

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA

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CONVERSION FACTORS

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:

<u>Multiply inch-pound unit</u>	<u>by</u>	<u>To obtain metric unit</u>
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)
cubic foot per second (ft ³ /s)	0.028317	cubic meter per second (m ³ /s)

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 "Sea Level Datum of 1929."

NOTE

A section entitled "Accuracy of Records" is included under the description of the individual sites for which discharge is computed. The accuracy of streamflow records depends primarily on: (1) the stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements; and (2) the accuracy of observations of stage, direct (current meter) measurements of discharge, and interpretation of the data.

The U.S. Geological Survey has historically used subjective terms to describe the degree of accuracy of streamflow records. The term "excellent" means that about 95 percent of the daily discharge figures are within 5 percent of the true value; "good" records are within 10 percent of true value; and "fair" records are within 15 percent. Records are rated "poor" when they do not meet the above criteria. Different degrees of accuracy may be attributed to different parts of a given record (e.g. "fair" when affected by ice, but otherwise "good").

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INTRODUCTION

In 1981, the Alaska Power Authority (APA) completed construction of a dam and spillway at the north end of Solomon Lake near Valdez (fig. 1). As part of the APA - U.S. Geological Survey cooperative program, the Survey began to collect streamflow data in the Solomon Gulch basin in September 1986. This report briefly describes the water diversion facilities, their effects on streamflow, and the data-collection activities.

Elevation of the dam on Solomon Lake is 695 ft and the spillway elevation is 685 ft (from construction plans). Water from the lake is diverted, by means of two 48-inch diameter penstocks (figs. 2-4), to a Copper Valley Electric Association (CVEA) powerplant near tidewater at Port Valdez. From the powerplant, water is diverted (by various routes; see fig. 4) to the Valdez Fisheries Development Association (VFDA) fish hatchery, which lies across the Valdez Marine Terminal Highway from the plant. The hatchery also receives water from Solomon Gulch via the Falls Creek Diversion, located about 600 ft upstream from the mouth.

Solomon Gulch flows northerly into Port Valdez from the mountains southeast and across Port Valdez from the city of Valdez (fig. 1). The headwaters of the gulch originate at the base of several small glaciers at altitudes of 3,000 to 4,000 ft and flow northerly for about 8 mi to Solomon Lake. Water diverted for power generation draws the lake level down and substantially reduces flow in the natural channel of Solomon Gulch during winter months. In spring, runoff from melting snow and ice begins to refill the lake, and in most years the lake begins to overtop the spillway by early July. Water then flows through a small lake and eventually rejoins the natural channel below the dam. Between the lake and tidewater at Port Valdez, the channel is very steep, is incised in near-vertical rock walls, and includes a series of waterfalls. The channel itself is mostly bedrock, although the more gently sloping parts of the streambed are covered by gravel- to boulder-sized material.

The Geological Survey collected daily streamflow data at a site near the mouth of Solomon Gulch from July to December 1948 and from October 1949 through September 1956. Regulation and diversion from the dam since 1982 have significantly altered the natural flow characteristics of Solomon Gulch. In September 1986, data collection was begun in an attempt to determine mean daily discharge at four sites below Solomon Lake and thus document the effects of regulation and diversion of water on the flow at various points in the system. Periodic discharge measurements and continuous records of water stage are being obtained at two of the sites, and daily discharge values are being computed for all four sites. Descriptions of the

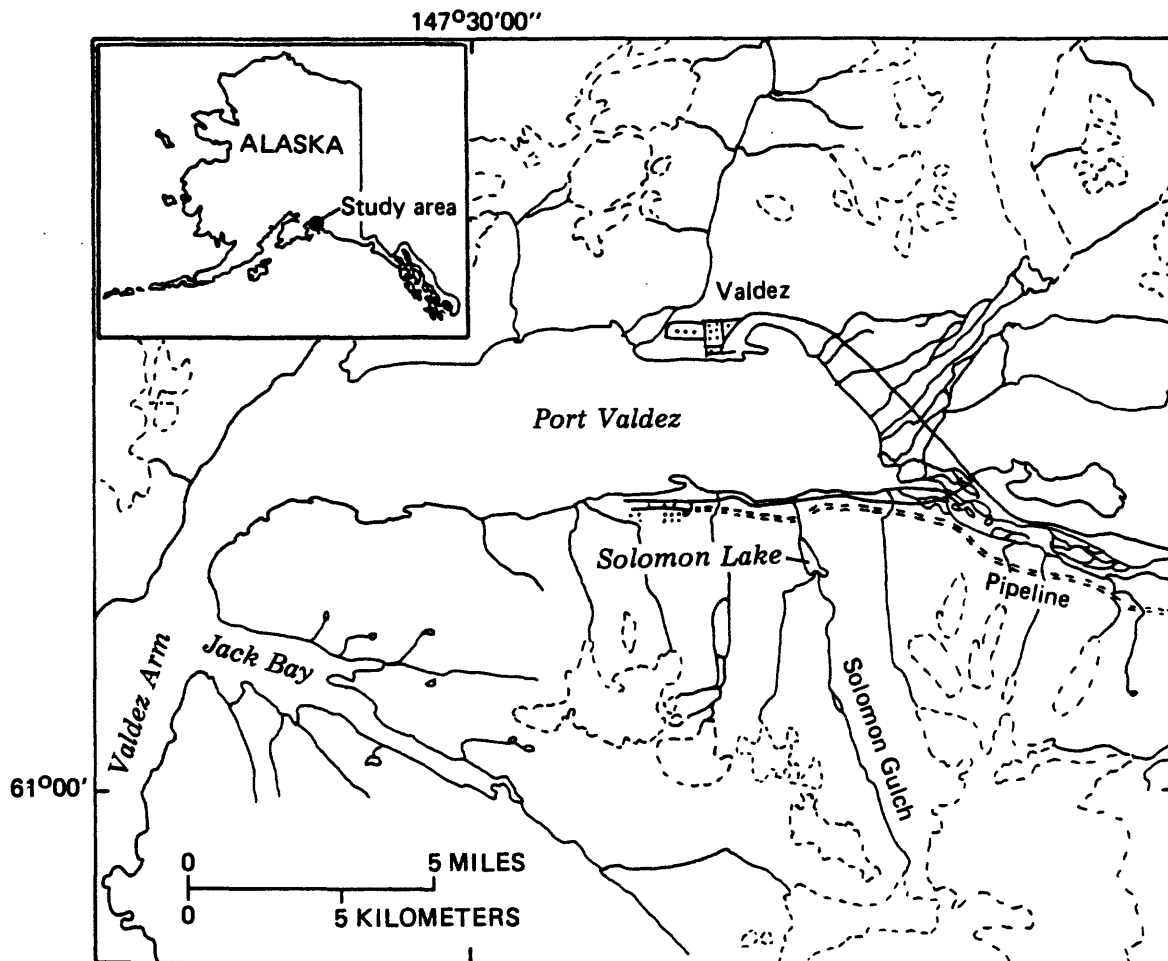


Figure 1.--Valdez area showing location of Solomon Lake and Solomon Gulch south of Port Valdez.

