Overview of Environmental and Hydrogeologic Conditions at Tanana, Alaska

By Allan S. Nakanishi and Joseph M. Dorava

U.S. GEOLOGICAL SURVEY

Open-File Report 94-527

Prepared in cooperation with the

FEDERAL AVIATION ADMINISTRATION

Anchorage, Alaska
1994

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

For additional information write to:

District Chief
U.S. Geological Survey
4230 University Drive, Suite 201
Anchorage, AK 99508-4664

Copies of this report may be purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Federal Center
Denver, CO 80225-0425

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
centimeter (cm)	0.3937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
square kilometer (km^2)	0.3861	square mile
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 x °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 both the United States and Canada, formerly called Sea Level Datum of 1929.

Other abbreviation used in this report:

mg/L, milligram per liter

Overview of Environmental and Hydrogeologic Conditions at Tanana, Alaska

By Allan S. Nakanishi and Joseph M. Dorava

Abstract

The remote Native village of Tanana along the Yukon River in west-central Alaska has long cold winters and short summers. The Federal Aviation Administration owns or operates airway support facilities near Tanana and wishes to consider the subsistence lifestyle of the residents and the quality of the current environment when evaluating the severity of environmental contamination at these facilities. Tanana is located on the flood plain of the Yukon River and obtains its drinking water from a shallow aquifer located in thick alluvium underlying the village. Surface spills and disposal of hazardous materials combined with annual flooding of the Yukon River may affect the quality of the ground water. Alternative drinking-water sources are available, but may cost more than existing supplies.

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 (PCB's), 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 (CERCLA or "Superfund Act") and the Resource Conservation and Recovery Act (RCRA). To complete these environmental studies, the FAA requires information on the hydrology and geology of areas surrounding the sites. This report is the product of a compilation, review, and summary of existing hydrologic and geologic data by the U.S. Geological Survey, in cooperation with the FAA, and provides such information for the FAA facility and nearby areas at Tanana, Alaska.

BACKGROUND

Location

Tanana (fig. 1) is located in the western interior of Alaska at latitude 65°10'00" N., longitude 152°04'00" W., approximately 350 km west of Fairbanks. Tanana is on the north bank of the Yukon River, approximately 5 km northwest from the mouth of the Tanana River. The FAA facilities are at the Tanana airport (fig. 2), which has a 1340-m gravel runway immediately north of the village (Campbell, 1985; U.S. Army Corps of Engineers, 1987).

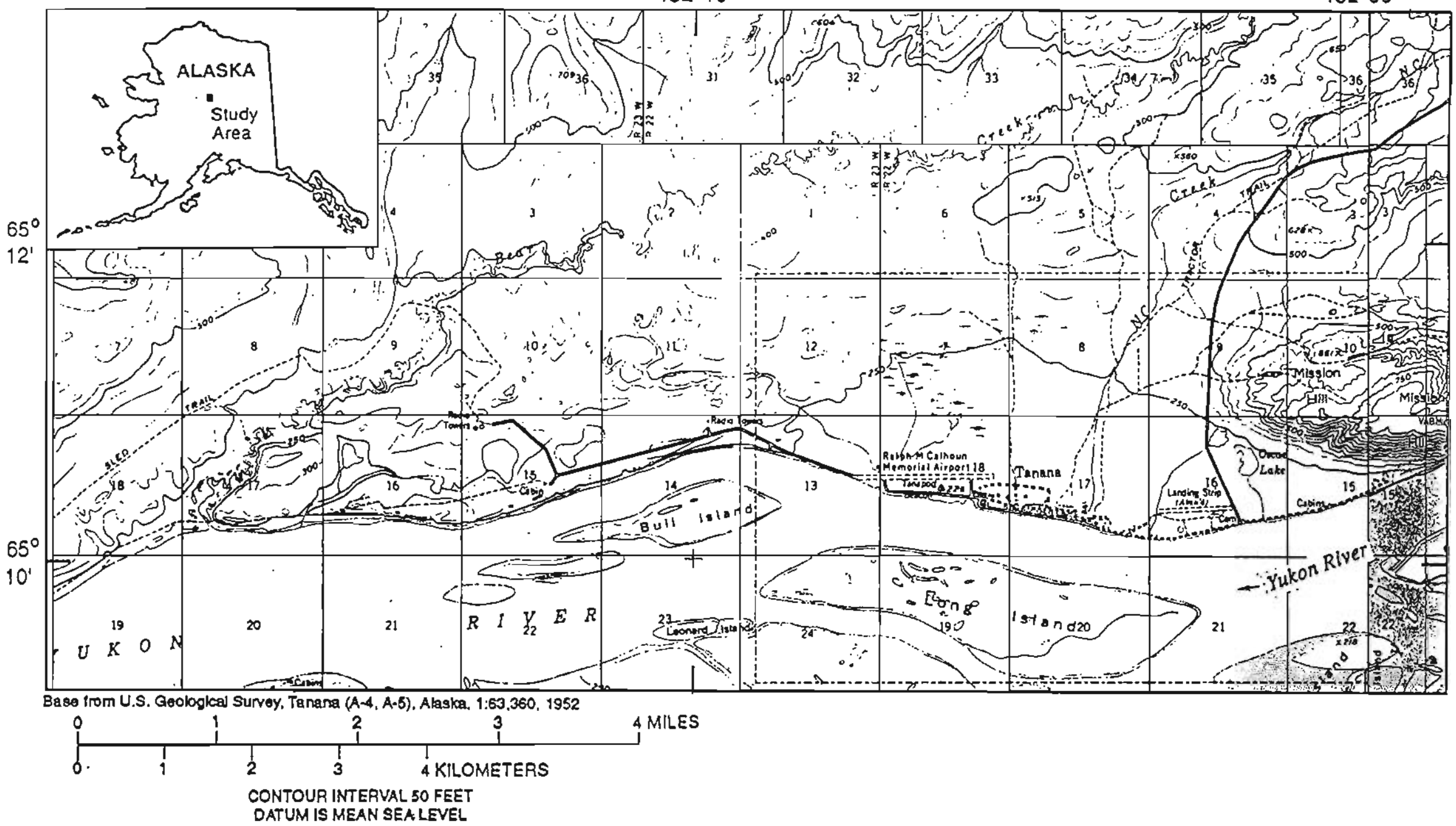


Figure 1. Location of Tanana.

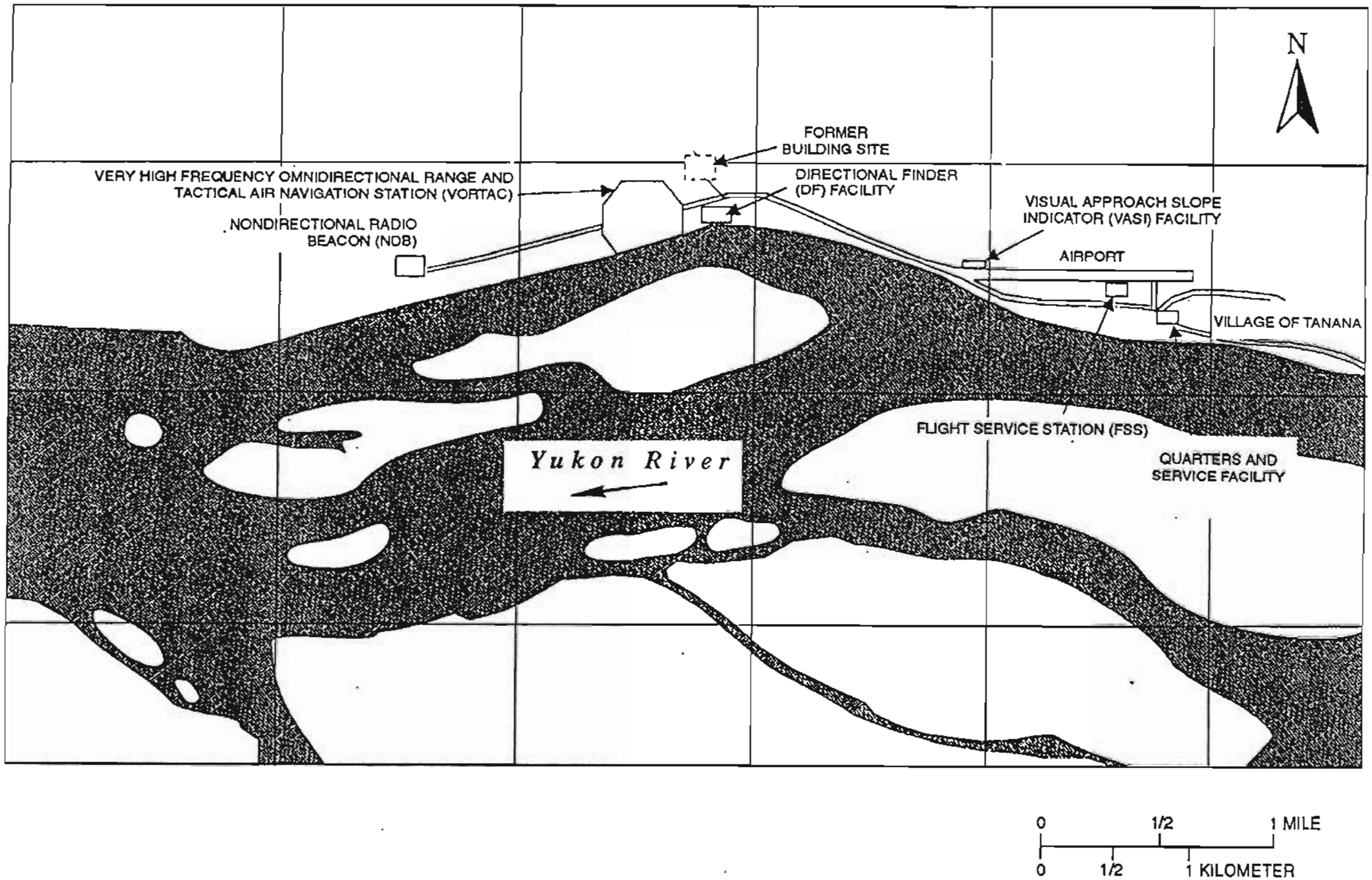


Figure 2. Location of Federal Aviation Administration (FAA) facilities near the village of Tanana (modified from Ecology and Environment Inc., 1992).

History and Socioeconomics

The area around Tanana was originally the territory of the Tanana and Koyukon Athabascan Indians who used semi-permanent sites along the Yukon River during the spring and summer to harvest fish and waterfowl (Campbell, 1985). During the mid-1800's, early European traders established Tanana as a trading outpost with the local Indians. The St. James Mission built a school and hospital complex between 1887 and 1900, which established Tanana as an important service and social contact center for area residents (Alaska Department of Community and Regional Affairs, 1993). The U.S. Army established Fort Gibbon in 1898 to maintain a telegraph line connecting Fairbanks to Nome (Campbell, 1985; Alaska Department of Community and Regional Affairs, 1993). The Tanana Hospital, which was in operation from the early 1940's to 1982, was for many years the only medical facility serving Interior Alaska. The activities of the regional hospital supported the expansion of the airport and FAA facilities, making Tanana an important air terminal and refueling stop (Campbell, 1985).

Tanana was incorporated as a first-class city in 1961. The village is managed by an elected mayor and a six-member council. According to the U.S. Bureau of Census (1991), the population of Tanana in 1990 was 345, of which 78 percent were American Indian, Eskimo, or Aleut. The Tanana economy is highly dependent on government spending and subsistence (Campbell, 1985; Fison and Associates, 1987). Many of the government jobs, however, are seasonal and part time. Trapping and commercial fishing also provide seasonal cash income.

PHYSICAL SETTING

Climate

Tanana is situated at the southwestern tip of the Rampart Trough physiographic province (Wahrhaftig, 1965). The area surrounding Tanana is described by Hartman and Johnson (1984) as having continental climatic conditions. Low precipitation, low cloudiness, low humidity, light surface winds, and great diurnal and annual temperature variations are typical. Freezing of the Yukon River typically occurs in early to mid-October and break-up occurs in mid-May (Fountain, 1984; Fountain and Vaughn, 1984). The mean annual temperature is -4.4 °C, but temperatures range from a July mean maximum of 21.3 °C to a January mean minimum of -27.4 °C. Mean annual precipitation is 336 mm; approximately 1,270 mm of snow falls annually (Leslie, 1989). Most rainfall occurs in July and August. Mean monthly temperature, precipitation, and snowfall are summarized for the periods 1922-76 and 1985-87 in table 1.

Vegetation

The Tanana area forest consists of a closed spruce-hardwood along the Yukon River (Viereck and Little, 1972). Well-drained, high-relief areas contain aspen, birch, poplar, and white spruce (Campbell, 1985; Hartman and Johnson, 1984). The flat, poorly drained areas away from the river consist predominantly of densely spaced black spruce, birch, and alder. The forest floor in both well and poorly drained areas has undergrowth that includes moss, sedge, alder, willow, wild rose, high and low bush cranberry, blueberry, Labrador tea and equisetum (Campbell, 1985). Poorly drained wet areas contain extensive growths of muskeg, sedges, tussock grasses, dwarf birch, and larch.

Table 1. Mean monthly temperature, precipitation, and snowfall for the combined periods 1922-76 and 1985-87, Tanana
[Modified from Leslie (1989); °C, degree Celsius; mm, millimeter]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temperature (°C)													
Mean maximum	-18.9	-15.5	-7.9	2.4	13.4	20.7	21.3	17.8	10.6	-0.9	-12.7	-18.8	0.9
	(Record maximum: 34.4 June 1933)												
Mean minimum	-27.4	-25.8	-21.2	-10.6	0.4	6.9	8.4	6.2	0.7	-8.6	-20.4	-27.2	-9.9
	(Record minimum: -57.2 January 1947)												
Mean	-23.2	-20.7	-14.6	-4.1	6.9	13.8	14.9	12.0	5.6	-4.8	-16.6	-23.0	-4.4
Precipitation (mm of moisture)	16.5	13.5	13.7	8.9	16.8	34.5	58.4	69.9	46.2	24.1	17.0	16.5	335.8
Snowfall (mm)	208.3	177.8	193.0	68.6	7.6	0.0	0.0	0.0	17.8	195.6	188.0	218.4	1272.5

Bedrock Geology

The mountains and hills north of Tanana consist primarily of metamorphic and sedimentary rock. Sedimentary rock includes limestone, dolomite, greenstone, and chloritic schist of Paleozoic age (Chapman and others, 1982). Metamorphic rock includes quartz-mica schist, quartzite, slate, and phyllite which are early Paleozoic to Precambrian in age. Mission Hill, approximately 8 km west of the airport, is the closest bedrock exposure and is composed of conglomerate, sandstone, shale, siltstone and minor amounts of lignite of Tertiary age (Chapman and others, 1982). An early report by Mertie (1937) described the geomorphology, bedrock geology, and economic geology of the Yukon-Tanana Region. Drillers' logs for wells near Tanana indicate sandstone at an average depth of 15 m below land surface, and schist at approximately 19 m and 43 m depth below land surface (appendix 1).

Surficial Geology and Soils

The surficial deposits in the Tanana area are of Quaternary age and consist of alluvial, colluvial, and eolian deposits (Chapman and others, 1982). Alluvial deposits consist of sandy gravel and sandy silt with sub-rounded to well-rounded coarse-grained clasts. Alluvium was deposited in much of the flood plain of the Yukon River and its tributaries. Colluvial deposits are undifferentiated and consist predominantly of silt containing some poorly sorted sand and gravel. These deposits are found along valley sides and valley bottoms north of Tanana and border the alluvial deposits. Eolian loess consisting of well-sorted silt is found predominantly on the flood plain across the Yukon River, south of Tanana (Chapman and others, 1982).

Rieger and others (1979) described three basic types of soils in the Tanana area as poorly drained, well drained, and organic.

Poorly drained soils are found in low-lying areas such as meander scars on the flood plains. They have thick surface organic horizons composed primarily of sedges or sphagnum moss. The texture varies from silt-loam to sandy-loam. Poorly drained soils are usually saturated above a shallow permafrost table, but some are dry in the upper horizons in midsummer.

Well-drained soils are found on natural levees along existing and former river channels. The soil texture generally consists of stratified silt-loam and fine sand. Thin seams of organic material occur throughout the soil. Permafrost may occur at depths greater than 150 cm under these soils.

Organic soils are found on slightly lower areas of the flood plains than the poorly drained mineral soils. They consist of thick deposits of very acidic moss-peat in the upper layer and of fibrous sedge-peat in the lower layers. The soils are underlain by permafrost at depths of 12 to 75 cm.

HYDROLOGY

Surface Water

The Yukon River at Tanana flows roughly from east to west and drains into the Bering Sea about 1,110 km downstream from the village. The Yukon River is the largest drainage system in Alaska in terms of drainage basin area and mean annual flow. The two closest major drainages into the Yukon River are the northward flowing Tanana River and southward flowing Tozitna River, located 5 km upstream and 15 km downstream from Tanana, respectively.

Other than the Yukon River, the two local surface-water bodies closest to the village of Tanana are Bear and NC Creeks (fig. 1). Bear Creek flows southwestward into the Yukon River and drains the mountains and hills north and northwest of Tanana (fig. 1). NC Creek flows southward through the eastern part of Tanana into the Yukon River and drains the mountains and hills to the northeast of the village (fig. 1). The mouth of Bear Creek is located approximately 10 km from the village and the mouth of NC Creek is located at the east end of the village and on the north bank of the Yukon River. Streamflow data for both creeks are not available; however, mean annual flow estimates were calculated using Parks and Madison's (1985) equation for regional streamflow characteristics. This equation requires values of mean annual precipitation and drainage basin area. The drainage basin areas for Bear and NC Creeks, as measured from the USGS Tanana 1:250,000 quadrangle, are about 197 and 34 km^2, respectively. The mean annual precipitation of 510 mm was used to represent the precipitation for the drainage area of the creeks (Lamke, 1978). Mean annual streamflow estimates are 1.6 m^3/s for Bear Creek and 0.25 m^3/s for NC Creek.

Several small lakes (less than 0.65 km^2 in size) are near the mouth of the Bear Creek drainage and east of the village: the closest is about 2.5 km from the airport. Two small lakes, Oscar Lake and an unnamed lake are about 3.2 km west of the airport.

Floods

The U.S. Army Corps of Engineers (1993) recorded flooding at the village of Tanana in 1937, 1964, 1972, 1989, and 1991. The flood hazard in Tanana area is considered low by the U.S. Army Corps of Engineers (1993): approximately 50 houses are located within the 100-year flood zone. During the 1991 flood, one house was reported to have been inundated (U.S. Army Corps of Engineers, 1993). Because of the low flood hazards at Tanana, construction of flood-protection measures for the village have not been undertaken.

The primary cause of floods at Tanana is ice jams and subsequent stream overflow (U.S. Army Corps of Engineers, 1993). Ice-jam flooding occurs when river ice broken during spring thawing is transported downstream and its movement is blocked in locations where a constriction, a sandbar, or other obstruction such as a sharp meander bend exists (Beltaos, 1990). The blockage prevents ice movement and restricts water flow as the ice jam builds in thickness and length. This subsequently slows the water velocity and produces a rise in water level, or a backwater effect, that propagates upstream from the ice jam. When the ice jam releases, a flood wave propagates downstream.

Flooding at Tanana not only damages structures and roads, but can also cause contaminants on the surface of the land to mobilize and move into inadequately sealed wells. If flood waters are higher than the top of well casings, contaminants may move directly into drinking-water supplies.

The flood frequency for the Yukon River at Tanana (table 2) was obtained using the graph of discharge to drainage area (Jones and Fahl, 1994, fig. 10) for the Yukon River. The drainage area for the Yukon River basin upstream from Tanana is about 637,000 km^2. The frequency curves of Jones and Fahl (1994), however, apply only to floods generated by rainfall and snowmelt runoff and are not applicable to ice-jam floods.

Table 2. Estimated peak discharges of the Yukon River at Tanana for various recurrence intervals

[Discharge in cubic meters per second]

Recurrence interval						
2 years	5 years	10 years	25 years	50 years	100 years	500 years
16,000	20,000	23,000	25,000	27,000	29,000	33,000

Ground Water

Ground-water recharge to the Tanana area occurs from infiltration of precipitation, infiltration from streams, and normal ground-water movement from areas near the slopes of the surrounding highlands. Ground-water recharge most likely takes place from local streams such as Bear and NC Creeks and from the Yukon River. Recharge from the streams is assumed because the elevation of the stream bottom is most likely higher than the expected water table. Descriptions of ground water in permafrost regions by Cederstrom and others (1953), Hopkins and others (1955), and Williams and Waller (1963) include ground water of the Tanana area.

Tanana is located in a zone of discontinuous permafrost (Ferrians, 1965). Paths for ground-water flow are influenced by the presence of permafrost acting as an impermeable barrier. Alluvium is probably unfrozen beneath the bed of the Yukon River throughout its course in Alaska and is likely to be extensively, but not completely frozen, beneath the flood plain adjacent to the river. The hydraulic continuity of the unfrozen alluvium away from the river is expected to have a profound influence on the directions of ground-water flow. However, little information is available on the continuity of the permafrost in Tanana. If the permafrost in the area is discontinuous, the unconsolidated materials will behave like an aquifer, or if continuous, the permafrost will act as a confining layer. According to Smith (1986), most of the wells that supply the Yukon River villages from Canada to the Bering Sea are along the riverbank where the warming effect of the river affects the thickness of frozen ground.

Well-log and water-quality data are available from the U.S. Public Health Service for the years 1967-81 (appendix 1). Permafrost was recorded in logs of about three-fourths of the dry wells. The wells ranged in depth from 13 to 63 m and averaged approximately 28 m. Static water levels ranged from 4 to 12 m below land surface and averaged 7 m. Ground water appears to be produced consistently from a layer of sandy gravel that occurs at depths of 10 to 20 m below land surface. Bedrock, which was found in about one-third of the wells, was reached at depths from 11 to 43 m below land surface and at an average depth of 18 m. Well yields ranged from a low of 0.017 L/s to a high of 3.2 L/s, and averaged about 0.80 L/s.

Ground-Water and Surface-Water Interaction

The variations in river stage and ground-water elevations at Tanana will generally follow the pattern of the discharge hydrograph for the Yukon River at Ruby (fig. 3) located about 190 km downstream from Tanana. Continuous streamflow records are not available for the Yukon River at Tanana; however, a mean daily discharge record for the period 1956-78 is available for the Yukon River at Ruby (U.S. Geological Survey, 1957-79). The drainage basin area for the Yukon River at the village of Tanana is 637,000 km^2 and that for the Yukon River at the stream-gaging station at Ruby is 671,000 km^2. The difference in the drainage basin areas between these two sites is about five percent.

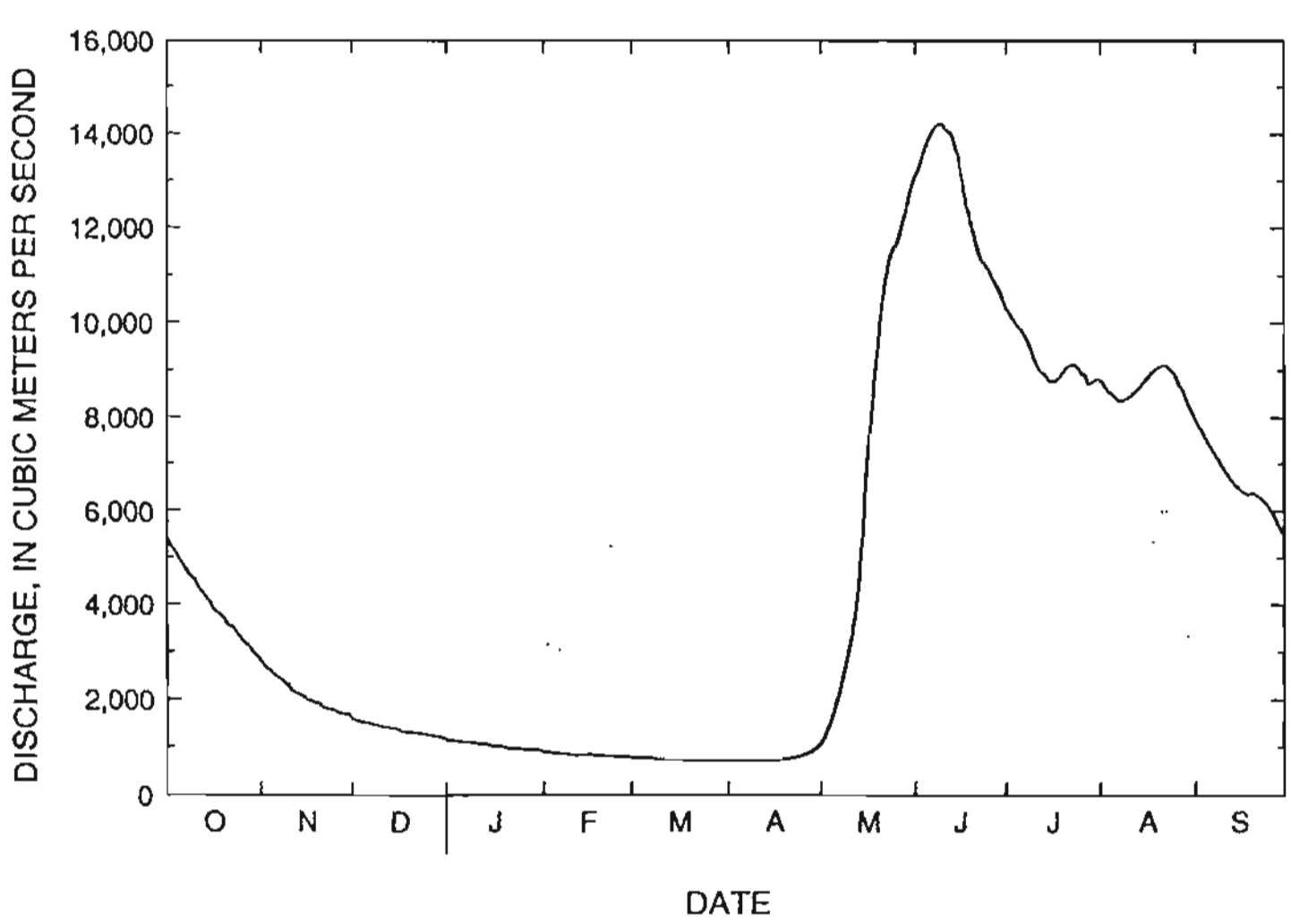


Figure 3. Mean daily discharge for the Yukon River at Ruby, water years 1966-76.

Adjacent to the river, shallow ground water can flow into and out of the riverbanks depending on the elevation of water of the river surface relative to the water table. Typically, the Yukon River will fluctuate from a maximum discharge in late May or early June to a minimum flow in late April or early May (fig. 3). The river also rises during late summer rainstorms. The water table will generally rise and fall in response to these river fluctuations, but will be attenuated with distance from the river. This flow of water into and out of the aquifer in response to changing stage of the river is termed "bank storage effects" (Linsley and others, 1982). Bank storage effects have not been studied at Tanana. Because the FAA facilities and village utilities are adjacent to the river, bank storage effects could have a significant influence on the ground-water flow beneath them.

Simulation of Ground-Water Movement

A mathematical ground-water model approximates the directions and rates of water movement through an aquifer system. Partial-differential equations thought to represent the physical processes of ground-water flow are solved by the model and requires that the hydraulic properties and boundaries be defined for the modeled area. The aquifer system was overlain by a grid, which was extended in the third dimension to form blocks or "cells." The cells form rows, columns, and layers. Each cell in the model grid represents a block of permeable material within which the hydraulic properties are assumed to be uniform. Any specific cell may be referenced by citing its row, column, and layer location. The limits of the modeled area were selected to include or nearly coincide with natural flow boundaries. The "boundary surface" of the flow region corresponds to identifiable hydrogeologic features at which some characteristic of ground-water flow can be described. For the conceptual model, these features could be a drainage divide, river bank, or artificially induced (depending on the modelled area). In cases where there is no apparent natural flow boundaries, such as in an open flood plain, the model grid was extended far enough away from the area of study so the error created from the artificial boundary is minimized.

Ground-water flow in the Tanana area was simulated using a computer program, MODFLOW (McDonald and Harbaugh, 1988), as a simple steady-state conceptual model. Under steady state conditions, the recharge to the system is equal to the discharge from the system, no water is derived from storage, and there is no change in head with time. Output from MODFLOW was graphically presented using METAZ, a contouring program specifically designed for MODFLOW and developed by S.A. Leake and R.T. Hanson (U.S. Geological Survey, written commun., 1993). The conceptual model requires that the hydraulic head at the aquifer boundaries is known, all recharge and discharge is assumed to occur at the river, flow is horizontal, and the aquifer materials are homogeneous and isotropic. The data, assumptions, justifications, and data sources used in the model packages are summarized in appendix 2. An example output file of the model is shown in appendix 3. The purpose of undergoing a mathematical ground-water simulation was to identify hydrologic features that may have a significant influence on the ground-water flow direction in the Tanana area. Two ground-water flow simulations were used to identify features having the greatest influence on ground-water flow direction.

The southern aquifer boundary was assumed to be the banks of the Yukon River. Elevations for the Yukon River were established from the USGS 1:63,360 scale Tanana A-4 and A-5 topographic maps. The contact between the alluvial aquifer and the bedrock hills was estimated to be the 250-foot topographic contour line taken from the Tanana A-5 quadrangle and this contour line was modeled as the northern aquifer boundary. The ground-water flow simulations assume that

permafrost is not a barrier to flow in the Tanana area. Potentially significant hydrologic features, such as Bear and NC Creeks (fig. 1), were included in the ground-water model to determine their effects on the ground-water flow in the area.

Simulated ground-water flow in the Tanana area is generally towards the southwest (fig. 4). Two simulations were done assuming low and high streambed conductances for the local creeks. The degree of influence of Bear and NC Creeks on ground-water flow is dependent on the streambeds' vertical hydraulic conductances. In general, an increase in conductance increases the rate of flow between the streambed and the aquifer. The effect of the creeks becomes apparent in the highest streambed conductance model run where ground-water flow direction changes from a southwestward (fig. 4) to a nearly southward direction (fig. 5).

The simulations, each using different assumptions of the conductance of the streambed, illustrate the importance of the hydraulic connection between Bear and NC Creeks and the aquifer. Further investigation of the extent of permafrost in the Tanana area is necessary to establish its influence on ground-water flow. Without these field data, shallow ground-water flow directions can not be ascertained exactly, but can be described only generally on the basis of assumed boundary conditions.

DRINKING WATER

Present Drinking-Water Supplies

The village of Tanana obtains its drinking-water supply from ground water using both public and private wells. The Alaska Department of Community and Regional Affairs database (1993) indicates that 109 households use the village-managed public water system, 22 households use individual wells, and another 33 households use unspecified water sources. A community watering point (washeteria) is supplied by two wells, one active and one backup. The community water is softened to reduce iron content, fluoridated, chlorinated, and then stored in holding tanks in the village-maintained washeteria building. Water quantity provided by the community wells fluctuates with seasonal changes and is lowest during the spring months (Fison and Associates, 1987; Campbell, 1985). The village of Tanana operates a water truck that delivers water to homes equipped with water storage tanks. Residents who do not have water delivered regularly haul drinking water from the washeteria (Campbell, 1985).

The Tanana village school, health center, elderly center, council building, and teacher housing are supplied by a 47-m deep well drilled in 1976 (appendix 1). This water is chlorinated, fluoridated, and stored in three 76,000-liter storage tanks (Fison and Associates, 1987).

The FAA owns four wells, of which three are active. One of the wells, about 15 m deep, is used for drinking water and serves the flight service station and FAA housing (Fison and Associates, 1987; Ecology and Environment Inc., 1993). The second active well is used to supply water to a flush toilet and the third active well is used as a standby source of drinking water (Ecology and Environment Inc., 1993).

The average per capita water use for the village of Tanana is estimated to be 150 L/d for self-supplied water and 300 L/d for public-supplied water (Solley and others, 1993). The average water use per person for all uses for the entire State of Alaska in 1990 is estimated to be 1,950 L/d.

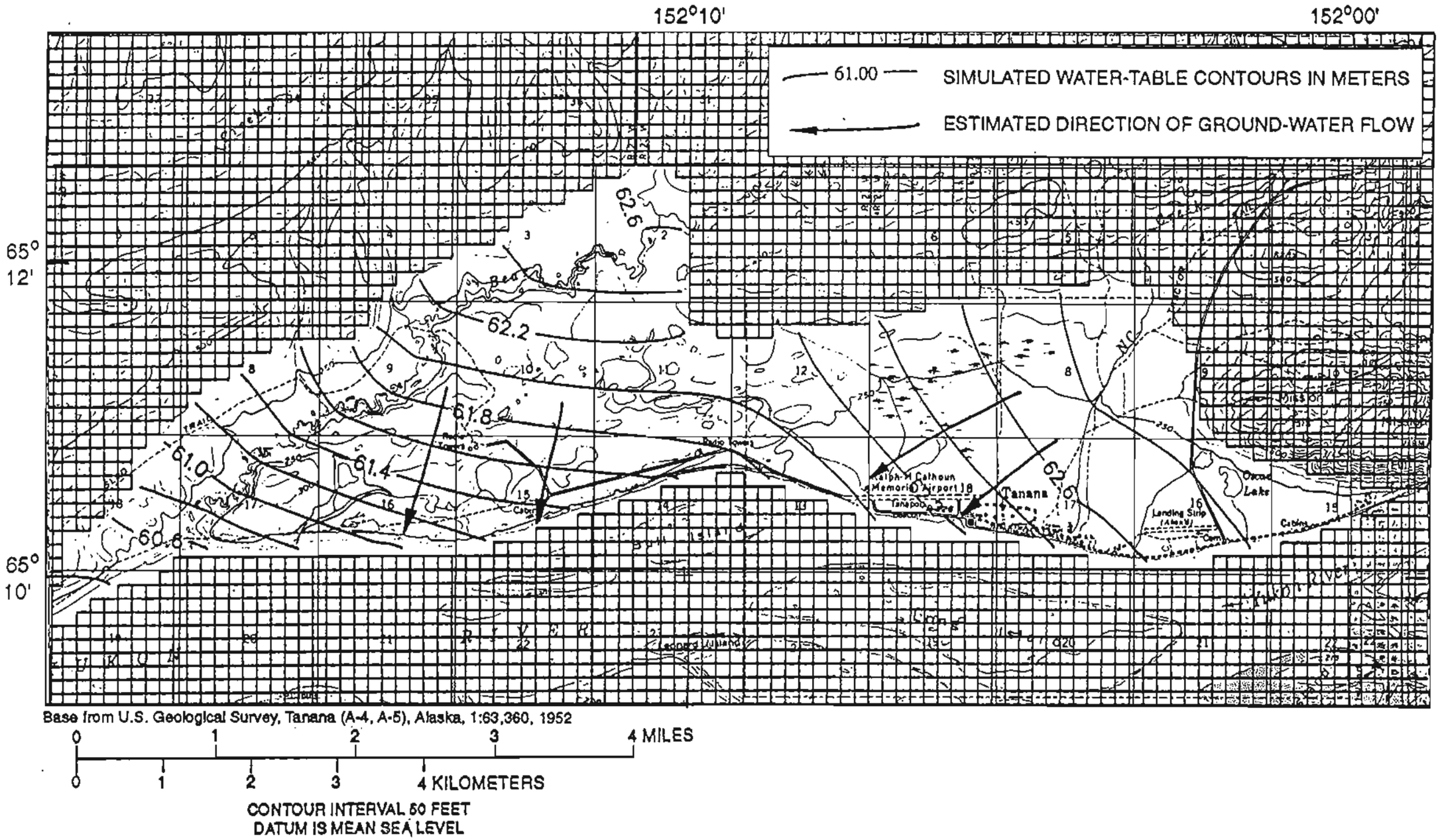


Figure 4. Simulated water-table contours and estimated flow direction of shallow ground water with low streambed conductance in the Tanana area.

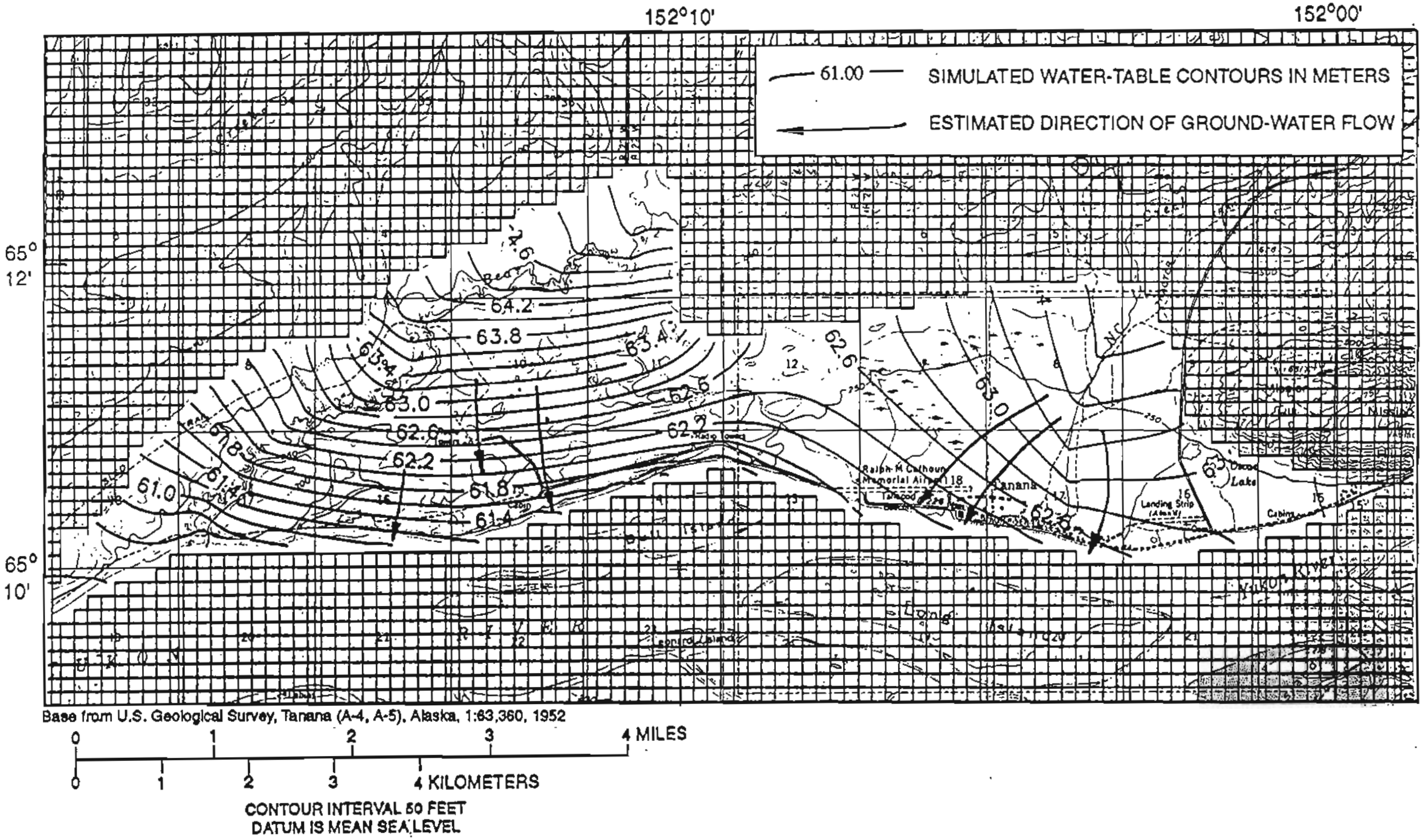


Figure 5. Simulated water-table contours and estimated flow direction of shallow ground water with high streambed conductance in the Tanana area.

Quality of Present Supplies

Permafrost commonly has a strong influence on the water quality in an area. Shallow aquifers above the permafrost (suprapermafrost aquifers) are generally susceptible to surface contamination. The quantity of water from this source is often low and unreliable. Ground water found below permafrost (subpermafrost aquifers) is generally deficient in dissolved oxygen. As a result, high concentrations of some minerals, such as iron and manganese, which are soluble under these conditions, are present. Subpermafrost ground water is commonly hard and occasionally contains dissolved organic substances (Williams, 1970).

Sporadically kept records on the water quality in the Tanana area are available from the U.S. Public Health Service for the period 1973-80 (appendix 1) and from the USGS for the period 1955-73 (appendix 4). Analyses of untreated samples taken from various locations in Tanana indicate an average silica content of 11 mg/L, an average hardness as $CaCO_3$ of 283 mg/L, and an average iron content of 1.6 mg/L (appendixes 1 and 4). Silica and hardness may create scale in plumbing and boilers but is of little health concern to most users. The average iron content is higher than the 0.30 mg/L secondary maximum contaminant level (SMCL) regulations set by the U.S. Environmental Protection Agency (USEPA) (1993) for drinking water, but does not prohibit this water from being used for drinking.

