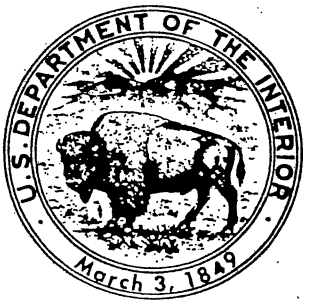
# GEOHYDROLOGY OF THE DELTA-CLEARWATER AREA, ALASKA

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS 80-92

PREPARED IN COOPERATION WITH THE
ALASKA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FOREST, LAND, AND WATER MANAGEMENT



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The Delta Agricultural Project is developing more than 93 square miles of land in the study area. The alluvial aquifer there consists of lenticular, interbedded deposits of silt, sand, and gravel. Ground water is both confined and unconfined. The potentiometric surface slopes approximately north at [redacted] about 1 to 25 feet per mile. Well yields are as high as 1,500 gallons per minute from a well at Fort Greely. Water discharges from the aquifer into the Clearwater Creek network and Clearwater Lake, the mouth of the Delta River, and the Tanana River along the study area's northern boundary. From May 1977 to July 1979 flow at a gaging station on spring-fed Clearwater Creek ranged from 650 to 773 cubic feet per second. Average annual ground-water discharge is estimated at more than 1,200 cubic feet per second. The aquifer is recharged by seepage through [redacted] streambeds and by infiltration of precipitation. Hydrographs from observation wells reflect seasonal recharge pulses. Additional work is required to verify the following hypothesis: Losses from the Gerstle River, several small creeks draining the Alaska Range, and the Tanana River east of Clearwater Creek recharge the sections of the aquifer that discharge at the Clearwater Creek network. Losses from the Delta River and Jarvis Creek are the main sources of recharge to the sections of the aquifer that discharge near Clearwater Lake and Big Delta.

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By Dorothy E. Wilcox

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DIVISION OF FOREST, LAND, AND WATER MANAGEMENT

Anchorage, Alaska
1980

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

H. William Menard, Director

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For additional information write to:

U.S. Geological Survey
Water Resources Division
733 West 4th Avenue, Suite 400
Anchorage, Alaska 99501

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## CONVERSION TABLE

| Multiply | By | To obtain |
|---|---|---|
| inch (in.) | 25.40 | millimeter (mm) |
| foot (ft) | 0.3048 | meter (m) |
| mile (mi) | 1.609 | kilometer (km) |
| square mile ($mi^2$) | 2.590 | square kilometer ($km^2$) |
| feet per year (ft/yr) | 0.3048 | meters per year (m/yr) |
| cubic feet per second ($ft^3/s$) | 0.02832 | cubic meters per second ($m^3/s$) |
| gallons per minute (gal/min) | 0.06309 | liters per second (L/s) |
| cubic feet per day per square foot of channel area | 0.3048 | cubic meters per day per square meter of channel area |
| feet per mile (ft/mi) | 0.1894 | meters per kilometer (m/km) |
| degrees Fahrenheit (°F) | (°F-32)0.555 | degrees Celsius (°C) |

# GEOHYDROLOGY OF THE DELTA-CLEARWATER AREA, ALASKA

By D. E. Wilcox

## ABSTRACT

The Delta Agricultural Project is developing more than 93 square miles of land in the Delta-Clearwater area. Geohydrologic information can help planners, farmers, and environmentalists evaluate ground-water supplies and potential effects of development on ground and surface water.

The alluvial aquifer system underlying the Delta-Clearwater area is composed of lenticular, interbedded deposits of silt, sand, and gravel. Ground water here occurs under both confined and unconfined conditions. The potentiometric surface across the area slopes approximately northward at gradients ranging from about 1 to 25 feet per mile. Well yields are as high as 1,500 gallons per minute from a well at Fort Greely. Water discharges from the alluvial aquifer into the Clearwater Creek network and Clearwater Lake, into the mouth of the Delta River, and into the Tanana River along the northern boundary of the study area. The discharge rate from the aquifer shows little variation; from May 1977 to July 1979 flow at a gaging station on spring-fed Clearwater Creek ranged from 650 to 773 cubic feet per second. Average annual ground-water discharge is estimated to be greater than 1,200 cubic feet per second. The aquifer is recharged by seepage through the streambeds of rivers and creeks in the area and by infiltration of precipitation. Reaches of many rivers and creeks are perched above the aquifer and lose water to it. Hydrographs from observation wells in the area reflect seasonal recharge pulses.

