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L. Bartlett

ALASKA
DEPARTMENT OF FISH AND GAME

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

Subtask 7.10

Phase 1 Final Draft Report

Aquatic Studies Program

ADF & G / Su Hydro 1982

by
Alaska Department of Fish and Game
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for

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1. INTRODUCTION

1. INTRODUCTION

1.1 Background and Objectives

This report highlights and compares selected physical, chemical, and biological data contained in a series of reports evaluating the feasibility of the Susitna Hydroelectric (Su-Hydro) project. The feasibility study reports were submitted to Acres American Inc. (Acres) by the Alaska Department of Fish and Game (ADF&G) Su-Hydro Aquatic Studies Team and other project investigators. Acres was contracted in 1979 by the Alaska Power Authority (APA) to assess the feasibility of the proposed two dam Susitna Hydroelectric project. The feasibility assessment includes a five year, two-phase fish ecology study program. Objectives established for this program are (Acres 1980):

1. describe the fishery and aquatic habitat resources of the Susitna River (Figure E.1.1);

2. assess the impacts of development and operation of the Su-Hydro project on these resources; and

3. propose mitigation measures to minimize adverse impacts.

The ADF&G Aquatic Studies Team was contracted by the APA under a Reimbursable Services Agreement to begin the collection program directed at meeting the first objective. The second and third objectives were subcontracted to Terrestrial Environmental Specialists (TES) by Acres in 1980.

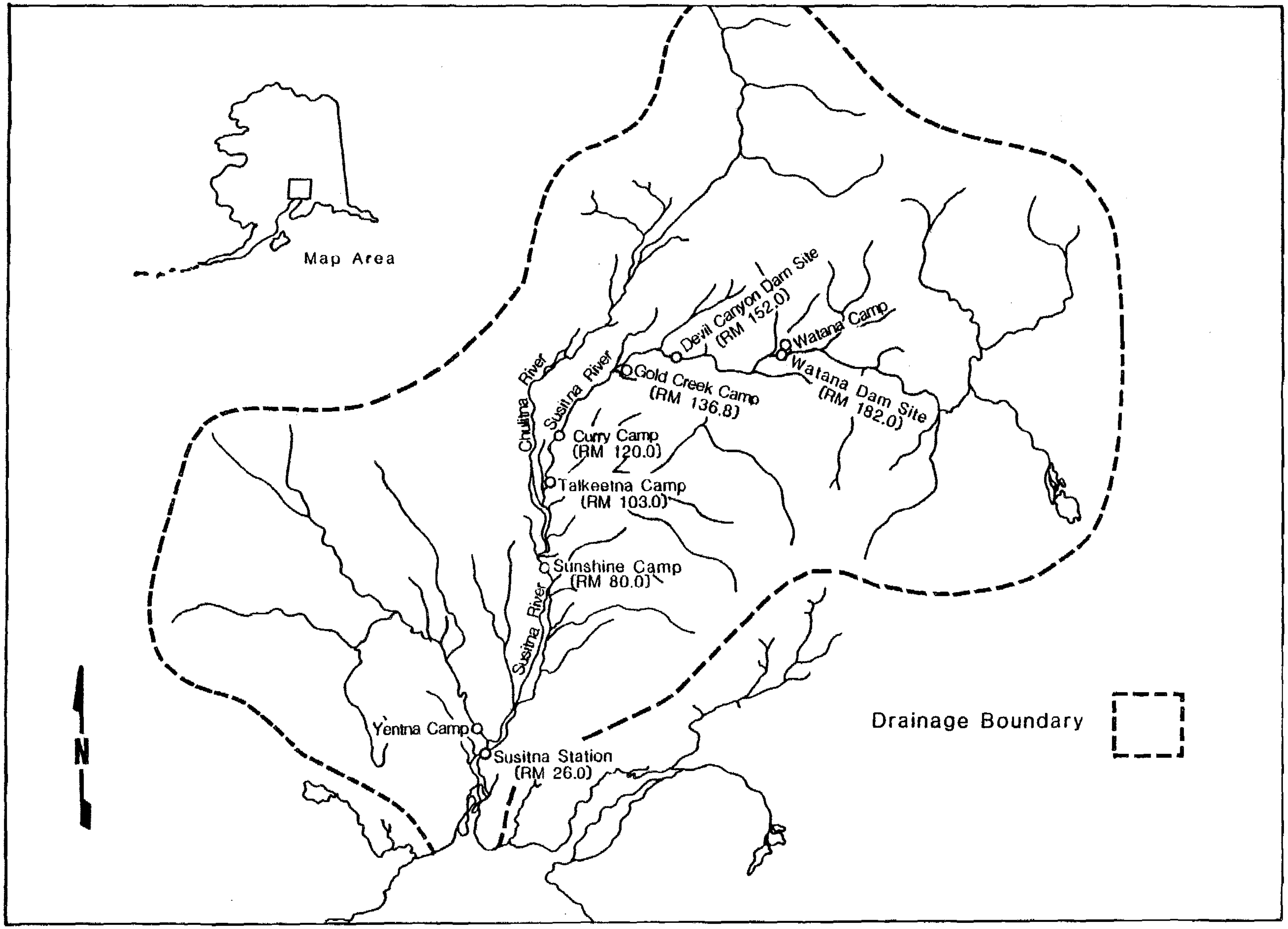

Figure E.1.1. Susitna River drainage basin.

The ADF&G data collection program (designed to meet objective one) was initiated in November 1980. The ice-covered (November 1980-May 1981) portion of the field data collection program was subdivided into two sections: 1) Resident and Juvenile Anadromous Fish Studies (RJ), and Aquatic Habitat and Instream Flow Studies (AH). During the open water field season (June 1981-October 1981), the program was subdivided into three sections: Adult Anadromous Fish Studies (AA), RJ, and AH.

Specific objectives of the AA, RJ, and AH sections based on a five year study program are:

1. determine the seasonal distribution and relative abundance of adult anadromous fish populations produced within the study area (Figure E.1.2) (AA);

2. determine the seasonal distribution and relative abundance of selected resident and juvenile anadromous fish populations within the study area (RJ); and

3. characterize the seasonal habitat requirements of selected anadromous and resident fish species within the study area (AH).

Following preliminary data reduction, field data collected by the ADF&G during 1980-1981 were summarized in a series of six reports (ADF&G 1981a, b, c, d, f, g). Progress towards meeting the first ADF&G aquatic study objective included the collection of escapement data which gave a description of the five adult salmon populations which returned to the Susitna River during an odd-year

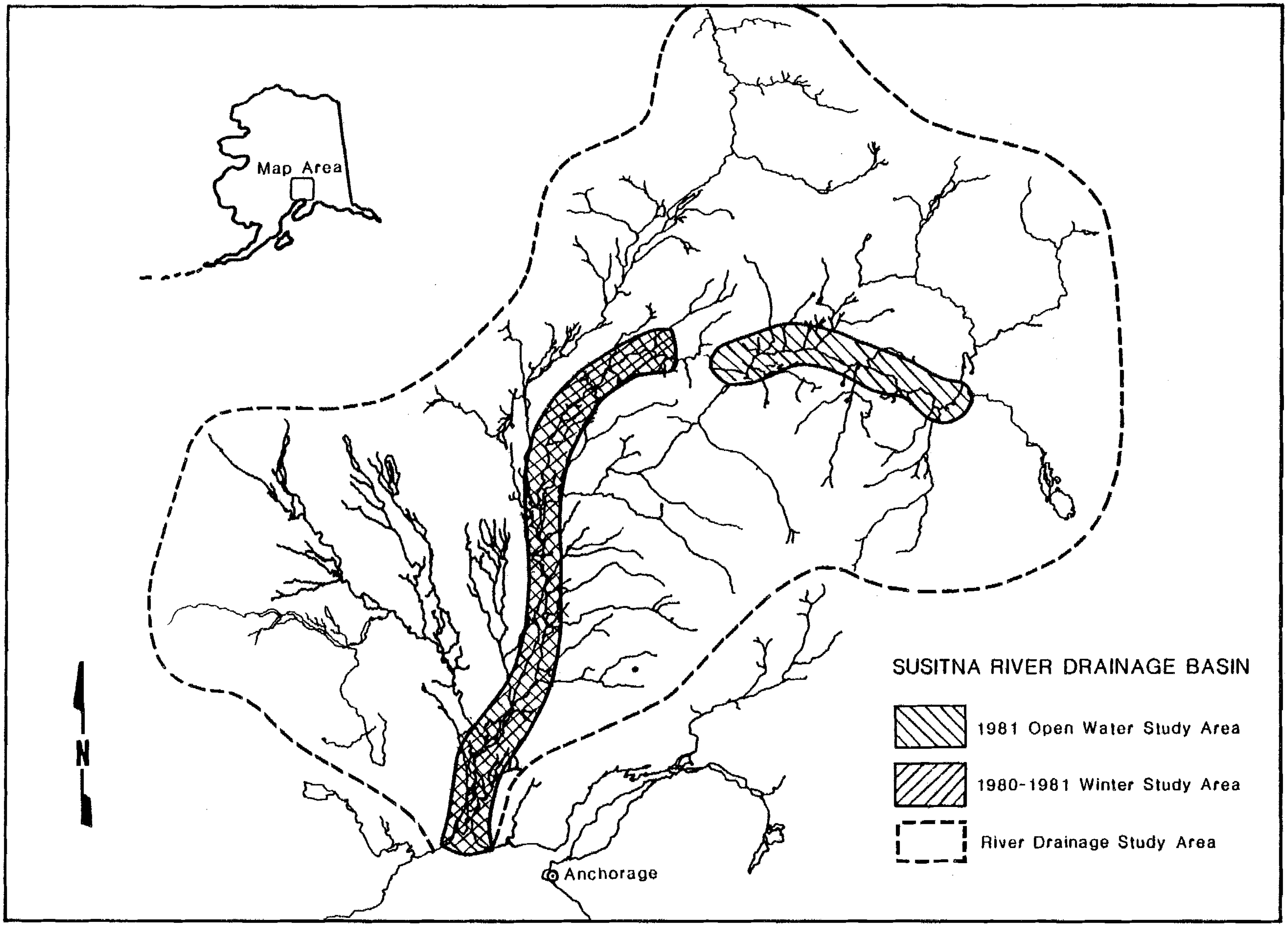

Figure E.1.2. Drainage map of the Susitna River showing phase 1 study areas.

salmon run (ADF&G 1981a and b)*. AA field studies in 1981 did not include an assessment of the seasonal distribution and relative abundance of eulachon (Thaleichthys pacificus) or Bering cisco (Coregonus laurettae). Bering cisco, not previously known to utilize this system, were observed spawning in the Susitna River during 1981 (ADF&G 1981f).

Progress on the second aquatic study objective included describing the distribution and abundance of selected resident and juvenile anadromous fish observed over one year (ADF&G 1981d, f, g). Although some of this information was quite detailed [e.g. information on Arctic grayling (Thymallus arcticus) populations in the proposed impoundment area], other data were quite sparse and did not permit definitive determinations of distribution or abundance. For example, the extent, location, and duration of fresh-water rearing of juvenile sockeye populations is largely unknown.

Progress towards addressing the third aquatic study objective was limited to a first attempt at describing the aquatic resources of selected areas in the Susitna River and characterizing the relationships between the fishery resources and their aquatic habitats. The description of the aquatic habitat relationships studied by AH in 1980-1981 are summarized in the AH report (ADF&G 1981c).

To accomplish the three aquatic study objectives, additional information will be required through succeeding years. Relationships between the fishery

* Salmon runs vary on a year to year basis (e.g. pink salmon escapement is usually highest during even years).

resources and aquatic habitat which can presently be identified are preliminary and are limited to those fish species/life stages and habitat areas in which data on both fish distribution/abundance and aquatic habitat characteristics are most complete. These relationships were not reported in detail in the six ADF&G reports. Therefore, one of the objectives for preparing this report is to present a better description of these fishery/aquatic habitat relationships. Accordingly, the first chapter of this report describes those fishery/aquatic habitat relationships which can be developed given existing information.

A second objective of this report is to expand the discussions describing the relationships between individual physical and chemical (physiochemical) aquatic habitat parameters contained in the earlier AH report (ADF&G 1981c). Accordingly, the second chapter describes the relationships observed between individual aquatic habitat parameters (eg. temperature and turbidity) and discharge. These are some of the obvious relationships which can be affected by the installation and operation of the proposed dams.

A third objective of this report is to discuss some of the preliminary physical computer models which have been developed by Acres and their subcontractors to predict postproject temperature and stage/discharge relationships of the Susitna River downstream of the two dams. Comparisons between predicted and observed stage, temperature, and discharge characteristics are included in this chapter. Predicted and observed discharge characteristics are also related to provisional periodicity data on adult anadromous salmon spawning activity. These data could also be used to refine the existing models and identify additional data collection requirements.

It should be emphasized that this report should not be interpreted as an impact analysis : a more thorough analysis of the six previously produced ADF&G reports (ADF&G 1981a, b, c, d, f, and g), this report, and other documents (e.g. ADF&G 1974, 1976, 1977, 1978; ADNR 1977, 1979; R&M 1982a) by a designated contractor is required. Also, note that the analysis and summarization of information contained in this report is not intended to substitute for the six individual ADF&G aquatic study summary reports.

1.2 Description of Study Area

The study area was limited to the mainstem Susitna River and the mouths of major tributaries (Figures E.1.1, E.1.2). The Susitna River is approximately 275 miles long from its sources in the Alaska Mountain Range to its point of discharge into Cook Inlet. Its drainage encompasses an area of 19,400 square miles. The mainstem and major tributaries of the Susitna River, including the Chulitna, Talkeetna and Yentna Rivers, originate in glaciers and carry a heavy load of glacial flour during the ice-free months (approximately May through October). There are many smaller tributaries which are perennially clear. Specific descriptions of the study sites and additional details are presented in the AA, AH and RJ reports (ADF&G 1981a, b, c, d, f, g).

Anadromous fish species inhabiting the Susitna River include eulachon, Bering cisco, and five of the six species of Pacific salmon (chinook, Oncorhynchus tschawytscha; coho, O. kisutch; chum, O. keta; sockeye, O. nerka; and pink, O. gorbuscha). With the exception of sockeye salmon, the majority of upper Cook Inlet salmon production occurs within the drainage (ADF&G 1981b).

Some of the important resident species found in the Susitna River drainage include Arctic grayling, rainbow trout (Salmo gairdneri), lake trout (Salvelinus namaycush), burbot (Lota lota), Dolly varden (Salvelinus malma), and round whitefish (Prosopium cylindraceum).

The principal impacts of the proposed Susitna Hydroelectric project on fish species will likely result from changes in the natural flow regimes of the river; of particular concern are: modification of seasonal instream flows*, increased turbidity levels during winter months, and variation of thermal and chemical parameters. The feasibility studies will ultimately provide the basis for quantifying these impacts and evaluating mitigation options.

1.3 Methods

Data collection methods are discussed in the ADF&G Procedures Manual (ADF&G 1981e) and AH, RJ and AA subject reports (ADF&G 1981a, b, c, d, f, g). Data analysis techniques utilized in this report are discussed in the respective sections.

* The quantity or flow of water which is present in a river or stream at a given location and time constitutes the instream flow.

2. FISHERIES AND HABITAT RELATIONSHIPS

2. FISHERIES AND HABITAT RELATIONSHIPS

2.1 Introduction

This chapter describes several fishery/aquatic habitat relationships which can presently be developed. These relationships are limited to those areas in which data on both fish distribution/abundance and aquatic habitat characteristics are most complete. It should be noted, however, that information on all species and their corresponding habitats in the Susitna River is still in a preliminary stage of development and analysis.

2.2 Salmon Periodicity and Sonar Counts in Relation to Discharge

Changes in discharge can influence fish behavior and activities (Hynes 1970; Hocutt et al. 1980). Provisional discharge data (Table E.2.1) for the Susitna River at Gold Creek, Sunshine (Parks Highway Bridge), and Susitna Station gaging sites, and the Yentna River gaging site (T.R.M. 10)*, for the period May through September 1981, are presented as hydrographs (discharge versus time plots) in Figure E.2.1

Figures E.2.2 - E.2.6 combine the Susitna River hydrographs with provisional periodicity charts illustrating the known seasonal timing of spawning, incubation, rearing, and passage for each of the five species of salmon inhabiting the Susitna River in two reaches downstream of Devil Canyon (R.M. 0 - R.M. 84 and R.M. 84 - R.M. 149).** The periodicity charts are based on a combination of the data presented in the AA and RJ subject reports (ADF&G

* Tributary river mile.
** Susitna river mile.

Table E.2.1. Provisional USGS discharge data (cfs) for the Susitna River at Gold Creek, Sunshine, and Susitna Station and for the Yentna River near Susitna Station for the period of May - September, 1981 (USGS 1981).

Date	Susitna River			Yentna River
	Gold Creek	Sunshine	Susitna	Susitna
810501	---	---	28,000	10,000
810502	---	---	35,000	10,000
810503	---	---	45,000	11,000
810504	---	---	60,000	12,000
810505	---	---	70,000	14,000
810506	---	---	70,000	17,000
810507	---	---	75,000	26,000
810508	---	35,300	80,000	45,000
810509	---	56,600	95,000	50,000
810510	24,000	49,300	100,000	52,000
810511	22,400	46,000	95,000	52,000
810512	20,000	42,800	85,000	50,000
810513	18,400	41,000	80,000	45,000
810514	19,100	41,000	80,000	40,000
810515	21,800	44,700	85,000	40,000
810516	21,900	45,600	95,000	45,000
810517	20,700	44,600	110,000	45,000
810518	19,100	42,000	100,000	50,000
810519	18,200	41,100	100,000	54,000
810520	17,000	39,400	100,000	58,100
810521	14,600	37,000	99,800	60,500
810522	12,700	34,000	91,100	50,900
810523	11,300	31,400	83,200	44,500
810524	10,800	32,700	76,400	40,500
810525	11,700	31,800	75,100	39,700
810526	13,300	34,500	78,700	43,300
810527	14,600	37,000	86,900	49,500
810528	16,400	40,500	94,900	52,900
810529	19,900	46,700	102,000	54,100
810530	20,500	48,400	105,000	55,700
810531	22,400	51,600	110,000	58,900
810601	27,600	62,400	120,000	62,200
810602	23,400	57,200	122,000	60,900
810603	19,000	48,000	112,000	57,000
810604	17,000	44,800	103,000	53,200
810605	17,000	43,300	98,900	49,600
810606	19,100	46,600	98,000	48,000
810607	18,000	45,700	94,900	43,900
810608	15,800	43,100	94,700	45,300
810609	16,700	44,300	94,300	46,600
810610	18,300	47,200	99,500	49,400
810611	16,200	43,700	97,200	44,500
810612	14,800	41,200	90,200	42,700
810613	14,000	40,200	89,000	42,900

--- Data unavailable.

Table E.2.1 (Continued).

Date	Susitna River Gold Creek	Susitna River Sunshine	Susitna River Susitna	Yentna River Susitna
810614	14,200	40,900	89,700	44,600
810615	15,300	42,000	93,000	47,900
810616	18,200	47,400	98,800	50,900
810617	18,300	50,700	105,000	52,700
810618	17,400	51,100	113,000	58,600
810619	17,200	52,700	117,000	63,000
810620	16,600	53,100	121,000	66,600
810621	17,000	53,500	122,000	67,200
810622	16,800	53,600	122,000	65,500
810623	16,500	51,400	117,000	61,000
810624	16,600	51,900	116,000	60,500
810625	17,100	51,600	117,000	61,400
810626	17,200	50,000	118,000	61,500
810627	18,000	49,000	117,000	60,500
810628	23,000	52,000	119,000	61,100
810629	24,100	56,000	127,000	57,900
810630	24,000	56,000	132,000	57,800
810701	21,800	51,000	131,000	49,200
810702	18,800	46,000	115,000	41,600
810703	16,200	43,000	103,000	38,500
810704	14,600	42,000	95,200	37,700
810705	13,900	42,000	91,600	38,300
810706	14,600	46,000	89,800	39,200
810707	16,900	50,000	92,600	42,700
810708	24,800	56,000	98,300	45,500
810709	24,900	68,000	108,000	43,400
810710	36,300	86,000	119,000	51,600
810711	49,100	100,000	183,000	76,700
810712	58,200	130,000	198,000	78,000
810713	49,300	115,000	189,000	68,300
810714	38,600	100,000	176,000	67,500
810715	32,200	99,000	174,000	78,400
810716	34,000	98,700	189,000	95,100
810717	38,400	98,500	200,000	95,300
810718	43,000	97,100	194,000	85,900
810719	43,500	97,100	189,000	79,000
810720	43,000	96,800	186,000	76,900
810721	40,800	97,000	190,000	81,800
810722	35,900	90,100	185,000	78,100
810723	33,100	87,100	172,000	72,900
810724	34,200	86,500	168,000	69,200
810725	36,100	88,800	166,800	69,600
810726	37,500	90,200	176,000	78,700
810727	36,300	86,500	173,000	75,500
810728	31,000	80,000	158,000	65,200

Table E.2.1 (Continued).

Date	Susitna River Gold Creek	Susitna River Sunshine	Susitna River Susitna	Yentna River Susitna
810729	28,800	75,100	146,000	60,400
810730	28,100	76,000	142,000	58,400
810731	26,200	78,900	140,000	57,300
810801	33,100	78,800	134,000	53,800
810802	51,900	126,000	174,000	68,400
810803	49,500	116,000	223,000	83,200
810804	40,200	99,400	201,000	72,500
810805	32,300	85,600	171,000	65,000
810806	27,500	76,800	154,000	61,500
810807	26,200	72,500	146,000	60,000
810808	28,800	73,600	146,000	64,400
810809	40,400	84,600	161,000	77,500
810810	42,600	92,300	176,000	79,300
810811	43,500	95,000	185,000	84,000
810812	42,400	96,500	190,000	91,900
810813	46,400	104,000	217,000	113,000
810814	51,300	110,000	227,000	97,800
810815	50,800	118,000	223,000	83,400
810816	48,400	117,000	228,000	69,100
810817	40,900	98,500	201,000	53,500
810818	32,900	81,600	161,000	43,900
810819	30,200	73,000	138,000	38,300
810820	34,200	76,400	132,000	36,600
810821	41,300	82,800	137,000	39,600
810822	41,700	84,700	142,000	36,400
810823	37,900	81,600	138,000	35,000
810824	33,400	74,700	130,000	33,600
810825	28,600	65,500	120,000	32,100
810826	25,600	61,500	113,000	32,300
810827	24,200	60,200	110,000	36,300
810828	24,200	61,200	113,000	41,000
810829	23,900	62,100	116,000	45,400
810830	23,600	62,300	120,000	47,800
810831	22,400	60,700	120,000	48,000
810901	21,500	58,800	117,000	48,200
810902	20,200	54,800	113,000	44,000
810903	18,300	49,200	106,000	38,900
810904	16,600	44,400	97,800	37,200
810905	16,000	41,300	93,000	36,000
810906	15,700	40,800	90,100	36,500
810907	15,800	40,500	90,500	39,200
810908	15,900	39,200	91,200	36,700
810909	14,500	37,000	84,900	31,000
810910	14,200	34,400	76,000	27,000
810911	14,300	34,200	69,800	24,500

Table E.2.1 (Continued).

Date	Susitna River Gold Creek	Susitna River Sunshine	Susitna River Susitna	Yentna River Susitna
810912	14,100	34,600	67,100	23,300
810913	13,200	33,300	66,200	23,600
810914	12,700	31,800	63,500	22,700
810915	11,800	30,500	58,400	20,700
810916	11,300	29,000	54,200	---
810917	11,300	28,000	51,000	---
810918	10,800	27,000	48,000	---
810919	10,500	27,000	46,000	---
810920	11,400	28,000	44,000	---
810921	12,200	29,000	43,000	---
810922	11,600	27,000	45,000	---
810923	10,600	26,000	41,000	---
810924	10,400	24,000	38,000	---
810925	10,100	23,000	36,000	---
810926	9,560	22,000	35,000	---
810927	8,890	21,000	34,000	---
810928	---	20,000	33,000	---
810929	---	19,000	33,000	---
810930	---	19,000	32,000	---
811001	10,500	---	43,000	---
811002	10,300	---	42,000	---
811003	10,100	---	40,000	---
811004	9,800	---	39,000	---
811005	9,520	---	38,000	---
811006	9,380	---	37,000	---
811007	9,340	---	39,000	---
811008	9,760	---	42,000	---
811009	10,100	---	44,000	---
811010	9,700	---	47,300	---
811011	8,820	---	42,500	---
811012	8,160	---	38,300	---
811013	7,620	---	34,400	---
811014	7,290	---	32,500	---
811015	7,440	---	33,100	---

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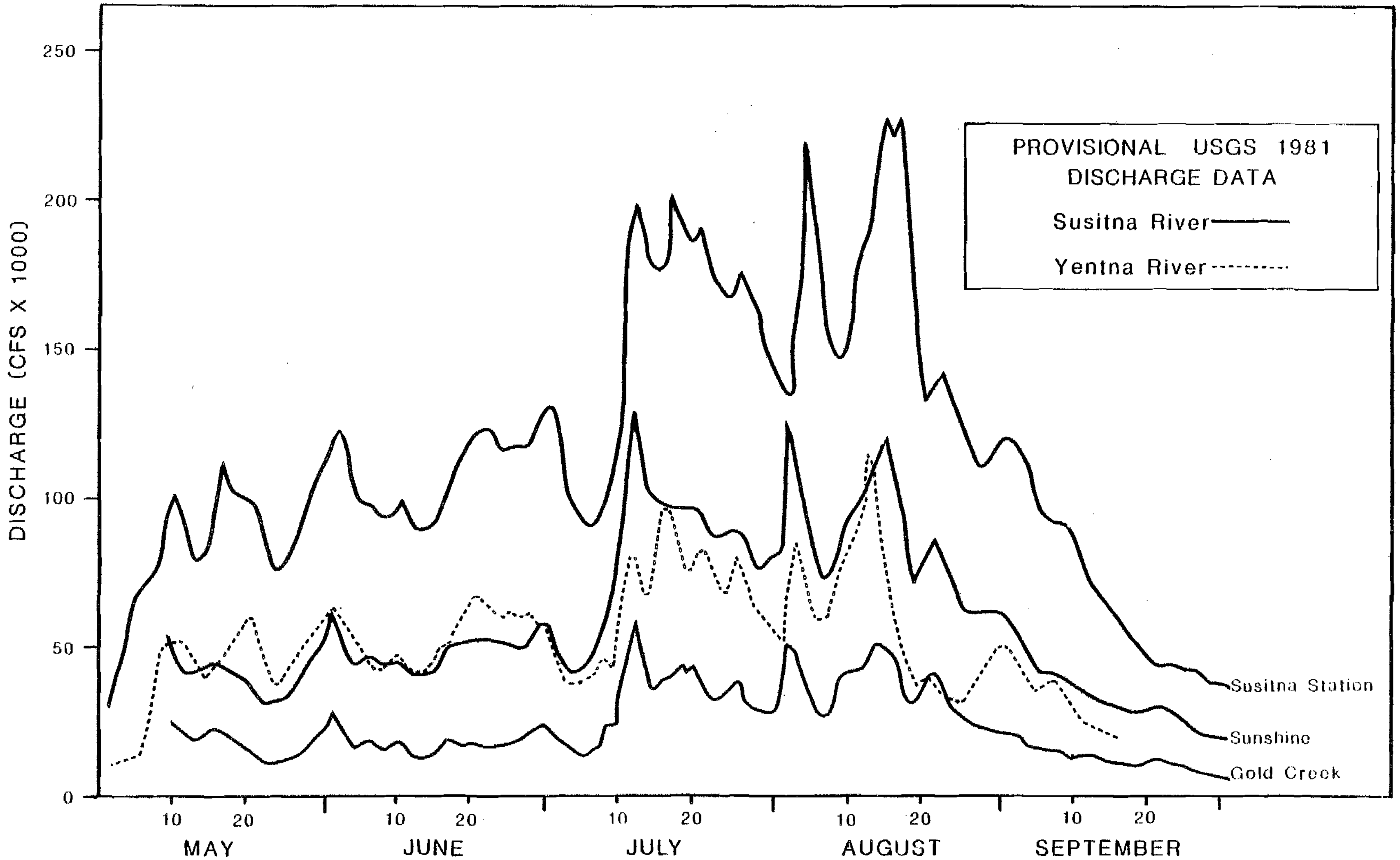
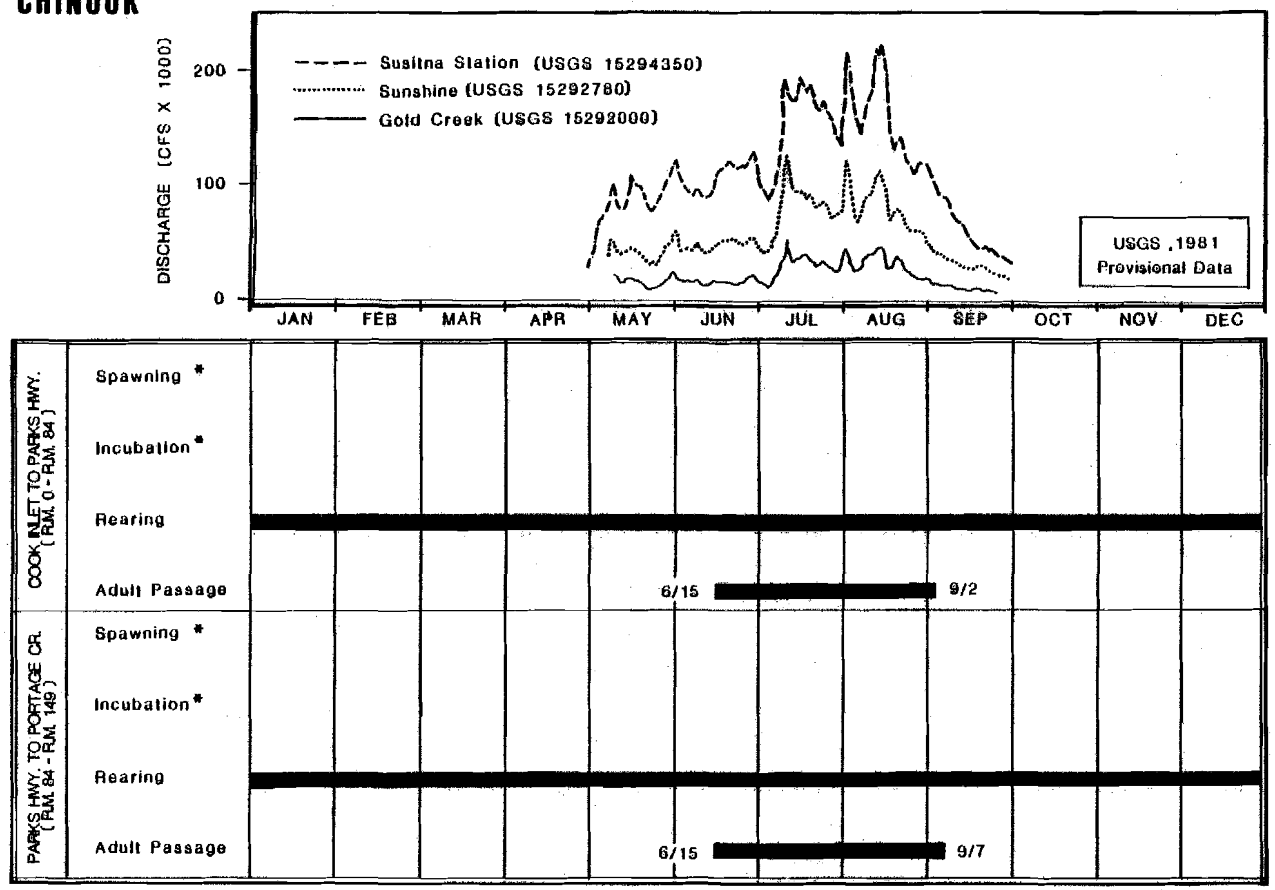


Figure E.2.1. Hydrograph (discharge vs. time) for May-September 1981 for the Susitna River at Gold Creek, Sunshine, and Susitna stations and for the Yentna River near Susitna Station (USGS 1981).

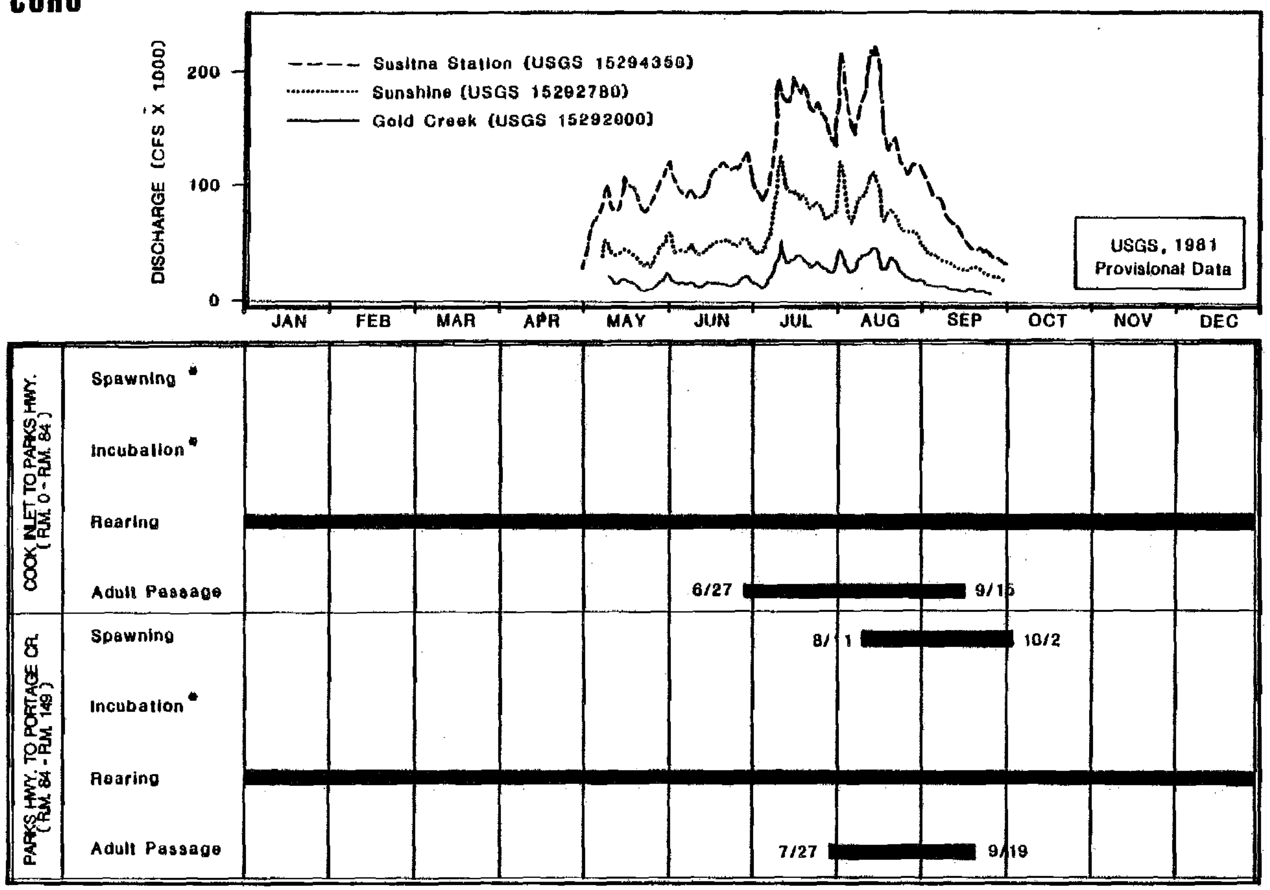
CHINOOK



* Data unavailable.

Figure E.2.2. Provisional periodicity for the various life phases of chinook salmon as it relates to discharge of the Susitna River (USGS 1981). Consult ADF&G for further interpretation.

COHO



* Data unavailable.

Figure E.2.3. Provisional periodicity for the various life phases of coho salmon as it relates to discharge of the Susitna River (USGS 1981). Consult ADF&G for further interpretation.

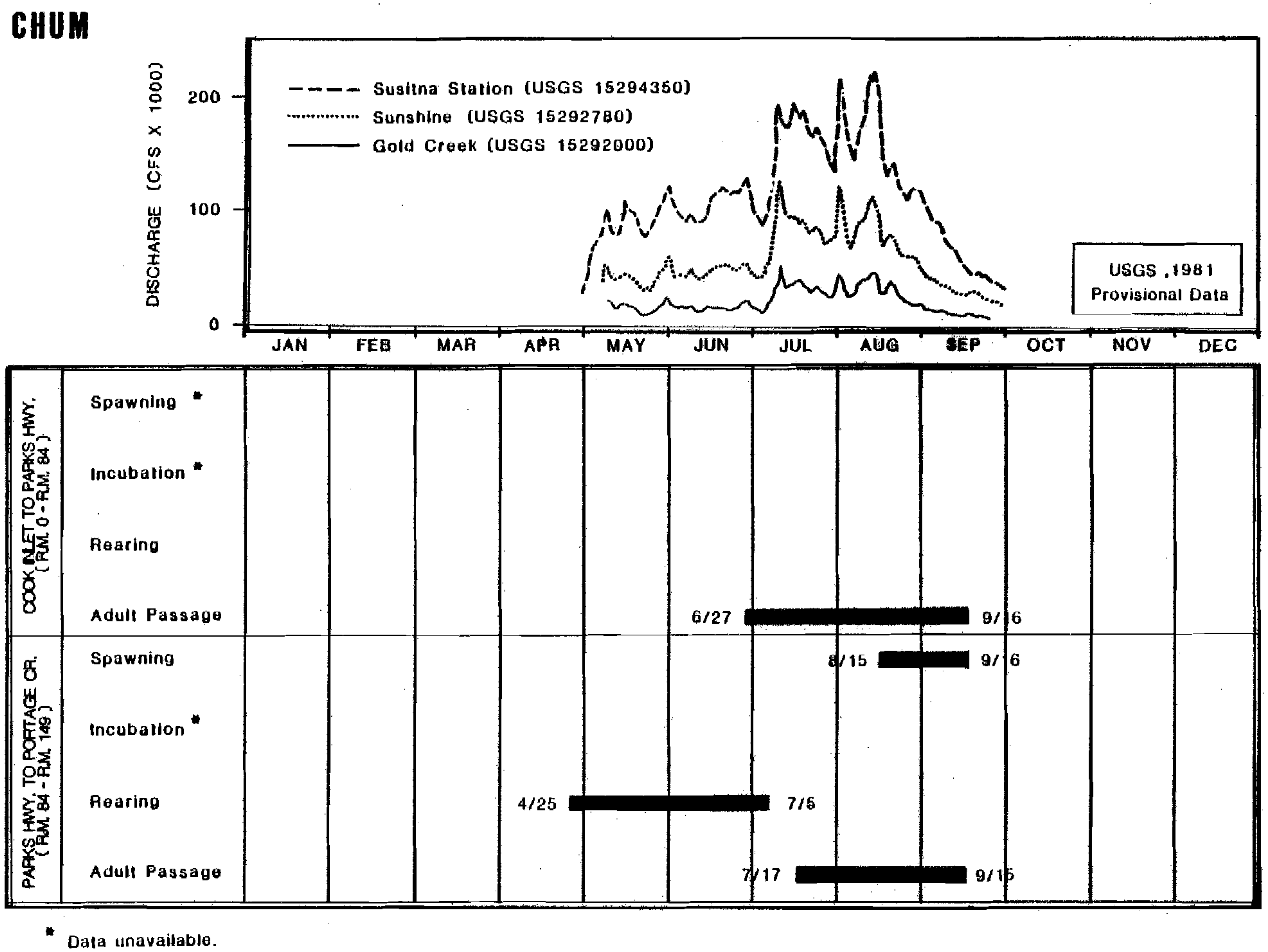
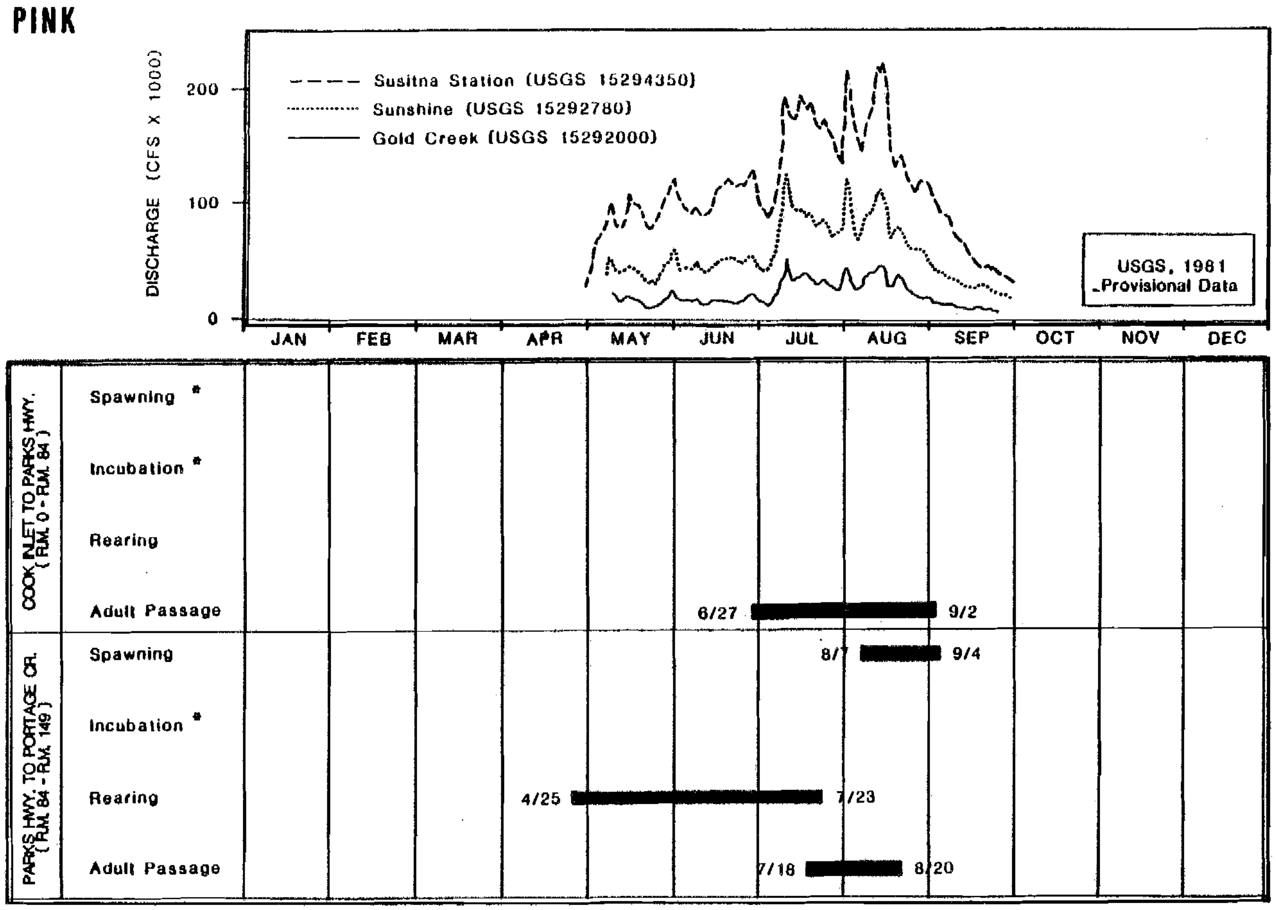


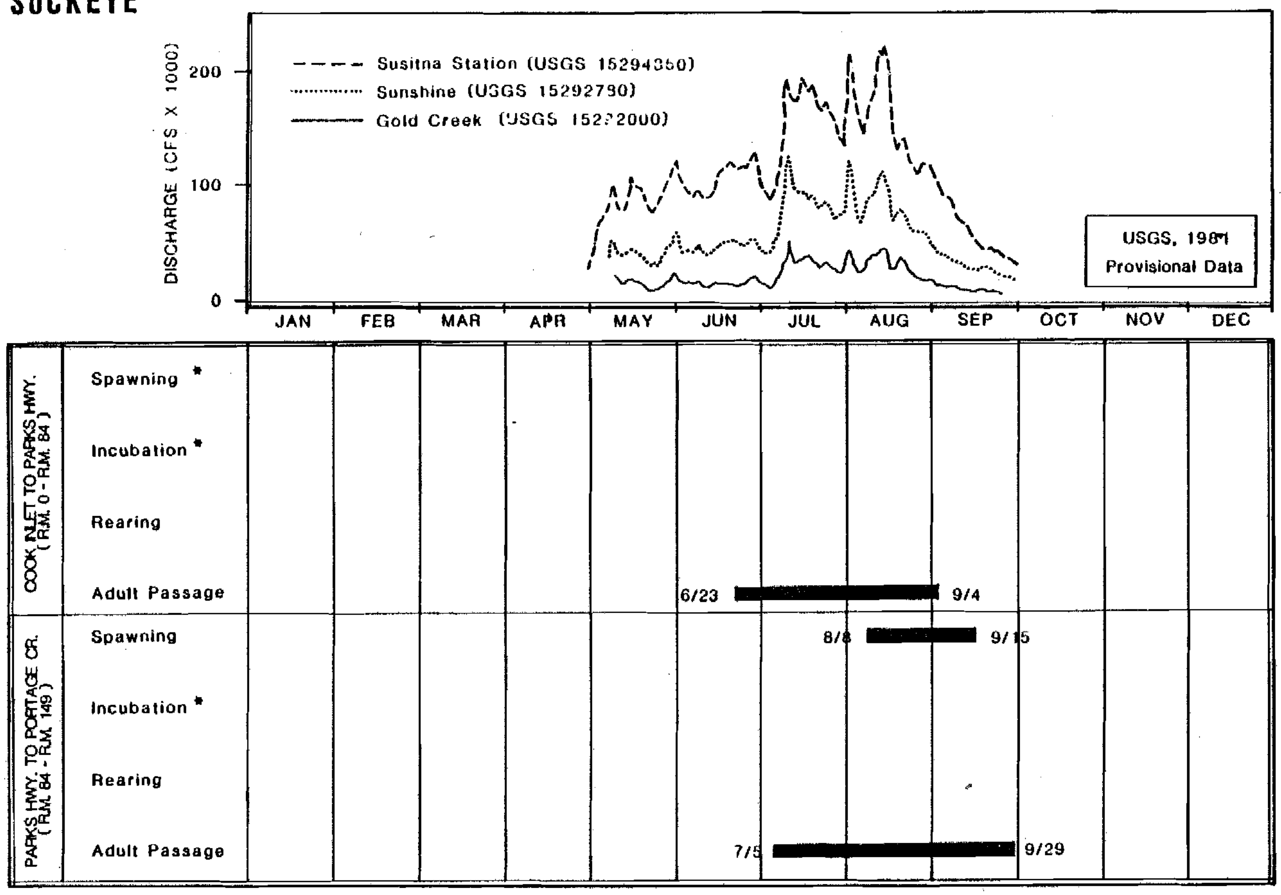
Figure E.2.4. Provisional periodicity for the various life phases of chum salmon as it relates to discharge of the Susitna River (USGS 1981). Consult ADF&G for further interpretation.



* Data unavailable.

Figure E.2.5. Provisional periodicity for the various life phases of pink salmon as it relates to discharge of the Susitna River (USGS 1981). Consult ADF&G for further interpretation.

SOCKEYE



* Data unavailable.

Figure E.2.6. Provisional periodicity for the various life phases of sockeye salmon as it relates to discharge of the Susitna River (USGS 1981). Consult ADF&G for further interpretation.

1981a, b, d), field observations by Su-Hydro and other ADF&G personnel, and review of drafts of these charts by Su-Hydro staff. The data presented in these charts are in a preliminary stage of refinement and the ADF&G should be consulted regarding their interpretation. Periodicity charts were not developed for resident fish species due to insufficient data.

Generally, passage of adult salmon corresponded with the peak periods of the hydrograph (Figures E.2.2 - E.2.6). Spawning of adult salmon occurred during the waning of the peak flow periods. However, passage of adult salmon on a day to day basis, as monitored by daily sonar counts of adult salmon (Figures E.2.7-E.2.11), indicated that salmon movements decreased during periods of highest flows and increased as flows subsided following major flow events. Apparently, peak flows, with the corresponding increased water velocities, discouraged passage and encouraged milling.

2.3 Percent Incidence of Selected Fish Species in Relation to Discharge

The percent incidence of catch for three fish species at habitat sites* between Talkeetna and Devil Canyon were compared with mainstem Susitna River discharge at Gold Creek from June through September 1981 (Figures E.2.12 - E.2.14). Percent incidence of catch equals the total number of habitat locations where at least one individual of the target species was captured, divided by the total number of habitat locations that were sampled during a designated sampling period, multiplied by 100.

* See ADF&G 1981a, c, d, f and g for descriptions and listings of habitat locations.

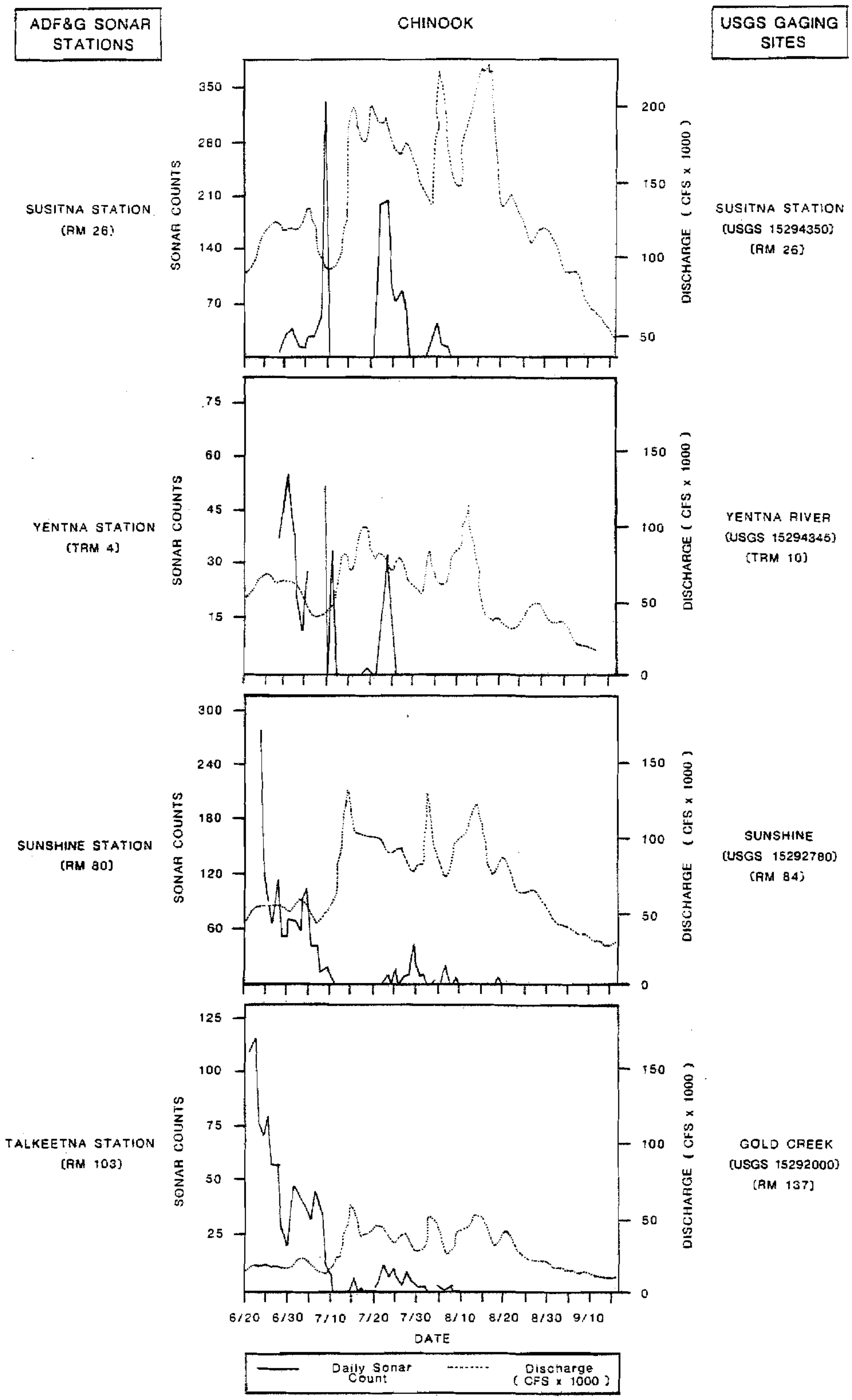


Figure E.2.7. Sonar counts of adult chinook salmon at each AA sonar site as compared to discharge of the Susitna River (adapted from USGS 1981 and ADF&G 1981a).

