Overview of Environmental and Hydrogeologic Conditions at Wrangell, Alaska

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U.S. GEOLOGICAL SURVEY

Open-File Report 95-344

Prepared in cooperation with the

FEDERAL AVIATION ADMINISTRATION

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By Eppie V. Hogan

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Anchorage, Alaska
1995

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

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
centimeter (cm)	0.3937	inch
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
square kilometer (km^2)	0.3861	square mile
meter per kilometer (m/km)	5.280	foot per mile
liter (L)	0.2642	gallon
liter per second (L/s)	15.85	gallon per minute
liter per day (L/d)	0.2642	gallon per day
cubic meter per second (m^3/s)	35.31	cubic foot per second
cubic meter per second per square kilometer ($(m^3/s)/km^2$)	91.4	cubic foot per second per square mile

In this report, temperature is reported in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 1.8\,(°C) + 32$$

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

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

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ABSTRACT

Wrangell Island is in southeast Alaska, about 200 kilometers southeast of Juneau. The Federal Aviation Administration has airway support facilities on Wrangell Island near the City of Wrangell. They wish to consider current environmental and hydrogeologic conditions when evaluating options for compliance with environmental regulations at these facilities. Wrangell Island lies in the maritime climate zone and has mild winters and cool summers. Local vegetation consists of coastal western hemlock-Sitka spruce forest. The bedrock on Wrangell Island consists of sedimentary and intrusive rocks of Cretaceous age. The principal surficial materials are beach, alluvial, and glacial deposits. The Stikine River, Mill Creek, and the Wrangell City Reservoirs are the principal fresh surface-water bodies near the Federal Aviation Administration facility. Limited amounts of ground water may be found in unconsolidated deposits or bedrock. Most residents on the island obtain their drinking water from surface-water sources. Ground water may be an alternative drinking-water source; however, the quantity and quality of these resources is poorly documented.

INTRODUCTION

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

BACKGROUND

Location

The city of Wrangell is located on Wrangell Island in southeast Alaska at approximate lat 56°28' N., long 132°22' W (fig. 1). It is about 200 km southeast of Juneau and about 1050 km southeast of Anchorage. The island lies in the foothills of the Coast Range and has a topography

