Overview of Environmental and Hydrogeologic Conditions near Petersburg, Alaska

By Eppie V. Hogan

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
square kilometer (km^2)	0.3861	square mile
liter (L)	0.2642	gallon
liter per second (L/s)	15.85	gallon per minute
liter per day (L/d)	0.2642	gallon per day
cubic meter per second (m^3/s)	35.31	cubic foot per second
degree Celsius (° C)	°F=1.8(°C)+32	degree Fahrenheit (°F)

Sea Level:

In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—A geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviated water-quality units used in this report:

Chemical concentration and water temperature are given only in metric units. Chemical concentration in water is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the solute mass per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

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ABSTRACT

Petersburg is on Mitkof Island in southeast Alaska, approximately 175 kilometers southeast of Juneau and approximately 1,050 kilometers southeast of Anchorage. The island is in the maritime climate zone and has mild winters and cool summers. Most residents on the island obtain drinking water from surface-water sources. Ground water may be an alternative drinking-water source. The Federal Aviation Administration owns or operates airway support facilities near Petersburg. They are considering environmental and hydrogeologic conditions when evaluating options for environmental compliance and remediation at these facilities. This report describes the climate, vegetation, geology, hydrology, and flooding potential of the area surrounding the Petersburg Federal Aviation Administration facility.

INTRODUCTION

The Federal Aviation Administration (FAA) owns and (or) operates airway support and navigational facilities throughout Alaska. At many of these sites, fuels and potentially hazardous materials such as solvents, polychlorinated biphenyls, and pesticides may have been used and (or) disposed of. To determine if environmentally hazardous materials have been spilled or disposed of at the sites, the FAA is conducting environmental studies mandated under the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act. To complete these more comprehensive environmental studies, the FAA requires information on the hydrology and geology of areas surrounding the sites. This report, the product of compilation, review, and summary of existing hydrologic and geologic data by the U.S. Geological Survey (USGS), in cooperation with the FAA, provides such information for the FAA facility and nearby areas of Petersburg, Alaska.

BACKGROUND

Location

Petersburg is located on the north end of Mitkof Island near the entrance to the Wrangell Narrows (fig. 1) at approximate lat 56°48' N., long 132°57' W. It is approximately 175 km southeast of Juneau and approximately 1,050 km southeast of Anchorage. The FAA facilities are concentrated at the municipal airport approximately 1.5 km south of the city of Petersburg. The FAA also leases land at Frederick Point, about 8 km southeast of Petersburg. The FAA facilities are in the foothills of the Coast Mountains, where topography is characterized by blocks of high mountains separated by flat-floored valleys and straits 0.8 to 16 km wide (Wahrhaftig, 1965).

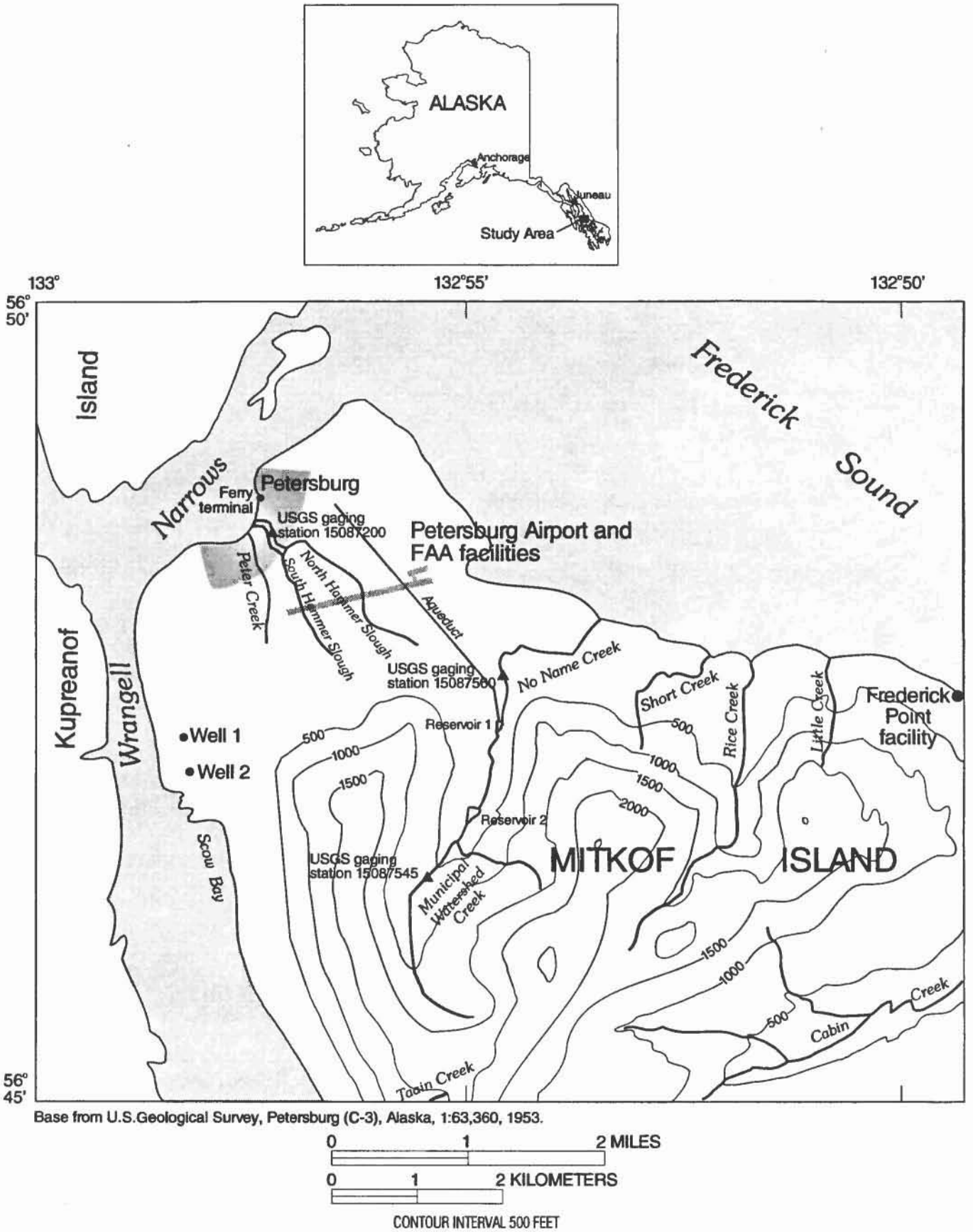

Figure 1. Location of Petersburg, Alaska and the Federal Aviation Administration facilities.

History and Socioeconomics

At the time of initial Western contact, two groups of Indians, the Tlingit and the Haida, occupied southeastern Alaska (Selkregg, 1976). Each Indian clan was based on maternal descent and relied on subsistence activities such as hunting and fishing for survival. Tlingit Indians had established a summer fishing camp on the north end of Mitkof Island near the current location of Petersburg.

The first non-native settlement was a salmon cannery and sawmill built in 1897 by Peter Buschmann, after whom Petersburg was named (Orth, 1967). This area was chosen because of its proximity to the rich fishing grounds in Frederick Sound and the salmon runs in Peter Creek and other streams (Alaska Department of Community and Regional Affairs, 1984). In 1930, the population of Petersburg was 1,252; in 1939 it was 1,323; in 1950 it was 1,619; in 1980, it was 2,821; in 1990, it was 3,207; and by 1994, the population had grown to 3,680 (Alaska Department of Community and Regional Affairs, 1984, 1994). According to the U.S. Bureau of Census (1991), about 10 percent of the people were American Indian, Eskimo, or Aleut, about 87 percent were Caucasian, about 2 percent were African-American or Asian/Pacific Islander, and about 1 percent were of other ethnic origin. Employment in Petersburg is mostly in non-government activities such as commercial fishing, agriculture, forestry, transportation, retail trade, and services.

The FAA presence in Petersburg began in 1975 when the Alaska Department of Transportation and Public Facilities granted a lease to install, operate, and maintain a Visual Approach Slope Indicator (VASI). Through additional leases, the FAA installed a VASI runway, runway identification lights, an omnidirectional lighting system, a weather observation station, and a field monitor system. The facilities are concentrated at the Petersburg Airport (fig. 1). Two FAA personnel who reside in Petersburg maintain the facilities. A detailed account of properties near Petersburg that are owned, leased, or transferred by the FAA and a listing of suspected sources of contamination are in the Environmental Compliance Investigation Report by Ecology and Environment, Inc. (1993).

PHYSICAL SETTING

Climate

The Petersburg area has a maritime climate characterized by small temperature variations, high humidity, and abundant precipitation, which accounts for its wet, cool summers and relatively mild winters (Hartman and Johnson, 1984). The mean annual temperature is 5.6°C, but temperatures range from a July mean maximum of 17.6°C to a January mean minimum of -5.4°C (Leslie, 1989). Mean annual precipitation is about 2,690 mm and about 2,580 mm of snow falls annually. Mean monthly and annual temperature, precipitation, and snowfall are summarized in table 1.