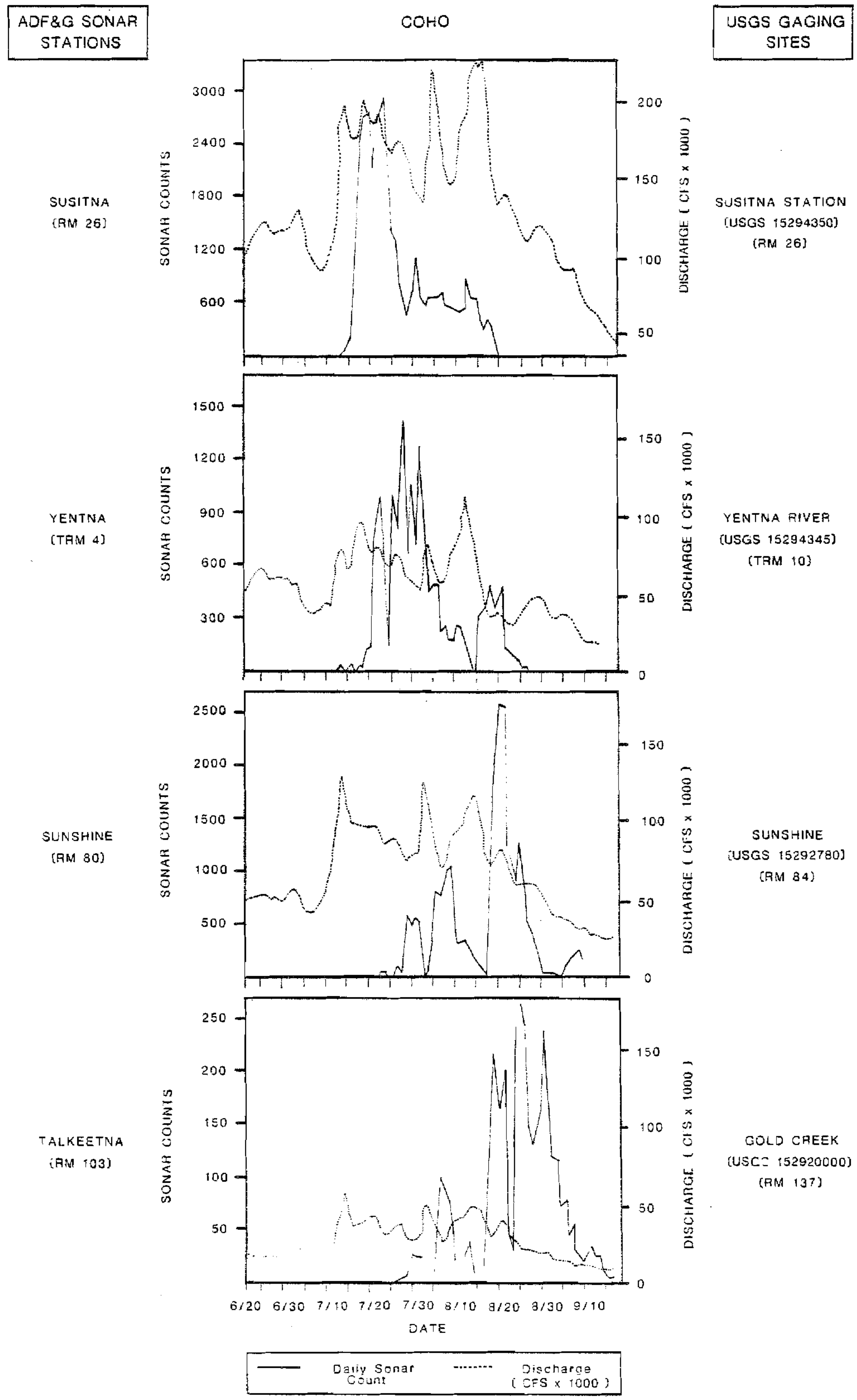


Figure E.2.8. Sonar counts of adult coho salmon at each AA sonar site as compared to discharge of the Susitna River (adapted from USGS 1981 and ADF&G 1981a).

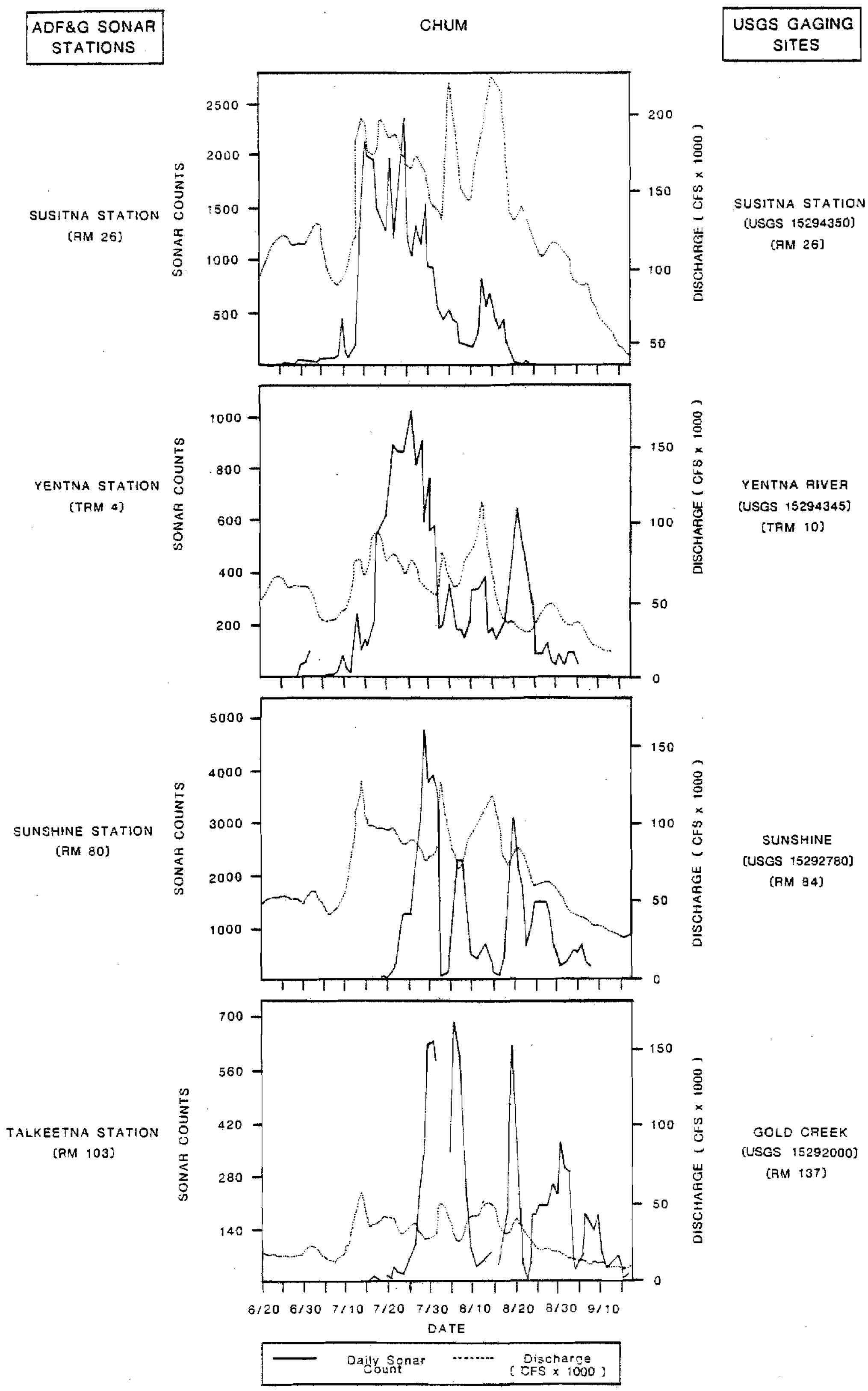


Figure E.2.9. Sonar counts of adult chum salmon at each AA sonar site as compared to discharge of the Susitna River (adapted from USGS 1981 and ADF&G 1981a).

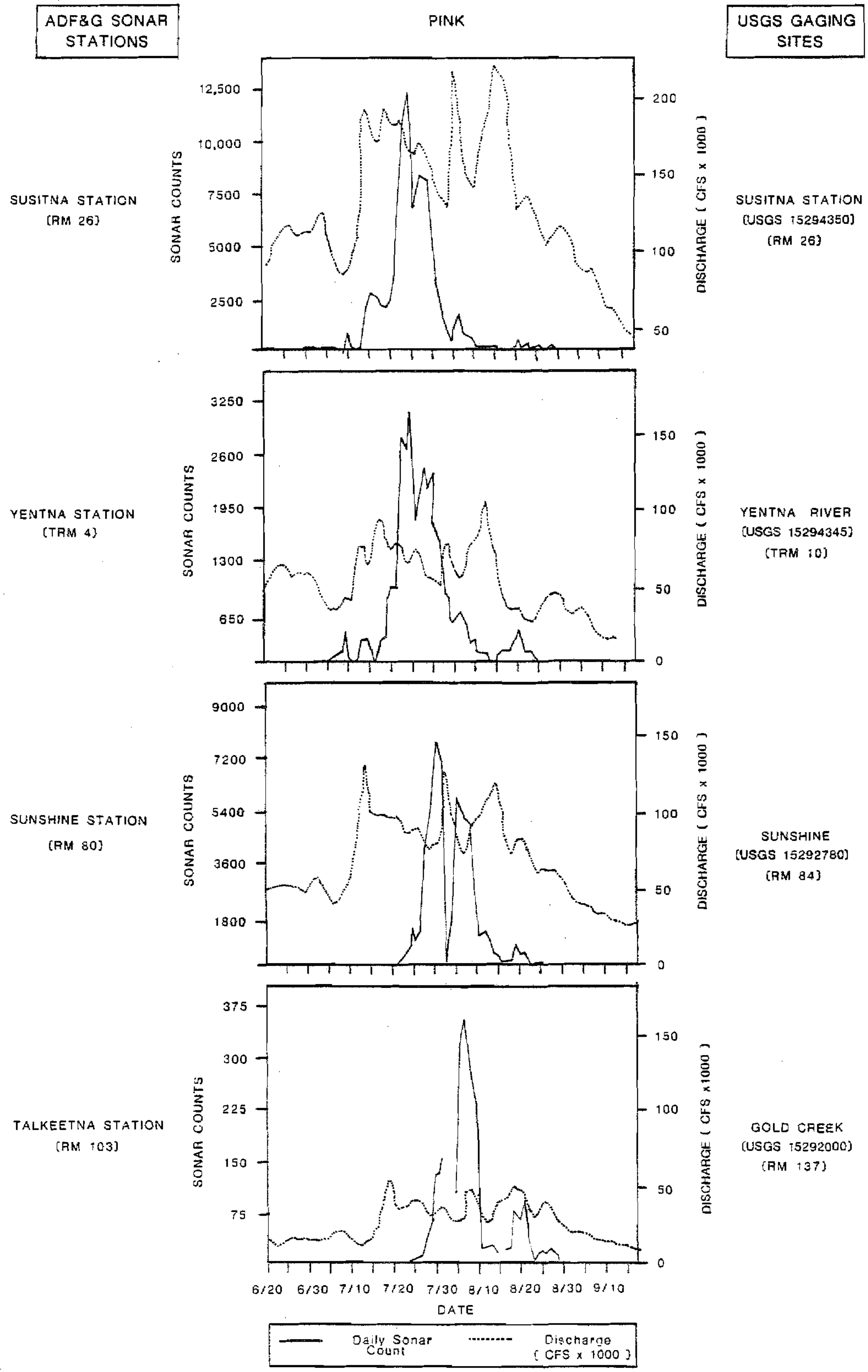


Figure E.2.10. Sonar counts of adult pink salmon at each AA sonar site as compared to discharge of the Susitna River (adapted from USGS 1981 and ADF&G 1981a).

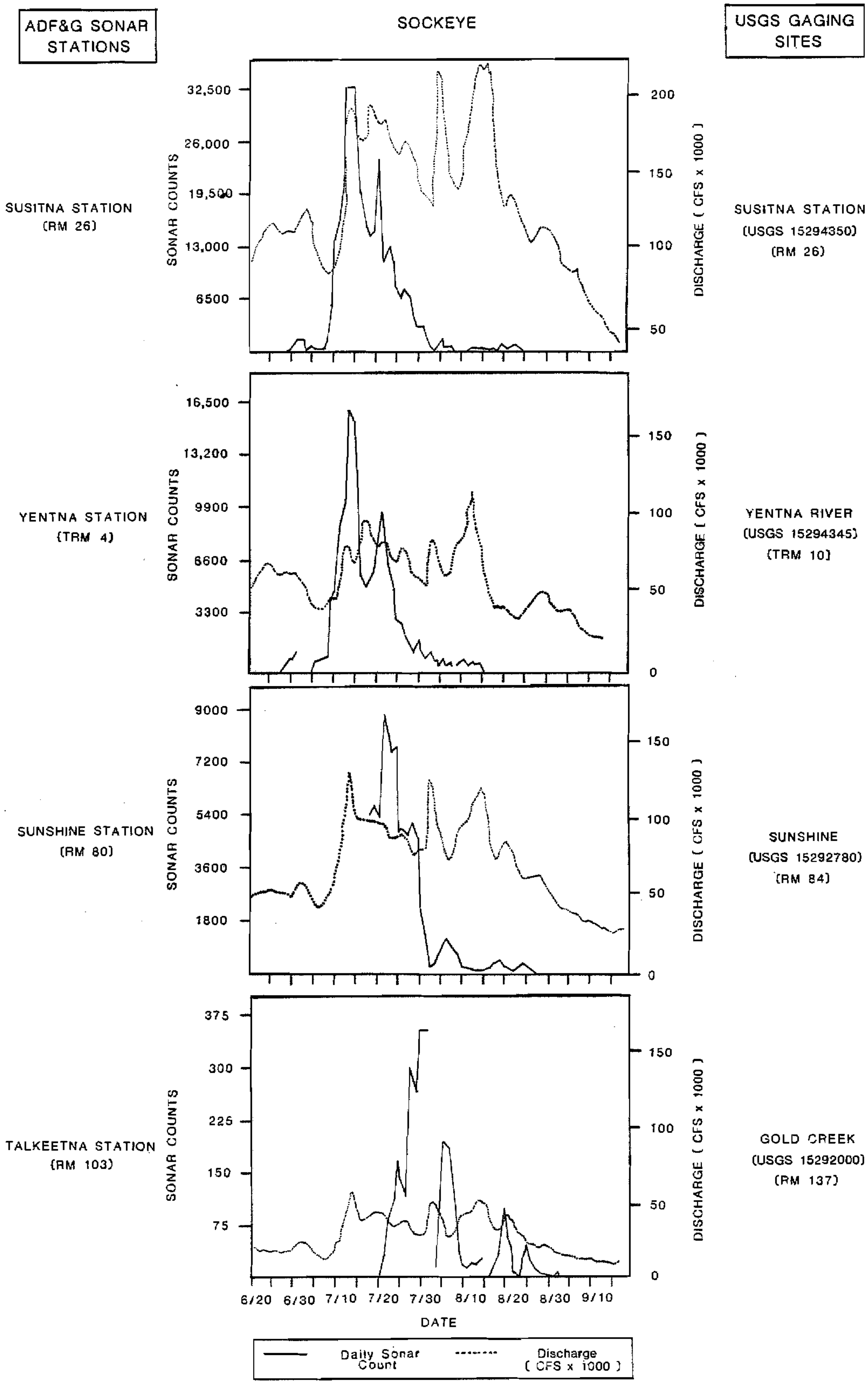


Figure E.2.11. Sonar counts of adult sockeye salmon at each AA sonar site as compared to discharge of the Susitna River (adapted from USGS 1981 and ADF&G 1981a).

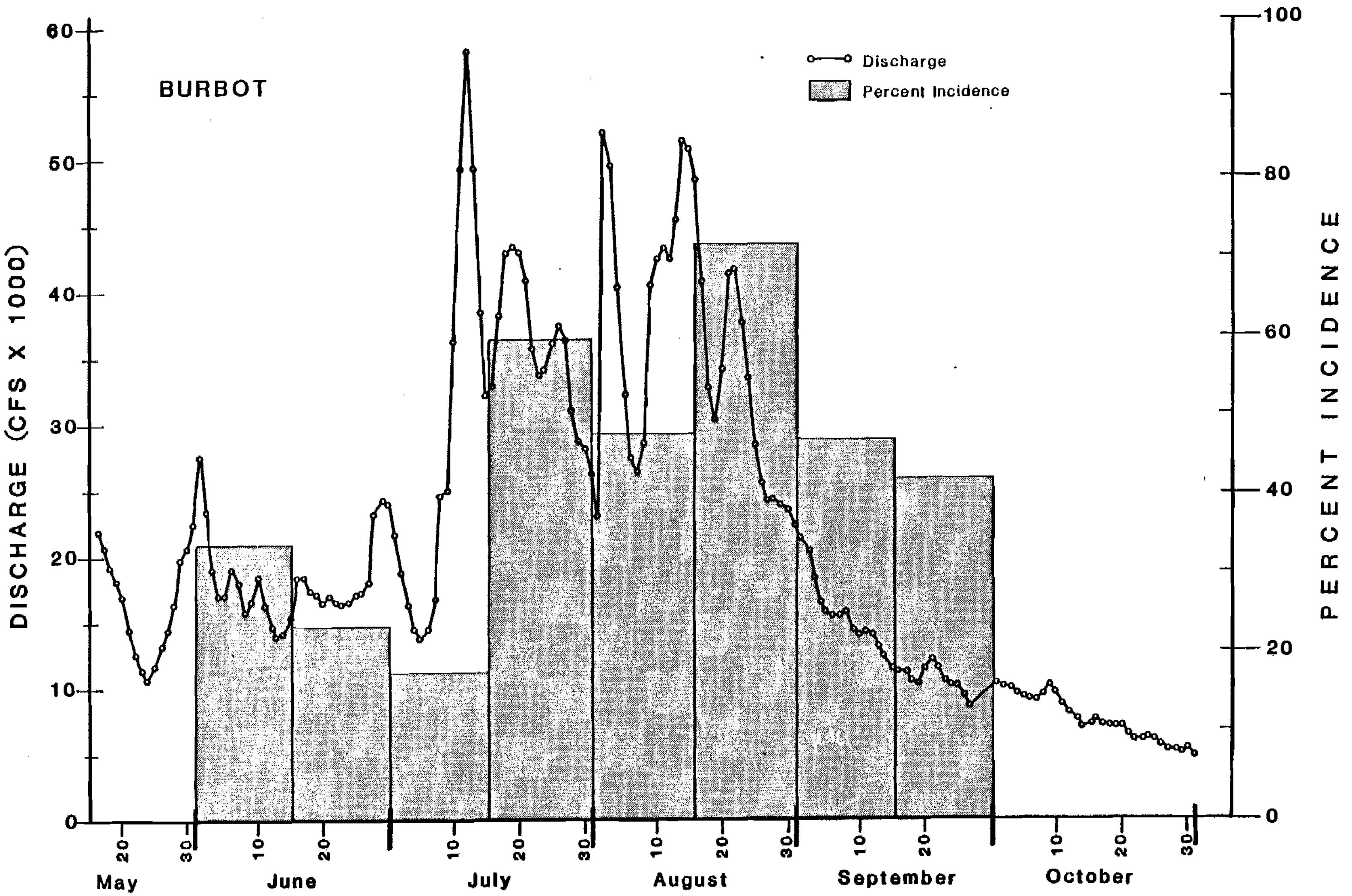


Figure E.2.12. Changes in the percent incidence of burbot catch in the Talkeetna to Devil Canyon reach of the Susitna River as it relates to mainstem discharge of the Susitna River at Gold Creek (adapted from USGS 1981 and ADF&G 1981f).

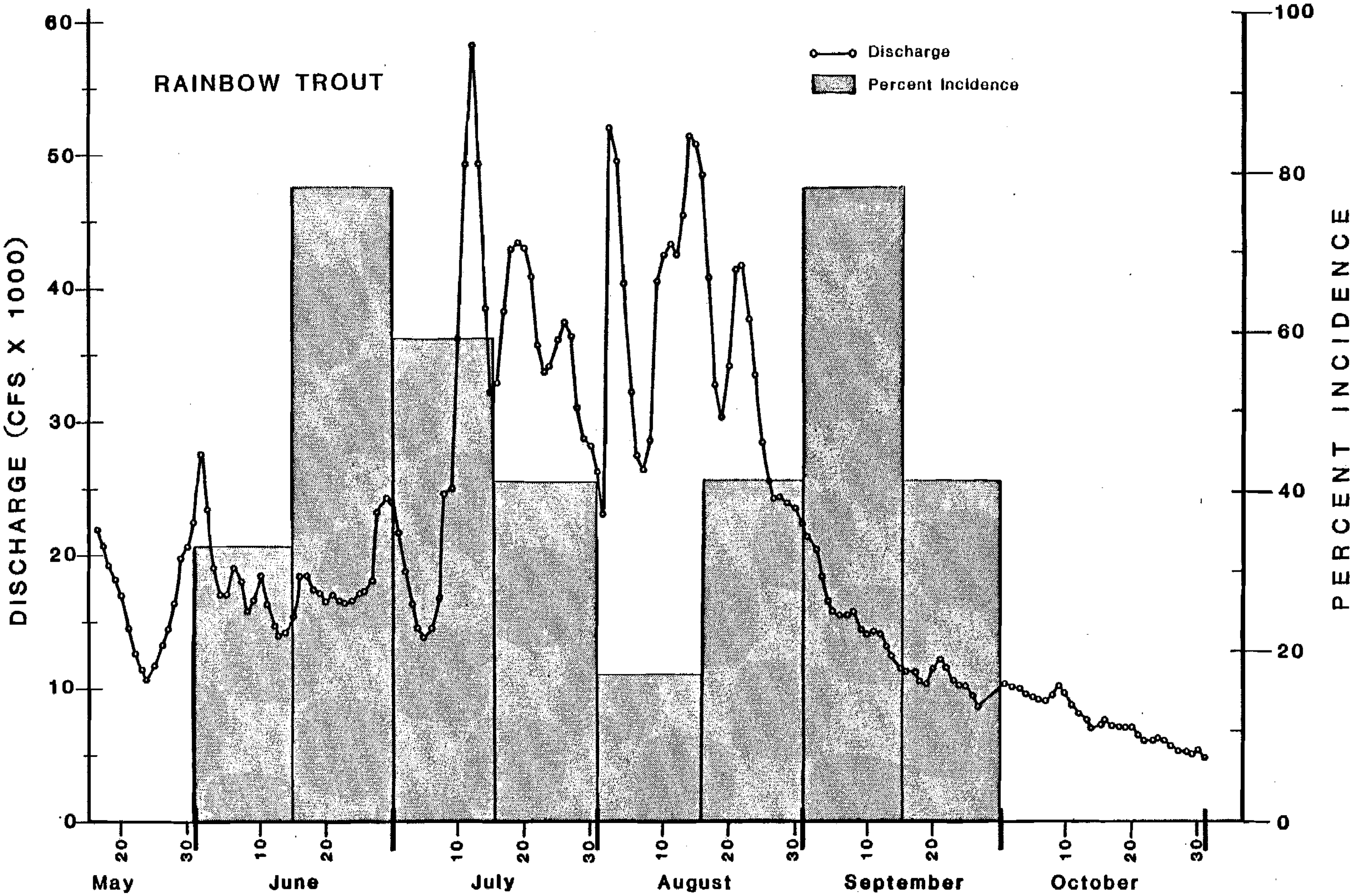


Figure E.2.13. Changes in the percent incidence of rainbow trout catch in the Talkeetna to Devil Canyon reach of the Susitna River as it relates to mainstem discharge of of the Susitna River at Gold Creek (adapted from USGS 1981 and ADF&G 1981f).

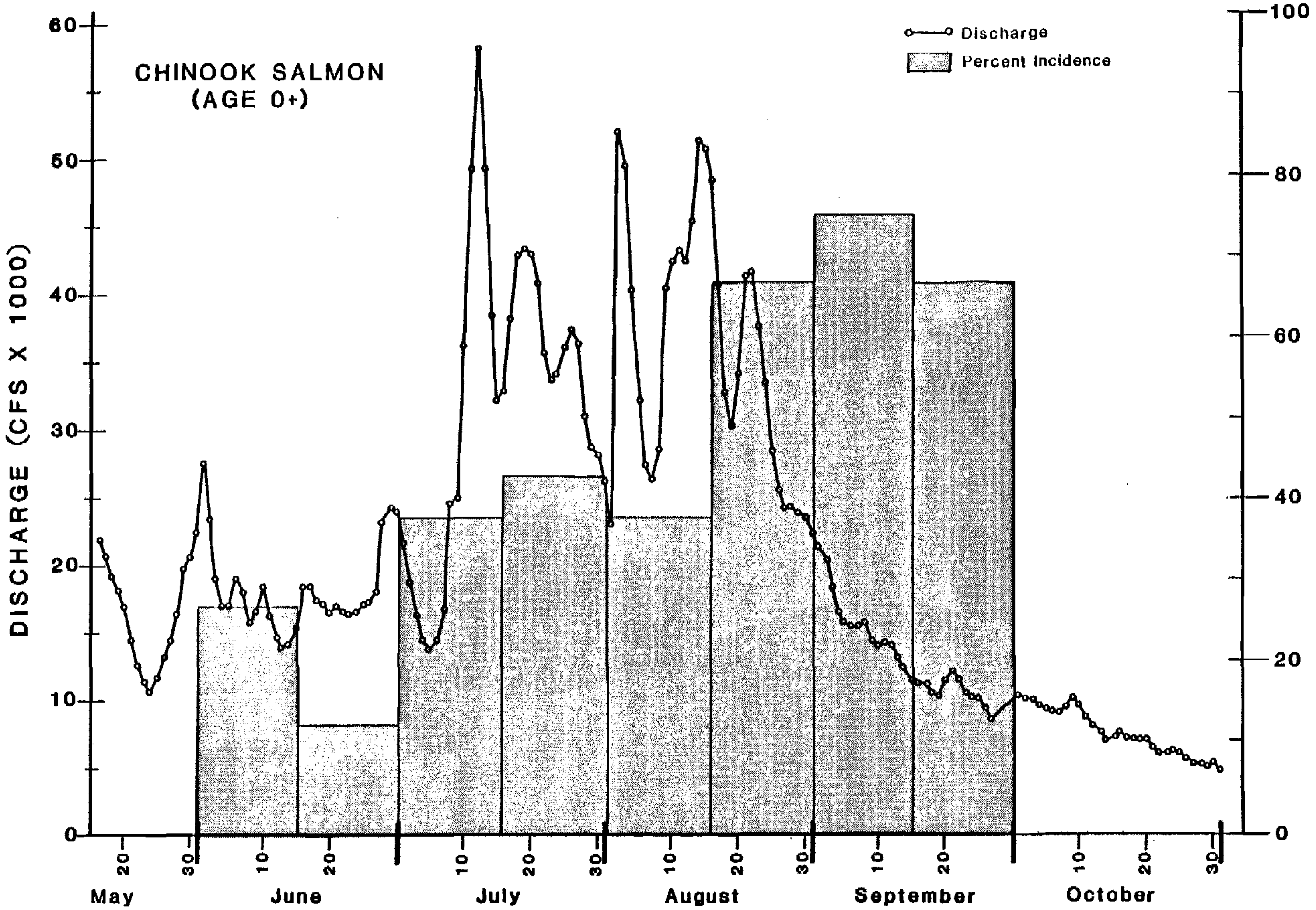


Figure E.2.14. Changes in the percent incidence of chinook salmon fry (age 0+) catch in the Talkeetna to Devil Canyon reach of the Susitna River as it relates to mainstem discharge of the Susitna River at Gold Creek (adapted from USGS 1981 and ADF&G 1981f).

Burbot, rainbow trout, and juvenile chinook salmon (age class 0+)* were selected for analysis because sampling techniques used to capture these species remained consistent throughout the open water season. Accordingly, the percent incidence figures reflect actual changes in fish distribution. Percent incidence for each species was calculated for minnow traps and trot lines for each two week period between June and September 1981. An equivalent number of study sites were sampled at mainstem (5), slough and side channel (7), and tributary mouth (5) habitat locations. Discharge data used in this analysis were recorded at the Gold Creek gaging station (USGS 1981). The percent incidence for all three species may not represent actual fish distribution for the June 1 through 15 and September 16 through 30 sampling periods due to limited sampling efforts. Likewise, data collected during peak discharge events may reflect gear efficiency rather than the influence of discharge on the suitability of fish habitat.

Changes in the percent incidence of burbot catch appear to coincide with similar changes in discharge (Figure E.2.12). Burbot were captured at fewer locations during low flows resulting in a corresponding low percent incidence of catch. The relative increases of both percent incidence of burbot catch and discharge may indicate that additional suitable habitat is available at higher flows. Burbot catches, during low flow conditions, were primarily restricted to the mainstem Susitna and deeper slough and side channel habitats. During higher flows, burbot were captured at a greater number of habitat locations, including shallow side-channels, sloughs, and tributary mouths.

* Age was determined by length/frequency and scale analysis (see ADF&G 1981d).

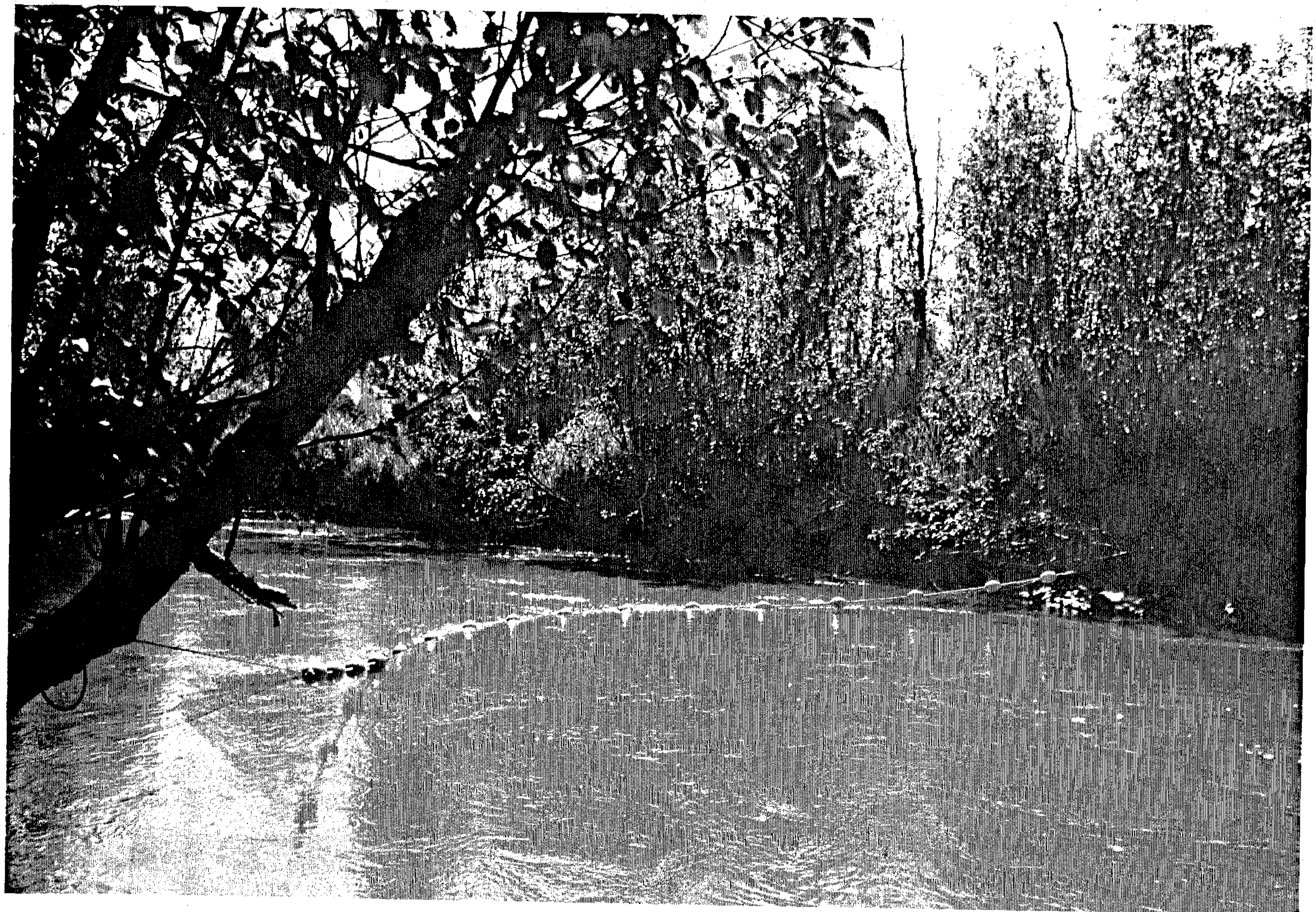


Plate 1. Gill net set at Slough West Bank (R.M. 74.4).

The percent incidence of rainbow trout catch illustrates an apparent inverse relationship to changes in mainstem discharge (Figure E.2.13). Rainbow trout were captured at a higher percentage of habitat locations during June and September 1981 (when mainstem discharges at Gold Creek ranged from approximately 10,000 to 20,000 cfs) than during July and August 1981 (when mainstem discharges generally ranged from 20,000 to 50,000 cfs). The change in percent incidence of catch could be explained by the migrational patterns of rainbow trout. Habitats utilized seasonally by rainbow trout for overwintering, spawning, and summer feeding vary (Scott and Crossman 1973; Morrow 1980). During the winter, rainbow trout are only captured in isolated slough and mainstem study sites, resulting in a low percent incidence of catch. As spring approaches and fish begin to migrate to tributaries to spawn, the rainbows are found in a greater range of study site habitats, corresponding to a higher percent incidence of catch during this period. Once the spring spawning migration is completed and the fish have relocated into the tributaries for spawning and summer habitat, the fish are found at fewer study sites, corresponding to a lower percent incidence of catch. As freeze-up begins and the fish outmigrate from the tributaries, they are again found to inhabit a greater range of study habitats, resulting in a higher percent incidence of catch.

The percent incidence of catch of chinook salmon fry in the Talkeetna to Devil Canyon reach of the Susitna River appears to be a function of fish growth (Figure E.2.14). The percent incidence of catch of these fry is relatively low in early June and increases at a steady rate through September regardless of fluctuations in discharge. The average total length of age 0+ chinook salmon increased from approximately 45 mm in early June to 75 mm in late

September (ADF&G 1981d). Therefore, it appears that as juvenile chinook salmon increase in length, they inhabit a greater variety and number of the habitats sampled (e.g. includes areas having higher water velocities).

2.4 Percent Trapping Incidence of Selected Fish Species in Relation to Point Specific Depth and Velocity

Point specific data* are required to ascertain the degree and extent to which specific habitat criteria (e.g. depth, velocity, substrate, water temperature, etc.) are utilized by an individual fish species for each life phase (i.e. spawning, incubation, rearing, and passage). These data provide the basis for defining the types and ranges of habitat characteristics which are associated with the continued existence of various life phases of a fish species. By comparing point specific utilization criteria with hydraulic data (which quantifies the wetted area having various point specific values at a range of discharges), one can predict the potential impacts of various flow regimes on fish habitat availability.

Point specific data (ADF&G 1981c) were collected at RJ fish trapping sites during the 1980-1981 field season. Evaluation of substrate characteristics was prevented when turbid water conditions were present. Fish trapping locations were selected on the basis of professional biological judgment, the primary objective being to select locations optimum for capturing fish as opposed to selecting locations representing the range of habitat types present

* Data collected in the same vertical water column and depth (or mean depth of the water column) as an organism or object of interest.

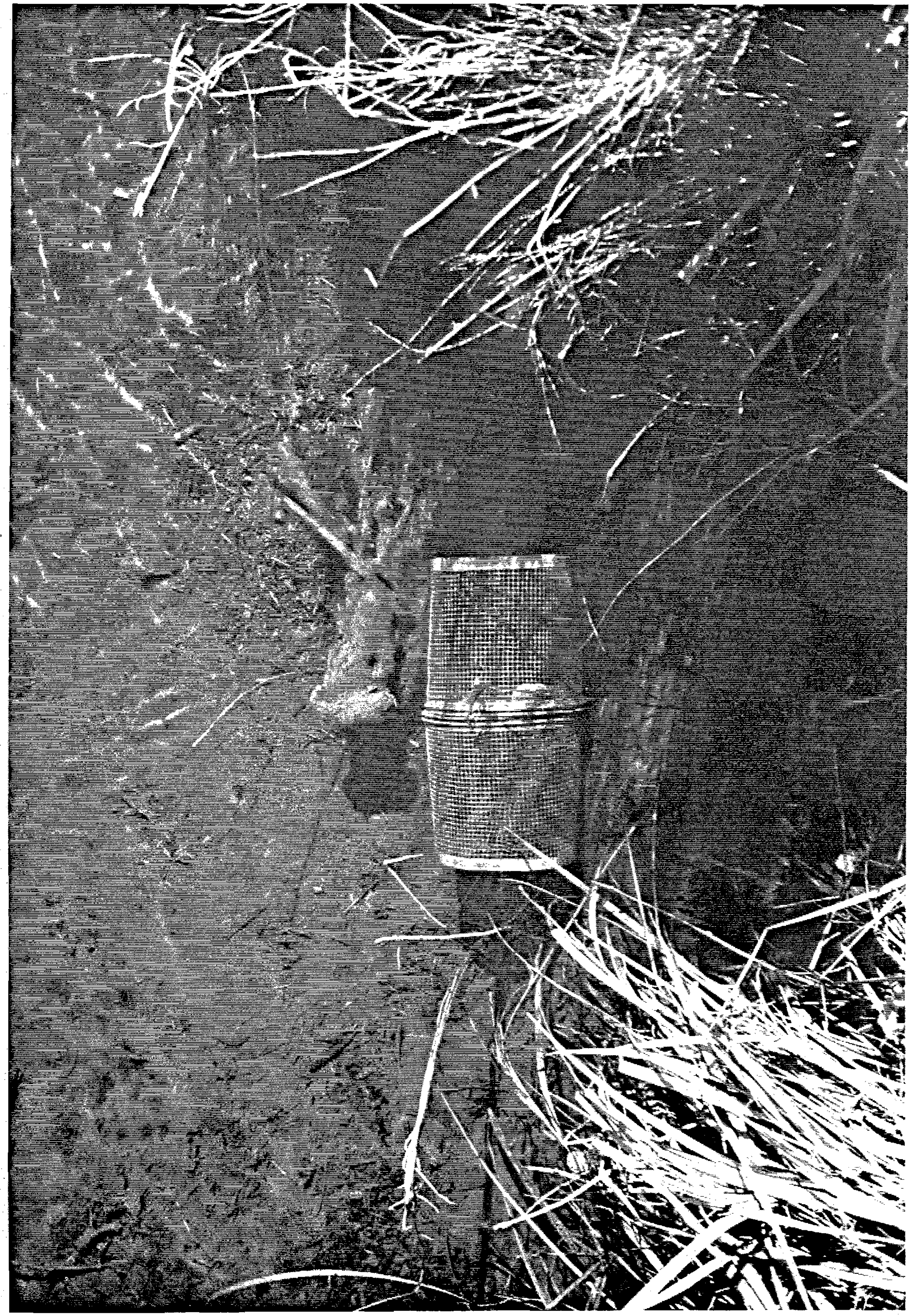


Plate 2. Baited fry trap set at Whiskers Creek.

at the individual fish collection site. Accordingly, interpretation of 1981 observed relationships between trapping incidence and point selected depths and velocities is limited to the distribution of depths and velocities occurring at specific trap sites.

Analytical limitations resulting from this restricted sampling distribution can be partially overcome from a statistical (or data analysis point of view) by controlling for the given sampling distribution (the range over which the parameters were actually sampled). However, interpretation of trapping incidence as it might be affected by depth and velocity would then only be valid from a statistical point of view.

Two examples of trapping incidence (juvenile chinook salmon captured in baited minnow traps and rainbow trout captured on baited trotlines) versus point specific depth and mean column velocity are presented as illustrations (Figures E.2.15 and E.2.16)*. The sparse sampling effort in terms of the larger depths and velocities (Figures E.2.15 and E.2.16) may indicate that a narrow range of habitat types with these larger depths and velocities was sampled. Generally, it appears that both juvenile chinook salmon captured in minnow traps and rainbow trout on trotlines are collected in all of the depths and velocities from which they are sampled (Figure E.2.15 and E.2.16). However, this apparent relationship may only be a function of the limited

* Note that the top two graphs on both figures represent the total sampling distribution of the appropriate gear in terms of depth and velocity. The bottom two graphs represent the number of traps or trotlines in which at least one individual of the appropriate species were collected.

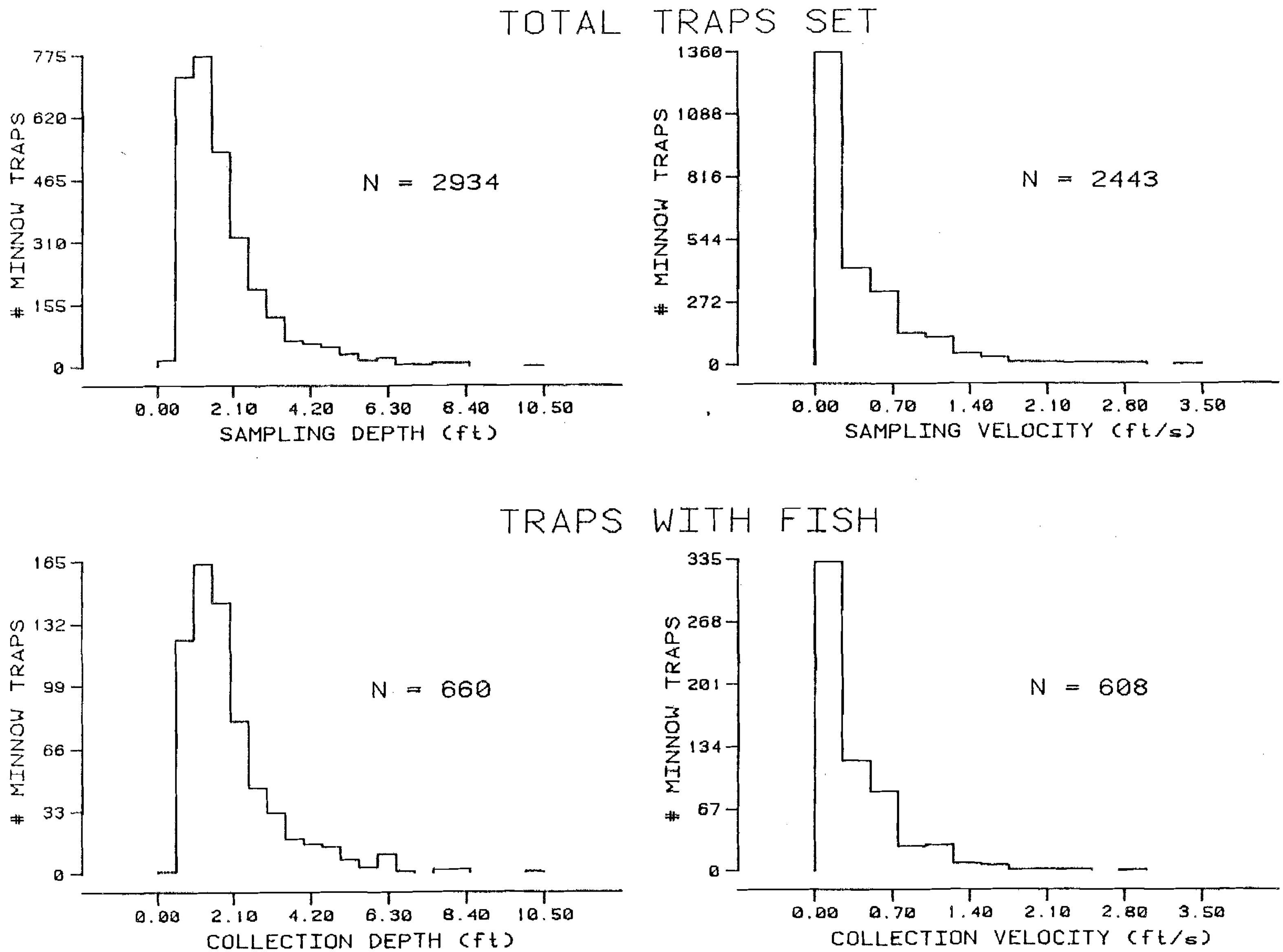


FigurE.2.15. Trapping incidence data for juvenile chinook salmon versus point specific depth and mean column water velocity data collected in minnow traps at habitat locations, 1981 (ADF&G 1981c and d).

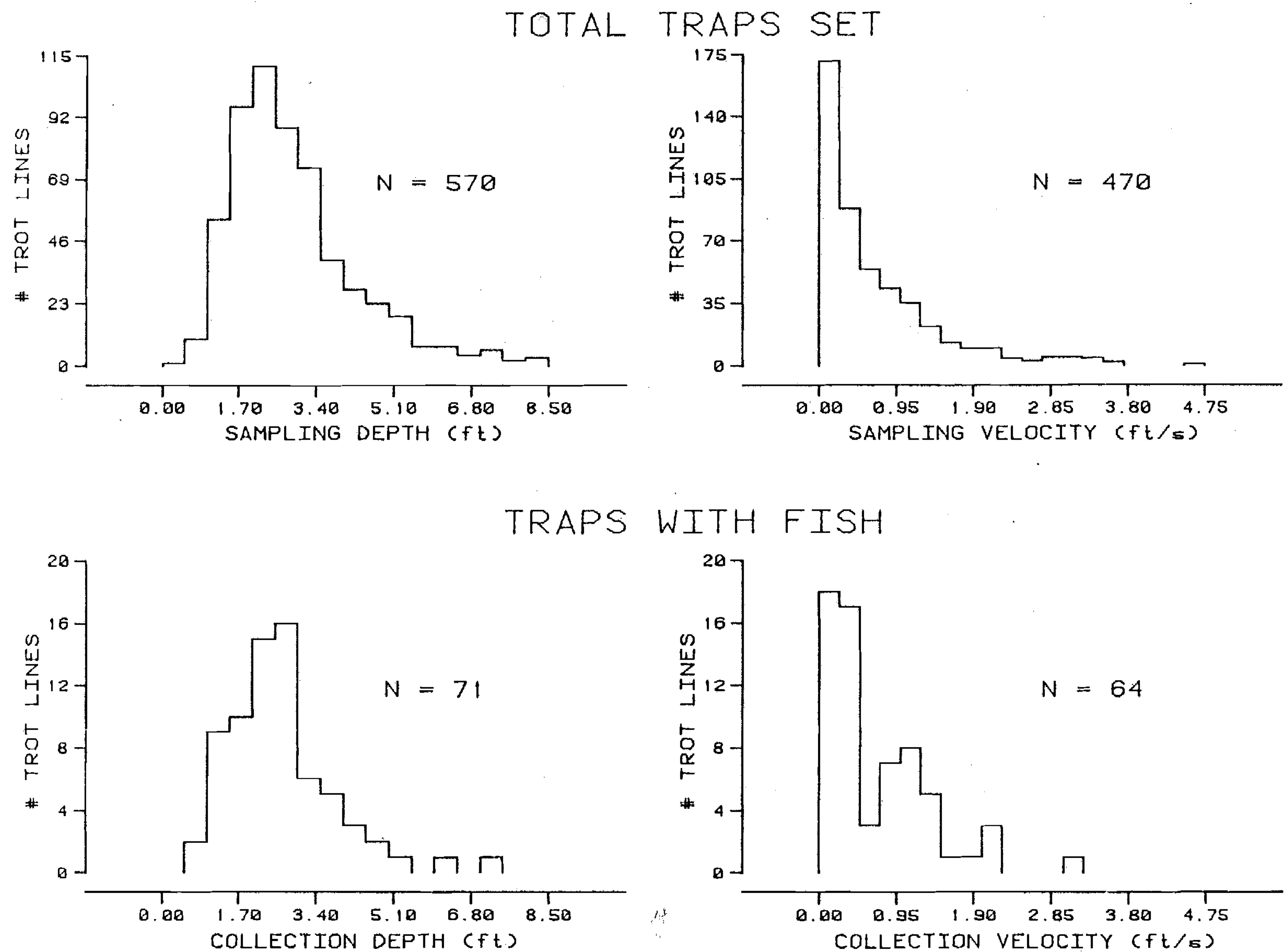


Figure E.2.16. Trapping incidence data for rainbow trout versus point specific depth and mean column water velocity data collected by trot lines at habitat locations, 1981 (ADF&G 1981c and f).

sampling distribution chosen. Without information on the distribution of depths and mean column velocities in the habitats sampled, it is inappropriate to conclude that these fish utilize a particular depth or velocity. These data can however be viewed to represent the effectiveness of various types of sampling gear to collect a particular species in the habitats sampled.