The drinking water at the FAA station was sampled regularly as a part of the Alaska Department of Environmental Conservation monitoring program. This monitoring program only required the testing for total coliform bacteria, and the tests consistently indicated satisfactory water quality for the Tanana FAA station (Ecology and Environment Inc., 1993).

Alternative Drinking-Water Sources

The FAA has requested information on alternative drinking-water sources in the Tanana area in order to plan actions that would be taken if the present drinking-water source became contaminated. Alternative drinking-water sources to be considered include nearby surface-water sources or aquifers that are separated from the present water-supply aquifer by a tight confining layer. It is possible that a continuous permafrost layer would act as a confining layer. However, the areal continuity of the permafrost is uncertain and it may or may not inhibit movement of contaminants to the subpermafrost aquifer. On the basis of well drillers' logs (appendix 1), it is unlikely that a separate aquifer system exists at the Tanana village site. The Yukon River is a possible water source for Tanana. Potential development and maintenance cost of a surface-water distribution system make the Yukon River less feasible as a water source (Smith, 1986).

Quality of Alternative Sources

Water quality of Arctic rivers can vary with the season and is generally excellent in the winter and poor in the summer (Smith, 1986). Streamflows are much greater in the summer than in winter and water from the river contains higher sediment concentrations from melting glaciers during the summer (Smith, 1986). Water from the Yukon River in winter is usually clear and free of sediment (Campbell, 1985). Because of the sediment concentrations during the summer, however, Yukon River water would require treatment. A treatment system would likely be more expensive to operate and maintain than the current system.

Water-quality information for the Yukon River is not available for the Yukon River at Tanana; however, water quality data are available for the Yukon River at Ruby. The water quality for the Yukon River at Ruby should closely reflect the water quality upstream on the Yukon River at Tanana. An analysis of sample data for all of the periods of record shows that iron concentration is typically below the USEPA's SMCL of 0.30 mg/L, but concentrations of 1.86 mg/L were recorded on July 9, 1967 (appendix 5). Maximum and minimum sediment concentrations have been 867 mg/L and 2 mg/L, respectively (appendix 5), and correlate closely with maximum and minimum river flow.

SUMMARY

Tanana serves as an important transportation, service and commercial center for the western interior of Alaska. Its remote location and lack of road access make it dependent on the airport or the river for transportation. The subsistence lifestyle of the Native residents makes them dependent on a sustainable environment. The community obtains drinking water from both village-maintained and private ground-water wells. The ground-water flow is strongly influenced by the Yukon River, by local streams, and by the continuity of permafrost in the area. The Yukon River could be an alternative drinking-water supply, but costs have not been estimated for the community to utilize this source.

REFERENCES CITED

Alaska Department of Community and Regional Affairs, 1993, Alaska Department of Community and Regional Affairs Database: Alaska Department of Community and Regional Affairs Municipal and Regional Assistance Division, 11 p.

Beltaos, Spyridon, 1990, Breakup jams, *in* Ryan, R.L., and Crissman, R.D., eds., Cold regions hydrology and hydraulics: American Society of Civil Engineers Monograph, p. 485-510.

Campbell, C., 1985, Tanana community profile: City of Tanana, 49 p.

Cederstrom, D.J., Johnston, P.M., and Subitzky, S., 1953, Occurrence and development of ground water in permafrost regions: U.S. Geological Survey Circular 275, 30 p.

Chapman, R.M., Yeend, W., Brosge, W.P., and Reiser, H.N., 1982, Reconnaissance geologic map of the Tanana quadrangle, Alaska: U.S. Geological Survey Open-File Report 82-734, 17 p., 1 map sheet.

Ecology and Environment, Inc., 1992, Environmental compliance investigation report, Tanana FAA station Tanana, Alaska: Anchorage [Draft report available from Federal Aviation Administration, Alaskan Region], variously paged.

Ferrians, O.J. Jr., 1965, Permafrost map of Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-445, 1 sheet, scale 1:250,000 (reprinted, 1981)

Fison and Associates, 1987, Tanana community profile: Anchorage, Alaska [Draft], 26 p.

Fountain, A.G., 1984, Yukon River breakup--The 82-year record: The Northern Engineer, v. 16, no. 1. p. 20 - 24.

Fountain, A.G., and Vaughn, B.H., 1984, Yukon River ice--Freeze up data (1883-1975): U.S. Geological Survey Open-File Report 84-601, 51 p.

Hartman, C.W., and Johnson, P.R., 1984, Environmental atlas of Alaska: University of Alaska Fairbanks, Institute of Water Resources/Engineering Experiment Station, 95 p.

Hopkins, D.M., Karlstrom, T.N.V., and others, 1955, Permafrost and groundwater in Alaska: U.S. Geological Survey Professional Paper 264-F, p. 113 - 146.

Jones, S.H., and Fahl, C.B., 1994, Magnitude and frequency of floods in Alaska and conterminous basins of Canada: U.S. Geological Survey Water Resources Investigations Report 93-4179, 122 p. + 2 pl.

Lamke, R.D., 1978, Flood characteristics of Alaskan streams: U.S. Geological Survey Water-Resources Investigations 78-129, 61 p.

Leslie, L.D., 1989, Alaska climate summaries (2d ed.): University of Alaska Anchorage, Arctic Environmental Information and Alaska Climate Center Technical Note 5.

Linsley, R.K., Kohler, M.A., and Paulhus, J.L., 1982, Hydrology for engineers (3d ed.): New York, McGraw Hill Book Company, 508 p.

McDonald M.G. and Harbaugh, A.W., 1988, A modular three-dimensional finite-difference ground-water flow model: U.S. Geological Survey Techniques of Water-Resources Investigations book 6, chap. A1, 576 p.

Mertie, J.B., 1937, The Yukon-Tanana region, Alaska: U.S. Geological Survey Bulletin 872, 276 p.

Parks, Bruce and Madison, R.J., 1985, Estimation of selected flow and water-quality characteristics of Alaskan streams: U.S. Geological Survey Water-Resources Investigations Report 84-4247, 64 p.

Rieger, Samuel, Schoephorster, D.B., and Furbush, C.E., 1979, Exploratory soil survey of Alaska: Soil Conservation Service report, 213 p.

Smith, D.W., 1986, Cold climate utilities manual: Canadian Society for Civil Engineering, variously paged.

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 76 p.

U.S. Army Corps of Engineers, 1987, Interim water resources study, Yukon and Kuskokwim Rivers, Alaska: U.S. Army Corps of Engineers, Alaska District, 104 p.

_____1993, Alaskan communities flood hazard data: U.S. Army Corps of Engineers, Alaska District, 335 p.

U.S. Bureau of Census, 1991, Percent distribution Alaska population by sex, race and Hispanic origin--1990 census: Compiled by Alaska Department of Labor, Research and Analysis, 3 p.

U.S. Environmental Protection Agency, 1993, Drinking water regulations and health advisories: U.S. Environmental Protection Agency report, 11 p.

U.S. Geological Survey, 1957-63, Quantity and quality of surface waters of Alaska. Annual reports as follows: water year 1956, Water-Supply Paper 1486, water year 1957, Water-Supply Paper 1500; water year 1958, Water-Supply Paper 1570; water year 1959, Water-Supply Paper 1640; and water year 1960, Water-Supply Paper 1720.

_____1971, Surface-water supply of the United States, 1961-65, Part 15, Alaska: U.S. Geological Survey Water-Supply Paper 1936.

_____1976, Surface-water supply of the United States, 1966-70, Part 15, Alaska: U.S. Geological Survey Water Supply Paper 2136.

_____1972-75, Water resources data for Alaska, 1971-74, Part 1, Surface water records: U.S. Geological Survey Water-Data Reports AK-71 to AK-74 (published annually).

_____1976-79, Water resources data for Alaska, water years 1975-78: U.S. Geological Survey Water-Data Reports AK-75-1 to AK-79-1 (published annually).

Viereck, L.A., and Little, E.L. Jr., 1972, Alaska trees and shrubs: U.S. Department of Agriculture Handbook No. 410, 265 p.

Wahrhaftig, Clyde, 1965, Physiographic divisions of Alaska: U.S. Geological Survey Professional Paper 482, 52 p.

Williams, J.R., 1970, Ground water in permafrost regions of Alaska: U.S. Geological Survey Professional Paper 696, 83 p.

Williams, J.R., and Waller, R.M., 1963, Occurrence of ground water in the permafrost regions of Alaska: Purdue University, Indiana, International Conference on Permafrost, 19 p.

APPENDIX 1

Selected well drillers' logs, aquifer test data,
and ground-water quality data for Tanana, Alaska

from U.S. Public Health Service village files

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND: Milton Nicholia	DEPTH OF WELL: 46 feet
ADDRESS: 1--72	STATIC LEVEL OF WATER FT.: 18
WELL—SITE: Tanana, Alaska	DRAW DOWN FT.: 16
DATE—STARTED: [illegible] 7, 1967	GALS. PER HR.: 720
DATE—ENDED: July 7, 1967	KIND OF CASING: 6 5/8" [illegible]

KIND OF FORMATION:

FROM FT.	TO FT.	FORMATION
0	4	Over Burden
4	12	Sand & Gravel
12	22	Clay & Gravel
22	31	Dry Sand
31	44	Hard Pan
44	46	Black water, sand, fine gravel

MISCL. INFORMATION:

Well cased to 46 feet. Well grouted to 10 feet.

PROJECT ENGINEER ______________ DRILLER'S NAME ______________

LOG OF DRILLING by A & L DRILLING COMPANY 2

OWNER OF LAND Roy Folger

ADDRESS 2--26

WELL—SITE Tanana, Alaska

DATE—STARTED July 8, 1967

DATE—ENDED July 8,1967

DEPTH OF WELL 44 ft.

STATIC LEVEL OF WATER FT. 18

DRAW DOWN FT. 7

GALS. PER HR. 900

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	3	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	3	FT. TO	23	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	23	FT. TO	29	FT.	Sand, damp	FROM ..... FT. TO ..... FT.	
FROM	29	FT. TO	34	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	34	FT. TO	36	FT.	Sand & Gravel Wet	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	36	FT. TO	44	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Cased to 38 feet. Casing perforated from 31 ft. to 36 ft.
After 10 hours air developing, water yield increased to 15 GPM
Well grouted to 10 ft.

PROJECT ENGINEER _____ DRILLER'S NAME .....

61

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Joseph Leroy — DEPTH OF WELL 47 ft.

ADDRESS 3—27 — STATIC LEVEL OF WATER FT. 20

WELL—SITE Tanana, Alaska — DRAW DOWN FT. 4

DATE—STARTED July 9, 1967 — GALS. PER HR. 480

DATE—ENDED July 9, 1967 — KIND OF CASING 6-5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 3	FT. Over Burden	FROM	FT. TO	FT.
FROM 3	FT. TO 26	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 26	FT. TO 35	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 35	FT. TO 39	FT. Wet Sand & Gravel	FROM	FT. TO	FT.
FROM 39	FT. TO 47	FT. Hard Pan	FROM	FT. TO	FT.
FROM 47	FT. TO	FT. Blue Clay	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Cased to 42 ft. 4 inches; perforated from 35 ft. to 39 ft.
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND: Ted Kosenikoff

ADDRESS: 4-37

WELL—SITE: Tanana, Alaska

DATE—STARTED: July 9, 1967

DATE—ENDED: July 9, 1967

DEPTH OF WELL: 50 ft.

STATIC LEVEL OF WATER FT.: dry

DRAW DOWN FT.: dry

GALS. PER HR.: dry

KIND OF CASING: 6 5/8" O.D.

KIND OF FORMATION:

FROM 0 FT. TO 4 FT. Over Burden	FROM ..... FT. TO ..... FT.
FROM 4 FT. TO 12 FT. Clay	FROM ..... FT. TO ..... FT.
FROM 12 FT. TO 42 FT. Perma Frost	FROM ..... FT. TO ..... FT.
FROM 42 FT. TO 46 FT. Sand	FROM ..... FT. TO ..... FT.
FROM 46 FT. TO 50 FT. Clay	FROM ..... FT. TO ..... FT.
FROM / FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.	FROM ..... FT. TO ..... FT.

MISCL. INFORMATION:

Cased to 49 ft. Casing perforated from 43' to 45'.
Bell-grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

12

LOG OF DRILLING by A & L DRILLING COMPANY

5 V

OWNER OF LAND Mary Dick

ADDRESS 5--31

WELL—SITE Tanana, Alaska

DATE—STARTED July 10, 1967

DATE—ENDED July 10, 1967

DEPTH OF WELL 51 ft.

STATIC LEVEL OF WATER FT. 24

DRAW DOWN FT. 3

GALS. PER HR. 720

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	3	FT.	Over Burden.	FROM ..... FT. TO ..... FT.	
FROM	3	FT. TO	16	FT.	Sand, Gravel	FROM ..... FT. TO ..... FT.	
FROM	16	FT. TO	42	FT.	Fine Sand	FROM ..... FT. TO ..... FT.	
FROM	42	FT. TO	46	FT.	Gravel, Wet	FROM ..... FT. TO ..... FT.	
FROM	46	FT. TO	48	FT.	Sand, Gravel, Wet	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	48	FT. TO	51	FT.	Sand Stone	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Cased to 49 feet. Perforated from 43 feet to 46 feet.
Well grouted to 10 foot.

PROJECT ENGINEER _____ DRILLER'S NAME .....

22

LOG OF DRILLING by A & L DRILLING COMPANY

6

OWNER OF LAND: Alfred Grant
ADDRESS: 6--53
WELL—SITE: Tanana, Alaska
DATE—STARTED: July 10, 1967
DATE—ENDED: July 10, 1967

DEPTH OF WELL: 75 feet
STATIC LEVEL OF WATER FT.: Dry
DRAW DOWN FT.: dry
GALS. PER HR.: Dry
KIND OF CASING: ------

KIND OF FORMATION:

FROM	FT. TO	FT.
0	6	Over Burden
6	47	Perma Frost
47	75	Sand Stone, Dry

MISCL. INFORMATION:

DRY HOLE

PROJECT ENGINEER ______________________ DRILLER'S NAME ....

23

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND	Willy Groue	DEPTH OF WELL	50
ADDRESS	7--29	STATIC LEVEL OF WATER FT.	Dry
WELL—SITE	Tanana, Alaska	DRAW DOWN FT.	Dry
DATE—STARTED	July 11, 1967	GALS. PER HR.	Dry
DATE—ENDED	July 11, 1967	KIND OF CASING	------

KIND OF FORMATION:

FROM	FT. TO	FT.	FROM	FT. TO	FT.
0	3	Over Burden			
3	14	Clay & Gravel			
14	50	Frost			

MISCL. INFORMATION:

DRY HOLE

PROJECT ENGINEER ______________ DRILLER'S NAME ______________

24

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Pete Micholia

ADDRESS B--23

WELL—SITE Tanana, Alaska

DATE—STARTED July 13, 1967

DATE—ENDED July 13, 1967

DEPTH OF WELL 75

STATIC LEVEL OF WATER FT. ---

DRAW DOWN FT. ----

GALS. PER HR. ----

KIND OF CASING ----

KIND OF FORMATION:

FROM 0	FT. TO 4	FT Over Burden	FROM	FT. TO	FT.
FROM 4	FT. TO 75	FT Perma Frost--dry	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION: Sand GRAVEL 44-68-A

DRY HOLE

Sand Stone 68 - 75

PROJECT ENGINEER _____ DRILLER'S NAME

25

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Harry Nicholia — DEPTH OF WELL 50 feet

ADDRESS 9--36 — STATIC LEVEL OF WATER FT. Dry

WELL—SITE Tanana, Alaska — DRAW DOWN FT. Dry

DATE—STARTED July 13, 1967 — GALS. PER HR. Dry

DATE—ENDED July 13, 1967 — KIND OF CASING

KIND OF FORMATION:

FROM 0 FT. TO 5 FT. Over Burden	FROM FT. TO FT.
FROM 5 FT. TO 36 FT. Perma Frost	FROM FT. TO FT.
FROM 36 FT. TO 47 FT. Sand & Gravel	FROM FT. TO FT.
FROM 47 FT. TO 50 FT. Perma Frost	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.
FROM FT. TO FT.	FROM FT. TO FT.

MISCL. INFORMATION:

DRY HOLE

ROJECT ENGINEER _____ DRILLER'S NAME

26

LOG OF DRILLING by A & L DRILLING COMPANY

10

OWNER OF LAND Ekada

ADDRESS 10--6

WELL—SITE Tanana, Alaska

DATE—STARTED July 14, 1967

DATE—ENDED July 14, 1967

DEPTH OF WELL 51 feet

STATIC LEVEL OF WATER FT. 19

DRAW DOWN FT. 8

GALS. PER HR. 420

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 4	FT. Over Burden		FROM	FT. TO	FT.	
FROM 4	FT. TO 33	FT. Perma Frost		FROM	FT. TO	FT.	
FROM 33	FT. TO 37	FT. Gravel, Frozen		FROM	FT. TO	FT.	
FROM 37	FT. TO 51	FT. Hard Pan, Frozen, Water		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	
FROM 51	FT. TO	FT. Sand, Gravel, Water, 7 gpm		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	
FROM	FT. TO	FT.		FROM	FT. TO	FT.	

MISCL. INFORMATION:

Cased to 42'8"; not cased to full depth of well--water temperature--
32 degrees. Air developed 7 hours.
Grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

27

LOG OF DRILLING by A & L DRILLING COMPANY

12

OWNER OF LAND Richard Grant

ADDRESS 12--78

WELL SITE Tanana, Alaska

DATE STARTED July 17, 1967

DATE ENDED July 17, 1967

DEPTH OF WELL 44 feet

STATIC LEVEL OF WATER FT. 22

DRAW DOWN FT. 7

GALS. PER HR. 540

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 15	FT. Sand	FROM	FT. TO	FT.
FROM 15	FT. TO 25	FT. Gravel	FROM	FT. TO	FT.
FROM 25	FT. TO 34	FT. Sand	FROM	FT. TO	FT.
FROM 34	FT. TO 35	FT. Sand, wet	FROM	FT. TO	FT.
FROM 35	FT. TO 37	FT. Sand, Gravel, wet	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 37	FT. TO 40	FT. Fine Sand	FROM	FT. TO	FT.
FROM 40	FT. TO 44	FT. Hard Pan	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Cased to 41'3". Perforated from 35 feet to 38 feet.
Well grouted to 10 foot.

PROJECT ENGINEER _____ DRILLER'S NAME Lee Ludlum

28

LOG OF DRILLING by A & L DRILLING COMPANY

13 ✓

OWNER OF LAND Christopher Grant

ADDRESS 13--79

WELL—SITE Tanana, Alaska

DATE—STARTED July 18, 1967

DATE—ENDED July 18, 1967

DEPTH OF WELL 49 feet

STATIC LEVEL OF WATER FT. 22

DRAW DOWN FT. 4

GALS. PER HR. 600

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 20	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 20	FT. TO 35	FT. Sand	FROM	FT. TO	FT.
FROM 35	FT. TO 45	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 45	FT. TO 49	FT. Sand, Gravel, Water, 10 gpm	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well grouted to 10 feet. Well cased to 49 feet. Casing perforated from 43 feet to 46 feet.

PROJECT ENGINEER

DRILLER'S NAME

29

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Ray Johnson

ADDRESS 29-60

WELL—SITE Tanana, Alaska

DATE—STARTED August 1, 1967

DATE—ENDED August 1, 1967

DEPTH OF WELL 55 feet

STATIC LEVEL OF WATER FT. 20

DRAW DOWN FT. 20

GALS. PER HR. 90

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 2	FT. Over Burden	FROM	FT. TO	FT.
FROM 2	FT. TO 10	FT. Sand	FROM	FT. TO	FT.
FROM 10	FT. TO 20	FT. Sand, Gravel, small	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 20	FT. TO 40	FT. Sand, Gravel, large	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 40	FT. TO 50	FT. Sand, Gravel, small, water	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 50	FT. TO 55	FT. Sandstone	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well cased to 50'10". Casing perforated from 44'10" to 49'10".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Maggie Ellis

ADDRESS 28--59

WELL—SITE Tanana, Alaska

DATE—STARTED August 1, 1967

DATE—ENDED August 1, 1967

DEPTH OF WELL 65 feet

STATIC LEVEL OF WATER FT. 20

DRAW DOWN FT. 40

GALS. PER HR. 15

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 1	FT. TO 2	FT. Over burden	FROM	FT. TO	FT.
FROM 2	FT. TO 15	FT. Sand, Frost	FROM	FT. TO	FT.
FROM 15	FT. TO 51	FT. Sand, Gravel	FROM	FT. TO	FT.
FROM 51	FT. TO 65	FT. Sandstone, 15 gph	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well Cased to 53 feet. Casing perforated from 49' to 52'. Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Bacco Hinook

ADDRESS 27—53

WELL SITE Tenana, Alaska

DATE STARTED July 31, 1967

DATE ENDED July 31, 1967

DEPTH OF WELL 51 feet

STATIC LEVEL OF WATER FT. 20

DRAW DOWN FT. 25

GALS. PER HR 10

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ____ FT. TO ____ FT.	
FROM	1	FT. TO	10	FT.	Sand	FROM ____ FT. TO ____ FT.	
FROM	10	FT. TO	15	FT.	Sand & Gravel	FROM ____ FT. TO ____ FT.	
FROM	15	FT. TO	27	FT.	Sand	FROM ____ FT. TO ____ FT.	
FROM	27	FT. TO	40	FT.	Hard Pan	FROM ____ FT. TO ____ FT.	
FROM	40	FT. TO	43	FT.	Sand, Gravel, Water	FROM ____ FT. TO ____ FT.	
FROM	____	FT. TO	____	FT.		FROM ____ FT. TO ____ FT.	
FROM	43	FT. TO	51	FT.	Hard Pan, 10 gph	FROM ____ FT. TO ____ FT.	
FROM	____	FT. TO	____	FT.		FROM ____ FT. TO ____ FT.	
FROM	____	FT. TO	____	FT.		FROM ____ FT. TO ____ FT.	
FROM	____	FT. TO	____	FT.		FROM ____ FT. TO ____ FT.	
FROM	____	FT. TO	____	FT.		FROM ____ FT. TO ____ FT.	

MISCL. INFORMATION:

Well cased to 43'3". Casing perforated from 39'3" to 42'3". Well grouted to 10 feet.

PROJECT ENGINEER _____

DRILLER'S NAME _____

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Haine Somers

ADDRESS 26-43

WELL SITE Tenana, Alaska

DATE STARTED July 31, 1967

DATE ENDED July 31, 1967

DEPTH OF WELL 60 feet

STATIC LEVEL OF WATER FT. -----

DRAW DOWN FT. -----

GALS. PER HR. -----

KIND OF CASING -----

KIND OF FORMATION:

FROM 0	FT. TO 2	FT. Sod	FROM	FT. TO	FT.
FROM 2	FT. TO 18	FT. Sand	FROM	FT. TO	FT.
FROM 18	FT. TO 44	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 44	FT. TO 51	FT. Sand Stone	FROM	FT. TO	FT.
FROM 51	FT. TO 60	FT. Bed Rock	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

DRY HOLE
Frozen from 18 to 60 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

33

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Sammy Hagg

ADDRESS 25--76

WELL—SITE Tanana, Alaska

DATE—STARTED July 31, 1967

DATE—ENDED July 31, 1967

DEPTH OF WELL 51 Ft.

STATIC LEVEL OF WATER FT. 25

DRAW DOWN FT. 5

GALS. PER HR. 480

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	8	FT.	Sand		
FROM	8	FT. TO	24	FT.	Sand & Gravel		
FROM	24	FT. TO	42	FT.	Hard Pan		
FROM	42	FT. TO	47	FT.	Sand, Graval, Wet		
FROM		FT. TO		FT.			
FROM	47	FT. TO	51	FT.	Sand, Gravel, grey, Water		
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

MISCL. INFORMATION:

Well cased to 48 feet. Casing perforated from 43 feet to 46 feet.
Well grouted to 10 feet.

PROJECT ENGINEER

DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Fred Starr

ADDRESS 24—90

WELL—SITE Tanana, Alaska

DATE—STARTED July 29, 1967

DATE—ENDED July 29, 1967

DEPTH OF WELL 76 feet

STATIC LEVEL OF WATER FT. ———

DRAW DOWN FT. ———

GALS. PER HR. ———

KIND OF CASING ———

KIND OF FORMATION:

FROM 0	FT. TO 5	FT. Over Burden	FROM	FT. TO	FT.
FROM 5	FT. TO 26	FT. Frost, Clay, Brown	FROM	FT. TO	FT.
FROM 26	FT. TO 33	FT. Gravel, Frost	FROM	FT. TO	FT.
FROM 33	FT. TO 48	FT. Boulders, Frost	FROM	FT. TO	FT.
FROM 48	FT. TO 76	FT. Gravel, Frost	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Dry Hole

PROJECT ENGINEER _____

DRILLER'S NAME

35

LOG OF DRILLING by A & L DRILLING COMPANY 23

OWNER OF LAND	Lee Albert, Sr.	DEPTH OF WELL	75 ft.
ADDRESS	25--88	STATIC LEVEL OF WATER FT.	25
WELL—SITE	Tanana, Alaska	DRAW DOWN FT.	40 ft.
DATE—STARTED	July 23, 1967	GALS. PER HR.	90
DATE—ENDED	July 28, 1967	KIND OF CASING	6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.	FROM	FT. TO	FT.
0	1	Over burden			
1	10	Sand, Fine			
10	21	Sand, Gravel			
21	45	Fine Sand			
45	60	Sand, Gravel, wet			
60	75	Sandstone, Broken small lenses, coarse sand, Gravel, seepage			

MISCL. INFORMATION:

15 feet produces 1 1/2 gpm. Well cased to 63 feet. Well casing perforated from 52 feet to 62 feet. 10 hours Air developed. Well grouted to 10 feet.

PROJECT ENGINEER ____________ DRILLER'S NAME ____________

LOG OF DRILLING by A & E DRILLING COMPANY

OWNER OF LAND Lester Erhart

ADDRESS 22--82

WELL—SITE Tenana, Alaska

DATE—STARTED July 27, 1967

DATE—ENDED July 27, 1967

DEPTH OF WELL 55 feet

STATIC LEVEL OF WATER FT. 25

DRAW DOWN FT. 12

GALS. PER HR. 900

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 3	FT. Over Burden	FROM	FT. TO	FT.
FROM 3	FT. TO 10	FT. Sand	FROM	FT. TO	FT.
FROM 10	FT. TO 30	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 30	FT. TO 47	FT. Sand	FROM	FT. TO	FT.
FROM 47	FT. TO 50	FT. Fine Sand, Gravel Water	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 50	FT. TO 55	FT. Sand Stone	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well cased to 53'1". Casing perforated from 47'1" to 50'1".
Well grouted 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY 21

OWNER OF LAND Lillian Folger

ADDRESS 21--81

WELL—SITE Tanana, Alaska

DATE—STARTED July 26, 1967

DATE—ENDED July 26, 1967

DEPTH OF WELL 55

STATIC LEVEL OF WATER FT. 24

DRAW DOWN FT. 15

GALS. PER HR. 720

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.	FROM	FT. TO	FT.
0	1	Over Burden			
1	6	Sand			
6	26	Sand & Gravel			
26	28	Gravel			
28	42	Sand & Gravel			
42	55	Gravel			

MISCL. INFORMATION:

Well cased to 51 feet. Casing perforated from 45 ft. to 48 ft.

Well grouted to 10 feet.

PROJECT ENGINEER ____________ DRILLER'S NAME ____________

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Arlie Cluckie

ADDRESS 20--95

WELL—SITE Tanana, Alaska

DATE—STARTED July 25, 1967

DATE—ENDED July 25, 1967

DEPTH OF WELL 75 feet

STATIC LEVEL OF WATER FT. ----

DRAW DOWN FT. ----

GALS. PER HR. ----

KIND OF CASING ----

KIND OF FORMATION:

FROM 0 FT. TO 3 FT. Over Burden

FROM 3 FT. TO 43 FT. Dark Brown Clay Frozen

FROM ..... FT. TO ..... FT. .....

FROM 43 FT. TO 61 FT. Sand & Gravel Frozen

FROM 61 FT. TO 64 FT. Clay, Blue Frozen

FROM ..... FT. TO ..... FT. .....

FROM 64 FT. TO 75 FT. Sand & Gravel, Frozen

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

FROM ..... FT. TO ..... FT. .....

MISCL. INFORMATION:

DRY HOLE

PROJECT ENGINEER _____ DRILLER'S NAME .....

LOG OF DRILLING by A & L DRILLING COMPANY 19

OWNER OF LAND Stan Joseph

ADDRESS 19--36

WELL—SITE Tanana, Alaska

DATE—STARTED July 25, 1967

DATE—ENDED July 25, 1967

DEPTH OF WELL 93 feet

STATIC LEVEL OF WATER FT. 18

DRAW DOWN FT. 60

GALS. PER HR. 150

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden.	FROM ..... FT. TO ..... FT.	
FROM	1	FT. TO	6	FT.	Perma Frost, Dead Sand	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	6	FT. TO	23	FT.	Dead Sand, Perma Frost	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	23	FT. TO	25	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM	25	FT. TO	28	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	28	FT. TO	29	FT.	Sand Stone	FROM ..... FT. TO ..... FT.	
FROM	29	FT. TO	75	FT.	Silt	FROM ..... FT. TO ..... FT.	
FROM	75	FT. TO	85	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	85	FT. TO	95	FT.	Gravel, Sand, water	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Well Cased to 93 feet. Casing perforated from 83 to 92 feet.
Well grouted to 10 feet. Air developed 7 hours.

PROJECT ENGINEER _____ DRILLER'S NAME .....

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Arthur Antoski

ADDRESS 18--32

WELL—SITE Tenana, Alaska

DATE—STARTED July 24, 1967

DATE—ENDED July 24, 1967

DEPTH OF WELL 50 feet

STATIC LEVEL OF WATER FT. 24

DRAW DOWN FT. 10

GALS. PER HR. 420

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 1	FT. TO 3	FT. Overburden	FROM	FT. TO	FT.
FROM 3	FT. TO 24	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 24	FT. TO 27	FT. Gravel	FROM	FT. TO	FT.
FROM 27	FT. TO 43	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 43	FT. TO 46	FT. Gravel, wet	FROM	FT. TO	FT.
FROM 46	FT. TO 50	FT. Limestone & Sand, Mixed.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well cased to 47'4". Well casing perforated from 41' to 44'.
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Edgar Joseph
ADDRESS 17--24
WELL—SITE Tanana, Alaska
DATE—STARTED July 21, 1967
DATE—ENDED July 21, 1967

DEPTH OF WELL 65 feet
STATIC LEVEL OF WATER FT. dry
DRAW DOWN FT. dry
GALS. PER HR. dry
KIND OF CASING ------

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	1	FT. TO	6	FT.	Clay	FROM ..... FT. TO ..... FT.	
FROM	6	FT. TO	21	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	21	FT. TO	25	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	25	FT. TO	50	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	50	FT. TO	52	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	52	FT. TO	65	FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

PROJECT ENGINEER _____ DRILLER'S NAME _____

42

16

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND: Warren Thompson

ADDRESS: 16--47

WELL—SITE: Tanana, Alaska

DATE—STARTED: July 20, 1967

DATE—ENDED: July 20, 1967

DEPTH OF WELL: 46 feet

STATIC LEVEL OF WATER FT.: 22

DRAW DOWN FT.: 4

GALS. PER HR.: 720

KIND OF CASING: 6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.
0	4	Over Burden
4	26	Sand & Gravel
26	31	Fine Sand
31	40	Hard Pan
40	46	Sand, Gravel, Water

MISCL. INFORMATION:

Well cased to 45'8", casing perforated from 39 feet to 42 feet.
Well grouted to 10 feet.

PROJECT ENGINEER ________________ DRILLER'S NAME ....

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND George Edwin

ADDRESS 15--45

WELL—SITE Tanana, Alaska

DATE—STARTED July 20, 1967

DATE—ENDED July 20, 1967

DEPTH OF WELL 51foot

STATIC LEVEL OF WATER FT. 23

DRAW DOWN FT. 5

GALS. PER HR. 600

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	5	FT.	Over Burdon	FROM ..... FT. TO ..... FT.	
FROM	5	FT. TO	22	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	22	FT. TO	24	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	24	FT. TO	42	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	42	FT. TO	43	FT.	Coal	FROM ..... FT. TO ..... FT.	
FROM	43	FT. TO	48	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	48	FT. TO	51	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Casing perforated from 42 feet to 49 feet.

Well grouted to 10 feet. Well cased to 48 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

14

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND: Sam Joseph

ADDRESS: 14--30

WELL—SITE: Tanana, Alaska

DATE—STARTED: July 19, 1967

DATE—ENDED: July 19, 1967

DEPTH OF WELL: 58 feet.

STATIC LEVEL OF WATER FT.: 24

DRAW DOWN FT.: 5

GALS. PER HR.: 980

KIND OF CASING: 6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.
0	5	Over Burden
5	32	Sand & Gravel
32	42	Course Gravel
42	54	Course Gravel
54	58	Sand, Gravel, water

FROM	FT. TO	FT.

MISCL. INFORMATION:

Cased to 57 feet--Perforated from 51feet to 54 feet.

Well grouted to 10 feet.

PROJECT ENGINEER ______________________ DRILLER'S NAME ....

LOG OF DRILLING by A & L DRILLING COMPANY

(39)

OWNER OF LAND David Henry

ADDRESS 30--61

WELL—SITE Tanana, Alaska

DATE—STARTED August 2, 1967

DATE—ENDED August 2, 1967

DEPTH OF WELL 57 feet

STATIC LEVEL OF WATER FT. 34

DRAW DOWN FT. 18

GALS. PER HR 12

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	5	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	5	FT. TO	16	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	16	FT. TO	41	FT.	Gravel, Sand	FROM ..... FT. TO ..... FT.	
FROM	41	FT. TO	50	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM	50	FT. TO	55	FT.	Sand, Black Gravel, water	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	
FROM	55	FT. TO	57	FT.	Sand Stone	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	
FROM	.....	FT. TO	.....	FT.	.....	FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Well cased to 55 feet. Casing perforated from 49 feet to 52 feet.
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND	Abandoned	DEPTH OF WELL	50 feet
ADDRESS	[illegible]-97	STATIC LEVEL OF WATER FT.	19
WELL—SITE	Tanana, Alaska	DRAW DOWN FT.	26
DATE—STARTED	August 3, 1967	GALS. PER HR.	16
DATE—ENDED	August 3, 1967	KIND OF CASING	6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.		FROM	FT. TO	FT.
0	1	Over Burden				
1	8	Sand				
8	44	Sand & Gravel				
44	50	Black Sand, Gravel Wet				

MISCL. INFORMATION:

Well cased to 49'5". Casing perforated from 41'5" to 47'5".
Well grouted to 10 feet.

PROJECT ENGINEER ______________ DRILLER'S NAME ______________

47

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Jason Edwin — DEPTH OF WELL 48 feet.

ADDRESS 32--36 — STATIC LEVEL OF WATER FT. 18

WELL SITE Tanana, Alaska — DRAW DOWN FT. 7

DATE STARTED August 4, 1967 — GALS. PER HR. 1300

DATE ENDED August 4, 1967 — KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 1	FT. Cvar Burden	FROM	FT. TO	FT.
FROM 1	FT. TO 9	FT. Sand	FROM	FT. TO	FT.
FROM 9	FT. TO 18	FT. Sand & Gravel	FROM	FT. TO	FT.
FROM 18	FT. TO 23	FT. Conrse Sand	FROM	FT. TO	FT.
FROM 23	FT. TO 47	FT. Gravel, Sand, Brown	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 47	FT. TO 48	FT. Gray Sand, Gravel Wet--water	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well cased to 47'2". Casing perforated from 42'2" to 45'2".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

49

LOG OF DRILLING by A & L DRILLING COMPANY 33

OWNER OF LAND Jimmy Albert

ADDRESS 33—34

WELL—SITE Tanana, Alaska

DATE—STARTED August 4, 1967

DATE—ENDED August 4, 1967

DEPTH OF WELL 55 ft.

STATIC LEVEL OF WATER FT. ----

DRAW DOWN FT. ----

GALS. PER HR. ----

KIND OF CASING ------

KIND OF FORMATION:

FROM	1	FT. TO	2	FT.	Overburden	FROM ..... FT. TO ..... FT.	
FROM	2	FT. TO	8	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	8	FT. TO	31	FT.	Sand, Gravel, Perma Frost	FROM ..... FT. TO ..... FT.	
FROM	/	FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	31	FT. TO	46	FT.	Sand, Gravel, Coarse, Perma Frost	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	46	FT. TO	49	FT.	Sand, Gravel, Grey, Perma Frost	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	49	FT. TO	56	FT.	Clay, Grey, Blue Perma Frost	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

DRY HOLE

PROJECT ENGINEER _____ DRILLER'S NAME Lee Sullivan

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Glenn Gregory

ADDRESS 34--3

WELL—SITE Tanana, Alaska

DATE—STARTED August 7, 1967

DATE—ENDED August 7, 1967

DEPTH OF WELL 50 feet

STATIC LEVEL OF WATER FT. 17

DRAW DOWN FT. 20

GALS. PER HR. 2100

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0 FT. TO 12 FT.	Sand		FROM FT. TO FT.		
FROM 12 FT. TO 16 FT.	Gravel, small, sand		FROM FT. TO FT.		
FROM FT. TO FT.			FROM FT. TO FT.		
FROM 16 FT. TO 25 FT.	Sand		FROM FT. TO FT.		
FROM 25 FT. TO 29 FT.	Sand&Gravel, Water		FROM FT. TO FT.		
FROM FT. TO FT.			FROM FT. TO FT.		
FROM 29 FT. TO 35 FT.	Small Gravel, Sand		FROM FT. TO FT.		
FROM FT. TO FT.			FROM FT. TO FT.		
FROM 35 FT. TO 48 FT.	Hard Ian, Clay Base		FROM FT. TO FT.		
FROM FT. TO FT.			FROM FT. TO FT.		
FROM 48 FT. TO 50 FT.	Water, Sand, Black		FROM FT. TO FT.		
FROM FT. TO FT.			FROM FT. TO FT.		

MISCL. INFORMATION:

Well cased to 46'4" Casing perforated from 40'4" to 43'4".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Miller

ADDRESS 38--2

WELL—SITE Tanana, Alaska

DATE—STARTED August 9, 1967

DATE—ENDED August 9, 1967

DEPTH OF WELL 48 feet

STATIC LEVEL OF WATER FT. 18

DRAW DOWN FT. 20

GALS. PER HR. 1800

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	2	FT	Over Burden	FROM ... FT. TO ... FT	
FROM	2	FT. TO	18	FT	Small Sand	FROM ... FT. TO ... FT	
FROM	18	FT. TO	21	FT	Coarse Sand, Lighter Color	FROM ... FT. TO ... FT	
FROM	21	FT. TO	32	FT	Coarse Sand, Dark Gravel	FROM ... FT. TO ... FT	
FROM	32	FT. TO	35	FT	Small Gravel, Sand	FROM ... FT. TO ... FT	
FROM	35	FT. TO	38	FT	Large Gravel, Sand	FROM ... FT. TO ... FT	
FROM	38	FT. TO	48	FT	Small Gravel, Sand, wet	FROM ... FT. TO ... FT	

MISCL. INFORMATION:

Well cased to 47'5". Casing perforated from 40'5" to 44'5". Well grouted to 10 feet.

PROJECT ENGINEER John R Worley ENGINEER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY 36

OWNER OF LAND Walter Nicholia — DEPTH OF WELL 50 feet

ADDRESS 36--13 — STATIC LEVEL OF WATER FT. 18

WELL—SITE Tanana, Alaska — DRAW DOWN FT. 17

DATE—STARTED August 9, 1967 — GALS. PER HR. 1800

DATE—ENDED August 9, 1967 — KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 0	FT. TO 2	FT. Over Burden	FROM	FT. TO	FT.
FROM 2	FT. TO 10	FT. Sand	FROM	FT. TO	FT.
FROM 10	FT. TO 15	FT. Small Gravel, Sand	FROM	FT. TO	FT.
FROM 15	FT. TO 20	FT. Large Gravel, Sand	FROM	FT. TO	FT.
FROM 20	FT. TO 41	FT. Small Gravel, Sand	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM 41	FT. TO 47	FT. Water, Sand	FROM	FT. TO	FT.
FROM 47	FT. TO 50	FT. Sand Stone	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.
FROM	FT. TO	FT.	FROM	FT. TO	FT.

