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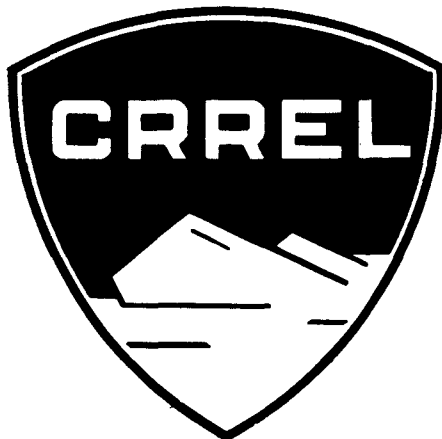
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Technical Report 101

AUGUST, 1962

Ground Temperature Observations, Aniak, Alaska

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COLD REGIONS RESEARCH AND ENGINEERING LABORATORY



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PREFACE

Collection of the data presented herein was authorized in July 1946 by the Chief of Engineers in "Instructions and Outline on Meteorological Data Study." The program was initiated by the Permafrost Division, St. Paul District, and continued by the Arctic Construction and Frost Effects Laboratory (ACFEL), U. S. Army Engineer Division, New England. It was carried out for the Civil Engineering Branch, Engineering Division, Military Construction, Office, Chief of Engineers. In February 1961 ACFEL was merged with the U. S. Army Snow Ice and Permafrost Research Establishment to form the U. S. Army Cold Regions Research and Engineering Laboratory (USA CRREL).

The program included the collection of data at 20 stations in Alaska and one in Canada. The present report summarizes the data obtained at one of these stations. The data obtained at the other stations in this program will be presented in separate reports.

The investigation was a cooperative venture of the Corps of Engineers, the United States Weather Bureau, and the Federal Aviation Agency (formerly Civil Aeronautics Administration). Substantial support and assistance in the investigation were provided by personnel of the Alaska Field Station, CRREL (formerly Arctic Construction Investigation Area) at Fairbanks, Alaska, under the direction of Mr. F. F. Kitze, Chief. Personnel from the AFS installed and maintained the ground-temperature-measuring equipment and rendered technical assistance to the operating personnel of the U. S. Weather Bureau and Federal Aviation Agency.

This report was prepared by the Civil Engineering Branch (Mr. E. F. Lobacz, Chief) as a project of the Experimental Engineering Division (Mr. K. A. Linell, Chief).

Construction Engineering Branch personnel actively engaged in this project have been Messrs. George W. Aitken, C. W. Fulwider, and Pfc. R. Huck. Mr. J. F. Haley, formerly Assistant Chief, ACFEL, Mr. Harry Carlson, formerly Chief, Permafrost Division, and many others of these organizations contributed substantially in this investigation. Mr. Aitken and Mr. Fulwider analyzed the project data and prepared the basic format for the report series. Mr. Aitken was primarily responsible for this report.

Commanding Officer of USA CRREL during the preparation and publication of this report was Colonel William L. Nungesser. Technical Director was Mr. W. K. Boyd.

This report has been reviewed and approved for publication by the Office of the Chief of Engineers, U. S. Army.

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Technical Report 101

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**Ground Temperature
Observations,
Aniak, Alaska**

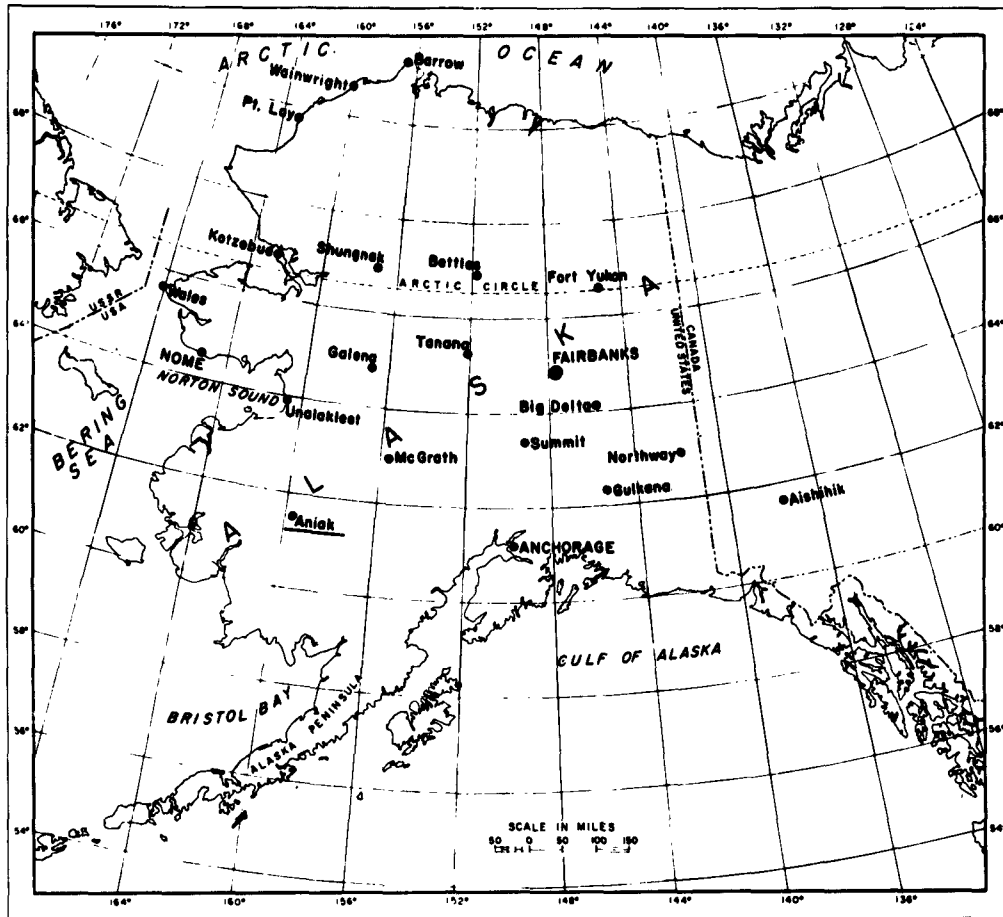
by George W. Aitken and C. W. Fulwider

**U. S. ARMY COLD REGIONS RESEARCH
AND ENGINEERING LABORATORY**
Corps of Engineers
Hanover, New Hampshire

SUMMARY

This report summarizes climatological, ground-temperature, and soil data obtained at Aniak, Alaska. The climatological data were obtained from U. S. Weather Bureau Records for the years 1944 to 1958; the ground-temperature data were obtained from daily observations during the years 1947 to 1958; and the soil data were obtained from samples taken while drilling two holes: one in August 1946 and the other in July 1958.

GROUND TEMPERATURE OBSERVATIONS



Ground temperature observation sites.

GROUND TEMPERATURE OBSERVATIONS, ANIAK, ALASKA

INTRODUCTION

Purpose

The Aniak, Alaska data summarized in this report were obtained in connection with an investigation to evaluate the relationship between climatic conditions, soil conditions and soil temperatures in arctic and subarctic areas. These data could be used by agencies requiring general knowledge of this area for such purposes as site selection or as a guide in more detailed investigational efforts.

Scope

The investigational program involved the collection of climatological, ground temperature, and soil data from 20 stations in Alaska and one in Canada.

The climatological data for Aniak, Alaska, were obtained from U. S. Weather Bureau records for the years 1944 to 1958. Ground temperature observations were obtained on a daily basis from 1947 to 1958 by the U. S. Federal Aviation Agency for the Arctic Construction and Frost Effects Laboratory, U. S. Army Engineer Division, New England. Soil data were obtained from samples taken during the drilling of two holes, one in August 1946 and the other in July 1958.

DESCRIPTION OF SITE

Location

Aniak is a small village in south-western Alaska. It is located on the south bank of the Kuskokwim River at 61°35' north latitude and 159°36' west longitude (Fig. 1). A gravel-surfaced runway, 5000 feet long, provides the only practical year-round access to the village. This runway is located only 10 feet above the average level of the Kuskokwim River and is probably quite soft during the spring breakup period.