Improvements in this data base will be necessary to better define the ranges of physical characteristics utilized by fish. Fish distribution and habitat utilization field crews will be segregated in 1982. This will enable habitat utilization crews to concentrate their efforts at specific sites and better define the range of point specific habitat criteria utilized by fish (i.e. sample with the primary objective of identifying fish habitat utilization rather than of catching fish). Sampling methods will be employed which permit fish to be observed in the habitat they are occupying, that is techniques which do not attract fish to sampling sites or at least reduce the extent to which a technique will attract fish to a sampling site or to leave the habitat originally occupied. These methods could include: direct visual observation, electrofishing, seining, baited* and baitless (and possibly modified) minnow traps, radio telemetry, and nets. In addition to perfecting these sampling approaches, modifications to substrate evaluation techniques will be adopted so that methods become more uniform and practical (in terms of application to the Susitna River drainage).

* A series of baited minnow traps which are equally distributed along a transect to ensure that a variety of habitats are sampled while at the same time reducing the bias of baiting traps.

2.5 Bering Cisco Spawning Habitat Evaluation

Although Bering cisco were not previously known to occur in the Susitna River system, spawning activities of these fish were observed by RJ/AH electrofishing crews downstream of Talkeetna in 1981 (ADF&G 1981f). Although four major areas of spawning activity were located between R.M. 75 and R.M. 80, the extent of Bering cisco spawning activity in other portions of the Susitna River is unknown. A discussion of the life history of the Bering cisco and 1981 catch data are presented in the RJ subject report (ADF&G 1981f).

A preliminary habitat evaluation of these three spawning areas was undertaken to begin understanding the habitat characteristics associated with Bering cisco spawning. The results of the surveys are presented in Table E.2.2 and Figures E.2.17 to E.2.19. Bering cisco were observed to spawn in relatively shallow water, riffle, and bank zone areas. Substrate used for spawning ranged from silt/sand (particle sizes less than 1/16") to cobble (particle sizes 3"-6"), with gravel (particle sizes 1"-3") and cobble being predominant. Mean water column velocities and water depths were measured at the surveyed spawning areas as described in Bovee and Cochnauer (1977), and ranged from 1.5 to 4.7 ft/sec. and 1.4 to 1.9 ft deep respectively. Surface water temperatures ranged from 3.0 to 3.8°C.

The limited number of spawning sites evaluated (Table E.2.2 and Figures E.2.17 - E.2.19) may not represent the range of conditions characterizing Bering cisco spawning habitat. Accordingly, continuation of these detailed studies are planned for Phase II in 1982.

Table E.2.2. Bering cisco spawning site evaluation on the Susitna River, October 10-13, 1981 (adapted from ADF&G 1981c, f).

Site	Water Temp. (°C)	pH	Specific Conductance (umhos /cm)	Dissolved Oxygen (mg/l)	Mean Spawning Depth (ft)	Mean Spawning Depth Standard Error	Mean Spawning Velocity ft/sec	Mean Spawning Velocity Standard Error	Substrate
Sunshine (R.M. 78-79) (combined riffle and gravel bar zone)	3.8	7.0	127	12.3	1.50	0.08 (n=39)	1.50	0.12	40%:1"-3"gravel 25%:3"-6"gravel 20%:silt & sand 10%:1/4"-1"gravel
Montana 1 (R.M. 77-77.5) (gravel bar zone)	3.0	7.0	131	13.4	1.38	0.16 (n=12)	2.23	0.27	30%:1"-3"gravel 30%:3"-6"gravel 20%:silt & sand 10%:1/4-1"gravel
Montana 2 (R.M. 76-77) (upper riffle zone)	3.3	6.8	128	12.6	1.64	0.09 (n=18)	1.66	0.12	30%:1"-3"gravel 30%:3"-6"gravel 20%:silt & sand 10%:1/4"-1"gravel
Mainstem-West Bank (R.M. 75.0) (gravel bar zone)	3.1	7.0	134	13.0	1.85	0.12 (n=12)	4.67	0.25	40%:1"-3"gravel 20%:3"-6"gravel 20%:sand & silt 10%:1/4"-1"gravel

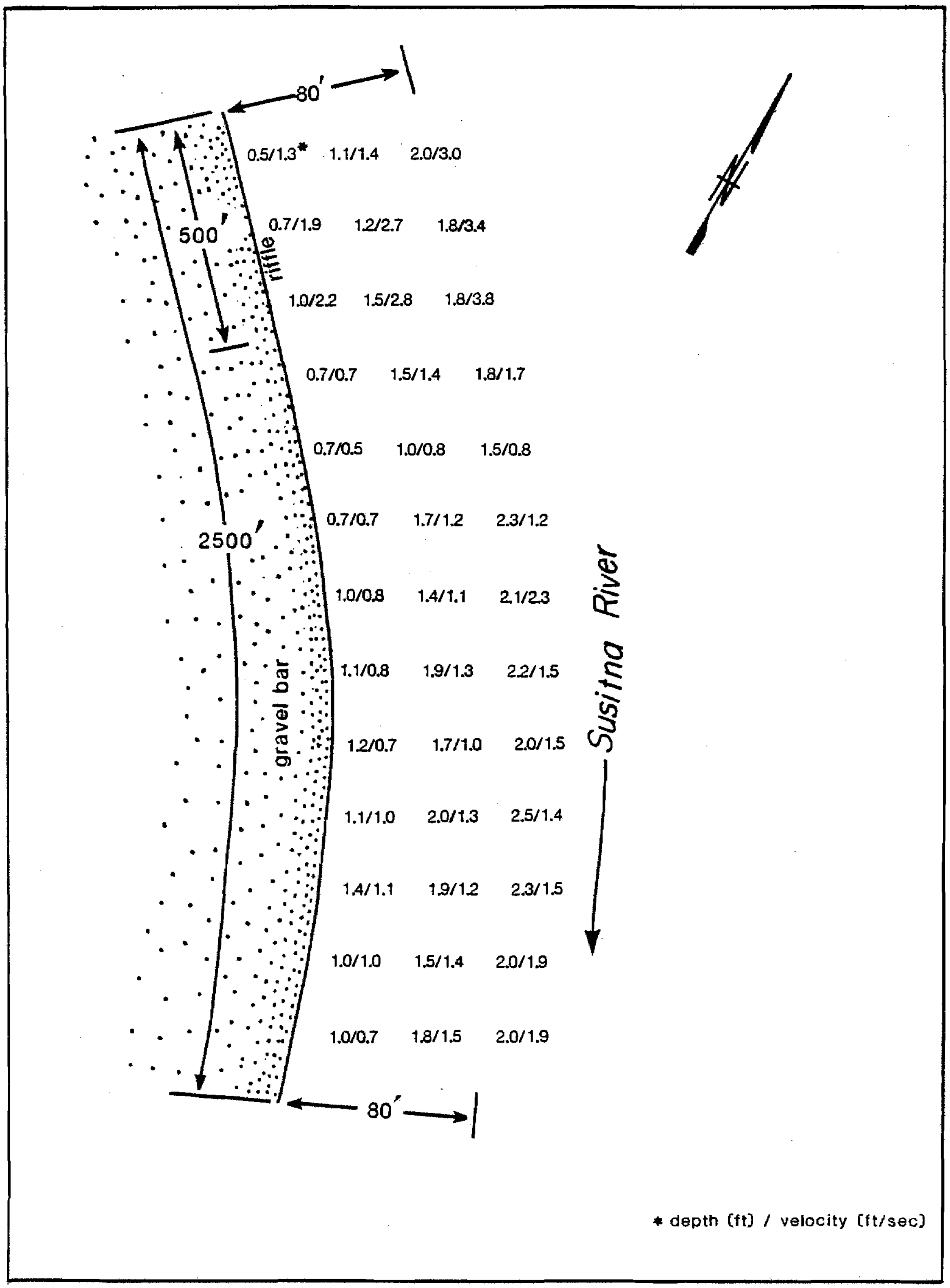


Figure E.2.17. Bering cisco spawning area on the Susitna River at Sunshine, R.M. 78.0 to R.M. 79.0, October 13, 1981 (adapted from ADF&G 1981f).

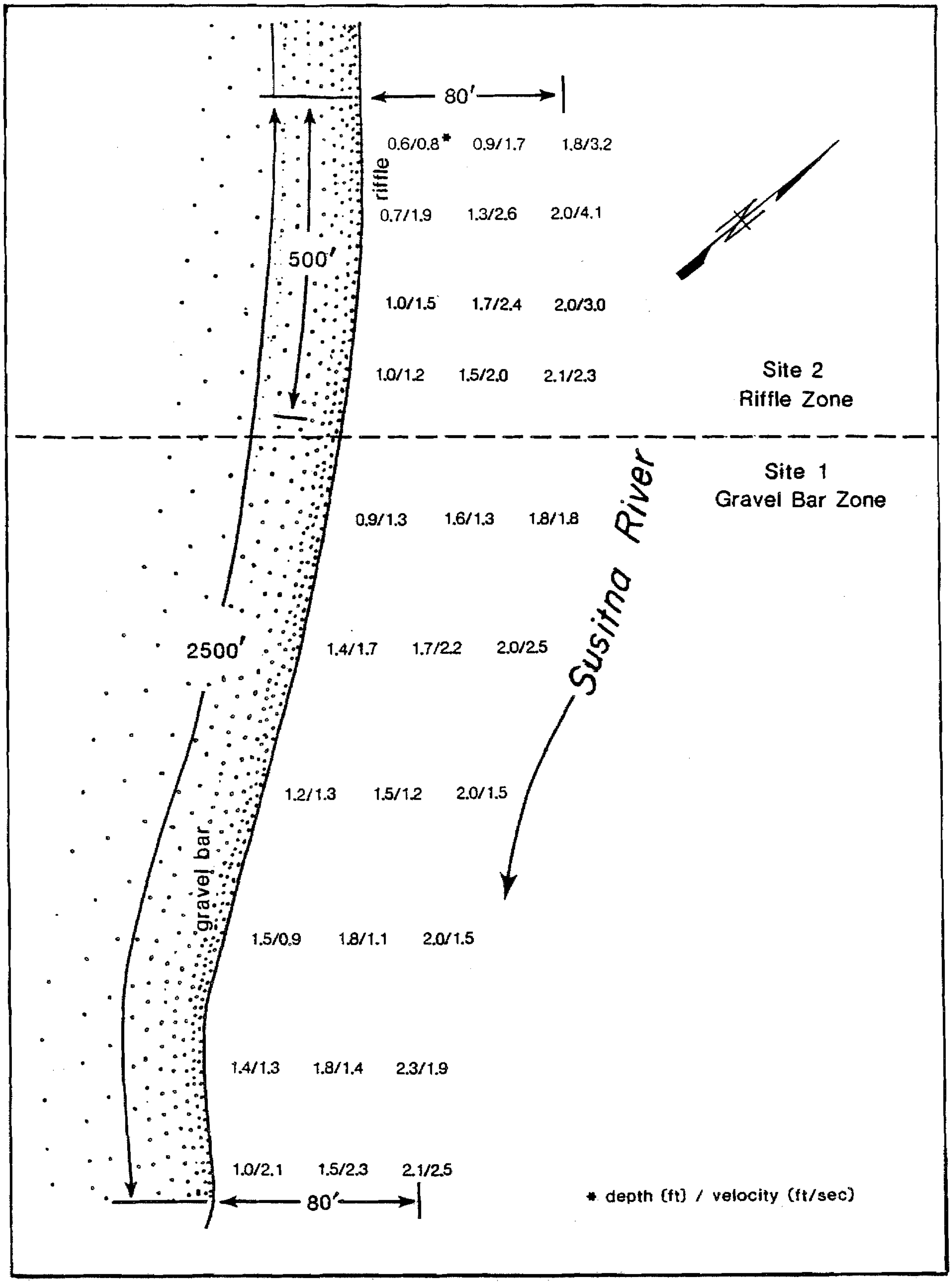


Figure E.2.18. Bering cisco spawning area on the Susitna River at Montana Creek (Sites 1 and 2), R.M. 76.0 to R.M. 77.5, October 15, 1981 (adapted from ADF&G 1981f).

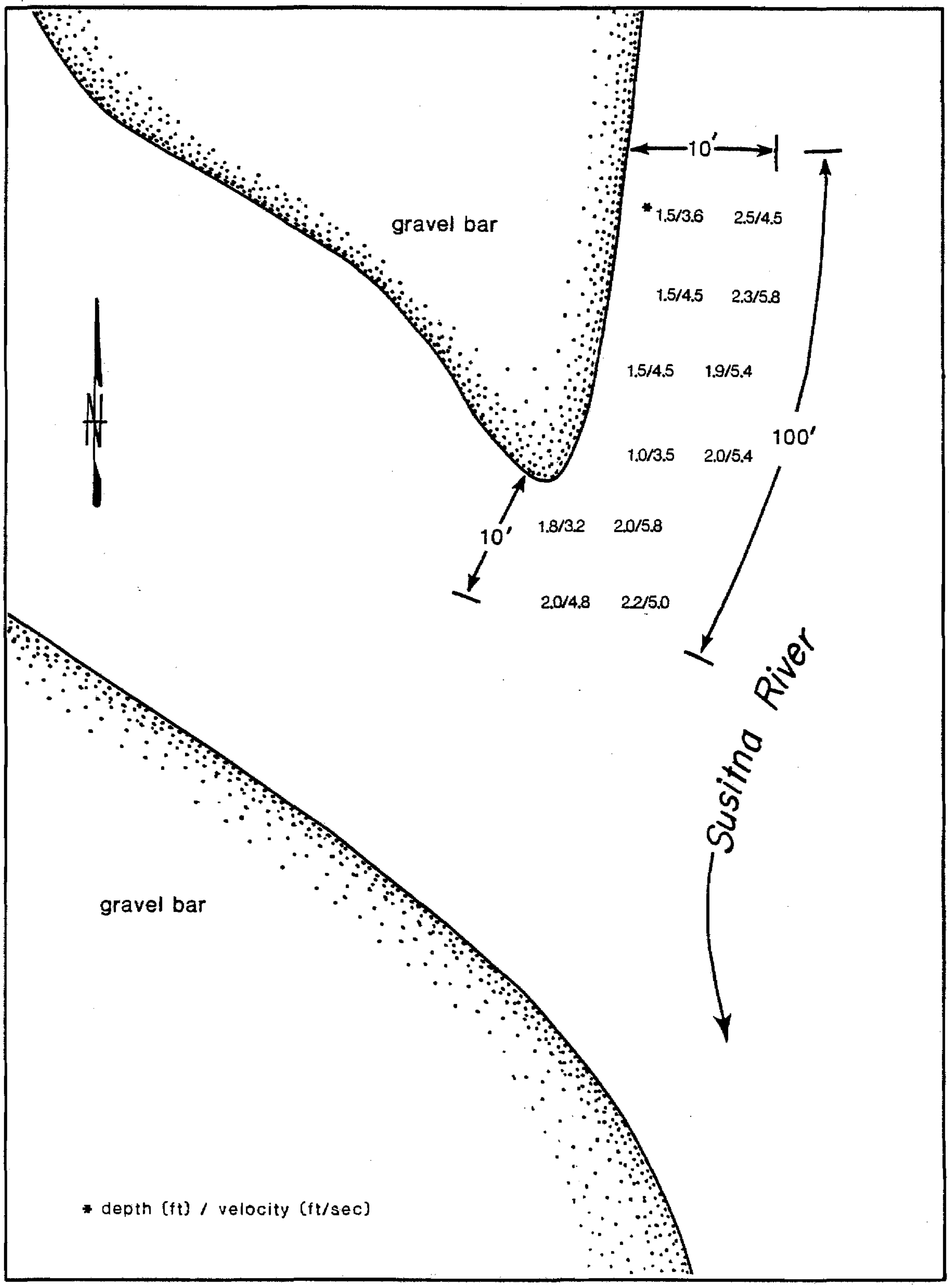


Figure E.2.19. Bering cisco spawning area on the Susitna River at mainstem West Bank R.M. 75.0 October 13, 1981 (adapted from ADF&G 1981f).

2.6 Matrixes of Fishery and Physiochemical Observations

Matrixes of the ranges of physiochemical parameters measured (ADF&G 1981c) and life phases of fish* species (ADF&G 1981a, d, f, g) captured or observed during the open water (May-September, 1981) field season at each general habitat evaluation study site**, grouped by river reach, are presented in Tables E.2.3 to E.2.7. Selected habitat slough evaluation site** data are presented in Table E.2.8. This information is intended for use as a general indication of the relative changes in water quality over the five month open-water sampling period in 1981 and to catalog fish species observed at the time of sampling. The physiochemical data do not represent the full range of seasonal habitat conditions used by the life stages of fish species included in the matrix. Species lists for each location do not necessarily include all species and life phases present at that location. Further study combined with additional analysis data collected prior to 1981, will be required to define patterns of fish occurrence and the habitat criteria associated with these patterns.

Keeping these limitations in mind, some provisional conclusions can be derived from these matrixes. Adult anadromous salmon species have not been observed in the impoundment study reach, supporting the belief that hydraulic characteristics of the Susitna River at Devil Canyon may act as a barrier to salmon movement. The higher number of fish species present in the lower

* Arctic lamprey (*Lampetra japonica*) may represent both anadromous and resident forms (ADF&G 1981f).

** Descriptions and locations of these sites are presented in the AA, AH, and RJ subject reports (ADF&G 1981a, c, d, f, g).

Table E.2.3. Matrix of observed fish species and physiochemical parameters for habitat locations in the Yentna study reach of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for futher interpretation.

HABITAT LOCATION	FISH SPECIES: Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.
Fish Creek		X				X							X		X	X		X	X					
Alexander Creek																								
Site A		X		X									X	X	X	X		X	X		X	X		1
Site B		X		X										X		X		X	X		X	X		
Site C	X	X		X			X	X				X	X	X		X	X	X	X		X	X		
Anderson Creek	X	X	X	X	X					X			X	X	X	X		X	X		X	X		
Kroto Slough Mouth		X	X	X	X								X			X		X	X				X	
Mainstem Slough		X	X	X	X		X			X	X	X	X		X	X		X	X		X			
Mid-Kroto Slough		X	X	X									X	X	X	X		X	X		X			
Deshka River																								
Site A		X	X	X	X		X		X			X		X	X	X		X	X	X	X	X		1
Site B		X		X								X		X				X	X		X	X		
Site C		X											X	X				X	X		X	X		
Delta Island		X							X				X				X	X	X					
Little Willow Creek	X	X	X	X			X						X	X	X				X		X	X		1

HABITAT LOCATION	PHYSIOCHEMICAL PARAMETERS: Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Fish Creek	9.6 - 9.7	---	114 - 118	210.00 - 230.00	12.4 - 13.6	19.2 - 21.0	
Alexander Creek							
Site A	8.9 - 10.2	6.9 - 7.2	78 - 99	1.40 - 29.00	11.6 - 14.4	11.0 - 12.2	
Site B	9.0 - 9.7	7.1	78 - 96	2.50 - 36.00	11.7 - 15.4	12.0 - 15.5	
Site C	8.4 - 9.6	6.4 - 7.1	76 - 95	.99 - 24.00	12.3 - 17.8	12.5 - 21.0	
Anderson Creek	8.4 - 11.3	6.5 - 7.9	70 - 123	4.00 - 190.00	6.0 - 14.3	6.1 - 21.4	
Kroto Slough Mouth	8.3 - 9.9	6.8 - 9.7	80 - 199	18.00 - 150.00	5.9 - 16.8	10.1 - 25.0	
Mainstem Slough	9.7 - 12.0	7.0 - 9.2	88 - 137	24.50 - 225.00	3.6 - 14.9	8.1 - 15.8	
Mid-Kroto Slough	9.8 - 10.9	7.3 - 7.4	94 - 132	21.00 - 200.00	8.9 - 15.2	13.7 - 21.0	
Deshka River							
Site A	8.2 - 11.4	6.6 - 7.4	39 - 80	3.10 - 90.00	5.4 - 15.8	6.0 - 18.0	
Site B	8.4 - 11.5	6.0 - 7.0	29 - 66	1.60 - 3.60	3.9 - 19.4	6.0 - 20.8	
Site C	8.5 - 12.0	6.0 - 6.9	28 - 47	2.00 - 5.40	4.1 - 16.2	7.0 - 22.4	
Delta Island	9.7 - 10.6	7.6	103 - 118	110.00 - 150.00	10.9 - 13.2	15.4 - 34.0	
Little Willow Creek	9.9 - 12.4	5.5 - 6.9	34 - 39	1.50 - 28.00	2.0 - 15.5	12.0 - 31.0	

[1] ADF&G 1978

--- Data not collected.

Table E.2.4. Matrix of observed fish species and physiochemical parameters for habitat locations in the Sunshine study reach of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for further interpretation.

FISH SPECIES

HABITAT LOCATION	Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Greyling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.
Rustic Wilderness		X		X								X					X	X	X		X	X		
Kashwitna River		X	X	X					X			X	X	X	X		X	X	X			X		2
Caswell Creek		X	X	X	X		X		X					X				X	X			X		
Slough-West Bank		X		X									X				X	X				X		
Sheep Creek Slough	X	X	X	X			X		X				X	X	X	X	X	X	X			X		
Goose Creek (Lower) 1		X	X	X			X		X			X	X	X			X		X		X	X		
Goose Creek (Lower) 2		X	X	X			X		X			X	X	X	X		X	X				X		
Goose Creek Slough		X	X	X			X		X			X	X	X	X		X	X				X		
Mainstem-West Bank		X		X								X	X	X	X	X		X	X			X		
Montana Creek	X	X	X	X	X		X		X			X		X	X		X	X	X		X	X		1,2,3
Sunshine Camp Fishwheel	X		X		X		X		X		X	X	X	X	X	X	X							

PHYSIOCHEMICAL PARAMETERS

HABITAT LOCATION	Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Rustic Wilderness	8.9 - 12.1	6.9 - 7.5	67 - 72	61.00 - 150.00	8.5 - 14.2	12.2 - 17.4	
Kashwitna River	9.8 - 12.9	6.4 - 7.1	24 - 36	4.50 - 42.00	6.4 - 12.4	10.4 - 21.2	1,2
Caswell Creek	7.6 - 11.3	6.1 - 7.0	27 - 46	1.00 - 1.90	9.0 - 16.0	12.8 - 16.0	1,2
Slough-West Bank	8.0 - 12.1	6.8 - 7.6	68 - 216	21.00 - 210.00	6.4 - 10.8	10.2 - 16.0	
Sheep Creek Slough	9.3 - 11.0	6.1 - 7.2	29 - 47	2.20 - 4.00	7.8 - 18.0	12.0 - 21.6	
Goose Creek (Lower) 1	9.2 - 12.2	6.1 - 7.1	18 - 37	0.40 - 4.50	6.3 - 10.7	9.6 - 17.8	1,2
Goose Creek (Lower) 2	10.4 - 12.1	6.0 - 7.1	19 - 27	0.63 - 3.40	7.3 - 10.3	11.8 - 18.6	
Goose Creek Slough	10.6 - 12.1	6.8 - 7.7	56 - 85	9.10 - 120.00	7.7 - 11.0	---	
Mainstem-West Bank	10.5 - 12.6	6.7 - 8.0	76 - 142	6.30 - 255.00	3.2 - 10.0	5.5 - 16.4	
Montana Creek	10.0 - 11.9	6.0 - 6.7	21 - 37	0.30 - 1.70	10.9 - 12.6	13.4 - 18.6	1,2,3
Sunshine Camp Fishwheel	---	---	---	---	---	---	

1 ADF&G 1976
2 ADF&G 1977
3 ADF&G 1978
--- Data not collected.

Table E.2.5. Matrix of observed fish species and physiochemical parameters for habitat locations in the Talkeetna study reach of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for further interpretation.

FISH SPECIES

HABITAT LOCATION	Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.
Mainstem 1	X	X	X	X	X		X		X			X	X	X	X	X	X	X	X					
Sunshine Creek	X	X	X	X								X	X	X	X	X		X	X			X		
Birch Creek Slough		X	X	X	X		X					X	X	X	X	X		X	X			X		
Birch Creek		X	X	X	X	X	X					X	X	X			X	X	X			X		1,2,3
Cache Creek Slough		X	X	X			X					X	X	X	X		X	X	X			X		
Cache Creek		X	X	X	X		X	X	X			X	X	X	X			X	X			X		
Whiskers Creek Slough	X	X		X								X	X	X	X	X	X	X	X			X		
Whiskers Creek	X	X	X	X										X				X	X		X	X		1,2,4
Slough 6A		X		X			X						X	X	X	X		X	X			X		1,2,4
Lane Creek	X	X		X			X					X	X	X				X	X			X		1,2,4
Mainstem 2	X	X	X	X	X		X		X			X	X	X	X	X	X	X	X			X		1,2,4

PHYSIOCHEMICAL PARAMETERS

HABITAT LOCATION	Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Mainstem 1	10.3 - 11.3	6.4 - 7.5	78 - 145	25.00 - 170.00	7.7 - 12.8	9.4 - 18.0	
Sunshine Creek	9.8 - 10.9	5.6 - 7.3	40 - 65	1.60 - 23.00	8.9 - 15.5	8.0 - 18.2	
Birch Creek Slough	9.4 - 10.3	6.2 - 7.4	67 - 132	2.40 - 95.00	8.4 - 16.0	8.0 - 20.0	
Birch Creek	9.4 - 11.1	5.7 - 7.2	43 - 100	0.50 - 7.50	8.8 - 15.4	9.0 - 19.6	1,2,3
Cache Creek Slough	11.2 - 12.3	6.2 - 7.7	57 - 135	80.00 - 270.00	4.9 - 14.1	5.0 - 23.0	
Cache Creek	5.0 - 12.3	5.7 - 7.3	31 - 304	0.60 - 22.00	5.5 - 11.9	12.0 - 24.5	
Whiskers Creek Slough	10.5 - 11.6	5.3 - 6.6	18 - 43	0.50 - 23.00	7.6 - 18.0	10.0 - 23.6	
Whiskers Creek	10.7 - 12.8	5.1 - 6.6	15 - 31	0.60 - 3.70	7.6 - 16.2	11.0 - 23.0	1,2,4
Slough 6A	11.8	5.6 - 7.1	42 - 113	1.00 - 22.00	4.8 - 16.5	7.0 - 22.4	1,2,4
Lane Creek	10.9	6.4 - 7.2	45 - 65	0.60 - 5.40	5.2 - 9.8	7.0 - 21.8	1,2,4
Mainstem 2	11.6	6.6 - 7.4	98 - 158	13.00 - 135.00	5.3 - 15.2	7.0 - 18.0	

[1] ADF&G 1974
[2] ADF&G 1976
[3] ADF&G 1977
[4] ADF&G 1978
--- Data not collected.

Table E.2.6. Matrix of observed fish species and physiochemical parameters for habitat locations in the Gold Creek study reach of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for further interpretation.

FISH SPECIES

HABITAT LOCATION	Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.
Curry		X					X					X	X	X	X		X	X	X			X		2
Side Channel		X					X					X	X	X	X		X	X				X		
Gravel Bar		X		X			X					X	X	X				X				X		
Slough 8A		X	X	X	X		X			X			X	X	X	X	X	X	X			X		
4th of July Creek	X	X	X	X			X		X	X		X		X			X	X	X			X		2,3,4
Slough 10	X	X		X			X	X		X		X	X	X	X	X	X	X	X			X		2,3,4
Slough 11		X	X	X	X		X	X						X	X	X		X	X			X		2,3,4
Inside Bend	X	X		X								X	X	X				X				X		
Indian River	X	X	X	X		X	X					X		X	X	X	X	X				X		2,3,4
Slough 20		X		X	X		X	X				X	X	X				X	X			X		2,3,4
Island		X										X	X		X			X	X			X		
Portage Creek	X	X								X		X	X	X	X	X	X	X				X		2,3,4
<u>Helicopter Sites</u>																								
Indian River 1		X		X						X				X			X					X		
Indian River 2		X		X													X					X		
Indian River 3a																								
Indian River 3b		X		X													X					X		
Portage Creek 1		X		X											X		X					X		
Portage Creek 2		X															X							
Portage Creek 3a				X													X							
Portage Creek 3b																	X							

PHYSIOCHEMICAL PARAMETERS

HABITAT LOCATION	Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Curry	9.1 - 10.9	7.2 - 7.5	98 - 152	23.00 - 110.00	6.9 - 15.0	8.8 - 21.4	1
Side Channel	9.5 - 10.3	6.7 - 7.6	77 - 129	22.00 - 93.00	8.1 - 16.3	11.2 - 26.0	
Gravel Bar	9.6 - 11.0	7.3 - 7.8	104 - 167	7.50 - 230.00	0.6 - 14.5	3.6 - 19.8	
Slough 8A	8.8 - 10.5	6.8 - 7.6	108 - 160	0.70 - 205.00	4.5 - 16.4	3.0 - 26.4	2,4
4th of July Creek	9.2 - 10.1	6.3 - 6.7	15 - 31	0.40 - 30.00	2.0 - 15.0	2.2 - 25.1	3,4
Slough 10	9.0 - 11.5	7.0 - 7.8	101 - 171	1.50 - 190.00	2.7 - 12.8	4.6 - 24.2	2,3,4
Slough 11	9.3 - 10.7	6.8 - 7.1	144 - 222	1.50 - 98.00	4.0 - 9.7	5.3 - 25.0	2,3,4
Inside Bend	10.4 - 11.8	7.0 - 7.6	92 - 168	9.00 - 150.00	1.8 - 11.8	0.6 - 23.4	
Indian River	8.6 - 10.6	6.4 - 7.4	31 - 49	2.00 - 15.00	5.4 - 12.2	3.0 - 17.6	1,2,4
Slough 20	10.3 - 11.0	6.9 - 7.6	39 - 104	1.50 - 148.00	3.8 - 11.5	4.2 - 18.0	2,4
Island	10.2 - 11.9	7.2 - 7.5	66 - 150	13.00 - 140.00	2.7 - 11.7	4.8 - 15.4	
Portage Creek	9.5 - 11.0	6.6 - 7.1	55 - 98	2.30 - 25.00	2.9 - 8.9	4.6 - 17.8	1,3,4
<u>Helicopter Sites</u>							
Indian River 1	10.6 - 12.3	5.8 - 6.7	40 - 52	0.50 - 1.80	2.7 - 7.2	4.4 - 13.6	
Indian River 2	6.8 - 12.0	5.9 - 6.8	38 - 45	1.00 - 2.40	3.4 - 7.9	4.1 - 19.2	
Indian River 3a	10.7	6.8	51	---	4.6	---	
Indian River 3b	10.0 - 11.8	6.0 - 6.3	38 - 49	0.75 - 2.20	3.3 - 8.4	2.9 - 20.5	
Portage Creek 1	10.2 - 12.1	6.9	78 - 158	0.75 - 3.80	1.5 - 9.4	1.9 - 20.4	
Portage Creek 2	10.3 - 12.3	6.7 - 6.9	72 - 128	0.25 - 0.40	1.5 - 8.3	2.1 - 26.3	
Portage Creek 3a	10.4	7.2	50	---	5.9	---	
Portage Creek 3b	10.6 - 12.3	6.1 - 6.8	48 - 82	0.44 - 0.50	2.0 - 7.0	2.4 - 23.8	

[1] ADF&G 1974
[2] ADF&G 1976
[3] ADF&G 1977
[4] ADF&G 1978
--- Data not collected.

Table E.2.7. Matrix of observed fish species and physiochemical parameters for habitat locations in the Impoundment study reach of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for further interpretation.

FISH SPECIES

HABITAT LOCATION	Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.
Susitna at Fog Creek																		X						
Fog Creek - Sec. 01												X					X					X		1
Fog Creek - Sec. 02												X												
Fog Creek - Sec. 03												X												
Susitna at Tsusena Creek																		X						
Tsusena Creek - Sec. 01												X			X							X		
Susitna at Deadman Creek													X					X						
Deadman Creek - Sec. 01												X										X		1
Deadman Creek - Sec. 02												X												
Susitna at Watana Creek													X		X			X						
Watana Creek - Sec. 01												X										X		1
Watana Creek - Sec. 02												X												
Watana Creek - Sec. 03												X												
Watana Creek - Sec. 04												X												
Watana Creek - Sec. 05												X												
Susitna at Kosina Creek													X		X	X		X						
Kosina Creek - Sec. 01												X										X		1
Kosina Creek - Sec. 02												X												
Kosina Creek - Sec. 03												X												
Kosina Creek - Sec. 04												X												
Kosina Creek - Sec. 05												X												

PHYSIOCHEMICAL PARAMETERS

HABITAT LOCATION	Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Susitna at Fog Creek							
Fog Creek - Sec. 01	10.1 - 11.6	7.4 - 7.5	73 - 90	0.34 - 1.40	6.1 - 10.4	16.5 - 22.0	1
Fog Creek - Sec. 02	10.0 - 11.8	7.3 - 7.4	68 - 81	0.65 - 1.10	6.4 - 9.4	17.0 - 19.2	
Fog Creek - Sec. 03	10.5 - 11.6	7.3 - 7.4	68 - 81	0.60 - 1.50	6.4 - 9.7	16.8 - 19.0	
Susitna at Tsusena Creek	9.8 - 12.2	7.3 - 7.5	106 - 107	48.00 - 125.00	8.6 - 10.0	12.5 - 14.0	
Tsusena Creek - Sec. 01	9.9 - 13.2	6.8 - 7.3	55 - 71	0.60 - 1.80	7.5 - 9.8	13.0 - 15.0	
Susitna at Deadman Creek	9.9 - 11.6	7.3 - 7.7	100 - 138	51.00 - 130.00	8.4 - 12.6	11.4 - 19.0	
Deadman Creek - Sec. 01	9.5 - 12.6	7.0 - 7.5	44 - 79	0.68 - 1.80	7.6 - 12.4	11.4 - 19.0	1
Deadman Creek - Sec. 02	9.4 - 12.6	7.0 - 7.3	44 - 79	1.50 - 2.30	7.5 - 12.4	11.4 - 15.0	
Susitna at Watana Creek	9.6 - 11.7	7.5 - 7.7	109 - 132	58.00	8.0 - 11.7	14.5 - 16.0	
Watana Creek - Sec. 01	9.5 - 14.1	7.1 - 7.7	101 - 245	1.30 - 9.80	1.5 - 11.3	1.3 - 18.0	
Watana Creek - Sec. 02	9.8 - 13.9	7.3 - 7.7	101 - 243	---	1.9 - 11.2	3.7 - 18.0	
Watana Creek - Sec. 03	9.7 - 14.3	7.3 - 7.7	103 - 246	1.30 - 9.60	2.1 - 11.4	3.8 - 19.0	
Watana Creek - Sec. 04	10.2 - 11.7	7.6 - 7.6	149 - 248	---	8.3 - 10.0	16.5 - 21.5	
Watana Creek - Sec. 05	9.7 - 10.6	7.6 - 7.7	156 - 247	3.10	10.4 - 11.4	19.0 - 21.0	
Susitna at Kosina Creek	9.0 - 12.1	6.8 - 7.5	106 - 146	10.00 - 145.00	3.3 - 12.5	5.2 - 24.0	
Kosina Creek - Sec. 01	9.1 - 12.9	7.1 - 7.5	54 - 68	0.50 - 1.90	2.8 - 12.3	5.0 - 24.0	
Kosina Creek - Sec. 02	9.9 - 13.6	7.1 - 7.5	53 - 67	---	2.7 - 10.5	5.4 - 23.5	
Kosina Creek - Sec. 03	9.2 - 13.7	7.1 - 7.6	54 - 67	0.60 - 1.50	2.7 - 10.9	5.3 - 19.0	
Kosina Creek - Sec. 04	9.1 - 13.5	7.1 - 7.5	54 - 67	---	2.7 - 11.2	5.3 - 28.0	
Kosina Creek - Sec. 05	9.2 - 13.6	7.1 - 7.4	53 - 68	1.50 - 4.40	2.9 - 11.5	6.8 - 24.5	

[1] ADF&G 1978

--- Data not collected.

Table E.2.7. (continued).

HABITAT LOCATION	FISH SPECIES: Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.	PHYSIOCHEMICAL PARAMETERS: Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
Susitna at Jay Creek													X		X			X							9.1 - 12.3	7.2 - 7.7	100 - 170	19.00 - 155.00	6.7 - 11.4	10.7 - 18.0	
Jay Creek -																															
Sec. 01												X										X		1	9.9 - 13.0	7.4 - 7.9	124 - 175	0.60 - 2.20	5.7 - 9.7	10.6 - 18.0	1
Sec. 02												X													10.1 - 13.1	7.5 - 7.8	128 - 175	---	3.6 - 9.4	11.0 - 16.0	
Sec. 03												X													10.0 - 13.1	7.5 - 7.8	128 - 174	0.50 - 8.60	4.0 - 8.3	7.8 - 17.0	
Sec. 04												X													10.1 - 13.0	7.6 - 7.8	128 - 174	---	4.2 - 8.5	10.2 - 24.0	
Sec. 05												X													10.1 - 13.2	7.5 - 7.7	128 - 173	0.60 - 5.40	4.3 - 8.8	9.6 - 24.0	
Susitna at Goose Creek													X					X							8.5 - 12.9	7.3 - 7.7	100 - 152	23.00 - 155.00	5.0 - 13.7	6.0 - 24.0	
Goose Creek -																															
Sec. 01												X										X		1	8.6 - 13.1	7.0 - 7.5	47 - 66	0.40 - 2.20	5.4 - 14.4	6.0 - 21.5	
Sec. 02												X													8.8 - 13.6	7.1 - 7.4	47 - 64	0.35 - 0.40	4.3 - 12.3	6.2 - 19.0	
Sec. 03												X													8.9 - 13.5	7.0 - 7.4	47 - 64	0.35 - 1.70	4.7 - 13.4	7.8 - 23.5	
Sec. 04												X													8.6 - 13.8	7.0 - 7.4	48 - 64	0.32 - 0.40	4.9 - 14.4	7.9 - 23.0	
Sec. 05												X													8.6 - 13.6	7.0 - 7.4	48 - 66	0.35 - 2.60	5.2 - 14.6	7.7 - 22.0	
Susitna at Oshetna River													X		X			X							9.3 - 12.3	7.4 - 7.6	101 - 152	24.00 - 175.00	6.3 - 12.3	8.5 - 20.0	
Oshetna River -																															
Sec. 01												X										X		1	8.9 - 12.0	7.2 - 7.6	69 - 135	1.20 - 9.00	7.0 - 12.6	7.8 - 14.0	
Sec. 02												X													9.4 - 12.0	7.2 - 7.6	65 - 135	1.50	5.2 - 10.7	10.0 - 18.5	1
Sec. 03												X													9.6 - 12.1	7.2 - 7.6	65 - 135	1.30 - 19.00	5.8 - 10.8	10.0 - 21.0	
Sec. 04												X													9.5 - 12.0	7.2 - 7.6	65 - 130	1.90	5.8 - 11.0	10.0 - 22.5	
Sec. 05												X													9.6 - 12.0	7.2 - 7.6	65 - 132	1.20 - 13.00	6.0 - 11.5	10.0 - 23.5	

[1] ADF&G 1978

--- Data not collected.

Table E.2.8. Matrix of observed fish species and physiochemical parameters for the selected habitat slough study sites of the Susitna River, May-September, 1981 (adapted from ADF&G 1981a, c, d, f, g). Consult ADF&G for further interpretation.

SLOUGH	FISH SPECIES* Anadromous: Chinook Salmon - Adult	Chinook Salmon - Juvenile	Coho Salmon - Adult	Coho Salmon - Juvenile	Sockeye Salmon - Adult	Sockeye Salmon - Juvenile	Chum Salmon - Adult	Chum Salmon - Juvenile	Pink Salmon - Adult	Pink Salmon - Juvenile	Bering Cisco	Resident: Arctic Grayling	Longnose Sucker	Rainbow Trout	Round Whitefish	Humpback Whitefish	Dolly Varden	Burbot	Threespine Stickleback	Ninespine Stickleback	Arctic Lamprey	Sculpin	Northern Pike	Presence of fisheries data in past studies.	PHYSIOCHEMICAL PARAMETERS**: Dissolved Oxygen (mg/l)	pH	Specific conductance (umhos/cm)	Turbidity (NTU)	Surface water temperature (°C)	Air temperature (°C)	Presence of physiochemical data in past studies.
8A		X		X	X		X			X			X	X	X	X	X	X	X			X		2,4	8.8 - 10.5	6.8 - 7.6	108 - 160	0.70 - 205.00	4.5 - 16.4	3.0 - 26.4	2,4
9			X		X		X																	1,2,4	10.6 - 11.4	6.8 - 7.4	113 - 145	0.60 - 130.00	5.6 - 14.2	7.5 - 20.1	2,4
16B							X																	1,2,3,4	10.8 - 11.7	6.4 - 7.1	64 - 72	0.50 - 43.00	4.8 - 14.0	---	2,3,4
19					X		X																	1,2,3,4	9.4 - 10.4	6.5 - 7.3	127 - 150	0.40 - 2.50	1.8 - 9.8	---	2,3,4
21		X		X	X		X																	1,2,3,4	10.3 - 11.3	7.0 - 7.7	103 - 226	0.40 - 150.00	2.4 - 11.3	---	2,4

* 1981 fishery data for juvenile anadromous and resident fish species were not collected in Sloughs 9, 16B, 19, and 21.
** Physiochemical data for Sloughs 9, 16B, 19, and 21 are based on three sampling visits. Slough 8A was sampled on a routine basis as a habitat location.

1 ADF&G 1974
2 ADF&G 1976
3 ADF&G 1977
4 ADF&G 1978

reaches of the river suggest that a greater diversity of habitat types or more favorable conditions are present in the downstream portion of the river. This however does not infer that the existing habitats in the impoundment study area cannot support anadromous fish populations. Several trends in physiochemical characteristics are also apparent: e.g. specific conductance values are usually higher in the mainstem than in slough or tributary study sites; pH values are higher in the impoundment study reach than in other study reaches.

2.7 Chum and Sockeye Adult Salmon Observations in Selected Sloughs in Relation to Mainstem Discharge

Surveys of spawning grounds in the Susitna River and its sloughs were conducted by AA personnel to enumerate adult salmon in these areas (Table E.2.9). Table E.2.9 compares chum and sockeye salmon enumeration at Sloughs* 8A, 9, 9B, 19, and 21 (Figure E.2.20) with discharge data for the mainstem Susitna River at Gold Creek on the same day. These sloughs were selected for comparing hydrologic characteristics with spawning activity because physiochemical characteristics were evaluated in greater detail at these locations than at other study sites. Additional discussions of these areas are presented in Chapters 3 and 4 and the AA, AH, and RJ subject reports (ADF&G 1981a, c, d, f). When mainstem flow is too low to enter the head (upstream end) or mouth (downstream end) of a slough (values which are unique

* Sloughs, as defined in this study, are the side channel or adjacent wetted habitats to the mainstem Susitna River which periodically receive a portion of their surface water from the mainstem Susitna River in addition to other water sources (e.g. groundwater, intragravel and surface water). The contribution of the mainstem Susitna River to the surface water flow in each slough can vary from 0 to nearly 100% depending on the Susitna River stage/discharge relationship to the thalweg of the slough.

Table E.2.9. Comparison of adult sockeye and chum salmon escapement counts for Sloughs 8A, 9, 9B, 19, and 21 (ADF&G 1981a) to Susitna River discharge data (cfs) at Gold Creek (USGS 1981).

Slough 8A

Date	Sockeye	Chum	Survey Conditions	Susitna River Discharge
810807	0	16	Excellent	26,200
810820	0	0	Poor	34,200
810827	0	0	Poor	24,200
810904	177	620	Excellent	16,600
810912	105	311	Excellent	14,100
810921	38	7	Excellent	12,200
810927	9	0	Excellent	8,890

Slough 9

Date	Sockeye	Chum	Survey Conditions	Susitna River Discharge
810807	0	0	Poor	26,200
810811	0	5	Fair	43,500
810820	0	0	Poor	34,200
810823	0	0	Excellent	37,900
810827	---	---	---	24,200
810904	10	260	Excellent	16,600
810916	6	71	Excellent	14,100
810920	10	16	Excellent	11,400
810927	0	2	Excellent	8,890

Slough 9B

Date	Sockeye	Chum	Survey Conditions	Susitna River Discharge
810807	---	--	---	26,200
810811	27	58	Excellent	43,500
810820	---	---	---	34,200
810823	47	90	Excellent	37,900
810827	81	71	Excellent	24,200
810904	71	49	Excellent	16,600
810916	62	26	Excellent	14,100
810920	54	7	Excellent	11,400
810927	35	0	Excellent	8,890

--- Data unavailable.

Table E.2.9 (Continued).

Slough 19

Date	Sockeye	Chum	Survey Conditions	Susitna River Discharge
810806	0	0	Excellent	27,500
810810	0	0	Fair	42,600
810821	13	3	Excellent	41,300
810826	20	0	Excellent	25,600
810903	23	1	Excellent	18,300
810911	18	0	Excellent	14,300
810919	8	0	Excellent	10,500
810926	6	0	Excellent	9,560

Slough 21

Date	Sockeye	Chum	Survey Conditions	Susitna River Discharge
810806	0	0	Poor	27,500
810810	0	0	Poor	42,600
810821	0	0	Poor	41,300
810826	1	169	Excellent	25,600
810903	26	274	Excellent	18,300
810911	38	136	Excellent	14,300
810919	33	67	Excellent	10,500
810926	3	0	Excellent	9,560

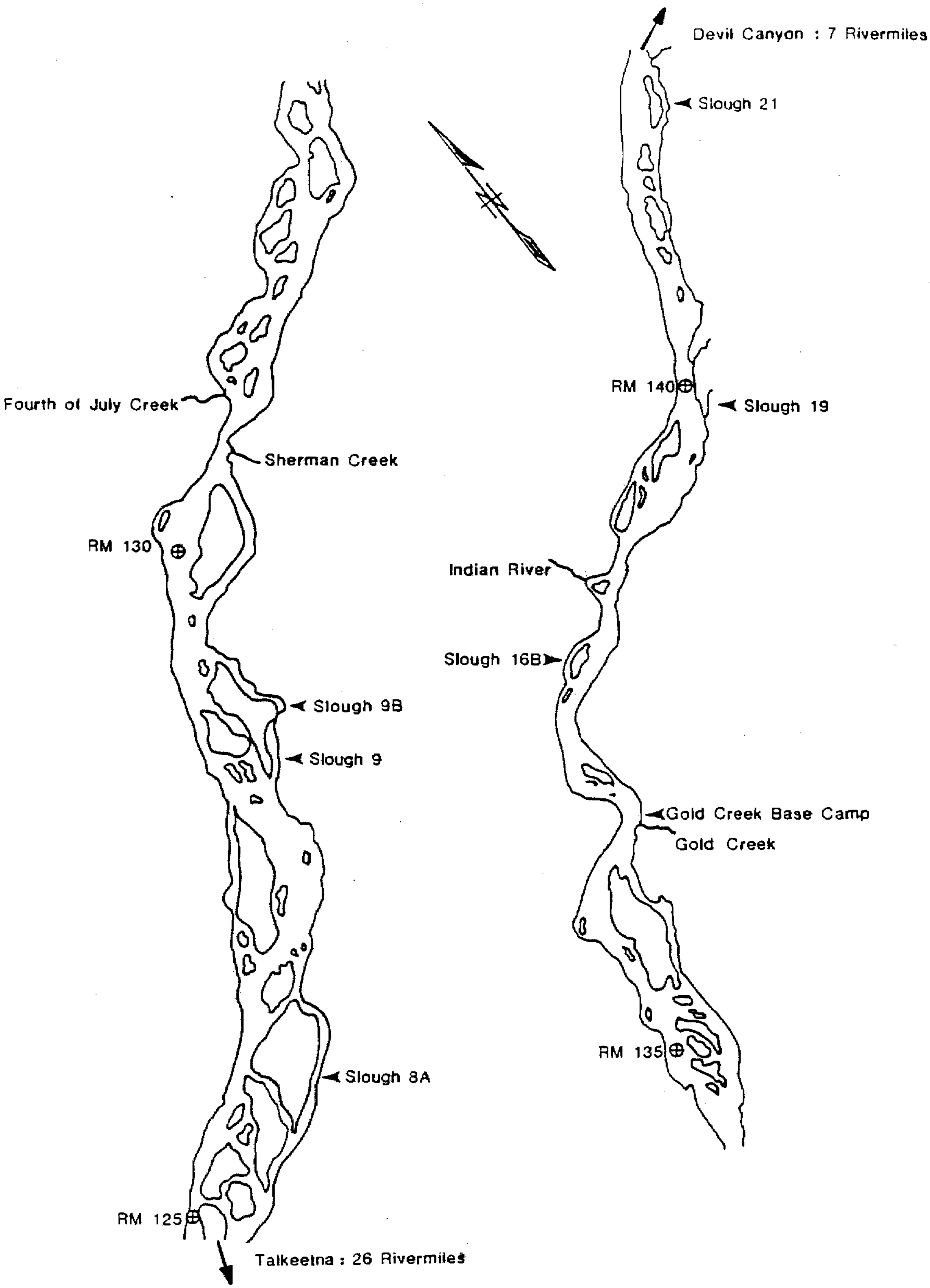


Figure E.2.20. Location of selected habitat slough sites along the Susitna River between Talkeenta and Portage Creek (adapted from ADF&G 1981a) for each slough), surface water influence from the mainstem is effectively eliminated and clear water base flows are still observed in the sloughs. These base flows could originate from various sources, including tributaries, springs and groundwater inflow. Spring water could be fed by a perched water table or from interstitial flow (flow of water through spaces in the substrate) from the mainstem. Sloughs 8A, 9 and 21 have tributaries contributing water to the base flow. Slough 19 originates from a large spring at its head (upstream end). Sloughs 19 and 21 also have many areas of upwelling throughout the stream bed, and Slough 21 has water seeping in along the edges during periods of falling discharge of the mainstem Susitna River.

Observations of fish activity in these sloughs indicate that they provide the most important salmon spawning habitat of the Susitna River habitats evaluated during 1981 between Devil Canyon and Talkeetna (ADF&G 1981a, c).

Peak spawning activity of sockeye salmon was observed to occur in the sloughs during the last week in August and the first three weeks of September (ADF&G 1981a). Chum salmon peak spawning activity occurred during the last two weeks of August and the first two weeks in September. Counts of spawning activity were highest for chum salmon in Slough 8A and highest for sockeye in Slough 11. One factor contributing to the large numbers of salmon spawning in these sloughs may be the availability of holding areas at the mouth of the sloughs in proximity to suitable spawning substrate within the main channel of the sloughs. The level of spawning activity in Sloughs 9 and 9B (Table E.2.9) may be attributed to the availability of spawning substrate as well as flows sufficient to provide access into the mouths of these sloughs from the mainstem Susitna River. Flow levels in these two sloughs are augmented by tributaries which contribute to the availability of suitable habitat within the sloughs when the mainstem flow of the Susitna River decreases.

The limited spawning activity observed in Slough 19 (Table E.2.9) may be due to limited access during lower flows of the mainstem Susitna River and to lack of spawning substrate. During low discharges of the mainstem Susitna River, access to the mouth of Slough 19 was limited to a depth of 0.3 feet on September 26 when mainstem Susitna River discharge at the Gold Creek station equalled 9,560 cfs. At high mainstem Susitna River discharges, a backwater forms at the lower end of this slough. The deep deposits of silt near the mouth of Slough 19 are characteristic when streamflows are insufficient to flush fine sediments from this slough. The absence of spawning salmon suggests that these deposits of deep silt are undesirable as spawning substrates.