MISCL. INFORMATION:

Well cased to 49'9". Casing perforated from 42'9" to 46'9".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Martha Wright

ADDRESS 37--55

WELL—SITE Tanana, Alaska

DATE—STARTED August 10, 1967

DATE—ENDED August 10, 1967

DEPTH OF WELL 51 feet

STATIC LEVEL OF WATER FT. 22

DRAW DOWN FT. 16

GALS. PER HR. 210

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	2	FT.	Over Burden		
FROM	2	FT. TO	11	FT.	Sand		
FROM	11	FT. TO	17	FT.	Sand, Gravel, Small		
FROM		FT. TO		FT.			
FROM	17	FT. TO	18	FT.	Sand, Gravel, Large		
FROM		FT. TO		FT.			
FROM	18	FT. TO	25	FT.	Coarse Sand, Brown, some Gravel		
FROM		FT. TO		FT.			
FROM	26	FT. TO	28	FT.	Large Gravel, Sand, Brown		
FROM		FT. TO		FT.			
FROM	29	FT. TO	39	FT.	Coarse Sand, Gravel, Brown		
FROM		FT. TO		FT.			
FROM	39	FT. TO	43	FT.	Sand, Grey		
FROM		FT. TO		FT.	Gravel, Water, 1 1/1		
FROM		FT. TO		FT.	GPM		
FROM	43	FT. TO	48	FT.	Sandstone,		
FROM		FT. TO		FT.	Water, 2 GPM		
FROM	48	FT. TO	51	FT.	Hard Rock		
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

MISCL. INFORMATION:

Well cased to 44'5". Casing perforated from 35'5" to 43'5". Well grouted to 10 feet.

PROJECT ENGINEER _____

DRILLER'S NAME _____

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND: Gus Norlor

ADDRESS: 49--94

WELL—SITE: Tanana, Alaska

DATE—STARTED: August 26, 1967

DATE—ENDED: August 26, 1967

DEPTH OF WELL: 48 feet

STATIC LEVEL OF WATER FT.: 18

DRAW DOWN FT.: 15

GALS. PER HR.: 1200

KIND OF CASING: 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden		
FROM	1	FT. TO	11	FT.	Sand		
FROM	11	FT. TO	19	FT.	Sand & Gravel		
FROM	19	FT. TO	27	FT.	Coarse Sand, Gravel		
FROM	27	FT. TO	39	FT.	Hard Lan		
FROM	39	FT. TO	44	FT.	Sand, wet		
FROM	44	FT. TO	48	FT.	Large Gravel, Sand, Wet		

FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

MISCL. INFORMATION:

Well cased to 47'7". Casing perforated from 41'7" to 44'7".
Well grouted to 10 foot.

CHIEF ENGINEER

DRILLER'S NAME

LOG OF DRILLING by A & L DRILLING COMPANY

52

OWNER OF LAND Jake Starr

ADDRESS 90--86

WELL—SITE Tanana, Alaska

DATE—STARTED August 26, 1967

DATE—ENDED August 27, 1967

DEPTH OF WELL 56 feet

STATIC LEVEL OF WATER FT. 19

DRAW DOWN FT. 26 feet

GALS. PER HR. 40

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden		
FROM	1	FT. TO	5	FT.	Sand		
FROM	5	FT. TO	8	FT.	Sand & Gravel		
FROM	8	FT. TO	10	FT.	Large Gravel, Sand		
FROM		FT. TO		FT.			
FROM	10	FT. TO	13	FT.	Sand & Gravel		
FROM	13	FT. TO	25	FT.	Coarse Sand, Gravel		
FROM		FT. TO		FT.			
FROM	25	FT. TO	31	FT.	Sand, Gravel, Boulders		
FROM		FT. TO		FT.			
FROM	31	FT. TO	40	FT.	Sand & Gravel		
FROM	40	FT. TO	42	FT.	Large Gravel, Sand		
FROM	42	FT. TO	44	FT.	Sand, Gravel, Hot		
FROM		FT. TO		FT.			
FROM	44	FT. TO	45	FT.	Large Gravel, Sand		
FROM		FT. TO		FT.			
FROM	45	FT. TO	49	FT.	Hard Pan		
FROM	49	FT. TO	51	FT.	Water Sand Gravel		
FROM		FT. TO		FT.			
FROM	51	FT. TO	56	FT.	Sand, Silt Seepage		
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

MISCL. INFORMATION:

Well cased to 46'7". Casing perforated from 0'7" to 43'7".
Well grouted to 10 feet.

PROJECT ENGINEER

DRILLER'S NAME

55

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Community Hall

ADDRESS Front Street

WELL—SITE Tanana, Alaska

DATE—STARTED August 28, 1967

DATE—ENDED August 28, 1967

DEPTH OF WELL 49 feet

STATIC LEVEL OF WATER FT. 22

DRAW DOWN FT. 18

GALS. PER HR. 360

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	1	FT. TO	8	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	8	FT. TO	18	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	18	FT. TO	22	FT.	Coarse Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	22	FT. TO	23	FT.	Large Gravel, Sand	FROM ..... FT. TO ..... FT.	
FROM	23	FT. TO	31	FT.	Coarse Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	31	FT. TO	36	FT.	Water Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	36	FT. TO	42	FT.	Water Sand, Fine	FROM ..... FT. TO ..... FT.	
FROM	42	FT. TO	49	FT.	Rock	FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Well cased to 42 feet 6 inches. Casing perforated from 34'6" to 39'6". Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

Todd Prozenikoff
54--37 (Well No. 2)
Tonana, Alaska
August 28, 1967
August 28, 1967

65 feet

Dry Hole

0	3	Over Burden
3	12	Frost, Sand
12	22	Sand, Gravel, dry
22	36	Hard Pan, Frost
36	47	Sand, Gravel, dark
47	62	Sand, Moist
62	65	Blue Clay

DRY HOLE. Frozen from 3 feet to 65 foot.

PROJECT ENGINEER _____

LOG OF DRILLING by A & L DRILLING COMPANY—54

OWNER OF LAND David Ellis — DEPTH OF WELL 51 ft. 6 inches

ADDRESS 54--53 — STATIC LEVEL OF WATER FT. 16

WELL SITE Tanana, Alaska — DRAW DOWN FT. 20

DATE STARTED August 29, 1967 — GALS. PER HR. 420

DATE ENDED August 30, 1967 — KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM 1 FT. TO 4 FT. Over Burden

FROM 4 FT. TO 26 FT. Sand and Gravel

FROM 26 FT. TO 30 FT. Gravel, Course

FROM 30 FT. TO 44 FT. Sand and Gravel

FROM 44 FT. TO 48 FT. Gravel

FROM 48 FT. TO 51-6FT. Water Sand

FROM ____ FT. TO 51-6FT. Sand Stone

MISC. INFORMATION:

Well cased to 51'6". Perforated from 45'6" to 49'6".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

LOG OF DRILLING by A & L DRILLING COMPANY

89

OWNER OF LAND David Ella — DEPTH OF WELL 45 feet

ADDRESS 39--25 — STATIC LEVEL OF WATER FT. ———

WELL—SITE Tanana, Alaska — DRAW DOWN FT. ———

DATE—STARTED August 11, 1967 — GALS. PER HR. ———

DATE—ENDED August 11, 1967 — KIND OF CASING ———

KIND OF FORMATION:

FROM 0	FT. TO 3	FT Over Burden	FROM	FT. TO	FT		
FROM 3	FT. TO 10	FT Sand, Frost	FROM	FT. TO	FT		
FROM 10	FT. TO 17	FT Gravel, Sand, Frost	FROM	FT. TO	FT		
FROM 17	FT. TO 24	FT Coarse Sand, small Gravel, Frost	FROM	FT. TO	FT		
FROM	FT. TO	FT	FROM	FT. TO	FT		
FROM 24	FT. TO 35	FT Sand, Gravel, Frost	FROM	FT. TO	FT		
FROM	FT. TO	FT	FROM	FT. TO	FT		
FROM 35	FT. TO 37	FT Boulders, Gravel, Sand, Frost	FROM	FT. TO	FT		
FROM	FT. TO	FT	FROM	FT. TO	FT		
FROM 37	FT. TO	FT Bed Rock, Quartz Frost	FROM	FT. TO	FT		
FROM	FT. TO	FT	FROM	FT. TO	FT		
FROM	FT. TO	FT	FROM	FT. TO	FT		

MISCL. INFORMATION:

DRY HOLE

PROJECT ENGINEER _____ DRILLER'S NAME _____

LOG OF DRILLING by A & L DRILLING COMPAN

OWNER OF LAND Phillip Kennedy, Sr. — DEPTH OF WELL 65 foot

ADDRESS 40--42 — STATIC LEVEL OF WATER FT. ----

WELL—SITE Tanana, Alaska — DRAW DOWN FT. ----

DATE—STARTED August 11, 1967 — GALS. PER HR. Dry

DATE—ENDED August 11, 1967 — KIND OF CASING ----

KIND OF FORMATION:

FROM	0	FT. TO	3	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	3	FT. TO	11	FT.	Sand, Frost	FROM ..... FT. TO ..... FT.	
FROM	11	FT. TO	30	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	30	FT. TO	45	FT.	Large Gravel	FROM ..... FT. TO ..... FT.	
FROM	45	FT. TO	49	FT.	Boulders	FROM ..... FT. TO ..... FT.	
FROM	49	FT. TO	61	FT.	Water, Sand, Frozen	FROM ..... FT. TO ..... FT.	
FROM	61	FT. TO	65	FT.	Black Mika, Schist	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

DRY HOLE
Frozen from 3 to 65 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Teresa Butler and John Swenson
ADDRESS 41--15 A,16
WELL—SITE Tanana, Alaska
DATE—STARTED August 19, 1967
DATE—ENDED August 19, 1967

DEPTH OF WELL 51 feet
STATIC LEVEL OF WATER FT. 17
DRAW DOWN FT. 20
GALS. PER HR. 480
KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	2	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	2	FT. TO	7	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	7	FT. TO	10	FT.	Sand, Gravel	FROM ..... FT. TO ..... FT.	
FROM	10	FT. TO	17	FT.	Small Gravel	FROM ..... FT. TO ..... FT.	
FROM	17	FT. TO	20	FT.	Large Gravel	FROM ..... FT. TO ..... FT.	
FROM	20	FT. TO	35	FT.	Sand, Small Gravel	FROM ..... FT. TO ..... FT.	
FROM	35	FT. TO	38	FT.	Coarse Sand, Small Gravel	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM	38	FT. TO	48	FT.	Water Sand	FROM ..... FT. TO ..... FT.	
FROM	48	FT. TO	51	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION: Well cased to 50'8". Casing perforated from 43'8" to 47'8".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Hudson-Nicholia

ADDRESS 1-42--17

WELL—SITE Tanana, Alaska

DATE—STARTED August 20, 1967

DATE—ENDED August 20, 1967

DEPTH OF WELL 42 feet

STATIC LEVEL OF WATER FT. 8

DRAW DOWN FT. 15

GALS. PER HR. 1080

KIND OF CASING 6 5/8" C.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	1	FT. TO	5	FT.	Sand	FROM ..... FT. TO ..... FT.	
FROM	5	FT. TO	15	FT.	Sand, Gravel	FROM ..... FT. TO ..... FT.	
FROM	15	FT. TO	18	FT.	Sand, Gravel	FROM ..... FT. TO ..... FT.	
FROM	18	FT. TO	26	FT.	Sand, Gravel	FROM ..... FT. TO ..... FT.	
FROM	26	FT. TO	35	FT.	Coarse Sand, Small Gravel	FROM ..... FT. TO ..... FT.	
FROM	35	FT. TO	36	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	36	FT. TO	39	FT.	Black Water, sand	FROM ..... FT. TO ..... FT.	
FROM	39	FT. TO	42	FT.	Hard Pan	FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	
FROM		FT. TO		FT.		FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

Well cased to 41'9". Casing perforated from 35'9" to 38'9".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

AQUIFER TEST FIELD DATA SHEET

roject No. 76-621 R Project Name Tanana Well # 2

ocation of Well PHS Hospital - Tanana, Alaska

epth of Well 155 ft. Length of Casing 97 ft. Pumped Well / ~~Observation Well~~

f Observation Well, Dist. to Pumped Well ____ ft. Top of Casing to Static Level

ate Drilling Completed 8-26-76 Driller Bordner Date Tested 8-26-76

lock ime	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawdown @ 50 gpm ~~or~~ Recovery	Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	~~Drawdown~~ @ 50 ~~or~~ Recovery
	Static Level	25'-6"	---		Static Level	25'-6"	---
	5 min.	29'	3'-6"		1 min.	26'-1"	7"
	6	29'-10"	4'-4"		3	26'	6"
	7	30'	4'-6"		4	26'	6"
	8	34'-4"	8'-10"		5	25'-11-3/4"	5-3/4"
	9	34'-4"	8'-10"		6	25'-11-1/2"	5-1/2"
	10	34'-4"	8'-10"		7	25'-11-1/2"	5-1/2"
	11	34'-4"	8'-10"		8	25'-11-1/2"	5-1/2"
	12	34'-5"	8'-11"		9	25'-11-1/2"	5-1/2"
	15	34'-5"	8'-11"		10	25'-11-1/2"	5-1/2"
	20	34'-8"	9'-2"				
	25	34'-8-1/2"	9'-2-1/2"				
	30	34'-9-1/2"	9'-3-1/2"				
	40	34'-10-1/2"	9'-4-1/2"				
	50	35'-1"	9'-7"				
	60	35'	9'-6"				
	80	34'-7"	9'-1"				
	20 hrs.	34'-7"	9'-1"				

AQUIFER TEST FIELD DATA SHEET Page 1 of 1

oject No. 76-1-31R Project Name TANANA Well # 2

cation of Well PHS HOSPITAL — TANANA AK.

pth of Well 155 ft. Length of Casing 97 ft. Pumped Well / ~~Observation Well~~

Observation Well, Dist. to Pumped Well ____ ft. Top of Casing to Static Level

te Drilling Completed 8-26-76 Driller BORDNER Date Tested 8-26-76

ock me	Elapsed Time Since Pumping Started/~~Stopped~~	Depth to Water From TOC	Drawdown @ 50 gpm or ~~Recovery~~	Clock Time	Elapsed Time Since Pumping ~~Started~~/Stopped	Depth to Water From TOC	~~Drawdown~~ @ 50 gpm or Recovery
	STATIC LEVEL	25'-6"	—		STATIC LEVEL	25'-6"	—
	5 MIN.	29'	3'-6"		1 MIN	26'-1"	7"
	6	29'-10"	4'-4"		3	26'	6"
	7	30'	4'-6"		4	26'	6"
	8	34'-4"	8'-10"		5	25'-11¾"	5¾"
	9	34'-4"	8'-10"		6	25'-11½"	5½"
	10	34'-4"	8'-10"		7	25'-11½"	5½"
	11	34'-4"	8'-10"		8	25'-11½"	5½"
	12	34'-5"	8'-11"		9	25'-11½"	5½"
	15	34'-5"	8'-11"		10	25'-11½"	5½"
	20	34'-8"	9'-2"				
	25	34'-8½"	9'-2½"				
	30	34'-9½"	9'-3½"				
	40	34'-10½"	9'-4½"				
	50	35'-1"	9'-7"				
	60	35'	9'-6"				
	80	34'-7"	9'-1"				
	20 HRS	34'-7"	9'-1"				

(64)

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION PHS HOSPITAL - TANANA, AK DATE STARTED 8-18-76

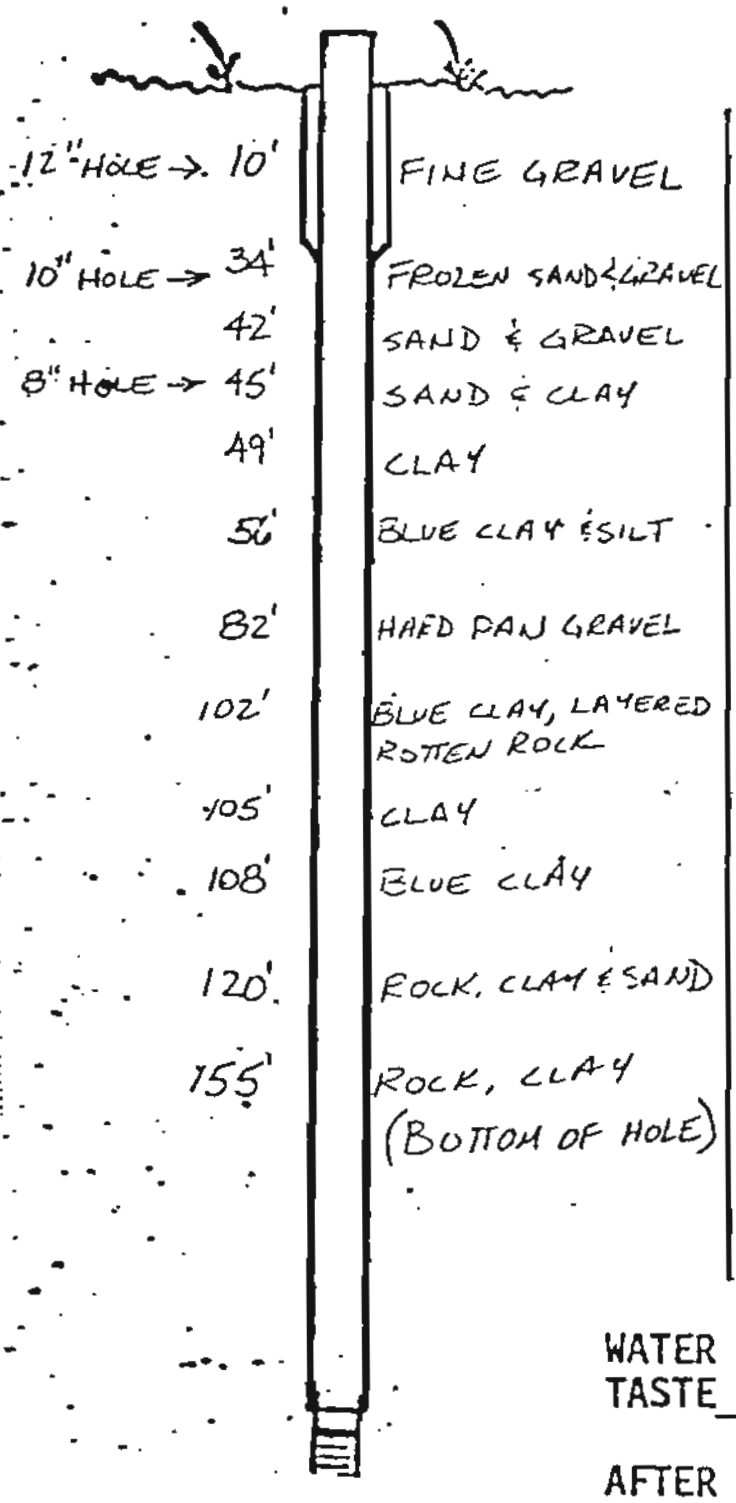
DATE COMPLETED 8-28-76 CREW BORDNER - HORNER

TOTAL DEPTH OF WELL 155 FT. CASING INSTALLED 97' DIAMETER 8" & 6"

GROUT BENTONITE SCREEN SIZE #40 MFG. JOHNSON LENGTH 10'

STATIC WATER LEVEL 25'-6" HRS. PUMPED 20 @ 50 GPM DRAWDOWN _____ FT.

DEVELOPMENT PROCEDURES RUN SURGE BLOCKS 8 HOURS



DATE	DEPTH FROM - TO	FORMATION
	0'-10'	FINE GRAVEL
	10'-34'	FROZEN SAND & GRAVEL
	34'-42'	SAND & GRAVEL
	42'-45'	SAND & GRAY CLAY
	45'-49'	GRAY CLAY
	49'-56'	BLUE CLAY SILT
	56'-82'	HARD PAN GRAVEL
	82'-102'	BLUE CLAY, LAYERED ROTTEN ROCK
	102'-105'	CLAY (PURPLISH COLOR)
	105'-108'	BLUE CLAY
	108'-120'	ROCK, CLAY (GRAY) & SAND
	120'-155'	ROCK, CLAY (BOTTOM OF HOLE)

WATER DATA FIELD TEST

TASTE GOOD APPEARANCE FRESH GOOD

AFTER 24 HOURS _____ IRON _____ CHLORIDES _____

TDS _____ ALKALINITY _____ pH _____

SPECIAL NOTES:

~~CASING ONLY GOES DOWN~~ TO 97 FEET ~~TOP 39 FEET IS~~ 8" CASING. ~~THEN A 10 FEET~~ SLOT SCREEN AND 18 FEET (65) ~~6" CASING~~ SEE ATTACHED DRAWING.

WELL LOG

9/1/76 U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION PHS HOSPITAL - TANANA, AK DATE STARTED 8/18/76

DATE COMPLETED 8/28/76 DRILLER BOEDWEG, C. & HUEBNER, H.

TOTAL DEPTH OF WELL 155 FT. CASING INSTALLED 6" TO 97 DIAMETER _____

GROUT Bentonite SCREEN SIZE #40 MFG Johnson LENGTH 10 Ft

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
12" HOLE → 0-10 →		FINE GRAVEL
10" HOLE → 10 - 34 →		FROZEN SAND AND GRAVEL
34 - 42 →		SAND + GRAVEL
11" HOLE → 42 - 45 →		SAND CLAY (GRAY)
45 - 49 →		CLAY (GRAY)
49 - 56 →		BLUE CLAY SILT
56 - 82 →		HARD PAN GRAVEL
82 - 102 →		BLUE CLAY Layered rotten rock
102 - 105 →		CLAY (purplish color)
105 - 108 →		BLUE CLAY
108 - 120 →		ROCK CLAY (gray) SAND
120 - 155 →		ROCK CLAY (BOTTOM OF HOLE)

SOIL DATA TO 15 FT. - 8-19-76

FEET THAWED 10 - Silt & Sand

BOTTOM OF FROST & MATERIAL 34 - gravel

SEASONAL OR PERMA FROST Perma

WATER DATA FIELD TEST - 36°

TASTE Good

APPEARANCE FRESH Good

AFTER 24 HOURS _____

IRON _____

CHLORIDES _____

TDS _____

PUMP TEST 256 - STATIC LEVEL

PUMPING LEVEL 347 @ 50 GPM

AFTER 20 HRS.

HIGHEST RECOMMENDED PUMP RATE 50 gpm

WILL STATIC LEVEL CHANGE WITH TIDES No OR FROST Yes

DEVELOP PROCEDURE Run Surge Blocks 8 hrs

ESTIMATED MAN HOURS FOR DRILLING 84 HOURS FOR TOTAL JOB 132

CREW CHARLIE BOEDWEG, HENRY HUEBNER

(4)

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION PHS Hospital-Tanana, Alaska DATE STARTED August 18, 1976

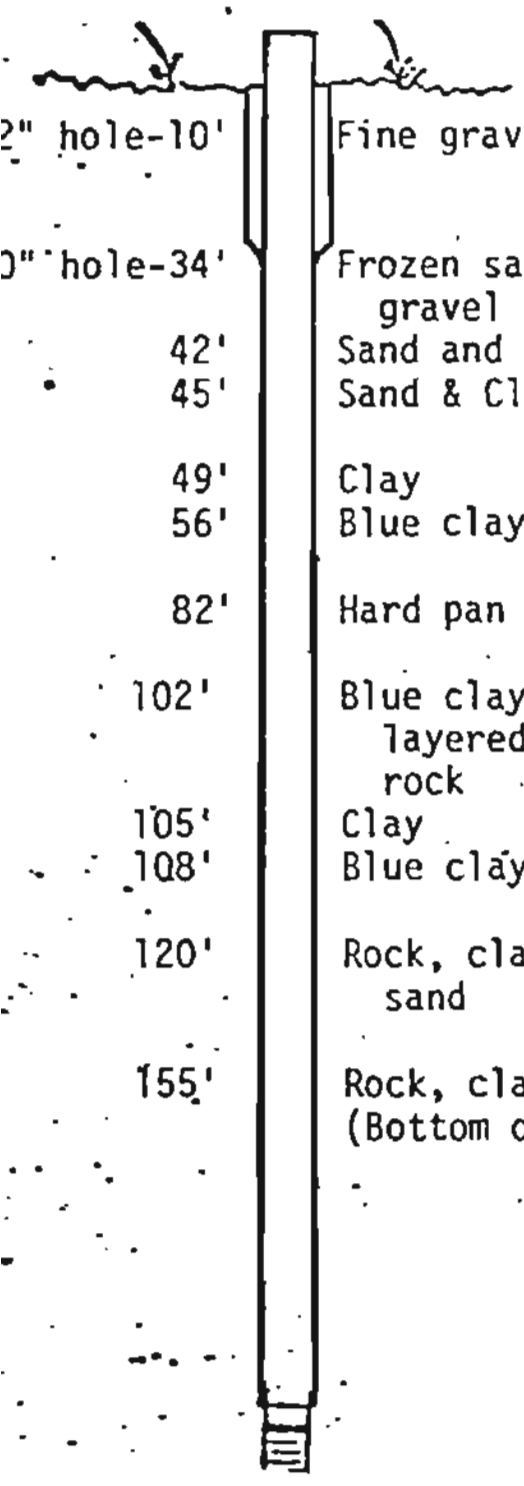
DATE COMPLETED August 28, 1976 CREW Bordner & Horner

TOTAL DEPTH OF WELL 155 FT. CASING INSTALLED 97' DIAMETER 8" & 6"

GROUT Bentonite SCREEN SIZE #40 MFG. Johnson LENGTH 10'

STATIC WATER LEVEL 25'-6" HRS. PUMPED 20 @ 50 GPM DRAWDOWN ____ FT.

DEVELOPMENT PROCEDURES Run surge blocks 8 hrs.



DATE	DEPTH FROM - TO	FORMATION
	0-10'	Fine gravel
	10-34'	Frozen sand & gravel
	34-42'	Sand & gravel
	42-45'	Sand & gray clay
	45-49'	Gray clay
	49-56'	Blue clay silt
	56-82'	Hard pan gravel
	82-102'	Blue clay, layered rotten rock
	102-105'	Clay (purplish color)
	105-108'	Blue clay
	108-120'	Rock, clay (gray) & sand
	120-155'	Rock, clay (bottom of hole)

WATER DATA FIELD TEST

TASTE Good APPEARANCE FRESH Good

AFTER 24 HOURS ____ IRON ____ CHLORIDES ____

TDS ____ ALKALINITY ____ pH ____

SPECIAL NOTES:

See attached drawing.

MARCH, 1977

WATER WELL ANALYSIS

SANITATION FACILITIES CONSTRUCTION

TANANA, ALASKA

PROJECT NO. AN-76-621R

ENGINEER

Mark Brumbaugh, P.E.
Sanitary Engineer
Asst. Manager, Construction
Operations

ALASKA AREA NATIVE HEALTH SERVICE
Office of Environmental Health

CONTENTS:

PROJECT HISTORY

The existing well source for the PHS Hospital in Tanana was contaminated by an oil spill in late 1974. As a result, OEH was approached by the Hospital's Construction and Maintenance Branch to drill a new source. An agreement was reached, and the sum of $9000.00 was transfered to OEH control.

A PHS drill rig in Koyukuk had been leased to the state over the winter. Part of the lease agreement entitled PHS to have the state barge the drilling equipment to Tanana, free of charge to PHS. The drilling equipment arrived in Tanana in July 1976.

Charlie Bordner and Henry Horner drilled the new well in August. The well was drilled to a depth of 155 feet, as it was felt that the water bearing formation was somewhat shallow. As no water was hit, the casing was pulled back to 97 feet. The remainder of the hole was filled with cuttings.

WATER ANALYSIS REPORT FORM

Report to: ARCH BARRETT, ADMIN. OFFICER
OFFICE OF ENVIRONMENTAL HEALTH
P. O. BOX 7-741
ANCHORAGE, AK 99510

C 956

E OR LOCATION: TANANA PHS HOSPITAL, TANANA, ALASKA

LECTED BY: T. J. HARTRICH, JR. DATE 5/23/79 HOUR: 9:00AM

WATER SYSTEM

Well Type DRILLED Depth 206 Gallons per minute 50

Surface Water: _____ Temporary [ ] Permanent [X]

Number of Homes Served: 40 + SCHOOL + HOSPITAL

Treatment: [X] Yes [ ] No New or Existing Source EXISTING

PURPOSE OF ANALYSIS

[ ] 1. Water Approval for Building Permit. (Column 1)
[ ] 2. Routine Analysis. (Column 1 & 2)
[ ] 3. Special: Check Specific Items for Analysis (Columns 1,2,3)

COLUMN 1 COLUMN 2 COLUMN 3

	Analysis	Limits
n (Fe)	0.2	0.3
oride (F)	0.37	1.5
oride (Cl)	13	250
(PO_4)		.05 good
sphate	0.07	30 poor
al Hardness	278	50 soft 300 hard
ersents	0	0
	7.6	6.5 8.5
cific ductance	438	

	Anal.	Limit
Magnesium (Mg)	44	125
Calcium (Ca)	64	300
Turbidity	2	5
Color	10	15
Bicarbonate (HCO_3)	265	25 good 500 poor
Carbonate	0	350
Alkalinity	217	350
Total Dissolved Solids	252	500

	Analysis	Limits
Sodium (Na)		200
Potassium (K)		.
Sulfate (SO_4)		250
Sulfite **(SO_3)		5.0
Nitrate (NO_3)		10
Suspended Solids		
Arsenic (As)		0.01
Copper (Cu)		1.0
Cyanide (Cn)		0.01
Phenols		0.00
Zinc (Zn)		5.0
Barium (Ba)		1.0
Cadmium (Cd)		0.01
Lead Pb)		0.05
Silver (Ag)		0.05
Mercury (Hg)		0.05
Manganese (Mn)		0.05

MENTS: _____

STRUCTIONS:

Rinse container several times in water source to be sampled.

Place cap on sample container firmly.

Place sample in carton mailer, and forward to:

Public Health Laboratory
SRO, Medical Arts Bldg.
Pouch J
Juneau, AK 99801

OCT 9 [illegible]

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

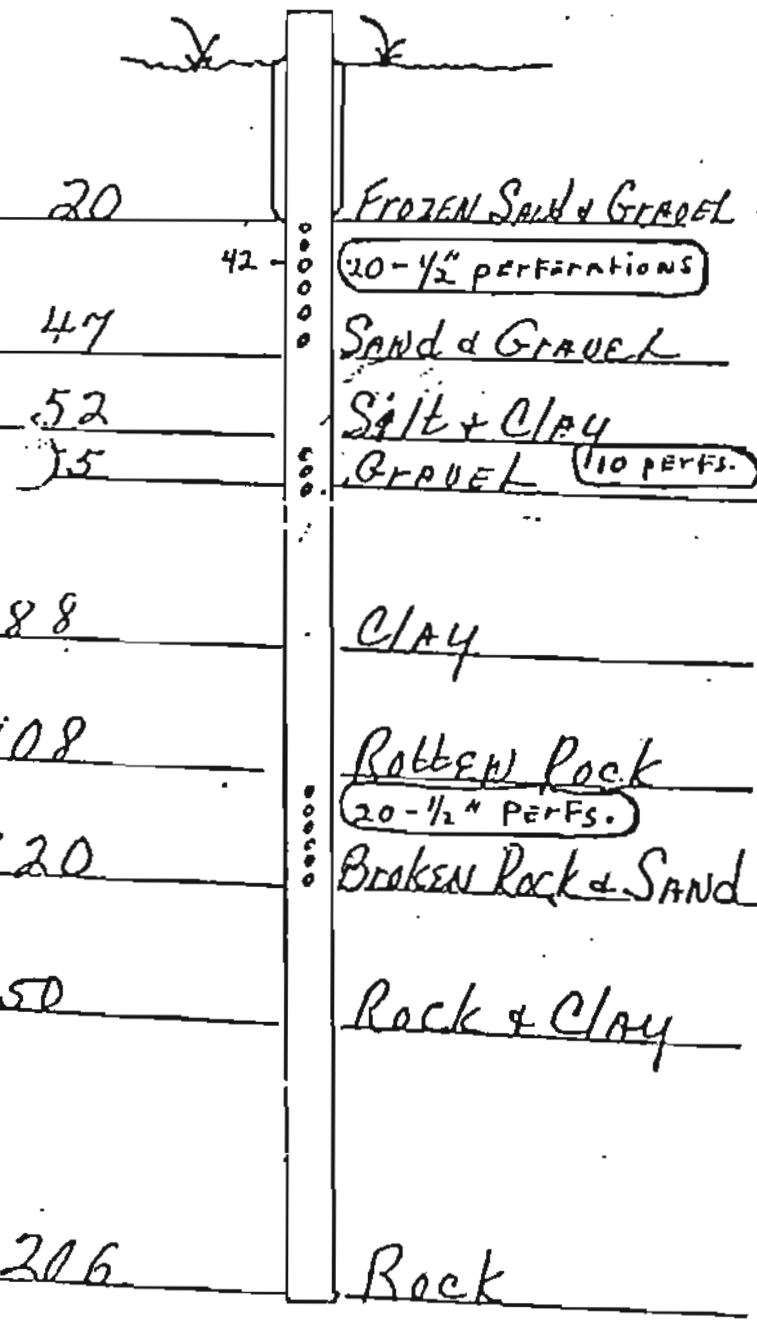
LOCATION Tanana P.H.S. Hospital DATE STARTED 1/21/72

DATE COMPLETED 3/10/72 DRILLER Corky Unrein

TOTAL DEPTH OF WELL 206 FT. CASING INSTALLED 153 DIAMETER 6"

GROUT NONE ~~SCREEN SIZE~~ 50-½" perforations LENGTH 17'

STATIC WATER LEVEL 41 HRS. PUMPED 4 days @ 30-40-58 GPM. DRAWDOWN _____ FT.



DATE	DEPTH FROM - TO	FORMATION	DRILLER
1/30	0 - 20	Frozen Sand & Gravel	
1/31	20 - 47	Sand & Gravel	
2/1	47 - 52	Salt & Clay	
	52 - 55	Gravel	
2/2	55 - 88	Clay	
2/14	88 - 108	Rotten Rock	
2/16	108 - 120	Broken Rock & Sand	
2/20	120 - 150	Rock & Clay	
2/29	150 - 206	Rock	

SPECIAL NOTES:

Zone 108 - 120 — Was developed 8 hrs. by surging, bailing & was test pumped at 3 gpm for 10 hrs.

Zone 52 - 55 — Was developed by surging and bailing for 3 hrs. test pumped at 30 gpm with 9 ft. drdw down

Zone 42 - 47 (?) Was developed by surging & bailing & test pumped at

Tanana

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

350' E OF N.C. STATE
GO 200' OVER E side of road

LOCATION Alamance - City Well DATE STARTED _____

DATE COMPLETED 9-29-50 DRILLER St. Anthony - Fowler

TOTAL DEPTH OF WELL 194' FT. CASING INSTALLED 168' DIAMETER 6"

GROUT n/a SCREEN SIZE n/a MFG. n/a LENGTH n/a

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0-25'	Brown Stet
25'-40'	Gravel
40-50'	Blue Clay
50-58'	White Clay
58-62'	H²O - Gravel
62'-140'	Fine Stet
140'-187'	Black Clay Dirty - Schist
187-194	Rock fractured

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL _____
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH w/p
AFTER 24 HOURS - Dirty
IRON n/a
CHLORIDES _____
TDS _____

PUMP TEST 45' - STATIC LEVEL
PUMPING LEVEL 100' @ 5 GPM
AFTER 30 minutes HRS.

HIGHEST RECOMMENDED PUMP R
WILL STATIC LEVEL CHANGE WI
TIDES _____ OR FROST _____

DEVELOP PROCEDURE Not Enough water - Less than 1gpm.

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____ (72) _____ _____

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Imanna, Alaska #2 DATE STARTED 9-30-80

DATE COMPLETED 10-1-80 DRILLER St. Anthony - Fowler

TOTAL DEPTH OF WELL 55 FT. CASING INSTALLED 50' DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED — @ — GPM DRAWDOWN — F

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
1-5'	Muskeg
5-30	Brown Silt
30-46'	Brown Gravel Sand
46-50'	Blue Gravel
50-55'	Black Silt

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL _____
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH _____
AFTER 24 HOURS _____
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST _____ - STATIC LEVEL
PUMPING LEVEL _____ @ _____ GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE Dry Hole

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

(73)

ON LOT #12 ELLER SUBDIVISION

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TANANA, ALASKA WELL #2 DATE STARTED 9/30/80

DATE COMPLETED 10/1/80 DRILLER STEVE ST. ANTHONY GLENN FINLEY

TOTAL DEPTH OF WELL 55 FT. CASING INSTALLED 50' DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED — @ — GPM DRAWDOWN — FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
1-5'	MUCKEG AND ORGANIC MAT
5-30'	BROWN SILT
30'-46'	BROWN GRAVEL AND SAND
46'-50'	BLUE GRAVEL
50'-55'	BLACK SILT

SOIL DATA TO 15 FT.
FEET THAWED
BOTTOM OF FROST & MATERIAL
SEASONAL OR PERMA FROST 45'

WATER DATA FIELD TEST
TASTE
APPEARANCE FRESH
AFTER 24 HOURS
IRON DRY HOLE
CHLORIDES
TDS

PUMP TEST DRY HOLE - STATIC LEVEL
PUMPING LEVEL @ GPM
AFTER N/A HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES N/A OR FROST DRY HOLE

DEVELOP PROCEDURE N/A DRY HOLE

ESTIMATED MAN HOURS FOR DRILLING 40 HRS HOURS FOR TOTAL JOB 40 HRS

CREW STEVE ST ANTHONY (74) / GLENN FINLEY (

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana Alaska - City Well DATE STARTED Oct. 1 - 1980

DATE COMPLETED 10-3-80 DRILLER St Anthony - Fowler

TOTAL DEPTH OF WELL 50' FT. CASING INSTALLED 50' DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. _____ LENGTH _____

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ F

DEPTH | HOLE DIAMETER / CASING DIAMETER | FORMATION

SOIL DATA TO 15 FT.