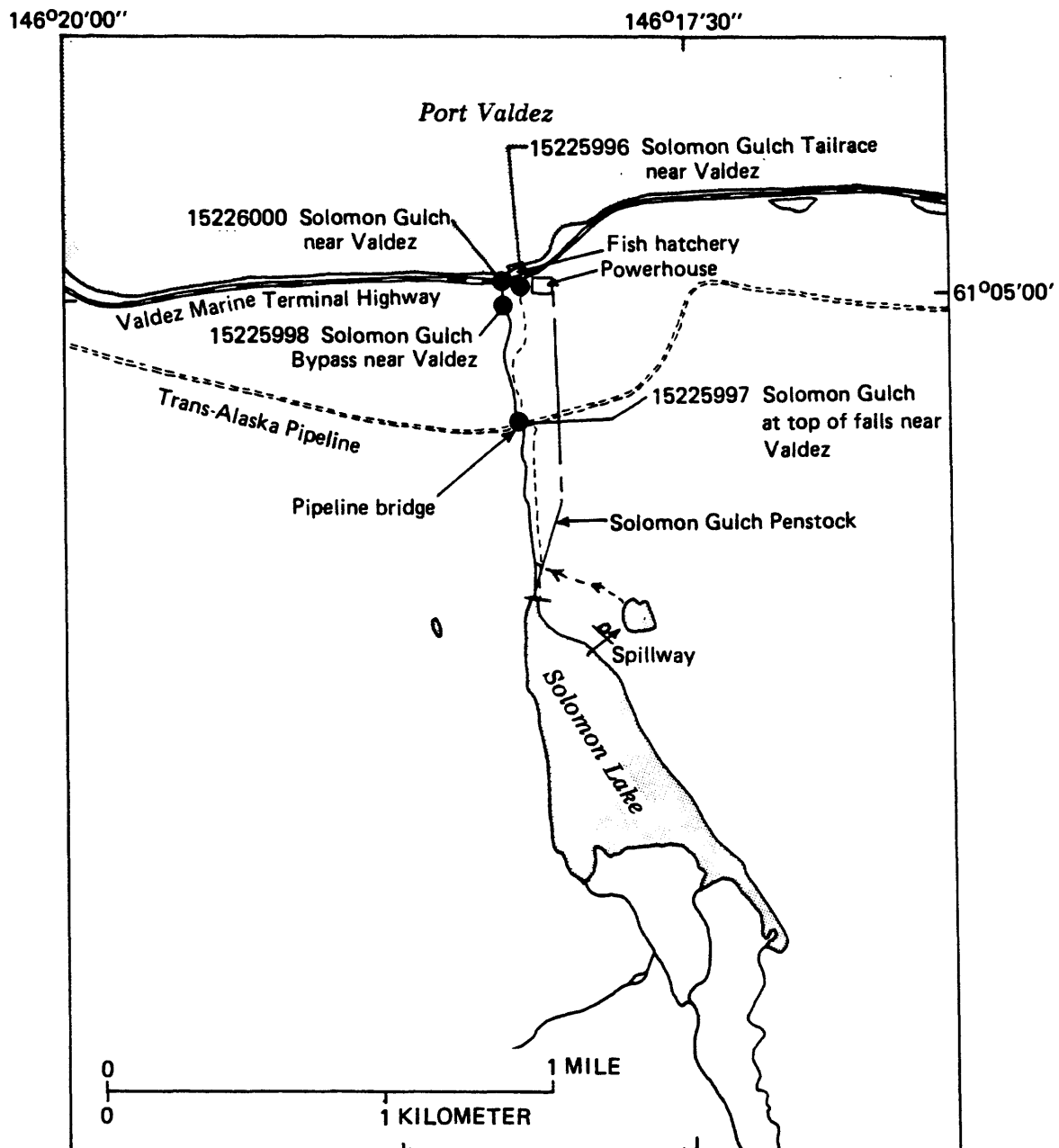


Figure 2.—Solomon Gulch downstream from Solomon Lake and location of U.S. Geological Survey data-collection sites.