The following ground-water flow system is hypothesized: Losses from the Gerstle River, losses from several small creeks draining the Alaska Range, and losses from the Tanana River east of Clearwater Creek recharge the sections of the aquifer that discharge at the Clearwater Creek network. Losses from the Delta River and Jarvis Creek are the main sources of recharge to the sections of the aquifer that discharge in the vicinities of Clearwater Lake and Big Delta. Additional work is needed to verify these hypotheses.

## INTRODUCTION

The State of Alaska is conducting a development program, the Delta Agricultural Project (locally known as the Delta Barley Project), in the Delta-Clearwater area (fig. 1). Agricultural rights to more than 93 $mi^2$ of land were sold to farmers in 1978, clearing of the land was scheduled for completion by 1980, and the first crops were produced in 1979. The Barley Project area was largely undisturbed prior to this agricultural development program. Development will include stripping and burning of the native vegetation; introducing non-native crops; cultivating large areas of previously untilled land; applying agrichemicals to the land surface; and irrigating the land. The hydrology of the Delta-Clearwater area is an important consideration in this program because spring-fed creeks that are valuable recreation and salmon-spawning sites lie downslope from the agricultural development. The potential effects of agricultural activities on ground- and surface-water quality and flow are of interest to residents, planners and developers.

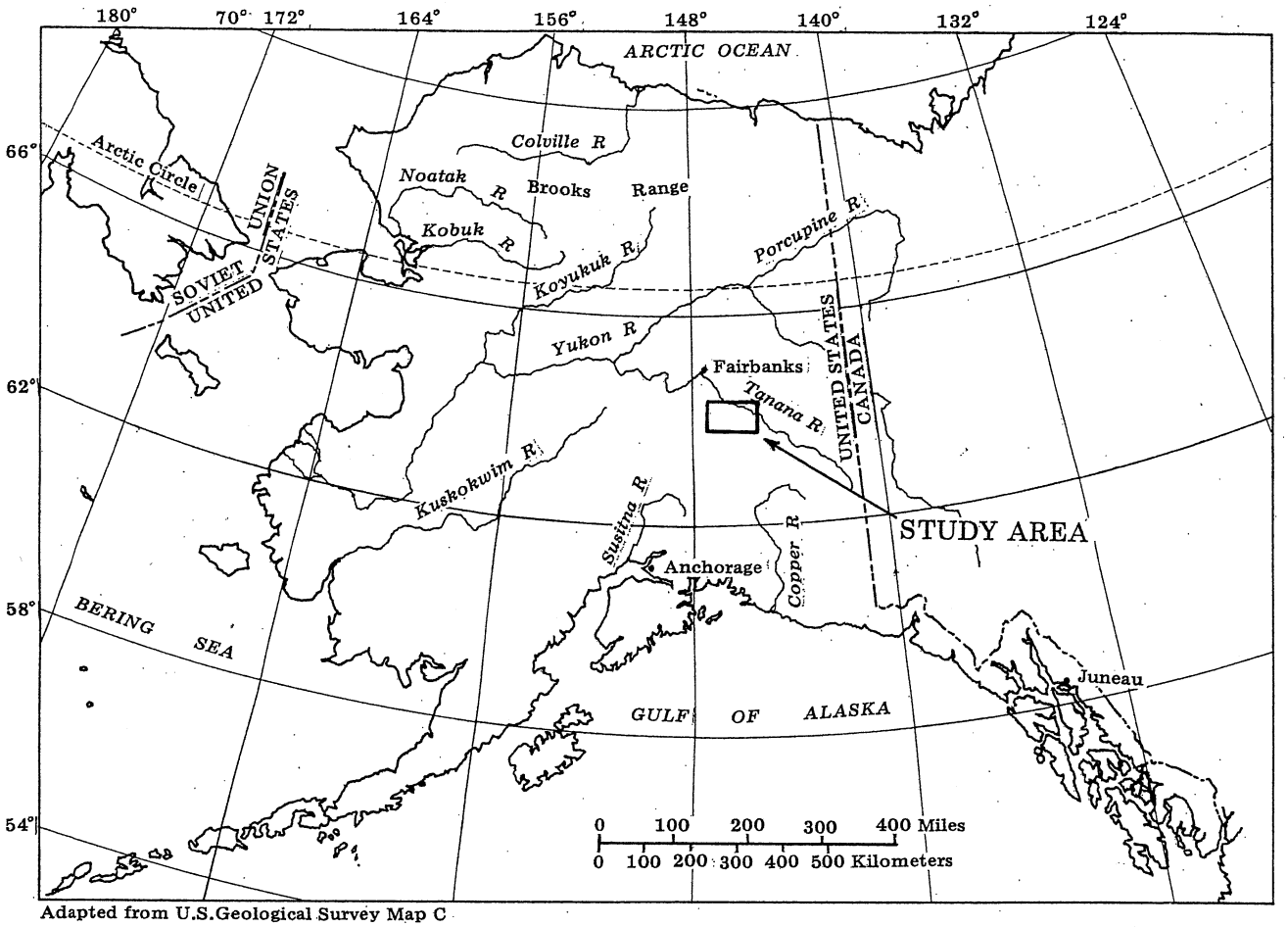
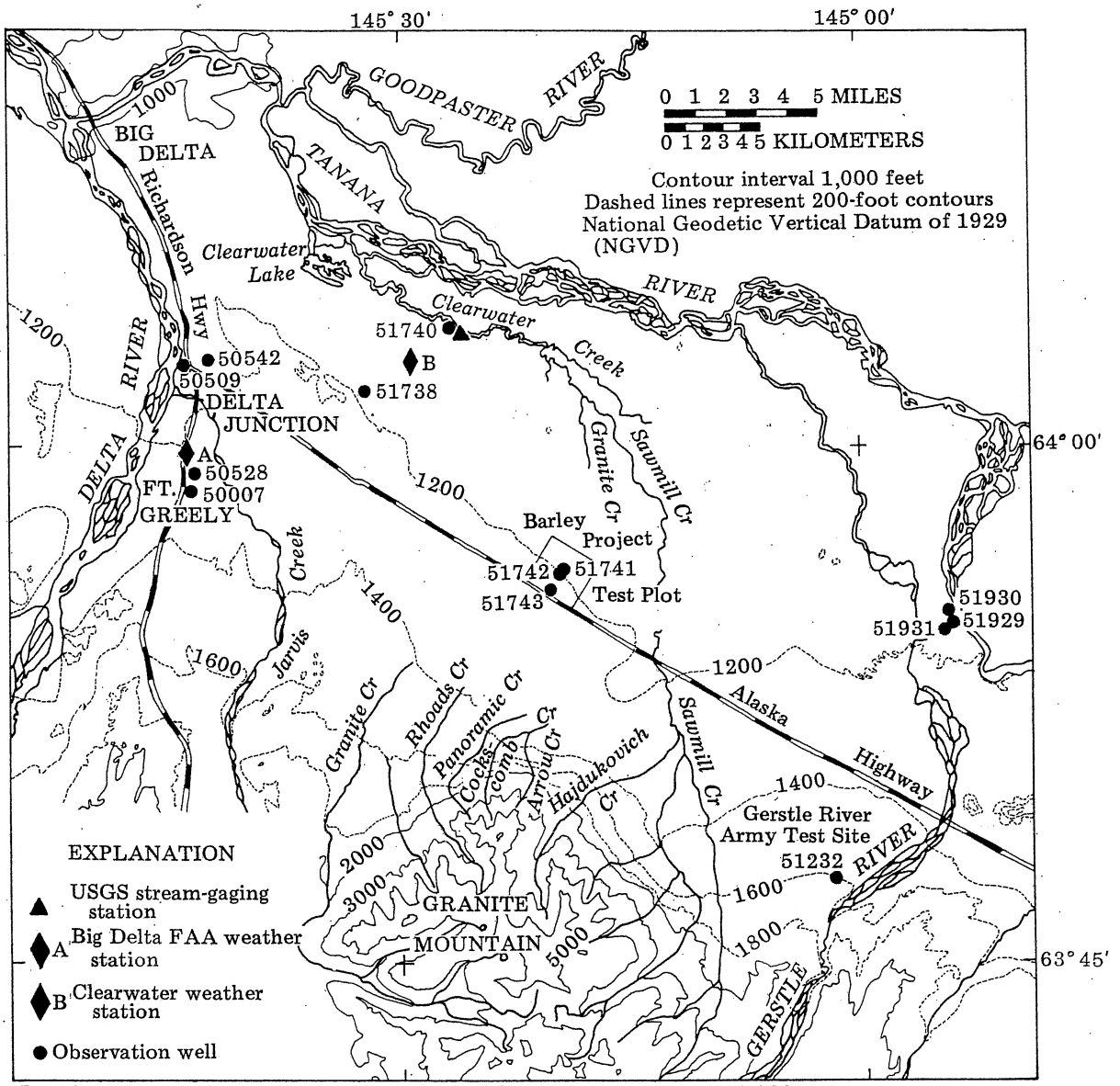



