Prepared in cooperation with the
MUNICIPALITY OF ANCHORAGE

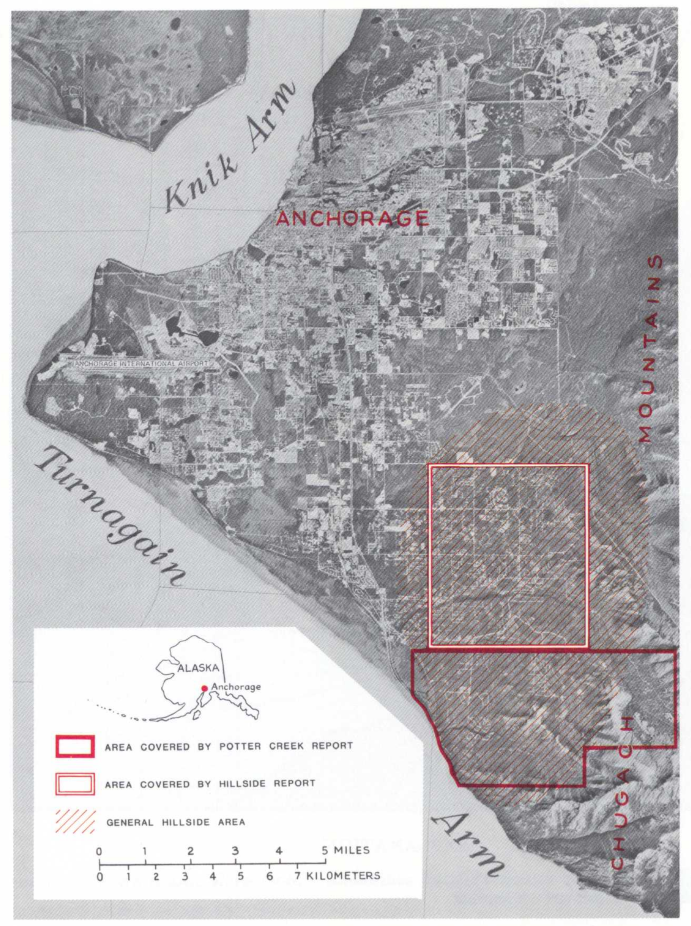


Figure 1. -- Location of Potter Creek study area. Also shown are the study area of the "Hillside report", (Dearborn and Barnwell, 1975) and the general Hillside area which encompasses both study areas.

INTRODUCTION

This report contains hydrogeologic information of interest to landowners, developers, and land-use planners concerned with the Potter Creek area of Anchorage. It shows the kinds and quality of hydrogeologic data that can be obtained from a relatively sparsely developed area to guide further development. Among the hydrogeologic features that affect development in the Potter Creek area are conditions created by erosion and poor drainage, the availability of water supplies, and the suitability of land for onsite liquid-waste disposal.

Many new homes are being built in the southeast quadrant of the Anchorage bowl, an area locally known as the Hillside and which includes the Potter Creek area (fig. 1). By mid-1980, about 220 homes had been built in the study area (Bruce Silva, Municipality of Anchorage, written commun., June 1980).

The Potter Creek study area encompasses approximately 16 mi^2; about one-third of this area is in Chugach State Park. To obtain information on which to base long-range planning and management of the Potter Creek area, the U.S. Geological Survey and the Municipality of Anchorage jointly funded a hydrogeologic study of the area. This project is a southward extension of earlier work in the Hillside by the U.S. Geological Survey (Dearborn and Barnwell, 1975). The significance of hydrology for land-use planning, especially as it applies to the Hillside, is discussed in greater detail in the 1975 report.

