ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

SUBTASK 3.01 - CLOSEOUT REPORT
REVIEW OF AVAILABLE MATERIAL

FEBRUARY 1981

Acres American Incorporated
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Main at Court
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Telephone (716) 853-7525

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1 - INTRODUCTION

1.1 - Background

The development of hydroelectric power in the Susitna River Basin has been under study for the last three decades. Streamflow observations in the basin extend over 30 years at the oldest established gaging stations. Some climatic records at Talkeetna and Summit stations date back from 1938. Most of the data has been collected by agencies such as the United States Geological Survey (USGS), U.S. Soil Conservation Service (SCS), National Oceanic and Atmospheric Administration (NOAA) and the Arctic Environmental Information and Data Center (AEIDC).

The Acres American Incorporated Plan of Study (POS) (1) for the reassessment of the feasibility of the Susitna Hydroelectric Project includes Hydrologic Studies under Task 3 which is composed of several subtasks. The objective of the Subtask 3.01 is to assemble and review all available reports, maps and studies relating to the hydrologic aspects of the Susitna and neighboring basins and abstract hydrologic design parameters required for the planning studies concerned with alternative hydro sites including small hydro development in the Railbelt.

Studies of potential hydroelectric development in the Susitna and the neighboring basins have chiefly been conducted by the U.S. Corps of Engineers (COE), U.S. Bureau of Reclamation (USBR), Kaiser Engineers, Alaska Power Administration and the Federal Energy Regulatory Commission (FERC - formerly Federal Power Commission). While identifying suitable sites for development, these studies have collected and interpreted hydrological and climate data to derive various design parameters.

1.2 - Report Contents

The report is briefly summarized in Section 2. The scope of work associated with Subtask 3.01 is described in Section 3. A review of previous hydrologic data collection and processing work undertaken within the Susitna Basin is outlined in Section 4 while Section 5 discusses hydrologic data pertinent to other potential hydroelectric development schemes in the vicinity of the railbelt. Section 6 deals with the available climatic data. Short extracts from several publications are appended for ready reference of useful data.

2 - SUMMARY

2.1 - Available Data

USGS (13,14,15,16) collects streamflow data at over a hundred stations within the State of Alaska (see Figure 2.1). Temperature, sediment discharge and water quality observations are made at a smaller number of gaging stations. The main objective of the USGS is to obtain sufficient data to evaluate, on a regional basis, the water resource potential of the State. Thus, data at specific locations of interest to a hydroelectric or other development are not usually available directly from USGS records.

Continuous streamflow records exist for the station at Gold Creek on the Susitna River for over 30 years. Most of the river basins have some flow records extending over similar periods. On the Yukon River at Eagle, streamflow records date back to 1911. Water quality and sediment discharge records are usually available for much shorter periods.

Climate data is collected mainly by NOAA (formerly by the National Weather Service) at various airports. The data includes daily temperatures, relative humidity, precipitation, wind speed and direction, sunshine hours, weather type and sky cover. NOAA operates some 24 local climatological data stations in the State where 3 or 6 hourly observations are made for most of the above parameters. Additional information is available from AEIDC in the form of processed climatic data.

The SCS runs regular snow course surveys in the area and snow depths and water equivalent data are available at a number of stations in and around the Susitna basin. At several stations, the surveys date back to the winter of 1964.

In addition, water resources data have been collected and/or analyzed by the Alaska Department of Fish and Game (ADF&G) and Alaska Department of Natural Resources (DNR) in conjunction with special studies.

2.2 - Previous Studies

The most comprehensive analysis of hydrological information for the Susitna River to date is to be found in the COE Feasibility reports (5,6) (1975 and 1979) dealing with hydroelectric development of the Susitna basin. Preliminary hydrologic analyses for Cook Inlet and tributaries, Copper River and Gulf Coast and Yukon and Kuskokwim River Basins were undertaken in 1950/51 by the COE and described in their Harbors and Rivers in Alaska - Survey Reports (4).

In 1952 the USBR reported (8) on the potential development of water resources in the Susitna River Basin. This report provides hydrologic information at several identified dam sites (see Figure 2.2). Later results in 1960 by the USBR (9) and the Alaska Power Administration (1974) (10) for the Devil Canyon project on the Susitna River provide updated information at that site. The 1974 report by Kaiser Engineers (2) include hydrologic analyses for the High Devil Canyon and other dam sites on the Susitna.

(1) Numbers in brackets refer to the reference number.

The 1976 Federal Power Commission report (12), the 1979 COE National Hydroelectric Power Resources Study (7) and the 1980 Alaska Power Administration Hydroelectric Alternatives for the Alaska Railbelt report (11) include inventory-level hydrologic calculations for large and small potential hydroelectric developments covering the entire state. Figure 2.3 shows some of the more promising of these developments which are included in current Task 6 engineering studies.

2.3 - Conclusions

An Index (3) of available hydrologic and climatic data has been prepared and should be consulted if more detailed outline of available data is required. Extracts from the Index are included in Appendix A, C, D, G, and H. A detailed review of the information has generally confirmed the proposed supplementary data collection program and the hydrologic analyses outlined in the February 1980 Acres POS. On the basis of this review it became apparent that some minor modifications to the proposed supplementary data collection program should be made. These are as follows:

- Because of the potential for extremely deep snow cover in the mountainous regions, the use of snow pillows is not advised as the snow tends to bridge across these relatively large pressure plates. A more appropriate measurement procedure is the use of snow markers supported by conventional measurement using snow tubes;

- The proposed water quality (both water chemistry and suspended sediment load measurements) should be scheduled to obtain a maximum amount of information during specific hydrologic events such as floods and low flow periods rather than on a regular basis as originally proposed;

- A few basic water quality parameters should be collected using a continuous monitoring device at Watana to study the short-term variations of certain key parameters such as water temperature, dissolved oxygen concentration, specific conductance, pH and oxidation-reduction potential. This would facilitate a better understanding of the processes involved and assist with interpretation of historical data.

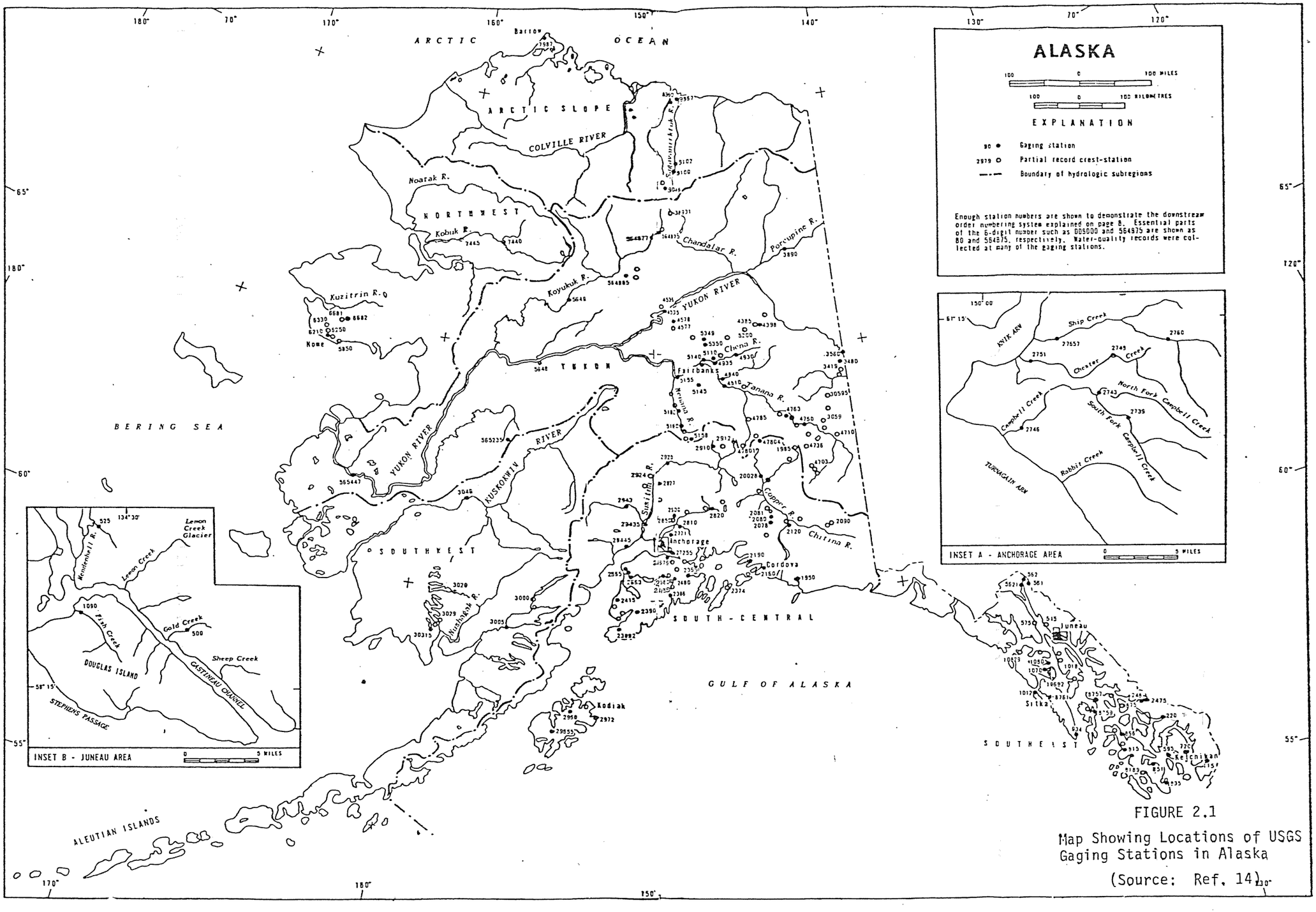
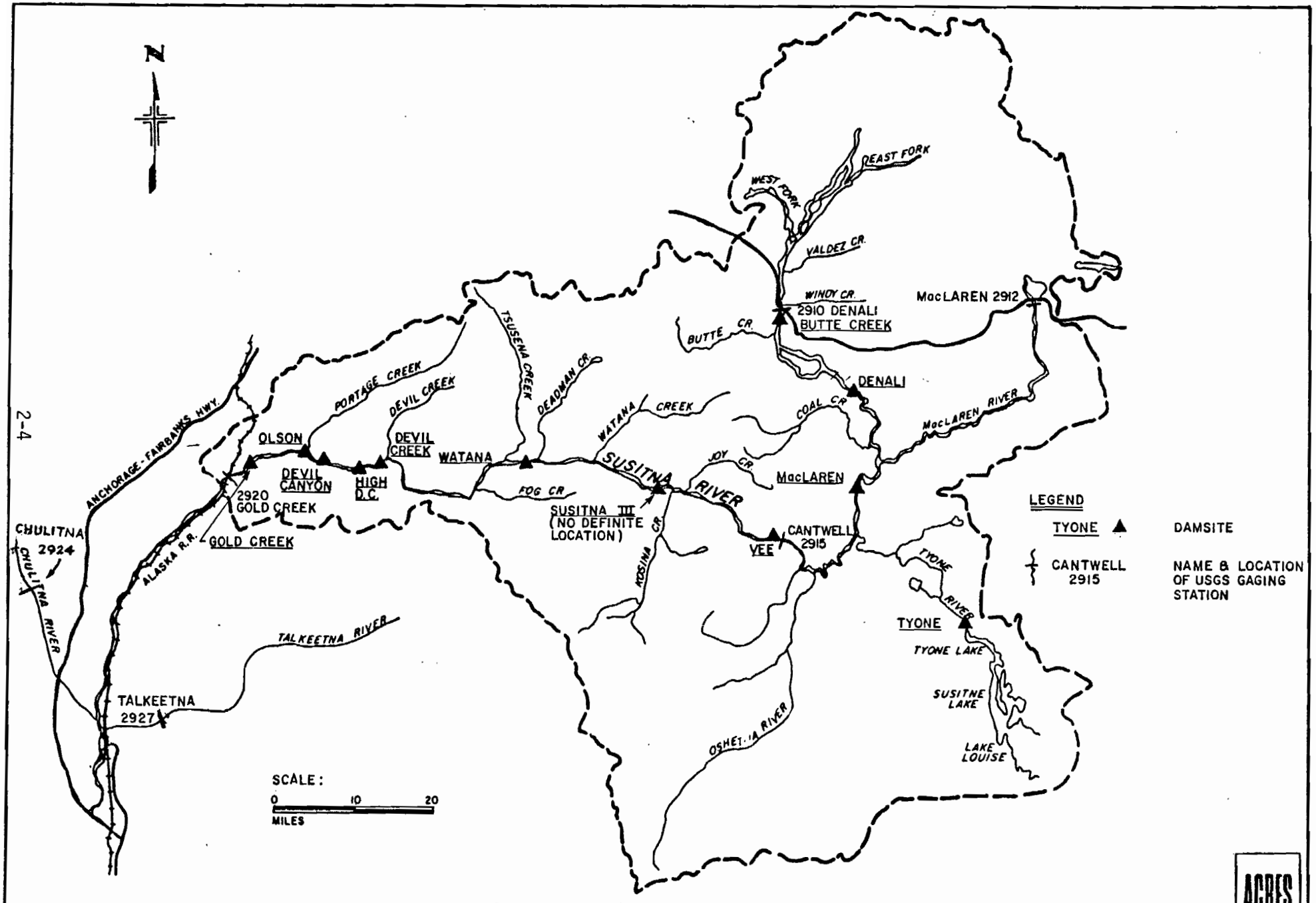


FIGURE 2.1

Map Showing Locations of USGS Gaging Stations in Alaska

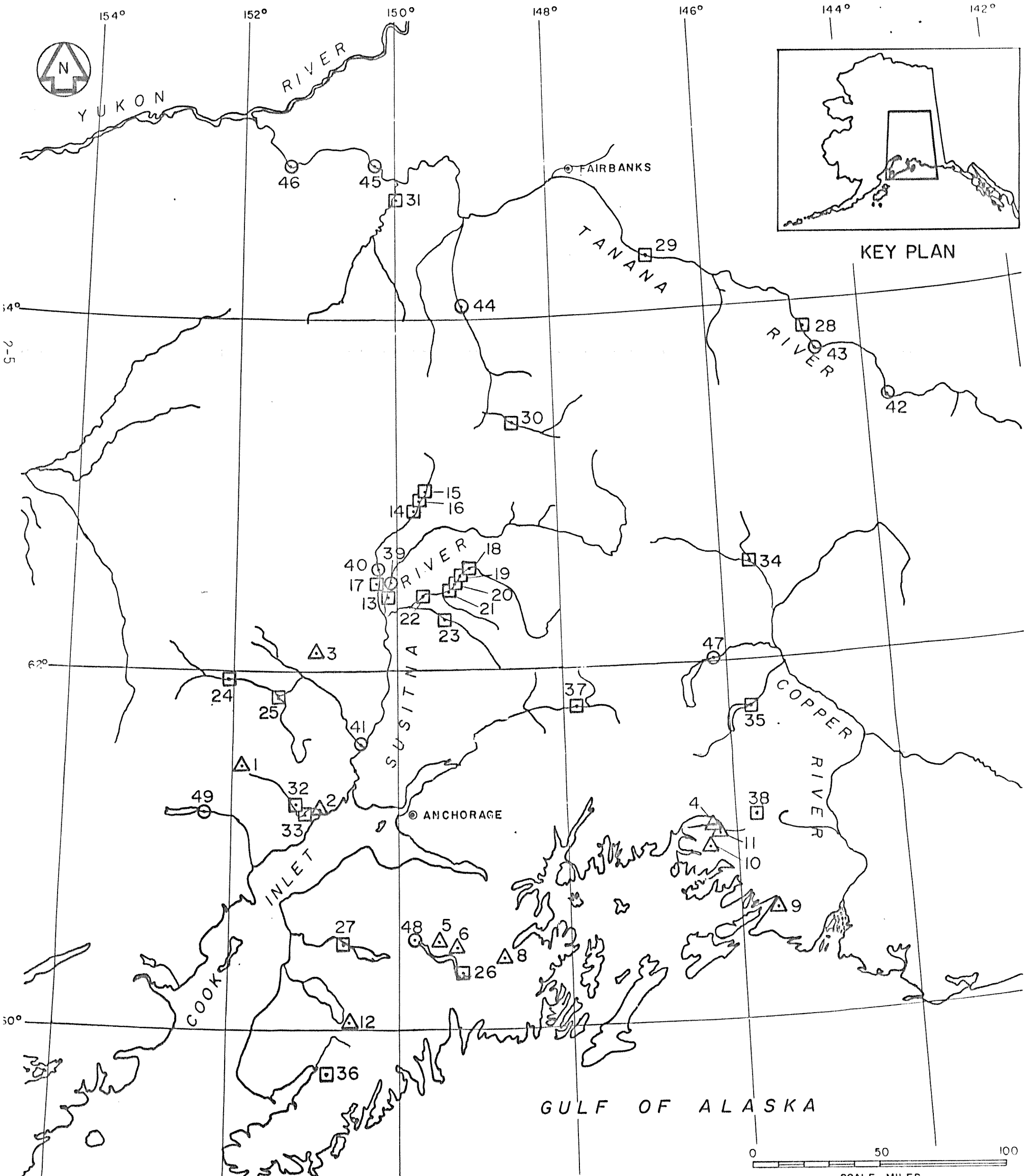
(Source: Ref. 14)



LOCATION OF GAGING STATIONS AND IDENTIFIED DAM SITES

FIGURE 2.2

ACRES



ALASKA RAILBELT REGION

SELECTED ALTERNATIVE HYDROELECTRIC SITES

△ 0-25 MW

1. Strandline L.
2. Lower Beluga
3. Lower Lake Cr.
4. Allison Cr.
5. Crescent Lake 2
6. Grant Lake
7. McClure Bay
8. Upper Nellie Juan
9. Power Creek
10. Silver Lake
11. Solomon Gulch
12. Tustumena

⊡ 25-100 MW

13. Whiskers
14. Coal
15. Chulitna
16. Ohio
17. Lower Chulitna
18. Cache
19. Greenstone
20. Talkeetna 2
21. Granite Gorge
22. Keetna
23. Sheep Creek
24. Skwentna
25. Talachulitna
26. Snow
27. Kenai Lower
28. Gerstle
29. Tanana R.
30. Bruskasna
31. Kantishna R.
32. Upper Beluga
33. Coffee
34. Gulkana R.
35. Klutina
36. Bradley Lake
37. Hick's Site
38. Lowe

⊙ >100 MW

39. Lane
40. Tokichitna
41. Yentna
42. Cathedral Bluffs
43. Johnson
44. Browne
45. Junction Is.
46. Vachon Is.
47. Tazilna
48. Kenai Lake
49. Chakachamna

FIGURE 2.3

3 - SCOPE OF WORK

The reports contained in the Bibliography were reviewed and all useful summary data abstracted and incorporated in this report. Detailed discussions were held with the staff of the USGS, Alaska regional office, AEIDC, DNR, ADF&G and the SCS. The objective of these discussions was to determine what data was available and to firm up the proposed supplementary data collection program proposed for 1980-82. Selected minutes of meetings held with these agencies are presented in Appendix E.

4 - HYDROLOGIC DATA FOR THE SUSITNA BASIN

4.1 - Streamflow

(a) USGS Records

The USGS monitors river stages at over a hundred gaging stations in the State. There are six stations currently being operated in the Susitna Basin, three on the main stem and three on the tributaries. The gaging station on the Susitna at Gold Creek (see Figure 2.2) has a continuous streamflow record for 31 years from 1949 with some minor gaps. The Susitna station near the river mouth has only six years of record. Record lengths at other stations vary between these two extremes. Over ten years of record are available at two stations, Susitna River at Cantwell and Chulitna River near Talkeetna, but observations were discontinued after 1972. Partial and short discharge records are also available for several small tributaries of the Susitna. A list of the gaging stations and record lengths is shown in Appendix A.

The USGS field measurements involve continuous river stage monitoring. Using established stage-discharge relationships, mean daily and instantaneous peak and low flows are calculated. The data is usually presented in the form shown in Table 4.1.

In the periods between October and May, ice cover on the river makes accurate stage observations impossible. The daily mean flows published by the USGS are, therefore, estimated by interpolating daily flows from a few manually observed values. However, as the average flow of Susitna in these months accounts only for some 20 percent of the mean annual flow, the effect of any inaccuracy on the total measured supply is small.

(b) Previous Analyses of Data

The USBR study of 1952 was based on only 2 years (1949-51) of streamflow records on the Susitna at Gold Creek. All the estimates of runoff were derived from this record which was extended back to 1922 by correlation with precipitation records at Talkeetna. Due to the shortness of records, the USBR estimates of mean annual flows are not as reliable as the more recent estimates. At the Watana dam site, for example, the USBR estimate of mean annual runoff was 7550 ft^3/s compared to the 1975 COE estimate of 8150 ft^3/s which was based on some 25 years of record at Gold Creek. The flood studies in the USBR report were based on recorded peak discharges of all interior Alaska streams. The periods of record on all the streams, except one, were 5 years or less. The COE analyses were based on 10 or more years of record at gaging stations in the Susitna Basin.

Water resource analyses for the Devil Canyon Project by the USBR were based on a ten year (1950-59) streamflow record at Gold Creek. Records of Susitna runoff near Denali were extended to cover this period by correlation with Gold Creek runoff. Runoff at the dam sites was estimated by proportioning based on intervening drainage areas. Estimates of peak flood inflows at Devil Canyon and Denali dam sites were made. However, the rationale used in the derivation is not described in the reports.

The COE report on the Upper Susitna Basin presents the most comprehensive analysis to date on the hydrology of the river. These studies are based on a 25 year record (up to 1974) of streamflow at Gold Creek and shorter lengths of record at Denli (16 years) and Cantwell (12 years) stations on the Susitna, and on the Maclaren River near Paxson (15 years). Monthly streamflows at the latter stations were extended by linear correlations with the Gold Creek station records. Interpolation of observed and estimated monthly streamflow for the dam sites was accomplished by adopting linear drainage area relationships between stations and dam sites. Tables 4.2 to 4.5 show estimated monthly flows for the period 1950-74 for the dam sites at Devil Canyon, Watana, Vee and Denali, respectively.

Power studies were carried out utilizing 25 years of recorded streamflow (observed or extended). The driest and the second driest years of records occurred consecutively in 1969 and 1970. To assess the severity of the driest sequence, i.e. a 32-month period from October 1968 to May 1971, the COE generated monthly streamflows for 400 years based on 25 years of record at Gold Creek using stochastic techniques. The results showed that the observed driest sequence has a return period well in excess of 400 years (see Figures 4.1 and 4.2).

The COE carried out frequency analyses of observed peak flows and flood volumes at Gold Creek, Denali, Cantwell and Paxson gaging stations. To derive the Probable Maximum Flood (PMF) the COE used the Streamflow Synthesis and Reservoir Regulation (SSARR) computer model developed by the North Pacific Division of the COE, Portland, Oregon. The model was calibrated using observed precipitation, temperatures and discharges in the basin for four flood events in the period May through August. It was verified by comparing computed and observed hydrographs for the gaging stations at Gold Creek, Cantwell, Denali and Paxson. Spring and summer probable maximum floods were estimated for the Watana and Devil Canyon dam sites using this model in conjunction with Probable Maximum Precipitation (PMP) estimates obtained from National Weather Service (see Appendix B).

Results of the frequency analyses and PMF estimates along with relevant data are shown in Tables 4.6 to 4.9 and Figures 4.3 to 4.6.

4.2 - Sediment Discharge

(a) USGS Records

Periodic suspended sediment samples have been collected by the USGS at the four gaging stations above Gold Creek for varying periods between 1952 and 1979. A list of stations and the periods of record available are shown in Appendix C. Results are published in their water year books and other water supply papers. Typical data collected is shown in Table 4.10.

The data coverage during high-flow high-sediment events is poor and consequently any estimate of total annual sediment yield has a high degree of uncertainty. The majority of the samples collected are analyzed for size distribution. Curves showing typical size distribution of suspended sediment are shown in Figure 4.7. Except for three bed material samples collected by USGS at Denali in September 1958, no bed samples have been taken at any station.

(b) Previous Analyses of Data

Analyses in the USBR reports were based on the periodic USGS sampling at Gold Creek, Denali and other interior Alaska streams. The mean annual sediment inflow at Devil Canyon was estimated at 6440 acre ft. without any upstream development as compared to the 1975 COE estimate of 5040 acre ft. which was based on longer USGS records (1952-74). Corresponding figures for Denali reservoir are 11,400 and 5800 acre ft., respectively. These figures are based on an assumed deposited weight of 80 lb/ft^3 and include an allowance for bed load.

As in the case of streamflow, the most comprehensive analysis of sedimentation in reservoirs is that undertaken by the COE in 1975. Suspended sediment rating curves were developed by regression analyses and sediment transport was calculated using the flow-duration and sediment rating curves (see Figure 4.8). Table 4.11 shows estimated suspended load at the gaging stations. For the sediment samples collected at Denali gage, USGS have computed total sediment load for ten of these observations by use of modified Einstein procedure. The bed load analysis was based on the three bed load measurements taken at Denali. The COE developed a bed load rating curve (Figure 4.9) based on these USGS estimates. Using a flow-duration curve, the COE estimated bed load transport at Denali at about 30 percent of the suspended sediment load at the station. Lack of data at other stations precluded estimates of bed load at these stations. Based on field reconnaissance of bed material it was assumed (by COE) that at Maclaren the bed load would also approximate 30 percent of suspended load as at Denali while at Vee, Watana and Devil Canyon it would be of the order of 10 percent of the suspended load. A basin-wide sediment rating curve (Figure 4.10) was developed using glacial area to basin area ratio and average catchment elevation as independent variables and was used to estimate sediment inflows at the dam sites (see Table 4.12).

4.3 - Water Quality

(a) USGS Records

The locations at which water quality data have been collected within the Susitna Basin and the information available are listed in Appendix D. Since measurements are taken periodically, the number of measurements, timing and specific parameters measured vary from year to year at any given station. A list of the water quality parameters that have been measured in the basin is also presented in Appendix D. Typical information available from the USGS records are shown in Table 4.13.

(b) Previous Analyses of Data

The USBR reports contain little information on the water quality studies for the reservoirs. A somewhat detailed description of the problems of water quality peculiar to the Susitna basin and effects of reservoir developments on the water quality in the downstream reaches are presented in the COE report of 1975. The report concludes that additional information is necessary for evaluating project effects on water quality and suggests a data collection and analysis program.

4.4 - Ice Cover Data

Information on river ice observation is collected by various agencies at several locations in the basin. A summary of the available information are presented in Table 4.14.

4.5 - Discussion

The USBR studies are based on shorter, less extensive data on streamflow and sediment transport. The 1975 COE report contains the most comprehensive analyses of all hydrological data for the basin. Therefore, much of the information available in the COE report was used as input to Acres preliminary project definition studies carried out during 1980. The COE estimates for the Probable Maximum Floods of Watana and Devil Canyon have been interpolated for use at other dam sites (see Table 4.15). Estimates for sediment transports and reservoir deposition have similarly been processed and the results are presented in Table 4.16.