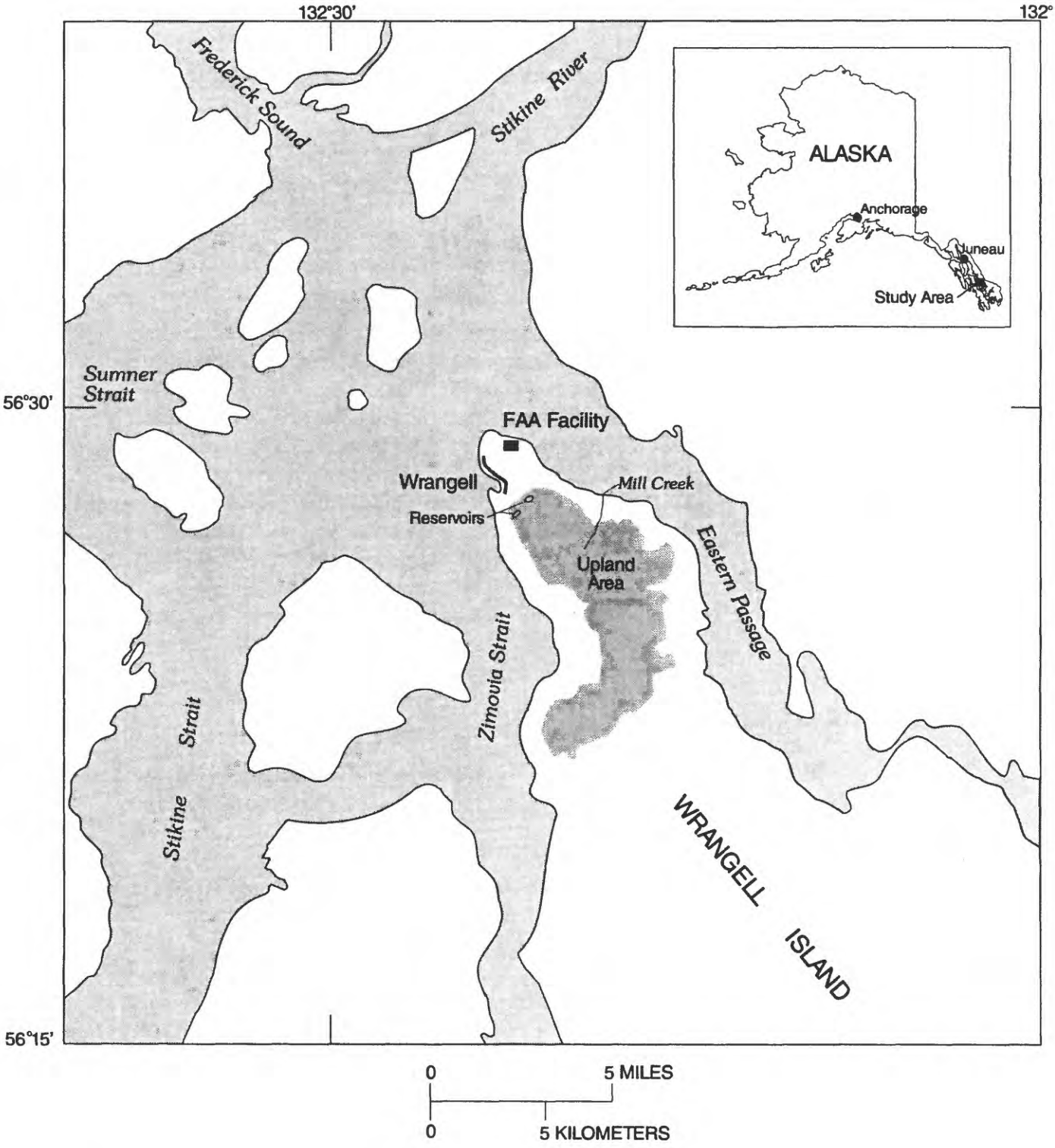

Figure 1. Location of Wrangell, Alaska and the Federal Aviation Administration facility.

characterized by blocks of high mountains 5-50 km wide, separated by valleys and straits 0.8-16 km wide (Wahrhaftig, 1965). The Eastern Passage lies north and east of Wrangell Island and Zimovia Strait is due west (fig. 1). The Wrangell FAA facilities are concentrated at the airport near the northern tip of the island (fig.1).

History and Socioeconomics

The Tlingit and the Haida Indians occupied this part of Alaska before the first non-Native contact in 1834 (Selkregg, 1976). Each Indian clan was based on maternal descent and relied on subsistence activities such as hunting and fishing for survival.

The first non-Native settlement was a stockade built by occupying Russians in 1834. The Russians called the stockade Red Dioniciya meaning Redoubt Saint Dionysius (Orth, 1967). In 1839, the British leased part of southeast Alaska from the Russians and changed the name to Fort Stikine. The United States purchased Alaska from Russia in 1867 and the name was changed to Fort Wrangell (Orth, 1967). The City of Wrangell became an important supply center for fur traders and gold miners during the time of the Stikine gold rush (Orth, 1967).

In 1890, the population of Wrangell was 316; in 1938, it was 1,000; in 1950, it was 1,162; and by 1990, the population had grown to 2,479 (Orth, 1967; U.S. Bureau of Census, 1991). According to the 1990 U.S. Census, about 20 percent of the people are American Indian, Eskimo, or Aleut, 79 percent are Caucasian, and 1 percent are African-American, Asian/Pacific Islander, and of other ethnic origin.

Residents of Wrangell have supported themselves on subsistence activities such as fishing and hunting, but today more people rely on a cash economy. Employment is mostly in private sector, natural-resource based activities such as commercial fishing, logging, lumber and pulp, tourism, retail trade, and services. According to the 1990 U.S. Census, Wrangell has a potential work force of 1,803 people: 725 work for private organizations, 290 for the Federal, State, or local government, 165 are self-employed, 9 are unpaid family workers, 117 are unemployed, and 497 are not in the labor force.

The FAA activities on Wrangell Island began in 1969. Currently, the FAA facilities at Wrangell, include a visual approach slope indicator, runway end identification lights, an automated weather observation station, a telecommunication cable site, and a display site. A detailed account of FAA facilities near Wrangell and a listing of suspected sources of contamination around these facilities can be found in an environmental compliance investigation report by Ecology and Environment, Inc., (1993).

PHYSICAL SETTING

Climate

Wrangell has a maritime climate characterized by small temperature variations, high humidity, and abundant precipitation. It has wet, cool summers and relatively mild winters (Hartman and Johnson, 1984). The mean annual temperature is 6.3°C. Temperatures range from a July mean maximum of 18.2°C to a January mean minimum of -4.3°C (Leslie, 1989). Mean annual

precipitation is about 2,070 mm and about 1,580 mm of snow falls annually (Leslie, 1989). Mean monthly and annual temperature, precipitation, and snowfall are summarized in table 1.