FEET THAWED _____

BOTTOM OF FROST & MATERIAL _____

SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST

TASTE _____

APPEARANCE FRESH _____

AFTER 24 HOURS _____

IRON _____

CHLORIDES _____

TDS _____

PUMP TEST _____ - STATIC LEVEL

PUMPING LEVEL _____ @ _____ GPM

AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

DEVELOP PROCEDURE Dry Hole

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

ACP

THIS WELL IS LOCATED ON LOT #7 ELLER SUBDIVISION

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION: TANANA, ALASKA WELL #3 DATE STARTED 10/2/50

DATE COMPLETED 10/4/50 DRILLER STEVE ST ANTHONY / GLENN FOWLER

TOTAL DEPTH OF WELL 60' FT. CASING INSTALLED 60' DIAMETER 6"

GRADE N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL DRY HOLE HRS. PUMPED — @ — GPM DRAWDOWN — FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
SURFACE - 3'	ORGANIC MAT MUCKEG
3' - 25'	SILTY MATERIAL
25' - 60'	GRAVEL

SOIL DATA TO 15 FT.
FEET THAWED
BOTTOM OF FROST & MATERIAL
SEASONAL OR PERMA FROST 4 FT

WATER DATA FIELD TEST
TASTE DRY HOLE
APPEARANCE FRESH
AFTER 24 HOURS
IRON
CHLORIDES
TDS

PUMP TEST DRY HOLE - STATIC LEVEL
PUMPING LEVEL @ GPM
AFTER HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES OR FROST DRY HOLE

DEVELOP PROCEDURE N/A DRY HOLE

ESTIMATED MAN HOURS FOR DRILLING 40 HOURS FOR TOTAL JOB

CREW STEVE ST. ANTHONY (76) / GLENN FOWLER

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana Well #3 DATE STARTED _____

DATE COMPLETED _____ DRILLER Steve St Anthony

TOTAL DEPTH OF WELL 60 FT. CASING INSTALLED 60' DIAMETER _____

GROUT _____ SCREEN SIZE _____ MFG. _____ LENGTH _____

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ F

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
1-5	Muskeg
5-30	Brown Silt
30-46	Brown silty gravel
46-60	Blue Gravel

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL _____
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH _____
AFTER 24 HOURS _____
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST _____ - STATIC LEVEL
PUMPING LEVEL _____ @ _____ GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW Steve St. Anthony & Glen Fowler

J(77)

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana Alaska DATE STARTED 10-2-80

DATE COMPLETED 10-4-80 DRILLER St. Anthony

TOTAL DEPTH OF WELL 60' FT. CASING INSTALLED 60' DIAMETER 6"

GROUT n/a SCREEN SIZE _____ MFG. _____ LENGTH _____

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0-3'	Muskeg
3'-25'	Silt
25'-60'	Gravel

SOIL DATA TO 15 FT.
- FEET THAWED _____
- BOTTOM OF FROST & MATERIAL _____
- SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
- TASTE _____
- APPEARANCE FRESH _____
- AFTER 24 HOURS _____
- IRON _____
- CHLORIDES _____
- TDS _____

PUMP TEST _____ - STATIC LEVEL

PUMPING LEVEL _____ @ _____ GPM

AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

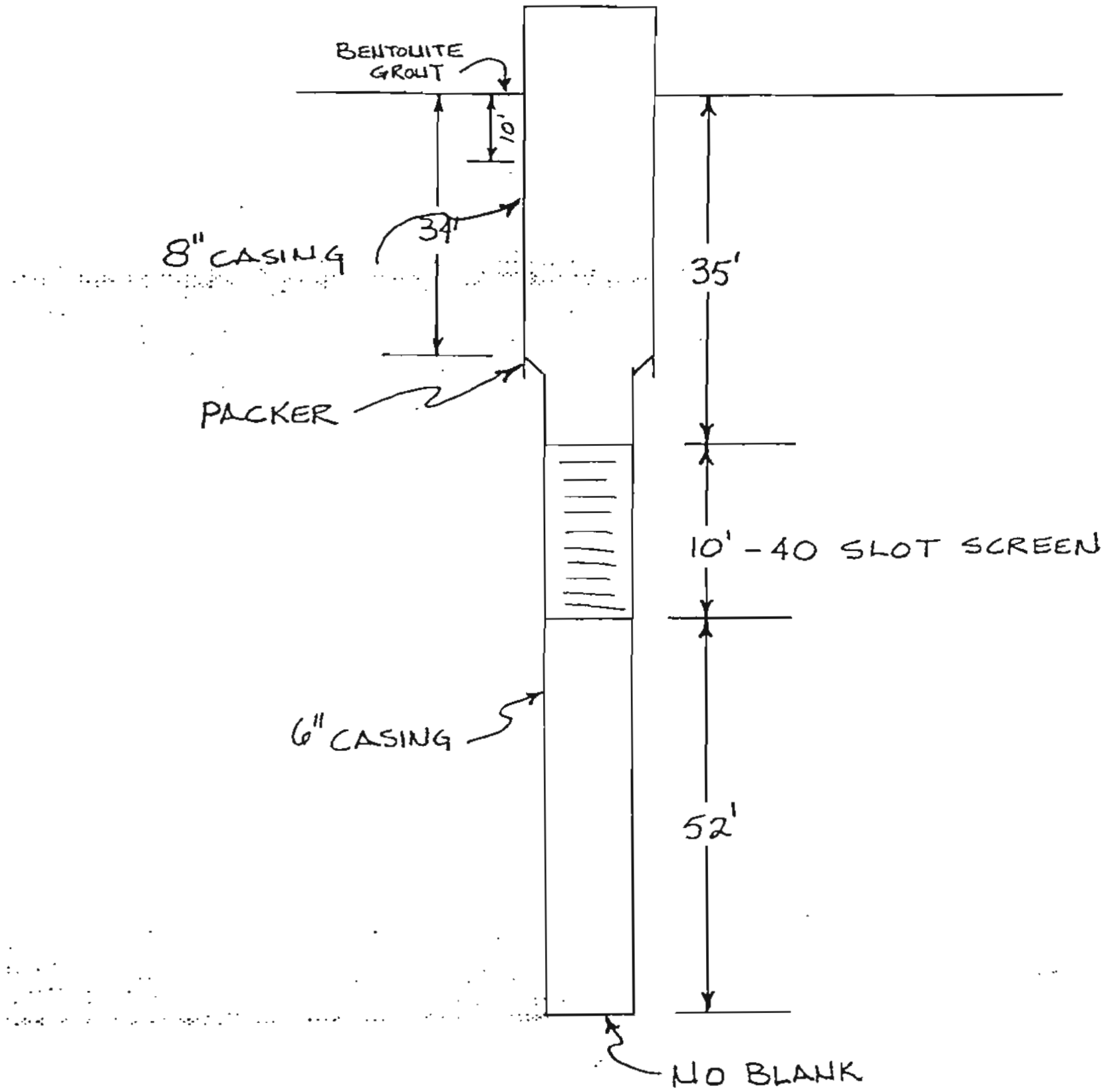
DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

TAIWAN WELL #2 DATE 8-26-76

RECOVERY (FEET) — TIME IN MINUTES SINCE DRAWDOWN


BENTOLITE GROUT
10'
34'
8" CASING
35'
PACKER
10' - 40 SLOT SCREEN
6" CASING
52'
NO BLANK

COST SUMMARY FOR EXPENSES

ASSOCIATED W/WELL DRILLING

IN THE VILLAGE OF Tanana

I.	Drilling manhours costs; includes drilling, bailing, driving casing, setting screens, development, setting pumps, test pumping, abandonement, fishing tools.	
	DRILLING MH COST	$ 2,520
2.	Other manhour costs; includes travel time, standby time, site preparation, rig repair, loading and unloading equipment	
	OTHER MH COST	$ 4,247
3.	TOTAL MH COST	$ 6,767
4.	Travel expense; includes expenses associated with transportation of drilling crews.	
	TRAVEL EXPENSE	$ 338
5.	Cost to move rig; includes transporation costs for moving major well drilling items only	
	COST TO MOVE RIG	$ 376
6.	Supply purchases; purchase of all well supplies including transportation	
	SUPPLY PURCHASES	$ 4,234
7.	TOTAL COSTS	$ 11,715*
8.	#Wells/Total FT	1/155
9.	Drilling Labor Cost/Ft	$ 16.00
IO.	Total Cost/Ft	$ 76.00

*Of this amount $2,250 was charged to McGrath.

Project Name [illegible] Well #5-[illegible]

ation of Well TAWANA

th of Well 44 ft. Length of Casing 39 ft. Pumped Well / Observation We

Observation Well, Dist. to Pumped Well _____ ft. Top of Casing to Static Le

e Drilling Completed 3-20-81 Driller APEX IRR'D Date Tested 3-28-8

ck e.	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawdown @ 20 gpm or Recovery	Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawd @ — or Recov
	1	32'			1		
	2	DREW	DOWN	TO	45' 2 TO		
	3	PUMP	IN FIRST		3		
	4	MIN.	STAYED	AT	30 6P 4M		
	5	12 HR			5		
	6	PUMP	SET	AT	6		
	7	BOTTOM	OF	WELL	7		
	8				8		
	9				9		
	10				10		
	11				11		
	12				12		
	15				15		
	20				20		
	25				25		
	30				30		
	40				40		
	50				50		
	60				60		
	80				80		
	100				100		
	140				140		
	180 (3 hrs.)				180 (3 hrs.)		
	240 (4 hrs.)				240 (4 hrs.)		
	300				300		
	360				360		
	420				420		
	480				480		
	540				540		
	600				600		

Project Name [illegible] Well #S-10-8

Location of Well TANANA Near Church + Store

Depth of Well 44 ft. Length of Casing 39 ft. Pumped Well / Observation We

Observation Well, Dist. to Pumped Well ____ ft. Top of Casing to Static Le

Date Drilling Completed 3-20-81 Driller Archibald Date Tested 3-25-8

Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC (32')	Drawdown @ 10 gpm or Recovery	Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawd @ or Recov
8:00	1	33' 1"			1 HR.	36 1/2	
	2	36 5 1/2			2 HR.	36 1/2	
	3	36 6 1/2			3		
	4	36 6 1/2			4		
	5	36 6 1/2			5		
	6	36 6 1/2			6		
	7	36 6 1/2			7		
	8	36 6 1/2			8		
	9	36 6 1/2			9		
	10	36 6 1/2			10		
	11	36 6 1/2			11		
	12	36 6 1/2			12		
	15	36 6 1/2			15		
:1	20	36 6 1/2			20		
1	25	36 6 1/2			25		
	30	36 6 1/2			30		
	40	36 6 1/2			40		
	50	36 6 1/2			50		
	60	36 6 1/2			60		
	80	36 6 1/2			80		
	100	36 6 1/2			100		
	140	36 6 1/2			140		
	180 (3 hrs.)	36 6 1/2			180 (3 hrs.)		
	240 (4 hrs.)	36 6 1/2			240 (4 hrs.)		
	300	36 6 1/2			300		
	360	36 6 1/2			360		
	420	36 6 1/2			420		
	480	36 6 1/2			480		
	540	36 6 1/2			540		
	600	36 6 1/2			600		

(83) ALSO PUMPED AT 20 GPM

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

CUSTOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

DATE COLLECTED 3-23-81 TIME COLLECTED: ---

SAMPLED BY P.Archibald SOURCE City Well No. 2

REMARKS Well Located on River Bank in Front of Store

FOR LAB USE ONLY
RECVD. BY GY LAB # 7126
DATE RECEIVED 4-3-81
DATE COMPLETED 4-10-81
DATE REPORTED 4-10-81
SIGNED Archie L Green

	mg/l		mg/l		mg/l
]Ag,Silver	<0.05	[]P,Phosphorous	<0.05	[]Cyanide	
]Al,Aluminum	<0.05	[]Pb,Lead	<0.05	[]Sulfate	14
]As,Arsenic	<0.10	[]Pt,Platinum	<0.05	[]Phenol	
]Au,Gold	<0.05	[]Sb,Antimony	<0.10	[]Total Dissolved Solids	185
]B,Boron	<0.05	[]Se,Selenium	<0.10	[]Total Volatile Solids	
]Ba,Barium	0.29	[]Si,Silicon	5.0	[]Suspended Solids	
]Bi,Bismuth	<0.05	[]Sn,Tin	<0.10	[]Volatile Suspended Solids	
]Ca,Calcium	56	[]Sr,Strontium	0.19	[]Hardness as $CaCO_3$	
]Cd,Cadmium	<0.01	[]Ti,Titanium	<0.05	[]Alkalinity as $CaCO_3$	170
]Co,Cobalt	<0.05	[]W,Tungsten	<1	[]	
]Cr,Chromium	<0.05	[]V,Vanadium	<0.05	[]	
]Cu,Copper	<0.05	[]Zn,Zinc	<0.05	[]	
]Fe,Iron	0.14	[]Zr,Zirconium	<0.05	[]	
				* * * * * *	
]Hg,Mercury	<0.10	[]Ammonia Nitrogen-N		[]mmhos Conductivity	300
]K,Potassium	<1	[]Kjedahl Nitrogen-N		[]pH Units	7.3
]Mg,Magnesium	14	[]Nitrate-N		[]Turbidity NTU	
]Mn,Manganese	0.38	[]Nitrite-N		[]Color Units	
]Mo,Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
]Na,Sodium	3.0	[]Chloride	8	[]	
]Ni,Nickel	<0.05	[]Fluoride		[]	

(84)

WELL LOG Located at Block 6, Lot 10

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana, Alaska - Judy Sommers DATE STARTED March 22, 1981

DATE COMPLETED March 24, 1981 DRILLER Pete Archibald/Glenn Fowler

TOTAL DEPTH OF WELL 52 FT. CASING INSTALLED 52' DIAMETER 6"

GROUT cement bentonite SCREEN SIZE 20 slot MFG. Johnson LENGTH 5'

STATIC WATER LEVEL 31 HRS. PUMPED 12 @ 20 GPM DRAWDOWN 72" FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0-2'	Frozen silt
2'-20'	Sand
20'-50'	Gravels
50'-52'	Blue clay

SOIL DATA TO 15 FT.
FEET THAWED
BOTTOM OF FROST & MATERIAL 2'
SEASONAL OR PERMA FROST seasonal

WATER DATA FIELD TEST
TASTE no iron taste
APPEARANCE FRESH good
AFTER 24 HOURS no visual trace of iron
IRON
CHLORIDES
TDS

PUMP TEST 31' - STATIC LEVEL
PUMPING LEVEL 49' @ 20 GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE Surge block

ESTIMATED MAN HOURS FOR DRILLING 40 hours HOURS FOR TOTAL JOB 40 hours

CREW Pete Archibald/Glenn Fowler

(85)

WELL LOG LOCATED BLOCK 6 LOT 10

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TANANA ALASKA / JUDY SOMMERS DATE STARTED 3/22/81

DATE COMPLETED 3/24/81 DRILLER PETE ARCHIBALD / GLENN FOWLER

TOTAL DEPTH OF WELL 52 FT. CASING INSTALLED 52 DIAMETER 6"

GROUT CEMENT BENTONITE SCREEN SIZE 20 SLOT MFG. JOHNSON LENGTH 5'

STATIC WATER LEVEL 31 HRS. PUMPED 12 @ 20 GPM DRAWDOWN 72" FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0 - 2'	FROZEN SILT
2' - 20'	SAND
20' - 50'	GRAVELS
50' - 52'	BLUE CLAY

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL 2'
SEASONAL OR PERMA FROST SEASONAL

WATER DATA FIELD TEST
TASTE NO IRON TASTE
APPEARANCE FRESH GOOD
AFTER 24 HOURS NO VISUAL TRACE OF IRON
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST 31' - STATIC LEVEL
PUMPING LEVEL 49' @ 20 GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE SURGE BLOCK

ESTIMATED MAN HOURS FOR DRILLING 40 HRS HOURS FOR TOTAL JOB 40 HRS

CREW PETE ARCHIBALD (86) GLENN FOWLER

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION JANNA ~~Blackwater~~ Lots 10 DATE STARTED 3-12-81

DATE COMPLETED 3-14-81 DRILLER ARCHIBALD

TOTAL DEPTH OF WELL 52 FT. CASING INSTALLED 52 DIAMETER 6"

GROUT _____ SCREEN SIZE 20 MFG. Johnson LENGTH 5'

STATIC WATER LEVEL 31 HRS. PUMPED 12 @ _____ GPM DRAWDOWN 73"

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
3-24-81	
	2 Ft. Frozen
	SAND 10
	SAND 20
	GRAVEL 30
	GRAVEL 40
	GRAVEL 50
	50 Blue CLAY => 52'

35 feet WATER BEARING GRAVEL TO 50'

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL 2'
SEASONAL OR PERMA FROST Seasonal

WATER DATA FIELD TEST
TASTE IRON - OK
APPEARANCE FRESH Yes
AFTER 24 HOURS Yes
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST 31 · STATIC LEVEL
PUMPING LEVEL 49' @ 20 GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW ARCHIBALD

ject No. _____ Project Name J. SUMMERS Well # 3-24-8

ation of Well FAIRFIELD LOT

th of Well 52 ft. Length of Casing 52 ft. Pumped Well / Observation We

Observation Well, Dist. to Pumped Well _____ ft. Top of Casing to Static Le

e Drilling Completed 3-24-81 Driller Shelburne Date Tested 3-25-81

ck e	Elapsed Time Since Pumping Started/Stopped	36'10" Depth to Water From TOC	Drawdown @ ___ gpm or Recovery	Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawd @ ___ or Recov
	1	34 6			1		
	2	34 6			2		
	3	34 6			3		
	4	34 6			4		
	5	34 6			5		
	6		DRAW	10	34'6"6		
	7		WATER	LEVEL	RETRIEVED	SAME	
	8		FOR	10HR	8		
	9				9		
	10				10		
	11				11		
	12				12		
	15				15		
	20				20		
	25				25		
	30				30		
	40				40		
	50				50		
	60				60		
	80				80		
	100				100		
	140				140		
	180 (3 hrs.)				180 (3 hrs.)		
	240 (4 hrs.)				240 (4 hrs.)		
	300				300		
	360				360		
	420				420		
	480				480		
	540				540		
	600				600		

WELL LOG

DRY HOLE

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana, Alaska Next to Episcopal Church DATE STARTED March 3, 1981

DATE COMPLETED March 16, 1981 DRILLER Pete Archibald/Glenn Fowler

TOTAL DEPTH OF WELL 80 FT. CASING INSTALLED 80' DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED N/A @ -- GPM DRAWDOWN --- FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
Frozen silt	1'-17'
Brown fine sand	17'-53'
Black sand	

Beyond 53 feet the drilling became very difficult. They had to drive the casing and then drill the plug out. 1½ hours to drive the pipe 1 foot and then drill the plug out. It was decided by the staff geologist that we should pull out and attempt another hole.

SOIL DATA TO 15 FT.
FEET THAWED froze to 17'
BOTTOM OF FROST & MATERIAL 17'
SEASONAL OR PERMA FROST seasonal + permafrost

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH _____
AFTER 24 HOURS _____
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST dry hole - STATIC LEVEL
PUMPING LEVEL _____ @ _____ GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB 60 man hours

CREW Pete Archibald/Glenn Fowler

(89)

WELL LOG

DRY HOLE

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TANANA MIDDLE NEXT TO EPISCOPAL CHURCH DATE STARTED 3/13/81

DATE COMPLETED 3/16/81 DRILLER PETE ARCHIBALD GLENN FOWLER

TOTAL DEPTH OF WELL 50' FT. CASING INSTALLED 30' DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED N/A @ — GPM DRAWDOWN — FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
Frozen Silt	1'-17'
Brown Fine Sand	17'-53'
BLACK SAND	

found 53 feet
drilling became
difficult. They
to drive the
ing and then
the plug out.
hrs to drive
pipe 1 ft and
drill the
out. It
decided by the
off geologist that we should pull out and attempt another hole.

SOIL DATA TO 15 FT.
FEET THAWED FROZE TO 17'
BOTTOM OF FROST & MATERIAL 17 FEET
SEASONAL OR PERMA FROST SEASONAL + PERMA

WATER DATA FIELD TEST
TASTE —
APPEARANCE FRESH
AFTER 24 HOURS
IRON
CHLORIDES
TDS

PUMP TEST DRY HOLE · STATIC LEVEL
PUMPING LEVEL @ GPM
AFTER HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES OR FROST

DEVELOP PROCEDURE

ESTIMATED MAN HOURS FOR DRILLING HOURS FOR TOTAL JOB 60 MANHOURS ~~MANHOURS~~

CREW PETE ARCHIBALD GLENN FOWLER

(90)

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TINAK DATE STARTED 3-12-81

DATE COMPLETED 3-16-81 DRILLER ARCHIBALD

TOTAL DEPTH OF WELL 80' FT. CASING INSTALLED 80' DIAMETER 6"

GROUT — SCREEN SIZE — MFG. — LENGTH —

STATIC WATER LEVEL None HRS. PUMPED NA @ NA GPM DRAWDOWN NA F

HOLE DIAMETER
CASING DIAMETER

DEPTH		FORMATION
3-16-81	0	
		Frozen silt
	10	
		silt
	20	
		GRAVEL
	30	
		Ice
	40	
		GRAVEL
	50	
		GRAVEL
	60	
		GRAVEL
	70	
	80	

SOIL DATA TO 15 FT.
FEET THAWED —
BOTTOM OF FROST & MATERIAL 10+
SEASONAL OR PERMA FROST Seasonal

WATER DATA FIELD TEST
TASTE —
APPEARANCE FRESH
AFTER 24 HOURS —
IRON —
CHLORIDES —
TDS —

PUMP TEST — · STATIC LEVEL
PUMPING LEVEL — @ — GPM
AFTER — HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES — OR FROST —

DEVELOP PROCEDURE NA

ESTIMATED MAN HOURS FOR DRILLING — HOURS FOR TOTAL JOB —

CREW ARCHIBALD.

(91)

0-10' Frozen Silt
10'-20' HARDPAN Drilled to 17' 8" Opentrace
20'-30' MED. SAND
30-40' MED SAND
40' 53' MED SAND
53-63 CLAY gravelmix HARD DRIVING PIPE
63-68 SAME MIX to Bottom of Well
68-74 DRY At 80'
74-80

COMP ON 3-16-81

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Tanana, City Well #2 DATE STARTED March 17, 1981

DATE COMPLETED March 20, 1981 DRILLER Archibald

TOTAL DEPTH OF WELL 48 FT. CASING INSTALLED 44 DIAMETER 6"

GROUT Bentowite SCREEN SIZE 40 MFG. Johnson LENGTH 5 feet

STATIC WATER LEVEL 32 feet HRS. PUMPED _____ @ 10 GPM DRAWDOWN 43-1/2" FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
March 20, 1981	
	0 frozen
	6 silt
	10 silt
	20 sand
	30 gravel
44 feet top -- of screen	40 gravel
	45 gravel

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL 6 feet
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE Iron
APPEARANCE FRESH yes
AFTER 24 HOURS yes
IRON 3 ppm
CHLORIDES _____
TDS _____

PUMP TEST 32 feet - STATIC LEVEL
PUMPING LEVEL 42 feet @ 10 GPM
AFTER 12 HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW Archibald (93)

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

STOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

TE COLLECTED 4-6-81 TIME COLLECTED: ---

MPLED BY Glen Fowlers SOURCE Sommer Well

MARKS Slightly Discolored. No Treatment, Petroleum Smell

FOR LAB USE ONLY
RECVD.BY GY LAB # 7156
DATE RECEIVED 4-7-81
DATE COMPLETED 4-14-81
DATE REPORTED 4-16-81
SIGNED Archie L. Green

	mg/l		mg/l		mg/l
Ag, Silver	<0.05	[]P, Phosphorous	0.11	[]Cyanide	
Al, Aluminum	<0.05	[]Pb, Lead	<0.05	[]Sulfate	34
As, Arsenic	<0.10	[]Pt, Platinum	<0.05	[]Phenol	
Au, Gold	<0.05	[]Sb, Antimony	<0.05	[]Total Dissolved Solids	440
B, Boron	<0.05	[]Se, Selenium	<0.10	[]Total Volatile Solids	
Ba, Barium	0.46	[]Si, Silicon	4.9	[]Suspended Solids	
Bi, Bismuth	<0.05	[]Sn, Tin	<0.1	[]Volatile Suspended Solids	
Ca, Calcium	135	[]Sr, Strontium	0.39	[]Hardness as $CaCO_3$	445
Cd, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	380
Co, Cobalt	<0.05	[]W, Tungsten	<1	[]Oil & Grease	1.3
Cr, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
Cu, Copper	<0.05	[]Zn, Zinc	0.14	[]	
Fe, Iron	5.2	[]Zr, Zirconium	<0.05	[]	
				* * * * * *	
Hg, Mercury	<0.10	[]Ammonia Nitrogen-N		[]mmhos Conductivity	630
K, Potassium	1	[]Kjedahl Nitrogen-N		[]pH Units	7.0
Mg, Magnesium	24	[]Nitrate-N		[]Turbidity NTU	
Mn, Manganese	0.79	[]Nitrite-N		[]Color Units	
Mo, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
Na, Sodium	3.7	[]Chloride	6	[]	
Ni, Nickel	<0.05	[]Fluoride	(94)	[]	

TO: Bill MACE

SUBJ: TANANA WELL LOCATIONS

DUE TO THE FAIRLY CONSISTENT SANDY GRAVELS AT DEPTHS RANGING FROM 35' to 65' AND relatively discontinuous permafrost — probability of subsurface water is just as good IN ONE PLACE AS ANOTHER WITHIN THE proposed subdivision.

POSSABILITY OF FROZEN GROUND MAY EXIST ~~MAY EXIST~~ DOWN TO BEDROCK WHERE WATER, IF ANY, WILL ONLY BE AVAILABLE IN FISSURES WITH FAIRLY LOW YIELD.

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DOUGLAS LABORATORY FACILITY

(1)

VILLAGE SAFE WATER PROGRAM

TO BE COMPLETED BY SAMPLER

Sample Source or Location: Tanana Hospital		Collected by: Ruth Grant	
Address: well		Sample Number: 6RG79	
Village: Tanana	State: AK	Zip Code:	Sample Date: 11/28/79

- ☐ Surface Water
- ☒ Untreated Water
- ☒ Routine Sample
- ☒ Ground Water
- ☐ Treated Water
- ☐ Special Purpose Sample

Laboratory Analysis Number: 79120307	Received by: PARRY MOTHCOSHOAD	Date: 12/3/79

	Limit	Mg/l
Arsenic	(0.05)	TR
Barium	(1.)	TR
Cadmium	(0.010)	TR
Chromium	(0.05)	TR
Iron	(0.3)	1.1
Lead	(0.05)	ND
Manganese	(0.05)	0.971
Mercury	(0.002)	TR
Selenium	(0.01)	ND
Silver	(0.05)	ND
Sodium	(250)	8.5
Calcium		127.
Magnesium		24.
Potassium		2.0

	Limit	Mg/l	
Chloride		15.5	
Fluoride	(2.4)	0.4	
Nitrate — N	(10.)	TR	
Sulfate		24.0	
Carbonate Alkalinity		353.6	
TFR @ 180° C		409	
pH		7.8	
Turbidity		6.6	NTU
Color		35	PCU
Conductivity @ 25° C		680	µmhos/cm

ND=Not Detected
TR=Trace Detected

Date Analysis Completed: 1/4/80	Signature of Laboratory Supervisor: T. A Tmbe	Date Reported: 1/4/80

319(12/78)

Please fill out form as completely as possible.
Mail to Douglas Laboratory in enclosed addressed labeled envelope.

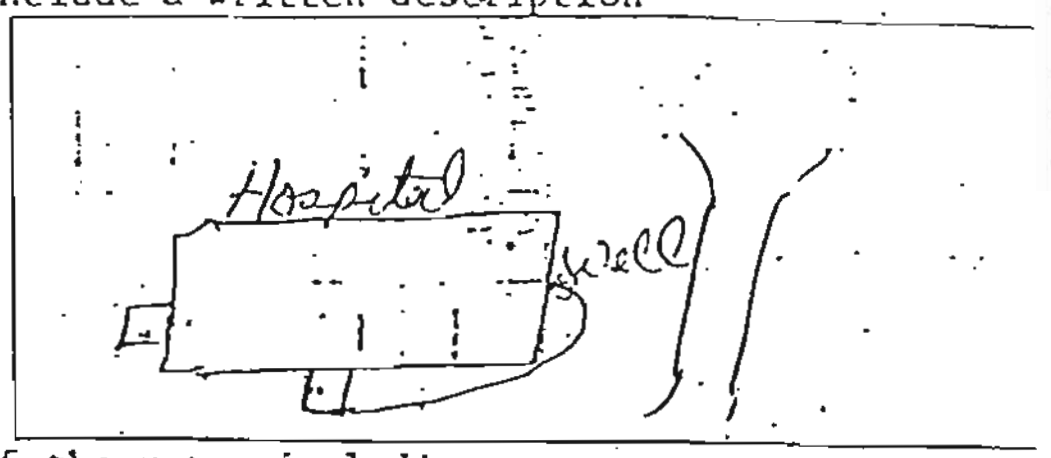
Sample # _____

Village of: Tanana AK

Special Information See directions on back side.

1. Specify the exact sample location so there is no confusion about where the sample was collected. Include a written description and a map or sketch.

Tanana Hospital
Well



2. Describe the physical appearance of the water including:

Color Clear

Taste flat

Odor no odor

Turbidity _____

3. Describe the area immediately surrounding the sample site including nearby honey bucket dumps, oil storage areas, landfills. ect.

none above

4. Label each sample to include:

Name of Collector Ruth A. Grant

Time and date of collection 1:00 pm on NOV 28-79

Date sample mailed NOV-28-79

Water temperature _____

Sample depths/distance from shore (for surface sources) _____

Tidal influence (if any) _____

Approximate flow rate _____

Depth of well _____

Pumping rate and drawdown of well _____

pH _____

5. ☒ Raw water (97) ☐ Treated water

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DOUGLAS LABORATORY FACILITY

VILLAGE SAFE WATER PROGRAM

TO BE COMPLETED BY SAMPLER

Sample Source or Location		Collected by	
Tanana VSW watering point		Noel Palmer	
Address		**Sample Number**	
		13NPS0	
Village	**State**	**Zip Code**	**Sample Date**
Tanana	Ak		5/13/80

☐ Surface Water ☒ Ground Water

☐ Untreated Water ☒ Treated Water

☒ Routine Sample ☐ Special Purpose Sample

Laboratory Analysis Number	Received by	Date
80051601	Parry Mothershead	5/16/80

	Limit	Mg/l
Arsenic	(0.05)	ND
Barium	(1.)	0.16
Cadmium	(0.010)	ND
Chromium	(0.05)	ND
Iron	(0.3)	0.10
Lead	(0.05)	0.014
Manganese	(0.05)	0.44
Mercury	(0.002)	ND
Selenium	(0.01)	ND
Silver	(0.05)	ND
Sodium	(250)	9.8
Calcium		226.
Magnesium		54.
Potassium		3.6

	Limit	Mg/l
Chloride		145.
Fluoride	(2.4)	TR
Nitrate — N	(10.)	TR
Sulfate		64.
Carbonate Alkalinity		416.
TFR @ 180° C		750.

pH	7.4	
Turbidity	17.	NTU
Color	60.	PCU
Conductivity @ 25° C	236.	µmhos/cm

ND=Not Detected
TR=Trace Detected

Date Analysis Completed	Signature of Laboratory Supervisor	Date Reported
6/19/80	T. C. Trine	6/19/80

18-319(12/78)

(98)

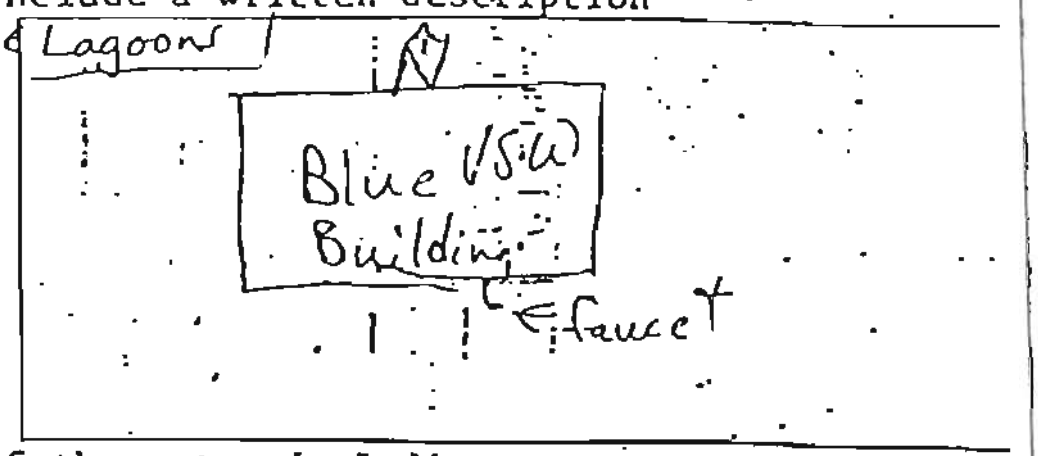
Sample # 15NT80

Village of: Tanana

Special Information Lab# 8005160 1

1. Specify the exact sample location so there is no confusion about where the sample was collected. Include a written description and a map or sketch.

Tanana VSW from watering point



2. Describe the physical appearance of the water including:

Color None

Taste None

Odor None

Turbidity None

Please send { Dennis Sweetsir Water Plant Operator Tanana, AK 99777 needs copy of results

3. Describe the area immediately surrounding the sample site including nearby honey bucket dumps, oil storage areas, landfills. ect.

A community sewage lagoon is Northwest of VSW building but I believe well was elsewhere.

4. Label each sample to include:

Name of Collector Noel Palmer

Time and date of collection 13May80 1:20 PM

Date sample mailed 13May80

Water temperature 78°F

Sample depths/distance from shore (for surface sources) N/A

Tidal influence (if any) N/A

Approximate flow rate not checked

Depth of well Not known operator not available

Pumping rate and drawdown of well not known

pH

5. ☐ Raw water (99) ☒ Treated water

Comments Taken outside faucet ok Probably

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DOUGLAS LABORATORY FACILITY

VILLAGE SAFE WATER PROGRAM

TO BE COMPLETED BY SAMPLER

Sample Source or Location	Collected by
Tanana Hospital; taken from ice machine	Misha Charles VSW 4
Address	**Sample Number**
	2 NP 81
Village / **State**	**Zip Code** / **Sample Date**
Tanana / AK	

- ☐ Surface Water
- ☑ Ground Water
- ☐ Untreated Water
- ☑ Treated Water
- ☐ Routine Sample
- ☑ Special Purpose Sample

Laboratory Analysis Number	Received by	Date
80102001	Wendy L. Whelan	10/20/80

	Limit	Mg/l		Limit	Mg/l
Arsenic	(0.05)		Chloride		
Barium	(1.)		Fluoride	(2.4)	
Cadmium	(0.010)		Nitrate – N	(10.)	
Chromium	(0.05)		Sulfate		
Iron	(0.3)		✓ Carbonate Alkalinity		176.
Lead	(0.05)		TFR @ 180° C		
Manganese	(0.05)				
Mercury	(0.002)				
Selenium	(0.01)		✓ pH		8.3
Silver	(0.05)		Turbidity		NTU
Sodium	(250)		Color		PCU
✓ Calcium		80.	Conductivity @ 25° C		µmhos/cm
✓ Magnesium		18.5			
Potassium					

ND=Not Detected
TR=Trace Detected

Date Analysis Completed	Signature of Laboratory Supervisor	Date Reported
10/22/80		10/23/80

8-319(12/78)

(100)

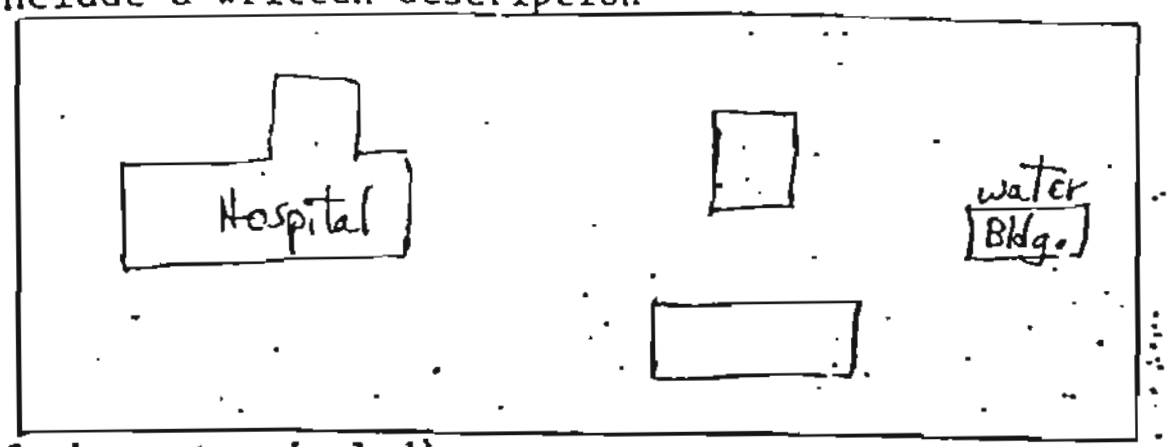
Src

Sample # ANFSL

Information Lab # S0102001

Specify the exact sample location so there is no confusion about where the sample was collected. Include a written description and a map or sketch.

Tanana Hospital



Describe the physical appearance of the water including:

Color _____

Taste _____

Odor _____

Turbidity _____

TAKEN AS ICE FROM ICE MACHINE

Describe the area immediately surrounding the sample site including nearby honey bucket dumps, oil storage areas, landfills. ect.

Label each sample to include:

Name of Collector MISHA CHARLES, DIETARY

Time and date of collection 10-15-80 NOON

Date sample mailed 10-15-80 4PM

Water temperature ICE

Sample depths/distance from shore (for surface sources) N/A well source

Tidal influence (if any) N/A

Approximate flow rate unK.

Depth of well unK.

Pumping rate and drawdown of well _____

pH _____

☐ Raw water ☒ Treated water

Comments Chlorination & Fluoridation

UNITED STATES GOVERNMENT

2-Way Memo

Subject : Tanana Water sample 2NF81

To : → Water Chemist
Mr Lee ?

INSTRUCTIONS

Use routing symbols whenever possible.

SENDER:
Use brief, informal language.
Conserve space.
Forward original and one copy.

RECEIVER:
Reply below the message, keep one copy, return one copy.

DATE OF MESSAGE: 160ct80

Routing Symbol:

SIGNATURE OF ORIGINATOR 452-8251
Noel Palmer

TITLE OF ORIGINATOR
Sr. Sanitarian

FOI

INITIAL MESSAGE

The laboratory technician at the Tanana Hospital indicated that the crystaline material in frozen water looked milky. The above sample was supposed to have been taken from the ice machine so it may have the crystals in the sample.

REPLY MESSAGE

We could not notice any crystals or precipitate in the water sample when it was received. We suspected the crystaline material was carbonate so had the sample analyzed for Ca, Mg, pH, & alkalinity. However, the results were lower (except pH) than those of previous work. If the sample was of melted ice, it then explained the difference. However, if you could collect some crystals, (maybe water by filtration, & then place the crystals on a filter paper with paper towel, etc.) add a drop of vinegar to see if it would bubble and dissolve, if not please send the dry crystal to me for identification.

From :

DATE OF REPLY: 10/27/80

Routing Symbol:

SIGNATURE OF REPLIER

TITLE OF REPLIER
Chief Tech. Chemist

5027-104

1. TO BE RETAINED BY ADDRESSEE

OPTIONAL FORM 27
JULY 1973
GSA FPMR (41 CFR) 101-11.6

STATE OF ALASKA
DEPARTMENT OF HEALTH AND WELFARE
ENVIRONMENTAL HEALTH

WATER SAMPLE INFORMATION FOR CHEMICAL ANALYSIS

Source (Lake, River, Well, etc.) _____ Water System - Private ( ) Public ( )
City or Town Tanana Collected By _____
Send Report: Name Glen D. Charlie Address [illegible]
Date Collected 3-7-73 Time Collected [illegible]
Collected from water system at: (Well, Faucet, Stream, etc.) _____
Water Collected is Untreated ( ) Filtered ( ) Other Treatment _____
Kind of Analysis Desired: (Please check the most applicable box or boxes).
( ) Routine (Marked *) ( ) Special, Designate by marking or entering items in blank spaces).
Analysis of this sample is Routine ( ) Urgent ( )
Remarks: _____

CHECK ITEMS FOR ANALYSIS (IF OTHER THAN ROUTINE)

	ANALYSIS RESULTS	(PPM) LIMITS[1]		ANALYSIS RESULTS	(PPM) LIMITS[1]
Silica (SiO_2)		15 good 300 poor	* Bicarbonate (HCO_3)	[illegible]	25 good 500 poor
Aluminum (Al)			* Carbonate (CO_3)	0	350
* Iron (Fe)	0.04	0.3	* Sulfate (SO_4)	[illegible]	250
Manganese (Mn)	0.1	0.5	Sulfite (SO_3)		5.0
* Calcium (Ca)	100	300	* Chloride (Cl)	12	250
* Magnesium (Mg)	70	125	* Fluoride (F)		1.5
Sodium (Na)		200	* Nitrate (NO_3)	[illegible]	45
Potasium (K)			* Nitrite (NO_2)		2.0
			* Phosphate (PO_4)	0.04	.05 good 30 poor
Remarks					
Total					

	ANALYSIS RESULTS	LIMITS		ANALYSIS RESULTS	LIMITS
* pH, Lab	7.95	6.5 - 8.5	Suspended solids		
Specific conductance (Micromhos/cm-25°C.)	705		Total Dissolved Solids	416	500
*. Turbidity (units)	3	5	Total Solids		500
* Color (units)	0	15	Total Hardness ($CaCO_3$)	342	50 very soft 300 very hard
Detergents (MBAS)		0	* Alkalinity ($CaCO_3$)	365	200
			Noncarbonate Hardness ($CaCO_3$)		
			Calcium Hardness ($CaCO_3$)		

Date Received 3/15/73 Date Completed [illegible] By [illegible] Lab No. [illegible]

1. U.S.P.H.S. Required and Recommended Drinking Water Standards, 1962

WATER ANALYSIS REPORT FORM (52)

3/25/74

Report to: ARCH HAMMETT, ADMIN. OFFICER
OFFICE OF ENVIRONMENTAL HEALTH
P. O. BOX 7-741
ANCHORAGE, AK 99510

C 855

E OR LOCATION: TANANA COMMUNITY WELL

LECTED BY: T. J. HARTRICH, JR. DATE 5/23/74 HOUR: 1:45 PM

WATER SYSTEM

Well Type DRILLED Depth 49 Gallons per minute 6

Surface Water: Temporary [ ] Permanent [X]

Number of Homes Served: 0 (WATERING PT. ONLY)

Treatment: [ ] Yes [X] No New or Existing Source EXISTING

PURPOSE OF ANALYSIS

[X] 1. Water Approval for Building Permit. (Column 1)
[X] 2. Routine Analysis. (Column 1 & 2)
[X] 3. Special: Check Specific Items for Analysis (Columns 1,2,3)

COLUMN 1 COLUMN 2 COLUMN 3

	Analysis	Limits
n (Fe)	0.37	0.3
oride (F)	0.55	1.5
oride (Cl)	10	250
(PO4) sphate	0	.05 good 30 poor
al Hardness	109	50 soft 300 hard
erents	0	0
	7.01	6.5 8.5
cific nductance	378	

	Anal.	Limit
Magnesium (Mg)	15	125
Calcium (Ca)	103	300
Turbidity	0	5
Color	10	15
Bicarbonate (HCO_3)	171	25 good 500 poor
Carbonate	0	350
Alkalinity	140	350
Total Dissolved Solids	190	500

	Analysis	Limits
Sodium (Na)		200
Potassium (K)		-
Sulfate (SO_4)		250
Sulfite **(SO_3)		5.0
Nitrate (NO_3)		10
Suspended Solids		
Arsenic (As)		0.01
Copper (Cu)		1.0
Cyanide (Cn)		0.01
Phenols		0.00
Zinc (Zn)		5.0
Barium (Ba)		1.0
Cadmium (Cd)		0.01
Lead Pb)		0.05
Silver (Ag)		0.05
Mercury (Hg)		0.05
Manganese (Mn)		0.05

MENTS:

STRUCTIONS:

Rinse container several times in water source to be sampled.