Table 1. Mean monthly and annual temperature, precipitation, and snowfall for the period 1922 to 1987, Petersburg, Alaska

[Modified from Leslie (1989); °C, degree Celsius]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temperature (°C)													
Mean maximum	0.5	2.7	5.1	9.0	13.2	16.3	17.6	17.2	14.1	9.4	4.7	1.7	9.3
	(Record maximum 28.9 °C, July 1927)												
Mean minimum	-5.4	-3.7	-2.2	0.3	3.6	7.2	8.8	8.3	6.2	3.3	-0.8	-3.4	1.8
	(Record minimum -28.3 °C, January 1947)												
Mean	-2.4	-0.5	1.5	4.7	8.4	11.7	13.2	12.8	10.2	6.4	2.0	-0.8	5.6
Precipitation, in millimeters of moisture													
	236.5	199.4	182.6	176.3	150.4	127.0	136.1	192.3	283.2	427.5	304.5	270.8	Total 2,686.6
Snowfall, in millimeters													
	723.9	533.4	398.8	55.9	0.00	0.00	0.00	0.00	0.00	15.2	241.3	607.1	Total 2,575.6

Vegetation

Vegetation in the Petersburg area consists of Coastal spruce-hemlock forest (Viereck and Little, 1972). The forest is characterized by an overstory of Sitka spruce, western hemlock, and Alaska yellow cedar and an understory of blueberry, red huckleberry, salal, skunk cabbage, grasses, and mosses (Alaska Department of Community and Regional Affairs, 1984; Viereck and Little, 1972). The extensive tidal areas along the shores of Mitkof Island support sedges, hairgrass, herbs, ryegrass, rockweeds, sea lettuce, and kelp (Alaska Department of Community and Regional Affairs, 1984). Alpine vegetation is found in upland areas south of Petersburg and consists of mountain hemlock, deer cabbage, heather, lichen, berries, and willow.

GEOLOGY

The geology of the Petersburg area is described by Paige (1965), Yehle (1978), Burrell and others (1982), Brew and others (1984, 1989), and Berg and Gehrels (1992) as principally sedimentary and igneous rocks of Cretaceous age overlain by diamicton (sand and gravel) and organic deposits. Narrow alluvial deposits occur in stream channels, but alluvium is not a significant unit areally. The sedimentary bedrock includes marine graywacke and mudstone. Igneous rocks near Petersburg include batholiths and small plutons of granodiorite, tonalite, and quartz diorite that are part of the Coast Mountains. Other rock types found in minor amounts include andesitic to basaltic volcanic rocks and limestone. The depth to bedrock is unknown; a 63-m-deep well drilled near Petersburg in 1970 terminated in unconsolidated deposits (appendix 1).

Deposits of sand and gravel that are locally tens of meters thick are the principal surficial materials found in the Petersburg area (appendix 1). McConaghy (appendix 1) believed the material was derived from rocks on Kupreanof Island less than 2 km to the west (fig. 1), and was deposited by the rivers that once flowed in nearby valleys. Yehle (1978), however, believes that alluvial deposits near Petersburg are minor, and most of the surficial deposits are diamicton (sand and gravel) and organic materials. The lithology of the sediments exposed by a well drilled to a depth of about 63 m (fig. 1, Well 1) is given in appendix 1.

Soils near Petersburg are of two major types. Well-drained, acidic soils are associated with the forested slopes southeast of Petersburg. Under a thick mat of partially to highly decomposed forest litter, these soils have a thin gray surface layer and black-brown subsurface layers (Rieger and others, 1979). Thick layers of poorly drained, organic-rich soils are found in low-lying areas and on slopes from which ground water seeps (Rieger and others, 1979). The Petersburg area is free of permafrost (Ferrians, 1965).

Mitkof Island is located within the circum-Pacific seismic belt that rims the north Pacific Ocean. The area is traversed by the Chatham Strait Fault, the Fairweather Fault, and numerous smaller fault systems. Several earthquakes with Richter magnitudes greater than 7 have been recorded along these fault systems (Brower and others, 1977; Stephens and others, 1986).

Natural erosion by mass wasting is a common phenomenon throughout southeast Alaska and may occur in the upland areas southeast of Petersburg. Mass wasting is the downslope movement of large volumes of sediment and other material caused by gravity. Creep, earth flow, slump, rock slides, avalanches, and debris flows are common in southeast Alaska. Movement can be triggered by slope undercutting, slope overloading, earthquake vibrations, and increased moisture content from heavy rains and (or) rapid snowmelt.

HYDROLOGY

Surface Water

Several small streams and two reservoirs are the principal fresh surface-water bodies near Petersburg. Reservoirs 1 and 2 (fig. 1) are southeast of Petersburg, approximately 2 and 3 km, respectively. Reservoir 1 holds approximately 190 million L of water (Alaska Department of Community and Regional Affairs, 1984). No data are available for Reservoir 2.

At least 10 streams on Mitkof Island are within 10.5 km of the city of Petersburg (table 2; fig. 1). These streams originate in the upland area southeast of Petersburg and flow toward the coast emptying into the Wrangell Narrows or Frederick Sound (fig. 1). Stream drainage basins range in area from 1.1 to 19.3 km^2 (table 2; appendix 1). Cabin Creek is the longest stream near Petersburg at 7.7 km (table 2).

Table 2. Characteristics of stream drainage basins near Petersburg
[Modified from appendix 1]

Stream name	Distance to Petersburg (kilometers)	Length (kilometers)	Drainage basin area (square kilometers)	Elevation (of headwaters; meters)	Average gradient (meters/ kilometers)
Peter Creek	0.5	1.3	1.8	30.5	22.5
South Hammer Slough	0.6	1.4	1.8	30.5	21
North Hammer Slough	0.5	2.3	1.6	53	22.5
No Name Creek	4.0	6.3	8.2	396	62
Short Creek	5.5	1.6	2.6	289	178
Rice Creek	5.9	4.0	4.6	550	135
Little Creek	6.6	1.4	1.1	441	302
Taain Creek	9.7	1.6	1.1	457	281
Municipal Water-shed Creek	5.0	3.2	5.8	396	90
Cabin Creek	10.5	7.7	19.3	750	97

Streamflow data are available for the Hammer Slough, No Name Creek, and Municipal Watershed Creek. North Hammer Slough and South Hammer Slough together form the Hammer Slough. Discharge in the slough was reported periodically from 1964 to 1967 at USGS stream-gaging station 15087200 (fig. 1; table 3). From November to April mean monthly flow averaged 0.28 m^3/s (U.S. Geological Survey, 1965–68). Maximum mean monthly discharge averaged 0.7 m^3/s during October, and minimum mean monthly discharge of about 0.2 m^3/s occurred during July (U.S. Geological Survey, 1965–68). Rainfall runoff on October 22, 1965, caused a maximum discharge of 17 m^3/s (Jones and Fahl, 1994).

Table 3. Mean monthly flow at USGS stream-gaging station 15087200, Hammer Slough at Petersburg, water years 1964–67
[Values in cubic meters per second]

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	0.74	0.27	0.28	0.30	0.28	0.26	0.27	0.37	0.12	0.12	0.11	0.26
Maximum	0.85	0.36	0.32	0.51	0.38	0.63	0.36	0.57	0.14	0.29	0.18	0.41
Minimum	0.62	0.21	0.2	0.15	0.21	0.04	0.18	0.21	0.04	0.02	0.04	0.03

The discharge in No Name Creek was reported periodically from 1971 to 1973 at USGS stream-gaging station 15087560 (fig. 1; table 4). Maximum mean monthly discharge in the creek occurred during periods of snowmelt in the spring and during periods of heavy precipitation in the fall. Mean monthly flow from April to June averaged 1 m^3/s, and mean flow from September to November averaged 0.6 m^3/s (U.S. Geological Survey, 1972–74). Minimum mean monthly discharge, which occurs during the winter months, averaged 0.14 m^3/s (U.S. Geological Survey, 1972–74). On October 5, 1972, rainfall runoff caused a maximum creek discharge of 9.9 m^3/s (Jones and Fahl, 1994).

Table 4. Mean monthly flow at USGS stream-gaging station 15087560, No Name Creek near Petersburg, water years 1971–73

[Values in cubic meters per second]

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	0.75	0.49	0.14	0.16	0.11	0.21	0.72	1.41	1.22	0.57	0.66	0.65
Maximum	1.13	0.79	0.18	0.19	0.20	0.33	1.25	1.50	1.49	0.85	0.93	0.80
Minimum	0.29	0.10	0.06	0.12	0.05	0.05	0.17	1.30	0.80	0.40	0.48	0.51

The discharge in Municipal Watershed Creek was reported from 1979 to 1988 at USGS stream-gaging station 15087545 (fig. 1; table 5). Streamflow is fairly constant year-round with mean monthly flow ranging from 0.4 to 1.1 m^3/s (table 5). The highest mean monthly discharge of 1.1 m^3/s typically occurred in October during periods of intense precipitation (table 5). Minimum mean monthly discharge 0.06 m^3/s occurred in December (table 5). Rainfall runoff on October 14, 1986, caused a maximum stream discharge of about 31 m^3/s (Jones and Fahl, 1994).

Table 5. Mean monthly flow at USGS stream-gaging station 15087545, Municipal Watershed Creek near Petersburg, water years 1979–88

[Values in cubic meters per second]

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	1.1	0.7	0.4	0.6	0.5	0.4	0.6	1.0	0.7	0.4	0.4	0.7
Maximum	1.8	1.4	0.9	1.4	1.1	0.8	1.0	1.6	1.3	0.7	0.8	1.6
Minimum	0.5	0.5	0.06	0.1	0.08	0.2	0.4	0.6	0.3	0.2	0.08	0.4

Tides

A two-layered estuarine circulation system is a common occurrence in southeast Alaska (U.S. Army Corps of Engineers, 1989). It is a seasonal phenomenon beginning during spring thaw with an increase in freshwater discharge. The freshwater flows seaward along the surface (of the ocean) and is replaced by saline water intruding at greater depths. During the fall and winter, storms and reduced runoff combine to thoroughly mix the layers and destroy the system (U.S. Army Corps of Engineers, 1989). Tidal fluctuations may also contribute to the mixing and circulation of freshwater and saltwater. The diurnal tide range is the difference in height between mean high water and mean low water on a single day. The diurnal tide range near Petersburg averages 4.6 m (Brower and others, 1977). The maximum daily tide predicted to occur near Petersburg is 5.8 m above mean sea level. The minimum daily tide predicted is -1.3 m below mean sea level (Brower and others, 1977).