Figure 1.--Location of the Delta-Clearwater study area.

The purposes of this study are to provide baseline hydrologic data and a geohydrologic interpretation for use in evaluating environmental changes in the Delta-Clearwater area that may be caused by agricultural development of the Delta Barley Project. Data are sparse in the interior of the study area, so the approach to the geohydrology was one of an investigation of boundary values, including aquifer properties, recharge, and discharge. Field observations summarized in this report were made from May 1977 through the summer of 1979.

The Delta-Clearwater area is bounded by the Gerstle, Delta, and Tanana Rivers and the north slope of the Alaska Range (fig. 2). It covers approximately 400 $mi^2$ and slopes gently northward from the base of the Alaska Range to the Tanana River. The peaks in the Alaska Range directly south of the area range from about 4,000 to 5,500 ft above the National Geodetic Vertical Datum of 1929 (NGVD). The lowest point in the study area is at the mouth of the Delta River, at approximately 1,000 ft above NGVD.

This report is a product of a cooperative water-resources investigation of the U.S. Geological Survey and the Alaska Department of Natural Resources. The author thanks Del Ivester and Earl Vegoren of Fort Greely, Lee Spears, Jim Harding, Mr. and Mrs. Norman Cosgrove, and Dean Cummings for access to water wells and other data-collection sites on their premises or under their authority.



Base from U.S. Geological Survey Mt. Hayes and Big Delta, Alaska, 1:250,000

Figure 2.--Physical features and hydrologic stations in the Delta-Clearwater study area.

## Previous Work

Péwé (1955) discussed the springs near Big Delta and the slope of the water table beneath the outwash plain. Holmes and Benninghoff (1957) prepared a terrain study of the Army test area at Fort Greely, which included permafrost, groundwater, and climatological data from the area and discharge data from Jarvis Creek. Data on ground water, surface water, water quality, and soils in the vicinity of Fort Greely were included in a report by the U.S. Army Corps of Engineers (1959). Waller, Feulner, and Tisdel (1961) mapped the potentiometric surface in the vicinity of Fort Greely. Reports by Waller and Tolen (1962a, 1962b) contain data on wells and springs along the Alaska and Richardson Highways. Péwé and Holmes (1964) published a geologic map of the Mount Hayes D-4 quadrangle which included some well data. The U.S. Geological Survey inventoried wells in the Big Delta, Delta Junction, and surrounding areas in 1965; these data are currently on file at

the Geological Survey office in Fairbanks. Anderson (1970) authored a report on general hydrologic conditions in the Tanana basin. Williams (1970) discussed ground water, wells, and permafrost of the Delta area. Dingman and others (1971) made a hydrologic reconnaissance of the Delta River and its drainage basin. In 1972, the Tanana Valley Irrigation Study team reported on irrigation potential of the Tanana Valley. Pease (1974) collected some water-quality data and made a discharge measurement on Clearwater Creek.