Place cap on sarple container firmly.

Place sample in carton mailer, and forward to:

Public Health Laboratory
SRO, Medical Arts Bldg.
Pouch J
Juneau, AK 99801

6/13/74

OCT 9

(104)

RECEIVED
SEP 15 1976

3/15/74

WATER ANALYSIS REPORT FORM

Mail Report to: ARCH HAMMITT, ADMIN. OFFICER
OFFICE OF ENVIRONMENTAL HEALTH
ANCHORAGE, ALASKA 99510

BRANCH OF PUBLIC
HEALTH LABORATORIES
353

NAME OR LOCATION: TANANA, ALASKA

COLLECTED BY: JF DATE 8/30/76 HOUR: 9 AM

WATER SYSTEM

1. Well Type Drilled Depth 55 FT. Gallons per minute
2. Surface Water: Temporary [ ] Permanent [X]
3. Number of Homes Served:
4. Treatment: [ ] Yes [X] No New or Existing Source ✓

PURPOSE OF ANALYSIS

[ ] 1. Water Approval for Building Permit. (Column 1)
[X] 2. Routine Analysis. (Column 1 & 2)
[ ] 3. Special: Check Specific Items for Analysis (Columns 1,2,3)

COLUMN 1

	Analysis	Limits
Iron (Fe)	11.0	0.3
Fluoride (F)	0.28	1.5
Chloride (Cl)	46	250
Phosphate (PO_4)	0.02	.05 good 30 poor
Total Hardness	453	50 soft 300 hard
Detergents	0	0
pH	7.72	6.5 8.5
Specific Conductance	802	

Read 9/9/76

COLUMN 2

	Anal.	Limit
Magnesium (Mg)	34.8 2.0	125
Calcium (Ca)	100.0	300
Turbidity	*	5
Color	40	15
Bicarbonate (HCO_3)	427	25 good 500 poor
Carbonate	0	350
Alkalinity	350	350
Total Dissolved Solids	538	500

COLUMN 3

	Analysis	Limit
Sodium (Na)		200
Potassium (K)		
Sulfate (SO_4)		250
Sulfite **(SO_3)		
Nitrate (NO_3)		10
Suspended Solids		
Arsenic (As)		0
Copper (Cu)		1
Cyanide (Cn)		0
Phenols		0
Zinc (Zn)		5
Barium (Ba)		1
Cadmium (Cd)		0
Lead Pb)		0
Silver (Ag)		0
Mercury (Hg)		0
Manganese (Mn)		0

COMMENTS: Well was contaminated last spring from surface water. And was treated with
* Lab error, not done. Chlorine
9/13/76

INSTRUCTIONS:

1. Rinse container several times in water source to be sampled.
2. Place cap on sample container firmly. (105)

D G Hunter
Public Health Laboratory
580 Medical Arts Bldg.

Mail Report to: ARCH HAMMETT, ADMIN. OFFICER
OFFICE OF ENVIRONMENTAL HEALTH
P.O. BOX 7-741
ANCHORAGE, ALASKA 99510

Di Paul

C-1092 Date: 04-28-77

Name of Village: Tanana Name of Source: PHS Hospital Tanana

Sampling Site: Pharmacy SINK Collected By: STEVEN Cohen

WATER SOURCE (circle one:)

(Well), Spring, Lake, River, Creek, Ditch, Slough, Other: _____

Sample Description: Raw, (Treated), Other: (Describe) _____

PURPOSE OF ANALYSIS

[/] 1. Water Approval for Building Permit. (Column 1)

[/] 2. Routine Analysis. (Columns 1 & 2)

[X] 3. Special: Circle Specific Items for Analysis. (Columns 1, 2, 3)

COLUMN 1		Limits	COLUMN 2		Limit	COLUMN 3		Analysis Limits
(Iron (Fe))	0.03	0.3	Magnesium (Mg)		125	Sodium (Na)		200
(Fluoride (F))	1.96	1.5	Calcium (Ca)		300	Potassium (K)		
Chloride (Cl)		250	Turbidity		5	Sulfate (SO_4)		250
Phosphate (PO_4)		.05 good 30 poor	Color		15	Sulfite **(SO_3)		5.
Total Hardness		50 soft 300 hard	Bicarbonate (HCO_3)		25 good 500 poor	Nitrate (NO_3)		10
Detergents		0	Carbonate		350	Suspended Solids		
pH		6.5 8.5	Alkalinity		350	Arsenic (As)		0.
Specific Conductance			Total Dissolved Solids		500	Copper (Cu)		1.
						Cyanide (Cn)		0.
						Phenols		0.
						Zinc (Zn)		5.
						Barium (Ba)		1.
						Cadmium (Cd)		0.
						Lead (Pb)		0.
						Silver (Ag)		0.
						Mercury (Hg)		0.
						Manganese (Mn)		0.

Rec'd. 5/9/77

Comments: _____

5/23/77
D. Parker, Jr.
M. Madsen

Instructions:

1. Rinse container several times in water source to be sampled.

2. Place can on sample container [illegible]

Public Health Laboratory

(106)

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O.BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

ANALYTICAL REPORT

Water Analysis(Facility) Alaska Area Native Health Service

Date Collected: 8-30-76 Time Collected: ---- By: ---

Source of Sample: Tanana (4-621R)

Physical Observations, Remarks:

[] ____ mg/l Aluminum	[X] 410 mmhos Conductivity	[X] 56 mg/l Hardness as $CaCO_3$
[] ____ mg/l Arsenic	[X] 7.3 units pH	[X] 240 mg/l Alkalinity as $CaCO_3$
[] ____ mg/l Barium	[] ____ mg/l Ammonia Nitrogen-N	[] ____ mg/l Acidity-T as $CaCO_3$
[] ____ mg/l Boron	[] ____ mg/l Kjedahl Nitrogen-N	[] ____ mg/l Acidity Free as $CaCO_3$
[] ____ mg/l Cadmium	[] ____ mg/l Organic Nitrogen-N	[] ____ /100ml Coliform-T
[X] 6 mg/l Calcium	[] ____ mg/l Nitrate(N)	[] ____ /100ml Coliform-F
[] ____ mg/l Copper	[] ____ mg/l Nitrite(N)	[] ____ /100ml Strep-F
[] ____ mg/l Chromium-Total	[] ____ mg/l Phosphorus (Ortho)-P	[] ____ units Color
[] ____ mg/l Chromium-Tri	[] ____ mg/l Phosphorus (Total)-P	[X] <0.1 mg/l Oil and Grease
[] ____ mg/l Chromium-Hex	[X] 4 mg/l Chloride	[] ____ ____
[X] <0.1 mg/l Iron-Total	[] ____ mg/l Fluoride	
[] ____ mg/l Iron-Dissolved	[] ____ mg/l Cyanide	
[] ____ mg/l Lead	[X] Trace mg/l Sulfate	
[X] 10 mg/l Magnesium	[] ____ mg/l Phenol	
[] ____ mg/l Manganese	[] ____ mg/l MBSA	
[] ____ mg/l Mercury	[] ____ mg/l BOD	
[] ____ mg/l Nickel	[] ____ mg/l COD	
[X] 2 mg/l Potassium	[X] 149 mg/l TD Solids	
[] ____ mg/l Selenium	[] ____ mg/l TV Solids	
[X] 3 mg/l Sodium	[] ____ mg/l Suspended Solids	
[] ____ mg/l Silver	[] ____ mg/l SV Solids	
[] ____ mg/l Zinc	[] (107) JTU Turbidity	

Transported by: ____
Received by: ____

Transported by: ____
Received by: ____

FOR LAB USE ONLY

Lab# 4704 Rec'd by: Se

Date sample rec'd: 8-30-76

Date analysis completed: 8-30-76

Date results reported: 8-31-76

Signed: Cynthia L. Thompson

Date: September 3, 1976

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
TELEPHONE (907) 279-4014 P.O.BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

ANALYTICAL REPORT

Water Analysis(Facility) Arctic Environmental Engineers

Date Collected: 11-30-77 Time Collected: ------- By: -----

Source of Sample: Submitted by: Mr. Willem S. Van Hemert

Physical Observations, Remarks:

[ ]	____ mg/l	Aluminum	[ ] 500 mmhos	Conductivity	[ ] 251 mg/l	Hardness as $CaCO_3$
[ ]	____ mg/l	Arsenic	[ ] 7.0 units	pH	[ ] 285 mg/l	Alkalinity as $CaCO_3$
[ ]	____ mg/l	Barium	[ ] ____ mg/l	Ammonia Nitrogen-N	[ ] ____ mg/l	Acidity-T as $CaCO_3$
[ ]	____ mg/l	Boron	[ ] ____ mg/l	Kjedahl Nitrogen-N	[ ] ____ mg/l	Acidity Free as $CaCO_3$
[ ]	____ mg/l	Cadmium	[ ] ____ mg/l	Organic Nitrogen-N	[ ] ____ /100ml	Coliform-T
[ ]	68 mg/l	Calcium	[ ] ____ mg/l	Nitrate(N)	[ ] ____ /100ml	Coliform-F
[ ]	____ mg/l	Copper	[ ] ____ mg/l	Nitrite(N)	[ ] ____ /100ml	Strep-F
[ ]	____ mg/l	Chromium-Total	[ ] ____ mg/l	Phosphorus (Ortho)-P	[ ] ____ units	Color
[ ]	____ mg/l	Chromium-Tri	[ ] ____ mg/l	Phosphorus (Total)-P	[ ] ____	____
[ ]	____ mg/l	Chromium-Hex	[ ] < 5 mg/l	Chloride	[ ] ____	____
[ ]	0.3 mg/l	Iron-Total	[ ] ____ mg/l	Fluoride		
[ ]	____ mg/l	Iron-Dissolved	[ ] ____ mg/l	Cyanide		
[ ]	____ mg/l	Lead	[ ] 70 mg/l	Sulfate		
[ ]	20 mg/l	Magnesium	[ ] ____ mg/l	Phenol		
[ ]	0.1 mg/l	Manganese	[ ] ____ mg/l	MBSA		
[ ]	____ mg/l	Mercury	[ ] ____ mg/l	BOD		
[ ]	____ mg/l	Nickel	[ ] ____ mg/l	COD		
[ ]	0.9 mg/l	Potassium	[ ] 336 mg/l	TD Solids		
[ ]	____ mg/l	Selenium	[ ] ____ mg/l	TV Solids		
[ ]	6.4 mg/l	Sodium	[ ] ____ mg/l	Suspended Solids		
[ ]	____ mg/l	Silver	[ ] (108) mg/l	SV Solids		

Transported by: ____
Received by: ____

Transported by: ____
Received by: ____

FOR LAB USE ONLY

Lab# 6927 Rec'd by: SE

Date sample rec'd: 11-30-77

Date analysis completed: 11-30-77

Date results reported: 11-30-77

Signed: Archie L. Thomas

Date: November 30, 1977

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

STOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

TE COLLECTED 7-28-80 TIME COLLECTED: ---

MPLED BY Bill Mace SOURCE 6" Water Well

MARKS Richard Swenson, Second House, No Treatment
Extremely hard water with a high level of Manganese

FOR LAB USE ONLY
RECVD. BY SE LAB # 4510-1
DATE RECEIVED 7-30-80
DATE COMPLETED 7-31-80
DATE REPORTED 8- 1-80
SIGNED Stephen C. Ede

	mg/l		mg/l		mg/l
Ag, Silver	<0.05	[]P, Phosphorous	0.22	[]Cyanide	
Al, Aluminum	0.09	[]Pb, Lead	<0.05	[]Sulfate	
As, Arsenic	<1.0	[]Pt, Platinum	<0.10	[]Phenol	
Au, Gold	<0.05	[]Sb, Antimony	<0.10	[]Total Dissolved Solids	
B, Boron	<0.05	[]Se, Selenium	<0.10	[]Total Volatile Solids	
Ba, Barium	0.37	[]Si, Silicon	4.6	[]Suspended Solids	
Bi, Bismuth	<0.05	[]Sn, Tin	<0.1	[]Volatile Suspended Solids	
Ca, Calcium	138	[]Sr, Strontium	0.49	[]Hardness as $CaCO_3$	411
Cd, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	
Co, Cobalt	<0.05	[]W, Tungsten	<1.0	[]	
Cr, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
Cu, Copper	<0.05	[]Zn, Zinc	0.20	[]	
Fe, Iron	<0.10	[]Zr, Zirconium	<0.05	[]	
Hg, Mercury	<0.10	[]Ammonia Nitrogen-N		* * * * * * []mmhos Conductivity	
K, Potassium	1.6	[]Kjedahl Nitrogen-N		[]pH Units	
Mg, Magnesium	16	[]Nitrate-N		[]Turbidity NTU	
Mn, Manganese	0.75	[]Nitrite-N		[]Color Units	
Mo, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
Na, Sodium	45	[]Chloride		[]	

(109)

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

TOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana Store

E COLLECTED 7-28-80 TIME COLLECTED: ---

PLED BY B. Mace SOURCE Glen Gregory

ARKS Treated by Sears Iron Rmoval. Hard Water with Slightly high Iron concentration

FOR LAB USE ONLY
RECVD. BY SE LAB # 4510-3
DATE RECEIVED 7-30-80
DATE COMPLETED 7-31-80
DATE REPORTED 8- 1-80
SIGNED: Stephen C. Ede

	mg/l		mg/l		mg/l
g, Silver	<0.05	[]P, Phosphorous	0.08	[]Cyanide	
l, Aluminum	0.08	[]Pb, Lead	<0.05	[]Sulfate	
s, Arsenic	<1.0	[]Pt, Platinum	<0.10	[]Phenol	
u, Gold	<0.10	[]Sb, Antimony	<0.10	[]Total Dissolved Solids	
, Boron	<0.05	[]Se, Selenium	<0.10	[]Total Volatile Solids	
a, Barium	0.35	[]Si, Silicon	4.1	[]Suspended Solids	
i, Bismuth	<0.05	[]Sn, Tin	<0.10	[]Volatile Suspended Solids	
a, Calcium	76	[]Sr, Strontium	0.22	[]Hardness as $CaCO_3$	220
d, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	
o, Cobalt	<0.05	[]W, Tungsten	<1.0	[]	
r, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
u, Copper	0.49	[]Zn, Zinc	<0.05	[]	
e, Iron	0.31	[]Zr, Zirconium	<0.05	[]	
				* * * * * *	
g, Mercury	<0.1	[]Ammonia Nitrogen-N		[]mmhos Conductivity	
, Potassium	0.7	[]Kjedahl Nitrogen-N		[]pH Units	
g, Magnesium	7.4	[]Nitrate-N		[]Turbidity NTU	
n, Manganese	<0.05	[]Nitrite-N		[]Color Units	
o, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
a, Sodium	3.7	[]Chloride		[]	
i, Nickel	<0.05	[]Fluoride	(40)	[]	

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

USTOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

ATE COLLECTED --- TIME COLLECTED: ---

AMPLED BY Bill Mace SOURCE Basco Minook Well

EMARKS No Treatment. Extremely hard water with high Iron and Manganese. levels. No TAG with sample.

FOR LAB USE ONLY
RECVD. BY SE LAB # 4661-1
DATE RECEIVED 8-11-80
DATE COMPLETED 8-19-80
DATE REPORTED 8-19-80
SIGNED Richard L. Green

	mg/l		mg/l		mg/l
]Ag, Silver	<0.05	[]P, Phosphorous	<0.05	[]Cyanide	
]Al, Aluminum	0.14	[]Pb, Lead	<0.05	[]Sulfate	28
]As, Arsenic	<0.1	[]Pt, Platinum	<0.10	[]Phenol	
]Au, Gold	<0.05	[]Sb, Antimony	<0.10	[]Total Dissolved Solids	612
]B, Boron	<0.05	[]Se, Selenium	<0.1	[]Total Volatile Solids	
]Ba, Barium	0.48	[]Si, Silicon	5.8	[]Suspended Solids	
]Bi, Bismuth	<0.05	[]Sn, Tin	<0.10	[]Volatile Suspended Solids	
]Ca, Calcium	115	[]Sr, Strontium	0.44	[]Hardness as $CaCO_3$	496
]Cd, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	740
]Co, Cobalt	<0.05	[]W, Tungsten	<0.05	[]	
]Cr, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
]Cu, Copper	<0.05	[]Zn, Zinc	<0.05	[]	
]Fe, Iron	7.6	[]Zr, Zirconium	<0.05	[]	
				* * * * * *	
]Hg, Mercury	<0.1	[]Ammonia Nitrogen-N		[]mmhos Conductivity	995
]K, Potassium	<1.0	[]Kjedahl Nitrogen-N		[]pH Units	7.1
]Mg, Magnesium	47	[]Nitrate-N		[]Turbidity NTU	
[]Mn, Manganese	0.51	[]Nitrite-N		[]Color Units	
[]Mo, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
[]Na, Sodium	10	[]Chloride	29	[]	
[]Ni, Nickel	<0.05	[]Fluoride		[]	

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

OMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

COLLECTED 8/6/80 TIME COLLECTED: —

LED BY Bill Mace SOURCE Pauline Swenson Well

RKS No Treatment. Extremely hard water with moderate Iron and Manganese levels. No TAG with sample

FOR LAB USE ONLY
RECVD. BY SE LAB # 4661-3
DATE RECEIVED 8-11-80
DATE COMPLETED 8-19-80
DATE REPORTED 8-19-80
SIGNED Archie K. Hanson

	mg/l		mg/l		mg/l
,Silver	<0.05	[]P,Phosphorous	<0.05	[]Cyanide	
,Aluminum	0.10	[]Pb,Lead	<0.05	[]Sulfate	67
,Arsenic	<0.1	[]Pt,Platinum	<0.10	[]Phenol	
,Gold	<0.05	[]Sb,Antimony	<0.10	[]Total Dissolved Solids	708
,Boron	<0.05	[]Se,Selenium	<0.1	[]Total Volatile Solids	
,Barium	0.18	[]Si,Silicon	3.6	[]Suspended Solids	
,Bismuth	<0.05	[]Sn,Tin	0.16	[]Volatile Suspended Solids	
,Calcium	150	[]Sr,Strontium	0.47	[]Hardness as $CaCO_3$	513
,Cadmium	<0.01	[]Ti,Titanium	<0.05	[]Alkalinity as $CaCO_3$	720
,Cobalt	<0.05	[]W,Tungsten	<0.05	[]	
,Chromium	<0.05	[]V,Vanadium	<0.05	[]	
,Copper	<0.05	[]Zn,Zinc	0.65	[]	
,Iron	0.78 .94	[]Zr,Zirconium	<0.05	[]	
				* * * * * *	
,Mercury	<0.1	[]Ammonia Nitrogen-N		[]mmhos Conductivity	1300
Potassium	1.0	[]Kjedahl Nitrogen-N		[]pH Units	7.2
,Magnesium	33	[]Nitrate-N		[]Turbidity NTU	
,Manganese	0.16	[]Nitrite-N		[]Color Units	
,Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
,Sodium	30	[]Chloride	64	[]	
,Nickel	<0.05	[]Fluoride	(112)	[]	

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

CUSTOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

DATE COLLECTED — TIME COLLECTED: —

SAMPLED BY Bill Mace SOURCE Jasen Edwin Well

REMARKS No Treatment. Extremely hard water with high Iron and Manganese levels. No TAG with sample.

FOR LAB USE ONLY

RECVD. BY SE LAB # 4661-2

DATE RECEIVED 8-11-80

DATE COMPLETED 8-19-80

DATE REPORTED 8-19-80

SIGNED Archie L. Green

	mg/l		mg/l		mg/l
[]Ag, Silver	<0.05	[]P, Phosphorous	0.22	[]Cyanide	
[]Al, Aluminum	0.44	[]Pb, Lead	<0.05	[]Sulfate	45
[]As, Arsenic	<0.1	[]Pt, Platinum	<0.1	[]Phenol	
[]Au, Gold	<0.05	[]Sb, Antimony	<0.1	[]Total Dissolved Solids	585
[]B, Boron	<0.05	[]Se, Selenium	<0.1	[]Total Volatile Solids	
[]Ba, Barium	0.54	[]Si, Silicon	7.2	[]Suspended Solids	
[]Bi, Bismuth	<0.05	[]Sn, Tin	0.18	[]Volatile Suspended Solids	
[]Ca, Calcium	130	[]Sr, Strontium	0.54	[]Hardness as $CaCO_3$	540
[]Cd, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	710
[]Co, Cobalt	<0.05	[]W, Tungsten	<0.05	[]	
[]Cr, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
[]Cu, Copper	<0.05	[]Zn, Zinc	0.25	[]	
[]Fe, Iron	4.7	[]Zr, Zirconium	<0.05	[]	
[]Hg, Mercury	<0.1	[]Ammonia Nitrogen-N		* * * * * * []mmhos Conductivity	1350
[]K, Potassium	1.5	[]Kjedahl Nitrogen-N		[]pH Units	7.4
[]Mg, Magnesium	50	[]Nitrate-N		[]Turbidity NTU	
[]Mn, Manganese	0.55	[]Nitrite-N		[]Color Units	
[]Mo, Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
[]Na, Sodium	14	[]Chloride	62	[]	

(43)

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

TELEPHONE (907) 279-4014

ANALYTICAL REPORT

Water Analysis(Facility) Alaska Area Native Health Service

Date Collected: 1-24-78 Time Collected: ------ By: Steven Cohen

Source of Sample: Tanana Hospital, Water from Well

Physical Observations, Remarks: Raw water, preserved with HNO_3

[] mg/l Aluminum	[] mmhos Conductivity	[] mg/l Hardness as $CaCO_3$
[] mg/l Arsenic	[] units pH	[] mg/l Alkalinity as $CaCO_3$
[] mg/l Barium	[] mg/l Ammonia Nitrogen-N	[] mg/l Acidity-T as $CaCO_3$
[] mg/l Boron	[] mg/l Kjedahl Nitrogen-N	[] mg/l Acidity Free as $CaCO_3$
[] mg/l Cadmium	[] mg/l Organic Nitrogen-N	[] /100ml Coliform-T
[] mg/l Calcium	[] mg/l Nitrate(N)	[] /100ml Coliform-F
[] mg/l Copper	[] mg/l Nitrite(N)	[] /100ml Strep-F
[] mg/l Chromium-Total	[] mg/l Phosphorus (Ortho)-P	[] units Color
[] mg/l Chromium-Tri	[] mg/l Phosphorus (Total)-P	[]
[] mg/l Chromium-Hex	[] mg/l Chloride	[]
[] 1.3 mg/l Iron-Total	[] mg/l Fluoride	
[] mg/l Iron-Dissolved	[] mg/l Cyanide	
[] mg/l Lead	[] mg/l Sulfate	
[] mg/l Magnesium	[] mg/l Phenol	
[] mg/l Manganese	[] mg/l MBSA	
[] mg/l Mercury	[] mg/l BOD	
[] mg/l Nickel	[] mg/l COD	
[] mg/l Potassium	[] mg/l TD Solids	
[] mg/l Selenium	[] mg/l TV Solids	
[] mg/l Sodium	[] mg/l Suspended Solids	
[] mg/l Silver	[] (114) mg/l SV Solids	

Transported by:
Received by:

Transported by:
Received by:

FOR LAB USE ONLY

Lab# 7261-1 Rec'd by: SE

Date sample rec'd: 1-30-78

Date analysis completed: 1-31-78

Date results reported: 2-1-78

Signed: Richard L. Green

Date: February 1, 1978

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

TELEPHONE (907) 279-401·

ANALYTICAL REPORT

Water Analysis(Facility) Arctic Environmental Engineers

Date Collected: 1-27-78 Time Collected: ---- By: ---

Source of Sample: Submitted by: Mr. Dave Yanoshek

Physical Observations, Remarks:

[]	mg/l	Aluminum	[] 690 mmhos	Conductivity	[] 507 mg/l Hardness as $CaCO_3$
[] < 0.01	mg/l	Arsenic	[] 7.6 units	pH	[] 448 mg/l Alkalinity as $CaCO_3$
[] 0.2	mg/l	Barium	[]	mg/l Ammonia Nitrogen-N	[] mg/l Acidity-T as $CaCO_3$
[]	mg/l	Boron	[]	mg/l Kjedahl Nitrogen-N	[] mg/l Acidity Free as $CaCO_3$
[] < 0.005	mg/l	Cadmium	[]	mg/l Organic Nitrogen-N	[] < 1 /100ml Coliform-T
[] 136	mg/l	Calcium	[] 0.84	mg/l Nitrate(N)	[] /100ml Coliform-F
[] < 0.1	mg/l	Copper	[]	mg/l Nitrite(N)	[] /100ml Strep-F
[]	mg/l	Chromium-Total	[]	mg/l Phosphorus (Ortho)-P	[] 10 units Color
[]	mg/l	Chromium-Tri	[]	mg/l Phosphorus (Total)-P	[]
[]	mg/l	Chromium-Hex	[] 8	mg/l Chloride	[]
[] 1.5	mg/l	Iron-Total	[] 0.1	mg/l Fluoride	
[] 0.6	mg/l	Iron-Dissolved	[] < 0.01	mg/l Cyanide	Transported by:
[] 0.01	mg/l	Lead	[] 55	mg/l Sulfate	Received by:
[] 41	mg/l	Magnesium	[]	mg/l Phenol	Transported by:
[] 0.3	mg/l	Manganese	[]	mg/l MBSA	Received by:
[] < 0.001	mg/l	Mercury	[]	mg/l BOD	FOR LAB USE ONLY
[] < 0.1	mg/l	Nickel	[] < 10	mg/l COD	Lab# 7241 Rec'd by: SE
[] 1.5	mg/l	Potassium	[] 522	mg/l TD Solids	Date sample rec'd: 1-27-78
[] < 0.01	mg/l	Selenium	[]	mg/l TV Solids	Date analysis completed: 2-6-78
[] 12	mg/l	Sodium	[] < 1	mg/l Suspended Solids	Date results reported: 2-7-78
[] < 0.05	mg/l	Silver	[] (115)	mg/l SV Solids	Signed: Archie L Thomas
					Date: February 7, 1978

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

TELEPHONE (907) 279-4014

ANALYTICAL REPORT

ter Analysis(Facility) Arctic Environmental Engineers

te Collected: 4-18-78 Time Collected: ----- By: -----

urce of Sample: Tanana, Alaska water well

ysical Observations, Remarks:

	mg/l	Aluminum	[] 860	mmhos	Conductivity	[] 583	mg/l Hardness as $CaCO_3$
	mg/l	Arsenic	[] 7.0	units	pH	[] 510	mg/l Alkalinity as $CaCO_3$
	mg/l	Barium	[]	mg/l	Ammonia Nitrogen-N	[]	mg/l Acidity-T as $CaCO_3$
	mg/l	Boron	[]	mg/l	Kjedahl Nitrogen-N	[]	mg/l Acidity Free as $CaCO_3$
	mg/l	Cadmium	[]	mg/l	Organic Nitrogen-N	[]	/100ml Coliform-T
150	mg/l	Calcium	[]	mg/l	Nitrate(N)	[]	/100ml Coliform-F
	mg/l	Copper	[]	mg/l	Nitrite(N)	[]	/100ml Strep-F
	mg/l	Chromium-Total	[]	mg/l	Phosphorus (Ortho)-P	[]	units Color
	mg/l	Chromium-Tri	[]	mg/l	Phosphorus (Total)-P	[]	
	mg/l	Chromium-Hex	[] 15	mg/l	Chloride	[]	
2.9	mg/l	Iron-Total	[]	mg/l	Fluoride		
	mg/l	Iron-Dissolved	[]	mg/l	Cyanide		
	mg/l	Lead	[] 80	mg/l	Sulfate		
49	mg/l	Magnesium	[]	mg/l	Phenol		
	mg/l	Manganese	[]	mg/l	MBSA		
	mg/l	Mercury	[]	mg/l	BOD		
	mg/l	Nickel	[]	mg/l	COD		
<1	mg/l	Potassium	[] 614	mg/l	TD Solids		
	mg/l	Selenium	[]	mg/l	TV Solids		
11	mg/l	Sodium	[]	mg/l	Suspended Solids		

(46)

Transported by:
Received by:

Transported by:
Received by:

FOR LAB USE ONLY

Lab# 7727 Rec'd by: SE

Date sample rec'd: 4-18-78

Date analysis completed: 4-21-78

Date results reported: 4-21-78

Signed: Archie L Green

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907)-279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

USTOMER Alaska Area Native Health Service SAMPLE LOCATION: Tanana, Alaska

ATE COLLECTED 7-28-80 TIME COLLECTED: —

AMPLED BY B. Mace SOURCE Miller Well

EMARKS No Treatment
Very Hard Water with high levels of Iron and Manganese

FOR LAB USE ONLY
RECVD. BY SE LAB # 4510-2
DATE RECEIVED 7-30-80
DATE COMPLETED 7-31-80
DATE REPORTED 8- 1-80
SIGNED Stephen C. Ede

	mg/l		mg/l		mg/l
]Ag, Silver	<0.05	[]P, Phosphorous	0.19	[]Cyanide	
]Al, Aluminum	<0.05	[]Pb, Lead	<0.05	[]Sulfate	
]As, Arsenic	<1.0	[]Pt, Platinum	<0.10	[]Phenol	
]Au, Gold	<0.10	[]Sb, Antimony	<0.10	[]Total Dissolved Solids	
]. Boron	<0.05	[]Se, Selenium	<0.10	[]Total Volatile Solids	
]Ba, Barium	0.36	[]Si, Silicon	4.2	[]Suspended Solids	
]Bi, Bismuth	<0.05	[]Sn, Tin	<0.1	[]Volatile Suspended Solids	
]Ca, Calcium	82	[]Sr, Strontium	0.24	[]Hardness as $CaCO_3$	245
]Cd, Cadmium	<0.01	[]Ti, Titanium	<0.05	[]Alkalinity as $CaCO_3$	
]Co, Cobalt	<0.05	[]W, Tungsten	<1.0	[]	
]Cr, Chromium	<0.05	[]V, Vanadium	<0.05	[]	
]Cu, Copper	<0.05	[]Zn, Zinc	<0.05	[]	
]Fe, Iron	6.0 (6.51)	[]Zr, Zirconium	<0.05	[]	
				* * * * * *	
]Hg, Mercury	<0.1	[]Ammonia Nitrogen-N		[]mmhos Conductivity	
]K, Potassium	0.8	[]Kjedahl Nitrogen-N		[]pH Units	
]Mg, Magnesium	7.3	[]Nitrate-N		[]Turbidity NTU	
]Mn, Manganese	0.51	[]Nitrite-N		[]Color Units	
]. Molybdenum	<0.05	[]Phosphorus (Ortho)-P		[]T.Coliform/100ml	
]Na, Sodium	2.6	[]Chloride		[]	
]Ni, Nickel	<0.05	[]Fluoride	(117)	[]	

APPENDIX 2

Data, assumptions, justifications, and data sources used in the MODFLOW packages

Ground-water flow at Tanana, Alaska - Modflow Notes

BAS Package

Packages Used: BAS, BCF, OC, SIP, RCH, RIV, STR

Single-layer model

Grid size:100 columns x 50 rows

IBOUND: All cells south of RIV nodes set at no-flow (0)

no-flow above the 250-ft contour (0), estimated limites of the aquifer

all other cells set at variable head (1)

Anisotropy: 1.00

BCF Package

Layer thickness: 100 ft (layer bottom is 100 ft above MSL)

DELR: 528 ft (0.1 mile)

DELC: 528 ft

Hydraulic Conductivity (K) along Rows: 80 ft/day, constant for all cells

RCH Package

Net annual recharge (recharge minus evapotranspiraton): 0.2300E-03 ft/day (1 inch/year)

RIV Package

River Reaches: 99

Yukon River

Slope: 0.000183, estimated from USGS Tanana A-4 and A-5, 1:63,360 scale maps.

Highest River Stage:207.2 ft, estimated from USGS Tanana A-4 and A-5, 1:63,360 scale maps.

River Conductance: 5.600E+06 ft^2/day (K = 20 ft/day = 7.1E-03 cm/s), estimated

Reach Length (L): 528 ft, unit cell size

Reach Width (W): 528 ft, unit cell size

Reach riverbed depth (D):1 ft, estimated

Conductivity Equation: (LW/D)K

Bottom elevation is estimated to be 50 ft lower than river stage height, estimated

STR Package

Total Stream Reaches: 67
Total Stream Segments: 2

Bear Creek
Southward flowing
Stream Reaches: 48
Stream Segments: 1
Streambed Conductance:
- low streambed conductance model value: 1.0E03 ft^2/day
- high steambed conductance model value: 5.0E03 ft^2/day
Reach Length (L):528 ft, unit cell size
Reach Width (W): 10 ft, estimated
Reach streambed depth (D): 0.5 ft, estimated
Conductivity Equation: (LW/D)K
Slope of stream was estimated from 1" to mile USGS topo elevation conturs: 0.002735
Lowest point of stream: at confluence with Yukon R. (r38,c12), 198.8 ft
Stream bed thickness: 0.5 ft (assumed)
Stream bed bottom elevation: 0.5 ft below streambed top elevation
Streambed top elevation:3 ft below stream stage
Streambed conductance: variable, influences magnitude of the stream effects on groundwater flow.

NC Creek
Southward flowing
Stream Reaches: 19
Stream Segments: 1
Streambed Conductance:
- low streambed conductance model value: 1.5E02 ft^2/day
- high steambed conductance model value: 1.5E04 ft^2/day
Reach Length (L): 528 ft
Reach Width (W): 5 ft
Reach streambed depth (D): 0.5 ft
Conductivity Equation: (LW/D)K
Slope of stream, estimated from USGS Tanana A-4 and A-5, 1:63,360 scale maps
seg.1-3: 0.0237
seg. 4-8: 0.0186
seg. 9-19: 0.00778
Stream bed thickness: 0.5 ft estimated
Stream bed bottom elevation: 0.5 ft below streambed top elevation, estimated
Streambed top elevation:3 ft below stream stage, estimated

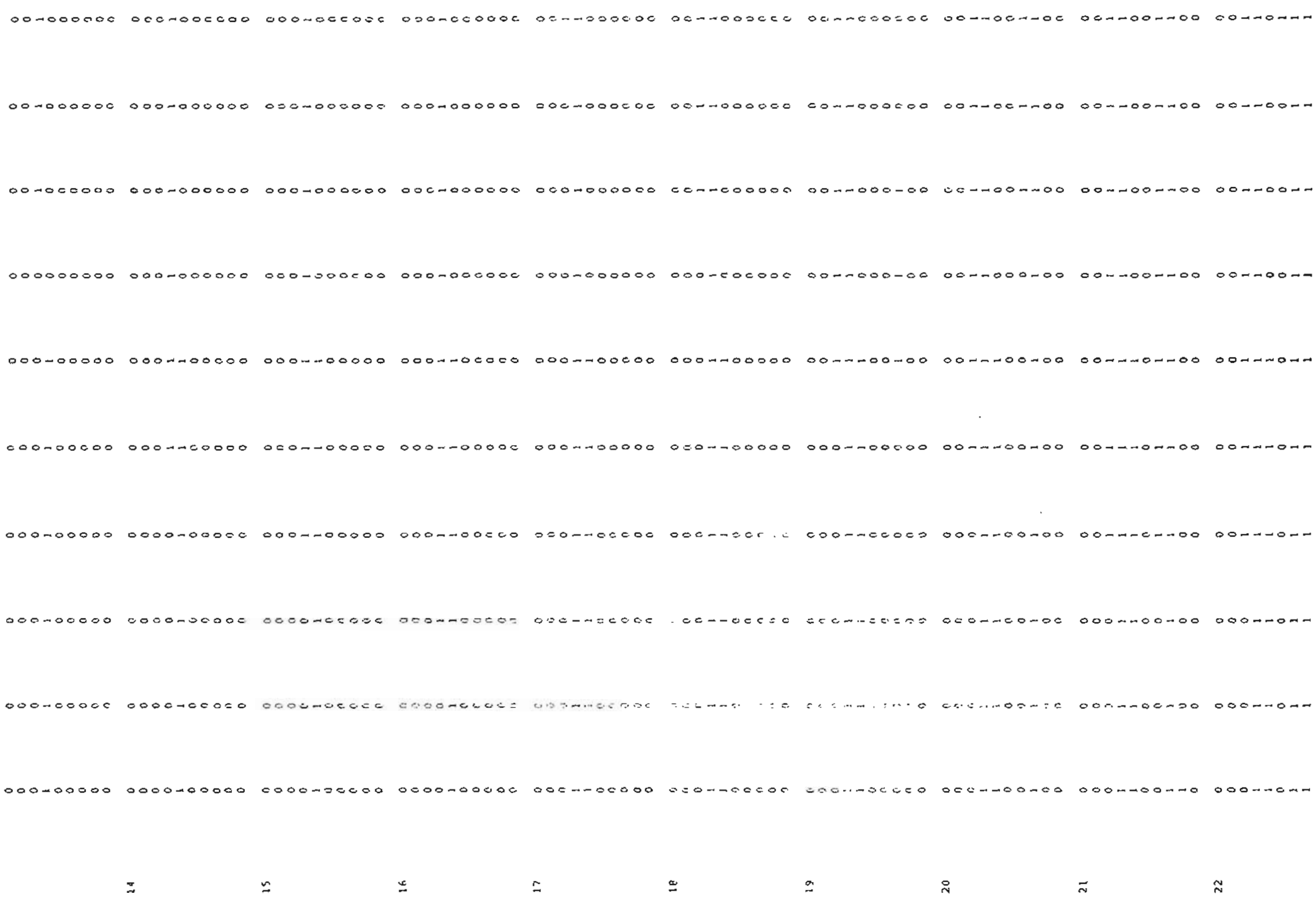
APPENDIX 3

Example output file of the U.S. Geological Survey

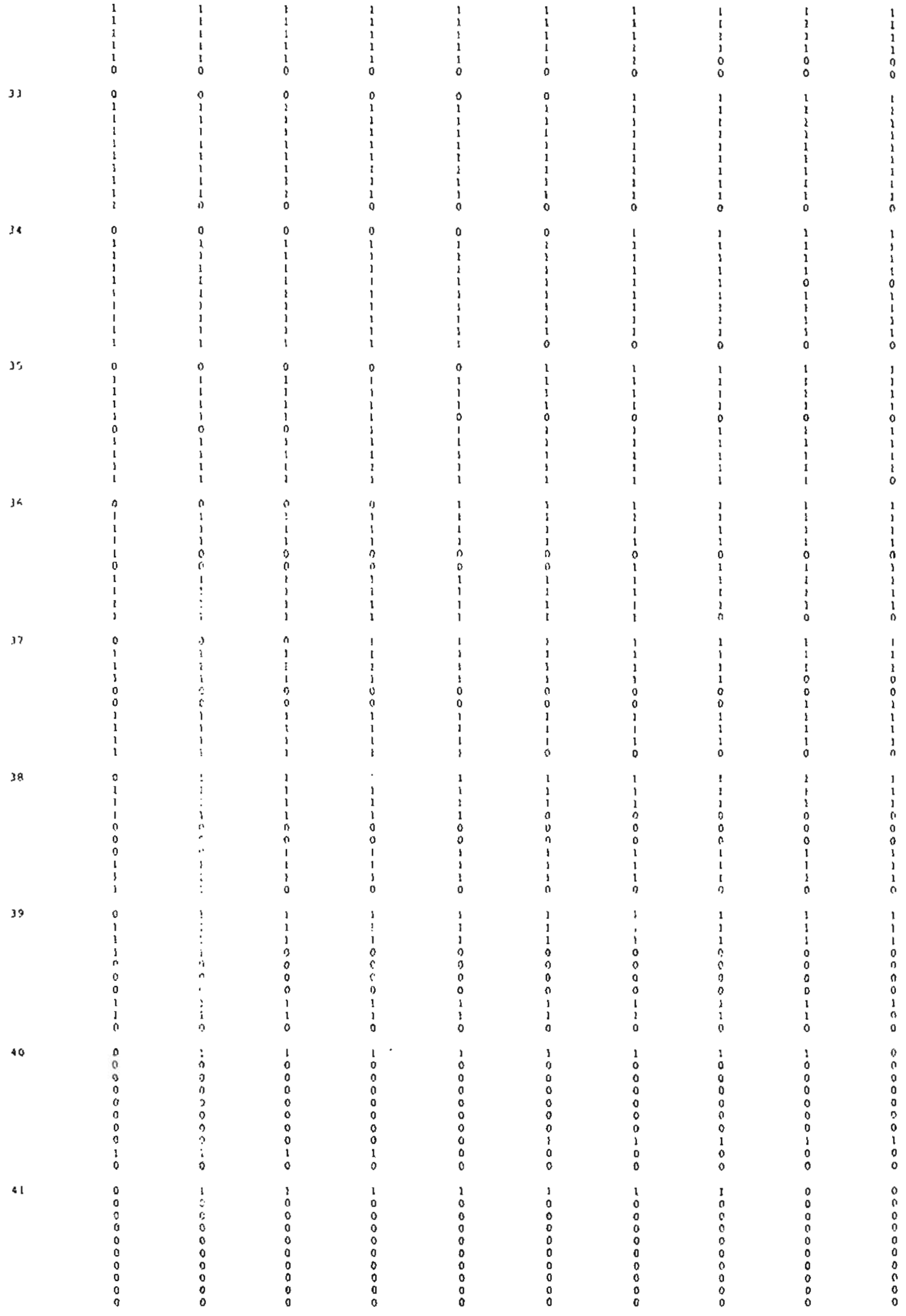
Modular Finite-Difference Ground-Water Model

```
                    U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL

TWO DIMENSIONAL MODEL OF GROUND-WATER FLOW AT TANANA                          : layer, 50 rows, 100 columns, 0.1 mile grid
   1 LAYERS         50 ROWS        100 COLUMNS
  1 STRESS PERIOD(S) IN SIMULATION
MODEL TIME UNIT IS DAYS

I/O UNITS:
ELEMENT OF IUNIT:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
        I/O UNIT: 31  0  0 34  0  0  0 38 39  0  0 42  0  0  0  0  0 35  0  0  ?  0  0  0

BAS1 -- BASIC MODEL PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT  5
ARRAYS RHS AND BUFF WILL SHARE MEMORY.
START HEAD WILL BE SAVED
   45154 ELEMENTS IN X ARRAY ARE USED BY BAS
   45154 ELEMENTS OF X ARRAY USED OUT OF  350000

BCF2 -- BLOCK-CENTERED FLOW PACKAGE, VERSION 2, 7/1/91 INPUT READ FROM UNIT 31
STEADY-STATE SIMULATION
CELL-BY-CELL FLOWS WILL BE RECORDED ON UNIT 21
HEAD AT CELLS THAT CONVERT TO DRY=  0.00000E+00
WETTING CAPABILITY IS NOT ACTIVE
     LAYER  AQUIFER TYPE
     --------------------
        1         1
   10001 ELEMENTS IN X ARRAY ARE USED BY BCF
   55155 ELEMENTS OF X ARRAY USED OUT OF  350000

RCH1 -- RECHARGE PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 38
OPTION 1 -- RECHARGE TO TOP LAYER
CELL-BY-CELL FLOW TERMS WILL BE RECORDED ON UNIT 21
    5000 ELEMENTS OF X ARRAY USED FOR RECHARGE
   60155 ELEMENTS OF X ARRAY USED OUT OF  350000

RIV1 -- RIVER PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 34
MAXIMUM OF   99 RIVER NODES
CELL-BY-CELL FLOWS WILL BE RECORDED ON UNIT 21
     594 ELEMENTS IN X ARRAY ARE USED FOR RIVERS
   60749 ELEMENTS OF X ARRAY USED OUT OF  350000

SIP1 -- STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 39
MAXIMUM OF  50 ITERATIONS ALLOWED FOR CLOSURE
 5 ITERATION PARAMETERS
   20205 ELEMENTS IN X ARRAY ARE USED BY SIP
   80954 ELEMENTS OF X ARRAY USED OUT OF  350000

STRM -- STREAM PACKAGE, VERSION 2, 12/18/90 INPUT READ FROM UNIT 35
MAXIMUM OF   60 STREAM NODES

NUMBER OF STREAM SEGMENTS IS      2

NUMBER OF STREAM TRIBUTARIES IS      2

STREAM STAGES WILL BE CALCULATED USING A CONSTANT OF**********
    1082 ELEMENTS IN X ARRAY ARE USED FOR STREAMS
   82036 ELEMENTS OF X ARRAY USED OUT OF  350000

TWO DIMENSIONAL MODEL OF GROUND-WATER FLOW AT TANANA                          : layer, 50 rows, 100 columns, 0.1 mile grid

                    BOUNDARY ARRAY FOR LAYER  1 WILL BE READ ON UNIT 61 USING FORMAT:  (10012)

     1     2     3     4     5     6     7     8     9    10
    11    12    13    14    15    16    17    18    19    20
    21    22    23    24    25    26    27    28    29    30
    31    32    33    34    35    36    37    38    39    40
    41    42    43    44    45    46    47    48    49    50
    51    52    53    54    55    56    57    58    59    60
    61    62    63    64    65    66    67    68    69    70
    71    72    73    74    75    76    77    78    79    80
    81    82    83    84    85    86    87    88    89    90
    91    92    93    94    95    96    97    98    99   100
-----------------------------------------------------------------------------------------------

  1                0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0

  2                0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0
                   0     0     0     0     0     0     0     0     0

  3          0     0     0     0     0     0     0     0     0     0
             0     0     0     0     0     0     0     0     0     0
             0     0     0     0     0     0     0     0     0     0
             0     0     0     0     0     0     0     0     0     0
             0     0     0     0     0     0     0     0     0     0
```

4										
5										
6										
7										
8										
9										
10										
11										
12										
13										


14
15
16
17
18
19
20
21
22

	1 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
23	0 0 0 1 1 0 1 1 1 0	0 0 0 1 1 0 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 0 1 1 1 1 0	0 0 1 1 0 1 1 1 1 0
24	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 0 0	0 0 1 1 1 1 1 1 0 0	0 0 1 1 1 1 1 1 0 0	0 0 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0
25	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0
26	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0
27	0 0 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0
28	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0
29	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0
30	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0
31	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 1 0	0 1 1 1 1 1 1 1 0 0	0 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0	1 1 1 1 1 1 1 1 0 0
32	0 1 1 1	0 1 1 1	0 1 1 1	0 1 1 1	0 1 1 1	0 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1



42
1 1 1 1 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

43
1 1 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

44
1 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

45
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

46
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

47
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

48
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

49
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

50
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

AQUIFER HEAD WILL BE SET TO 999.00 AT ALL NO-FLOW NODES (IBOUND=0).

