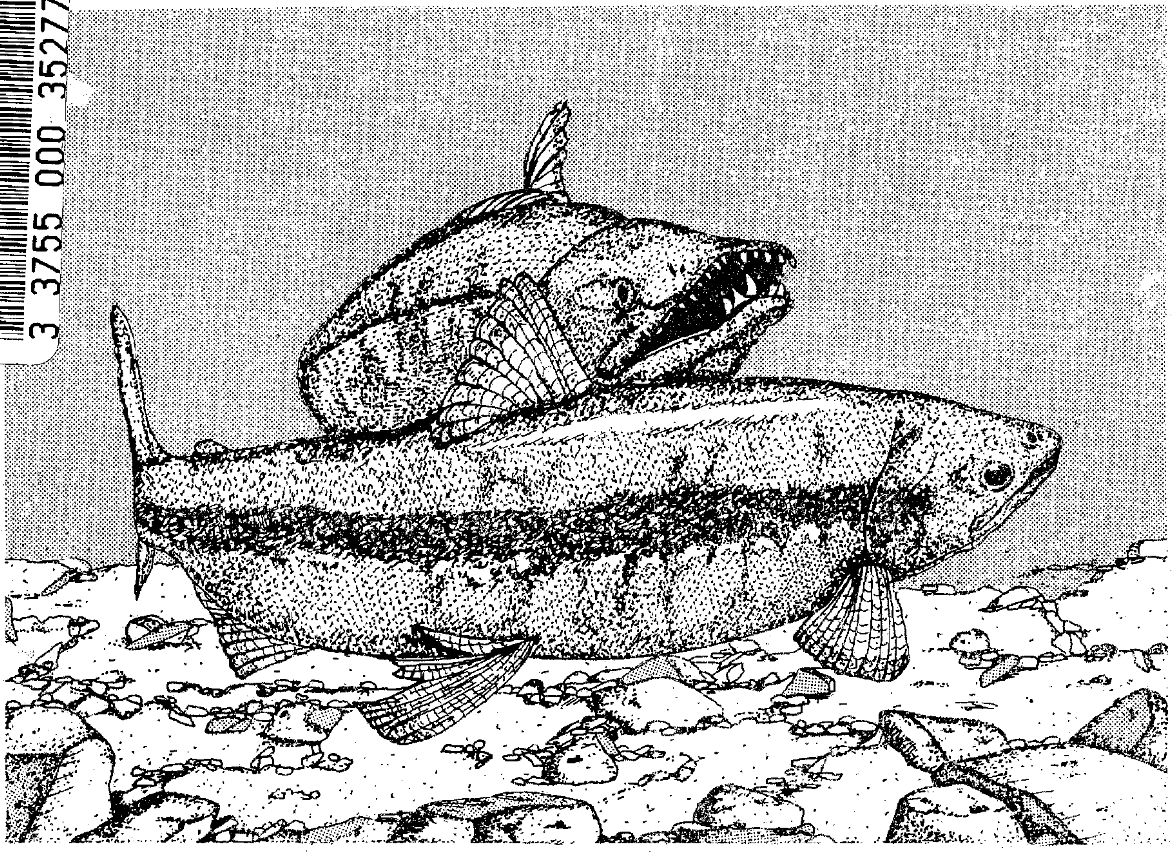

ADF&G Su Hydro Aquatic Studies
May 1983 - June 1984

Procedures Manual
Final Draft

February 2, 1984
Alaska Power Authority
Susitna Hydroelectric Project

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Procedures Manual
Final Draft

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Appendices

1. Instructions for completing Juvenile Anadromous Habitat Study (JAHS) sampling forms and field data notes.
2. Operational procedures for the Epson HX-20 microcomputer data form program.

AQUATIC HABITAT AND INSTREAM FLOW PROJECT

Appendicies

1. Outline describing flow chart for salmon spawning habitat evaluation.

2. Revisions to the operation and maintenance instructions, Hydrolab Digital 4041.

ANADROMOUS ADULT FISHERIES PROJECT

1.0 INTRODUCTION

The Susitna River, a major Southcentral Alaska river system, flows into Cook Inlet near the city of Anchorage. The drainage encompasses an area of 19,600 square miles and extends north of Mt. McKinley and east almost to the town of Glennallen. The mainstem river and its major tributaries are of glacial origin and carry a heavy silt load during ice-free months. Many of the smaller tributaries are perennially silt-free.

Construction of hydroelectric dams will affect portions of the fish and wildlife resources of the Susitna River Basin. The two dam system proposed would inundate approximately 45,800 acres of aquatic and terrestrial habitat upstream of Devil Canyon. Historically, the long and short term environmental impacts of hydroelectric dams have adversely altered the sport and commerical fisheries of affected drainages (Hagen et al., 1973 Keller, 1980). Regulation of the mainstem river will substantially alter the natural flow regime downstream. The transmission line corridor, substations, road corridor and construction pad sites will also impact aquatic and terrestrial communities and their habitat.

The proposed hydroelectric development necessitates gaining a substantial knowledge of its chemical, physical and biological parameters prior to final dam design approval and construction authorization.

To insure adequate information is available to determine the impacts of the proposed hydroelectric project and to design proper mitigative strategies, a data collection program has been developed. This manual addresses field sampling procedures to be conducted within the proposed study area in fiscal year 1984 (FY84).

2.0 EULACHON

2.1 Objectives

1. Determine the timing, upper limit of migration and relative abundance of eulachon spawning runs.

2. Define the age, length, weight and sex composition of eulachon spawning runs.

3. Define where eulachon spawning occurs and identify basic habitat parameters associated with spawning areas.

2.2 Technical Procedures

2.2.1 Operation Period and Survey Reach

Field operations will begin immediately following ice-out in the Susitna River estuary (May 10, approximately) and terminate at the completion of spawning (June 8, approximately).

Investigations will extend from RM 4 in the estuary to beyond the upper spawning limits to approximately river mile (RM) 60.

2.2.2 Methods

2.2.2.1 Estuary Sampling

A standard sinking gill net measuring five feet wide, 25 feet long with a 1.5 inch stretch mesh will be fished at Site III and II (1982) according to the following schedule.

1. Every daylight high tide from the first day of sampling (May 10, approximately) to the first day the Susitna River main channel is navigable between the estuary and the Kashwitna River (RM 60).

2. Every fourth high tide thereafter for the next seven days.

3. Every fifth high tide thereafter for the duration of the season or June 8, whichever occurs last. The close of season is defined as when on two consecutive fishing days the average catch is less than 0.1 immigrants (pre-spawners and spawners) per net minute fished.

Gill netting will be conducted only during daylight hours. If the fourth or fifth sampling schedule occurs during a non-light period, the preceding high tide will be considered the frequency end and fished accordingly.

Two categories of eulachon catch will be recorded: (1) pre-spawners and spawners, and (2) post-spawners. Pre-spawners are defined as gravid and post-spawners as essentially void of eggs or milt (spawned out). Spawners are fish which are freely releasing eggs or milt without being palpitated.

The two set net locations will be fished independently and respectively in the same order. Set net sites III (RM 2.3) and II (RM 4.5) (1982) will be fished 30 minutes each starting at:

Site III - 45 minutes prior to high tide.

Site II - 15 minutes following high tide.

At sites III and II fishing time will be monitored to the nearest minute. Fishing time may be less than 30 minutes at a site when an observation indicates a 200 plus eulachon catch. Daily tides in the Susitna River estuary are determined by applying a minus 36 minute correction factor to the 1983 high tide tables for the Anchorage District (U.S. Coast Guard, 1982).

In conjunction with set net operations, a hand held dip net will be used to collect 10 pre-spawning eulachon per sex from set net site II for age (two otoliths per fish), weight (0.1 g) and length (tip of mouth to fork of tail to the nearest millimeter) data. Dip netting is to be conducted prior to or after completion of set netting at site II. Minimum effort expended to collect the 10 samples per sex is to be 0.5 dip net hours (hrs.) and the maximum 1.0 hrs. Otolith collection procedures will be demonstrated in the field by the Adult Anadromous (AA) Project Leader.

All pre-spawning eulachon caught by dip netting at site II are to be sexed. Determination of sex will be by morphological examination and when necessary by palpitation of the abdominal region.

2.2.2.2 Main Channel Sampling

Main Channel investigations are composed of three sampling schemes and schedules:

1. Spawning Habitat - The primary objective of main channel sampling is to define where eulachon spawn. An average of three or more hours per day is to be spent surveying the main channel for eulachon spawning when the sample crew is not involved in set net related duties in the estuary. An electroshocking boat and hand held dip net gear will be used to sample for spawning locations. Specific operation and safety procedures on the electroshocking gear are outlined in Appendix V. Spawning areas will be considered those which meet the following criteria: a single sampling of a site produces at least 25 eulachon with at least two spawning condition females, or one pre-spawning and one spawning condition female or one spawning and one post-spawning condition female in addition to male eulachon, all in a vigorous free-swimming condition.

2. Periodicity - Once ever five days the study reach will be sampled at two mile minimum intervals for eulachon presence. Hand held dip nets and electroshocking gear will be used to sample for eulachon

presence. Data recorded per location will include gear method, date and number of pre-spawning, spawning and post-spawing condition eulachon by sex.

3. Age, weight and length (AWL) - Once every three days with electroshocking and dip net gear 10 pre-spawning eulachon per sex are to be collected for age, length and weight analysis. The minimum sampling effort is to be 2.0 hours per sampling day.

Set netting, AWL, sex composition and periodicity data will be recorded as defined on the appropriate forms (2.3 Data Procedures) and transmitted to the Anchorage office at the end of the eulachon season. All data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

2.3 Data Procedures

Set netting results will be recorded on the Estuary Set Net Log (Table 1). Recorded data will include date, site location, fishing time and catch by species with eulachon recorded into one of two categories: (a) pre-spawners and spawners and (b) post-spawners.

Age, length and weight data will be recorded on the Eulachon AWL Log (Table 2) and age samples consisting of two otoliths per fish will be stored in labeled vials with corresponding sample and subsample numbers and date to reference specific data entries on the Eulachon AWL Log.

Sex composition data will be recorded on the Eulachon Sex Composition Log (Table 3) and will include the date, location, number of fish by sex, collectors name, and collection method and effort.

The presence of eulachon in the main channel will be recorded on the Eulachon Periodicity Log (Table 4). Information recorded will include sampling date, location, method, eulachon numbers by spawning condition and sex, and water temperature.

Spawning areas will be logged on the Eulachon Spawning Log (Table 5). Information recorded shall include date, location, water temperature, depth and velocity as referenced in the data form.

Table 1.

Page ____ of ____

AA-83-25
EULACHON
ESTUARY SET NET LOG

Site 1 ___/___/___/___/___/___

Site 2 ___/___/___/___/___/___

Date	Site No. 1/ and River Mile	Tide		Fishing Time 2/			Catch			Comments
				Net		Total (min)	Eulachon 3/			
		Ht.	Time	In	Out		Pre-spawn and Spawners	Post Spawners	Other 4/	

1/ Recorded river mile to nearest 0.1 mile.
2/ Military time.
3/ Pre-spawners and spawners into one category.
4/ Identify species in comment section.
5/ Include collector(s) name.

Table 2.

COLLECTION:

AA-83-23
EULACHON
AWL LOG

Sample No: ________

Date ___/___/83
Location
(RM) ________
Method ________

Collector(s): ________________

____

No.	Species	Sex M	Sex F	Length 1/	Weight 2/	Age Class	Comments
1	511						
2	511						
3	511						
5	511						
6	511						
7	511						
8	511						
9	511						
10	511						
11	511						
12	511						
13	511						
14	511						
15	511						
16	511						
17	511						
18	511						
19	511						
20	511						

Age Samples: Date read ___/___/83

By whom ________

1/ Record length from snout tip to fork-of-tail to nearest mm.

2/ Record to nearest 0.1 gram.

Table 3.

Page ___ of ___

AA-83-08
EULACHON
SEX COMPOSIITON LOG

Date	Location 1/ (River Mile)	Sample Method	Number of Pre-spawners		Comments 2/
			Male	Female	

1/ Define to nearest 0.1 river mile.

2/ Include collector name(s) and measure of effort (i.e., 50 dip nets).

Table 4.

Page ___ of ___

AA-83-24
EULACHON
PERIODICITY

Date	Location 1/ (River Mile)	Sample Method	Number Sampled						Comments 2/
			Male			Female			
			Pre	Spawning	Post	Pre	Spawning	Post	

1/ Define to nearest 0.1 river mile.

2/ Include collector name(s).

Table 5.

Page ___ of ___

AA-83-26
EULACHON
SPAWNING LOG 1/

Date	Spawning Location		Water 2/			Substrate 3/ Type	Eulachon Catch Number				Comments 4/
							Male	Female			
	River Mile	Geographic Code	Temperature	Depth	Velocity			Pre	Spawning	Post	

1/ Complete form when a sample of 25 eulachon produces at least one pre-spawning condition female and one post-spawning or spawning condition female in addition to male eulachon which are in vigorous free swimming condition.

2/ Temperature to nearest 0.1°C, depth to nearest 10 cm, and surface velocity to nearest 0.5 ft/sec.

3/ Substrate types: organic matter [detritus], silt [very fine], sand [fine], gravel [¼" - 3"], rubble [3" - 6"], cobble [5" - 10"].

4/ Include general habitat description, gear, and name of collector(s).

3.0 ADULT SALMON

3.1 Objectives

Adult Salmon

1. Determine the magnitude and timing of the sockeye, pink, chum and coho salmon escapements in the Susitna and Yentna rivers at Yentna Station (YRM 4), Sunshine Station (RM 80), Talkeetna Station (RM 103) and Curry Station (RM 120).

2. Determine the magnitude and timing of the chinook salmon escapement in the Susitna River at Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations.

3. Define the age, length, sex composition and migrational characteristics of sockeye, pink, chum and coho salmon in the Susitna and Yentna rivers at Yentna (YRM 4), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. In addition, evaluate the same parameters for chinook salmon at Sunshine, Talkeetna and Curry stations.

4. Define where and when and to what level chinook, sockeye, pink, chum and coho salmon spawn in stream and slough habitats in the Susitna River drainage above RM 98.6.

5. Determine the average stream or spawning life of sockeye and chum salmon in slough habitats as necessary to define total escapements into slough habitats.

3.2 Technical Procedures

3.2.1 Main Channel Sampling

3.2.1.1 Operation Periods

Field operations using side scan sonar (SSS) counters and tag/recapture fishwheels will begin and end on the following dates by station:

Yentna Station (YRM 4)	July 1 to September 5
Sunshine Station (RM 80)	June 4 to September 10
Talkeetna Station (RM 103)	June 7 to September 12
Curry Station (RM 120)	June 10 to September 14

3.2.1.2 Methods

3.2.1.2.1 Sonar and Tag/Recapture

At Yentna Station (YRM 4) two SSS counters will be deployed, one off the north bank and the other off the south bank at the locations defined in Figure 1. The counters will be operated consistent with procedures specified in the 1980 Side Scan Sonar Counter Installation and Operation Manual, Bendix Corporation (Appendix I).

Counter accuracy at Yentna Station (YRM 4) will be monitored four or more times daily by hand tallying fish related echos displayed on an oscilloscope (Appendix II). The ratio of visual counts to SSS counts will be used to adjust the counter as defined in the above cited manual.

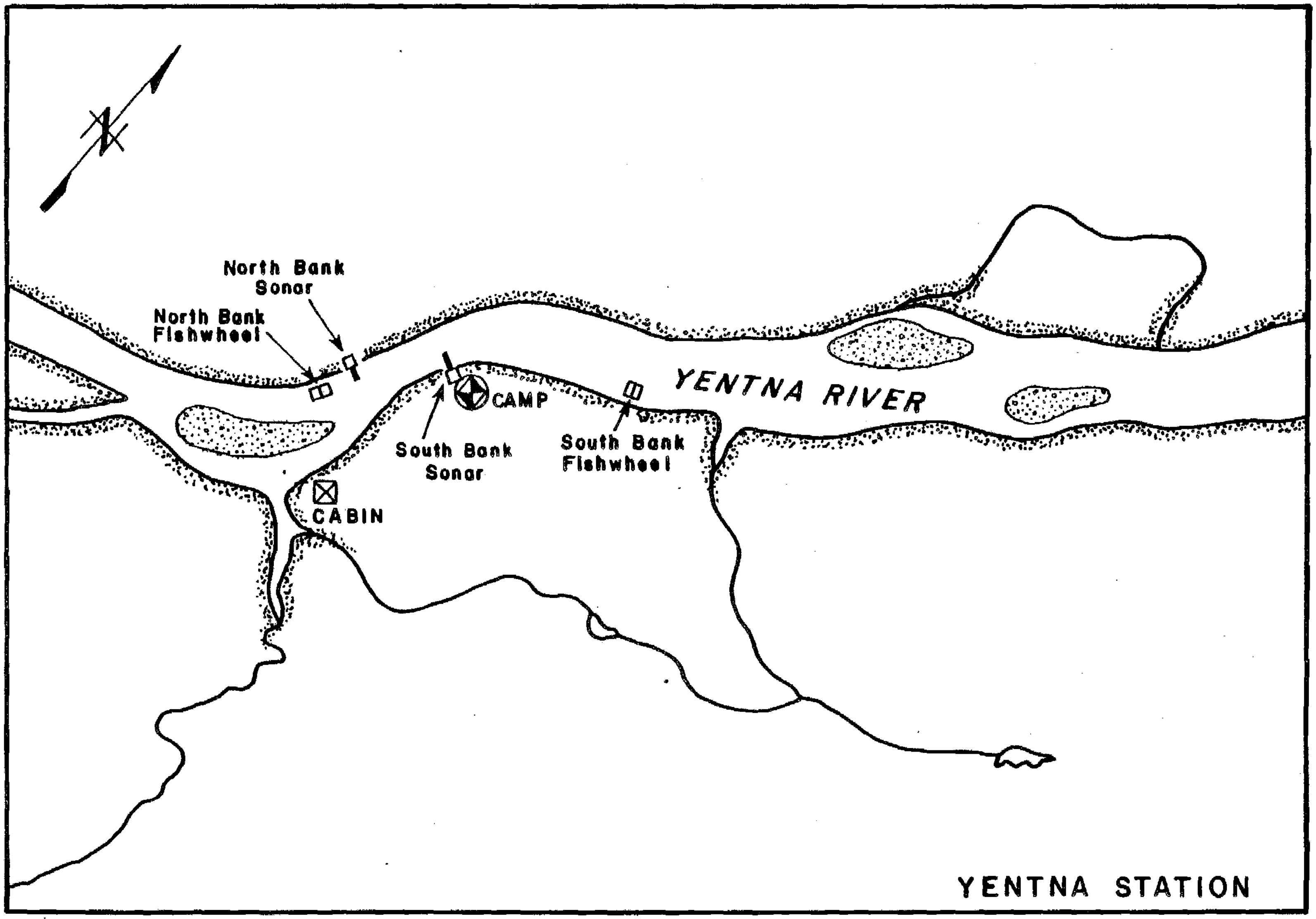

Figure 1. Yentna station with fishwheel and sonar locations defined.

Two fishwheels will be operated daily at Yentna Station (YRM 4), one in the immediate vicinity of each SSS counters. These fishwheels will be used to provide species composition data to apportion the SSS counts.

At Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations fishwheels will be operated for tag and recapture purposes at locations identified in Figures 2 through 4. Two fishwheels will be deployed on each side of the Susitna River at Sunshine and Talkeetna stations. At Curry Station, a single fishwheel will be operated offshore of each bank. Fishwheel design is described in the Phase I ADF&G/Su Hydro Adult Anadromous Report (1981) and fishwheel operation in Appendix III. Each fishwheel will be operated 24 hours per day, and sampled for catch and checked for maintenance needs five or more times daily.

All adult salmon caught with fishwheels at Sunshine (RM 80), Talkeetna (RM 130) and Curry (RM 120) stations will be tagged and released except those fish which appear lethargic, stressed or are smaller than 351 mm in fork length (FL). These fish will be released without being tagged. Procedures for tagging fish are defined in Appendix IV. The type of tags and colors that are to be used at Sunshine, Talkeetna and Curry stations are defined below:

	Tag	
Sunshine Station	Type	Color
Chinook Salmon	1" dia. Petersen Disc	White-red
Sockeye Salmon	FT-4 Spaghetti	Pink
Pink Salmon	FT-4 Spaghetti	Pink
Chum Salmon	FT-4 Spaghetti	Pink
Coho Salmon	FT-4 Spaghetti	Pink

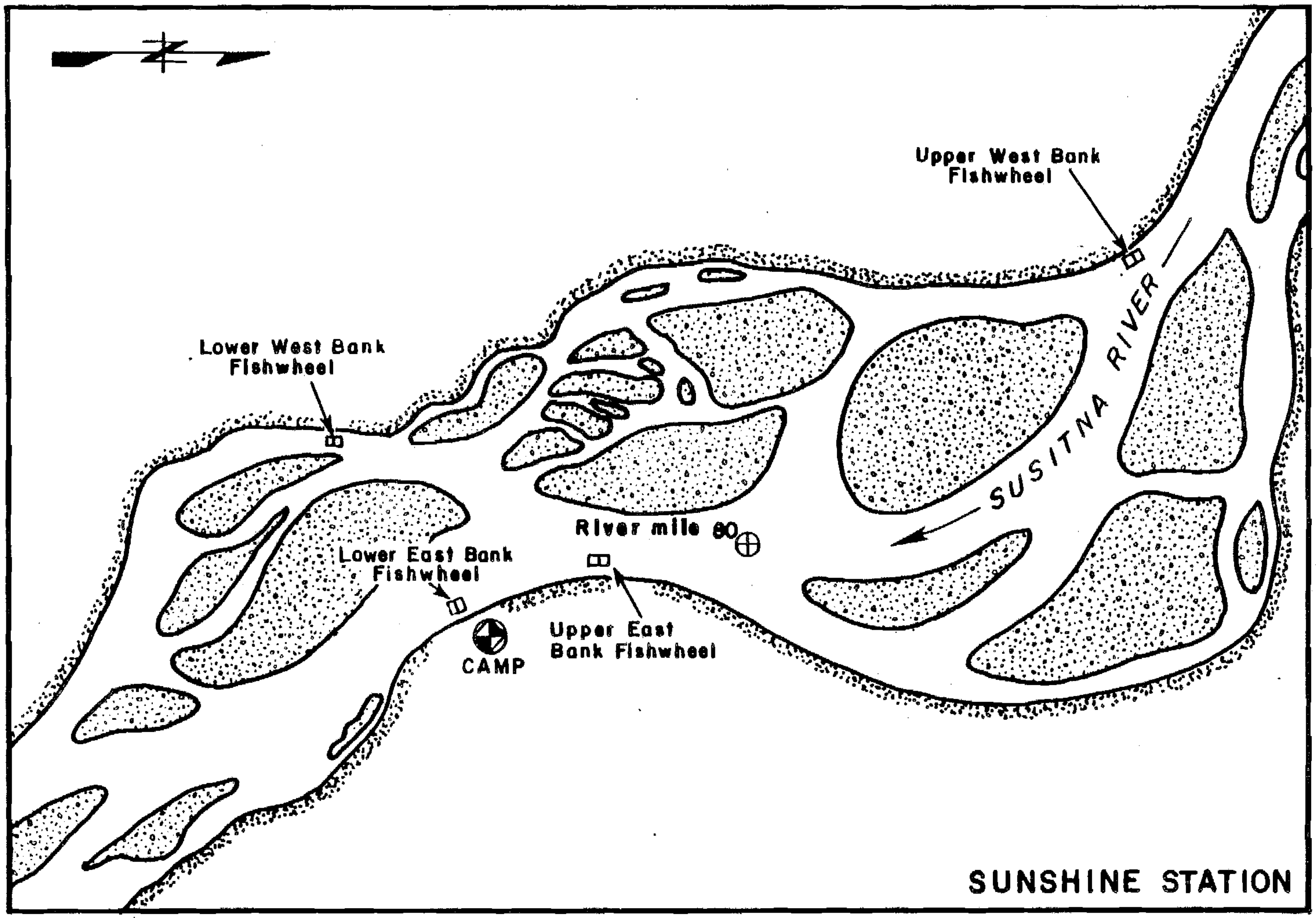

Figure 2. Sunshine station with fishwheel locations defined.

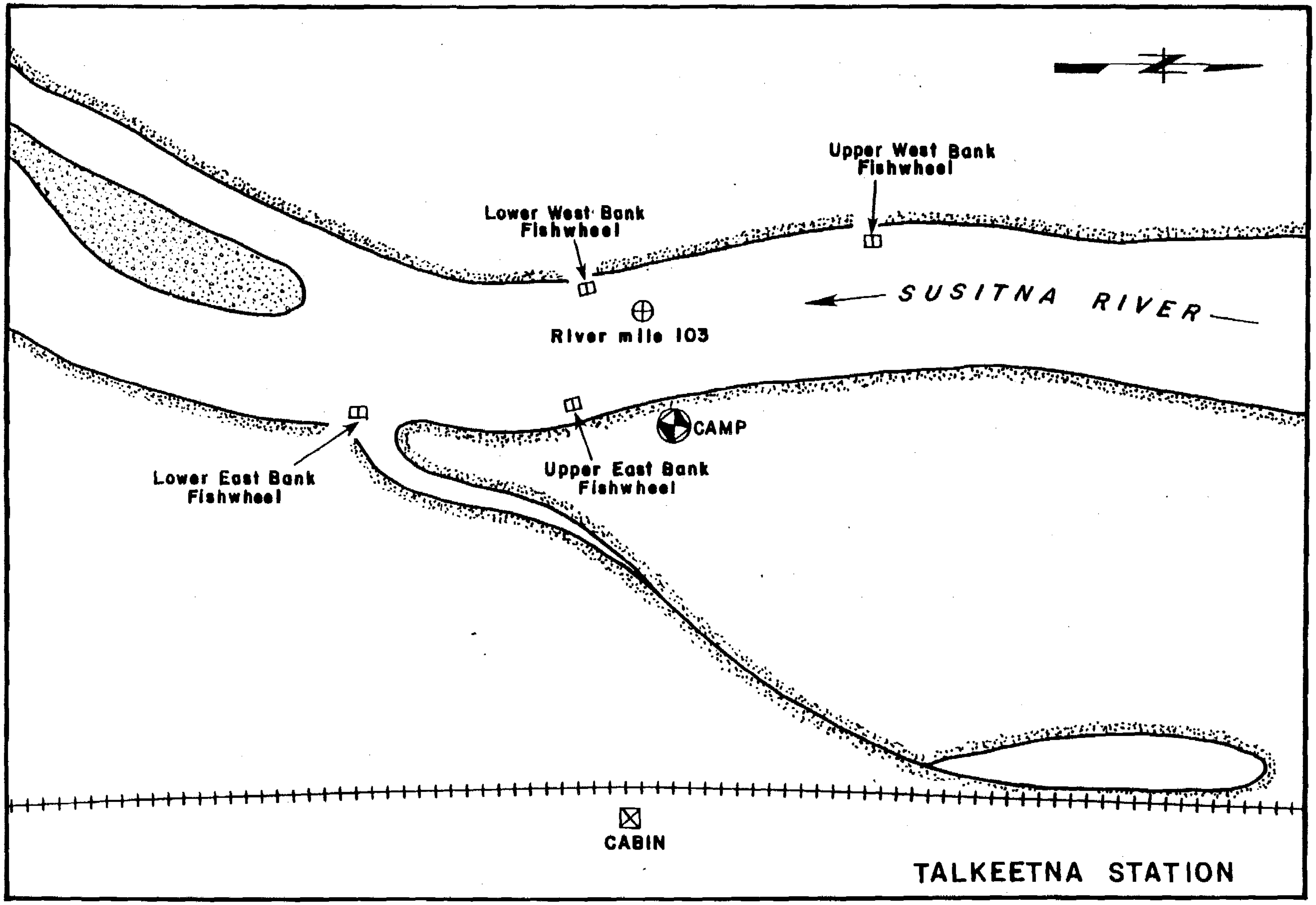

Figure 3. Talkeetna station with fishwheel locations defined.

