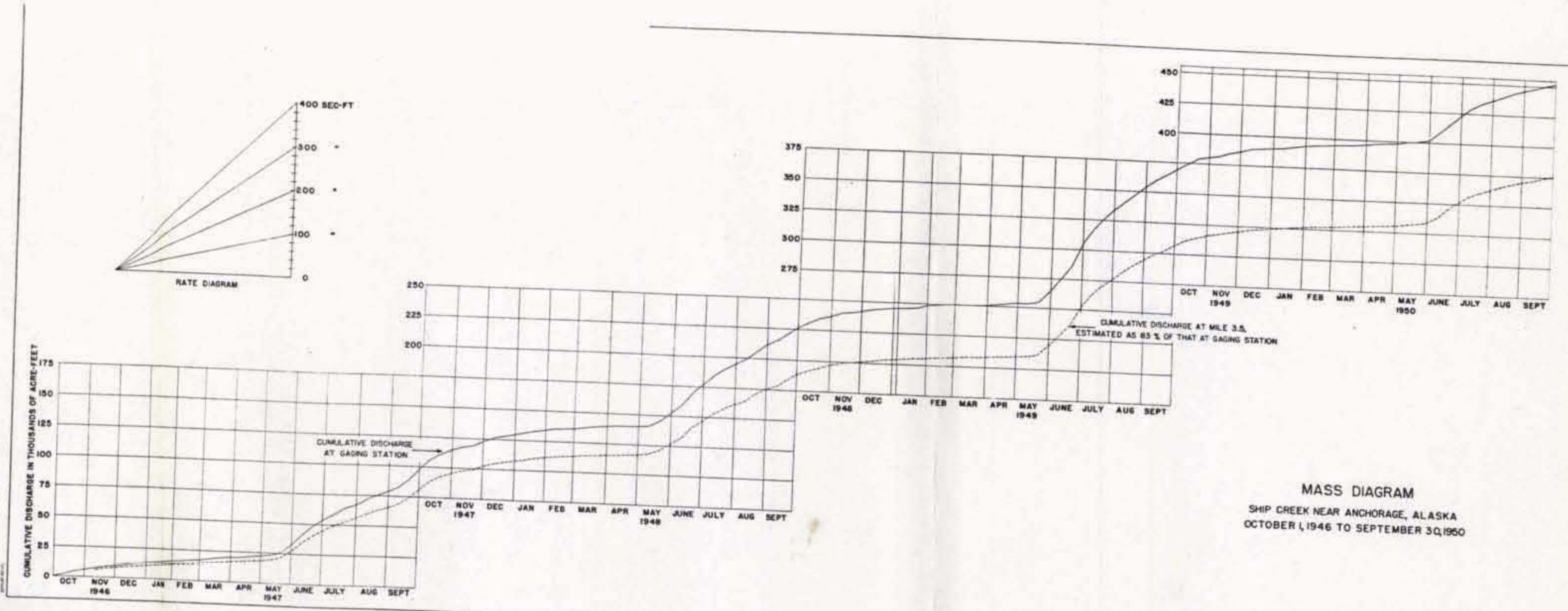
Tenth Rescue Squadron Cabin, 0.6 mile south from; on right bank of creek, 200 feet from channel, 1/4 mile above mouth; 100 feet west from Old Mail Trail; stump with copper nail and washer in top. 1301.8

Tenth Rescue Squadron cabin, 0.6 mile southwest from; 0.4 mile northwest from mouth of creek flowing by said cabin, 300 feet west from a swale and at south edge of flat area; 12" spruce tree, copper nail and washer in root on south side. Aluminum plate on tree stamped "1527" 1527.8

Ft. Richardson diversion dam, 1.7 miles east from along Pioneer Road to Tenth Rescue Squadron cabin; 25 feet west of small creek crossing road and 40 feet north of road; 16" spruce tree dividing into two trunks 3 feet above ground; copper nail and washer in root. Aluminum plate on tree stamped "1271" 1271.2

Ft. Richardson diversion dam, 1.1 miles east from along road to Tenth Rescue Squadron cabin; 18 feet south of road and 40 feet north from top of steep bank; 18" spruce tree with two trunks both of which have been broken off, copper nail and washer in root on north side. Aluminum plate on tree stamped "1132" 1131.8

Ft. Richardson diversion dam, 0.5 mile northeast from along Pioneer Road to Tenth Rescue Squadron cabin; 20 feet south of road; 12" spruce tree with copper nail and washer in root in west side. Aluminum plate on tree stamped "809". 809.0




MASS DIAGRAM

SHIP CREEK NEAR ANCHORAGE, ALASKA

OCTOBER 1, 1946 TO SEPTEMBER 30, 1950

FIGURE