TABLE 4.1

Typical USGS Streamflow Records

(Reproduced from Reference 14)

SOUTH-CENTRAL ALASKA

15292000 SUSITNA RIVER AT GOLD CREEK

LOCATION.--Lat 62°46'04", long 149°41'28", in NW¼ sec.20, T.31 N., R.2 W., Matanuska-Susitna Borough, Hydrologic Unit 19050002, near left bank under Alaska Railroad bridge, 0.1 mi (0.2 km) downstream from Gold Creek, 0.9 mi (1.4 km) north of Gold Creek railroad station, and 2.0 mi (3.2 km) downstream from Indian River.

DRAINAGE AREA.--6,160 mi^2 (15,950 km^2), approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--August 1949 to current year.

GAGE.--Water-stage recorder. Datum of gage is 676.50 ft (206.197 m) above mean sea level. Prior to June 6, 1957, nonrecording gage at same site and datum. June 7, 1957 to June 2, 1964, water-stage recorder at site 0.3 mi (0.5 km) upstream at same datum.

REMARKS.--Water-discharge records good except those for Oct.26 to May 16, which are poor.

AVERAGE DISCHARGE.--28 years, 9,667 ft^3/s (273.8 m^3/s), 21.32 in/yr (542 mm/yr), 7,004,000 acre-ft/yr (8.64 km^3/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 90,700 ft^3/s (2,570 m^3/s) June 7, 1964, gage height, 16.58 ft (5.054 m); maximum gage height observed, 24.48 ft (7.462 m) May 10, 1954, ice jam; minimum daily discharge, about 600 ft^3/s (17.0 m^3/s) Feb. 16-20, 1950.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 54,300 ft^3/s (1,540 m^3/s) June 15, gage height, 13.94 ft (4.249 m); minimum daily discharge, about 1,500 ft^3/s (42 m^3/s) Mar. 1-31.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5400	3000	3000	2000	1700	1500	1600	1900	30900	30000	24200	10600
2	4980	3000	2900	2000	1700	1500	1600	1900	36700	26000	26200	10700
3	4750	2800	2800	2000	1700	1500	1600	2000	39000	22000	23400	10700
4	4520	2800	2800	1900	1700	1500	1600	2000	39700	20000	21500	10500
5	4750	2800	2800	1900	1700	1500	1600	2200	38100	18000	21700	9840
6	4700	2800	2800	1900	1600	1500	1600	2200	33200	18000	23400	9520
7	4720	2800	2600	1900	1600	1500	1600	2500	31300	18000	23400	9880
8	4520	2800	2600	1900	1600	1500	1600	3000	31500	19000	21200	11400
9	4100	2600	2600	1900	1600	1500	1600	3500	31900	20000	19300	12500
10	3880	2600	2600	1900	1600	1500	1600	4000	34400	22000	19900	10800
11	3840	2600	2600	1900	1600	1500	1600	4000	38500	24000	20400	14000
12	3800	2600	2400	1900	1600	1500	1600	5000	44200	26000	21200	16700
13	3740	2600	2400	1900	1600	1500	1600	6000	51400	28000	18900	16980
14	3720	2600	2400	1800	1600	1500	1600	8000	52600	30000	18000	16800
15	3610	2600	2400	1800	1600	1500	1600	10000	52600	30000	20100	15000
16	3760	2600	2400	1800	1600	1500	1700	12000	50400	29000	20600	15600
17	3720	2400	2400	1800	1600	1500	1700	13600	44800	27000	19200	14500
18	3880	2400	2400	1800	1600	1500	1700	15300	42400	25000	18600	14400
19	3870	2400	2200	1800	1600	1500	1700	22700	41000	23000	18500	13000
20	3720	2400	2200	1800	1600	1500	1700	26400	37000	22400	18500	12200
21	3760	2400	2200	1800	1600	1500	1700	21600	34400	22200	19100	14200
22	3760	2400	2200	1800	1600	1500	1700	17900	33000	21800	20100	14600
23	3560	2400	2200	1800	1600	1500	1700	16600	33000	23000	21600	14800
24	3390	2400	2200	1800	1600	1500	1800	16900	33000	22800	21500	13000
25	3250	2400	2200	1700	1600	1500	1800	16800	34000	21300	18800	11400
26	3200	2600	2200	1700	1600	1500	1800	18200	34000	20500	16000	10400
27	3200	2800	2000	1700	1600	1500	1800	21800	35000	19500	14400	9840
28	3000	2900	2000	1700	1600	1500	1800	23800	35000	19700	13400	11000
29	3000	3000	2000	1700	---	1500	1900	28400	34000	19900	12200	11800
30	3000	3000	2000	1700	---	1500	1900	33100	32000	19600	11000	12500
31	3000	---	2000	1700	---	1500	---	29700	---	21200	10000	---
TOTAL	120100	79500	74500	56700	45300	46500	50400	393000	1139000	708900	596300	379080
MEAN	3874	2650	2403	1829	1618	1500	1680	12680	37970	22870	19240	12640
MAX	5400	3000	3000	2000	1700	1500	1900	33100	52600	30000	26200	16900
MIN	3000	2400	2000	1700	1600	1500	1600	1900	30900	18000	10000	9520
CFSM	.63	.43	.39	.30	.26	.24	.27	2.06	6.16	3.71	3.12	2.05
IN.	.73	.48	.45	.34	.27	.28	.30	2.37	6.88	4.28	3.60	2.29
AC-FT	238200	157700	147800	112500	89850	92230	99970	779500	2259000	1406000	1183000	751900

CAL YR 1976 TOTAL 2930760 MEAN 8008 MAX 33300 MIN 900 CFSM 1.30 IN 17.70 AC-FT 5813000
WTR YR 1977 TOTAL 3689280 MEAN 10110 MAX 52600 MIN 1500 CFSM 1.64 IN 22.28 AC-FT 7318000

Note.--No gage-height record Feb. 13 to May 16.

TABLE 4.2: ESTIMATE OF MONTHLY FLOWS AT DEVIL CANYON DAM SITE (ft^3/s)

(Source: Ref. 5, 6)

Drainage Area - 5810 Square Miles

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual Average
1950	5998	2444	1360	970	744	685	822	10903	18837	21839	19151	7878	7636
1951	3642	1229	1039	906	774	699	1529	13349	19961	21754	18950	20170	8667
1952	5270	2596	1796	1512	945	831	869	5131	30886	25399	20144	13747	9094
1953	7761	3309	1607	1039	774	774	1527	18259	26123	19583	19848	14498	9592
1954	5336	1987	1418	1229	945	737	1167	16372	24170	19733	25088	12266	9204
1955	5080	2612	1934	1698	1323	1039	1134	8827	28519	26498	24754	13567	9749
1956	4683	1798	1229	926	916	888	897	16732	31800	29813	23590	17405	10890
1957	5493	2886	2026	1607	1418	1134	1134	13026	29117	22644	19955	18804	9937
1958	7743	3728	3062	1846	1227	1077	1442	12121	24678	22099	21595	7195	8984
1959	4549	2027	1421	1357	1223	915	1167	15049	22492	24022	29764	16003	9999
1960	6220	2709	2089	1749	1374	1133	1228	14965	14949	22184	22674	19525	9233
1961	7386	2842	2543	2307	1652	1705	2498	16425	28004	23638	21280	12695	10248
1962	5602	2563	1986	1789	1413	1319	1603	11896	41050	24972	22757	15101	11004
1963	6341	2646	1884	1507	1413	944	786	18061	24855	33033	22937	11812	10518
1964	6075	2117	1404	985	908	670	702	4093	48120	22054	15896	9140	9347
1965	5964	2657	1146	908	814	851	1288	12313	24385	26572	20201	18619	9643
1966	6780	1976	1536	1318	1224	1224	1673	9095	31309	19216	20885	11211	8962
1967	3938	1514	1418	1418	1323	1134	1103	14672	28217	25801	30336	16013	10574
1968	4635	2226	1943	1873	1797	1797	1806	15275	30103	25628	16800	8394	9356
1969	3609	1544	832	683	682	769	1422	10451	15163	15819	8596	4922	5374
1970	2978	1166	829	784	729	735	1027	10782	17788	21825	19171	8666	7207
1971	4965	3204	2153	1355	973	892	1016	3550	31409	23239	30643	13731	9761
1972	5521	2916	2365	2109	1910	1717	1611	20979	33158	22449	18997	11990	10477
1973	4544	2122	1379	1129	1128	941	966	7882	26834	18008	19814	8790	7795
1974	3552	1456	992	839	745	693	944	15258	17143	18327	15899	13231	7423
AVG.	5347	2331	1656	1354	1135	1012	1254	12619	26763	23046	21189	13015	9227

TABLE 4.3: ESTIMATE OF MONTHLY FLOWS AT WATANA DAM SITE (ft^3/s)

(Souce: Ref. 5, 6)

Drainage Area - 5180 Square Miles

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual Average
1950	5067	2083	1174	847	657	607	722	9600	16527	19133	16791	6929	6678
1951	3089	1064	904	793	682	619	1315	11757	17519	19057	16614	17759	7598
1952	4457	2211	1540	1301	825	730	761	4511	27164	22280	17664	12100	7962
1953	6548	2810	1381	904	682	682	1314	16085	22959	17138	17403	12762	8389
1954	4512	1700	1223	1064	825	651	1012	14422	21234	17271	22015	10795	8060
1955	4297	2225	1656	1457	1205	904	984	7770	25074	23251	21721	11941	8540
1956	3964	1541	1064	809	801	777	785	15947	30237	28301	22370	16576	10264
1957	4644	2455	1733	1381	1223	984	984	11472	25520	19808	17453	16555	8684
1958	6538	3164	2608	1585	1064	938	1244	10700	21662	19363	18966	6319	7846
1959	3851	1735	1227	1174	1062	803	1015	13282	19716	21081	26174	14104	8769
1960	5251	2303	1784	1499	1185	983	1063	13178	13107	19441	19896	17179	8072
1961	6230	2417	2168	1972	1420	1465	2131	14475	24653	20736	18662	11173	8959
1962	4726	2275	1765	1605	1257	1176	1451	11181	36248	23432	20208	12954	9856
1963	5581	2478	1701	1316	1201	875	761	15526	21137	29169	21146	10822	9309
1964	5235	1809	1205	856	787	579	613	3607	43031	20162	14241	7711	8320
1965	4896	2376	1061	852	801	797	1216	10995	21384	23470	17650	16465	8497
1966	5398	1608	1239	1085	1007	1007	1372	7319	26477	16569	17790	9442	7526
1967	3328	1237	1155	1140	1065	917	880	12703	24974	22436	26101	13850	9149
1968	4050	1948	1713	1631	1572	1572	1586	13009	26103	22554	24589	7268	8966
1969	3155	1363	751	617	608	686	1262	9327	14094	14948	7842	4339	4916
1970	2472	1034	721	653	615	632	974	9574	14816	18835	16586	7363	6190
1971	1750	2572	1736	1120	796	733	832	2933	27848	21312	27650	12248	8461
1972	4969	2589	1990	1716	1537	1402	1334	16722	28194	20276	17723	11022	9123
1973	3852	1815	1191	981	980	823	844	6915	23520	15679	17304	7687	6799
1974	3010	1251	861	733	655	612	823	13459	15046	16012	13867	11590	6493
AVG.	4435	2003	1422	1164	980	878	1091	11059	23530	20469	19137	11478	8137

TABLE 4.4: ESTIMATE OF MONTHLY FLOWS AT VEE CANYON DAM SITE (ft^3/s)

(Souce: Ref. 5, 6)

Drainage Area - 4140 Square Miles

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual Average
1950	3529	1489	867	643	513	479	557	7449	12713	14665	12895	5362	5097
1951	2177	791	682	606	530	487	963	9128	13487	14606	12758	13780	5833
1952	3114	1576	1117	954	628	563	584	3487	21021	17130	13572	9382	6094
1953	4545	1986	1009	682	530	530	962	12498	17736	13103	13369	9896	6404
1954	3151	1226	900	791	628	508	756	11203	16388	13207	16941	8367	6172
1955	3004	1585	1196	1060	1009	682	737	6024	19388	17892	16714	9258	6546
1956	2777	1117	791	617	612	595	601	11451	21652	20188	15920	11887	7351
1957	3242	1743	1249	1009	900	737	737	8907	19583	15127	13324	12843	6617
1958	4550	2234	1859	1153	795	708	918	8354	16682	14847	14626	4873	5967
1959	2700	1253	907	871	795	617	764	10364	15133	16226	20247	10969	6737
1960	3651	1634	1281	1087	874	735	791	10227	10065	14912	15309	13305	6166
1961	4323	1716	1549	1418	1038	1068	1525	11256	19121	15946	14339	8660	6830
1962	3281	1800	1400	1300	1000	940	1200	10000	28320	20890	16000	9410	7962
1963	4326	2200	1400	1000	850	760	720	11340	15000	22790	18190	9187	7314
1964	3848	1300	877	644	586	429	465	2806	34630	17040	11510	5352	6624
1965	3134	1911	921	760	780	709	1097	8818	16430	18350	13440	12910	6605
1966	3116	1000	750	700	650	650	875	4387	18500	12200	12680	6523	5169
1967	2322	780	720	680	640	560	513	9452	19620	16880	19190	10280	6803
1968	3084	1490	1332	1232	1200	1200	1223	9268	19500	17480	10940	5410	6113
1969	2406	1063	618	508	485	548	998	7471	12330	13510	6597	3376	4159
1970	1638	815	543	437	426	463	887	7580	9909	13900	12320	5211	4511
1971	2155	1530	1048	731	503	470	529	1915	21970	18130	22710	9800	6791
1972	4058	2050	1371	1068	922	881	876	9694	20000	16690	15620	9423	6888
1973	2709	1309	881	737	737	628	643	5319	18048	11834	13161	5865	5158
1974	2114	912	646	559	507	478	624	10488	11585	12190	10513	8880	4958
AVG.	3158	1460	1037	850	726	657	822	8355	17952	15989	14515	8808	6194

TABLE 4.5: ESTIMATE OF MONTHLY FLOWS AT DENALI DAM SITE (ft^3/s)

(Souce: Ref. 5, 6)

Drainage Area - 1260 Square Miles

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual Average
1950	1651	635	333	226	165	149	186	2903	7470	10406	8217	2029	2864
1951	976	296	245	209	173	153	380	3573	7686	10396	8145	5442	3140
1952	1443	679	454	375	219	188	198	1331	9798	10880	8570	3675	3151
1953	2163	881	401	245	173	173	379	4926	8877	10106	8467	3881	3389
1954	1462	507	348	296	219	163	279	4406	8500	10127	10294	3269	3323
1955	1388	683	492	426	401	245	271	2335	9340	11027	10180	3625	3368
1956	1274	454	296	214	212	204	206	4505	9975	11469	9778	4680	3606
1957	1508	760	518	401	348	271	271	3485	13844	12442	10891	5098	4153
1958	1846	877	506	345	230	188	306	1870	9769	10399	7766	2295	3033
1959	1267	529	264	209	161	98	119	2657	10164	9697	9581	3423	3181
1960	2029	949	718	562	411	347	344	4212	6087	10293	9197	5937	3424
1961	2321	860	661	492	382	396	590	3908	8018	9419	8459	5233	3395
1962	1700	820	549	373	318	292	358	2600	11411	10991	10628	4656	3725
1963	1452	603	403	343	331	237	227	4448	8473	12305	11062	4436	3693
1964	1329	438	281	203	199	154	174	1143	14109	8496	7318	3289	3094
1965	1959	840	324	251	212	238	361	3113	6091	8231	6958	7956	3044
1966	1556	471	377	319	301	301	420	2447	9096	9481	7852	4013	3053
1967	1064	402	376	382	354	298	294	4026	9204	11012	12695	4400	3709
1968	1208	1261	474	464	441	441	441	4308	9802	13230	10793	2721	3799
1969	765	452	213	179	177	187	309	2324	8639	9848	4274	2480	2487
1970	1233	563	389	325	274	242	349	2801	6369	9816	7407	2554	2693
1971	1015	687	469	281	208	195	221	913	9803	11315	11830	4009	3412
1972	1317	640	557	521	479	432	400	5364	8805	11395	9234	3241	3532
1973	996	470	302	250	236	211	213	1495	7257	9343	8376	2944	2674
1974	1128	557	426	359	313	273	319	3426	6620	10570	10179	6202	3364
AVG.	1442	653	415	330	277	243	305	3141	9008	10508	9126	4060	3292

TABLE 4.6: YEARLY PEAK FLOWS OF RECORD

(Source: Ref. 5, 6)

Gold Creek		Cantwell		Denali		Maclaren	
Date	Peak ft^3/s	Date	Peak ft^3/s	Date	Peak ft^3/s	Date	Peak ft^3/s
8/25/59	62,300	6/23/61	30,500	8/18/63	17,000	9/13/60	8,900
6/15/62	80,600	6/15/62	47,000	6/07/64	16,000	6/14/62	6,650
6/07/64	90,700	6/07/64	50,500	9/09/65	15,800	7/18/65	7,350
6/06/66	63,600	8/11/70	20,500	8/14/67	28,200	8/14/67	7,600
8/15/67	80,200	8/10/71	60,000	7/27/68	19,000	8/10/71	9,300
8/10/71	87,400	6/22/72	45,000	8/08/71	38,200	6/17/72	7,100

TABLE 4.7: UPPER SUSITNA RIVER BASIN PEAK DISCHARGES, (ft^3/s)

(Source: Ref. 5, 6)

Recurrence Interval (years)	Susitna at Gold Creek	Susitna near Cantwell	Susitna near Denali	Maclaren near Paxson
5	67,000	42,000	19,500	7,300
10	78,000	48,500	23,200	8,200
25	90,000	56,000	27,500	9,200
50	101,000	63,000	32,000	10,100
100	111,000	69,000	37,000	11,000

TABLE 4.8: SUMMER PROBABLE MAXIMUM FLOOD

(Source: Ref. 5, 6)

Project	Maximum Inflow ft^3/s	Maximum Outflow ft^3/s
Watana	213,000	186,000
Devil Canyon with Watana	223,000	218,000

TABLE 4.9: SPRING PROBABLE MAXIMUM FLOOD

(Source: Ref. 5, 6)

Project	Maximum Inflow ft^3/s	Maximum Outflow ft^3/s
Watana	223,000	192,000
Devil Canyon with Watana	226,000	222,000

TABLE 4.10

Typical USGS Suspended Sediment Records

(Source: Ref. 14)

SOUTH-CENTRAL ALASKA

15291000 SUSITNA RIVER NEAR DENALI--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1957-66, 1968-69, 1974 to current year.

PERIOD OF DAILY RECORD.--
WATER TEMPERATURES: August 1974 to current year (seasonal).

INSTRUMENTATION.--Temperature recorder since Aug. 29, 1974.

REMARKS.--No record Dec. 3 to May 31 when temperature sensor froze in ice.

EXTREMES FOR PERIOD OF DAILY RECORD.--
WATER TEMPERATURES: Maximum, 11.0°C June 11, 1977; minimum, 0.0°C on most days during winter periods.

EXTREMES FOR CURRENT YEAR.--
WATER TEMPERATURES: Maximum, 11.0°C June 11; minimum, 0.0°C on most days during winter period.

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	TEMPERATURE (DEG C)	COLOR (PLATINUM-COBALT UNITS)	SUSPENDED SEDIMENT (MG/L)	SUSPENDED SEDIMENT DISCHARGE (T/DAY)	SUS. SED. FALL DIAM. % FINER THAN .002 MM	SUS. SED. FALL DIAM. % FINER THAN .004 MM	SUS. SED. FALL DIAM. % FINER THAN .008 MM
JUN 01...	1130	3970	--	--	630	6750	2	6	10
JUL 08...	2400	8590	8.0	--	1510	35000	7	11	18
AUG 11...	1600	13700	5.0	--	1420	52500	9	16	23
SEP 26...	1830	1890	3.5	5	124	633	--	--	--

DATE	SUS. SED. FALL DIAM. % FINER THAN .016 MM	SUS. SED. FALL DIAM. % FINER THAN .031 MM	SUS. SED. SIEVE DIAM. % FINER THAN .062 MM	SUS. SED. SIEVE DIAM. % FINER THAN .125 MM	SUS. SED. SIEVE DIAM. % FINER THAN .250 MM	SUS. SED. SIEVE DIAM. % FINER THAN .500 MM	SUS. SED. SIEVE DIAM. % FINER THAN 1.00 MM	SUS. SED. SIEVE DIAM. % FINER THAN 2.00 MM
JUN 01...	16	27	44	61	78	90	97	100
JUL 08...	33	49	57	63	72	86	97	100
AUG 11...	33	47	65	80	93	99	100	--
SEP 26...	--	--	32	47	73	98	100	--

TABLE 4.11: SUSPENDED SEDIMENT TRANSPORT

(Source: Ref. 5, 6)

Station	Sediment Transport (Tons/year)	Initial Unit Weight (lb/ft^3)
Susitna at Gold Creek	8,734,000	65.3
Susitna near Cantwell	5,129,000	70.6
Susitna near Denali	5,243,000	70.4
Maclaren near Paxson	614,000	68.6

TABLE 4.12: RESERVOIR SEDIMENT INFLOW

(Source: Ref. 5, 6)

	Upstream Development	Sediment Inflow 50-year Volume (acre-feet)	Sediment Inflow 100-year Volume (acre-feet)
Devil Canyon	None	252,000	497,000
	Denali	138,000	272,000
	Vee	94,000	186,000
	Watana	35,000	70,000
Watana	None	204,000	403,000
	Denali	102,000	202,000
	Vee	59,000	116,000
Vee (2300 feet W.S. El.)	None	162,000	320,000
	Denali	44,000	87,000
Denali (2535 feet W.S. El.)	None	290,000	572,000

Note:

50-year unit weight of sediment is 80 lbs/ft^3.
100-year unit weight of sediment is 81 lbs/ft^3.

TABLE 4.13

Typical USGS Water Quality Records

(Source: Ref. 14)

SOUTH-CENTRAL ALASKA

15292000 SUSITNA RIVER AT GOLD CREEK--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1949-58, 1962, 1967-68, 1974 to current year.

PERIOD OF DAILY RECORD.--
WATER TEMPERATURES: June to September 1957, July 1974 to current year (seasonal).
SUSPENDED-SEDIMENT DISCHARGE: May to September 1952, June to September 1957.

INSTRUMENTATION.--Temperature recorder since July 30, 1974.

REMARKS.--No record Oct. 1 to May 23 and July 9 to Sept. 30 due to recorder malfunction.

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TIME	INSTANTANEOUS DISCHARGE (CFS)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	AIR TEMPERATURE (DEG C)	TEMPERATURE (DEG C)	COLOR (PLATINUM-COBALT UNITS)	DISSOLVED OXYGEN (MG/L)	HARDNESS (CA,MG) (MG/L)	NONCARBONATE HARDNESS (MG/L)	DISSOLVED CALCIUM (CA) (MG/L)	DISSOLVED MAGNESIUM (MG) (MG/L)
OCT												
01...	1400	5340	--	--	--	3.5	--	--	--	--	--	--
MAY												
10...	1830	3760	--	--	--	1.0	--	--	--	--	--	--
18...	1000	14200	--	--	--	--	--	--	--	--	--	--
JUN												
14...	1630	52000	102	6.8	17.0	8.0	45	12.2	36	13	12	1.4
JUL												
28...	1730	21000	--	--	--	14.0	--	--	--	--	--	--
AUG												
10...	1430	20000	163	7.9	--	12.0	25	11.1	75	30	23	4.3

DATE	DISSOLVED SODIUM (NA) (MG/L)	DISSOLVED POTASSIUM (K) (MG/L)	BICARBONATE (HCO3) (MG/L)	CARBONATE (CO3) (MG/L)	DISSOLVED SULFATE (SO4) (MG/L)	DISSOLVED CHLORIDE (CL) (MG/L)	DISSOLVED FLUORIDE (F) (MG/L)	DISSOLVED SILICA (SIO2) (MG/L)	DISSOLVED SOLIDS (RESIDUE AT 180 C) (MG/L)	DISSOLVED SOLIDS (SUM OF CONSTITUENTS) (MG/L)	DISSOLVED NITRITE PLUS NITRATE (N) (MG/L)	DISSOLVED ORTHO. PHOSPHORUS (P) (MG/L)
OCT												
01...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
10...	--	--	--	--	--	--	--	--	--	--	--	--
18...	--	--	--	--	--	--	--	--	--	--	--	--
JUN												
14...	2.4	1.1	28	0	4.7	15	.1	5.2	63	56	.06	.02
JUL												
28...	--	--	--	--	--	--	--	--	--	--	--	--
AUG												
10...	3.6	4.4	55	0	14	5.4	.1	4.9	76	130	--	.02

DATE	TOTAL ALUMINUM (AL) (UG/L)	TOTAL ARSENIC (AS) (UG/L)	TOTAL BARIUM (BA) (UG/L)	TOTAL CADMIUM (CD) (UG/L)	TOTAL CHROMIUM (CR) (UG/L)	TOTAL COPPER (CU) (UG/L)	TOTAL IRON (FE) (UG/L)	DISSOLVED IRON (FE) (UG/L)	TOTAL LEAD (PB) (UG/L)	TOTAL MANGANESE (MN) (UG/L)	DISSOLVED MANGANESE (MN) (UG/L)	TOTAL MERCURY (HG) (UG/L)
OCT												
01...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
10...	--	--	--	--	--	--	--	--	--	--	--	--
18...	--	--	--	--	--	--	--	--	--	--	--	--
JUN												
14...	14000	5	0	<10	30	50	20000	100	100	370	40	.2
JUL												
28...	--	--	--	--	--	--	--	--	--	--		--
AUG												
10...	13000	12	500	<10	40	50	18000	--	<100	320	180	.3

TABLE 4.13 (cont'd)
Typical USGS Water Quality Records
(Source: Ref. 14)

SOUTH-CENTRAL ALASKA

15292000 SUSITNA RIVER AT GOLD CREEK --Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DATE	TOTAL MOLYB-DENUM (MO) (UG/L)	TOTAL NICKEL (NI) (UG/L)	TOTAL SELE-NIUM (SE) (UG/L)	TOTAL SILVER (AG) (UG/L)	TOTAL ZINC (ZN) (UG/L)	SUS-PENDED SEDI-MENT (MG/L)	SUS-PENDED SEDI-MENT DIS-CHARGE (T/DAY)	SUS. SED. FALL DIAM. % FINER THAN .002 MM	SUS. SED. FALL DIAM. % FINER THAN .004 MM	SUS. SED. FALL DIAM. % FINER THAN .008 MM	SUS. SED. FALL DIAM. % FINER THAN .016 MM	SUS. SED. FALL DIAM. % FINER THAN .031 MM
OCT												
01...	--	--	--	--	--	10	144	--	--	--	--	--
MAY												
10...	--	--	--	--	--	120	1220	--	--	--	--	--
18...	--	--	--	--	--	1110	42600	7	9	17	27	44
JUN												
14...	1	50	0	<10	80	915	128000	2	4	6	11	22
JUL												
28...	--	--	--	--	--	394	22300	14	19	29	44	54
AUG												
10...	0	<50	1	<10	80	656	35400	13	19	27	39	52