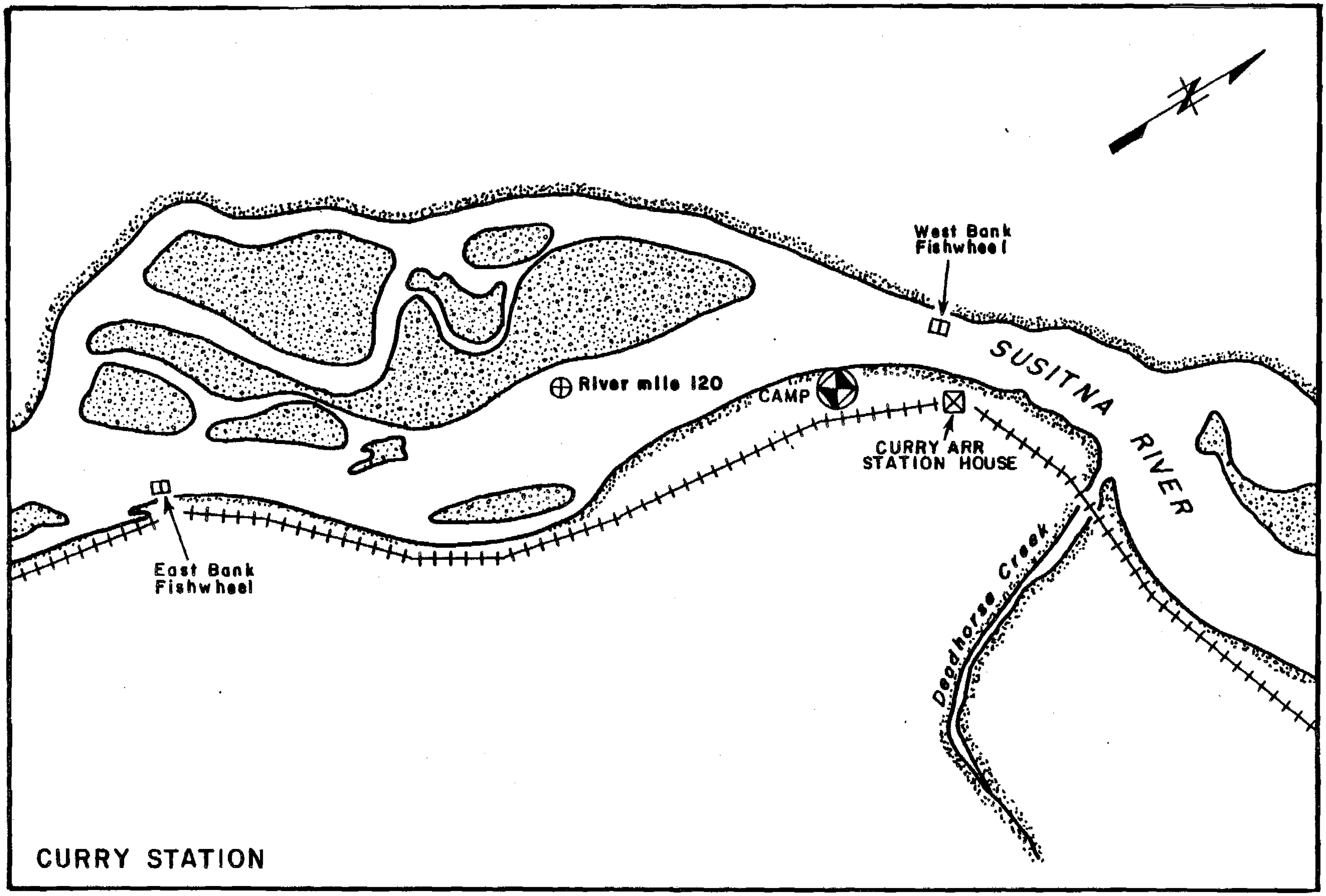

Figure 4. Curry station with fishwheel locations defined.

	Tag	
Talkeetna Station	Type	Color
Chinook Salmon	1" dia. Petersen Disc	Green
Sockeye Salmon	FT-4 Spaghetti	Blue
Pink Salmon	FT-4 Spaghetti	Blue
Chum Salmon	FT-4 Spaghetti	Blue
Coho Salmon	FT-4 Spaghetti	Blue
Curry Station		
Chinook Salmon	1" dia. Petersen Disc	Orange
Sockeye Salmon	1" dia. Petersen Disc 1/	Orange
Pink Salmon	1" dia. Petersen Disc	Orange
Chum Salmon	1" dia. Petersen Disc 1/	Orange
Coho Salmon	1" dia. Petersen Disc	Orange

1/ Exclusive use of large numbered disc tags for marking chum and sockeye salmon at Curry Station.

Fish which are recaptured from other tagging locations are to be released with the original tag in place following species identification and recording of tag type, color and number (3.3Data Procedures). All non-salmon catches will be identified to species and released.

Completed fishwheel catch forms, sonar form; and tag deployment and recapture data will be transmitted to the Anchorage office every three weeks from Yentna (YRM 4), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. All data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

3.2.1.2.2 Age/Length/Sex Composition Sampling:

At Yentna (YRM 4), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations age, length and sex data (3.3 Data Procedures) will be collected daily for each species as follows:

Chinook Salmon:	Age, sex and length samples from 60 consecutively caught fish.
Sockeye Salmon:	Age, sex and length samples daily from 30 consecutively caught fish.
Chum Salmon:	Age, length and sex samples daily from 20 consecutively caught fish.
Coho Salmon:	Age, length and sex samples daily from 20 consecutively caught fish.
Pink Salmon:	Length and sex samples daily from 30 consecutively caught fish.

Age, length and sex composition data will be forwarded to the Anchorage office every three weeks from Yentna (YRM 4), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations.

3.2.2 Stream and Slough Surveys

3.2.2.1 Operation Period and Survey Reach

Escapement surveys will be conducted from July 25 to October 7. Between July 25 and August 7, two chinook spawning surveys of Lane Creek (RM 113.6), Fourth of July Creek (RM 131.1), Gold Creek (RM 136.7), Indian River (RM 138.9), Portage Creek (RM 148.6), Cheechako Creek (RM 152.4), Chinook Creek (RM 157.0) and Devil Creek (RM 161.0) will be conducted no less than seven days apart (Table 6). Additionally, between July 25 and August 7 tag recovery surveys will be conducted in field selected reaches of Prairie Creek (RM 97.1), Clear Creek (RM 97.1), Chulitna River (RM 97.8), Indian River (RM 138.6) and Portage Creek (RM 148.9) (Table 7).

Between August 8 and October 7 all streams and sloughs of known and suspected adult salmon use from RM 98.6 to 161.0 will be surveyed as close to weekly as possible. The sloughs will be surveyed in their entirety and streams to a standard index limit or the upper spawning limit as defined in Table 8.

3.2.2.2 Methods

All spawning ground and tag recovery surveys will be conducted by trained observers. The slough habitats will be surveyed on foot in their entirety. Stream habitats will be surveyed by a combination of foot and helicopter travel as defined in Tables 6-8. During each survey, observers will wear polarized glasses and use hand-held tally counters to record live tagged and untagged adult salmon and carcasses. Survey data will be recorded on the appropriate forms (3.3 Data Procedures) and transmitted to the Anchorage office once every three weeks. The data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

Table 6. Chinook salmon escapement survey schedule.

Stream	RM 1/	Survey Period	Survey Frequency 2/	Survey Method	Survey Distance 3/
Chase Creek	106.9	7/25-8/7	Once	Foot	1 Mile
Lane Creek	113.6	7/25-8/7	Twice	Foot	Upper Spawning Limit
Fifth of July Cr.	123.7	7/25-8/7	Twice	Foot	Upper Spawning Limit
Sherman Creek	130.8	7/25-8/7	Twice	Foot	Upper Spawning Limit
Fourth of July Cr.	131.1	7/25-8/7	Twice	Foot	Upper Spawning Limit
Gold Creek	136.7	7/25-8/7	Twice	Foot or hel.	Upper Spawning Limit
Indian River	138.9	7/25-8/7	Twice	Helicopter	Upper Spawning Limit
Portage Creek	148.9	7/25-8/7	Twice	Helicopter	Upper Spawning Limit
Cheechako Creek	152.4	7/25-8/7	Twice	Helicopter	Upper Spawning Limit
Chinook Creek	157.0	7/25-8/7	Twice	Helicopter	Upper Spawning Limit
Devil Creek	161.0	7/25-8/7	Twice	Helicopter	Upper Spawning Limit

1/ RM = River Mile

2/ Conduct surveys no less than seven days apart under notation of 'twice.'

3/ Distance either expressed in standard distance to be surveyed from mouth or to upper spawning limit.

Table 7. Specific chinook salmon tag recovery survey schedule.

Stream	RM 1/	Survey Period	Survey Frequency	Survey Method	Survey Distance
Prairie Creek	97.1	7/25-8/7	Once min.	Foot	Field Selected
Clear Creek	97.1	7/25-8/7	Once min.	Foot	Field Selected
Chulitna River	97.8	7/25-8/7	Once min.	Foot	Field Selected
Indian River	138.9	7/25-8/7	Twice	Foot	Field Selected
Portage Creek	148.9	7/25-8/7	Twice	Foot	Field Selected

1/ RM = River Mile.

Table 8. General salmon escapement survey schedule.

Stream	RM 1/	Survey Period	Frequency	Method	Distance
Birch Creek	88.4	8/10-25	Once	Foot	Field Selected
		9/15-28	Once	Foot	Field Selected
Answer Creek	84.1	9/15-28	Once	Foot	Field Selected
Question Creek	84.1	9/15-25	Once	Foot	Field Selected
Fish Creek	97.1	8/10-25	Twice	Foot	Field Selected
Byers Creek	97.8	8/10-15	Once	Foot	Field Selected
Troublesome Creek	97.8	9/5-15	Once	Foot	Field Selected
Swan Lake	97.8	9/5-20	Once	Foot	Field Selected
All Sloughs	98.6-161.0	8/8-10/7	Weekly	Foot	Entire
Whiskers Creek	101.4	8/8-10/7	Weekly	Foot	0.5
Chase Creek	106.4	8/8-10/7	Weekly	Foot	0.75
Slash Creek	106.9	8/8-10/7	Weekly	Foot	0.25
Gash Creek	111.6	8/8-10/7	Weekly	Foot	1.0
Lane Creek	113.6	8/8-10/7	Weekly	Foot	0.5
Lower McKenzie Cr.	116.2	8/8-10/7	Weekly	Foot	0.25
McKenzie Creek	116.7	8/8-10/7	Weekly	Foot	0.25
Little Portage Cr.	117.7	8/8-10/7	Weekly	Foot	0.25
Dead Horse Creek	120.9	8/8-10/7	Weekly	Foot	0.25
Fifth of July Cr.	123.7	8/8-10/7	Weekly	Foot	0.25
Skull Creek	124.7	8/8-10/7	Weekly	Foot	0.25
Sherman Creek	130.8	8/8-10/7	Weekly	Foot	0.25
Fourth of July Cr.	131.1	8/8-10/7	Weekly	Foot	0.25
Gold Creek	136.7	8/8-10/7	Weekly	Foot	0.25
Indian River	138.6	8/8-10/7	Weekly	Foot	1.0
	138.6	8/8-10/7	Weekly	Heli.	Upper Spawning Limit
Jack Long Creek	144.5	8/8-10/7	Weekly	Foot	0.25
Portage Creek	148.9	8/8-10/7	Weekly	Foot	0.25
	148.9	8/8-10/7	Weekly	Heli.	Upper Spawning Limit
Cheechako Creek	152.4	8/8-10/7	Weekly	Heli.	1.0
Chinook Creek	157.0	8/8-10/7	Weekly	Heli.	1.5
Devil Creek	161.0	8/8-10/7	Weekly	Heli.	1.0

1/ RM = River Mile

3.2.3 Stream Life

3.2.3.1 Operation Period and Survey Reach

Investigations will extend from August 16 to freeze-up (approximately October 15) and will be conducted by a crew based at Curry Station (RM 120). Areas surveyed will be sloughs 11, 9, 8A and Moose.

3.2.3.2 Methods

Beginning August 16, sloughs 11, 9, 8A and Moose will be surveyed on foot approximately every third day for sockeye and chum salmon that were tagged at Curry Station (RM 120). Fish will be individually identified by orange, one inch Petersen discs bearing full size identification numbers. Surveyors will wear polaroid glasses, use polaroid binoculars and record observation as outlined in Section III Data Procedures.

Survey data will be forwarded to the Anchorage office every three weeks. The data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

3.3 Data Procedures

3.3.1 Side Scan Sonar Operations

3.3.1.1 Daily Procedures

1. PRINTER TAPE STAMP: Each day's printer tape will be stamped (Figure 5) at the beginning and end of the tape as well as anytime during the day that control settings are changed. Each morning the tape is to be removed from the counter, stamped on both ends of the tear and filled with the same information on each stamp.

2. DAILY LOG FOR SIDE SCAN SONAR COUNTER FORM: This is a summary of changes in controls which will be updated daily (Table 9). The information is necessary when interpreting sonar counts and calibration factor data.

3. SIDE SCANNER COUNTER LOG FORM: Details the mechanics of operation of the counter, substrate and related equipment (Table 10). Any apparent malfunctions should be recorded with description, frequency and consistency noted. Also, changes in sensitivity, spare card changes, raising or moving of substrate, anticipated problems, and needed repairs on equipment. This is the place where suggestions on improving operations, notes on river conditions which might have an effect on the equipment, and general comments should be noted.

Location: ______________________

Date: __________ Time: __________

Beam Angle: ____________________

Velocity: ______________________

Dead Range: ____________________

Live Range: ____________________

Observers: _____________________

Remarks: _______________________

____

Figure 5. Stamp used to stamp printer tape to record sonar counter adjustments.

Table 9.

Page ___ of ___

AA-83-12

DAILY LOG FOR SIDE SCAN SONAR COUNTER

Station: Yentna   Bank: ______________________   S/N: ______________________

Date	Time	Fish Velocity	Beam Angle	Dead Range	Counting Range	Command Print Time	Printout Time	Auto Test Time

Table 10.
Page ___ of ___

AA-83-14

SIDE SCANNER COUNTER LOG

Station: Yentna

Bank: ___________

Date	Time	Remarks (i.e., Substrate lifted, any controls reset, etc.)

3.3.2 Tag/Recapture Operations

3.3.2.1 Daily Procedures

1. Daily fishwheel catches will be summarized on the Daily Fishwheel Catch Log form (Table 13 or 14). Each time a fishwheel is checked, the catch will be recorded along with the corresponding time in military hours on the Individual Fishwheel Worksheet (Table 15). Following the last daily check, the catches will be summarized and entered in the appropriate space on the Daily Fishwheel Catch Log form and the 1983 Daily and Cumulative Fishwheel Catch form (Table 16).

2. Fish tagging effort will be recorded on the Tag Deployment Log form (Table 17). Information recorded will include: date, project location and tag type, color and number series used.

3. Tag recaptures from other sampling stations will be logged on the Tag Recapture Record form (Table 18). Recorded information shall include: fishwheel locations; tag number, color and type; and species. A summary of recapture data by species shall be entered in the space indicated on the form. Fish recaptured at the sampling station where they were tagged will be released and will not be recorded on the Fishwheel Daily Catch Log form or the Tag Recapture Record form.

4. DAILY SONAR COUNT FORM: Sonar counts from printer tapes are entered by hour and sector (Table 11). Counts which register debris or are skipped in printing should be noted with a "d" or "s" in the appropriate hour-sector box. Enter "0" if there are no counts. To tabulate data: an average of the hour on each side of a skip will be used to interpolate for the debris or skip block. Counts should be totalled for each sector and each hour. The grand total is the total of all sectors or all hours (they should be equal). This is known as the "daily raw count." After each day's counts are tabulated and reported, printer tapes and SSS count forms are to be placed in notebooks and sent to the main office every two weeks. The Operations Control Leader will edit the forms and then forward them to the Data Processing Section.

5. SIDE SCAN SONAR COUNTER FIELD COUNTER CALIBRATION LOG FORM: Raw counts will be calibrated in season by visual monitoring of the counters with an oscilliscope. Counters will be calibrated a minimum of four times daily. All calibration counts are to be recorded on the Side Scanning Sonar Counter Field Calibration Log form (Table 12).

Table 11.

AA-83-09

Page ___ of ___

Daily Sonar Counts

Bank: ______________________ Date: ______________________

Station: YENTNA

Time	Sector 1	2	3	4	5	6	Total	Sector 7	8	9	10	11	12	Total
0100														
0200														
0300														
0400														
0500														
0600														
0700														
0800														
0900														
1000														
1100														
1200														
1300														
1400														
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400														
Total														

______________ (Total raw counts)
- ______________ (Total debris counts)
= ______________ (Total good counts)
______________ (debris blocks)

Total good counts ________ x 144 =
Total good blocks ________

Adjusted Raw Count
(Sectors 1-6) ______________

______________ (Total raw counts)
- ______________ (Total debris counts)
= ______________ (Total good counts)
______________ (debris blocks)

Total good counts ________ x 144 =
Total good blocks ________

Adjusted Raw Count
(Sectors 7-12) ______________

TOTAL DAILY ESCAPEMENT (Adjusted raw count sectors 1-6 + 7-12) = ______________

COMMENTS ON BACK

Table 12.

AA-83-10

SIDE SCAN SONAR COUNTER FIELD CALIBRATION LOG

Station: Yentna Bank: ____________ S/N: ____________

Date	Observer	Time		Scope Count (1)	Sonar Count (2)	Percent Agreement (1÷2)100	Beam Width Alt., 2°, 4°	Fish Velocity (Sec/ft)	Sensitivity	Comments
		Start	Stop							

Table 13.

Page ___ of ___

AA-83-01A

Date __/__/ 83

Station: ______________

Geographic Codes

EBU __/___/___/___
EBL __/___/___/___
WBU __/___/___/___
WBL __/___/___/___

DAILY FISHWHEEL CATCH LOG

Fishwheel		Salmon					Whitefish			Miscellaneous		Total Catch
Location	Hours Operated	Chinook	Sockeye	Pink	Chum	Coho	Round	Hump-back	Bering Cisco	Species	No.	
Eastbank Upper												
Eastbank Lower												
EASTBANK TOTAL												
Westbank Upper												
Westbank Lower												
WESTBANK TOTAL												
DAILY TOTAL EAST AND WEST BANKS												

COMMENTS:

Table 14.

Page ___ of ___

AA-83-01B

Geographic Codes

NB __ __/ __ __ __/ __ __ __/ __ __ __
SB __ __/ __ __ __/ __ __ __/ __ __ __

Date __/__/ 83

Station: YENTNA

DAILY FISHWHEEL CATCH LOG

Fishwheel		Salmon					Whitefish			Miscellaneous		Total Catch
Location	Hours Operated	Chinook	Sockeye	Pink	Chum	Coho	Round	Hump-back	Bering Cisco	Species	No.	
NORTHBANK												
SOUTHBANK												
DAILY TOTAL NORTH AND SOUTH BANKS												

COMMENTS:

Table 15.

INDIVIDUAL FISHWHEEL WORKSHEET

Date ___/___/ 83

Station: ______________ Fishwheel Location: ______________

Time	Number of Fish Captured					
(Military)	Chinook	Sockeye	Pink	Chum	Coho	Other *

Hours Operated: ______________

* Identify species and number caught

Table 16.
Page ___ of ___

AA-83-04

Station ____________________

1983 DAILY AND CUMULATIVE FISHWHEEL CATCH

Date	Chinook		Sockeye		Pink		Chum		Coho	
	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum

Table 17.
Page ___ of ___

AA-83-05

TAG DEPLOYMENT LOG

Project Location (camp): ____________________, ___/___/___/___

Date: ___/___/ 83

LAST Tag Number of day: ____________________ Tag Color 1/ __________

FIRST Tag Number of day: ____________________ Tag Type 2/ __________

Number of Missing Tags: ____________________

TOTAL Number of Numbered Tags Deployed: ________________

Summary of Adult Salmon Tagged

Chinook Salmon	__________
Sockeye Salmon	__________
Pink Salmon	__________
Chum Salmon	__________
Coho Salmon	__________
TOTAL	__________

COMMENTS:

1/ Color: Int orange = O
White/red = W
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

Table 18.

Page ___ of ___

AA-83-19

TAG RECAPTURE RECORD

Project Station: ________________________, __ __/ __ __ __/ __ __ __/ __ __ __

Date	Fishwheel Location	Species	Tag			Leave Blank (Office Use Only)
			Number	Color 1/	Type 2/	

SHEET SUMMARY

	No. Recaptures
Chinook (41)	________
Sockeye (42)	________
Coho (43)	________
Pink (44)	________
Chum (45)	________
TOTAL	________

1/ Color: Int orange = O
White/red = W
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

3.3.3 Stream and Slough Survey Operations

Escapement surveys of slough habitats will be recorded on the Slough Survey Log (Table 19). For each survey a recording by species of the live and dead fish count, tagged and untagged fish numbers and survey conditions and distance surveyed in percentage will be made. Under the "Comments" column include surveyor's name(s) and reference to any tag loss.

Escapement surveys of stream habitats will be recorded on the Stream Survey Log Form (Table 20). Data recorded on each survey will include date, stream, survey conditions, distance surveyed, live and dead fish counted by species and number of live tagged fish by tag type and color. The "Remarks" column, in particular will include names of survey staff and reference to any tag loss. Tags on carcasses will be removed as schedule permits and the information recorded on the back side of the Stream Survey Log Form.

3.3.4 Stream Life Operation

The Stream Life Log Form will be used to record site observations of sockeye and chum salmon tagged at Curry Station (RM 120) (Table 21). Data recorded will include site location, date, fish identification number, species and behavior and or condition of fish (i.e., milling, spawning, post-spawning, carcass).

Table 19.

Page ___ of ___

AA-83-17
SLOUGH SURVEY LOG

Slough No.	Date	Survey [1] Cond.	Survey [1] Distance	Species Surveyed	No. Observed Live [2]	No. Observed Dead	No. Observed Total	No. Live Tagged Fish: Petersen Disc White w/Red	Petersen Disc Green	Petersen Disc Int. Org.	Spaghetti Pink	Spaghetti Blue	Comments [3]
				Chinook									
				Sockeye									
				Pink									
				Chum									
				Coho									
				Chinook									
				Sockeye									
				Pink									
				Chum									
				Coho									
				Chinook									
				Sockeye									
				Pink									
				Chum									
				Coho									

1/ Survey conditions: poor, fair, good, or excellent.
Survey distance: note by percentage (i.e. 100%).

2/ Include all live tagged and untagged fish.

3/ Note overall activity of salmon at mouth only, survey, personnel, tag loss, etc.

Table 20.

Page ___ of ___

Date 1/ ___/___/ 83

Stream ____________

AA-83-18
STREAM SURVEY LOG

Area	Survey Conditions 2/	Species Surveyed	No. Observed: Live 3/	Dead	Total	No. Live Tagged Fish: Petersen Disc: White w/Red	Green	Int. Org.	Spaghetti: Pink	Blue	Comments 4/
Mouth		Chinook									
		Sockeye									
		Pink									
		Chum									
		Coho									
Mouth to Standard Index Point		Chinook									
		Sockeye									
		Pink									
		Chum									
		Coho									
Additional Distance Surveyed (Optional)		Chinook									
		Sockeye									
		Pink									
		Chum									
		Coho									

1/ Day and month.
2/ Poor, fair, good or excellent.
3/ Include all live tagged and untagged fish.
4/ Note overall activity of salmon at mouth only.

Table 21.

Page ___ of ___

AA-83-02

STREAM LIFE LOG

Species	Tag Number	Date	Location		Fish Activity/Condition 2/	REMARKS
			Slough	Sub Habitat 1/		

1/ Define subhabitat such as: Mouth, riffle, pool, etc.

2/ Fish Activity/Condition note as: Milling, spawning, postspawning, carcass, etc.

4.0 Literature Cited

Keller, E.A. 1980. Environmental Geology. 2nd ed. Chase. E. Merrill Pub. Co. Columbus, OH. 548pp.

Hagen, R.M. et. al. 1973 Ecological impacts of water storage and diversion projects. Environmental quality and water development. Ed. Goldman, C.R. et. al. W.H. Freeman Co. San Francisco, CA.

U.S. Coast Guard, 1983. Cook Inlet tide tables.

RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

1.0 INTRODUCTION

The Resident and Juvenile Anadromous Fish Studies (RJ) are directed toward accomplishing the general objectives described in 1979 by the Alaska Department of Fish and Game for the Susitna Hydroelectric Project. These objectives are stated below:

1. Define seasonal distribution and relative abundance of resident and juvenile anadromous fish in the Susitna River between Cook Inlet and Devil Canyon.

2. Characterize the seasonal habitat requirements of selected anadromous and resident species within the study area.

The Resident and Juvenile Anadromous Fisheries Studies began in November of 1980 and will continue through the licensing process. From the onset of these studies, general surveys of the lower Susitna River mainstem and associated habitats, and the portions of the upper Susitna River basin to be inundated by the proposed impoundments, have been conducted. During the winter of 1981, and the spring and summer of 1982, the studies have been concentrated on those areas that may be most severely affected by the development of the Susitna Hydroelectric Project.

The primary purpose of the RJ studies was to address the distribution and abundance of resident and juvenile anadromous fish (Objective A). During the 1982 summer investigations, the studies concentrated on developing more information on habitat relationships of rearing resident and juvenile anadromous species that may be affected by the Susitna Hydroelectric Project (Objective B).

Amended studies proposed for the 1983-84 season address geographical areas where data have not previously been collected and provide a more direct and focused effort on habitat and rearing relationships of the juvenile anadromous species and selected resident species of importance.

2.0 TECHNICAL PROCEDURES

2.1 Study Description and Rationale

2.1.1 Resident Fish Studies

2.1.1.1 Habitat and Population Data

2.1.1.1.1 Sub-objectives

Quantify the important habitat parameters associated with spawning and rearing (growth) of selected resident fish species and measure fish density in spawning and rearing habitats to provide an estimate of habitat quality.

2.1.1.1.2 Rationale

Habitat conditions in the mainstem Susitna River between the Chulitna River confluence and Devil Canyon will be altered by the regulation of discharge from the proposed hydroelectric dams upstream. Several species of resident fish are currently harvested by sport fishermen in this reach of the Susitna River. Rainbow trout and burbot are the most sought after resident species (Mills, 1983).

Our investigations indicate that burbot are widely distributed in the mainstem Susitna River, while rainbow trout are more closely associated with tributary mouths. Catch data indicate that burbot largely avoid clear water areas during the open water season. An evaluation of the suitability of the mainstem Susitna River for burbot under post- project conditions can be made by comparing post-project turbidity data and hydraulic conditions with the data on the habitat conditions used by the species under pre-project conditions.

The resident fish studies will address the following questions:

- o How will the rainbow trout population respond to decreased turbidity and altered post-project mainstem discharges?

- o What is the current population of burbot in the mainstem Susitna River and what will their response be to altered turbidity and discharge under post project conditions?

2.1.1.1.4 Field Study Design

<u>Definition of the problem</u>

The resident fish studies conducted during 1981 and 1982 on the Susitna River between Devil Canyon and the Chulitna confluence provided information on the general distribution of the resident fish species, their relative abundance, and macro-habitat preference. Most of the data collection sites were located near the confluences of clear water tributaries or in sloughs, although mainstem and sidechannel habitat sites were also sampled. Data collected in 1981 and 1982 provides a general description of the distribution of resident fish; however, further quantification of their micro-habitat and populations is desirable.

Studies done in 1981 and 1982 did not included clear water tributary habitat and consequently have not allowed any comparison of use or distribution of the species among habitats influenced by the mainstem Susitna discharge and the habitats not affected by the mainstem. To properly assess impacts to or enhancement potential of resident species, it is necessary to determine the portion of their life cycles in which they are associated with mainstem habitats. To estimate resident fish habitat conditions under altered mainstem Susitna River flow regimes it is necessary to develop physical habitat criteria using all utilized habitats. These data can then be used to estimate the suitability of unoccupied habitats in areas influenced by the mainstem under alternative flows. These areas are being evaluated by the ADF&G Aquatic Habitat and Instream Flow Study Group to apply the data can be applied to the physical habitat models being assembled.

It is necessary to establish population index areas for the primary resident species of interest. These areas can be repetitively sampled to provide indicators of the response of resident fish populations to annual changes in habitat, and provide the basis for measuring responses of the populations to altered habitat conditions after the hydroelectric dams are operating.

The following questions are the primary items being addressed by the Resident Fish Studies:

- What proportion of the primary resident species populations currently use the mainstem Susitna and adjacent habitats and what is the timing of this use?

- What are the current populations in selected index areas of the primary resident species?

- What are the physical and biological environmental factors that determine the distribution and abundance of resident fish species in this portion of the Susitna Basin?

Although answers to all of these questions would be desirable so that an accurate quantitative prediction of the Susitna Hydroelectric Project impacts can be made, complete answers are not possible because of cost limitations and the length of study time necessary to provide complete answers. However, our previous studies (ADF&G 1983a) suggest certain hypotheses as to possible answers to these questions. The study design proposed attempts to test these ideas.