The objectives of the Potter Creek study were to:

- Evaluate the water-supply potential of the Potter Creek area
- Describe existing and potential drainage problems associated with land development in the area
- Summarize data relating to the susceptibility of the area's water resources to degradation by onsite waste disposal systems

Data used in this study are from fieldwork during 1979-1980 and from files of the U.S. Geological Survey and of State and municipal agencies. Information was also gathered from water-well drillers and landowners in the area. Streamflow and water-quality data were collected at several sampling sites established for the study (fig. 2). Soils data were obtained from the U.S. Department of Agriculture, Soil Conservation Service.

Sparseness of data in undeveloped areas is a common impediment in hydrogeologic studies. Building excavations, road construction, and well drilling are sources of valuable data, but where these data are sparse or unavailable, certain interpretations are difficult and may be of low reliability. Knowledge of subsurface geology, for example, is closely tied to the density and distribution of wells and test borings. However, knowledge of other characteristics, such as precipitation and landslope, may not be dependent on development. In studying this report it is therefore important to consider the nature of the data on which individual maps, graphs, and interpretations are based, as well as the density and distribution of data points used.

Figure 3a. -- Road damaged by seepage of shallow ground water (172nd Avenue near Goldenview Drive, June 1979.

Figure 3b. -- Hazardous road conditions created by malfunctioning road drainage systems and freezing of subsequent ground-water seepage (Goldenview Drive, December 1980).

Figure 3c. -- Erosion of road by melt water during the spring (Spain Drive near Potter Creek, April 1980).

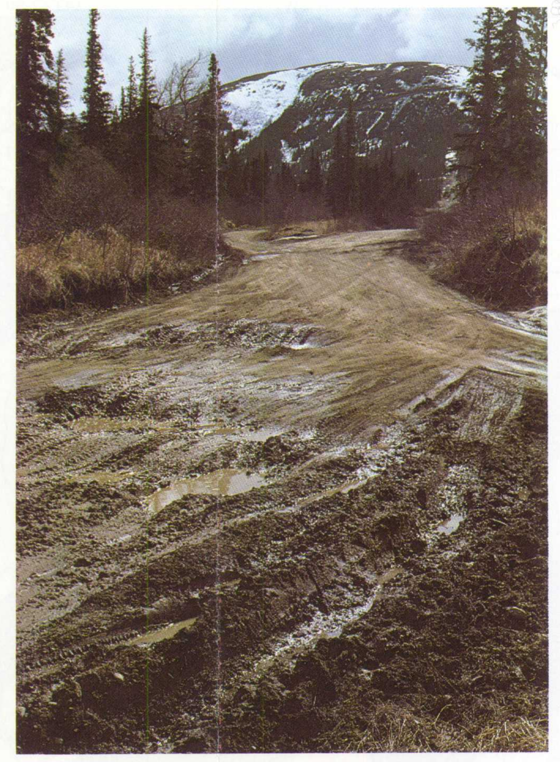


Figure 3d. -- Road damaged by poor drainage and high water table during the spring (Carl Street near upper Little Rabbit Creek, May 1980).

CONVERSION TABLE

Multiply	by	to obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square inch (in^2)	6.45	square centimeter (cm^2)
square mile (mi^2)	2.590	square kilometer (km^2)
inch per year (in/yr)	2.54	centimeter per year (cm/yr)
cubic feet per second (ft^3/s)	28.32	liters per second (L/s)
million gallons per day (Mgal/d)	90.85	liters per second (L/s)
degrees Fahrenheit (°F)	(°F-32)/1.8	degrees Celsius (°C)
micromhos per centimeter at 25°C (µmhos)	1000	microsiemens per centimeter at 25°C (µS/cm)

Note: The National Geodetic Vertical Datum of 1929 (NGVD of 1929) is a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada. This datum was formerly referred to as Mean Sea Level. NGVD of 1929 is called sea level in this report.

SURFACE-WATER DRAINAGE BASINS AND COLLECTION OF SURFACE-WATER AND PRECIPITATION DATA

The two principal streams draining the Potter Creek study area are Potter Creek and Little Rabbit Creek. In addition, Rabbit Creek drains part of the mountainous eastern section of the study area, and a small part of the northeastern corner of the study area is drained by South Fork Campbell Creek. Two areas totaling about 3.5 mi^2 adjacent to Cook Inlet drain into the inlet without significant streamcourses.