Climate

Climatological data for Aniak, Alaska, are given in Table I and in Figures 3 and 4.

Table I gives air temperatures, amounts of precipitation, snowfall and thawing indexes. The air temperatures were obtained in accordance with standard Weather Bureau procedures. The snow cover measurements were made in the vicinity of the FAA control building and are believed to be representative of the area where the ground-temperature assembly is located.



Figure 1. Vicinity map.

GROUND TEMPERATURE OBSERVATIONS



Figure 2. Aerial view of Aniak, looking east.

Figure 3, a climograph (also called a hythergraph), gives: mean monthly values of precipitation versus temperature; direction and force of prevailing winds; amount of cloud cover; number of days of precipitation (rain and/or snow); and fog data for the area.

Figure 4 presents meteorological data and ground isotherms for a typical year (October 1947-October 1948). The meteorological data includes average daily air temperatures, degree days of thaw and freeze (cumulative on the last day of each month), daily precipitation (rain and/or snow) and depth of snow on the ground.

GROUND TEMPERATURE OBSERVATIONS

Table I. Climatological data
for
Aniak, Alaska.

Air temperature — °F	
Mean annual	28.3
Recorded high (7/13/51)	87
Recorded low (1/19/47)	-62
Precipitation - inches	
Mean annual	20.2
Max. annual (1955)	29.0
Max. monthly (Aug 1949)	9.2
Snowfall — inches	
Mean annual	62.7
Max. annual (1955)	113.1
Max. monthly (Mar 1954)	28.8
Freezing index (degree-days F below 32 F)	
Average (1946-1957)	4370
Minimum (Oct 49-Apr 50)	3681
Maximum (Oct 55-Apr 56)	5399
Thawing index (degree-days F above 32 F)	
Average (1947, 1948, 1950-1955 & 1957)	2735
Minimum (May 1948-Oct 1948)	2330
Maximum (April 1947-Oct 1947)	3260
Average date start freeze season	16 Oct
Average date start thaw season	21 Apr
Average length of freeze season (days)	186
Average length of thaw season (days)	179

Snow cover — inches
first day of month for 1948, 1949,
1952-1958

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Maximum recorded	-	0	6	14	34	39	67	61	19	0
Minimum recorded	-	0	T	2	5	6	11	11	T	0
9-year average	-	0	1	7	16	21	28	23	5	0

T = Trace

GROUND TEMPERATURE OBSERVATIONS

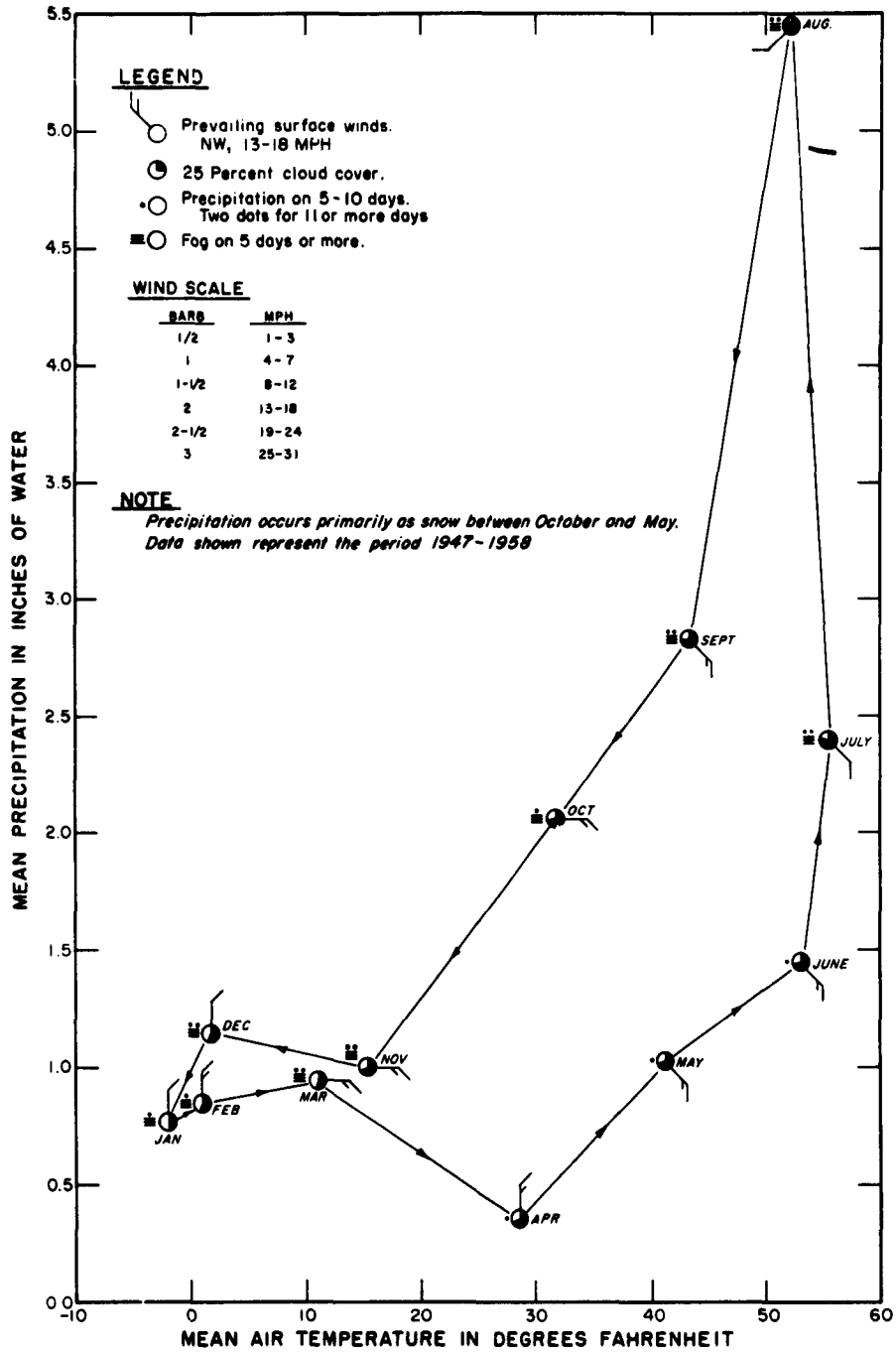
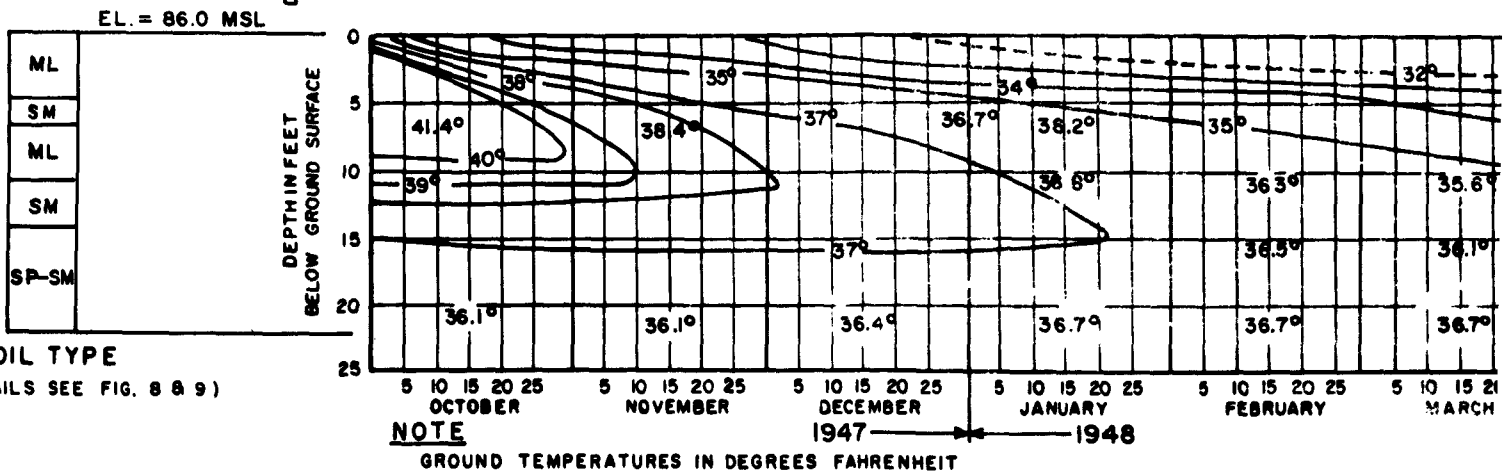
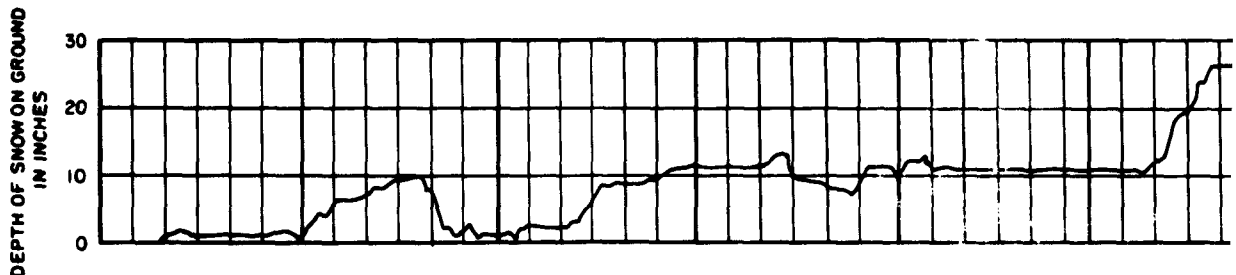
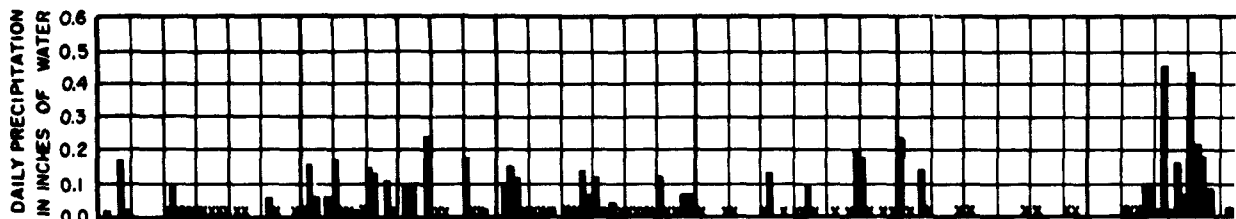
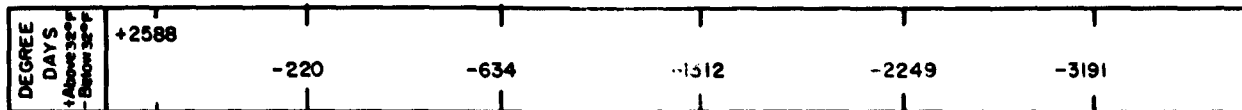
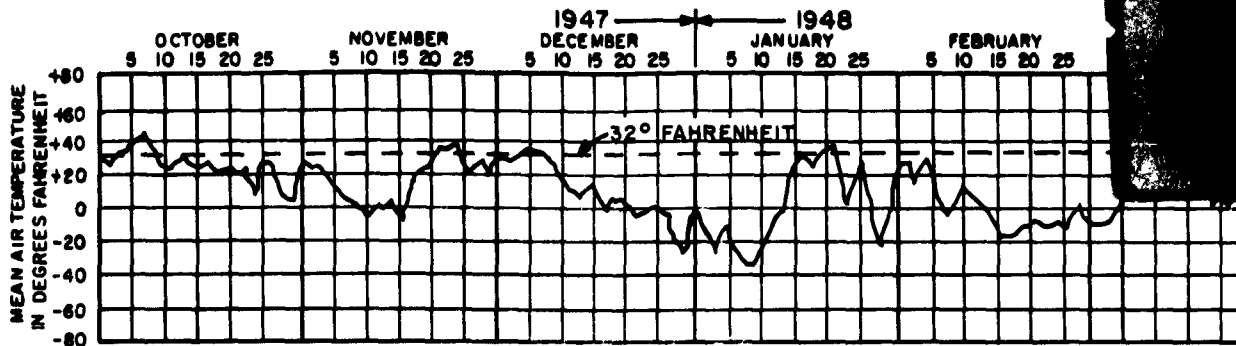