Hypotheses to be tested

Because of the correlative nature of impact studies, specific hypotheses that can be experimentally tested under laboratory conditions are not possible in field studies of this type. Rather, it is necessary to evaluate the validity of the hypotheses by correlations and inference. The following are some of the specific hypothesis that will be addressed by the proposed study design.

- Rainbow trout abundance is limited by available spawning habitat with successful rearing attributable to clear water tributaries with mainstem areas primarily being used for migration and overwintering.

- Burbot abundance is restricted to light-limited environments and are closely associated with mainstem Susitna turbidity.

- Mainstem habitat conditions limit production of resident species because of unstable flows, turbidity, and consequent limited food production.

- Potential production in the mainstem and sidechannels for the primary resident species is predicated on turbidity, depth, and velocities available during the summer rearing months.

Analytical approach

To test these hypotheses, the following analytical approach is planned.

- o The rearing period of the life cycle will be examined for rainbow trout and burbot by monitoring macro-habitat conditions used by radio-tagged adults and the location of fish captured by other means. This data will be the basis for determining the timing and the proportion of the populations in this reach of river that utilize the habitats affected by the mainstem Susitna River.

- o Micro-habitat utilization and preference will be evaluated by comparing catch per unit effort or population density values associated with the available habitat conditions.

- o Population index areas will be established to compare annual changes and variations in fish population densities.

- o The effects of instream flow incremental changes on physical habitat will be used in concert with the micro-habitat criteria to estimate the effects of flow variation on the species being studied.

Specific analytical methods will be further defined in the data analysis section of this manual.

2.1.2 Juvenile Anadromous Fish Studies

2.1.2.1 Abundance, Outmigration, Timing and Survival

2.1.2.1.1 Sub-objectives

Estimate the total number of sockeye and chum salmon outmigrants and their survival and provide an estimate of the relative abundance of pink, chinook, and coho salmon juveniles outmigrating from the Susitna River above the Chulitna River confluence.

2.1.2.1.2 Rationale

The relative abundance of all species of salmon juveniles in the Susitna River has been determined by the operation of a downstream migrant trap during the 1982 open water season. Because pink and chum juvenile salmon outmigrated before the trap was in place, limited information on these and on the early outmigration rates of other salmon species was accrued. To determine the stimuli that trigger the outmigration of juvenile salmon in the Susitna River, further data are necessary on the timing and rates of outmigration.

A pilot program was initiated during the spring of 1983 to determine the feasibility of obtaining population estimates of juvenile sockeye and chum salmon by mark and recapture methodology at six selected sloughs. The entire drainage production will also be estimated by recovery of marked fish at two downstream migrant traps. By comparing egg production for sockeye and chum with juvenile outmigration numbers, survival can be estimated for the freshwater life phase of these species of salmon in the Susitna River above the Chulitna River confluence. These data can then be used to correlate the survival versus the habitat conditions experienced at the individual sloughs which have been monitored over the past season, and will provide an indication of contribution that these sloughs make to the overall production of chum and sockeye salmon juveniles in this reach of river.

The low flow year experienced during 1982 provides a unique opportunity to assess the effect of these low flow conditions on overall survival in the Susitna River drainage above the Chulitna confluence. The coded wire tags will provide the opportunity to monitor the returning adult salmon for survival throughout one entire life cycle of sockeye and chum salmon.

The coded wire tag program will also add to the understanding of the importance of sockeye salmon in the Susitna River from the Chulitna River confluence to Devil Canyon. Available data suggests that limited sockeye rearing occurs in this reach (ADF&G 1983a). Although not an integral part of the study, the option will remain open for further adult salmon tag recovery work to provide definitive evidence concerning the contribution that sloughs provide to the overall production of salmon in the system. Depending upon the results of the 1983 program, the option is available to continue the study during the 1984 spring period, and provide a comparison of survival under different habitat conditions and escapement that will probably occur.

2.1.2.1.3 Field Study Design

Definition of the problem

The study design described in this section addresses only the open water portion of the field season for juvenile rearing chum, sockeye, chinook, and coho salmon. Observations of the timing and distribution of juvenile anadromous species in the Susitna River between the Chulitna River confluence and Devil Canyon, have been compiled since the winter of 1980. These data have suggested certain trends and hypotheses regarding the timing and distribution of these species but have provided limited information on the populations and quantification of the populations of juvenile fish as they are primarily based on catch per unit effort which are dependent upon the habitat types sampled and gear types used.

The data from the following work plan will provide a baseline data set to use to determine mitigation requirements, timing of flow or discharge releases necessary to maintain existing rearing stocks, and the ability to monitor survival of existing stocks as a function of natural annual changes in discharge. Although habitat models are to be used to estimate habitat response to discharge, the only true test of the models is to provide measurements of the survival of juvenile salmon under variable discharge conditions. Therefore, the problems to be addressed include the following:

- What are the current numbers of salmon outmigrants?

- What is the survival from egg to outmigrant and what is the condition of the outmigrants under current environmental conditions?

- What are the outmigrant timing windows and consequently length of rearing residence time for chinook, coho, sockeye, and chum salmon and how do these timing windows respond to discharge?

- Of the major habitat types identified, what is the contribution of the particular habitat areas to juvenile salmon production?

Although answering all of these questions for all species would be desirable, only part of them can be addressed with available resources. Based on previous observations and experience, the 1983 field program will be designed to collect data necessary to further our understanding of the basic biology of juvenile salmon in the system. This program will provide initial data that can be used to test, over the long term, specific hypotheses about the relationship of mainstem discharge to the survival and consequent production of salmon during their freshwater residence in the Chulitna River confluence to Devil Canyon reach of the Susitna River.

Hypotheses to be tested

The monitoring of outmigrants and the determination of outmigrant timing and survival does not lend itself to short term hypotheses testing methods commonly used in experimental biology. These data products have their most immediate use in the support of other analytical studies, such as determining the timing windows of necessary downstream discharges, determining the populations that will be affected by flow regulation on the river, and determination of short term flow variations and other environmental conditions on survival. These products will be further defined under the "Analytical Approach" section that follows. However, specific hypotheses that can be tested by use of these data sets on the long term, are applicable to this program. The following are examples of the types of hypotheses that can be resolved with longer term data collection coupled with continued monitoring of adult escapement and habitat parameters in the system.

- Annual survival of outmigrant sockeye and chum salmon from egg to juvenile is dependent upon discharge-determined habitat conditions during the spawning and incubation stages of their life cycle in sloughs and sidechannel habitats associated with the mainstem Susitna River.

- The condition (growth) of the outmigrant sockeye, chum, chinook, and coho salmon juveniles is independent of mainstem discharge effects on rearing habitat.

- The redistribution and length of rearing of juvenile sockeye, chum, chinook, and coho salmon is dependent upon the mainstem discharge effects on available habitat.

To effectively test these hypotheses, several years of data will be required. However, short term phenomena, such as high water peaks, coupled with analysis of available habitat by use of physical habitat models, and the collection of fish distribution data at the various macro-habitat sites affected by the mainstem discharge changes, should provide an initial test as to the validity of these hypotheses. In addition to the juvenile salmon, the data base collected on juvenile resident species will provide an insight as to the effects of discharge on the migration and redistribution of resident fish species.

Analytical approach

The following analytical approach will be used to address the previous questions and hypotheses. The analysis will include:

- The relative abundance of outmigrants of all species over time.

- The proportion of the population and the length of time the populations of juvenile salmon rear in the reach of river being examined.

- The 1982 brood year outmigrant populations of sockeye and chum salmon.

- The survival of 1982 brood year sockeye and chum salmon during the portion of their freshwater life cycle spent above the outmigrant trap.

- Correlations of the outmigrant timing, survival, and growth with mainstem discharge habitat conditions and other habitat or other variables.

- Preliminary data and analysis of the contribution of selected sloughs to the outmigrant populations and relative survival estimates from these sloughs.

Based on these analyses, the support for the hypotheses and questions previously listed will be discussed and evaluated. These data can then be used by other investigators to provide timing for downstream flow releases, to provide different weights or relative values on the different species for a given time period, and to assess the validity of the instream flow habitat analysis being undertaken.

2.1.2.2 Emergence and Development

2.1.2.2.1 Sub-objective

Determine emergence timing and rates of embryonic development under the natural variable conditions that occur in mainstem, slough, and tributary sites in the Susitna River above the Chulitna River confluence for pink, coho, and chinook salmon. Complete the monitoring activities on chum and sockeye salmon development rates initiated during the winter of 1982-1983.

2.1.2.2.2 Rationale

To determine if the post-project conditions will be sufficiently altered to allow spawning by chinook, pink, and coho salmon in the mainstem Susitna River, data on habitat conditions currently experienced by these species in side sloughs and tributaries are needed. Limited use of the mainstem for spawning by all of these species suggest that conditions in the tributaries more closely reflect the conditions necessary for successful reproduction of these species. By testing the hypothesis: The mainstem and slough substrate and/or temperatures limit the reproduction of these species at these sites; the study will suggest whether or not post-project mainstem conditions have the potential to provide alternative spawning habitat. The data analysis will be limited to testing the previous hypothesis and to correlating development rates and observed mortality to habitat conditions such as temperature and substrate. An assessment of late fall floods will also be evaluated to determine their effects on egg survival. Data collected during the 1982-83 winter on pre-emergent sockeye and chum salmon have provided useful information on factors (such as intragravel temperatures) which may have major influences on survival within a slough environment. Because of the significance of these findings on possible winter post-project operations, a further refinement of the data for sockeye and chum in the slough environment is warranted.

2.1.2.2.3 Field Study Design

Definition of the problem

The distribution of adult salmon spawning areas in the upper Susitna River indicates that each species segregates into specific areas of macro- and micro-habitat. Chinook and coho spawn almost exclusively in tributaries, pink predominately in tributaries with some slough spawning, chum in both sloughs and tributaries in addition to mainstem/sidechannel areas, and sockeye, exclusively in sloughs. This distribution pattern suggests that variable environmental parameters among these habitat sites may contribute to the selection of the different species with regard to macro-habitat types.

Under post-project conditions, the thermal properties of the mainstem are speculated to be significantly different from the current conditions although multiple outlet ports in the dam may provide the ability to regulate downstream temperatures. To determine desirable incubation temperatures for all five species of salmon, it is necessary to develop a data set indicating the development rate and the associated thermal regimes under natural conditions. These data may then be used to determine potential adverse conditions as well as potentials for enhancement of spawning conditions in the mainstem and sidechannels of the Susitna River under alternative thermal regimes created by release of water from the reservoirs.

Investigations by ADF&G and parallel U.S. Fish and Wildlife Service laboratory studies of the thermal requirements of chum and sockeye spawning in the sloughs have been conducted. Although these data provide a basis for estimating the impacts of altered downstream thermal conditions on these species, data for the tributary spawning chum salmon, chinook, coho, and pink salmon have not been developed.

The primary focus of the 1983-84 winter studies on juvenile salmon incubation in the Susitna River address the following questions:

- What are the baseline intragravel temperatures at sites currently used by tributary spawning salmon in the Susitna River between the Chulitna River confluence and Devil Canyon?

- What are the baseline development rates of incubating eggs and developing alevins under current tributary thermal regimes?

- How do these rates compare with the species or populations currently using slough or sidechannels for spawning?

Our answers to these questions can then be used by other investigators to determine the limitations or affects of altered mainstem thermal regimes on all five salmon species. This analysis can then be used to estimate, for thermal requirements only, the impacts of the hydroelectric project on habitats influenced by mainstem Susitna water. The analysis can also be used to estimate the mitigation potential of the post-project thermal regime.

Hypotheses to be tested

To answer the previous questions, we propose the following hypotheses on the importance of temperature with regard to its effects on distribution and the success of salmon egg incubation in the Susitna River basin areas under study.

- Sockeye and chum salmon embryos survive in the Susitna River because of their ability to tolerate cold (near 4°C) temperatures of sloughs or tributaries during their initial development stages and can successfully incubate and develop in water of a constant temperature.

  This hypotheses suggests that tributary chum spawners, as well as sockeye and chum slough spawners, key on upwelling water that is initially colder but warmer throughout the remainder of the development period, when compared with other species.

- o Sockeye salmon are limited to spawning in upwelling areas in sloughs and are unable to exploit tributary areas because of other unknown and undefined limits on their life cycle.

- o Chinook salmon require warmer initial temperatures for successful incubation and therefore spawn in tributaries rather than sloughs because of the cold temperatures associated with ground water upwelling in sloughs.

- o Coho salmon are limited in selection of spawning areas because of non-thermal factors associated with their development.

- o Pink salmon require initial warmer temperatures (tributary habitats) to successfully spawn and slough spawners are strays or relatively less successful in completing incubation in these habitat types.

Because the study will address only thermal requirements and associated development rates, the ability to test the hypotheses related to non-thermal effects is limited. However, data collected by other study components should be of value in addressing the validity of these hypotheses as well.

Analytical approach

To test the validity of the above hypotheses and address the questions raised, the following analytical components will be completed. The hypotheses proposed are not directly testable by analytical means because of the nature of this type of data. Instead the hypotheses must be addressed by correlations and examining other data sets which address other habitat parameters. The suitability of spawning habitat may often be limited by other habitat components, even if thermal data analysis does not suggest that temperature limits the spawning habitat of these species.

The following are specific analysis which will be completed on the field data sets to be collected:

- Calculate the thermal units associated with developmental stage of chinook, coho, chum and pink salmon spawning in the Susitna River tributaries.

- Compare the intragravel and surface temperatures of tributary spawning habitats among the species and with slough spawning areas.

- Evaluate the hypothetical effects of alternative mainstem, sidechannel and slough intragravel and surface temperatures on the development rates of each of the species.

These analysis will then be used to discuss the validity of the hypotheses when compared with other types of habitat data collected on other study components for the species in question and from the literature. This discussion will address the validity of using thermal analysis in projecting available spawning habitat in the mainstem river if the thermal regime changes after the system is regulated.

2.1.2.3 Rearing Habitat

2.1.2.3.1 Sub-objectives

Determine the relationship of juvenile salmon distribution to hydraulic parameters, temperature, turbidity, and cover at selected study sites that will provide a representative sample of mainstem, slough and clear water tributary rearing habitat in the study area.

2.1.2.3.2 Rationale

Because post-project turbidity, temperature, and discharge will be substantially different from pre-project conditions, we are proposing to continue our evaluation of the effect of these changes on the ability of juvenile salmon to successfully rear in the Susitna River drainage. The key parameters that affect the successful rearing of the juvenile salmon are hypothesized as being different for each of the five salmon species that occur in this reach of river. For juvenile chum salmon the hypothesized parameters include water velocity, available cover, and access. The same factors are hypothesized for sockeye juveniles, plus the development of plankton populations. Pink salmon juveniles require adequate water for passage out of the natal area. Coho and chinook rearing requirements may differ by age class. Adequate cover and food are considered to be main factors for these species, with passage into sloughs and other backwater rearing areas also being important. Food studies are not included in this study plan.

Study sites are being selected with specific study field designs that will provide an ability to test the above hypotheses to determine important factors which influence the distribution of juvenile salmon. If a factor or combination of factors is found to be important in determining the distribution of the fish species present, an evaluation of the response of the factor to mainstem discharge or temperature changes will be undertaken.

2.1.2.3.3 Field Study Design

Definition of the problem

All five species of Pacific salmon spawn in the reach of the Susitna River between the Chulitna River confluence and Devil Canyon. With the exception of pink salmon, substantial freshwater rearing and growth occur in this reach of the river during the juvenile portion of their life cycle. The data collected during 1981 and 1982 indicate the general distribution patterns of these species and their habitat utilization. The 1982 studies also investigated the response of selected macro-habitat areas to mainstem discharge changes. This study demonstrated species differences in the use of "hydraulic zones". These zones were subsections of the slough and tributary mouth areas that were affected by backwater of the mainstem Susitna River, mixing areas of the mainstem with slough or tributary flow, and free-flowing tributary or slough water above the backwater zone. The surface area of these zones, as a function of discharge, was analyzed using the relative use of the zones by each of the juvenile salmon species. This analysis provided an incremental index of habitat availability for each species as a function of mainstem discharge. "Habitat", in this case, was defined as different hydraulic zones. This analysis provided an initial indication of the effects of discharge changes on macro-habitat areas under the range of flows investigated. During the course of this study, observations of the distribution of juvenile salmon suggested certain micro-habitat parameters within the zones studies may respond to discharge changes at a higher rate than the responses of zone surface areas that were being evaluated. These micro-habitat factors include cover and turbidity, with depth and velocity having a somewhat lesser importance. Evaluation of this hypotheses will require a substantial change in the study design for 1983. The numbers of habitats to be examined will need to be limited to available resources as the revised methods require more intensive study at each of the sites.

Hypotheses to be tested

Based on 1981 and 1982 studies, the following hypotheses are proposed for evaluation during the 1983 open water field season Juvenile Anadromous Study program:

- o Juvenile chinook, coho, chum, and sockeye salmon use of habitat is correlated to micro-habitat parameters such as turbidity, velocity, depth, and cover.

- o Variations in these micro-habitat parameters caused by changes in mainstem discharge have a significant influence on the distribution of juvenile salmon.

As with other study components, strict analytical testing of the above hypotheses is not possible because of the correlative nature of the data base being collected. The analytical approach will address these hypotheses by inference from the data set.

Analytical approach

Preference curves will be developed for all juvenile salmon species (except non-rearing pink salmon) by examining frequency curves of habitat availability and use of each habitat parameter by juvenile salmon at all sites. Interactions between parameters may be considered in the development of the curves.

Hydraulic models of sites in three sloughs and four side-channels are being developed for use in determining the response of spawning salmon habitat to discharge. These study sites can also be used to evaluate juvenile salmon and resident fish habitat. Six additional sites will also be used to determine the response of juvenile salmon rearing habitat to mainstem discharge without the use of a hydraulic model.

Evaluation of the habitat at these last six sites will be conducted with a regression analysis of available cover and wetted area over variable discharges of the mainstem Susitna River. This analysis requires much less field data collection and analysis and will complement the hydraulic models implemented at the other sites.

Study sites selected will represent the major macro-habitat types that are affected by mainstem discharge. These habitat types will be mapped and the total area of each habitat type in this reach will be calculated by a different study component undertaken by Trihey and Associates.

One of the problems encountered with conducting instream flow studies and development of the impacts of incremental flows involves the assignment of flows during different time periods that will affect life cycle stages of the different species in different ways. The method developed by Bovee (1982) involved projection of habitat ratios, based on density information on the life cycles of a particular species. This requires a data base not obtainable in the Susitna River.

To address the problem of determining instream flows for different portions of the life cycles, an alternative approach can be used in the Susitna studies. Because such habitat ratio information is not available, other techniques must be found. One method could be based on timing of the species movements. Adult salmon have a short period of residency in fresh water and the timing of flow requirements for adult salmon is much shorter than an equivalent timing for adults of resident species. This timing window also overlaps with the rearing of juvenile chinook, coho, and sockeye salmon in the river. The data base obtained on juvenile rearing will allow estimates of the relative proportion of the populations that will be influenced by mainstem flows during this period of overlapping flow requirements. These data can be used by other investigators to assess the importance of the juveniles versus the adult spawners during this period of time.

The analytical approach will include the following items:

- o Determine the timing and relative use of macro-habitat areas by each of the juvenile salmon species over time.

- o Determine physical habitat criteria for use of cover, depth, velocity, and turbidity for each of the species for various timing windows of their use of macro-habitat areas associated with the mainstem Susitna River.

- o Project changes in the micro-habitat parameters of wetted areas and cover for six study sites located within macro-habitat areas associated with the mainstem Susitna River by regression analysis over the range of mainstem flows measured during the 1983 open water season.

- o Project changes in the micro-habitat parameters of velocity, depth, cover, substrate, and turbidity at three sloughs and four sidechannels sites by use of habitat simulation models (to be completed by the Aquatic Habitat and Instream Flow component of the studies).

- Project incrementally available habitat over the range of mainstem flows for sites studied under the two previous items listed above for those physical parameters that have significant positive correlation with the distribution of fish. Test projected habitat values with fish distribution data collected.

- Plot the habitat available versus discharge for each of the study sites for each of the rearing salmon species.

2.1.3 Fish and Habitat Surveys Along the Proposed Access/ Transmission Corridors

2.1.3.1 Sub-Objectives

Inventory the resident fish species in the streams and lakes within and adjacent to the proposed access and transmission corridors. Collect baseline aquatic habitat data to document the physical and chemical characteristics of streams and lakes within and adjacent to the proposed access and transmission corridor routes.

2.1.3.2 Rationale

Establishment of construction camps and development of the access and transmission corridors will have an impact on many of the adjacent lakes and streams both during and after development. By providing information on the resident fish populations and their habitat requirements in areas that may be affected by road crossings, camp construction, borrow areas, and a major increase in sport fishing pressure, impact analysis can be made and appropriate mitigation activities planned.

Arctic grayling and lake trout are the two major sport fish in the proposed study area. Access to the area will allow a substantial increase in sport fishing pressure on fish populations that have been virtually unexploited due to the inaccessibility of the area. The Deadman Lake and Deadman Creek system, which is adjacent to the proposed access road for approximately 10 miles, is one of the few trophy sport fishing areas for Arctic grayling in interior Alaska. Because of the importance of this stock of Arctic grayling it is necessary to document the present abundance and biological structure of the species in the area to use as a basis to predict the impacts of increased fishing pressure and increased harvests.

2.1.3.3 Field Study Design

Definition of the problem

Survey work conducted in the Deadman Creek and Lake system during 1982 suggested the population of Arctic grayling and lake trout may be of above average importance to the sport fishery because of the comparatively large size of the fish in this drainage. Because this drainage is now separated from the mainstem Susitna River by a waterfall, the population may be subjected to influences not found in tributaries without barriers to the mainstem Susitna River. Because this drainage will be paralleled for much of its length by the proposed access road, and because the inundation of the Deadman Creek falls by the impoundment will allow movement of stocks from the mainstem Susitna River into the drainage, there is a potential for substantial changes in the population and the age/size structure.

The 1983 open water study is designed to answer the following questions:

- What are the baseline fishery and aquatic habitat resources in the streams to be crossed by the proposed access corridor?

- What are the populations of sport fish species found in selected streams and lakes that will have substantially improved access and consequently major increases in sport fisheries?

By answering these two questions, it may be possible to determine the potential impacts of new sport fisheries at proposed access corridor stream crossings and suggest management strategies to mitigate impacts to areas where access is being enhanced by the development of the project. Further analysis of the Arctic grayling population structure in Deadman Creek may also determine the probable consequences of inundation of the falls on this population.

Hypotheses to be tested

In addition to the presentation of descriptive baseline data, the following hypotheses will be examined:

- The age/size distribution of Arctic grayling in the Deadman Lake drainage is the result of low recruitment and, consequently, reduced density-dependent mortality. The isolation of this drainage from other systems limits recruitment by reducing overwintering and juvenile rearing habitat.

- The population of lake trout in Deadman Lake is similarly limited by recruitment.

- The population of grayling in the Deadman Creek drainage have a very low maximum sustained yield because of the recruitment limitations and as a consequence, the population will rapidly decrease with small increases in sport fishery induced mortality.

Ideally, these hypotheses could be examined quantitatively by obtaining population data for all age classes of Arctic grayling and lake trout. In practice, obtaining quantitative data on the young age classes is not practical with reasonable limits on expenditures, so certain assumptions may have to be made, based on comparisons of density of catchable adults and age class mortality observed in the older fish, and the limited information that will be obtained on spawning and fecundity rates.

Analytical approach

Analysis of the data will consist of the following:

- Report information on the fish species, size, and habitat conditions in study sites on streams and lakes in the vicinity of the access road and transmission corridors.

- Calculate population estimates for representative reaches of lower Deadman Creek for Arctic grayling and population estimates for the whitefish species and lake trout of Deadman Lake.

- Analyze the population structure of the grayling and lake trout in the Deadman drainage and model the effects of incremental increases in sport fishing induced mortality on the population structure. Project the maximum sustained yield for alternative sport fish harvest management strategies.

The last two descriptions above are dependent upon the quality of the data base that is obtained using the methods described in the following sections. The quality of such projections and estimates is dependent upon the quality of the data base that can be obtained on age classes of the fish being examined.

2.2 Field Data Collection Work Plans

2.2.1 Resident Fish Studies

A two man crew will take samples of resident fish on the Susitna River between the Chulitna River confluence and Devil Canyon for habitat and relative abundance studies, fish preference studies, population estimates, and a radio telemetry-migrational study. River boats, fixed wing aircraft and helicopters will be used for support. Sampling methods to be used in this study are electrofishing, angling, trotlines, gill nets, and hoop nets. During the open water season the crew will operate out of tent camps located on the Susitna River at Talkeetna Station and Gold Creek. After freeze-up radio tracking and sampling will be conducted by aircraft out of Anchorage or Talkeetna.

2.2.1.1 Methods

2.2.1.1.1 Habitat and Relative Abundance

Resident fish will be collected at mainstem and tributary sites with a boat mounted electrofishing unit.

All resident fish captured will be identified to species. Biological data (age, length, sex, and sexual maturity) will be collected as defined in the 1982 procedures manual (ADF&G 1982).

The following habitat parameters will be collected at all resident fish spawning sites, at all sites where radio tagged fish are located, and at a select number of resident fish preference sites: water temperatures, water depths, water velocities, specific conductance, dissolved oxygen, pH, turbidity, intragravel temperatures, and substrate composition.

The tag recapture program to monitor the seasonal movements of adult resident fish will be continued. In 1981, 1,550 adult resident fish were tagged in the Susitna River between Cook Inlet and Devil Canyon (ADF&G 1981a). During 1982, 3,118 adult resident fish were tagged in the same reach (ADF&G 1983a). Tagging crews will attempt to tag an additional 3,000 resident fish during the 1983-1984 field season.

Floy anchor tags will be used to tag seven species of adult resident fish. Species to be tagged are humpback whitefish, round whitefish, burbot, longnose suckers, rainbow trout, Arctic grayling, and Dolly Varden.

With the exception of burbot, all resident fish that appear to be healthy after capture and have a fork length greater than 200 millimeters (mm) will be tagged. Burbot with a total length of 225 mm or greater will be tagged.

Floy anchor tags will be inserted between the lateral line and the posterior ray of the dorsal fin with a Floy tagging gun.

Tags will be recovered by the following means:

- Boat electrofishing crews
- The angling public will be requested to return recovered tags or report the tag number to the nearest office of the Alaska Department of Fish and Game with information regarding the location and date of catch and if the fish was released with the tag intact. The public will be informed of the tagging program by news releases to the media, RJ Su Hydro staff, and posters placed in conspicuous place frequented by anglers.
- Adult Anadromous fishwheel operations.

2.2.1.1.2 Fish Preference Studies

Ten locations will be designated as resident fish preference study sites. Locations selected as resident fish preference sites were chosen from sites that were reported to contain large numbers of resident fish in 1982 (ADF&G 1983a).

Each resident fish preference site will be divided into one to three grids. Grids will be located so that the water quality within them will be as uniform as possible and so that the grids will encompass a variety of habitat types. Resident fish preference sites at tributary mouths will be divided into three grids. At tributary mouths one grid will be located in the mainstem Susitna River above the confluence of the tributary, the second grid will be set up within or below the confluence where the tributary is the primary water source, and the third grid will be situated in the zone where the mainstem Susitna River and the tributary waters are mixed (Figure B-1). Resident fish preference sites located in the mainstem Susitna River, will have only one grid. Because grids at resident fish preference sites are dependent upon specific hydraulic characteristics, their locations can and will change from one sampling trip to the next. Therefore the location of grids at each resident fish preference site will be redetermined during each sampling trip based on differences in turbidity and water chemistry readings.

Grids will be subdivided into cells. Each cell within a grid will contain a specific habitat type (i.e. substrate, depth, cover). Cells will be rectangular and the length and width of each cell will vary according to the habitat parameters being studied within each cell.

The length boundaries of cells within each grid will be clearly marked with orange flagging prior to sampling. The width boundaries of cells within a grid will not be marked. Cell widths will be five feet or a multiple of five feet depending on the habitat parameters involved. Five feet was chosen as a standard cell width because it is the average effective capture width of the electrofishing sampling equipment used.