Floods

The city of Petersburg has a low flood hazard rating and has no history of significant waterfront flooding (U.S. Army Corps of Engineers, 1993). The city is vulnerable to some degree of flooding by storm-surge or earthquake-generated tsunami waves (U.S. Army Corps of Engineers, 1993). Winds are generally from the east in the winter and southeast in the summer (Brower and others, 1977). These winds acting over a large area of water may result in large waves that can combine with high tides and erode coastal areas and expose homes to wave damage. Brower and others (1977) describe return periods for maximum wave heights for coastal areas in Alaska. A 100-year wave over 20 m high is a possibility for Petersburg (table 6). A wave of this magnitude could affect the Frederick Point nondirectional beacon facility, which is approximately 9 m above mean sea level, and the municipal airport, which is approximately 15 m above mean sea level.

Table 6. Annual maximum wave heights for selected return periods near Petersburg
[Modified from Brower and others, 1977]

Return period (years)	Maximum wave height (meters)
5	12.0
10	14.0
25	16.0
50	18.5
100	20.5

Overbank flooding of stream channels in southeast Alaska usually occurs during heavy rainfall. Flood crests are typically of short duration, often less than 1 day, and are characterized by a very sharp rise and decline of water flow. Volume of runoff during flooding is relatively small. No flooding was reported at the Petersburg Airport when Hammer Slough flooded on October 22, 1965.

Ground Water

Several wells have been drilled in the Petersburg area (appendixes 1 and 2). Wells were drilled to depths ranging from 19 to 63 m below land surface, and water was reached at depths ranging from 0.5 to 8.5 m below land surface. A 63-m-deep well drilled near Scow Bay (fig. 1, Well 1) was pumped at a rate of 126 L/s for 5 hours. The pumping resulted in 30.5 m of drawdown after 5 hours of pumping. The well produced increasing amounts of sand after 1 hour of pumping. The well, however, did not have a properly sized screen. A screen might have excluded the sand. The well produced calcium bicarbonate water, which commonly indicates a well that is situated in or near the mixing zone between freshwater and saltwater. If this is the case for Well 1, then continued pumping at high rates might cause saltwater intrusion.

Areally extensive aquifers have not been identified in the Petersburg area. McConaghy (appendix 1) believed that ground-water resources in alluvial deposits in the area might be significant. Yehle (1978), however, believes that alluvial deposits are minor, and most of the area consists of peat and other organic deposits over diamicton (generally till). Diamicton of the type described by Yehle includes high percentages of fine-grained materials and is probably not a significant aquifer.

The general direction of ground-water flow is from the high ground toward the coast. Locally, however, the flow directions may be influenced by the slope of the buried bedrock or of the uppermost till layer. Alluvial deposits along the streams are not areally extensive and are significant only as an interface between the stream and the more widely distributed sediments and bedrock.

DRINKING WATER

Present Drinking-Water Supplies

Approximately 70 percent of the population of Petersburg receives drinking water from surface-water sources, and the other 30 percent uses ground-water sources (G.L. Solin, U.S. Geological Survey, oral commun., 1995). Reservoir 1 is approximately 2 km southeast of Petersburg and serves as the principal drinking-water source for the community (Alaska Department of Community and Regional Affairs, 1994). The water is transferred through an aqueduct to a treatment plant where it is filtered, chlorinated, and transferred to a storage tank that has an operational capacity of approximately 2.2 million L (Alaska Department of Community and Regional Affairs, 1984). Average consumption of water supplied by the reservoir is approximately 430 (L/d)/person (G.L. Solin, U.S. Geological Survey, oral commun., 1995). Average consumption of water from individual wells is approximately 190 (L/d)/person (G.L. Solin, U.S. Geological Survey, oral commun., 1995).

The USGS sampled water from Reservoir 1 in 1968 (table 7; appendix 2). Major ions, nutrients, dissolved metals, and water properties were analyzed. These constituents and properties are within current U.S. Environmental Protection Agency (USEPA) and Alaska Department of Environmental Conservation (ADEC) drinking-water regulations (Salvato, 1992; Alaska Department of Environmental Conservation, 1995). Public drinking-water supplies are typically sampled every month for compliance with these regulations. The reservoir is at a higher elevation than the FAA facility and is not vulnerable to contamination by surface spills or disposal of hazardous wastes at the FAA facility.

Table 7. Selected water-quality data for Reservoir 1 near Petersburg, water year 1968

[U.S. Geological Survey, 1969; mg/L, milligram per liter; µg/L, micrograms per liter]

Date	pH	Sodium, dissolved (mg/L as Na)	Chloride, dissolved (mg/L as Cl)	Hardness (mg/L as $CaCO_3$)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Iron, (µg/L as Fe)
06-22-68	6.0	0.5	0.3	2.0	0.0	1.9	0.13
12-12-68	6.1	1.1	0.7	4.0	0.1	2.4	0.04

Alternative Drinking-Water Sources

Ground water represents an alternative drinking-water source for residents near Petersburg. There are few records of wells in Petersburg; however, domestic wells drilled near the ferry terminal (fig. 1) typically have low yields, and those near Scow Bay (fig. 1) have adequate to high yields (appendix 1). The possibility of saltwater intrusion into coastal and island aquifers exists, especially with increased well depth (Waller and Tolen, 1962; Selkregg, 1976). During 1969–70, the water in Wells 1 and 2 was sampled (appendix 1). Major ions and water properties were analyzed. The iron concentration in Well 2, the total dissolved-solids concentration in Well 1, and the sodium concentration in Wells 1 and 2 exceeded current or proposed USEPA and ADEC drinking-water regulations (table 8).

Table 8. Selected water-quality data for Wells 1 and 2 near Petersburg, water years 1969-70
[Modified from appendix 1; mg/L, milligrams per liter]

Constituent (or property)	Drinking-water regulation (mg/L)	Range in concentration (Well 1) (mg/L)	Concentration (Well 2) (mg/L)
Iron (Fe)	0.3	0.04-0.12	1.21
Sulfate (SO_4)	250	13-20	16
Fluoride (F)	2	0.5-0.8	0.6
Sodium (Na)	100 (proposed)	139-166	166
Chloride (Cl)	250	50-53	63
Total dissolved solids	500	542-548	483
pH (units)	6.5 to 8.5	7.9-8.2	8.4

SUMMARY

Petersburg is on Mitkof Island in southeast Alaska approximately 175 km southeast of Juneau. The island lies in the maritime climate zone, characterized by mild winters and cool summers. Flooding by tsunami and storm-surge waves and erosion of steep coastal slopes are potential hazards. The city of Petersburg and the FAA facility obtain their drinking water from Reservoir 1 located approximately 2 km to the southeast. Ground water and the development of additional surface-water supplies are potential alternative drinking-water sources. However, water-quality problems such as saltwater intrusion have been documented, and many surface-water sources remain unquantified and of unknown quality.

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APPENDIX 1

Water-Resources Reconnaissance of Petersburg, Alaska

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES RECONNAISSANCE OF PETERSBURG, ALASKA

By

James A. McConaghy

Prepared in Cooperation with
the City of Petersburg, Alaska

Water Resources Division
Alaska District
July 1971

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WATER-RESOURCES RECONNAISSANCE OF PETERSBURG, ALASKA

By James A. McConaghy

INTRODUCTION

Scope and Purpose of Investigation

Petersburg, Alaska, has a history of water shortages that is of concern to its citizens. Most of the people of Petersburg depend either directly or indirectly on income from the fishing industry. Because fish processing requires large quantities of water, shortages at the height of the packing period are disasterous. Winter shortages, intensified by water being allowed to run to prevent freezing of the system, affect everyone in town. The recurring shortages have resulted in contracts and cooperative agreements with consultants and government agencies to investigate the water resources and to suggest improvement of the water-supply system. In 1965, the Stearns-Roger Corporation prepared a report for the city of Petersburg in which they evaluated three potential sources of water, Crystal Lake, Deer Creek,

and No Name Creek. They concluded that expansion of the present facility on No Name Creek, would provide the most suitable supply. The "City of Petersburg Comprehensive Development Plan" prepared by the Alaska State Housing Authority in 1966 suggested the construction (during 1967) of a pipeline from Crystal Lake, which is about 16 miles south of town. In December 1970, Redford Engineers prepared a preliminary engineers' report on water-system improvements for the city of Petersburg in which they proposed increased utilization of the present source.

In July 1970, the U.S. Geological Survey began a 1-year cooperative study to analyze the available data and to determine the type of data-collection program required to evaluate the water resources of the Petersburg area. The Geological Survey also agreed to assist the city in testing three wells. This report contains the findings of that study. Fieldwork consisted of about 15-man days spent interviewing local residents, surveying the area, and making a preliminary pump test on one well. The other wells had not been completed at the end of the study.

Geohydrologic Setting

Petersburg is located on the northwestern tip of Mitkof Island in southeastern Alaska. The 1970 Census showed a population of 2,042. Mitkof Island, typical of most of southeastern Alaska, is an area of high relief and abundant precipitation; it can be reached only by plane or by boat. The northwestern part of Mitkof Island is geologically and hydrologically different from the remainder of the island. In this area, a thick deposit of water-bearing sand and gravel has been found.

