WATER RESOURCES NEAR DILLINGHAM IN THE BRISTOL BAY AREA, ALASKA

By Roy L. Glass

U.S. GEOLOGICAL SURVEY

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CONVERSION TABLE

For readers who may prefer to use metric (International System) units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit	by	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
acre foot (acre-ft)	1,233	cubic meter (m^3/s)
square mile (mi^2)	2.590	square kilometer (km^2)
gallon (gal)	3.785	liter (L)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
gallon per minute (gal/min)	0.06308	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
degree Fahrenheit	°C = 5/9 x (°F-32)	degree Celsius (°C)

Other abbreviations in this report are:

mg/L, milligrams per liter
µg/L, micrograms per liter
µS/cm, microsiemens per centimeter at 25 degrees Celsius

Sea level

In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD 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 "Mean Sea Level of 1929."

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ABSTRACT

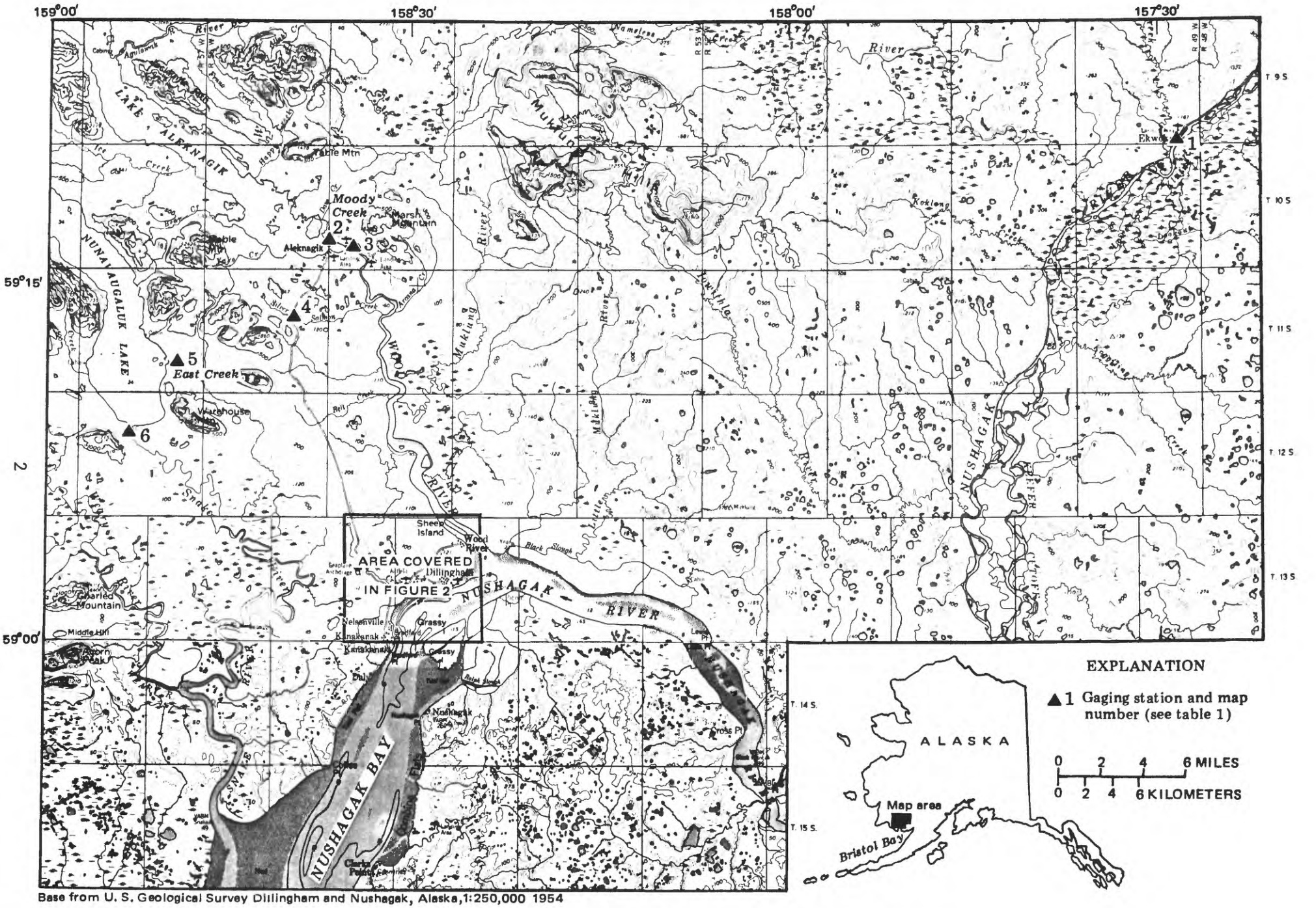
Dillingham, the largest community in the Bristol Bay area of Alaska, lies near the confluence of the Wood and Nushagak Rivers. Mean annual discharges for the Wood and Nushagak Rivers are 4,824 and 22,650 cubic feet per second. Flows generally are greatest in May through July and lowest in January through April. The surface waters are a calcium bicarbonate type and have low concentrations of dissolved solids and suspended sediments. Water in the Wood-Nushagak estuary near Dillingham during a high tide in autumn 1985 had specific conductance values ranging from 110 to 3,000 microsiemens per centimeter.

Ground water is the predominant source of public, private, and commercial/industrial supply. Wells range in depth from 20 to 213 feet, yield up to 225 gallons per minute, and have water levels that range from 4 to 76 feet below land surface. All water levels measured during June and July 1986 were above sea level. Samples of ground water contained less than 500 milligrams per liter dissolved solids but concentrations of iron and manganese were as great as 870 and 1,200 micrograms per liter, respectively. Peak water use is in midsummer. In 1986, peak use in the townsite area was between 300,000 and 400,000 gallons per day whereas in previous years it has been as great as 1 million gallons per day.

INTRODUCTION

Dillingham lies at the northern end of Nushagak Bay, a northern extension of Bristol Bay, near the confluence of the Wood and Nushagak Rivers (fig. 1). The city is the regional center for governmental activities and distribution of goods and services to western Bristol Bay area villages. In 1985 Dillingham had a population of about 2,100. Dillingham's predominant economic base is the fishing and fish-processing industries (DOWL Engineers, 1981). Fish-processing facilities use large quantities of water, and almost all the water used in Dillingham comes from wells. During the height of the fish-processing season, late June through early July, wells within 1,500 ft of the Nushagak Bay estuary are heavily pumped. Data are needed to help determine whether increased ground-water pumping will induce saltwater to migrate into freshwater aquifers that are used for public supply.

The purpose of this report is to compile water-resources data that have been collected in the Dillingham area. The study was performed during 1985-86 in cooperation with the City of Dillingham to help determine the availability of water for the area's future needs. The report is not a thorough evaluation of the area's ground- and surface-water resources, but most of the data required for such an evaluation is included here. The scope of the study was limited to: collection



Base from U. S. Geological Survey Dillingham and Nushagak, Alaska, 1:250,000 1954

Figure 1. -- Location of Dillingham and surface-water data-collection sites.

Table 1.--Summary of data available for streams in the Dillingham area

Map number (fig. 1)	Station number	Name	Period of record				
			Streamflow		Water quality		
			Continuous record	Partial record (crest stage)	Chemical	Water temperature	Sediment
1	15302500	Nushagak River at Ekwok	1977-	--	1956; 79-	1979-80	1979-
2	15302900	Moody Creek at Aleknagik	--	1969-	--	--	--
3	15303000	Wood River near Aleknagik	1957-70	1972	1958-60; 67	1967-68	--
4	15303010	Silver Salmon Creek near Aleknagik	1985-	1965-67; 69-	1971	--	1970-72
5	15303100	East Creek near Dillingham	1973-75	--	--	1973-76	1974-75
6	15303150	Snake River near Dillingham	1973-83	--	--	1974-80	1974

and review of available hydrologic data and drillers' logs; measurement of water levels in wells; and measurement of specific conductance of water in estuaries of Wood and Nushagak Rivers.

HYDROLOGIC SETTING

Climatologically, Dillingham lies in a transition zone that is influenced by both maritime climate and the Arctic climate of interior Alaska. Mean annual temperature is 34.1 °F and mean monthly temperatures are below freezing from November through April, based on data from 1922 through 1979 (Arctic Environmental Information and Data Center, written commun., 1986) and from monthly summaries of the National Oceanic and Atmospheric Administration (1979-85). Average annual precipitation (the total water equivalent of rain, snow, and ice pellets) at Dillingham is 25.6 in. On the average the smallest monthly precipitation (1.26 in.) falls in April, whereas the greatest amount (3.89 in.) falls in August.

Dillingham lies on a moraine- and outwash-mantled lowland with 50- to 100-foot-high hills and wide expanses of wetland and lakes. The area is underlain by a complex sequence of primarily fine-grained glacial, fluvial, and marine sediments that are several hundred feet thick.

SURFACE WATER QUANTITY AND QUALITY

The Nushagak and Wood Rivers are the main rivers in the Dillingham area. Stream-gaging stations (fig. 1) have been maintained by the U.S. Geological Survey on these and other rivers. Table 1 summarizes data available for these streams, and table 2 shows a compilation of streamflow data for continuous-record sites. The streamflow and water-quality data contained in this report and those which are referenced in table 1 are available through data retrieval programs from the Geological Survey. Streamflow data since 1961 and water-quality data since 1964 have also been published annually in a series of reports by the U.S. Geological Survey (1961-85).

Near Dillingham, the Nushagak River has an estimated drainage area of 12,400 mi^2. At the Survey's stream-gaging station at Ekwok, 40 mi northeast of Dillingham, the Nushagak River has a drainage area of approximately 9,850 mi^2. The maximum recorded discharge at the gaging station was 89,200 ft^3/s, and the minimum discharge was 5,600 ft^3/s. During the period October 1977 through September 1985 the Nushagak River at Ekwok had an average discharge of 22,650 ft^3/s.

Seventeen miles north-northeast of Dillingham, Wood River flows out of Lake Aleknagik and has a drainage area of approximately 1,110 mi^2. For the period September 1957 through September 1970, average discharge for Wood River near Aleknagik was 4,824 ft^3/s, and the maximum discharge was 23,400 ft^3/s; however, a peak discharge of 25,000 ft^3/s occurred during June 1972.

A statistical summary of selected water-quality properties and chemical constituents of water of Nushagak and Wood Rivers is shown in table 3. The waters contain low concentrations of suspended sediment and dissolved solids, and their

Table 2.--Mean monthly and mean annual discharge for selected streams

NUSHAGAK RIVER AT EKWOK (15302500)

LOCATION.--Lat 59°20'57", long 157°28'23", in SE¼SE¼ sec. 35, T.9 S., R.49 W., Hydrologic Unit 19040002, on right bank at Ekwok, 0.6 mi upstream from Klutuk Creek, and 40 mi northeast of Dillingham.

DRAINAGE AREA.--9,850 mi^2, approximately.

PERIOD OF RECORD.--October 1977 to current year.

GAGE.--Nonrecording gage. Altitude of gage is 90 ft above National Geodetic Vertical Datum of 1929 (determined from topographic map). Prior to Apr. 17, 1979, at site 0.4 mi downstream at different datum.