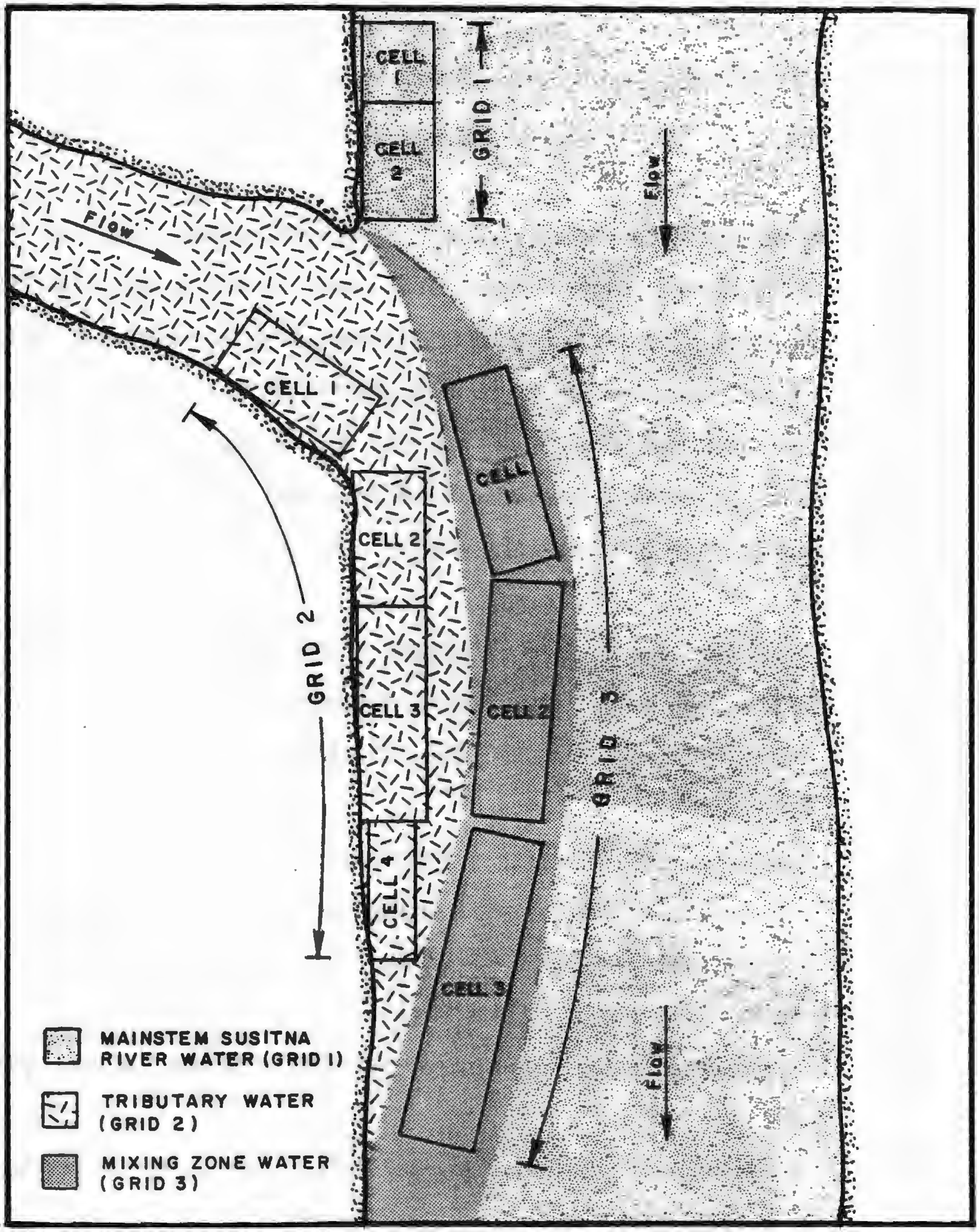

Figure B-1. Arrangement of grids and cells at a resident fish preference study site.

All resident fish collected will be identified to species. Age, length, sex, maturity, and spawning condition data will be recorded as specified in the 1981 and 1982 procedures manuals (ADF&G 1981; 1982). All healthy adult resident fish will be Floy anchor tagged and released.

Microhabitat parameters (e.g., dissolved oxygen, specific conductance, pH, turbidity water temperature, water velocity, and water depth) will be recorded for each cell at Resident Fish Preference sites. However, if the microhabitat parameters within a grid are relatively constant, only one sample will be recorded to represent all cells within that grid. Turbidity samples will be collected in 250 ml plastic bottles and stored in a cool dark place until they are analyzed.

Substrate data will be collected in accordance with modified procedures used by the Aquatic Habitat and Instream Flow Group at Habitat Model and Fisheries Data Collection sites (ADF&G 1982).

Fisheries data at Resident Fish Preference study sites will be collected with a Coffelt boat mounted electrofishing unit, Model VVP-3E powered by a 2500 watt Onan portable generator. A stop watch will be used to record the time electrofished per cell. Procedures used for boat electrofishing are described in the 1982 procedures manual (ADF&G 1982).

The mean depth of each study cell will be measured to the nearest tenth of a foot with a topsetting weighing rod.

The mean velocity of each cell will be measured with a Price Model AA velocity meter and the standard rating tables supplied with each meter. Turbidity measurements will be recorded for each grid, immediately following sample collection, using a HF Instrument turbidometer, Model DRT-15.

Water quality measurements will be taken in each grid with a Hydrolab multi parameter meter, Model 4001. These meters will be recalibrated prior to each field sampling trip.

A 200 feet Leitz brand fiber-plastic surveyors tape or a calibrated range finder will be used to make all length measurements.

2.2.1.1.3 Population Estimates

Data for population estimates will be collected for the following species of resident fish in the Susitna River between the Chulitna River confluence and Devil Canyon: rainbow trout, Arctic grayling, burbot, round whitefish, and longnose suckers.

Rainbow trout population estimate data will be collected in Fourth of July Creek using hook and line sampling techniques. Hook and line sampling will be repeated with the same gear and effort at least three times at 24 hour intervals.

Arctic grayling, round whitefish, and longnose sucker population estimate data will be gathered using electrofishing gear. Sites containing these species will be electrofished at least three times at two hour intervals.

Burbot population estimate data will be collected using trotlines, hoop nets, and fish traps as capture methods. These gear types will be set and checked at least three times at 24 hour intervals.

Population estimates will be made using a multiple removal model (White et al. 1982). This method entails plotting a regression of the fish removal data, an estimate of the total population of each target species of resident fish in a defined area of the Susitna River can be determined.

The removal model requires that all captured fish be marked so that recaptured fish can be identified and not counted on successive sampling trips. Consequently, all captured resident fish over 200 millimeters in length will be Floy anchor tagged and all fish under 200 millimeters will have the tip of the upper caudal fin clipped.

To use the multiple removal model to generate population estimates the capture probability must have a value of 0.2 or greater. The ratio between recaptured and unmarked fish will be recorded at each site during each sampling trip to calculate the capture probability. The percentage of the total number of fish that are recaptured is the capture probability for that species.

To account for differences in capture probability for fish of different sizes, the data will be divided into two groups (lengths less than or equal to 200 millimeters, and lengths greater than 200 millimeters) and analyzed separately for all species.

2.2.1.1.4 Radio Telemetry

During 1983-84, the resident fish studies crew will attempt to deploy 40 radio tags. Between May and October, 1983, radio tags will be implanted in approximately 30 rainbow trout and 10 burbot in the Susitna River between the Chulitna River confluence and Devil Canyon.

Tagging crews will radio tag healthy adult resident fish collected within the proposed study area.

Tags to be implanted in rainbow trout during the 1983-84 radio telemetry study are Advanced Telemetry Systems, Model 10-35. Smith Root model 4500L radio transmitters will be used to radio tag burbot.

The same procedures to surgically implant radio tags in resident fish that were previously described in the 1982 procedures manual (ADF&G 1982) will be used in 1983.

2.2.1.2 Study Locations

2.2.1.2.1 Habitat and Relative Abundance Measurements

Most sites to be sampled by boat electrofishing crews will be selected randomly and will include mainstem, sidechannel, slough, and tributary mouth sites on the Susitna River between the Chulitna River confluence and Devil Canyon. However, 12 habitat and relative abundance sites will be sampled regularly to monitor seasonal trends in relative abundance of resident fish (Table B-1).

Adult resident fish caught by fishwheels and the downstream migrant traps will also be recorded to help evaluate trends in relative abundance and seasonal movements.

In May and early June, 1983, surveys will be conducted on upper Fourth of July Creek, upper Indian River and upper Portage Creek to locate rainbow trout spawning areas and document the time of spawning for this species.

2.2.1.2.2 Fish Preference Studies

Resident Fish Preference Studies will be conducted at 11 sites on the Susitna River between the Chulitna River confluence and Devil Canyon (Table B-1).

Table B-1. Resident fish study sites on the Susitna River between the Chulitna River confluence and Devil Canyon.

Site	River Mile	Fish Habitat & Relative Abundance Site	Fish Preference Site	Populatio Estimate Site/Reac
Whiskers Creek Slough - Mouth	101.2	X	X	
Slough 6A	112.3	X	X	
Lane Creek - Mouth	113.6	X	X	
Skull Creek - Mouth	124.7	X		
Slough 8A	125.3	X	X	X
Susitna Mainstem	128.4-129.4			X
Susitna Sidechannel	131.0-131.8			X
Fourth of July Creek - Mouth	131.1	X	X	
Slough 11	135.3		X	
Susitna Mainstem	137.2		X	
Susitna Mainstem - West Bank	137.2-138.2	X	X	X
Indian River - Mouth	138.6	X	X	
Susitna Mainstem	138.9-140.1			X
Slough 20 - Mouth	140.1	X		
Jack Long Creek - Mouth	144.5	X	X	X
Portage Creek - Mouth	148.8	X	X	
Susitna Mainstem - Eddy	150.1	X		
	TOTAL	12	11	6

2.2.1.2.3 Population Estimates

Data for resident fish population estimates will be collected at 6 sites on the Susitna River between the Chulitna River confluence and Devil Canyon (Table B-1). These sites will include 1 slough, 1 sidechannel, 1 tributary mouths, and 3-one mile stretches of the mainstem Susitna River in this reach.

Data for resident fish population estimates will also be collected at selected sites in the upper reaches of Fourth of July Creek, Indian River, and Portage Creek.

2.2.1.2.4 Radio Telemetry

Selection of radio tagging sites in the mainstem Susitna between the Chulitna River confluence and Devil Canyon will be based on resident fish distribution data collected during the 1981 and 1982 open water field season (ADF&G 1981a; 1983a). Rainbow trout which may be spawning or rearing in the upper reaches of Fourth of July Creek, Indian River, and Portage Creek will also be tagged.

2.2.1.3 Schedule of Activities and Frequency of Sampling

2.2.1.3.1 Habitat and Relative Abundance Measurements

The open water field season will be divided into three time periods: ice-out to June 30th, July 1st to August 30th, and September 1st to freeze-up.

From ice-out to June 30th and from September 1st to freeze-up, emphasis will be placed on capturing and tagging as many resident fish as possible, identifying and characterizing resident fish spawning habitat, recording timing of resident fish spawning, and collecting adult resident fish for radio telemetry studies.

Between July 1st and August 30th, field crews will identify and characterize rearing areas for juvenile and adult resident fish. During this time, habitat preference data on resident fish will also be collected.

Point specific habitat data will be collected periodically between September, 1983 and March, 1984 at sites where radio tagged fish are rearing and/or spawning.

Winter sampling efforts will concentrate on determining the timing and locations of burbot spawning on the Susitna River below Devil Canyon.

Based on 1982-1983 winter data (ADF&G 1983b), burbot sampling will be conducted above and below the Chulitna River confluence once every two weeks between January 15th and February 15th.

2.2.1.3.2 Fish Preference Studies

Resident Fish Preference Study sites will be sampled at least once between August and October, 1983 to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the habitat models.

2.2.1.3.3 Population Estimates

Data for population estimates of Arctic grayling, rainbow trout, round whitefish, and longnose suckers will be collected in July, 1983.

During August, 1983, population estimates of burbot in selected reaches of the mainstem Susitna River will be attempted.

2.2.1.3.4 Radio Telemetry

Two to three days during each sampling trip between May and October, 1983 will be allotted to the capture of and implanting of radio tags in resident fish.

From May, 1983 to October, 1983, radio tracking surveys will be made every 10 to 20 days by boat or fixed-wing aircraft. After freeze up radio tracking will be conducted from fixed-wing aircraft, helicopter, or snowmobile every 15 to 30 days until all of the radio tag batteries have expired.

During the spring of 1984, attempts will be made to locate radio tagged rainbow trout on their spawning grounds. During May and June, frequent aerial surveys will be flown to locate and monitor movements of potential spawners. When a tagged rainbow trout is suspected to be in a spawning area, the site will be visited by helicopter to map the sites, characterize the spawning habitat, and evaluate the relative spawning maturity of other rainbow trout in the immediate vicinity of the radio tagged fish.

From late June through mid August, 1983, similar techniques will be used to identify summer rearing habitats of radio tagged fish.

In January, 1984, attempts will be made to recapture radio tagged fish with gill nets and trotlines. This will be done to locate and define the overwintering habitats of resident fish.

2.2.2 Juvenile Anadromous Fisheries Studies

2.2.2.1 Abundance, Outmigration, Timing, and Survival

2.2.2.1.1 Methods

Coded wire tagging

A five man crew will conduct the coded wire tagging operation at selected sites in the Susitna River above the Chulitna River confluence. The crew will be based at the Gold Creek field station (RM 136.8) and use an 18 foot riverboat as the primary means of transportation.

Binary coded one-half length wire tags will be used in conjunction with adipose fin clips to field mark post emergent sockeye and chum salmon fry.

Coded wire tagging operations will take place at the individual collection sites with equipment and personnel being transferred at the end of each tagging period. However in the event of logistical or equipment problems, the fish to be tagged will be transported from the collection area to the Gold Creek field station for tagging and will be returned to the collection site for release following the tagging procedure.

The primary fisheries collection techniques will include beach seines (both active and passive), dip nets, and backpack electrofishing units.

One or more passive beach seines will be set at fixed locations across the lower end of the sampling location and fished as necessary during the tagging period. The seines will be made from 3/16 inch or 1/4 inch square mesh, four feet deep and 25 to 40 feet in length. Passive seines will be checked periodically to collect fish and remove debris. All captured fish will be removed by dipnet and placed in live boxes for holding until the tagging operation. Active beach seining, dip netting, and backpack electrofishing will supplement the passive seines at sites where passive seining does not provide enough fish for the tagging operation, or at those sites at which passive seines are not deployable.

The coded wire tagging equipment will be leased from Northwest Marine Technology, Inc. (Shaw Island, Washington) and operated in accordance with the manufacturer's instruction and operation manual. The equipment to be based will be the NMT, Model MK2A tagging unit and include the following:

- Coded wire tag injector with 1/2 length tag capability
- Quality Control Device (QCD)
- Water pump
- Portable power supply

This equipment is field portable and includes a more compact prototype of the standard quality control device.

The one-half length tag capability is necessary due to the small size of the fish to be tagged. Susitna River chum salmon emerge at mean total lengths of 40 mm and averaging 1,500 fish per pound, while sockeye salmon were observed emerging at a mean total length of 32 mm and averaging approximately 3,000 fish per pound. The small area of cartilage in the snout of fish at this size for tag implantation does not allow the use of full length tags.

The coded wire tags for the program are made from biologically inert stainless steel wire which are capable of magnetic detection, and have a continually repeating binary code etched into the wire which allows code reading of recovered tags. Half-length tags measure .02 inches (.533 mm) in length and .01 inches (.254 mm) in diameter.

A total of 68,000 one-half length coded wire tags consisting of ten separate binary code groups, six code groups of 10,000 tags each, and four code groups of 2,000 tags each, will be ordered for the program. As many tag code groups as possible will be implanted, however only one tag code being used at any given site during each collection and tagging period. A tagging period will consist of one to six days of tagging per site, depending on the availability of fish. At the completion of each tagging period, a new tag code group will be used for the next site to be sampled.

Up to three different tag code groups being implanted at any one site during the entire program. A minimum of ten days will separate the tagging periods of implantation and release of different tag code groups at the same site to minimize the recapture of previously tagged fish, and to provide a clear separation between tagging periods from the same site.

The coded wire tag implantation procedures will be similar to those outlined by Moberly et al. (1977). Adjustments to these procedures will be implemented as necessary by our particular field program.

At the end of the tagging day, a random sample of 100 tagged fish will be collected from the holding tank and run through the QCD to determine the percent tag retention. Tag mortality will be recorded the following day. All tagged fish will be released at the capture site at the end of each tagging period.

The necessary numbers of fish to be tagged of each species to provide accurate population estimates will be calculated using the estimator provided by Robson and Regier (1964). This will provide a Petersen estimate of population varying not more than 25 percent from the true population in 95 percent of the trials. To establish the numbers of marked fish necessary for accurate estimates, certain variables must be predetermined. These are the adult escapement, male to female ratio of adults, average fecundity, estimated survival from egg to fry, and the estimated number of fish which will be recovered and examined for marks.

Adult salmon escapement and male to female ratio data from both the Talkeetna and Curry fishwheels in 1982 will be used in the calculations.

The data collected from the Curry site is suspected to provide more accurate estimates due to the large amount of milling activity reported in the vicinity of the Talkeetna fishwheel site by fish ultimately bound for the Chulitna and Talkeetna Rivers (ADF&G 1983). It has also been observed during these past studies that almost all spawning of chum and sockeye salmon in the upper Susitna River occurs in the reach between Curry and Devil Canyon. Therefore fish comprising the escapement past Curry are those which will make up the spawning populations in this reach. Thus, the Curry data should be more indicative of the true spawning escapement for this reach.

Chum salmon fecundity will be determined from Bird (1980), and sockeye salmon fecundity will be taken from Thompson (1964). Egg to fry survival is dependent on the interplay of many environmental factors including temperature and dissolved oxygen and survival varies widely under changing habitat conditions (Bjornn, 1968; Hunter, 1959; Mathison, et al., 1962). Expected numbers of fish to be recovered and examined for marks will be expanded from the results of the 1982 operation of the downstream migrant trap and will take into consideration the deployment of a second trap.

Dye marking

A separate study to test the feasibility of utilizing dyes to mark post emergent fish will be tested. Bismark Brown dye will be used to mark some of the juvenile salmon collected to determine dye retention and its ability to be observed on recovered fish.

The dye will be used in conjunction with coded wire tagging as pilot study to determine the feasibility of providing population estimates of sockeye and chum salmon fry for individual sites within the study area using the multiple mark-recapture method outlined by Ricker (1975).

Recovery of marked and unmarked fish

A three man crew will recover coded wire tagged chum and sockeye salmon juveniles with two downstream migrant traps located at the Talkeetna Camp on the mainstem Susitna River (RM 103.0).

The downstream migrant traps have two polyethylene plastic modular pontoons to float a welded steel lattice frame in which is mounted the inclined plane and livebox. The steel infrastructure is covered by a two-feet wide plywood deck surrounding a five by ten feet center opening for suspension of the inclined plane and livebox. A three-feet high safety railing is attached to the rear of the trap. The entire trap structure measures 10 by 17 feet.

The inclined plane is eight feet long with an entrance opening measuring 4.5 feet square and is covered by one-quarter inch galvanized hardware cloth on the sides and bottom. Hand crank winches are used to adjust the fishing depth and to raise the inclined plane for cleaning. The livebox is covered by one-eighth inch hardware cloth on the sides and bottom, and is removable from the trap structure to accommodate cleaning and retrieval of captured fish.

The stationary inclined plane trap requires a river velocity of at least 1.0 feet per second for successful operation. The mesh of the inclined plane allows the major portion of the sampled water column to pass through the screen while retaining the fish and the remaining water which pass over a baffle and into the livebox. The trap will be secured with a cable and rope attached to large trees upstream of the trap and held off the bank by a boom log attached to the trap and shore.

Sampling of the trap catch will be done by lifting the livebox from its fishing position and placing it to the rear of the deck. The incline is then raised for cleaning using the hand crank winches. The livebox is picked clean by hand and the above procedure is reversed to return the trap to fishing mode.

Fishing depth and trap distance from shore will be adjusted to maximize catches and minimize mortalities. Distance from shore is adjusted by moving the attached boom log up or down the beach.

Additions and alternatives to the downstream migrant traps may be implemented depending on their success in capturing coded wire tagged fish. Wiers from shore to the traps may be added to divert more fish into the traps and the traps may be held in mid channel for shorter intervals using riverboats.

Untagged fish species expected to be caught by the downstream migrant traps include juvenile chinook, coho, and pink salmon, round whitefish, humpback whitefish, Arctic grayling, Dolly Varden, rainbow trout, slimy sculpin, longnose sucker, three-spine stickleback, Arctic lamprey, and burbot. All fish captured will be anesthetized using Tricane methane-sulfonate (MS-222). Chum and sockeye salmon juveniles will be visually checked for an adipose fin-clip which would indicate the presence of a coded wire tag. Fin-clipped fish will be passed through a Northwest Marine Technologies FSD-1 field sampling detector to audibly denote the presence of a tag and then preserved for later tag analysis. All other fish will be retained until anesthetic recovery is complete and then released downstream of the traps to minimize the chance of recapture.

Three pieces of equipment will be used in the collection of the habitat data at the downstream migrant traps. Turbidity samples will be analyzed using an HF Instruments turbidimeter, Model DRT 15. A Hydrolab multiparameter meter, Model 4041, will be used to collect water temperature, pH, DO, and conductivity measurements. Water velocity at each trap will be measured daily using a Marsh McBirney velocity meter, Model 201.

Secondary recovery operations will be conducted at the tagging sites during periods of fish collection for tagging. Recoveries may also occur during the sampling conducted by the Juvenile Anadromous Habitat Studies (JAHS) crews at the survey sites.

Dependent on the future of the Susitna Hydro Aquatic Studies, returning adults may be observed for tags at the fishwheels and the specific spawning sites.

2.2.2.1.2 Study Locations

Coded wire tagging

Sites of the coded wire tagging program will be selected from locations where high density spawning has been documented (ADF&G 1983), and from surveys of the availability of sufficient numbers of juvenile chum and sockeye salmon for collection and tagging. Those locations which will be surveyed as possible tagging sites are Sloughs 8A (RM 125.3), 9 (RM 129.2), 11 (RM 135.3), 20 (RM 140.1), and 21 (RM 142.0) (Figure B-1). One tributary site on Indian River (RM 138.6) will also be surveyed as a potential collection site.

Dye marking

Dye marking will be conducted at Slough 11 and Slough 21 on sockeye and chum salmon juveniles.

Recovery of marked and unmarked fish

Two downstream migrant traps will be deployed on the Susitna River at the Talkeetna base camp (RM 103.0) above the confluence of the Chulitna River (Figure B-2). One trap will be set off the east bank and the other off the west bank of the river. The east bank site is deep and the bottom drops off quickly from shore. The west bank site is relatively shallow and has a gradual gradient (Figure B-3).

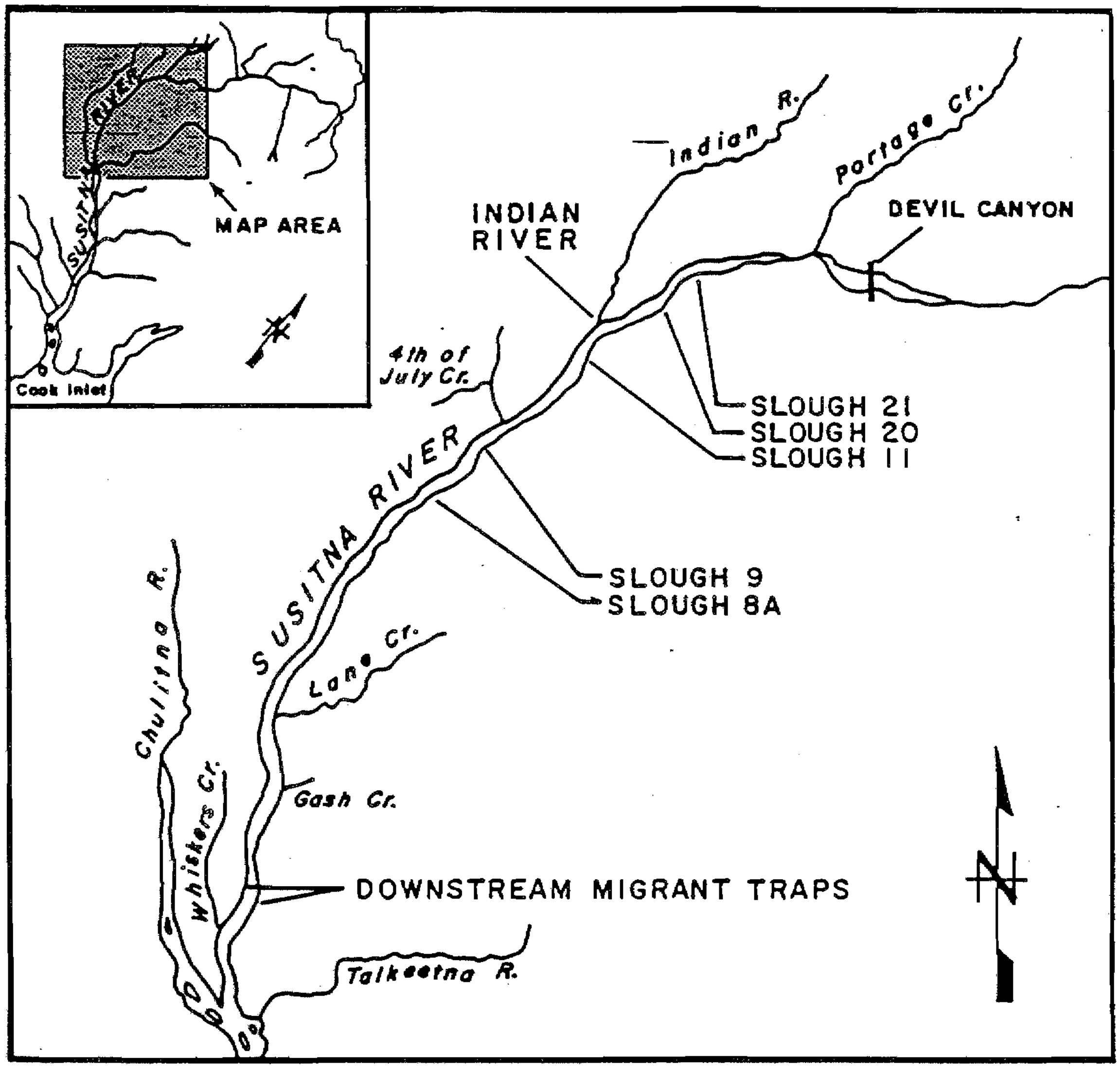

Figure B-2. Map showing the locations of five juvenile salmon coded wire tagging sites and two downstream migrant traps on the Susitna River, 1983.

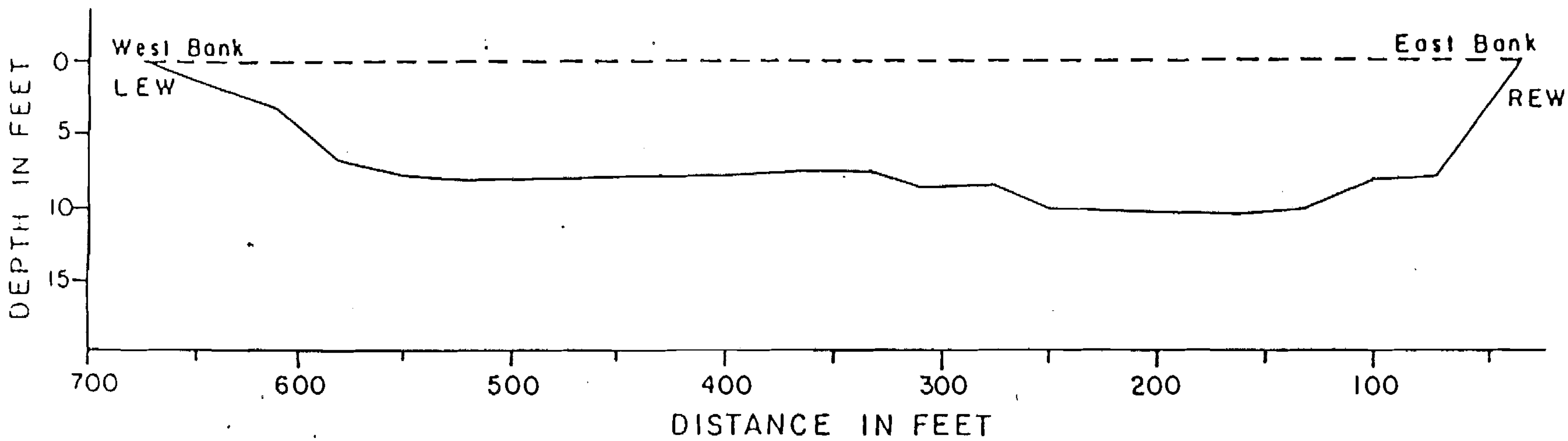

Figure B-3. Bottom profile of the Susitna River (RM 103.0) at the downstream migrant trap sites. USGS preliminary data - 37,348 cfs discharge on June 22, 1982.