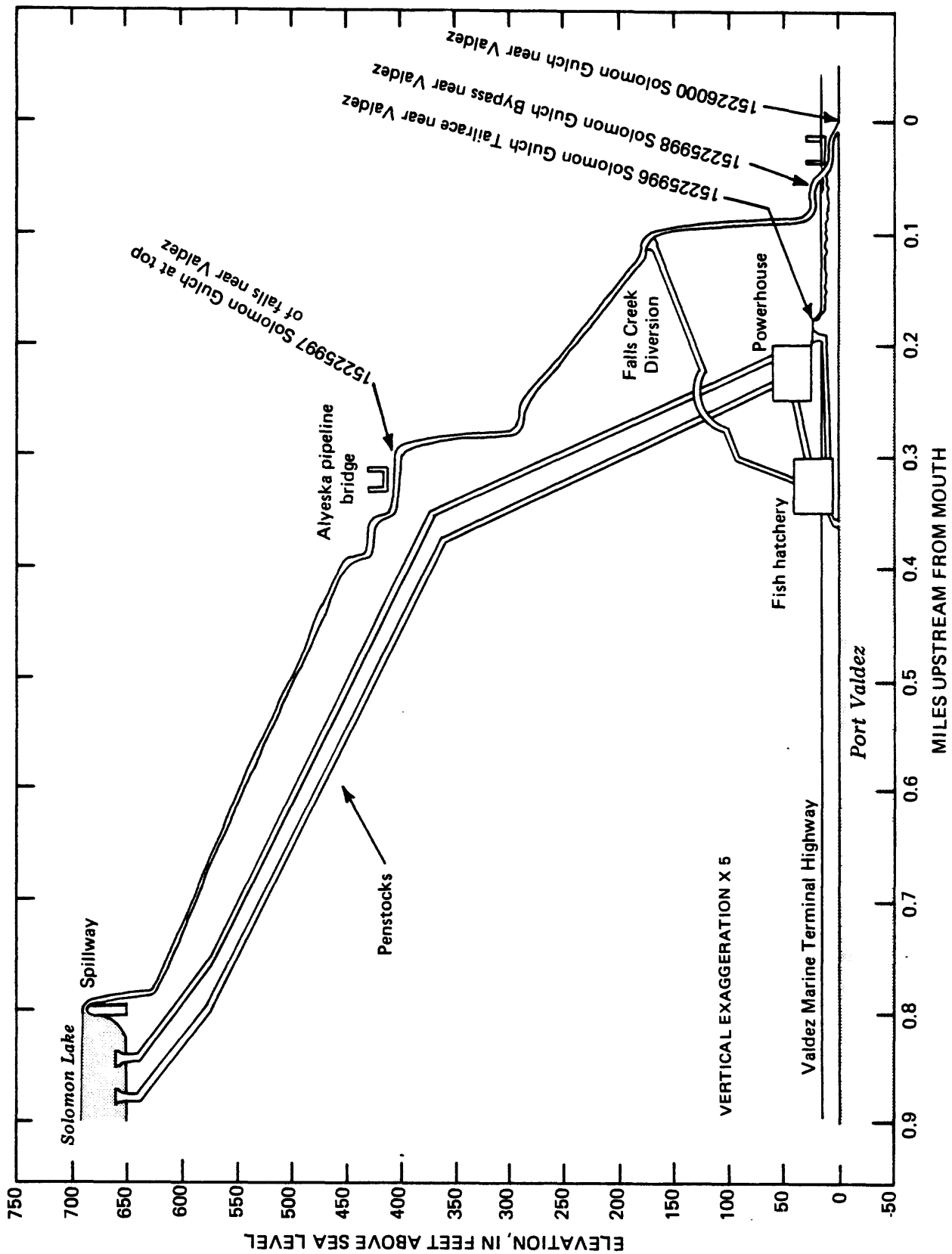


Figure 3.--Profile of Solomon Gulch and water diversion structures.

EXPLANATION

PS Penstocks
 UPS Unaerated penstocks
 PAS Aerated penstocks
 WW Warm water

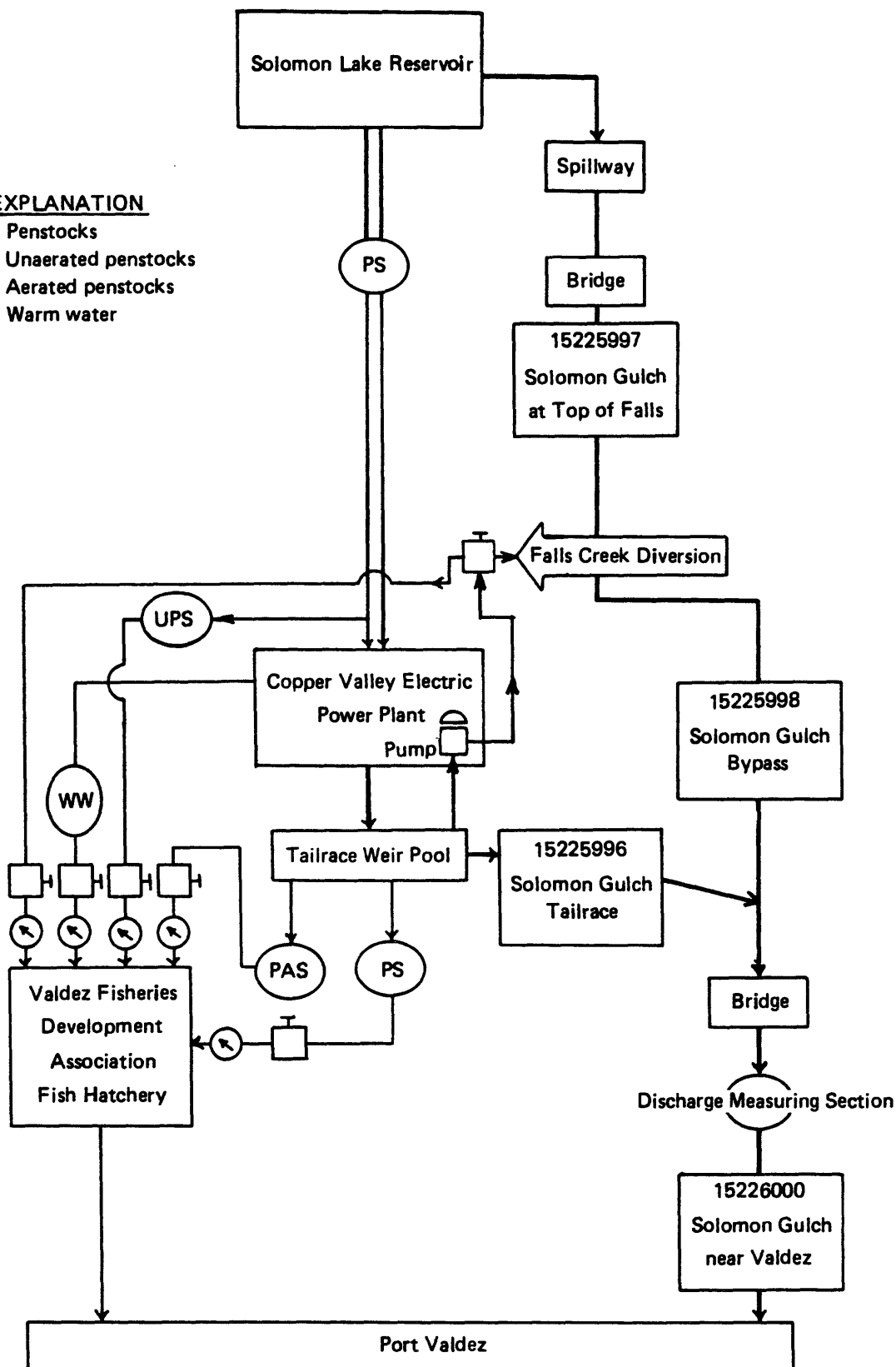


Figure 4.-- Schematic diagram of Solomon Gulch flow pattern.

data-collection sites follow, and the records for September 1986 and water year 1987 (October 1, 1986 through September 30, 1987) are included in tables in this report.

DATA-COLLECTION SITES AND DISCHARGE RECORDS

Solomon Gulch Tailrace near Valdez

(USGS Streamgaging Station No. 15225996)

Description of site: Location is at weir in the discharge pool downstream from the CVEA powerhouse, 350 ft upstream from mouth of the tailrace at Solomon Gulch. Elevation is about 40 ft above mean sea level; flow is not subject to tidal influence.

Stage measurement and discharge values: Continuous stage record is obtained with an electronic data recorder located on the powerhouse "catwalk" and a pressure transducer installed in the weir pool. The concrete weir 35 ft below the powerhouse (fig. 5) provides a stable control for the gage pool. Water discharged into the tailrace (fig. 6) has passed through one or both turbines for power generation. Discharge values here represent flow past the weir and do not include any of the diversions to the VFDA hatchery.

Stage-discharge relation and discharge measurements: A stage-discharge relation developed for this site is verified by ongoing direct measurements near the weir. Twenty-six measurements were made between September 1986 and August 1988.