Figure 3. Climograph.



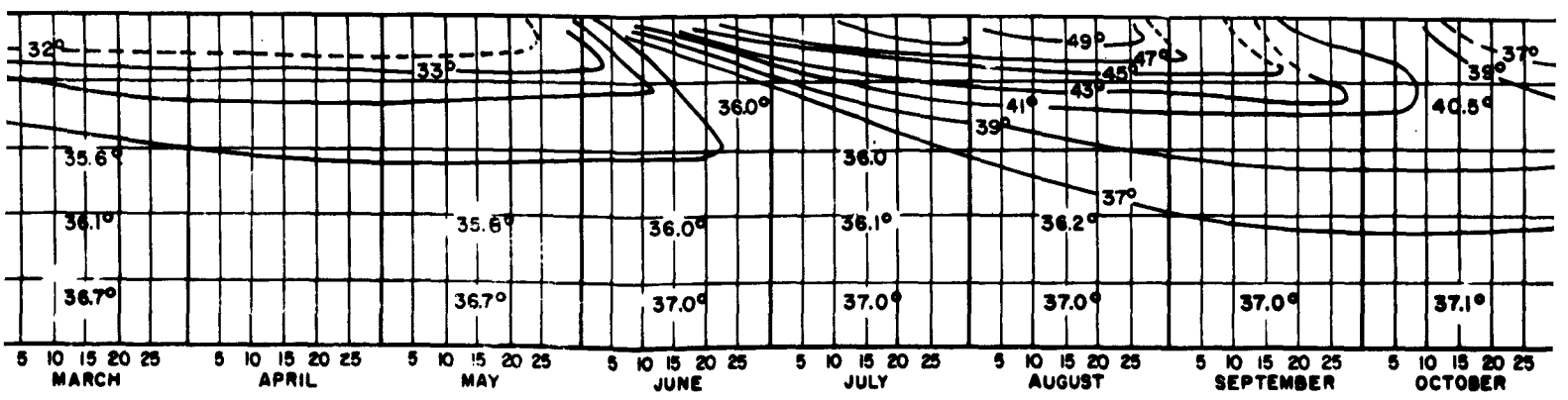
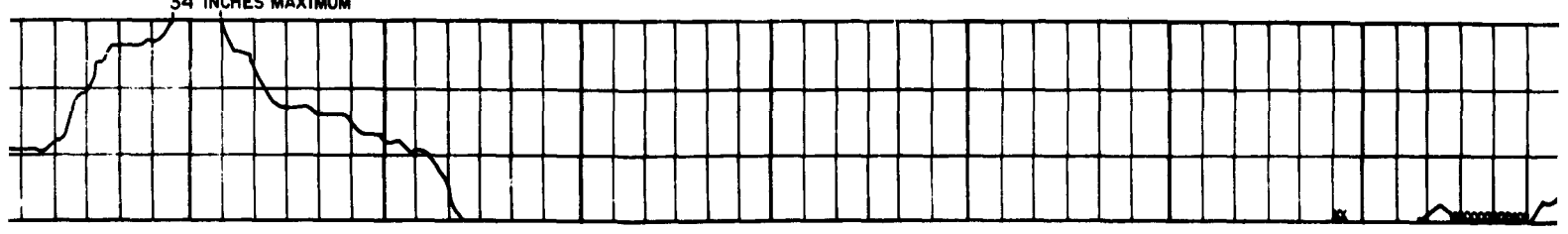
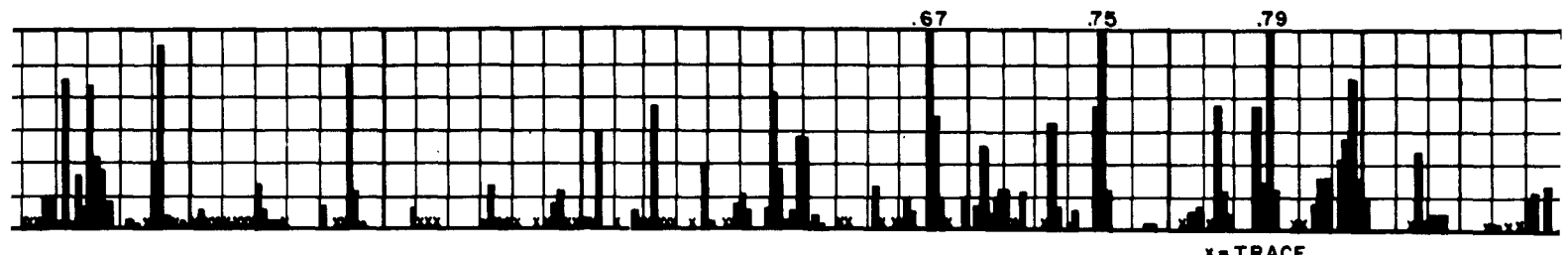
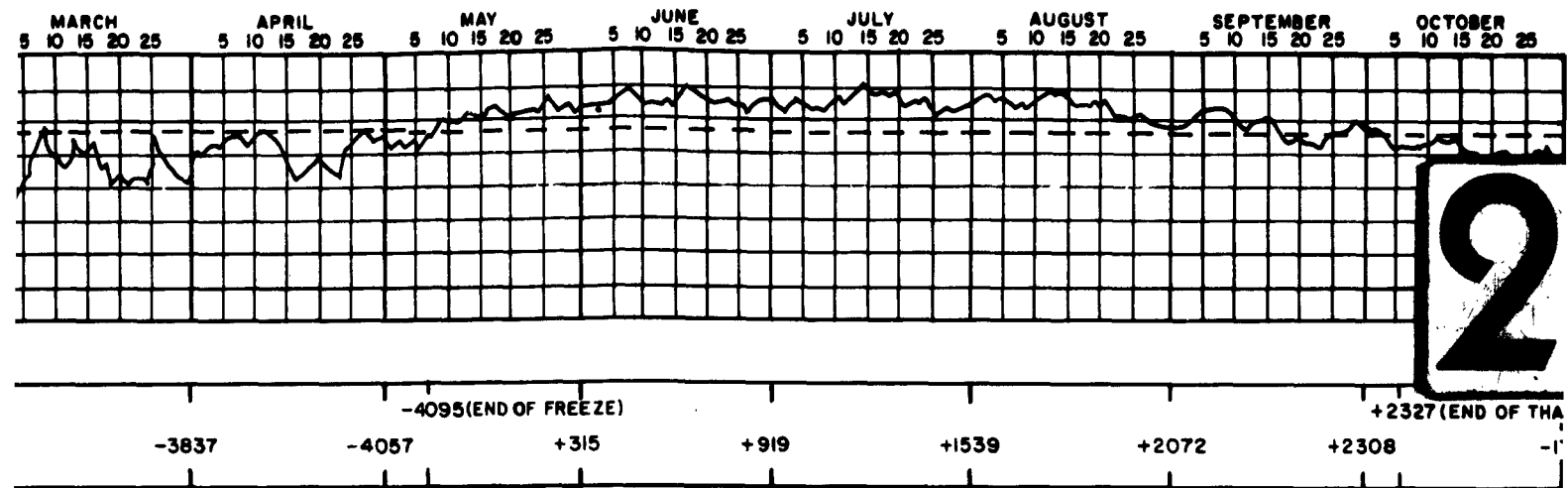


Figure 4. Meteorological Data and Ground Isotherms

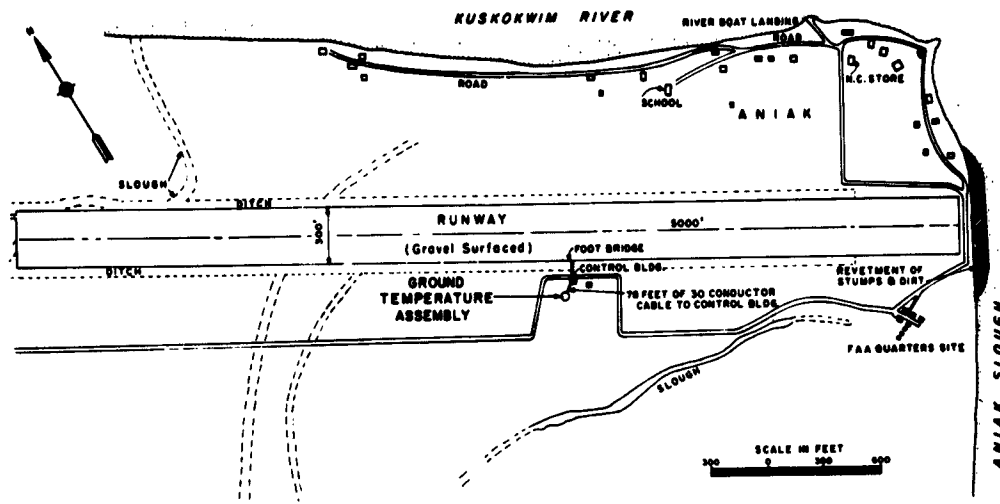


Figure 5. Site location.

GROUND-TEMPERATURE ASSEMBLY

Location

The ground-temperature assembly at Aniak, Alaska, was located 78 feet southwest of the Federal Aviation Agency (FAA) control building and $\frac{1}{4}$ -mile southwest of the Kuskokwim River (Fig. 5).

The location of the temperature assembly in such close proximity to the Kuskokwim River should be considered when interpreting the ground-temperature data as it is possible that ground temperatures will vary considerably as the distance from the river increases.

Drainage and vegetation

The ground-temperature assembly was so located in a low area that all local surface drainage from a northerly direction was directly towards the assembly. The assembly location was covered with approximately 4 feet of water in the spring of 1949 and the spring of 1956. It is quite probable that the area was inundated by lesser amounts of water during the spring thaw periods of other years.

During the observational period the vegetation in the general area consisted of a very heavy growth of 3- to 4-ft-high grass, weeds, and willow brush (Fig. 6).

Drilling the temperature well

The 22.5 ft-deep temperature well was drilled on 23 August 1946. The drilling was completed in one day with no difficulty, using a combination of driving and water jetting.

Instrumentation

The ground-temperature-measuring equipment installed at Aniak consisted of nine copper resistance thermometers (thermohms). Originally the three top thermohms were encased in $\frac{3}{8}$ -in. diam tubing, and the other six thermohms were suspended in a 2-in. diam oil-filled pipe. In July 1950, when the top three thermohms became inoperative because of water freezing in the $\frac{3}{8}$ -in. diam tubing, they were replaced with thermohms placed directly in the ground. The thermohms extended from 0.0 to 22.0 feet below the ground surface, spaced as shown in Figure 7. It should be noted that the 0.0-ft thermohm is actually $\frac{1}{8}$ -in. to $\frac{1}{4}$ -in. below the ground surface.

GROUND TEMPERATURE OBSERVATIONS



Figure 6. Surface cover in area of ground-temperature assembly.