AVERAGE DISCHARGE.--8 years, 22,650 ft^3/s, 31.23 in/yr, 16,410,000 acre-ft/yr.
(9 years, 22,430 ft^3/e, 30.93 in/yr, 16,210,000 acre-ft/yr.)[1]

EXTREMES.--Maximum discharge observed, 89,200 ft^3/e, June 8, 1982, gage height, 13.22 ft; maximum gage height, 14.46 ft, from floodmarke, site and datum then in uee, in April 1979, backwater from ice; minimum discharge, about 5,600 ft^3/s Apr. 21 to May 2, 1985.

MONTHLY AND YEARLY MEAN DISCHARGE, (FT^3/S)

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	THE YEAR
1978	48630	22700	15580	13190	11250	9903	10530	32320	34350	32980	23150	23670	23290
1979	24130	20350	12840	10380	7107	6484	21900	49050	41520	30920	30280	23720	23320
1980	31380	36180	15610	11940	10620	10320	25170	50870	58840	52710	37450	28110	30810
1981	29890	17870	8516	7606	8686	11390	20960	45520	37890	30440	30270	23610	22810
1982	20740	16920	10030	8326	11440	11110	10790	42570	51380	38960	25950	51490	25000
1983	33890	12120	8329	7271	7000	6910	7440	35450	36710	24440	20200	13170	17840
1984	23870	17730	16190	13000	13000	12000	12800	26660	24290	22430	17620	14690	17890
1985	13660	9260	7484	6426	6143	5897	5733	24070	57460	37580	36160	32230	20230
a1986	37640	17580	12840	9829	8171	7774	7500	20890	30340	28810	30410	37560	20860

WOOD RIVER AT ALEKNAGIK (15303000)

LOCATION.--Lat 59°16'30", long 158°35'37", in SE¼ sec. 30, T.10 S., R.55 W., on left bank at outlet of Lake Aleknagik, 1 mi east of Aleknagik, and 5 mi upstream from Arcana Creek.

DRAINAGE AREA.--1,110 mi^2, spproximately.

PERIOD OF RECORD.--September 1957 through October 1970.

GAGE.--Nonrecording gage. Altitude of gage is 20 ft above National Geodetic Vertical Datum of 1929 (determined by altimeter). Oct. 21, 1965 to Nov. 12, 1968, water-stage recorder at same site and datum.

AVERAGE DISCHARGE.--13 years, 4,824 ft^3/s, 59.02 in/yr, 3,495,000 acre-ft/yr.

EXTREMES.--Maximum discharge, 23,400 ft^3/s June 22, 1969, gage height, 13.42 ft, from floodmark; minimum not determined. A peak discharge of 25,000 ft^3/s occurred during June 1972, gage height 13.83 ft.

MONTHLY AND YEARLY MEAN DISCHARGE, (FT^3/S)

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	THE YEAR
1958	6302	8225	4814	2843	2047	1768	1657	5199	13580	13080	7198	5711	6054
1959	6135	3699	2797	1948	1607	1248	1319	4199	9322	6565	4656	4215	3988
1960	6933	3900	2590	2048	1503	1248	785	5595	10240	7773	7508	5966	4685
1961	5933	4823	3690	2597	1954	1448	1317	5182	10290	6636	6287	6997	4774
1962	6311	3800	2039	1797	1701	1630	1773	5041	12150	8323	4523	5088	4525
1963	5685	4229	3360	3377	3461	3129	2257	5224	10290	7696	4918	8319	5164
1964	6907	3642	2573	1997	1703	1597	1563	2503	11880	9099	5577	6008	4590
1965	6608	4571	3071	2239	1543	1742	2939	4896	18390	9508	5681	9517	5896
1966	9127	3078	1600	1100	880	800	790	990	8923	10210	6882	7146	4315
1967	9856	4966	2072	969	727	700	940	3838	12280	7420	4517	3912	4366
1968	3403	2500	1961	1800	1697	1460	1707	5207	8003	5046	4863	4255	3495
1969	3396	2862	2329	2101	1993	2044	1966	5238	16970	10400	4245	4014	4802
1970	8481	7968	6332	4187	2532	2334	2626	5487	10940	9185	6297	5949	6046

Table 2.--Mean monthly and mean annual discharge for selected streams--Continued

SILVER SALMON CREEK NEAR ALEKNAGIK (15303010)

LOCATION.--Lat 59°13'34", long 158°40'21", in NW¼ sec 14, T.11 S., R.56 W., Hydrologic unit 19040002, on right bank 4.5 mi from mouth at Wood River and 4 mi southwest of Alaknagik.

DRAINAGE AREA.-- 4.46 mi^2.

PERIOD OF RECORD.--Annual maximum, water years 1965-67 and 1969-83. October 1984 to current year.

GAGE.--Water-stage recorder. Altitude of gage is 170 ft above National Geodetic Vertical Datum of 1929 (determined from topographic map).

EXTREMES.--Maximum discharge, 340 ft^3/s, June 12, 1967, gage height, 11.85, site than in use; maximum gage height 12.65 ft, May 18, 1985; minimum discharge recordad, 1.3 ft^3/s, Apr. 24, 25, 1985, but may have baan less during the period, Nov. 11 to Dec. 31, 1984.

MONTHLY AND YEARLY MEAN DISCHARGE, (FT^3/S)

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	THE YEAR
1985	4.77	1.62	1.50	2.00	2.50	2.50	1.83	20.8	59.6	9.37	18.1	18.0	11.9
[a]1986	31.2	12.8	6.67	4.06	2.81	2.26	2.04	9.45	23.1	9.88	14.8	18.0	11.5

EAST CREEK NEAR DILLINGHAM (15303100)

LOCATION.--Lat 59°11'39", long 158°49'17", in NE¼SW¼ sec. 26, T.11 S., R.57 W., on right bank 0.5 mi upstream from mouth at Lake Nunavaugaluk, and 15 mi northwest of Dillingham.

DRAINAGE AREA.--2.12 mi^2. A significantly larger area contributas to ground-water basa flow.

PERIOD OF RECORD.--August 1973 to September 30, 1975.

GAGE.--Water-stage recorder. Altitude of gage is 90 ft above National Geodetic Vertical Datum of 1929 (determinad from topographic map).

EXTREMES.--Maximum discharge, 41 ft^3/s, Sept. 17, 1975, gage height, 5.94 ft; maximum gage height, 6.10 ft, Nov. 11, 1974, backwater from ice; minimum daily discharge, 7 ft^3/s, Mar. 21 to Apr. 16, 1974 and Feb. 21 to Apr. 25, 1975.

MONTHLY AND YEARLY MEAN DISCHARGE, (FT^3/S)

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	THE YEAR
1973	--	--	--	--	--	--	--	--	--	--	18.3	20.4	--
1974	22.4	20.0	13.5	11.2	8.89	7.65	7.67	15.7	21.1	18.5	16.1	16.5	15.0
1975	22.1	18.0	13.9	9.97	7.71	7.00	7.20	19.8	28.4	22.4	15.3	20.0	16.0

SNAKE RIVER NEAR DILLINGHAM (15303150)

LOCATION.--Lat 59°08'54", long 158°53'14", in NW¼SW¼ sec. 9, T.12S., R.57W., Hydrologic Unit 19040002, on right bank at outlat of Laka Nunavaugaluk, 15 mi northwest of Dillingham.

DRAINAGE AREA.--113 mi^2.

PERIOD OF RECORD.--August 1973 to September 30, 1983.

GAGE.--Water-stage recorder. Altitude of gage is 34 ft above National Geodetic Vertical Datum of 1929 (determined from topographic map).

AVERAGE DISCHARGE.--10 years, 545 ft^3/s, 65.50 in/yr, 394,900 acre-ft/yr.

EXTREMES.--Maximum discharge, 2,470 ft^3/s June 17, 1977, gage haight, 6.81 ft; minimum discharga, about 70 ft^3/s Jan. 31 and Feb. 2, 1977.

MONTHLY AND YEARLY MEAN DISCHARGE, (FT^3/S)

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	THE YEAR
1973	--	--	--	--	--	--	--	--	--	--	438	645	--
1974	570	445	304	240	143	117	202	660	868	435	274	428	392
1975	595	508	247	168	200	180	166	596	1459	844	341	681	499
1976	804	538	367	261	200	134	95.2	306	977	429	225	620	413
1977	761	419	329	366	365	372	284	506	1838	927	1248	613	670
1978	470	257	119	125	119	144	247	1004	911	794	472	871	463
1979	648	810	732	619	325	257	560	1466	1065	520	853	558	704
1980	1037	1108	489	293	263	260	279	1292	1432	883	449	369	680
1981	545	424	189	193	229	499	296	970	735	368	624	592	473
1982	319	395	265	201	239	257	260	787	1734	1130	716	1292	633
1983	1044	636	484	404	322	208	198	1092	862	450	357	239	527

[a]Preliminary data.

Table 3.--Statistical summary of physical characteristics and major chemical constituents of water from Nushagak and Wood Rivers

[µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter]

Substance or property analyzed and unit	Number of analyses	Mean	Minimum value	Maximum value
Nushagak River at Ekwok (15302500)				
Specific conductance (µS/cm)	47	51	27	65
pH (standard units)	45	a7.0	5.7	7.7
Temperature (degrees Celsius)	35	6.7	.0	16.3
Calcium, dissolved (mg/L as Ca)	51	6.6	3.9	9.6
Magnesium, dissolved (mg/L as Mg)	51	1.4	1.0	2.4
Sodium, dissolved (mg/L as Na)	51	1.7	1.0	4.7
Potassium, dissolved (mg/L as K)	49	.36	< .1	.6
Alkalinity, field (mg/L as $CaCO_3$)	32	20	14	26
Sulfate, dissolved (mg/L as SO_4)	51	4.3	.8	8.8
Chloride, dissolved (mg/L as Cl)	50	.87	< .1	3.5
Fluoride, dissolved (mg/L as F)	49	.07	< .1	.2
Silica, dissolved (mg/L as SiO_2)	51	7.1	5.1	11
Solids, sum of constituents, dissolved (mg/L)	46	35	26	46
Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	31	.11	< .1	.3
Phosphorus, dissolved (mg/L as P)	35	.015	< .01	.04
Iron, dissolved (µg/L as Fe)	26	160	71	280
Manganese, dissolved (µg/L as Mn)	26	9.3	1.0	21
Sediment, suspended (mg/L)	30	13	1.0	46
Wood River near Aleknagik (15303000)				
Specific conductance (µS/cm)	7	41	40	44
pH (standard units)	7	a6.9	6.4	7.3
Temperature (degrees Celsius)	5	7.3	1.0	10.5
Calcium, dissolved (mg/L as Ca)	7	5.4	4.8	6.4
Magnesium, dissolved (mg/L as Mg)	7	1.5	< .1	5.0
Sodium, dissolved (mg/L as Na)	7	1.1	1.0	1.2
Potassium, dissolved (mg/L as K)	7	.14	.1	.2
Alkalinity, field (mg/L as $CaCO_3$)	7	14	11	16
Sulfate, dissolved (mg/L as SO_4)	7	4.3	2.0	8.0
Chloride, dissolved (mg/L as Cl)	7	2.6	< .1	9.0
Fluoride, dissolved (mg/L as F)	7	.01	< .1	.1
Silica, dissolved (mg/L as SiO_2)	7	4.2	3.3	5.2
Solids, sum of constituents, dissolved (mg/L)	7	28	23	43
Sediment, suspended (mg/L)	3	4.0	2.0	5.0

a Median value

principal cation and anion are calcium and bicarbonate (as indicated by "alkalinity").