The relatively high number of spawning chum salmon and sockeye observed in Slough 21 (Table E.2.9) may be primarily due to suitable spawning substrate and maintenance of flows. These flows are maintained by groundwater and tributaries, and provide adequate spawning habitat when mainstem flows of the Susitna River are too low to flow into the slough. Spawning activity was observed to peak long after mainstem flow of the Susitna River was completely restricted from entering the head portion of the slough. (The flow within Slough 21 is compared to corresponding mainstem discharges in Table E.5.7 of the ADF&G subject report, ADF&G 1981c).

2.8 Fisheries and Habitat Relationships in the Proposed Impoundment Area

2.8.1 Introduction

This section compares data on Arctic grayling and habitats in eight major clearwater tributaries located in the study area upstream of Devil Canyon (Impoundment reach) by RJ and AH personnel during the 1981 open water field season.* Data from each tributary were collected between the tributary mouth and the proposed impoundment elevations, PIE of the Watana (2185 ft msl) and Devil Canyon (1455) Reservoirs (Figure E.2.21). Habitat study locations and miscellaneous sampling site areas are illustrated in Figure E.2.21. Detailed habitat descriptions of these study areas are presented in the AH and RJ subject reports (ADF&G 1981c, g).

2.8.2 Water Quality

Water quality data collected in the Impoundment study reach are presented in Table E.2.7 (See Section E.2.6). No major differences are apparent in the range of water quality data from various sites which might influence grayling distribution and abundance in tributaries and the mainstem Susitna River.

Although increased turbidity levels in the Oshetna River, Jay Creek and Watana Creek were at times associated with lower catch per unit effort, CPUE (Tables E.2.10 and E.2.11) and total catch (Table E.2.12), population estimates remained relatively high for the Oshetna River and Jay Creek (Table E.2.13).

* Arctic grayling were selected for analysis because of their importance as a sport fish and the availability of sufficient data on this species.

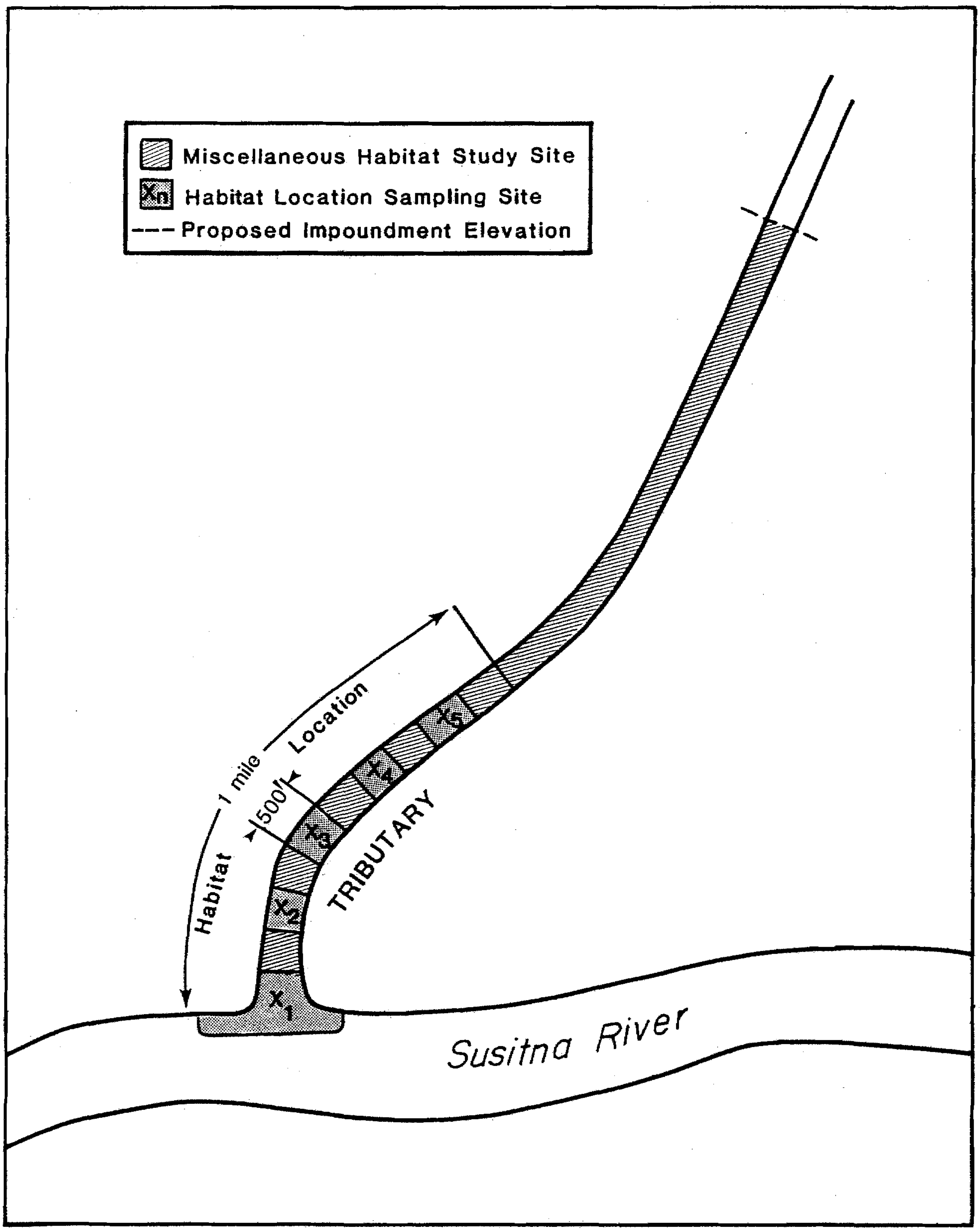


Figure E.2.21. Sampling design for identifying habitat location and miscellaneous fish habitat study sites in the Impoundment study reach tributaries.

Table E.2.10. Arctic grayling hook and line catch and effort at habitat location sites in the lower mile of each tributary in the Impoundment study area, 1981 (adapted from ADF&G 1981g).

TRIBUTARY HABITAT LOCATION		May	June	July	August	Sept.	TOTAL
Fog Creek	Total Catch	14.0	17.0	11.0	4.0	5.0	51.0
	Man Hours	1.8	3.9	2.6	1.8	2.5	12.5
	CPUE	8.0	4.4	4.3	2.3	2.0	4.1
Tsusena Creek	Total Catch	23.0	19.0	74.0	18.0	1.0	135.0
	Man Hours	5.0	3.4	8.3	5.5	0.5	22.6
	CPUE	4.6	5.6	8.9	3.3	2.0	6.0
Deadman Creek	Total Catch	53.0	69.0	27.0	4.0	0.0	153.0
	Man Hours	7.5	9.0	3.5	2.2	1.4	23.6
	CPUE	7.1	7.7	7.7	1.8	0.0	6.5
Watana Creek	Total Catch	1.0	29.0	14.0	5.0	10.0	59.0
	Man Hours	3.3	5.4	4.3	2.0	3.1	18.1
	CPUE	0.3	5.4	3.3	2.5	3.3	3.3
Kosina Creek	Total Catch	119.0	79.0	87.0	17.0	33.0	335.0
	Man Hours	16.6	7.3	6.8	3.0	2.8	36.5
	CPUE	7.2	10.8	12.8	5.7	12.0	9.2
Jay Creek	Total Catch	3.0	49.0	64.0	13.0	47.0	176.0
	Man Hours	2.4	5.4	7.3	2.9	5.5	23.4
	CPUE	1.3	9.1	8.8	4.6	8.6	7.5
Goose Creek	Total Catch	121.0	76.0	36.0	32.0	2.0	267.0
	Man Hours	16.3	12.3	4.5	7.4	2.4	42.9
	CPUE	7.4	6.2	8.0	4.3	0.8	6.2
Oshetna Creek	Total Catch	4.0	43.0	50.0	46.0	7.0	150.0
	Man Hours	2.2	4.8	7.7	5.1	3.4	23.2
	CPUE	1.8	9.1	6.5	9.0	2.1	6.5
TOTAL	TOTAL CATCH	338.0	381.0	363.0	139.0	105.0	1,326.0
	MAN HOURS	55.1	51.3	45.0	29.9	21.6	202.8
	CPUE	6.1	7.4	8.1	4.6	4.9	6.5

Table E.2.11. Arctic grayling hook and line catch and effort at miscellaneous fish habitat sites* between the mouth and proposed impoundment elevations (PIE) at each tributary in the Impoundment study area, 1981 (adapted from ADF&G 1981g).

Tributary		MISCELLANEOUS FISH HABITAT SITES 1st Mile	Above Mile 1 to PIE**
Fog Creek	Total Catch	21.00	---
	Man Hours	4.16	---
	CPUE	5.05	---
Tsusena Creek	Total Catch	---	---
	Man Hours	---	---
	CPUE	---	---
Deadman Creek	Total Catch	37.00	---
	Man Hours	5.07	---
	CPUE	7.30	---
Watana Creek	Total Catch	21.00	186.00
	Man Hours	4.50	19.56
	CPUE	5.19	9.51
Kosina Creek	Total Catch	57.00	357.00
	Man Hours	11.46	32.16
	CPUE	4.92	11.10
Jay Creek	Total Catch	60.00	81.00
	Man Hours	6.35	7.41
	CPUE	9.45	10.93
Goose Creek	Total Catch	64.00	51.00
	Man Hours	8.49	6.16
	CPUE	7.54	8.28
Oshetna River	Total Catch	59.00	297.00
	Man Hours	7.91	22.07
	CPUE	7.46	13.96
TOTAL	TOTAL CATCH	319.00	972.00
	MAN HOURS	47.50	87.41
	CPUE	6.70	11.12

* Does not include fish habitat location sites.
** PIE for Fog and Tsusena Creeks = 1455 ft; all others = 2185 ft.
--- Data unavailable.

Table E.2.12. Arctic grayling hook and line total catch by tributary between the mouth and proposed impoundment elevations (PIE*) and month in the Impoundment study area, 1981 (adapted from ADF&G 1981g).

	CATCH					
TRIBUTARY	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
Fog Creek	22	17	23	5	5	72
Tsusena Creek	23	19	74	18	1	135
Deadman Creek	53	86	42	6	3	190
Watana Creek	1	49	16	172	28	266
Kosina Creek	136	246	143	67	187	779
Jay Creek	3	178	70	16	50	317
Goose Creek	121	136	82	37	6	382
Oshetna River	19	92	155	73	167	506
TOTAL CATCH	378	823	605	394	447	2,647

* PIE for Fog and Tsusena Creeks = 1455 ft; all other tributaries = 2185 ft.

Table E.2.13. Arctic grayling population estimates for tributaries in the Impoundment study area, 1981 (adapted from ADF&G 1981g).*

STREAM	POPULATION ESTIMATE	CONFIDENCE** INTERVAL
Fog Creek	176	115- 369
Tsusena Creek	1,000	743-1,530
Deadman Creek	979	604-2,575
Kosina Creek	2,787	2,228-3,720
Jay Creek	1,089	868-1,462
Goose Creek	1,327	1,016-1,913
Oshetna River	2,017	1,525-2,976

* Watana Creek estimate is not included because the number of recaptures was too low.

** Based on June through September recoveries.

Therefore, the lower catch values most likely resulted from the reduced effectiveness of hook and line sampling in turbid water. Grayling recaptures in Watana Creek were insufficient for calculating the population.

Grayling distribution and abundance in the Impoundment reach appeared to be closely associated with surface water temperature. As water temperatures in the tributaries increased in the spring, increased numbers of grayling were observed migrating upstream into areas having pool type habitats [presumably after spawning in the lower reaches of the tributaries, (Morrow 1980)]. Tagging studies indicate that a large number of these fish continued to utilize these areas for rearing into the summer. As surface water temperatures began to decrease in the late summer and early fall, lower numbers of fish were observed in these upper stream habitats. CPUE also decreased in most of these areas and tagged fish were observed to be migrating downstream. The large decline in total catch (Table E.2.12) and lower CPUE levels (Table E.2.10) in late summer and early fall indicate that fewer fish were present.

In small shallow streams such as Goose and Jay Creeks, grayling began moving downstream earlier in the season. Lower numbers of fish were captured in these smaller streams in the late summer. Conversely, fish were observed in the larger streams (e.g. Oshetna River and Kosina Creek) up until late September, at which time it appeared as though a downstream migration of the grayling was beginning. Thermographs were not placed in these streams, and continuous water temperature records are not available for correlating specific water temperatures with grayling migrations on different streams.

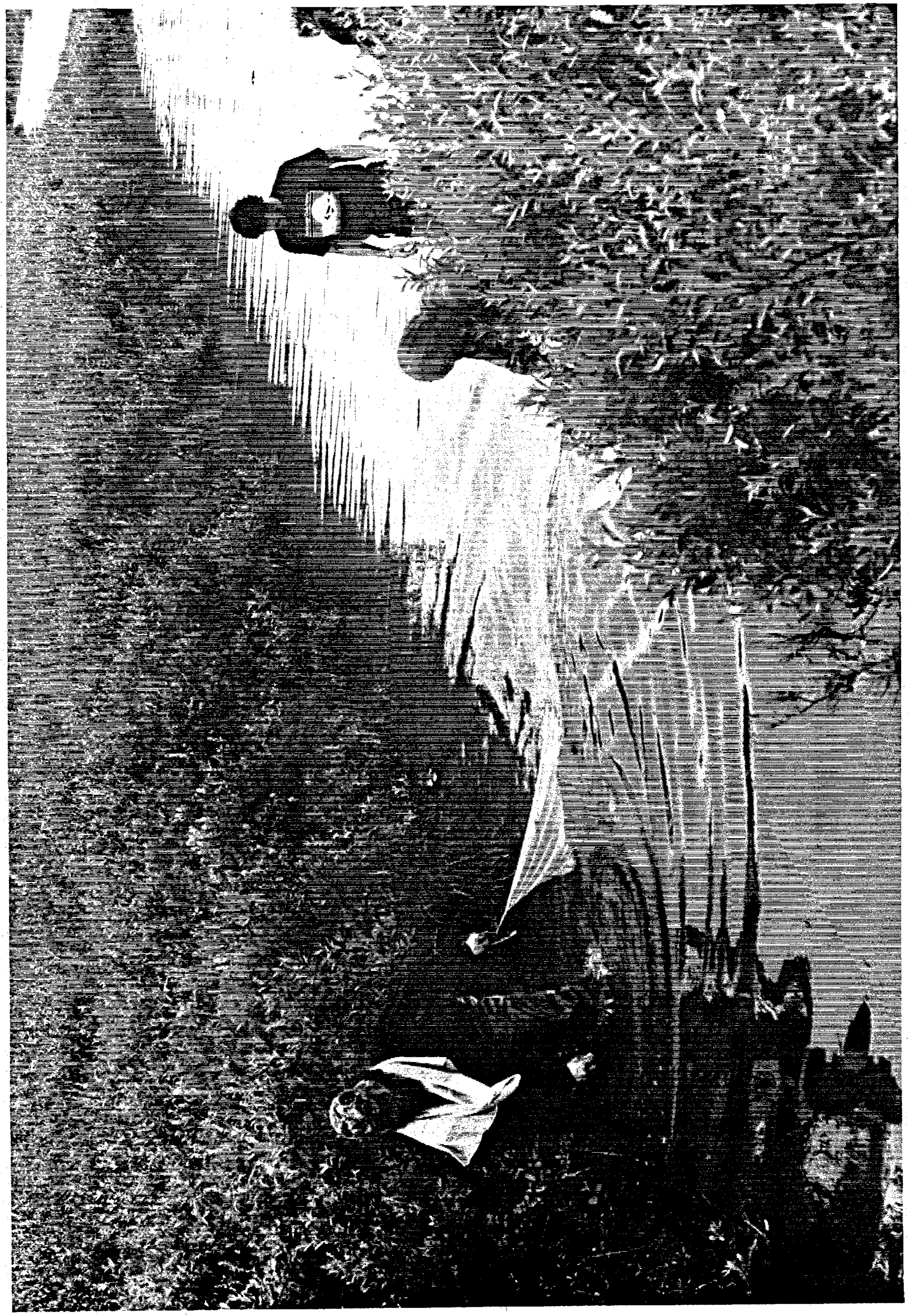


Plate 3. Seining Jay Creek Slough.

Installation of thermographs and intensive sampling at selected sites in 1982 may help substantiate these observations.

2.8.3 Substrate

Substrate composition at the habitat evaluation sites in the lower mile of each tributary in the Impoundment study area are presented in Appendix EA of the AH subject report (ADF&G 1981c). Substrates in the lower mile of each tributary appear to be similar to the composition of substrate in the reach above the lower mile up to the PIE. Therefore, substrate data presented for the lower mile of each tributary appears to be representative for that particular tributary up to the PIE (Watana Creek cannot be included in this evaluation because it was not assessed above the lower mile).

Grayling have been observed to spawn over a wide variety of substrates with a preference for sandy gravel (Morrow 1980). Although spawning has not been observed in the Impoundment reach, it probably occurs to some extent in all eight tributaries sampled, since suitable spawning habitat has been observed in each stream. Assuming other conditions for spawning are favorable, it is not likely that the availability of spawning substrate is the limiting factor influencing grayling numbers in the upper Susitna and its tributaries. Substrate relationships to food production (Reiser and Bjornn 1979) are probably more important in influencing grayling distribution in these tributaries.

Plate 4. Electrofishing in lower Jay Creek.

2.8.4 Streamflow and Channel Morphology

Streamflow and channel morphology may be the most important habitat characteristics in determining grayling distribution and abundance in the Impoundment study reach. High pool/riffle ratios with large deep pools and moderate streamflow velocities appear to indicate preferred grayling habitat. Higher CPUE occurred where these conditions were observed.

In the impoundment reach, large deep streams such as the Oshetna River and Kosina Creek appear to provide optimal fish habitat. Population estimates listed in Table E.2.13 support this evaluation. Kosina Creek, in particular, has a relatively high pool/riffle ratio and contains many large deep pools which may be used as overwintering habitat. Goose and Jay Creeks, which also have relatively high population estimates, are shallower and smaller than Kosina Creek and the Oshetna River, and do not appear to have suitable overwintering habitat.

In contrast to these streams, lower Deadman and Tsusena Creeks are characterized by few pools and long reaches of whitewater. The only habitat which might be suitable for overwintering in either of these creeks are the few pools located below their falls. With the exception of Fog Creek, which was one of the smallest areas studied in the Impoundment reach (Table E.2.13), population estimates were lowest in these two streams.

Mean column water velocities were measured near observed grayling during the 1981 season. Based on both visual observations of fish and CPUE in habitats where streamflow velocities in this range were measured, provisional data

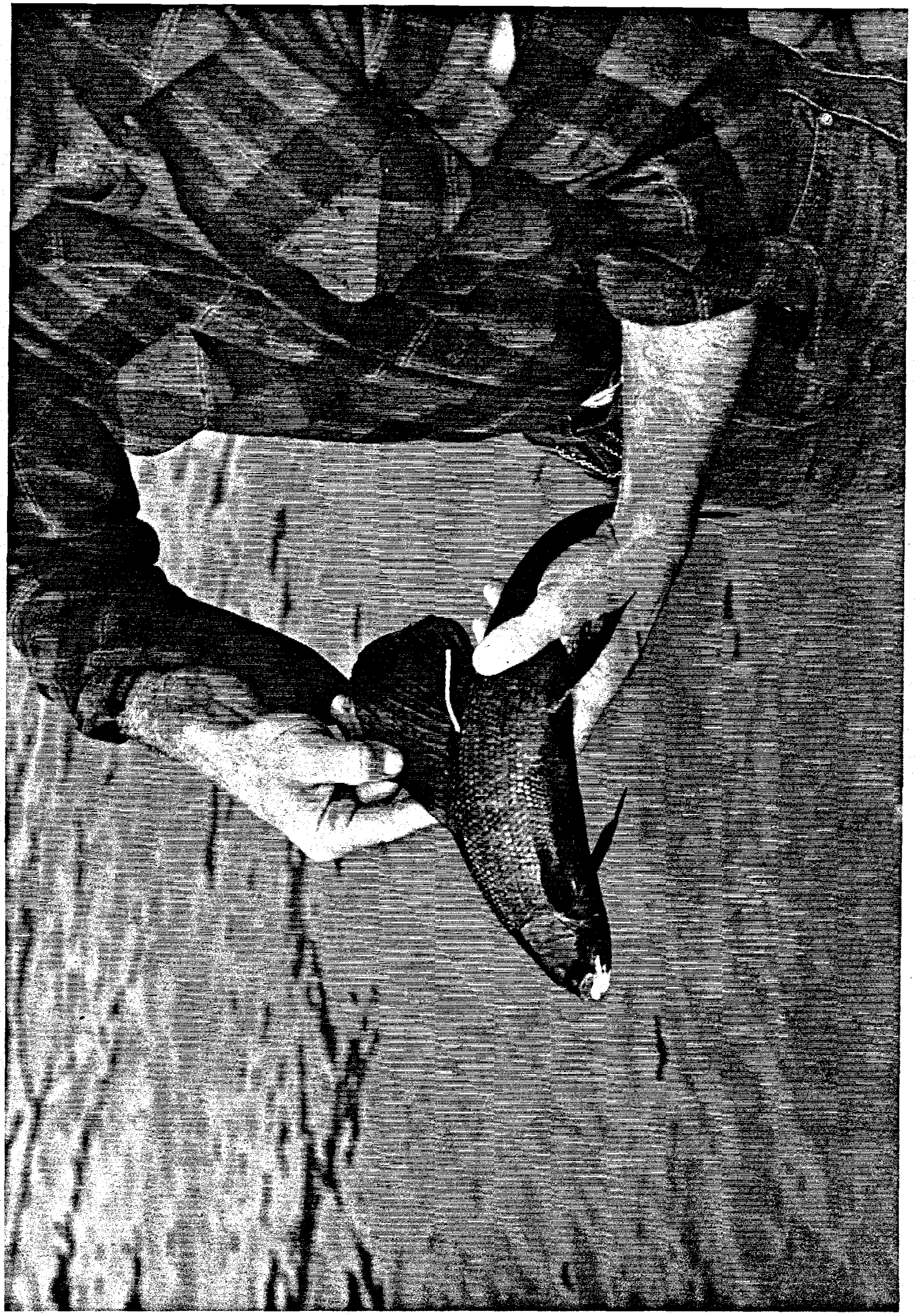


Plate 5. Arctic grayling with Floy anchor tag.

indicate that grayling may prefer to reside in habitats where mean column velocities are less than 2.0 ft/sec. Hook and line sampling may have biased the data because it proved to be an ineffective capture method in higher velocities.

Accurate visual observations were not possible in areas of high streamflow velocities.

2.8.5 Conclusions

With one year of limited data it is difficult to determine quantitatively the relationship between aquatic habitat and the distribution and abundance of grayling in the eight major tributaries in the study area. Data limitations include:

1. each of the streams in the study area was only sampled approximately two days per month and many of the habitat characteristics measured will have to be monitored more extensively to accurately assess fisheries habitat, and

2. with respect to fisheries data, there is a certain amount of bias associated with the primary method of capture (hook and line). In some cases, such as in areas with high turbidities, alternative fish capture techniques may improve catch rates.

Keeping these limitations in mind, some preliminary conclusions derived from the 1981 data are:

1. changes in water temperature appeared to influence grayling movements in and out of streams in spring and late summer respectively;

2. grayling were generally more abundant in habitats with streamflow velocities below 2.0 ft/sec;

3) channels with large deep pools and/or cutbanks appeared to provide optimal habitat, large numbers of grayling were found in these areas; and,

4) availability of spawning substrate did not appear to significantly limit grayling distribution and abundance in the study area.

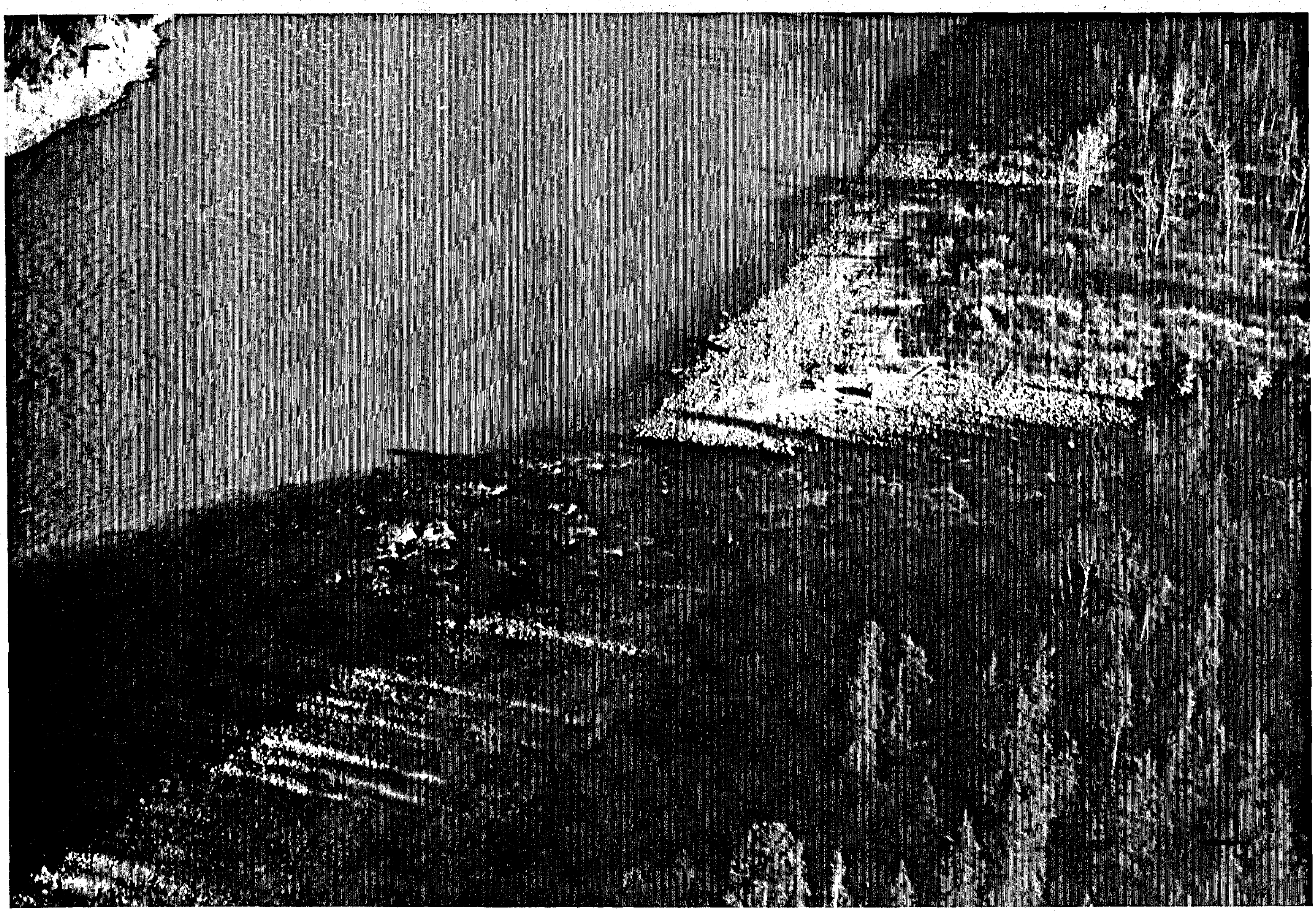


Plate 6. Confluence of Susitna River and Kosina Creek in the impoundment study reach, showning mixing of clear and turbid waters.

3. HABITAT RELATIONSHIPS

3. HABITAT RELATIONSHIPS

3.1 Introduction

This chapter discusses the relationships among specific physical aquatic habitat parameters. The data used in developing these relationships were originally reported in the AH, RJ and AA subject reports (ADF&G 1981a, b, c, d, f). Included in this chapter are descriptions of how several physiochemical parameters are related to discharge. These relationships can potentially be affected by the proposed development of the two dams.

3.2 Discharge and Turbidity Relationships

Relationships between mainstem Susitna River discharge (USGS 1981) and turbidity in the mainstem and sloughs (ADF&G 1981c) are shown in Figures E.3.1 - E.3.4. Figures E.3.1 and E.3.2 illustrate the relationships between mainstem discharge measured at Gold Creek and turbidity in selected mainstem and slough sites, between Talkeetna and Portage Creek. Figures E.3.3 and E.3.4 illustrate the relationship between mainstem discharge measured at Sunshine and turbidity in selected sites from the mainstem and sloughs, below Talkeetna. Mainstem Susitna River turbidity generally increases with mainstem discharge (Figures E.3.1 and E.3.3). Slough turbidity remains low as mainstem discharge increases until a certain threshold mainstem discharge level (unique for each slough) is attained; at that point, the turbidity in the slough rapidly increases and mirrors the turbidity and discharge relationships characterizing the mainstem (Figures E.3.2 and E.3.4). These relationships

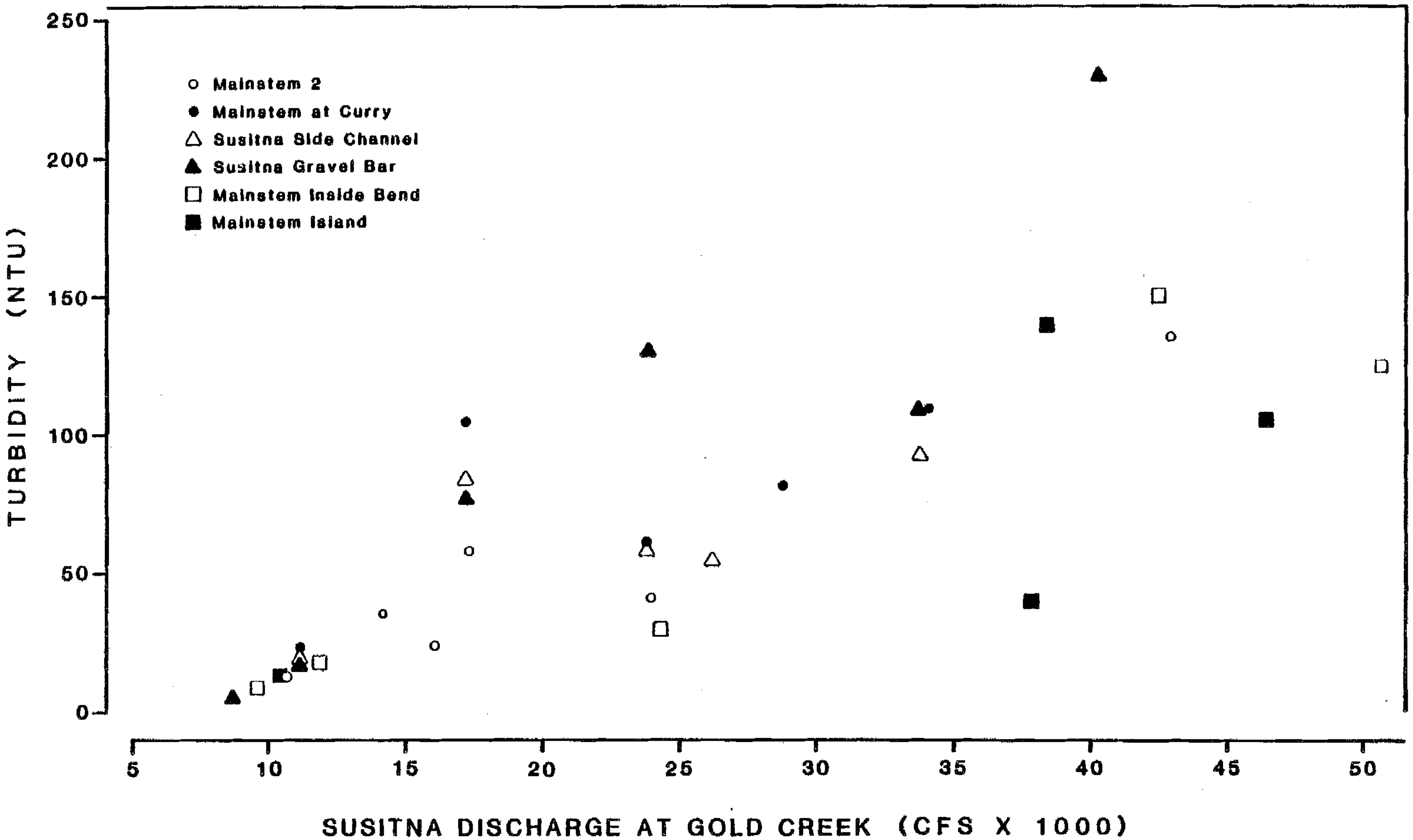


Figure E.3.1. Mainstem turbidity (Talkeetna to Portage Creek reach) versus mainstem discharge of the Susitna River at Gold Creek (adapted from ADF&G 1981c and USGS 1981).

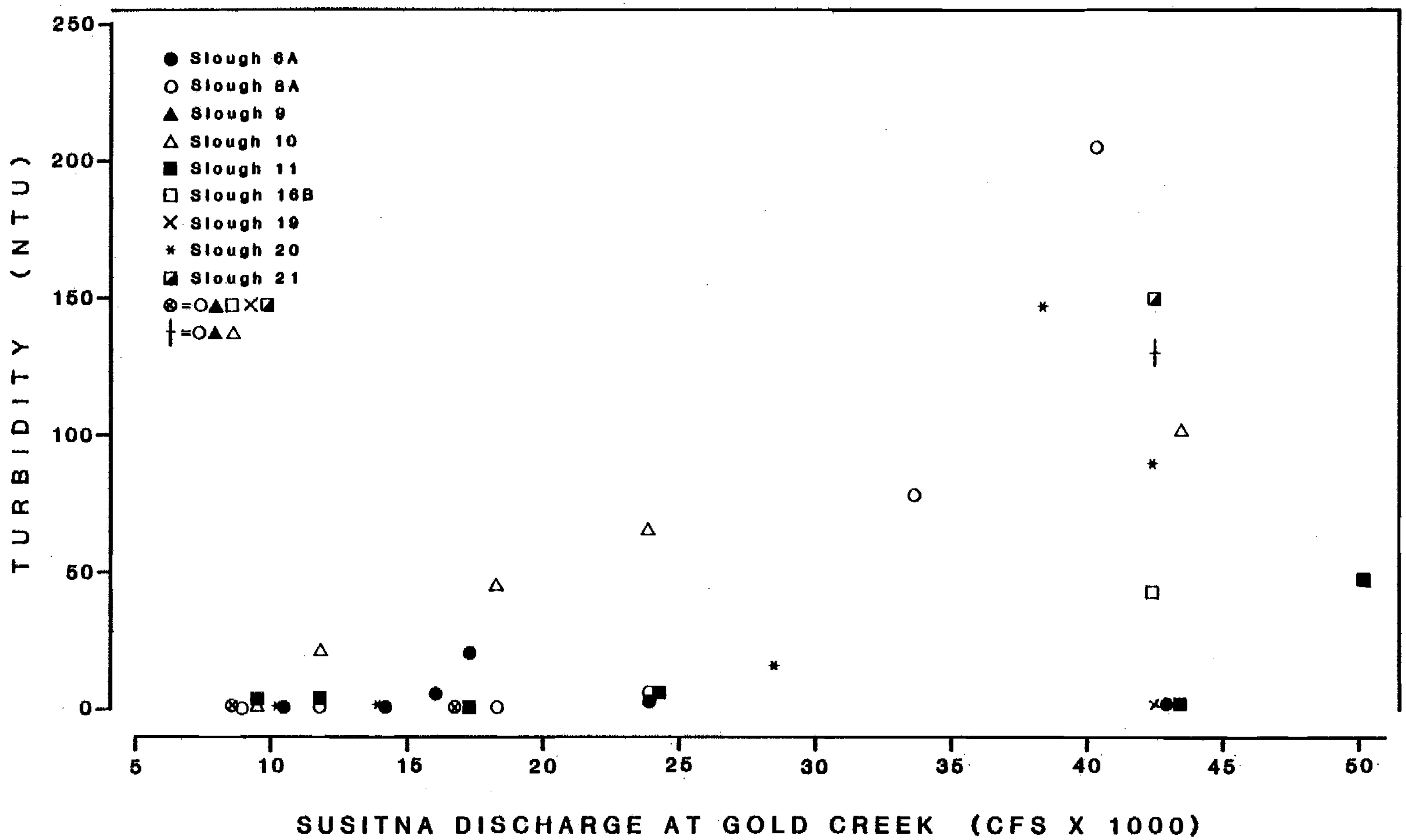


Figure E.3.2. Slough turbidity (Talkeetna to Portage Creek reach) versus mainstem discharge of the Susitna River at Gold Creek (adapted from ADF&G 1981c and USGS 1981.

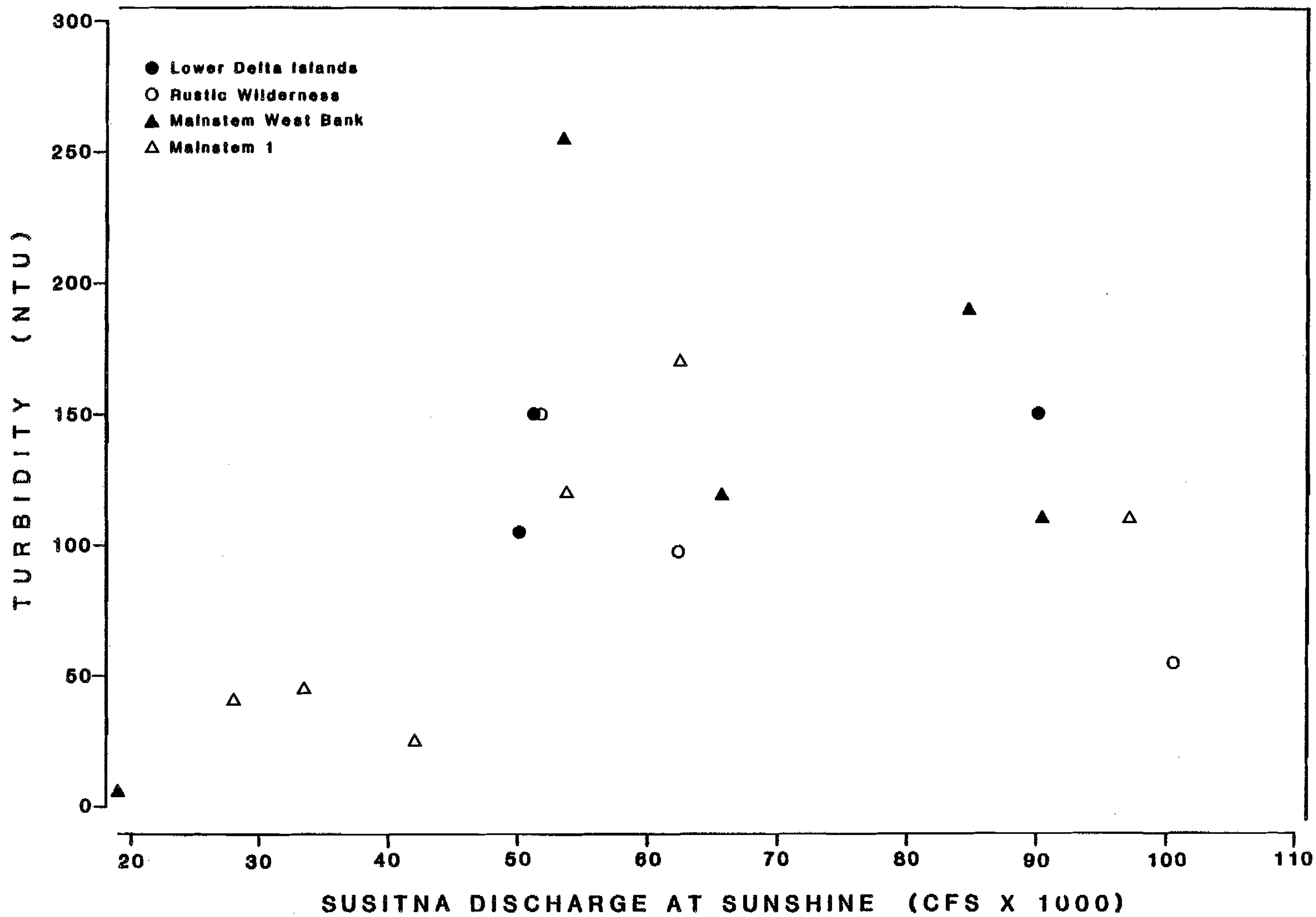


Figure E.3.3. Mainstem turbidity (downstream of Talkeetna) versus mainstem discharge of the Sunshine River at Sunshine (adapted from ADF&G 1981c and USGS 1981).

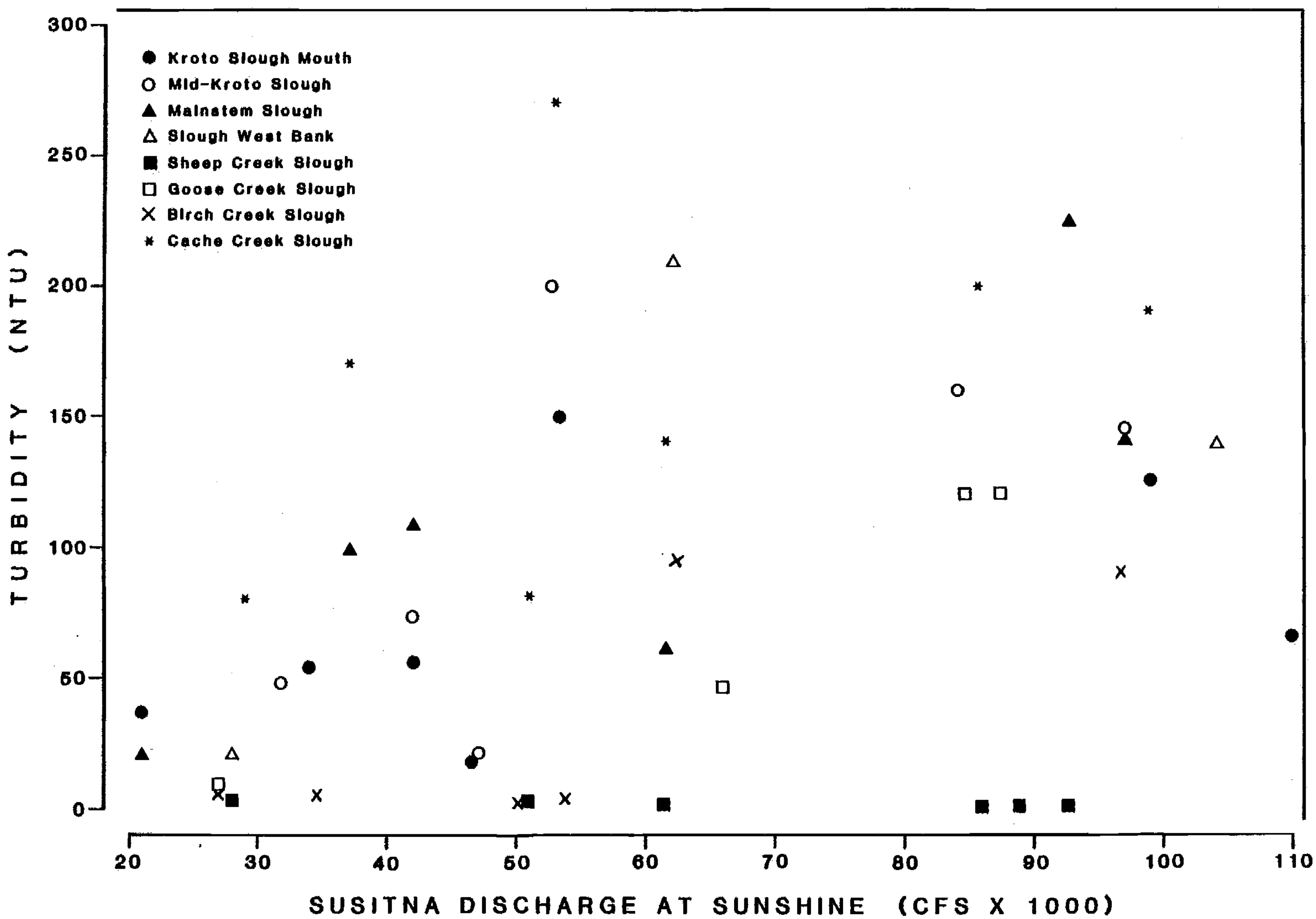


Figure E.3.4. Slough turbidity (downstream of Talkeetna) versus mainstem discharge of the Susitna River at Sunshine (adapted from ADF&G 1981c and USGS 1981).

are more easily observed in the reach of the Susitna River between Talkeetna and Devil Canyon than in the reach between Cook Inlet and Talkeetna. Some sloughs (e.g., Sloughs 6A and 19) retain low turbidities even at high mainstem discharges due to localized conditions, e.g. clear water influx or no upstream connection with the mainstem Susitna River*. Turbidity patterns at Slough 10 are similar to those in the mainstem because samples were actually collected in the mainstem at or below the slough mouth.

Figure E.3.5 illustrates changes in mainstem Susitna River turbidity from June through September 1981 at four sites: below the Deshka River (R.M. 31.0), above the Parks Highway Bridge (R.M. 84.0), above Gold Creek (R.M. 136.9), and above Jay Creek (R.M. 203.9). The points are connected to facilitate comparisons between sites; however, it should be noted that few points are plotted and that large variability may occur in turbidity for the time frame shown. Generally, turbidity levels increase with increases in discharge and this trend is followed throughout the length of the river (Figure E.2.1 and Figure E.3.5). Additional data will be required to represent the various peaks in discharge which were not represented with these data. Sites should be sampled more frequently to better define the discharges at which sloughs are affected by mainstem surface water influx and to determine if a difference in turbidity exists between rising versus falling discharge levels. Samples should be collected in both the mainstem Susitna River near the slough and within the slough.

* See Section 2.7 and Chapter 4.

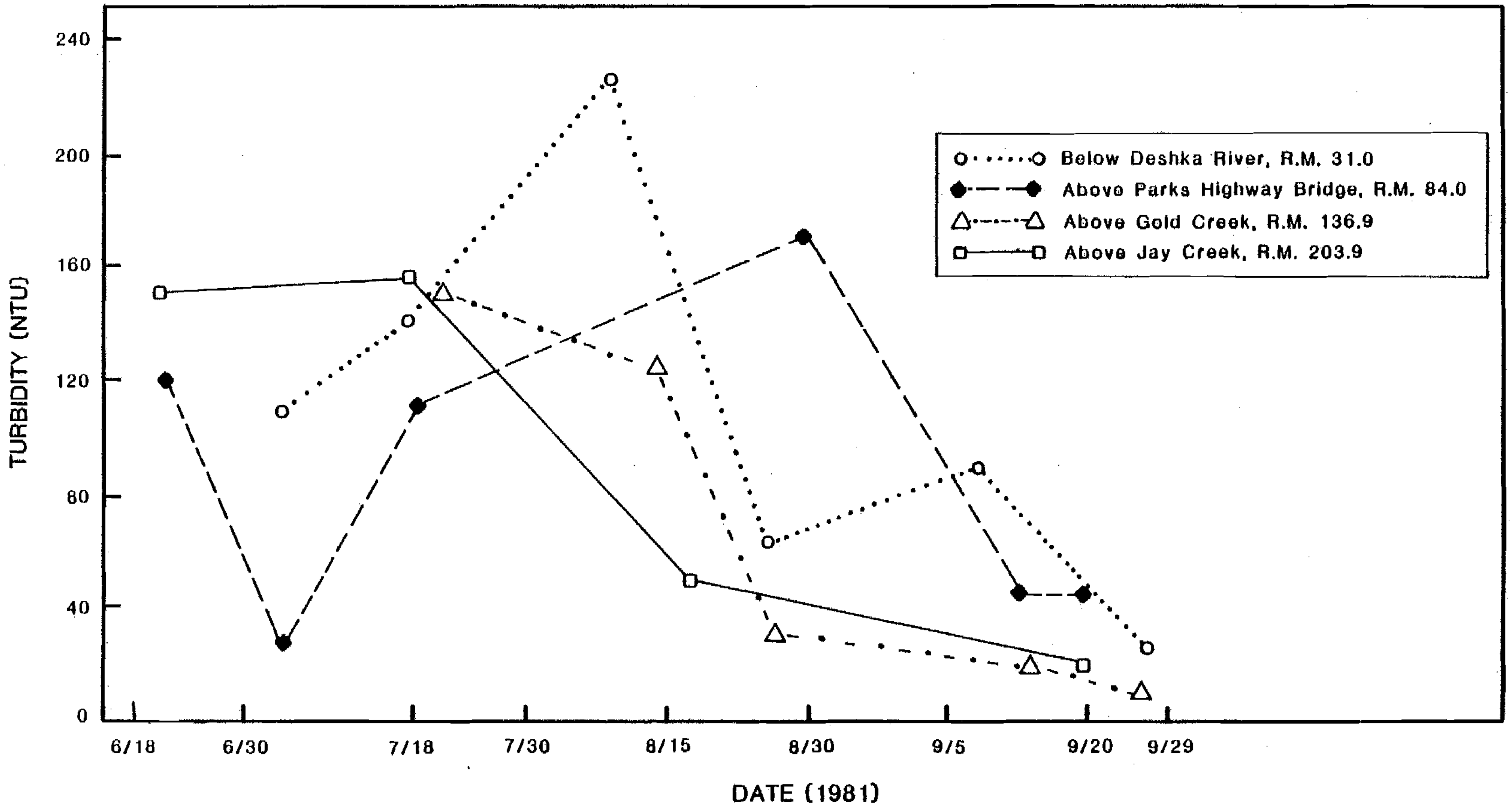


Figure E.3.5. Mainstem turbidity of the Susitna River as a function of time at the following sites: below Deshka River (R.M. 31.0); above the Parks Highway Bridge (R.M. 84.0); above Gold Creek (R.M. 136.9) and above Jay Creek (R.M. 203.9).

3.3 Differences Between Surface Water Temperatures at Mainstem Locations

Biweekly mean daily surface water temperatures of the mainstem Susitna River at 11 sites between Alexander Creek (R.M. 10.0) and Devil Canyon (R.M. 152.0) are listed in Table E.3.1 for the period from June 20 through September 27, 1981 (ADF&G 1981c). These data were used to construct temperature profiles for the mainstem Susitna River (Figures E.3.6 - E.3.13). Surface water temperatures for the Susitna River show significant variability upstream to downstream. This may be due to the effect of major tributaries (such as the Chulitna, Talkeetna and Yentna Rivers) on the temperature regime of the Susitna River. Inflow from these tributaries may also buffer Susitna River temperatures. Higher winter temperatures are predicted for the reach of the Susitna River between Talkeetna and Devil Canyon if the dams are built (Acres 1982). Inflows from the Chulitna, Talkeetna, and Yentna Rivers may therefore buffer this temperature alteration downstream from the respective confluences. Additional data will be collected in 1982 to better define the relationships between the Chulitna, Talkeetna, Yentna, and mainstem Susitna River temperatures and to predict the influence of post-project temperatures downstream of Talkeetna.