DATE	SUS. SED. FALL DIAM. % FINER THAN .062 MM	SUS. SED. FALL DIAM. % FINER THAN .125 MM	SUS. SED. FALL DIAM. % FINER THAN .250 MM	SUS. SED. FALL DIAM. % FINER THAN .500 MM	SUS. SED. FALL DIAM. % FINER THAN 1.00 MM	SUS. SED. SIEVE DIAM. % FINER THAN .062 MM	SUS. SED. SIEVE DIAM. % FINER THAN .125 MM	SUS. SED. SIEVE DIAM. % FINER THAN .250 MM	SUS. SED. SIEVE DIAM. % FINER THAN .500 MM	SUS. SED. SIEVE DIAM. % FINER THAN 1.00 MM	SUS. SED. SIEVE DIAM. % FINER THAN 2.00 MM
OCT											
01...	--	--	--	--	--	--	--	--	--	--	--
MAY											
10...	--	--	--	--	--	44	64	87	99	100	--
18...	--	--	--	--	--	63	76	90	99	100	--
JUN											
14...	40	62	84	97	100	--	--	--	--	--	--
JUL											
28...	--	--	--	--	--	70	80	92	99	100	--
AUG											
10...	--	--	--	--	--	65	74	86	95	98	99

TEMPERATURE (DEG. C) OF WATER, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

DAY	APRIL MAX	APRIL MIN	MAY MAX	MAY MIN	JUNE MAX	JUNE MIN	JULY MAX	JULY MIN	AUGUST MAX	AUGUST MIN	SEPTEMBER MAX	SEPTEMBER MIN
1			---	---	6.5	3.5	9.5	7.5				
2			---	---	6.5	3.5	10.0	7.5				
3			---	---	7.0	4.0	9.0	7.0				
4			---	---	5.0	3.5	9.0	7.0				
5			---	---	5.0	3.0	9.0	7.0				
6			---	---	5.5	3.5	10.5	7.5				
7			---	---	6.0	4.0	11.5	8.5				
8			---	---	6.0	3.5	12.0	9.0				
9			---	---	5.5	4.0	---	---				
10			---	---	6.0	4.0	---	---				
11			---	---	5.0	3.5	---	---				
12			---	---	4.0	3.0	---	---				
13			---	---	5.5	3.0	---	---				
14			---	---	5.5	3.5	---	---				
15			---	---	5.0	4.0	---	---				
16			---	---	6.0	4.5	---	---				
17			---	---	6.5	4.5	---	---				
18			---	---	5.0	4.0	---	---				
19			---	---	6.5	4.0	---	---				
20			---	---	7.5	4.5	---	---				
21			---	---	7.5	5.0	---	---				
22			---	---	6.5	5.0	---	---				
23			---	---	7.0	5.5	---	---				
24			5.0	3.5	8.5	6.0	---	---				
25			6.0	2.5	9.0	7.0	---	---				
26			7.0	3.0	9.0	7.0	---	---				
27			7.0	4.0	9.0	6.0	---	---				
28			7.0	4.0	10.0	7.5	---	---				
29			5.5	4.0	9.5	8.0	---	---				
30			5.5	3.5	9.5	7.5	---	---				
31			6.5	4.0	---	---	---	---				
MONTH			7.0	2.5	10.0	3.0	12.0	7.0				

TABLE 4.14: ICE OBSERVATION DATA FOR SUSITNA RIVER

PAXSON

Measurements made on Maclaren River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
11/17/60	50	slush	1.1	12/06/63	Missing	2.2	2.8
01/03/61	48	slush	2.7	03/12/64	45	4.7	5.2
05/01/61	17	slush	2.0	12/04/64	48	1.7	4.0
11/26/61	Missing	0.8	1.4	02/08/65	46	3.0	3.6
01/20/62	Missing	2.0	2.5	01/21/67	50	1.5	2.4
01/07/63	Missing	2.0	2.3	03/27/68	108	2.4	3.4
02/19/63	Missing	2.8	3.3	04/16/68	60	4.7	5.2
04/04/63	50	3.3	4.2				

CANTWELL

Measurements made on Susitna River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
04/10/62	320	0.6	4.7	03/12/64	220	2.6	4.3
01/07/63	Missing	1.3	3.8	02/08/65	250	2.7	4.2
02/19/63	Missing	1.5	4.0	01/21/67	280	3.0	5.3
04/04/63	220	1.8	3.2	03/28/67	80	2.3	5.2
05/02/63	290	2.1	2.7	03/23/70	212	3.1	4.2
12/23/63	100	1.1	3.2				

GOLD CREEK

Measurements made on Susitna River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
03/18/50	210	2.1	3.9	03/15/61	310	1.5	4.0
12/28/50	80	1.3	3.2	01/04/63	Missing	2.3	3.1
02/21/51	95	2.1	4.2	02/20/63	Missing	3.0	4.6
04/01/52	360	1.9	4.2	04/05/63	220	3.4	5.7
03/18/53	332	1.1	3.9	12/23/63	Missing	1.5	3.4
12/19/53	299	0.4	3.4	02/19/64	270	1.8	3.7
02/11/54	472	2.0	4.6	01/12/65	170	1.6	3.8
03/30/54	424	3.4	4.8	01/19/67	130	2.3	2.8
04/24/55	360	1.6	4.3	04/08/67	155	2.7	3.9
01/05/56	155	1.9	4.6	04/15/69	582	1.6	4.2
04/17/56	130	1.5	4.1	04/01/70	290	2.5	3.8

TABLE 4.14 (Continued)

SKWENTA

Measurements made on Skwenta River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
03/14/61	270	slush	2.9	03/16/64	200	slush	2.9
05/03/61	320	1.9	3.8	01/13/65	95	0.8	1.9
01/18/62	Missing	2.4	3.1	03/19/65	85	2.9	4.4
03/09/62	Missing	2.3	2.9	02/01/66	250	slush	2.6
01/02/63	Missing	1.5	2.5	02/14/67	220	slush	2.7
02/18/63	Missing	3.2	3.7	03/29/67	120	2.3	3.1
04/05/63	235	2.9	4.1	03/26/68	230	2.2	4.0
11/27/63	Missing	1.0	1.6	04/01/69	118	1.9	3.0
01/23/64	Missing	1.9	2.7	01/19/72	165	slush	4.5

TALKEETNA

Measurements made on Chulitna River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
03/15/61	125	slush	5.0	01/18/67	170	1.2	4.9
11/27/61	Missing	0.7	1.8	04/09/67	190	2.4	4.4
02/02/62	Missing	2.0	3.0	03/26/68	260	slush	3.1
03/29/62	Missing	2.8	3.0	12/23/68	278	open water	2.2
01/03/63	Missing	2.4	3.5	04/04/69	165	0.2	3.0
02/18/63	Missing	2.8	4.2	03/31/70	190	0.9	3.5
11/27/63	Missing	0.2	1.8	04/01/71	200	2.2	5.3
01/23/64	Missing	1.8	3.1	01/18/72	195	0.5	2.4
01/12/65	180	1.3	4.2	04/17/72	145	2.3	5.0

TALKEETNA

Measurements made on Talkeetna River

Date	River Width (ft)	Ice Thickness (ft) Least	Greatest	Date	River Width (ft)	Ice Thickness (ft) Least	Greatest
01/04/66	182	slush	3.2	12/21/68	207	1.4	2.1
01/29/66	155	1.0	3.2	04/03/69	210	open water	3.3
03/16/66	135	0.7	3.0	04/01/70	218	1.3	2.3
04/07/67	170	1.7	2.9	03/31/71	285	1.1	2.8
01/10/68	245	0.7	2.3				

TABLE 4.15: PMF ESTIMATES AT OTHER DAM SITES

(Source: Ref. 5, 6)

Dam Site	PMF Estimate (ft^3/s)*
Denali	120,000
Maclaren	141,000
Vee	177,000
Susitna III	183,000
Watana	233,000
High Devil Canyon	264,000
Devil Canyon	267,000

TABLE 4.16: RESERVOIR SEDIMENT DEPOSIT AT DAM SITES

(Source: Ref. 5, 6)

Dam Site	50-Year Sediment Accumulation (Acre-feet)*
Denali	290,000
Maclaren	243,000
Vee	162,000
Susitna III	165,000
Watana	204,000
High Devil Canyon	248,000
Devil Canyon	252,000

*Withoiut upstream dam.

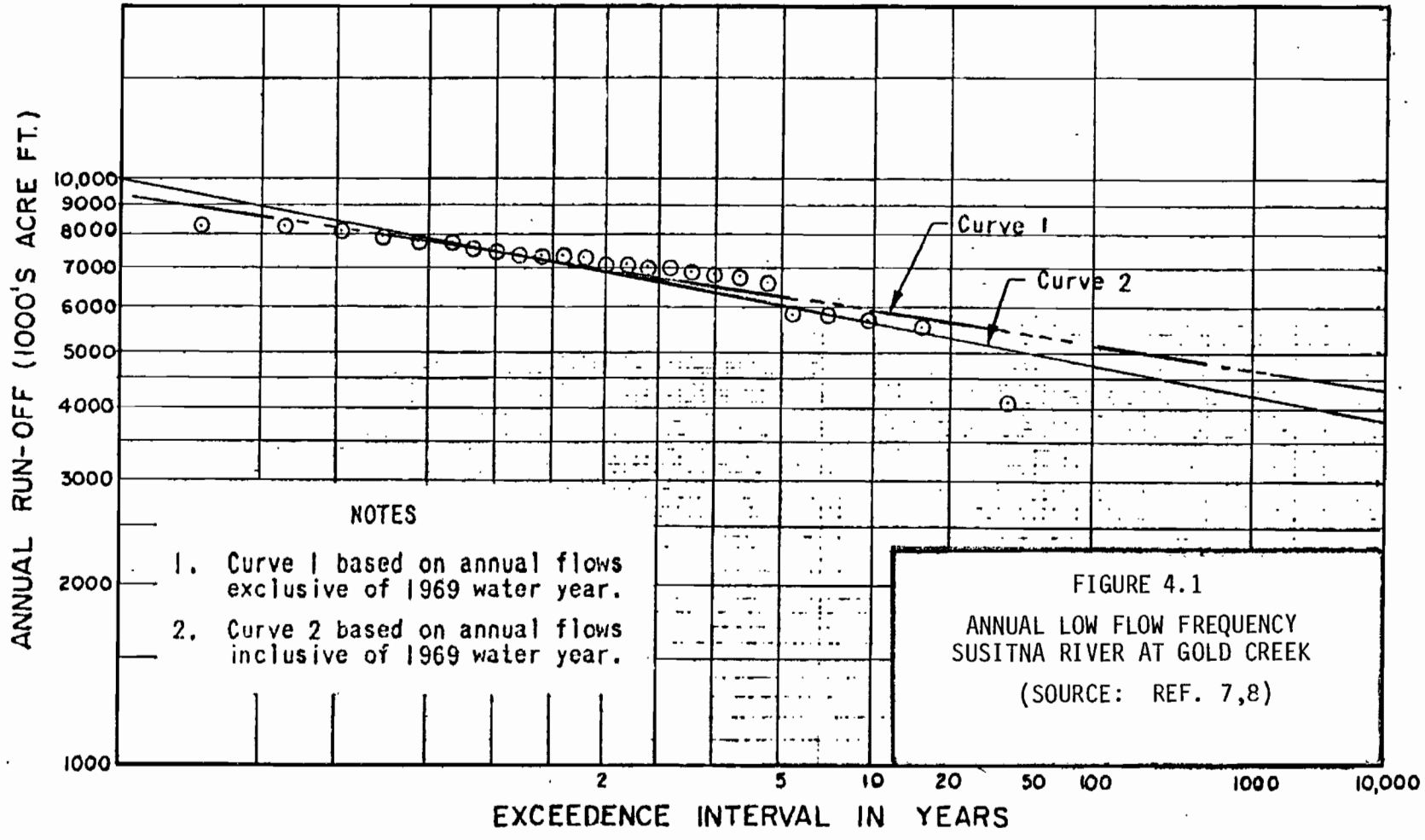


FIGURE 4.1

ANNUAL LOW FLOW FREQUENCY
SUSITNA RIVER AT GOLD CREEK

(SOURCE: REF. 7,8)

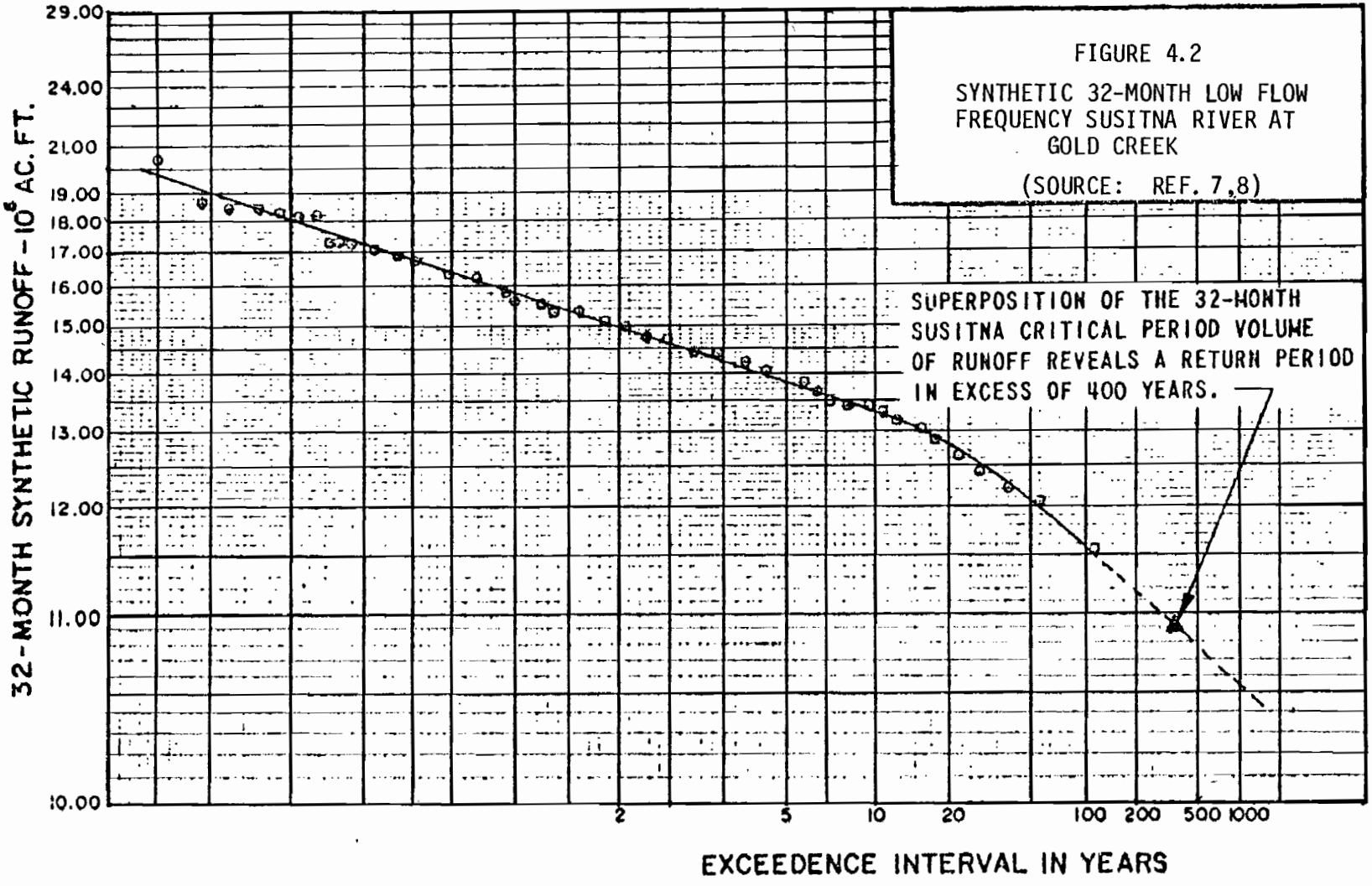
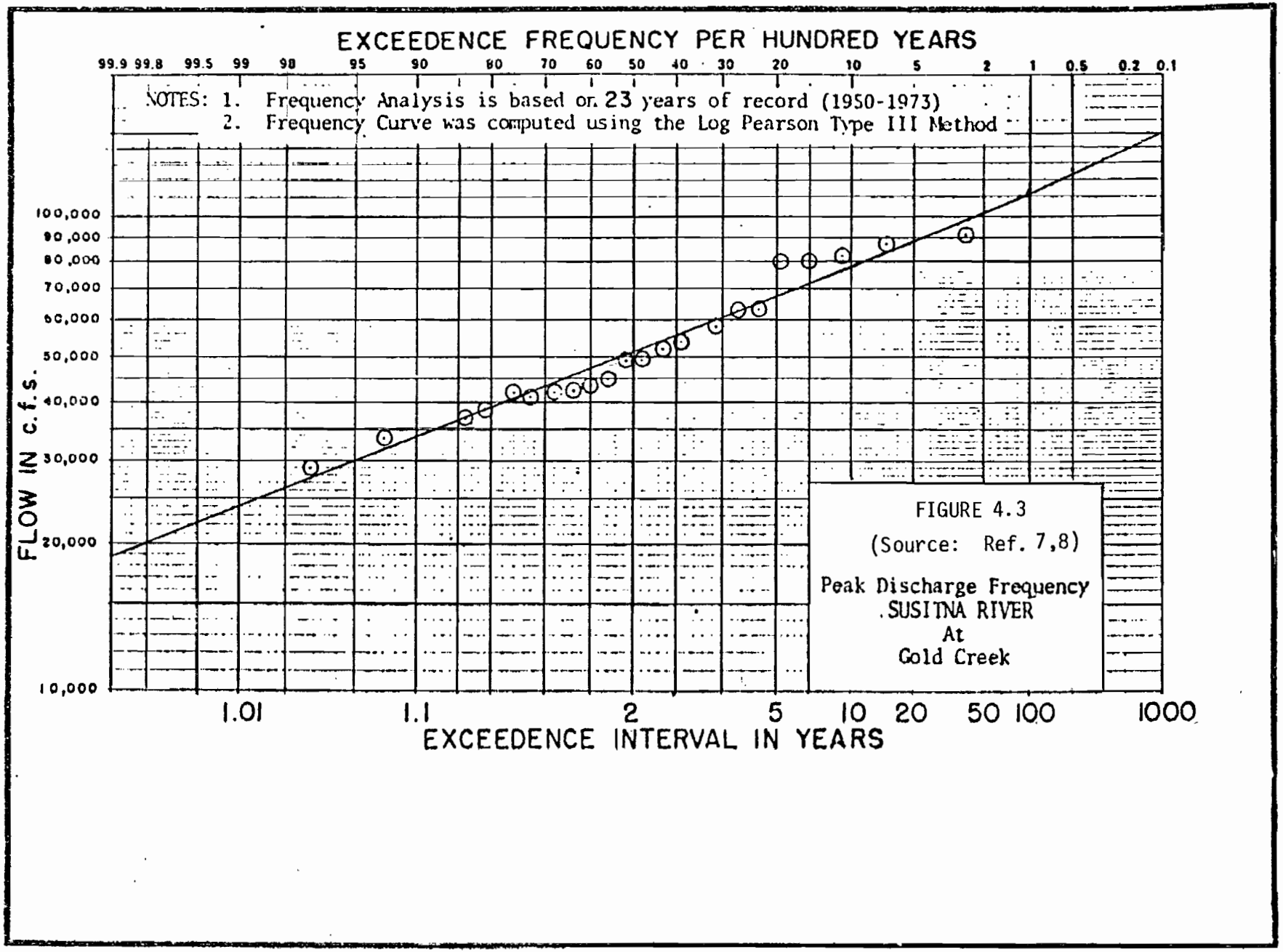


FIGURE 4.2

SYNTHETIC 32-MONTH LOW FLOW FREQUENCY SUSITNA RIVER AT GOLD CREEK

(SOURCE: REF. 7,8)


EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.9 99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1
NOTES: 1. Frequency Analysis is based on 23 years of record (1950-1973)
2. Frequency Curve was computed using the Log Pearson Type III Method
FLOW IN c.f.s.
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
1.01
1.1
2
5
10
20
50
100
1000
EXCEEDENCE INTERVAL IN YEARS
FIGURE 4.3
(Source: Ref. 7,8)
Peak Discharge Frequency
SUSITNA RIVER
At
Gold Creek

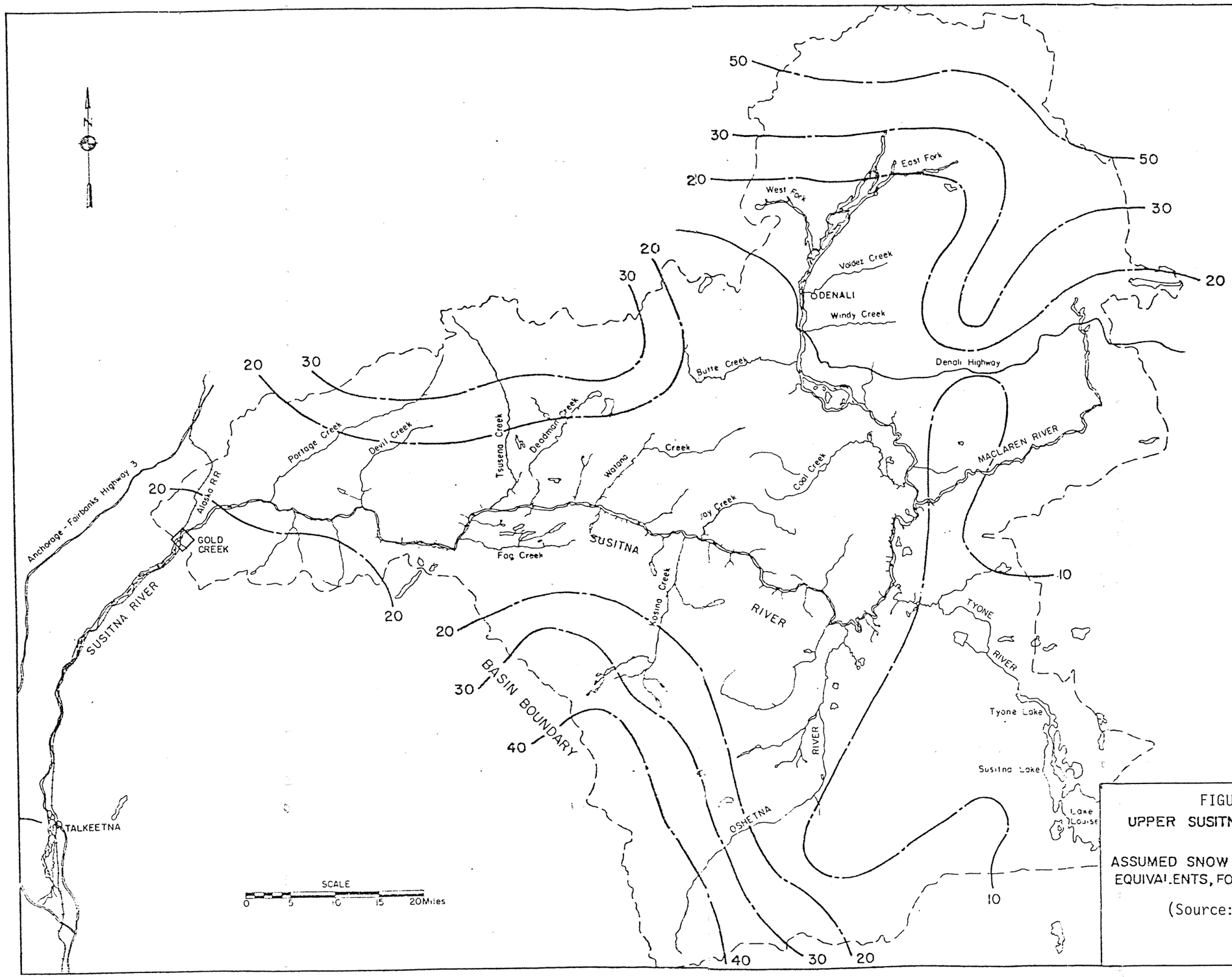


FIGURE 4.4
UPPER SUSITNA RIVER BASIN

ASSUMED SNOW PACK, IN WATER EQUIVALENTS, FOR PMF DERIVATION

(Source: Ref. 7,8)

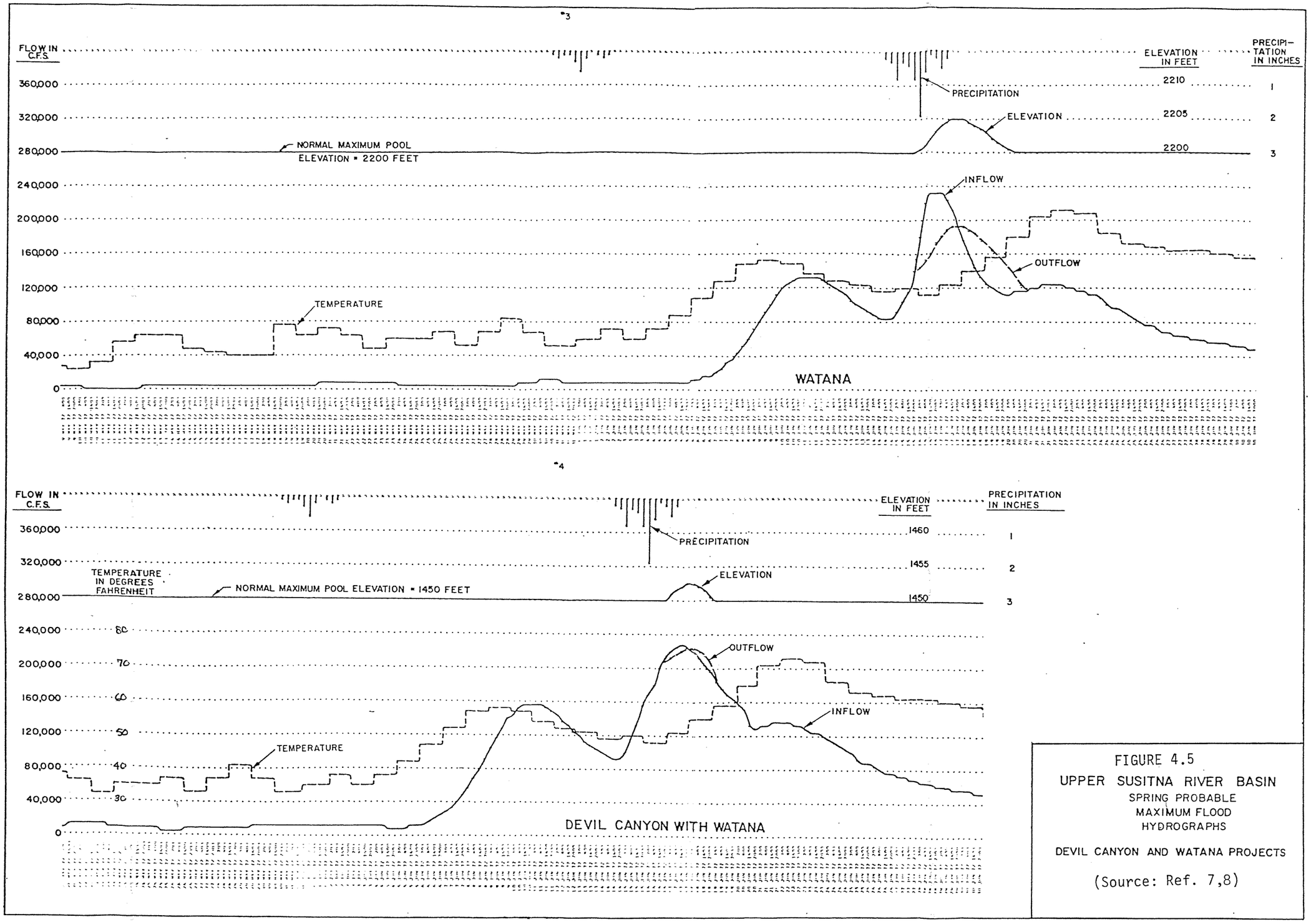


FIGURE 4.5
UPPER SUSITNA RIVER BASIN
SPRING PROBABLE
MAXIMUM FLOOD
HYDROGRAPHS

DEVIL CANYON AND WATANA PROJECTS

(Source: Ref. 7,8)