Measurements of specific conductance of water in the Nushagak and Wood Rivers were made to determine the salinity of estuary water near Dillingham. Measurements were made on September 25, 1985 at a tide of approximately 15 ft. (For reference, mean lower low water is 0 ft and mean high water is 18 ft.) Water samples were collected near the water's surface and near the bottom. The specific conductance of water ranged from 110 to 135 uS/cm in the Wood River at Snag Point dock and from 1,330 to 3,000 uS/cm in the Nushagak River; in Scandinavian Creek at Dillingham's small-boat harbor it was 300 uS/cm (fig. 2). These values indicate a slight effect by salinity from tides in the channel of the Nushagak River at the prevailing flow conditions in late September. High tides in spring, when streamflow is low, would increase salinity to a much greater value in the estuary.

GROUND WATER AVAILABILITY AND QUALITY

An estimated 400 to 500 wells have been drilled in the Dillingham area. The locations of wells for which information is available are shown in figure 2. A summary of available well data is included in table 4, and lithologic descriptions from drillers' logs for some of these wells are presented in table 5. Drillers' logs for most of the wells listed in table 4 are on file at the Geological Survey office in Anchorage, Alaska.

Wells range in depth from 20 to 213 feet and yield from 5 to 225 gal/min. Well-yield information was determined by drillers by pumping or bailing for short periods, generally from 0.25 to 2 hours, and may not reflect the long-term capacity of the aquifer to supply water.

Water levels in well PHS No. 2 or SC01305521ABBD1 001 (see explanation of well-numbering system in table 4) have been monitored intermittently with a strip-chart recorder since 1978. Water levels in this 88-foot deep well have ranged from 68.3 to 75.9 ft below land surface (about 9.0 to 16.6 ft above sea level). Continuous water-level records for this well are not available. Water-level values for this well reported in table 6 and figure 3 are the highest water levels (lowest numerical values) for the 5th, 10th, 15th, 20th, 25th, and last day (end) of each month (EOM). Water-level values for all other wells in this report are values that were measured by using a steel tape; they are instantaneous values and may not be the highest water level for that day.

Infiltration of rain, snowmelt, and streamflow recharges the aquifers that are tapped by wells to yield water for domestic and public supplies. Depths to water in wells ranged from about 4 to 76 ft. Natural seasonal fluctuations of water levels are less than 6 ft. The hydrograph of water levels in well PHS No. 2 (fig. 3) shows that in most years there are two periods of low water levels. Water levels are lowest during June and July when ground-water pumpage is greatest, and fish processing is most intensive. At times, water levels also are low during winter, possibly because of seasonal decrease in the amount of water that recharges the aquifer. Water levels in well PHS No. 2 fluctuate more widely than in most other wells in the area because it is only about 10 ft from a public-supply well.

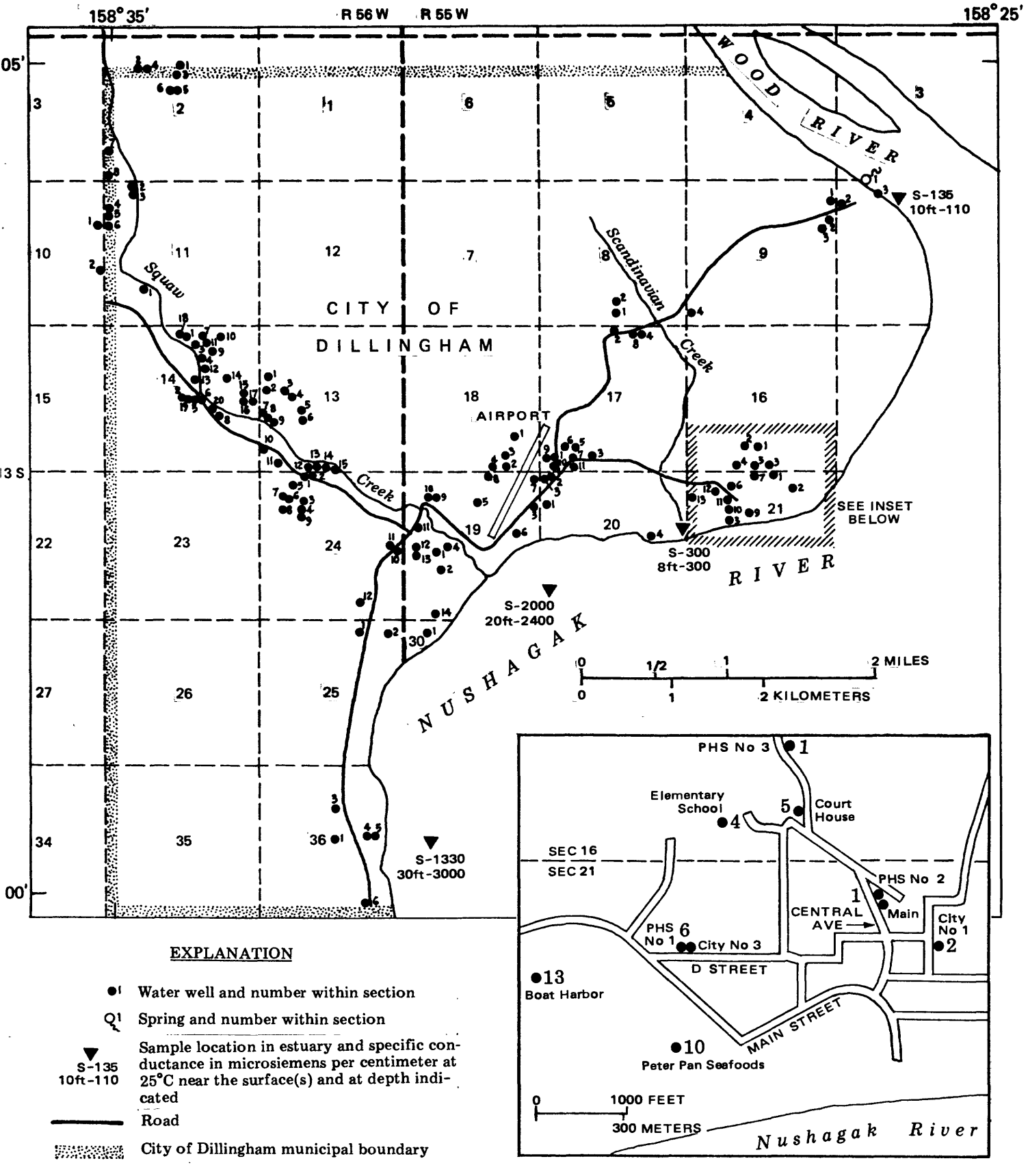


Figure 2.--Water-well locations in the Dillingham area, and areal distribution of specific conductance of water in the Wood-Nushagak estuary, September 25, 1985.

Table 4.--Summary of data for wells and springs

[See explanation following table]