Accuracy of records: The weir is virtually free of debris and does not appear to be affected by backwater from snow or ice. Records of discharge from the powerplant are available for comparison. Records of discharge at this site (table 1) are generally considered good.

Solomon Gulch Bypass near Valdez

(USGS Streamgaging Station No. 15225998)

Description of site: Location is in a pool at base of the farthest downstream falls on Solomon Gulch (fig. 7), 100 ft upstream from Solomon Gulch Tailrace and 300 ft upstream from the mouth at Port Valdez. Elevation is about 25 ft above mean sea level, and flow is affected (backwater) by extreme high tides on Port Valdez.

Stage measurement and discharge values: A continuous record of water stage in the gage pool is provided by an analog recorder driven by a gas-purge manometer system; the orifice is installed in the pool and the recorder is located in the CVEA powerhouse. Large boulders at the outflow from the pool create an extremely stable control for the gage pool.

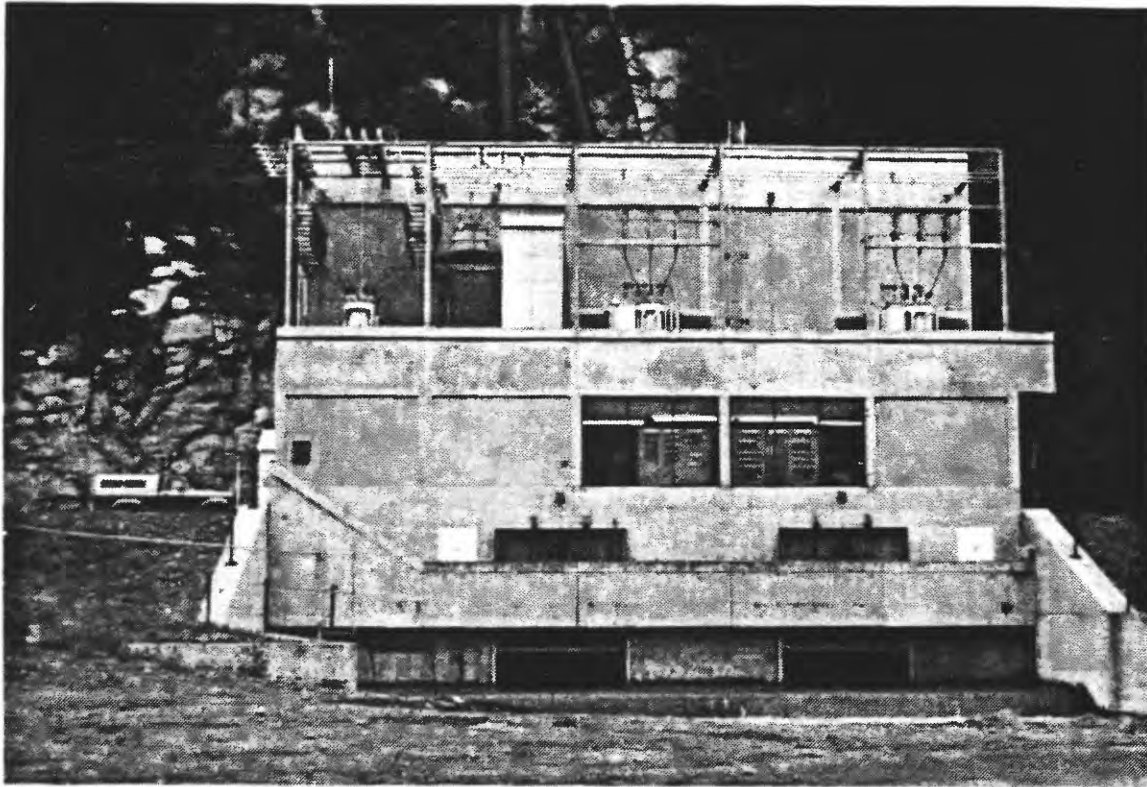


Figure 5. -- Copper Valley Electric Association powerhouse on Solomon Gulch.

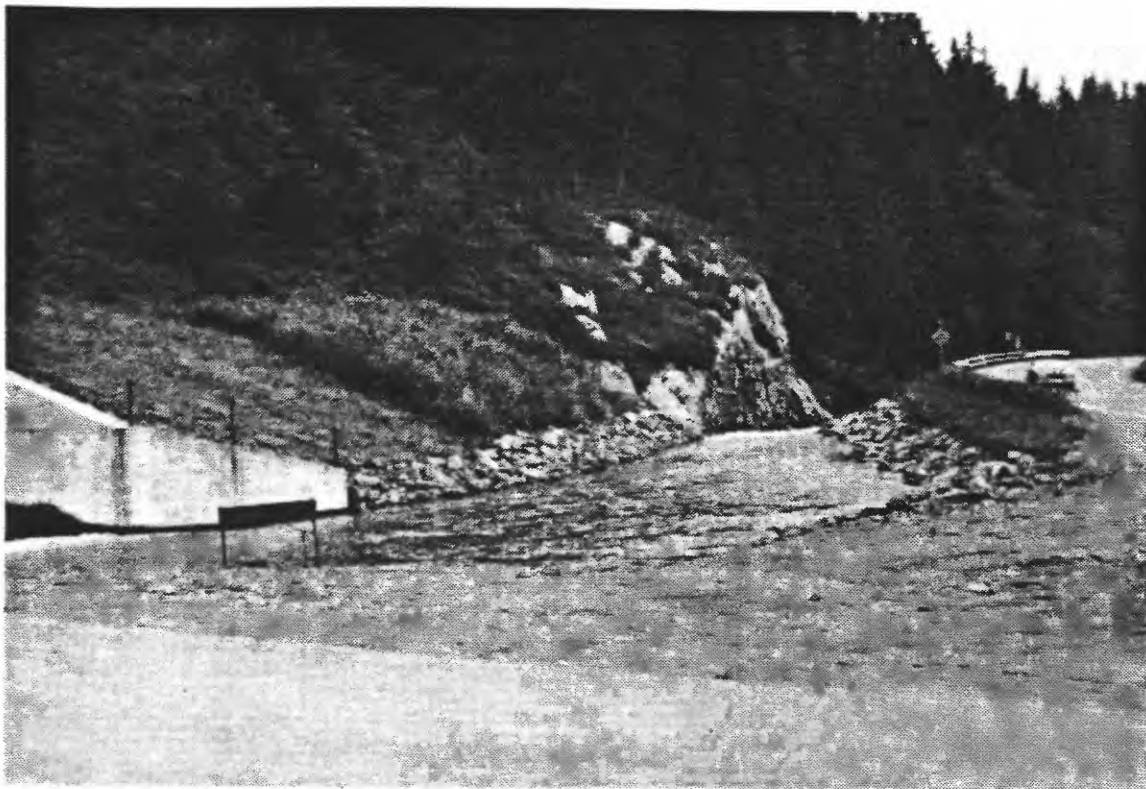


Figure 6. -- Tailrace downstream from Copper Valley Electric Association powerhouse.