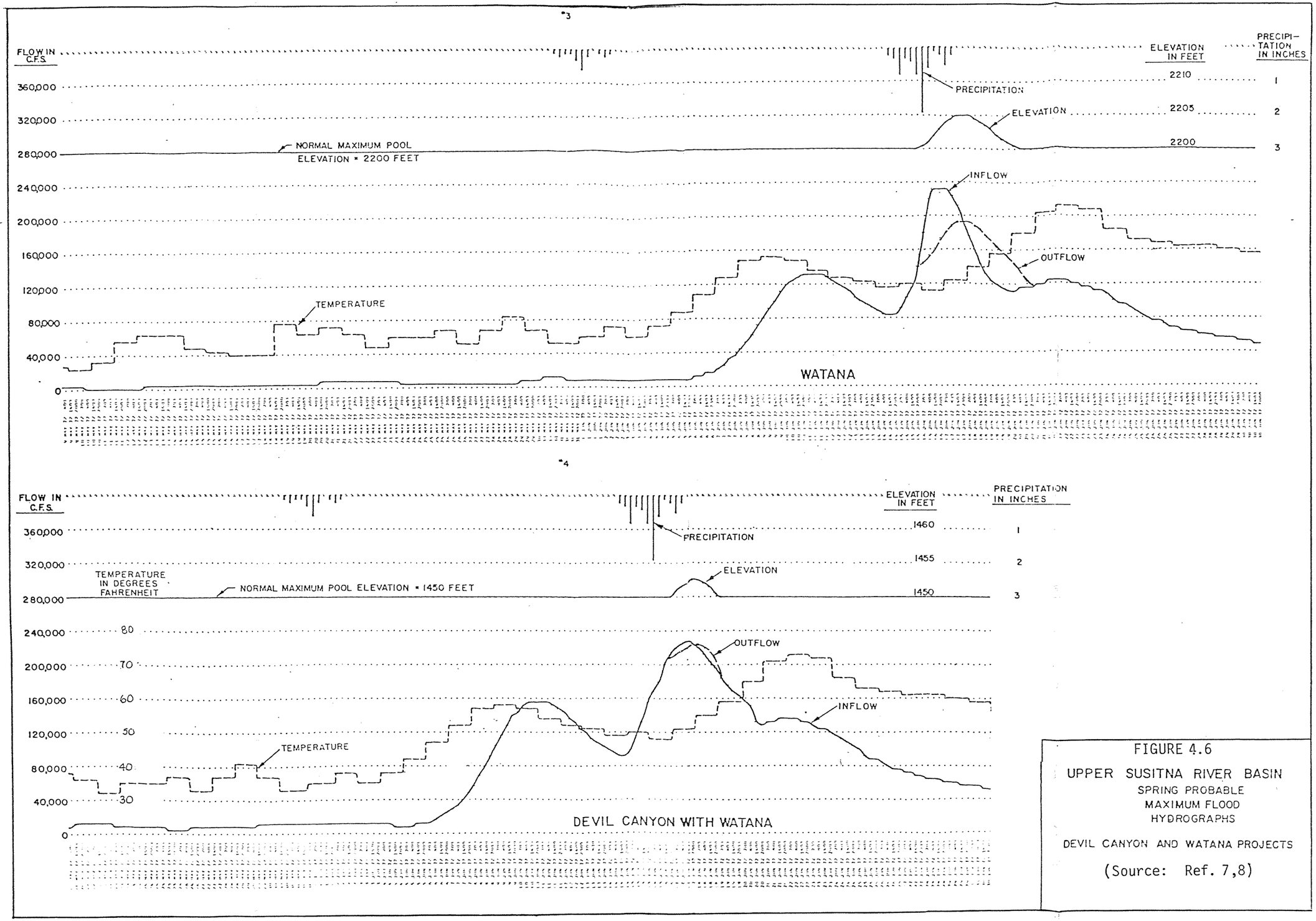


FIGURE 4.6

UPPER SUSITNA RIVER BASIN
SPRING PROBABLE
MAXIMUM FLOOD
HYDROGRAPHS

DEVIL CANYON AND WATANA PROJECTS

(Source: Ref. 7,8)

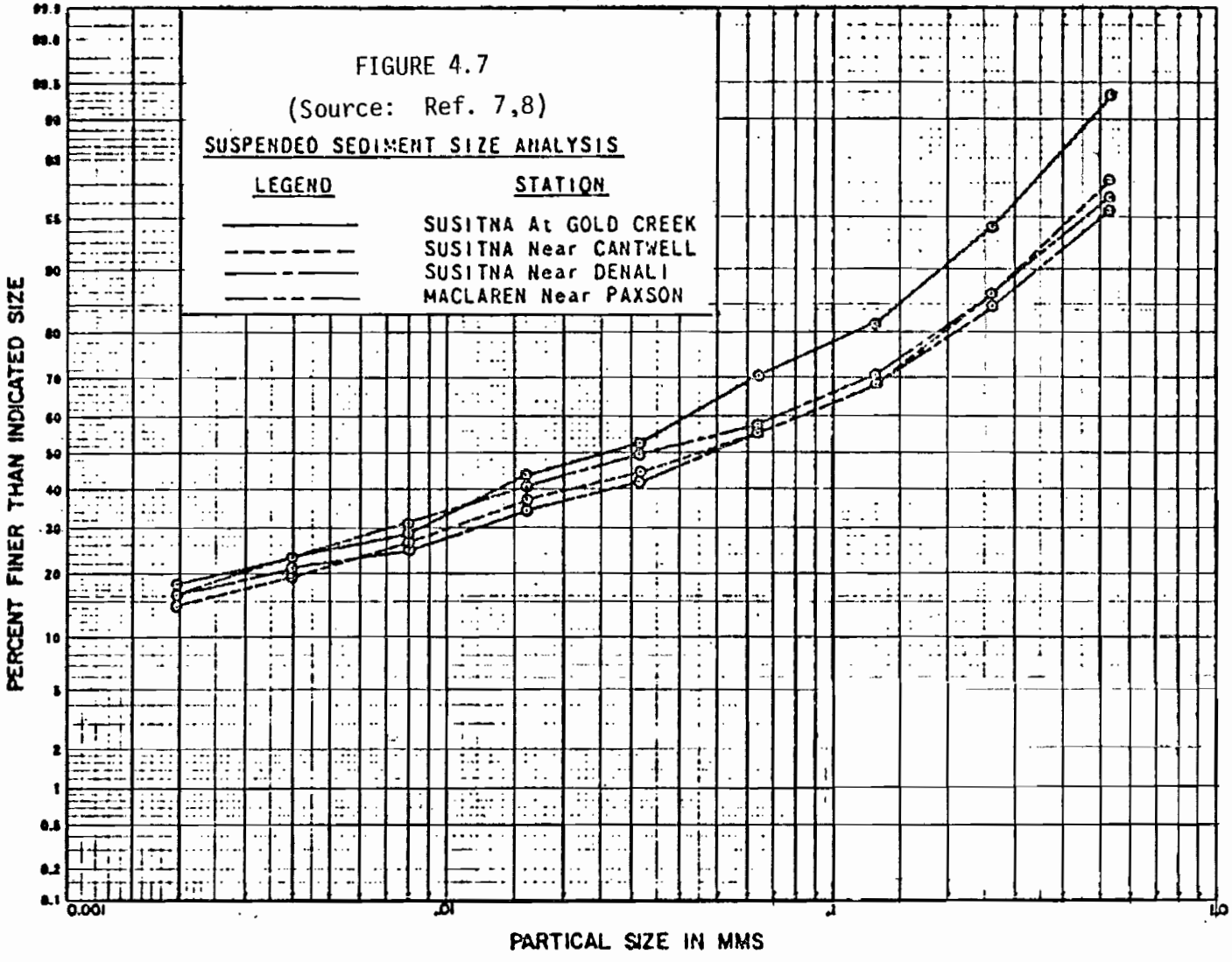


FIGURE 4.7
(Source: Ref. 7,8)
SUSPENDED SEDIMENT SIZE ANALYSIS
LEGEND
STATION
SUSITNA At GOLD CREEK
SUSITNA Near CANTWELL
SUSITNA Near DENALI
MACLAREN Near PAXSON
PERCENT FINER THAN INDICATED SIZE
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
0.001
.01
.1
1.0
PARTICAL SIZE IN MMS

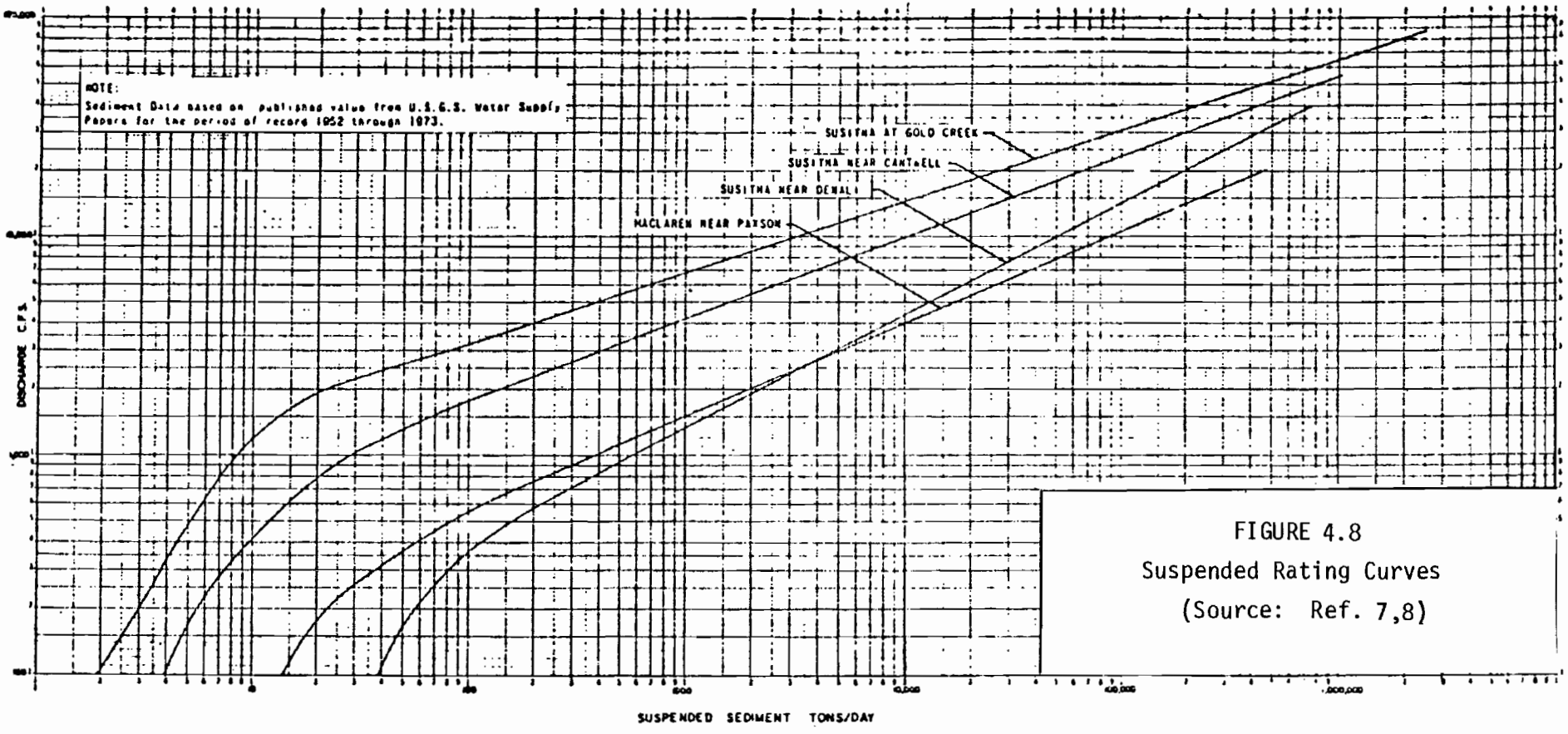


FIGURE 4.8
Suspended Rating Curves
(Source: Ref. 7,8)

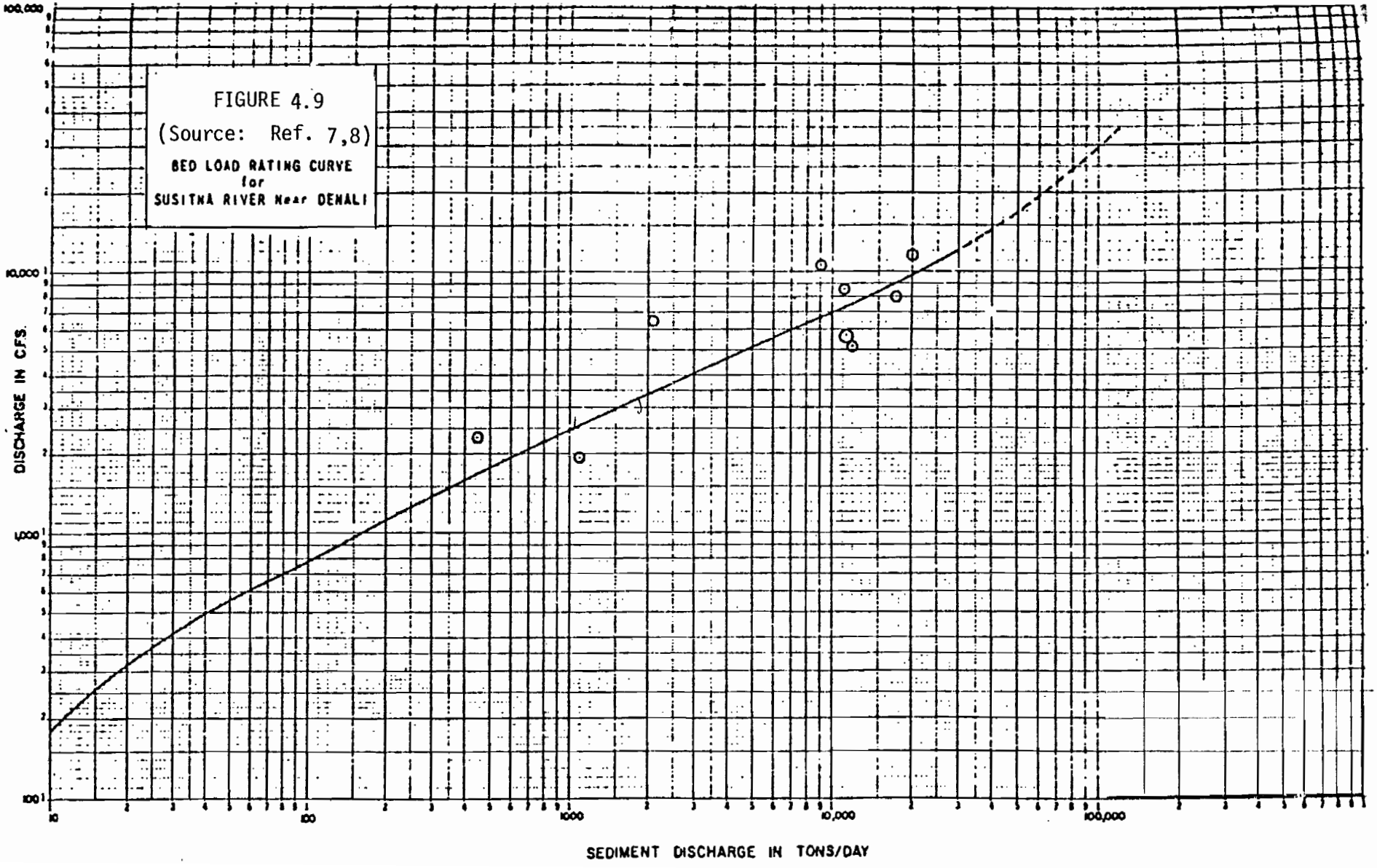


FIGURE 4.9
(Source: Ref. 7,8)
BED LOAD RATING CURVE
for
SUSITNA RIVER Near DENALI
DISCHARGE IN C.F.S.
100,000
10,000
1000
100
10
100
1000
10,000
100,000
SEDIMENT DISCHARGE IN TONS/DAY

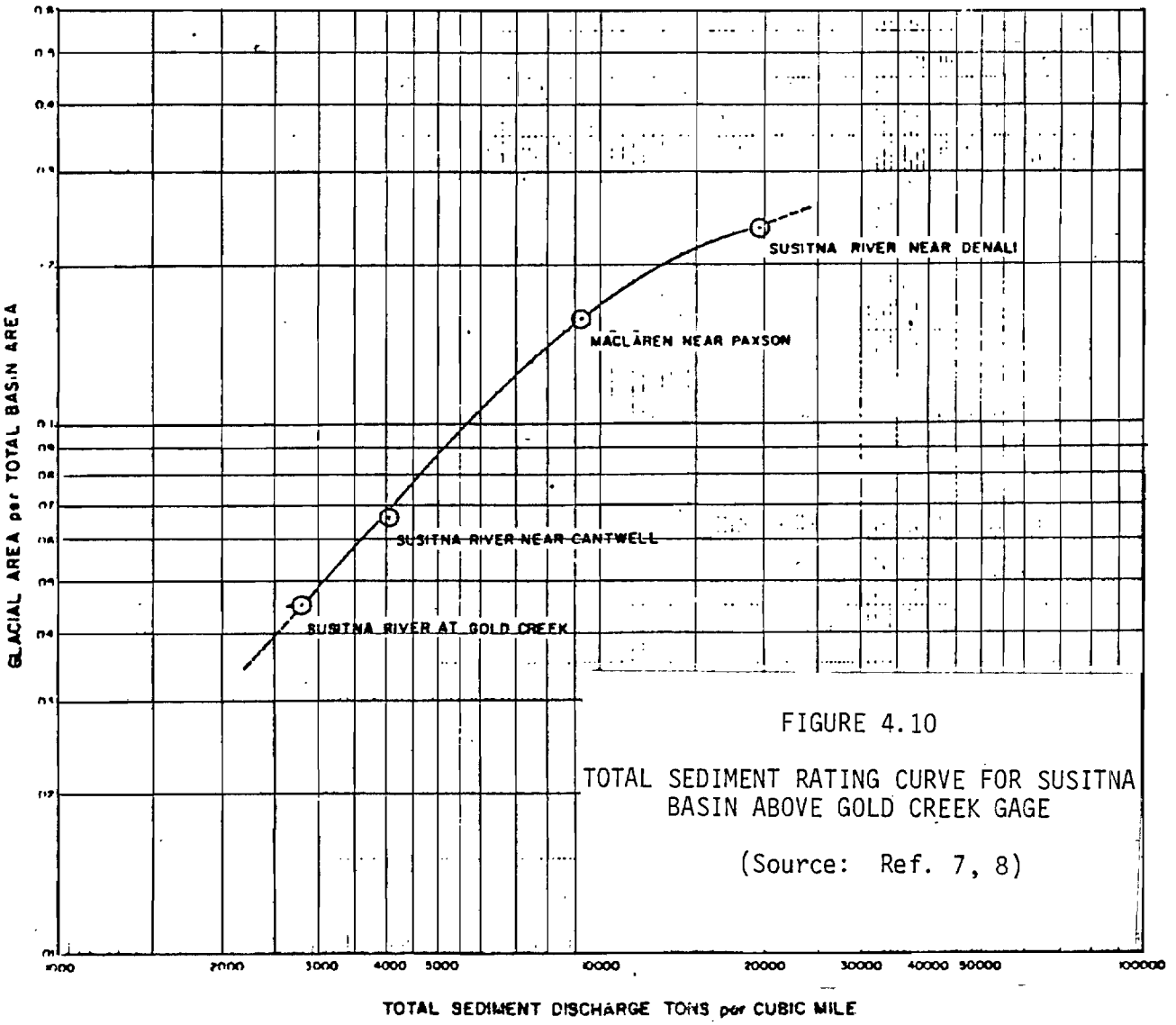


FIGURE 4.10

TOTAL SEDIMENT RATING CURVE FOR SUSITNA BASIN ABOVE GOLD CREEK GAGE

(Source: Ref. 7, 8)

5 - HYDROLOGIC DATA FOR ALTERNATIVE HYDRO SITES

5.1 - Introduction

As part of the engineering studies conducted during 1980, preliminary information on capital cost and energy potential were developed for ten alternative hydroelectric development sites (see Figure 2.3) within the Railbelt but outside the upper Susitna basin. This section briefly outlines the studies undertaken to generate sufficient hydrological information at these sites and summarizes the results.

5.2 - Streamflow Data

(a) USGS Records for All Sites

The USGS currently operates 39 stream gages in the Railbelt Region. In addition, there are at least 35 stream gages which monitored streamflow within the Railbelt but have been discontinued or converted to partial record stations. Among the base stations used to provide streamflow data for the ten sites in the Railbelt area, the station on the Nenana River (No. 5160) (see Figure 2.1) has continuous streamflow records for 23 years, from October 1950 to September 1973, and was subsequently converted into a partial records station. The station on Snow River has only four months of record and is not currently operated. Records at other stations vary in length between these two extremes. Over 13 years of records are available on Klutina River and for Chakachamna and Strandline Lakes, but observations were discontinued after 1972. USGS field activities have included discharge and/or stage measurements at the stream gages.

(b) Streamflow Analyses

The inflows used as input into the Acres reservoir operation studies were determined based on a streamflow analysis at eight gaging stations within the Railbelt. Fortunately, most of the stream gaging activity has taken place nearest to areas of human activity which until recently has been predominantly in the South-Central province, including the Railbelt. The existing data base used to estimate the input into the reservoir operation studies is presented in Table 5.1.

The first six gaging stations shown on Table 5.1 represent the best data for estimating the inflows to the reservoirs. Some periods of records were considered too short to be used in reservoir operation studies. For these cases, annual and monthly streamflows were transposed from stations located on the same river or hydrologically similar stations loated on adjacent rivers, using monthly and seasonal correlations of streamflows and/or ratios of intervening drainage areas. The hydrologic criteria for selecting similar stations included the proximity of the watersheds, the orientation of the drainage basin and the direction of the main water course, special features of the runoff such as glaciers and/or lakes and, whenever possible, the size of the drainage area. Homer on Bradley River and Lawing on Trail River were selected to extend the information at the Lawing Station on Wolverine Creek and the Seward Station on Snow River, respectively. The procedures used in extending the information at the base

stations are presented on Table 5.2. After expansion and/or transposition of data, the length of the streamflow data used as input into the reservoir operations varied between 13 and 27 years. Monthly streamflow data is shown in Appendix F for the ten selected sites.

TABLE 5.1: STREAMFLOW DATA BASE

USGS No.	Gaging Station	River	Drainage Area (mi^2)	Period of Record From mo/yr	Period of Record To mo/yr	Mean Annual Flow (ft^3/s)
2927	Talkeetna	Talkeetna	2,006	06/64	09/78	4,000
5160	Windy	Nenana	710	10/51	09/73	1,204
2060	Copper Center	Klutina	880	08/49	06/67	1,686
2945	Tyonek	Chakachatna	1,120	06/59	09/72	3,506
2369	Lawing	Wolverine Creek	10	10/66	09/78	87
2439	Seward	Snow	128	09/70 08/74 08/77	09/70 09/74 08/77	1,360
2390	Homer	Bradley	54	10/57	09/78	418
2480	Lawing	Trail	181	05/47	09/74	780

TABLE 5.2: GENERATION OF STREAMFLOW DATA BASE FOR PROJECT SITES

Project Site		Streamflow Data				
Dam Site/River	Drainage Basin Area (mi^2)	USGS No.	Station/River	Drainage Basin Area (mi^2)	General Procedure	Total Period of Generated Record (years)
Snow/Snow	85	2439	Seward/Snow	128	Correlation of gage 2439 on 2480 (1) D.A. Ratio = 0.66	27
Bruskasna/Nenana	653	5160	Windy/Nenana	710	D.A. Ratio = 0.92	23
Ketna/Talkeetna	1,250	2927	Talkeetna/Talkeetna	2,006	D.A. Ratio = 0.63	14
Cache/Talkeetna	750	2927	Talkeetna/Talkeetna	2,006	D.A. Ratio = 0.37	14
Browne/Nenana	2,450	5160	Windy/Nenana	710	D.A. Ratio = 3.45	23
Talkeetna/Talkeetna	850	2927	Talkeetna/Talkeetna	2,006	D.A. Ratio = 0.42	14
Hicks/Matanuska (3)	950	2060	Copper Creek/Klutina	880	D.A. Ratio = 1.08	17
Chakachamna/ Chakachatna	1,120	2945	Tyonek/Chakachatna	1,120	D.A. Ratio = 1.00	13
Allison/Allison Creek (3)	6	2369	Lawing/Wolverine	10	Correlation of gage 2369 on 2390 (2) D.A. Ratio = 0.60	15
Strandline/Beluga (3)	54	2945	Tyonek/Chakachatna	1,120	D.A. Ratio = 0.05	13

Notes: D.A. = Drainage Area
(1) Correlation Coefficient = 0.55
(2) Correlation Coefficient = 0.90
(3) Streamflow generation based on Adjacent River Gaging Station

6 - CLIMATIC DATA

6.1 - Climatic Data

Climatic data, including temperature, precipitation, wind, cloud cover, humidity, etc. has been collected by NOAA and others at a number of stations within and adjacent to the Susitna River Basin. The location of the stations and length of records available are presented in Appendix G.

Typically, NOAA records are presented as annual summaries with comparative data for each station (see Table 6.1). Monthly summaries of the same are also available for most of the parameters presented in the annual summary on a daily basis with selected parameters presented on a 3-hour or hourly interval. A summary of the available climatological data for the basin is presented in Table 6.2.

6.2 - Evaporation Data

The closest stations to the Upper Susitna Basin where Pan evaporation data is collected are at the Matanuska Valley Agricultural Experiment Station near Palmer and at the University Experiment Station near Fairbanks. The period of record for each station is for the summer months in 1944 to the present with several gaps in records. A summary of the monthly averages is presented in Table 6.3.

6.3 - Snow Survey

The SCS performs regular snow course surveys and collect snow depth and water equivalent data at a number of locations within and surrounding the basin. Usually one measurement a month is taken at each site during the winter months, February through May. Appendix H lists the stations and period of records available.