Table 1. Mean monthly and annual temperature, precipitation, and snowfall, 1922-87, Wrangell, Alaska.
[Modified from Leslie (1989);°C, degree Celsius]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temperature (°C)													
Mean maximum[1]	1.4	3.2	5.8	9.5	13.8	16.9	18.2	17.8	14.6	10.1	5.4	2.4	9.9
Mean minimum[2]	-4.3	-2.8	-0.8	1.6	4.7	7.8	9.5	9.3	7.1	3.8	-0.2	-2.9	2.7
Mean	-1.4	0.2	2.4	5.6	9.3	12.4	13.8	13.6	10.8	6.9	2.6	-0.3	6.3
Precipitation, in millimeters of moisture													
	185	151	141	128	112	103	126	150	212	329	240	198	Total 2,070
Snowfall, in millimeters													
	470	381	175	27.9	0.0	0.0	0.0	0.0	0.0	7.6	150	371	Total 1,580

[1]Record maximum, 33.3°C, July 1934.
[2]Record minimum, -23.3°C, January 1947.

Vegetation

Vegetation on Wrangell Island consists of coastal western hemlock-Sitka spruce forest. The forest is characterized by an overstory of Sitka spruce, western hemlock, and Alaska yellow cedar with an understory of blueberry, five-leaf bramble, single delight, skunk cabbage, and mosses (Alaska Department of Community and Regional Affairs, 1984; Viereck and Little, 1972). Expanses of sub-tidal wetlands exist in numerous places on Wrangell Island and surround the FAA facilities. Wetland vegetation consists of silverweed, hair grass, yarrow, buttercup, and a variety of sedges. Alpine vegetation, starting at about 600 m above sea level, comprises mountain hemlock, deer cabbage, heather, lichen, berries, and willow.

GEOLOGY

The geology of Wrangell Island has been described by Berg (1980), Karl and Koch (1985, 1990), Hunt and Brew (1986), Brew and others (1989), and Berg and Gehrels (1992). The bedrock on Wrangell Island consists of sedimentary and intrusive rocks of Cretaceous age. The sedimentary rocks consist of marine graywacke, mudstone, and minor amounts of limestone (Berg and Gehrels, 1992). Other rock types on the island include andesitic to basaltic volcanic rocks. Intrusive rocks near the city of Wrangell include small plutons and batholiths of granodiorite, tonalite, and subordinate quartz diorite that are part of the Coast Range (Berg and Gehrels, 1992). Bedrock is exposed at low tide on northern Wrangell Island. Further inland, where covered by surficial deposits, bedrock may be more than 10 m below land surface (Waller and Tolen, 1962).

The principal surficial materials found on Wrangell Island are beach, alluvial, and glacial deposits. Typical beach deposits consist of layers of gravel and sand which were reworked from glacial deposits by wave action and tidal currents. Alluvial deposits in the same area include stratified silt, sand, and gravel. These deposits are between 1.5 and 5.0 m thick and are found along the flood plains of large streams and rivers. Glacial deposits consist of unconsolidated silt, sand, gravel, and boulders. Waller and Tolen (1962) describe the lithology of sediments from a well drilled to a depth of 30 m in the city of Wrangell, as muskeg to a depth of about 1.0 m; hard clay and boulders to a depth of about 8.5 m; and hard black slate (bedrock) 30 m below land surface (Appendix 1). The soils that develop on the well-drained surficial materials are characterized by an organic-rich layer 5-12 cm thick, and dark, acidic sub-layers (Rieger and others, 1979). Wrangell Island is free of permafrost (Ferrians, 1965).

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

HYDROLOGY

Surface Water

The Stikine River, Mill Creek, and the Wrangell City Reservoirs are the principal fresh surface-water bodies near the FAA facility (fig. 1). The Stikine River is less than 10 km north of the FAA facility and flows from northeast to southwest. Mill Creek is about 5 km southeast of the FAA facility, flows from southwest to northeast, and empties into the Eastern Passage. The Wrangell City Reservoirs are due south of the city of Wrangell and are used as drinking-water sources. A northerly topographic gradient of about 20 m/km directs runoff from the FAA facility towards the coast.

Daily mean discharge of the Stikine River was reported from 1976 to 1993 at streamflow gaging-station 15024800, located about 30 km northeast of Wrangell Island. During open-water months from May to September, mean flow is about 3,300 m^3/s and during the winter from December to April, mean flow is about 370 m^3/s (table 2; U.S. Geological Survey, 1994). The mean annual discharge of the river is about 1,630 m^3/s. The Stikine River drains an area of about 52,000 km^2 upstream from the gaging station (U.S. Geological Survey, 1994). Average annual runoff in the Stikine River drainage area is about 0.03 $(m^3/s)/km^2$ (U.S. Geological Survey, 1994).