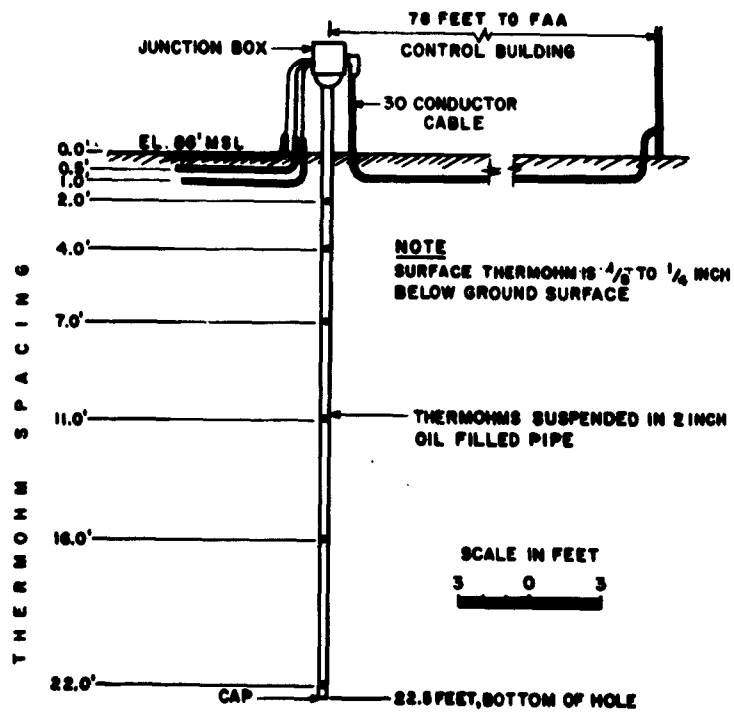


Figure 7. Resistance thermometer installation.

GROUND TEMPERATURE OBSERVATIONS

7

Temperature observations were made with a Leeds and Northrup Model 8015-S temperature indicator; it was a double range, Wheatstone-bridge type with one scale range of -50C to -5C and one of -15C to +30C.

Resistance thermometers were used instead of thermocouples because similar equipment had been used previously by the U. S. Weather Bureau and station personnel were familiar with the observational procedure involved.

SOIL INVESTIGATIONS

Exploration

In conjunction with drilling operations for the temperature well, representative soil samples were obtained with a 1-in. hand auger after each drill run. During a field trip to the site to remove equipment on 18 and 19 July 1958, a 22.5-ft-deep exploratory hole was drilled adjacent to the temperature well. The exploratory drilling was performed by drive sampling with a Chicago-Pneumatic drill rig equipped with a 200-lb drop weight. A 3-in. -diam hardened-steel drive tube was used to obtain continuous soil samples for the full depth of the hole.

Soil data

Laboratory tests were performed to identify and classify the soil samples obtained, with moisture and density tests made on suitable representative samples. The boring log and soil data for the temperature well are shown on Figure 8, and the boring log and soil data for the exploratory hole are shown on Figure 9.

GROUND TEMPERATURES

Observed ground temperatures

Ground temperatures were recorded daily at Aniak for 11 years (1947-1958). The maximum, minimum, and the average of the temperatures recorded the first day of each month are shown in Table II. The actual ground temperatures recorded the first day of each month for the 1947-1958 period of observations are shown in Table III.

Ground-temperature gradients and maximum-minimum curves

Ground-temperature gradients for a typical thaw and freeze season (1952-1953) at Aniak are shown in Figure 10. Gradients were plotted for the end-of-thaw, mid-thaw, and end-of-freeze. The maximum and minimum ground temperatures recorded during the period of record at each depth are also presented.

The end-of-thaw gradient indicates the maximum temperatures recorded at each depth below 4 feet for the 1952 thawing season; the end-of-freeze gradient shows the minimum subsurface temperatures recorded (at depths greater than 4 feet) for the freezing season. It should be noted that the maximum and minimum temperatures shown for the various depths do not represent the 1952-1953 season as do the gradients; rather, they are the maximum and minimum temperatures recorded at each depth during the years 1947 to 1958.

Seasonal frost

The depth of seasonal frost penetration at Aniak varied slightly from year to year; the average seasonal depth of penetration during the period of record (1947-1958) shown by the ground-temperature data was approximately 3.5 feet below the ground surface.

The ground-temperature data obtained at Aniak shows that there is no permafrost at the temperature well location to a depth of 22.5 feet. These data were corroborated by the 22.5-ft-deep holes drilled in August 1946 and July 1958.

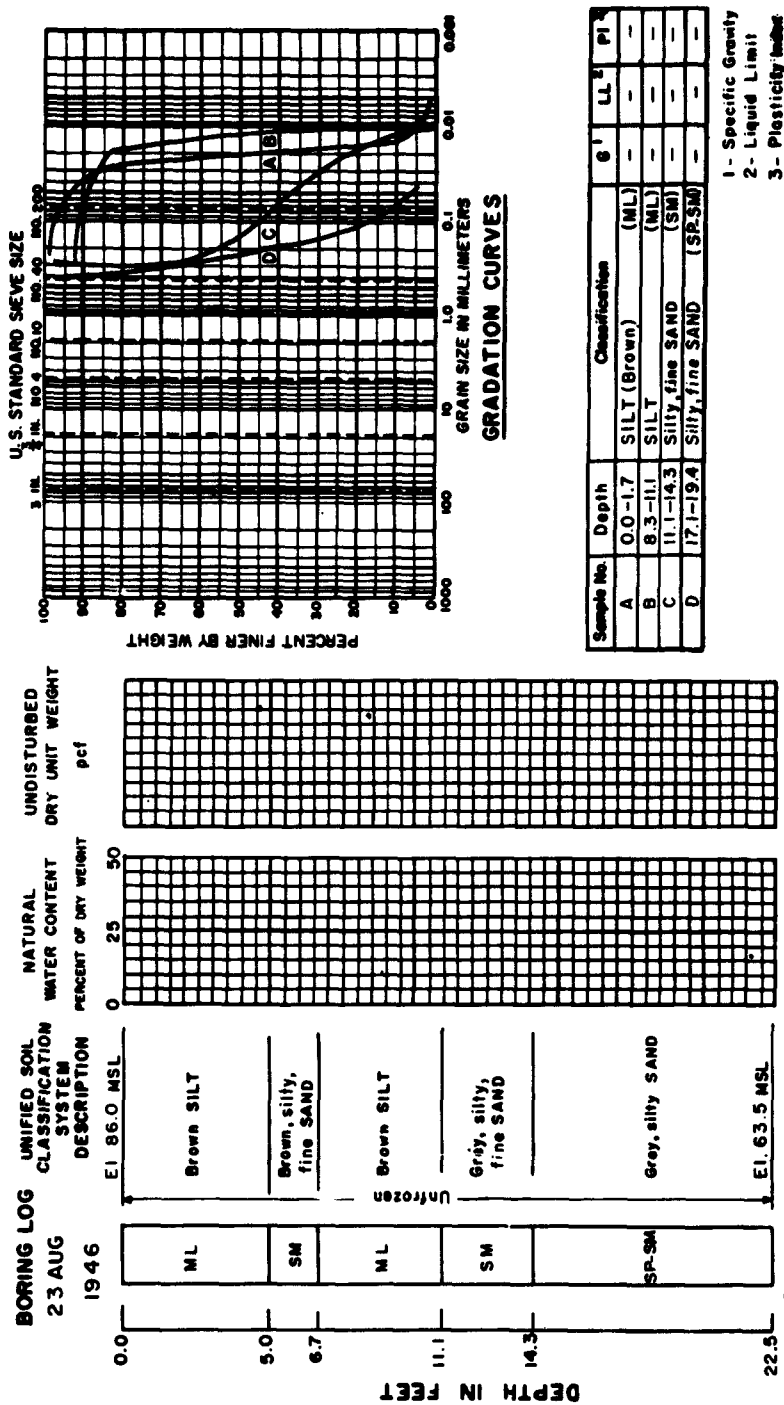


Figure 8. Boring log and soil data, ground-temperature well.