TABLE 6.1: TYPICAL NOAA CLIMATE DATA RECORD
(SOURCE: REFERENCE 14)

Meteorological Data For The Current Year

Station. SUMMIT, ALASKA # 26414 — SUMMIT AIRPORT — Standard time used: ALASKAN — Latitude: 63° 20' N — Longitude: 149° 08' W — Elevation (ground): 2397 feet — Year: 1976

Month	Temperature °F: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct.: Hour 02 (Local time)	Hour 08 (Local time)	Hour 14 (Local time)	Hour 20 (Local time)	Wind: Resultant: Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F: Maximum (b): 90° and above	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb: Elev. 2405 feet m.s.l.
JAN	9.0	-3.8	2.6	34	30	-26	9	1931	0	2.17	1.15	18-19	49.7	21.5	18-19	67	70	73	71				28	23	30		6.0	11	4	16	12	7	0	2	0	29	31	20	
FEB	4.2	-10.4	-3.1	33	5	-28	11	1975	0	1.11	0.50	4	19.6	8.7	5-6		65	68	68				31	07	23		3.9	17	4	8	7	6	0	0	0	27	29	24	
MAR	18.2	2.2	10.2	30	6	-14	15	1696	0	1.65	0.45	3-4	41.1	8.7	9		75	67					35	07	17		8.0	4	4	23	.11	8	0	0	0	31	31	15	
APR	36.3	14.5	25.4	51	30	-3	15	1180	0	0.14	0.08	26	5.8	3.1	26		68						20	08	14		6.2	8	8	14	3	2	0	0	0	8	30	2	
MAY	43.6	29.4	36.5	54	2	17	7	878	0	2.98	1.90	8	8.7	2.6	8		69						17	24	18		7.5	5	6	20	7	4	0	0	0	27	0		
JUN	60.6	40.8	50.8	74	27	34	8	420	0	0.51	0.30	30	0.0	0.0			69						18	22	17		6.9	6	8	16	4	0	0	0	3	0	0	0	
JUL	62.1	43.6	52.9	76	23	33	6	368	0	1.05	0.33	23	0.0	0.0			81						29	23	27		8.1	3	7	21	14	0	0	1	4	0	0	0	
AUG	62.8	41.8	52.3	78	2	31	29	383	0	0.96	0.20	7	0.0	0.0			80						20	26	7						13	0	0	0	9	0	1	0	
SEP	49.8	31.7	40.8	59	14	16	30	718	0	1.59	0.48	9	0.4	0.3	20		76						25	25	19		7.6	3	9	18	13	0	0	2	0	0	17	0	
OCT																							20	08	12														
YEAR																																							

Normals, Means, And Extremes – THROUGH 1975#

Month	Temperatures °F: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum $ in 24 hrs.	Year	Snow, ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct.: Hour 02 (Local time)	Hour 08 (Local time)	Hour 14 (Local time)	Hour 20 (Local time)	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	† Precipitation .01 inch or more	Snow, ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b): 90° and above	32° and below	Min.: 32° and below	0° and below	Average station pressure mb: Elev. 2405 feet m.s.l.
(a)				35		35					35		35		35		34		35		5	7	7	6	8	5	7	7			7	7	7	7	20	8	8	.8	34	34	36	34	2
J	7.9	-4.8	1.6	44	1945	-45	1971	1965	0	0.91	3.38	1948	0.09	1945	0.80	1948	64.8	1948	16.3	1973	68	68	69	68	15.1	NE	44	05	1968		5.2	13	5	13	9	4	0	*	0	30	31	20	921.4
F	13.5	-.4	6.6	45	1942	-45	1947	1635	0	1.23	4.31	1951	T	1950	2.79	1951	44.5	1951	28.0	1964	76	75	75	76	11.9	NE	46	07	1974		7.0	6	5	17	10	5	0	1	0	26	28	15	918.8
M	19.4	3.0	11.2	49	1961	-35	1971	1668	0	1.04	4.53	1946	0.07	1961	1.67	1946	59.1	1946	18.1	1946	76	76	70	73	11.1	NE	48	10	1971		6.2	9	6	16	10	5	0	1	0	27	31	14	917.2
A	32.9	14.1	23.5	57	1956	-30	1944	1248	0	0.67	4.45	1966	0.06	1944	0.97	1963	28.7	1970	9.7	1968	80	75	65	75	7.6	NE	33	08	1971		7.2	5	7	18	7	4	0	1	0	13	30	3	922.9
M	45.7	29.1	37.4	76	1960	-14	1945	836	0	0.77	2.66	1966	0.04	1949	0.96	1946	17.4	1958	7.8	1946	83	70	58	67	7.7	W	28	07	1969		7.5	3	9	19	7	2	*	1	*	1	22	*	923.1
J	58.0	39.9	49.0	89	1961	25	1947	480	0	2.19	4.45	1949	0.41	1942	2.22	1967	9.4	1974	8.7	1974	84	73	57	65	8.3	SW	29	22	1970		8.2	2	6	22	12	1	2	1	3	0	2	0	924.7
J	60.2	43.8	52.0	81	1961	32	1970	403	0	3.09	5.58	1959	1.17	1955	1.95	1948	9.7	1970	9.7	1970	89	78	62	72	7.8	SW	30	23	1974		8.2	2	7	22	16	*	2	1	5	0	*	0	929.1
A	56.0	41.1	48.6	81	1968	20	1955	508	0	3.30	6.33	1955	0.79	1941	2.10	1944	9.0	1955	6.0	1955	88	81	62	76	7.4	SW	31	22	1975		8.3	2	6	23	18	0	*	1	1	0	2	0	930.3
S	47.1	32.6	39.9	75	1957	6	1956	733	0	2.81	6.13	1965	0.29	1969	2.07	1944	21.5	1958	14.0	1955	85	81	59	75	7.5	NE	32	23	1972		7.4	5	5	20	16	2	*	1	*	1	14	0	924.1
O	30.4	17.5	24.0	59	1969	-15	1975	1271	0	1.62	3.79	1952	0.12	1967	1.24	1963	54.8	1970	12.6	1970	83	85	76	81	8.0	NE	35	23	1970		7.6	5	5	21	13	7	0	2	0	18	30	2	916.7
N	15.7	3.7	9.7	44	1962	-29	1948	1659	0	1.23	4.85	1952	0.06	1963	1.30	1964	79.1	1967	21.9	1970	79	79	78	79	11.3	NE	39	25	1970		7.1	7	4	19	9	5	0	1	0	27	30	13	921.3
D	9.2	-3.4	2.9	42	1969	-43	1961	1925	0	1.20	4.63	1951	0.24	1945	1.09	1967	50.7	1970	27.4	1970	76	78	76	77	12.7	NE	44	11	1970		6.5	9	5	17	11	6	0	1	0	30	31	19	914.7
YR	33.0	18.0	25.5	89	JUN 1961	-45	JAN 1971	14368	0	20.06	6.74	AUG 1944	T	FEB 1950	2.79	FEB 1951	75.1	NOV 1967	28.0	FEB 1964	81	76	67	74	9.7	NE	48	10	MAR 1971		7.2	68	70	227	138	41	5	12	9	173	251	86	922.0

NOTE: Due to less than full time operation on a variable schedule, manually recorded elements are from broken sequences in incomplete records. Daily temperature extremes and precipitation totals for portions of the record may be for other than a calendar day. The period of record for some elements is for other than consecutive years.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise north
FAS -- ...E WIND ... als fast. ...cates ... ved 1-... lue when the direction is in tens of degrees.

$ For calendar day prior to 1968.
@ For the period 1950-1954 and January 1968 to date when available for full year.
† For the period 1942-1953 and January 1968 to date when available for full year.
# Data for this station not available for archiving nor

TABLE 6.2: BASIN CLIMATOLOGICAL DATA

(Source: Ref. 5, 6)

MEAN MONTHLY PRECIPITATION (IN)

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Matanuska Valley Agriculture Exp. Stn.	.90	.73	.43	.39	.74	1.30	2.24	2.90	2.39	1.59	1.01	.92	15.54
Talkeetna	1.76	1.72	1.46	.75	1.34	1.77	3.19	5.33	4.46	2.85	1.79	1.62	23.02
Summit	.88	1.31	1.21	.73	.81	2.24	3.15	3.27	2.90	1.72	1.37	1.34	20.93
Sheep Mountain	.55	.68	.62	.72	.56	1.97	2.43	1.24	1.41	1.13	.71	.56	12.58
McKinley Park	.83	.69	.37	.47	.68	1.93	2.59	2.81	1.54	.98	.75	.65	14.29
Gulkana	.68	.47	.36	.22	.60	1.40	1.92	1.58	1.85	.79	.60	.72	11.19

MEAN MONTHLY TEMPERATURE - °F

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Matanuska Valley Agriculture Exp. Stn.	12.1	18.8	24.6	37.1	47.2	55.4	57.7	55.4	47.7	35.6	21.9	13.2	35.6
Talkeetna	9.4	15.5	20.3	33.8	44.8	55.1	57.9	54.7	46.0	33.1	18.8	9.6	33.3
Summit	2.1	7.5	11.3	23.3	36.9	48.6	52.2	48.5	40.3	24.4	9.4	2.9	25.6
Sheep Mountain	5.1	9.5	15.7	27.8	41.0	53.3	52.9	51.0	42.4	28.0	12.7	5.1	28.8
McKinley Park	1.4	7.1	13.2	28.4	41.5	52.2	54.6	50.4	41.3	25.9	10.4	2.1	27.4
Gulkana	-1.3	2.8	14.5	29.5	43.1	53.3	56.6	52.5	43.4	27.7	6.8	-3.1	26.6

TABLE 6.3: PAN EVAPORATION DATA

(Source: Ref. 5, 6)

Month	Average Monthly Pan Evaporation, Inches			
	Matanuska Valley Agr. Exp. Station		University Exp. Stn.	
	Evap.	Yrs. Rcd.	Evap.	Yrs. Rcd.
May	4.63	15	4.46	19
June	4.58	24	5.09	26
July	4.09	29	4.50	30
August	2.99	29	2.96	30
September	1.83	26	1.42	24
SUBTOTAL	18.12		18.43	

Average Consumptive Use

Month	Consumptive Use (in)
May	2.30
June	3.50
July	3.86
August	3.08
September	0.16
TOTAL	12.90

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APPENDIX A

STREAMFLOW GAGING STATIONS IN THE SUSITNA BASIN (3)

WATER RESOURCES DATA COLLECTED IN THE SUSITNA RIVER BASIN

0100 STREAMFLOW CONTINUOUS GAGING

Mean daily discharge and/or annual maximum flood peak discharge data have been collected by the U.S. Geological Survey & R&M Consultants at several locations within the Susitna River Basin. The stations for which this information is available and the period of record at each location are listed below. Unless indicated by agency name in parentheses following the period of record, all data has been collected by the USGS. All data listed in this section are on file at R&M Consultants according to index number and name.

Index No.	Description
0110	Susitna River near Denali - USGS Station 15291000
	Mean Daily Discharge Records: May 1957 - September 1966; July 1968 - Present
	Annual Maximum Discharge Records: 1957-1966, 1968-1980
	Annual Instantaneous Peak Flow:1957-1963, 1965, 1967, 1967-1979
0115	Maclaren River near Paxson - USGS Station 15291200
	Mean Daily Discharge Records: June 1958 - Present
	Annual Maximum Discharge Records: 1958-1980
	Annual Instantaneous Peak Flow:1958 - 1980

Index No.	Description
0120	Susitna River near Cantwell - USGS Station 15291500
	Mean Daily Discharge Record: May 1961 - September 1972; May 1980 - Present
	Annual Maximum Discharge Records: 1961-1972
	Annual Instantaneous Peak Flow:1960-1972
0130	Susitna River near Watana Damsite - R&M SG-1
	Mean Daily Discharge Records: July 1980 - Present
	Miscellaneous Discharge Measurements: 1980: August 20 (R&M) August 21 (R&M) September 3 (R&M) September 18 (R&M) October 20 (R&M)
0140	Susitna River near Gold Creek - USGS Station 15292000
	Mean Daily Discharge Record: August 1949 - Present
	Annual Maximum Discharge Record: 1950-1980
	Annual Instantaneous Peak Flow:1950- 1980
0145	Chulitna River near Talkeetna - USGS Station 15292400
	Mean Daily Discharge Record: February 1958 - September 1972
	Continuous Stage Gage Reactivated: May 1980
	Annual Maximum Discharge Record: 1958-1972
	Crest Stage Record: 1973-1977
	Annual Instantaneous Peak Flow: 1958-1977

Index No.	Description
0155	Talkeetna River near Talkeetna - USGS Station 15292700
	Mean Daily Discharge Record: June 1964 - Present
	Annual Maximum Discharge Record: 1964-1980
	Annual Instantaneous Peak Flow: 1964-1980
0160	Susitna River near Sunshine - Proposed 1981
0162	Willow Creek near Willow - USGS Station 15294005
	Mean Daily Discharge Record: June 1978 - Present
	Annual Maximum Discharge Record: 1978-1980
0163	Deception Creek near Willow - USGS Station 15294010
	Mean Daily Discharge Record: May 1978 - Present
	Annual Maximum Discharge Record: 1978-1980
0165	Skwentna River near Skwentna - USGS Station 15294300
	Mean Daily Discharge Record: August 1959 - Present
	Annual Maximum Discharge Record: 1959-1980
	Annual Instantaneous Peak Flow: 1959-1980
0175	Yentna River near Susitna Station
	Mean Daily Discharge Record: October 1980 - Present
0190	Susitna River near Susitna Station - USGS Station 15294350
	Mean Daily Discharge Record: October 1974 - Present
	Annual Maximum Discharge Record: 1974-1980

0200 STREAMFLOW PARTIAL RECORDS

All data collected relating to river stage or water discharge for the Susitna River Basin not previously listed under Section 0100: Streamflow Continuous Gaging are included below. This section includes all records from crest stage gages, staff gages or fragmentary data. Agencies collecting the data include: U.S. Geological Survey (USGS), R&M Consultants (R&M) and National Weather Service (NWS). The agency responsible for data collection at each site is indicated by the agency name in parentheses following the period of record.

It should be noted that National Weather Service stations provide real-time river stage data which can be obtained from the NWS Alaska River Forecast Center at any time.

Alaska Department of Fish and Game has additional data on stage and water discharge of selected tributaries and fresh-water sloughs in the Susitna River Basin. Appendix I includes location and period of record for the data available.

All data given below are on file at R&M Consultants according to index number and location, unless marked by an asterisk following the period of record.

Index No.	Description
0201	Raft Creek near Denali - USGS Station 15291000
	Annual Maximum Discharge from Crest-Stage Gage: 1963-1977 (USGS)
0205	Susitna River at Deadman Creek - R&M CSR-9
	Crest-Stage Gage: 1980 (R&M)

Index No.	Description
0210	Susitna River at Watana Dam Site - R&M CSR-8
	Crest Stage Gage: 1980 (R&M)
0215	Susitna River above Devil Canyon - R&M CSR-7
	Crest-Stage Gage: 1980 (R&M)
	Staff Gage: Proposed
0220	Portage Creek above Gold Creek - R&M CSR-6
	Crest-Stage Gage: 1980 (R&M)
0225	Susitna River at Sherman - R&M CSR-5
	Crest-Stage Gage: 1980 (R&M)
0230	Susitna River at Section 25 - R&M CSR-4
	Crest-Stage Gage: 1980 (R&M)
0235	Susitna River at Curry - R&M CSR-3
	Crest-Stage Gage: 1980 (R&M)
	Partial Discharge Record: 1948 - 2 dates (USGS)
0240	Susitna River near Chase - R&M CSR-2
	Crest-Stage Gage: 1980 (R&M)
0245	Susitna River above Susitna-Chulitna Confluence - R&M CSR-1
	Crest-Stage Gage: 1980 (R&M)
0246	Talkeetna River near Talkeetna
	Partial Discharge Record: 1949 - 2 dates (USGS)

Index No.	Description
0247	Talkeetna River at Talkeetna Railroad Bridge Partial Stage Record: 1976-1980 (NWS)
0250	Susitna River at Sunshine - USGS Station 15292780 Partial Discharge Record: 1969-1971, 1976-80 (NWS)
0251	Montana Creek near Montana - USGS Station 15292800 Crest-Stage Gage: 1963-1972 (USGS)
0252	Montana Creek at Parks Highway Partial Stage Record: 1973-1980 (NWS)
0253	Goose Creek near Montana - USGS Station 15292900 Crest-Stage Gage: 1963-1971 (USGS)
0254	Caswell Creek near Caswell - USGS Station 15293000 Crest-Stage Gage: 1963-1980 (USGS)
0255	Little Willow Creek near Kashwitna - USGS Station 15293700 Low-Flow Discharge Record: 1978 (USGS)
0256	Willow Creek at Hatcher Pass Road near Willow - USGS Station 15294002 Low-Flow Discharge Record: 1978-1980 (USGS)
0257	Deception Creek above Tributary near Houston - USGS Station 15294007 Low-Flow Discharge Record: 1978-1980 (USGS)

Index No.	Description
0258	Deception Creek Tributary near Houston - USGS Station 15294008
	Low-Flow Discharge Record: 1978-1980 (USGS)
0259	Willow Creek at Parks Highway near Willow
	Low-Flow Discharge Record: 1978-1980 (USGS)
	Partial Stage Record: 1973-1980 (NWS)

APPENDIX B

MEMO ON PROBABLE MAXIMUM PRECIPITATION
ESTIMATES FROM NATIONAL WEATHER SERVICE
TO CORPS OF ENGINEERS - UNDATED

DRAFT

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UBJ: Tentative Estimates of Probable Maximum Precipitation (PMP) and Snowmelt Criteria for Four Susitna River Drainages

Introduction

The Office of Chief of Engineers, Corps of Engineers requested PMP and snowmelt criteria for the subject drainages in a memorandum to the Hydrometeorological Branch, dated December 12, 1974. The Alaska District requested the study be completed by February 1, 1975; however, a more realistic date for completing a study in which we have confidence is June 1, 1975. Because of the need to soon begin hydrologic studies based on meteorological criteria, the Branch has concentrated on the problem and has determined the general level of criteria. A range of PMP values are given in this memorandum within which we believe values from a more comprehensive study will fall. The sequences of snowmelt winds, temperatures, and dew points should be checked with additional studies. In addition, if we knew in detail how snowmelt will be computed, we could give emphasis to the more important elements.

PMP estimates for four drainages

A range of estimates of PMP for 6, 24, and 72 hours for four drainages outlined on the map accompanying the December 12, 1974 memorandum are listed in table 1. These are numbered from 1 to 4 (smallest to largest).

The estimates are for the months of August and September - the season of greatest rainfall potential. For the snowmelt season, multiply the estimates by 70 percent.

The estimates take into account numerous considerations including several methods of modifying PMP estimates made previously for other Alaska drainages, and PMP estimates from the Western United States for areas with similar terrain.

Temperatures and Dew Points for Snowmelt

A. During PMP Storm

1. Dew point for PMP centered on June 15 = 56°F (assume maximum 1-day PMP in middle of 3-day storm).
2. For PMP placement prior to June 15 subtract 0.8°F for each 3-day period prior to June 15 (e.g. the PMP dew point for June 12 will be 55.2°F). This -0.8°F per 3-days may be applied to obtain the maximum 1-day dew point during the PMP back to as early as May 15.
3. For first day of PMP storm, subtract 1°F from criteria of 2; for 3rd day of PMP storm subtract 2°F.
4. Add 2°F to each of the three daily dew points to get daily temperatures for the 3-day PMP period.

B. Temperatures and Dew Points Prior to 3-Day PMP Storm (High dew point case)

Adjustment to temperature and dew point on day of maximum PMP

Day prior to PMP	Temperature (°F)	Dew point (°F)
1st	-2	-2
2d	-1	-4
3rd	0	-4
4th	+1	-5

C. Temperatures, Dew Points Prior to 3-day PMP (High temperature case)

Adjustment of temperature and dew point on day of maximum PMP

Day prior to PMP	Temperature (°F)	Dew point (°F)
1st	+1	-12
2d	+2	- 9
3rd	+4	- 7
4th	+7	- 6

Elevation Adjustment

For the 3 days of PMP and for the high dew point case, apply a -3°F per 1000 ft to the temperatures and dew points. The basic criteria are considered applicable to 1000 mb or zero elevation.

For the high temperature criteria apply a -4°F per 1000 ft increase in elevation.

Half-day Values

If half-day values are desired for temperatures and dew points, the following rules should be followed:

1. For the high-temperature sequence, apply an 18°F spread for temperatures and a 6°F spread for dew point. For example, for a mean daily dew point of 50°F, the half-day values would be 47°F and 53°F.

2. For the high dew point case, apply a 12°F spread for temperature and a 4°F spread for dew point.

3. In no case, however, should a 12-hr dew point be used that exceeds the 1-day value for that date. For example, the value not to be exceeded for June 15 is 56°F, for June 3 (four 3-day periods before June 15) is 52.8°F.

Wind Criteria for Snowmelt

Since two sets of criteria (one emphasizing high temperature and the other high dew point sequences) are given for snowmelt prior to PMP, two sets of wind criteria are also necessary since the pre-PMP synoptic situation favoring high temperatures differs from the criteria favoring high dew points. The recommended winds, tables 2 and 3, are given by elevation bands. In the high dew-point case, table 2, (where synoptic conditions exist favoring maritime influences prior to PMP), the same wind for 4-days prior to PMP is appropriate.

All of the winds presented in tables 2 and 3 have been adjusted for applicability over a snow surface. Although a seasonal variation in the high dew point wind criteria is realistic for the present tentative criteria, they are considered applicable to May and June.

Snowmelt Winds During the PMP

Wind criteria for the 3-day PMP are the same for both the high temperature and high dew point sequences. They are shown in table 4.

Snow Pack Available for Melt

Some work was done in determining the mean and maximum October-April precipitation of record for the available precipitation stations. These stations and other data are tabulated in table 5. The drainages and available stations are shown in figure 1.

Table 5 also shows the years of record available for October-April precipitation, as well as a column labeled "synthetic October-April precipitation." This gives the sum of the greatest October, greatest November, etc., to the greatest April precipitation total from the available record. These synthetic October-April precipitation values and the means are plotted on figure 1.

Approximately 9 years of snow course data are available for 14 locations in and surrounding the Susitna drainage. From these records, the greatest water equivalents were plotted on a map. These varied from a low of 6 inches at Oshetka Lake (elevation 2950 ft) to an extreme of 94.5 inches at Gulkana Glacier, station C (elevation 6360 ft). A smooth plot of all maxima against elevation gave a method of determining depths at other elevations. Figure 2 shows resulting smooth water equivalents based on smoothed elevation contours and this relation.

Some additional guidance could be obtained from mean annual precipitation maps. One such map available to us is in NOAA Technical Memorandum NWS AR-10, "Mean Monthly and Annual Precipitation, Alaska." The mean annual of this report covering the Susitna drainage is shown in figure 3.

Also on this figure is shown the mean runoff for three portions of the Susitna River drainage based on the years of record shown. No adjustment has been made for evapotranspiration or any other losses. This indicates that the actual mean annual precipitation is probably greater than that given by NWS AR-10.

Conclusion. Time hasn't allowed checks, evaluation, and comparison of the several types of data summarized here. It appears the "synthetic October-April precipitation" generally is less than the maximum depths over the drainages based on snow course measurements. There depths, or figure 2, would be considered the least that could be available for melt in the spring.

Further Studies

The variation of precipitation with terrain features in Alaska is important but yet mostly unknown and unstudied. More effort should be placed on attempts to develop mean annual or mean seasonal precipitation maps, at least for the region of the Susitna River. Some 10 years of data at about a dozen or so snow courses could be used in this attempt, as well as stream runoff values.

Some work has been done toward estimating maximum depth-area-duration values in the August 1967 storm; an important input to the present estimates. Attempts should be made to carry out a complete Part I and Part II for this storm, although data are sparse and emphasizing the use of streamflow as a data source.

The objective of these two studies with regard to the Susitna drainages is to attempt a better evaluation of topographic effects, and to make a better evaluation of snow pack available for melt.

Study of additional storms could give some important conclusions and guidance on how moisture is brought up the Cook Inlet to the Talkeetna Mountains and how these mountains effect the moisture.

Snowmelt criteria in this quick study is limited to 7 days. Considerably more work needs to be done to extend this to a longer period. Then we would need to emphasize compatability of a large snow cover and high temperatures. More known periods of high snowmelt runoff need to be studied to determine the synoptic values of the meteorological parameters.

Table 1

General level of PMP estimates for 4 Susitna River drainages

Drainage Number	Area (sq mi)	72-hr PMP (in.)
1	1260	9-12
2	4140	7.5-10.5
3	5180	7-9
4	5810	7-9

For 24-hr PMP, multiply 72-hr value by 0.60.

For 6-hr PMP, multiply 72-hr value by 0.30.

PMP for intermediate durations may be obtained from a plotted smooth curve through the origin and the 3 values specified.

Table 2

Snowmelt Winds preceding PMP for Susitna Basins for high dew point sequence

Elevation (ft)	Daily Wind speed* (mph)
sfc	8
1000	9
2000	12
3000	18
4000	25
5000	34
6000	36
7000	37
8000	39
9000	40
10,000	42

*For each of the 4 days preceding the 3-day PMP.