One possible explanation of the origin of this sand and gravel, tapped by the Roundtree well at Scow Bay, is that it was derived from rocks in the valleys on Kupreanof Island to the west. The ancestoral rivers that flowed in these valleys, now occupied by Petersburg and Coho Creeks and the unnamed tributary across from Skow Bay, converged near Petersburg. The deposit was subsequently eroded when Wrangell Narrows formed, hence a similar aquifer might be located across Wrangell Narrows from Petersburg. This reasoning also suggests that the low-lying area occupied by Falls and Big Creeks might be underlain by thick deposits of permeable sand and gravel.

STREAMFLOW

Streams near Petersburg are small and their runoff is variable (table 1). Their basins (fig. 1) range in size from one-half to about 23 square miles; the average basin area is about 4 square miles. The longest stream is only 8 miles. The gradient of all streams averages about 470 feet per mile. No intensive use is made of the surface-water resources except that Crystal Creek has been developed for power generation and No Name Creek provides the city water supply.

Table 1.--Characteristics of major drainage basins near Petersburg, Alaska.

Plate no.	Creek name	Latitude	Longitude	Miles to Petersburg	Length (miles)	Area (sq mi)	Altitude (head) (feet)	Altitude (mouth) (feet)	Average gradient (ft/mi)
1	Peter	56°48'31"	132°57'31"	0.3	0.8	0.71	100	0	120
2	South Hammer	56°48'25"	132°57'30"	0.4	0.9	0.71	100	0	110
3	North Hammer	56°48'23"	132°57'05"	0.3	1.4	0.63	175	0	120
4	No Name	56°47'31"	132°54'34"	2.5	3.9	3.17	1,300	0	330
5	Short	56°47'46"	132°52'11"	3.4	1.0	1.02	950	0	950
6	Rice	56°47'44"	132°51'43"	3.6	2.5	1.79	1,800	0	720
7	Little	56°47'46"	132°50'47"	4.1	0.9	0.44	1,450	0	1,610
8	Tasin	56°44'45"	132°56'25"	6.0	1.0	0.43	1,500	0	1,500
9	Deer	56°46'13"	132°47'52"	6.5	5.0	7.41	1,400	0	280
10	Twin	56°43'13"	132°55'34"	6.4	2.9	3.01	1,100	0	380
11	Frederick	56°45'32"	132°46'38"	7.6	3.7	4.53	1,100	0	300
12	Fur	56°42'30"	132°56'14"	7.3	1.8	1.20	1,150	0	640
13	Falls	56°41'00"	132°55'30"	10.0	8.0	17.29	850	0	110
14	Flat	56°43'08"	132°44'29"	10.3	2.0	3.68	250	0	120
15	Danger	56°40'06"	132°54'28"	10.0	1.4	0.63	200	0	140
16	Big Gulch	56°38'20"	132°54'00"	12.0	2.0	1.63	250	0	120
17	Big	56°42'00"	132°42'36"	12.0	7.0	22.93	1,200	0	170
18	Lake	56°41'00"	132°40'54"	13.5	0.5	0.54	150	0	300
19	Coney	56°40'23"	132°38'51"	15.1	2.8	3.18	150	0	50
20	Raven	56°35'55"	132°46'21"	16.2	2.5	1.79	1,900	25	760
21	Cosmos	56°38'43"	132°37'51"	16.9	5.5	7.16	1,225	0	220
22	Ledge	56°37'10"	132°57'14"	13.4	1.4	0.69	800	0	570
23	Anchor	56°37'41"	132°55'23"	12.7	2.5	1.90	1,050	0	420
24	Blind	56°37'33"	132°53'05"	13.0	2.7	3.78	1,300	0	480
25	Crystal	56°36'49"	132°49'17"	14.6	1.8	2.89	1,250	0	690
26	Battery	56°33'53"	132°57'21"	17.1	2.6	4.50	800	0	310
27	December	56°32'59"	132°57'25"	18.0	1.0	0.94	1,000	0	1,000
28	Alexander	56°30'26"	132°55'22"	21.0	1.3	0.41	1,100	0	850
29	Sumner	56°30'37"	132°52'30"	21.0	4.6	6.86	1,500	0	330
30	Muskeg	56°32'41"	132°46'46"	19.5	5.4	12.4	1,450	0	270
31	West	56°34'50"	132°44'28"	17.8	4.1	6.01	1,150	25	280
32	Quartz	56°32'17"	132°45'18"	20.5	2.0	2.13	875	0	440
33	East	56°34'50"	132°44'28"	17.8	4.0	7.76	1,750	0	440
34	Dry	56°37'17"	132°36'24"	18.8	2.5	4.06	1,350	0	540
35	Eagle	56°32'27"	132°40'40"	21.5	2.8	2.15	700	0	250
36	Steep	56°32'47"	132°40'00"	21.4	1.5	1.21	1,450	0	970
37	Manzanita	56°33'16"	132°38'33"	21.3	2.8	4.11	2,000	0	710
38	Sam	56°36'36"	132°35'50"	19.4	1.9	2.50	825	0	430
39	Favor	56°36'44"	132°34'45"	19.8	1.2	1.10	650	0	540
40	Blaquire	56°34'26"	132°34'04"	22.0	1.0	0.78	650	0	650

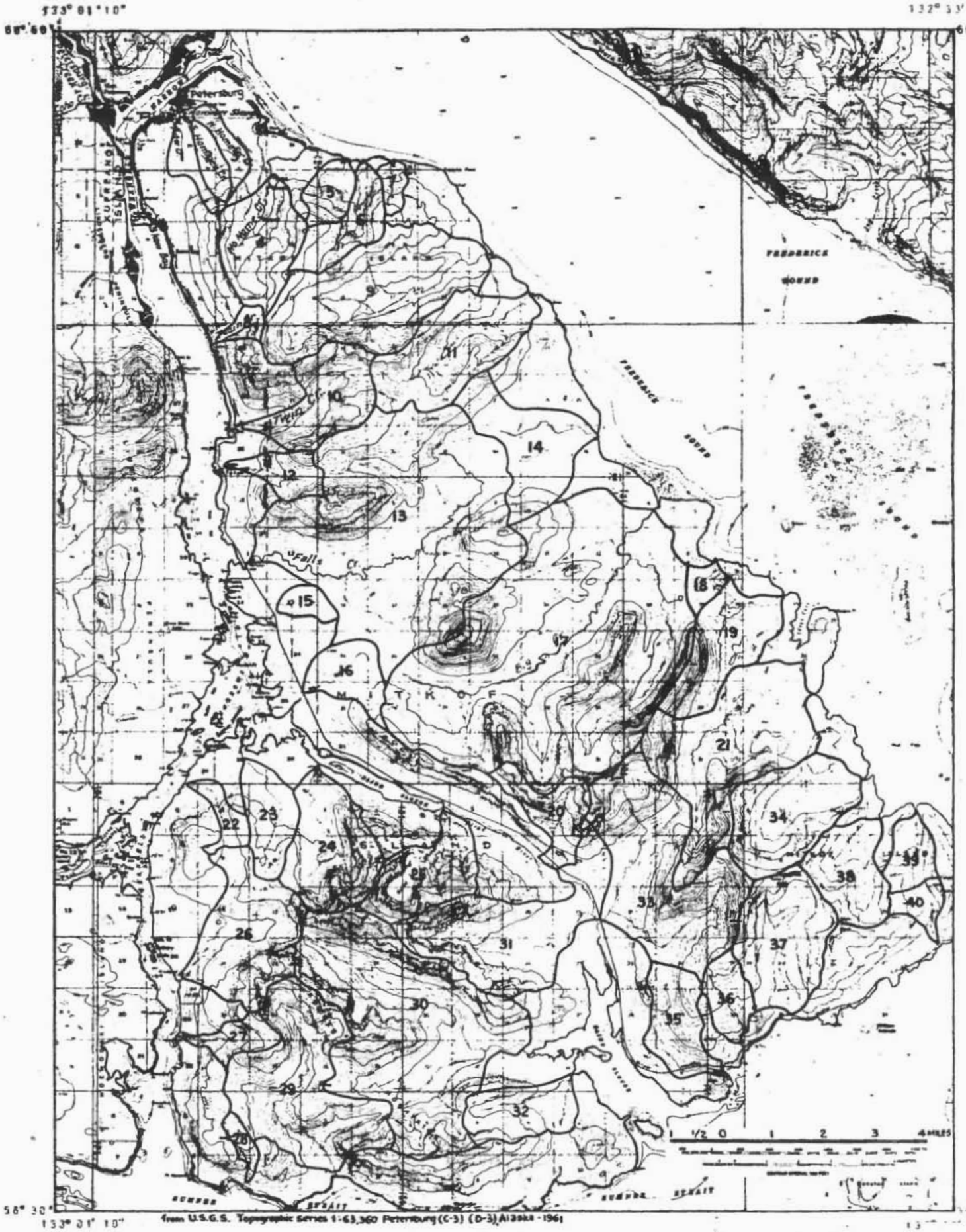


Figure 1.--Major drainage basins near Petersburg, Alaska.

(See table 1.)

GROUND WATER

Ground water is found in fractured bedrock and in unconsolidated sand and gravel near Petersburg. Two areas on Mitkof Island might be underlain by thick deposits of sand and gravel (fig. 2). An attempt was made on March 25, 1970, to test the Roundtree well at Scow Bay, which taps these deposits. The well was pumped at about 2,000 gpm (gallons per minute) for 5 hours but began increasingly to produce sand after 1 hour. At the end of 5 hours drawdown was about 100 feet. Drawdown for this same period in the Reid well (1,000 feet away) was about 40 feet. Although the test was generally unsatisfactory, it provided data that may be useful in planning future tests.