Well number	Map number	Owner	Local, subdivision, or survey name	Year drilled	Altitude (feet)	Hole depth (feet)	Well depth (feet)	Water level (feet below land surface)	Yield (gallon per minute)	Other date in this report
SC01305508DCBC1	002	WASKEY ROAD 8 PLEX	BERNIE LO2	1985	75	40	40	21	20	--
SC01305508DCCB1	001	SHEETS RON	WOOD RIVER LO6	1978	110	74	74	45	11	--
SC01305509AADD1	001	LANER JOHN	KALLENBERGS LO4	1981	100	134	134	--	8	--
SC01305509ADAA1	002	KAWAGLIA WASSILLI E	BUCKSHOT EST LO2	1979	125	154	154	72	--	--
SC01305509ADAC1	003	SNYDER DAVE	BUCKSHOT EST LO5	--	125	75	75	--	--	--
SC01305509ADAC2	003	CLINE DON	BUCKSHOT EST LO6	--	125	35	35	--	--	--
SC01305509CCCB1	004	TORRISI FRED	BLACKIES KNOB LO1	1981	112	70	70	--	15	--
SC01305510BABC1	003	DRAGNET	USS 2488	--	25	201	201	--	--	--
SC01305510BABC2	003	DRAGNET	USS 2488	1983	25	85	85	--	13	--
SC01305510BBAA1S		WOOD RIVER COMUNITY	SPRING	--	20	--	--	--	1	QW
SC01305510BBCC1	002	BAIR NORMAN	USS 4972 LO8A	1977	105	165	156	76	--	--
SC01305516CDAB1	001	DILLINGHAM CITY OF	PHS NO. 3	1977	47.56	70	70	21.8	--	LOG, WL
SC01305516CDAC1	002	TUCKER TOM	USS 4974 LO1	1978	50	65	65	15	10	--
SC01305516CDCD1	004	DILLINGHAM CITY OF	ELEMENTARY SCHOOL	1983	55.52	70	70	36	40	LOG, WL
SC01305516DCCC1	003	THOMASON FRANK	USS 2732 LO3B03	1977	75	73.5	73.5	57	--	--
SC01305516CDDD1	005	DILLINGHAM CITY OF	COURT HOUSE	--	72.92	90	90	--	70	WL
SC01305517ABAA1	004	DOLEMAN HARRY	USS 4973 LO5	1976	75	26	26	17	10	--
SC01305517ABAB1	008	RUSSIAN CHURCH	--	--	100	47.2	47.2	--	--	--
SC01305517ABBB1	002	NAT BANK OF AK	WOOD RIVER LO2	1977	105	69.5	69.5	47	--	--
SC01305517ABBB2	002	JACKSON DAVE	WOOD RIVER LO3	--	112	65	65	--	--	--
SC01305517CCAC1	006	NELSON ANDREW	USS 3643 L14	1978	80	70	70	35	15	--
SC01305517CCAD1	005	PLEIER CARL	USS 3643 L14	1977	80	47.7	47.7	32.3	--	--
SC01305517CCCA1	001	BRANNON PAUL G	--	1976	80	89.2	89.2	--	--	--
SC01305517CCCB1	009	BENEDICT CORY	SUTHERLAND LOC	--	75	45	45	--	--	--
SC01305517CCCD1	010	SUTHERLAND PAUL	SUTHERLAND LOA	1983	75	37	37	26	10	--
SC01305517CCDA1	007	BRISTOL BAY NTV CORP	--	1975	80	57.7	57.7	33	--	--
SC01305517CCDD1	011	TUBBS CLIFF	BRASWELL TROP	--	75	35	35	--	--	--
SC01305517CDCA1	003	TIMMERMAN JIM	USS 3643 L29	1977	80	42	42	33	--	LOG, QW
SC01305517CDCA2	003	CEDAR HOMES	CEDAR SUB	1981	80	49	49	36	--	--
SC01305518DCDA1	001	WIENAIR DILLINGH	USS 5688 TRO3	1976	70	87	87	--	--	QW
SC01305518DCDC1	004	SOUTHWEST AIR	USS 5688 LO3AB500A	--	87	60	60	--	--	--
SC01305518DDCB1	003	ARMSTRONG AIR SERV	USS 5688 LO4B500A	1977	80	37	37	26	--	--
SC01305518DDCC1	002	BINGMAN PHIL	--	1976	80	40	40	27	10	--
SC01305519AAAA1	007	BUELL BILL	BRASWELL TROK	1984	87	40	40	--	--	--
SC01305519AADC1	003	GLADDEN DAVID	BRASWELL L24A	1978	60	75	75	--	5	--
SC01305519ABBA1	008	YUTE	USS 5688 LO1DB500A	--	87	80	80	--	--	--
SC01305519ABCD1	005	MUHIC STEVE	USS 3699 LO3	1976	75	116	116	39	--	--
SC01305519ADCA1	006	NUNN LANCE	USS 5688 LO1	1977	77	98	98	36	15	--
SC01305519BBDA1	009	JONES FANNIE	MISSION LO2	1979	87	52	51.3	37.3	--	--
SC01305519BBDA2	009	MCGILL KARLA	--	1979	87	40	40	30	--	--
SC01305519BBDA3	009	THORSON JIM	USS 3185	1983	87	53	53	38	10	--
SC01305519BBDB1	010	MORSE JACK NO1	USS 3699 LO2	1983	50	33	33	23	10	--
SC01305519BBDB2	010	MORSE JACK NO2	USS 3699 LO2	1983	50	33	33	20	10	--
SC01305519BCBD1	011	BENNIS J.D.	BENNIS LO6A & LO6B	1983	37	38	38	20	10	--
SC01305519BCBD2	011	BENNIS J.D.	BENNIS LO6A & LO6B	--	37	31	30	--	--	--
SC01305519CABB1	004	CLARK MARTIN	SAMPSON L14F	1977	55	73.7	71	32	15	--
SC01305519CABB2	004	CLARK MARTIN	SAMPSON L14F1	--	55	59	59	--	--	--
SC01305519CABB3	004	CLARK MARTIN	SAMPSON L14F2	--	55	158	158	--	--	--
SC01305519CACB1	002	CHRISTENSE NICK	SAMPSON L14D	1977	55	46	46	12	10	--
SC01305519CBAA1	001	MAVES ROGER	SHANNONS L14A	1976	75	52	39	--	5	--
SC01305519CBBA1	012	SMITH KENT	MAVES LO1	--	75	41	41	--	--	--
SC01305519CBBD1	013	WILSONS VERNER	USS 4980 L15	1979	87	40	40	23	--	--
SC01305519CCDD1	014	SHADE MARY	USS 4980 L20	--	87	25	25	--	--	--
SC01305520ADCC1	004	BALL BROTHERS	USS 4980 L16	--	25	37	36	--	--	--
SC01305520ADCC2	004	BALL BROTHERS	USS 4980 L16	--	25	37	36	--	--	--
SC01305520BBBA1	002	SAGMOEN OLE	--	1976	80	37	36.7	27	--	--
SC01305520BBBB1	003	NICHOLSON BOB	--	1983	87	42	42	--	--	--
SC01305520BBCC1	001	KNUTSEN GUSTY	BRASWELL TROD	1976	75	84	84	--	--	--
SC01305521ABAC1	002	DILLINGHAM CITY OF	CITY NO. 1	--	83.72	128	128	64	20	LOG, WL,QW
SC01305521ABBD1	001	DILLINGHAM CITY OF	PHS NO. 2	1977	84.93	88	88	75.2	48	LOG, WL
SC01305521ABBD2	001	DILLINGHAM CITY OF	MAIN	1978	80	91	85	69	225	LOG
SC01305521ABBD3	001	DILLINGHAM CITY OF	ABANDONED	1977	80	85	85	--	--	LOG
SC01305521BAAB1	007	DILLINGHAM CITY OF	CITY NO. 2, HIGH SC	1959	75	83	83	43	--	--
SC01305521BABD1	006	DILLINGHAM CITY OF	PHS NO. 1	1977	35	130	118	--	15	LOG
SC01305521BABD2	006	DILLINGHAM CITY OF	CITY NO. 3	1974	34.78	119	115	12.5	100	LOG,WL,QW
SC01305521BACB1	011	PETER PAN SEAFOODS	--	1978	35	140	140	18	150	--
SC01305521BACC1	010	PETER PAN SEAFOODS	OLD WELL	1927	35	213	213	15	--	QW
SC01305521BBAD1	012	PETER PAN SEAFOODS	TENT CITY	1977	35	105	105	7	--	--
SC01305521BBCD1	013	PETER PAN SEAFOODS	BOAT HARBOR	1977	27.79	205	190	6.41	--	LOG, WL
SC01305521BDAB1	009	SEA INN BAR	USS 2732 LO2B31	1976	60	111	108	30	10	--
SC01305521BDBB1	003	PETER PAN	USS 0155	--	37	131	131	--	--	--
SC01305530BBAC1	001	HANSEN OLAF	OLAFS ACRES L21	1979	37	110	110	--	--	--
SC01305530BBAC2	001	HANSEN PAUL	OLAFS ACRES L21	1979	37	142	100	55	--	--

Table 4.--Summary of data for wells and springs--Continued

[See explanation following table]

Well number	Map number	Owner	Local, subdivision, or survey name	Year drilled	Altitude (feet)	Hole depth (feet)	Well depth (feet)	Water level (feet below land surface)	Yield (gallon per minute)	Other data in this report
SC01305602BADD1	001	NELSON LARS	LARS NELSON L01B03	--	162	69	69	--	--	--
SC01305602BCAA1	002	HARTSHORN JIM	LARS NELSON L04B02	1983	150	60	60	44	15	--
SC01305602BDAD1	003	PARKINS JACK	STRADAVARIUS L07A	--	162	46	46	--	--	--
SC01305602BDBB1	004	CHRISTENSEN RAY	LARS NELSON L06B02	--	150	58	58	--	--	--
SC01305602BDBB2	004	RITTY GORDON	LARS NELSON L05B02	--	150	52	52	--	--	--
SC01305602BDDA1	005	KING BOB	STRADAVARIUS L07B	--	150	42	42	--	--	--
SC01305602BDDBA	006	TRASK JUDI	STRADAVARIUS L06B	--	150	41	41	--	--	--
SC01305602CCBB1	007	MOATOS	AHKLUN VW EST L10	1983	150	37	37	26	10	--
SC01305602CCCC1	008	MEYER CHUCK	AHKLUN VW EST L08	1983	137	32	32	15	--	--
SC01305610ADAA1	001	TENNYSON B	AHKLUN VW EST L09B01		87	48	48	--	--	--
SC01305610DAAD1	002	HEYANO ROBERT	AHKLUN VW EST L06A		87	20	20	--	--	--
SC01305611BBAA1	002	DAVIDSON	AHKLUN VW EST L01	1983	137	51	51	38	15	--
SC01305611BBAA2	002	INGRAM BILL, JR.	AHKLUN VW EST L02	1983	137	51	51	36	12	--
SC01305611BBAD1	003	HALL MARK	AHKLUN VW EST L03	--	137	38	38	--	--	--
SC01305611BBCB1	004	STEPHENS BILL	AHKLUN VW EST L03B01	1983	125	50	50	20	8	--
SC01305611BBCC1	005	DIESETH SCOTT	AHKLUN VW EST L05A	--	125	50	50	--	--	--
SC01305611BCBB1	006	FLYNN JACK	AHKLUN VW EST L08B01	--	112	39	39	--	--	--
SC01305611CBDD1	001	BARNES HARRY	DSS 4982 L11	1977	110	42	42	23	--	--
SC01305613BCBC1	001	LADD	NERKA IV L04B04	--	62	30	30	--	--	--
SC01305613BCCB1	002	COUGHSIENHAUER	NERKA IV L14B01	--	87	35	35	--	--	--
SC01305613BCDB1	003	FISHER	--	1983	75	30	30	19	8	--
SC01305613BCDD1	004	LAYLAND	NERKA IV L09B04	1983	50	34	34	20	13	--
SC01305613CABC1	005	BINGMAN LESTER	NERKA V L02	1985	50	40	35	--	--	--
SC01305613CACB1	006	FOX ALICE	NERKA VI	1985	62	42	40	--	--	--
SC01305613CBBC1	007	SATTERFIELD JAY	NERKA II L08B02	1982	87	40	40	--	10	--
SC01305613CBBC2	007	SATTERFIELD JAY	NERKA II L08B02	1984	87	31	31	15	8	--
SC01305613CBBC3	007	TAYLOR KEN	NERKA II L07B02	--	87	49	49	--	--	--
SC01305613CBBC4	007	COLLINS	NERKA II L08B01	1981	87	40	40	25	10	--
SC01305613CBBD1	008	ISAACS GORDY	NERKA L06	1981	87	50	50	30	15	--
SC01305613CBBD2	008	BUCHER WESLEY	NERKA II L09B02	1982	87	40	40	24	10	--
SC01305613CBDA1	009	TAYLOR JOHN	NERKA L01	1983	87	40	40	28	8	--
SC01305613CBDA2	009	ROBERTS FREEMAN	NERKA L12	--	87	27	27	--	--	--
SC01305613CCBC1	010	FIREHALL	VOLUNTEER L02	1985	62	42	40	--	--	--
SC01305613CCDB1	011	JONES WARD	T.J. L01	1984	75	40	40	19	8	--
SC01305613CCDB2	011	JONES WARD	T.J.	--	75	38	38	--	--	--
SC01305613CDCD1	012	MINARD	FIREWEED L12	--	37	30	30	--	--	--
SC01305613CDCD2	012	IMDIEKE ROY	FIREWEED L09	--	37	35	35	--	--	--
SC01305613CDDC1	013	STOUT	FIREWEED L08	1983	37	30	30	--	7	--
SC01305613CDDD1	014	DAVISON BILL	FIREWEED L06	--	37	130	65	--	--	--
SC01305613DCCC1	015	TENNYSON RICK	FIREWEED L04	--	37	35	35	--	--	--
SC01305614AABB1	010	OCONNELL DANIEL	THERESA L05A	1983	87	31	31	18	8	--
SC01305614ABAC1	011	MADDOX SUE	THERESA TERR L17A	1983	100	32	32	19	--	--
SC01305614ABBD1	007	CHRISTIANS BOB	--	1978	100	55	55	31	--	--
SC01305614ABCB1	003	ANDERSON ANDY	USS 4982 L09-15A	1976	100	40	40	26	--	--
SC01305614ABCD1	004	LUCKHURST VERN	USS 4982 L09-1A	1976	100	35	35	22	--	--
SC01305614ABCD2	004	KOUTCHAK RUBY	COHO L08B01	--	112	30	30	--	--	--
SC01305614ABDC1	009	OBRIEN DAN	USS 4982 L09-4A	1976	105	36.7	36.7	20	--	--
SC01305614ABDC2	009	RYAN GEORGE	THERESA TERR L03A	--	112	32	32	--	--	--
SC01305614ACAB1	012	ROBINSON LES	NAPAQ L01B01	1983	112	40	40	27	8	--
SC01305614ACAB2	012	MULKEIT FRED	NAPAQ L02B02	--	112	36	36	--	--	--
SC01305614ACBD1	013	IRKE KEITH	COHO L02B02	1982	87	34	34	--	10	--
SC01305614ADBC1	014	NELSON CARL	NAPAQ L05B03	1951	112	55	55	35	--	--
SC01305614ADDB1	015	SORENSON JOHN	NERKA II L02B03	1984	100	35	35	32	10	--
SC01305614ADDC1	016	HILL	NERKA II L02B02	--	100	38	38	--	--	--
SC01305614ADDD1	017	WIGHTMAN ROBERT	NERKA II L04B01	1981	87	40	40	15	10	--
SC01305614BAAA1	018	WARD JIM	THERESA TERR L01B	--	112	35	35	--	--	--
SC01305614BAAD1	001	KROPOFF PAUL	USS 4982 L9-10A	1976	105	42	42	32	--	--
SC01305614BAAD2	001	DARDEN DON	USS 4982 L9-11A	1976	105	41	41	32	--	LOG, QW
SC01305614BAAD3	001	NELSON MIKE	USS 4982 L9-13A	1976	105	40	40	27	5	--
SC01305614CAAA1	002	HIRATSUKA FRANK	USS 4982 L05	1976	105	42	42	22	--	--
SC01305614CAAA2	002	HIRATSUKA FRANK	USS 4982 L05	1977	105	30	23	12	14	--
SC01305614DAAA1	019	REYNOLDS MARK	NERKA II L05B01	1982	87	40	40	15	10	--
SC01305614DAAA2	019	NBA HOUSE	NERKA II L06B02	--	87	80	80	--	--	--
SC01305614DBAD1	020	DUNCAN BILL	DUNCAN ACRES L01	--	37	40	40	--	--	--
SC01305614DBBA1	006	DUNCAN BILL	USS 4982 L03	1976	60	30	30	16	--	--
SC01305614DBBB1	005	ABRAMS MEL	SHANNON L03	1976	75	35	33	21	--	LOG, QW
SC01305614DBBB2	005	MURPHY RICK	SHANNON L06	1977	75	30	30	16	--	--
SC01305614DBDA1	008	MULLINS CONSTR	USS 4982 L03	1977	100	42	42	17	--	--
SC01305624BABA1	002	HOLSTROM	FIREWEED L10	1983	50	40	40	29.5	8	--
SC01305624BABB1	001	CHERRY BEN	FIREWEED L14	1982	50	31	31	15	12	--
SC01305624BABB2	001	MANARD MAC	FIREWEED L11	--	50	32	32	--	--	--
SC01305624BACB1	003	OBERHAULSER CHRIS	SAMPSON EST L15	--	50	46	46	--	--	--
SC01305624BACC1	004	SAMPSON RODNEY	SAMPSON EST L03	--	50	40	40	--	--	--
SC01305624BACC2	004	MERTON	SAMPSON EST L17	1983	50	30	30	17	10	--
SC01305624BBAD1	005	SCHLEGAL TOM	SAMPSON EST L09	--	75	33	33	--	--	--
SC01305624BBAD2	005	BROWN CARY	SAMPSON EST L10	--	75	40	40	--	--	--
SC01305624BBDA1	006	LAW KEN	SAMPSON EST L07	--	87	30	30	--	--	--
SC01305624BBDA2	006	FOY STEVE	SAMPSON EST L08	--	87	40	40	--	--	--
SC01305624BBDB1	007	SIPPERLY ANDY	SAMPSON EST II L19	--	87	32	32	--	--	--