Table 3

Snowmelt winds preceding PMP for Susitna Basins
for high temperature sequence

Elevation (ft)	Daily wind speed (mph) Day prior to 3-day PMP			
	1st	2nd	3rd	4th
sfc	10	13	4	4
1000	10	13	4	4
2000	11	14	5	5
3000	12	16	5	5
4000	13	16	6	6
5000	13	17	6	6
6000	14	18	6	6
7000	15	20	6	6
8000	16	20	7	7
9000	16	20	7	7
10,000	17	21	7	7

Table 4

Winds during 3-day PMP

Elevation (ft)	Wind speed (mph) Day of maximum PMP	Day of 2nd highest PMP	Day of 3rd highest PMP
sfc	12	9	8
1000	14	10	9
2000	19	14	12
3000	29	21	18
4000	42	31	27
5000	56	42	36
6000	58	44	38
7000	62	46	40
8000	64	48	41
9000	68	51	44
10,000	70	52	45

Table 5

Stations with Precipitation Records in and surrounding the Susitna Drainage

Station	Elevation (ft.)	Yrs of record for complete Oct.-Apr. precipitation	Maximum obs. Oct-Apr. prec. (in.)	Yr of Maximum	Mean Number of months for synthetic Oct.-Apr. season	Synthetic Oct.-Apr. precip. (in.)	Mean Oct.-Apr. Precip. (in.)
Susitna Meadows	750	4	17.18	70-71	4	23.18	13.77
Gulkana	1572	18	6.77	56-57	18	12.68	4.19
Paxson	2697	2	8.42	43-44	6	14.25	7.64
Trims Camp	2408	3	23.26	59-60	5	35.82	15.3
Summit	2401	19	14.09	51-52	20	26.59	7.93
Talkeetna	345	35	21.17	29-30	37	40.59	12.26
Sheep Mountain	2316	13	11.91	59-60	12	18.42	4.78

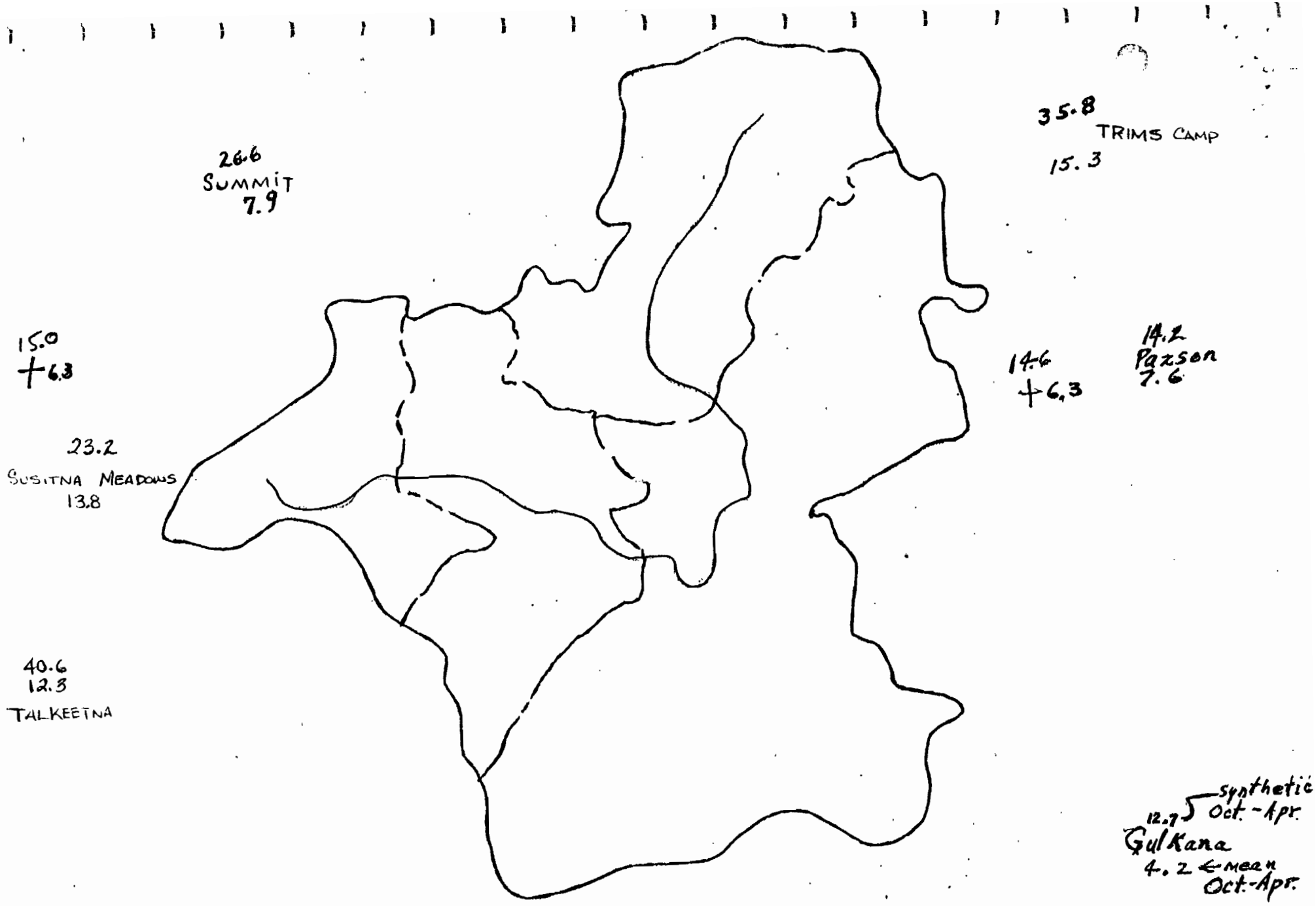

Figure 1.--Drainage outlines and October-April precipitation in inches.
(Upper values = synthetic October-April precipitation;
Lower = mean October-April precipitation.)

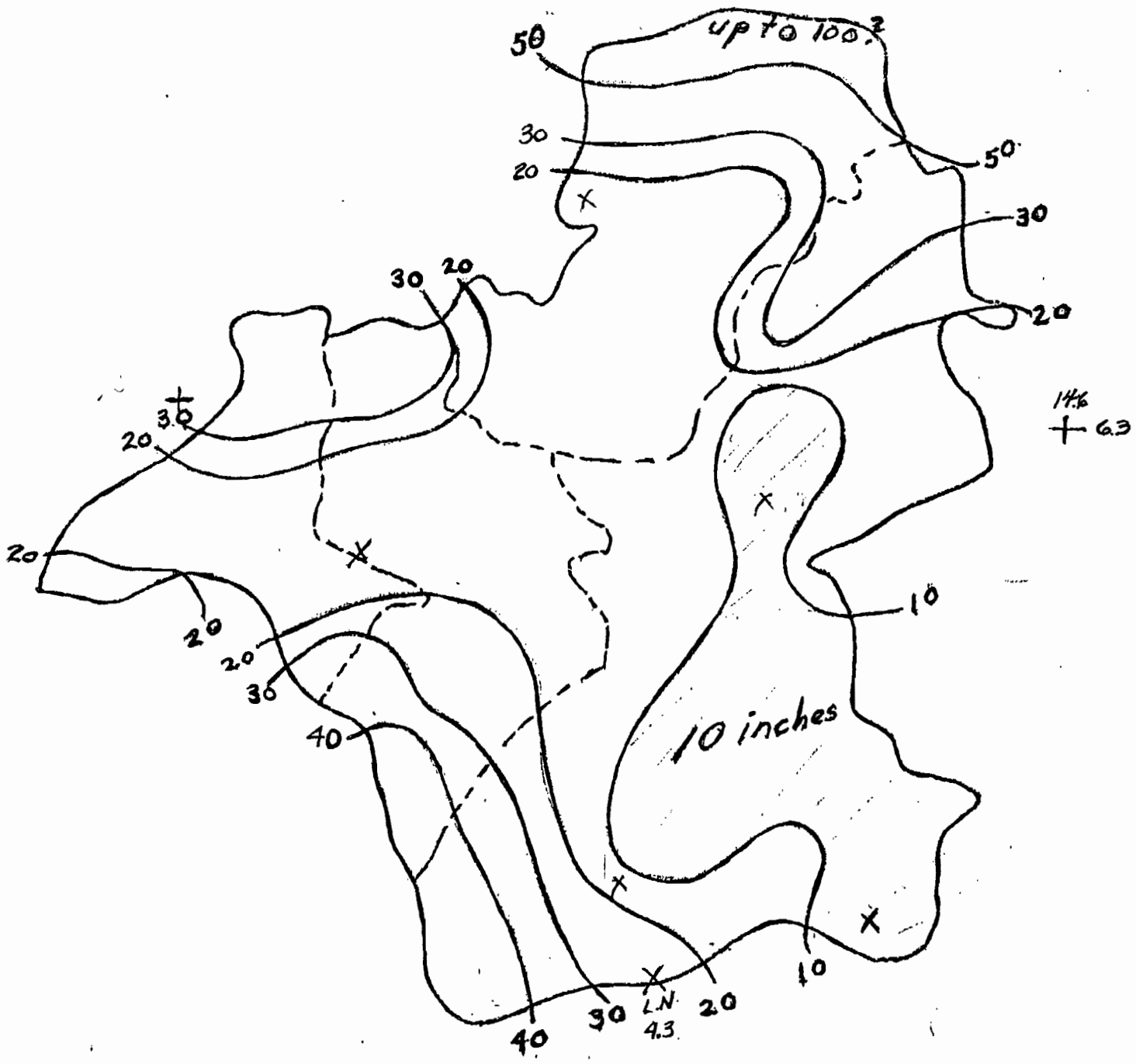

Figure 2.--Minimum water equivalents of snow pack in inches (based on gross smoothing of maximum snow course measurements.)

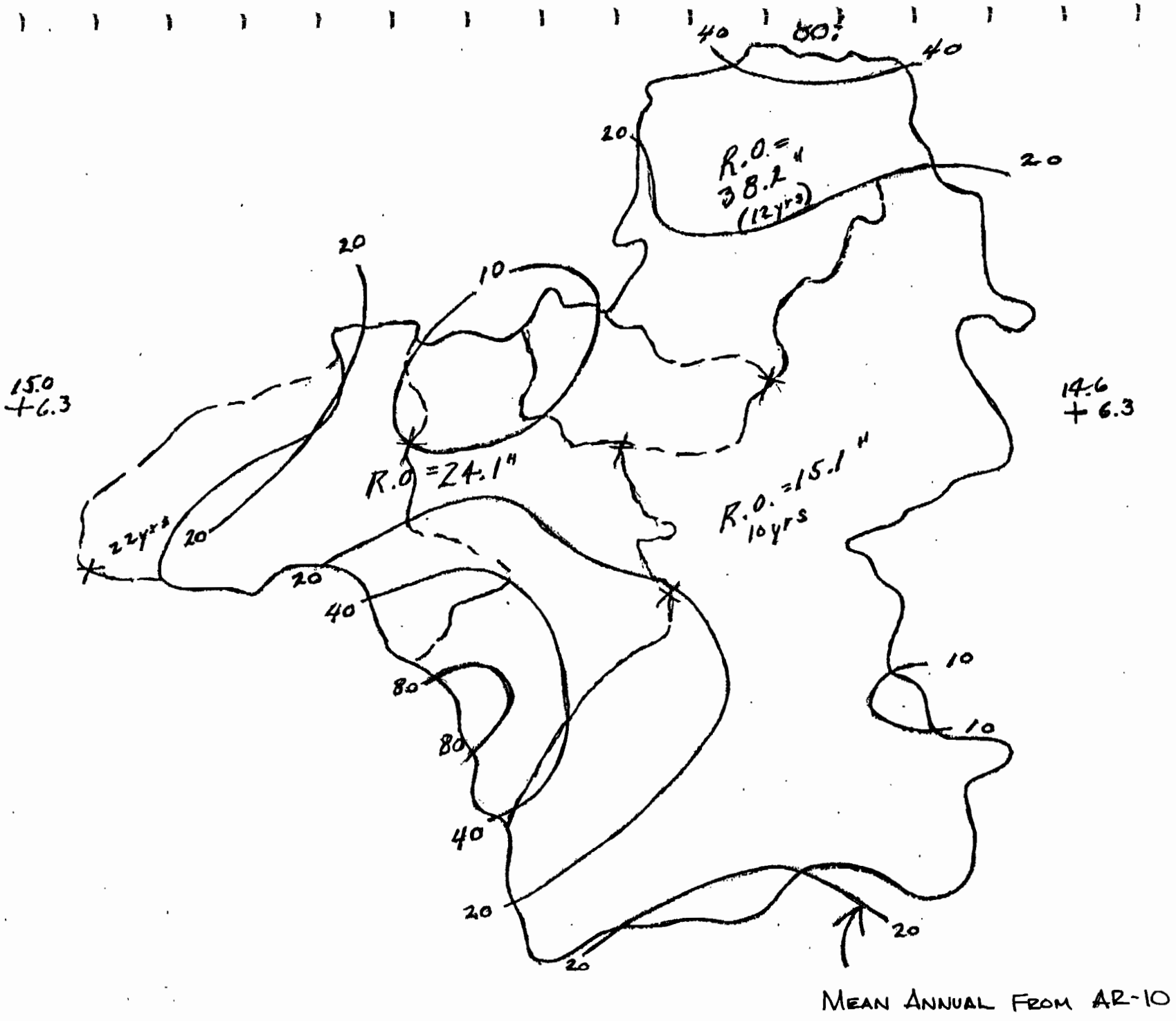

Figure 3.--Mean annual precipitation and stream runoff (in inches).

APPENDIX C

SUSPENDED SEDIMENT GAGING STATIONS (3)

0500 SEDIMENT DISCHARGE

Suspended sediment concentration (mg/l) suspended sediment discharge (tons/day) and suspended sediment particle size analysis data have been collected by the U.S. Geological Survey (USGS) and R&M Consultants (R&M) at several sites within the Susitna River Basin. The locations where this information has been collected are listed below. All of the data, except 1980 data collected by the USGS, are on file at R&M Consultants.

Unless indicated by agency name in parentheses following the period of record, all data have been collected by the USGS.

Index No.	Description
0510	Susitna River near Denali - USGS Station 15291000 Sediment Concentration and Sediment Discharge: 1958-1979 1980: May 22 June 24 July 22 August 2 October 1 Particle Size Analysis: 1958-1980
0515	Maclaren River near Paxson - USGS Station 15291200 Sediment Concentration and Sediment Discharge: 1958-1968, 1974-1975 Particle Size Analysis: 1958-1967, 1974-1975

Index No.	Description
0520	Susitna River near Cantwell - USGS Station 15291500 Sediment Concentration and Sediment Discharge: 1962-1972 1980: September 5 (R&M) September 17 (R&M) October 17 (R&M) Particle Size Analysis: 1962-1972, 1980
0525	Susitna River above Portage Creek near Gold Creek - USGS Station 624941149221500 Sediment Concentration and Sediment Discharge: 1977 Particle Size Analysis: 1977
0540	Susitna River at Gold Creek - USGS Station 15292000 Sediment Concentration and Sediment Discharge: 1952-1957, 1962, 1967, 1974-1979 1980: May 14 August 19 October 7 October 16 (R&M) Particle Size Analysis: 1953, 1955-1957, 1962, 1974-1980
0545	Chulitna River near Talkeetna - USGS Station 15292400 Sediment Concentration and Sediment Discharge: 1967 - 1972 1980: May 21 June 3 June 23 July 17 September 1 September 30 October 22 Particle Size Analysis: 1967-1972, 1980

Index No.	Description
0555	Talkeetna River near Talkeetna - USGS Station 15292700
	Sediment Concentration and Sediment Discharge: 1966-1979
	1980: February 15 April 11 May 15 July 3 July 14 August 14 October 8
	Particle Size Analysis: 1966-1980
0560	Susitna River at Sunshine - USGS Station 15292780
	Sediment Concentration and Sediment Discharge: 1971, 1977
	Particle Size Analysis: 1971, 1977
0561	Montana Creek near Montana - USGS Station 15292800
	Sediment Concentration and Sediment Discharge: 1970-1971, 1973
	Particle Size Analysis: 1970-1971, 1973
0563	Deception Creek near Willow - USGS Station 15294010
	Sediment Concentration and Sediment Discharge: 1978-1980
0565	Skwentna River near Skwentna - USGS Station 15294300
	Sediment Concentration and Sediment Discharge: 1967-1968, 1974-1975
	1980: June 12 August 21
	Particle Size Analysis: 1967-1968, 1974-1975, 1980

Index No.	Description
0575	Yentna River near Susitna Station
	Sediment Concentration and Sediment Discharge: to begin 1981
0590	Susitna River near Susitna Station - USGS Station 15294350
	Sediment Concentration and Sediment Discharge: 1975 - 1979
	1980: February 12 March 12 June 16 July 30 October 10
	Particle Size Analysis: 1975 - 1980

APPENDIX D

WATER QUALITY - STATIONS AND PARAMETERS (3)

0300 WATER QUALITY

Water quality data have been collected by the U.S. Geological Survey and R&M Consultants at several sites within the Susitna River Basin. The locations for which this information is available and the period of record at each site are given below. Since the measurements are only taken periodically the number of measurements, timing and specific parameters measured vary from year to year at any given station. A list of water quality parameters that have been measured by the USGS and R&M are included at the end of this appendix.

Unless indicated by the agency name in parentheses following the period of record, data have been collected by the USGS.

Data collected by the Alaska Department of Fish & Game are all included in Appendix I. Therefore, they have not been listed again in this section.

The data listed in this section are all on file at R&M Consultants according to index number and name, except where dates are marked by an asterisk. Most of the data are also available through the U.S. Geological Survey.

Index No.	Description
0310	Susitna River near Denali - USGS Station 15291000 Period of Record: 1957-1961, 1968, 1976
0311	Raft Creek near Denali - USGS Station 15291100 Period of Record: 1972

Index No.	Description
0313	Clearwater Creek near Paxson - USGS Station 630230146530000 Period of Record: 1958*
0315	Maclaren River near Paxson - USGS Station 15291200 Period of Record: 1958-1961, 1967-1968, 1975
0318	Little Oshetna River near Eureka - USGS Station 621130147391500 Period of Record: 1953*
0320	Susitna River near Cantwell - USGS Station 15291500 Period of Record: 1967-1970 1980: June 19 (R&M) August 8 (R&M) September 5 (R&M) September 17 (R&M) October 17 (R&M)
0330	Susitna River near Watana Damsite - R&M WQ-1 Period of Record: October 1980 - Present (R&M)
0335	Susitna River above Portage Creek near Gold Creek - USGS Station 624941149221500 Period of Record: 1977
0339	Gold Creek at Gold Creek - USGS Station 624606149412500 Period of Record: 1977*

Index No.	Description
0340	Susitna River at Gold Creek - USGS Station 15292000 Period of Record: 1949-1958, 1967-1968, 1975, 1977 1980: May 2 August 8 (R&M) August 19 October 7 October 14 (R&M)
0345	Chulitna River near Talkeetna - USGS Station 15292400 Period of Record: 1958-1959, 1967-1968, 1970
0355	Talkeetna River near Talkeetna - USGS Station 15292700 Period of Record: 1954, 1967-1980
0360	Susitna River at Sunshine - USGS Station 15292780 Period of Record: 1975, 1977
0361.1	Montana Creek near Montana - USGS Station 15292800 Period of Record: 1971-1972
0361.2	Sheep Creek at Highway near Willow - USGS Station 615945150024300 Period of Record: 1972
0361.3	Caswell Creek near Caswell - USGS Station 15293000 Period of Record: 1972
0361.4	Kashwitna River near Willow - USGS Station 615535150041500 Period of Record: 1972

Index No.	Description
0362.3	Willow Creek at Upper Bridge near Willow - USGS Station 614522149401700 Period of Record: 1972
0362.4	Willow Creek at Hatcher Pass Road near Willow - USGS Station 15294002 Period of Record: 1978-1980
0362	Willow Creek near Willow - USGS Station 15294005 Period of Record: 1972
0362.1	Willow Creek below Canyon near Willow - USGS Station 614607149552000 Period of Record: 1972
0362.2	Willow Creek at Parks Highway near Willow Period of Record: 1972
0363	Deception Creek near Willow - USGS Station 15294010 Period of Record: 1978-1980
0363.1	Deception Creek at Mouth near Willow - USGS Station 614552150021000 Period of Record: 1972
0363.2	Deception Creek above Tributary near Houston - USGS Station 15294009 Period of Record: 1978-1980
0363.3	Deception Creek Tributary near Houston - USGS Station 15294008 Period of Record: 1978-1980

Index No.	Description
0365	Skwentna River near Skwentna - USGS Station 15294300 Period of Record: 1959, 1961, 1967-1968
0366	Yentna River near Skwentna - USGS Station 615815151070000 Period of Record: 1955*
0390	Susitna River at Susitna Station - USGS Station 15294350 Period of Record: 1955, 1970, 1975-1979 1980: February 12 March 12 June 16 July 30 October 10

0400 WATER TEMPERATURE

Water temperature data have been collected by the U.S. Geological Survey, R&M Consultants and Alaska Department of Fish and Game (ADF&G) at many locations within the Susitna River Basin. The locations for which this information is available and the period of record at each site are given below. Continuous water temperature records are generally available for open-water months only, but the length of record will vary for each site from year to year. Data collected by ADF&G have all been included in Appendix C. Therefore, they have not been listed again in this section. It should also be noted that instantaneous temperature measurements have been taken and may be found in the water quality records published by the USGS.

Unless indicated by agency name in parentheses following the period of record, all data have been collected by the USGS.

The data listed in this section are on file at R&M Consultants according to index number and name, except 1980 data collected by the USGS and Talkeetna River data from 1954.

Index No.	Description
0410	Susitna River near Denali - USGS Station 15291000
	Water Temperature Record: 1974 - 1980
	Temperature Cross Sections: 1980: May 22 June 24 July 22 August 26 October 1

Index No.	Description
0415	Maclaren River near Paxson - USGS Station 15291200
	Miscellaneous Water Temperatures: 1980
0420	Susitna River near Cantwell - USGS Station 15291500
	Water Temperature Record: May 1980 - Present
0430	Susitna River near Watana Damsite
	Water Temperature Record: October 1980 - Present (R&M)
0440	Susitna River at Gold Creek - USGS Station 15292000
	Water Temperature Record: 1957, 1974-1980
	Temperature Cross Sections: 1980: May 14 July 2 August 19 October 7
	Miscellaneous Water Temperatures: 1980 (R&M)
0445	Chulitna River near Talkeetna - USGS Station 15292400
	Water Temperature Record: to begin 1981
	Temperature Cross Sections: 1980: June 3 July 17 September 1 October 22
	Miscellaneous Water Temperatures: 1980

Index No.	Description
0455	Talkeetna River near Talkeetna - USGS Station 15292700
	Water Temperature Record: 1954
	Temperature Cross Section: 1980: April 1 April 22 May 23 June 30 July 10 July 28 July 29 September 9 October 15
0460	Susitna River near Sunshine - USGS Station 15292780
	Water Temperature Record: proposed 1981
0462	Willow Creek near Willow - USGS Station 15294005
	Water Temperature Record: 1978-1979
0463	Deception Creek near Willow - USGS Station 15294010
	Water Temperature Record: 1978 - Present
0465	Skwentna River near Skwentna - USGS Station 15294300
	Miscellaneous Water Temperatures: 1967-68, 1974-75
	Temperature Cross Sections: 1980: April 14 June 12 August 21 October 17
0475	Yentna River near Susitna Station
	Water Temperature Record: to begin 1981
0490	Susitna River at Susitna Station - USGS Station 15294350
	Water Temperature Record: 1975 - Present

WATER QUALITY PARAMETERS
THAT HAVE BEEN SAMPLED BY THE USGS
WITHIN THE SUSITNA RIVER BASIN

Site Parameters

Available for each sample

- Date
- Time
- Instantaneous Stream Flow (cfs)

Occasionally available for sample

- Sampling Depth (ft)
- Stream Width (ft)
- Percent of Total Depth
- Sample Location in Cross Section (ft from left bank)

Physical Parameters

- Color (Platinum - Cobalt Units)
- Hardness (mg/l as $CaCO_3$)
- Hardness, Noncarbonate (mg/l as $CaCO_3$)
- Methylene Blue Active Substance
- pH
- Solids, Dissolved (tons/day, tons/ac-ft)

Solids, Dissolved Residue at 105°C (mg/l)
Solids, Dissolved Residue at 180°C (mg/l)
Solids, Suspended Residue at 180°C (mg/l)
Specific Conductance (Micromhos/centimeter)
Temperature, Instantaneous (°C)
Turbidity (Jackson Turbidity Units)

Inorganic Parameters

Alkalinity (mg/l as $CaCO_3$)
Aluminum, Total Recoverable (ug/l as Al)
Arsenic, Dissolved (ug/l as As)
Arsenic, Total (ug/l as As)
Arsenic, Total Suspended (ug/l as As)
Barium, Dissolved (ug/l as Ba)
Barium, Total Recoverable (ug/l as Ba)
Beryllium, Dissolved (ug/l as Be)
Bicarbonate (mg/l as HCO_3)
Boron, Dissolved (ug/l as B)
Cadmium, Dissolved (ug/l as Cd)
Cadmium, Total Recoverable (ug/l as Cd)
Calcium, Dissolved (mg/l as Ca)
Carbon Dioxide, Dissolved (mg/l as CO_2)
Carbonate (mg/l as CO_3)
Chloride, Dissolved (mg/l as Cl)
Chromium, Dissolved (ug/l as Cr)
Chromium, Dissolved Hexavalent (ug/l as Cr)
Chromium, Suspended Recoverable (ug/l as Cr)
Chromium, Total Recoverable (ug/l as Cr)
Cobalt, Dissolved (ug/l as Co)
Copper, Dissolved (ug/l as Cu)
Copper, Total Recoverable (ug/l as Cu)
Cyanide, Total (mg/l as Cn)

Fluoride, Dissolved (mg/l as F)
Iron (ug/l as Fe)
Iron, Dissolved (ug/l as Fe)
Iron, Total Recoverable (ug/l as Fe)
Lead, Dissolved (ug/l as Pb)
Lead, Total Recoverable (ug/l as Pb)
Lithium, Dissolved (ug/l as Li)
Magnesium, Dissolved (mg/l as Mg)
Manganese (ug/l as Mn)
Manganese, Dissolved (ug/l as Mn)
Manganese, Total Recoverable (ug/l as Mn)
Mercury, Dissolved (ug/l as Hg)
Mercury, Total Recoverable (ug/l as Hg)
Molybdenum, Dissolved (ug/l as Mo)
Molybdenum, Total Recoverable (ug/l as Mo)
Nickel, Dissolved (ug/l as Ni)
Nickel, Total Recoverable (ug/l as Ni)
Nitrogen, Dissolved Ammonia (mg/l as N, mg/l as NH_4)
Nitrogen, Dissolved Nitrate (mg/l as N, mg/l as NO_3)
Nitrogen, Dissolved Nitrate + Nitrite (mg/l as N)
Nitrogen, Total (mg/l as NO_3)
Nitrogen, Total Ammonia (mg/l as N)
Nitrogen, Total Ammonia + Organic (mg/l as N)
Nitrogen, Total Nitrate (mg/l as N, mg/l as NO_3)
Nitrogen, Total Nitrate + Nitrite (mg/l as N)
Nitrogen, Total Nitrite (mg/l as N)
Nitrogen, Total Organic (mg/l as N)
Oxygen, Dissolved (mg/l, percent saturation)
Phosphate, Dissolved Ortho (mg/l as PO_4)
Phosphate, Total (mg/l as PO_4)
Phosphorus, Total (mg/l as P)
Phosphorus, Dissolved (mg/l as P)
Phosphorus, Dissolved Ortho (mg/l as P)
Potassium, Dissolved (mg/l as K)

Selenium, Dissolved (ug/l as Se)
Selenium, Total (ug/l as Se)
Silica, Dissolved (mg/l as SiO_2)
Silver, Dissolved (ug/l as Ag)
Silver, suspended recoverable (ug/l as Ag)
Silver, total recoverable (ug/l as Ag)
Sodium Adsorption Ratio
Sodium, Dissolved (mg/l as Na)
Sodium, Percent
Sodium + Potassium, Dissolved (mg/l as Na)
Strontium, Dissolved (ug/l as Sr)
Sulfate, Dissolved (mg/l as SO_4)
Uranium, Dissolved - Extraction (ug/l)
Uranium, Dissolved - Direct Flourometric (pci/l)
Zinc, Dissolved (ug/l as Zn)
Zinc, Total Recoverable (ug/l as Zn)

Organic Parameters

Aldrin, Total (ug/l)
Aldrin, Total in Bottom Material (ug/kg)
Biochemical Oxygen Demand, Five Day (mg/l)
Chlordane, Total (ug/l)
Chlordane, Total in Bottom Material (ug/kg)
2,4-D, Total (ug/l)
2,4-D, Total in Bottom Material (ug/kg)
DDD, Total (ug/l)
DDD, Total in Bottom Material (ug/kg)
DDE, Total (ug/l)
DDE, Total in Bottom Material (ug/kg)
DDT, Total (ug/l)
DDT, Total in Bottom Material (ug/kg)
Diazinon, Total (ug/l)

Dieldrin, Total (ug/l)
Dieldrin, Total in Bottom Material (ug/kg)
Endosulfan, Total (ug/l)
Endosulfan, Total in Bottom Material (ug/kg)
Endrin, Total (ug/l)
Endrin, Total in Bottom Material (ug/kg)
Ethion, Total (ug/l)
Ethion, Total in Bottom Material (ug/kg)
Heptachlor., Total (ug/l)
Heptachlor., Total in Bottom Material (ug/kg)
Heptachlor., Total Epoxide (ug/l)
Heptachlor., Total Epoxide in Bottom Material (ug/kg)
Lindane, Total (ug/l)
Lindane, Total in Bottom Material (ug/kg)
Malathion, Total (ug/l)
Malathion, Total in Bottom Material (ug/kg)
Mirex, Total (ug/l)
Napthalenes, Total Polychlor (ug/l)
Parathion, Total (ug/l)
Parathion, Total in Bottom Material (ug/kg)
Parathion, Total Methyl (ug/l)
Parathion, Total Methyl in Bottom Material (ug/kg)
PCB, Total (ug/l)
PCB, Total in Bottom Material (ug/kg)
PCN, Total in Bottom Material (ug/kg)
Perthane, Total (ug/l)
Phenols (ug/l)
Silvex, Total (ug/l)
Silvex, Total in Bottom Material (ug/kg)
2, 4, 5 - T, Total (ug/l)
2, 4, 5 - T, Total in Bottom Material (ug/kg)
Toxaphene, Total (ug/l)
Toxaphene, Total in Bottom Material (ug/kg)
Trithion, Total (ug/l)

Trithion, Total in Bottom Material (ug/kg)
Trithion, Total Methyl (ug/l)
Trithion, Total Methyl in Bottom Material (ug/kg)
Vanadium, Dissolved (ug/l as V)

Radioactive Parameters

Alpha, Dissolved Gross (pci/l as U-NAT, ug/l as U-NAT)
Alpha, Total Suspended Gross (pci/l as U-NAT, pci/g as U-NAT, ug/l as U-NAT)
Beta, Dissolved Gross (pci/l as Cs-137, pci/l as Sr/Yt - 90)
Beta, Total Suspended Gross (pci/l as Cs-137, pci/g as Sr/Yt - 90, pci/g as Cs-137)
Radium 226, Dissolved - Random Method (pci/l)

Coliform Bacteria

Coliform, Fecal - 0.45 UM-MF (Cols./100 ml.)
Coliform, Fecal - 0.7 UM-MF (Cols./100 ml.)
Coliform, Streptococci Fecal (Cols./100 ml.)
Coliform, Streptococci Fecal - KF Agar (Cols./100 ml.)
Coliform, Total - Delayed (Cols./100 ml.)
Coliform, Total - Immediate (Cols./100 ml.)