INITIAL HEAD = 208.0000 FOR LAYER 1

HEAD PRINT FORMAT IS FORMAT NUMBER 3 DRAWDOWN PRINT FORMAT IS FORMAT NUMBER 3

HEADS WILL BE SAVED ON UNIT 20 DRAWDOWNS WILL BE SAVED ON UNIT 0

OUTPUT CONTROL IS SPECIFIED EVERY TIME STEP

COLUMN TO ROW ANISOTROPY = 1.000000

DELR WILL BE READ ON UNIT 31 USING FORMAT: (10F5.0) 3

528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00

DELC WILL BE READ ON UNIT 31 USING FORMAT: (10F5.0) 3

528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00
528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00	528.00

HYD. COND. ALONG ROWS = 60.00000 FOR LAYER 1

BOTTOM = 100.0000 FOR LAYER 1

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

MAXIMUM ITERATIONS ALLOWED FOR CLOSURE = 50
ACCELERATION PARAMETER = 1.0000
HEAD CHANGE CRITERION FOR CLOSURE = 0.10000E-02
SIP HEAD CHANGE PRINTOUT INTERVAL = 1

CALCULATE ITERATION PARAMETERS FROM MODEL CALCULATED WSEED

STRESS PERIOD NO. 1, LENGTH = 1.000000

NUMBER OF TIME STEPS = 1

MULTIPLIER FOR DELT = 1.000

INITIAL TIME STEP SIZE = 1.000000

RECHARGE = 0.2300000E-03

99 RIVER REACHES

LAYER	ROW	COL	STAGE	CONDUCTANCE	BOTTOM ELEVATION	RIVER REACH
1	35	99	207.2	0.5600E+07	157.2	1
1	35	98	207.1	0.5600E+07	157.1	2
1	36	97	207.0	0.5600E+07	157.0	3
1	35	96	206.9	0.5600E+07	156.9	4
1	37	95	206.8	0.5600E+07	156.8	5
1	37	94	206.7	0.5600E+07	156.7	6
1	37	93	206.6	0.5600E+07	156.6	7
1	38	92	206.5	0.5600E+07	156.5	8
1	38	91	206.4	0.5600E+07	156.4	9
1	38	90	206.3	0.5600E+07	156.3	10
1	39	89	206.2	0.5600E+07	156.2	11
1	39	88	206.1	0.5600E+07	156.1	12
1	39	87	206.0	0.5600E+07	156.0	13
1	39	86	205.9	0.5600E+07	155.9	14
1	39	85	205.8	0.5600E+07	155.8	15
1	40	84	205.8	0.5600E+07	155.8	16
1	40	83	205.7	0.5600E+07	155.7	17
1	40	82	205.6	0.5600E+07	155.6	18
1	40	81	205.5	0.5600E+07	155.5	19
1	40	80	205.4	0.5600E+07	155.4	20
1	40	79	205.3	0.5600E+07	155.3	21
1	40	78	205.2	0.5600E+07	155.2	22
1	40	77	205.1	0.5600E+07	155.1	23
1	40	76	205.0	0.5600E+07	155.0	24
1	39	75	204.9	0.5600E+07	154.9	25
1	39	74	204.8	0.5600E+07	154.8	26
1	39	73	204.7	0.5600E+07	154.7	27
1	39	72	204.6	0.5600E+07	154.6	28
1	39	71	204.5	0.5600E+07	154.5	29
1	38	70	204.4	0.5600E+07	154.4	30
1	38	69	204.3	0.5600E+07	154.3	31
1	38	68	204.2	0.5600E+07	154.2	32
1	38	67	204.1	0.5600E+07	154.1	33
1	38	66	204.0	0.5600E+07	154.0	34
1	38	65	203.9	0.5600E+07	153.9	35
1	38	64	203.8	0.5600E+07	153.8	36
1	38	63	203.7	0.5600E+07	153.7	37
1	37	62	203.6	0.5600E+07	153.6	38

1	37	61	203.5	0.5600E+07	153.5	39
1	37	60	203.4	0.5600E+07	153.4	40
1	37	59	203.3	0.5600E+07	153.3	41
1	36	58	203.2	0.5600E+07	153.2	42
1	36	57	203.1	0.5600E+07	153.1	43
1	35	56	203.0	0.5600E+07	153.0	44
1	35	55	202.9	0.5600E+07	152.9	45
1	35	54	202.9	0.5600E+07	152.9	46
1	34	53	202.8	0.5600E+07	152.8	47
1	34	52	202.7	0.5600E+07	152.7	48
1	34	51	202.6	0.5600E+07	152.6	49
1	33	50	202.5	0.5600E+07	152.5	50
1	33	49	202.4	0.5600E+07	152.4	51
1	34	48	202.3	0.5600E+07	152.3	52
1	34	47	202.2	0.5600E+07	152.2	53
1	34	46	202.1	0.5600E+07	152.1	54
1	34	45	202.0	0.5600E+07	152.0	55
1	35	44	201.9	0.5600E+07	151.9	56
1	35	43	201.8	0.5600E+07	151.8	57
1	35	42	201.7	0.5600E+07	151.7	58
1	36	41	201.6	0.5600E+07	151.6	59
1	36	40	201.5	0.5600E+07	151.5	60
1	36	39	201.4	0.5600E+07	151.4	61
1	37	38	201.3	0.5600E+07	151.3	62
1	37	37	201.2	0.5600E+07	151.2	63
1	37	36	201.1	0.5600E+07	151.1	64
1	38	35	201.0	0.5600E+07	151.0	65
1	38	34	200.9	0.5600E+07	150.9	66
1	38	33	200.8	0.5600E+07	150.8	67
1	39	32	200.7	0.5600E+07	150.7	68
1	39	31	200.6	0.5600E+07	150.6	69
1	39	30	200.5	0.5600E+07	150.5	70
1	39	29	200.4	0.5600E+07	150.4	71
1	39	28	200.3	0.5600E+07	150.3	72
1	39	27	200.2	0.5600E+07	150.2	73
1	39	26	200.1	0.5600E+07	150.1	74
1	39	25	200.0	0.5600E+07	150.0	75
1	39	24	200.0	0.5600E+07	150.0	76
1	39	23	199.9	0.5600E+07	149.9	77
1	39	22	199.8	0.5600E+07	149.8	78
1	39	21	199.7	0.5600E+07	149.7	79
1	39	20	199.6	0.5600E+07	149.6	80
1	39	19	199.5	0.5600E+07	149.5	81
1	39	18	199.4	0.5600E+07	149.4	82
1	39	17	199.3	0.5600E+07	149.3	83
1	39	16	199.2	0.5600E+07	149.2	84
1	39	15	199.1	0.5600E+07	149.1	85
1	39	14	199.0	0.5600E+07	149.0	86
1	39	13	198.9	0.5600E+07	148.9	87
1	39	12	198.8	0.5600E+07	148.8	88
1	39	11	198.7	0.5600E+07	148.7	89
1	39	10	198.6	0.5600E+07	148.6	90
1	40	9	198.5	0.5600E+07	148.5	91
1	41	8	198.4	0.5600E+07	148.4	92
1	41	7	198.3	0.5600E+07	148.3	93
1	41	6	198.2	0.5600E+07	148.2	94
1	42	5	198.1	0.5600E+07	148.1	95
1	42	4	198.0	0.5600E+07	148.0	96
1	43	3	197.9	0.5600E+07	147.9	97
1	44	2	197.8	0.5600E+07	147.8	98
1	44	1	197.7	0.5600E+07	147.7	99

67 STREAM NODES

LAYER	ROW	COL	SEGMENT NUMBER	REACH NUMBER	STREAMFLOW	STREAM STAGE	STREAMBED CONDUCTANCE	STREAMBED BOT ELEVATION	STREAMBED TOP ELEVATION
1	15	46	1	1	0.4320E+06	266.7	1000.	263.2	263.7
1	14	45	1	2	0.0000E+00	265.3	1000.	261.8	262.3
1	14	44	1	3	0.0000E+00	263.8	1000.	260.3	260.8
1	15	43	1	4	0.0000E+00	262.4	1000.	258.9	259.4
1	16	43	1	5	0.0000E+00	260.9	1000.	257.4	257.9
1	17	43	1	6	0.0000E+00	259.5	1000.	256.0	256.5
1	18	43	1	7	0.0000E+00	258.0	1000.	254.5	255.0
1	18	42	1	8	0.0000E+00	256.6	1000.	253.1	253.6
1	17	41	1	9	0.0000E+00	255.1	1000.	251.6	252.1
1	17	40	1	10	0.0000E+00	253.7	1000.	250.2	250.7
1	17	39	1	11	0.0000E+00	252.3	1000.	248.8	249.3
1	18	39	1	12	0.0000E+00	250.8	1000.	247.3	247.8
1	19	38	1	13	0.0000E+00	249.4	1000.	245.9	246.4
1	20	37	1	14	0.0000E+00	247.9	1000.	244.4	244.9
1	19	36	1	15	0.0000E+00	246.5	1000.	243.0	243.5
1	19	35	1	16	0.0000E+00	245.0	1000.	241.5	242.0
1	20	34	1	17	0.0000E+00	243.6	1000.	240.1	240.6
1	20	33	1	18	0.0000E+00	242.2	1000.	238.7	239.2
1	20	32	1	19	0.0000E+00	240.7	1000.	237.2	237.7
1	20	31	1	20	0.0000E+00	239.3	1000.	235.8	236.3
1	20	30	1	21	0.0000E+00	237.8	1000.	234.3	234.8
1	21	29	1	22	0.0000E+00	236.4	1000.	232.9	233.4
1	22	28	1	23	0.0000E+00	234.9	1000.	231.4	231.9
1	22	27	1	24	0.0000E+00	233.5	1000.	230.0	230.5
1	22	26	1	25	0.0000E+00	232.0	1000.	228.5	229.0
1	23	26	1	26	0.0000E+00	230.6	1000.	227.1	227.6
1	24	27	1	27	0.0000E+00	229.2	1000.	225.7	226.2
1	25	27	1	28	0.0000E+00	227.7	1000.	224.2	224.7
1	26	27	1	29	0.0000E+00	226.3	1000.	222.8	223.3
1	27	26	1	30	0.0000E+00	224.8	1000.	221.3	221.8
1	28	25	1	31	0.0000E+00	223.4	1000.	219.9	220.4
1	28	24	1	32	0.0000E+00	221.9	1000.	218.4	218.9
1	28	23	1	33	0.0000E+00	220.5	1000.	217.0	217.5
1	29	22	1	34	0.0000E+00	219.0	1000.	215.5	216.0
1	29	21	1	35	0.0000E+00	217.6	1000.	214.1	214.6
1	29	20	1	36	0.0000E+00	216.2	1000.	212.7	213.2
1	30	19	1	37	0.0000E+00	214.7	1000.	211.2	211.7
1	30	18	1	38	0.0000E+00	213.3	1000.	209.8	210.3

1	31	18	1	39	0.0000E+00	211.8	1000.	208.3	208.8
1	31	17	1	40	0.0000E+00	210.4	1000.	206.9	207.4
1	32	16	1	41	0.0000E+00	208.9	1000.	205.4	205.9
1	33	15	1	42	0.0000E+00	207.5	1000.	204.0	204.5
1	34	14	1	43	0.0000E+00	206.0	1000.	202.5	203.0
1	35	14	1	44	0.0000E+00	204.6	1000.	201.1	201.6
1	35	13	1	45	0.0000E+00	203.2	1000.	199.7	200.2
1	36	12	1	46	0.0000E+00	201.7	1000.	198.2	198.7
1	37	11	1	47	0.0000E+00	200.3	1000.	196.8	197.3
1	38	12	1	48	0.0000E+00	198.8	1000.	195.3	195.8
1	20	80	2	1	0.8640E+05	325.0	1000.	321.5	322.0
1	21	80	2	2	0.0000E+00	312.5	1000.	309.0	309.5
1	22	79	2	3	0.0000E+00	300.0	1000.	296.5	297.0
1	23	79	2	4	0.0000E+00	290.2	1000.	286.7	287.2
1	24	78	2	5	0.0000E+00	280.4	1000.	276.9	277.4
1	25	77	2	6	0.0000E+00	270.5	1000.	267.0	267.5
1	26	77	2	7	0.0000E+00	260.7	1000.	257.2	257.7
1	27	76	2	8	0.0000E+00	250.0	1000.	246.5	247.0
1	28	76	2	9	0.0000E+00	245.9	1000.	242.4	242.9
1	29	75	2	10	0.0000E+00	241.8	1000.	238.3	238.8
1	30	75	2	11	0.0000E+00	237.7	1000.	234.2	234.7
1	31	75	2	12	0.0000E+00	233.6	1000.	230.1	230.6
1	32	75	2	13	0.0000E+00	229.5	1000.	226.0	226.5
1	33	75	2	14	0.0000E+00	225.3	1000.	221.8	222.3
1	34	75	2	15	0.0000E+00	221.2	1000.	217.7	218.2
1	35	75	2	16	0.0000E+00	217.1	1000.	213.6	214.1
1	36	75	2	17	0.0000E+00	213.0	1000.	209.5	210.0
1	37	74	2	18	0.0000E+00	208.9	1000.	205.4	205.9
1	38	74	2	19	0.0000E+00	204.8	1000.	201.3	201.8

LAYER	ROW	COL	SEGMENT NUMBER	REACH NUMBER	STREAM WIDTH	STREAM SLOPE	ROUGH COEF.
1	15	46	1	1	10.00	0.2735E-02	0.3000E-01
1	14	45	1	2	10.00	0.2735E-02	0.3000E-01
1	14	44	1	3	10.00	0.2735E-02	0.3000E-01
1	15	43	1	4	10.00	0.2735E-02	0.3000E-01
1	16	43	1	5	10.00	0.2735E-02	0.3000E-01
1	17	43	1	6	10.00	0.2735E-02	0.3000E-01
1	18	43	1	7	10.00	0.2735E-02	0.3000E-01
1	18	42	1	8	10.00	0.2735E-02	0.3000E-01
1	17	41	1	9	10.00	0.2735E-02	0.3000E-01
1	17	40	1	10	10.00	0.2735E-02	0.3000E-01
1	17	39	1	11	10.00	0.2735E-02	0.3000E-01
1	18	39	1	12	10.00	0.2735E-02	0.3000E-01
1	19	38	1	13	10.00	0.2735E-02	0.3000E-01
1	20	37	1	14	10.00	0.2735E-02	0.3000E-01
1	19	36	1	15	10.00	0.2735E-02	0.3000E-01
1	19	35	1	16	10.00	0.2735E-02	0.3000E-01
1	20	34	1	17	10.00	0.2735E-02	0.3000E-01
1	20	33	1	18	10.00	0.2735E-02	0.3000E-01
1	20	32	1	19	10.00	0.2735E-02	0.3000E-01
1	20	31	1	20	10.00	0.2735E-02	0.3000E-01
1	20	30	1	21	10.00	0.2735E-02	0.3000E-01
1	21	29	1	22	10.00	0.2735E-02	0.3000E-01
1	22	28	1	23	10.00	0.2735E-02	0.3000E-01
1	22	27	1	24	10.00	0.2735E-02	0.3000E-01
1	22	26	1	25	10.00	0.2735E-02	0.3000E-01
1	23	26	1	26	10.00	0.2735E-02	0.3000E-01
1	24	27	1	27	10.00	0.2735E-02	0.3000E-01
1	25	27	1	28	10.00	0.2735E-02	0.3000E-01
1	25	27	1	29	10.00	0.2735E-02	0.3000E-01
1	27	26	1	30	10.00	0.2735E-02	0.3000E-01
1	28	25	1	31	10.00	0.2735E-02	0.3000E-01
1	28	24	1	32	10.00	0.2735E-02	0.3000E-01
1	28	23	1	33	10.00	0.2735E-02	0.3000E-01
1	29	22	1	34	10.00	0.2735E-02	0.3000E-01
1	29	21	1	35	10.00	0.2735E-02	0.3000E-01
1	29	20	1	36	10.00	0.2735E-02	0.3000E-01
1	29	19	1	37	10.00	0.2735E-02	0.3000E-01
1	30	18	1	38	10.00	0.2735E-02	0.3000E-01
1	31	18	1	39	10.00	0.2735E-02	0.3000E-01
1	31	17	1	40	10.00	0.2735E-02	0.3000E-01
1	32	16	1	41	10.00	0.2735E-02	0.3000E-01
1	33	15	1	42	10.00	0.2735E-02	0.3000E-01
1	34	14	1	43	10.00	0.2735E-02	0.3000E-01
1	35	14	1	44	10.00	0.2735E-02	0.3000E-01
1	35	13	1	45	10.00	0.2735E-02	0.3000E-01
1	36	12	1	46	10.00	0.2735E-02	0.3000E-01
1	37	11	1	47	10.00	0.2735E-02	0.3000E-01
1	38	12	1	48	10.00	0.2735E-02	0.3000E-01
1	20	80	2	1	5.000	0.2367E-01	0.3000E-01
1	21	80	2	2	5.000	0.2367E-01	0.3000E-01
1	22	79	2	3	5.000	0.2367E-01	0.3000E-01
1	23	79	2	4	5.000	0.1860E-01	0.3000E-01
1	24	78	2	5	5.000	0.1860E-01	0.3000E-01
1	25	77	2	6	5.000	0.1860E-01	0.3000E-01
1	26	77	2	7	5.000	0.1860E-01	0.3000E-01
1	27	76	2	8	5.000	0.1860E-01	0.3000E-01
1	28	76	2	9	5.000	0.7780E-02	0.3000E-01
1	29	75	2	10	5.000	0.7780E-02	0.3000E-01
1	30	75	2	11	5.000	0.7780E-02	0.3000E-01
1	31	75	2	12	5.000	0.7780E-02	0.3000E-01
1	32	75	2	13	5.000	0.7780E-02	0.3000E-01
1	33	75	2	14	5.000	0.7780E-02	0.3000E-01
1	34	75	2	15	5.000	0.7780E-02	0.3000E-01
1	35	75	2	16	5.000	0.7780E-02	0.3000E-01
1	36	75	2	17	5.000	0.7780E-02	0.3000E-01
1	37	74	2	18	5.000	0.7780E-02	0.3000E-01
1	38	74	2	19	5.000	0.7780E-02	0.3000E-01

MAXIMUM NUMBER OF TRIBUTARY STREAMS IS 2

STREAM SEGMENT	TRIBUTARY STREAM SEGMENT NUMBERS
1	0 0
2	0 0

```
AVERAGE SEED = 0.00024707
MINIMUM SEED = 0.00024674


   5 ITERATION PARAMETERS CALCULATED FROM AVERAGE S

          0.0000000E+00  0.8746271E+00  0.9842817E+00  0 '       E+00  0.95'752'E+'


   26 ITERATIONS FOR TIME STEP   1 IN STRESS PERIOD  1

MAXIMUM HEAD CHANGE FOR EACH ITERATION

 HEAD CHANGE LAYER,ROW,COL  HEAD CHANGE LAYER,ROW,COL  HEAD CHANGE LAYER,R(        HEAD CHANGE L       OW,COL  HEAD CHANGE LAYER,ROW,COL
-------------------------------------------------------  ----------------  ---------------------  ---------------------------------
--
  -10.29     (  1, 44,  1)  -6.152     (  1  11,  21       14      '  1, 22,  )   4.712     (  1, 29, 10)  -2.089     (  1, 23, 73)
 -0.3537     (  1, 23, 48) -0.2691     (  1, _3, 47) -0.._.38         1, 16, 35) -0.8701     (  1, 11, 45) -0.4013     (  1, 25, 38)
 -0.9853E-01 (  1, 11, 45) -0.6719E-01 (  1, 12, 44) -0.1040      (  1, 11, 45)  0.1385     (  1, 14, 36) -0.8183E-01 (  1  21, 45)
 -0.1040E-01 (  1, 11, 45) -0.1682E-01 (  1, 21, 39) -0.2324E-01 (  1, 20, 41) -0.7050E-01 (  1, 11, 45) -0 3902E-01 (  1, 21, 30)
 -0.6818E-02 (  1, 11, 45) -0.3587E-02 (  1, 12, 44)  0.4771E-02 (  1, 29, 64) -0.4173E-02 (  1, 19, 43) -0 5907E-02 (  1, 11, 45)
  0.6799E-0) (  1, 27, 28)


HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 0     CELL-BY-CELL FLOW TERM FLAG =21

OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
  HEAD     DRAWDOWN  HEAD  DRAWDOWN
PRINTOUT  PRINTOUT  SAVE    SAVE
-----------------------------------
    1         0       1       0
"   CONSTANT HEAD" BUDGET VALUES WILL BE SAVED ON UNIT 21 AT END OF TIME STEP  1, STRESS PERIOD  1
"FLOW RIGHT FACE " BUDGET VALUES WILL BE SAVED ON UNIT 21 AT END OF TIME STEP  1, STRESS PERIOD  1
"FLOW FRONT FACE " BUDGET VALUES WILL BE SAVED ON UNIT 21 AT END OF TIME STEP  1, STRESS PERIOD  1
"        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 21 AT END OF TIME STEP  1, STRESS PERIOD  1
"   RIVER LEAKAGE" BUDGET VALUES WILL BE SAVED ON UNIT 21 AT END OF TIME STEP  1, STRESS PERIOD  1

            LAYER       ROW       COLUMN      STREAM      REACH      FLOW INTO      FLOW INTO      FLOW OUT OF      HEAD IN
                                              NUMBER      NUMBER     STREAM REACH   AQUIFER        STREAM REACH     STREAM

              1          15         45          1           1       0.431E+06      [illegible]    0.431E+06       264.07
              1          16         45          1           2       0.431E+06      [illegible]    0.430E+06       262.67
              1          14         44          1           3       0.430E+06      [illegible]    0.429E+06       261.17
              1          15         43          1           4       0.429E+06      [illegible]    0.429E+06       259.77
              1          16         43          1           5       0.429E+06      [illegible]    0.428E+06       258.27
              1          17         43          1           6       0.428E+06      [illegible]    0.427E+06       256.87
              1          18         43          1           7       0.427E+06      [illegible]    0.426E+06       255.37
              1          18         42          1           8       0.426E+06      [illegible]    0.425E+06       253.97
              1          17         41          1           9       0.425E+06      [illegible]    0.424E+06       252.47
              1          17         40          1          10       0.424E+06      [illegible]    0.423E+06       251.07
              1          17         39          1          11       0.423E+06      [illegible]    0.422E+06       249.67
              1          18         39          1          12       0.422E+06      [illegible]    0.422E+06       248.17
              1          19         38          1          13       0.422E+06      [illegible]    0.421E+06       246.77
              1          20         37          1          14       0.421E+06      [illegible]    0.420E+06       245.27
              1          19         36          1          15       0.420E+06      [illegible]    0.419E+06       243.97
              1          19         35          1          16       0.419E+06      [illegible]    0.418E+06       242.37
              1          20         34          1          17       0.418E+06      [illegible]    0.417E+06       240.97
              1          20         33          1          18       0.417E+06      [illegible]    0.416E+06       239.56
              1          20         32          1          19       0.416E+06      [illegible]    0.416E+06       238.06
              1          20         31          1          20       0.416E+06      [illegible]    0.415E+06       236.66
              1          20         30          1          21       0.415E+06      [illegible]    0.414E+06       235.16
              1          21         29          1          22       0.414E+06      [illegible]    0.413E+06       233.76
              1          22         28          1          23       0.413E+06      [illegible]    0.412E+06       232.26
              1          22         27          1          24       0.412E+06      [illegible]    0.411E+06       230.86
              1          23         26          1          25       0.411E+06      [illegible]    0.410E+06       229.36
              1          23         25          1          26       0.410E+06      [illegible]    0.409E+06       227.96
              1          24         27          1          27       0.409E+06      [illegible]    0.409E+06       226.56
              1          25         27          1          28       0.409E+06      [illegible]    0.408E+06       225.06
              1          26         27          1          29       0.409E+06      [illegible]    0.407E+06       223.66
              1          27         26          1          30       0.407E+06      [illegible]    0.406E+06       222.16
              1          28         25          1          31       0.406E+06      [illegible]    0.405E+06       220.76
              1          28         24          1          32       0.405E+06      [illegible]    0.404E+06       219.26
              1          28         23          1          33       0.404E+06      [illegible]    0.403E+06       217.86
              1          29         22          1          34       0.403E+06      [illegible]    0.403E+06       216.36
              1          29         21          1          35       0.403E+06      [illegible]    0.402E+06       214.96
              1          27         20          1          36       0.402E+06      [illegible]    0.401E+06       213.56
              1          30         19          1          37       0.401E+06      [illegible]    0.400E+06       212.06
              1          30         18          1          38       0.400E+06      [illegible]    0.399E+06       210.66
              1          31         18          1          39       0.399E+06      [illegible]    0.398E+06       209.16
              1          31         17          1          40       0.398E+06      [illegible]    0.397E+06       207.75
              1          32         16          1          41       0.397E+06      [illegible]    0.397E+06       206.25
              1          33         15          1          42       0.397E+06      [illegible]    0.396E+06       204.85
              1          34         14          1          43       0.396E+06      [illegible]    0.395E+06       203.35
              1          35         14          1          44       0.395E+06      [illegible]    0.394E+06       201.95
              1          35         13          1          45       0.394E+06      [illegible]    0.393E+06       200.55
              1          36         12          1          46       0.393E+06      -454.          0.394E+06       199.05
              1          37         11          1          47       0.394E+06      -.146E+04      0.395E+06       197.65
              1          38         12          1          48       0.395E+06      -.278E+04      0.398E+06       196.15
              2          20         80          2           1       0.864E+05      612.           0.859E+05       322.11
              2          21         80          2           2       0.858E+05      612.           0.852E+05       309.61
              2          22         79          2           3       0.852E+05      611.           0.846E+05       297.11
              2          23         79          2           4       0.846E+05      619.           0.839E+05       287.32
              2          24         78          2           5       0.839E+05      619.           0.833E+05       277.52
              2          25         77          2           6       0.833E+05      618.           0.827E+05       267.62
              2          26         77          2           7       0.827E+05      618.           0.821E+05       257.82
              2          27         76          2           8       0.821E+05      617.           0.815E+05       247.12
              2          28         76          2           9       0.815E+05      651.           0.808E+05       243.05
              2          29         75          2          10       0.808E+05      651.           0.802E+05       238.95
              2          30         75          2          11       0.802E+05      650.           0.795E+05       234.85
              2          31         75          2          12       0.795E+05      649.           0.789E+05       230.75
              2          32         75          2          13       0.789E+05      648.           0.782E+05       226.65
              2          33         75          2          14       0.782E+05      648.           0.776E+05       222.45
              2          34         75          2          15       0.776E+05      647.           0.769E+05       218.35
```

```
      1     35     75     2     16     0.769E+05     645.          0.763E+05     214.25
      1     36     75     2     17     0.763E+05     645.          0.756E+05     210.15
      1     37     74     2     18     0.756E+05     645.          0.750E+05     206.04
      1     38     74     2     19     0.750E+05     -.289E+04     0.779E+05     201.95

            HEAD IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  3
   -----------------------------------------------------------------------------

       1      2      3      4      5      6      7      8      9     10     11     12     13     14     15
      16     17     18     19     20     21     22     23     24     25     26     27     28     29     30
      31     32     33     34     35     36     37     38     39     40     41     42     43     44     45
      46     47     48     49     50     51     52     53     54     55     56     57     58     59     60
      61     62     63     64     65     66     67     68     69     70     71     72     73     74     75
      76     77     78     79     80     81     82     83     84     85     86     87     88     89     90
      91     92     93     94     95     96     97     98     99    100
.........................................................................................................

 1   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 2   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 3   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 4   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 5   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 6   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 7   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 8   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

 9   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

10   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

11   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  205.4  205.4  205.5  205.5
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
     999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0

12   999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0  999.0
```

	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	205.3	205.4	205.4	205.5	205.5	
	205.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
13	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	205.2	205.2	205.3	205.3	205.4	205.5	205.5	
	205.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
14	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	205.0	205.0	205.1	205.2	205.2	205.3	205.3	205.4	205.4	205.5	205.5
	205.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
15	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	204.9	204.9	205.0	205.0	205.1	205.2	205.2	205.3	205.3	205.4	205.4	205.4
	205.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
16	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	204.8	204.8	204.9	204.9	205.0	205.1	205.1	205.2	205.2	205.3	205.3	205.3	
	205.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
17	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	204.4
	204.5	204.6	204.7	204.8	204.8	204.9	205.0	205.0	205.1	205.2	205.2	205.2	205.2	205.2	
	205.2	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
18	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	204.2	204.3	204.4
	204.5	204.5	204.6	204.7	204.8	204.8	204.9	204.9	205.0	205.0	205.1	205.1	205.1	205.1	205.1
	205.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
19	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	204.0	204.0	204.2	204.2	204.3
	204.4	204.5	204.6	204.6	204.7	204.8	204.8	204.9	204.9	204.9	204.9	204.9	204.9	204.9	204.9
	204.9	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	206.3	206.3	206.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
20	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.8	203.9	204.0	204.1	204.2	204.3
	204.4	204.4	204.5	204.6	204.6	204.6	204.7	204.7	204.7	204.7	204.7	204.7	204.7	204.7	204.7
	204.7	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	205.6	205.7	205.8	205.8	205.9	206.0	206.1	206.2
	206.1	206.3	206.4	206.4	206.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
21	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.6	203.7	203.8	203.9	204.0	204.1	204.2
	204.2	204.3	204.3	204.4	204.4	204.5	204.5	204.5	204.5	204.6	204.6	204.6	204.6	204.6	204.5
	204.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	205.2	205.3	205.4	205.5	205.6	205.7	205.7	205.8	205.9	206.0	206.1	206.2
	206.2	206.3	206.4	206.4	206.5	206.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
22	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.5	203.6	203.8	203.9	203.9	204.0	204.0
	204.1	204.1	204.2	204.2	204.3	204.3	204.3	204.3	204.4	204.4	204.4	204.4	204.4	204.4	204.4
	204.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	204.7
	204.8	204.9	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0	206.1	206.1
	206.2	206.3	206.4	206.4	206.4	206.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
23	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.1	203.3	203.5	203.6	203.7	203.8	203.8	203.9
	203.9	204.0	204.0	204.0	204.1	204.1	204.1	204.2	204.2	204.2	204.2	204.2	204.2	204.2	204.2
	204.1	204.0	203.9	999.0	999.0	999.0	999.0	204.0	204.0	204.1	204.2	204.3	204.4	204.5	204.7
	204.8	204.9	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0	206.0	206.1
	206.2	206.3	206.3	206.4	206.4	206.4	206.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
24	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	201.9	202.0	202.1	202.3	202.5	202.7	202.9	203.1	203.3	203.4	203.6	203.6	203.6	203.7
	203.7	203.8	203.8	203.9	203.9	203.9	204.0	204.0	204.0	204.0	204.0	204.0	204.0	204.0	204.0
	203.9	203.9	203.8	203.8	203.8	203.8	203.9	203.9	204.0	204.1	204.2	204.3	204.4	204.5	204.6
	204.7	204.8	204.9	205.0	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.8	205.9	206.0	206.1
	206.2	206.3	206.3	206.3	206.4	206.4	206.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
25	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	201.6
	201.7	201.8	202.0	202.1	202.2	202.4	202.6	202.8	203.0	203.1	203.3	203.4	203.4	203.5	203.5
	203.6	203.6	203.6	203.7	203.7	203.7	203.8	203.8	203.8	203.8	203.8	203.9	203.9	203.8	203.8