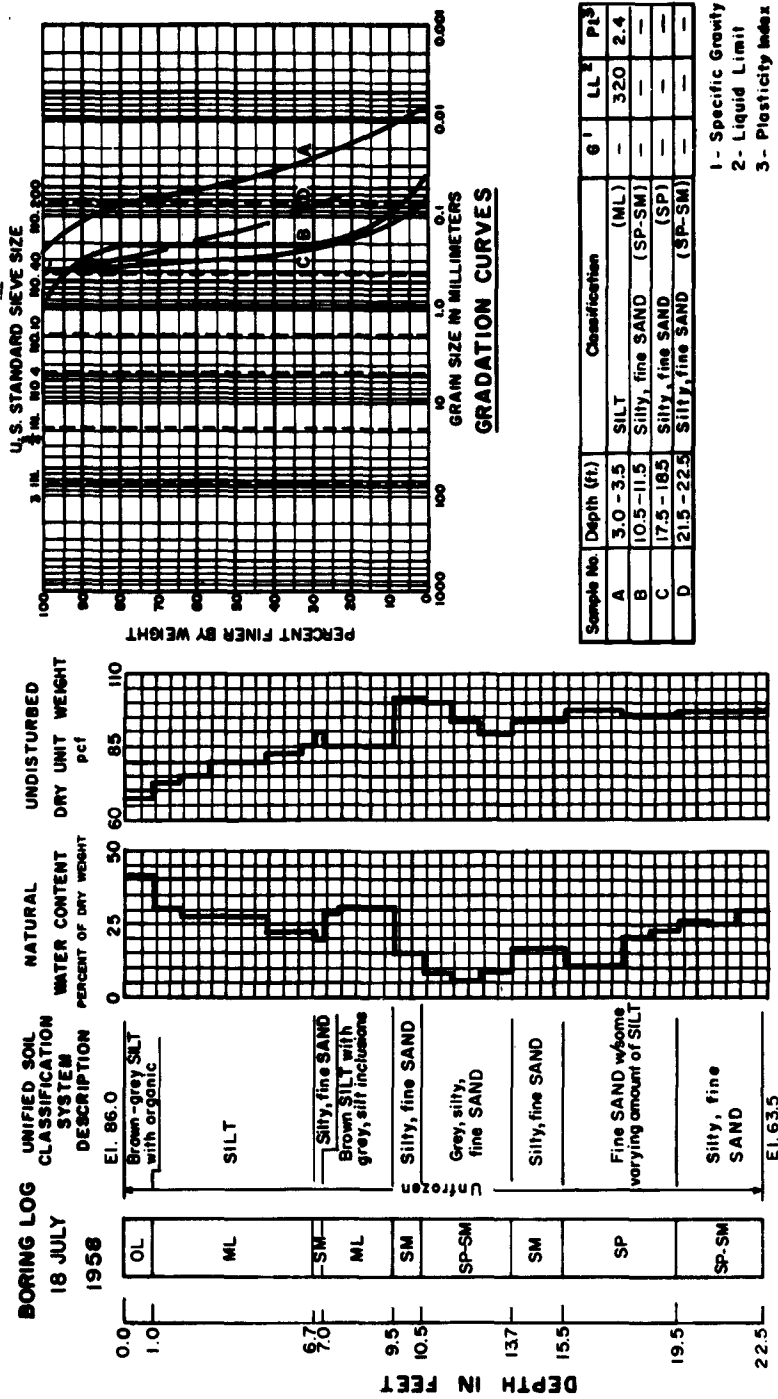


Figure 9. Boring log and soil data, exploratory drilling.

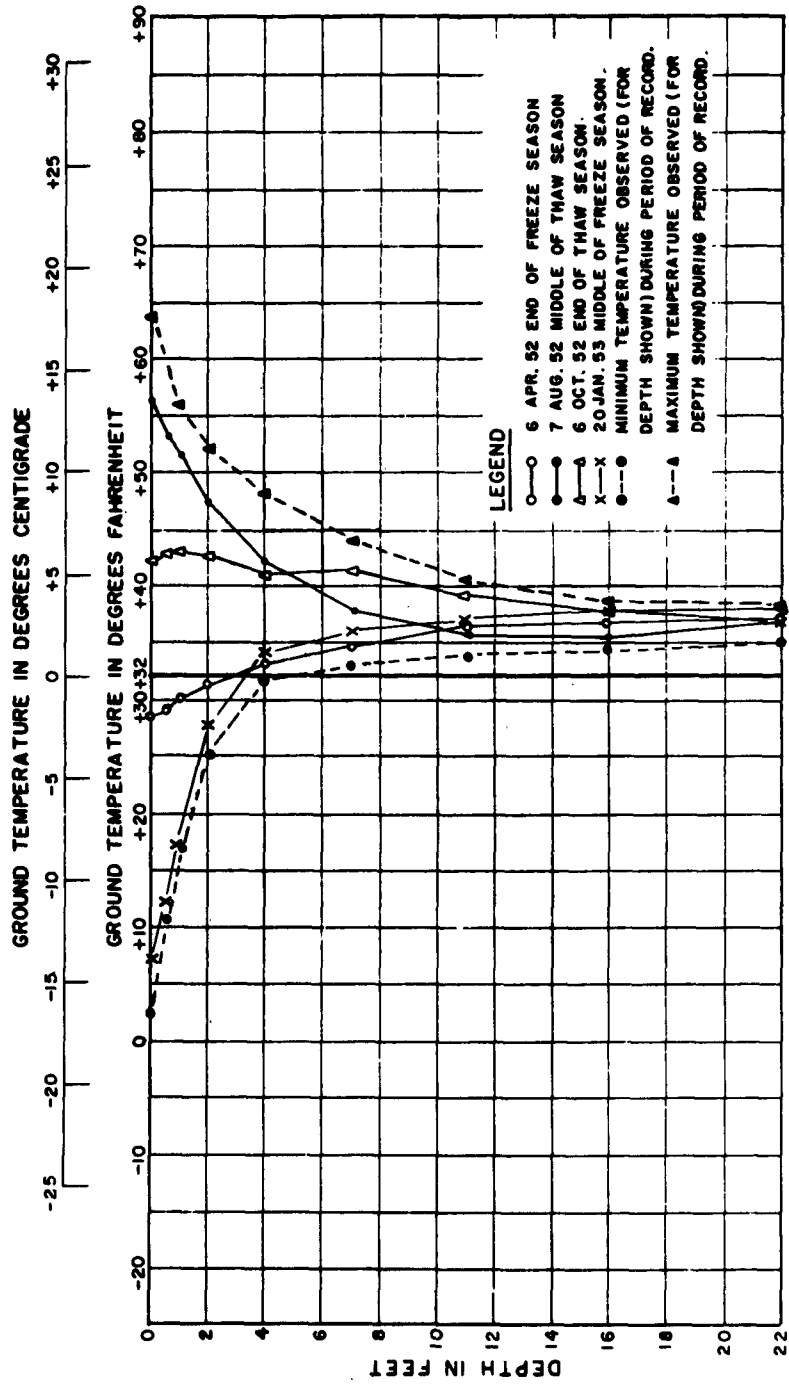


Figure 10. Ground-temperature gradients and maximum-minimum curves.

GROUND TEMPERATURE OBSERVATIONS

Table II. Ground temperatures, °F, maximum, minimum, and average observed first day of month, 1947-1958.

DEPTH IN FEET	MONTH																	
	JAN.			FEB.			MAR.			APR.			MAY			JUN.		
	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
0.0*	30.7	27.7	29.4	29.6	18.7	26.9	31.6	26.2	29.5	31.6	25.2	28.7	36.7	31.6	32.9	58.6	38.8	46.6
0.5	32.4	28.6	30.5	30.7	20.4	27.9	31.6	27.7	29.9	32.0	25.5	29.4	31.8	31.6	31.7	43.2	33.8	38.9
1.0	32.7	25.9	30.8	31.8	22.4	29.4	31.6	23.5	29.5	31.8	26.6	30.2	31.8	30.0	31.5	41.0	33.1	36.4
2.0	32.9	30.0	31.7	32.2	26.0	31.1	32.2	30.0	31.1	32.2	28.2	31.2	37.0	31.3	32.6	40.3	32.6	34.8
4.0	35.8	38.8	34.6	34.5	32.7	33.7	34.7	32.5	33.3	33.6	31.6	32.9	36.1	32.0	33.1	38.8	32.5	33.5
7.0	38.1	36.0	36.8	36.3	35.2	35.8	36.3	33.1	35.0	35.0	32.7	34.4	36.5	32.2	34.7	37.8	32.6	34.2
11.0	39.2	37.0	37.9	38.0	36.3	37.0	37.2	33.8	36.3	36.7	33.6	35.8	40.1	33.4	35.8	37.2	33.2	35.3
16.0	38.5	37.0	37.7	37.8	36.3	37.2	37.8	34.3	36.8	37.4	34.2	36.5	36.5	34.2	36.3	36.7	34.7	36.2
22.0	38.0	36.8	37.5	37.8	36.5	37.5	37.8	35.2	37.3	37.6	36.5	37.1	37.9	35.2	37.0	37.4	35.6	37.0