3.4 Diel Surface Water Temperature Fluctuations

Water temperatures in the Susitna River drainage fluctuate on both a temporal and spatial basis. Variations in temperature over a 24 hour period are referred to as diel fluctuations. Water temperature data for selected thermograph sites (see ADF&G 1981c) were plotted (Figures E.3.14 to E.3.15) to show diel fluctuations at representative sites. The plots show the one week

Table E.3.1. Mainstem Susitna River surface water temperatures, °C (ADF&G 1981c), for various sites used in developing Figures E.3.6 to E.3.13.

MAINSTEM SITE	RIVER MILE	DATE (1981) June 20	June 30	July 18	July 29	August 18	August 25	September 11	September 27
		TEMPERATURE							
Above Alexander Creek	10.1	10.1	7.1	8.6	8.1	7.1	7.1	---	---
Above Yentna River	32.3	13.4	8.5	11.1	10.5	8.2	9.5	---	2.4
Above Little Willow Creek	50.5	---	7.8	10.0	9.4	7.3	8.7	6.9	2.6
Above Kashwitna River	61.2	---	---	---	---	---	---	7.3	2.4
Above Montana Creek	77.5	12.6	7.7	---	---	---	---	10.3	5.4
Sunshine (Parks Highway Bridge)	83.3	13.3	8.1	---	---	---	---	---	---
Talkeetna Base Camp	103.0	13.6	8.5	---	---	8.1	9.2	8.4	1.8
Above Fourth of July Creek	131.8	12.8	5.5	10.2	10.6	6.8	7.6	7.4	2.5
Above Gold Creek	136.8	---	---	---	9.3	6.9	8.5	6.3	0.2
Above Indian River	138.7	---	---	9.1	8.1	6.2	7.5	6.5	1.2
Above Portage Creek	148.8	---	---	10.0	10.1	7.1	9.6	7.3	1.4

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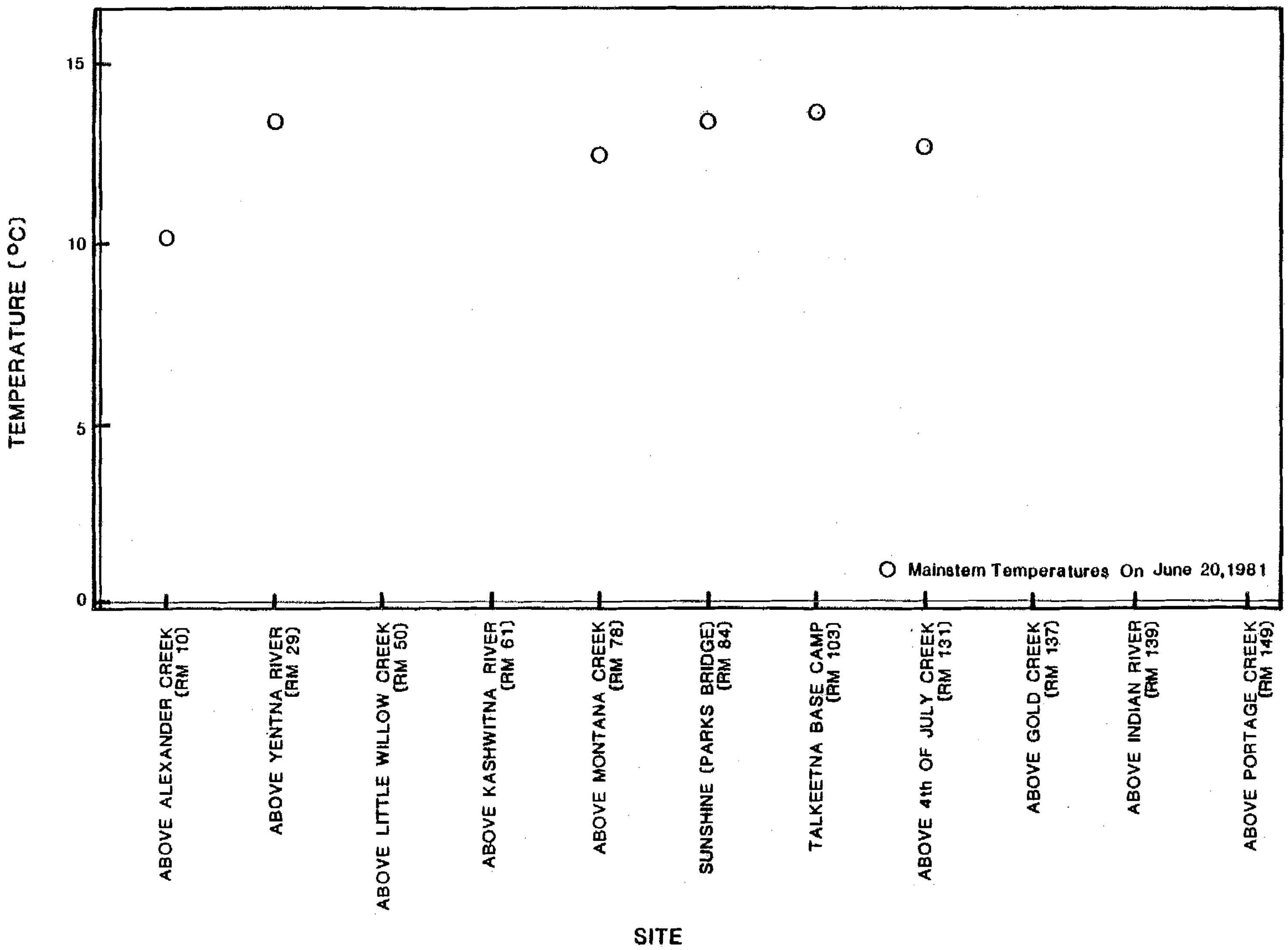

Figure E.3.6. Mean daily mainstem surface water temperature profile for the Susitna River for June 20, 1981.

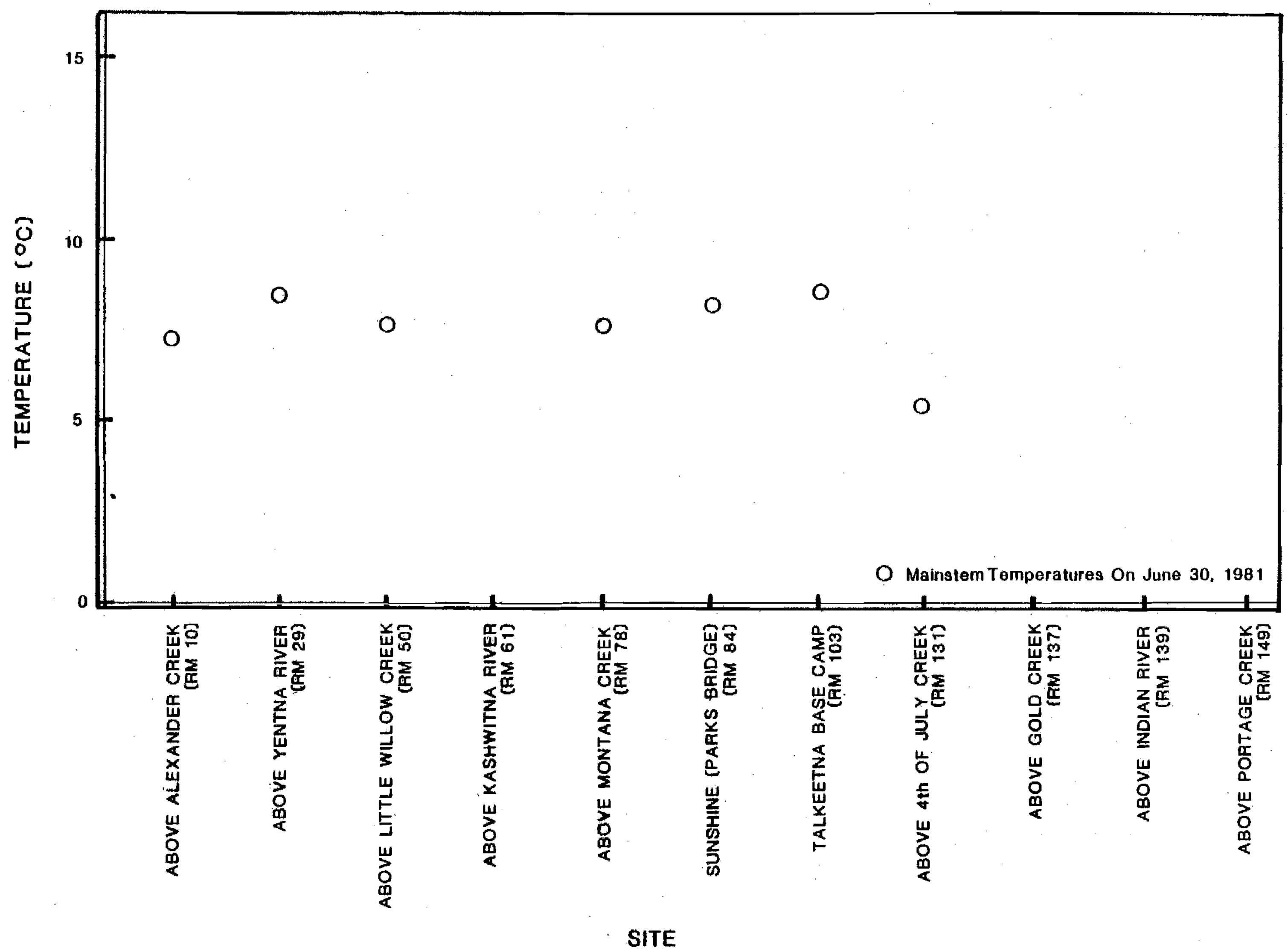

Figure E.3.7. Mean daily mainstem surface water temperature profile for the Susitna River for June 30, 1981.

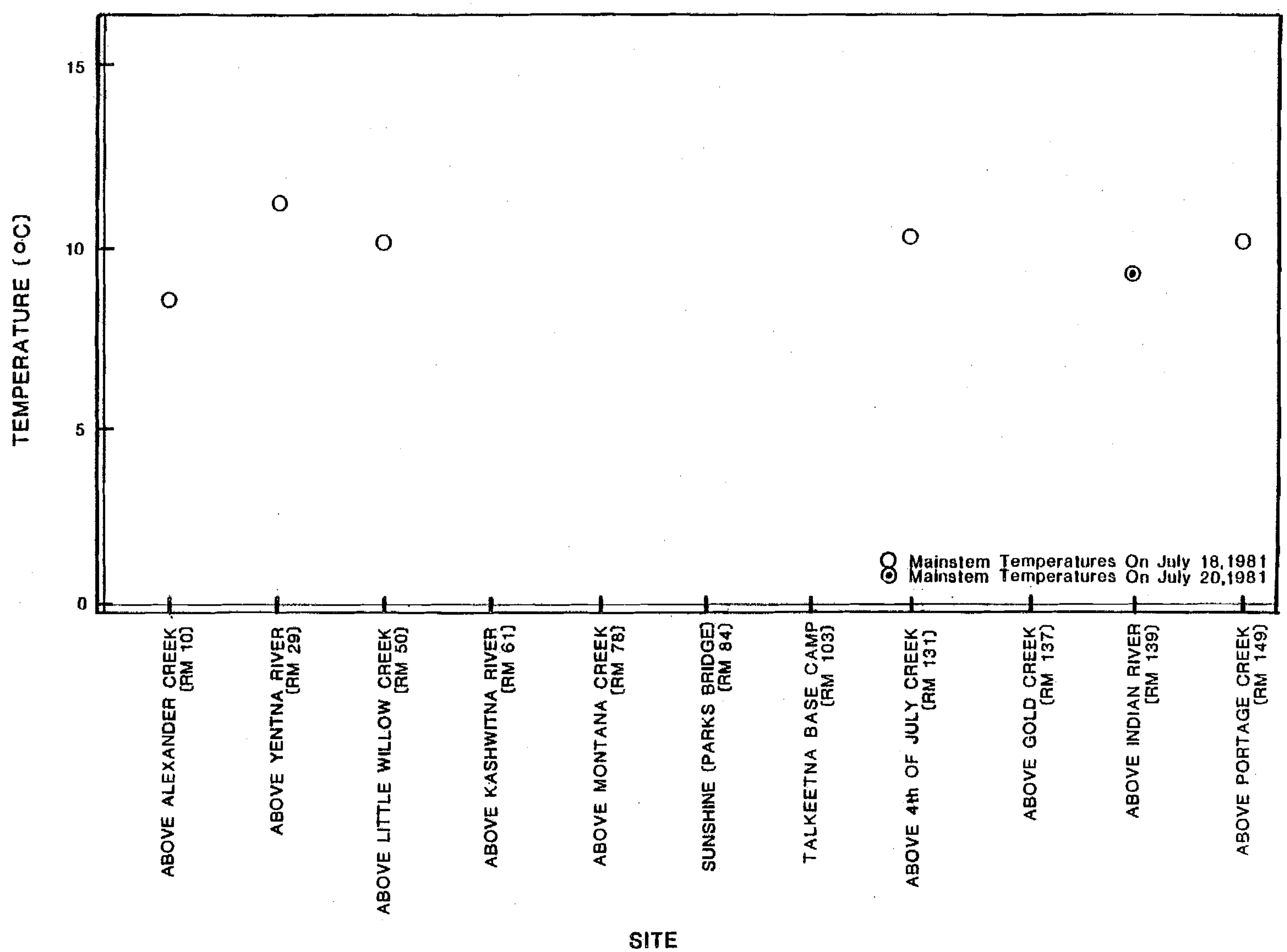

Figure E.3.8. Mean daily mainstem surface water temperature profile for the Susitna River for July 17, 1981.

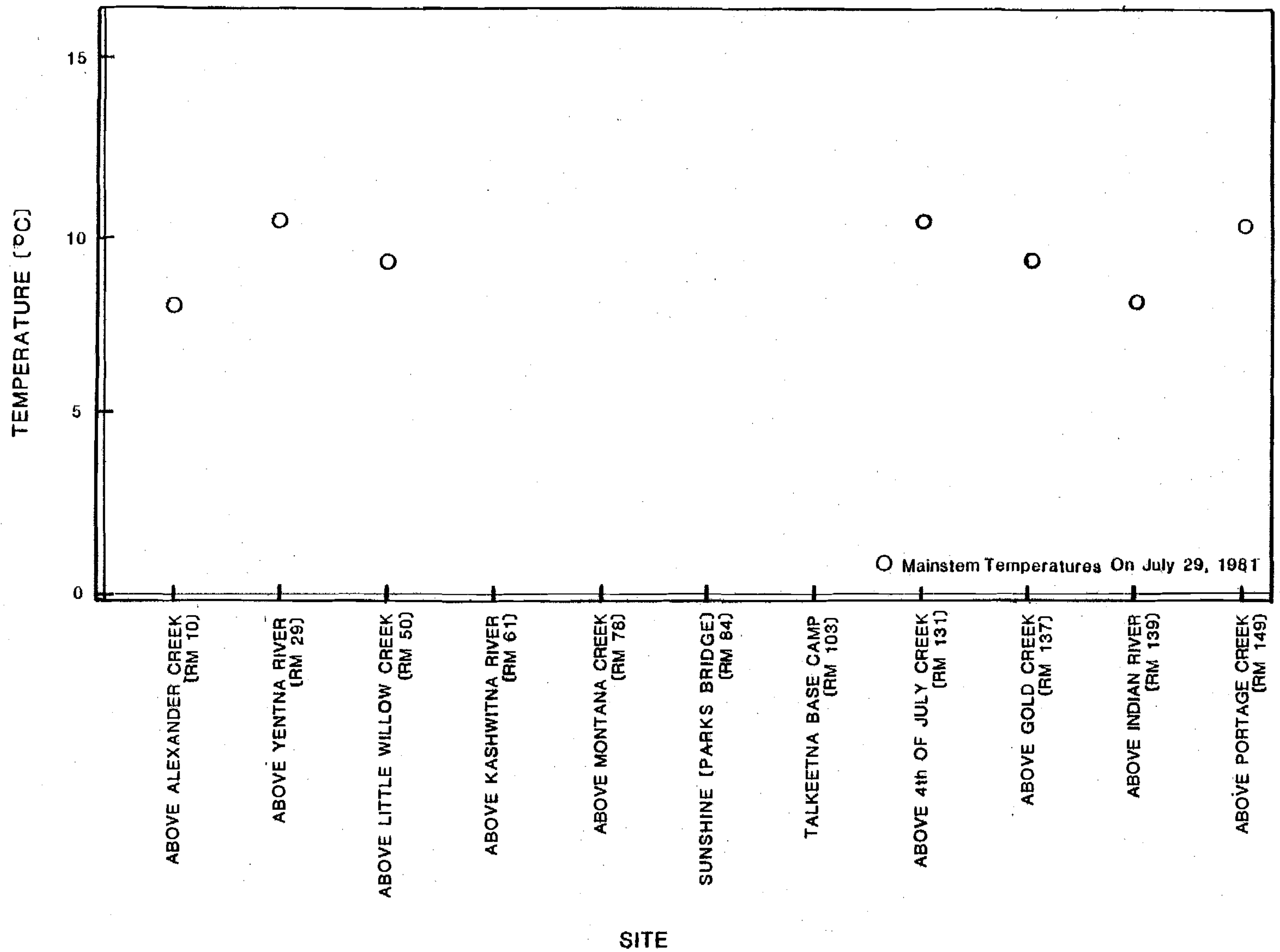

Figure E.3.9. Mean daily mainstem surface water temperature profile for the Susitna River for July 29, 1981.

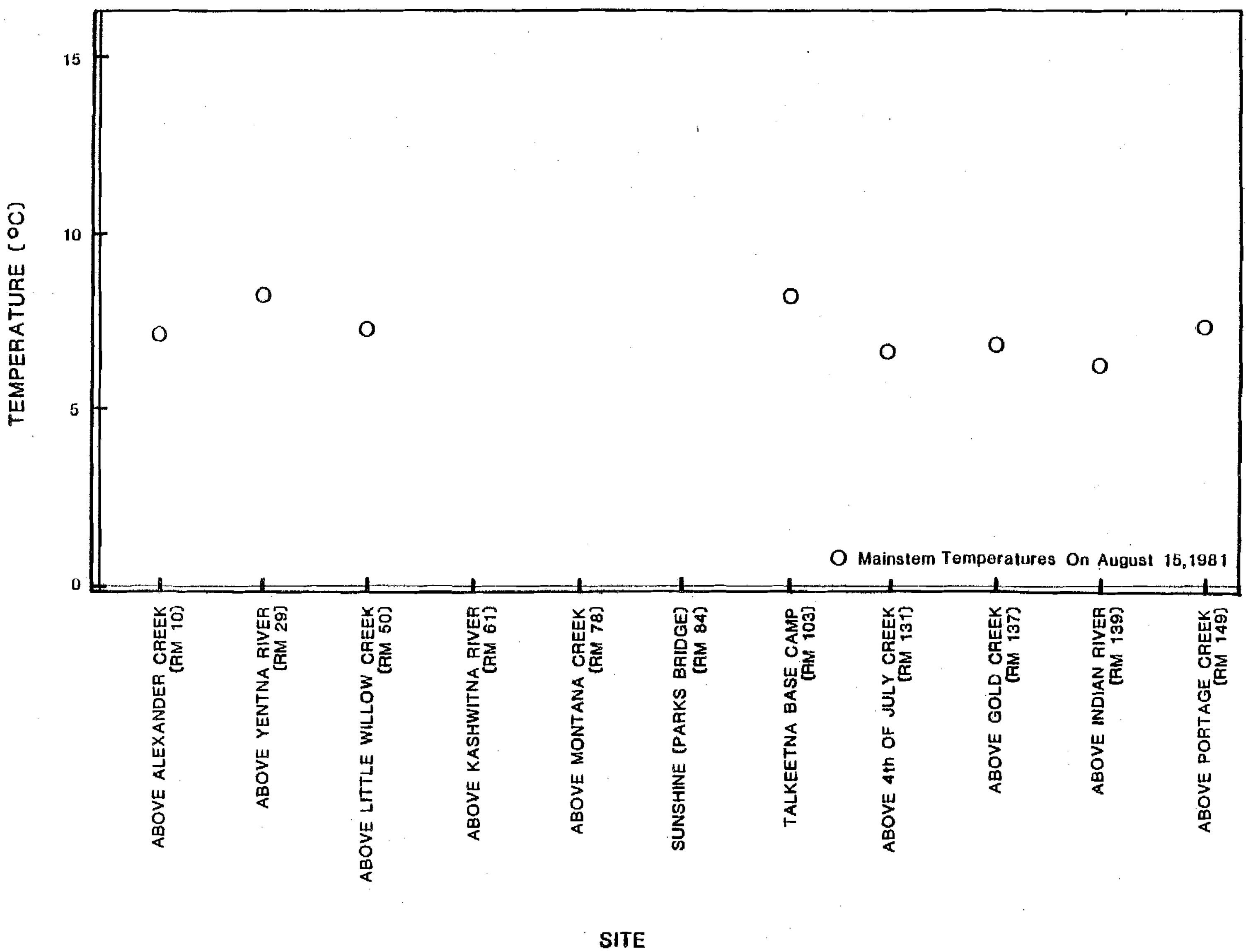

Figure E.3.10. Mean daily mainstem surface water temperature profile for the Susitna River for August 15, 1981.

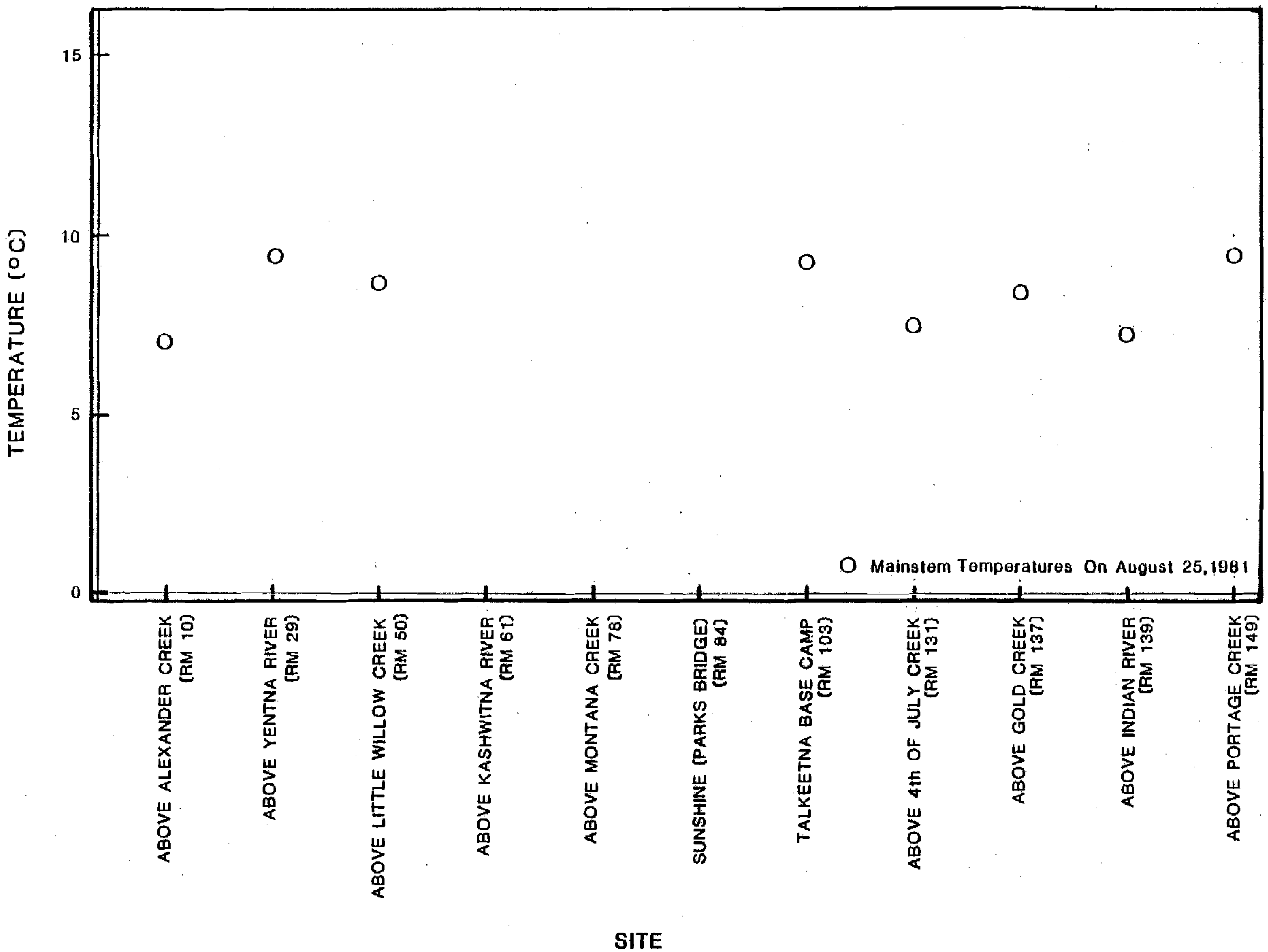

Figure E.3.11. Mean daily mainstem surface water temperature profile for the Susitna River for August 25, 1981.

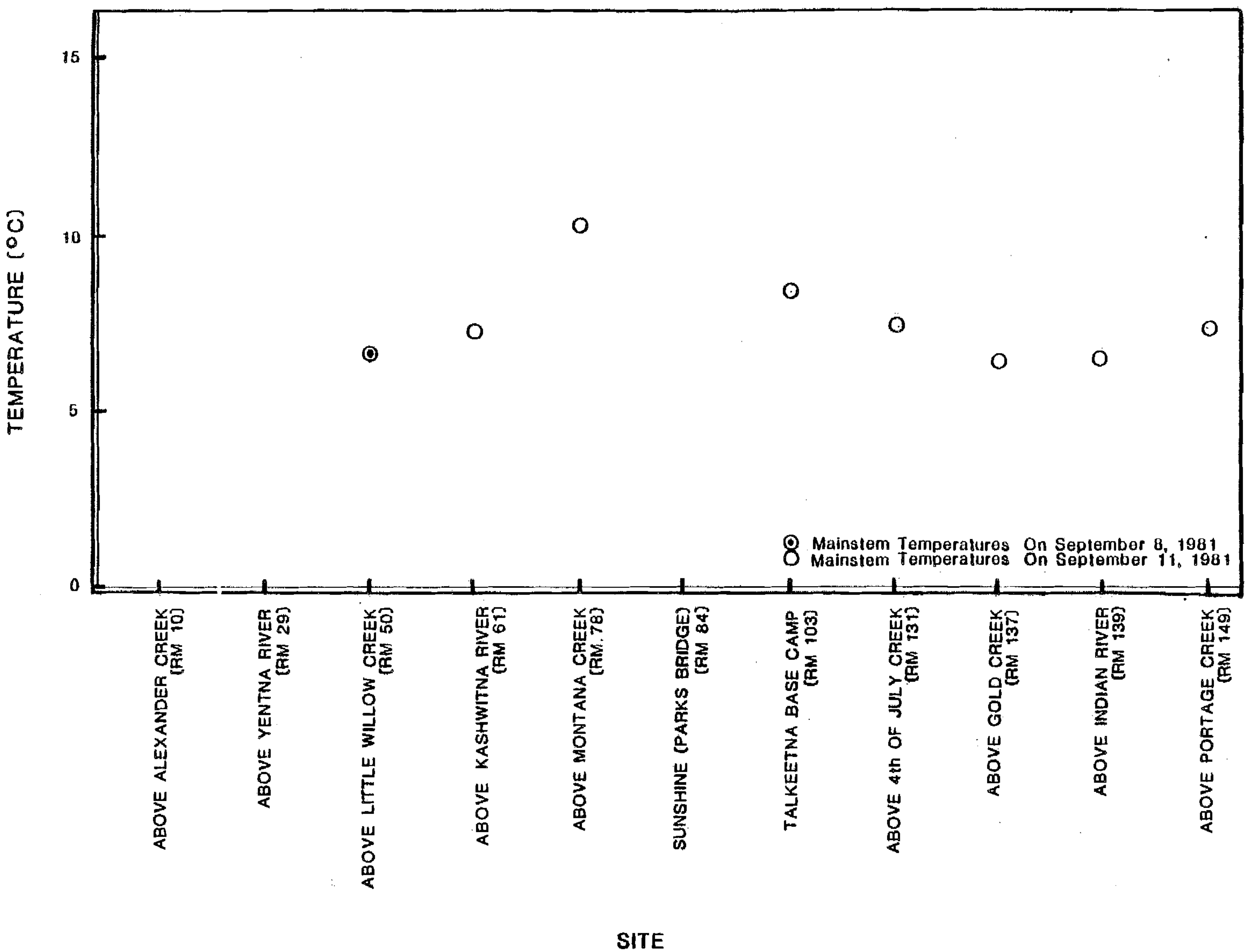

Figure E.3.12. Mean daily mainstem surface water temperature profile for the Susitna River September 8 and 11, 1981.

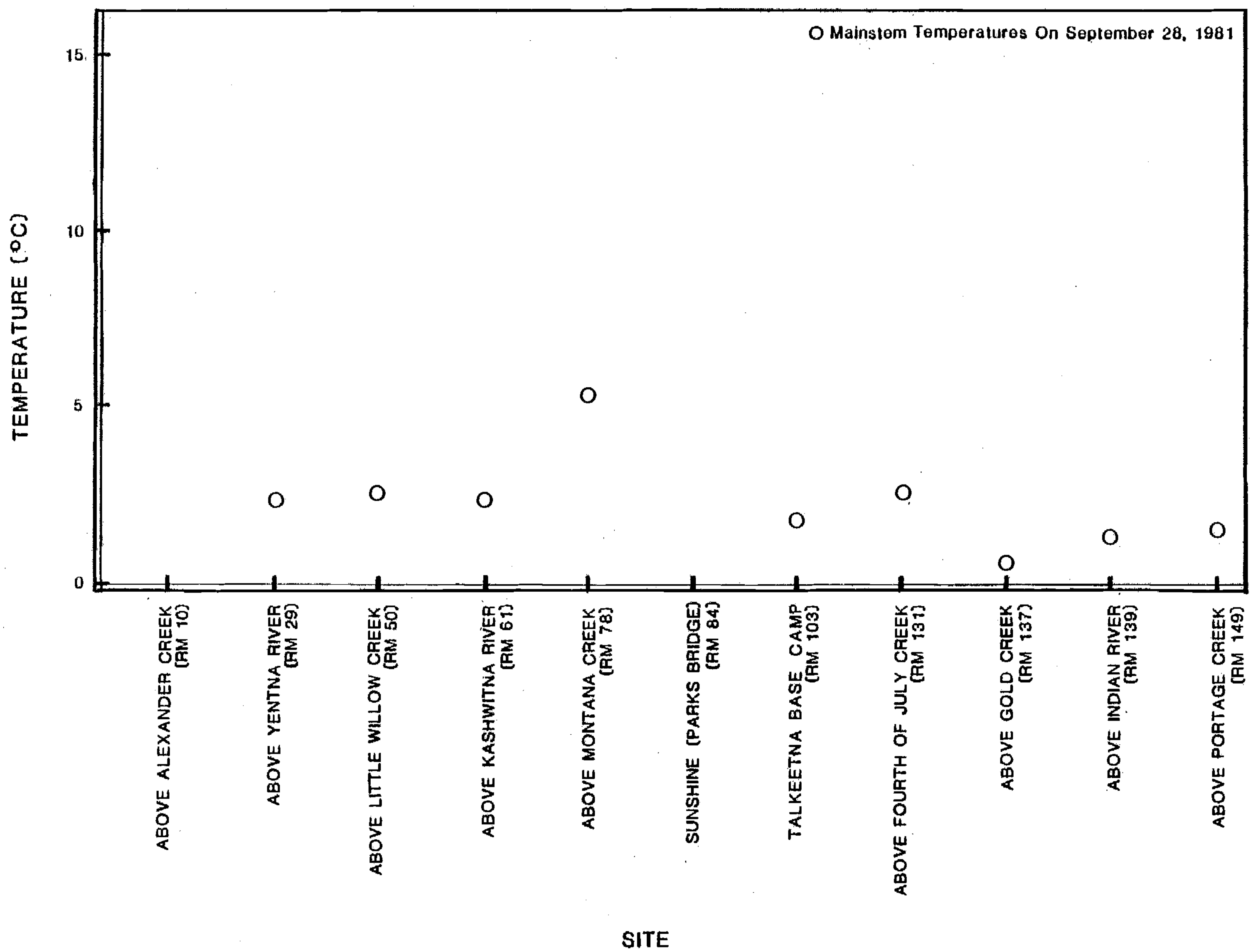

Figure E.3.13. Mean daily mainstem surface water temperature profile for the Susitna River for September 28, 1981.

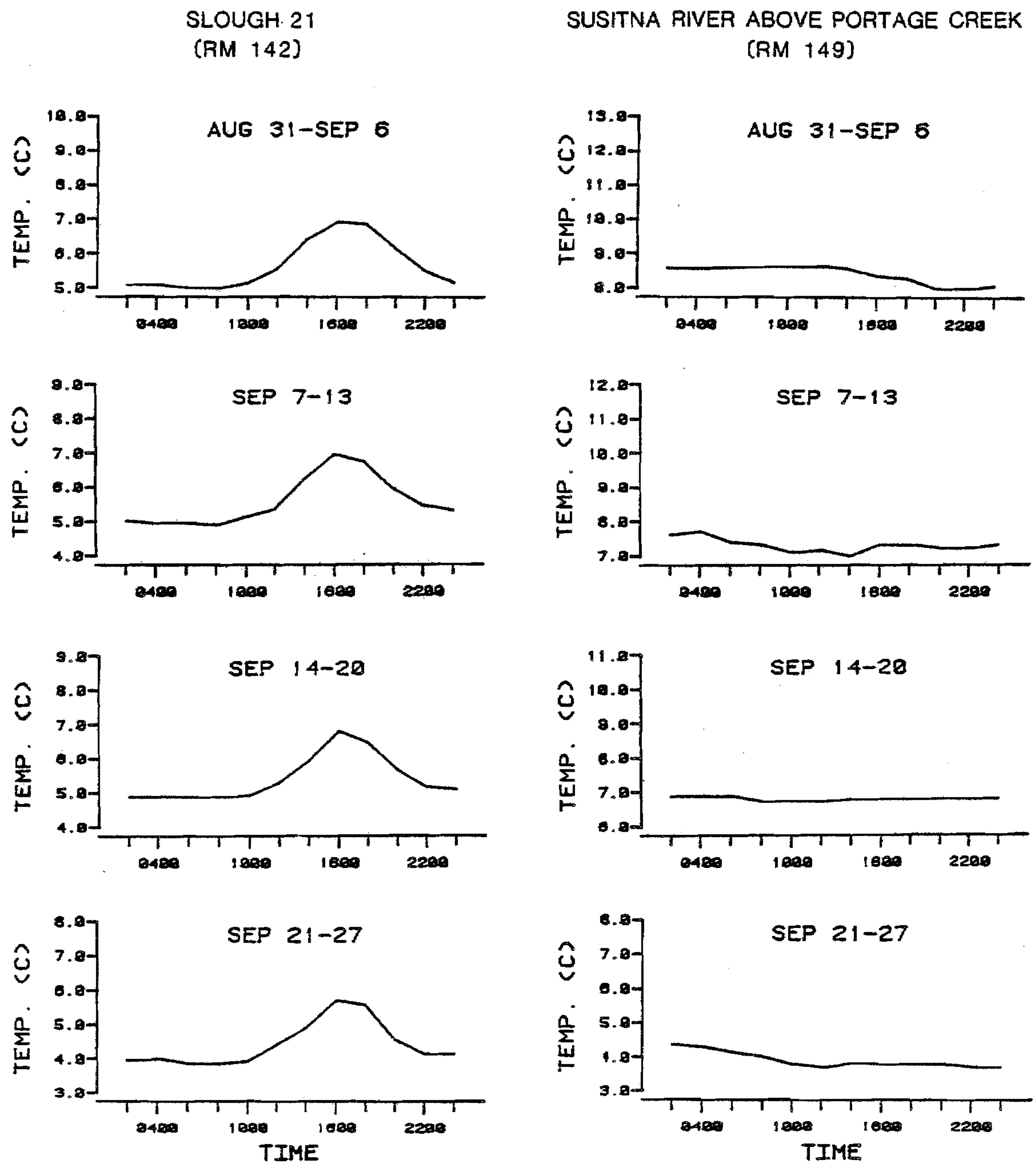

Figure E.3.14. Comparison of weekly diel surface water temperature variations in Slough 21 and the mainstem Susitna River at Portage Creek (adapted from ADF&G 1981c).

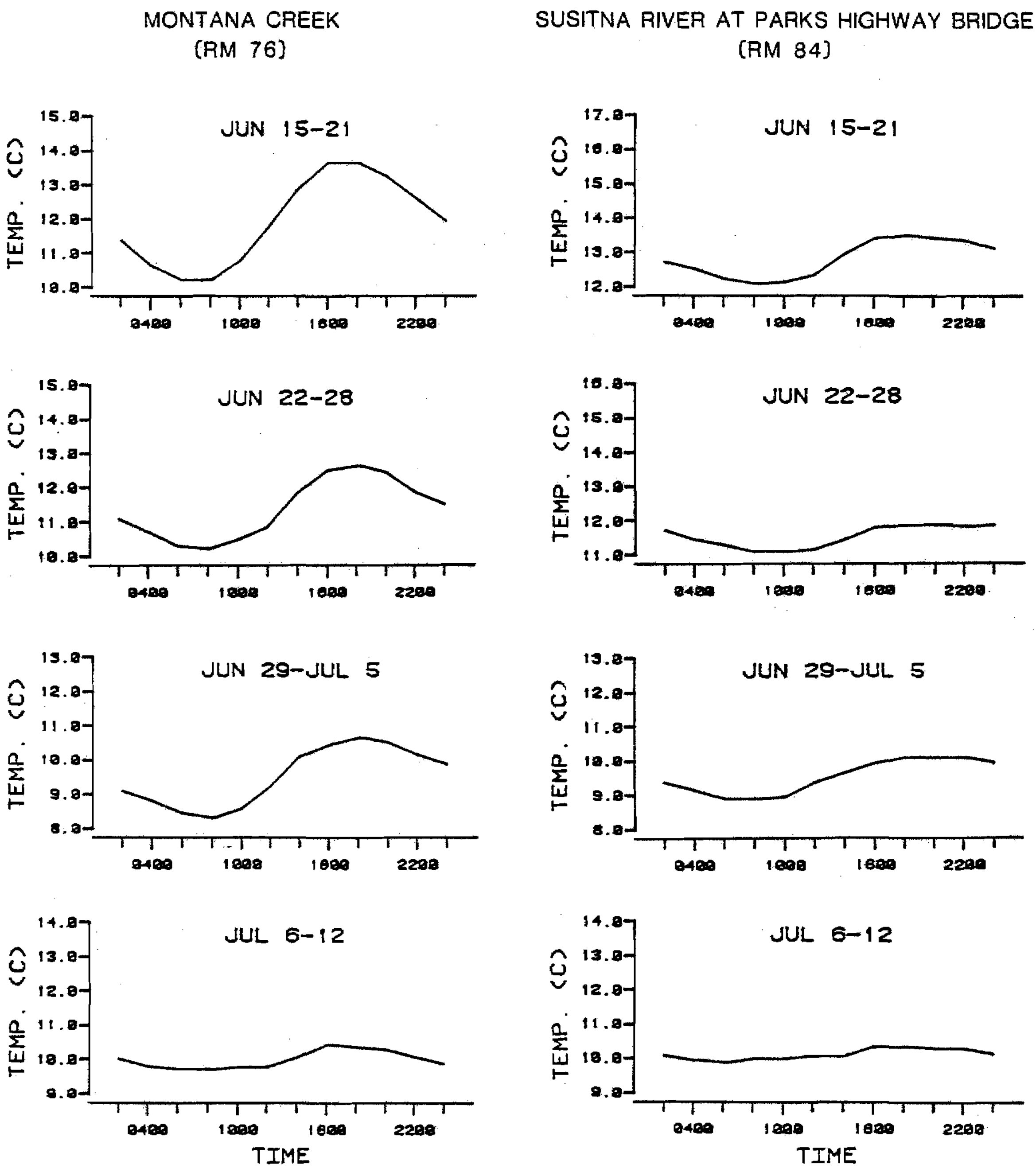

Figure E.3.15. Comparision of weekly diel surface water temperature variations in Montana Creek and the mainstem Susitna River at the Parks Highway Bridge (adapted from ADF&G 1981c).

average of two hour intervals for a 24 hour period (i.e. each point equals the average water temperature at a specific time of day for a seven day period). The values on each temperature axis were selected to best reflect the range of water temperatures recorded. Each temperature axis encompasses a 5°C span in water temperature. Diel temperature fluctuations can differ in a slough from those recorded in the mainstem (Figure E.3.14). Surface water temperatures in Slough 21 during September 1981 significantly increased during the afternoon, while the mainstem Susitna River temperature near Portage exhibited no corresponding increase, and in some cases decreased slightly (these sites are separated by 6 river miles). Slough temperature increases may be due to the increased solar warming of the shallow water in the sloughs; the glacial source of mainstem flows keeps water temperatures nearly constant. These data were collected during a period when the slough head was dewatered; thus mainstem water had little influence on slough temperatures. Slough water temperatures would be expected to correspond more closely to mainstem temperatures during periods of high discharge when mainstem flows enter the slough.

Figure E.3.15 illustrates temperature regimes for Montana Creek and the mainstem Susitna River at the Parks Highway Bridge for mid-June through mid-July 1981. The timing of diel temperature fluctuations in Montana Creek is similar to that in the mainstem; however, mainstem fluctuations are dampened. It appears that the larger amount of water in the Susitna buffers temperature change.

Diel temperature patterns may exert an influence fishery resources and the productivity of aquatic habitats (Hocutt et al. 1980; Ward and Stanford 1979;

Baxter and Glaude 1980). Depending upon the relationship between surface and intragravel water temperatures, alteration of diel variations may influence egg development and fry emergence (Reiser and Bjornn 1979). Altering Susitna River temperatures may affect stocks of rearing fish in unknown ways. The effects on productivity in the Susitna River are also unknown. Diel temperature fluctuations may influence or be related to diel fluctuations in productivity. However, because primary productivity was not evaluated during the 1981 field season, it is unknown whether diel fluctuations occur in productivity. Studies should be considered to define the relationship between surface and intragravel water temperature fluctuations, as well as temperature influence on productivity in the mainstem, sloughs, and major tributaries.

3.5 Selected Slough Habitat Studies*

3.5.1 Introduction

Comprehensive water quality and discharge data were collected on a cooperative basis with the USGS at five selected slough habitat study sites between Talkeetna and Devil Canyon (Sloughs 8A, 9, 16B, 19, and 21, Figure E.2.20). Figure E.3.16 illustrates stream gradient and relative elevation of each slough between Talkeetna and Portage Creek. Planimetric and morphometric maps of Sloughs 16B, 19, and 21 are included in the AH subject report (ADF&G 1981c). Planimetric maps of Sloughs 8A and 9 are presented in this report (Figures E.3.17 and E.3.18). These sites were selected because they represented varied types of slough habitat and fishery activities as deter-

* Refer to Sections 2.6, 2.7 and the AH subject report (ADF&G 1981c) for additional site description and background information.

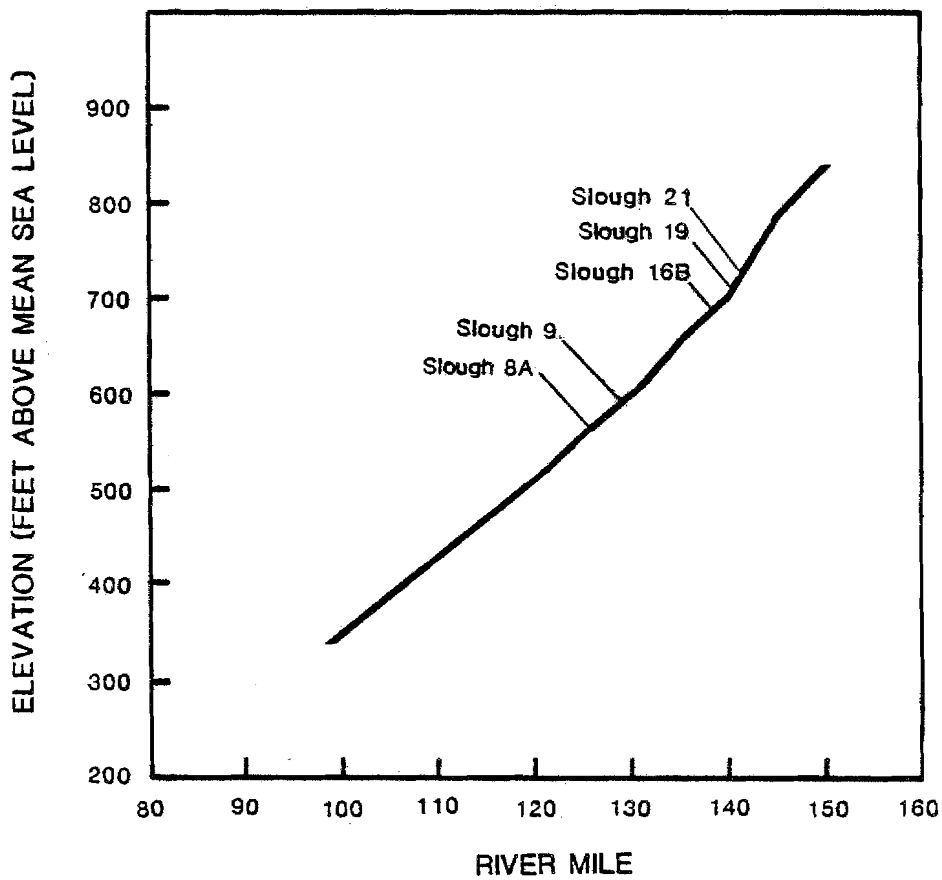

Figure E.3.16. Susitna River gradient between Talkeetna and Portage Creek showing positions of selected habitat study sloughs (adapted from R&M 1982b).

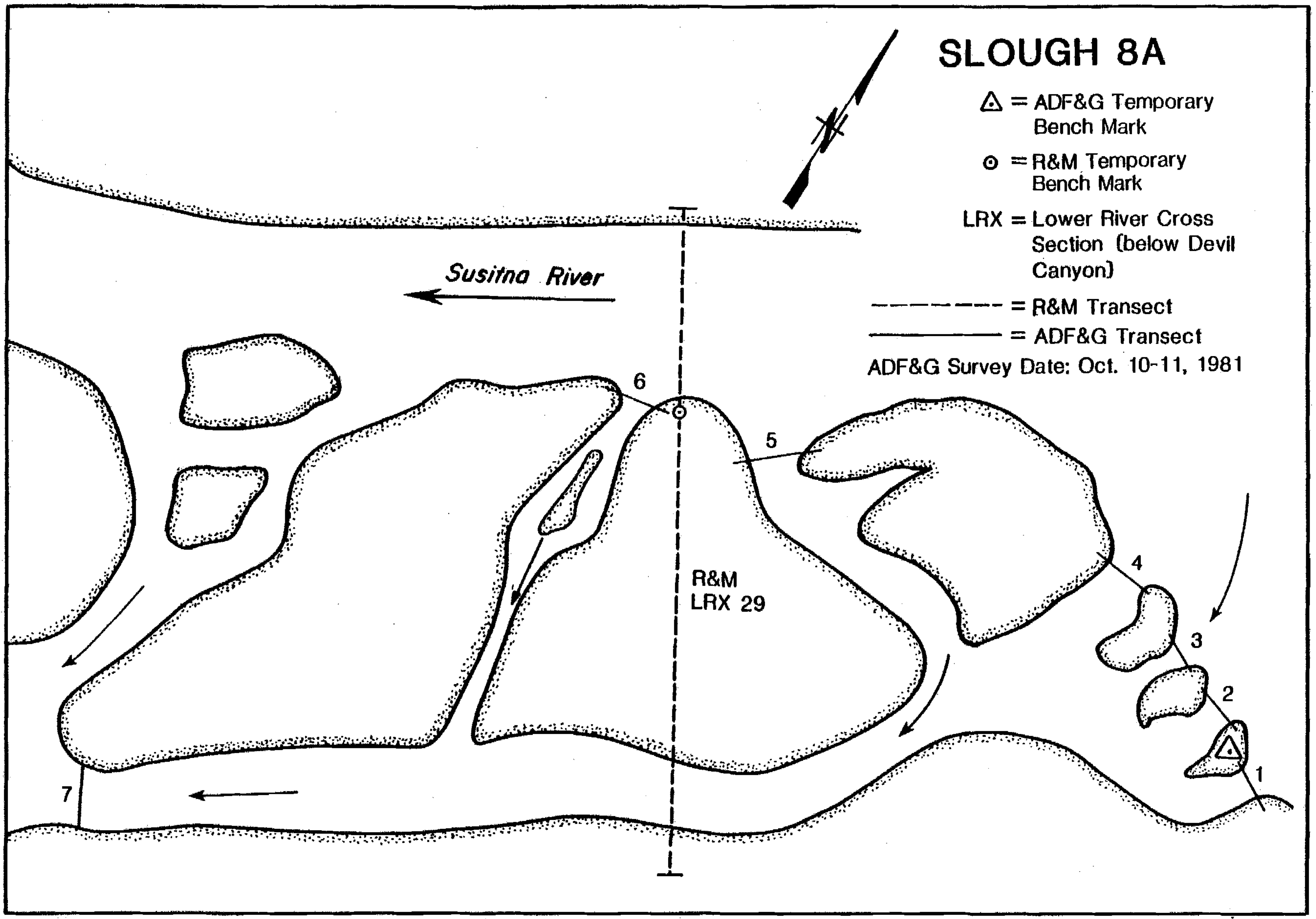

Figure E.3.17. Planimetric map of Slough 8A.

