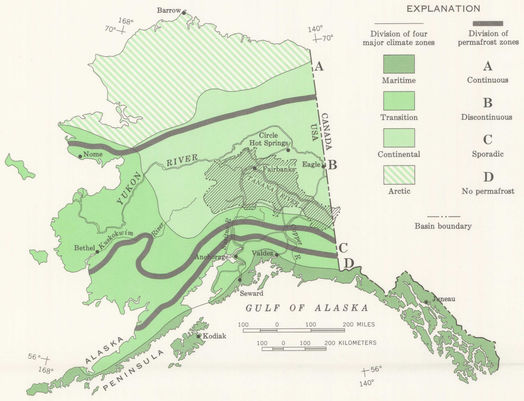
PHYSICAL SETTING



LOCATION OF TANANA BASIN ALASKA WITH RESPECT TO GEOGRAPHY, CLIMATIC ZONES, AND PERMAFROST ZONES
(Permafrost zones after Hopkins, Karlstrom and others, 1955)

INTRODUCTION

The Tanana basin in interior Alaska covers approximately 44,500 square miles with 576 square miles of its headwaters in Canada (see location map). It is traversed by major highways, air routes, waterways of the Yukon River basin, and The Alaska Railroad. The largest city is Fairbanks, population 16,758 (1964 census), (see principal map). Fairbanks, the second largest city in Alaska, is the primary trade and transportation center for interior and arctic Alaska. Scattered throughout the basin are many military installations and smaller settlements. The total population of the basin is approximately 50,000.

This report is intended to define in broad terms the hydrology of the Tanana basin. Although basic data are limited, sufficient information is available to formulate a framework for further collection of basic data, preliminary development planning, and identification of problems.

The early economic development of the Tanana basin was stimulated by the discovery of placer gold in 1902. Various mining activities flourished throughout the basin during the early 1900's, reached peak production in 1940, and decreased to a low level by 1960. Beginning with World War II, military activities have dominated the basin economy with lesser contributions from agriculture, mining, tourism, the University of Alaska, trade and services.

The first demands for surface-water information were stimulated by the placer mining operations in the early 1900's. The U. S. Geological Survey conducted a general survey of surface-water supplies of the Yukon-Tanana region from 1907 to 1912 (Ellsworth and Davenport, 1915). In 1947, the U. S. Geological Survey began a systematic stream-gaging program for south-central Alaska, including the Tanana River basin, and a study of ground water in the Fairbanks area (Cederstrom, 1963). The first comprehensive report on surface water of the basin was prepared by the U. S. Army Corps of Engineers in 1951. Since statehood in 1959, a growing effort has been made by Alaska's scientific community to evaluate the State's water resources (Waananen, 1964).

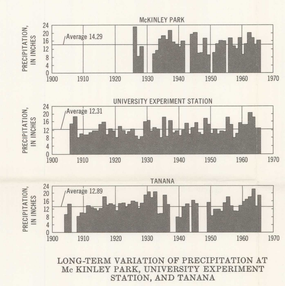
CLIMATE

The Tanana basin has a continental climate characterized by cold, dry winters and warm but relatively moist summers. Temperatures range from −76°F. to +100°F. Mean yearly temperatures in the basin range from 21.7°F. at Northway to 27.5°F. at Big Delta; mean daily maximum temperatures for the warmest month, July, range from 69.3°F. at Summit to 71.7°F. at Nenana and the University Experiment Station, and mean daily minimum temperatures for the coldest month, January, range from −27.2°F. at Northway to −4.3°F. at Summit. Graphs of mean daily maximum and minimum temperature for 10 stations in the basin are illustrated on the principal map.

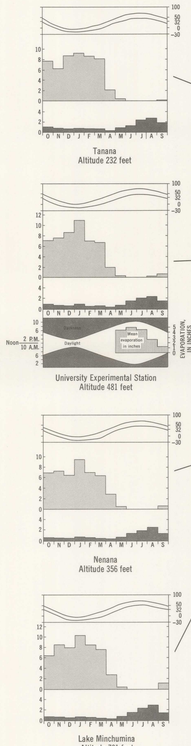
Associated with the subfreezing mean annual air temperatures of the basin is the occurrence of discontinuous permafrost (see location map). In areas of permafrost, ground temperatures are below freezing, even during the summer.