CLIMATE AND WATER QUALITY
PARAMETERS MEASURED BY R&M

Climate Parameters Measured

- Wind Direction
- Wind Speed
- Temperature
- Relative Humidity
- Solar Radiation
- Precipitation
- Peak Wind Gust

Water Quality Parameters Measured

Field:

- Dissolved Oxygen
- pH
- Conductivity
- Temperature
- Carbon Dioxide
- Alkalinity
- Settleable Solids

Laboratory:

- Turbidity
- Total Dissolved Solids
- Total Suspended Solids
- Total Phosphate
- Kjeldahl Nitrogen
- Total Nitrogen
- Nitrate Nitrogen
- Ammonia Nitrogen
- Chemical Oxygen Demand
- Hardness
- Chloride
- Color
- Sulfate
- ICAP Scan(1)
- Uranium
- Radioactivity, Gross Alpha
- Organic Chemicals
- Total Organic Carbon
- Total Inorganic Carbon

(1) ICAP Scan includes:

- Silver
- Aluminum
- Arsenic
- Gold
- Boron
- Barium
- Bismuth
- Calcium
- Cadmium
- Cobalt
- Chromium
- Copper
- Iron
- Mercury
- Potassium
- Magnesium
- Molybdenum
- Sodium
- Nickel
- Manganese
- Phosphorus
- Lead
- Platinum
- Antimony
- Selenium
- Tin
- Strontium
- Titanium
- Vanadium
- Tungsten
- Zinc
- Zirconium

APPENDIX E

MISCELLANEOUS CORRESPONDENCE AND MINUTES OF MEETINGS WITH VARIOUS AGENCIES

R&M CONSULTANTS, INC. 5024 CORDOVA ■ BOX 6087 ■ ANCHORAGE, ALASKA 99502 ■ PH. 907-279-0483 ■ TLX. 090-25360

ENGINEERS
GEOLOGISTS
PLANNERS
SURVEYORS

April 2, 1980

R&M No. 052303

Recd
4/7/80

Acres American, Inc.
The Liberty Bank Building
Main @ Court
Buffalo, N.Y. 14202

Attention: G. Krishnan

Re: Water Quality Program - Meeting with Alaska Department of Conservation

Dear Mr. Krishnan:

On March 28, 1980, a meeting was held with Dave Sturdevant (ADEC) concerning the Susitna Project water quality program. Present were Jim Landman, Larry Pederson and Brent Drage. The meeting addressed the present status of the Susitna Project water quality program and a request by ADEC, that they be kept informed on the Susitna project progress.

Attached is an informal response by ADEC to the Water Quality Program as outlined in the P.O.S. We explained that the Water Quality Program is currently under revision and once it is finalized we would send ADEC a copy. After describing our program and quality control procedures, he appeared to be satisfied. We are entering him on our Data Index Distribution mailing list so that ADEC will be kept abreast of our progress.

Very truly yours,

R&M CONSULTANTS, INC.

Brent T. Drage, P.E.
Susitna Project Coordinator

BTD/dj/L3-N

02-0018 (Rev 10/76)

STATE
of ALASKA

MEMORANDUM

TO: Dave Sturdevant
Management & Technical Assistance

DATE: March 14, 1980

FILE NO:

TELEPHONE NO:

FROM: Jeff Hock
EQM&LO

SUBJECT: Comments - Acres POS
Susitna Hydro Development

The following comprise a summation of comments regarding the water quality section of Acres American plan of study (POS) for Phase I Feasibility Studies of the Susitna Hydroelectric Project.

1. The POS recognizes the inter-relationship between water quantity and water quality.

2. Definitions of summer and winter should be more clearly defined, utilizing break-up and freeze-up as transition boundaries.

3. USGS will monitor temperature on a continuous basis. This will be essential for permit and certification purposes. An understanding of natural temperature variation will be valuable.

4. Due to the glacial origin of the Susitna River, turbidity should be monitored on more frequent intervals through the summer months, including data at peak flow periods.

5. Field instrumentation should be clearly established, including models and degree of precision expected for each parameter. Methodology for each parameter should be established and clearly referenced. It should be EPA approved or meet specification guidelines.

6. In order to assure accurate and reliable data, Acres should include an outline of their quality control program for each parameter to be monitored. How often will the instrument be calibrated? What approach will be taken with regard to standard and reference materials? Each parameter should institute some plan for quality control over the results.

7. Methodology utilized in the collection and transport of samples from the sampling point to the location for analysis should be clearly defined, including sample container preparation.

8. It is unclear as to what is meant by total nitrogen on pg. 5-56. Nitrate (NO_3) and nitrite (NO_2) nitrogen would be more valuable for monitoring productivity. It is the soluble, inorganic nitrate (NO_3) nitrogen that is utilized by the aquatic primary producers. Total kjeldahl nitrogen will monitor the degree of organic decomposition present.

9. It would be valuable to acquire background data regarding nitrogen gas. Nitrogen supersaturation is a problem associated with large scale dams. The potential has been addressed in the POS, through engineering design considerations.

10. Methodology for total dissolved and suspended solids should be defined, referred to in Standard Methods (14th ed.) as total filterable and non-filterable residues. Exceedingly high residue levels can produce interference in filtration, and drying.

11. The type of trace metals to be analyzed should be specified, including methodology, equipment and degree of precision.

12. A biological inventory should be established through coordination with respective resource agencies, so ADEC can determine what species and life stages are most biologically important and sensitive.

DEPARTMENT OF FISH AND GAME

FILE: PS700.11.70

333 RASPBERRY ROAD
ANCHORAGE, ALASKA 99502

cc. Brent Vrana (R&M)

[redacted]

JUN
4 Feb 80
R2R.097

RECEIVED

January 31, 1980

Mr. Edward Reed
Terrestrial Environmental Specialists Inc.
R.D. 1, Box 388
Phoenix, New York 13135

Dear Ed:

We reviewed the hydrology section of the original Acres P.O.S. to determine if the planned climatological monitoring efforts would be adequate for big game studies. We concluded that additional stations will be necessary. The enclosed map indicates approximate locations we recommend. We suggest use of the standard Soil Conservation Service snow course and recommend that snow courses be run at all climatological stations.

I suggest that other projects, particularly furbearers, may have additional needs. A coordinated approach would be most efficient. We would appreciate it if you would have the hydrologists review our proposal along with others. We are willing to modify our request somewhat if necessary and will participate in some of the field activities such as setting up stations and at least some data gathering.

We will also need more snow data downstream, but want to wait until we have identified potential sites for detailed vegetation studies. These sites will probably be more accessible than those upstream and less expensive to operate.

We had a good meeting with Jay after we left Fairbanks. It will take a while to work everything out and we still aren't sure if it will be possible to do all that we would like. However, I think we agreed on how to approach things and established a good air of cooperation. Next time we put the squeeze on you we will probably be a joint Alaska Department of Fish and Game - University of Alaska effort.

The enclosed schedule is preliminary and just deals with major field activities. We will refine it as we go along and supplement it in our monthly reports.

Sincerely,

Karl

Karl Schneider
Research Coordinator
Division of Game

KTLM

Received Acres Anchorage
2/13/80 — 12:00 pm.

N

ANCHORAGE-FAIRBANKS HWY.

ALASKA R.R.

CHULITNA RIVER

TALKEETNA RIVER

PORTAGE CREEK

DEVIL CREEK

TSUSENA CREEK

DEADMAN CR.

BUTTE CR.

WEST FORK

EAST FORK

VALDEZ CR.

WINDY CR.

2910

2912

DENALI

WATANA CREEK

COAL CR.

MacLAREN RIVER

OLSON

DEVIL CANYON

HIGH D.C.

WATANA

FOG CR.

SUSITNA RIVER

JOY CR.

2920

2927

KOSINA CR.

VEE

2915

TYONE RIVER

TYONE LAKE

SUSITNE LAKE

OSHETNA RIVER

LAKE LOUISE

0 10 20
MILES

PROPOSED DAMSITES

EXISTING STATIONS
- U.S.G.S. GAGING STATION
- SNOW COURSE

PROPOSED STATIONS
- SNOW COURSE
- STREAMFLOW GAGING
- WATER LEVEL
- SEDIMENT DISCHARGE
- WATER QUALITY
- SNOW COURSE REQUESTED BY ADF&G

ACRES

SUSITNA HYDROELECTRIC PROJECT

PROPOSED DATA COLLECTION STATIONS IN THE SUSITNA BASIN-1980

MINUTES OF MEETING
held at the offices of
USGS, Anchorage, Alaska
on Friday, February 7, 1980.

February 11, 1980
P5700.14.07
P5700.14.03

PRESENT:

Mr. Don Baxter	APA (Project Engineer
Mr. Brent Drage	R&M Consultants
Mr. Ian Hutchison	AAI Consultants
Mr. Tom Trent	ADF&G
Mr. Richmond Brown	USGS (Associate District Chief)
Mr. Bob Madison	USGS
Mr. Bob Lamke	USGS
Mr. Bill Long	AK. DGGS
Mr. George Clagett	Soil Conservation Service
Mr. Larry Leveen	USGS
Mr. Harry Hulsing	USGS (AK. District Chief)
Mr. Brent Petree	AK. DNR

1. Presentation of Meeting Agenda (Don Baxter, APA)

   1.1 Attachment 1 lists Agenda

2. Rules of USGS Participation in Hydrologic Data Collection Programs (Harry Hulsing, USGS)

   2.1 USGS can only cooperate with State or other government agencies (i.e., not private consultants)

   2.2 Constraints: USGS basic responsibility is regional assessment if water resources (i.e. not site specific work.) They must satisfy this responsibility in any cooperative program.

   2.3 The State G and GS (Geologic and Geophysical Survey) is the designated agency for cooperative long term programs.

   2.4 Currently USGS only has sole Federal funding to operate approximately 30 gaging stations in Alaska. The rest of the stations are run as cooperative programs.

   2.5 In presenting new cooperative programs for funding the need for the information must be emphasized.

3. Current USGS Program in The Susitna Basin

   3.1 Summary sheet was tabled by USGS. See attachment 3

4. Outline Of The Hydrologic Data Collection Program Contained in the Acres POS (Brent Drage, R&M - see attachment 2.) General comments by the USGS was as follows:

   4.1 Vee Site Gage (Cantwell) - could be of interest to USGS only if we ensured it was not drowned out by reservoir at Watana.

4.2 Watana/Devil Canyon Sites - site specific, of no interest to USGS. They did not feel discharge would be required at Devil Canyon.

4.3 Maclaren at Paxson - USGS interested but would perhaps consider relocating further downstream at some future date.

4.4 Susitna at Denali - Bad gaging site. Not of major interest.

4.5 USGS are interested in gaging other tributaries such as the Tyone river.

4.6 USGS amenable to go along with temporary locations for first part of program and to relocate to permanent sites at a later stage.

4.7 Sediment gaging - No need to collect sediment data the way it has been done in the past, i.e. more or less random sampling. This has led to most data points being on the recession limb of the hydrographs and therefore not ideal for defining the sediment: discharge curve. Event type data collection is required to improve the current sediment: discharge curve, (i.e. intense monitoring during a range of storm or major runoff events.)

4.8 Water quality - In general same comments as above. There is no need for extensive in-organic water quality data collection. They believe it would require a large expenditure to achieve more comprehensive information on nutrients and suggest programs be geared to study particular problems; e.g.
DO - Critically low in late winter, may be problem downstream from reservoirs.
Fe - Reducing environment created under ice cover due to Fe in solution; once ice disappears Fe goes back into bottom sediments.

5. <u>USGS Participation in Proposed Hydrologic Data Collection Program</u>

5.1 USGS sees problems in obtaining additional funding for cooperative programs.

5.2 Attachment 4 was produced jointly at the meeting and lists all potential gaging sites and indicates which of these the USGS has no interest in.

5.3 USGS indicated they would review this table and respond in writing to APA outlining which of the remaining stations they could service as part of a cooperative program and what funds would be required.

5.4 Note: Attachment 4 also includes the three "Southern Tributaries"; i.e., the Deception and Willow Creeks and the Deshka River. It was agreed that these would be treated seperately under the auspices of the environmental task. (Task 7 in the POS)

5.5 Any cooperative program should be finalized as soon as possible so that it can be submitted for funding.

6. SCS Participation in Hydrologic Data Collection Program

6.1 George Clagett informed the meeting that U.S. Corps funding of the existing course stations in the basin had been withdrawn. No February 1, 1980 survey was undertaken.

6.2 To reinstate and complete this winter's program SCS would require approximately $3000 and the support would have to be finalized before the end of next week (i.e. Friday, February 15, 1980.)

6.3 George Clagett agreed to send a letter to APA indicating what the requirements of the SCS are to: 1) complete this winter's program, 2) expand this winter's program to include the proposed additional stations mentioned in the Acres POS. (confirmed in subsequent telephone conversation between R&M and SCS, 2/8/1980.

7. DNR Participation in Hydrologic Data Collection Program

This matter was not pursued because of lack of time.

Reported by _____
I. Hutchison

IH/ja

cc: B. Drage
D. Baxter
File

SUSITNA HYDROLOGIC

DATA COLLECTION

AGENDA

1. Introduction

   Don Baxter - Alaska Power Authority
   Brent Drage - R&M Consultants

2. Hydrologic Data Collection Program as envisaged December, 1979.

   - Streamflow
   - Sediment
   - Chemical Water Quality
   - Snow Surveys

3. Summary of U.S.G.S., S.C.S. and D.N.R. comments.

4. Participation by U.S.G.S., S.C.S. and D.N.R.

   - Installation
   - Monitoring
   - Equipment and Supplys
   - Schedule

SUSITNA HYDROELECTRIC PROJECT

HYDROLOGIC DATA COLLECTION STATIONS

Stream Gaging Stations

*	Susitna Near Denali	15291000
*	Maclaren Near Paxon	15291200
	Susitna at Vee	
	Susitna at Watana	
	Susitna at Devil Canyon	
*	Susitna at Gold Creek	15292000
	Chulitna near Talkeetna	
*	Talkeetna at Talkeetna	15292700
	Susitna near Parks Highway Bridge	
	Yentna near Susitna Station	
*	Susitna at Susitna Station	15294350

Sediment Gaging Stations

*	Susitna near Denali
	Maclaren near Paxon
	Susitna at Vee
*	Susitna at Gold Creek
	Chulitna near Talkeetna
*	Talkeetna at Talkeetna
*	Susitna near Susitna Station

Chemical Water Quality Stations

	Susitna at Vee
	Susitna at Watana
	Susitna at Devil Canyon
*	Susitna at Gold Creek
*	Talkeetna near Talkeetna
*	Susitna near Susitna Station

*Data Currently Being Collected by U.S.G.S.

Generalized Index of Data Collected at Gaging Stations and Crest-stage Stations by U.S. Geological Survey in Susitna Basin

STATION IDENTIFICATION	NAME	LOCATION Latitude	Longitude	DRAINAGE AREA (mi^2)	DAILY DISCHARGE Period	Years	DAILY SEASONAL TEMPERATURE Period	Years	CREST-STAGE	CHEMICAL	SEDIMENT	STATUS	AVERAGE DISCHARGE (ft^3/s)
15291000	Susitna R nr Denali	63°06'14"	147°30'57"	a 950	1957-66 68-	19	1974-	5	---	1957-61, 68, 76	1955-66. 68; 74-	Active	2,707
15291100	Raft C nr Denali	63°03'04"	147°16'22"	4.33					1963-	1972		Active	
15291200	MacLaren R nr Paxson	63°07'10"	146°31'45"	280	1958-	20				1958-61; 67-68. 75	1958-68. 74-75	Active	980
15291500	Susitna R nr Cantwell	62°41'57"	147°32'40"	4,140	1961-72	11				1967-70	1962-72	Disc.	6,295
15292000	Susitna R at Gold Creek	62°46'04"	149°41'28"	6,160	1949-	29	1957, 74-	6		1949. 50-53*; 54-55-57*; 57. 67-68. 75, 77	1952*; 53-56. 57*; 62, 67, 77-	Active	9,616
15292400	Chulitna R nr Talkeetna	62°33'31"	150°14'02"	2,570	1958-72	14			1973-77	1958-59, 67-68, 70	1967-72	Disc.	8,748
15292700	Talkeetna R nr Talkeetna	62°20'49"	150°01'01"	3,006	1964-	14	1954	1		1954*; 1967-	1966	Active	4,000
15292800	Montana C nr Montana	62°06'32"	150°03'12"	164					1963-72	1971-72	1970-71; 73	Disc.	
15292900	Goose C nr Montana	62°03'42"	150°03'20"	14.5					1963-71			Disc.	
15293000	Caswell C nr Caswell	61°56'55"	150°03'14"	19.6					1963-	1971-72		Active	
15294005	Willow C nr Willow	61°46'49"	149°52'44"	166	1978-	---				1978		Active	---
15294010	Deception C nr Willow	61°44'52"	149°55'59"	48	1978-	---						Active	---
15294100	Deska R nr Willow	61°46'05"	150°20'16"	592	1978-	---						Active	---
15294300	Skwentna R nr Skwentna	61°52'23"	151°22'01"	2,250	1959-	19				1959.61. 67-68	1967-68. 74-75	Active	6,373
15294350	Susitna R at Susitna Station	61°32'41"	150°30'45"	19,400	1974-	4	1975-			1955. 70 73-	1975-	Active	est 47,000

NOTE: Years of record are through 1978.

1 - VITAL

STATE (APA) PRIORITIES. 2 - DESIRABLE 3 - USEFULL.

PRIORITY	STATION	DRAINAGE AREA MILE²	MAF CFS	OBJECTIVES	PARAMETERS	PARTICIPATION
1	DENALI (SUSITNA)			SHORT: Study/design input LONG: Reservoir operation	CURRENT: Q, S, (random) T (continuous, Summer) PROPOSED: Q, S (event related), Bed Material, T as before	CURRENT: USCORPS/USGS till Sept30/80 FUTURE: ?
1	PAXSON (MACLAREN)			SHORT: as above LONG: ? as above (possible relocation)	CURENT: Q PROPOSED: Q, S (event related) Bed Material	CURRENT: as above FUTURE: ?
2	MOUTH (TYONE)			SHORT: as above LONG: ? (note: research application)	CURRENT: – PROPOSED: Q, LQ, limited S	CURRENT: NONE FUTURE: ?
3	MOUTH (OSHETNA)			SHORT: as above LONG: ? Reservoir operation	CURRENT: – PROPOSED: Q, Limited S	CURRENT: NONE FUTURE: ?
1	VEE (SUSITNA)			SHORT: as above LONG: inflow station reservoir management	CURRENT: – PROPOSED: Q, LQ, S, T (Event oriented)	CURRENT: NONE FUTURE: APA AND.....
1	WHITANA (SUSITNA)			SHORT: as above LONG: none	CURRENT: – PROPOSED: - Q, LQ, S (event)	CURRENT: NONE FUTURE: APA ONLY
1	DEVIL CANYON (SUSITNA)			SHORT: as above LONG: none	CURRENT: – PROPOSED: stage, occasional Q	CURRENT: NONE FUTURE: APA. ONLY
1	GOLD CREEK (SUSITNA)			SHORT: as above LONG: ? project performance monitoring (environmental)	CURRENT: Q, S, T, WQ PROPOSED: ditto	CURRENT: USCORPS/USGS till Sept 30/80 FUTURE:
1 SHORT 2 LONG	BRIDGE (CHULITNA) (NEAR TALKEETNA)			SHORT: as above LONG: ?	CURRENT: ~~Q, S, T~~ None PROPOSED: ~~ditto~~ Q, S, T.	CURRENT: NONE. FUTURE: APA AND.....
2	PARKS HWY (SUSITNA)			SHORT: as above LONG: ?	C: ~~Q, S, T~~ None P: Q, S, WQ?	C: NONE F: APA AND.....
1	MOUTH (YENTNA)			SHORT: as above LONG: ? monitoring future sources	C: Q None P: Q, S?	C: NONE F: APA AND..... (Sediment ??)
1	SUSITNA STATION (SOSITNA)			SHORT: as above LONG: ! monitoring future sources	C: Q, S, T, WQ P: -"-	C: USCORPS/USGS till Sept 30/80 F: ?
1	TALKEETNA (TALKEETNA)			SHORT: as above LONG: ~~monitoring future flows~~	C: Q, S, WQ P: -"-	C: USGS. F: USGS.

general: S should be event oriented

EASTERN TRIBUTARIES — ENVIRONMENTAL.

PRIORITY	STATION	DRAINAGE AREA MI²	MAF CFS	OBJECTIVES	PARAMETERS	PARTICIPATION.
	DECEPTION			SHORT: upstream flow/baseline conditions; LONG: project monitoring	CURRENT: None PROPOSED: ?	FUTURE: USGS support at least one gage in conjunction with ??!
	WILLOW					
	DESHKA					
					ACTION TO BE INITIATED BY ENVIRONMENTAL GROUP. !	

APPENDIX F

MONTHLY STREAMFLOW DATA FOR ALTERNATIVE HYDRO SITES

SNOW DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	664.	343.	241.	74.	58.	42.	78.	349.	2702.	343.	0.	0.
2	323.	138.	51.	31.	25.	31.	46.	257.	1665.	2904.	2009.	2200.
3	243.	308.	162.	58.	39.	37.	40.	182.	2709.	3101.	3258.	1762.
4	189.	63.	38.	31.	26.	25.	49.	241.	1447.	3385.	2047.	3030.
5	160.	98.	59.	36.	32.	30.	27.	94.	1463.	3512.	2146.	801.
6	1125.	544.	176.	93.	66.	47.	119.	1192.	5016.	4329.	3269.	1370.
7	1009.	129.	70.	52.	40.	34.	51.	505.	2275.	2503.	2472.	716.
8	299.	257.	106.	65.	40.	32.	36.	193.	1324.	4350.	2436.	1310.
9	148.	70.	43.	40.	34.	31.	52.	264.	1044.	2901.	3194.	776.
10	115.	99.	93.	46.	41.	44.	67.	318.	2850.	2337.	2449.	3451.
11	828.	323.	107.	83.	51.	40.	136.	368.	3285.	2990.	2814.	299.
12	186.	117.	73.	48.	37.	33.	77.	708.	3397.	2443.	2028.	275.
13	229.	162.	98.	63.	57.	42.	56.	1843.	2692.	3317.	2289.	822.
14	237.	164.	199.	256.	108.	52.	66.	930.	2901.	3710.	2792.	1575.
15	221.	128.	60.	49.	38.	29.	91.	224.	2316.	2987.	1847.	372.
16	314.	269.	93.	55.	53.	60.	49.	285.	1480.	3443.	2215.	1447.
17	272.	103.	116.	78.	56.	39.	134.	216.	3628.	2939.	2962.	1575.
18	269.	177.	120.	94.	52.	71.	135.	220.	1578.	3018.	2283.	1575.
19	247.	87.	68.	55.	39.	39.	66.	207.	2692.	2978.	3373.	3097.
20	444.	164.	74.	47.	43.	39.	48.	289.	2285.	2572.	3020.	4829.
21	314.	147.	112.	84.	78.	100.	59.	689.	2057.	2727.	2132.	422.
22	136.	106.	52.	31.	38.	39.	83.	486.	3545.	2829.	893.	399.
23	3734.	277.	267.	121.	119.	105.	94.	314.	1891.	2787.	2498.	532.
24	145.	698.	102.	49.	41.	40.	43.	189.	2451.	4265.	3833.	1360.
25	265.	94.	59.	35.	27.	31.	29.	163.	982.	2794.	2582.	1382.
26	231.	103.	63.	430.	35.	35.	53.	291.	1449.	2565.	1756.	677.
27	148.	73.	57.	43.	35.	33.	67.	67.	2125.	2518.	1521.	4180.

BRUSKASNA DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	503.	211.	188.	179.	151.	142.	213.	2016.	2286.	1782.	1712.	2539.
2	697.	466.	338.	229.	174.	146.	160.	719.	3400.	2674.	1781.	1468.
3	1049.	439.	465.	119.	101.	128.	201.	1318.	3134.	1771.	1915.	2096.
4	636.	256.	211.	183.	152.	119.	137.	1197.	2203.	1928.	2413.	1498.
5	688.	417.	191.	183.	183.	174.	146.	1540.	3874.	2963.	2624.	1991.
6	717.	334.	289.	192.	174.	146.	151.	1992.	4116.	2677.	2618.	1776.
7	854.	413.	283.	206.	187.	179.	209.	1872.	3969.	2835.	2464.	1829.
8	804.	389.	266.	193.	176.	168.	197.	1762.	3736.	2669.	2319.	1721.
9	615.	330.	202.	178.	151.	114.	146.	1946.	2733.	2645.	2048.	1417.
10	831.	480.	314.	286.	234.	210.	196.	2476.	1329.	1945.	2306.	2245.
11	766.	288.	266.	244.	177.	181.	268.	2395.	3082.	2480.	2636.	1566.
12	881.	468.	308.	260.	200.	179.	206.	1866.	4451.	2787.	2081.	2211.
13	853.	442.	256.	210.	192.	174.	192.	1647.	3651.	3507.	2827.	1332.
14	946.	371.	165.	174.	137.	119.	174.	285.	3802.	2820.	1711.	1147.
15	935.	411.	248.	176.	146.	146.	230.	2009.	3751.	3180.	1583.	2106.
16	1016.	412.	247.	197.	174.	165.	183.	1199.	4799.	1881.	2210.	1660.
17	712.	239.	204.	179.	164.	151.	151.	1603.	3291.	1896.	3064.	1403.
18	738.	436.	307.	256.	220.	199.	192.	1906.	4649.	2282.	1190.	746.
19	416.	130.	85.	75.	73.	76.	164.	1807.	2063.	1160.	824.	600.
20	417.	241.	188.	167.	160.	156.	168.	1521.	2447.	3130.	2293.	1261.
21	611.	246.	181.	158.	153.	146.	139.	751.	5969.	2567.	2917.	1618.
22	807.	451.	282.	158.	146.	146.	149.	1780.	3281.	2013.	1515.	1140.
23	729.	365.	246.	210.	197.	187.	188.	1698.	3068.	1891.	2035.	1061.