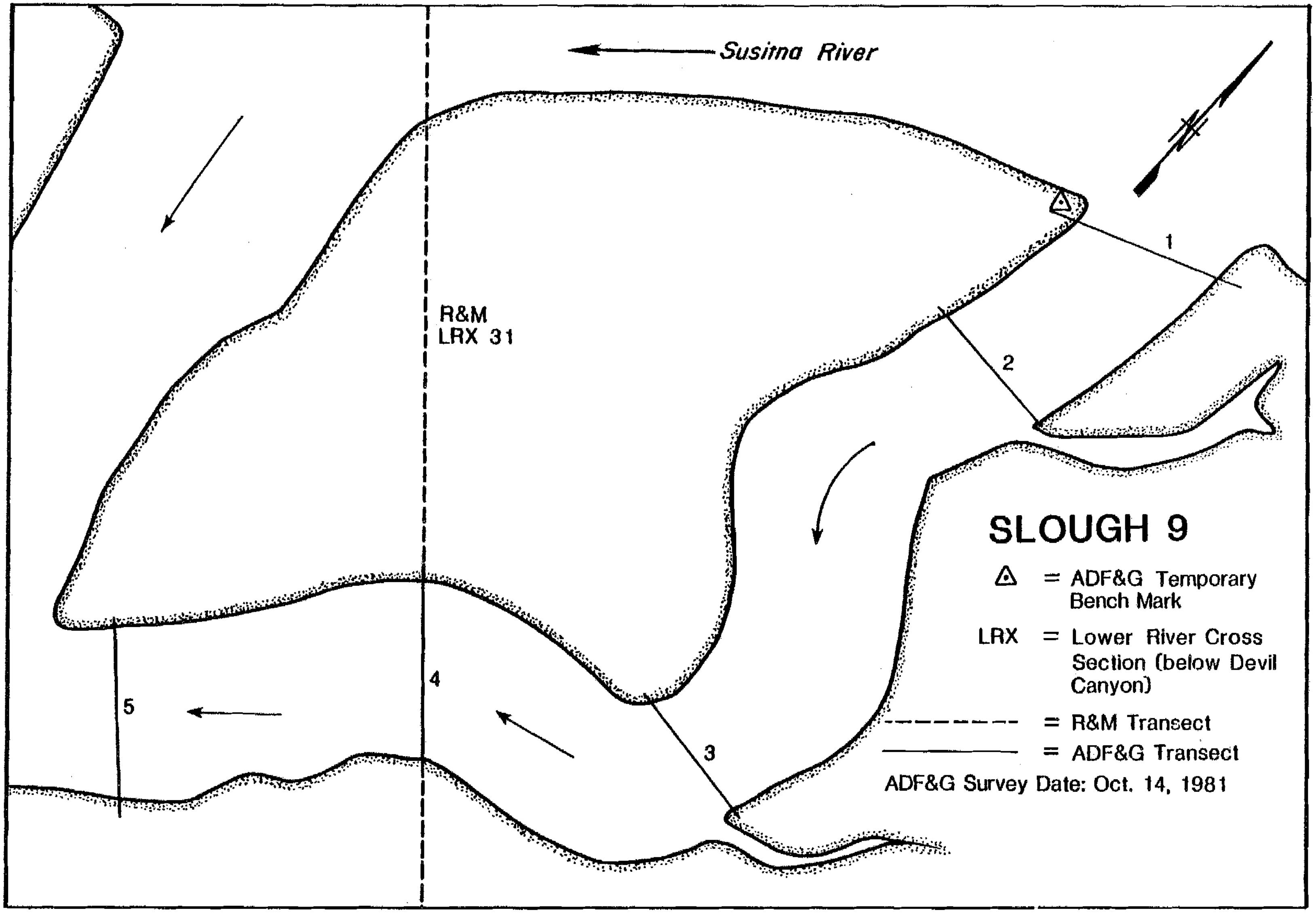

Figure E.3.18. Planimetric map of Slough 9.

mined from:

a) fishery, water quantity and quality baseline data collected by the ADF&G (1974, 1977, 1978); and

b) a reconnaissance trip to the study area in June 1981 by ADF&G Su-Hydro and USGS personnel.

Supplemental fishery and physiochemical data for these sloughs are presented in Chapter Two. Water quality data analysis is preliminary and interpretation is limited to three sets of data collected in the summer of 1981.

3.5.2 Relationships Between Water Quality in the Mainstem River and Selected Sloughs with Respect to Mainstem Discharge

Mainstem and slough water quality data can be used to identify relationships between these two systems. At high mainstem Susitna River flows, many of the sloughs are essentially shallow branches of the mainstem. As mainstem discharge drops, the flow of mainstem water into the sloughs is reduced until mainstem surface water no longer enters the headwaters of the sloughs.* Turbidity is one of the water quality parameters that can be used for observing these discharge water quality relationships. Turbidity levels in sloughs drop below mainstem levels when slough headwaters are no longer interconnected with mainstem surface waters (Table E.5.8 in ADF&G 1981c). This however does not preclude the possibility that mainstem flows enter slough channels as intragravel seepage.*

* See Sections E.2.7 and E.3.2 for additional slough/mainstem relationships.

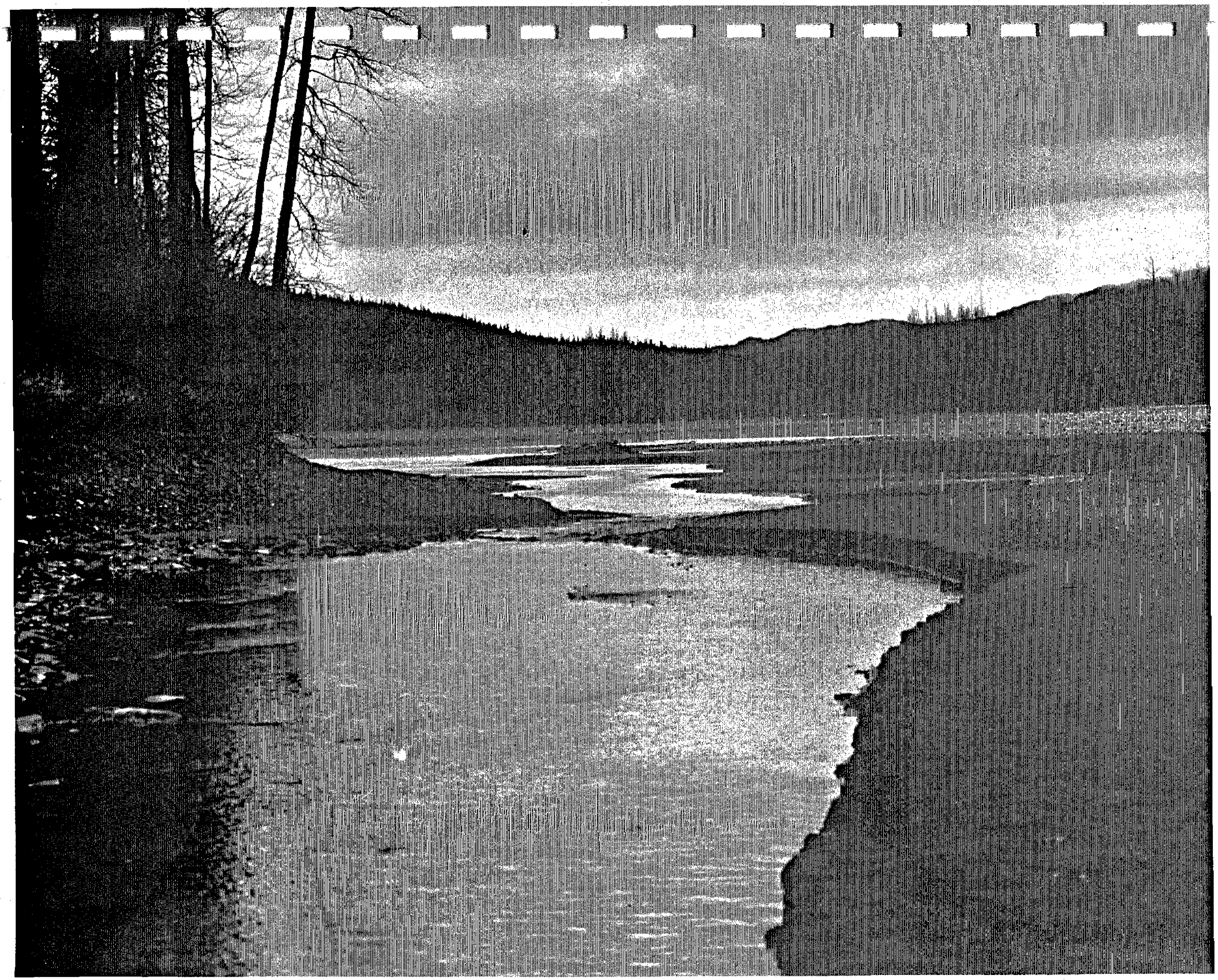

Plate 7. Mouth of Slough 9 (mainstem Susitna River discharge 7920 cfs) October 14, 1981.

During periods when the surface water in the sloughs is clear there can remain some influence of mainstem turbidity at the mouth if a backwater area exists.

Another parameter which demonstrates mainstem/slough relationships is the concentration of suspended trace metals. When mainstem discharge is high and enters the sloughs, trace metal concentrations in the sloughs are high (Table E.5.8 in ADF&G 1981c). At high mainstem flows in Sloughs 8A, 9, and 21, slough trace metal concentrations essentially equal those measured in the mainstem (Table E.5.8, ADF&G 1981c). At high mainstem flows, trace metal levels in Sloughs 16B and 19 were somewhat lower than those measured in other study sloughs and the mainstem river. This relationship may indicate that a larger percentage of flow in Sloughs 16B and 19 originates from groundwater or other sources. In spite of this, a positive correlation is still evident between mainstem flows and trace metal concentrations in these sloughs when slough inlets receive mainstem surface flows of the Susitna River. At low mainstem discharges, trace metal concentrations in all sloughs are well below concentrations in the mainstem. Trace metals are associated with suspended sediment rather than with dissolved constituents (Table E.5.8 in ADF&G 1981c). Thus, as slough turbidity drops, sediment-associated parameters such as trace metal concentrations also drop. Other water quality parameters in the sloughs during low mainstem flows do not vary significantly from those of the mainstem.

* See Sections E.2.7, E.3.2 and Chapter 4 for additional slough/mainstem relationships.

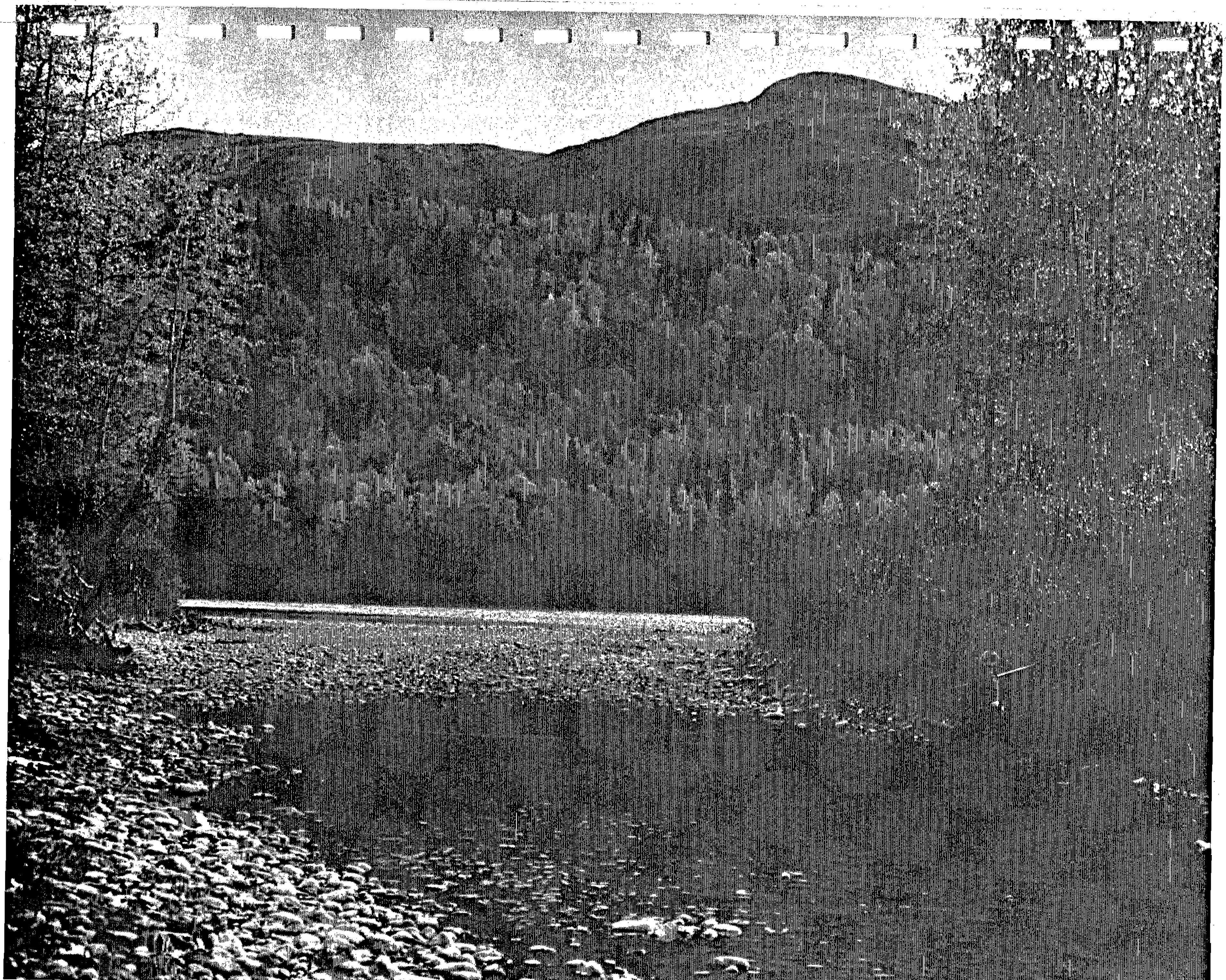

Plate 8. View of head of Slough 16B (mainstem Susitna River discharge 14,500 cfs), September 9, 1981.

3.5.3 Relationships Between Water Quality Characteristics in Study Sloughs

A brief overview of water quality data presented in the AH subject report (ADF&G 1981c) for each of the five selected habitat study sloughs (Sloughs 8A, 9, 16B, 19, and 21) reveals intrinsic differences between water quality in each of the sloughs. Water quality differences may be explained by differences in morphology. For example, the turbidity in Slough 19, during high mainstem discharge, is low compared to the other four sloughs. This can be attributed to the source of water in Slough 19; it is the only slough that is not connected to the mainstem at its head and is almost entirely spring fed. The lower slough turbidity is likely the result of the lack of mainstem water influence (See section 3.2 and Figure E.3.2).

Although water quality in Slough 19 appears to be independent of direct mainstem influence, stage within this slough, is directly affected by the mainstem Susitna at high flows. During high mainstem flows the stage of the mainstem Susitna River acts as a hydraulic barrier at the slough outlet and a large backwater forms in the lower end of the slough (See chapter 4). Under these conditions, discharge data indicate that outflow from the slough is essentially eliminated (Table E.5.8 in ADF&G 1981c). Eventually, the stage in the mainstem Susitna drops enough to allow slough outflow. This and similar backwater areas in other sloughs provide rearing areas for juvenile fish.

Plate 9. View of mouth of Slough 16B (mainstem Susitna River discharge 14,500 cfs), September 9, 1981.

Water quality characteristics of Slough 16B also differ from those of other sloughs. The specific conductance and alkalinity are markedly lower in Slough 16B than in any of the other sloughs studied (Table E.5.8 in ADF&G 1981c). Slough 16B also has the lowest turbidity (with the exception of Slough 19) and the lowest trace metal concentrations during both high and low mainstem flows, of any other sloughs or the mainstem Susitna. It is suspected that this occurs because the Indian River (approximately 1 mile upstream of Slough 16B) contributes a portion of the surface and subsurface flows in the slough.

Sloughs 8A, 9, and 21 all appear to behave similarly. During periods of high discharge in the Susitna River, the water quality in each of these sloughs is essentially the same as that in the mainstem. As discharge drops, a critical mainstem discharge level is attained at which point the clearwater sources in each slough becomes predominant. A backwater area forms at the mouths of these sloughs during periods of high mainstem discharge.

Data for Slough 21 (presented in the AH subject report, ADF&G 1981c) indicate that surface water diel temperatures ranged from 4.5 to 8.5°C while the intragravel temperature remained constant at 3.0°C from August 27 to September 29, 1981. This temperature relationship is important to the fishery because both larval development and emergence from the egg is dependent upon water temperature in the substrate (Reiser and Bjornn 1979). Subsequent fry growth and behavior would be dependent upon surface water temperatures (Reiser and Bjornn 1979).

Because of the relative importance of slough habitats to the fishery resources of the Susitna River, it will be important to further define relationships

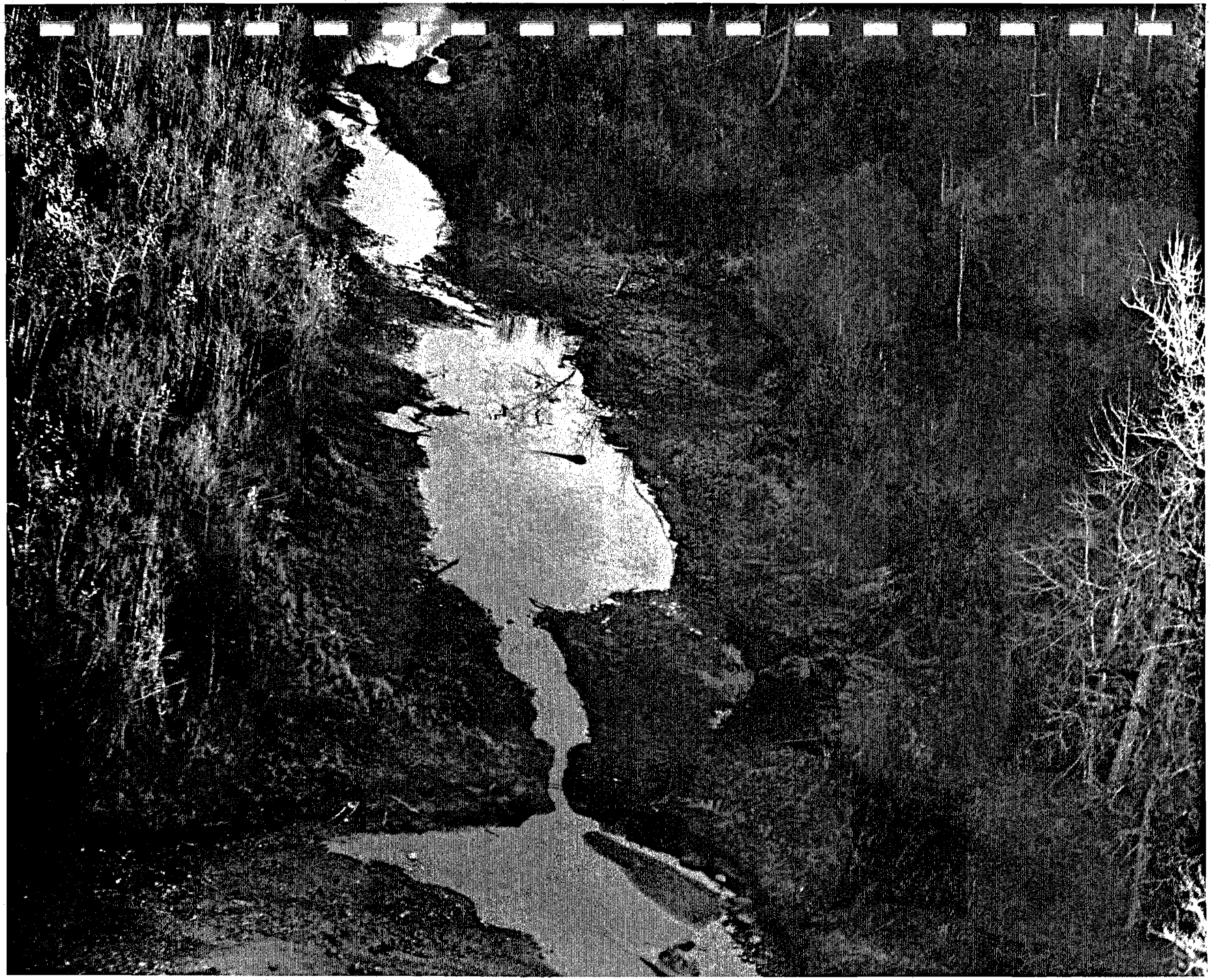

Plate 10. Aerial view of Slough 19 (mainstem Susitna River discharge 7,440 cfs), October 15, 1981.

between mainstem discharges and slough water quality characteristics. Further studies should be directed towards:

1) determining the actual sources and volumes of base flows in the sloughs;

2) studying a greater variety of sloughs with different characteristics;

3) determining surface and intragravel water temperatures in the sloughs and the factors which influence them;

4) determining concentrations of intragravel oxygen in the sloughs and the factors which influence them; and

4) evaluating data collected by the ADF&G and other investigators during and prior to 1981.

4. PREDICTIVE MODELS

4.0 PREDICTIVE MODELS

4.1 Introduction

This chapter discusses some of the preliminary computer models which have been developed by Acres and their subcontractors to predict post-project temperature and stage/discharge relationships in the Susitna River downstream from the proposed two dam hydroelectric system. Included in this chapter are comparisons between predicted and known (see ADF&G 1981c) stage, discharge and temperature characteristics. Existing data can be used to refine the current models and identify additional data collection requirements.

4.2 Stage Analysis

R&M Consultants, Inc., subcontractors to Acres American, Inc., applied the HEC-2 hydraulic model (R&M 1982a, b) to forecast water surface elevations (WSEL) in the Susitna River between Talkeetna and Devil Canyon at various discharges. This model is likely to become a key decision making tool as feasibility studies progress (e.g. what WSEL at specific sites, such as sloughs, are associated with certain mainstem Susitna streamflows). Therefore, it is important to establish confidence in the predictive capabilities of the model.

The HEC-2 hydraulic model has been used to predict WSEL at approximately 70 mainstem cross sections for a range of mainstem discharges. Predicted stage/discharge relationships can be compared with observed WSEL or stage data collected by the ADF&G at eight mainstem sites between Talkeetna (R.M. 97.0) and Devil Canyon (R.M. 152.0) during the 1981 summer field season (Table E.4.1). Elevations at two of these sites, Sloughs 16B and 19, have been referenced to the project (MSL) datum, thereby allowing WSEL datum to be computed from their respective stage data. For each site, an observed gage height or stage/ discharge relationship was plotted using 1981 Susitna River discharge data from the Gold Creek station (USGS 1981; Figures E.4.1 - E.4.8). The observed stage/discharge relationships were compared to WSEL/discharge relationships predicted by the HEC-2 hydraulic model. Either the closest WSEL datum for an R&M survey cross section (if within 0.1 mile of the mainstem ADF&G site) or WSEL datum interpolated from the nearest upstream and downstream cross sections (assuming a linear drop in elevation between the cross sections) were used for comparative purposes.

When comparing predicted WSEL/discharge relationships to observed gage height or stage/discharge relationships, the characteristic to note is the relative slope of each plot (Figures E.4.1 - E.4.8). Several discrepancies between predicted and observed values are apparent. The model generally predicts a smaller than observed change in mainstem stage (or WSEL) when the discharge values are below 20,000 cfs. Therefore, more of the river channel would become dewatered for an incremental decrease in streamflow than the model predicts. An exception is noted in the vicinity of Slough 19 where the observed rate of changes in stage of the Susitna River, for discharge values less than 20,000 cfs, is smaller than that predicted by the model. The model also predicts that WSEL values at Sloughs 16B and 19 (for a given mainstem Susitna River streamflow) will be higher than actually observed at these sites

Table E.4.1. Comparison of observed stage (ADF&G 1981c) to predicted water surface elevation (WSEL) data (R&M 1982a, b) at various Susitna River discharges, cfs (USGS 1981), used in developing Figures E.4.1 - E.4.8.

Location	OBSERVED Stage	Discharge*	PREDICTED WSEL	Discharge*
Talkeetna AA Fish Camp	---	---	362.7	9,990
(R.M. 101.0)	1.86	14,100	363.4	13,800
	2.36	16,600	363.8	17,508
	3.64	24,200	364.5	24,107
	5.18	35,900	365.3	35,540
	7.14	51,900	366.8	53,566
Mainstem 2	1.46	10,600	468.4	9,990
(R.M. 114.4)	2.64	14,600	469.5	13,800
	3.07	17,400	470.3	17,508
	4.36	28,800	471.9	24,107
	5.82	38,400	473.5	35,540
	6.16	43,000	476.4	53,566
Curry AA Fish Camp	0.00	10,500	516.6	9,990
(R.M. 120.0)	1.52	13,900	517.1	13,800
	2.16	17,200	517.5	17,508
	3.63	24,000	518.4	24,107
	5.16	36,300	519.3	35,540
	6.07	58,200	521.2	53,566
Mainstem Susitna-Curry	---	---	521.8	9,700
(R.M. 120.7)	---	---	522.6	13,400
	2.33	17,200	523.3	17,000
	3.86	24,900	524.3	23,401
	5.23	34,200	525.4	34,500
	5.68	36,100	527.2	51,998
Mainstem Susitna -	1.18	9560	684.0	9,700
Inside Bend	2.22	14,600	685.1	13,400
(R.M. 136.9)	2.51	16,200	685.8	17,000
	2.88	18,800	687.0	23,401
	---	---	688.1	34,500
	---	---	689.9	51,998
Slough 16B**	695.10	8,890	699.5	9,700
(R.M. 138.0)	695.80	10,400	700.4	13,400
	696.00	10,800	701.1	17,000
	696.10	11,300	702.0	23,401
	696.50	11,800	702.9	34,500
	697.00	14,500	704.4	51,998
	697.40	15,900	---	---

--- Data unavailable.
* Susitna River at Gold Creek.
** Stage as converted into project datum elevation.

Table E.4.1. (Continued).

Location	OBSERVED Stage	OBSERVED Discharge*	PREDICTED WSEL	PREDICTED Discharge*
Slough 19** (R.M. 140.0)	720.00	8,890	722.1	9,540
	720.30	9,560	723.0	13,178
	720.30	10,100	723.7	16,720
	720.40	10,400	724.8	23,001
	720.40	10,800	725.8	33,910
	720.60	11,800	727.4	51,109
	721.20	15,700	---	---
	722.80	16,000	---	---
Mainstem Susitna - Island (R.M. 146.9)	1.41	28,600	810.9	9,540
	2.39	33,400	812.0	13,179
	3.23	38,400	812.8	16,720
	3.66	43,000	814.2	23,001
	4.21	46,400	815.9	33,910
	4.51	51,300	819.1	51,109

--- Data unavailable.
*   Susitna River at Gold Creek.
** Stage as converted into project datum elevation.

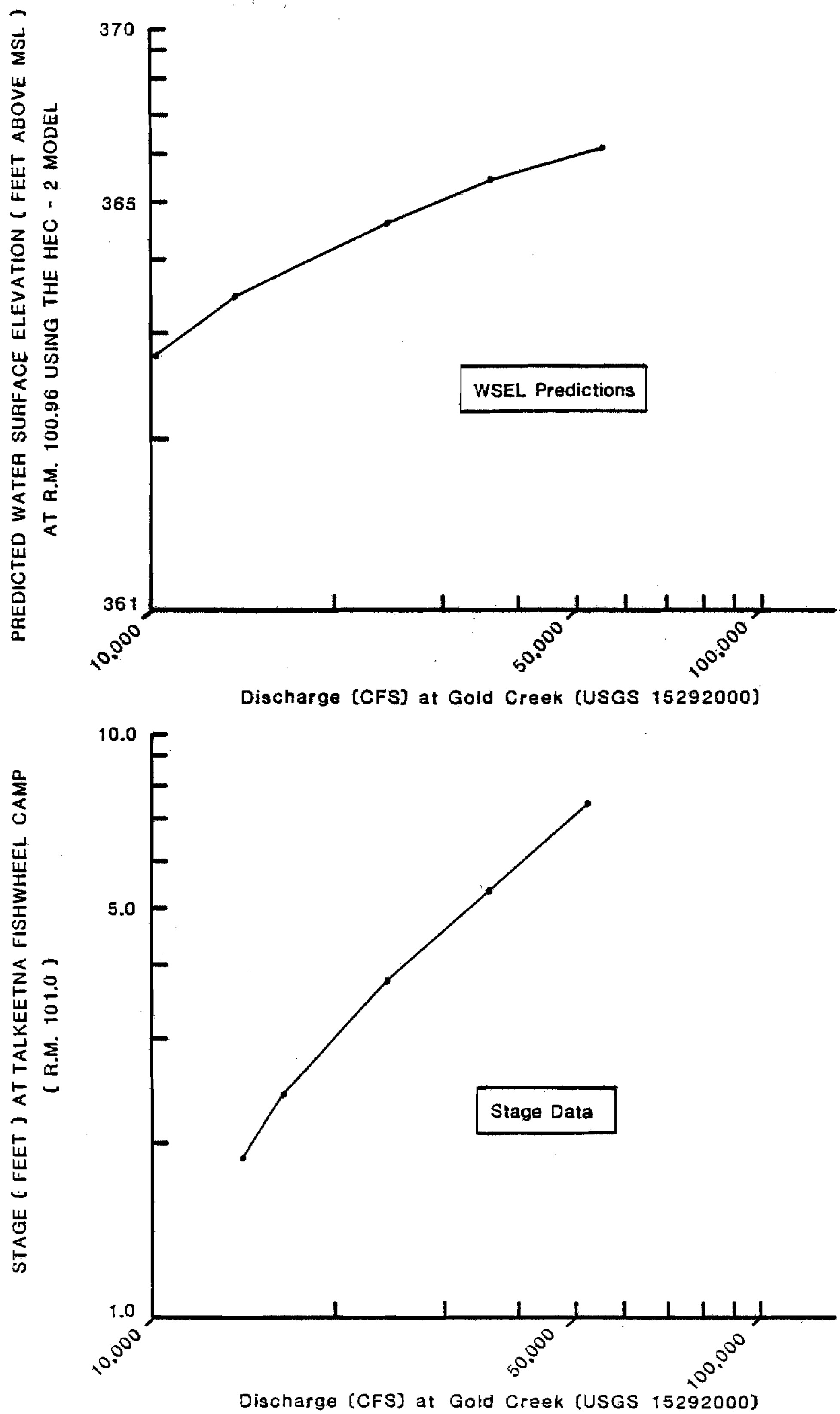

Figure E.4.1. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at Talkeetna Base Camp (R.M. 101.0).

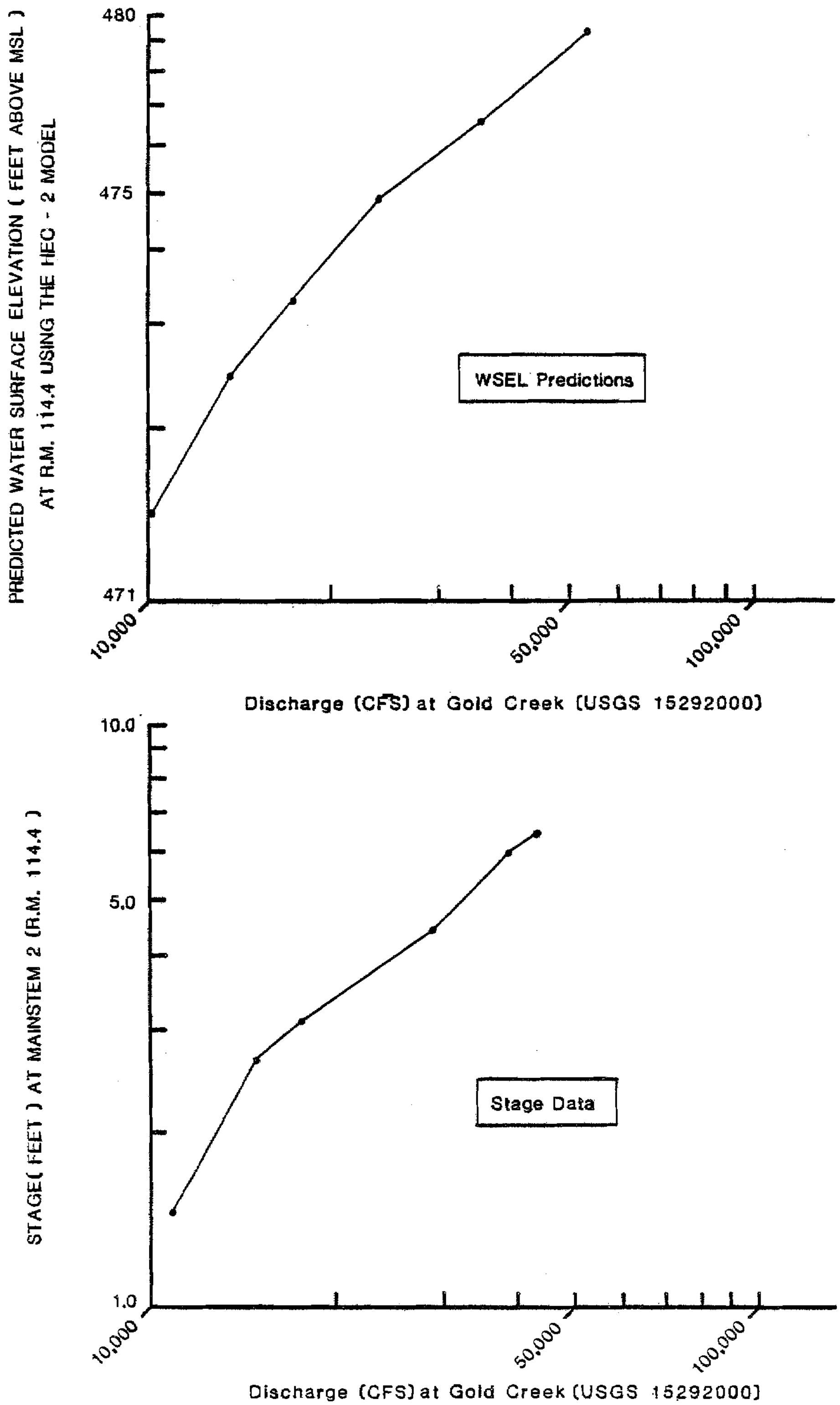

Figure E.4.2. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at the Mainstem 2 habitat location (R.M. 114.4).

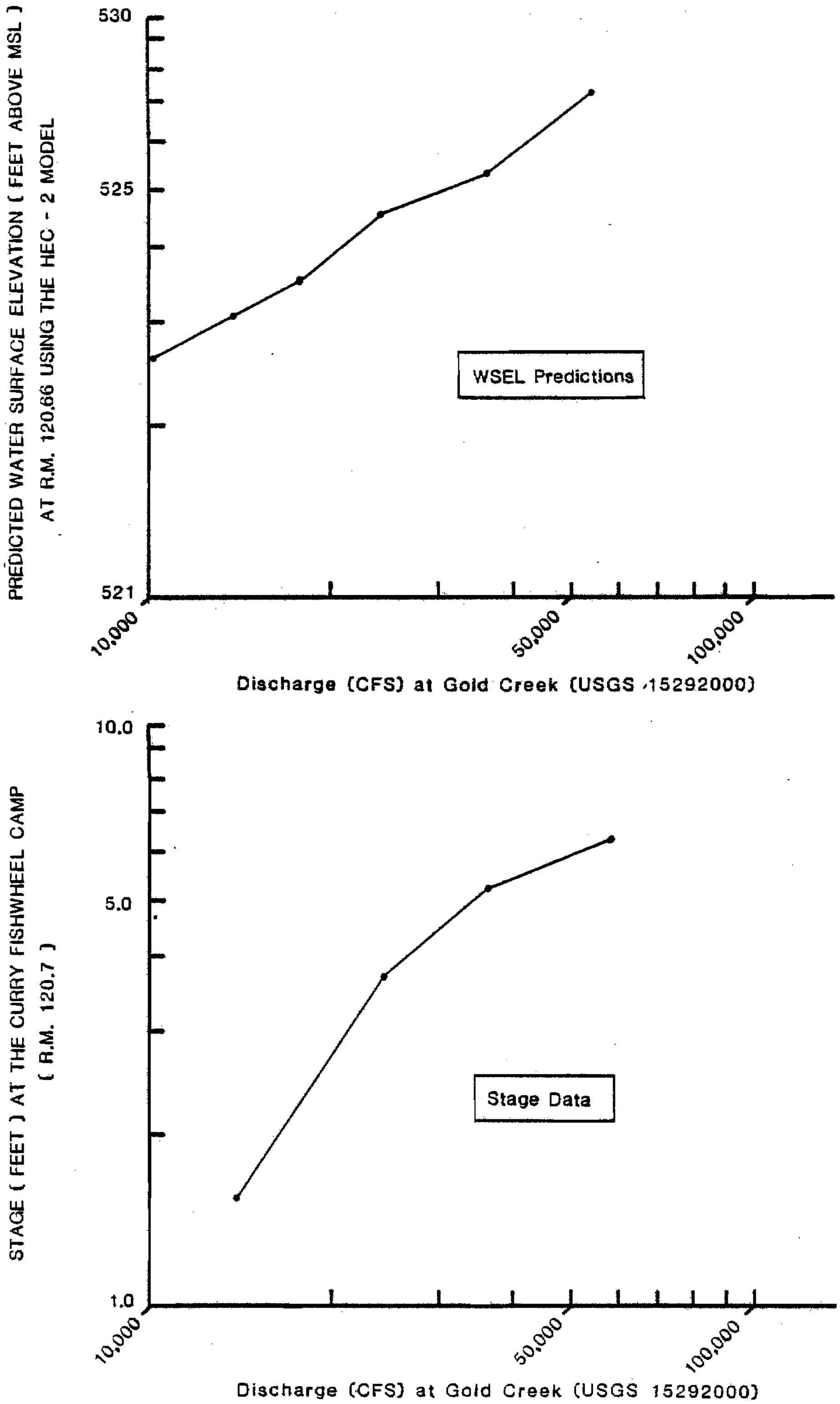

Figure E.4.3. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at the Curry Fishwheel Camp (R.M. 120.7).

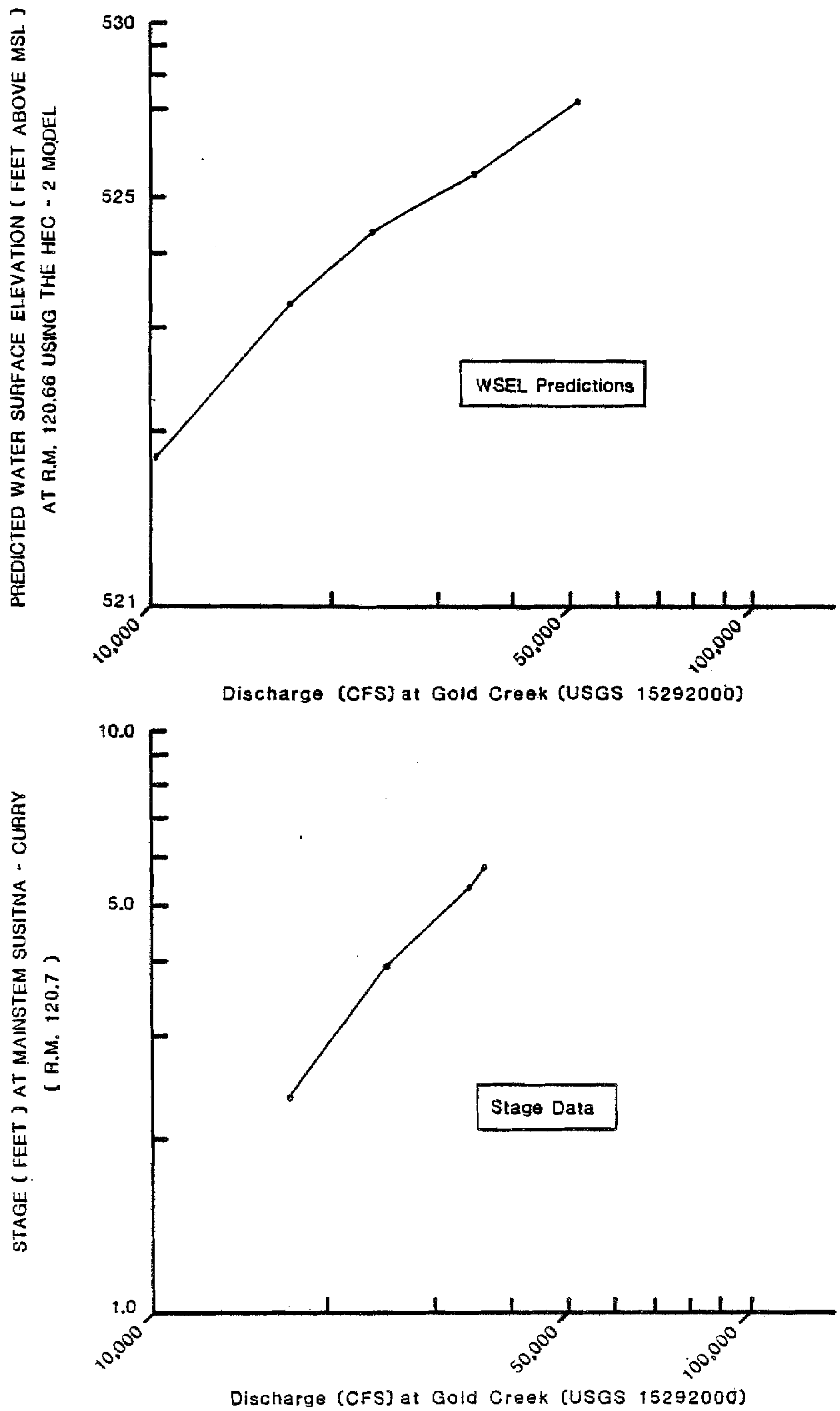

Figure E.4.4. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at the Curry habitat location (R.M. 120.7).

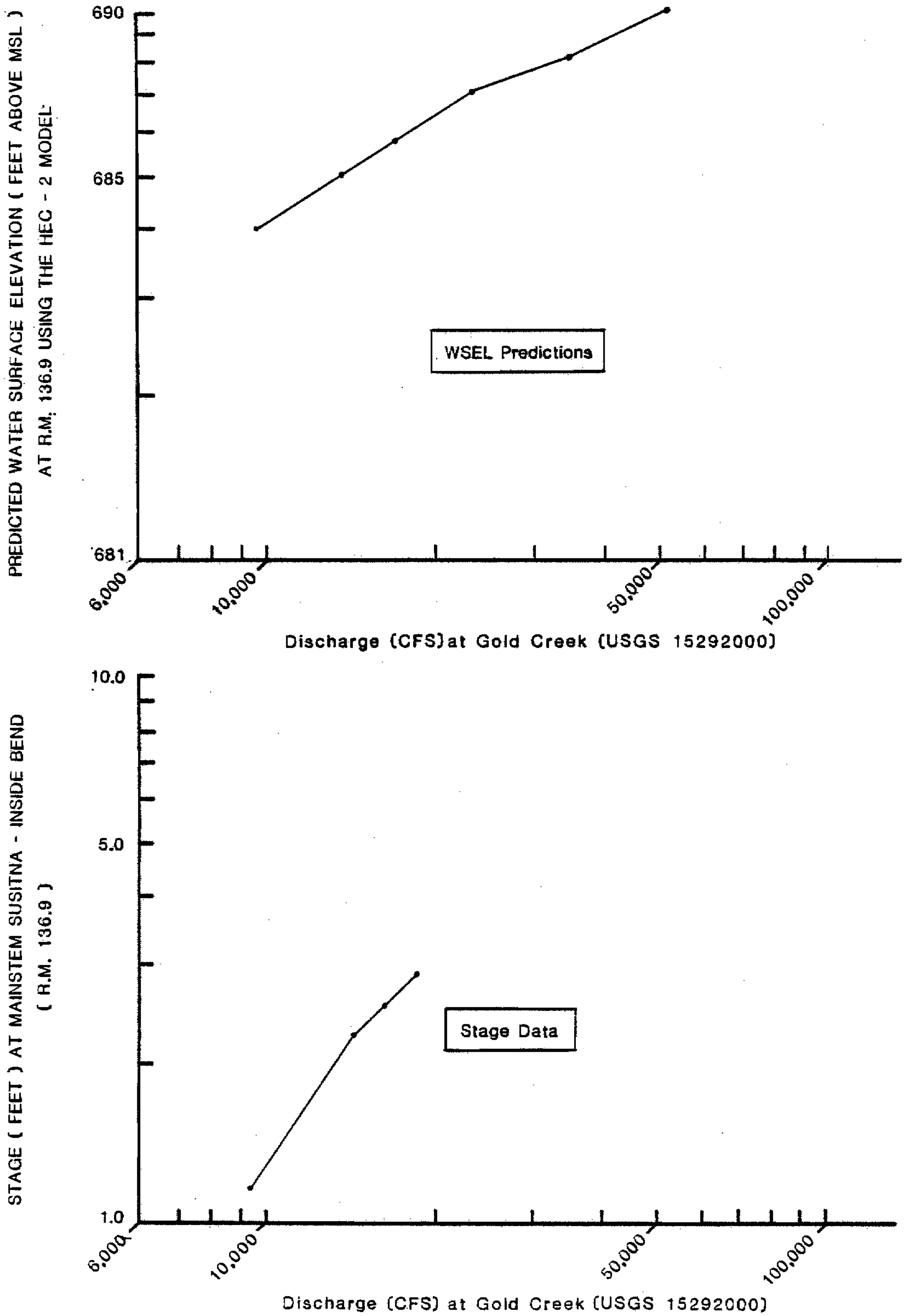

Figure E.4.5. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at the Mainstem Susitna-Inside Bend habitat location (R.M. 136.9).

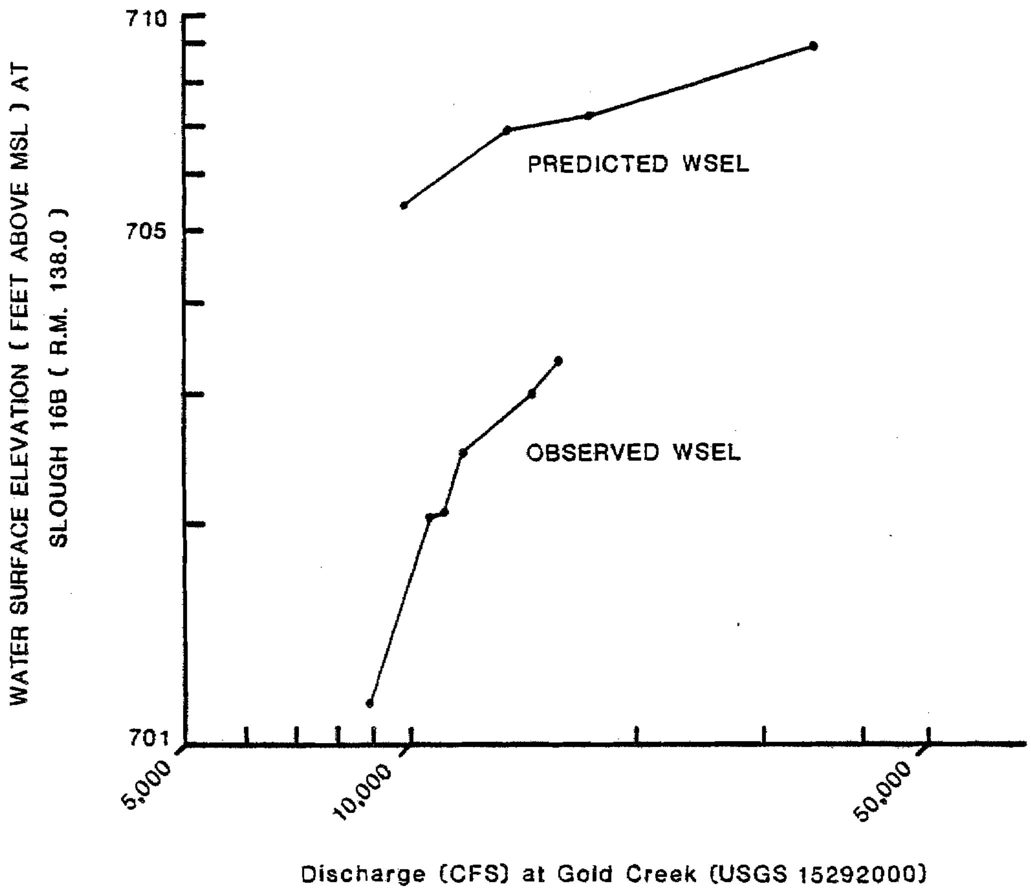

Figure E.4.6. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at Slough 16B (R.M. 138.0).

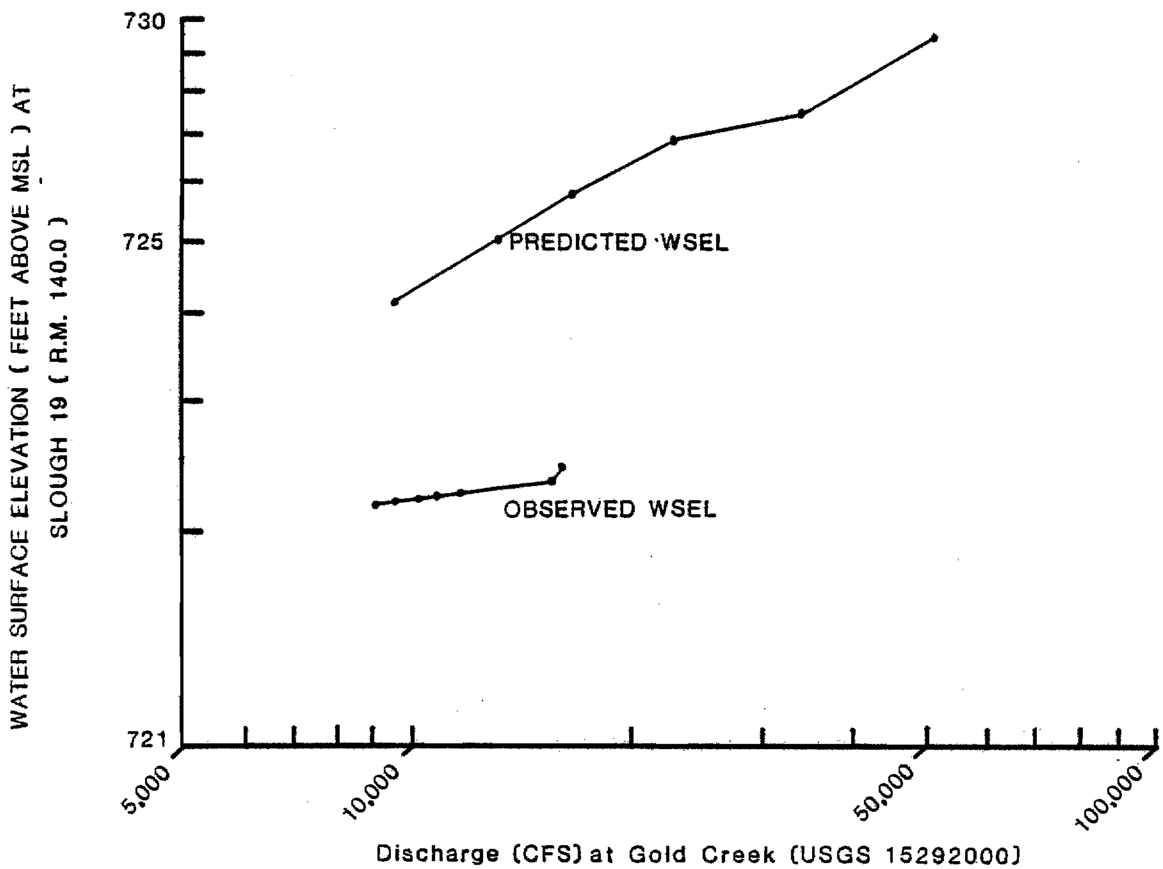

Figure E.4.7. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge relationship (R&M 1982a, b) for the Susitna River at Slough 19 (R.M. 140.0).