Table 4.--Summary of data for wells and springs--Continued

[See explanation following table]

Well number	Map number	Owner	Local, subdivision, or survey name	Year drilled	Alti-tude (feet)	Hole depth (feet)	Well depth (feet)	Water level (feet below land surface)	Yield (gallon per minute)	Other data in this report
SC01305624BBDB2	007	WENTZ MAREEN	SAMPSON EST II L20	--	87	37	37	--	--	--
SC01305624BBDC1	008	PETTERSON STEVE	SAMPSON EST L06	1984	87	30	30	18	10	--
SC01305624BDBB1	009	NOVAK JOHN	SAMPSON EST L04	--	87	30	30	--	--	--
SC01305624BDBB2	009	WREN STEVE	WREN L01	1984	87	30	30	21	10	--
SC01305624DAAA1	010	SIFSOF VICTOR	USS 4980 L29A	--	75	38	38	--	--	--
SC01305624DAAB1	011	BACKFORD GERTRUDE	BACKFORD L09	1979	75	42	42	26	--	--
SC01305624DAAB2	011	SUTTLES ERIC	BACKFORD L09	--	75	36	36	--	--	--
SC01305624DAAB3	011	SUTTLES ERIC	BACKFORD L09	--	75	48	48	--	--	--
SC01305624DCDA1	012	BURKHART RUSS	USS 6165	--	37	116	116	--	--	--
SC01305625AAAC1	002	MAHRT DAVE	BEAVER HOUSE L03	--	37	98	98	--	--	--
SC01305625ABAD1	001	LECLAIR DON	USS 4980 L12	1976	80	120	118	50	--	--
SC01305636ACBB1	003	NICHOLSEN JOHN	USS 5755 L01	1979	62	51	51	--	--	--
SC01305636ACBB2	003	NICHOLSEN WILLIAM	USS 5755 L02	--	62	140	140	--	--	--
SC01305636ACDD1	004	STAMBAUGH	PETE HANSEN L04	--	75	46	46	--	--	--
SC01305636ADCC1	005	MICHOLSON PAUL	PETE HANSEN L05	--	75	40	40	--	--	--
SC01305636BDDD1	001	TIMMERMAN JOHN	USS 4985 L15	1977	50	47.2	47.2	18	--	LOG, QW
SC01305636DCDA1	006	SASSA WALLONA	S & W L14C	1979	62	54	54	30	--	--

EXPLANATION OF TABLE HEADINGS

WELL NUMBER: The wall-numbering system used in this report is the Alaska Water Resources Division's local well-numbering system and is based on the rectangular subdivision of public lands. The first two letters indicate the well's position in reference to a base and meridian (first letter) and the quadrant formed by the intersection of the base line and the principal meridian (second letter), lettered counter-clockwise from the northeast corner:

B	A
C	D

In this report, all wells are in the Seward base and meridian (S) and in its southwestern quadrant (C). The first three digits indicate the township in which the well is located, the next three digits the range, and the last two digits the section. For example, a well numbered SC01305508DCCB1 is located in township 13 south, range 55 west, section 8. Letters following the section number indicate further subdivision: the quarter section, the quarter-quarter section, and so forth to the fourth section subdivision. Like the quadrants formed by the base and meridian, each succeeding subdivision is lettered counter-clockwise from the northeast corner. Well SC01305508DCCB1 is thus located in the northwest quarter (B) of the southwest quarter (C) of the southwest quarter (C) of the southeast quarter (D) of section 8.

T. 13 S.

8 R. 55 W.

SC01305508DCCB1 001

MAP NUMBER: Map number refers to the sequential listing of wells within a square-mile section (see figure 2 for map locations). Thus, well SC01305508DCCB1 001 was the first well recorded in section 8.

OWNER: Person, business, or agency reaponsible for the well at the time the well information was reported or collected.

LOCAL, SUBDIVISION, OR SURVEY NAME: This entry may further assist one in locating a well. Lot and block numbers may also be listed in this column, for example, lot 2 block 31 is listed as "L02B31".

YEAR DRILLED: Date driller recorded the well log, usually when the last test was made or well reached final depth.

ALTITUDE: Altitudes of land surface at wells were determined from topographic maps that have 25-foot contour intervals or by a level survey which used reference marks on fire hydrants that were previously surveyed for the City of Dillingham. Altitudes are in feet above sea level.

HOLE AND WELL DEPTHS: Depth of hole and well, from land surface, as reported by the driller or owner. It is the distance from land surface at the well to the bottom of the casing or screen. Most domestic wells in this area are completed with open-ended casings that are 5 or 6 in. in diameter.

WATER LEVEL: Depth to water from land surface, in feet, in the completed well. Most entries were reported by drillers or owners and have not been field checked. All water levels are assumed to be a static water surface, that is, a natural level not influenced by any recent withdrawal of water from the well.

YIELD: The rate, in gallons per minute, that that water has been withdrawn from the well during a short test period. Usually this testing is accomplished by the well driller by pumping or bailing for 0.25 to 2 hours. Caution: this entry often does not reflect the long-term capacity of the well to supply water and commonly either overestimates or underestimates the full potential of the aquifer at that location.

OTHER DATA IN THIS REPORT:

LOG, lithologic descriptions from driller's log are shown in table 5. Most wells listed in table 4 have a driller's log on file at the U.S. Geological Survey - Water Resources Division's offica in Anchorage, Alaska.

WL, water levels measured by U.S. Geological Survey personnel are shown in table 6.

QW, water quality collected by U.S. Geological Survey personnel are shown in table 7.

Table 5.--Lithologic descriptions from drillers' logs of selected wells

Depth below land surface, in feet	Lithologic description
Well SC01305516CDAB1 001, City of Dillingham PHS No. 3	
[Log by U.S. Public Health Service]	
0 to 2	Muskeg
2 to 9	Silty sand
9 to 26	Sand and gravel, dry
26 to 59	Sand and gravel, clean and heaving
59 to 63	Sand, black, tight; no water
63 to 70	Sand and gravel, coarse; water
Well SC01305516CDCD1 004, Dillingham Elementary School	
[Log by Fortune Enterprises]	
0 to 18	Brown dirt and clay
18 to 31	Sand and gravel
31 to 52	Gravel
52 to 58	Sand and small gravel
58 to 70	Large gravel
Well SC01305517CDCA1 003, Jim Timmerman	
[Log by Jim's Drilling]	
0 to 10.5	Topsoil and red clay
10.5 to 21	Red clay
21 to 31.5	Red clay; into gravel and rock at 25.5 ft; 1 ft of blue clay at 24 ft
31.5 to 36.8	Gravel and rock to 1.5 in.; some water at 35 ft
36.8 to 42	Gravel and rock to 2 in.; small amount of coarse sand

Table 5.--Lithologic descriptions from drillers' logs of selected wells--Continued

Depth below land surface, in feet	Lithologic description
Well SC01305521ABAC1 002, City of Dillingham No. 1	
[Log by Robert Plier]	
1 to 1.5	Tundra
1.5 to 12	Sand
12 to 32	Blue clay
32 to 48	Blue clay and gravel
48 to 79	Blue clay
79 to 87	Blue clay and gravel
87 to 90	Fine sand and gravel, water
90 to 95	Coarser sand and gravel
95 to 100	Very fine sand and silt
100 to 102	Coarse sand and gravel; heaving sand
102 to 110	Fine sand
110 to 116	Fine silt and sand; heaving sand
116 to 125	Dirty sand and gravel
125 to 127	Fine sand and gravel; some clay
127	Blue clay with streaks of brown
Well SC01305521ABBD1 001, City of Dillingham PHS No. 2	
[Log by U.S. Public Health Service]	
0 to 2	Muskeg
2 to 27	Yellow clay and silt
27 to 30	Yellow silt and sand; small rock
30 to 35	Yellow silt and fine sand; water
35 to 46	Yellow clay
46 to 48	Yellow sand and silt
48 to 52	Sand and gravel; water (static water level is 11 ft)
52 to 54	Blue clay
54 to 72	Gravel and big rocks; dry
72 to 85	Coarse gravel and rocks; water (well screened from 75 to 85 ft)
85 to 88	Blue clay
Well SC01305521ABBD2 001, City of Dillingham, Main well	
[Log by U.S. Public Health Service]	
0 to 2	Muskeg
2 to 27	Yellow clay and silt
27 to 30	Yellow silt and sand; small rock
30 to 35	Yellow silt and fine sand; water
35 to 46	Yellow clay
46 to 48	Yellow sand and silt
48 to 52	Sand and gravel; water
52 to 54	Blue clay
54 to 72	Gravel and big rock
72 to 85	Coarse gravel and rock (well screened from 75 to 85 ft)
85 to 88	Blue clay