* SURFACE THERMOHM INSTALLED 1/8 INCH TO 1/4 INCH BELOW SURFACE

DEPTH IN FEET	MONTH																	
	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.		
	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
0.0*	58.8	46.6	52.8	54.0	52.0	52.5	49.1	46.2	47.6	43.2	30.4	36.6	34.5	26.2	30.3	32.0	23.4	28.4
0.5	49.3	45.2	47.6	52.4	49.4	51.6	50.2	48.7	48.9	45.2	36.2	40.1	35.4	32.0	32.9	32.4	29.8	31.2
1.0	50.7	43.7	45.7	52.7	47.8	50.5	52.1	46.9	50.0	45.5	38.8	41.3	36.2	32.9	34.2	32.9	31.3	32.3
2.0	47.8	36.3	41.6	52.3	40.1	47.6	50.7	46.0	48.6	45.1	40.6	42.8	38.1	34.9	35.8	34.7	30.5	32.9
4.0	41.5	33.6	37.0	45.0	33.6	42.8	47.3	41.6	45.6	45.1	41.7	43.7	40.8	37.7	38.9	37.4	34.0	36.0
7.0	36.8	33.4	34.8	39.8	32.0	38.7	42.6	40.8	41.6	43.7	39.6	42.3	42.0	38.3	40.5	39.9	37.7	38.4
11.0	36.0	34.0	35.1	36.7	34.3	35.8	39.4	36.5	37.9	40.6	34.5	39.0	40.1	33.9	39.2	40.1	37.4	38.9
16.0	36.5	34.2	35.7	36.2	34.3	35.7	36.8	34.7	36.0	37.8	36.0	37.0	38.5	36.5	37.8	38.5	36.8	37.8
22.0	37.7	35.4	36.8	37.2	35.0	36.6	37.2	35.6	36.4	37.2	35.6	36.6	37.8	36.2	37.0	37.8	36.3	37.2

GROUND TEMPERATURE OBSERVATIONS

DEPTH IN FEET		1947													
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
0.0	-	31.6	27.7	31.8	58.6	58.8	52.9	48.6	30.4	-	-	-	-	-	-
0.5	-	31.6	29.1	31.6	42.1	49.3	52.3	48.7	36.3	32.9	32.4	-	-	-	-
1.0	-	31.6	30.4	31.6	34.7	47.3	52.7	49.4	39.8	34.3	33.3	-	-	-	-
2.0	-	32.0	30.5	32.0	35.0	43.3	52.3	49.8	40.6	31.9	33.6	-	-	-	-
4.0	-	32.2	32.4	32.2	32.7	37.9	46.9	47.5	42.6	37.7	35.8	-	-	-	-
7.0	-	33.1	32.7	32.9	33.1	34.2	48.4	42.4	42.1	39.6	37.7	-	-	-	-
11.0	-	33.8	33.6	33.4	34.0	34.0	35.4	38.0	38.8	38.8	38.0	-	-	-	-
16.0	-	34.3	34.2	34.2	34.7	34.2	34.3	35.4	36.0	36.5	36.9	-	-	-	-
22.0	-	35.2	35.2	35.2	35.6	35.4	35.0	35.6	35.6	36.2	36.3	-	-	-	-

DEPTH IN FEET		1948													
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.5	32.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0	32.7	-	-	-	30.0	35.4	-	-	-	-	-	-	-	-	-
2.0	32.9	32.2	31.5	32.0	31.8	35.8	47.8	48.6	45.0	40.6	35.2	30.5	-	-	-
4.0	35.0	33.8	33.4	33.1	32.9	33.8	41.5	44.6	45.0	41.7	37.7	35.4	-	-	-
7.0	36.7	35.8	35.0	34.2	34.0	34.5	36.5	39.4	41.4	41.4	39.2	37.6	-	-	-
11.0	37.4	36.3	36.2	35.4	35.0	36.0	35.6	36.5	37.8	38.8	39.0	38.5	-	-	-
16.0	37.0	36.3	36.5	36.0	35.8	36.5	35.8	36.0	36.0	37.0	37.8	37.6	-	-	-
22.0	36.8	36.5	36.8	36.7	36.5	37.2	37.2	36.8	36.7	37.0	37.4	37.6	-	-	-

DEPTH IN FEET		1949													
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	30.2	32.2	32.2	32.2	32.2	40.5	50.0	49.3	45.1	36.2	32.7	-	-	-	-
4.0	33.8	33.6	33.1	33.4	32.7	36.5	44.3	46.0	45.1	39.6	36.5	-	-	-	-
7.0	36.2	35.4	34.9	34.7	34.2	35.0	38.3	41.4	42.8	41.0	39.0	-	-	-	-
11.0	37.2	36.5	36.1	36.0	35.2	35.9	36.0	39.4	39.0	40.1	39.4	-	-	-	-
16.0	37.2	37.0	36.8	36.8	36.3	36.5	36.1	36.0	36.8	37.7	38.0	-	-	-	-
22.0	34.4	37.6	37.6	37.6	37.4	37.7	37.2	36.7	36.7	36.5	37.0	37.2	-	-	-

DEPTH IN FEET		1950													
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
0.0	-	-	-	-	-	-	-	54.0	46.2	43.2	26.2	-	-	-	-
0.5	-	-	-	-	-	-	-	51.4	50.2	44.2	32.4	-	-	-	-
1.0	-	-	-	-	-	-	-	51.8	51.2	44.6	33.8	-	-	-	-
2.0	32.2	32.0	31.5	31.5	32.4	33.8	43.5	49.3	50.2	45.0	34.9	-	-	-	-
4.0	34.9	34.0	33.8	33.2	33.1	33.1	37.6	44.6	47.3	45.0	39.0	-	-	-	-
7.0	36.7	35.8	35.6	35.0	34.2	34.2	34.7	39.6	42.6	43.2	41.4	-	-	-	-
11.0	38.1	37.4	36.7	36.2	36.0	35.2	35.4	36.7	38.8	40.1	33.9	-	-	-	-
16.0	37.9	37.4	37.4	37.0	36.5	36.7	36.2	36.2	36.8	37.6	38.5	-	-	-	-
22.0	37.6	37.4	37.8	37.6	37.2	37.4	37.2	36.8	37.2	37.2	37.4	-	-	-	-

Table III. Ground temperatures, ° F recorded,
first day of month, 1947-1958.