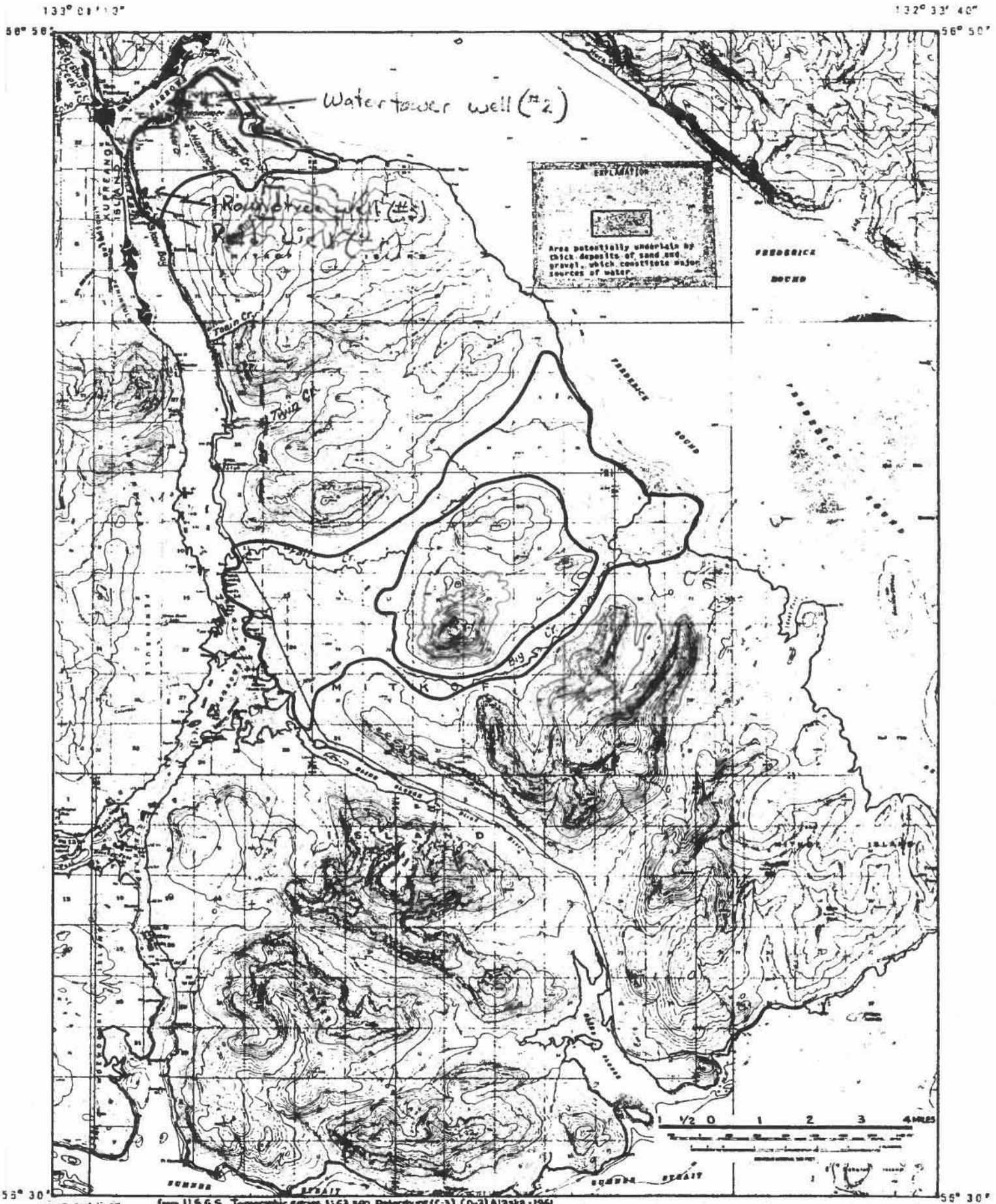


Figure 2.--Location of principal ground-water reservoirs near Petersburg, Alaska.

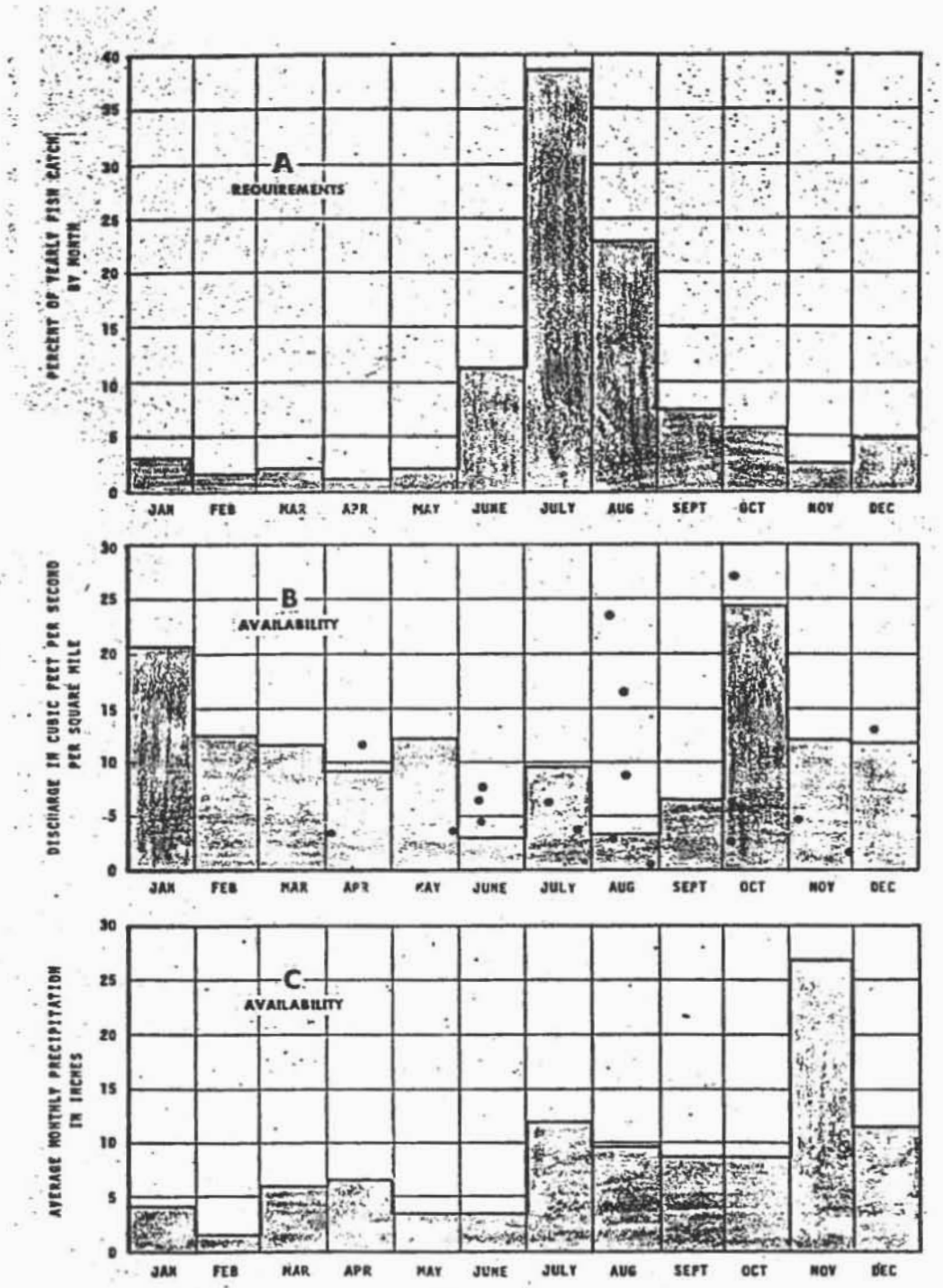
WATER USE

The present water supply for Petersburg is obtained from No Name Creek about two miles southeast of town. Water is collected in a shallow reservoir behind an earthfill dam and transmitted by a wood-stave line to be chlorinated and stored in a 100,000-gallon tank. The water contains some sediment and has some discoloration and odor. All areas within the city limits are served by the system. Present pressure in the distribution system is inadequate for fire-protection requirements.

In the outlying areas, consumers have developed wells or diverted water from streams or springs. There are few records of these wells and diversions. Domestic wells drilled near the ferry terminal generally have low yields, but those near Scow Bay are generally adequate. The successful drilling of domestic wells near Scow Bay resulted in the recent drilling of three large-diameter wells for the city, which have not been tested. Water for domestic supply can be obtained at most places on the island, but locations for public supplies are much more restricted. Wells drilled near tide water may supply brackish water, especially under heavy pumping.

Present water use for Petersburg, as computed by Redford Engineers (1970, p. 13), averages 1.5 mgd (million gallons per day). This includes an average of about 1.1 mgd by canneries and an average domestic per capita use of 180 gpd (gallons per day) or about 0.4 mgd. Average daily demand on the system was estimated to be about 4 mgd by 1980. The assumption of Stearns-Roger that peak day's rate equals 160 percent of the average daily rate indicates that peak day's rate would be more than 6 mgd by 1980.

Water use is seasonably related to fish processing. As shown in figure 3, precipitation and consequent streamflow are usually lowest when water demand is highest. Use and supply patterns such as this dictate the need for either surface- or ground-water storage.