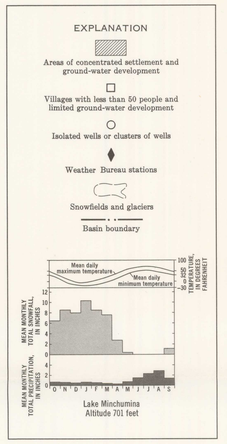
Annual precipitation is shown on the graphs at the right for the three stations having the longest records in the Tanana basin. Average annual precipitation is shown graphically on the principal map for these and 7 other stations in the basin. Average annual precipitation at the reporting stations ranges from 10 to 20 inches. At the head of Gulkana Glacier, altitude of about 7,000 feet; Mayo (written commun. 1963) reported that the average annual precipitation measured in a 3-year study was more than 120 inches (water equivalent).

Precipitation tends to be least in the eastern part of the basin and greatest in the southwest corner of the basin and in the low passes of the Alaska Range. Precipitation tends to increase with altitude and snowfall provides nearly 100 percent of the annual precipitation at higher altitudes. The regional snow line is at about 5,000 feet.



LONG-TERM VARIATION OF PRECIPITATION AT Mc KINLEY PARK, UNIVERSITY EXPERIMENT STATION, AND TANANA





MAJOR SETTLEMENTS, TRANSPORTATION ROUTES, AND CLIMATIC CHARACTERISTICS OF THE TANANA BASIN
(Climatic data from published records of the U.S. Weather Bureau)

PHYSIOGRAPHY

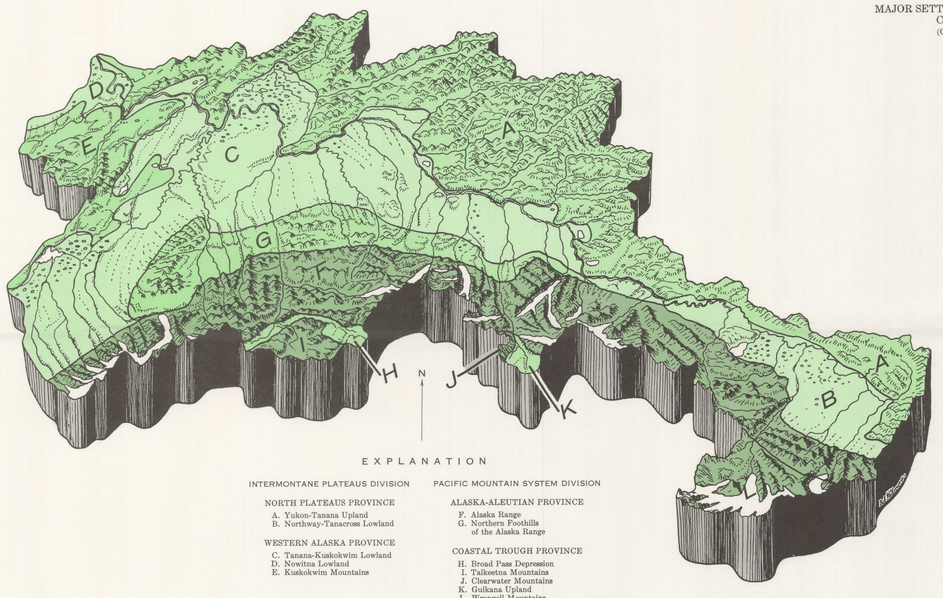
The Tanana basin is bordered on the north by the Yukon-Tanana Upland. On the south, the most continuous divide is the Alaska Range, but many of the major Tanana River tributaries breach the range and head in highlands to the south. The Kuskokwim Mountains close the west end of the basin. The Tanana River flows through a broad alluvial valley consisting of two basins, the Northway-Tanacross Lowland and the Tanana-Kuskokwim Lowland. The block diagram shows the major physiographic sections of the Tanana basin. The geologic units and their associated land forms are summarized on sheet 2.

The Yukon-Tanana Upland consists of a central core of rugged mountains ranging in altitude from 4,000 to 6,000 feet. Surrounding the mountains are rounded hills and spurs. There are no existing glaciers, but unconsolidated sediments are distributed throughout the uplands.

The Alaska Range is an arcuate band extending from the Canadian border to its northern limit near the Nenana River whence it trends southwest toward the Alaska Peninsula. Generally, the altitude of the crest ranges from 6,000 to 9,000 feet, but many peaks exceed 10,000 feet. Mount McKinley, altitude 20,269 feet, is the highest peak on the North American Continent. The Alaska Range is extensively capped with glaciers, which are assumed to be the greatest source of runoff to the Tanana River. The greatest concentrations of glaciers are in the Mount McKinley area and in the area between the Nenana and Robertson Rivers.