Table 5.--Lithologic descriptions from drillers' logs of selected wells--Continued

Depth below land surface, in feet	Lithologic description
Well SC01305521ABBD3 001, City of Dillingham, abandoned	
[Log by U.S. Public Health Service]	
0 to 2	Muskeg
2 to 27	Yellow clay and silt
27 to 30	Yellow silt and sand; small rocks
30 to 35	Yellow silt and fine sand; water
35 to 46	Yellow clay
46 to 48	Yellow sand and silt
48 to 52	Sand and gravel; water (static water level is 11 ft)
52 to 54	Blue clay
54 to 72	Gravel and big rock; dry
72 to 85	Coarse gravel and rocks; water
Well SC01305521BABD1 006, City of Dillingham, PHS No. 1	
[Log by U.S. Public Health Service]	
0 to 8	Brown muskeg
8 to 12	Blue silt and sand
12 to 30	Blue clay
30 to 47	Blue clay and sand; silt
47 to 55	Sand and gravel
55 to 93	Blue clay
93 to 118	Fine sand (well screened from 93 to 118 ft)
Well SC01305521BABD2 006, City of Dillingham No. 3	
[Log by City of Dillingham]	
0 to 19	Tundra
20 to 24	Sand and water
24 to 30	Clay, sand and water
30 to 35	Pea gravel
35 to 50	Gravel
50 to 53	Gravel and sand
53 to 57	Gravel and clay
57 to 96	Clay
96 to 99	Clay and sand
99 to 101	Clay and gravel
101 to 119	Sand and gravel (well has 20 ft of perforations)

Table 5.--Lithologic descriptions from drillers' logs of selected wells--Continued

Depth below land surface, in feet	Lithologic description
Well SC01305521BBCD1 013, Peter Pan Seafoods, boat harbor	
[Log by Jim's Drilling]	
0 to 11	Topsoil
11 to 21.5	Sand
21.5 to 32	Sand and blue clay
32 to 63.7	Blue clay
63.7 to 74.2	Silt and fine sand
74.2 to 84.8	Compacted silt
84.8 to 95.3	Compacted silt and blue clay
95.3 to 105.8	Silt, blue clay, and rock
105.8 to 116.3	Hard blue clay and rock
116.3 to 127	Hard blue clay, rock, and compacted silt
127 to 148.1	Compacted silt
148.1 to 158.7	Compacted silt and blue clay
158.7 to 179.7	Hard blue clay, gravel and rock
179.7 to 190.2	Blue and brown clay and rock
190.2 to 196	Clay
196 to 205	Silt and muck
Well SC01305614BAAD2 001, Don Darden	
[Log by Jim's Drilling]	
0 to 10	Topsoil
10 to 15	Clay, gravel, rocks, and sand
15 to 30	Gravel, rocks, and some sand
30 to 35	Gravel, rocks, some sand, and white clay
35 to 41	White chalk clay, rocks, gravel, and sand; water
Well SC01305614DBBB1 005, Mel Abrams	
[Log by Jim's Drilling]	
0 to 20	Red clay
20 to 25	Gravel, rock, and sand
25 to 30	Gravel, rock, and sand; water
30 to 35	Gravel and rock
Well SC01305636BDDD1 001, John Timmerman	
[Log by Jim's Drilling]	
0 to 10.5	Topsoil and clay
10.5 to 21	Sand and silt
21 to 26.3	Sand and clay
26.3 to 31.5	Mud
31.5 to 36.8	Silt and clay
36.8 to 42	Mud and gravel
42 to 47.3	Gravel and rocks; water

Table 6.–Ground-water levels

Local number, SC01305516CDAB1 001, Dillingham PHS No. 3

LOCATION.--Lat 59°02'08", long 158°27'43", Hydrologic unit 19040002, northwest of PHS quonset hut, Second Avenue, Dillingham. Owner: City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 8 in, depth 70 ft, open end.
INSTRUMENTATION.--Intermittent measurements.
DATUM.--Altitude of land surface is 47.56 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1978 to 1986.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 19.76 ft below land-surface datum, April 16, 1979; lowest, 24.71 ft below land-surface datum, June 30, 1986.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
JUL 14, 1978	21.82	MAY 08, 1979	21.48	NOV 28, 1979	21.77	JAN 18, 1981	23.33
OCT 20, 1978	22.90	JUN 07, 1979	23.12	JUN 04, 1980	22.40	MAR 10, 1981	22.82
JAN 11, 1979	21.44	JUN 27, 1979	24.18	JUN 24, 1980	22.94	OCT 07, 1982	19.90
APR 16, 1979	19.76	NOV 27, 1979	21.72	SEP 24, 1980	22.93	SEP 24, 1985	23.05
						JUN 30, 1986	24.71

Local number, SC01305516CDCD1 004, Dillingham Elementary School

LOCATION.--Lat 59°02'39", long 158°27'48", Hydrologic unit 19040002, southwest of Elementary School, Dillingham. Owner:City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 6 in, depth 72 ft.
INSTRUMENTATION.--Intermittent measurements.
DATUM.--Altitude of land surface is 55.52 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1985 to 1986.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 30.75 ft below land-surface datum, September 24, 1985; lowest, 32.62 ft below land-surface datum, July 16, 1986.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
SEP 24, 1985	30.75	JUN 30, 1986	32.19	JUL 16, 1986	32.62

Local number, SC01305516CDDD1 005, Dillingham Courthouse Well

LOCATION.--Lat 59°02'39", long 158°27'35", Hydrologic unit 19040002, about 200 ft east of the State court building, near the intersection of 2nd Avenue and the old airstrip, Dillingham. Owner: City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 6 in, depth 90 ft, screened.
INSTRUMENTATION.--Intermittant measurements with steel tape.
DATUM.--Altitude of land surface is 72.92 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1985 to 1986.

DATE	WATER LEVEL	DATE	WATER LEVEL
SEP 24, 1985	48.20	JUN 30, 1986	67.57

Local number, SC01305521ABAC1 002, Dillingham City Well No. 1

LOCATION.--Lat 59°02'30", long 158°27'18", Hydrologic unit 19040002, First Avenue East and D street, Dillingham. Owner: City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 6 in, depth 127.5 ft, finish unknown.
INSTRUMENTATION.--Intermittent measurements.
DATUM.--Altitude of land surface is 83.72 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1985 to 1986.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 62.20 ft below land-surface datum, September 24, 1985; lowest, 66.00 ft below land-surface datum, July 17, 1986.

DATE	WATER LEVEL	DATE	WATER LEVEL
SEP 24, 1985	62.20	JUL 17, 1986	66.00

Local number, SC01305521ABBD1 001, Dillingham PHS No. 2

LOCATION.--Lat 59°02'34", long 158°27'25", Hydrologic unit 19040002, Central Avenue near water-treatment plant, Dillingham. Owner: City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 6 in, depth 88 ft, screened 75 to 85 ft.
INSTRUMENTATION.--Continuous strip-chart recorder.
DATUM.--Altitude of land surface is 84.93 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1978 to 1987.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 68.30 ft below land-surface datum, Jan. 5, 1979; lowest, 75.92 ft below land-surface datum, July 7, 1979.
REMARKS.--Each water-level value for this well that is listed in the table below is the highest water level recorded during that day. However, the annual low water level listed below each year's data is the lowest water level recorded during that year.

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	---	69.60	69.15	68.30	69.39	71.84	71.41	70.03	70.25	73.44	72.24	70.60
10	---	69.68	69.18	69.03	70.99	71.56	71.46	70.21	70.00	73.09	71.93	70.85
15	---	69.92	69.06	68.80	70.85	71.60	70.37	70.12	70.12	73.09	71.46	70.38
20	70.66	70.05	---	68.83	71.32	71.86	69.46	70.46	70.86	73.42	70.99	70.25
25	70.36	69.55	68.90	68.82	71.86	71.08	69.41	70.68	71.33	72.85	70.86	69.89
EOM	69.84	69.53	68.40	69.33	71.76	71.40	69.64	70.32	72.26	72.53	70.60	69.86

WTR YR 1979 HIGH 68.30 JAN 5 LOW 75.92 JUL 7

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	69.84	---	69.85	70.88	72.25	71.36	71.27	71.38	71.60	72.02	73.79	72.01
10	69.71	---	70.15	71.05	71.89	71.17	71.17	71.80	71.44	71.97	73.93	71.81
15	---	---	70.35	71.66	71.87	71.51	71.00	71.17	71.56	71.91	72.96	71.55
20	---	---	70.95	71.54	71.49	72.27	71.67	70.88	72.13	72.00	73.16	71.07
25	---	---	71.17	71.79	71.03	71.52	71.43	70.68	72.33	72.83	72.23	71.40
EOM	---	69.93	70.54	72.05	71.32	71.28	71.54	71.65	72.14	73.76	72.39	70.93

WTR YR 1980 HIGH 69.15 OCT 14 LOW 74.95 AUG 13

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	70.52	70.82	70.33	71.80	71.53	72.35	71.69	71.69	---	---	---	72.64
10	70.61	70.18	71.41	71.17	71.26	73.93	71.83	71.99	---	---	75.11	72.76
15	70.64	70.28	---	71.36	72.38	72.65	71.74	72.51	72.87	---	73.46	72.54
20	70.65	70.73	72.48	70.81	71.59	72.72	71.64	71.97	---	---	73.56	72.53
25	70.45	69.96	---	71.42	72.04	72.29	71.62	71.83	---	---	73.78	72.28
EOM	69.87	70.20	72.17	70.94	72.02	71.82	71.93	---	---	---	73.02	72.08

WTR YR 1981 HIGH 69.81 NOV 1 LOW 75.14 AUG 10

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MINIMUM VALUES

DAY	OCT
5	72.17
10	72.14
15	---
20	---
25	---
EOM	---

NO DATA AVAILABLE FOR REMAINDER OF WATER YEAR.