A) WATER REQUIREMENTS: Indicated by fish processing. Data for 1969 from *Alaska Statistical Review, 1970*, p. 45; Department of Economic Development, State of Alaska.

B) WATER AVAILABILITY: Indicated by average monthly discharge of Hanmer Creek during two years of record and by random measurements (●) of Twin Creek since 1966.

C) WATER AVAILABILITY: Indicated by average monthly precipitation at Petersburg during 37 years of record by U.S. Weather Bureau.

Figure 3.--Water requirements and availability at Petersburg, Alaska.

DATA REQUIREMENTS

Data on water resources is scanty in the Petersburg area. As of 1971, data collected by the Geological Survey near Petersburg consisted of about 2 years of partial record on Hammer Creek; 4 years of partial record on Twin Creek; and operation of a newly installed continuous stream gage on No Name Creek. Miscellaneous data collected by the Geological Survey include several quality-of-water analyses, driller's log on the test well, and data on the aquifer test. These data are contained in tables 2, 3, and 4 of this report. A map (fig. 1) and a table (table 1) showing the extent and characteristics of the major drainage basins on Mitkof Island have already been introduced in this report.

Data needs at Petersburg are great. Although a comprehensive data-collection program will require time, an immediate start should be made with whatever funds are available to build the data base for this area. The most critical data needs are in conjunction with the expansion of the public water-supply system and its future management. However, the effects of waste disposal and urbanization on water resources should not

Table 2.--Geologist's log of Roundtree well (85,359).

LOCATION: Lat 56°46'10" N., long 132°58'27" E., NE1/4NW1/4SE1/4 sec. 4, T. 59 S., R. 79 E., Copper River meridian.

WELL DESCRIPTION:

Completed: March 1970
Depth: 207 ft (plugged from 250 ft)
Casing: 18 inch steel
Perforations: Louver, 107-207 ft.
Pump: Driller's diesel-powered vertical turbine; intake set at 195 ft; bowls set at 182 ft.

LOG:

	Depth of sample (feet)
Clay, dark gray with some ¼ in. pebbles that are well rounded black slate	50
Sand, coarse, angular, with silt	60
Sand, coarse to fine gravel, well rounded, quartz	70
Clay, dark gray	80
Silt with coarse sand	90
Silt, medium to fine gravel	100
Sand, coarse, angular with silt	110
Sand, coarse with angular volcanic pebbles	120
Sand, coarse with angular volcanic pebbles, silty	130
Same as 130 but pebbles up to ½ in.	140
Sand, coarse with angular volcanic pebbles	150
Sand, medium to coarse with rounded ¼ in. pebbles	160
Sand, medium to coarse, clean, well rounded, with angular ¼ in. pebbles	170
Sand, medium to coarse, angular	180
Sand, fine to medium, clean, with rounded ¼ in. pebbles	190
Sand, fine to medium, clean with rounded ¼ in. pebbles	200
Sand, coarse, angular with ¼ in. pebbles (unmarked)	207 (?)

Table 3.--Notes on short pumping test of Roundtree well.

Date	Hour	Elapsed time (minutes)	Pumping rate (gallons per minute)	Depth of water from measuring point (feet)	Drawdown (feet)	Remarks
3-24-70	0700	0	2,000	87	0	Well pumped by driller on day before scheduled pump test.
	1230	530	2,000	140	53	Pump off; water clear.
	2000	1,300	--	87.1	--	Water-level recovery observed overnight.
3-25-70	0045	--	--	87.3	--	
	0800	0	2,000	87.3	0	Pump test started; water clear.
	0802	2	2,000	111.1	23.8	Conductivity 900 micromhos
	0803	3	2,000	115.0	27.7	
	0804	4	2,000	117.0	29.7	
	0805	5	2,000	119.0	31.7	
	0806	6	2,000	120.0	32.7	
	0807	7	2,000	121.5	34.2	
	0808	8	2,000	123.0	35.7	
	0809	9	2,000	124.0	36.7	
	0810	10	2,000	125.0	37.7	
	0815	15	2,000	130.00	42.7	
	0820	20	2,000	134.00	46.7	

Table 3.--Notes on short pumping test of Roundtree well--Continued.

Date	Hour	Elapsed time (minutes)	Pumping rate (gallons per minute)	Depth of water from measuring point (feet)	Drawdown (feet)	Remarks
3-25-70	0825	25	2,000	138.5	51.2	
	0830	30	2,000	141.0	53.7	Water turned cloudy and became progressively worse.
	0835	35	2,000	144.5	57.2	
	0840	40	2,000	146.0	58.7	
	0845	45	2,000	147.5	60.2	
	0850	50	2,000	152.0	64.7	
	0900	60	2,000	154.9	67.6	
	0910	70	2,000	159.0	71.7	
	0920	80	2,000	163.0	75.7	
	0930	90	2,000	167.0	79.7	
	0940	100	2,000	168.0	80.7	
	1000	120	2,000	172.0	84.7	
	1020	140	2,000	176.5	89.2	
	1040	160	2,000	182.0	94.7	
	1100	180	2,000	184.5	97.2	
	1120	200	2,000	186.5	99.2	
	1150	230	2,000	192+	104.7+	Tape hung.
	1300	500	1,700 at 1230	--	--	Pump off; back flushed before test stopped.
	2240	1,440	--	102.0	--	Recovery
3-26-70	1040	--	--	102.0	--	

Table 3.--Notes on short pumping test of Roundtree well.--Continued.

Date	Hour	Elapsed time (minutes)	Pumping rate (gallons per minute)	Depth of water from measuring point (feet)	Drawdown (feet)	Remarks
			Reid Well (Observation well 1,000 feet from Roundtree well)			
3-25-70	0800	0	--	77.5	0	Pump test started.
	0820	20	--	78.2	0.7	
	0830	30	--	79.3	1.8	
	0840	40	--	81.7	4.2	
	0850	50	--	83.4	5.9	
	0900	60	--	85.0	7.5	
	0920	80	--	86.9	9.4	
	0940	100	--	90.5	13.0	
	1020	140	--	96.5	19.0	
	1040	160	--	100.5	23.0	
	1100	180	--	103.0	26.5	
	1120	200	--	106.7	29.2	
	1150	230	--	109.3	31.8	Observation discontinued.

Table 4.--Selected water-quality analyses of wells and streams near Petersburg, Alaska.

(Values in milligrams per liter except where indicated)

Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color
														Noncarbonate			
No. Name Creek: City of Petersburg Water Supply																	
9-15-59	2.7	.2	1.6	.2	1.0	.1	5	1.0	2.0	0	.1	11	5	1	15	6.3	80
1-11-65	4.1	.07	2.2	1.5	1.2	.3	5	6.7	2.8	.1	1.0	22	12	8	30	6.0	50
7-11-66	1.7	.28	.0	1.9	0	0	5.0	1.0	1.0	.2	.6	9	8.0	3.9	32	6.0	20
5- 2-67	1.9	1.4	1.0	.3	.6	.5	2	1.0	.0	.0	.1	8	4	2	15	6.0	20
7-10-67	2.2	.07	.6	.2	1.4	0	3	1.0	.0	.0	1.3	8	3	2.2	20	5.8	75
6-22-68	1.9	.13	.5	.2	.5	.0	4.8	.0	.3	.0	.0	6	2	0	10	6.0	55
8- 8-68	4.3	1.22	1.3	.8	.8	.1	2.2	.4	1.4	.2	.9	11	3	2.2	20	5.8	75
12-12-68	2.4	.4	1.0	.4	1.1	.1	4	.0	.7	.1	.0	7	4	1	16	6.1	5
1- 8-71	1.6	.25	1.0	.2	.8	.2	1.5	.4	2.0	.1	.2	7.2	3.5	2.3	12	6.4	0
Well No. 85,354: City of Petersburg test well on Reid property																	
5-20-69	16	1.21	10	5.6	166	10	371	26	63	.6	.1	483	49	0	809	8.4	10
Well No. 85,359: City of Petersburg test well on Roundtree property																	
3-10-70	13	.12	24	14	139	49	471	20	53	.5	.5	548	118	0	960	8.2	---
10-23-70	20	.04	32	6.1	166	9.0	473	23	50	.8	---	542	388	0	1000	7.9	---

be overlooked. The city's decision to discontinue ground-water development in favor of surface-water development dictates that the currect data-collection program emphasize surface water. However, ground water is a valuable resource for the city of Petersburg, and its orderly development should be encouraged. By study of new well records and acquisition of quantitative information and proper planning of urban development, the city can do much to assure optimum use of ground water. Data are needed on the thickness and extent of the sand and gravel deposit, on the rate that water moves through the deposit, and on the quality of water. These data can only be obtained by test drilling to bedrock at selected sites and testing wells for both yield and quality of the water. Few new wells should be drilled until the records of previous wells are evaluated. In general, a protracted testing program would be more effective than a crash program, although drilling might be cheaper if several holes were contracted at one time. The quality of both surface water and ground water is important, and data should be acquired to supply this information.

Data of this kind will permit the local water manager to choose from the many options available to him. The present water source might be adequate for future needs, but supplemental sources should be considered. The projected maximum daily demand of slightly more than 6 mgd could be supplied by wells, an infiltration gallery, or a small stream. A combined well yield of about 4,200 gpm, or an average streamflow of 9.3 cfs (cubic feet per second) would be adequate.