The Kuskokwim Mountains consist of northeastward-trending rounded to flat ridges. The basin divide through the Kuskokwim Mountains ranges in altitude from 1,000 to 2,000 feet; only one peak exceeds 3,000 feet in altitude.

The Northway-Tanacross Lowland and the Tanana-Kuskokwim Lowland are characterized by extensive glaciofluvial sedimentary deposits and large alluvial fans that protrude from the major tributary valleys and coalesce to form a nearly continuous apron flanking the south side of the Tanana Valley. These deposits are fairly coarse and form areas favorable to recharge; they are the principal aquifers of the basin. At the lower end of the fans, fine-grained organic-rich fluvial, eollan, and lacustrine sediments were deposited. Alluviation of the Tanana Valley has dammed many nonglacial tributaries to create large lakes such as Tetlin, George, Healy, Harding, and Minchumina along the valley margin.



PHYSIOGRAPHIC DIVISIONS OF THE TANANA BASIN
(After Wahrhaftig, 1965)

VEGETATION

The natural distribution of vegetation is largely controlled by climate, drainage, soils, and geology. The distribution pattern allows some interpretations of hydrologic elements such as depth to water and water loss by evapotranspiration.

The vegetation of the Tanana basin can be characterized by five types (Spetzman, 1963) (see vegetation map): 1) barren or tundra, 2) deciduous brush and muskeg, 3) low mixed evergreen and deciduous forest, and 4) moderately high mixed evergreen and deciduous forest, and 5) high evergreen spruce forest.

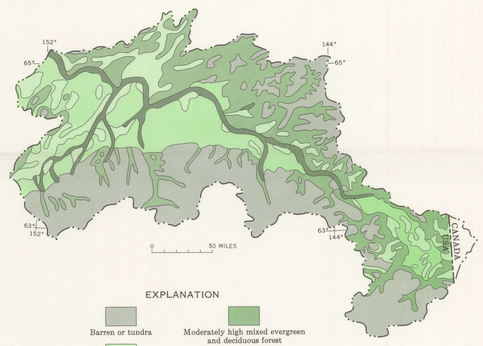
Barren or tundra type occurs above tree line (approximately 3,000 feet) where vegetation is either absent or consists of low-flowering plants, lichens, willow, alder, dwarf birch, prostrate shrubs, herbs, and grasses. Evapotranspiration in this zone is assumed to be low because the density of vegetation is low and the growing season is short. Depth to water is probably great.

Deciduous brush and muskeg occurs in the poorly drained areas, and consists of low willow, alder, dwarf birch, heath, dwarf black spruce, berry bushes, and a wet spongy ground cover of moss and sedges. Evapotranspiration is assumed to be high and in many places ground water is at or near the surface.

Low mixed evergreen and deciduous forest is common on alluvial deposits flanking the south side of the valley. Trees, less than 50-feet tall, consist of aspen and white spruce in dry areas grading to black spruce in moist areas; undergrowth includes willow, dwarf birch, and heath shrubs. Forest ranges from open with widely spaced individual trees or clusters of trees to dense continuous stands. Evapotranspiration is moderate.

Moderately high mixed evergreen and deciduous forest is common on well-drained hill slopes. Trees, less than 80-feet tall, consist of white spruce, black spruce, quaking aspen, balsam poplar, and white birch; undergrowth includes thick spongy moss, low brush, or grasses. Forest stands are dense. Depth to water probably is considerable and evapotranspiration moderate.

High evergreen spruce forest occurs on moist soil with good internal drainage on low terraces and flood plains of major rivers. Trees less than 100-feet tall consist of white spruce, balsam poplar, willow, and alder on young gravel bars, islands, and channel scars. Forest stands are dense. Depth to water is shallow to moderate and evapotranspiration probably is fairly large.



DISTRIBUTION OF VEGETATION TYPES IN THE TANANA BASIN
(After Spetzman, 1963)

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1970—W66187

HYDROLOGIC RECONNAISSANCE OF THE TANANA BASIN, CENTRAL ALASKA

By
G. S. Anderson

1970

For sale by the U.S. Geological Survey, price $2.00 per set