Stream discharge data have been collected at four sites on Little Rabbit Creek and three sites on Potter Creek. Water-quality data have been collected at all sites except the middle Potter Creek site, at Potter Ravine. These sites and the drainage basin boundaries are shown on figure 2.

Precipitation in the Potter Creek area and at Glen Alps was measured at National Weather Service stations. These sites are also shown on figure 2.

The data-collection site near the mouth of Little Rabbit Creek was equipped with a continuous streamflow recorder from May 1979 until September 1980. The data are published in the annual Geological Survey publication "Water Resources Data for Alaska." The monthly mean discharges, based on daily mean values, ranged from 18.1 to 4.34 ft^3/s. The small discharge of this and other study area streams (relative to other Hillside streams) suggests that reservoirs or diversions of surface flow for water supplies would be impractical. Surface water is not now a widely used source of domestic water supplies in the Hillside area.

In September 1980, the recorder on Little Rabbit Creek was relocated about 1.8 mi upstream to a more stable reach of the creek channel. Streamflow data continue to be collected at the new site (December 1981).

At each of the other six surface-water data-collection sites, two instantaneous streamflow measurements were made, in October 1979 and March 1980. October and March are normally periods of low streamflow in the Anchorage area. Under low streamflow conditions, ground-water contributions to streamflow are proportionally greatest and most easily measured, and the chemical quality of stream water most closely corresponds to ground-water quality. Measurements made during low-flow conditions thus provide useful information about both streams and ground water.

Measurements of water temperature, specific conductance, pH, and dissolved oxygen were made at all six surface-water quality data-collection sites (fig. 2) during October 1979 and March 1980. Water samples were also taken for chemical and bacteriological analyses. The results of water-quality analyses are presented on sheet 4.

The maps and interpretations presented here are somewhat generalized. As development of the Potter Creek area proceeds, additional information will become available, and refinement of some of the maps and interpretations presented on the sheets of this atlas will be possible.

With the exception of units dealing with topography, which are derived from a metric base map, units in this report are in the inch-pound system. Conversion tables on each page permit the conversion of units appearing on that page to the metric system.

DRAINAGE, ICING, AND EROSION PROBLEMS

Except for the Old and New Seward Highways, all roads in the Potter Creek area are unpaved. In winter, ice builds up where ground water seeps onto road surfaces. In spring, runoff from melting snow and ice causes locally uneven, muddy surfaces where drainage is poor, or it may erode the roadway or, in more extreme cases, cause washouts. In places, roads are not passable for periods of time each spring. Some sites where drainage, icing, and erosion have damaged road surfaces or created other problems are shown in figures 3a-d. In addition to the inconvenience and hazards created by these road conditions, erosion of road surfaces and embankments adds to the suspended-sediment loads of nearby streams, which affects water quality. Although road washouts and winter icings are highly visible and sometimes spectacular, they are not the only problems that can arise in poorly drained soils. Ground-water seepage and frost heave can cause structural damage to houses as well as roads. In addition, shallow ground water can prevent proper functioning of septic systems. Special attention to potential drainage problems during design and construction of roads and houses can reduce or eliminate these problems.

A map showing wetlands and areas of shallow ground water in the Potter Creek area is presented on sheet 3 of this report (fig. 11). Further discussion of the limitations on development created by drainage problems and the occurrence of shallow ground water is presented with figure 11.

HYDROLOGIC CYCLE OF THE POTTER CREEK AREA

The hydrologic cycle and water budget for the Potter Creek study area are shown in figure 4.