Table 2. Mean monthly flow at streamflow gaging-station 15024800, the Stikine River near Wrangell, Alaska, 1976-93 water years
[Values in cubic meters per second]

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	1,760	750	400	350	280	320	480	1,980	3,950	3,920	3,090	2,190
Maximum	3,200	1,650	730	1,100	540	1,200	900	3,370	5,660	4,640	3,800	3,640
Minimum	870	280	200	170	160	130	260	913	2,930	3,090	2,400	1,440

Mill Creek is a small stream originating in the upland area just south of the FAA facility (fig. 1). This stream drains an area of about 0.2 km^2 upstream from streamflow gaging-station 15087000, where a partial-record of discharge for the period 1964-66 was collected. Maximum mean monthly discharge during periods of heavy rainfall in September and October is about 0.1 m^3/s and minimum mean monthly discharge during June and July is about 0.004 m^3/s (U.S. Geological Survey, 1967). On September 3, 1966 rainfall runoff caused a maximum creek discharge of 4 m^3/s. Mean annual runoff for Mill Creek near Wrangell is about 0.1 $(m^3/s)/km^2$.

The diurnal tide range—the difference in height between mean high water and mean low water during a single day—near the city of Wrangell averages 4.8 m (Brower and others, 1977). The maximum daily tide predicted to occur at Wrangell, Alaska is 5.9 m above sea level. The minimum predicted daily tide is -1.2 m below sea level (Brower and others, 1977).

Floods

The city of Wrangell has a low flood hazard rating and has no history of significant waterfront flooding (Federal Emergency Management Agency, 1981; U.S. Army Corps of Engineers, 1993). Although there is a small risk of flooding by storm-surge or tsunami waves, the Thanksgiving Day Storm of 1968, considered to be the largest storm in recent times, produced no unusual flooding in Wrangell. (Federal Emergency Management Agency, 1981; U.S. Army Corps of Engineers, 1993). Winds at that time were generally from the southeast and the effects from high waves and storm surges were negligible. A storm on October 26, 1976, considered to be less severe than the Thanksgiving Day storm, did cause some waterfront damage near Wrangell (Federal Emergency Management Agency, 1981). The winds were predominately from the southwest, an unusual direction. These winds acting over a large area of water resulted in a combination of high tide and large waves that eroded fill and exposed some homes to minor wave and log damage. Brower and others (1977) describe return periods for maximum wave heights for coastal areas in Alaska. A 100-year-wave more than 20-m high is estimated for coastal areas near Wrangell Island (table 3). A flood of this magnitude may affect the FAA facility which is about 10 m above sea level.

Table 3. Annual maximum waves for selected return periods near Wrangell, Alaska
[Modified from Brower and others, 1977]

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

Riprapping of exposed land formations has provided flood protection along Zimovia Strait and the Eastern Passage (Federal Emergency Management Agency, 1981). Protection for the small boat harbor is provided by a rubble mound breakwater constructed in 1926. The structure is well armored and shows no signs of damage (Federal Emergency Management Agency, 1981).

Over-bank flooding of stream channels in southeast Alaska usually occurs during heavy rainfall; snowmelt rarely causes flooding. Flood crests are typically of short duration, often less than one day, and are characterized by a very sharp rise and decline of flow. On September 11, 1981 rainfall runoff caused a maximum discharge of about 8,500 m^3/s at U.S. Geological Survey stream-gaging station 15024800, on the Stikine River near Wrangell, Alaska (U.S. Geological Survey, 1994). However, no flooding was reported near the city of Wrangell at this time.

Ground Water

Most communities in southeast Alaska use the abundant surface-water supplies for domestic use. As a result, ground-water data are scarce. Near Wrangell, ground water may be found within unconsolidated deposits or fractured bedrock. Several wells have been drilled near the city of Wrangell (Appendix 1; Waller and Tolen, 1962). Well depths ranged from 15 to 73 m below land surface and water levels were between 0.2 and 9 m below land surface. Well yields ranged from 0.6 to 4.7 L/s. Following 16 hours of bailing, a 73-m-deep well in the city of Wrangell was reported to have 54 m of drawdown (Waller and Tolen, 1962). It is not known how long it took the water level to recover. The possibility of salt-water intrusion into coastal and island aquifers increases with depth and pumping rate (Waller and Tolen, 1962). However, no significant analyses of saltwater intrusion have been conducted near Wrangell.

DRINKING WATER

Present Drinking-Water Supplies

The Wrangell City Reservoirs, two reservoirs in the upland area south of Wrangell, supply the city and the FAA facility with water (Alaska Department of Community and Regional Affairs, 1984; Ecology and Environment Inc., 1993). The water is chlorinated and stored in a 666,000 L tank. The water is distributed by pipe to residents and businesses. Average water use in Wrangell city is about 2,625,000 L/d (Alaska Department of Community and Regional Affairs, 1984). The capacity of the public system is about 3.7 million L/d (Alaska Department of Community and Regional Affairs, 1984).