KEETNA DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	1115.	1568.	1110.	720.	620.	540.	580.	3474.	11090.	12180.	11150.	10610.
2	4438.	1460.	876.	711.	526.	395.	422.	2410.	12970.	10100.	10730.	5370.
3	2388.	897.	750.	637.	546.	471.	427.	4112.	9286.	12600.	14160.	6971.
4	2029.	1253.	987.	851.	777.	743.	983.	8840.	14100.	11230.	7546.	4120.
5	1637.	827.	556.	459.	401.	380.	519.	3869.	5207.	7080.	3787.	2070.
6	1450.	765.	587.	504.	458.	440.	545.	3950.	7979.	10320.	8752.	5993.
7	2817.	1647.	1103.	679.	459.	402.	503.	2145.	19040.	11760.	16770.	5990.
8	2632.	1310.	545.	727.	628.	481.	518.	3516.	12700.	12030.	9570.	8709.
9	3630.	1370.	889.	748.	654.	574.	571.	3860.	12210.	7676.	9927.	3861.
10	1807.	960.	745.	645.	559.	482.	535.	5678.	8030.	7755.	7704.	4763.
11	1976.	1002.	774.	694.	586.	508.	522.	4084.	13180.	12070.	8487.	7960.
12	2884.	773.	558.	524.	480.	470.	613.	3439.	10580.	9126.	8088.	3205.
13	1857.	1105.	1069.	700.	549.	506.	548.	4244.	18280.	9344.	8055.	5963.
14	3268.	1121.	860.	746.	576.	485.	534.	2950.	7429.	10790.	7001.	5367.

BROWNE DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	1894.	794.	707.	673.	569.	535.	804.	7598.	8616.	6715.	6453.	9569.
2	2626.	1756.	1273.	863.	656.	552.	604.	2709.	12816.	10080.	6712.	5535.
3	3955.	1656.	1001.	449.	380.	483.	759.	4969.	11812.	6674.	7219.	7906.
4	2398.	966.	794.	690.	573.	449.	518.	4510.	8302.	2767.	9096.	5645.
5	2591.	1570.	721.	690.	690.	656.	552.	5804.	14603.	11166.	9890.	7505.
6	2702.	1260.	863.	725.	656.	552.	569.	7509.	15514.	10090.	9869.	6694.
7	3218.	1556.	1064.	773.	703.	673.	787.	7047.	14943.	10674.	9276.	6885.
8	3084.	1491.	1020.	742.	674.	645.	754.	6754.	14320.	10229.	8890.	6598.
9	2319.	1242.	763.	669.	569.	431.	552.	7336.	10300.	9969.	7719.	5342.
10	3133.	1808.	1184.	1077.	883.	790.	738.	9334.	5007.	7329.	8692.	8416.
11	2888.	1052.	1004.	918.	666.	683.	1011.	9027.	11619.	9348.	9935.	5904.
12	3320.	1763.	1159.	980.	756.	673.	814.	7033.	16777.	10504.	7843.	8333.
13	3216.	1667.	966.	794.	725.	656.	725.	9659.	13761.	13220.	10656.	5021.
14	3565.	1398.	621.	656.	518.	449.	656.	1073.	14331.	10628.	6449.	4324.
15	3523.	1549.	935.	663.	552.	552.	282.	7571.	14138.	11988.	5966.	7937.
16	3830.	1553.	932.	725.	656.	621.	690.	4520.	18088.	7091.	8330.	6329.
17	2685.	901.	770.	676.	618.	569.	569.	6042.	12409.	10915.	11550.	5290.
18	2781.	1643.	1156.	956.	828.	749.	725.	7184.	19523.	8603.	4486.	2812.
19	1567.	490.	321.	284.	276.	285.	618.	6812.	7774.	4372.	3106.	2260.
20	1570.	908.	707.	631.	604.	587.	635.	5732.	7224.	11798.	8644.	4752.
21	2302.	928.	683.	597.	576.	552.	525.	2830.	22499.	9676.	10994.	6097.
22	3040.	1701.	1063.	597.	552.	552.	562.	6708.	12367.	7588.	5711.	4296.
23	2747.	1377.	928.	790.	742.	704.	707.	6401.	11563.	7129.	7671.	3999.

TALKEETNA 2 DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	472.	664.	470.	305.	263.	229.	246.	1472.	4699.	5161.	4725.	4496.
2	1881.	619.	371.	301.	223.	167.	179.	1021.	5496.	2480.	4547.	2275.
3	1021.	380.	218.	270.	231.	200.	181.	1742.	3935.	5339.	6000.	2454.
4	860.	533.	418.	361.	329.	315.	417.	3746.	5975.	4758.	3197.	1746.
5	694.	350.	236.	194.	170.	161.	220.	1639.	2206.	3000.	1605.	877.
6	614.	324.	249.	214.	194.	186.	231.	1674.	3381.	2725.	3708.	2539.
7	1194.	698.	467.	288.	194.	170.	213.	909.	8068.	4983.	7106.	2538.
8	1115.	555.	231.	308.	266.	204.	219.	1490.	5381.	5097.	4055.	3690.
9	1538.	581.	377.	317.	277.	243.	242.	1636.	5174.	3253.	4206.	1636.
10	766.	407.	316.	273.	237.	204.	227.	2406.	3403.	3286.	3264.	2018.
11	837.	425.	328.	294.	248.	215.	221.	1731.	5585.	5114.	3596.	3373.
12	1222.	328.	236.	222.	203.	199.	260.	1457.	4483.	3925.	3427.	1358.
13	787.	468.	453.	297.	233.	214.	232.	1798.	7746.	3959.	3392.	2527.
14	1385.	475.	364.	316.	244.	206.	226.	1250.	3148.	4572.	2967.	2274.

HICKS DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	1791.	774.	399.	237.	146.	146.	180.	939.	3824.	5193.	5124.	2597.
2	1016.	410.	312.	270.	248.	259.	259.	919.	2583.	6016.	4392.	5788.
3	1617.	655.	291.	205.	173.	162.	151.	535.	2545.	5296.	4991.	2073.
4	1917.	983.	766.	540.	432.	281.	270.	1098.	6138.	7633.	5969.	2797.
5	964.	448.	281.	216.	173.	140.	137.	1193.	3633.	4477.	6225.	2949.
6	964.	601.	218.	312.	237.	205.	119.	286.	2166.	5824.	4194.	2533.
7	783.	245.	211.	173.	162.	173.	259.	1033.	3447.	5851.	5540.	2381.
8	1128.	446.	413.	271.	189.	275.	281.	1351.	6414.	5579.	4904.	5684.
9	2255.	1165.	530.	393.	282.	248.	241.	949.	5344.	5442.	4860.	2032.
10	893.	565.	232.	173.	178.	182.	151.	1114.	5524.	5841.	4450.	1885.
11	1287.	696.	490.	328.	259.	254.	259.	1675.	4056.	5038.	5105.	3971.
12	1629.	578.	386.	349.	293.	243.	232.	1135.	3404.	4728.	5050.	3436.
13	1245.	626.	356.	270.	248.	237.	281.	717.	4601.	6103.	5047.	2652.
14	1144.	501.	378.	356.	345.	323.	313.	1024.	2485.	6148.	5549.	3160.
15	1319.	446.	399.	389.	345.	248.	238.	372.	5140.	5480.	4752.	2467.
16	990.	491.	399.	324.	291.	248.	216.	569.	2245.	4652.	3766.	3103.
17	1417.	518.	335.	227.	184.	205.	259.	553.	4094.	5172.	4108.	2403.

CHAKACHAMNA DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	2022.	992.	658.	504.	381.	325.	250.	1483.	6368.	10500.	10300.	4364.
2	1800.	1116.	882.	817.	780.	544.	394.	876.	5673.	12090.	12330.	6989.
3	2638.	1200.	730.	690.	630.	540.	470.	620.	5222.	13000.	12285.	5317.
4	1827.	1144.	744.	553.	387.	361.	332.	748.	3441.	12640.	12240.	7739.
5	2768.	1384.	1007.	618.	436.	434.	370.	471.	6278.	10590.	12030.	5654.
6	2026.	1090.	852.	620.	449.	360.	350.	525.	2114.	10020.	13180.	10260.
7	4027.	1180.	650.	480.	400.	350.	350.	615.	5995.	10040.	10310.	7142.
8	3790.	1100.	820.	600.	500.	430.	380.	935.	6616.	14380.	16610.	7333.
9	2939.	1565.	947.	626.	535.	490.	511.	1695.	6190.	12580.	12170.	4369.
10	1552.	939.	823.	639.	550.	500.	533.	1003.	6548.	13100.	8416.	3347.
11	3098.	1822.	1006.	705.	568.	550.	625.	1285.	4893.	9960.	8884.	3687.
12	2201.	1247.	829.	532.	467.	467.	692.	2381.	10930.	14470.	13710.	4513.
13	1351.	902.	726.	585.	484.	446.	481.	906.	4294.	12860.	12750.	6995.

STRANDLINE LAKE DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	97.	48.	32.	24.	18.	16.	12.	72.	307.	506.	497.	210.
2	87.	54.	43.	39.	38.	26.	19.	42.	274.	583.	594.	337.
3	127.	58.	35.	33.	30.	26.	23.	30.	252.	627.	592.	256.
4	88.	55.	36.	27.	19.	17.	16.	36.	166.	609.	590.	373.
5	133.	67.	49.	30.	21.	20.	18.	23.	303.	511.	580.	273.
6	98.	53.	41.	30.	22.	17.	17.	25.	102.	48.	0.	0.
7	194.	57.	31.	23.	19.	17.	17.	30.	289.	484.	497.	344.
8	183.	53.	40.	29.	24.	21.	18.	45.	319.	693.	801.	354.
9	142.	75.	46.	30.	26.	24.	25.	82.	298.	607.	587.	211.
10	75.	45.	35.	31.	27.	24.	26.	48.	316.	632.	406.	161.
11	149.	88.	49.	34.	27.	27.	30.	62.	236.	480.	428.	178.
12	106.	60.	40.	26.	23.	23.	33.	115.	527.	698.	806.	218.
13	65.	43.	35.	28.	23.	22.	23.	44.	207.	620.	615.	337.

ALLISON CREEK DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	17.	16.	1.	0.	0.	0.	0.	0.	19.	131.	210.	92.
2	16.	4.	3.	2.	1.	0.	0.	2.	48.	222.	258.	90.
3	19.	3.	1.	1.	1.	0.	0.	6.	62.	184.	123.	95.
4	9.	3.	2.	1.	1.	1.	1.	4.	104.	201.	229.	210.
5	8.	2.	2.	1.	1.	1.	1.	8.	66.	163.	196.	102.
6	31.	2.	2.	1.	1.	1.	1.	2.	58.	215.	222.	134.
7	24.	5.	2.	1.	1.	1.	1.	5.	91.	218.	257.	94.
8	34.	4.	2.	1.	1.	1.	1.	4.	56.	147.	200.	162.
9	57.	1.	2.	1.	1.	1.	1.	1.	82.	130.	178.	124.
10	46.	4.	1.	1.	1.	1.	1.	3.	63.	120.	130.	189.
11	61.	8.	1.	1.	0.	0.	1.	6.	99.	118.	241.	221.
12	52.	1.	1.	1.	0.	0.	1.	21.	91.	128.	170.	220.
13	13.	17.	3.	1.	1.	2.	1.	30.	69.	116.	133.	45.
14	19.	1.	1.	1.	1.	1.	1.	30.	190.	170.	110.	82.
15	252.	15.	19.	2.	2.	2.	2.	33.	90.	143.	154.	86.

(P570006) CASHE DAMSITE

STREAMFLOW (CFS)

YEAR	OCT (31)	NOV (30)	DEC (31)	JAN (31)	FEB (28)	MAR (31)	APR (30)	MAY (31)	JUN (30)	JUL (31)	AUG (31)	SEP (30)
1	321.	452.	320.	207.	179.	156.	167.	1001.	3195.	3509.	3213.	3057.
2	1279.	421.	252.	205.	152.	114.	122.	694.	3737.	2910.	3092.	1547.
3	688.	258.	216.	184.	157.	136.	123.	1185.	2676.	3631.	4080.	2009.
4	585.	362.	284.	245.	224.	214.	283.	2547.	4036.	3236.	2174.	1187.
5	612.	309.	208.	172.	150.	142.	194.	1447.	1947.	2647.	1416.	774.
6	542.	286.	219.	188.	171.	165.	204.	1477.	2983.	1019.	3272.	2241.
7	1053.	616.	412.	254.	173.	150.	188.	802.	7119.	4397.	6270.	2240.
8	984.	490.	204.	272.	235.	180.	194.	1315.	4748.	4498.	3578.	3256.
9	1357.	512.	332.	280.	245.	215.	213.	1443.	4565.	2870.	3711.	1444.
10	676.	359.	279.	241.	209.	180.	200.	2123.	3002.	2899.	2280.	1781.
11	739.	375.	289.	259.	219.	190.	195.	1527.	4928.	4513.	3173.	2976.
12	1078.	289.	209.	196.	179.	176.	229.	1256.	3956.	3375.	3024.	1198.
13	694.	413.	400.	262.	205.	189.	205.	1587.	6834.	3494.	2993.	2229.
14	1222.	419.	322.	279.	215.	181.	200.	1103.	2777.	4034.	2618.	2007.

APPENDIX G

CLIMATE DATA STATIONS (3)

CLIMATIC STATIONS IN THE SUSITNA BASIN

Index Number	Station Name	Measured By	Report[1] Available	Period of Record
0610	Susitna Glacier	R&M	-	7/20 - 8/7/80 8/7 - 8/14/80 8/28 - Present
0618	Gracious House	NOAA	B	1959 - 1978
0620	Denali	R&M	-	7/18 - 8/28/80 8/28 - ? 10/17 - Present
0630	Tyone R.	R&M	-	8/27 - 8/30/80 10/17 - Present
0640	Kosina Cr.	R&M	-	8/25 - Present
0650	Watana	R&M		4/8 - 6/10/80 6/19 - 7/30 8/14 - 10/2 10/17 - Present
0660	Devils Canyon	R&M	-	7/17 - 8/28/80 10/16 - Present
0670	McKinley Park	NOAA	B	1949 - Present
0671	Healy 2	NOAA	B	1972 - Present*
0672	Healy Power Plant I	NOAA	-	Miscellaneous Wind Data*
0673	Healy Power Plant II	NOAA	-	Miscellaneous Wind Data*
0674	Rapids	NOAA	-	Miscellaneous Wind Data*
0675	Big Delta	NOAA	A	1949 - Present*
0676	Paxson	NOAA	A	1922 - Present

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[1] NOAA Reports Available:

A Annual Summary with Comparative Data (see Ref. 11)

B - Annual Climatologic Summary (see Ref. 11)

* Miscellaneous Wind Data

Index Number	Station Name	Measured By	Report[1] Available	Period of Record
0677	Gulkana	NOAA	A	1949 - Present*
0678	Summit	NOAA	A	1946 - Present*
0679	Chulitna R. Lodge	NOAA	B	1971 - Present
0680	Edgemire Lakes	NOAA	B	1971 - Present
0681	Chulitna Hwy. Camp	NOAA	B	1972 - Present
0682	Talkeetna	NOAA	A	1949 - Present*
0683	Willow Hwy. Camp	NOAA	B	1977 - Present
0684	Whites Crossing	NOAA	B	1971 - Present
0685	Puntilla	NOAA	B	1949 - Present
0686	Skwentna	NOAA	B	1949 - Present
0687	Anchorage	NOAA	A	1946 - Present

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1 NOAA Reports Available:

A Annual Summary with Comparative Data

B - Annual Climatologic Summary

* Miscellaneous Wind Data

MISCELLANEOUS WIND DATA

Stations: Healy 2, Healy Power Plant I, Healy Power Plant II

Table containing wind speed percent frequency and cumulative frequency at one meter per second increments. Table containing wind direction frequency in percent. Table containing wind speed and joint frequency.

Station: Rapids

Period summary by combined velocity groups (1 to 12 observations daily) covering 1935 - 1941.

Station: Big Delta

Period summary by combined velocity groups (1 to 3 observations daily) covering 1935 - 1941.

Station: Gulkana

Percentage frequency of occurrence, direction by speed groups - a summary of the data between January 1945 and November 1958.

Station: Summit

Period summary by combined velocity groups (16 observations daily) covering 1940 - 1941.

Station: Talkeetna

Period summary by combined velocity groups (16 observations daily) covering 1940 - 1941.

APPENDIX H

SNOW SURVEY - STATIONS AND PERIOD OF RECORDS (3)

0800 SNOW SURVEY

Snow depth and water equivalent data have been collected by the U.S. Soil Conservation Service, the Alaska Department of Fish and Game and R&M Consultants. The locations for which this information is available are listed below generally in order from the upstream end to the downstream end of the Susitna Basin.

The ADF&G markers have been established for the purpose of studying the effect of snow depth on game movements. There are 8 locations each along a tributary stream to the Susitna River with 4 - 6 aerial snow markers at each location. These markers are placed at different elevations moving up the stream valley.

The cross reference numbers for SCS sites listed on the following page correspond to map numbers as published in the Snow Survey Bulletin issued by the Soil Conservation Service. Cross reference numbers for R&M and ADF&G snow courses are arbitrary. These will be changed to map numbers when they are included in the Snow Survey bulletin.

All of the data listed can be obtained from the agency responsible for the snow course or from R&M Consultants.

Index Number	Course Name	Measured By	Cross Reference Number	Years of Previous Record	Drainage Basin
0802	Cirque	R&M	W-1	-	West Fork Gl.
0803	Ice Cave	R&M	W-2	-	West Fork Gl.
0804	West Fork Gl.*	R&M	W-3	-	West Fork G.
0805	Crevasse	R&M	S-1	-	Susitna Gl.
0806	Mt. Hayes*	R&M	S-2	-	Susitna Gl.
0807	Caribou	R&M	S-3	-	Susitna Gl.
0808	Malamute	R&M	S-4	-	Susitna Gl.
0809	Mt. Deborah	R&M	S-5	-	Susitna Gl.
0810	Aurora Peak	R&M	S-6	-	Susitna Gl.
0811	East Fork*	R&M	E-2	-	East Fork Gl.
0812	Pyramid	R&M	E-1	-	East Fork Gl.
0813	Jatu Pass*	R&M	E-3	-	East Fork Gl.
0814	Monahan Flats*	SCS	25	15	West Fork Gl.
0815	Denali*	R&M	-	-	Susitna River
0816	Butte Creek	R&M	B-3	-	Butte Creek
0817	Moose	R&M	B-2	-	Butte Creek
0818	Red Fox	R&M	B-1	-	Butte Creek
0819	Clearwater Lake*	SCS	26	14	Maclaren River
0820	Tyone R.*	R&M	-	-	Tyone River
0821	Lake Louise*	SCS	29	15	Tyone River
0822	Little Nelchina	SCS	31	12	Oshetna R.
0823	Kosina Cr.*	R&M	-	-	Kosina Cr.
0824	Oshetna Lake*	SCS	30	15	Oshetna R.
0825	Goose Creek	ADF&G	8	-	Goose Creek
0826	Coal Creek	ADF&G	7	-	Coal Creek
0827	Gaging Station Cr.	ADF&G	6	-	Gaging Station Cr.
0828	Jay Creek	ADF&G	5	-	Jay Creek
0829	Kosina Cr.	ADF&G	4	-	Kosina Cr.
0830	Watana Cr.	ADF&G	3	-	Watana Cr.
0831	Fog Cr.	ADF&G	2	-	Fog Cr.

* Indicates site with snow course and aerial stadia marker, all other aerial stadia markers only.

Index Number	Course Name	Measured By	Cross Reference Number	Years of Previous Record	Drainage Basin
0832	Devil Mountain	ADF&G	1	-	Susitna River
0833	Fog Lakes*	SCS	24	10	Fog Cr.
0834	Watana Camp*	R&M	-	-	Susitna River
0835	Devils Canyon*	R&M	-	-	Susitna River
0836	Devils Canyon	SCS	124	3	Susitna River
0837	Talkeetna R.	SCS	135	13	Talkeetna R.
0838	Chulitna R.	SCS	137	1	Talkeetna R.
0839	Talkeetna	SCS	22	13	Susitna River
0840	Middle Fork Iron Cr.	SCS	134	1	Talkeetna R.
0841	Rainbow Lake	SCS	136	2	Talkeetna R.
0842	Bald Mt. Lake*	SCS	23	15	Talkeetna R.
0843	Talkeetna R. Pass	SCS	133	1	Talkeetna R.
0844	Sheep River	SCS	132	1	Sheep River
0845	Sheep Creek Cirque	SCS	131	1	Sheep Creek
0846	Upper Kashwitna R.	SCS	130	1	Kashwitna R.
0847	Kashwitna R. Cirque	SCS	129	1	Kashwitna R.
0848	Little Willow Cr.	SCS	128	1	Kashwitna R.
0849	Independence Mine	SCS	33	13	Willow Creek
0850	Deception Cr.*	SCS	142	1	Willow Creek
0851	Mt. Bullion*	SCS	141	2	Willow Creek
0852	Capitol Site*	SCS	140	2	Willow Creek
0853	Willow Airstrip	SCS	32	16	Willow Creek
0854	Tokositna Valley	SCS	-	-	Kahiltna R.
0855	Ramsdyke Cr.*	SCS	-	-	Kahiltna R.
0856	Dutch Hills	SCS	-	-	Kahiltna R.
0857	Peters Hills	SCS	21	12	Kahiltna R.
0858	Chelatna Lake	SCS	20	16	Kahiltna R.
0859	Skwentna*	SCS	19	12	Yentna R.
0860	Alexander Lake*	SCS	18	16	Yentna R.
0861	Haggard Cr.*	SCS	48	14	Copper R.
0862	St. Anne Lake*	SCS	28	15	Copper R.

* Indicates site with snow course and aerial stadia marker, all other aerial stadia markers only.

0900 SNOW CREEP

R&M is currently planning to install devices for measuring the effect of snow creep forces on transmission line towers. Two locations are planned along the proposed transmission line route. As this data is collected, it will be filed at R&M according to site number and name.

Some previous research on snow creep was done by the U.S. Army Corp of Engineers in 1974, reported in the following paper:

> Snow Creep Investigations in Southeast Alaska; Meyer, Robert. Alaska District, Army Corps of Engineers.

APPENDIX I

DATA COLLECTED BY
ALASKA DEPARTMENT OF FISH & GAME (3)

DATA COLLECTED BY ALASKA DEPARTMENT OF FISH AND GAME (ADF&G) FROM THE SUSITNA RIVER BASIN BETWEEN 1974 and 1978

Streamflow, water quality and water temperature data have been collected by the Alaska Department of Fish and Game at a number of locations within the Susitna River Basin. Since the measurements have been taken periodically, the number of measurements, timing and specific parameters measured vary from year to year at any given station. Information available from the Alaska Department of Fish and Game has been included below. These reports are all on file at R&M Consultants.

Barrett, Bruce M. 1974. An assessment study of the anadromous fish populations in the Upper Susitna River watershed between Devil's Canyon and the Chulitna River. Cook Inlet Data Report No. 74-2. Alaska Department of Fish and Game. Division of Commerical Fisheries. 56 pp.

Figure 10: Profile of Susitna River water temperatures for September 4 - 11 at Gold Creek and Devil's Canyon Fishwheel Camp.

Figure 11: Profile of water and air temperatures recorded daily at east bank fishwheel.

Friese, Nancy V. 1975. Preauthorization assessment of anadromous fish populations of the Upper Susitna River watershed in the vicinity of the proposed Devil's Canyon Hydroelectric project. Cook Inlet Data Report No. 75-2. Alaska Department of Fish and Game - Division of Commerical Fisheries. 121 pp.

Table 10: Survey of winter conditions in Indian River, Lane Creek and Gold Creek.

Table 11: Analysis of Water Conditions in Indian River, at Chase Creek, 1974 - 1975.

Table 12: Analysis of Water Conditions at Gold Creek, 1974 - 1975.

Table 13: Analysis of water conditions at Parks Highway Bridge, 1974 - 1975.

Riis, James C. 1975. Pre-authorization assessment of the Susitna River Hydroelectric Projects: preliminary investigations of water quality and aquatic species composition. Alaska Department of Fish and Game. Division of Sport Fish. 61pp.

Figure 1: Daily water temperature in the Susitna River at Parks Highway Bridge, June 20 - September 23, 1975.

Figure 2: Maximum daily water temperatures of Birch Creek, April 11 - August 30, 1975.

Figure 3: Maximum daily water temperatures for Willow Creek, April 10 - September 23, 1975.

Riis, James C., 1977. Pre-authorization assessment of the proposed Susitna River Hydroelectric Projects: preliminary investigations of water quality and aquatic species composition. Alaska Department of Fish and Game. Division of Sport Fish. 91 pp.

Appendix A

Table 1: Water quality data collected from the Susitna River at the Parks Highway Bridge between July 21 and October 1, 1976.

Table 2: Water quality data collected from the Susitna River at the Gold Creek Railroad Bridge between July 13 and October 1, 1976.

Table 3: Water quality data collected from the Susitna River upstream of Portage Creek between July 15 and October 29, 1976.

Table 4: Water quality data collected from sloughs 8 and 10, between June 25 and September 30, 1976.

Table 5: Water quality data collected from sloughs 11 and 13 between June 23 and September 30, 1976.

Table 6: Water quality data collected from Sloughs 14 & 15 between June 25 and September 30, 1976.

Table 7: Water quality data collected from Sloughs 16 & 17 between June 24 and September 29, 1976.

Table 8: Water quality data collected from Sloughs 18 & 19 between June 15 and September 29, 1976.

Table 30: Slough 3C cross sections and stage gage information.

Table 31: Chase Creek cross sections and stage gage information.

Table 32: Tributary flow data, 1976.

Riis, James C. and Friese, Nancy V., 1978. Fisheries and Habitat Investigations of the Susitna River - A preliminary study of potential impacts of the Devil's Canyon and Watana Hydroelectric Projects. Alaska Department of Fish and Game, Division of Sport & Commerical Fish. 116 pp.

Table 8: Water quality data from selected tributaries to the Susitna River, 1977.

Table 10: Water flows of Montana, Rabideux and Willow Creeks from May through November, 1977.

Table 11: Daily maximum and minimum water temperatures from the Susitna River at the Parks Highway Bridge, June 27 - October 12, 1977.

Appendix II

Table 2: Water quality data from sloughs and clearwater tributaries of the Susitna River, June 14 - October 5, 1977.

Table 3: Daily maximum and minimum water temperatures in Rabideux Creek, May 25 - October 23, 1977.