The hydrologic cycle has no starting point or end, and a drop of water may take many paths. Water is constantly moving through soil and rock, over the land surface, and through the atmosphere. Water evaporates from oceans, lakes, streams, and marshes; some is also transpired into the atmosphere by plants. From the atmosphere it falls as rain or snow back onto land or water bodies. On land, some water runs into streams, into lakes, or into the ocean, and some infiltrates into the ground, occupying pores in soil, rocks, and sediments. Ground water is in motion too, flowing beneath the land surface from recharge zones, such as the Chugach mountain front in the Potter Creek area, to discharge areas, such as the floor of Cook Inlet.

A dynamic balance exists among the paths of the hydrologic cycle, and one way to study the balance is by calculating a water budget -- by measuring or estimating how much water is flowing through the various pathways.

Water enters the Potter Creek area by three routes:

- streamflow
- ground-water inflow
- precipitation

Streamflow entering the Potter Creek study area is estimated to be 5 Mgal/d. Most entering streamflow is in Rabbit Creek in the eastern part of the area. Ground water flows into the Potter Creek area from bedrock higher in the Chugach Mountains to the east. The rate of this inflow is estimated to be 3 Mgal/d. This estimate is based on rates of seepage observed during construction of a bedrock tunnel at Eklutna (Sommers and Marcher, 1965) and on other U.S. Geological Survey studies (Barnwell and others, 1972; U. S. Geological Survey unpublished data on file in Anchorage, Alaska, 1979). Precipitation in the study area is about 30 in/yr, or about 23 Mgal/d for the total area (Gerald Nibler, National Weather Service, written commun., May 1980). Total inflow is, thus, about 31 Mgal/d.

Water leaves the Potter Creek area by three routes:

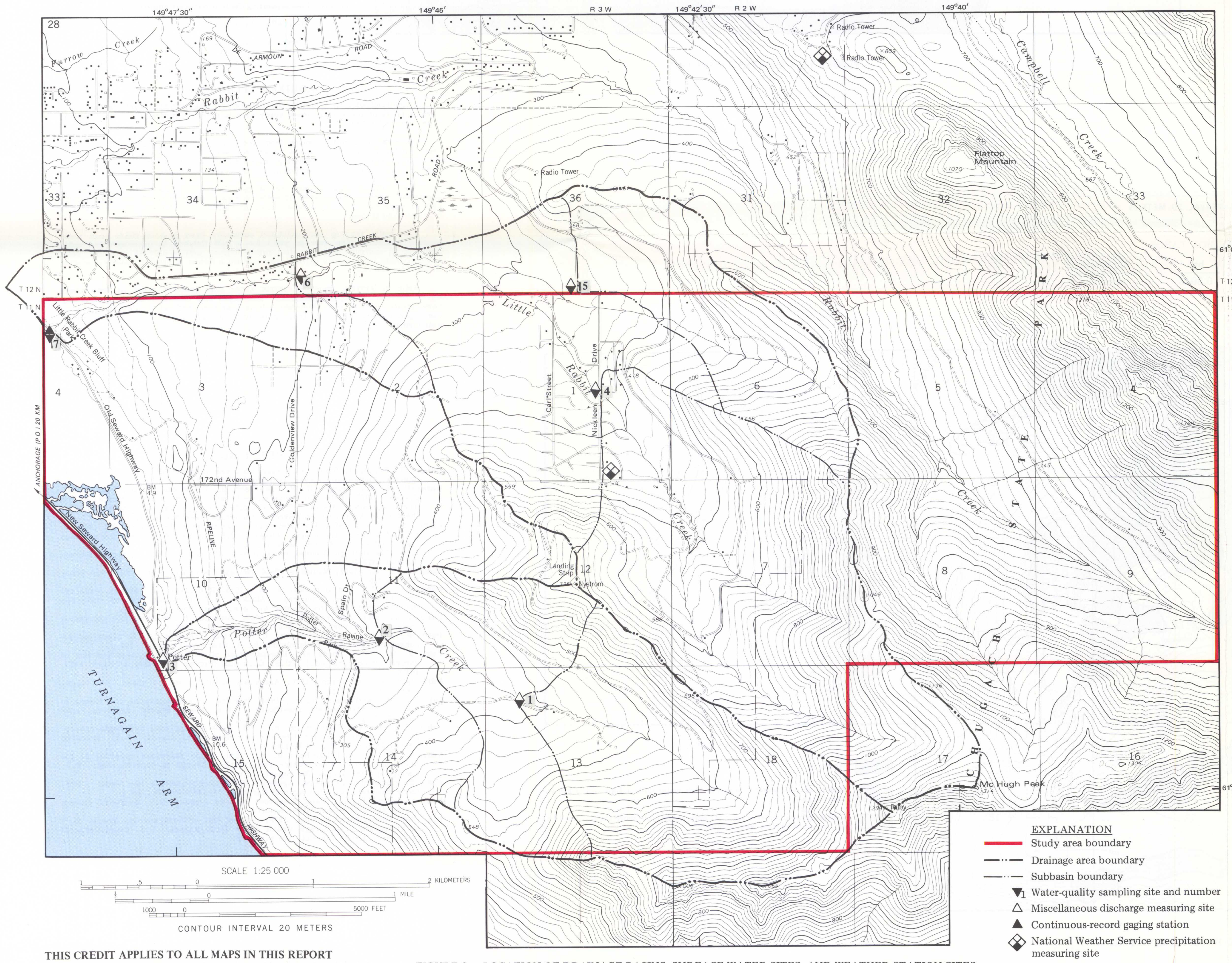
- streamflow
- evapotranspiration
- ground-water outflow