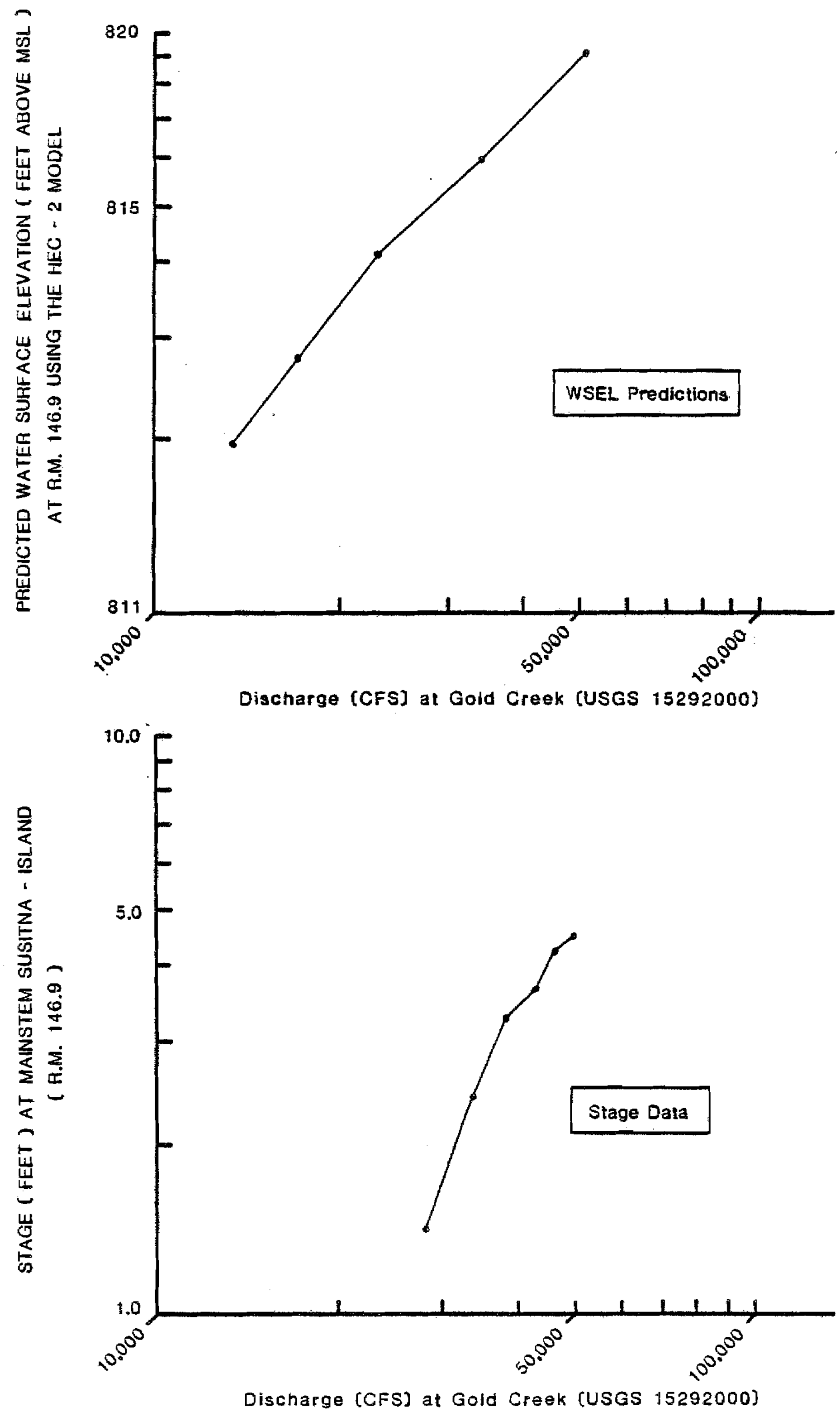

Figure E.4.8. Comparison of the observed stage/discharge relationship (ADF&G 1981c) to the predicted WSEL/discharge (R&M 1982a, b) for the Susitna River at the Mainstem Susitna-Island habitat location (R.M. 146.9).

(Figures E.4.6 and E.4.7). This discrepancy indicates that larger Susitna River streamflow values, than are predicted by the model, will be required to provide a specific stage at these locations.

It should be pointed out that observed discrepancies may be partly attributable to the assumption used when interpolating specific WSEL datum at various discharges for a given site, that is, elevation will drop linearly between cross sections. It is also important to note that observations indicate that stage at each site reacts in a unique fashion to changes in mainstem Susitna River discharge. The implications of these comparisons are significant, suggesting that it is difficult to predict reliable WSEL for various discharges at mainstem study sites with the existing data base. Accordingly, additional cross sections are required to calibrate the model or a different approach is needed to predict accurate WSEL values for specific mainstem discharges at particular locations.

4.3 Water Temperature Analysis

Acres has applied a model to predict pre-project and post-project mean monthly surface water temperatures for the Susitna River reach between Talkeetna and Devil Canyon (Acres 1982). Predicted (Acres 1982) pre-project temperature data* for June through September, are compared to the 1981 observed (ADF&G 1981c) mean monthly water temperatures for the same period for nearby sites (Table E.4.2). Differences between observed and predicted temperatures

* Calibrated with 1981 climatic and Susitna River discharge data for the open-water season (Trihey 1982).

Table E.4.2. Comparison of observed mean monthly surface water temperatures, °C (ADF&G 1981c), to predicted mean monthly surface water temperatures (Acres 1982) for the Susitna River.

Month	Temperature prediction for LRX 34 R.M. 130.5	Observed temperature value for R.M. 131.3	Temperature prediction for LRX 47 R.M. 137.2	Observed temperature value for R.M. 136.8	Temperature prediction for LRX 54 R.M. 140.8	Observed temperature value for R.M. 138.7	Temperature prediction for LRX 61 R.M. 148.7	Observed temperature value for R.M. 148.8
July	10.1	9.2	10.0	9.6*	9.9	9.1*	9.8	10.0*
August	8.7	8.6	8.7	8.5	8.5	7.6	8.5	8.7
September	6.1	6.4	6.1	5.1	5.9	5.4	5.7	6.0

* Incomplete data set (1/2 month period of record).

are minimal, suggesting that the model can be used to predict temperatures for the open-water season when calibrated. However, these temperatures only represent a portion of the 1981 open water season conditions for the mainstem Susitna River and do not include temperatures for the ice covered season. Therefore, year-round temperature data must also be collected to assess how well the Acres temperature model can predict accurate year-round mainstem surface water temperatures.

Temperature predictions are particularly important, because temperature significantly affects the suitability of the mainstem Susitna River, its associated sloughs, and side channel habitats to support various life phases of fish species. Chum salmon, for example, could be highly impacted by altered thermal regimes (Reiser and Bjornn 1979) because they use all three habitats seasonally (ADF&G 1981a, d). As a result, the applicability of the Acres temperature model to slough and side channel habitats should also be studied.

4.4 Pre-project and Post-project Flow Comparisons

R&M Consultants calculated theoretical post-project monthly discharges for the Susitna River at Gold Creek (Table E.4.3), Sunshine, and Susitna Station based on the assumption that the proposed two dam system had gone into operation in 1950 (R&M 1982a). Historical discharge records (USGS 1977, 1978a, 1978b, 1979) for the Susitna River at Gold Creek (Table E.4.4), Sunshine, and Susitna Station, were used to predict the outflow regimes (post-project discharges) from the dams that would have provided optimum power production (Case A scenario).

Table E.4.3. Case A scenario mean monthly post-project discharge (cfs) for the Susitna River at Gold Creek (R&M 1982a) for the years 1950-1978.

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	7736	9073	12669	10814	8961	7877	7931	10434	10176	8338	5773	4906
1951	6967	7875	9414	8340	6614	6604	6355	10016	9362	7650	6111	12518
1952	7464	10635	13130	11386	9173	8031	7856	8838	13752	9211	8027	6692
1953	10094	11388	12930	10886	8992	7971	8195	11809	12915	7642	9453	8148
1954	7476	9991	12729	11087	9173	7932	8031	13161	12866	8060	9628	6109
1955	7006	10074	13274	11581	9573	8251	7998	10179	12109	8858	14554	8159
1956	6843	9791	12529	10766	9143	8092	7972	12287	13255	15641	16005	14617
1957	7698	10941	13371	11487	9673	8352	7993	11151	11989	8472	10243	12789
1958	10104	11845	14487	11759	9480	8299	8114	10518	10704	7992	9257	4995
1959	6972	7686	10229	11234	9480	8131	8103	13428	12095	9401	14602	9909
1960	8451	10741	13430	11632	9625	8348	7967	10312	9259	8359	6411	11258
1961	9686	10891	13923	12239	9926	8961	9231	11297	13741	10718	12031	6466
1962	7700	10591	13329	11687	9673	8552	8281	8832	16353	14623	16462	12177
1963	8616	10691	13229	11387	9673	8152	7793	11310	12406	15775	14713	8131
1964	8341	10141	12723	10835	9139	7974	7878	8373	16524	14787	8482	5156
1965	7082	9062	12440	10747	9033	8051	7941	9600	11602	9908	10868	12339
1966	9097	9989	12861	11186	9473	8452	8356	10127	14134	8370	7412	5355
1967	6876	7599	11735	11286	9573	8351	8056	10504	11886	12937	17240	14905
1968	7589	10244	13284	11768	10073	9051	8491	10929	12927	13800	8329	5032
1969	6793	7664	9304	10510	8896	7967	8091	9312	8547	6053	5164	4957
1970	7172	8004	9519	8420	6801	6968	5875	6737	11552	9506	6034	5151
1971	7144	7780	8987	8222	7128	7462	8403	8918	12834	8086	6732	5270
1972	6900	7758	11879	12026	10201	8974	8291	13492	14059	14508	10628	5634
1973	6630	9987	12694	10986	9372	8151	7851	8526	11066	6587	5581	4932
1974	7060	7922	9300	7844	8798	7876	7859	10869	10046	7560	5682	5413
1975	6916	7775	9304	8227	6515	7573	8173	11254	12710	14690	9124	9298
1976	9631	9884	12310	10760	9123	8051	8050	11258	11496	6634	5271	5070
1977	7194	8175	9717	8191	8160	8651	8260	11686	13729	11817	9834	5861
1978	9231	11416	13819	11815	9841	8756	8283	8295	8865	7516	5777	5071

Table E.4.4. Mean monthly pre-project discharge (cfs) for the Susitna River at Gold Creek (USGS 1977, 1978a, 1978b, 1979) for the years 1950-1978.

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	6335	2583	1439	1027	788	726	870	11510	19600	22600	19880	8301
1951	3848	1300	1100	960	820	740	1617	14090	20790	22570	19670	21240
1952	5571	2744	1900	1600	1000	880	920	5419	32370	26390	20920	14480
1953	8202	3497	1700	1100	820	820	1615	19270	27320	20200	20610	15270
1954	5604	2100	1500	1300	1000	780	1235	17280	25250	20360	26100	12920
1955	5370	2760	2045	1794	1400	1100	1200	9319	29860	27560	25750	14290
1956	4951	1900	1300	980	970	940	950	17660	33340	31090	24530	18330
1957	5806	3050	2142	1700	1500	1200	1200	13750	30160	23310	20540	19800
1958	8212	3954	3264	1965	1307	1148	1533	12900	25700	22880	22540	7550
1959	4811	2150	1513	1448	1307	980	1250	15990	23320	25000	31180	16920
1960	6558	2850	2200	1845	1452	1197	1300	15780	15530	22980	23590	20510
1961	7794	3000	2694	2452	1754	1810	2650	17360	29450	24570	22100	13370
1962	5916	2700	2100	1900	1500	1400	1700	12590	43270	25850	23550	15890
1963	6723	2800	2000	1600	1500	1000	830	19030	26000	34400	23670	12320
1964	6449	2250	1494	1048	966	713	745	4307	50580	22950	16440	9571
1965	6291	2799	1211	960	860	900	1360	12990	25720	27840	21120	19350
1966	7205	2098	1631	1400	1300	1300	1775	9645	32950	19860	21830	11750
1967	4163	1600	1500	1500	1400	1200	1167	15480	29510	26800	32620	16870
1968	4900	2353	2055	1981	1900	1900	1910	16180	31550	26420	17170	8816
1969	3822	1630	822	724	723	816	1510	11050	15500	16100	8879	5093
1970	3124	1215	866	824	768	776	1080	11380	18630	22660	19980	9121
1971	5288	3407	2290	1442	1036	950	1082	3745	32930	23950	31910	14440
1972	5847	3093	2510	2239	2028	1823	1710	21890	34430	22770	19290	12400
1973	4826	2253	1465	1200	1200	1000	1027	8235	27800	18250	20290	9074
1974	3733	1523	1034	874	777	724	992	16180	17870	18800	16220	12250
1975	3739	1700	1603	1516	1471	1400	1593	15350	32310	27720	18090	16310
1976	7739	1993	1081	974	950	900	1373	12620	24380	18940	19800	6881
1977	3874	2650	2403	1829	1618	1500	1680	12680	37970	22870	19240	12640
1978	7571	3525	2589	2029	1668	1605	1702	11950	19050	21020	16390	8607

Observed mean monthly pre-project discharges are compared to predicted post-project discharges for the Susitna River at Gold Creek, Sunshine and Susitna Stations over the period 1950-1978 in Table E.4.5 and plotted as hydrographs in Figures E.4.9 to E.4.11. Comparisons of observed pre-project and predicted post-project discharges with the periodicity of adult salmon passage and spawning for the Susitna River at Gold Creek are illustrated in Figures E.4.12 and E.4.13.

These figures and tables illustrate that the observed pre-project Susitna River streamflows at Gold Creek Station are altered by the proposed power production flow regimes. During winter, flow is higher due to increased power demand, while during summer, flow is reduced to refill the reservoir (Figure E.4.9). As a result, normally observed high summer discharge events (floods) are dampened or eliminated (Figures E.4.12 and E.4.13). Susitna River hydrographs for Sunshine Station (downstream of the Talkeetna and Chulitna Rivers) and at Susitna Station (downstream of the Yentna River) show predicted post-project flows deviating in similar ways from observed pre-project conditions (Figures E.4.10 and E.4.11). However, differences between predicted post-project and observed pre-project conditions of the mainstem Susitna River decrease progressively downstream of the Talkeetna, Chulitna, and Yentna Rivers.

Fish movement may be altered by changes in the flow regime (see Section 2.3). Fish passage into sloughs can be obstructed if these habitats are dewatered. Many sloughs between Talkeetna and Devil Canyon begin dewatering at their heads when mainstem streamflows drop to approximately 20,000 cfs (at

Table E.4.5. Comparison of mean monthly pre-project (USGS 1977, 1978a, 1978b, 1979) and predicted post-project power discharges, cfs (R&M 1982a), for the Susitna River at Gold Creek, Sunshine and Susitna Station over the period 1950-1978.

	Gold Creek Discharge*		Sunshine Discharge*		Susitna Station Discharge*	
Month	Pre-project	Post-project**	Pre-project	Post-project**	Pre-project	Post-project**
OCT	5,664	7,810	13,775	15,921	29,822	31,967
NOV	2,465	9,504	5,835	12,874	12,577	19,616
DEC	1,776	12,019	4,195	14,438	8,177	18,419
JAN	1,456	10,658	3,492	12,695	7,874	17,078
FEB	1,234	9,010	2,943	109,959	7,006	14,782
MAR	1,111	8,130	2,620	9,637	6,295	13,314
APR	1,365	7,989	3,159	9,783	6,920	13,544
MAY	13,298	10,464	27,505	24,671	59,746	56,912
JUN	28,040	12,171	64,348	48,479	123,829	107,960
JUL	23,680	10,121	62,882	49,323	131,568	118,009
AUG	21,514	9,497	56,141	44,125	110,242	98,225
SEP	13,254	7,804	32,494	27,044	65,674	60,225

* Susitna River
** Power flows (Case A Scenario)

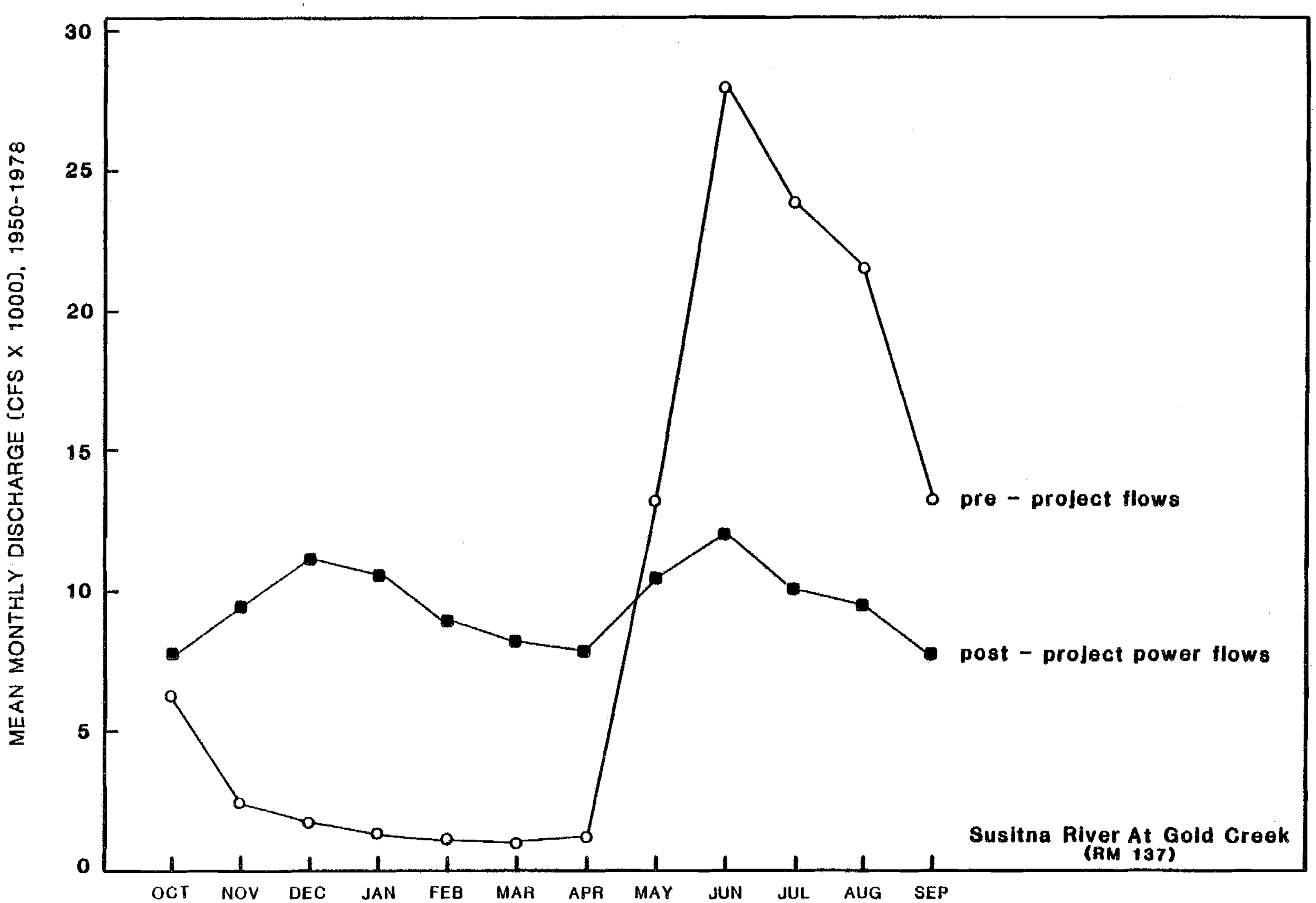

Figure E.4.9. Mean monthly pre-project (USGS 1977, 1978a, 1978b, 1979) and predicted (R&M 1982a, b) post-project power (Case A scenario) discharge (cfs) of the Susitna River at Gold Creek for the period 1950-1978.

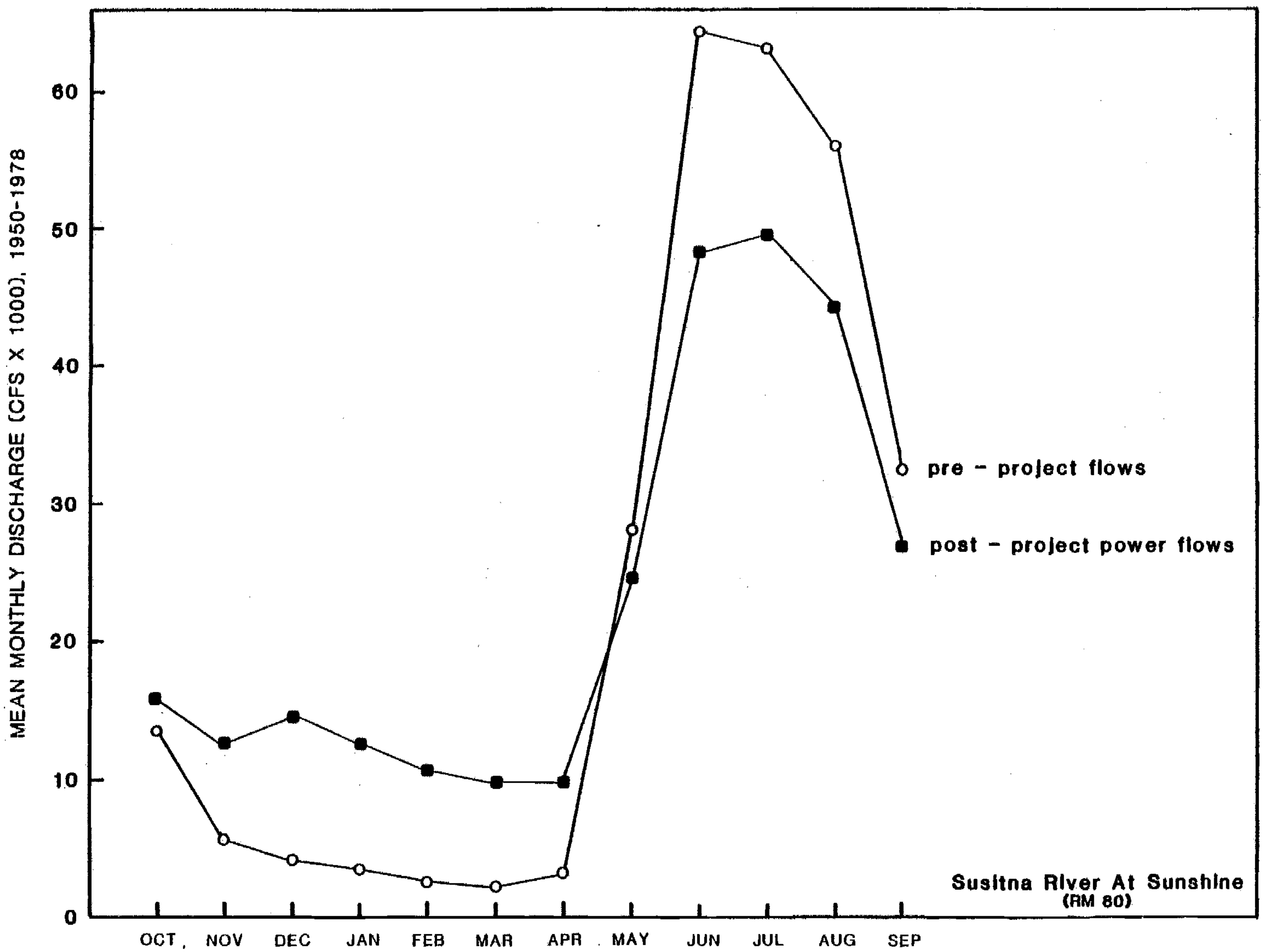

Figure E.4.10. Mean monthly pre-project (USGS 1977, 1978a, 1978b, 1979) and predicted (R&M 1982a) post-project power (Case A scenario) discharge (cfs) of the Susitna River at Sunshine for the period 1950-1978.

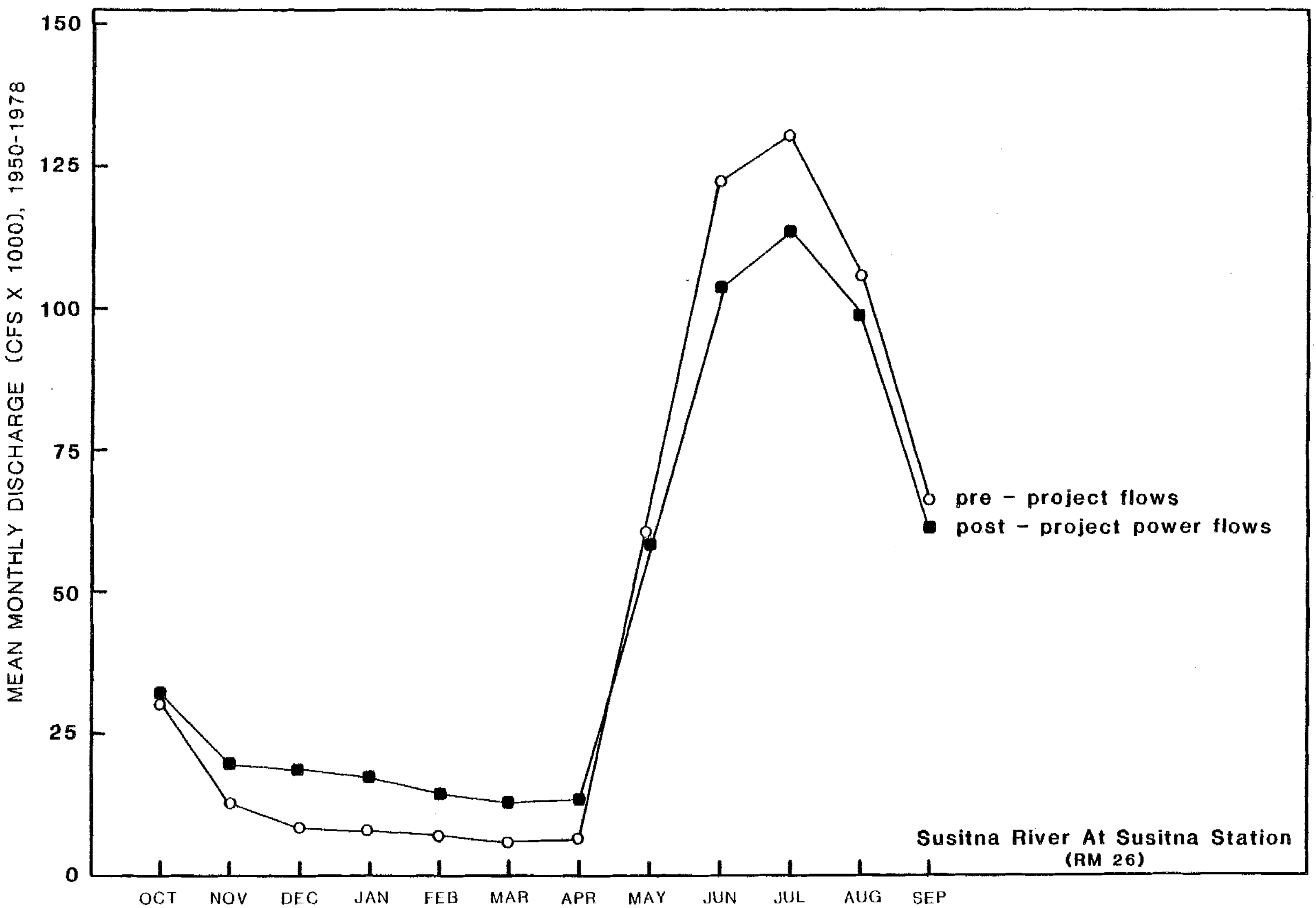

Figure E.4.11. Mean monthly pre-project (USGS 1977, 1978a, 1978b, 1979) and predicted (R&M 1982a) post-project power (Case A scenario) discharge (cfs) of the Susitna River at Susitna Station for the period 1950-1978.

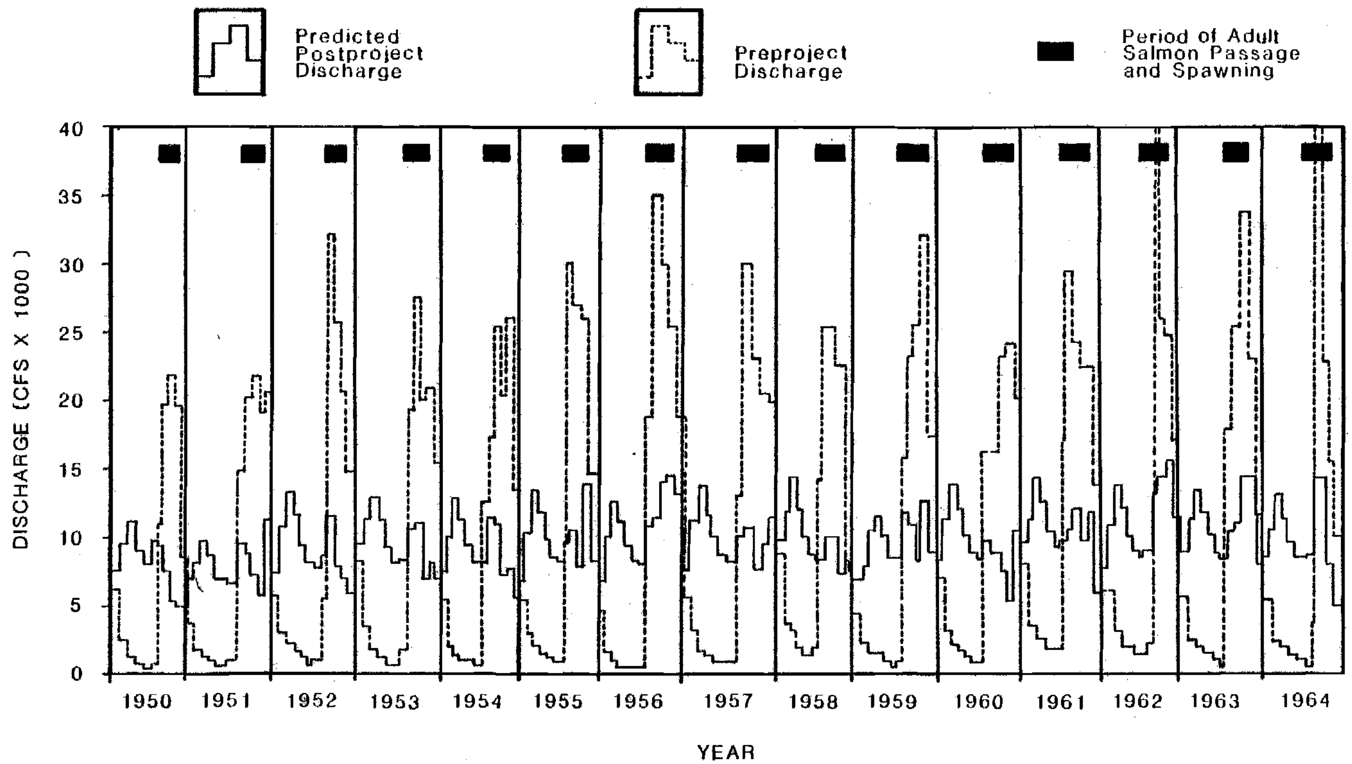

Figure E.4.12. Mean monthly pre-project (USGS 1978a)and predicted (R&M 1982a) post-project power (Case A scenario) discharge (cfs) of the Susitna River at Gold Creek for the years 1950-1964 and provisional periodicity of adult salmon spawning and passage.

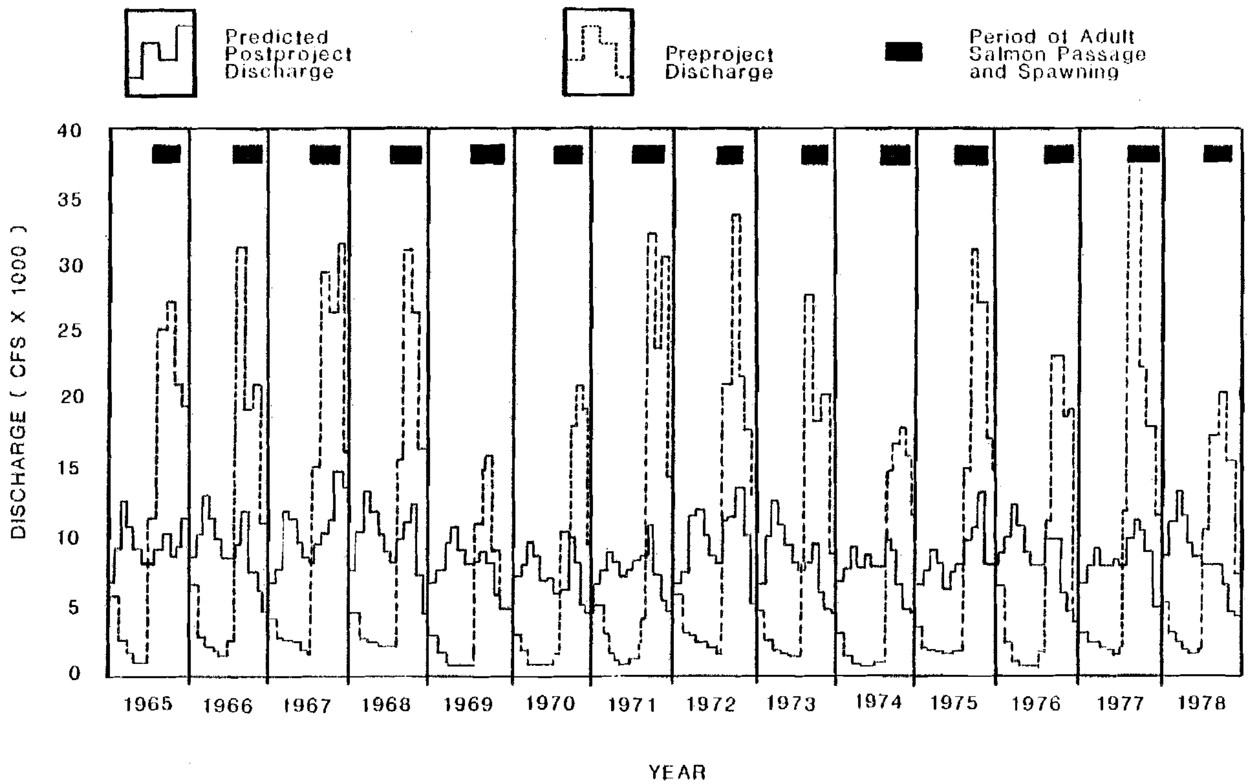

Figure E.4.13. Mean monthly pre-project (USGS 1977, 1978a, 1978b, 1979) and predicted (R&M 1982a) post-project power (Case A scenario) discharge (cfs) of the Susitna River at Gold Creek for the years 1965-1978 and provisional of adult salmon spawning and passage.

Gold Creek), and at their mouths when flows drop to approximately 10,000 cfs (see Section 2.7 and ADF&G 1981c). Projected post-project average summer discharges at Gold Creek never exceed 15,000 cfs, and during the period of major salmon passage (July-September) rarely exceed 10,000 cfs (Figures E.4.12 and E.4.13). This means a portion of the slough habitat would not be available for salmon spawning at these streamflows because salmon passage into the sloughs would be hampered or eliminated. Periodic flood events have a flushing effect on the mainstem its side channels, and sloughs. The extent to which these periodic cleansing floods affect the fish habitat in the Susitna River is not well known, but changes in flushing events may constitute an impact to the fishery.

Investigations to obtain a better understanding of these observed and predicted relationships are planned for 1982.

5. CONCLUSION

5. CONCLUSION

It is hoped that this report provided an introduction to the scope and types of data collection programs presently being undertaken by the ADF&G as part of the APA's Su-Hydro Environmental Feasibility Studies.

Keeping in mind that this report represents a partial synthesis of the 1981 fishery and aquatic habitat data collected, it is recommended that a contractor be designated to analyze these and other relevant data as part of a comprehensive aquatic studies impact analysis. All past and present reports related to the fishery and aquatic habitat characterization of the Susitna River should be included in this evaluation. New information should also be incorporated into this analysis as it becomes available.

6. CONTRIBUTORS

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9. APPENDIX

APPENDIX EA

Head Pin and Cross Section Elevations

The following data consists of head pin and cross sectional elevations, measured in feet, for five Susitna River sloughs (8A, 9, 16B, 19 and 21) studied during the 1981 field season (ADF&G 1981c). One table of head pin data exists for each slough and one table of cross section elevation data exists for each transect in each of the sloughs. There are different numbers of transects in each slough; the break down was as follows: 8A-7, 9-9, 16B-17, 19-10, and 21-17. Two head pins were established for each transect, one on each side of the stream channel. The head pin tables include elevations for all head pins surveyed in each slough. Left and right banks were determined looking upstream.

Headings for the head pin elevation tables are: Bench Mark, Elevation and True Elevation. Bench Mark refers to the location (i.e. head pin, temporary bench mark, or ground) where an elevation was determined. Elevation refers to the height, in feet, of that particular location in reference to a temporary bench mark established by the ADF&G prior to tying into R&M datum. True elevation refers to the elevation of a location in reference to an R&M transect (feet above mean sea level). Headings for the cross section tables are the same except that Bench Mark is replaced by Station. Station refers to the distance from the head pin established as 0.0 feet.

The mainstem water surface elevations were determined at the head portions of sloughs 8A, 9, 16B and 21 with the exception of transect 5 of Slough 8A where the mainstem water surface elevation was not measured. At Slough 19, the mainstem water surface elevation was determined at the mouth of the slough because there is no head. The mainstem water surface elevations are listed in the head pin elevation table for sloughs 16B, 19 and 21. Water surface elevations for sloughs 8A and 9 are listed with the cross section elevations.

For the sake of brevity, abbreviations have been used in the tables. The abbreviations are as follows:

TBM	-	temporary bench mark.
LBHP 1	-	left bank head pin for transect number 1
RBHP	-	right bank head pin
GB	-	ground beside the head pin previously listed
LWS	-	left bank water surface
RWS	-	right bank water surface
LWE	-	left bank waters edge
RWE	-	right bank waters edge
R&M LRX 32	-	lower river cross section (downstream of Devil Canyon) number 32 established by R&M consultants.

Table EA-1. Head pin elevations in Slough 8A, surveyed October 7-10, 1981.

Bench Mark	Elevation	True Elevation
TBM	100.00	586.46
LBHP 1 (Head)	100.45	586.91
GB	100.08	586.54
RBHP 1 (Head)	100.33	586.79
GB	99.99	586.40
LBHP 2 (Head)	99.35	585.81
GB	98.96	585.42
RBHP 2 (Head)	100.12	586.58
GB	99.77	586.23
LBHP 3 (Head)	98.97	585.43
GB	98.60	585.06
RBHP 3 (Head)	99.02	585.48
GB	98.69	585.15
LBHP 4 (Head)	96.97	583.43
GB	96.55	583.01
RBHP 4 (Head)	98.73	585.19
GB	98.32	584.78
LBHP 5 (Head)	96.62	583.08
GB	96.10	582.56
RBHP 5 (Head)	92.22	578.68
GB	91.76	578.22
LBHP 6 (Head)	89.93	576.39
GB	89.39	575.86
RBHP 6 (Head)	92.31	578.77
GB	91.81	578.27
LBHP 7 (Mouth)	80.10	566.56
GB	79.63	566.09
RBHP 7 (Mouth)	82.54	569.00
GB	82.06	568.52
R&M LRX 29	91.97	578.43

Table EA-2. Cross section elevations in transect 1 (first head) of Slough 8A, surveyed October 10, 1981. Transect dewatered.

Station	Elevation	True Elevation
0.0 LBHP 1	100.45	586.91
0.0 GB	100.13	586.59
7.7 Bankfull	99.96	586.42
15.5	93.80	580.26
18.5	94.37	580.83
21.9	94.86	581.32
26.2	95.54	582.00
31.4	96.15	582.61
39.1	96.44	582.90
46.4	97.72	584.18
48.0 Mainstem RWS	93.31	579.77
50.2	96.37	582.83
52.6	96.05	582.51
54.9	96.35	582.81
57.4	96.68	583.14
59.0	97.64	584.10
65.0	97.66	584.12
67.1	99.13	585.59
68.8 Bankfull	99.92	586.38
78.0 GB	99.95	586.41
78.0 RBHP 1	100.35	586.81

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 10, 1981 was 9,700 cfs (USGS 1981).

Table EA-3. Cross section elevations in transect 2 (second head) of Slough 8A, surveyed October 10, 1981. Transect was dewatered.

Station	Elevations	True Elevation
0.0 LBHP 2	99.35	585.81
0.0 GB	98.96	585.42
11.3	99.31	585.77
21.1	98.69	585.15
26.6 Bankfull	98.61	585.07
37.2	97.85	584.31
48.5	97.34	583.80
57.4	97.14	583.60
70.8	97.45	583.91
77.8	96.74	583.20
88.3	97.30	583.76
95.2	97.57	584.03
103.4	94.41	583.87
116.8	97.85	584.31
125.5	97.77	584.23
131.3	97.31	583.77
137.9	97.03	583.49
150.9	97.19	583.65
166.3	97.31	583.77
170.5	97.04	583.05
137.8	97.45	583.91
194.1	97.04	583.50
199.9	96.74	583.20
207.0	97.11	583.57
233.2	97.11	583.57
247.6	97.05	583.51
257.6	96.83	583.29
269.4	97.16	583.62
264.3	96.86	583.32
300.0 Mainstem RWS	92.18	578.64
328.5	96.70	583.16
336.0	96.40	582.86
381.7	96.40	582.86
396.3	96.75	583.21
427.6	96.75	583.21
443.9	96.30	582.76
452.7	97.03	583.49
463.4	97.33	583.79
480.4	97.61	584.07
486.7	97.65	584.11
490.6 Bankfull	98.24	584.70
497.3	98.98	585.44
507.0 GB	99.77	586.23
507.0 RBHP 2	100.12	586.58

Provisional Susitna River mainstem discharge recorded at Gold Creek on October 10, 1981 was 9,700 cfs (USGS 1981).

Table EA-4. Cross section elevations in transect 3 (third head) of Slough 8A, surveyed October 10, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 3	98.97	585.43
0.0 GB	98.60	585.06
11.8	98.33	584.79
21.5 Bankfull	97.66	584.12
24.6	96.95	583.41
26.4	95.97	582.43
34.5	94.42	580.88
45.0	93.83	580.29
48.3	95.02	581.48
52.4	94.81	581.27
56.4	94.59	581.05
61.7	95.03	581.49
70.6	95.22	581.68
81.2	95.30	581.76
86.0 Mainstem RWS*	90.85	577.31
91.4	95.20	581.66
99.7	94.86	581.32
107.6	94.71	581.17
111.6	94.52	580.98
116.0	94.61	581.07
119.1	95.04	581.50
121.5	95.70	582.16
123.4	96.06	582.52
125.8	96.31	582.77
129.0	97.09	583.55
131.2 Bankfull	97.85	584.31
138.2	98.43	584.89
147.1 GB	98.69	585.15
147.1 RBHP 3	99.02	585.48

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 10, 1981 was 9,700 cfs (USGS 1981).

* A right bank mainstem water surface elevation of 577.31 ft was determined at 334° magnetic north at an unknown distance from transect station 86.

Table EA-5. Cross section elevations in transect 4 (fourth head) of Slough 8A, surveyed October 10, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 4	96.97	583.43
0.0 GB	96.55	583.01
3.7	96.24	582.70
19.2	95.61	582.07
41.6	95.44	581.90
46.5	95.37	581.83
49.7	94.96	581.42
53.5	94.58	581.04
59.0	94.13	580.59
69.0	93.64	580.10
74.8	94.02	580.48
77.5	94.67	581.13
80.8	94.96	581.42
116.7	94.93	581.39
145.9	95.09	581.55
146.0 Mainstem RWS	90.35	576.81
168.4	94.66	581.12
184.4	94.49	580.95
200.8	94.55	581.01
221.7	94.80	585.26
228.8	95.11	581.57
233.2	95.31	581.77
236.0	95.68	582.14
237.4	96.38	582.84
240.3	96.57	583.03
242.4 Bankfull	97.20	583.66
246.9	97.44	583.90
255.0	98.22	584.68
259.9 GB	98.32	584.78
259.9 RBHP 4	98.73	585.19

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 10, 1981 was 9,700 cfs (USGS 1981).

Table EA-6. Cross section elevations in transect 5 (fifth head) of Slough 8A, surveyed October 11, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 5	96.62	583.08
0.0 GB	96.10	582.56
5.0 Bankfull	95.91	582.37
8.2	93.75	580.21
10.1	92.91	579.37
13.5	91.81	578.27
16.3	91.21	577.67
19.5	90.52	576.98
24.1	90.30	576.76
28.8	91.07	577.53
31.1	90.40	576.86
34.8	90.04	577.50
39.3	89.60	576.06
45.7	88.53	574.99
47.3	88.82	575.28
50.4	88.51	574.97
52.4	89.15	575.61
55.2	89.79	576.25
57.7	90.59	577.05
61.5	90.27	576.73
63.6	90.65	577.11
66.9	89.95	576.41
70.3	89.28	575.94
74.2	89.65	576.11
78.3	90.01	576.47
81.9	90.16	576.62
84.0	89.75	576.21
86.5	89.87	576.33
88.7	89.05	575.51
90.7	88.20	574.66
93.0	87.56	574.02
95.0	87.28	573.74
98.7	87.77	574.23
100.9	88.71	575.17
102.3	89.10	575.56
104.2	89.45	575.91
106.1	89.31	575.77
108.0	88.59	575.05
109.3	88.08	574.54
110.7	87.02	573.48
114.7	87.08	573.54
116.1	87.80	574.26
118.4	87.42	573.88
121.8	87.08	573.54
126.3	86.71	573.17
129.5	86.94	573.40
140.3	86.78	573.24

Table EA-6. (Continued).

Station	Elevation	True Elevation
147.8	87.15	573.61
153.3	87.13	573.59
156.0	87.49	573.95
164.0	87.68	574.14
170.6	88.12	574.58
175.5	88.49	574.95
178.5	88.31	574.77
182.0	88.84	575.30
185.5	88.28	574.75
187.3	88.20	574.66
188.7	88.63	575.09
194.9	88.66	575.12
198.1	88.97	575.43
202.7	88.57	575.03
208.4	88.79	575.25
211.7	88.33	574.79
216.2	89.35	575.81
217.2	90.47	576.93
218.6 Bankfull	91.26	577.72
226.1 GB	91.76	578.22
226.1 RBHP 5	92.22	578.68

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 11, 1981 was 8,820 cfs (USGS 1981).

Table EA-7. Cross section elevations in transect 6 (sixth head) of Slough 8A, surveyed October 10, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 6	89.93	576.39
0.0 GB	89.39	575.85
14.0 Bankfull	89.20	575.66
33.6	88.28	574.74
58.3	87.61	574.07
105.3	87.36	573.82
123.4	86.98	573.44
170.5	87.01	573.47
181.0 Mainstem RWS	82.56	569.02
194.5	86.57	573.03
222.5	86.93	573.39
240.3	87.31	573.77
257.3	86.84	573.30
269.1	86.73	573.19
278.4	87.77	574.23
286.9	88.63	575.09
291.2	88.93	575.39
294.3 Bankfull	90.11	576.57
298.4	90.69	447.15
304.0	91.34	577.80
309.0	91.91	578.37
314.1 GB	91.81	578.27
314.1 RBHP 6	92.31	578.77

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 10, 1891 was 9,700 cfs (USGS 1981).

Table EA-8. Cross section elevations in transect 7 (mouth) of Slough 8A, surveyed October 10, 1981.

Station	Elevation	True Elevation
0.0 LBHP 7	80.10	566.56
0.0 GB	79.63	566.09
11.7 Bankfull	79.75	566.21
16.3	78.92	565.38
22.0	77.75	564.21
28.2	77.01	563.47
36.6	76.64	563.10
38.9	76.67	563.13
44.8	75.94	562.40
53.6	75.90	562.36
62.8	75.79	562.25
100.5 LWE	74.61	561.07
100.5 LWS	74.65	561.11
112.4	74.30	560.76
131.6	73.92	560.38
141.7	73.43	559.89
156.3	73.02	559.48
165.6	72.66	559.12
171.6	72.47	558.93
178.0	72.13	558.59
181.0	73.14	559.60
183.1 RWE	74.58	561.04
183.1 RWS	74.67	561.13
185.8	76.26	562.72
190.6 Bankfull	82.01	568.47
194.1 GB	82.06	568.52
194.1 RBHP 7	82.54	569.00

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 10, 1981 was 9,700 cfs (USGS 1981).

Table EA-9. Head pin elevations in Slough 9, surveyed October 12-14, 1981.

Bench Mark	Elevation	True Elevation
TBM	100.00	608.33
LBHP 1 (Head)	100.16	608.49
GB	99.74	608.07
RBHP 1 (Head)	100.83	609.16
GB	100.31	608.64
LBHP 2	101.37	609.70
GB	100.96	609.29
RBHP 2	97.55	605.88
GB	97.15	605.48
LBHP 3	93.06	601.39
GB	92.51	600.84
RBHP 3	92.27	600.60
GB	91.76	600.09
LBHP 4*	91.84	600.17
GB	91.46	599.79
RBHP 4*	89.11	597.44
GB	88.71	597.14
LBHP 5 (Mouth)	89.37	597.70
GB	89.98	597.31
RBHP 5 (Mouth)	91.34	599.67
GB	90.78	599.11
R&M LRX 32	100.39	608.72

* Transect 4 was located on the R&M LRX 31.

Table EA-10. Cross section elevation in transect 1 (Head) of Slough 9, surveyed October 14, 1981. Transect was dewatered.

Station		Elevation	True Elevation
0.0	LBHP 1	100.15	608.48
0.0	GB	99.71	608.04
5.4		99.45	607.78
8.2	Bankfull	98.73	607.06
9.1		97.24	605.57
11.0		96.60	604.93
13.3		96.02	604.35
15.9		95.57	603.40
25.8		95.93	604.26
33.8		95.20	603.53
39.3		95.64	603.97
79.0	Mainstem RWS	91.58	599.91
98.8		96.19	604.52
111.8		95.61	603.94
140.7		96.13	604.46
149.3		96.08	604.43
176.1		96.35	604.68
195.2		95.97	604.30
206.7		95.52	603.85
221.7		96.16	604.49
238.0		96.52	604.85
244.9		96.29	604.62
255.6		96.62	604.95
257.0		96.15	604.48
258.4		96.45	604.78
263.0		96.80	605.13
273.1		97.14	605.47
284.1		97.53	605.80
289.4		97.19	605.52
291.9		97.31	605.64
298.7		97.47	605.80
301.4		97.57	605.90
304.1		97.03	605.36
310.0		96.12	604.45
335.0		95.87	604.20
336.3		95.61	603.94
341.2		95.91	604.24
370.3		95.99	604.32
376.2		93.36	604.69
381.0		95.74	604.07
384.4		94.89	603.22
391.0		94.05	602.38
393.6		93.82	602.15
398.4		94.12	602.45
400.3		94.90	603.23
402.4		95.43	603.76

Table EA-10. (Continued).