Table 1.-- Discharge records at Solomon Gulch Tailrace near Valdez, September 1986 through September 1987

Discharge, in cubic feet per second, September 1986												
Mean values												
Day		Day		Day		Day		Day		Day		
1	131	6	101	11	135	16	135	21	126	26	97	
2	138	7	80	12	132	17	136	22	135	27	129	
3	140	8	89	13	130	18	134	23	135	28	126	
4	135	9	83	14	122	19	134	24	131	29	130	
5	136	10	104	15	134	20	131	25	121	30	126	
September total - 3716 Mean - 124 Maximum - 140 Minimum - 80 Acre-feet - 7370												
Discharge, cubic feet per second, water year October 1986 to September 1987												
Mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	130	104	101	89	125	129	98	77	138	139	139	176
2	130	113	84	92	124	123	96	45	138	140	143	187
3	134	111	81	83	123	109	95	41	139	139	133	186
4	120	114	82	91	124	107	93	75	145	137	142	199
5	121	105	88	109	121	107	84	101	146	139	147	185
6	126	76	82	114	117	110	93	90	137	141	146	186
7	131	74	81	93	107	100	82	109	139	140	146	186
8	129	79	85	92	109	104	82	106	141	143	139	188
9	124	78	78	91	111	103	103	98	141	138	137	199
10	94	81	84	79	118	109	109	94	144	146	136	201
11	76	85	86	82	118	112	106	105	146	146	136	194
12	72	87	91	89	118	111	111	122	140	138	116	190
13	78	82	95	88	118	111	113	137	134	134	126	178
14	112	81	94	91	116	106	112	141	126	134	126	187
15	133	80	92	87	114	106	110	151	134	137	125	191
16	124	83	95	87	120	105	110	139	134	141	120	192
17	114	89	92	78	117	88	107	138	142	140	116	201
18	119	92	119	79	115	82	105	151	140	139	105	188
19	125	114	119	69	125	83	99	150	136	133	122	183
20	128	111	119	83	126	85	90	152	126	134	170	180
21	129	117	113	89	126	80	86	150	126	132	191	183
22	124	121	120	91	122	79	72	150	140	141	184	179
23	125	119	117	87	127	80	45	145	134	138	178	185
24	126	105	124	83	128	77	42	136	131	139	180	156
25	117	88	126	75	124	83	4.8	143	135	133	184	135
26	114	91	126	84	94	88	38	148	134	129	188	132
27	117	105	121	98	112	92	46	146	139	138	190	124
28	102	109	126	107	128	96	.00	144	139	133	187	134
29	106	106	120	103	---	93	46	143	141	132	184	134
30	105	97	116	121	---	96	60	139	140	144	188	139
31	102	---	97	122	---	95	---	131	---	147	113	---
Total	3587	2897	3154	2846	3327	3049	2437.80	3797	4125	4284	4637	5288
Mean	116	96.6	102	91.8	119	98.4	81.3	122	137	138	150	176
Maximum	134	121	126	122	128	129	113	152	146	147	191	201
Minimum	72	74	78	75	94	77	.00	41	126	129	105	124
Acre-ft	7110	5750	6260	5650	6600	6050	4840	7530	8180	8500	9200	10490
Water year 1987 Total 43428.80 Mean 119 Maximum 201 Minimum .00 Acre-feet 86140												

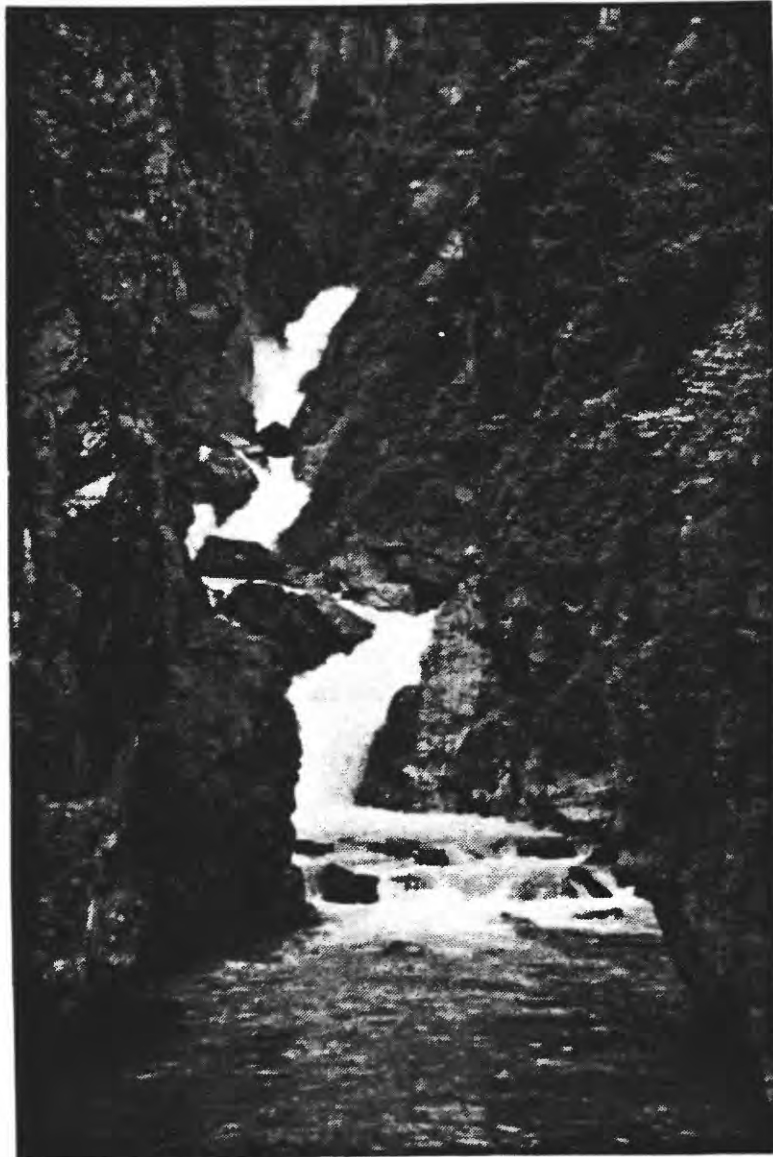


Figure 7. -- Solomon Gulch Bypass.