	203.8	203.8	203.7	203.7	203.7	203.8	203.8	203.9	204.0	204.0	204.1	204.2	204.3	204.4	204.6
	204.7	204.8	204.9	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0	206.1
	206.2	206.3	206.3	206.3	206.3	206.3	206.3	206.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
26	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	201.4	201.5
	201.6	201.8	201.9	202.0	202.2	202.3	202.5	202.7	202.8	203.0	203.1	203.2	203.2	203.3	203.3
	203.4	203.4	203.5	203.5	203.5	203.6	203.6	203.6	203.6	203.7	203.7	203.7	203.7	203.7	203.7
	203.7	203.6	203.6	203.6	203.7	203.7	203.8	203.8	203.9	204.0	204.1	204.2	204.3	204.4	204.5
	204.6	204.7	204.8	204.9	205.0	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0	206.1
	206.1	206.2	206.2	206.3	206.3	206.3	206.3	206.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
27	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	201.0	201.1	201.3	201.4
	201.6	201.7	201.8	202.0	202.1	202.3	202.4	202.6	202.7	202.8	202.9	203.0	203.0	203.1	203.1
	203.2	203.2	203.3	203.3	203.3	203.4	203.4	203.4	203.4	203.5	203.5	203.5	203.5	203.5	203.5
	203.5	203.5	203.5	203.5	203.6	203.6	203.7	203.8	203.8	203.9	204.0	204.1	204.2	204.3	204.4
	204.5	204.7	204.8	204.9	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0
	206.1	206.2	206.2	206.2	206.2	206.2	206.3	206.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
28	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	200.8	200.9	201.0	201.2	201.3
	201.5	201.6	201.7	201.9	202.0	202.2	202.3	202.4	202.6	202.7	202.7	202.8	202.8	202.9	202.9
	203.0	203.0	203.1	203.1	203.1	203.2	203.2	203.2	203.2	203.3	203.3	203.3	203.3	203.3	203.3
	203.3	203.4	203.4	203.4	203.5	203.5	203.6	203.7	203.7	203.8	203.9	204.0	204.1	204.3	204.4
	204.5	204.6	204.7	204.8	204.9	205.0	205.1	205.3	205.4	205.5	205.6	205.7	205.8	205.9	206.0
	206.1	206.1	206.1	206.2	206.2	206.2	206.2	206.2	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
29	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	200.5	200.7	200.8	200.9	201.1	201.2
	201.3	201.5	201.6	201.8	201.9	202.1	202.2	202.3	202.3	202.4	202.5	202.6	202.6	202.7	202.7
	202.8	202.8	202.9	202.9	202.9	203.0	203.0	203.0	203.0	203.1	203.1	203.1	203.1	203.1	203.2
	203.2	203.2	203.2	203.3	203.3	203.4	203.5	203.5	203.6	203.7	203.8	203.9	204.1	204.2	204.3
	204.4	204.5	204.6	204.7	204.8	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	206.0
	206.0	206.0	206.1	206.1	206.1	206.2	206.2	206.2	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
30	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	200.3	200.4	200.5	200.7	200.8	200.9	201.1
	201.2	201.4	201.5	201.7	201.7	201.8	201.9	202.0	202.1	202.2	202.3	202.4	202.4	202.5	202.5
	202.6	202.6	202.7	202.7	202.7	202.8	202.8	202.8	202.8	202.9	202.9	202.9	202.9	202.9	203.0
	203.0	203.0	203.1	203.1	203.2	203.2	203.3	203.4	203.5	203.6	203.7	203.8	204.0	204.1	204.2
	204.3	204.4	204.5	204.5	204.8	204.9	205.0	205.1	205.2	205.3	205.4	205.6	205.7	205.8	205.9
	205.9	206.0	206.0	206.1	206.1	206.1	206.1	206.1	206.1	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
31	999.0	999.0	999.0	999.0	999.0	999.0	999.0	200.0	200.2	200.3	200.4	200.5	200.7	200.8	200.9
	201.1	201.2	201.4	201.5	201.5	201.6	201.7	201.8	201.9	202.0	202.1	202.1	202.2	202.3	202.3
	202.4	202.4	202.4	202.5	202.5	202.5	202.6	202.6	202.6	202.6	202.7	202.7	202.7	202.7	202.8
	202.8	202.8	202.9	202.9	203.0	203.1	203.2	203.3	203.4	203.5	203.6	203.7	203.9	204.0	204.1
	204.2	204.3	204.4	204.6	204.7	204.8	204.9	205.0	205.1	205.2	205.4	205.5	205.6	205.7	205.8
	205.9	205.9	206.0	206.0	206.0	206.1	206.1	206.1	206.1	206.1	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
32	999.0	999.0	999.0	999.0	999.0	999.0	199.8	199.9	200.0	200.1	200.2	200.4	200.5	200.6	200.8
	200.9	201.0	201.1	201.2	201.3	201.4	201.5	201.6	201.7	201.8	201.8	201.9	202.0	202.0	202.1
	202.1	202.2	202.2	202.3	202.3	202.3	202.4	202.4	202.4	202.4	202.4	202.5	202.5	202.5	202.5
	202.6	202.6	202.7	202.7	202.8	202.9	203.0	203.1	203.3	203.4	203.5	203.6	203.7	203.9	204.0
	204.1	204.2	204.3	204.5	204.6	204.7	204.8	204.9	205.0	205.2	205.3	205.4	205.5	205.6	205.8
	205.8	205.9	205.9	205.9	206.0	206.0	206.1	206.1	206.1	206.1	206.2	206.2	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
33	999.0	999.0	999.0	999.0	999.0	999.0	199.7	199.8	199.9	200.0	200.1	200.2	200.3	200.5	200.6
	200.7	200.8	200.9	201.0	201.1	201.2	201.3	201.4	201.5	201.5	201.6	201.7	201.7	201.8	201.9
	201.9	202.0	202.0	202.0	202.1	202.1	202.1	202.2	202.2	202.2	202.2	202.2	202.3	202.3	202.3
	202.3	202.4	202.4	202.4	202.5	202.7	202.9	203.0	203.1	203.2	203.4	203.5	203.6	203.7	203.9
	204.0	204.1	204.2	204.4	204.5	204.6	204.7	204.8	204.9	205.1	205.2	205.3	205.4	205.5	205.7
	205.7	205.8	205.8	205.9	205.9	206.0	206.0	206.1	206.1	206.1	206.2	206.2	206.3	206.3	206.4
	206.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
34	999.0	999.0	999.0	999.0	999.0	999.0	199.5	199.6	199.7	199.8	199.9	200.0	200.1	200.3	200.4
	200.5	200.6	200.7	200.8	200.9	201.0	201.0	201.1	201.2	201.3	201.4	201.4	201.5	201.6	201.6
	201.7	201.7	201.8	201.8	201.8	201.9	201.9	201.9	201.9	202.0	202.0	202.0	202.0	202.1	202.0
	202.1	202.2	202.3	999.0	999.0	202.6	202.7	202.8	203.0	203.1	203.2	203.3	203.5	203.6	203.8
	203.9	204.0	204.1	204.3	204.4	204.5	204.6	204.7	204.8	205.0	205.1	205.2	205.3	205.4	205.6
	205.6	205.7	205.7	205.8	205.9	205.9	206.0	206.0	206.1	206.1	206.2	206.2	206.3	206.3	206.4
	206.5	206.5	206.6	206.7	206.7	999.0	999.0	999.0	999.0	999.0					
35	999.0	999.0	999.0	999.0	999.0	199.2	199.3	199.4	199.5	199.6	199.7	199.8	199.9	200.1	200.2
	200.2	200.3	200.4	200.5	200.6	200.7	200.8	200.9	201.0	201.1	201.1	201.2	201.3	201.3	201.4
	201.5	201.5	201.6	201.6	201.6	201.6	201.7	201.7	201.7	201.7	201.8	201.7	201.8	201.9	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	202.9	202.9	203.0	203.2	203.3	203.5	203.6
	203.8	203.9	204.0	204.1	204.3	204.4	204.5	204.6	204.7	204.8	205.0	205.1	205.2	205.3	205.5
	205.5	205.6	205.7	205.7	205.8	205.9	205.9	206.0	206.0	206.1	206.1	206.2	206.3	206.3	206.4
	206.5	206.5	206.6	206.7	206.8	206.9	207.0	207.1	207.2	999.0					
36	999.0	999.0	999.0	999.0	198.9	199.0	199.1	199.2	199.3	199.3	199.4	199.5	199.7	199.8	199.9
	200.0	200.1	200.2	200.3	200.4	200.5	200.6	200.7	200.7	200.8	200.9	201.0	201.0	201.1	201.2
	201.2	201.3	201.3	201.4	201.4	201.4	201.4	201.5	201.4	201.5	201.6	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.1	203.2	203.4	203.5
	203.6	203.8	203.9	204.0	204.1	204.3	204.4	204.5	204.6	204.7	204.8	205.0	205.1	205.2	205.3
	205.4	205.5	205.6	205.7	205.7	205.8	205.9	205.9	206.0	206.0	206.1	206.2	206.2	206.3	206.4
	206.5	206.5	206.6	206.7	206.8	206.9	207.0	999.0	999.0	999.0					
37	999.0	999.0	999.0	198.6	198.8	198.8	198.9	199.0	199.1	199.1	199.1	199.2	199.4	199.5	199.6
	199.7	199.8	199.9	200.0	200.1	200.2	200.3	200.4	200.5	200.6	200.6	200.7	200.8	200.9	201.0
	201.0	201.1	201.1	201.1	201.2	201.1	201.2	201.3	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	203.3	203.4
	203.5	203.6	203.8	203.9	204.0	204.1	204.2	204.3	204.5	204.6	204.7	204.8	204.9	205.1	205.2
	205.3	205.4	205.5	205.6	205.6	205.7	205.8	205.9	205.9	206.0	206.0	206.1	206.2	206.3	206.3
	206.4	206.5	206.6	206.7	206.8	999.0	999.0	999.0	999.0	999.0					
38	999.0	198.4	198.4	198.5	198.6	198.7	198.8	198.8	198.9	198.9	198.9	198.9	199.1	199.3	199.4
	199.5	199.6	199.7	199.8	199.9	200.0	200.1	200.2	200.2	200.3	200.4	200.5	200.6	200.6	200.7
	200.8	200.8	200.8	200.9	201.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	203.7	203.8	203.9	204.0	204.1	204.2	204.3	204.4	204.6	204.7	204.8	204.8	205.0

	205.2	205.3	205.4	205.5	205.6	205.7	205.7	205.8	205.9	205.9	206.0	206.1	206.1	206.2	206.3
	206.4	206.5	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
39	999.0	198.3	198.4	198.4	198.5	198.5	198.6	198.6	198.7	198.6	198.7	198.8	198.9	199.0	199.1
	199.2	199.3	199.4	199.5	199.6	199.7	199.8	199.9	200.0	200.0	200.1	200.2	200.3	200.4	200.5
	200.6	200.7	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	204.5	204.6	204.7	204.8	204.9
	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.7	205.8	205.8	205.9	206.0	206.1	206.2	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
40	999.0	198.2	198.3	198.3	198.3	198.4	198.5	198.5	198.5	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	205.0	205.1	205.2	205.3	205.4	205.5	205.6	205.7	205.8	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
41	999.0	198.1	198.1	198.2	198.2	198.2	198.3	198.4	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
42	197.9	198.0	198.0	198.0	198.1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
43	197.8	197.9	197.9	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
44	197.7	197.8	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
45	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
46	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
47	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
48	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
49	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					
50	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0					

HEAD WILL BE SAVED ON UNIT 20 AT END OF TIME STEP 1, STRESS PERIOD 1

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 1

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	0.00000E+00	STORAGE =	0.00000E+00
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
RECHARGE =	96821.	RECHARGE =	96821.
RIVER LEAKAGE =	4016.1	RIVER LEAKAGE =	4016.1
STREAM LEAKAGE =	49986.	STREAM LEAKAGE =	49986.
TOTAL IN =	0.15082E+06	TOTAL IN =	0.15082E+06
OUT:		OUT:	
STORAGE =	0.00000E+00	STORAGE =	0.00000E+00
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
RECHARGE =	0.00000E+00	RECHARGE =	0.00000E+00
RIVER LEAKAGE =	0.15031E+06	RIVER LEAKAGE =	0.15031E+06
STREAM LEAKAGE =	7584.8	STREAM LEAKAGE =	7584.8
TOTAL OUT =	0.15789E+06	TOTAL OUT =	0.15789E+06
IN - OUT =	-7066.8	IN - OUT =	-7066.8
PERCENT DISCREPANCY =	-4.58	PERCENT DISCREPANCY =	-4.58

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	86400.0	1440.00	24.0000	1.00000	0.273785E-02
STRESS PERIOD TIME	86400.0	1440.00	24.0000	1.00000	0.273785E-02
TOTAL SIMULATION TIME	86400.0	1440.00	24.0000	1.00000	0.273785E-02

APPENDIX 4

U.S. Geological Survey ground-water quality data for Tanana, Alaska

SAF)

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Analyses by Geological Survey, United States Department of the Interior
(parts per million)

9-268 q

Laboratory Number	13257
Date of collection	Not given
Silica (SiO_2)	12
Iron (Fe) (total-approx.)	2.3
Manganese (Mn)	0.20
Manganese (Mn)	
Calcium (Ca)	61
Magnesium (Mg)	27
Sodium (Na)	9.1
Potassium (K)	1.6
Bicarbonate (HCO_3)	265
Carbonate (CO_3)	00
Sulfate (SO_4)	24
Chloride (Cl)	20
Fluoride (F)	1.5
Nitrate (NO_3)	1.1
Phosphate (P04) Total	0.0
Dissolved solids	
Calculated	300
Residue on evaporation at 180°C	
Hardness as $CaCO_3$	263
Noncarbonate hardness as $CaCO_3$	29
Alkalinity as $CaCO_3$	234
ABS	0.0
Specific conductance (micromhos at 25°C)	509
pH	7.7
Color	-

13257 – Tanana Hospital (Raw water). NOTE: Mr. Black. Comment: Nothing was found on this water sample that would cause foaming.

24027

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location _____ County _____
Source PHS - Hospital - Tanana Depth (ft) _____ Diam (in.) _____
Cased to (ft) _____ Date drilled _____ Point of coll. _____
Owner _____
Treatment _____ Use _____
WBF _____ WL _____ Yield _____
Temp (°F) _____ Appear. when coll. _____
Collected 4-14-71 By Scribner
Remarks

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	3.5		Bicarbonate (HCO_3)	35	.57
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe)	.05				
Manganese Mn	.03				
Barium Ba	0.0		Sulfate (SO_4)	28.	.58
Copper Cu	0.00				
Zinc Zn	0.01		Chloride (Cl)	10.	.28
Cadium Cd	0 ug/l				
Nickle Ni	0 ug/l		Fluoride (F)	1.0	.05
Lead Pb	6 ug/l				
Arsenic As	0 ug/l				
Silver Ag	0 ug/l		Silenium Se	1.3 ug/l	
Calcium (Ca)	21.	1.03	ABS Detergents	0.0 mg/l	
			Cyandie Cn	0.00	
Magnesium (Mg)	3.0	.25	Nitrate (NO_3)	1.4	.02
Sodium (Na)	5.6	.24			
Potassium (K)	1.1	.03			
Total		1.55	Total		1.50

	mg/l		
		Specific conductance (micromhos at 25° C)	165
Dissolved solids:			
Calculated	92	pH	8.3
Residue on evaporation at 180°C			
		Color	0
Hardness as $CaCO_3$	64		
Noncarbonate	35		
Alkalinity as CaCo3	29		

Lab. No. Col 14535 Field No. Project State H&W

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana City Supply County
Source Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 4-14-71 By Scribner
Remarks

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	7.5		Bicarbonate (HCO_3)	192	3.15
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe)	.25				
Manganese Mn	.27				
Barium Ba	0.0		Sulfate (SO_4)	25.	.52
Copper Cu	0.00				
Zinc Zn	0.03		Chloride (Cl)	2.5	.07
Nickle Ni	0ug/l				
Cadium Cd	0ug/l		Fluoride (F)	0.3	.02
Lead Pb	11ug/l				
Arsenic As	0ug/l				
Silver Ag	0ug/l		ABS detergents	0.01mg/l	
Calcium (Ca)	56.	2.79	Cyanide Cn	0.00	
Magnesium (Mg)	11.	.90	Nitrate (NO_3)	0.0	.00
			Chromium (Cr)	0.00	
Sodium (Na)	3.0	.13	Selinium (Se)	1.0 ug/l	
Potassium (K)	0.9	.02			
Total		3.84	Total		3.76

	mg/l		
		Specific conductance (micromhos at 25° C)	348
Dissolved solids:			
Calculated	200	pH	7.7
Residue on evaporation at 180°C			
		Color	10
Hardness as $CaCO_3$	184		
Noncarbonate	27		
Alkalinity as CaCo3	157		

Lab. No. Col 14534 Field No. Project State H&W

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana Well County
Source Depth (ft) 42-47 Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 3-8-72 By Marley
Remarks

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	14		Bicarbonate (HCO_3)	500	8.20
Aluminum (Al)			Carbonate (CO_3)	00	0.00
Iron (Fe) approx. total	3.3				
Manganese (Mn) Approx. total	.72		Sulfate (SO_4)	28	0.58
			Chloride (Cl)	12	0.34
			Fluoride (F)	0.1	0.01
Calcium (Ca)	128	6.39			
Magnesium (Mg)	33	2.71	Nitrate (NO_3)	0.9	0.01
Sodium (Na)	7.0	0.30			
Potassium (K)	2.1	0.05			
Total		9.45	Total		9.14

	mg/l		
		Specific conductance (micromhos at 25° C)	785
Dissolved solids:			
Calculated	472	pH	7.3
Residue on evaporation at 180°C		Color	30
Hardness as $CaCO_3$	455		
Noncarbonate	45		
Alkalinity as CaCo3	410		

Lab. No. Col 15371 Field No. Project USPHS

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana PHS Hospital County
Source Depth (ft) 53-55 Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 3-8-72 By Results called to D.H. Marley
Remarks drilled by C. Bordner

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	14		Bicarbonate (HCO_3)	500	8.20
Aluminum (Al)			Carbonate (CO_3)	00	0.00
Iron (Fe) total approx.	4.1				
Manganese (Mn) approx. total	.74		Sulfate (SO_4)	27	0.56
			Chloride (Cl)	15	0.42
			Fluoride (F)	0.2	0.01
Calcium (Ca)	118	5.89			
Magnesium (Mg)	33	2.71	Nitrate (NO_3)	0.4	0.01
Sodium (Na)	6.7	0.29			
Potassium (K)	2.0	0.05			
Total		8.94	Total		9.20

	mg/l		
		Specific conductance (micromhos at 25° C)	774
Dissolved solids:	463	pH	7.8
Calculated			
Residue on evaporation at 180° C		Color	30
Hardness as $CaCO_3$	430		
Noncarbonate	20		
Alkalinity as CaCo3	410		

Lab. No. Col 15372 Field No. Project USPHS

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana School County
Source well Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 4/7/73 By Jim Anderson
Remarks

	mg/l	me/l		mg/l	me/l
Silica (SiO_2)			Bicarbonate (HCO_3)		
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe)					
			Sulfate (SO_4)		
			Chloride (Cl)		
			Fluoride (F)	0.2	0.01
Calcium (Ca)					
Magnesium (Mg)			Nitrate (NO_3)		
Sodium (Na)					
Potassium (K)					
Total			Total		

	mg/l		
		Specific conductance (micromhos at 25° C)	
Dissolved solids:		pH	
Calculated			
Residue on evaporation at 180° C		Color	
Hardness as $CaCO_3$			
Noncarbonate			

Lab. No. Col 16628 Field No. Project Public Health Service

ES

9-260
(January 1950)

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

ANALYTICAL STATEMENT

[Parts per million]

Location Tanana, Alaska

Source Well No. 1, Tanana

Alaska Native Health Service Hospital.

Chemist GWJ
Lab. No. 3222
Collector

Date of collection 11-28-55
Use
Temperature (°F)
Color pH 7.6
Suspended matter
Hardness as $CaCO_3$
N. C. 26. Total 364
Ignition loss
Dissolved solids
Specific conductance at 25°C (micromhos) 646

a/ Fe in soln 0.16
b/ Mn in soln .29

SiO_2	15
Fe a/	0.31
Ca	98
Mg	29
Na	6.6
K	2.1
CO_3	0
HCO_3	413
SO_4	25
Cl	10
F	1
NO_3	.8
Mn b/	.29
Sum	390

16—53248-4

B

9-200
(January 1950)

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

ANALYTICAL STATEMENT

(Parts per million)

Location Tanana, Alaska

Source Alaska Native Health Service Hospital

Treated water

Chemist GWW

Lab. No. 3223

Collector

Date of collection 11-28-55

Use

Temperature (°F)

Color ..... pH 7.6

Suspended matter

Hardness as $CaCO_3$

N. C. 0 Total 48

Ignition loss

Dissolved solids

Specific conductance at 25°C (micromhos) 686

a/ FE in soln

b/ Mn in soln

SiO_2	13
Fe a/	0.12
Ca	12
Mg	4.2
Na	158
K	1.2
CO_3	0
HCO_3	420
SO_4	25
Cl	13
F	.1
NO_3	.6
Mn b/	0.08
Sum	434

16—55248-4

B

Lab. No. 3223

rCa	.60	7.79
rMg	.35	7.85
rNa	6.87	.06
rK	.03	15.64 = ∓ 0.4% error
	7.85	

rCO_3	
$rHCO_3$	6.88
rSO_4	.52
rCl	.37
rF	.01
rNO_3	.01
	7.79

Date completed 12-15-55

Checked by EBW 12-20-55

Project

Transmitted

Remarks

geo 16—55248-4

9-260
(January 1950)

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

ANALYTICAL STATEMENT

[Parts per million]

Location Tanana, Alaska

Source Well No. 1, Tanana Alaska Native Health Service Hospital.

Chemist CHW
Lab. No. 3222
Collector ---

Date of collection 11-28-55
Use
Temperature (°F)
Color pH 7.6
Suspended matter
Hardness as $CaCO_3$
N. C. 26 Total 364
Ignition loss
Dissolved solids
Specific conductance at 25°C (micromhos) 646

a/ Fe in soln 0.16

b/ Mn in soln .29

SiO_2	15
Fe a/	0.31
Ca	98
Mg	29
Na	6.6
K	2.1
CO_3	0
HCO_3	413
SO_4	25
Cl	10
F	.1
NO_3	.8
Mn b/	.29
Sum	390

16—55248-4

B

Lab. No. 3222

[illegible]	.01	
Fe	.01	
rCa	4.89	7.59
rMg	2.38	7.63
rNa	.29	0.04
rK	.05	15.22 = ± 0.3% error
	7.63	
rCO_3		
$rHCO_3$	6.77	
rSO_4	.52	
rCl	.28	
rF	.01	
rNO_3	.01	
	7.59	

Date completed 12-15-55
Checked by FBW 12-20-55
Project
Transmitted
Remarks

CPO 16—55248-4

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location [illegible] County [illegible]
Source [illegible] Depth (ft) 62 Diam (in.) [illegible]
Cased to (ft) [illegible] Date drilled [illegible] Point of coll. [illegible]
[illegible] Owner [illegible]
Treatment [illegible] Use [illegible]
WBF [illegible] WL [illegible] Yield [illegible]
Temp (°F) [illegible] Appear. when coll. [illegible]
Collected Jan. 23, 1958 By [illegible]
Remarks

	ppm	epm		ppm	epm
Silica (SiO_2)	12		Bicarbonate (HCO_3)	310	5.08
Aluminum (Al)			Carbonate (CO_3)	0	
Iron (Fe) (in Sol.)	.00				
Iron (Fe)	4.9		Sulfate (SO_4)	0.0	.17
Mn	0.0		Chloride (Cl)	72	2.03
			Fluoride (F)	0.2	.01
Calcium (Ca)	93	4.64			
Magnesium (Mg)	20	1.64	Nitrate (NO_3)	0.0	.00
Sodium (Na)	20	0.87			
Potassium (K)	3.7	.04			
Total		7.39	Total		7.29

	ppm		
		Specific conductance (micromhos at 25° C)	496
Dissolved solids:			
Calculated	329	pH	7.2
Residue on evaporation at 180° C			
		Color	20
Hardness as $CaCO_3$	294		
Noncarbonate	40		

Lab. No. Col 4559 Field No. Project

(147)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana, Alaska County
Source Dug Well Depth (ft) 35 Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment None Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 3/17/58 By
Remarks AMHS

	ppm	epm		ppm	epm
Silica (SiO_2)	15		Bicarbonate (HCO_3)	500	8.20
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	2.2				
Mn	0.02		Sulfate (SO_4)	32	0.67
			Chloride (Cl)	36	1.02
			Fluoride (F)	0.1	0.00
Calcium (Ca)	119	5.94			
Magnesium (Mg)	38	3.12	Nitrate (NO_3)	1.1	0.02
Sodium (Na)	14	0.61			
Potassium (K)	3.0	0.08			
Total		9.75	Total		9.91

	ppm		
		Specific conductance (micromhos at 25° C)	867
Dissolved solids:	506	pH	7.2
Calculated			
Residue on evaporation at 180°C		Color	10
Hardness as $CaCO_3$	453		
Noncarbonate	43		

Lab. No. ~~Cok~~ 4654 Field No. Project

(148)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana IHS Hospital County
Source Well No.2 Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Raw Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected By
Remarks

	ppm	epm		ppm	epm
Silica (SiO_2)	11		Bicarbonate (HCO_3)	328	5.38
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe)	0.00				
Mn	0.02		Sulfate (SO_4)	19	0.40
			Chloride (Cl)	7.5	0.21
			Fluoride (F)	0.2	0.01
Calcium (Ca)	70	3.49			
Magnesium (Mg)	27	2.22	Nitrate (NO_3)	0.2	0.00
Sodium (Na)	2.9	0.13			
Potassium (K)	1.4	0.04			
Total		5.88	Total		6.00

	ppm		
		Specific conductance (micromhos at 25° C)	517
Dissolved solids:			
Calculated	301	pH	7.6
Residue on evaporation at 180°C			
		Color	0
Hardness as $CaCO_3$	286		
Noncarbonate	15		

Lab. No. ~~Gol~~ 5135 Field No. Project

(149)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana, Alaska ANHS Hospital County
Source Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use Hospital (Domestic)
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 18 June, 1959 By Dr. T. H. McQueen
Remarks

	ppm	epm		ppm	epm
Silica (SiO_2)	8.4		Bicarbonate (HCO_3)	210	3.44
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe) (in solution when analysed)	0.00				
Mn "	0.13	0.00	Sulfate (SO_4)	20	0.42
			Chloride (Cl)	6.0	0.17
			Fluoride (F)	0.2	0.01
Calcium (Ca)	56	2.79			
Magnesium (Mg)	14	1.15	Nitrate (NO_3)	0.4	0.01
Sodium (Na)	3.0	0.13			
Potassium (K)	1.4	0.04			
Total		4.11	Total		4.05

	ppm		
		Specific conductance (micromhos at 25° C)	371
Dissolved solids: Calculated	212	pH	7.9
Residue on evaporation at 180° C		Color	0
Hardness as $CaCO_3$	197		
Noncarbonate	25		

Lab. No. ~~XXXX~~ 5421 Field No. Project

(150)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location E Tanana, Alaska County
Source well in quarters area Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner FAA
Treatment raw water Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected before 5 October 1961 By
Remarks FAA Box 440, Anchorage Attn: AL-413.42

	ppm	epm		ppm	epm
Silica (SiO_2)	11		Bicarbonate (HCO_3)	240	3.93
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe) in sol	0.71				
Manganese (Mn) in sol	0.80	0.06	Sulfate (SO_4)	1.0	0.02
			Chloride (Cl)	1.0	0.03
			Fluoride (F)	0.4	0.02
Calcium (Ca)	60	2.99			
Magnesium (Mg)	11	0.90	Nitrate (NO_3)	0.2	0.00
Sodium (Na)	1.8	0.08			
Potassium (K)	1.7	0.04			
Lithium (Li)	0.07				
Strontium (Sr)	0.1				
Total		4.07	Total		4.00

	ppm		
		Specific conductance (micromhos at 25° C)	358
Dissolved solids:			
Calculated	208	pH	7.5
Residue on evaporation at 180° C		Color	60
Hardness as $CaCO_3$	198		
Noncarbonate	1		
CO2	12		
Alk as CaCO3	196		

Lab. No. Col 6696 Field No. Project

(151)

U.S. Mails

Wells

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Yukon & Tanana, Alaska County
Source Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll. New Drilled Well @ Control Bldg.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 20 September, 1962 By
Remarks Well Screen 030,000 Slots

	ppm	epm		ppm	epm
Silica (SiO_2)	15		Bicarbonate (HCO_3)	436	7.15
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe) (dis)	0.02				
Manganese (Mn)	0.00		Sulfate (SO_4)	70	1.46
			Chloride (Cl)	4.0	0.11
			Fluoride (F)	0.0	0.00
Calcium (Ca)	127	6.34			
Magnesium (Mg)	23	1.86	Nitrate (NO_3)	3.5	0.06
Sodium (Na)	6.8	0.30			
Potassium (K)	3,1	0.08			
Total		8.58	Total		8.78

	ppm		
		Specific conductance (micromhos at 25° C)	914
Dissolved solids:			
Calculated	466	pH	7.5
Residue on evaporation at 180°C		Color	25
Hardness as $CaCO_3$	410		
Noncarbonate	52		
Alkalinity as CaCO3	358		

Lab. No. Col 7152 Field No. Project

(152)

Solid Matrix

Wash.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Yukon & Tanana, Alaska County

Source Depth (ft) Diam (in.)

Cased to (ft) Date drilled Point of coll. New Drilled Well @ Quarters Area

Owner

Treatment Use

WBF WL Yield

Temp (°F) Appear. when coll.

Collected 12 September, 1962 By

Remarks Well Screen 020, ~~.001 Slots~~

	ppm	epm		ppm	epm
Silica (SiO_2)	12		Bicarbonate (HCO_3)	456	7.47
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe)(dis)	0.03				
Manganese (Mn)	0.00		Sulfate (SO_4)	61	1.27
			Chloride (Cl)	5.0	0.14
			Fluoride (F)	0.0	0.00
Calcium (Ca)	116	5.79			
Magnesium (Mg)	32	~~1.27~~	Nitrate (NO_3)	0.8	0.01
Sodium (Na)	8.3	0.36			
Potassium (K)	2.8	0.07			
Total		8.83	Total		8.89

	ppm		
		Specific conductance (micromhos at 25° C)	913
Dissolved solids:			
Calculated	462	pH	7.3
Residue on evaporation at 180° C		Color	10
Hardness as $CaCO_3$	420		
Noncarbonate	46		
Alkalinity as $CaCO_3$	374		

Lab. No. Col 7153 Field No. Project

(153)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Yukon - Tanana, Alaska County
Source Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll. New Drilled Well @ Control Bldg.
Owner
Treatment Use
WBF WL Yield
Temp (°F) Appear. when coll.
Collected 20 September, 1962 By
Remarks Well Screen 30,000 Slots

	ppm	epm		ppm	epm
Silica (SiO_2)	15		Bicarbonate (HCO_3)	436	7.15
Aluminum (Al)			Carbonate (CO_3)		
Iron (Fe) (dis)	0.02				
Manganese (Mn)	0.00		Sulfate (SO_4)	70	1.46
			Chloride (Cl)	4.0	0.11
			Fluoride (F)	0.0	0.00
Calcium (Ca)	127	6.34			
Magnesium (Mg)	23	1.86	Nitrate (NO_3)	3.5	0.06
Sodium (Na)	6.8	0.30			
Potassium (K)	3,1	0.08			
Total		8.58	Total		8.78

	ppm		
		Specific conductance (micromhos at 25° C)	914
Dissolved solids: Calculated	466	pH	7.5
Residue on evaporation at 180°C		Color	25
Hardness as $CaCO_3$	410		
Noncarbonate	52		
Alkalinity as $CaCO_3$	358		

Lab. No. Col 7152 Field No. Project

(154)

GROUND WATER | LAB. NO 24 42

County :
Sample No. :
Inv. : RCA POTABLE
W.O.No. :
GW Basin : YUKON
Loc. : @ BEAR CREEK
TANANA, ALASKA
Samp. Pt. : @ KITCHEN
Pumptime :
Temp. : °F.
Agency : RCA - USAF
Remarks : CLEAR @ COLLECTION

Loc.No:
Region: W of 141

Disch. :
Coll. : R.W. MITCHELL
PST
11 MAR 63

WELL DATA
Type :
Depth : Ft.
Cased : Ft.
Gravel packed:
Use :
Owner : RCA - USAF
Remarks :

Drilled:
Dia. : In.
Perf. :

CALCIUM ____ ml
12.0 N x 0.0216
F 20 EPM
Ca ppm 7.2

MAGNESIUM
epm TH 0.70
epm Ca 0.36
epm Mg 0.34
Mg ppm 4.3

SILICA 10 ml
A 43.5 mg 2.0
Factor 0.23
Asample 24.0
SiO_2 ppm 5.5

IRON(dis) 25 ml
A 11.6 mg 0.01
Factor 0.0345
Asample 1.5
Fe ppm 0.05

IRON(total) 25 ml
A 11.6 mg 0.01
Factor 0.0345
Asample 40 : NO NITRITE ON THE
Fe ppm

ALKALINITY
HCO_3 41 50 ml CO_3
2.05 ml
CO_2 = 7

SODIUM ____ dil
Sample 2.0 %T
Curve 40
No ppm 0.3

POTASSIUM ____ dil
Sample 3.5 %T x 0.154
K ppm 0.4

TOTAL ALKALINITY as CO_3 20
as HCO_3 41 as $CaCO_3$ 34

SULFATE 10 ml
~~0.25 - B = 0 ml~~
0.05 - B = 0.00 ml
SO_4 ppm 0.0

CHLORIDE ~~5~~ ml
1 ml = 0.5 mg Cl
0.20 - A = 0.10 ml
Cl ppm 1.0

FLUORIDE 10 ml
-2.0 x -0.0225
Corr. ml
mg Std 0.01
F ppm 0.0

NITRATE 25 ml
ml Ag_2SO_4
A 9.2 mg 0.01
Factor 0.0435
Asample 23.0
NO_3 ppm 1.0

BORON ____ ml
A ____ mg
Factor
Asample
B ppm

SUM 40
T/A ft
DISSOLVED SOLIDS ____ ml
D.S. ppm

HARDNESS ~~50~~ ml as $CaCO_3$
~~1.00 ml~~
1.75 ml CH
Total 35
HCO_3(0.82) 34
Non-Carb 1

% Na 1.4
SPECIFIC CONDUCTANCE
R(KCl) 333
R sample 4420
Micromhos at 25°C 75

pH 7.0
COLOR 5
TURB
% E ±0.0

epm		epm	
0.36	Ca	____	CO_3
0.34	Mg	0.67	HCO_3
____		0.00	SO_4
0.01	Na	0.03	Cl
0.01	K	0.00	F
____		0.02	NO_3
0.72	Sum	0.72	Sum

Δ 0.00
Σ 1.44

Palmer 1958 GPO 870283 (155)

DATE STARTED 20 MAR 63 CHEMIST CLB
DATE COMPLETED 28 CHECKED

#42

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER ANALYSIS

2SW

Location Bay well at Tarawa County
Source
Point of coll.
Owner Episcopal Church Treatment

Use Ind. Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 1-31-67 By Myram
Remarks Depth - 30'

	ppm	epm		ppm	epm
Silica (SiO_2)	13		Bicarbonate (HCO_3)	606	9.93
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	0.44				
Tannic like matter	0.02		Sulfate (SO_4)	59	1.23
Carbon Dioxide (CO_2)	96		Chloride (Cl)	45	1.26
Manganese (Mn)	0.08		Fluoride (F)	0.1	0.01
Calcium (Ca)	90	4.49			
Magnesium (Mg)	43	3.51	Nitrate (NO_3)	51	0.82
Sodium (Na)	113	4.92			
Potassium (K)	6.3	0.16			
Total		13.04	Total		13.25

	ppm		
		Specific conductance (micromhos at 25° C)	1,125
Dissolved solids: Calculated	720	pH	7.0
Residue on evaporation at 180°C		Color	15
Hardness as $CaCO_3$	400		
Noncarbonate	0		

Lab. No. 9945 Field No. Project Public Health Service

(156)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER ANALYSIS

2SW

Location Bar well at Texana County
Source
Point of coll.
Owner Perry Kerrine Treatment

Use Ind. Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 1-31-67 By Ayres
Remarks Depth - 22'

	ppm	epm		ppm	epm
Silica (SiO_2)	15		Bicarbonate (HCO_3)	613	10.05
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	0.14				
Boric Like Matter	0.02		Sulfate (SO_4)	16	0.37
Carbon Dioxide (CO_2)	61		Chloride (Cl)	7.1	0.20
Manganese (Mn)	0.04		Fluoride (F)	0.2	0.01
Calcium (Ca)	120	5.19			
Magnesium (Mg)	41	3.37	Nitrate (NO_3)	17	0.27
Sodium (Na)	21	1.22			
Potassium (K)	1.5	0.04			
Total		10.82	Total		10.90

	ppm		
		Specific conductance (micromhos at 25° C)	903
Dissolved solids:			
Calculated	550	pH	7.2
Residue on evaporation at 180°C		Color	15
Hardness as $CaCO_3$	470		
Noncarbonate	9		

Lab. No. 9944 Field No. Project Public Health Service

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER ANALYSIS

2SW

Location Dug well at Tarawa County
Source
Point of coll.
Owner City Treatment

Use Public Supply Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 1-31-67 By Byrem
Remarks Depth - 32'

	ppm	epm		ppm	epm
Silica (SiO_2)	10		Bicarbonate (HCO_3)	512	8.39
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	0.20				
Tannic Like Matter	0.02		Sulfate (SO_4)	64	1.33
Carbon Dioxide (CO_2)	41		Chloride (Cl)	15	0.42
Manganese (Mn)	0.02		Fluoride (F)	0.1	0.01
Calcium (Ca)	130	6.24			
Magnesium (Mg)	42	3.44	Nitrate (NO_3)	1.2	0.02
Sodium (Na)	5.7	0.25			
Potassium (K)	1.5	0.04			
Total		10.17	Total		10.17

	ppm		
		Specific conductance (micromhos at 25° C)	651
Dissolved solids:			
Calculated	520	pH	7.3
Residue on evaporation at 180° C		Color	15
Hardness as $CaCO_3$	464		
Noncarbonate	0		

Lab. No. 9543 Field No. (158) Project Public Health Service

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER ANALYSIS

2SW

Location Dug well at Tanana County
Source
Point of coll. Depth - 35'
Owner NC Co. Treatment

Use Ind. Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 1-31-67 By Eyres
Remarks

	ppm	epm		ppm	epm
Silica (SiO_2)	16		Bicarbonate (HCO_3)	699	11.46
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	0.56				
Tannic Like Matter	0.02		Sulfate (SO_4)	36	0.79
Carbon Dioxide (CO_2)	22		Chloride (Cl)	70	1.98
Manganese (Mn)	0.02		Fluoride (F)	0.2	0.01
Calcium (Ca)	154	7.68			
Magnesium (Mg)	60	4.92	Nitrate (NO_3)	14	0.23
Sodium (Na)	33	1.44			
Potassium (K)	0.2	0.01			
Total		14.05	Total		14.47

	ppm		
		Specific conductance (micromhos at 25° C)	1,149
Dissolved solids: Calculated	730	pH	7.7
Residue on evaporation at 180°C		Color	15
Hardness as $CaCO_3$	630		
Noncarbonate	57		

Lab. No. 9942 Field No. (159) Project Public Health Service

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Tanana Hospital (raw water) County
Source Depth (ft) 47 Diam (in.)
Cased to (ft) Date drilled August 1967 Point of coll. well house tap
Owner USPHS
Treatment Use
WBF WL Yield
Temp (°F) 45 Appear. when coll. Clear
Collected February 4, 1969 By Ervin Moore
Remarks

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	14		Bicarbonate (HCO_3)	472	7.74
Aluminum (Al)			Carbonate (CO_3)	0	.00
Iron (Fe)	0.69				
Manganese (Mn)	0.78	8.08	Sulfate (SO_4)	24	.50
			Chloride (Cl)	9.2	.26
			Fluoride (F)	.3	.02
Calcium (Ca)	109	5.45			
Magnesium (Mg)	32	2.63	Nitrate (NO_3)	2.2	.04
Sodium (Na)	6.2	0.27			
Potassium (K)	2.6	0.07			
Total		8.42	Total		8.56

	mg/l		
		Specific conductance (micromhos at 25° C)	727
Dissolved solids: Calculated	433	pH	7.6
Residue on evaporation at 180°C		Color	5
Hardness as $CaCO_3$	404		
Noncarbonate	17		

Lab. No. Col 12308-69-339 Field No. Project U. Public Health Service

(160)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER ANALYSIS

2SW

Location Dug well at Tenakee, Alaska County
Source
Point of coll.
Owner Cannery Treatment

Use Ind. Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 1-31-67 By Byrem
Remarks No other info given.

	ppm	epm		ppm	epm
Silica (SiO_2)	10		Bicarbonate (HCO_3)	180	2.95
Aluminum (Al)			Carbonate (CO_3)	0	0.00
Iron (Fe)	0.76				
Carbon Dioxide (CO_2)	--		Sulfate (SO_4)	14	0.29
Manganese (Mn)	0.01		Chloride (Cl)	16	0.44
			Fluoride (F)	0.1	0.01
Tannic Like Matter	.02				
Calcium (Ca)	60	2.99			
Magnesium (Mg)	6.7	0.55	Nitrate (NO_3)	13	0.21
Sodium (Na)	2.7	0.12			
Potassium (K)	0.2	0.01			
Total		3.67	Total		3.90

	ppm		
		Specific conductance (micromhos at 25° C)	322
Dissolved solids:			
Calculated	210	pH	6.6
Residue on evaporation at 180°C		Color	5
Hardness as $CaCO_3$	177		
Noncarbonate	30		

Lab. No. 9041 Field No. (161) Project Public Health Service

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location Texoma Hospital (raw water) County
Source Depth (ft) 47 Diam (in.)
Cased to (ft) Date drilled August 1967 Point of coll. well house tap
Owner USPHS
Treatment Use
WBF WL Yield
Temp (°F) 65 Appear. when coll. Clear
Collected February 4, 1969 By Kevin Moore
Remarks

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	14		Bicarbonate (HCO_3)	472	7.74
Aluminum (Al)			Carbonate (CO_3)	0	.00
Iron (Fe)	0.69				
Manganese (Mn)	0.76	0.03	Sulfate (SO_4)	84	.50
			Chloride (Cl)	9.2	.26
			Fluoride (F)	.3	.02
Calcium (Ca)	109	5.46			
Magnesium (Mg)	32	2.63	Nitrate (NO_3)	2.2	.04
Sodium (Na)	6.8	0.27			
Potassium (K)	2.6	0.07			
Total		8.42	Total		8.56

	mg/l		
		Specific conductance (micromhos at 25° C)	727
Dissolved solids:			
Calculated	433	pH	7.6
Residue on evaporation at 180° C		Color	5
Hardness as $CaCO_3$	404		
Noncarbonate	17		

Lab. No. Col 12306-69-359 Field No. Project U. Public Health Service

(162)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2GW

WATER ANALYSIS

Location ~~Tenens Hospital (treated water)~~ County
Source Depth (ft) 87 Diam (in.)
Cased to (ft) Date drilled August 1967 Point of coll. well house
Owner USPHS
Treatment Use
WBF WL Yield
Temp (°F) 80 Appear. when coll. Clear
Collected February 6, 1969 By Ervin Moore
Remarks **Chlorination, filtration, sedimentation, fluoridation**

	mg/l	ap/l		mg/l	ap/l
Silica (SiO_2)	11		Bicarbonate (HCO_3)	196	3.21
Aluminum (Al)			Carbonate (CO_3)	0	.00
Iron (Fe)	0				
~~Manganese~~ (Mn)	0	0.00	Sulfate (SO_4)	31	.64
			Chloride (Cl)	22	.62
			Fluoride (F)	1.0	.05
Calcium (Ca)	53	1.64			
Magnesium (Mg)	28	2.30	Nitrate (NO_3)	1.6	.02
Sodium (Na)	9.3	0.40			
Potassium (K)	2.6	0.07			
Total		4.41	Total		4.64

	mg/l		
		Specific conductance (micromhos at 25° C)	413
Dissolved solids: Calculated	236	pH	8.2
Residue on evaporation at 180°C		Color	5
Hardness as $CaCO_3$	197		
Noncarbonate	36		

Lab. No. Col 12309-68-340 Field No. Project Public Health Service

(163)
water was treated.