## Climate

The Big Delta Federal Aviation Administration (FAA) station has monitored local temperature and precipitation since 1942; the Clearwater station has been recording data since 1964 (fig. 2). Three additional meteorological stations have been recording data since the beginning of the Delta Barley Project in 1977. Graphs of monthly precipitation and average monthly temperature at the Big Delta station are shown in figures 3 and 4 for the years 1974-79 (National Oceanic and Atmospheric Administration, 1974-1979). The "normal" yearly average temperature and total precipitation at the Big Delta station are 27.4°F and 11.4 in., respectively. Precipitation was 0.33 in. greater than normal in 1977 and 3.12 in. less than normal in 1978.

## GEOLOGY

Crystalline bedrock in most of the Delta-Clearwater area is overlain by thick sediments, including silt, sand, and gravel. Granodiorites and quartz monzonites are exposed on Granite Mountain in the southern part of the area. These rocks are in instrusive contact with pelitic schist south and west of the area (Holmes and Péwé, 1965).

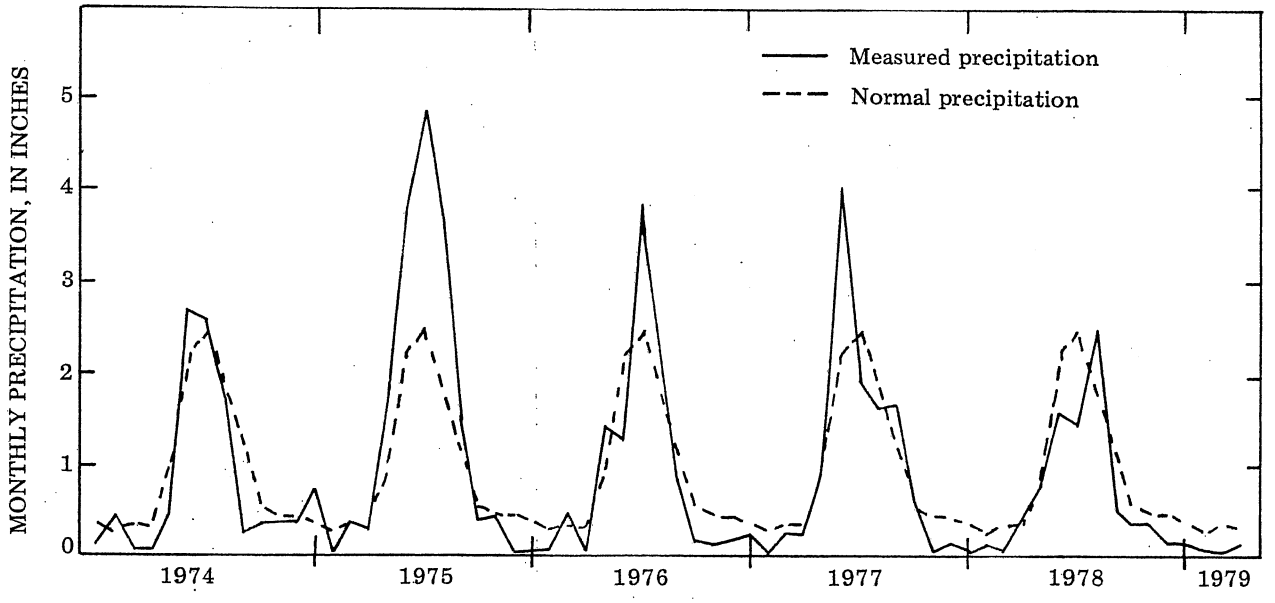



Figure 3.--Comparison of measured monthly precipitation with normal monthly precipitation at Big Delta. Climatological normals based on the period 1941-70 (National Oceanic and Atmospheric Administration, National Climatic Center, 1977).