2.2.2.1.3 Schedule of Activities and Frequency of Sampling

Coded wire tagging

Coded wire tags will be deployed on a continual basis from May 21 through June 19, 1983.

Dye marking

Dye marking will be conducted from May 22 through June 6, 1983.

Recovery of marked and unmarked fish

The downstream migrant traps will be deployed on May 18. They will be operated periodically as river conditions permit until outgoing ice clears sufficiently to allow safe operation on a full-time basis. The traps will be operated as continuously thereafter until August 31 and on a periodic basis from September 1 until freeze-up.

The traps will be monitored according to river conditions. Periods of high discharge will require more frequent checks due to the associated debris. Checks will be conducted at least twice daily in order to collect captured fish and to clean the screens.

2.2.2.2 Emergence and Development

A two man crew will conduct emergent and development studies at Lane Creek and Indian River from August, 1983 through April, 1984. The study will use modified Whitlock-Vibert boxes as artificial redds to determine the emergence timing and rate of embryonic development of chinook, chum, and pink salmon alevin at the tributary sites. Sampling will be conducted primarily from helicopters. The crew will operate out of the town of Talkeetna.

2.2.2.2.1 Methods

Surveys will be taken during the peak spawning periods for chinook, chum, and pink salmon to identify and mark natural redds and locate suitable sites for artificial redds.

Three emergence and development sites will be selected from existing Adult Anadromous Study (AA) escapement survey sites. Selection of emergence and development study sites on each tributary will be made in the field. Prospective sites must be used by adult salmon for spawning must be accessible and must be able to accommodate artificial redds.

Up to three pair of sexually ripe male and female chinook, chum, and pink salmon will be captured by dip net or gill net and artificially spawned utilizing techniques specified in Aquatic Habitat and Instream Flow Study section of this procedures manual.

Fertilized eggs will be placed in Whitlock-Vibert incubation boxes. Up to 100 eggs will be placed in each box and up to ten boxes will be buried in the substrate at each artificial redd site. The location of each box will be identified by orange flagging. Only one species of salmon will be studied at each artificial redd site.

All emergent and development study sites will be clearly identified and marked. Natural and artificial redd sites will be identified by tributary, species, distances and coordinates from fixed markers on shore, and the date of installation or observation of actual spawning at the site.

Sampling of artificial redds will consist of removing snow or ice cover and excavating one or two of the Whitlock-Vibert boxes at each site per sampling trip with a shovel.

Natural salmon redds will be sampled concurrently with the artificial redds in each tributary from January through April, 1984 for comparative purposes. Sampling of natural redds will be accomplished by recovering eggs in a 1/4 inch mesh catch screen with the aid of a modified Homelite gas-powered water pump mounted on a backpack frame. This device, commonly called an egg pump, employs a high pressure jet of water to penetrate the substrate in a salmon redd and forces some of the embryos or alevins to the surface for collection. Once the embryos or alevins reach the surface they are collected in a cylindrical screen that is 2 feet high, 2 feet in diameter, and open at both ends. A 1/4 inch mesh catch sack trails downstream of the sampling area in the current to catch the dislodged embryos and alevins. In the event that the egg pump freezes up or malfunctions, a shovel and a dip net will be used as a backup recovery method. Embryos and alevins will be preserved in Stockard's solution (Velsen 1980) and alevins will be preserved in 10 percent formalin for later laboratory analysis.

Embryos and alevins will be examined using a binocular steroscope and procedures described by Velsen (1980).

2.2.2.2.2 Study Locations

Three artificial salmon redd sites will be selected for emergence and development studies. Two artificial salmon redds, one for chinook and one for chum, will be established in Indian River (RM 138.6). A third artificial redd for pink salmon will be planted at Lane Creek (RM 113.6).

Natural salmon redds, of the same species as those being studied in each tributary, will be flagged in the vicinity of each artificial redds for comparative sampling throughout the winter months.

2.2.2.2.3 Schedule of Activities and Frequency of Sampling

Selection and installation of artificial redds for chinook, chum, and pink salmon will conincide with the peak spawning period for each species. Chinook salmon will be established between late July and early August and pink and chum salmon between late August through September.

The first sampling trip is scheduled for mid-November to conicide with the approximate time that the pink and chum salmon embryos "eye-up". One Whitlock-Vibert box will be excavated at each artificial redd at this time to determine survival rates and current stages of development.

Beginning in January, 1984 two Whitlock-Vibert boxes will be excavated monthly at each artificial redd through April. Based on development rates observed throughout the winter, field crews will attempt to schedule their later sampling trips so that they conicide with the period of emergence.

Table B-2 presents a summary of emergence and development study activities.

2.2.2.3 Rearing Habitat Studies

Two Juvenile Anadromous Habitat Study (JAHS) field crews, of two biologists each, will examine micro-habitat parameters of the rearing habitats used by juvenile salmon at selected sloughs, sidechannels, tributaries, and mainstem sites of the Susitna River between the Chulitna River confluence (RM 98.5) and Portage Creek (RM 148.8). JAHS sampling will be conducted from river boats during the open water seasons. Helicopter support will be enlisted as needed. Backpack electrofishing units and beach seines will be used to collect fisheries

Table B-2. Summary of emergence and development study activities, August, 1983 through April, 1984.

Activity	Aug. 1-31 1983	Sept. 1-30 1983	Oct. 1-31 1983	Nov. 1-30 1983	Dec. 1-31 1983	Jan. 1-31 1984	Feb. 1-28 1984	Mar. 1-31 1984	Apr. 1-30 1984
Survey and Mark Natural Redds	├──┤	├──┤							
Plant Artificial Redds	├──┤	├──┤							
Initial "Eye Up" Sampling				├──┤					
Egg Pumping and Artificial Redd Excavation						├──┤	├──┤	├──┤	├──┤
Laboratory Analysis of Developmental Stage				├──┤		├──┤	├──┤	├──┤	├──┤

data. Habitat data for fish preference studies and habitat modeling studies will be gathered using a Hydrolab multi parameter meter, a Price AA velocity meter, a topsetting wading rod, and a turbidometer. The crews will operate out of tent camps located on the Susitna River at Talkeetna Station and Gold Creek.

2.2.2.3.1 Methods

Fish preference studies

Techniques

Twenty-nine study locations will be designated as fish preference sites. Locations selected as fish preference sites are: (1) sites that were reported to contain large numbers of spawning adult salmon in 1982 (ADF&G 1983) and, (2) sites where large numbers of rearing juvenile salmon were observed or collected by RJ biologists in 1981 and 1982 (ADF&G 1981b; 1983a).

Each fish preference site will be divided into one or two grids. Grids will be located so that water quality within them will be as uniform as possible and so that they will encompass a variety of habitat types. Each grid will consist of a series of transects which intersect the channels of the study sites at right angles as illustrated in Figure B-4.

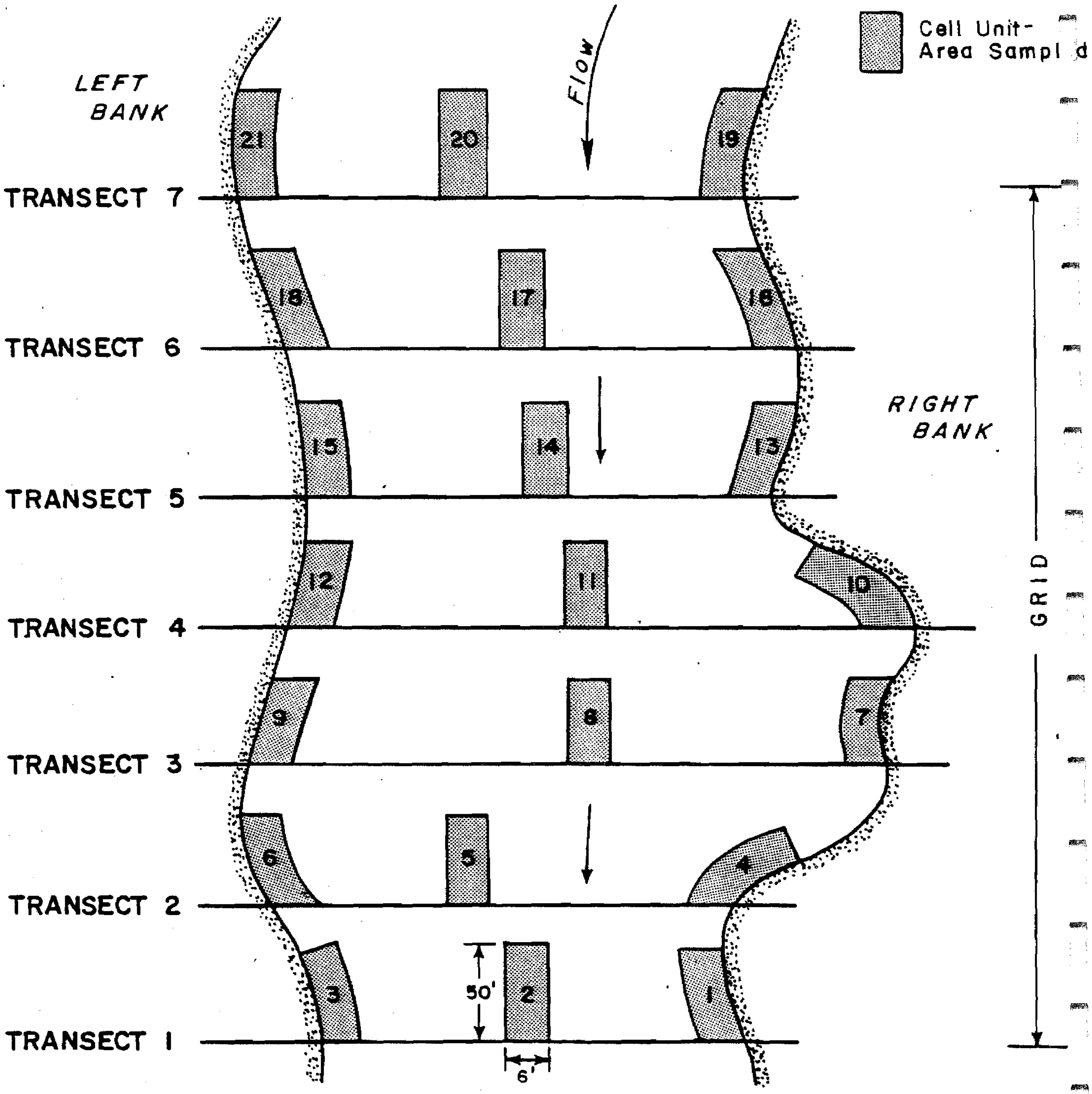

Figure B-4. Arrangements of transects, grids, and cells at a juvenile anadromous habitat study (JAHS) site.

There will be one to three cells at every transect within the grid. Attempts will be made to confine a uniform habitat type within each cell. Each of the cells will measure 50 feet in length and six feet in width. Two of the three cells will parallel both banks of the channel and the third cell will be located mid channel parallel to the bank cells. If the channel measures 18 feet or more in width at the transect, there will be a cell on each bank edge of the channel and one cell located approximately mid channel. If the slough is 12 feet to 18 feet in width, there will only be two cells, one on each side of the channel parallel with the bank, and if the channel is less than 12 feet in width there will only be one cell. Transects will be numbered consecutively beginning with the transect furthest downstream within the site (Figure B-3). Cells will also be numbered consecutively from right to left looking upriver. If there are less than three cells within a transect, cells will be numbered as if the missing middle cell were present.

Transects will be spaced at least 50 feet apart, and initial placement will be made so that the cell extends 50 feet upstream from the transect. Placement of the transects will be made to maximize a variety of habitat types. Survey stakes and orange flagging will be used to mark each transect within the grid.

Fisheries data will be collected from a minimum of seven cells within each grid at fish preference sites. Habitat data will be collected from only those cells actually sampled for fisheries data.

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All juvenile salmon collected will be identified to species in the field, measured for total length in millimeters and released. Those specimens that are not identified at the study site will be preserved in 10 percent formalin and later identified using a binocular stereoscope. The minimum sample size will be 50 fish of each species for each size class, and 10 percent of those captured in each size class thereafter.

Micro-habitat parameters such as water temperature, water depth, water velocity, pH, dissolved oxygen, specific conductance and turbidity will be collected from each cell sampled for fisheries data at fish preference sites. If the water quality is constant within a specific grid, only one sample will be recorded to represent that grid. Turbidity samples will be collected in 250 ml plastic bottles filled approximately two-thirds full and stored in a cool dark location prior to analysis.

Substrate data will be collected in accordance with modified procedures used by the Aquatic Habitat and Instream Flow project (ADF&G 1982) at habitat model and fisheries data collection sites.

Equipment

Sampling equipment that will be used to collect fisheries data from fish preference sites are backpack electrofishing units (Coffelt, Model BP1C and Smith Root, Model XVBPG) and beach seines. Procedures used for sampling with these techniques are described in the 1982 procedures manual (ADF&G 1982).

The mean depth of each study cell will be measured to the nearest one tenth of one foot with a topsetting weighing rod.

The mean velocity of each cell will be measured with a Price Model AA velocity meter and converted to feet per second using the standard rating tables supplied with each gage.

Turbidity measurements will be recorded for each grid, immediately following sample collection, using a HF Instruments turbidimeter, Model DRT-15.

Water quality measurements will be taken in each grid with a Hydrolab multi parameter meter, Model 4001. The meters will be recalibrated prior to each field sampling.

A Leitz brand fiber-plastic surveyors tape will be used to measure transect and grid lengths.

Data recorded

Fisheries and micro-habitat data collected at fish preference sites or habitat model sites will be recorded on JAHS HABITAT AND CATCH DATA FORM RJ 83-01. This form will be used to maintain a record of micro-habitat and catch data from each cell sampled. The instructions to complete form RJ 83-01 are outlined in Appendix B-1.

Fish habitat modeling studies

Techniques

Six locations will be selected as fish habitat model sites. These fish habitat modeling sites will be chosen from upland sloughs, side sloughs and mainstem sidechannels which meet the following criteria:

- o The effects of mainstem discharge (stage and flow) on the sites are measurable.
- o The sites are documented or thought to contain significant numbers of rearing juvenile salmon.
- o The sites are accessible by boat at normal mainstem discharges during the open water season.

Habitat modeling sites will be divided using the same system of grids and cells that was described for fish preference sites. Survey stakes and orange flagging will be used to mark each transect within the grid. Initial measurements of each grid will include distances and angles between transect bench marks on each bank and the distances and angles between bench marks of each transect. Habitat modeling sites will be sampled over as large a range of mainstem flows as possible. Wetted edge measurements will be made at each transect at the different flows providing that the staff gage readings indicate a significant change in stage within a site or on the mainstem Susitna. At this time, all cell habitat parameters will be measured in all cells at all transects.

Water quality data taken at Habitat Modeling Sites will include turbidity, pH, temperature, conductivity and dissolved oxygen. Each wetted cell from all transects in a given grid will be measured for mean depth and velocity. Dominant and subdominant substrate (subdominant substrate must comprise at least 10 percent of the total substrate within a cell to be documented) will be recorded. Percent cover and substrate class in each cell will be estimated using the cover substrate description (see fish preference techniques) and recorded.

One or more staff gages will be installed by the Aquatic Habitat and Instream Flow Project at each site to document changes in the stage at each site with changes in mainstem discharge. These gages will provide an index to compare the changes of habitat and hydraulic conditions at the site to changes in mainstem discharge.

Fisheries distribution and abundance data will be collected at habitat model sites when site conditions permit and fish preference data is needed.

Equipment

Equipment used to sample fish habitat modeling sites is identical to that used at fish preference sites with two exceptions: (1) fisheries collection gear will not be used at habitat modeling sites unless fisheries preference data is collected and (2) a Silva sighting compass will be used at habitat modeling sites to obtain compass headings between transect markers.

Data recorded

Data collected at fish habitat modeling sites will be recorded on forms RJ 83-01 and RJ 83-03. Data recorded on Form RJ 83-03 for fish habitat modeling sites will include wetted edge measurements, initial compass bearings, and distances between transect markers.

IFG-4 model studies

The Aquatic Habitat and Instream Flow (AH) group is generating IFG-4 models for three sloughs and three sidechannels on the Susitna River between the Chulitna River confluence and Devil Canyon. JAHS crews will collect juvenile salmon and habitat data at these six locations. This data will be included in IFG-4 modeling studies. These models provide a computer model simulation of the relationships of stage and velocity vs. changes in mainstem discharge and utilizes linear regression techniques to predict velocities and depths.

Techniques

The criteria for selecting IFG-4 modeling sites are specified in the Aquatic Habitat and Instream Flow (AH) section of this procedures manual.

Transects for IFG-4 modeling sites will be established and surveyed in by AH field crews. JAHS crews utilized these transects to set up grid and cell sampling areas. Sampling will be done in the same manner as previously described for fish preference sites.

All other techniques employed by JAHS crews at the six IFG-4 modeling sites are identical to those described for fish preference study sites.

Equipment

The equipment utilized by JAHS crews to collect fish and habitat data at IFG-4 modeling sites will be the same as those previously described for fish preference studies.

Data recorded

Fisheries and habitat data collected at IFG-4 modeling sites will be recorded solely on Form RJ 83-01.

2.2.2.3.2 Study Locations

Table B-3 presents all of the sites which will be sampled on the Susitna River and its major tributaries between the Chulitna River confluence and Devil Canyon by JAHS crews. JAHS study locations include 29 fish preference study sites, 6 fish habitat modeling sites, and 6 IFG-4 modeling sites.

Table B-3. Juvenile Anadromous Habitat Study (JAHS) sites on the Susitna River between the Chulitna River confluence and Devil Canyon, July, 1983 through June, 1984.

Site	River Mile	Fish Preference Site	Habitat Modeling Site	IFG-4 Modeling Site
Whiskers Creek Slough	101.2	X	X	
Whiskers Creek	101.2	X		
Chase Creek	106.9	X		
Slough 5	107.6	X	X	
Slough 6	108.2	X		
Oxbow I	110.0	X		
Slough 6A	112.3	X	X	
Slough 8	113.6	X	X	
Mainstem II	114.4	X		
Lower McKenzie Creek	116.2	X		
Upper McKenzie Creek	116.7	X		
Slough 8A - grid 1	125.3	X		X
- grid 2	125.3	X		
Sidechannel 10A	127.1	X	X	
Slough 9	129.2	X		X
Slough 10 Sidechannel	133.8	X		X
Slough 10	133.8	X		
Slough 11	135.3	X		
Slough 11 Upper Sidechannel	136.2	X		X
Indian River - Mouth	138.6	X		
Indian River - helio #1	138.6	X		
Slough 19	140.0	X		
Slough 20	140.1	X		
Slough 21 Sidechannel	140.6			X
Slough 21	142.0			X
Slough 22	144.3	X	X	
Jack Long Creek	144.5	X		
Portage Creek - Mouth	148.8	X		
Portage Creek - helio #1	148.8	X		
- helio #2	148.8	X		
- helio #3	148.8	X		
Totals		29	6	6

2.2.2.3.3 Schedule of Activities and Frequency of Sampling

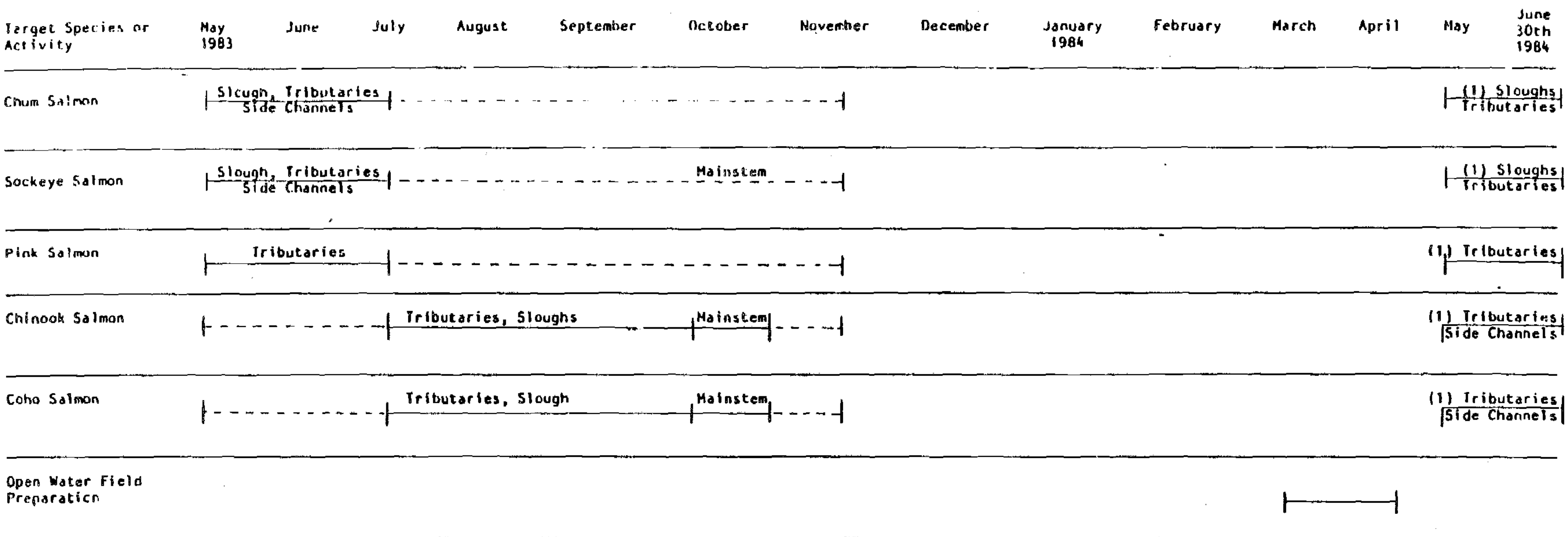
The schedule of activities and frequency of sampling for the 1983 summer field season is listed in Table B-4. Field sampling trips, lasting approximately 7-10 days will be conducted bimonthly from May to September by two JAHS crews. Frequency of data collection will vary among the three general categories of study sites during the field season.

Fish preference studies

Fish preference study sites will be sampled one or more times during the summer field season to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the habitat models.

The sampling schedule for fish preference study sites is dependent on the target species. Juvenile chum, pink, and sockeye salmon sites will be sampled in May and June. In late June or early July, sampling efforts will be redirected to collect data at sites previously identified as rearing areas for chinook and coho salmon. The chinook and coho salmon sites will be sampled until freezeup.

Table B-4. Juvenile Anadromous Habitat Study (JAHS) sampling and activity schedule, May, 1983 through June, 1984.



——— primary sampling

------- continued insidental data collection

Fish habitat modeling studies

Each of the fish habitat model sites will be sampled about five times at different mainstem flows. The sampling schedule for habitat model sites is dependent on the mainstem flow as well as target species.

IFG-4 modeling studies

The sampling schedule for IFG-4 modeling sites will be conducted identically to the fish preference study sites. IFG-4 modeling sites will be sampled one or more times during the open water field season to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the IFG-4 model.

2.2.3 Fish and Habitat Surveys Along the Proposed Access/ Transmission Corridors

2.2.3.1 Methods

2.2.3.1.1 Stream Studies at Proposed Access Road Crossings

Study sites will be established at proposed road crossing sites on all streams along the selected access and transmission corridors. Study site locations will be determined from maps developed by R&M Consultants, Inc. (Selected Access Plan 18, map #252210, 9/1/82) on which the proposed route is overlaid on USGS topographic maps (scale 1:63,360, 1951 series). At present, the route is not physically marked and the exact location of stream crossing sites are not certain. Sampling will be conducted in each stream 500 feet above and 500 feet below the proposed road crossing site.

Fish data collection

Streams will be inventoried for fish species present using backpack electroshockers as a capture technique. Time of sampling will vary depending on the size of the stream and the catch. Sampling will be conducted until the presence or absence of fish at each study site has been verified. Streams which have negligible or intermittent flows will not be sampled.

Biological data to be collected from a representative number of captured fish at each location will include: species and length. Lengths will be measured as fork lengths or total lengths as specified in the 1982 Procedures Manual.

Aquatic habitat data collection

Data collected at these sites will include general water quality (pH, conductivity, water temperature, and dissolved oxygen), discharge, and substrate. Water quality and discharge data will be collected at a representative location within the study area. Discharge data will not be collected from smaller streams in which negligible or intermittent flows would make accurate discharge measurements difficult. Substrate will be evaluated for each stream in the general area of the proposed crossing site. Each study area will also be photographed during the season. These data will be collected according to procedures presented in the 1981 and 1982 procedures manual (ADF&G 1981; 1982).

2.2.3.1.2 Reach Studies on Deadman Creek

Three, one-mile reaches of Deadman Creek from the lake outlet downstream to the falls will be selected as study sites. These reaches will be sampled by hook and line to generate Arctic grayling population estimates. A backpack electroshocker will be used to determine what other species are present.

Data to be collected and recorded from captured fish includes: reach, species, length, sex, age and tag number. Lengths will be measured as specified in the 1982 procedures manual (ADF&G 1982). Scales will be collected from a representative subsample (20 percent) of grayling catch in each reach. Scales and otoliths will be collected from all mortalities for subsequent age determination. All fish over 150 mm and apparently in good health will be tagged using Floy anchor tags.

2.2.3.1.3 Lake Studies

Fish data collection

Several of the major lakes adjacent to the proposed access corridor will be inventoried for fish species present. These will include, but are not limited to, Deadman Lake, Swimming Bear Lake, and the High Lake complex. Sampling will be conducted with gill nets, trotlines, and minnow traps set at selected areas along the shore of each lake. Time of sampling will vary depending on the effectiveness of the sampling methods.

In addition to survey work on Deadman Lake with gill nets and minnow traps, six Fyke nets (4 feet x 4 feet x 18 feet trap with two-4 feet x 40 feet wings) will be used to capture lake trout for a mark-recapture population estimate study. One Fyke net will also be used as a weir at the outlet of Deadman Lake in late September to identify and enumerate the various species of fish which move up Deadman Creek to overwinter in Deadman Lake.

Data to be collected includes: species, length, sex, age and tag number. Lengths will be measured as specified in the 1982 procedures manual (ADF&G 1982). Scales will be collected from all lake trout captured and otoliths will also be removed from all mortalities for subsequent age determination. All fish over 150 mm and apparently in good health will be tagged with Floy anchor tags.

Aquatic habitat data collection

Aquatic habitat data will not be collected from lakes adjacent to the proposed corridor other than Deadman Lake. Data collected from Deadman Lake will include water quality data for developing depth profiles for oxygen, pH, conductivity and temperature. These data will be collected by use of a Hydrolab and extension cables used according to manufacturers instructions. Depth contour profiles of Deadman Lake will be taken with a depth sounder (Lawrence, Model LRG-1510B) mounted on a boat powered by a 9.9 horsepower outboard motor traveling at constant trolling speed between points on specified transects. The location of the transects will be determined with a 1" to 400' scale aerial photo of the lake using landmarks for reference points. The profiles will be recorded on the instrument's recorder printout and to determine placement of depth contours on a depth contour map of Deadman Lake.

2.2.3.1.4 Spawning Surveys (Spring 1984)

Spawning surveys will be conducted during the Spring of 1984 using electroshockers, gill nets, hook and line and visual observation to determine the present, timing, and locations of Arctic grayling and rainbow trout spawning.

Data to be recorded includes: species, length, sex, age, tag number and sexual maturity. Lengths will be measured as specified in the 1982 Procedures Manual. Scales will be collected from all fish captured and otoliths from all mortalities for subsequent age determination. All fish over 150 mm and in good health will be tagged using Floy Anchor tags.

Point specific habitat data (velocity, depth and substrate) and water quality (pH, DO, conductivity and water temperature) will be collected at selected spawning sites to characterize the baseline habitat conditions necessary for grayling spawning activities.

2.2.3.2 Study Locations

The study locations for the 1983 access-transmission corridor and construction site surveys shown in Figure B-5 include the following areas:

2.2.3.2.1 Stream Studies at Proposed Access Road Crossings

Watana access road corridor - Mile 114 of the Denali Highway, south 44 miles to the Watana damsite.

22 stream crossings

Devil Canyon access road corridor - Watana damsite west and south a total of 36 miles to Devil Canyon damsite.