From 1958 to 1974, the U.S. Geological Survey sampled water from the Wrangell City Reservoirs (table 4; Appendix 1). Major ions, dissolved metals, and other analyzed constituents were within current U.S. Environmental Protection Agency (USEPA) and the State of Alaska Department of Environmental Conservation (ADEC) drinking-water regulations (ADEC, 1995; USEPA, 1995). The reservoirs are about 90 m above sea level upgradient from the city and the FAA facilities and, therefore, should not be susceptible to contamination from surface spills or disposal of hazardous wastes from these sources.

Table 4. Selected water-quality data for the Wrangell City Reservoirs at Wrangell
[mg/L, milligrams per liter; µg/L, micrograms per liter]

Date	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Hardness (mg/L as $CaCO_3$)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)
01-16-58	0.4	0.2	1.0	3	0.0	0.0	--
06-22-68	0.8	0.3	0.6	6	0.0	2.6	--
12-17-68	1.2	1.0	0.7	10	0.2	4.3	--
06-26-74	0.6	0.2	0.8	8	0.4	2.6	90

Alternative Drinking-Water Sources

Drinking-water alternatives for the FAA facility and the city of Wrangell include the Stikine River, Mill Creek, and ground water. Ground water in sufficient quantity for a municipal supply, however, has not been identified. Ground water is generally present at depths between 0.2 and 9 m below land surface with yields between 0.6 and 4.7 L/s. Analyses of ground-water samples indicate that major ions, with the exception of iron, and water properties are within current USEPA and ADEC drinking-water regulations (table 5; Appendix 1).

Table 5. Selected water-quality data from wells near Wrangell, Alaska
[mg/L, milligrams per liter]

Constituent (or property)	USEPA Drinking-water regulation (mg/L)	Concentrations (range from 5 wells; mg/L)
Manganese (Mn)	0.05	0.02 - 0.04
Iron (Fe)	0.3	0.0 - 0.4
Sulfate (SO_4)	250	14 - 19
Fluoride (F)	2	0.1 - 0.2
Total dissolved solids	500	149 - 213
pH (units)	6.5 - 8.5	7.3 - 8.1

The Stikine River represents a potential source of drinking water for the Wrangell Island area. During months of low discharge, mean flow of the river is about 300 m^3/s (table 2; U.S. Geological Survey, 1994). This is far greater than the estimated water use for the city of Wrangell. The quality of the Stikine River was measured from 1976 to 1993 by the U.S Geological Survey. Measured concentrations of major ions, nutrients, and water properties in the Stikine River are within current USEPA and ADEC drinking-water regulations (table 6; Appendix 1; U.S. Geological Survey, 1994).

Table 6. Selected water-quality data for the Stikine River near Wrangell, 1993 water year
[mg/L, milligrams per liter]

Constituent (or property)	Concentration (mg/L)
Chloride (Cl)	0.6 - 4.3
Iron (Fe)	0.07 - 0.2
Sulfate (SO_4)	8.2 - 20
Fluoride (F)	0.1 - 0.2
Total dissolved solids	52 - 122
pH (units)	7.6 - 7.8

Although the discharge from Mill Creek is small, it could possibly be used to supplement the present drinking-water supply if needed. Chemical analyses of water quality in Mill Creek have not been conducted. Suspended-sediment concentrations, however, ranged from 0 to 8 mg/L (U.S. Geological Survey, 1966). The USEPA recommended guideline value for suspended sediment concentration is 5 mg/L (USEPA, 1995).

SUMMARY

Wrangell Island is in southeast Alaska about 200 km southeast of Juneau. It lies in the maritime climate zone and has relatively mild winters and cool summers. A natural-resource based economy and supplemental subsistence lifestyle make local residents dependent on a sustainable environment. Flooding by tsunami and storm-surge waves is a low-rated hazard. The city of Wrangell and the FAA facility obtain their drinking water from two reservoirs. The Stikine River, Mill Creek, and ground water represent possible alternative drinking-water sources.

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APPENDIX 1

Hydrologic data for the Wrangell area, Alaska

Well no.	Owner or user	Year drilled	Topography	Altitude	Depth of well (ft)	Diameter of well (in.)	Water level: Below land surface (ft)	Water level: Date		Remarks
					WRANGELL AREA					
Wra-1	Wrangell	1959	Hill slope	75	240	8	4.85	4-20-59	T	C; L; inadequate for public supply.
Wra-2	do	1959	Slope	90	100	8	0.60	5-15-59	T	L; inadequate for public supply.
Wra-3	Wrangell Institute	1959	Base of hill	30	58	8	F	6-30-59	PS	C; L; test no. 1.
Wra-4	do	1959	do	30	111	8			D	Test no. 2; dry hole; casing pulled.
Wra-5	do	1959	do	30	64	8	F	7- ?-59	PS	C; L; test no. 3; yield 20 gpm
Wra-6	do	1959	do	30	79	8	F	8-24-59	PS	L; test no. 4; yield 10 gpm.