Water supply is a principal concern to the people of Petersburg, but they also need data on other aspects of their water resources. Data are needed on the quantity of water discharged from the public-supply system through sewers. Such data are useful in determining the condition of the sewage-collection system. If sewage volume increases for no apparent reason, the plant operator might find that ground water is entering the system. On the other hand, pronounced decreases in sewage volume could indicate contamination of shallow aquifers by leakage from the system. Periodic sampling of water quality at selected wells and streams would document the status of quality of the present environment and permit solution of pollution problems before they become serious. Although good records are being kept on total water used, details

of the use are not known. The total water available from No Name Creek and the magnitude of seasonal or long-term variations are presently unknown. Eventually, conflicts of water use will arise, and decisions as to the most appropriate use will have to be made. These decisions will be much easier after a data base has been established.

APPENDIX 2

Miscellaneous hydrologic data for the Petersburg area, Alaska

LOCAL WELL NUMBER		PRIMARY USE OF WATER	DEPTH OF WELL (FEET)	WATER LEVEL (FEET)	DATE WELL CONSTRUCTED	OWNER	ASSIGNOR OF OTHER IDENTIFIER	OTHER IDENTIFIER	TYPE OF LOG AVAILABLE
CD05907904DBBA1	003	H	181	--	11-07-77	THOMASSEN ELEANORE	REID SUB	L03	D
						EIDE JOHN	--	--	-
CD05907904DBCA1	001	H	146	--	12-05-70	PETERSON NEAL&ARLENE	--	--	D
CD05907904DDBB1	002	H	122	--	06-14-74	LYONS WILLIAM&ANN	--	--	D
CD05907904DDBB2	002	H	174	28.00	10-24-63	REID ALEX	--	--	D
CD05907904DDCA1	004	H	107	--	03-09-70	HEINER LARRY	--	--	D
CD05907909AABA1	001	H	95.0	--	03-02-69	REID STAN	--	--	D
CD06108115DDBD1	001	P	61.5	-1.5	12-19-85	USFS TONGASS N.F.	SECTION 15 LOTS	UNSUBD LOT	D
						--	USFS	OHMER CK	-

STATION NUMBER	DATE	TIME	LAT-I-TUDE	LONG-I-TUDE	LOCAL IDENT-I-FIER	MEDIUM CODE	SAMPLE TYPE	RECORD NUMBER
15087200	04-20-65	1400	56 48 27 N	132 57 10 W	HAMMER SLOUGH AT PETERSBUR	9	9	96500039
15087200	06-19-65	1800	56 48 27 N	132 57 10 W	HAMMER SLOUGH AT PETERSBUR	9	9	96500040
15087200	10-10-65	1530	56 48 27 N	132 57 10 W	HAMMER SLOUGH AT PETERSBUR	9	9	96600037
15087545	01-29-80	1600	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98000083
15087545	04-15-80	1400	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98000084
15087545	08-01-80	1515	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98000085
15087545	11-01-80	1600	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100237
15087545	02-12-81	1530	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100238
15087545	06-03-81	1730	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100239
15087545	06-03-81	1731	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100240
15087545	06-03-81	1732	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100241
15087545	06-03-81	1733	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100242
15087545	06-03-81	1734	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98100243
15087545	10-12-81	1500	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98200066
15087545	12-10-81	1530	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98200067
15087545	03-28-82	1200	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98200068
15087545	06-05-82	1330	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98200069
15087545	08-06-82	1500	56 46 40 N	132 55 07 W	MUNICIPAL WATERSHED C NR P	9	9	98200070
15087550	06-22-68	1245	56 47 21 N	132 54 39 W	PETERSBURG CITY RE AT PETE	9	9	96800127
15087550	12-12-68	1330	56 47 21 N	132 54 39 W	PETERSBURG CITY RE AT PETE	9	9	96900052
15087560	01-08-71	--	56 47 31 N	132 54 33 W	NO NAME C NR PETERSBURG AK	9	9	97100112
15087560	05-14-71	0850	56 47 31 N	132 54 33 W	NO NAME C NR PETERSBURG AK	9	9	97100113
15087560	07-22-71	0915	56 47 31 N	132 54 33 W	NO NAME C NR PETERSBURG AK	9	9	97100114
15087560	09-07-71	1640	56 47 31 N	132 54 33 W	NO NAME C NR PETERSBURG AK	9	9	97100115
564440132562200	03-11-70	1230	56 44 40 N	132 56 22 W	TAAIN C NR PETERSBURG AK	9	9	97000738

STATION NUMBER	DATE	STREAM WIDTH (FT) (00004)	SAMPLE LOC-ATION, CROSS SECTION (FT FM L BANK) (00009)	TEMPER-ATURE WATER (DEG C) (00010)	AGENCY COL-LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) (00028)	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	TUR-BID-ITY (NTU) (00076)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)
15087200	04-20-65	--	--	4.0	--	--	3.9	--	--	--
15087200	06-19-65	--	--	8.0	--	--	60	--	--	--
15087200	10-10-65	--	--	7.0	--	--	3.2	--	--	--
15087545	01-29-80	--	--	--	--	80020	2.0	--	--	24
15087545	04-15-80	--	--	1.5	--	80020	35	--	--	12
15087545	08-01-80	--	--	10.5	--	80020	69	--	--	11
15087545	11-01-80	23.0	--	6.5	--	80020	82	--	--	13
15087545	02-12-81	5.50	--	0.5	--	80020	1.2	0.11	--	23
15087545	06-03-81	23.0	--	--	--	80020	118	--	--	--
15087545	06-03-81	--	5.00	7.0	--	--	--	--	--	2
15087545	06-03-81	--	10.0	7.0	--	--	--	--	--	2
15087545	06-03-81	--	15.0	7.0	--	--	--	--	--	2
15087545	06-03-81	--	20.0	7.0	--	--	--	--	--	2
15087545	10-12-81	--	--	6.0	80020	80020	3.7	--	--	<25
15087545	12-10-81	--	--	0.0	80020	80020	3.2	--	--	5
15087545	03-28-82	--	--	0.5	80020	80020	3.8	--	--	30
15087545	06-05-82	--	--	5.0	80020	80020	21	--	--	17
15087545	08-06-82	--	--	11.0	80020	80020	7.4	--	--	<25
15087550	06-22-68	--	--	10.0	--	--	--	--	55	10
15087550	12-12-68	--	--	--	--	--	--	--	5	16
15087560	01-08-71	--	--	0.0	--	--	33	--	0	12
15087560	05-14-71	--	--	1.0	--	--	37	--	--	11
15087560	07-22-71	--	--	14.5	--	--	3.3	--	25	14
15087560	09-07-71	--	--	9.0	--	--	72	--	60	10
564440132562200	03-11-70	--	--	--	--	--	1.0	--	--	80

STATION NUMBER	DATE	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	PH WATER WHOLE LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	ALKA-LINITY WAT WH TOT FET FIELD MG/L AS CACO3 (00410)	BICAR-BONATE WATER WH FET FIELD MG/L AS HCO3 (00440)	CAR-BONATE WATER WH FET FIELD MG/L AS CO3 (00445)	NITRO-GEN DIS-SOLVED (MG/L AS N) (00602)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)
15087200	04-20-65	--	--	--	--	--	--	--	--	--
15087200	06-19-65	--	--	--	--	--	--	--	--	--
15087200	10-10-65	--	--	--	--	--	--	--	--	--
15087545	01-29-80	13.0	6.3	--	3.6	3	4	0	0.58	0.49
15087545	04-15-80	12.6	6.3	--	2.7	2	3	0	0.83	0.83
15087545	08-01-80	10.0	5.1	--	40	2	3	0	0.25	0.25
15087545	11-01-80	11.4	6.3	5.8	--	2	--	--	0.69	0.64
15087545	02-12-81	13.8	--	6.1	--	--	--	--	0.66	0.53
15087545	06-03-81	--	--	5.5	--	2	--	--	0.66	0.54
15087545	06-03-81	11.9	4.5	--	--	--	--	--	--	--
15087545	06-03-81	11.9	4.5	--	--	--	--	--	--	--
15087545	06-03-81	12.0	4.5	--	--	--	--	--	--	--
15087545	06-03-81	12.0	4.5	--	--	--	--	--	--	--
15087545	10-12-81	11.3	6.7	6.2	--	3	--	--	--	--
15087545	12-10-81	11.5	6.3	6.3	--	5	--	--	--	--
15087545	03-28-82	13.2	6.2	6.5	--	5	--	--	0.51	--
15087545	06-05-82	13.1	5.5	6.4	--	1	--	--	--	1.6
15087545	08-06-82	11.0	--	6.8	--	--	--	--	1.4	1.1
15087550	06-22-68	--	6.0	--	8.0	4	5	--	--	--
15087550	12-12-68	--	6.1	--	5.1	3	4	0	--	--
15087560	01-08-71	--	6.4	--	1.3	2	2	0	--	--
15087560	05-14-71	--	6.3	--	2.4	2	3	--	--	--
15087560	07-22-71	--	6.4	--	1.9	2	3	0	--	--
15087560	09-07-71	--	6.2	--	4.0	3	4	0	--	--
564440132562200	03-11-70	--	7.7	--	1.2	30	37	--	--	--