14 stream crossings (including Tsusena Creek)

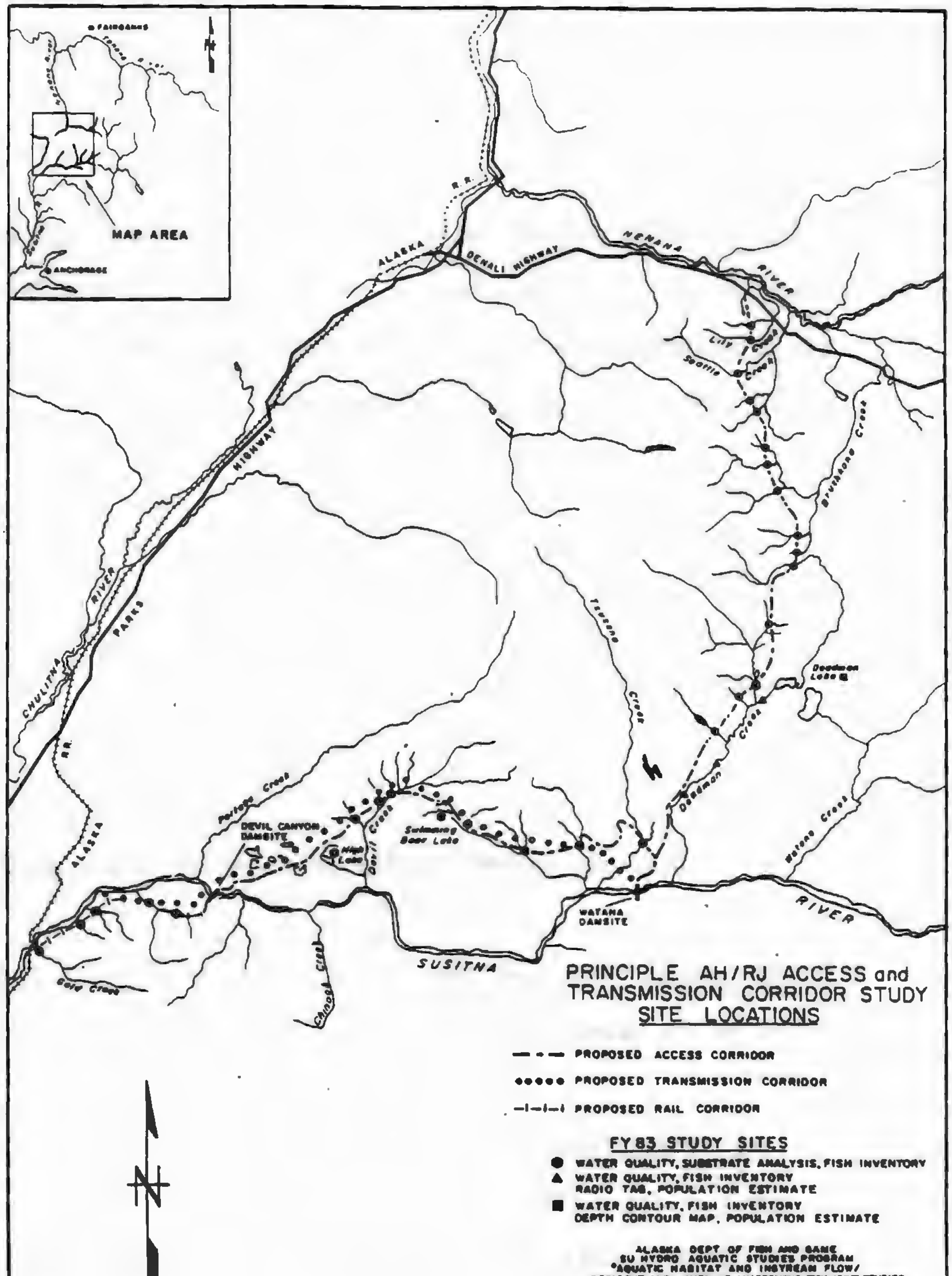


Figure B-5. Map showing the locations of the principle Access and Transmission Corridor Study sites.

Railroad spur and transmission line - Gold Creek 12 miles east northeast to the Devil Canyon damsite.

6 stream crossings

2.2.3.2.2 Reach Studies on Deadman Creek

Three one-mile segments along Deadman Creek parallel to the access road for about 10 miles:

- one mile downstream from the Deadman Lake outlet
- a one mile segment in the middle reach
- a one mile segment in the reach just above Deadman falls

2.2.3.2.3 Lake Studies

Three lakes:

- Deadman Lake
- Swimming Bear Lake
- the High Lakes complex

Spawning Surveys (spring 1984)

<u>Arctic grayling spawning</u>:

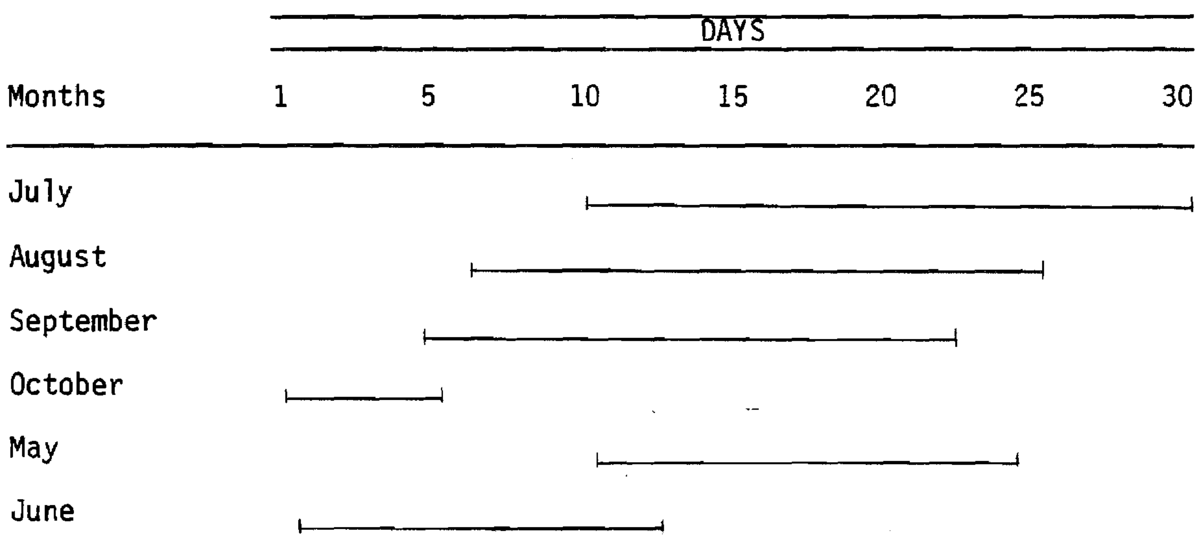
- Deadman Creek (above and below Deadman Lake)
- Brushkana Creek
- Seattle Creek

<u>Rainbow trout spawning</u>:

- High Lake

2.2.3.3 Schedule of Activities and Frequency of Sampling

Tentative Field Schedule



2.2.3.3.1 Stream Studies at Proposed Access Road Crossings

Study sites on the streams crossed by the access roads will be sampled once during the 1983 summer studies in August or early September.

2.2.3.3.2 Reach Studies on Deadman Creek

All three reaches of Deadman Creek will be sampled in July. Each reach will be sampled five times.

2.2.3.3.3 Lake Studies

Deadman Lake will be sampled monthly throughout the open water season.

Swimming Bear Lake and the High Lakes complex will be sampled for one, 24-hour period in August or September.

2.2.3.3.4 Spawning Studies (spring 1984)

Spawning surveys for Arctic grayling and rainbow trout will be conducted in May and June, before, during, and after breakup.

3.0 DATA PROCEDURES

3.1 Resident Fish Studies

3.1.1 Field Data

3.1.1.1 Habitat and Relative Abundance

Biological data recorded at habitat and relative abundance study sites included species, length, sex, scale card number, age, and fate.

Catch data gathered at habitat and relative abundance sites are location, river mile/tributary mile, geographic code, date, collectors, catch by species, tag number, fate, recapture code/number, gear code, data set, date pulled, time set, time pulled total time fished or catch per unit effort, time shocked, distance shocked, conductivity, voltage, amps, net length, mesh size, bait type, hook size, and hook type.

Habitat data to be collected at habitat and relative abundance sites are water depth, water velocity, pH, dissolved oxygen, specific conductance, turbidity, surface water temperature, intragravel temperature, air temperature, substrate, percent cover, cover type, grid number, cell number and area.

Sampling forms to be utilized at habitat and relative abundance sites are presented in Figures B-6 to B-12.

3.1.1.2 Fish Preference Studies

Biological data to be recorded at each resident fish preference study site include species, number of each species captured, length, and fate.

Habitat data that will be documented at each resident fish preference study site are turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification.

Other data recorded include time sampled, date, location, grid number, cell number, gear code, and effort. The resident fish preference sites were also mapped at periodic intervals.

Resident fish preference study data will be recorded on Forms RJ 83-08 (Figure B-12).

3.1.1.3 Population Estimates

Biological data recorded at population estimate sites included species, length, and fate.

Catch data will be composed of gear code, catch by species, tag number, recapture number, location, date, time, and collectors.

File No. 03-82-7.10-272 Page ____ of ____

SUSITNA HYDRO BIOLOGICAL DATA RJ 82-02

Location ______________________ RM/TRM ________ GC __/___/___/__/___

Date collected ____/____/____ (yr. / mo. / day) Collector Initials ______________________

	Species Code	Length (mm)	Sex M	Sex F	Age	Scale Card No.	Gear Code		Mesh Size (in.)	Tag Number	[illegible]	Remarks
1									.			
2									.			
3									.			
4									.			
5									.			
6									.			
7									.			
8									.			
9									.			
10									.			
11									.			
12									.			
13									.			
14									.			
15									.			
16									.			
17									.			
18									.			
19									.			
20									.			

Comments:

Figure B-6. Susitna Hydro biological data form, RJ 82-02.

File No. 03-82-7.10-2.73

SUSITNA HYDRO TAG DEPLOYMENT DATA RJ 82-03

Tag Number	Gear Code	Date			Species Code	Length (mm)	Sampling Location	Mainstem	Tributary	River Mile
		yr.	mo.	day						
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										

Comments:

Figure B-7. Susitna Hydro tag deployment data form, RJ 82-03.

File No. 03-82-7.10-2.74

SUSITNA HYDRO TAG RECAPTURE DATA RJ 82-04

Tag Number	Recapture Code	Gear Code	Date			Length (mm)	Sampling Location	Mainstem	Tributary	River Mile	Fate Code
			yr.	mo.	day						
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											
0											

Comments:

Figure B-8. Susitna Hydro tag recapture data form, RJ-82-04.

File No. 03-82-7.10-2.75 Page____ of____

SUSITNA HYDRO OPPORTUNISTIC GEAR CATCH DATA RJ 82-05

Location ______________________ RM/TRM __________ GC __/__ __ __/__ __ __/__ __/__ __ __

Date: Gear Set ____/____/____ Gear Pulled ____/____/____ Collector Initials ______________

Gear Code	PSN	Net Length	Mesh Size	TIME Set	TIME Pulled	TIME Total	Catch – Species Code Number								Remarks

		Conductivity	Volts	Amps											Unit – Make and Model No.

		Bait Type	Hook Size	Hook Type											

Comments:

Figure B-9. Susitna Hydro opportunistic gear catch data form, RJ 82-05.

AA 82-03

Electroshocking Catch Form

Crew: __________ Location: ____________________

Sample: ________ River Mile: ____________________

Date (YY/MM/DD): ___/___/___ Trib. River Mile: ____________________

Time (military): ____________ Geographic Code: _/_ _ _/_ _ _/_ _/_ _/_ _ _/_

Distance Shocked (yards): ____ Time Shocked (minutes): ______________

Species		Catch	Remarks
Resident			
Dolly Varden	(530)		
Rainbow	(541)		
Humpback Whitefish	(582)		
Round Whitefish	(586)		
Arctic Grayling	(610)		
Longnose sucker	(640)		
Burbot	(590)		

Figure B-10. Electroshocking catch form, AA 82-03.

AQUATIC HABITAT ELECTROFISH SUMMER FORM AH-107

File No. ____________ Location ____________

Page ____ of ____ Description ____________

Crew ____________ R.M. ________ T.R.M. ________

Date ____________ Time ________ Geographic Code ___/___/___/___/___

Sample #	Depth (feet)	Velocity (feet/second) 0.2	0.8	x / 0.6

PHYSIOCHEMICAL DATA

Sample #	Air (°C) Temp.	Intragravel Temp. (°C)	Surface Water (°C) Temp.	pH	Dissolved Oxygen (mg/l)	Specific Conductance (μmhos/cm) M.R. / C.R.

SUBSTRATE DATA

Comments

Hydrolab # ____________

Marsh-McBirney # ____________

Figure B-11. Aquatic habitat electorfish summer form, AH-107.

RESIDENT FISH HABITAT AND CATCH DATA RJ 83-08 PAGE ___ OF ___

LOCATION: ______________ COLLECTOR'S INITIALS: ________

DATE: ___ (yr.) / ___ (mo.) / ___ (day) GRID NO.: ________ HYDROLAB NO.: ________ TIME: ________

TURBIDITY: ________ WATER TEMP.: ________ pH: ________ D.O.: ________ COND.: ________

HABITAT DATA							CATCH DATA								
Cell No	Area (sq/ft)	Vel. ft/sec.	Depth (ft)	Sub-strate	% Cover	Cover Type	Gear Code	Effort	Species Code	No. of Fish	Length (mm)	Fate Code	Tag No.	Recap. No.	REMARKS

SUBSTRATE CODE

1 SILT
2 SAND
3 SMALL GRAVEL (1/8"-1")
4 LARGE GRAVEL (1"-3")
5 RUBBLE (3"-5")
6 COBBLE (5"-10")
7 BOULDER (>10")

DOMINANT COVER

1 NO COVER
2 EMERGENT VEGETATION
3 AQUATIC VEGETATION
4 DEBRIS / DEADFALL
5 OVERHANGING RIPARIAN
6 UNDERCUT BANKS
7 LARGE GRAVEL 1"-3"
8 RUBBLE 3"-5"
9 COBBLE OR BOULDER >5"

% COVER

1 0-5 %
2 6-25 %
3 26-50 %
4 51-75 %
5 76-95 %
6 96-100%

SPECIES CODES

412-CHINOOK
422-SOCKEYE
433-COHO
440-PINK
450-CHUM
541-RAINBOW TROUT
586-ROUND WHITE
590-BURBOT
610-ARCTIC GRAYLING
640-LONGNOSE SUCKER
660-3 SPINE STICKLEBACK

Figure B-12. Resident fish habitat and catch data form, RJ 83-08.

Habitat data gathered at population data sites will include water velocity, water depth, water temperature, turbidity, pH, dissolved oxygen, specific conductance, substrate, percent cover, cover type, grid number, cell number, and area.

Figure B-12 depicts the form which will be utilized to collect data for the resident fish population estimate studies.

3.1.1.4 Radio Telemetry

Biological data to be collected from radio tagged fish are species, length, sex, scale card number, and age.

Catch data for radio tagged fish will include capture date, capture location, capture river mile, release date, release site, and release river mile.

The following surgical data will be recorded for each radio tagged fish: time anesthetized, time surgery begun, time surgery completed, and the total time for the operation.

Tag data to be recorded at the time of implantation and during each tracking flight are frequency, pulse per second, and seconds per pulse. The location, date, and river mile of each radio tag signal that is received will be recorded during each tracking flight.

Figure B-13 and B-14 presents the forms which were used to collect data for the radio telemetry studies.

3.1.2 Data Transfer

Data forms for resident fish habitat and relative abundance, population estimates, and radio telemetry will be checked for accuracy and completeness following each sampling trip. Habitat and relative abundance data is then submitted to the data processing unit for key punching and the population estimate and radio telemetry data are filed for hand compilation at a later date. Printouts of the initial habitat and relative abundance data are returned to the individuals who collected the data so that they can be rechecked for errors before they are incorporated into the computer data base for analysis (Figure B-15).

Field trip reports, which summarize the preliminary data finds, will be submitted after each sampling trip.

3.1.3 Data Analysis

Procedures used to analyze data for the resident fish studies will be similar to those presented for the juvenile anadromous habitat study in Figure B-19. The final products for the resident fish studies are: (1) description of the distribution and relative abundance for selected resident fish species, including an analysis of the environmental factors affecting distribution, (2) preference curves for selected resident fish species for various habitat parameters, (3) an analysis to

SUSITNA HYDRO RADIO TAG DEPLOYMENT DATA, RJ 83-06

					RADIO TAG DATA				CAPTURE DATA						TIME OF OPERATION		
Species	Fork lenght/age in mm	Sex	Floy tag #	Scale Card #	Freqeuncy	delta	Pulses per sec	Secs per pulse	DATE capt.	DATE rel	loc.	R.M.	Method of capt.	Aneth. Time	Beg Sur.	End Sur.	Total Time

Figure B-13. Susitna Hydro radio tag deployment data form, RJ 83-06.

SUSITNA HYDRO RESIDENT FISH RADIO TRACKING DATA, RJ 83-07.

DATE: ___/___/___ TIME: _______ to ______ WEATHER: _______________

Species	Channel	Tag	Release Site	Date	RM	Last Position	Date	RM	New Position	RM
	1	600.5								
		600-1								
		600-2								
		600-3								
	2	610.5								
		610-1								
		610-2								
		610-3								
	3	620.5								
		620-1								
		620-2								
		620-3								
	4	630.5								
		630-1								
		630-2								
		630-3								
	5	640.5								
		640-1								
		640-2								
		640-3								
	6	650.5								
		650-1								
		650-2								
		650-3								
	7	660.5								
		660-1								
		660-2								
		660-3								
	8	670.5								
		670-1								
		670-2								
		670-3								
	9	680.5								
		680-1								
		680-2								
		680-3								
	10	700.5								
	11	710-1								
		710-3								
	12	730-2								

REACH OF RIVER FLOWN: _______________

ESTIMATED ALTITUDE (ft.): _______________

EQUIPMENT USED: _______________

RELATIVE RIVER CONDITION: _______________

NAMES OF PEOPLE FLYING: _______________

FLYING SERVICE: _______________

TRIBUTARY REACHES FLOWN: _______________

Figure B-14. Susitna Hydro resident fish radio tracking data form, RJ 83-07.

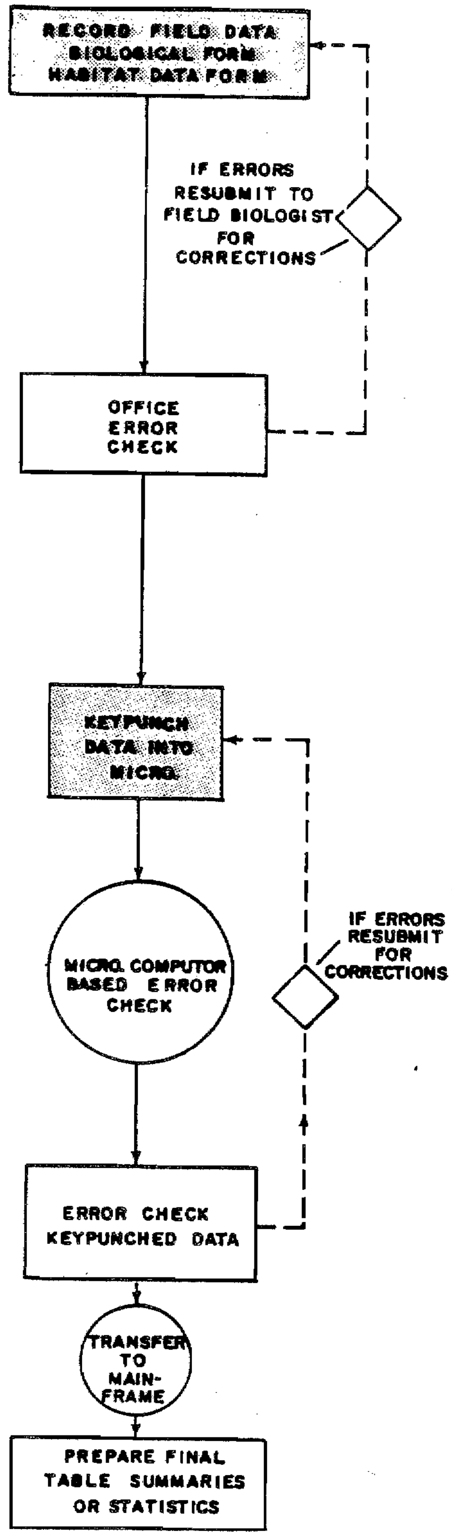


Figure B-15. Resident and Juvenile Anadromous Studies (RJ) data transfer flow chart (includes all RJ studies except outmigrant studies and access/transmission corridor studies).

determine if the data set will support an incremental analysis of instream flow on selected resident fish species, and (4) IFG-4 models with input from preference curves, if appropriate.

3.2 Juvenile Anadromous Fish Studies

3.2.1 Abundance, Outmigration, Timing, And Survival

3.2.1.1 Field Data

3.2.1.1.1 Coded Wire Tagging

Tagging data to be recorded at each tagging site will include species, mean length, number of fish tagged, percent tag retention, and mortality. Site, data, tag code, and time of release will also be recorded.

3.2.1.1.2 Recovery of Marked and Unmarked Fish

Biological data to be collected at the downstream migrant traps will include fish species, length, fate of captured fish, and scale sampling. Upon reaching a total of 50 representatives of one species in a given day, a tally of that species will be kept for the remainder of that day minus the biological data.

Samples to be collected include scales from predetermined size classes of resident and juvenile anadromous species for age classification. All adipose fin clipped chum and sockeye salmon juveniles will be collected and preserved for future dissection and analysis of the coded wire tags.

Habitat data collected in association with the biological data at the downstream migrant traps will include depth fished (feet), distance from shore (feet), velocity at each trap (fps), river stage (feet), air and water temperature (°C), pH, dissolved oxygen (ppm), conductivity (um/hos), and turbidity (NTU). Depth fished is read from the water surface to the bottom of the front of the incline. Distance from shore will be measured from water's edge to the center of the incline plane. Velocity will be read from the center of the bow of each trap directly in front of the incline. If the depth at this point exceeds three feet, velocity readings will be read at 0.2 and 0.8 of the total depth and averaged. If the depth is less than three feet, one reading will be taken at 0.6 of the total depth. River stage will be read from a staff gage to be surveyed in by AH staff. Water temperature, pH, DO, conductivity and turbidity samples will be taken from the deck of the east bank trap and air temperature will be measured in camp.

Depth fished and distance from shore will be recorded for each trap at every check. All other parameters will be measured once daily.

Habitat and biological data will be entered directly into an Epson HX-20 microcomputer. This computer has printing and cassette drive functions. The microcomputer will provide an initial entry printout and a final corrected printout as well as recording the data on two micro-cassette tapes, a primary tape and a backup tape. The program for data entry includes "prompts" for all habitat and biological data (see Appendix B-2) and can store up to 100 individual entries per file.

Each trap check will correspond to a file number on the Epson printouts and cassette tapes, and consist of entries for all relevant water quality and habitat data followed by the biological data and individual species tallies. In the event that the Epson micro-computer fails to provide adequate storage or proves unworkable, data will be recorded by hand.

3.2.1.2 Data Transfer

3.2.1.2.1 Recovery of Marked and Unmarked Fish

Field data will be transferred to the data processing section by micro-cassette tape and paper printout from the Epson microcomputer as it is collected (Figure B-16). Trip reports will be submitted monthly to include total catch by species, coded wire tag recoveries, efficiency of the Epson as a data recording system, and river conditions.

3.2.1.3 Data Analysis

3.2.1.3.1 Coded Wire Tagging

Preliminary data analysis will begin following the end of the tagging program in June with the preparation of a table for the Pacific Marine

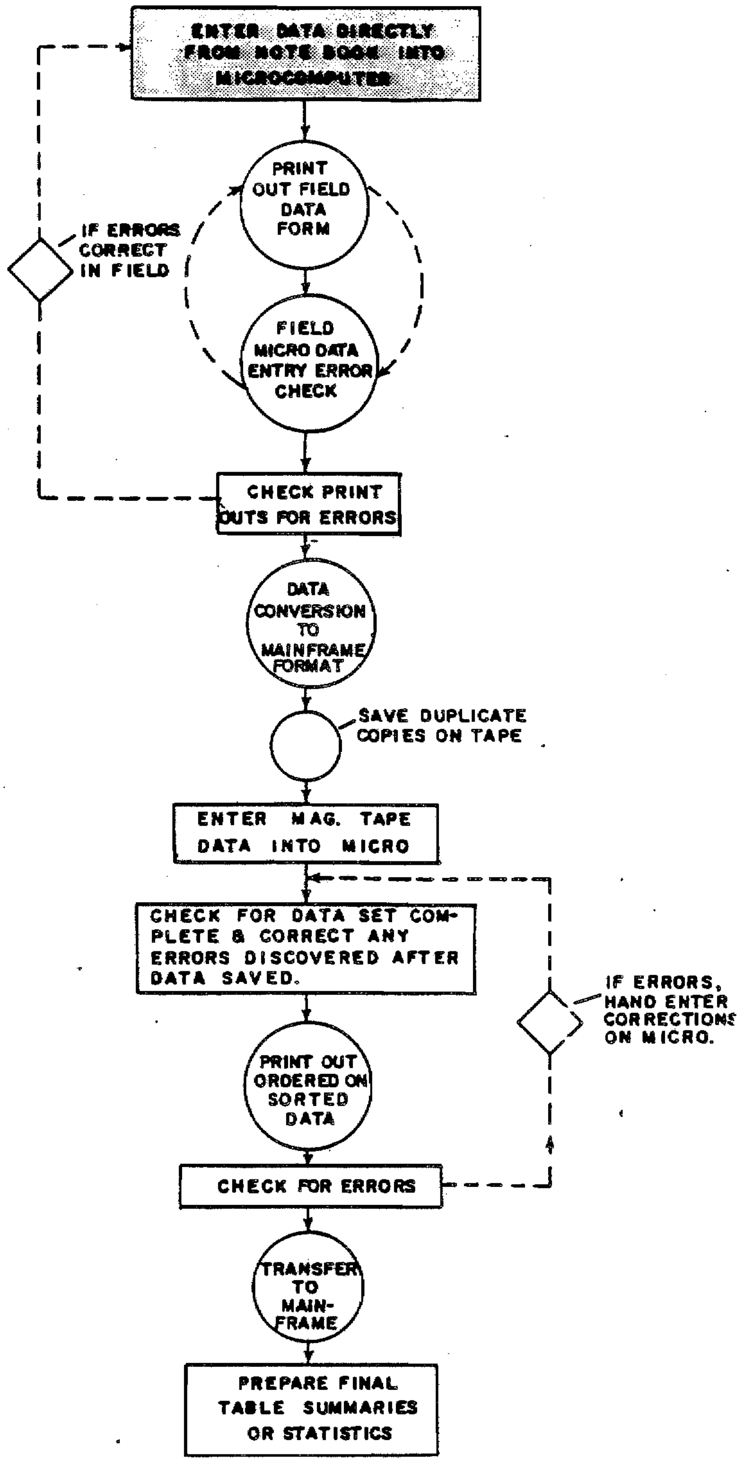


Figure B-16. Data transfer flow chart for outmigrant studies at the downstream migrant traps.

Fisheries Commission (PMFC). This table will outline the tagging sites, dates of release, species and numbers of fish tagged, and mean length of fish tagged. Also provided at this time will be a preliminary inner office report on the outcome of program implementation.

Tags collected from recovered fish will be read at the end of the field season. Population and survival estimates will be calculated following the compilation and preliminary analysis of data collected at the downstream migrant traps. A report on the coded wire tagging program will be included in the 1983 Aquatic Studies Basic Data report. Population estimates from the mark-recovery program will be provided using the Petersen and Schaefer estimators of Ricker (1975). Survival will be back calculated from using the estimates of total egg deposition and outmigrant populations.

3.2.1.3.2 Recovery of Marked and Unmarked Fish

All data will be compiled and organized by data processing personnel. Variables to be used in catch data analysis will include Gold Creek discharge, water temperature, diurnal timing, turbidity, seasonal timing, and horizontal and vertical distribution in the water column.

3.2.1.3.3 Dye Marking

Dye mark retention on juvenile salmon will be checked at the study sites and at the downstream migrant traps to determine how long the dyes markings remain visible.

3.2.2 Emergence and Development

3.2.2.1 Data Recording

Data to be recorded at artificial redd sites will include: site location, species, hole number, counts of viable and inviable eggs in each Whitlock-Vibert box, siltation of Whitlock-Vibert boxes, water temperature, intragravel temperature, and ice conditions.

At natural salmon redds the following data will be recorded: redd location, species, approximate depth of the redd, substrate description, water temperature, intragravel temperature, and ice conditions.

Specimens of preserved salmon embryos and alevins collected in the field will be analyzed in our laboratory to describe the stage of organogenesis, the percentage of yolk vascularization, and the percent of yolk absorption. The number and percentages of each stage will be recorded by tributary, site, date, and species.