Total streamflow leaving the study area, based on limited discharge data from the major streams, is about 17 Mgal/d. Patric and Black, in a 1968 report for the U.S. Forest Service, estimated that evapotranspiration (evaporation and transpiration combined) is 12-15 in/yr in the Anchorage area. This translates into an estimated outflow by evapotranspiration of 9-11 Mgal/d for the study area. Assuming the hydrologic system in the study area is in equilibrium, so that the amount of water leaving the system equals the amount entering, then ground-water outflow from the study area is estimated to be 3-5 Mgal/d.

PRECIPITATION

Figure 5 shows monthly precipitation for 3 years of record (1977-79) at two National Weather Service stations in Anchorage: the Little Rabbit Creek station on Nickleen Drive (fig. 2), and the Anchorage International Airport station (fig. 1), about 11 mi northwest of Nickleen Drive. Data for the Little Rabbit Creek station are from unpublished National Weather Service records (Gerald Nibler, National Weather Service, written commun., May 1980). For the 4 months when Little Rabbit Creek station data were not available, estimates were made based on National Weather Service data from a nearby station at Glen Alps (fig. 2). Precipitation in the Anchorage area is derived primarily from warm, moist air from the Gulf of Alaska. As the air rises to pass over the mountains, it cools, inducing precipitation. There is thus a general increase in precipitation toward and into the Chugach Mountains, reflecting a general increase with altitude.

The Potter Creek study area ranges in altitude from sea level to about 4,500 ft above sea level, and it comprises the margin of the Chugach Mountains in that area. The amount of annual precipitation varies in the study area and is generally considerably higher than in the main part of the Anchorage bowl. The National Weather Service station on Nickleen Drive is at about 1,450 ft above sea level. Average annual precipitation at that site during 1977-1979 was 34 in, compared with 17.2 in at Anchorage International Airport, which is at an altitude of about 85 ft. Thus, average annual precipitation in the Potter Creek area is about twice that at Anchorage International Airport.



THIS CREDIT APPLIES TO ALL MAPS IN THIS REPORT
Base from U.S. Geological Survey, Anchorage, (A-8, SE), Alaska, 1:25,000, 1979

FIGURE 2. -- LOCATION OF DRAINAGE BASINS, SURFACE-WATER SITES, AND WEATHER-STATION SITES.