Discharge values here represent flow over the spillway of the dam on Solomon Lake plus any inflow between the dam and the gage, minus the Falls Creek Diversion. Because channel conditions almost always prevent direct measurement of discharge near the gage pool, values of discharge at this site are determined by measuring discharge in Solomon Gulch below its confluence with the powerhouse tailrace and subtracting the discharge at the tailrace (station No. 15225996, Solomon Gulch Tailrace) at the time of measurement.

Stage-discharge relation and discharge measurements: A stage-discharge relation was developed for this site and is verified by periodic current-meter measurements. Twenty-three measurements were made between September 1986 and August 1988. On July 29, 1988, a direct measurement was also made between the gage pool and the mouth of the tailrace (fig. 8). The results verified the computed discharge with 1.2 percent.

Accuracy of records: The stage-discharge relation (rating curve) for this site is subject to considerable deviation or shifting. During summer and fall, various types of debris -- leaves, twigs, and dead salmon -- lodge between the boulders and raise the level of water in the gage pool. In winter, the stage-discharge relation is affected by backwater caused by snow and ice on the boulder control. Records of discharge (table 2) are considered good, except for those during periods of ice effect, which are rated as fair to poor.

Solomon Gulch at Top of Falls

(USGS Streamgaging Station No. 15225997)

Description of site: Location is at the top of a series of falls; 100 ft downstream from the Alyeska Pipeline Service Company bridge, and 0.3 mi upstream from the mouth at Port Valdez. Elevation is 400 ft above mean sea level, from topographic map.

Stage measurement and discharge values: Water stage is not being recorded. Daily discharge values for this site are determined by adding values of the Falls Creek Diversion, provided by employees of the VFDA hatchery, to daily discharge values for the Solomon Gulch Bypass site (station No. 15225998). Water is diverted to the hatchery via the Falls Creek Diversion, located about 1,000 ft downstream from this site and about 300 ft upstream from the bypass gage site.

Profiles of the high-water marks for the flood of October 11, 1986, and channel geometry on the upstream side of the pipeline bridge were surveyed in July 1987. Computations from this indirect measurement survey indicate a peak flow of 3,280 ft³/s through the bridge opening. Figure 9 shows the maximum height of the water surface about 100 ft upstream from the bridge. At peak stage of the flood, water was in contact with the bottom upstream bridge stringer.

Discharge measurements: Only two direct measurements of flow have been made at the "Top of Falls" site -- on September 24, 1987 and on July 29, 1988.

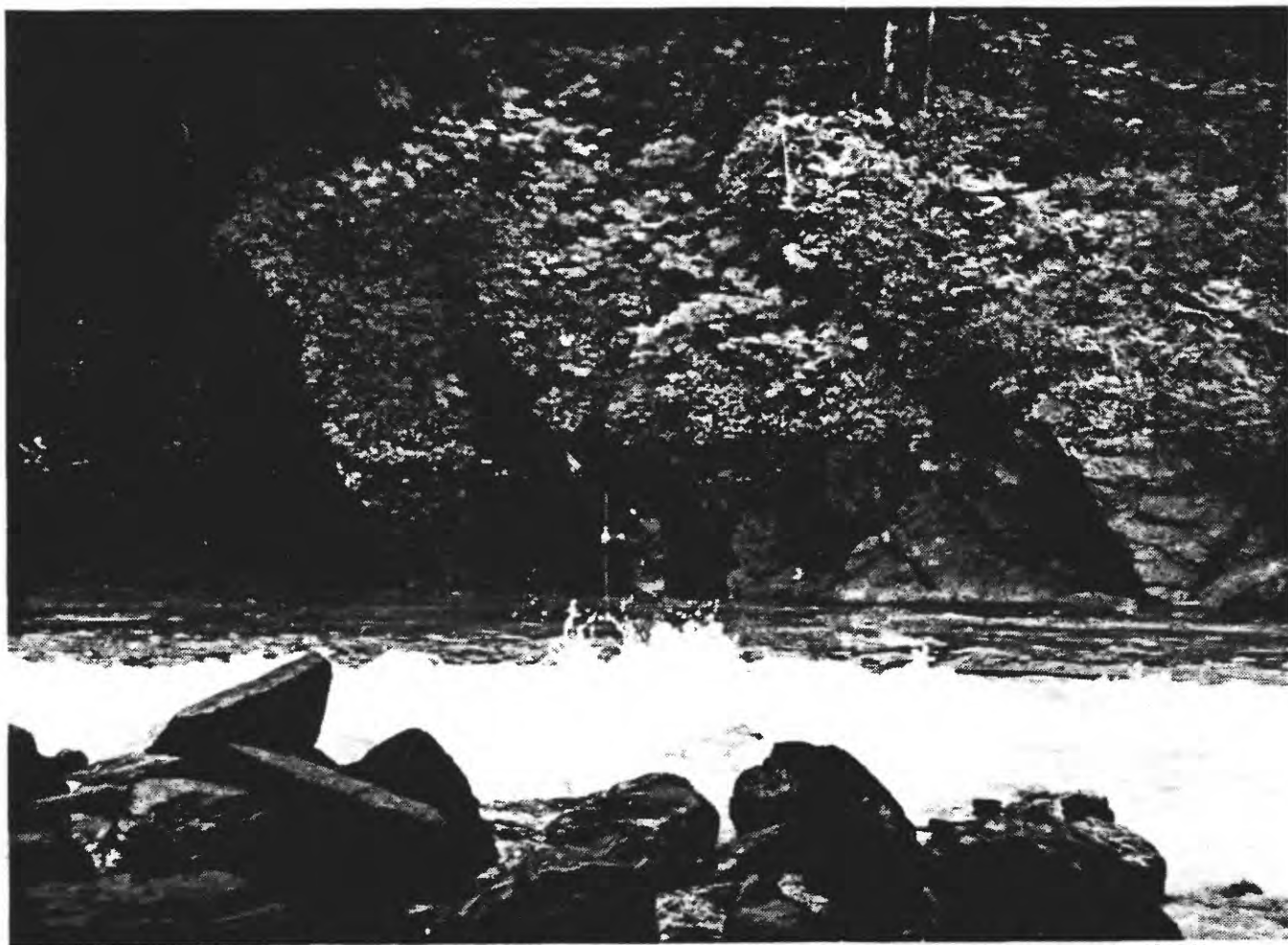


Figure 8. -- Discharge measurement in Solomon Gulch Bypass, just upstream from mouth of tailrace.



Figure 9. -- Survey rod indicating height of water surface at peak flow on October 11, 1986, 100 feet upstream from the Alyeska Pipeline Service Company bridge over Solomon Gulch.