3.2.2.2 Data Transfer

Field data will be summarized in trip reports after the completion of each field trip. Salmon embryo and alevin collected will be classified by developmental stage and tabulated by tributary, site, date, and species.

3.2.2.3 Data Analysis

A regression analysis will be performed for mean temperature units versus development by species and site (see ADF&G 1983b, Section 3.4.1) to determine dates for 50 percent hatching and 50 percent emergence.

Survival of eggs to the eyed stage, and hatching and emergence will be calculated. Rates of development will be correlated with substrate type, and ice cover.

3.2.3 Rearing Habitat Studies

3.2.3.1 Field Data

3.2.3.1.1 Fish Preference Studies

Biological data to be recorded at each fish preference study site include species, number of each species captured, length, and fate (Figure B-17).

Habitat data that will be documented at each fish preference study site are turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification (Figure B-17).

JAHS HABITAT AND CATCH DATA RJ-83-01

PAGE ___ OF ___

LOCATION: ______________ HABITAT MODEL ________ COLLECTOR'S INITIALS: ________

DATE: ___ / ___ / ___ (yr. / mo. / day) GRID NO.: ________ HYDROLAB NO.: ________ TIME: ________

TURBIDITY: ________ WATER TEMP.: ________ pH: ________ D.O.: ________ COND.: ________

	HABITAT DATA							CATCH DATA							
	Cell No.	Area (sq/ft)	Vel. ft/sec.	Depth (ft)	Sub-strate	% Cover	Cover Type	Gear Code	Effort	Species Code	No. of Fish	Length (mm)	Fate Code	Slide No.	REMARKS
1															
2															
3															
4															
5															
6															
7															
8															
9															
0															
11															
12															
3															
14															
19															

SUBSTRATE CODE

1 SILT
2 SAND
3 SMALL GRAVEL (1/8"-1")
4 LARGE GRAVEL (1"-3")
5 RUBBLE (3"-5")
6 COBBLE (5"-10")
7 BOULDER (>10")

DOMINANT COVER

1 NO COVER
2 EMERGENT VEGETATION
3 AQUATIC VEGETATION
4 DEBRIS / DEADFALL
5 OVERHANGING RIPARIAN
6 UNDERCUT BANKS
7 LARGE GRAVEL 1"-3"
8 RUBBLE 3"-5"
9 COBBLE OR BOULDER >5"

% COVER

1 0-5 %
2 6-25 %
3 26-50 %
4 51-75 %
5 76-95 %
6 96-100%

SPECIES CODES

412- CHINOOK
422- SOCKEYE
433- COHO
440- PINK
450- CHUM
541- RAINBOW TROUT
586- ROUND WHITE
590- BURBOT
610- ARCTIC GRAYLING
640- LONGNOSE SUCKER
660- 3 SPINE STICKLEBACK

Figure B-17. JAHS habitat and catch data form, RJ 83-01.

Other data recorded include time sampled, date, location, grid number, cell number, gear code, and effort. The fish preference sites were also mapped at periodic intervals (Figure B-18).

3.2.3.1.2 Fish Habitat Modeling Studies

Habitat data recorded at fish habitat modeling sites included turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification (Figure B-17).

Additional data recorded at fish habitat modeling sites are time sampled, date, location, grid number, and cell number. Maps of fish habitat modeling sites will include wetted edge measurements, initial compass bearings, and distance between transect markers (Figure B-18).

Biological data will not be collected regularly at fish habitat modeling sites. However, when the opportunity presents itself to collect data which will augment fish preference studies, biological data such as species, number of each species captured, length, and fate will be collected.

3.2.3.1.3 IFG-4 Modeling Studies

Field data recorded for IFG-4 modeling sites will be the same biological, habitat, and other data parameters recorded for fish preference study sites.

JAHS SITE MAP RJ 83-03

LOCATION ____________ RM ____________ GC. ___/___/___/___/___

DATE ___/___/___ (yr. mo. day) GRID NO. ______ COLLECTOR'S INITIALS ______

STAFF GAUGE	
NO.	READING

PAGE ___ OF ___

Figure B-18. JAHS site map form, RJ 83-03.

3.2.3.2 Data Transfer

After each sampling trip, fish preference study and habitat modeling study data forms will be checked for accuracy and completeness before submitting them to the data processing unit for key punching. Printouts of the initial data will then be returned to the individuals who collected the data so that it can be rechecked for errors before it is incorporated into the computer data base for analysis (Figure B-15).

Field trip reports will be completed immediately after each sampling trip and will summarize the initial data findings of each sampling trip.

3.2.3.3 Data Analysis

Data analysis will proceed as per Figure B-19. There are basically four final products: (1) description of distribution and relative abundance for each species (including an analysis of several environmental factors affecting distribution), (2) preference curves for each species for various habitat parameters, (3) IFG-4 models with input from preference curves, and (4) a model of juvenile rearing habitat at the RJ habitat model sites that will incorporate cover, turbidity, and velocity preferences record at these sites.

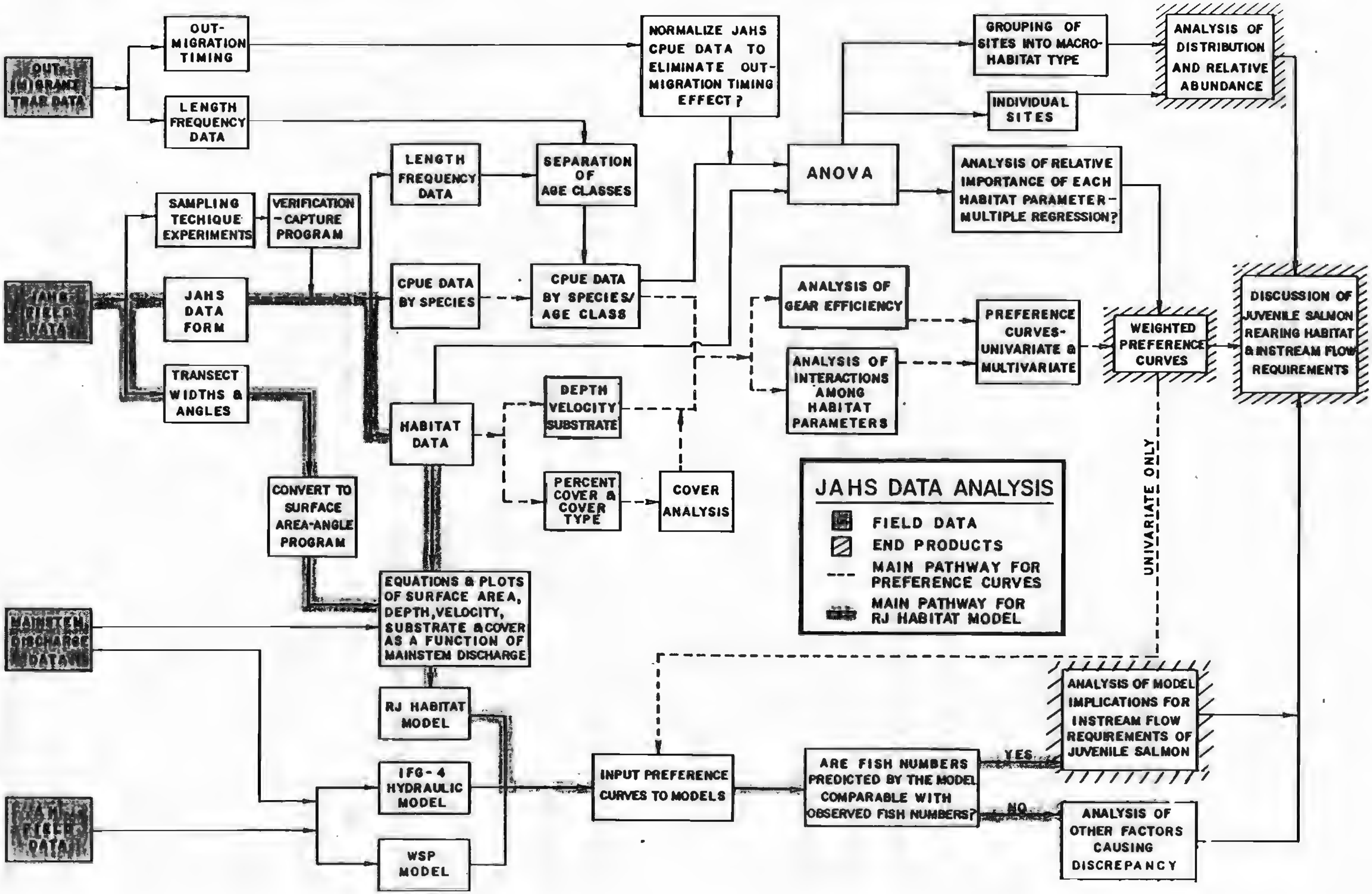


Figure B-19. Juvenile Anadromous Habitat Study (JAHS) data analysis flow chart.

3.3 Fish and Habitat Surveys Along the Proposed Access/Transmission Corridors

3.3.1 Field Data

3.3.1.1 Fish Data Collection

All field data will be recorded in, "Rite-in-the-Rain," notebooks and transferred to Forms RJ 83-04 and RJ 83-05 (Figure B-20 and B-21). This data will include site, date, effort, gear type, collectors, species, length, sex, scale card number, and tag number.

3.3.1.2 Aquatic Habitat Data Collection

Aquatic habitat data collected at proposed stream crossing sites will be recorded in field notebooks and transcribed to data forms (Figure B-22). These data will include dissolved oxygen, specific conductance, pH, air and water temperature, discharge and substrate. Other field data collected in associated with lakes and other areas of the study will be recorded in field notebooks. Upon returning to the office field notes will be copied on a copy machine and filed for use in the final report.

3.3.2 Data Transfer

Trip reports will be written monthly summarizing field activities and preliminary data findings.

SUSITNA HYDRO CORRIDOR STUDIES, CATCH AND BIOLOGICAL DATA
RJ 83-04

PAGE ___ OF ____

LOCATION ____________________ MILE ________ G.C. __/__/__/__/__

DATE ____________________ COLLECTORS ____________________

REMARKS

Gear Code	Total Time	CATCH (Species Codes) 610	550	162			
2							
9							
5							
1							

Sample No.	Species	Length	Sex	Age	Scale Card No.	Tag No.	Sample No.	Species Code	Length	SEX	Age	Scale Card No.	Tag No.
1							26						
2							27						
3							28						
4							29						
5							30						
6							31						
7							32						
8							33						
9							34						
10							35						
11							36						
12							37						
13							38						
14							39						
15							40						
16							41						
17							42						
18							43						
19							44						
20							45						
21							46						
22							47						
23							48						
24							49						
25							50						

Figure B-20. Susitna Hydro corridor studies, catch and biological data form, RJ 83-04.

SUSITNA HYDRO CORRIDOR STUDIES TAGGING / RECAPTURE DATA
RJ-83-05

TAG DEPLOYMENT DATA					TAG RECOVERY DATA					
Tag Number	Species	Length	Date	Location*	Date	Length	Location*	Date	Length	Location*

*Study site name.
At stream crossings put "above" or "below".

Figure B-21. Susitna Hydro corridor studies tagging/recapture data form, RJ 83-05.

SUSITNA HYDRO CORRIDOR STUDIES-AQUATIC HABITAT DATA

AH-IMP 83-01

SAMPLING AREA: ____________ PAGE ____ OF ____

CREW: ____________ FILE NO. ____________ SAMPLING PERIOD: ____________

LOCATION	Corridor Mile	Date	Military Time	Hydrolab No.	D.O.			Spec. Cond.		pH	Temp °C		Turbidity	Gradient	Discharge	Substrate			
					Bar. Pres.	% Sat.	Conc. mg/l	Meter	Adj.		H_2O	Air	NTU	%	cfs	% Embed	%-1 Class	%-2 Class	%-3 Class
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			

(ADFG/SU HYDRO,5/83,JS)

Figure B-22. Susitna Hydro corridor studies - aquatic habitat data form, AH-IMP 83-01.

Two copies will be made of all data forms, one will be filed under the access and transmission corridor/impoundment sub-project, and one will be filed with the Aquatic Habitat and Instream Flow Studies quality assurance section.

3.3.3 Data Analysis

Data will be collected only once during the field season at each proposed stream crossing site and will be presented in a general table format to be referenced as needed in the 1983 Basic Data Report.

The 1983 Basic Data Report for the Access-Transmission Corridor Studies will consist of a site by site narrative describing the fish and aquatic habitat components at each site sampled. Narratives will be derived from raw data, trip reports, and field notes.

4.0 QUALITY CONTROL

The Resident and Juvenile Anadromous Project Leader and his respective Sub-Project Leaders are charged with the responsibility of maintaining standards for collection, recording, and the processing of data. Sub-project Leaders report to the Project Leader after each sampling trip to discuss the progress of their individual studies. The Project Leader and/or his representative also inspect field operations periodically to insure that the sampling programs are conducted consistently and accurately.

Literature on the latest data collection and analysis procedures are continually reviewed to be sure that the best possible methods are being employed.

Field data from each sub-project are recorded and systematically checked for accuracy and completeness by each field crew. The data is then submitted to the Quality Assurance and Support Section where it is reviewed and routed to the Data Processing Section for key punching. Data processing returns a print-out of the data which is then cross checked with the original data forms by the individuals who initially collected it. When all parties concerned are satisfied with the data, it is routed through the project biometrician for final analysis before being incorporated into the basic data and analysis reports.

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AQUATIC HABITAT AND INSTREAM FLOW PROJECT

1.0 INTRODUCTION

1.1 Background

The overall objectives of the Aquatic Habitat and Instream Flow Project (AH) of the ADF&G Susitna Hydroelectric Feasibility Aquatic Studies are to characterize the seasonal physical and chemical requirements of selected anadromous and resident fish species within the various habitats within the study area (Figure 1) and to determine if and how mainstem Susitna River discharge levels influence the quality and availability of those characteristics of fish utilization within the various habitats. To meet these overall objectives Phase I investigations were initiated in FY82 (July, 1981 - June, 1982) to begin the process of identifying:

1. fish habitats in the study area;

2. seasonal relationships between mainstem discharge of the Susitna River and the physical and chemical characteristics of these fish habitats; and,

3. seasonal relationships between mainstem discharge of the Susitna River and fish distribution and abundance.

Studies downstream of Devil Canyon during these FY82 Phase I studies were focused on the reach of river between Talkeetna and Devil Canyon. Seven habitat types were identified: mainstem, side channel, side and

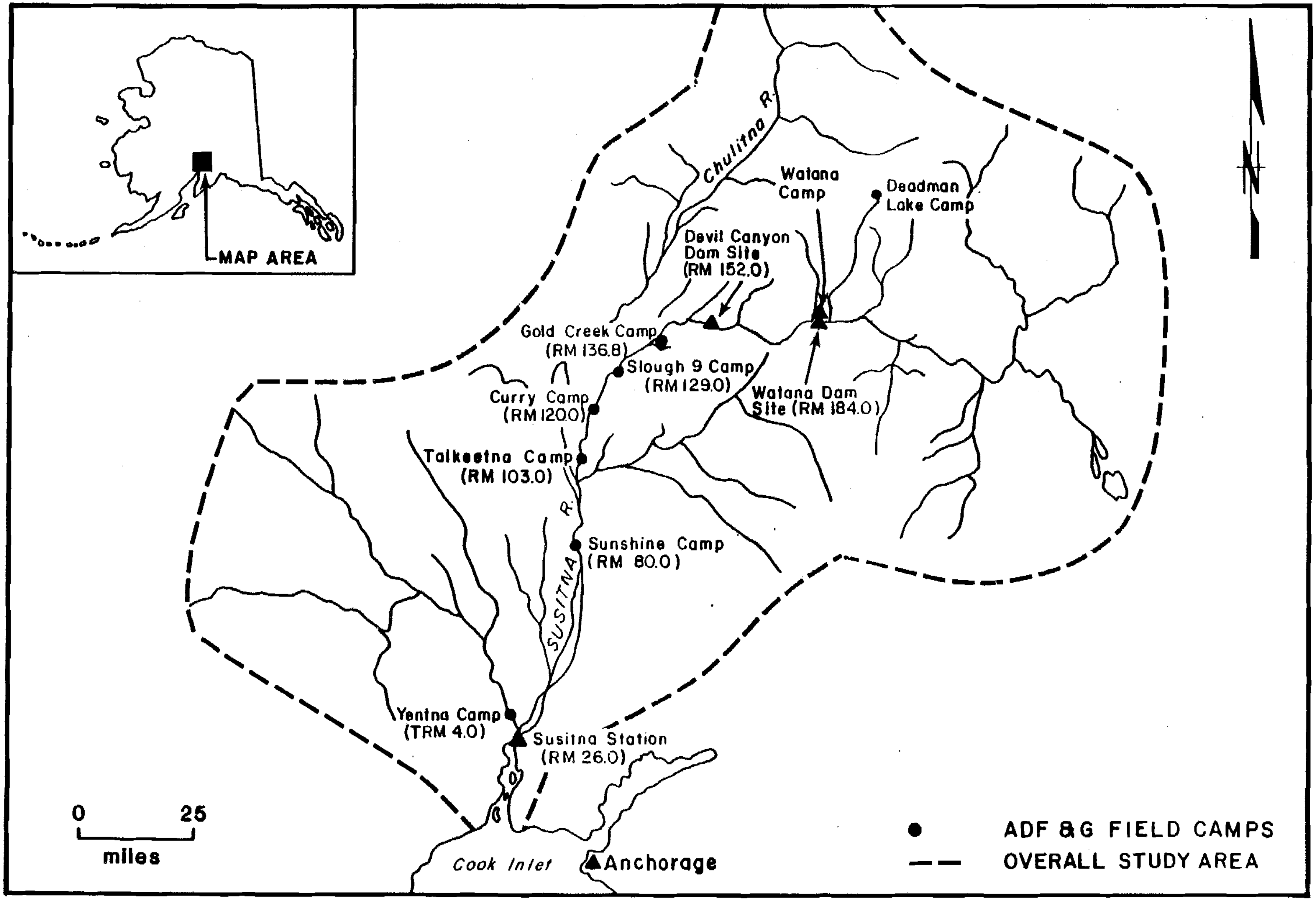


Figure 1. Susitna Hydroelectric Project study area.

upland slough, tributary, tributary mouth and lake. Emphasis was placed on selected slough habitats because it appeared that this habitat was the most sensitive to changes in mainstem flow. Results indicated that mainstem discharge influenced both the immigration of adult salmon to sloughs and the overall availability of spawning habitat within sloughs. High water conditions, insufficient resources, and the nature of the first year studies precluded collecting sufficient data to quantify these findings. Results and findings of these and other studies are summarized in the ADF&G Phase I Final Draft Report, Volume 1, Aquatic Habitat and Instream Flow Project (ADF&G 1981).

Studies were also initiated in the proposed impoundment areas (RJ Figure 5) during the FY82 Phase I studies to identify baseline physical and chemical characteristics of fish habitats which would be inundated by the proposed reservoirs, with the objective of quantifying the amount of resident fish habitat to be lost. Baseline information on resident fish habitat in major tributaries located within the boundaries of the proposed impoundments was collected and analyzed. A summary of the results is presented in the ADF&G Phase I Final Draft Report, Resident Fish Investigations in the Upper Susitna River (ADF&G 1981).

Phase II investigations were initiated in FY83 (July, 1982 - June, 1983) to further investigate and determine the relationship of baseline hydrological, hydraulic, and water quality characteristics of mainstem, side channel, slough, and tributary habitats to mainstem discharge and to further investigate and quantify the relationship of fish habitats in these habitats to mainstem discharge. These investigations were primarily focused on the reach of the river extending from Talkeetna to Devil Canyon. It was found that for the range of mainstem flows that were evaluated (8,000 to 30,000 cfs), the relationship between water surface elevation and mainstem discharge is relatively well defined at various mainstem locations between Talkeetna and Devil Canyon. In addition, a better understanding of the relationships between mainstem discharge and the hydraulic characteristics at the mouths of side sloughs was obtained for the mainstem discharges experienced. This information was used to evaluate and quantify the accessibilty of selected side slough habitats for salmon spawning. Insufficient information was, however, obtained to quantify the relative availability and utilization within side slough habitat or to determine the relationship between side slough and mainstem discharges.

Studies were also initiated during FY83 in the mainstem river between Cook Inlet and Devil Canyon to evaluate eulachon, Bering cisco, and salmon spawning habitat. The former two species were observed to use the mainstem as their primary spawning habitat whereas salmon were rarely found to spawn in the mainstem. A baseline study of the stage/discharge characteristics at two side channel sites downstream of Talkeetna was also initiated with the objective of identifying the degree of influence that variations in mainstem discharge have on access to known spawning areas in the Cook Inlet to Talkeetna river reach.

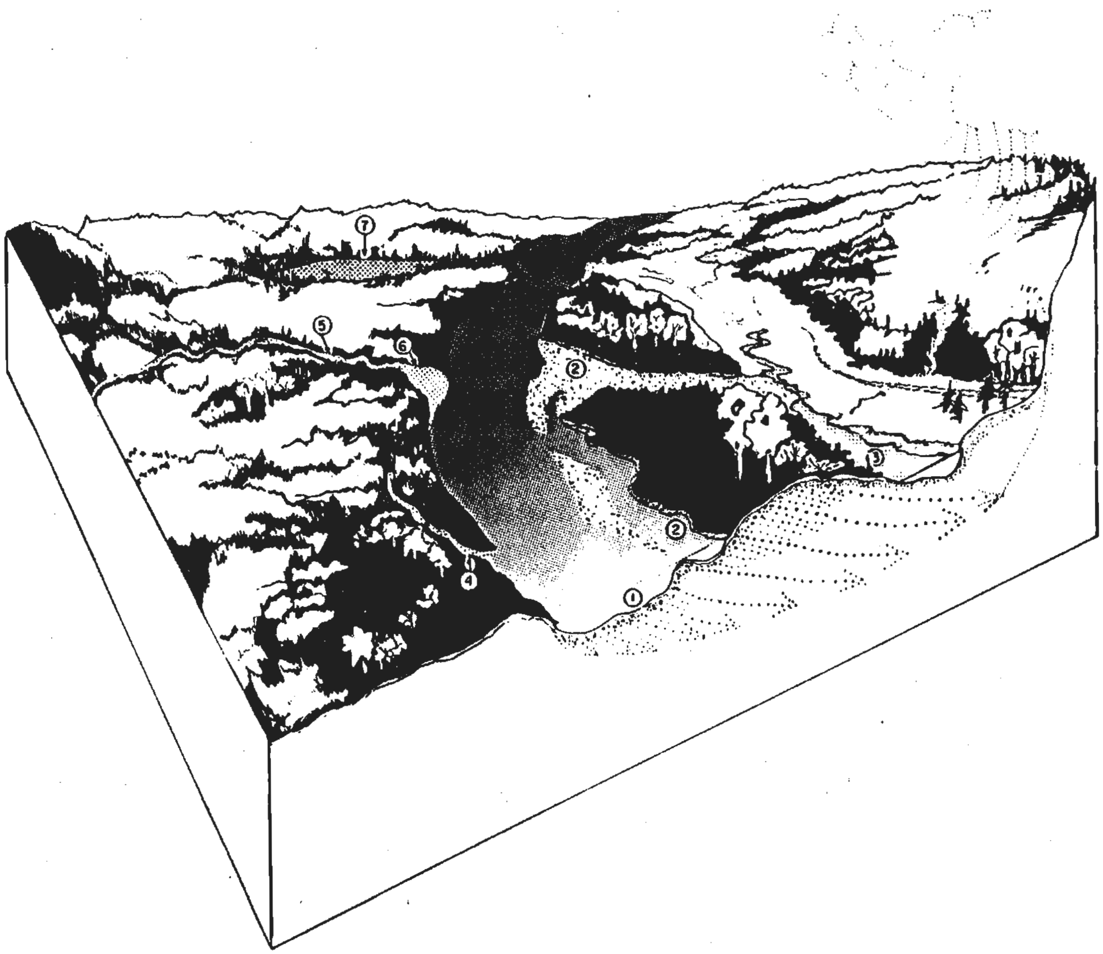
Complete results and findings of the FY83 Lower River Studies are summarized in the ADF&G Susitna Hydro Aquatic Studies Phase II Basic

Data Report, Volume 4: Aquatic Habitat and Instream Flow Studies, Parts I and II (ADF&G 1982).

Studies in the proposed impoundment areas (RJ Figure 5) were expanded during FY83 to include habitat evaluations in a one mile reach upstream of the proposed impoundment boundaries in the seven study tributaries, a general habitat evaluation of Sally Lake, and a preliminary evaluation of salmon habitat in two tributaries (Chinook and Cheechako creeks). A study of grayling spawning habitat was also initiated, however, the study was limited by our ability to coordinate sampling with spawning events due to insufficient information available on the timing and locations of grayling spawning activities in impoundment tributaries. Complete results and findings of the FY83 Impoundment Studies are summarized in the ADF&G Susitna Hydro Aquatic Studies Phase II Basic Data Report, Volume 5: Upper Susitna River Impoundment Studies (ADF&G 1982).

1.2 FY84 Studies

The FY84 program (i.e., the second year of Phase II studies) is specifically designed to expand the evaluation of habitat conditions at side sloughs to include the other six habitat types associated with the Talkeetna to Devil Canyon reach of the Susitna River (Figure 2). Attention is being directed towards defining the relationship between various levels of mainstem discharge and the habitat potential of mainstem, side channel, slough, tributary mouth and tributary habitats,



GENERAL HABITAT CATEGORIES OF THE SUSITNA RIVER

1) Mainstem Habitat consists of those portions of the Susitna River that normally convey streamflow throughout the year. Both single and multiple channel reaches are included in this habitat category. Groundwater and tributary inflow appear to be inconsequential contributors to the overall characteristics of mainstem habitat. Mainstem habitat is typically characterized by high water velocities and well armored streambeds. Substrates generally consist of boulder and cobble size materials with interstitial spaces filled with a grout-like mixture of small gravels and glacial sands. Suspended sediment concentrations and turbidity are high during summer due to the influence of glacial melt-water. Streamflows recede in early fall and the mainstem clears appreciably in October. An ice cover forms on the river in late November or December.

2) Side Channel Habitat consists of those portions of the Susitna River that normally convey streamflow during the open water season but become appreciably dewatered during periods of low flow. Side channel habitat may exist either in well defined overflow channels, or in poorly defined water courses flowing through partially submerged gravel bars and islands along the margins of the mainstem river. Side channel streambed elevations are typically lower than the mean monthly water surface elevations of the mainstem Susitna River observed during June, July and August. Side channel habitats are characterized by shallower depths, lower velocities and smaller streambed materials than the adjacent habitat of the mainstem river.

3) Side Slough Habitat is located in spring fed overflow channels between the edge of the floodplain and the mainstem and side channels of the Susitna River and is usually separated from the mainstem and side channels by well vegetated bars. An exposed alluvial berm often separates the head of the slough from mainstem or side channel flows. The controlling streambed/streambank elevations at the upstream end of the side sloughs are slightly less than the water surface elevations of the mean monthly flows of the mainstem Susitna River observed for June, July, and August. At intermediate and low-flow periods, the side sloughs convey clear water from small tributaries and/or upwelling groundwater (ADF&G 1981c, 1982b). These clear water inflows are essential contributors to the existence of this habitat type. The water surface elevation of the Susitna River generally causes a backwater to extend well up into the slough from its lower end (ADF&G 1981c, 1982b). Even though this substantial backwater exists, the sloughs function hydraulically very much like small stream systems and several hundred feet of the slough channel often conveys water independent of mainstem backwater effects. At high flows the water surface elevation of the mainstem river is sufficient to overtop the upper end of the slough (ADF&G 1981c, 1982b). Surface water temperatures in the side sloughs during summer months are principally a function of air temperature, solar radiation, and the temperature of the local runoff.

4) Upland Slough Habitat differs from the side slough habitat in that the upstream end of the slough is not interconnected with the surface waters of the mainstem Susitna River or its side channels. These sloughs are characterized by the presence of beaver dams and an accumulation of silt covering the substrate resulting from the absence of mainstem scouring flows.

5) Tributary Habitat consists of the full complement of hydraulic and morphologic conditions that occur in the tributaries. Their seasonal streamflow, sediment, and thermal regimes reflect the integration of the hydrology, geology, and climate of the tributary drainage. The physical attributes of tributary habitat are not dependent on mainstem conditions.

6) Tributary Mouth Habitat extends from the uppermost point in the tributary influenced by mainstem Susitna River or slough backwater effects to the downstream extent of the tributary plume which extends into the mainstem Susitna River or slough (ADF&G 1981c, 1982b).