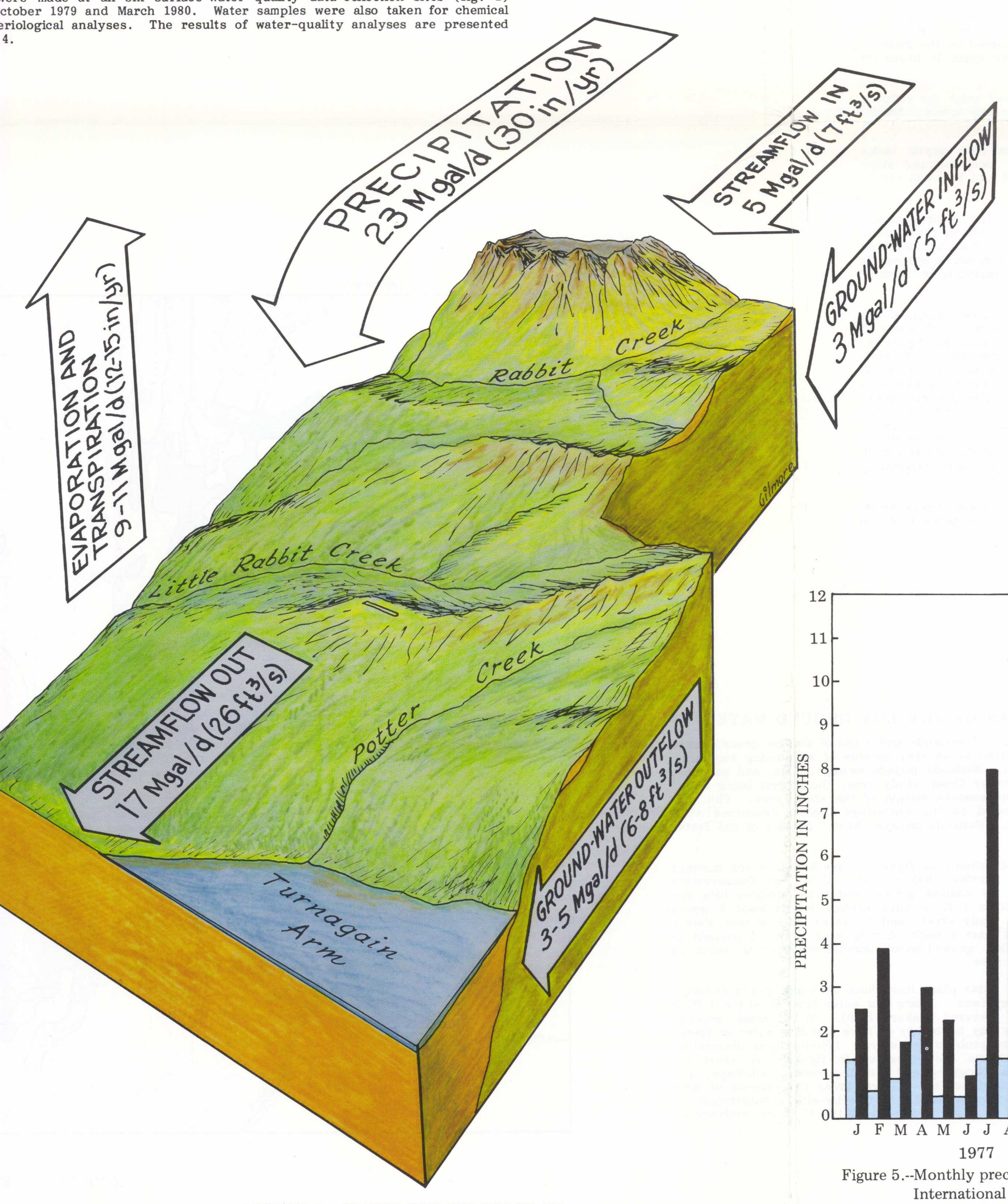


FIGURE 4. -- WATER BUDGET DIAGRAM.