WTR YR 1982 HIGH 71.90 OCT 1 LOW 72.97 OCT 9

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	---	---	---	71.80	72.80	73.40	71.90	71.90	---	---	---	---
10	---	---	---	---	73.10	73.50	72.40	71.90	---	---	---	72.21
15	---	---	71.10	72.00	73.20	73.20	71.80	72.60	---	---	---	71.92
20	---	---	71.20	72.40	73.70	73.00	71.40	72.50	---	---	---	71.57
25	---	---	71.40	72.70	73.40	71.70	71.20	73.30	---	---	---	71.58
EOM	---	---	71.60	72.60	73.30	71.20	71.30	74.70	---	---	---	71.20

WTR YR 1984 HIGH 70.80 APR 2 LOW 75.16 JUN 2

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	70.84	70.75	70.86	70.74	73.12	---	---	70.93	72.78	74.34	72.36	71.96
10	71.14	70.82	70.61	71.94	71.90	72.44	71.69	70.69	72.65	74.38	71.84	72.36
15	70.90	70.92	70.90	73.26	---	72.22	---	70.55	71.56	74.66	72.20	71.28
20	70.97	70.80	71.03	73.24	---	72.25	71.79	70.58	72.86	73.43	71.59	70.52
25	70.95	71.33	70.89	73.41	---	---	71.70	70.87	73.94	72.85	71.03	71.94
EOM	70.84	71.04	71.02	73.30	---	---	71.28	73.16	74.09	72.50	70.63	72.19

WTR YR 1985 HIGH 70.46 MAY 12 LOW 74.75 JUL 15-16

WATER LEVEL (FEET BELOW LAND SURFACE), WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986
MINIMUM VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5	72.76	72.91	69.53	69.78	72.50	72.26	71.93	73.36	72.68	73.80	72.27	71.90
10	71.91	72.04	70.27	69.60	71.44	72.14	72.13	72.84	72.56	73.50	71.68	72.92
15	72.41	70.50	70.09	69.79	71.36	72.47	72.15	71.86	72.87	73.32	70.95	72.94
20	71.49	70.00	69.49	69.88	71.29	72.10	72.33	73.41	73.66	73.71	70.52	71.86
25	72.30	69.88	69.29	70.41	---	71.78	72.44	72.56	73.11	73.58	72.47	72.56
EOM	72.81	69.60	69.43	71.67	---	71.48	72.65	72.41	73.61	73.45	72.92	71.88

WTR YR 1986 HIGH 69.29 DEC 25 LOW 73.94 JUL 15

Local number, SC01305521BABD2 006, Dillingham City Well No. 3

LOCATION.--Lat 59°02'31", long 158°27'54", Hydrologic unit 19040002, about 250 ft west of City of Dillingham's Public Works building, Dillingham. Owner: City of Dillingham.
AQUIFER.--Sand and gravel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 8 in, depth 115 ft.
INSTRUMENTATION.--Intermittent measurements.
DATUM.--Altitude of land surface is 34.78 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1978 to 1981, 1985 to 1986.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 8.08 ft below land-surface datum, January 11,1979; lowest, 16.08 ft below land-surface datum, April 16, 1979.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	
JUL 14, 1978	12.45	JUN 07, 1979	10.00	APR 10, 1980	9.44	JAN 08, 1981	10.20	
OCT 20, 1978	9.63	JUN 27, 1979	11.80	JUN 04, 1980	9.43	MAR 10, 1981	9.63	
JAN 11, 1979	8.08	NOV 27, 1979	8.65	JUN 24, 1980	10.18	SEP 24, 1985	10.03	
APR 16, 1979	16.08	JAN 30, 1980	9.88	SEP 24, 1980	9.30	JUN 30, 1986	11.44	
						JUL 17, 1986	18.88	Pumping

Local number, SC01305521BBCD1 013. Peter Pan Seafoods — Boat harbor well

LOCATION.--Lat 59°02'27", long 158°28'16", Hydrologic unit 19040002, East of Dillingham's small-boat herbor, Dillingham. Owner: Peter Pan Seafoods.
AQUIFER.--Clay, sand and grevel of the Quaternary System.
WELL CHARACTERISTICS.--Diameter 10 in, depth 190 ft, finish unknown.
INSTRUMENTATION.--Intermittent measurements.
DATUM.--Altitude of land surface is 27.79 ft above National Geodetic Vertical Datum of 1929 (determined from levels survey).
PERIOD OF RECORD.--1979 to 1982, 1985 to 1986.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 4.02 ft below land-surface datum, September 25, 1985; lowest, 8.10 ft below land-surface datum, October 7, 1982.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
JUN 06, 1979	6.41	APR 10, 1980	6.10	SEP 24, 1980	6.05	JUL 08, 1981	5.96
JUN 27, 1979	6.26	JUN 03, 1980	6.03	JAN 08, 1981	6.05	OCT 07, 1982	8.10
NOV 28, 1979	6.12	JUN 24, 1980	5.98	MAR 10, 1981	6.09	SEP 25, 1985	4.02
						JUL 17, 1986	5.78

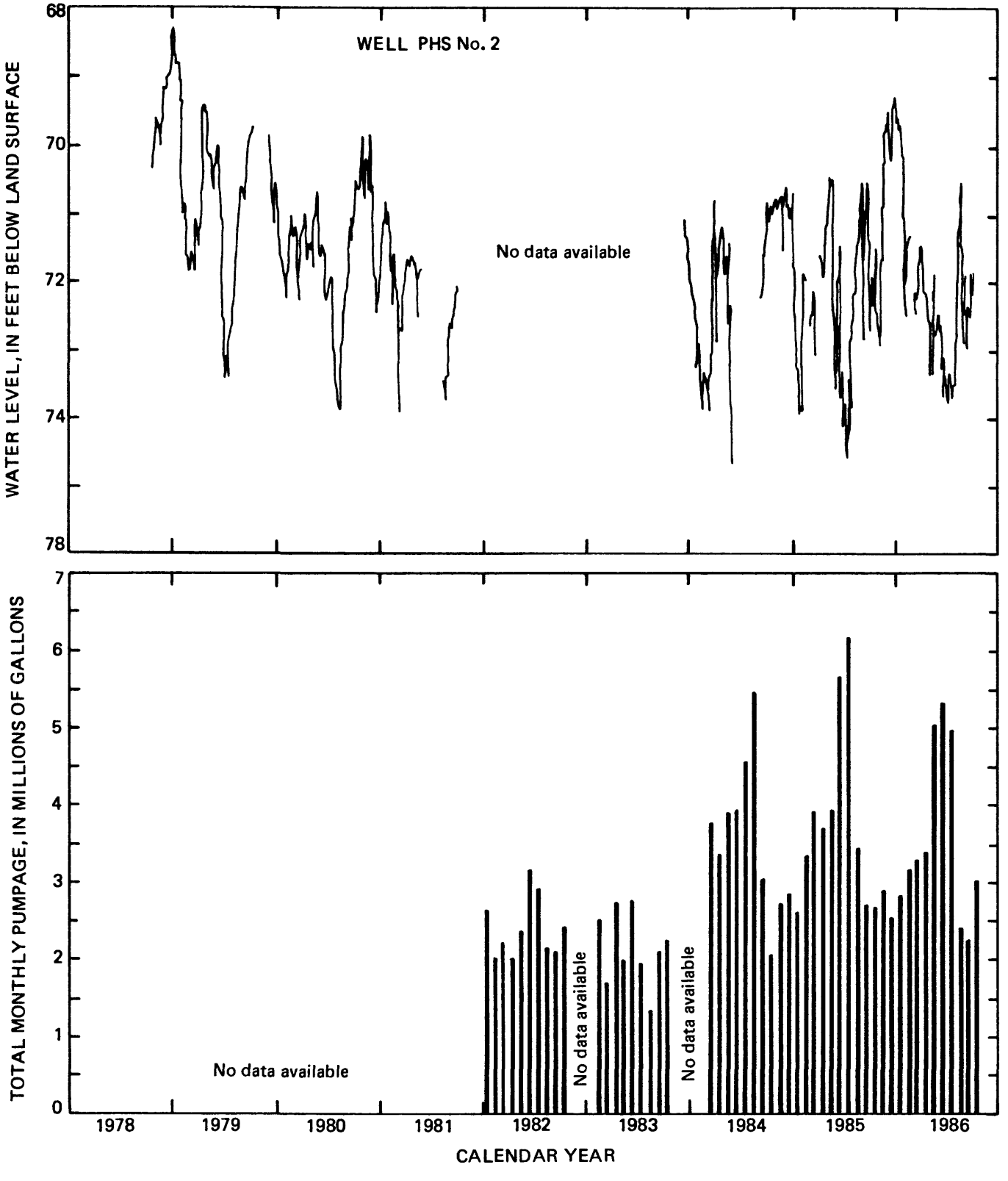


Figure 3.-- Water levels in well PHS No. 2 and total pumpage from three public-supply wells.

On September 24, 1985, water levels in seven wells in the Dillingham townsite area (PHS No. 3, elementary school, courthouse, City Nos. 1 and 3, PHS No. 1, and boat harbor) were between 21 and 25 ft above sea level, whereas the water level in well PHS No. 2, located about 10 ft from a public-supply well that was pumping intermittently, was about 13 ft above sea level. On June 30, July 16, and July 17, 1986, static (nonpumping) water levels in wells PHS Nos. 2 and 3, City Nos. 1 and 3, and elementary school were less than 4 ft lower than measurements made during the previous September, whereas the static water level in the courthouse well was 19.37 ft lower. On July 17, 1986, well City No. 3 was pumping, and its water level was 15.9 ft above sea level.

Ground-water levels that are near or below sea level are a cause for concern because increased pumping rates might produce a greater drawdown and possibly could induce saltwater from the estuary to migrate into aquifers that currently (1986) yield freshwater. However, the season of maximum ground-water use in midsummer coincides with high stream discharge (table 2) and great dilution of the estuary by freshwater. Thus, if pumping conditions remain at current levels (pumping rates that are about 100,000 gal/d during most of the year and a peak rate about 1 million gal/d that lasts only a few weeks), the threat of saltwater migrating inland to the city's public-supply wells seems unlikely. Periodically, however, ground-water levels need to be measured and water samples need to be collected and analyzed for specific conductance and concentrations of dissolved chloride to verify that saltwater is not migrating into aquifers used for public supply.

Nine samples of ground water from the Dillingham area have been analyzed for chemical and physical quality by the Geological Survey (table 7). Specific conductance, a commonly used indicator of dissolved-solids content, ranged from 65 to 700 µS/cm; this indicates that the water has a dissolved-solids content ranging from about 45 to about 500 mg/L. Less than 500 mg/L dissolved solids is desirable for domestic and most commercial and industrial uses (U.S. Environmental Protection Agency, 1977).

Chloride is present in elevated concentrations in seawater, and its chemical behavior is relatively nonreactive; thus chloride is a good indicator of salt-water intrusion. Few chloride analyses are available. In April 1979, water from well City No. 3 had a chloride concentration of 3.7 mg/L, and water from an old well at Peter Pan Seafoods had a chloride concentration of 21 mg/L. CH2M-Hill (written commun., 1983) reports that water collected on January 30, 1974 from well City No. 1 had a chloride concentration of 10 mg/L, and water collected on November 14 from well PHS No. 3 had a concentration of 6 mg/L. Water with chloride concentrations less than 250 mg/L is suitable for most domestic and industrial water uses (U.S. Environmental Protection Agency, 1977); high concentrations of chloride increase the corrosiveness of water and, in combination with sodium, give water a salty taste.

On the basis of accounts of the water's taste and staining properties, many wells in the Dillingham area are reported to yield water that contains undesirable concentrations of iron and manganese. Samples from only two wells were analyzed for iron and manganese (table 7). Water from the "main" public supply well has a high concentration of manganese, 170 µg/L, and well City No. 3 has high concentrations of iron (550 and 870 µg/L) and manganese (1,200 µg/L). Water with

Table 7.--Major chemical constituents and physical characteristics of ground water, 1979

[Analyses by U.S. Geological Survey; µS/cm, microsiemens per centimeter at 25°C; mg/L, milligrams per liter; µg/L, micrograms per liter.]