Wra-2. City of Wrangell (No. 2). Drilled by G. H. Ramsey. Cased to 60.97 feet. Yield: 10 gpm; drawdown 85 feet after 2 hours bailing.

Material	Thickness (feet)	Depth (feet)
Muskeg	3	3
Hard clay and boulders	25	28
Black slate	6	34
Black rock, very hard	16	50
Black rock, hard	50	100

WRANGELL - 25 MILE RADIUS

LOCAL WELL NUMBER		PRIMARY USE OF WATER	DEPTH OF WELL (FEET)	WATER LEVEL (FEET)	DATE WELL CONSTRUCTED	OWNER	ASSIGNOR OF OTHER IDENTIFIER	OTHER IDENTIFIER	TYPE OF LOG AVAILABLE
CD05908528CCAA1S		R	--	--	--	USFS TNGSS NF	--	--	-
CD06108115DDBD1	001	P	61.5	1.5	12-19-85	USFS TONGASS N.F.	SECTION 15 LOTS	UNSUBD LOT	D
						--	USFS	OHMER CK	-
CD06208324CAAB1	001	H	107	--	03-28-78	BIGELOW LOWELL	USS 1583	L04B03	D
CD06208324CAAB2	001	H	214	--	03-28-78	BIGELOW LOWELL	--	--	D
CD06208324CAAB3	001	H	65.0	--	04-28-68	GADD BARRE&LALONI	--	--	D
						HARTSHORN MARVIN	--	--	-
CD06308008BAAC1S		U	--	--	--	PUBLIC DOMAIN	--	--	-
CD06308407ACAA1	001	H	50.0	5.00	07-13-82	HAASETH OLE M	USS 2321	LX2T00X	D
						--	LAS	000024	-
CD06308419DDBA1	001	H	150	30.00	07-12-82	RAK DAVID	USS 2921	L19	D
						--	LAS	000011	-

--Chemical analyses of ground water in southeastern Alaska.
(In parts per million)

Well No.	Date of collection	U. S. Geological Survey Laboratory No.	Manganese (Mn)	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 (Calculated)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH
																Calcium, Magnesium	Noncarbonate		
								WRANGELL AREA											
Wra 1	4-22-59 4/	5225	.02	13	.41	24	17	15	4.7	172	19	3.0	.1	2.3	184	130	0	314	7.3
Wra 1	4-22-59 5/	5226	.04	13	4.8 6/	24	15	15	4.4	176	16	3.0	.1	1.6	184	122	0	303	7.3
Wra 3	6-30-59	5516	.02	24	0.00	20	7.6	41	5.8	190	14	7.0	.1	0.1	213	81	0	336	7.7
Wra 3 7/	9- 7-59	5549	.02	3.9	.03	20	9.3	20	5.6	146	15	3.0	.2	.0	149	88	0	259	8.1
Wra 4	9- 7-59	5550	.02	27	.10	23	9.3	34	5.6	190	14	4.0	.2	.0	211	96	0	334	8.1

1/ Water from 57-67 feet; 2/ Water from 81-83 feet; 3/ Water from 57-67, 81-83, and 91-93 feet; 4/ After 30 minutes pumping 20 gpm; 5/ After 8 hours pumping 20 gpm;
6/ Sample was contaminated by drill cuttings. 7/ Analyses and well numbers possibly reversed.

STATION NUMBER	DATE	TIME	LAT-I-TUDE	LONG-I-TUDE	LOCAL IDENT-I-FIER
15087000	10-12-64	1000	56 28 04 N	132 22 33 W	MILL C AT WRANGELL AK
15087000	04-12-65	0900	56 28 04 N	132 22 33 W	MILL C AT WRANGELL AK
15087000	06-07-65	0800	56 28 04 N	132 22 33 W	MILL C AT WRANGELL AK
15087000	08-13-65	--	56 28 04 N	132 22 33 W	MILL C AT WRANGELL AK
15087000	10-12-65	0950	56 28 04 N	132 22 33 W	MILL C AT WRANGELL AK
562732132214300	01-16-58	--	56 27 32 N	132 21 43 W	WRANGELL CITY RE AT WRANGE
562732132214300	06-22-68	0900	56 27 32 N	132 21 43 W	WRANGELL CITY RE AT WRANGE
562732132214300	12-17-68	1130	56 27 32 N	132 21 43 W	WRANGELL CITY RE AT WRANGE
562732132214300	06-26-74	1000	56 27 32 N	132 21 43 W	WRANGELL CITY RE AT WRANGE