GROUND TEMPERATURE OBSERVATIONS

DEPTH IN FEET	1952											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	30.7	29.3	31.6	28.8	31.6	47.3	53.4	50.7	48.2	36.7	30.5	23.4
0.5	30.9	29.8	31.3	29.6	31.6	33.8	45.7	49.4	48.9	40.6	32.7	30.9
1.0	31.1	30.0	30.9	30.5	31.6	31.8	43.0	48.9	48.9	42.0	33.8	32.7
2.0	32.7	31.3	31.6	31.5	31.6	32.6	36.3	46.0	46.9	42.6	36.0	32.6
4.0	34.7	33.8	33.4	33.2	32.7	32.6	33.6	41.6	42.9	39.0	36.5	
7.0	37.0	35.8	35.0	34.7	34.3	32.6	33.6	37.0	40.8	41.6	40.5	38.6
11.0	37.8	36.8	36.5	36.2	35.8	33.2	34.5	35.2	37.6	39.0	39.6	39.2
16.0	37.8	37.4	37.0	36.8	36.5	36.3	35.2	35.4	36.0	36.8	37.8	38.0
22.0	37.4	37.8	37.6	37.6	37.4	37.2	36.8	36.8	36.7	36.7	37.2	37.4

DEPTH IN FEET	1951											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	27.7	28.0	28.6	28.0	33.8	-	-	-	-	32.0	32.4	27.3
0.5	28.6	28.4	29.1	28.8	31.8	43.2	48.9	-	-	36.2	32.0	29.8
1.0	29.6	29.1	29.8	29.3	31.8	39.9	46.0	49.6	-	39.0	33.1	32.4
2.0	31.1	30.5	30.7	30.9	32.0	35.2	40.1	46.0	49.8	42.8	36.5	32.5
4.0	34.3	33.4	33.1	32.5	32.7	32.9	34.9	41.9	46.0	44.4	38.8	36.0
7.0	37.0	35.8	35.0	34.5	34.2	33.8	33.8	37.0	41.0	42.8	41.0	38.3
11.0	38.5	37.4	36.7	35.8	35.2	35.0	35.4	37.4	39.6	40.3	36.8	
16.0	38.1	37.6	37.2	36.7	36.0	36.3	36.0	36.0	36.0	37.2	38.5	38.0
22.0	37.6	37.8	37.4	36.5	37.6	37.2	37.0	36.7	36.7	36.8	37.8	37.6

DEPTH IN FEET	1954											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	30.5	29.1	26.2	31.6	31.6	46.0	53.0	52.9	49.1	43.0	34.5	32.0
0.5	31.1	30.0	27.7	32.0	31.6	39.2	48.6	51.8	49.8	45.2	35.4	31.5
1.0	31.8	30.9	29.0	31.6	31.3	36.7	45.0	50.4	50.5	45.5	36.2	31.6
2.0	31.5	30.5	30.2	31.6	31.3	33.8	37.0	46.0	48.2	44.2	37.4	34.2
4.0	34.2	33.2	34.5	32.9	32.0	32.5	33.6	41.2	45.0	43.9	39.6	36.5
7.0	36.0	35.2	36.3	33.4	32.2	32.9	33.4	37.0	41.0	42.2	41.0	38.5
11.0	37.0	36.3	36.0	35.4	33.8	34.7	34.3	35.2	36.8	39.4	39.8	39.2
16.0	37.0	36.7	36.7	36.3	35.0	35.6	35.4	35.4	36.0	36.7	37.8	38.0
22.0	37.2	37.0	37.4	37.0	36.7	36.5	36.5	36.3	36.5	36.5	36.8	37.2

DEPTH IN FEET	1953											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	27.9	28.7	28.0	25.2	36.7	42.5	52.2	52.0	47.3	34.5	27.9	30.7
0.5	29.3	20.4	28.2	25.5	31.8	39.6	48.2	49.6	49.3	38.3	32.0	31.3
1.0	30.9	22.4	28.6	26.6	31.8	37.4	44.0	47.8	49.3	40.1	32.9	31.3
2.0	31.4	26.0	30.0	28.2	31.6	33.1	-	40.1	49.3	41.4	34.5	33.2
4.0	34.7	32.7	32.4	31.6	32.2	-	33.6	41.6	41.7	37.6	34.0	
7.0	36.8	35.6	34.3	34.2	33.8	33.6	-	32.0	41.4	39.6	38.3	37.0
11.0	38.0	37.2	36.5	35.8	35.0	35.4	34.7	34.3	36.5	34.5	31.1	37.4
16.0	37.8	37.4	37.2	36.7	36.3	36.3	35.6	35.8	34.7	36.2	36.5	36.8
22.0	37.6	37.6	37.6	37.4	37.2	37.2	36.7	37.0	35.8	36.5	36.5	36.8

Table III. (Cont'd)

GROUND TEMPERATURE OBSERVATIONS

DEPTH IN FEET	1956											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	-	-	-	-	-	-	-	-	-	-	-	-
0.5	-	-	-	-	-	-	-	-	-	-	-	-
1.0	-	-	-	-	-	-	-	-	-	-	-	-
2.0	32.0	31.8	31.5	31.8	31.0	30.3	29.1	28.0	27.0	26.0	25.0	24.6
4.0	34.5	34.0	33.4	33.2	32.3	31.8	30.5	29.8	28.8	27.9	27.0	26.6
7.0	36.7	35.8	35.2	34.7	34.5	33.8	32.8	31.8	30.8	29.8	28.8	28.6
11.0	37.8	36.8	36.5	36.2	36.5	37.2	36.0	36.7	36.5	36.0	35.1	34.9
16.0	37.6	37.2	37.0	36.8	35.8	36.3	36.0	36.2	36.3	37.4	38.0	38.3
22.0	37.4	37.4	37.6	37.4	37.0	36.7	36.7	36.7	37.3	36.0	36.5	37.4

DEPTH IN FEET	1958											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	-	-	-	-	-	-	-	-	-	-	-	-
0.5	-	-	-	-	-	-	-	-	-	-	-	-
1.0	32.2	30.5	30.9	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8	31.8
2.0	32.1	32.2	32.0	32.0	31.8	33.1	34.2	34.2	34.2	34.2	34.2	34.2
4.0	35.3	34.5	33.8	33.6	32.2	33.3	32.6	32.6	32.6	32.6	32.6	32.6
7.0	38.1	36.3	35.6	35.2	35.0	34.5	34.4	34.4	34.4	34.4	34.4	34.4
11.0	39.2	38.0	37.2	36.7	36.3	35.8	35.6	35.6	35.6	35.6	35.6	35.6
16.0	38.5	37.9	37.8	37.4	36.8	36.3	36.1	36.1	36.1	36.1	36.1	36.1
22.0	38.0	37.8	37.8	37.6	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4

DEPTH IN FEET	1955											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	30.0	29.6	31.1	30.7	31.8	38.8	46.6	52.5	46.6	-	-	-
0.5	30.9	30.7	31.3	31.3	31.6	35.4	45.2	52.4	46.8	-	-	-
1.0	32.0	31.8	31.6	31.6	31.8	33.1	43.9	51.4	46.9	-	-	-
2.0	32.3	31.9	31.8	31.6	32.0	33.8	47.1	46.0	43.9	35.0	32.9	32.9
4.0	35.0	34.2	33.9	33.2	33.1	33.4	34.5	42.5	44.6	43.7	38.6	36.0
7.0	37.0	36.0	35.4	34.9	34.7	35.0	34.5	37.6	41.0	42.0	40.5	38.1
11.0	38.1	37.2	36.7	36.3	35.8	36.3	35.4	35.2	37.8	39.4	39.8	36.6
16.0	37.6	37.4	37.0	36.9	36.5	36.5	36.2	36.0	36.3	37.2	38.0	37.8
22.0	37.4	37.6	37.6	37.4	37.2	37.2	36.8	36.7	36.7	36.8	37.2	37.2

DEPTH IN FEET	1957											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	-	-	-	-	-	-	-	-	-	-	-	-
0.5	-	-	-	-	-	-	-	-	-	-	-	-
1.0	25.9	30.9	23.5	29.8	31.8	41.0	50.7	50.7	52.1	38.8	35.4	32.9
2.0	30.0	31.6	28.2	30.9	34.9	36.2	45.3	48.6	50.7	42.6	38.1	34.7
4.0	34.2	33.4	32.5	32.7	35.8	33.8	39.2	44.4	47.5	45.1	40.8	37.4
7.0	36.9	35.8	34.9	34.5	40.3	34.5	35.2	39.4	42.2	44.0	42.1	39.9
11.0	38.3	37.4	36.5	36.0	40.8	35.8	35.2	36.7	38.8	40.6	41.0	40.1
16.0	38.1	37.4	37.0	36.7	39.6	36.3	35.6	35.2	36.7	37.8	38.5	38.5
22.0	37.8	37.8	37.6	37.4	37.0	36.9	36.3	36.2	36.0	36.9	37.2	37.4

Table III. (Cont'd)

Seasonal freezing varied slightly from year to year; the average seasonal depth of freeze was approximately 3.5 ft below the ground surface. The data show that there is no permafrost at the temperature-well location to a depth of 22.5 ft.

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