Well owner and number	Date of sample	Specific conductance (µS/cm)	pH (standard units)	Temperature (deg C)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)
Wood River Community Spring:										
SC01305510BBAA1 Spring	06-06-79	90	5.5	5.0	--	--	--	--	18	--
Jim Timmerman:										
SC01305517CDCA1 003	06-27-79	82	6.5	7.0	--	--	--	--	34	--
Wien Air:										
SC01305518DCDA1 001	06-04-79	212	5.8	6.5	--	--	--	--	108	--
City of Dillingham, Main well:										
SC01305521ABBD2 001	04-18-79	142	6.0	--	14	5.0	8.6	1.5	55	5.8
City of Dillingham No. 3:										
SC01305521BABD2 006	04-16-79	270	7.4	3.5	24	11	11	8.2	99	6.7
	06-27-79	240	--	3.0	--	--	--	--	--	--
Peter Pan Seafoods - Old well:										
SC01305521BACC1 010	06-27-79	700	7.9	4.0	--	--	--	--	193	--
Don Darden:										
SC01305614BAAD2 001	06-28-79	65	6.1	9.0	--	--	--	--	22	--
Mel Abrams:										
SC01305614DBBB1 005	06-28-79	130	6.4	12.0	--	--	--	--	62	--
John Timmerman:										
SC01305636BDDD1 001	06-04-79	117	6.7	4.0	--	--	--	--	64	--

Well number	Date of sample	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3 dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Iron, dissolved (µg/L as Fe)	Manganese, dissolved (µg/L as Mn)
SC01305510BBAA1 Spring	06-06-79	--	--	--	--	--	--	--	--
SC01305517CDCA1 003	06-27-79	--	--	--	--	--	--	--	--
SC01305518DCDA1 001	06-04-79	--	--	--	--	--	--	--	--
SC01305521ABBD2 001	04-18-79	3.7	0.10	20	92	0.58	0.030	50	170
SC01305521BABD2 006	04-16-79	21	.20	30	170	.16	1.30	870	1,200
	06-27-79	--	--	--	--	--	--	550	1,200
SC01305521BACC1 010	06-27-79	--	--	--	--	--	--	--	--
SC01305614BAAD2 001	06-28-79	--	--	--	--	--	--	--	--
SC01305614DBBB1 005	06-28-79	--	--	--	--	--	--	--	--
SC01305636BDDD1 001	06-04-79	--	--	--	--	--	--	--	--

concentrations less than 300 µg/L dissolved iron and 50 µg/L dissolved manganese is suitable for most domestic and industrial water uses (U.S. Environmental Protection Agency, 1977). Iron and manganese in higher concentrations precipitate when exposed to air and cause turbidity, and stain plumbing fixtures, laundry, and cooking utensils. Elevated concentrations of iron and manganese also impart noticeable tastes and colors to foods and drinks.

CH2M-Hill (written commun., 1983) reported that water collected on March 31, 1983 from well PHS No. 1 contained 50 µg/L iron and 1,000 µg/L manganese, whereas water from well PHS No. 3 contained less than 50 µg/L iron and less than 50 µg/L manganese. CH2M-Hill also reported that water collected on December 12, 1979 from the "main" well contained less than 50 µg/L iron and 140 µg/L manganese.

WATER USE

Almost all water used in Dillingham for domestic, commercial, and industrial uses is obtained from ground water. The City of Dillingham supplies water to about 150 residential and commercial buildings in the townsite area; residential, commercial, and industrial water users outside of the townsite area are dependent on private wells.

The city's water system is described in Wince-Corthell and Associates (1974), DOWL Engineers (1981), and CH2M-Hill (written commun., 1983). The community water-supply facilities consist of four wells, a 500,000-gallon and a 770,000-gallon storage tank, and distribution mains in the old townsite and Snag Point Subdivision, which is about 0.2 mi northeast of the townsite and contains about 35 homes. During 1986, the "main" well was set to begin pumping when water levels in the storage tanks reached a certain level. The courthouse, elementary school, and City No. 3 wells were turned on manually when more water was needed. At times in the past, wells PHS No. 2 and 3 have also been pumped to provide water to the city's system. Under current (1986) well, pump, and aquifer conditions, pumping rates for the city's wells are:

Well number	Well name	Pumping rate (gal/min)
SC01305521ABBD2 001	Main	70
SC01305516CDDD1 005	Courthouse	70
SC01305516CDCD1 004	Elementary school	50
SC01305521ABBD2 006	City No. 3	50

The quantity of water flowing into and out of the storage tanks is monitored intermittently by personnel from the city's Public Works Department. Water from the main, courthouse, and elementary school wells is treated with chlorine and floride before it flows into storage tanks. Water from well City No. 3 flows directly into water mains and is not metered. The combined quantity of water which

was pumped from three public-supply wells and the quantity of treated water used are shown in table 8.

The rate of water use varies thoughout the year. During most of the year, Dillingham's water system delivers to its customers about 100,000 gal/d, but during short periods in midsummer, it delivers up to 345,600 gal/d. The highest rate of water use is in midsummer; in some years the total midsummer use from both public and private supply in the townsite area is about 1 million gal/d. During 1986, peak water use from both public and private supply is estimated to be between 300,000 and 400,000 gal/d.

The processing of fish uses large amounts of water, but this use is highly seasonal. Kemp Pacific Fisheries uses water from the city's distribution system, and its use has been metered since April 1985. From June 25 through July 25, 1985, Kemp used about 89,500 gal/d, which was about half of the total water supplied by the system during that period. The quantity of water used during that period represents about half of the total amount of water used by Kemp during a year.

Peter Pan Seafoods, the largest fish-processing operation in the Dillingham area, uses water from privately owned wells located at the western edge of town. During the peak of the fish-processing season, late June through early July, Peter Pan Seafoods used about 800,000 gal/d in 1984 and about 600,000 gal/d in 1985. For most of the rest of the year, Peter Pan uses about 10,000 gal/d or less. In 1986, Peter Pan did not process fish "onshore", and, therefore, its water use was small.

WATER-RELATED PROBLEMS

In much of the Dillingham area, a potential for ground-water pollution is posed by a naturally high ground-water table and permeable geologic materials. These environmental conditions, combined with shallow (less than 40 ft deep) wells and seepage from septic-tank systems in areas not served by sewers, create a potential for pollutants to enter the ground-water system used for domestic supplies. A sewer system serves the townsite area, the Snag Point Subdivision, and the Windmill Hill area southeast of the airport; however, sewage is not treated and wastes are discharged directly into Nushagak River (DOWL Engineers, 1982). The discharge of seafood-processing wastes to the river is also a potential source of pollution.

Many low areas in and near Dillingham would be inundated during a large flood. DOWL Engineers (1982) and the Federal Emergency Management Agency (1982) delineate areas that would be inundated by a flood with a frequency of approximately 100 years based on flood hazard work performed by the U.S. Army Corps of Engineers. The extent of potential property damage and danger to lives would, of course, increase with increasing development in flood plains of streams unless preventative measures were taken.

Table 8.--Water use, 1981-86

[Intermittent flow-meter readings were supplied by the City of Dillingham's Public Works Department; values in gallons; u, value unknown]

Total monthly and mean monthly pumpage of the main, elementary school, and courthouse wells

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981	u	u	u	u	u	u	u	u	u	u	u	u
1982	2,655,840	2,033,220	2,227,490	2,023,830	2,394,860	3,194,850	2,948,160	2,169,330	2,114,820	2,433,450	u	u
1983	u	2,542,350	1,715,830	2,759,510	2,010,650	2,781,530	1,967,840	1,376,580	2,117,590	2,264,790	u	u
1984	u	u	3,804,680	3,385,300	3,915,380	3,958,140	4,580,570	5,463,210	3,053,020	2,083,890	2,743,820	2,862,100
1985	2,633,700	3,367,720	3,926,040	3,722,590	3,949,090	5,688,520	6,180,620	3,458,440	2,723,510	2,690,220	2,909,060	2,561,400
1986	2,823,990	3,172,750	3,317,900	3,401,600	5,045,400	5,328,500	4,979,190	2,423,919	2,245,380	3,026,560	u	u
Mean	2,704,510	2,779,010	2,998,388	3,058,566	3,463,076	4,190,308	4,131,276	2,978,296	2,450,864	2,499,782	2,826,440	2,711,750

Monthly and mean monthly volumes of treated water supplied by the City of Dillingham

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981	u	u	u	u	u	u	u	u	u	u	1,683,690	2,055,300
1982	2,423,300	1,802,300	1,940,200	1,702,800	1,981,400	2,456,100	1,926,100	1,241,100	2,588,300	2,225,800	u	u
1983	u	2,696,000	2,084,200	1,747,300	1,740,000	2,817,600	4,375,700	4,359,300	3,091,400	2,684,800	u	u
1984	u	u	4,053,900	3,626,800	4,327,400	6,290,100	3,663,900	5,443,500	3,764,600	2,770,700	2,288,200	2,789,100
1985	2,638,900	3,627,000	4,437,900	4,681,700	3,792,000	6,609,000	7,524,900	3,195,700	2,233,600	2,060,400	2,574,600	2,159,100
1986	2,615,000	3,194,100	3,480,490	3,488,540	4,582,380	4,686,110	5,508,300	2,541,100	2,181,500	3,078,800	u	u
Mean	2,559,067	2,829,850	3,199,338	3,049,428	3,284,636	4,571,782	4,599,780	3,356,140	2,771,880	2,564,100	2,182,163	2,334,500

SUMMARY

- Climatic and geologic conditions in the Bristol Bay area provide sufficient water for current levels of water use in Dillingham.

- The Wood and Nushagak Rivers have flows that are generally greatest in May through July and lowest January through April. Average discharge for the Nushagak River at Ekwok is 22,650 ft^3/s and the average discharge for Wood River near Aleknagik is 4,824 ft^3/s.

- Waters in the Wood and Nushagak Rivers have low concentrations of dissolved solids and suspended sediments.

- The specific conductance of water in the Wood-Nushagak estuary near Dillingham during a high tide in autumn was as great as 3,000 µS/cm. High tides in spring, when streamflow is low, would increase salinity to a much greater value in the estuary.

- An estimated 400 to 500 wells have been drilled in the Dillingham area. Wells range in depth from 20 to 213 ft and yield 5 to 225 gal/min. All water levels in wells measured during 1985-86 were above sea level.

- Ground water is generally suitable for drinking-water purposes, except for elevated concentrations of iron and manganese in some areas.

- Most of the water used for public supply is pumped from four wells. Water use from the city's water system is about 100,000 gal/d during most of the year and up to 345,600 gal/d during short periods in midsummer. In some years total water use in the Dillingham area during the peak of the fish-processing season is about 1 million gal/d, but such high usage is confined to a few weeks. Pumpage of ground water at these rates and durations probably does not cause saltwater to migrate inland to wells used for public supplies.

- Potential water-related problems in Dillingham include ground-water pollution by on-site sewage disposal in areas of high water table and flooding in low-lying areas.

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