STATION NUMBER	DATE	RECORD NUMBER	SAM-PLING DEPTH (FEET) (00003)	TEMPER-ATURE WATER (DEG C) (00010)	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	ALKA-LINITY WAT WH TOT FET FIELD MG/L AS CACO3 (00410)
15087000	10-12-64	96500035	--	9.5	8.8	--	--	--	--	--
15087000	04-12-65	96500036	--	1.5	3.0	--	--	--	--	--
15087000	06-07-65	96500037	--	9.0	0.60	--	--	--	--	--
15087000	08-13-65	96500038	--	13.0	0.01	--	--	--	--	--
15087000	10-12-65	96600036	--	7.5	2.5	--	--	--	--	--
562732132214300	01-16-58	95800486	--	--	--	30	13	4.7	0	0
562732132214300	06-22-68	96800595	--	12.0	--	50	21	6.4	6.4	8
562732132214300	12-17-68	96900445	--	--	--	5	25	6.7	2.9	7
562732132214300	06-26-74	97400263	0.50	--	--	30	16	--	--	--

STATION NUMBER	DATE	BICAR-BONATE WATER WH FET FIELD MG/L AS HCO3 (00440)	CAR-BONATE WATER WH FET FIELD MG/L AS CO3 (00445)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRATE TOTAL (MG/L AS N) (00620)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)
15087000	10-12-64	--	--	--	--	--	--	--	--	--
15087000	04-12-65	--	--	--	--	--	--	--	--	--
15087000	06-07-65	--	--	--	--	--	--	--	--	--
15087000	08-13-65	--	--	--	--	--	--	--	--	--
15087000	10-12-65	--	--	--	--	--	--	--	--	--
562732132214300	01-16-58	0	--	0.00	--	--	--	--	--	3
562732132214300	06-22-68	10	0	0.020	--	--	--	--	--	6
562732132214300	12-17-68	9	0	0.00	--	--	--	--	--	10
562732132214300	06-26-74	--	--	--	0.030	0.030	0.030	0.06	0.020	8

STATION NUMBER	DATE	HARDNESS NONCARB WH WAT TOT FLD MG/L AS CACO3 (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	SODIUM PERCENT (00932)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	SULFATE DISSOLVED (MG/L AS SO4) (00945)
15087000	10-12-64	--	--	--	--	--	--	--	--	--
15087000	04-12-65	--	--	--	--	--	--	--	--	--
15087000	06-07-65	--	--	--	--	--	--	--	--	--
15087000	08-13-65	--	--	--	--	--	--	--	--	--
15087000	10-12-65	--	--	--	--	--	--	--	--	--
562732132214300	01-16-58	3	0.0	0.80	0.40	0.1	20	0.20	1.0	2.0
562732132214300	06-22-68	0	2.0	0.30	0.80	0.1	21	0.30	0.60	0.0
562732132214300	12-17-68	2	3.0	0.50	1.2	0.2	19	1.0	0.70	1.0
562732132214300	06-26-74	--	2.5	0.40	0.60	0.1	14	0.20	0.80	2.3

STATION NUMBER	DATE	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR) (01034)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)
15087000	10-12-64	--	--	--	--	--	--	--	--	--
15087000	04-12-65	--	--	--	--	--	--	--	--	--
15087000	06-07-65	--	--	--	--	--	--	--	--	--
15087000	08-13-65	--	--	--	--	--	--	--	--	--
15087000	10-12-65	--	--	--	--	--	--	--	--	--
562732132214300	01-16-58	0.0	0.0	--	--	--	--	--	--	--
562732132214300	06-22-68	0.0	2.6	--	--	--	--	--	--	--
562732132214300	12-17-68	0.20	4.3	--	0	--	--	0	90	--
562732132214300	06-26-74	0.40	2.6	<1	<100	ND	ND	--	<2	90

STATION NUMBER	DATE	LEAD, DISSOLVED (UG/L AS PB) (01049)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	ZINC, DISSOLVED (UG/L AS ZN) (01090)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	METHYLENE BLUE ACTIVE SUBSTANCE (MG/L) (38260)
15087000	10-12-64	--	--	--	--	--	--	--	--
15087000	04-12-65	--	--	--	--	--	--	--	--
15087000	06-07-65	--	--	--	--	--	--	--	--
15087000	08-13-65	--	--	--	--	--	--	--	--
15087000	10-12-65	--	--	--	--	--	--	--	--
562732132214300	01-16-58								
562732132214300	06-22-68								
562732132214300	12-17-68	0	--	0	0	30	0	0	0.0
562732132214300	06-26-74	ND	20	ND	--	ND	--	<1	--

STATION NUMBER	DATE	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	MANGANESE (UG/L AS MN) (71883)	IRON (UG/L AS FE) (71885)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	DRAINAGE AREA (SQ. MI.) (81024)
15087000	10-12-64	--	--	--	--	--	0	0.0	0.09
15087000	04-12-65	--	--	--	--	--	2	0.02	0.09
15087000	06-07-65	--	--	--	--	--	5	0.01	0.09
15087000	08-13-65	--	--	--	--	--	3	0.00	0.09
15087000	10-12-65	--	--	--	--	--	8	0.05	0.09
562732132214300	01-16-58	4	0.01	0.0	0	1400	--	--	--
562732132214300	06-22-68	12	0.02	0.10	--	700	--	--	--
562732132214300	12-17-68	16	0.02	0.0	220	740	--	--	--
562732132214300	06-26-74	--	--	--	--	--	--	--	--

15024800 STIKINE RIVER NEAR WRANGELL--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1975 to September 1993 (discontinued).