Station	Elevation	True Elevation
404.2	95.98	604.31
410.8	94.32	602.65
413.0	98.19	606.52
414.5 Bankfull	99.29	607.62
418.3	100.56	608.89
423.0 GB	100.26	608.59
423.0 RBHP 1	100.81	699.14

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 14, 1982 was 7,290 cfs (USGS 1981).

Table EA-11. Cross section elevations in transect 2 of Slough 9, surveyed October 14, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 2	101.37	609.70
0.0 GB	100.93	609.26
8.7 Bankfull	101.57	609.90
9.7	99.96	608.29
12.0	98.96	607.29
16.1	96.59	604.92
19.8	94.82	603.15
23.2	93.94	602.27
25.0	93.81	602.14
26.5	93.37	601.70
33.0	93.62	601.95
34.0	93.96	602.29
41.4	94.07	602.40
56.4	93.79	602.12
67.5	94.03	602.36
96.1	93.09	601.42
106.6	93.40	601.73
118.3	93.53	601.86
133.4	93.32	601.65
141.7	93.39	601.72
147.3	93.85	602.18
154.1	93.87	602.20
161.8	93.28	601.61
174.1	93.33	601.66
186.3	93.77	602.10
195.3	93.93	602.26
200.9	93.72	602.05
206.1	93.91	602.24
221.4	93.80	602.13
224.9	93.57	601.90
235.4	93.77	602.10
241.8	93.49	601.82
251.7	93.39	601.72
262.8	94.27	602.60
269.8	95.08	603.41
274.3	96.21	604.54
279.8 Bankfull	97.15	605.48
281.3 GB	97.13	605.46
281.3 RBHP 2	97.55	605.88

Provisional mainstem Susitna River discharge recorded at Gold Creek for October 14, 1981 was 7,290 cfs (USGS 1981).

Table EA-12. Cross section elevations in transect 3 of Slough 9, surveyed October 14, 1981.

Station	Elevation	True Elevation
0.0 LBHP 3	93.05	601.38
0.0 GB	92.49	600.82
3.1 Bankfull	92.35	600.66
11.2	91.40	599.73
22.8	91.38	599.71
28.2	90.95	599.28
37.6	90.87	599.20
47.0	90.02	598.35
49.6	89.61	597.94
52.0	89.95	598.28
56.0	89.69	598.02
65.4	89.93	598.26
69.7	90.13	598.46
75.4	89.47	597.80
81.5	88.64	596.97
89.4	88.50	596.83
100.6	88.27	596.60
113.5	87.48	595.81
124.6	87.04	595.37
138.5	86.58	594.91
163.3	86.58	594.91
183.9	86.33	594.66
197.0 LWS	86.08	594.41
197.0 LWE	86.06	594.39
203.0	85.83	594.16
206.8	85.94	594.27
210.0	85.85	594.18
215.1	85.68	594.01
219.2 RWS	85.93	594.26
219.2 RWE	85.92	594.25
222.6	86.37	594.70
227.3	86.21	594.54
238.7	86.95	595.28
242.0	88.98	597.31
245.2 Bankfull	91.61	599.94
252.1 GB	91.75	600.08
252.1 RBHP 3	92.25	600.58

Provisional mainstem Susitna River discharge recorded for October 14, 1982 at Gold Creek was 7,290 cfs (USGS 1981).

Table EA-13. Cross section elevation in transect 4 of Slough 9, surveyed October 14, 1981.

Station		Elevation	True Elevation
0.0	LBHP 4	91.84	600.17
0.0	GB	91.44	599.77
3.3	Bankfull	91.40	599.73
4.1		90.06	598.39
11.5		87.95	596.68
12.8		85.61	593.94
22.0		84.73	593.06
26.0	LWS	84.21	592.54
26.0	LWE	84.21	592.54
31.0		84.06	592.39
33.6		84.15	592.48
37.8		83.93	592.26
42.8		83.60	591.93
48.2		83.33	591.66
50.7		83.62	591.95
61.1		83.77	592.10
74.6	RWS	84.27	592.60
74.6	RWE	84.17	592.50
83.9		84.37	592.70
98.1		84.59	592.92
105.7		84.34	592.67
122.1		84.73	593.06
138.9		85.28	593.61
143.6		85.88	594.21
144.9		85.91	594.24
146.5		86.45	594.78
148.4	Bankfull*	87.36	595.69
159.0		87.40	595.73
173.6		87.35	595.68
184.3		87.89	596.22
187.4		88.51	596.84
191.2	GB	88.73	597.06
191.2	RBHP 4	89.13	597.46

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 14, 1981 was 7,290 cfs (USGS 1981).

* Located in a flood plain.

Table EA-14. Cross section elevations in transect 5 (Mouth) of Slough 9, surveyed October 14, 1981.

Station	Elevation	True Elevation
0.0 LBHP 5	89.37	597.70
0.0 GB	88.96	597.29
2.0 Bankfull	88.89	597.22
4.6	87.96	596.29
7.6	87.31	595.64
12.1	86.47	594.80
15.1	85.65	593.98
17.5	85.00	593.33
21.9	85.34	593.67
33.2	85.74	594.07
42.0	85.31	593.64
47.4	84.99	593.32
53.9	85.39	593.72
67.3	84.21	592.54
81.3	83.28	591.71
90.4	83.06	591.39
103.1	83.14	591.47
112.0	82.89	591.22
130.0	83.02	591.35
146.6	83.21	591.54
167.7	83.00	591.33
181.9	82.78	591.11
188.1	82.70	591.03
188.8 LWS	82.41	590.74
188.8 LWE	82.34	590.67
194.3	81.94	590.27
204.8	81.99	590.32
209.9	82.31	590.64
215.8 RWS	82.39	590.72
215.8 RWS	82.33	590.66
216.3	82.42	590.75
221.2	82.98	591.31
226.9	85.37	593.70
231.4 Bankfull	90.65	598.98
238.2 GB	90.74	599.07
238.2 RBHP 5	91.34	599.67

Provisional mainstem Susitna River discharge recorded at Gold Creek on October 14, 1981 was 7,290 cfs (USGS 1981).

Table EA-15. Head pin elevations in Slough 16B, surveyed September 9, 10, 16, and 17, 1981.

Bench Mark	Elevation	True Elevation
TBM	100.00	708.02
LBHP 1 (Mouth)	95.47	703.49
GB	94.96	702.98
RBHP 1 (Mouth)	93.30	701.32
GB	92.89	700.91
LBHP 2	95.96	703.98
GB	95.69	703.71
RBHP 2	95.28	703.30
GB	94.87	702.89
LBHP 3	96.24	704.26
GB	95.85	703.87
RBHP 3	96.22	704.24
GB	95.84	703.86
LBHP 4	96.25	704.27
GB	95.93	703.95
RBHP 4	96.58	704.60
GB	96.15	704.17
LBHP 5	96.31	704.33
GB	96.00	704.02
RBHP 5	96.54	704.56
GB	96.22	704.24
LBHP 6	96.60	704.62
GB	96.25	704.27
RBHP 6	95.89	703.91
GB	95.53	703.55
LBHP 7	96.97	704.99
GB	96.49	704.51
RBHP 7	96.57	704.59
GB	96.14	704.16
LBHP 8	96.76	704.78
GB	96.41	704.43
RBHP 8	97.37	705.39
GB	97.06	705.08
LBHP 9	97.52	705.54
GB	97.06	705.08
RBHP 9	96.86	704.88
GB	96.49	704.51
LBHP 10	96.71	704.73
GB	96.29	704.31
RBHP 10	97.52	705.54
GB	97.13	705.15
LBHP 11	98.54	706.56
GB	97.92	705.94
RBHP 11	97.24	705.26
GB	96.85	704.87

Table EA-15. (Continued).

Bench Mark	Elevation	True Elevation
LBHP 12	100.45	708.47
GB	100.01	708.30
RBHP 12	98.16	706.18
GB	97.75	705.77
LBHP 13	100.04	708.06
GB	99.61	707.63
RBHP 13	98.85	706.87
GB	98.33	706.35
LBHP 14	99.09	707.11
GB	98.68	706.70
RBHP 14	98.58	706.60
GB	98.23	706.25
LBHP 15	103.20	711.22
GB	102.82	710.84
RBHP 15	98.79	706.81
GB	98.42	706.44
LBHP 16	103.74	711.76
GB	103.19	711.21
RBHP 16	98.89	706.91
GB	98.49	706.51
LBHP 17 (Head)	100.00	708.02
GB	99.61	707.63
RBHP 17 (Head)	100.65	708.67
GB	100.19	708.21
R&M LRX 49	125.38	733.40
Mainstem RWS* on LRX 49	82.12	690.14
Mainstem LWS* on LRX 49	93.82	701.84

* Left and right bank mainstem Sustina River water surface elevations on R&M LRX 49 were surveyed on September 17, 1981.

Table EA-16. Cross section elevations in transect 1 (Mouth) of Slough 16B, surveyed September 9, 1981.

Station	Elevation	True Elevation
0.0 LBHP 1	95.47	703.49
0.0 GB	94.96	702.98
2.0	94.41	702.43
5.0	93.68	701.70
7.0	92.79	700.81
10.0	92.53	700.55
12.0	92.28	700.30
16.0	91.72	699.74
19.0	91.30	699.32
22.0	91.02	699.04
25.0	90.80	698.82
30.0	90.56	698.58
35.0	90.36	698.38
40.0	90.02	698.04
45.0	89.78	697.80
50.0	89.64	697.66
56.0 LWS	89.22	697.24
56.0 LWE	89.42	697.44
59.0	89.27	697.29
62.0	89.03	697.05
64.0	88.89	696.91
66.0	88.86	696.88
68.0	88.73	696.75
70.0	88.70	696.72
72.0	88.60	696.62
74.0	88.48	696.50
76.0	88.37	696.39
77.6	88.38	696.40
78.5	88.63	696.65
79.8 RWS	89.21	697.23
79.8 RWE	89.13	697.15
84.9	92.15	700.17
95.3	92.89	700.91
95.3 GB	93.30	700.91
95.3 RBHP 1	93.30	701.32

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 9, 1981 was 14,500 cfs (USGS 1981).

Table EA-17. Cross section elevations in transect 2 of Slough 16B, surveyed September 17, 1981.

Station	Elevation	True Elevation
0.0 LBHP 2	95.96	703.98
0.0 GB	95.69	703.71
8.0 Bankfull	94.47	702.49
14.0	93.29	701.31
32.7	91.01	699.03
52.6 LWE	89.19	697.21
52.6 LWS	89.22	697.24
61.8	88.69	696.71
67.7	87.95	695.97
75.5	88.46	696.48
81.5 RWE	89.02	697.04
81.5 RWS	89.22	697.24
84.5 Bankfull	94.62	702.64
88.8 GB	94.87	702.89
88.8 RBHP 2	95.28	703.30

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 17, 1981 was 11,300 cfs (USGS 1981).

Table EA-18. Cross section elevations in transect 3 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 3	96.24	704.26
0.0 GB	95.85	703.87
5.0	95.26	703.28
8.3 Bankfull	94.00	702.02
13.0	92.73	700.75
28.6	90.19	698.21
33.4	90.26	698.28
46.5 LWS	89.36	697.38
46.5 LWE	89.63	697.65
58.1	88.82	696.84
60.3 RWS	89.27	697.29
60.3 RWE	89.27	697.29
64.2	90.23	698.25
68.6	89.52	697.54
76.2	---	---
78.0	94.89	702.91
80.1 GB	95.84	703.86
80.1 RBHP 3	96.22	704.24

Provisional mainstem Susitna River discharge recorded at Gold Creek in September 16, 1981 was 11,300 cfs (USGS 1981).

--- Data not collected.

Table EA-19. Cross section elevations in transect 4 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 4	96.25	704.27
0.0 GB	95.93	703.95
5.0	95.48	703.50
9.1 Bankfull	94.69	702.71
17.8	92.72	700.74
25.5 LWE	90.04	698.06
25.5 LWS	90.03	698.05
30.0	89.48	697.50
39.2	89.89	697.91
56.1	89.89	697.91
68.8 RWE	89.92	697.94
68.8 RWS	89.90	697.92
83.6	90.38	698.40
94.2	92.45	700.47
98.9	94.12	702.14
99.5 Bankfull	95.85	703.87
104.4 GB	96.15	704.17
104.4 RBHP 4	96.58	704.60

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-20. Cross section elevations in transect 5 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 5	96.31	704.33
0.0 GB	96.00	704.02
2.6	96.23	704.25
3.8 Bankfull	96.40	704.42
5.7	93.39	701.41
9.2	91.64	699.66
10.0 LWE	89.83	697.85
10.0 LWS	90.03	698.05
16.2	89.08	697.10
24.1	88.96	696.98
36.4 RWE	90.05	698.07
36.4 RWS	90.02	698.04
46.1	90.65	698.67
54.5	91.42	699.44
70.0	91.65	699.67
77.7	93.11	701.13
84.1	94.31	702.33
88.6 Bankfull	95.62	703.64
93.9 GB	96.22	704.24
93.9 RBHP 5	96.54	704.56

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-21. Cross section elevations in transect 6 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 6	96.60	704.62
0.0 GB	96.25	704.27
1.4	96.04	704.06
2.9 Bankfull	95.71	703.73
4.5	91.27	699.29
8.1 LWS	90.02	698.04
8.1 LWE	90.11	698.13
16.2	89.42	697.44
23.0	89.64	697.66
29.8 RWS	90.03	698.05
29.8 RWE	90.10	698.12
41.5	90.86	698.88
61.6	91.82	699.84
70.8	91.94	699.96
77.7	92.98	701.00
81.8	94.41	702.43
86.7 Bankfull	95.58	703.60
90.4 GB	95.53	703.55
90.4 RBHP 6	95.89	703.91

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-22. Cross section elevations in transect 7 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 7	96.97	704.99
0.0 GB	96.49	704.51
3.0	96.27	704.29
4.3 Bankfull	95.85	703.87
6.4	91.31	699.33
17.1 LWE	90.30	698.32
17.1 LWS	90.35	698.37
24.5	89.94	697.96
35.1	90.54	698.56
43.3 RWE	90.67	698.38
43.3 RWS	90.36	698.69
53.2	91.08	699.10
62.5	91.47	699.49
67.4	91.92	699.94
71.1	93.33	701.35
75.5	94.61	702.63
78.2 Bankfull	96.07	704.09
79.5 GB	96.14	704.16
79.5 RBHP 7	96.57	704.59

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-23. Cross section elevations in transect 8 of Slough 16B, surveyed September 16, 1981.

Station	Elevations	True Elevation
0.0 LBHP 8	96.76	704.78
0.0 GB	96.39	704.41
3.4	96.38	704.40
5.7 Bankfull	96.22	704.24
7.2	94.10	702.12
8.9	83.32	701.34
11.7	92.40	700.42
14.6 LWE	91.21	699.23
14.6 LWS	91.22	699.24
17.1	91.00	699.02
26.1	90.81	698.83
34.5	90.98	699.00
40.1	90.99	699.01
49.0	90.87	698.89
56.6	90.41	698.43
60.7	90.87	698.89
67.9 RWE	91.05	699.07
67.9 RWS	91.20	699.22
69.0	92.13	700.15
72.8	93.37	701.39
74.7 Bankfull	96.27	704.29
77.5	96.83	704.85
83.4 GB	97.06	705.08
83.4 RBHP 8	97.36	705.38

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-24. Cross section elevations in transect 9 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 9	97.52	705.54
0.0 GB	97.06	705.08
2.7	96.45	704.47
3.6 Bankfull	96.32	704.34
6.4	95.37	703.39
9.7	94.50	702.50
11.7	94.07	702.09
14.0	93.36	701.38
16.6	92.43	700.45
19.6	91.65	699.67
26.1	91.31	699.33
27.2 LWE	91.18	699.20
27.2 LWS	91.22	699.24
31.7	91.05	699.07
40.2	90.96	698.98
44.9	90.92	698.94
50.8	90.85	698.87
53.4	90.57	698.59
58.6	90.50	698.52
60.0	90.29	698.31
63.9	90.34	698.36
68.0	90.55	698.57
69.6 RWE	91.06	699.08
69.6 RWS	91.22	699.24
69.9	91.44	699.46
71.4	92.28	700.30
72.6 Bankfull	95.42	703.44
74.3	96.52	704.54
76.6	96.79	704.81
79.0 GB	96.49	704.51
79.0 RBHP 9	96.86	704.88

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-25. Cross section elevations in transect 10 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 10	96.71	704.73
0.0 GB	96.29	704.31
1.6	96.04	704.06
2.0 Bankfull	95.52	705.54
4.0	92.65	700.67
5.6	91.41	699.43
7.3 LWE	91.21	699.23
7.3 LWS	91.70	699.72
11.0	91.21	699.23
16.1	90.89	698.91
22.9	90.82	698.84
25.6	90.95	698.97
26.9	90.75	698.77
30.7	91.05	699.07
33.8	91.15	699.17
37.1 RWE	91.21	699.23
37.1 RWS	91.70	699.72
44.7	91.67	699.69
50.0	91.93	699.95
55.1	92.12	700.14
60.3	92.13	700.15
61.9	92.65	700.67
64.5	93.07	701.09
67.0	93.81	701.83
69.1 Bankfull	95.69	703.71
70.5	96.96	704.98
72.0 GB	97.13	705.15
72.0 RBHP 10	97.52	705.54

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-26. Cross section elevations in transect 11 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 11	98.54	706.56
0.0 GB	97.92	705.94
2.0	97.31	705.33
3.9 Bankfull	96.79	704.81
4.3	93.86	701.88
7.8	92.53	700.55
11.4	92.13	700.15
15.0 LWE	91.66	699.68
15.0 LWS	91.70	699.72
17.9	91.48	699.50
20.5	91.54	699.56
26.6	91.30	699.32
30.7	91.47	699.49
33.5 RWE	91.63	699.65
33.5 RWS	91.70	699.72
39.9	92.04	700.06
46.1	92.37	700.39
51.0	92.61	700.63
56.3	92.82	700.84
63.6	92.89	700.91
70.7	93.02	701.04
73.4	93.38	701.40
75.4	94.34	702.36
77.3	95.07	703.09
79.9	95.54	703.56
81.4 Bankfull	96.38	704.40
82.7 GB	96.85	704.87
82.7 RBHP 11	97.24	705.26

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-27. Cross section elevations in transect 12 of Slough 16B, surveyed September 16, 1981.

Station	Elevation	True Elevation
0.0 LBHP 12	100.45	708.47
0.0 GB	100.01	708.03
3.0	99.15	707.17
6.0 Bankfull	97.81	705.83
7.0	95.64	703.66
9.5	94.64	702.66
15.8	93.19	701.21
20.6	92.48	700.50
25.1 LWE	91.98	700.00
25.1 LWS	92.24	700.26
27.3	91.99	700.01
32.8	91.93	699.95
38.2	91.88	699.90
42.9	92.08	700.10
47.5	92.11	700.13
51.1	91.98	700.00
54.2 RWE	92.19	700.21
54.2 RWS	92.23	700.25
57.1	92.39	700.41
59.8	92.73	700.75
61.6	92.51	700.53
66.4	92.56	700.58
68.8	93.19	701.21
70.9	94.36	702.38
71.2 Bankfull	96.73	704.75
76.0 GB	97.75	705.77
76.0 RBHP 12	98.16	706.18

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 16, 1981 was 11,300 cfs (USGS 1981).

Table EA-28. Cross section elevations in transect 13 of Slough 16B, Surveyed on September 10, 1981.

Station	Elevation	True Elevation
0.0 LBHP 13	100.04	708.06
0.0 GB	99.61	707.63
2.0 Bankfull	99.19	707.21
3.5	97.70	705.72
5.5	96.72	704.74
7.5	95.37	703.39
13.5	93.87	701.89
16.0 LWE	93.22	701.24
16.0 LWS	---	---
20.0	92.96	700.98
22.5 RWE	---	---
22.5 RWS	93.22	701.24
26.0	93.92	701.94
35.0	93.84	701.86
45.0	93.55	701.57
55.0	93.39	701.41
61.0 LWE	92.80	700.82
61.0 LWS	---	---
65.0	92.61	700.63
68.0	92.56	700.58
71.0	92.65	700.67
74.5	92.63	700.65
76.0	92.70	700.72
79.0	92.72	700.74
83.0	92.78	700.80
84.8 RWE	92.87	700.89
84.8 RWS	---	---
87.5	93.83	701.85
89.0	98.04	706.06
91.0 Bankfull	98.57	706.59
92.3 GB	98.33	706.35
92.3 RBHP 13	98.85	706.87

Provisional mainstem Susitna River discharge recorded on September 10, 1981 at Gold Creek was 14,200 cfs (USGS 1981).

--- Data not collected.

Table EA-29. Cross section elevations in transect 14 of Slough 16B, surveyed September 10, 1981

Station	Elevation	True Elevation
0.0 LBHP 14	99.09	707.11
0.0 GB	98.68	706.70
2.9 Bankfull	97.87	705.89
3.4 LWE	93.58	701.60
3.4 LWS	93.74	701.76
6.5	93.40	701.42
8.1	93.17	701.19
12.7	92.83	700.85
16.4	92.74	700.76
21.0	93.06	701.08
28.5	93.17	701.19
35.0	93.67	701.69
40.5	93.60	701.62
44.6	93.67	701.69
45.8 RWE	93.76	701.78
45.8 RWS	93.74	701.76
52.5	93.75	701.77
59.5	93.86	701.88
65.4	93.92	701.94
68.2	93.88	701.90
70.4	93.75	701.77
73.4	94.67	702.69
76.2 Bankfull	97.79	705.81
78.1 GB	98.23	706.25
78.1 RBHP 14	98.58	706.60

Provisional mainstem Susitna River discharge recorded at Gold Creek in September 10, 1981 was 14,200 cfs (USGS 1981).

Table EA-30. Cross section elevations in transect 15 of Slough 16B, Surveyed on September 10, 1981.

Station	Elevation	True Elevation
0.0 LBHP 15	103.20	711.22
0.0 GB	102.82	710.84
2.8 Bankfull	103.22	711.24
4.9	99.52	707.54
7.5	97.95	705.97
9.7	97.06	705.08
14.3	95.93	703.95
18.3	94.90	702.92
23.0	94.05	702.07
27.0 LWS	93.69	701.71
27.0 LWE	93.76	701.78
32.0	93.45	701.47
39.0	93.14	701.16
49.0	92.80	700.82
54.0	92.74	700.76
61.0	93.22	701.24
66.1 RWS	97.70	705.72
66.1 RWE	93.76	701.78
67.4	94.32	702.34
70.2 Bankfull	98.09	706.11
73.9 GB	98.42	706.44
73.9 RBHP 15	98.79	706.81

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 10, 1981 was 14,200 cfs (USGS 1981).

Table EA-31. Cross section elevations in transect 16 of Slough 16B, surveyed September 10, 1981.

Station	Elevation	True Elevation
0.0 LBHP 16	103.74	711.76
0.0 GB	103.19	711.21
2.7	103.11	711.13
6.4 Bankfull	97.14	705.16
15.4	95.89	703.91
21.3	94.38	702.40
26.6	94.30	702.32
30.5 LWS	94.11	702.13
30.5 LWS	---	---
36.7	93.94	701.96
49.9	93.67	701.69
53.0	93.72	701.74
68.3 RWE	93.85	701.87
68.3 RWS	93.92	701.94
72.0	94.45	702.47
76.1	95.75	703.77
76.7 Bankfull	98.11	706.13
77.6	98.48	706.50
82.2 GB	98.49	706.51
82.2 RBHP 16	98.89	706.91

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 10, 1981 was 14,200 cfs (USGS 1981).

--- Data not collected.

Table EA-32. Cross section elevations in transect 17 (Head) of Slough 16B surveyed September 9, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 17	100.00	708.02
0.0 GB	99.61	707.63
2.0	99.50	707.52
6.0	98.50	705.52
8.0	96.15	704.17
20.0	95.14	703.16
60.0	95.00	703.02
84.0	95.02	703.04
114.0	95.15	703.17
130.0	95.48	703.50
142.0	95.95	703.97
155.0	96.00	704.02
174.0	96.47	704.49
182.5	96.42	704.44
185.0	96.15	704.17
187.0	96.71	704.73
189.0	97.21	705.23
189.5	97.88	705.90
191.0	99.63	707.65
194.5 GB	100.18	708.20
194.5 RBHP 17	100.65	708.67

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 9, 1981 was 14,500 cfs (USGS 1981).

Table EA-33. Head pin elevations in Slough 19, surveyed September 25, 1981.

Bench Mark	Elevation	True Elevation
TBM	100.00	725.18
LBHP 1 (Mouth)	98.78	723.96
GB	98.42	723.60
RBHP 1 (Mouth)	101.21	726.39
GB	99.75	724.93
LBHP 2	98.96	724.14
GB	98.54	723.72
RBHP 2	100.19	725.37
GB	99.98	725.16
LBHP 3	99.66	724.84
GB	99.25	724.43
RBHP 3	99.60	724.78
GB	99.20	724.38
LBHP 4	100.15	725.33
GB	99.77	724.95
RBHP 4	99.65	724.83
GB	99.36	724.54
LBHP 5	99.41	724.59
GB	99.05	724.23
RBHP 5	100.26	725.44
GB	99.79	724.97
LBHP 6	99.81	724.99
GB	99.44	724.62
RBHP 6	100.47	725.65
GB	100.14	725.32
LBHP 7	100.00	725.18
GB	99.50	724.68
RBHP 7	101.21	726.39
GB	100.82	726.00
LBHP 8	100.06	725.24
GB	99.82	725.00
RBHP 8	99.79	724.97
GB	99.35	724.53
LBHP 9	100.67	725.85
GB	100.23	725.41
RBHP 9	99.68	724.86
GB	99.21	724.39
LBHP 10 (Head)	100.14	725.32
GB	99.72	724.90
RBHP 10 (Head)	100.53	725.71
GB	100.05	725.23
R&M LRX 53	108.58	733.76
Mainstem RWS*	94.48	719.66

* The right bank mainstem Susitna River water surface elevation was surveyed at a point adjacent to transect 1 on October 23, 1981.

Table EA-34. Cross section elevations in transect 1 (Mouth) of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 1	98.78	723.96
0.0 GB	98.40	723.58
8.0	97.86	723.04
18.0	97.53	722.04
23.0	97.29	722.47
31.4	96.80	721.98
34.0	96.55	721.73
43.5	96.83	722.01
46.3 Bankfull	97.23	722.41
49.9	96.66	721.84
51.2	95.40	720.58
53.4	94.95	720.13
55.5 LWS	94.00	719.18
55.5 LWE	93.88	719.06
56.0	93.74	718.92
56.5	93.68	718.86
57.1	93.61	718.79
57.5	93.73	718.91
57.8 RWS	93.92	719.18
57.8 RWE	94.63	719.10
59.1	94.63	791.81
52.2	94.98	720.16
64.8	96.27	721.45
71.4	96.81	721.99
74.3	97.53	722.71
80.8	96.33	721.51
97.1 Bankfull	97.04	722.22
101.5	98.97	724.15
106.6	99.73	724.91
106.6 RBHP 1	100.20	725.38

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-35. Cross section elevations in transect 2 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 2	98.95	724.13
0.0 GB	98.53	723.71
2.0 Bankfull	98.61	723.79
4.1	96.98	722.16
9.2	96.24	721.42
16.5	95.26	720.44
23.6	94.37	719.55
34.0 LWS	94.05	719.23
34.0 LWE	93.90	719.08
36.0	93.72	718.90
38.0	93.89	719.07
40.7	93.68	718.86
42.6	93.59	718.77
48.2	93.75	718.93
65.4 RWS	94.06	719.24
65.4 RWE	93.80	718.98
62.6	94.61	719.79
71.5	94.50	719.68
78.9	95.18	720.36
87.0	96.42	721.60
99.7	96.70	721.88
102.9	98.11	723.29
111.5	98.66	723.84
113.1 Bankfull	99.88	725.06
115.3 GB	100.19	725.37
115.3 RBHP 2	100.01	725.19

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-36. Cross section elevations in transect 3 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 3	99.66	724.84
0.0 GB	99.25	724.43
2.8 Bankfull	98.68	723.86
5.1	97.60	722.78
7.4	97.24	722.42
9.1	95.99	721.17
20.4	94.92	720.10
27.5 LWS	94.08	719.26
27.5 LWE	93.88	719.06
32.0	93.55	718.73
35.0	93.40	718.58
51.8	93.93	719.11
56.6	93.53	718.71
61.7 RWS	94.08	719.26
61.7 RWE	93.97	719.15
74.4	95.02	720.20
92.9	96.76	721.94
95.5	97.87	723.05
102.4 Bankfull	98.94	724.12
104.6 GB	99.20	724.38
104.6 RBHP 3	99.60	724.78

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-37. Cross section elevations in transect 4 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 4	100.16	725.34
0.0 GB	99.79	724.97
2.3 Bankfull	99.21	724.39
9.6	97.77	722.95
11.0	97.69	722.87
16.4	95.56	720.74
21.0	94.62	719.80
23.2 LWS	94.34	719.52
23.2 LWE	94.20	719.38
27.6	93.79	718.97
31.2	93.63	718.81
37.8	93.81	718.99
41.9 RWS	94.35	719.53
41.9 RWE	94.26	719.44
47.5	94.84	720.02
52.6	96.71	721.89
54.7 Bankfull	98.83	724.01
57.2 GB	99.38	724.56
57.2 RBHP 4	99.66	724.84

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-38. Cross section elevations in transect 5 of Slough 19, surveyed September 26, 1981

Station	Elevation	True Elevation
0.0 LBHP 5	99.41	724.59
0.0 GB	99.09	724.27
2.2 Bankfull	98.95	724.13
3.0	97.50	722.68
7.5	96.62	721.80
10.1	95.73	720.91
10.6	95.15	720.33
11.6 LWS	94.97	720.15
11.6 LWE	94.91	720.09
13.9	94.60	719.78
15.2	94.46	719.64
18.1	94.43	719.61
19.2	94.79	719.97
22.2 RWS	94.98	720.16
22.2 RWE	94.87	720.05
27.4 Dewatered	95.17	720.35
31.0 Dewatered	95.67	720.85
31.8 Dewatered	96.38	721.56
33.7 Dewatered	96.35	721.53
34.9 Dewatered	95.59	720.77
35.3 LWS	94.97	720.15
35.5 LWE	94.83	710.01
38.2	94.40	719.58
41.5 RWS	94.98	720.16
41.5 RWE	94.86	720.04
43.7	96.56	721.74
53.0	97.33	722.51
65.0	98.29	723.47
70.3 GB	---	---
70.3 RBHP 5	100.25	725.43

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

--- Data not collected.

Table EA-39. Cross section elevations in transect 6 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 6	99.81	724.99
0.0 GB	99.47	724.65
4.4 Bankfull	98.67	723.85
7.9	97.50	722.68
11.2	96.75	721.93
16.0	96.52	721.70
17.9	96.11	721.29
18.5 LWS	95.68	720.86
18.5 LWE	95.57	720.75
20.7	95.42	720.60
22.6	95.14	720.32
24.9	95.22	720.40
27.8 RWS	95.62	720.80
27.8 RWE	---	---
30.5	96.61	721.79
31.7 Bankfull	98.99	724.17
40.4 GB	100.18	725.36
40.4 RBHP 6	100.47	725.65

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

--- Data not collected

Table EA-40. Cross section elevations in transect 7 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 7	100.00	725.18
0.0 GB	99.59	724.77
1.9 Bankfull	99.07	724.25
6.8	97.67	722.85
10.4	96.44	721.62
17.8 LWS	96.07	721.25
17.8 LWE	95.97	721.15
21.2 Dewatered	96.13	721.31
19.3 Dewatered	96.10	721.28
26.3 Dewatered	95.95	721.13
28.6 RWS	96.12	721.30
28.6 RWE	95.98	721.16
30.3	96.59	721.77
31.4	98.23	723.41
33.4 Bankfull	100.28	725.46
36.0 GB	100.86	726.04
36.0 RBHP 7	101.21	726.39

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-41. Cross section elevations in transect 8 of Slough 19, surveyed September 26, 1981. Cross section was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 8	100.06	725.24
0.0 GB	99.83	725.01
2.2 Bankfull	99.68	724.86
5.4	98.62	723.80
8.7	97.62	722.80
13.3	97.27	722.45
17.7	97.58	722.76
20.1	97.40	722.58
22.2	96.94	722.12
23.8	96.83	722.01
25.7	98.18	723.36
30.0 Bankfull	99.34	724.52
35.2 GB	99.36	724.54
35.2 RBHP 8	99.79	724.97

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-42. Cross section elevations in transect 9 of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LBHP 9	100.67	725.85
0.0 GB	100.24	725.42
2.4 Bankfull	100.10	725.28
2.8	98.85	724.03
5.2	98.37	723.55
5.7	97.74	722.92
9.1	97.14	722.32
10.1 LWS	96.86	722.04
10.1 LWE	96.74	721.92
13.5	96.70	721.88
15.6 RWS	96.82	722.00
15.6 RWE	96.76	721.94
18.7	96.92	722.10
22.0	97.40	722.58
23.7 Bankfull	98.92	724.10
26.6 GB	99.21	724.39
26.6 RBHP 9	99.68	724.86

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-43. Cross section elevations in transet 10 (Head) of Slough 19, surveyed September 26, 1981.

Station	Elevation	True Elevation
0.0 LHBP 10	100.14	725.32
0.0 GB	99.76	725.94
3.4 Bankfull	98.64	723.82
4.5	97.12	722.30
5.7 LWS	96.80	721.98
5.7 LWE	96.78	721.96
9.6 RWS	96.80	748.98
9.6 RWE	96.77	721.95
16.5	97.15	722.33
12.2	98.42	723.60
13.5 Bankfull	98.64	723.82
16.1 GB	99.98	725.16
16.1 RBHP 10	100.54	725.72

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 26, 1981 was 9,560 cfs (USGS 1981).

Table EA-44. Head pin elevations in Slough 21 surveyed August 24-27, 1981.

Bench Mark	Elevation	True Elevation
LBHP 1 (Head)	100.12	759.42
GB	99.49	758.79
RBHP 1 (Head)	97.33	756.63
GB	96.71	756.01
LBHP 2	96.61	755.91
GB	96.20	755.50
RBHP 2	97.02	756.32
GB	96.41	755.71
LBHP 1-A	98.00	757.30
GB	97.54	756.84
RBHP 1-A	101.17	760.47
GB	100.64	759.94
LBHP 1-B	100.85	760.15
GB	100.30	759.60
RBHP 1-B	99.73	759.03
GB	99.34	758.64
LBHP 3	96.71	756.01
GB	96.25	755.55
RBHP 3	96.64	755.94
GB	96.09	755.39
LBHP 4	93.94	753.24
GB	93.49	752.79
RBHP 4	95.44	754.74
GB	94.87	754.17
LBHP 5	93.20	752.50
GB	92.92	752.22
RBHP 5	92.58	751.88
GB	92.15	751.45
HP 5-A	93.67	752.97
GB	93.12	752.42
LBHP 6	92.90	752.20
GB	92.42	751.72
RBHP 6	92.56	751.86
GB	92.13	751.43
LBHP 7	93.47	752.77
GB	93.04	752.34
RBHP 7	93.36	752.66
GB	92.77	752.07
LBHP 8	93.00	752.30
GB	92.57	751.87
RBHP 8	91.44	750.74
GB	90.92	750.22
LBHP 9	93.03	752.33
GB	92.62	751.92
RBHP 9	92.35	751.65
GB	91.93	751.23

Table EA-44. (Continued)

Bench Mark	Elevation	True Elevation
LBHP 10	93.23	752.53
GB	92.73	752.03
RBHP 10	92.27	751.57
GB	91.94	751.24
LBHP 11	91.68	750.98
GB	91.23	750.53
RBHP 11	92.08	751.38
GB	91.56	750.86
LBHP 12	91.94	751.24
GB	91.59	750.89
RBHP 12	92.30	751.60
GB	91.83	751.13
LBHP 13 (Mouth)	91.14	750.44
GB	90.77	750.07
RBHP 13 (Mouth)	92.08	751.38
GB	91.67	750.97
Mainstem RWS*	92.92	752.23
Mainstem RWS**	92.12	751.42
R&M LRX 56	100.00	759.30

* The mainstem water surface elevation was surveyed on September 27, 1981, 227 ft from the left bank head pin 13 at 282° from magnetic north.

** The mainstem water surface elevation was surveyed on October 23, 1981, 75 ft from the left bank head pin 13 at 290° from magnetic north.

Table EA-45. Cross section elevations in transect 1 (Head) of Slough 21, surveyed September 5, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 1	100.12	759.42
0.0 GB	99.52	758.82
22.0	98.88	758.18
34.0	92.22	756.52
40.0	96.56	755.86
50.0	95.02	754.32
61.5	94.51	753.81
69.0	95.23	754.53
75.5	95.00	754.30
79.0	94.42	753.72
81.9	94.75	754.05
96.0	94.71	754.01
105.0	95.73	755.03
123.0	96.40	755.70
135.6	96.55	755.85
139.3	95.94	755.24
155.8	96.68	755.98
159.1 GB	96.76	756.06
159.1 RBHP 1	97.37	756.67

Provisional mainstem discharge Susitna River recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

Table EA-46. Cross section elevations in transect 1-A (Head) of Slough 21, surveyed September 5, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 1-A	98.00	757.30
0.0 GB	97.58	756.88
5.0	97.49	756.79
12.0	97.12	756.42
20.5	96.67	755.97
26.6	96.51	755.81
29.5	96.05	755.35
34.5	97.50	756.80
39.0	98.60	757.90
50.0	99.60	758.90
57.6 GB	100.64	759.94
57.6 RBHP 1-A	101.17	760.47

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

Table EA-47. Cross section elevation in transect 1-B of Slough 21, surveyed September 5, 1981. Transect was dewatered.

Station	Elevation	True Elevation
0.0 LBHP 1-B	100.85	760.15
0.0 GB	100.26	759.59
1.5	99.07	758.37
6.0	98.09	757.39
16.5	97.69	756.99
19.4	98.00	757.30
22.0	97.28	756.58
24.0	97.76	757.06
33.0	97.19	756.49
38.0	97.53	756.83
40.5	97.22	756.52
43.0	97.55	756.85
46.5	96.76	756.06
48.5	97.14	756.44
52.5	96.69	755.99
57.5	96.20	755.50
66.1	96.37	755.67
70.2	98.24	757.54
78.3 GB	99.36	758.66
78.3 RBHP 1-B	99.74	759.04

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

Table EA-48. Cross section elevations in transect 2 of Slough 21, surveyed September 5, 1981. Transect was dewaterd.

Station	Elevation	True Elevation
0.0 LBHP 2	96.66	755.96
0.0 GB	96.25	755.55
3.0	96.04	755.34
13.0	95.15	754.45
16.0	94.30	753.60
17.3	93.59	752.89
21.0	92.95	752.25
44.0	92.82	752.12
59.5	93.09	752.39
78.5	93.77	753.07
95.2	94.55	753.85
103.0	95.42	754.72
109.7 GB	95.47	754.77
109.7 RBHP 2	96.08	755.38

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

Table EA-49. Cross section elevations in transect 2-A of Slough 21, surveyed September 5, 1981.

Station	Elevation	True Elevation
0.0 LBHP 2-A	97.00	756.30
0.0 GB	96.41	755.71
1.0	96.47	755.77
5.0	95.84	755.14
7.0	95.34	754.64
12.0	96.13	755.43
17.0	95.89	755.19
21.0	94.47	753.77
23.0 LWS	---	---
23.0 LWE	93.63	752.93
25.5	93.29	752.59
28.5	93.08	752.39
32.9 RWS	---	---
32.9 RWE	93.54	752.84
41.0	93.69	752.99
43.8	94.35	753.65
46.0	95.12	754.42
54.0	96.57	755.87
63.7	97.53	756.83
63.7 RBHP 2-A	98.04	757.34

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

--- Data not collected

Table EA-50. Cross section elevations in transect 3 of Slough 21, surveyed September 5, 1981

Station	Elevation	True Elevation
0.0 LBHP 3	96.71	756.01
0.0 GB	96.26	755.56
5.5	95.54	754.84
12.0	94.50	753.80
29.0	93.64	752.94
36.0	93.92	753.22
46.0	93.32	752.62
51.0	92.92	752.22
56.7	92.49	751.79
68.5	91.49	750.79
80.0 LWS	---	---
80.0 LWE	90.82	750.12
83.0	90.48	749.78
91.2	89.66	748.96
95.1	89.09	748.39
100.5	88.99	748.29
107.2 RWS	---	---
107.2 RWE	90.82	750.12
110.0	91.99	751.29
113.5	95.85	755.15
115.5 GB	96.07	755.37
115.5 RBHP 3	96.65	755.95

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

--- Data not collected

Table EA-51. Cross section elevations in transect 4 of Slough 21, surveyed September 5, 1981.

Station	Elevation	True Elevation
0.0 LBHP 4	93.94	753.24
0.0 GB	93.49	752.79
3.0	93.54	752.84
9.0	93.08	752.38
12.2	92.23	751.53
16.0	91.54	750.84
25.0 On top of rocks	91.78	751.08
25.0 On the substrate	90.92	750.22
29.8 LWS	---	---
29.8 LWE	90.65	749.95
34.5	90.40	749.70
40.6 Dry	90.70	750.00
46.0	90.64	749.94
48.8	90.37	749.67
51.0	90.47	749.77
53.3 RWS	---	---
53.3 RWE	90.73	750.03
62.0	91.18	750.48
73.5	91.66	750.96
84.0	93.08	752.38
95.6	94.66	753.96
96.7 GB	94.84	754.14
96.7 RBHP 4	95.44	754.74

Provisional mainstem Susitna River discharge recorded at Gold Creek on September 5, 1981 was 16,000 cfs (USGS 1981).

--- Data not collected.

Table EA-52. Cross section elevations in transect 5 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 5	93.20	752.50
0.0 GB	92.92	752.22
4.0	92.61	751.91
5.0	91.77	751.07
7.5	90.51	749.81
10.0	89.77	749.07
13.3 LWS	---	---
13.3 LWE	89.04	748.34
19.0	88.54	747.84
21.9	88.45	747.75
26.3	88.77	748.07
29.4	88.91	748.21
31.0 Dry	89.06	748.36
36.0	88.81	748.11
38.0	88.70	748.00
42.0	88.90	748.20
45.6	88.84	748.14
51.4 RWS	---	---
51.4 RWE	88.97	748.27
56.0	89.94	749.24
61.0	90.88	750.18
66.7	91.47	750.77
68.7	97.77	757.07
70.7	91.36	750.66
75.0	91.47	750.77
78.2 GB	92.13	751.43
78.2 RBHP 5	92.57	751.87

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-53. Cross section elevations in transect 5-A of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 5-A	92.58	751.88
0.0 GB	92.14	751.44
3.0	91.94	751.24
6.0	91.54	750.84
8.0	90.98	750.28
14.4	91.09	750.39
19.0	90.34	749.64
23.5	90.45	749.75
27.0	89.04	748.34
32.4 LWS	---	---
32.4 LWE	88.32	747.62
36.0	87.12	746.42
39.0	86.85	746.15
41.2	87.29	746.59
43.9 RWS	---	---
43.9 RWE	88.33	747.63
45.4	90.93	750.23
47.0	91.77	751.07
49.5	92.81	752.11
51.8 GB	93.16	752.46
51.8 RBHP 5-A	93.68	752.98

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-54. Cross section elevations in transect 6 of Slough 21, surveyed August 25, 1981.

Station		Elevation	True Elevations
0.0	LBHP 6	92.90	752.20
0.0	GB	92.10	751.40
7.0		92.03	751.33
12.0		91.69	750.99
20.0		90.73	750.03
29.0		89.95	749.25
36.0		89.18	748.48
46.0		89.34	748.64
56.0		89.18	748.48
64.0		88.44	747.74
69.0	LWS	---	---
69.0	LWE	88.18	747.48
73.0		87.84	747.14
76.0		87.88	747.18
79.0		87.78	747.08
83.0	lg. pile of rocks	87.76	747.06
86.0		87.83	747.13
90.0		87.92	747.22
92.3	RWS	88.13	747.43
92.3	RWE	87.84	747.14
95.5		90.19	749.49
98.0		91.18	750.48
99.0		91.92	751.22
100.2	GB	92.18	751.48
100.2	RBHP 6	92.55	751.85

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-55. Cross section elevations in transect 7 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 7	93.47	752.77
0.0 GB	93.04	752.34
5.0	92.54	751.84
8.0	91.39	750.69
14.0	88.48	747.78
16.0	88.37	747.67
17.5	88.49	747.79
22.2	90.05	749.35
27.0	90.83	750.13
35.0	91.11	750.41
54.5	90.45	749.75
62.0	90.44	749.74
75.0	89.65	748.95
89.6 LWS	---	---
89.6 LWE	87.77	747.07
94.0	87.17	746.47
98.5	87.02	746.32
103.0	87.02	746.32
104.0	87.13	746.43
105.0	87.11	746.41
107.0	87.23	746.53
109.5	87.09	746.39
114.3 RWS	---	---
114.3 RWE	87.73	747.03
119.0	89.35	748.65
119.7	91.98	751.28
124.5	95.52	754.82
126.1 GB	92.78	752.08
126.1 RBHP 7	93.37	752.67

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-56. Cross section elevations in transect 8 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 8	93.00	752.30
0.0 GB	92.57	751.87
5.5	91.66	750.96
7.0	90.21	749.51
12.5	88.42	747.72
26.0	87.77	747.07
30.0*	87.19	746.49
39.3 LWS	---	---
39.3 LWE	86.86	746.16
43.0	86.60	745.90
49.0	86.23	745.53
55.0	86.44	745.74
59.5	86.45	745.75
66.5	86.39	745.69
72.5	86.28	745.58
79.4 RWS	---	---
79.4 RWE	86.86	746.16
81.5	87.35	746.65
83.0	90.38	749.68
86.4 GB	90.92	750.22
86.4 RBHP 8	91.45	750.75

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

* Intragravel water was observed at this location.

--- Data not collected.

Table EA-57. Cross section elevations in transect 9 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 9	93.03	752.33
0.0 GB	92.60	751.90
5.0	91.96	751.26
7.0	89.72	749.02
11.0	89.67	748.97
17.0	89.40	748.70
28.0	86.59	745.89
40.1 LWS	---	---
40.1 LWE	86.07	745.37
47.0	85.91	745.21
56.0	85.78	745.08
65.0 Dry	86.07	745.37
72.5 Dry	85.99	745.29
78.0	85.65	744.95
84.0	85.51	744.81
87.0	85.64	744.94
89.0	85.66	744.96
92.6 RWS	---	---
92.6 RWE	85.91	745.21
95.1	85.99	745.29
98.0	87.74	747.04
102.5	91.92	751.22
105.4 GB	91.93	751.23
105.4 RBHP 9	92.36	751.66

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-58. Cross section elevations in transect 10 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 10	93.23	752.53
0.0 GB	92.72	752.02
6.0	90.36	749.66
11.0	88.66	747.96
15.0	88.45	747.75
20.0	86.54	745.84
22.6 LWS (Small Channel)	---	---
22.6 LWE (Small Channel)	86.38	745.68
25.7 RWS (Small Channel)	---	---
25.7 RWE (Small Channel)	86.37	745.67
35.0	86.64	745.94
60.0	86.40	745.70
82.4 LWS	---	---
82.4 LWE	85.58	744.88
95.0	85.06	744.36
97.0	84.81	744.11
98.0	85.09	744.39
99.4	84.88	744.18
105.8 RWS	---	---
105.8 RWE	85.60	744.90
109.0	86.34	745.64
113.5	91.81	751.11
116.1 GB	91.94	751.24
116.1 RBHP 10	92.28	751.58

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected

Table EA-59. Cross section elevations in transect 11 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 11	91.68	750.98
0.0 GB	91.25	750.55
3.0	90.99	750.29
4.0	89.74	749.04
5.5	89.28	748.58
7.5	89.55	748.85
15.0	88.26	747.56
17.5	87.19	746.49
19.1 LWS	---	---
19.1 LWE	85.89	745.19
21.0	85.76	745.06
24.5 RWS	---	---
24.5 RWE	85.88	745.18
28.4	85.95	745.25
32.0	87.82	747.12
36.0	88.59	747.89
38.9	88.38	747.68
40.6	85.69	744.99
42.5 LWS	---	---
42.5 LWE	85.58	744.88
Staff gage	87.75	747.05
43.5	84.55	743.85
47.0	84.79	744.09
51.0	86.02	745.32
53.0	85.26	744.56
64.0	85.23	744.53
73.0	85.13	744.45
79.0	85.25	744.55
93.0	85.59	744.89
100.0	85.47	744.77
104.3 RWS	---	---
104.3 RWE	85.55	744.85
108.0	90.18	749.48
111.0	91.41	750.71
112.2 GB	91.64	750.94
112.2 RBHP 11	92.08	751.38

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-60. Cross section elevations in transect 12 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 12	91.94	751.24
0.0 GB	91.60	750.90
3.0	91.26	750.56
6.5	88.42	747.72
17.0	89.27	748.57
11.5	88.06	747.36
27.5	88.88	748.18
32.5	88.14	747.44
40.0	88.82	748.12
43.5	88.36	747.66
47.0 LWS	---	---
47.0 LWE	85.40	744.70
49.5	84.14	743.44
54.5	84.46	743.76
72.0	84.70	744.00
79.0	84.87	744.17
92.0	84.60	743.90
103.5	84.74	744.04
108.6 RWS	---	---
108.6 RWE	85.43	744.73
115.0	91.42	750.72
117.4 GB	91.85	751.15
117.4 RBHP 12	92.22	751.52

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.

Table EA-61. Cross section elevations in transect 13 of Slough 21, surveyed August 25, 1981.

Station	Elevation	True Elevation
0.0 LBHP 13	91.15	750.45
0.0 GB	90.78	750.08
2.0	90.74	750.04
7.0	86.72	746.02
13.5	85.77	745.07
20.0	86.42	745.75
42.0	85.78	745.08
66.0	86.21	745.51
82.0	86.41	745.71
86.2 LWS	---	---
86.2 LWE	85.43	744.73
94.0	83.85	743.15
108.5	84.14	743.44
120.0	84.80	744.10
127.5	84.18	743.48
134.5	84.97	744.27
134.7 RWS	---	---
134.7 RWE	85.43	744.73
138.0	91.47	750.77
141.5 GB	91.66	750.96
141.5 RBHP 13	92.00	751.30

Provisional mainstem Susitna River discharge recorded at Gold Creek on August 25, 1981 was 28,600 cfs (USGS 1981).

--- Data not collected.