STATION NUMBER	DATE	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRATE TOTAL (MG/L AS N) (00620)	NITRO-GEN, AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	HARD-NESS NONCARB WH WAT TOT FLD MG/L AS CACO3 (00902)
15087200	04-20-65	--	--	--	--	--	--	--	--	--
15087200	06-19-65	--	--	--	--	--	--	--	--	--
15087200	10-10-65	--	--	--	--	--	--	--	--	--
15087545	01-29-80	0.030	--	0.060	0.52	0.060	0.060	0.010	10	7
15087545	04-15-80	0.00	--	--	0.83	0.00	0.00	0.020	2	0
15087545	08-01-80	0.00	--	--	0.25	0.00	0.00	0.040	4	2
15087545	11-01-80	0.050	--	--	0.69	0.00	0.00	0.050	4	--
15087545	02-12-81	0.090	--	0.040	0.62	0.040	0.040	0.010	6	--
15087545	06-03-81	0.120	--	--	0.66	0.00	0.00	0.020	11	9
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	10-12-81	<0.060	--	--	<0.21	--	<0.090	<0.010	13	10
15087545	12-10-81	<0.070	--	--	0.61	--	<0.100	0.020	6	1
15087545	03-28-82	<0.060	--	0.180	0.33	0.180	0.180	<0.010	6	1
15087545	06-05-82	0.060	--	--	1.7	--	<0.100	0.070	2	1
15087545	08-06-82	0.130	--	0.180	1.2	0.180	0.180	0.050	5	--
15087550	06-22-68	--	0.00	--	--	--	--	--	2	0
15087550	12-12-68	--	0.00	--	--	--	--	--	4	1
15087560	01-08-71	--	0.050	--	--	--	--	--	3	2
15087560	05-14-71	--	--	--	--	--	--	--	4	1
15087560	07-22-71	--	0.090	--	--	--	--	--	6	4
15087560	09-07-71	--	0.050	--	--	--	--	--	4	1
564440132562200	03-11-70	--	0.050	--	--	--	--	--	33	3

STATION NUMBER	DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	SODIUM PERCENT (00932)	SODIUM+ POTAS-SIUM DIS-SOLVED (MG/L AS NA) (00933)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)
15087200	04-20-65	--	--	--	--	--	--	--	--	--
15087200	06-19-65	--	--	--	--	--	--	--	--	--
15087200	10-10-65	--	--	--	--	--	--	--	--	--
15087545	01-29-80	2.9	0.60	1.0	0.1	17	1.7	0.70	1.7	1.0
15087545	04-15-80	0.80	0.10	0.60	0.2	33	--	0.20	0.60	1.9
15087545	08-01-80	1.0	0.30	0.60	0.1	24	--	0.30	0.60	2.3
15087545	11-01-80	0.80	0.60	0.60	0.1	21	--	0.40	1.0	1.5
15087545	02-12-81	1.6	0.40	1.0	0.2	27	--	0.30	0.60	2.0
15087545	06-03-81	4.1	0.20	0.90	0.1	15	--	0.20	0.50	4.9
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	10-12-81	4.2	0.50	1.1	0.1	16	--	0.30	1.1	<5.0
15087545	12-10-81	1.7	0.35	0.80	0.1	22	--	0.50	0.80	7.0
15087545	03-28-82	1.9	0.38	0.90	0.2	23	--	0.30	1.1	6.0
15087545	06-05-82	0.69	0.17	0.50	0.1	28	--	0.30	0.70	<5.0
15087545	08-06-82	1.5	0.42	0.80	0.1	23	--	0.40	0.70	9.0
15087550	06-22-68	0.50	0.20	0.50	0.2	34	--	0.0	0.30	0.0
15087550	12-12-68	1.0	0.40	1.1	0.2	36	--	0.10	0.70	0.0
15087560	01-08-71	1.0	0.20	0.80	0.2	33	--	0.20	2.0	0.40
15087560	05-14-71	--	--	--	--	--	--	--	--	--
15087560	07-22-71	1.6	0.50	0.60	0.1	17	--	0.20	1.5	2.0
15087560	09-07-71	1.0	0.40	0.50	0.1	20	--	0.20	0.50	0.40
564440132562200	03-11-70	10	1.9	1.0	0.1	6	--	2.0	2.8	3.8

STATION NUMBER	DATE	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR) (01034)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE) (01045)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN) (01055)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)
15087200	04-20-65	--	--	--	--	--	--	--	--	--
15087200	06-19-65	--	--	--	--	--	--	--	--	--
15087200	10-10-65	--	--	--	--	--	--	--	--	--
15087545	01-29-80	0.0	3.5	--	--	--	--	--	--	--
15087545	04-15-80	0.10	1.8	--	--	--	--	--	--	--
15087545	08-01-80	0.10	2.4	--	--	--	--	--	--	--
15087545	11-01-80	0.10	1.6	--	--	--	--	--	--	--
15087545	02-12-81	0.0	4.2	--	--	--	--	--	--	--
15087545	06-03-81	0.0	1.7	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	10-12-81	<0.10	4.2	--	--	--	--	--	--	--
15087545	12-10-81	0.0	4.1	--	--	--	--	--	--	--
15087545	03-28-82	0.10	4.7	--	--	--	--	--	--	--
15087545	06-05-82	<0.10	1.6	--	--	--	--	--	--	--
15087545	08-06-82	<0.10	3.9	--	--	--	--	--	--	--
15087550	06-22-68	0.0	1.9	--	--	--	--	--	--	--
15087550	12-12-68	0.10	2.4	0	0	70	--	0	--	0
15087560	01-08-71	0.10	1.6	--	--	--	250	--	10	--
15087560	05-14-71	--	--	--	--	--	--	--	--	--
15087560	07-22-71	0.20	2.8	--	--	--	100	--	0	--
15087560	09-07-71	0.10	2.2	--	--	--	260	--	10	--
564440132562200	03-11-70	0.0	4.0	--	--	--	--	--	--	--

STATION NUMBER	DATE	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	ZINC, DISSOLVED (UG/L AS ZN) (01090)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	METHYLENE BLUE ACTIVE SUBSTANCE (MG/L) (38260)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	NITROGEN, AMMONIA DISSOLVED (MG/L AS NH4) (71846)
15087200	04-20-65	--	--	--	--	--	--	--	--	--
15087200	06-19-65	--	--	--	--	--	--	--	--	--
15087200	10-10-65	--	--	--	--	--	--	--	--	--
15087545	01-29-80	--	--	--	--	--	14	0.07	0.02	0.04
15087545	04-15-80	--	--	--	--	--	8	0.72	0.01	0.0
15087545	08-01-80	--	--	--	--	--	9	1.69	0.01	0.0
15087545	11-01-80	--	--	--	--	--	8	1.75	0.01	0.06
15087545	02-12-81	--	--	--	--	--	--	--	--	0.12
15087545	06-03-81	--	--	--	--	--	14	4.41	0.02	0.15
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	06-03-81	--	--	--	--	--	--	--	--	--
15087545	10-12-81	--	--	--	--	--	18	0.18	0.02	0.08
15087545	12-10-81	--	--	--	--	--	18	0.16	0.02	0.09
15087545	03-28-82	--	--	--	--	--	19	0.20	0.03	0.08
15087545	06-05-82	--	--	--	--	--	--	--	--	0.08
15087545	08-06-82	--	--	--	--	--	--	--	--	0.17
15087550	06-22-68	--	--	--	--	--	6	--	0.01	--
15087550	12-12-68	0	10	0	0	0.0	8	--	0.01	--
15087560	01-08-71	--	--	--	--	--	8	0.67	0.01	--
15087560	05-14-71	--	--	--	--	--	--	--	--	--
15087560	07-22-71	--	--	--	--	--	11	0.10	0.02	--
15087560	09-07-71	--	--	--	--	--	7	1.46	0.01	--
564440132562200	03-11-70	--	--	--	--	--	44	0.12	0.06	--

STATION NUMBER	DATE	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	MANGANESE (UG/L AS MN) (71883)	IRON (UG/L AS FE) (71885)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	DRAINAGE AREA (SQ. MI.) (81024)	POTASSIUM 40 DISSOLVED (PCI/L AS K40) (82068)	SPECIFIC CONDUCTANCE LAB (US/CM) (90095)
15087200	04-20-65	--	--	--	--	4	0.04	1.46	--	--
15087200	06-19-65	--	--	--	--	23	3.7	1.46	--	--
15087200	10-10-65	--	--	--	--	10	0.09	1.46	--	--
15087545	01-29-80	--	--	--	400	1	0.01	2.20	--	--
15087545	04-15-80	--	--	--	400	3	0.29	2.20	--	--
15087545	08-01-80	--	--	--	400	5	0.93	2.20	--	--
15087545	11-01-80	--	--	--	400	13	2.9	2.20	--	9
15087545	02-12-81	--	--	--	400	1	0.00	2.20	0.20	17
15087545	06-03-81	--	--	--	400	4	1.3	2.20	0.20	11
15087545	06-03-81	--	--	--	400	--	--	2.20	--	--
15087545	06-03-81	--	--	--	400	--	--	2.20	--	--
15087545	06-03-81	--	--	--	400	--	--	2.20	--	--
15087545	06-03-81	--	--	--	400	--	--	2.20	--	--
15087545	10-12-81	--	--	--	400	2	0.02	2.20	--	15
15087545	12-10-81	--	--	--	400	0	0.0	2.20	--	10
15087545	03-28-82	--	--	--	400	3	0.03	2.20	--	27
15087545	06-05-82	--	--	--	400	--	--	2.20	--	11
15087545	08-06-82	--	--	--	400	0	0.0	2.20	--	18
15087550	06-22-68	0.0	--	130	--	--	--	--	--	--
15087550	12-12-68	0.0	20	40	--	--	--	--	--	--
15087560	01-08-71	0.20	--	--	250	--	--	3.17	--	--
15087560	05-14-71	--	--	--	250	--	--	3.17	--	--
15087560	07-22-71	0.40	--	--	250	--	--	3.17	--	--
15087560	09-07-71	0.20	--	--	250	--	--	3.17	--	--
564440132562200	03-11-70	0.20	--	30	--	--	--	--	--	--