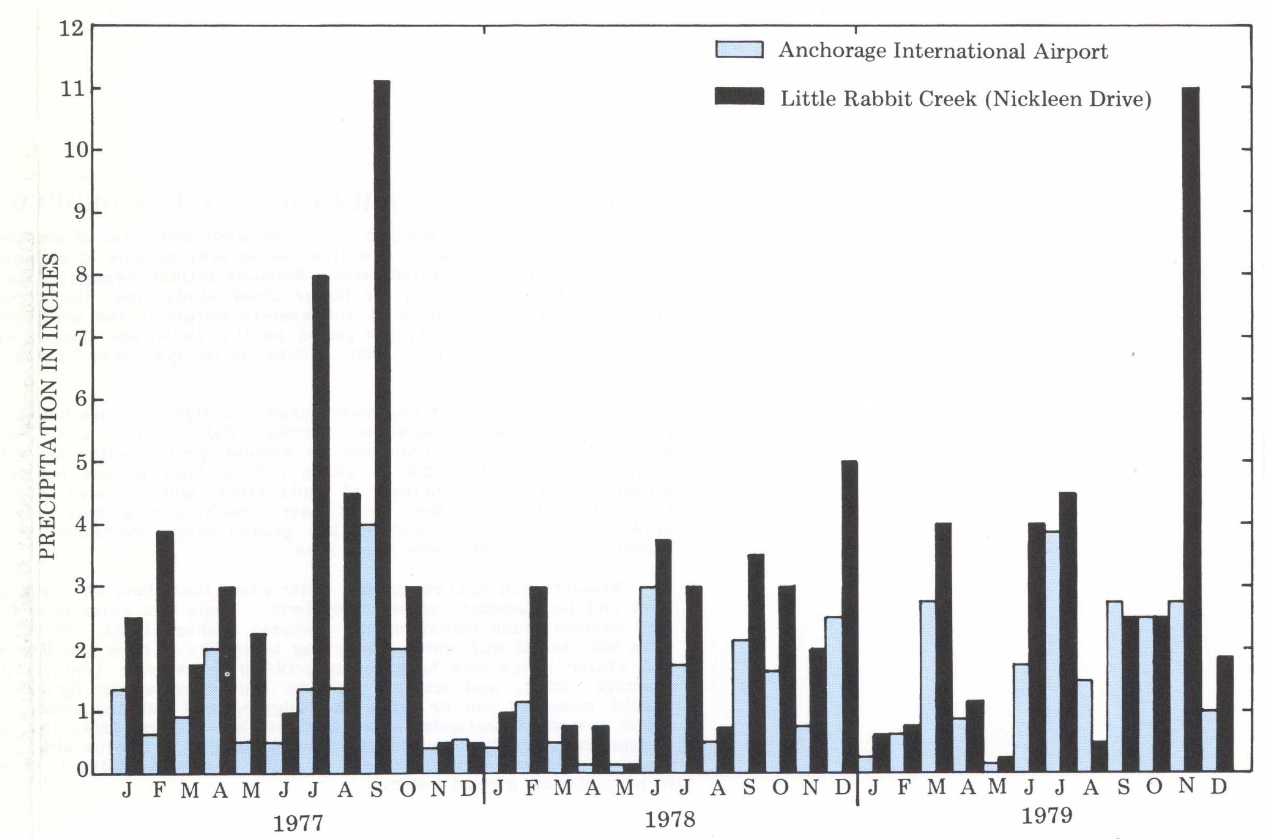


Figure 5.--Monthly precipitation, 1977-79. Blue bars represent total monthly precipitation at Anchorage International Airport; black bars represent precipitation at Little Rabbit Creek station on Nickleen Drive (fig. 2).

HYDROGEOLOGY FOR LAND-USE PLANNING: THE POTTER CREEK AREA, ANCHORAGE, ALASKA

By Richard P. Emanuel and Derrill J. Cowing