PERIOD OF DAILY RECORD.--
WATER TEMPERATURE: July 1976 to 1981. Once daily observations May 29 to Oct. 11, 1982 (discontinued).
SUSPENDED SEDIMENT DISCHARGE: May 28 to Oct. 12, 1982.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

DATE	TIME	SAMPLE LOCATION, CROSS SECTION (FT FM L BANK) (00009)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)
NOV					
21...	1545	500	--	--	0.5
21...	1547	400	--	--	0.5
21...	1549	300	--	--	0.5
21...	1551	200	178	--	0.5
21...	1553	100	187	--	0.5
JUN					
19...	1200	1400	77	7.6	8.0
19...	1202	1200	99	7.5	9.5
19...	1204	900	106	7.8	9.5
19...	1206	600	104	7.9	9.5
19...	1208	300	103	8.0	9.5
19...	1210	100	102	8.0	9.5

DATE	TIME	STREAM WIDTH (FT) (00004)	SAMPLE LOCATION, CROSS SECTION (FT FM L BANK) (00009)	SAMPLE LOCATION, CROSS SECTION (FT FM R BK) (72103)	GAGE HEIGHT (FEET) (00065)	DISCHARGE, INST. CUBIC FEET PER SECOND (00061)	SAMPLING METHOD, CODES (82398)	SAMPLER TYPE (CODE) (84164)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)
NOV												
21...	1600	562	--	--	7.45	16400	20	3043	182	7.6	-0.5	0.5
MAR												
31...	1600	880	520	360.0	8.32	9750	50	8010	223	7.8	1.0	0.0
JUN												
19...	1215	1400	--	--	20.57	141000	70	--	103	7.8	13.0	--
SEP												
09...	1300	1310	--	--	16.34	82500	70	--	96	7.6	11.0	5.0

DATE	TURBIDITY (NTU) (00076)	BAROMETRIC PRESSURE (MM OF HG) (00025)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	HARDNESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	BICARBONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)
NOV												
21...	4.8	762	11.6	80	<1	<1	82	26	6.0	6.4	1.1	82
MAR												
31...	3.1	770	12.0	81	--	--	92	29	6.7	5.6	1.2	100
JUN												
19...	58	--	10.1	--	--	300	50	16	2.5	1.4	0.60	46
SEP												
09...	64	--	--	--	--	25	42	14	1.8	1.2	1.1	43

DATE	CARBONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	ALKALINITY WAT WH TOT FET FIELD MG/L AS CACO3 (00410)	ALKALINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	NITROGEN, NITRITE TOTAL (MG/L AS N) (00615)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N) (00630)
NOV												
21...	0	67	68	17	3.3	0.10	6.0	122	103	<0.010	0.010	0.150
MAR												
31...	0	80	82	20	4.3	<0.10	6.6	132	122	--	<0.010	--
JUN												
19...	0	39	38	8.9	0.60	<0.10	4.4	63	58	--	<0.010	--
SEP												
09...	0	35	35	8.2	0.70	0.20	2.8	58	52	--	<0.010	--

15024800 STIKINE RIVER NEAR WRANGELL--Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

DATE	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO TOTAL (MG/L AS P) (70507)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	IRON, DIS-SOLVED (UG/L AS FE) (01046)
NOV												
21...	0.170	0.020	<0.010	<0.20	0.070	0.020	<0.010	0.010	70	41	<3	120
MAR												
31...	0.170	--	0.040	<0.20	<0.010	0.030	--	0.010	<10	46	<3	74
JUN												
19...	0.062	--	0.050	<0.20	0.160	0.030	--	<0.010	360	12	<3	210
SEP												
09...	0.087	--	0.080	<0.20	0.090	0.030	--	<0.010	310	13	<3	190

DATE	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
21...	<4	41	10	<1	<1	<1.0	140	<6	51	2260	67
MAR											
31...	<4	42	<10	<1	<1	<1.0	150	<6	12	316	78
JUN											
19...	<4	11	<10	<1	<1	<1.0	83	<6	--	--	--
SEP											
09...	<4	12	<10	<1	<1	<1.0	68	<6	--	--	--