Table 2. -- Discharge records at Solomon Gulch Bypass near Valdez, September 1986 through September 1987

Discharge, cubic feet per second, September 1986												
Mean values												
Day		Day		Day		Day		Day		Day		
1	138	6	25	11	38	16	8.3	21	351	26	8.4	
2	148	7	44	12	18	17	8.8	22	164	27	7.9	
3	96	8	203	13	10	18	23	23	78	28	7.8	
4	59	9	184	14	8.8	19	62	24	20	29	7.8	
5	33	10	93	15	8.5	20	604	25	11	30	8.8	
September total - 2477.1 Mean - 82.6 Maximum - 604 Minimum - 7.8 Acre-feet - 4910												
Discharge, cubic feet per second, water year October 1986 to September 1987												
Mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	9.3	9.1	11	12	8.0	11	8.6	13	16	13	197	21
2	9.0	13	11	12	7.5	11	8.5	15	18	13	170	4.4
3	21	13	11	12	7.5	12	8.4	15	16	12	157	252
4	184	14	11	12	7.5	11	8.8	15	16	12	130	1520
5	94	13	11	13	7.0	13	9.0	17	16	12	201	485
6	32	13	11	13	7.0	13	8.7	16	17	11	330	234
7	12	12	11	14	6.5	14	8.5	17	16	6.7	292	1390
8	11	12	11	13	6.5	15	8.4	17	15	6.6	197	1040
9	10	12	11	14	6.5	16	9.3	17	15	6.4	159	409
10	828	12	11	12	6.0	17	9.6	17	14	6.2	148	329
11	2140	12	9.5	11	6.0	18	8.7	16	14	6.4	142	190
12	603	12	9.5	11	6.0	20	8.8	16	14	8.5	161	88
13	570	12	9.5	9.5	5.5	21	8.7	17	14	14	164	68
14	555	12	9.5	8.5	5.5	22	6.8	18	14	167	196	32
15	247	12	9.5	6.5	5.5	25	6.7	20	14	183	183	12
16	116	12	9.5	8.0	5.0	26	6.6	18	13	216	127	9.6
17	48	12	9.5	7.5	5.0	27	7.9	20	13	205	114	9.6
18	22	12	9.5	7.5	5.0	29	9.5	17	13	222	98	14
19	12	13	9.5	8.0	5.0	23	9.5	17	13	268	79	23
20	11	12	9.5	8.0	4.5	19	9.5	17	13	369	55	17
21	23	12	8.5	8.5	5.5	16	9.6	17	13	349	36	11
22	36	12	8.5	8.5	6.5	13	8.3	17	14	359	23	12
23	17	12	8.5	8.5	7.5	11	6.7	15	13	360	22	54
24	15	11	8.0	9.5	8.5	10	6.7	18	13	266	26	168
25	11	11	8.0	9.5	9.5	9.3	6.7	16	12	262	41	150
26	10	11	7.5	9.5	10	9.0	6.7	18	13	331	50	146
27	9.6	11	7.5	8.5	11	8.5	8.4	16	15	345	44	94
28	9.5	11	8.5	8.5	11	8.4	11	17	15	309	35	54
29	9.3	11	9.5	8.5	---	8.2	12	16	15	266	32	47
30	9.1	11	12	8.0	---	9.0	14	17	17	250	40	22
31	8.8	---	13	8.0	---	9.1	---	17	---	240	40	---
Total	5692.6	357.1	304.5	310.0	192.5	474.5	260.6	519	434	5094.8	3689	6905.6
Mean	184	11.9	9.82	10.0	6.87	15.3	8.69	16.7	14.5	164	119	230
Maximum	2140	14	13	14	11	29	14	20	18	369	330	1520
Minimum	8.8	9.1	7.5	7.5	4.5	8.2	6.6	13	12	6.2	22	4.4
Acre-ft	11290	708	604	615	382	941	517	1030	861	10110	7320	13700
Water year 1987 Total 24234.2 Mean 66.4 Maximum 2140 Minimum 4.4 Acre-feet 48070												

Accuracy of records: The direct discharge measurements indicate that computed discharges are from 5 to 10 percent low in the 150 to 200 ft³/s range. However, overall records of discharge at this site (table 3) are considered to be of fair to poor accuracy.

Solomon Gulch near Valdez

(USGS Streamgaging Station No. 15226000)

Description of site: Location is at mouth of Solomon Gulch at Port Valdez (sea level), 3.8 mi southeast of city of Valdez.

Discharge values: Neither discharge nor water stage are measured at this site. Computed discharge values represent the total flow for Solomon Gulch. This includes flow at Solomon Gulch Tailrace (station No. 15225996), Solomon Gulch Bypass (station No. 15225998), the Falls Creek Diversion, and all penstock diversions to the VFDA hatchery. Tables of daily diversion to the hatchery are provided by VFDA. However, because the hatchery discharges "used" water directly into Port Valdez, direct measurements of that discharge for verification are virtually impossible.

The average annual discharge of Solomon Gulch at its mouth for water years 1950-56 (7 years), before any regulation of flow, was 144 ft³/s; the computed mean discharge for water year 1987, adjusted for changes in storage in Solomon Lake, was 194 ft³/s, about 35 percent higher than the earlier, longer term average value. This higher value seems reasonable if it is compared to the nearest long-term station in a comparable environment, Power Creek near Cordova (USGS streamgaging station No. 15216000). The average discharge at Power Creek for water years 1950-56 was 248 ft³/s. Mean discharge at Power Creek for the 1987 water year was 317 ft³/s or 28 percent higher than for the 7-year period.

In addition to the calculated "actual" daily flow values at the site, the Geological Survey publishes an additional set of monthly flow values, adjusted to account for changes in storage in Solomon Lake. This is an attempt to "reconstruct" natural or unregulated runoff patterns for Solomon Gulch.

Accuracy of records: On the basis of comparison with Power Creek, and on the expected accuracy of records for other data-collection sites in the basin, records of discharge at the mouth of Solomon Creek (table 4) are considered good.