GROUND WATER (E) NCH L. B. NO. 7601

County :
Sample No. :
Inv. :
W.O.No. :
GW Basin :
Loc. : [illegible] TAHOE, ALPINE
Samp. Pt. :

Loc.No:
Region:

Pumptime :
Temp. : °F.
Agency :
Remarks :

Disch. :
Coll. : 9/9/66 PST

WELL DATA
Type :
Depth : Ft.
Cased : Ft.
Gravel packed:
Use : Ind.
Owner : RGA SERVICE CO.
Remarks :

Drilled:
Dia. : In.
Perf. :

SILICA ____ ml
A ____ mg ____
Factor ____
Asample 0.270
SiO_2 ppm 5.9

IRON(dis) ____ ml
A ____ mg ____
Factor ____
Asample 0.040
Fe ppm 0.15

IRON(total) ____ ml
A ____ mg ____
Factor ____
Asample ____
Fe ppm ____

CALCIUM ____ ml
1.65
0.00
1.65
F ____
Ca ppm 13

MAGNESIUM
epm TH 1.26
epm Ca 0.65
epm Mg 0.61
Mg ppm 7.4

ALKALINITY
HCO_3 76 ____ ml CO_3 0
3.80
0.00
3.80

SODIUM ____ dil
Sample .7 %T
Curve 10-0
Na ppm 0.15

POTASSIUM ____ dil
Sample 16 %T
K ppm 0.7

TOTAL ALKALINITY as CO_3 37
as HCO_3 76 as $CaCO_3$ 62

SULFATE ____ ml
0.52
-0.52
0.00
SO_4 ppm 0

CHLORIDE ____ ml
1 ml = 0.5 mg Cl
0.35
0.25
0.10
Cl ppm 0.7

FLUORIDE ____ ml
Corr. ml 47-47
mg Std ____
F ppm -0-

NITRATE ____ ml
ml Ag_2SO_4 ____
A ____ mg ____
Factor ____
Asample 0.020
NO_3 ppm 0.5

BORON ____ ml
A ____ mg ____
Factor ____
Asample ____
B ppm ____

SUM 1.6
T/A ft
DISSOLVED SOLIDS ____ ml
D.S. ppm ____

HARDNESS ____ ml as $CaCO_3$
5.15
0.00
5.15
Total 6.3
HCO_3(0.82) 62
Non-Carb 1

% Na 0.8
SPECIFIC CONDUCTANCE
R(KCl) 334
Rsample 2734
Micromhos at 25°C 122

pH 7.3
COLOR 5
TURB
% E 0.4

epm		epm	
0.65	Ca	0.00	CO_3
0.61	Mg	1.25	HCO_3
		0.60	SO_4
0.01	Na	0.02	Cl
0.02	K	0.00	F
		0.01	NO_3
1.29	Sum	1.28	Sum

CO_2 = 76 x 0.080 = 6.1

Δ 0.01
Σ 2.57

(164)

Palmer 1958 GPO 976283 DATE STARTED 9/21/66 CHEMIST E

at Tanana

..S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Analyses by Geological Survey, United States Department of the Interior
(parts per million)

9-268 q

Laboratory Number	13530					
Date of collection	6-3-70					
Silica (SiO_2)	6.3					
Iron (Fe) (total)	1.41					
Manganese (Mn)	0.04					
Calcium (Ca)	15					
Magnesium (Mg)	3.2					
Sodium (Na)	0.7					
Potassium (K)	0.3					
Bicarbonate (HCO_3)	61					
Carbonate (CO_3)	00					
Sulfate (SO_4)	2.0					
Chloride (Cl)	0.4					
Fluoride (F)	0.0					
Nitrate (NO_3)	1.2					
Dissolved solids						
Calculated	59					
Residue on evaporation at 180°C						
Hardness as $CaCO_3$	52					
Noncarbonate hardness as $CaCO_3$	2					
Alkalinity as $CaCO_3$	60					
Specific conductance (micromhos at 25°C)	107					
pH	7.6					
Color	5					

13530 – Well #1 at Bear Creek (Tanana) – III, Site, 14°C., clear appearance, domestic use, sampling depth – 2'.

(165)

APPENDIX 5

U.S. Geological Survey water quality data for the Yukon River at Ruby and Yukon River below the Totzina River near Tanana

Chemical analyses, in parts per million, water year October 1956 to September 1957--Continued

Date of collection	Discharge (cfs)	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 $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
YUKON RIVER AT RUBY																		
Apr. 7, 1957.....	28,400	11	0.00	46	8.8	4.4	2.2	160	25	2.0	0.2	0.6	179	150	19	297	7.7	0
July 19	338,000	7.2	.08	31	7.3	2.5	2.1	108	23	.2	.1	.2	127	107	19	214	7.5	0

30-5648. YUKON RIVER AT RUBY

LOCATION.--Lat 64°44'25", long 155°29'55", at gaging station on left bank at Ruby, 300 feet downstream from Ruby Creek, 2 miles downstream from Melozitna River and 2.2 miles upstream from Ruby Slough.
DRAINAGE AREA.--259,000 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: June to September 1966.
Water temperatures: June to September 1966.
EXTREMES, June to September 1966.--Water temperatures: Maximum, 64°F July 24, 26.

Chemical analyses, in parts per million, June to September 1966

Date of collection	Mean discharge (cfs)	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 at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
June 8-17, 1966..	534000	5.8	0.08	24	5.6	1.2	1.1	85	12	0.7	0.3	0.5	93	83	41	165	7.6	5
June 18-30.....	511000	5.3	.12	28	4.9	1.2	1.5	90	15	.7	.1	.5	103	90	14	185	7.3	10
July 1-9.....	369000	6.1	.06	31	5.5	1.6	1.3	106	16	.7	.1	.0	114	100	13	210	7.6	10
July 10-17.....	323000	7.0	.12	31	7.2	1.8	1.9	114	19	.7	.1	.0	125	107	14	220	7.7	10
July 18-31.....	299000	7.3	.21	41	3.8	2.2	2.0	125	24	.0	.2	.8	144	118	15	232	7.2	20
Aug. 1-16.....	248000	7.6	.14	43	3.3	2.9	2.2	128	24	.0	.2	.3	146	121	16	251	7.5	20
Aug. 17-31.....	202000	7.7	.04	44	4.6	2.7	1.7	139	24	.7	.1	.0	154	129	15	262	7.6	10
Sept. 1-15.....	177000	7.6	.02	44	3.9	2.8	1.5	134	23	.4	.1	.0	149	126	16	252	7.6	10
Sept. 16-30.....	161000	8.3	.00	39	7.9	2.6	1.1	142	27	.7	.2	.2	157	130	14	269	7.6	15

(491)

(891)

15-5648. YUKON RIVER AT RUBY

LOCATION.--Lat 64°44'25", long 155°29'55", at gaging station on left bank at Ruby, 300 feet downstream from Ruby Creek, 2 miles downstream from Melozitna River and 2.2 miles upstream from Ruby Slough.
DRAINAGE AREA.--259,000 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: June 1966 to September 1967.
Water temperatures: June 1966 to September 1967.
EXTREMES, 1966-67.--Water temperatures: Maximum, 64°F June 24, July 11, 13.
EXTREMES, June 1966 to September 1967.--Water temperatures: Maximum, 64°F July 24, 26, 1966, June 24, July 11, 13, 1967.

Chemical analyses, in parts per million, water year October 1966 to September 1967

Date of collection	Mean discharge (cfs)	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 at 180°C)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color
														Calcium magnesium	Noncarbonate			
Oct. 1-15, 1966.....	140000	8.5	0.00	38	8.4	4.1	1.9	140	24	0.4	0.1	1.1	157	131	16	260	7.9	10
Oct. 16-29.....	125000	8.4	.09	38	9.6	3.5	1.4	140	26	.0	.1	2.1	158	134	19	260	7.7	10
May 22-31, 1967.....	415000	4.7	.13	23	4.3	1.9	1.2	78	12	.0	.5	1.4	87	75	11	151	7.4	100
May 25.....	406500	5.1	.31	30	3.8	1.8	1.6	88	20	.7	.3	.2	106	88	16	172	7.3	40
June 1-5.....	498000	4.9	.15	25	4.4	19	1.2	83	13	.0	.5	1.0	93	80	12	157	7.6	100
June 6-18.....	666000	4.9	.11	24	4.0	17	2.0	90	16	.4	.1	.7	98	83	9	165	7.4	20
June 19-30.....	506000	6.2	.08	30	5.0	2.3	2.2	100	18	.0	.0	.8	114	96	14	190	7.3	15
July 1-15.....	391000	6.9	.08	33	6.0	3.1	2.4	114	23	.4	.1	1.1	132	108	15	218	7.2	20
July 9.....	390400	6.8	1.86	30	6.2	1.9	.8	106	20	.0	.0	1.4	121	100	13	202	7.7	15
July 16-31.....	373000	6.7	.06	34	5.8	2.6	2.4	120	20	.0	.0	.6	131	108	10	221	7.2	15
Aug. 1-16.....	387000	7.2	.04	41	4.0	2.1	1.5	124	26	2.1	.2	.5	146	119	17	315	7.8	15
Aug. 17.....	564000	7.0	.14	28	5.5	2.1	1.7	99	20	.0	.1	1.5	115	92	11	132	7.5	35
Aug. 17-31.....	553000	7.0	.13	36	1.7	1.5	1.3	74	14	1.4	.2	.4	89	97	36	194	7.5	15
Sept. 1-5.....	371000	7.2	.08	42	.7	1.8	1.4	104	30	1.4	.2	.4	136	108	23	207	7.6	15
Sept. 6-17.....	318000	7.6	.04	40	2.4	2.8	1.4	117	21	.4	.1	.7	135	110	14	206	7.7	15
Sept. 18-27.....	287000	7.9	.04	36	4.4	2.8	1.3	114	24	.0	.1	.6	135	108	15	204	7.7	20
Sept. 28.....	247000	7.0	1.00	29	6.6	2.2	.8	98	20	1.4	.0	.8	117	99	18	198	7.8	10
Sept. 28-30.....	257000	8.2	.04	39	4.0	3.1	1.6	120	23	.4	.1	.7	140	113	15	207	7.7	20

15-5648. YUKON RIVER AT RUBY
(International Hydrologic Decade Station)

LOCATION.--Lat 64°44'25", long 155°29'55", at gaging station on left bank at Ruby, 300 feet downstream from Ruby Creek, 2 miles downstream from Melozitna River, and 2.2 miles upstream from Ruby Slough.
DRAINAGE AREA.--259,000 sq mi, approximately.
RECORDS AVAILABLE.--Chemical analyses: June 1966 to September 1968.
Water temperatures: June 1966 to September 1967.
EXTREMES, 1967-68.--Dissolved solids: Minimum, 95 mg/l June 3-17.
Hardness: Minimum, 81 mg/l June 13-17.
Specific conductance: Minimum, 154 micromhos June 16.
EXTREMES, 1966-68.--Dissolved solids (1967-68): Minimum, 95 mg/l June 3-17, 1968.
Hardness (1967-68): Minimum, 81 mg/l June 13-17, 1968.
Specific conductance (1967-68): Minimum, 154 micromhos June 16, 1968.
Water temperatures (1966-67): Maximum, 18°C July 24, 26, 1966, June 24, July 11, 13, 1967.

CHEMICAL ANALYSES IN MILLIGRAMS PER LITER, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DATE	DIS-CHARGE (CFS)	SILICA (SIO2)	TOTAL IRON (FE)	CAL-CIUM (CA)	MAG-NE-SIUM (MG)	SODIUM (NA)	PO-TAS-SIUM (K)	BICAR-BONATE (HCO3)	SULFATE (SO4)
OCT.									
01-05	33	9.2	--	38	6.1	2.9	1.1	130	23
06-14	188	9.0	.07	36	7.1	2.5	1.4	125	19
15-17	159	9.4	.75	39	8.0	5.2	1.9	139	20
JUNE									
02...	48	5.2	.55	27	47	1.5	1.3	93	14
03-17	614	5.5	--	25	4.5	1.5	1.1	87	13
18-27	449	8.0	--	26	5.1	2.0	1.1	92	17
28-30	431	8.2	--	27	5.6	2.2	1.1	95	19
JULY									
01-02	420	8.2	--	27	5.6	2.2	1.1	95	19
08-17	338	8.6	--	31	6.1	2.6	1.4	110	22
18-27	308	6.9	--	35	6.7	2.4	1.7	1	22
28-31	275	7.0	--	34	6.9	2.4	1.7	119	24
AUG.									
01-06	275	7.0	--	34	6.9	2.4	1.7	119	24
07-16	257	7.4	--	34	7.1	2.5	1.8	116	25
18-24	234	8.0	--	34	6.8	2.8	1.9	123	26
25-31	215	8.3	--	36	7.1	3.4	2.0	131	26
SEPT.									
01...	215	8.3	--	36	7.1	3.4	2.0	131	26
02-05	211	8.1	--	37	8.0	3.3	1.7	138	27
06-19	191	8.7	--	34	7.6	3.7	1.6	130	25
20-30	183	8.9	--	32	7.6	3.1	1.4	123	23

DATE	CHLO-RIDE (CL)	FLUO-RIDE (F)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	HARD-NESS (CA,MG)	NON-CAR-BONATE HARD-NESS	SPECI-FIC CONDU-CTANCE (MICRO-MHOS)	PH	COLOR
OCT.								
01-05	.4	.0	150	120	10	238	8.0	15
06-14	1.1	.0	138	119	17	233	7.7	20
15-17	3.2	.1	156	130	16	264	7.5	15
JUNE								
02...	1.0	.2	102	87	11	173	7.3	90
03-17	1.0	.2	95	81	10	168	7.6	60
18-27	.8	.2	106	87	12	200	7.7	30
28-30	1.0	.2	111	90	12	189	7.6	40
JULY								
01-02	1.0	.2	111	90	12	189	76.0	40
08-17	.9	.3	127	102	12	214	7.6	0
18-27	1.6	.1	136	115	17	227	7.8	1
28-31	1.0	.1	136	114	16	224	7.9	20
AUG.								
01-06	1.0	.1	136	114	16	224	7.9	20
07-16	1.4	.1	136	114	19	221	7.8	20
18-24	.6	.2	141	114	13	240	7.9	20
25-31	1.0	.2	149	119	12	254	7.5	20
SEPT.								
01...	1.0	.2	149	119	12	254	7.5	20
02-05	1.4	.1	155	126	13	262	7.8	10
06-19	1.8	.2	147	121	14	253	7.6	15
20-30	1.0	.1	137	111	10	239	7.5	20

15-5648. YUKON RIVER AT RUBY--Continued

SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C), WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1.....	--	--	--	--	--	--	--	--	--	188	225	268
2.....	--	--	--	--	--	--	--	--	--	188	229	270
3.....	--	--	--	--	--	--	--	--	165	196	233	281
4.....	--	--	--	--	--	--	--	--	174	192	230	276
5.....	--	--	--	--	--	--	--	--	162	190	230	262
6.....	--	--	--	--	--	--	--	--	167	190	231	245
7.....	--	--	--	--	--	--	--	--	172	195	227	244
8.....	--	--	--	--	--	--	--	--	176	201	226	244
9.....	--	--	--	--	--	--	--	--	166	213	221	244
10.....	--	--	--	--	--	--	--	--	171	203	216	244
11.....	--	--	--	--	--	--	--	--	149	205	216	275
12.....	--	--	--	--	--	--	--	--	162	206	225	245
13.....	--	--	--	--	--	--	--	--	162	217	215	234
14.....	--	--	--	--	--	--	--	--	155	212	214	247
15.....	--	--	--	--	--	--	--	--	164	224	214	243
16.....	--	--	--	--	--	--	--	--	154	218	220	253
17.....	--	--	--	--	--	--	--	--	160	237	--	247
18.....	--	--	--	--	--	--	--	--	166	225	231	244
19.....	--	--	--	--	--	--	--	--	168	225	237	260
20.....	--	--	--	--	--	--	--	--	168	228	235	237
21.....	--	--	--	--	--	--	--	--	178	235	242	236
22.....	--	--	--	--	--	--	--	--	179	225	223	240
23.....	--	--	--	--	--	--	--	--	186	222	243	242
24.....	--	--	--	--	--	--	--	--	185	221	233	238
25.....	--	--	--	--	--	--	--	--	183	223	244	247
26.....	--	--	--	--	--	--	--	--	184	237	242	234
27.....	--	--	--	--	--	--	--	--	185	221	245	244
28.....	--	--	--	--	--	--	--	--	181	229	245	233
29.....	--	--	--	--	--	--	--	--	187	228	253	236
30.....	--	--	--	--	--	--	--	--	184	223	250	229
31.....	--	--	--	--	--	--	--	--	--	225	259	--
AVERAGE	--	--	--	--	--	--	--	--	171	214	231	248

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968
(METHODS OF ANALYSIS: B, BOTTOM WITHDRAWAL TUBE; C, CHEMICALLY DISPERSED; N, IN NATIVE WATER; P, PIPET; S, SIEVE; V, VISUAL ACCUMULATION TUBE; W, IN DISTILLED WATER)

DATE	TIME	WATER TEMPERATURE (°C)	DISCHARGE (CFS)	CONCENTRATION (MG/L)	SUSPENDED SEDIMENT DISCHARGE (TONS/DAY)	PARTICLE SIZE: PERCENT FINER THAN THE SIZE (IN MILLIMETERS) INDICATED											METHOD OF ANALYSIS
						.002	.004	.008	.016	.031	.062	.125	.250	.500	1.00	2.00	
MAR 15, 1968	1700	0	30100	56	4600												
JUN 2.....	2200	7	501000	665	900000	16	19	30	46	61	78	93	100	--	--	--	VB&C
SEP 19.....	1700	--	187000	186	93900												

15-5648. YUKON RIVER AT RUBY
(International Hydrologic Decade Station)

LOCATION.--Lat 64°44'28", long 155°29'22", at gaging station on left bank at Ruby, 300 ft downstream from Ruby Creek, 1.5 miles downstream from Melozitna River, and 2.2 miles upstream from Ruby Slough.
DRAINAGE AREA.--259,000 sq mi, approximately.
PERIOD OF RECORD.--Chemical analyses: June 1966 to September 1969.
Water temperatures: June 1966 to September 1967, August to September 1969.
Sediment records: September 1967 to September 1969 (partial-record station).
EXTREMES, 1968-69.--Dissolved solids: Minimum, 109 mg/l June 8-19.
Hardness: Minimum, 92 mg/l June 8-19.
Specific conductance: Minimum daily, 185 micromhos June 7.
EXTREMES, 1966-69.--Dissolved solids (1967-69): Minimum, 95 mg/l June 3-17, 1968.
Hardness (1967-69): Minimum, 81 mg/l June 13-17, 1968.
Specific conductance (1967-69): Minimum daily, 154 micromhos June 16, 1968.
Water temperatures (1966-67): Maximum, 18°C July 24, 26, 1966, June 24, July 11, 13, 1967.
REMARKS.--Stream frozen over during period October to May.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DATE	MEAN DISCHARGE (CFS)	SILICA (SIO2) (MG/L)	TOTAL IRON (FE) (UG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM (NA) (MG/L)	POTASSIUM (K) (MG/L)	BICARBONATE (HCO3) (MG/L)	SULFATE (SO4) (MG/L)
OCT.									
01-13	166,000	9.3	--	33	7.7	3.6	1.2	125	24
14-18	144,000	9.0	--	36	8.6	3.2	1.4	138	26
JUN.									
08-19	254,000	7.4	.38	27	6.0	2.5	1.4	94	18
20-30	327,000	7.8	3.9	32	7.2	2.7	1.9	116	20
JUL.									
01-16	224,000	8.6	1.9	36	6.6	3.2	2.0	126	22
17-31	72,000	8.1	9.1	35	6.5	3.0	2.0	120	22
AUG.									
01-04	272,000	8.1	9.1	35	6.5	3.0	2.0	120	22
08-17	331,000	6.1	--	35	5.8	2.9	2.3	124	15
18-27	247,000	7.2	--	32	5.8	2.8	1.2	101	23
28-31	206,000	6.5	.08	33	5.4	3.0	1.2	107	26
SEP.									
01-06	206,000	6.5	.08	33	5.4	3.0	1.2	107	26
07-30	188,000	7.0	--	30	7.8	3.1	1.0	110	22

ANALYSES OF ADDITIONAL SAMPLES

DATE	MEAN DISCHARGE (CFS)	SILICA (SIO2) (MG/L)	TOTAL IRON (FE) (UG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM (NA) (MG/L)	POTASSIUM (K) (MG/L)	BICARBONATE (HCO3) (MG/L)	SULFATE (SO4) (MG/L)
MAR.									
08...	22,500	10	.07	44	9.6	3.7	2.8	164	26
MAY									
30...	312,000	5.1	.19	26	5.4	1.8	1.6	88	17
JUL.									
04...	239,000	5.7	.03	29	7.8	2.4	2.5	113	20
AUG.									
12...	365,000	5.5	.03	32	6.8	2.3	2.2	111	24
SEP.									
28...	183,000	6.9	.07	29	8.0	2.8	1.0	1040	14

DATE	CHLORIDE (CL) (MG/L)	FLUORIDE (F) (MG/L)	DISSOLVED SOLIDS (SUM OF CONSTITUENTS) (MG/L)	HARDNESS (CA,MG) (MG/L)	NONCARBONATE HARDNESS (MG/L)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	COLOR (PLATINUM-COBALT UNITS)
OCT.								
01-13	.9	.2	143	114	11	239	7.4	15
14-18	.9	.1	153	126	13	261	7.2	15
JUN.								
08-19	.7	.2	109	92	16	188	7.9	25
20-30	.0	.2	131	110	15	223	8.0	30
JUL.								
01-16	.0	.2	147	118	15	237	8.1	10
17-31	2.5	.2	139	115	17	232	8.1	10
AUG.								
01-04	2.5	.2	139	115	17	232	8.1	10
08-17	.7	.2	130	112	10	228	7.8	30
18-27	.7	.1	129	104	21	214	8.1	30
28-31	.7	.1	130	105	17	217	7.9	30
SEP.								
01-06	.7	.1	130	105	17	217	7.9	30
07-30	.0	.2	126	108	18	215	8.0	20

ANALYSES OF ADDITIONAL SAMPLES

DATE	CHLORIDE (CL) (MG/L)	FLUORIDE (F) (MG/L)	DISSOLVED SOLIDS (SUM OF CONSTITUENTS) (MG/L)	HARDNESS (CA,MG) (MG/L)	NONCARBONATE HARDNESS (MG/L)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	COLOR (PLATINUM-COBALT UNITS)
MAR.								
08...	.4	.4	178	149	15	294	7.5	5
MAY								
30...	1.1	.2	102	88	16	175	7.9	5
JUL.								
04...	.0	.2	126	105	12	215	8.0	--
AUG.								
12...	1.1	.1	129	109	18	223	8.0	30
SEP.								
28...	.4	.1	124	105	19	215	8.0	30

15-5648. YUKON RIVER AT RUBY--Continued

SPECIFIC CONDUCTANCE (MICROMOHOS AT 25°C), WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBE
1.....	230	--	--	--	--	--	--	--	--	230	226	216
2.....	227	--	--	--	--	--	--	--	--	247	221	219
3.....	233	--	--	--	--	--	--	--	--	230	229	210
4.....	244	--	--	--	--	--	--	--	--	240	217	211
5.....	230	--	--	--	--	--	--	--	--	255	--	210
6.....	237	--	--	--	--	--	--	--	186	248	--	213
7.....	254	--	--	--	--	--	--	--	185	256	--	211
8.....	249	--	--	--	--	249	--	--	186	248	292	213
9.....	240	--	--	--	--	--	--	--	189	240	279	213
10.....	241	--	--	--	--	--	--	--	192	238	228	217
11.....	240	--	--	--	--	--	--	--	190	240	217	219
12.....	240	--	--	--	--	--	--	--	186	238	217	217
13.....	241	--	--	--	--	--	--	--	188	249	230	216
14.....	252	--	--	--	--	--	--	--	190	237	233	216
15.....	258	--	--	--	--	--	--	--	194	241	210	216
16.....	262	--	--	--	--	--	--	--	194	251	200	219
17.....	267	--	--	--	--	--	--	--	198	239	203	217
18.....	265	--	--	--	--	--	--	--	188	239	220	215
19.....	--	--	--	--	--	--	--	--	193	232	221	218
20.....	--	--	--	--	--	--	--	--	204	234	217	220
21.....	--	--	--	--	--	--	--	--	222	229	215	219
22.....	--	--	--	--	--	--	--	--	216	225	215	217
23.....	--	--	--	--	--	--	--	--	218	226	218	216
24.....	--	--	--	--	--	--	--	--	225	226	216	216
25.....	--	--	--	--	--	--	--	--	229	260	218	217
26.....	--	--	--	--	--	--	--	--	234	223	214	218
27.....	--	--	--	--	--	--	--	--	234	222	215	220
28.....	--	--	--	--	--	--	--	--	231	216	218	217
29.....	--	--	--	--	--	--	--	--	231	223	216	217
30.....	--	--	--	--	--	--	--	--	238	219	223	222
31.....	--	--	--	--	--	--	--	--	--	232	217	--
AVERAGE	--	--	--	--	--	--	--	--	206	237	223	216

TEMPERATURE (°C) OF WATER, AUGUST TO SEPTEMBER 1969

MONTH	DAY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVERAGE
AUGUST...	--	--	--	--	--	--	--	12	12	11	11	11	11	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	--
SEPTEMBER	10	12	10	10	10	10	10	10	10	10	11	10	10	10	11	11	11	9	9	9	7	7	7	6	7	5	5	5	6	5	--	9

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969
(METHODS OF ANALYSIS: B, BOTTOM WITHDRAWAL TUBE; C, CHEMICALLY DISPERSED; N, IN NATIVE WATER; P, PIPET; S, SIEVE; V, VISUAL ACCUMULATION TUBE; W, IN DISTILLED WATER)

DATE	TIME	WATER TEMPERATURE (°C)	DISCHARGE (CFS)	CONCENTRATION (MG/L)	SUSPENDED SEDIMENT DISCHARGE (TONS/DAY)	PARTICLE SIZE: PERCENT FINER THAN THE SIZE (IN MILLIMETERS) INDICATED .002	.004	.008	.016	.031	.062	.125	.250	.500	1.00	2.00	METHOD OF ANALYSIS
MAR 18, 1969	1007	0.0	22100	2	119	--	--	--	--	--	--	--	--	--	--	--	
MAY 30.....	1130	12.0	313000	545	461000	5	9	16	28	42	58	81	99	100	--	--	VCBW
JUL 4.....	2300	16.0	239000	772	498000	37	50	54	65	70	76	85	95	100	--	--	VCPW
AUG 13.....	1100	9.0	366000	867	857000	17	24	35	51	67	77	88	100	--	--	--	VCPW
SEP 28.....	1130		184000	132	65600	--	--	--	--	--	38	66	100	--	--	--	VW

15564800 YUKON RIVER AT RUBY
(International Hydrological Decade River Station)

LOCATION.--Lat 64°44'28", long 155°29'22", at gaging station on left bank at Ruby, 300 ft downstream from Ruby Creek, 1.5 miles downstream from Melozitna River, and 2.5 miles upstream from Ruby Slough.

DRAINAGE AREA.--259,000 sq mi, approximately.

PERIOD OF RECORD.--Chemical analyses: June 1966 to September 1970.
Water temperatures: June 1966 to September 1967, August 1969 to September 1970.
Sediment records: September 1967 to September 1970 (partial-record station).

EXTREMES, 1969-70.--Dissolved solids: Maximum, 169 mg/l Mar. 8; minimum, 92 mg/l June 12.
Hardness: Maximum, 140 mg/l Mar. 8; minimum, 80 mg/l June 12.
Specific conductance: Maximum, 280 micromhos Mar. 8; minimum daily, 161 micromhos June 12.
Water temperatures: Maximum, 18°C July 1, 2, 4-6.

EXTREMES, 1966-70: Dissolved solids (1967-70): Maximum, 169 mg/l Mar. 8, 1970; minimum, 87 mg/l May 22-31, 1967.
Hardness (1967-70): Maximum, 140 mg/l Mar. 8, 1970; minimum, 75 mg/l May 22-31, 1967.
Specific conductance (1967-70): Maximum, 315 micromhos Aug. 1-16, 1967; minimum, 154 micromhos May 22-31, 1967.
Water temperatures (1966, 1967, 1970): Maximum, 18°C July 24, 26, 1966, June 24, July 11, 13, 1967, July 1, 2, 4-6, 1970.

REMARKS.--River frozen over during period October to May. Miscellaneous chemical data published for water years 1967-70 and sediment data for water years 1967-70.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DATE	DIS-CHARGE (CFS)	SILICA (SIO2) (MG/L)	TOTAL IRON (FE) (UG/L)	DIS-SOLVED IRON (FE) (UG/L)	CAL-CIUM (CA) (MG/L)	MAG-NE-SIUM (MG) (MG/L)	SODIUM (NA) (MG/L)	PO-TAS-SIUM (K) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	SULFATE (SO4) (MG/L)
MAY										
25-31	300000	7.1	--	20	26	5.3	2.1	1.2	85	18
JUNE										
01-30	362000	7.1	--	20	26	5.3	2.1	1.2	85	18
JULY										
01-02	362000	7.1	--	20	26	5.3	2.1	1.2	85	18
03-23	340000	3.1	20	--	26	6.2	2.4	1.5	93	15
24-31	311000	6.4	50	50	30	7.3	3.2	1.5	110	22
AUG.										
01-31	311000	6.4	50	50	30	7.3	3.2	1.5	110	22
SEPT.										
01-21	311000	6.4	50	50	30	7.3	3.2	1.5	110	22
ANALYSES OF ADDITIONAL SAMPLES										
MAR.										
08...	27200	10	--	50	42	8.6	3.6	2.2	152	23
JUNE										
12...	331000	4.8	--	--	24	4.8	1.8	1.3	78	16
JULY										
12...	317000	7.1	120	--	27	5.7	2.1	1.4	87	21
AUG.										
15...	262000	5.6	--	60	33	6.8	2.2	1.3	110	22
SEPT.										
21...	240000	6.0	--	160	34	7.5	2.7	1.1	114	23

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970--Continued

DATE	CHLORIDE (CL) (MG/L)	FLUORIDE (F) (MG/L)	NITRATE (NO3) (MG/L)	DISSOLVED SOLIDS (SUM OF CONSTITUENTS) (MG/L)	HARDNESS (CA,MG) (MG/L)	NONCARBONATE HARDNESS (MG/L)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	COLOR (PLATINUM-COBALT UNITS)	TEMPERATURE (DEG C)
MAY										
25-31	1.2	.2	.2	103	86	16	176	7.8	20	--
JUNE										
01-30	1.2	.2	.2	103	86	16	176	7.8	20	--
JULY										
01-02	1.2	.2	.2	103	86	16	176	7.8	20	--
03-23	1.5	.2	1.4	103	91	15	194	7.5	5	--
24-31	.8	.2	.3	126	105	15	219	8.1	10	--
AUG.										
01-31	.8	.2	.3	126	105	15	219	8.1	10	--
SEPT.										
01-21	.8	.2	.3	126	105	15	219	8.1	10	--
ANALYSES OF ADDITIONAL SAMPLES										
MAR.										
08...	1.4	.2	.8	169	140	15	280	8.2	10	.0
JUNE										
12...	.0	.2	.8	92	80	16	161	7.7	75	13.5
JULY										
12...	.1	.1	1.0	108	91	20	184	7.9	50	11.5
AUG.										
15...	.5	.1	.2	126	111	21	217	7.7	10	15.5
SEPT.										
21...	1.0	.1	.4	132	117	24	225	7.6	20	3.0

SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C), WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1.....	225	--	--	--	--	--	--	--	181	178	211	208
2.....	223	--	--	--	--	--	--	--	175	183	211	211
3.....	225	--	--	--	--	--	--	--	165	191	219	209
4.....	229	--	--	--	--	--	--	--	166	190	212	233
5.....	250	--	--	--	--	--	--	--	169	197	208	230
6.....	235	--	--	--	--	--	--	--	159	187	217	236
7.....	--	--	--	--	--	--	--	--	160	186	214	221
8.....	--	--	--	--	--	294	--	--	158	186	215	220
9.....	--	--	--	--	--	--	--	--	163	190	216	220
10.....	--	--	--	--	--	--	--	--	162	186	214	222
11.....	--	--	--	--	--	--	--	--	168	189	237	220
12.....	--	--	--	--	--	--	--	--	164	208	240	222
13.....	--	--	--	--	--	--	--	--	161	188	239	222
14.....	--	--	--	--	--	--	--	--	161	190	218	224
15.....	--	--	--	--	--	--	--	--	167	206	219	224
16.....	--	--	--	--	--	--	--	--	175	190	217	223
17.....	--	--	--	--	--	--	--	--	175	192	215	222
18.....	--	--	--	--	--	--	--	--	181	195	210	234
19.....	--	--	--	--	--	--	--	--	180	203	210	234
20.....	--	--	--	--	--	--	--	--	181	194	217	235
21.....	--	--	--	--	--	--	--	--	182	197	217	228
22.....	--	--	--	--	--	--	--	--	184	195	230	--
23.....	--	--	--	--	--	--	--	--	179	209	228	--
24.....	--	--	--	--	--	--	--	--	174	235	228	--
25.....	--	--	--	--	--	--	--	151	175	212	209	--
26.....	--	--	--	--	--	--	--	183	185	215	205	--
27.....	--	--	--	--	--	--	--	183	186	213	207	--
28.....	--	--	--	--	--	--	--	183	182	211	212	--
29.....	--	--	--	--	--	--	--	185	181	207	206	--
30.....	--	--	--	--	--	--	--	164	179	208	210	--
31.....	--	--	--	--	--	--	--	179	--	209	216	--
AVERAGE	--	--	--	--	--	--	--	--	173	198	218	--

TEMPERATURE (°C) OF WATER, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	8.0	17.0	14.5	13.0
2	---	---	---	---	---	---	---	---	8.0	16.0	14.5	11.5
3	---	---	---	---	---	---	---	---	9.0	16.0	14.0	11.5
4	---	---	---	---	---	---	---	---	9.0	15.5	14.5	11.0
5	---	---	---	---	---	---	---	---	10.0	15.0	15.0	10.0
6	---	---	---	---	---	---	---	---	10.0	15.5	14.5	9.5
7	---	---	---	---	---	---	---	---	11.0	15.5	14.5	9.0
8	---	---	---	---	---	---	---	---	12.0	16.0	14.0	8.5
9	---	---	---	---	---	---	---	---	13.0	17.0	14.0	8.5
10	---	---	---	---	---	---	---	---	14.0	17.0	14.5	8.5
11	---	---	---	---	---	---	---	---	14.0	17.0	14.0	8.5
12	---	---	---	---	---	---	---	---	15.5	17.5	14.5	8.0
13	---	---	---	---	---	---	---	---	15.5	16.5	15.5	8.0
14	---	---	---	---	---	---	---	---	14.0	15.5	15.0	8.0
15	---	---	---	---	---	---	---	---	14.5	15.5	15.0	7.5
16	---	---	---	---	---	---	---	---	13.0	15.0	14.0	7.0
17	---	---	---	---	---	---	---	---	13.0	15.5	14.0	7.0
18	---	---	---	---	---	---	---	---	13.0	16.5	14.0	7.0
19	---	---	---	---	---	---	---	---	14.0	16.5	14.0	6.5
20	---	---	---	---	---	---	---	---	15.0	16.5	12.0	6.0
21	---	---	---	---	---	---	---	---	16.0	16.5	13.0	7.0
22	---	---	---	---	---	---	---	---	17.0	16.5	---	7.0
23	---	---	---	---	---	---	---	---	17.0	17.0	12.5	7.0
24	---	---	---	---	---	---	---	---	17.5	17.0	12.5	7.0
25	---	---	---	---	---	---	---	---	18.0	17.0	12.0	6.0
26	---	---	---	---	---	---	---	---	18.5	16.5	12.0	5.5
27	---	---	---	---	---	---	---	---	18.5	17.0	13.0	5.0
28	---	---	---	---	---	---	---	---	18.5	16.0	13.0	4.5
29	---	---	---	---	---	---	---	---	17.5	---	13.0	4.5
30	---	---	---	---	---	---	---	---	---	16.0	13.0	5.0
31	---	---	---	---	---	---	---	8.0	---	15.5	13.0	---
MONTH	---	---	---	---	---	---	---	---	14.0	16.5	14.0	8.0

SUSPENDED SEDIMENT ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	TIME	TEMPERATURE (DEG C)	SPECIFIC CONDUCTANCE (MICROMHOS)	TURBIDITY (JTU)	DISCHARGE (CFS)	SUSPENDED SEDIMENT (MG/L)	SUSPENDED SEDIMENT DISCHARGE (T/DAY)	SUS. SED. FALL DIAM. % FINER THAN .002 MM
MAR. 19...	1915	.0	300	--	26500	16	1150	--
JUNE 09...	1815	13.0	142	60	594000	518	831000	11
AUG. 15...	1640	15.5	229	95	282000	--	--	--

DATE	SUS. SED. FALL DIAM. % FINER THAN .004 MM	SUS. SED. FALL DIAM. % FINER THAN .008 MM	SUS. SED. FALL DIAM. % FINER THAN .016 MM	SUS. SED. FALL DIAM. % FINER THAN .031 MM	SUS. SED. FALL DIAM. % FINER THAN .062 MM	SUS. SED. FALL DIAM. % FINER THAN .125 MM	SUS. SED. FALL DIAM. % FINER THAN .250 MM	SUS. SED. FALL DIAM. % FINER THAN .500 MM
MAR. 19...	--	--	--	--	--	--	--	--
JUNE 09...	18	22	32	47	68	87	99	100
AUG. 15...	--	--	--	--	--	--	--	--

WATER QUALITY DATA, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971--Continued

DATE	DIS-CHARGE (CFS)	SILICA (SIO2) (MG/L)	TOTAL IRON (FE) (UG/L)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	SODIUM (NA) (MG/L)	PO-TAS-SIUM (K) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	SULFATE (SO4) (MG/L)
MAY										
31-31	636800	4.2	--	--	22	4.0	1.9	1.3	78	9.8
JUNE										
01-14	636800	4.2	--	--	22	4.0	1.9	1.3	78	9.8
15-29	433000	5.3	--	--	26	5.1	2.3	1.5	96	13
30-30	324400	5.7	--	--	30	6.1	2.8	1.5	107	19
JULY										
01-17	324400	5.7	--	--	30	6.1	2.8	1.5	107	19
18-31	312500	6.1	--	--	36	6.4	3.2	1.9	126	19
AUG.										
01-28	312500	6.1	--	--	36	6.4	3.2	1.9	126	19
29-31	224400	6.8	--	--	33	7.3	3.7	1.5	117	22
SEP.										
01-29	224400	6.8	--	--	33	7.3	3.7	1.5	117	22
ANALYSES OF ADDITIONAL SAMPLES										
MAR.										
19...	26500	10	--	180	42	9.7	4.0	1.6	154	24
JUNE										
09...	594000	6.1	--	40	22	3.7	1.2	1.1	76	9.6
JULY										
14...	274000	5.6	2700	--	32	6.3	2.3	1.2	106	20
AUG.										
15...	282000	6.4	--	130	36	6.0	2.8	1.9	120	20

DATE	CHLO-RIDE (CL) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	NITRATE (NO3) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	HARD-NESS (CA,MG) (MG/L)	NON-CAR-BONATE HARD-NESS (MG/L)	SPECI-FIC CONDU-CTANCE (MICRO-MHOS)	PH (UNITS)	COLOR (PLAT-INUM-COBALT UNITS)	TEMP-ERATURE (DEG C)
MAY										
31-31	.5	.3	.7	83	72	8	142	7.6	50	--
JUNE										
01-14	.5	.3	.7	83	72	8	142	7.6	50	--
15-29	.5	.2	.2	101	86	7	179	7.5	20	--
30-30	.5	.1	.1	119	100	12	206	8.1	10	--
JULY										
01-17	.5	.1	.1	119	100	12	206	8.1	10	--
18-31	1.0	.2	.1	136	117	14	238	7.4	40	--
AUG.										
01-28	1.0	.2	.1	136	117	14	238	7.4	40	--
29-31	1.0	.2	.1	134	113	17	232	7.6	10	--
SEP.										
01-29	1.0	.2	.1	134	113	17	232	7.6	10	--
ANALYSES OF ADDITIONAL SAMPLES										
MAR.										
19...	1.0	.1	.6	169	146	20	287	7.8	10	.0
JUNE										
09...	2.0	.2	.4	83	73	11	142	7.6	50	13.0
JULY										
14...	.5	.2	.0	120	106	19	207	7.7	10	--
AUG.										
15...	.5	.2	.1	133	115	17	229	7.7	30	13.0

Chemical analyses, in parts per million, water years October 1953 to September 1956--Continued

Date of collection	Discharge (cfs)	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
														Calcium, magnesium	Noncarbonate			
YUKON RIVER BELOW TOZITNA RIVER NEAR TANANA																		
July 19, 1956		5.7	0.00	34	8.0	2.1	1.3	106	22	0.0	0.0	0.2	123	110	23	217	7.5	15