Table 3. --Discharge records at Solomon Gulch at top of falls near Valdez, September 1986 through September 1987

Discharge, cubic feet per second, September 1986												
Mean values												
Day	Day		Day		Day		Day		Day			
1	138	6	25	11	38	16	8.3	21	351	26	8.4	
2	148	7	44	12	18	17	8.8	22	164	27	9.0	
3	96	8	203	13	10	18	23	23	78	28	8.8	
4	59	9	184	14	8.8	19	62	24	20	29	8.8	
5	33	10	93	15	8.5	20	604	25	11	30	9.8	
September total - 2481.2 Mean - 82.7 Maximum - 604 Minimum - 8.3 Acre-feet - 4920												
Discharge, cubic feet per second, water year October 1986 to September 1987												
Mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	10	10	14	14	9.5	12	15	13	17	14	204	28
2	10	14	12	14	9.0	12	15	15	19	13	177	11
3	22	14	12	14	9.0	13	14	15	17	12	164	259
4	184	15	12	13	9.0	13	15	15	17	12	137	1530
5	94	14	12	14	8.5	14	15	17	17	12	208	492
6	32	14	12	14	8.5	15	15	16	18	12	337	241
7	12	13	12	15	8.0	16	14	17	17	17	299	1400
8	11	13	12	14	8.0	17	14	17	15	17	204	1050
9	10	13	12	15	8.0	18	15	17	15	17	166	416
10	828	13	12	13	7.5	19	15	17	14	17	155	330
11	2140	13	11	12	7.5	20	14	16	14	17	149	191
12	603	13	11	12	7.5	22	14	16	14	19	168	89
13	571	13	11	11	7.0	23	14	17	14	20	171	69
14	557	13	11	10	7.0	24	12	18	14	167	203	34
15	249	14	11	10	7.0	26	12	20	14	184	190	14
16	118	14	11	9.5	6.5	27	12	18	13	216	134	11
17	49	14	11	9.0	6.5	28	13	20	13	205	121	11
18	23	14	11	9.0	6.5	30	11	17	13	222	105	16
19	14	15	11	9.5	6.5	24	11	17	13	268	86	25
20	12	14	11	9.5	6.0	20	11	17	13	369	62	19
21	24	14	10	10	7.0	17	11	17	13	349	43	13
22	37	14	10	10	8.0	14	13	17	14	359	30	14
23	18	14	10	10	9.0	12	14	15	13	360	29	57
24	16	12	9.5	11	10	14	13	18	13	266	33	176
25	12	12	9.5	11	11	15	13	16	12	262	48	158
26	11	12	9.0	11	12	15	13	18	13	331	57	154
27	11	12	9.0	10	13	14	12	17	15	345	51	101
28	11	12	10	10	13	14	11	18	15	309	42	56
29	11	12	11	10	---	14	12	17	16	266	39	48
30	10	12	13	9.5	---	15	14	18	18	250	47	24
31	10	---	14	9.5	---	15	---	18	---	240	47	---
Total	5720	396	347.0	353.5	236.0	552	397	524	443	5167	3906	7037
Mean	185	13.2	11.2	11.4	8.43	17.8	13.2	16.9	14.8	167	126	235
Maximum	2140	15	14	15	13	30	15	20	19	369	337	1530
Minimum	10	10	9.0	9.0	6.0	12	11	13	12	12	29	11
Acre-ft	11350	785	688	701	468	1090	787	1040	879	10250	7750	13960
Water year 1987 Total 25078.5 Mean 68.7 Maximum 2140 Minimum 6.0 Acre-feet 49740												

Table 4. -- Discharge records for Solomon Gulch near Valdez, September 1986 through September 1987

Discharge, cubic feet per second, September 1986												
Mean values												
Day		Day		Day		Day		Day		Day		
1	280	6	136	11	183	16	154	21	488	26	115	
2	297	7	134	12	160	17	155	22	310	27	147	
3	247	8	302	13	150	18	168	23	224	28	144	
4	204	9	277	14	141	19	207	24	162	29	148	
5	179	10	207	15	153	20	746	25	143	30	145	
September total - 6506 Mean - 217 Maximum - 746 Minimum - 115 Acre-feet - 12900												
September (adjusted for change in Solomon Lake storage) Mean - 201 Cubic feet per second per square mile - 10.20												
Runoff in inches - 11.39 Acre-feet - 11,960												
Discharge, cubic feet per second, water year October 1986 to September 1987												
Mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	149	123	118	106	138	145	115	90	156	159	353	214
2	150	136	99	109	136	139	113	60	158	154	330	209
3	166	134	96	100	135	126	111	56	157	152	307	465
4	315	138	97	107	136	124	110	90	163	150	289	1740
5	226	128	103	126	133	125	101	118	164	152	365	687
6	168	99	97	131	129	129	110	106	156	154	493	437
7	153	96	96	111	118	120	98	126	157	158	455	1590
8	150	101	100	109	120	125	98	123	157	161	353	1240
9	144	100	93	109	122	125	120	115	157	158	313	625
10	932	103	99	95	129	132	126	111	159	166	301	541
11	2230	107	100	97	129	136	122	121	161	166	295	395
12	685	109	105	104	129	137	127	138	154	163	294	288
13	659	104	109	102	128	138	129	154	148	160	307	254
14	678	97	108	104	126	134	126	159	140	307	339	228
15	391	97	106	100	124	136	124	171	148	327	325	212
16	251	100	109	100	130	136	124	157	147	363	264	210
17	172	106	106	90	127	120	122	158	155	351	247	219
18	151	109	133	91	125	116	118	168	153	368	220	211
19	148	132	133	102	135	111	112	167	149	408	218	215
20	149	128	133	96	135	109	103	170	142	510	242	206
21	162	134	126	102	136	101	99	168	142	488	244	203
22	170	138	133	104	133	97	87	168	157	507	224	200
23	152	136	130	100	139	96	61	161	150	505	217	248
24	151	120	137	97	141	95	57	155	147	412	223	333
25	138	103	139	89	138	101	20	160	150	402	242	294
26	134	106	138	98	109	106	53	166	150	467	255	287
27	137	120	133	111	128	109	60	163	157	490	251	227
28	122	124	139	120	144	113	13	162	160	449	239	198
29	125	121	134	116	---	110	60	160	163	405	233	191
30	123	112	132	134	---	114	76	157	164	401	245	171
31	120	---	114	135	---	112	---	149	---	394	170	---
Total	9601	3461	3595	3295	3652	3717	2895	4327	4621	9607	8853	12538
Mean	310	115	116	106	130	120	96.5	140	154	310	286	418
Maximum	2230	138	139	135	144	145	129	171	164	510	493	1740
Minimum	120	96	93	89	109	95	13	56	140	150	170	171
Acre-ft	19040	6860	7130	6540	7240	7370	5740	8580	9170	19060	17560	24870
Water year 1987 Total 70162 Mean 192 Maximum 2230 Minimum 13 Acre-feet 139200												
Adjusted for change in storage in Solomon Lake												
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	291	79	41	39	19	51	20	211	436	419	286	418
Cubic ft. per sec. per mi ²	14.8	4.01	2.08	1.98	0.96	2.59	1.02	10.7	22.1	21.3	14.5	21.2
Runoff in inches	17.03	4.47	2.42	2.26	1.02	3.00	1.16	12.37	24.72	24.52	16.72	23.68
Ac-ft	17,890	4,690	2,550	2,370	1,070	3,150	1,210	13,000	25,970	25,760	17,560	24,870
Water year 1987 Mean 194 Cubic feet per second per square mile 9.85 Runoff in inches 133.38 Acre-feet 140,100												