7) Lake Habitat consists of various lentic environments that occur within the Susitna River drainage. These habitats range from small, shallow, isolated lakes perched on the tundra to larger, deeper lakes which connect to the mainstem Susitna River through well defined tributary systems. The lakes receive their water from springs, surface runoff and/or tributaries.

Figure 2. General habitat categories of the Susitna River - a conceptual diagram (ADF&G 1983).

with particular attention given towards identifying the influences of mainstem discharge less than 8,000 cfs and greater than 32,000 cfs.

The objectives of the revised AH studies being conducted for FY84 are based on comments received from Harza-Ebasco Susitna Joint Venture. The original proposal submitted in early March was based on a review and comparison of the information collected during the FY82 and FY83 field seasons, FERC and agency draft Exhibit E comments submitted to the APA, and comments from Harza-Ebasco Susitna Joint Venture and other agencies. For a listing of the specific references presented above and specific comments relating to these references, refer to the supplemental attachment to the ADF&G Su Hydro Aquatic Studies RSA with the APA dated June 30, 1983.

During FY84, AH studies are focused on the reach of the Susitna River from Talkeetna to Devil Canyon. The work plan partitions FY84 AH work into three sub-program elements: Fish Habitat Studies (FHS), Instream Flow Evaluations (IFE), and Quality Assurance and Laboratory Operations (QUALO)[1]. As many of the objectives of these sub-program elements closely coincide with the objectives of the AA and RJ projects, all of the work is closely coordinated using common resources to meet common objectives. The analysis of portions of the AH data also require the use of data collected by other projects within the study team. The intermeshing of these various activities of study groups at study sites between Talkeetna and Devil Canyon are shown in Table 1 and Figures 3, 4 and 5.

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1 AH staff also participate in the Access and Transmission Corridor Studies (AT). The procedures used in the AT studies are discussed in a separate section of the overall Procedures Manual.

Table 1. Summary of preliminary plans for FY84 Aquatic Studies Program activities by habitat type and river mile.

This table, prepared by Aquatic Habitat and Instream Flow personnel, presents the various study programs conducted by project personnel at FY84 study sites. Study sites are presented in order of ascending river mile by habitat catagory.

TABLE LEGEND

AH = Aquatic Habitat Investigations

- FHS = Fish Habitat Studies
  - A = Availability data
  - U = Utilization data
  - M = Modelling A+U (IFG type)
  - X = Cross Section
  - I = Incubation
  - V = Incubation Boxes
  - Th = Thalweg

- IFE = Instream Flow Evaluations
  - S = Staff gage
  - Q = Discharge
  - T = Surface water temp. thermograph
  - DIS = Intragravel & surface water temp. recorder
  - DST = Stage and surface water temp. recorder
  - DG = Datapod dissolved gas.
  - WQ = Water Quality
  - X = Cross Section

RJ = Resident Juvenile Investigations

- JH = Juvenile Habitat Study
  - IFG -4 Model
  - Habitat Model
  - WSP Model
- JP = Juvenile Preference Sites
- JC = Coded Wire Tag
- RT = Radio Telemetrs Tagging Site
- RH = Resident Fish Habitat Study
- RP = Resident Fish Population Estimate
- EF = Electrofishing Site
- JV = Juvenile Incubation Box Study

AA = Adult Anadromous Investigations

- SS = Stream Survey
- E = Escapement Estimate (Petersen)
- SO = Escapement Estimate (Sonar)
- Ma = Fish use maping
- EG = Egg Retention Studies

USGS & RM Investigations

- St = Stage Recorder - RM
- Qu = Discharge - USGS
- Qr = Discharge - RM

* Tributary River Mile

** Tributaries to the Chulitna River RM corresponds to Susitna River/ Talkeetna River confluence

Table 1: Continued

STUDY SITE	RIVER MILE	AH FHS	AH IFE	RJ	AA	USGS R & M
Slough						
Rabideaux Cr. Slough	83.1			ES		
Slough 1	99.6			ES	SS,EG	
Slough 2	100.2					
Whiskers Creek Slough	101.2	Th	S,Q,WQ,X	JH,RH,ES,JP	SS,Ma,EG	
Slough 3B	101.4			JP	SS,EG	
Slough 3A	101.9				SS,EG	
Slough 4	105.2				SS,EG	
Slough 5	107.6			JH,JP	SS,EG	
Slough 6	108.2				SS,EG	
Slough 6A	112.3	Th	S,Q,WQ,X	JH,RH,ES,JP	SS,Ma,EG	
Slough 7	113.2				SS,EG	
Slough 8	113.7		S,Q,WQ,X	JH,JP	SS,Ma,EG	
Slough 8D	121.8				SS,Ma,EG	
Slough 8C	121.9				SS,Ma,EG	
Slough 8B	122.2				SS,Ma,EG	
Moose Slough	123.5			RT,ES	SS,Ma,EG	
Slough A'	124.6			ES	SS,EG	
Slough A	124.7				SS,EG	
Slough 8A	125.1	M,I	DIS,S,Q,WQ,X	RP,JH,JC,RT,ES,JP	SS,Ma,EG	St
Slough B	126.3				SS,Ma,EG	
Slough 9	128.3	M,I	DIS,S,Q,WQ,X	JH,JC,JP	SS,Ma,EG	St
Slough 9B	129.2				SS,EG	
Slough 9A	133.8				SS,Ma,EG	
Slough 10	133.8	M,I,V,Th		JP	SS,Ma,EG	
Slough 11	135.3	I,V,U,X	T,S,Q	JC,JH,JP	SS,Ma,EG	
Slough 12	135.4				SS,EG	
Slough 13	135.9				SS,EG	
Slough 14	135.9				SS,EG	
Slough 15	137.2			ES	SS,Ma,EG	
Slough 16B	137.3	Th		ES	SS,EG	
Slough 17	138.9				SS,Ma,EG	
Slough 18	139.1				SS,EG	
Slough 19	139.7		T,S,Q,WQ,X	ES,JP	SS,Ma,EG	
Slough 20	140.0	X,Th	S,Q,WQ,X	JP,RH	SS,Ma,EG	
Slough 21	141.1	M,I,V	T,S,Q,WQ,X	JC,JH,ES,JP	SS,Ma,EG	
Slough 21A	144.3				SS,EG	
Slough 22	144.3	Th	S,Q	JH,JP	SS,EG	
Tributary						
Yentna River	30.1		T(4.0)*		E(4.0)*	
Answer Creek	84.1				SS	
Question Creek	84.1				SS	
Birch Creek	88.4				SS	
Fish Creek	97.2				SS	
Talkeetna River	97.2		T(1.5)*,WQ		SS	

Table 1: Continued.

		AH				
STUDY SITE	RIVER MILE	FHS	IFE	RJ	AA	USGS R &
Byers Creek **	98.6				SS	
Troublesome Creek **	98.6				SS	
Swan Lake **	98.6				SS	
Chulitna River	98.6		T(0.6)*,WQ		SS	
Whiskers Creek	101.4		S,Q	RT,JP,ES	SS	
Chase Creek	106.4			JP,ES	SS	
Slash Creek	111.5				SS	
Gash Creek	111.6				SS	
Lane Creek	113.6	U	S,Q	JV,RT,JP,RH,ES	SS	
Lower McKenzie Cr.	116.2			JP	SS	
Upper MeKenzie Cr.				JP		
McKenzie Creek	116.7				SS	
Little Portage Cr.	117.7				SS	
Dead Horse Creek	120.9			ES	SS	
Fifth of July Creek	123.7				SS	
Skull Creek	124.7			RT,ES	SS	
Sherman Creek	130.8			ES	SS	
Fourth of July Cr.	131.1	U,I,V	S,Q	RS,RT,JP,RH	SS	
Gold Creek	136.7		S,DST,Q		SS	
Indian River	138.6	U	S,DST,Q	ES,RT,JP,JV,RH	SS	
Indian River Hello	10.1*			JP		
Jack Long Creek	144.5			RP,ES,RT,JP,RH	SS	
Portage Creek	148.9	U	S,DST,Q	ES,RT,JP,RH,RP	SS	
Portage Creek Helio	4.2*			JP	SS	
Portage Creek Helio	8.0*			JP	SS	
Portage Creek Helio	10.2*			JP	SS	
Cheechako Creek	152.4				SS	
Chinook Creek	157.0				SS	
Devil Creek	161.0				SS	
Fog Creek	176.7					
Tsusena Creek	181.3		T(0.1)*	RT		
Deadman Creek	186.7		T(0.1)*			
Watana Creek	194.1		T(0.1)*			
Kosina Creek	206.8		T(0.1)*			
Jay Creek	208.5					
Goose Creek	231.3		T(0.1)*			
Oshetna River	233.4		T(0.1)*			
<u>Tributary Mouth</u>						
Portage Creek	148.8			JP		
Lane Creek	113.6	A,U	S	JP		
Fourth of July Cr.	131.1	A,U	S	JP		
Indian River	138.6			JP		
Whiskers Creek	101.4			JP		

Table 1: Continued.

STUDY SITE	RIVER MILE	AH FHS	AH IFE	RJ	AA	USGS R & M
Mainstem						
Flathorn MS	18.2		T			
MS at Susitna Sta.	25.5		T			
MS above Deshka	40.9		T			
Sunshine Station	80.0				E,SO	
MS at Parks Hwy. Br.	83.9		T,WQ			
MS at Whiskers Creek Slough mouth	101.2		S			
MS at Whiskers Creek Slough head	101.5		S	JP		
Mainstem below Talk. Camp	102.5			ES		
Talkeetna Station	103.0		S,T,WQ	JC	E,SO	
LRX 9	103.2		T			
LRX 10.2	105.9		S			
LRX 10.3	106.4		S			
LRX 11	106.7		S			
LRX 12	108.4		S			
Oxbow I	110.2			JP		
LRX 16	112.4		S			
MS above Slough 6A	112.3			JP		
LRX 18	113.0		S			
MS below Lane Cr. Mo.	113.4		S			
MS above Lane Cr. Mo.	113.7		S			
MS above Mainstem II NW Side Channel	115.6		S			
MS above Mainstem II NE Side Channel	115.9		S			
Mainstem - Curry	119.5			ES		
Curry Station	120.0		T		E,SO	
LRX 24	120.7		S,WQ			
LRX 28	124.4		S			
LRX 29	126.1		S,T,WQ			
MS above Slough 8A	127.2		S			
LRX 31	128.7		S			
LRX 32	129.8		S			
LRX 33	130.1		S			

Table 1: Continued

STUDY SITE	RIVER MILE	AH: FHS	AH: IFE	RJ	AA	USGS R &
LRX 34	130.6		S			
LRX 35	130.9		S			
MS at Fourth of July Creek	131.1		S	JP		
LRX 37	131.8		S			
LRX 40	134.3		S			
Side Channel below Mouth of Sl. 11	135.3		S	JP,JH		
Side Channel above Mouth of Sl. 11	135.3		S	JP,JH		
Cliff below Gold Cr. Creek Bridge	135.8		DG,T			Qu
LRX 44 Side Channel Slough 11	136.5		S			
Gold Creek Bridge	136.7		S,T			
MS above Gold Creek	136.8		T,WQ			
MS at mouth of Slough 16B	137.9		S			
MS at head of Slough 16B	138.3		S			
LRX 49	138.3		S	RH,ES		
LRX 50	138.5		S			
LRX 51	138.9		S			
MS at Slough 19	139.8		S			
LRX 53	140.1		S			
MS at mouth of Slough 21 Side Channel	140.6		S			
LRX 54	140.8		S			
LRX 55	141.5		S			
LRX 56	142.1		S	ES		
LRX 57	142.3		S,T,WQ			
MS at Slough 22 head	144.7		S			
Fat Canoe Island	147.0			RT,ES,RP,RH		
LRX 61	148.7		S			
LRX 62	148.9		S			
Canyon Back Eddy	150.0		T	RT,ES		
MS above Tsusena Cr.	181.5		T			
MS above Oshetna R.	234.4		T			
Side Channels						
Mainstem II	114.4	Th	S,Q,WQ,T	JP		
Slough 10 Side Ch.	133.7	M,Th	S,Q,W,QT	JP,JH		
Above Slough 11	136.1	M,Th	T,S,Q	JP,JH		Qr
Below Slough 11	135.3	X	S	JP JH		
Slough 21 Side Ch.	140.5	M,Th	S,Q,WQ,T	JP		
Side Channel 10A	132.1			JH		
Oxbow One	110.2			JP		
Side Channel	117.8			JP		

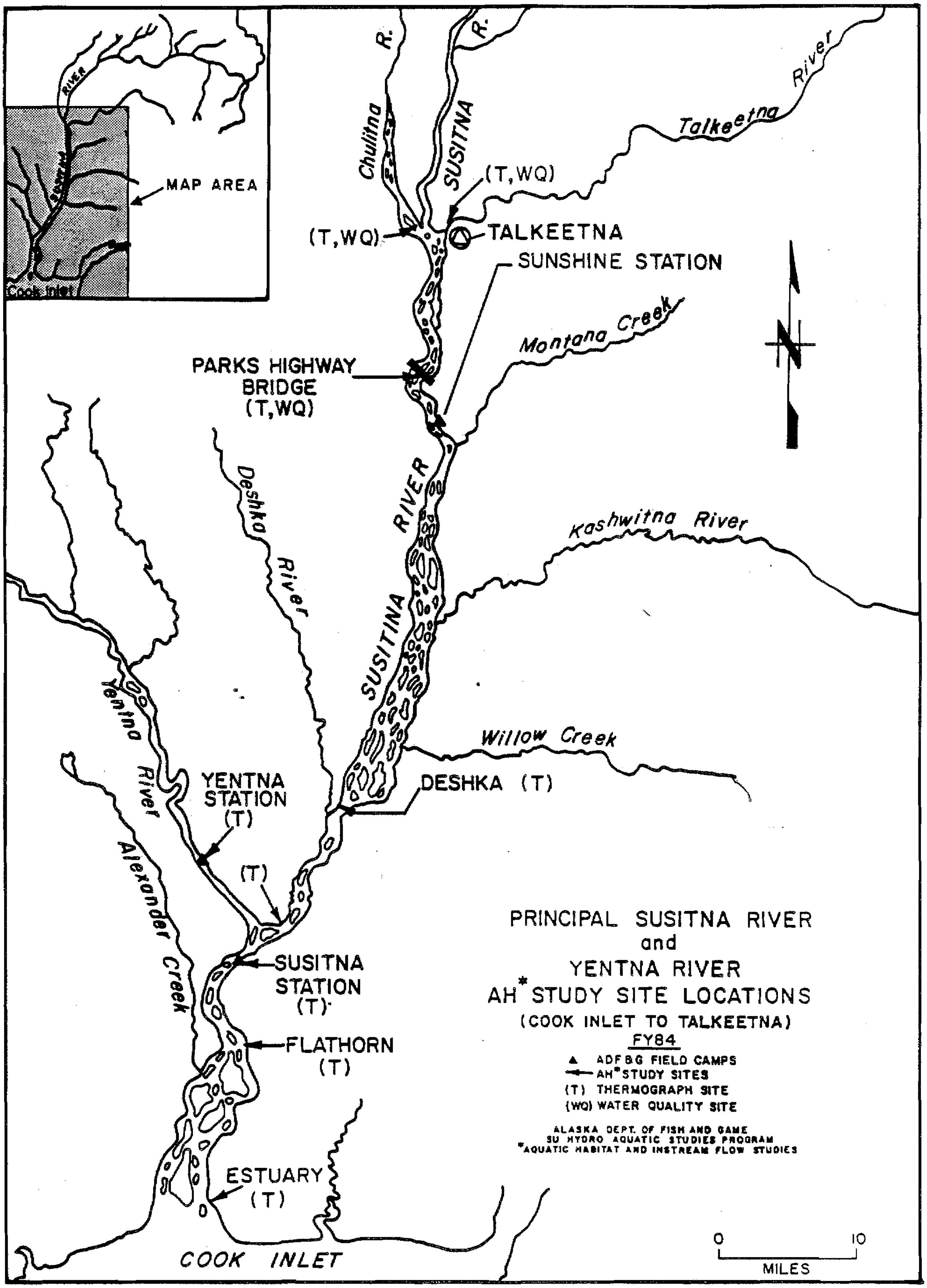

Figure 3. Principal AH study sites in the reach of the Susitna River extending from RM 0 to RM 95.

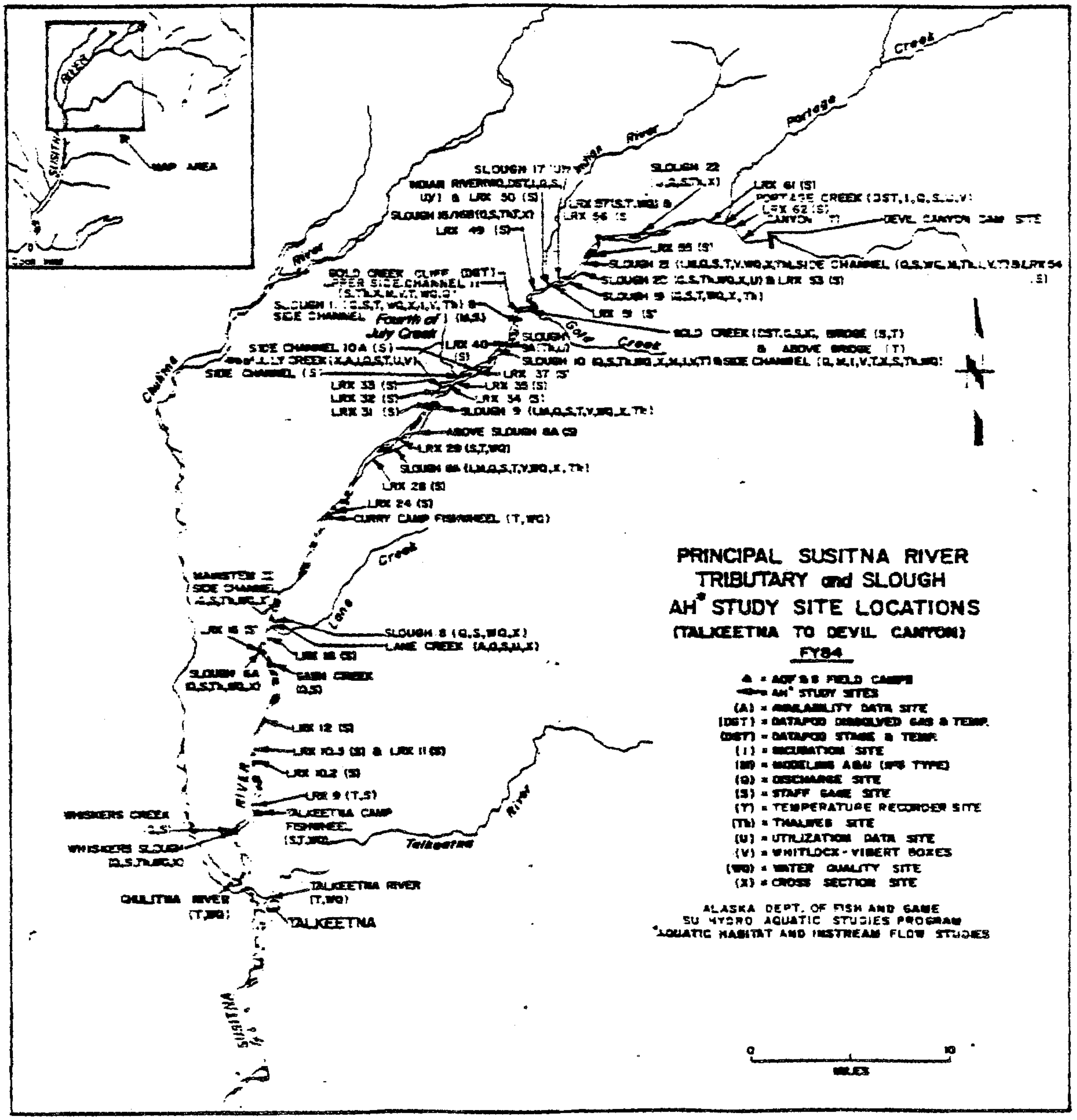

Figure 4. Principal FY84 AH study sites in the reach of the Susitna River extending from RM 95 to RM 150.

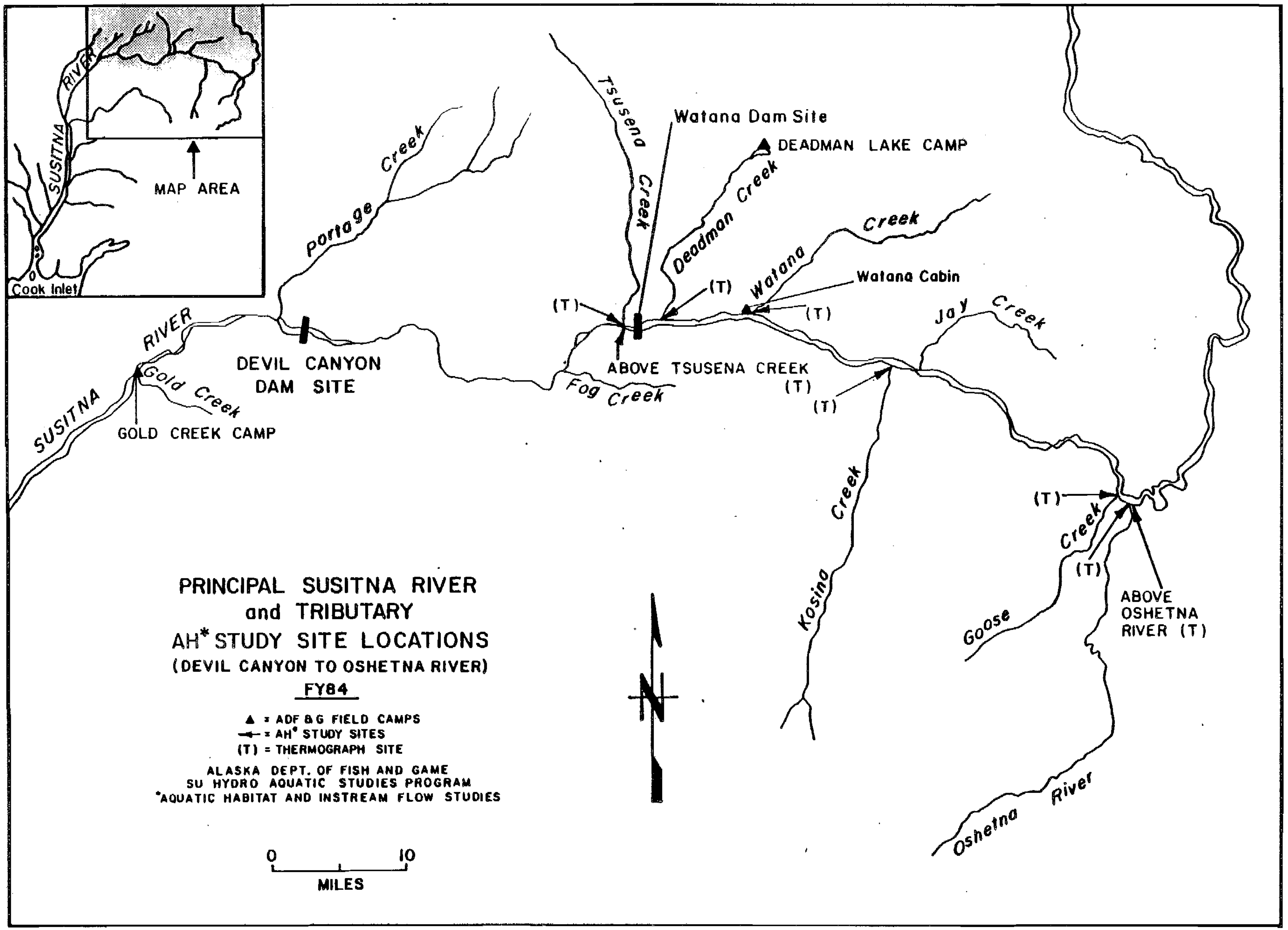

Figure 5. Principal FY84 AH study sites in the reach of the Susitna River extending from RM 150 to RM 235.

In the following two sections of this manual, work plans and new procedures used to meet FY84 objectives are presented.

These work plans and procedures, which include data analysis techniques, are presented according to AH sub-program element. Only the specific data collection methods and sampling designs used in the collection of the data to meet FY84 objectives that are not outlined in the FY82 or FY83 Procedures Manual are outlined in this document. Refer to the FY82 and FY83 Procedures Manuals for other procedures.

It is the purpose of this manual to provide:

1. A general level discussion of the FY84 aquatic habitat program objectives which expands upon information presented in the FY84 RSA;

2. A description of the data collected, where they are collected, and why they are collected;

3. A description of data that are recorded, verified and reported; and

4. A description of the field procedures that are followed when collecting these data. The description is limited to those field procedures that are not described in the FY82 or FY83 procedure manuals.

2.0 Work Plans

2.1 Instream Flow Evaluations

FY84 Instream Flow Evaluation (IFE) studies are directed towards an evaluation of the physical and chemical (stage, discharge, gradient, temperature, water quality, etc.) character of the various habitat types associated with the Susitna River. The studies are primarily conducted in the reach of the river extending from Talkeetna to Devil Canyon. The FY84 IFE program is composed of four major study components: Stage/Discharge Studies, Temperature Studies, Water Quality Studies, and Channel Morphology Studies. These studies are discussed below.

2.1.1 Stage/Discharge Studies

The baseline stage and discharge conditions which occur at mainstem, side channel, slough, and tributary habitats located between Talkeetna and Devil Canyon are being evaluated during the FY84 open water field season. The study approach, site selection, and data analysis study program implemented is discussed below according to habitat type.

2.1.1.1 Study Approach

2.1.1.1.1 Mainstem Habitats

The objectives of the FY84 stage monitoring program being conducted in the mainstem Susitna River between Talkeetna and Devil Canyon are to:

1) Collect sufficient water surface elevation data at selected mainstem locations to better define the relationship of mainstem water surface elevation to mainstem discharge. This information will be used by project engineers to further evaluate the predictive accuracy of various hydraulic simulation models currently being used.

2) Collect water surface elevation data at selected mainstem locations adjacent to selected side channel, slough, and tributary mouth study locations to evaluate if and how mainstem discharge influences the characteristics of these peripheral habitats.

Field data collection consists of obtaining stage measurements using procedures presented in part 3 of this section. Stage readings are obtained during the open water field season at least twice monthly and during specific discharge events to ensure that the full range of mainstem discharge conditions are evaluated. All stage measurements are converted to true water surface elevations referenced to project datum and are referenced to the mainstem Susitna River discharge obtained by the USGS at their Gold Creek gaging station (15292000).

2.1.1.1.2 Side Channel and Side and Upland Slough Habitats

The objectives of the FY84 stage/discharge monitoring program being conducted at side channel and slough (upland and side) habitats between Talkeetna and Devil Canyon are to:

1) Collect sufficient stage and discharge measurements within selected side channel and slough (upland and side) habitats to develop stage/discharge rating curves covering the full range of conditions experienced during the FY84 open water field season.

2) Collect measurements of water surface elevations within selected side channel and slough (upland and side) habitats to further evaluate whether and how the water surface elevation in these peripheral habitats is influenced by mainstem discharge.

3) Collect measurements of stage and discharge within selected side channel and slough (upland and side) habitats to support analyses of the effects of local (i.e., site) flow conditions on the availability and utilization within these habitats for fish passage, spawning, and rearing (refer to Fish Habitat Study) and to determine if and how mainstem flows influence these local flow conditions.

Emphasis is placed on evaluating the range of water surface elevations which occur within each study site for the full range of mainstem discharge as recorded at Gold Creek (USGS 15292000) for the FY84 open water season.

Measurements of stage are obtained at least twice monthly during the open water field season at each stage monitoring station within each study site. Stage monitoring stations are located at the mouth, free-flowing portion, and head of each study site location. Staff gages installed at the mouth (most downstream point of access) are monitored to evaluate the influences that mainstem discharge has on access conditions and backwater effects at the mouths of these habitats. Staff gages located upstream of the mouth within the free-flowing portion of these habitats are monitored to evaluate local stage-discharge relationships. Staff gages installed at the head are used to determine the mainstem discharge necessary to breach the head portions of the study site. Methods for determining mainstem flows required to breach the head of a study site are presented in Part 3 of this section. Procedures used in the installation and monitoring of staff gages are those presented in Part 3 of this section.

Discharge measurements are obtained over the full range of mainstem discharges occurring during the FY84 open water field season as recorded at Gold Creek (USGS 15292000) using procedures presented in Part 3 of this section. Sufficient discharge and corresponding stage measurements are obtained to develop stage/discharge rating curves.

2.1.1.1.3 Tributary Habitats

The objectives of the FY84 stage/discharge monitoring program being conducted at tributary habitats between Talkeetna and Devil Canyon are to:

1) Collect sufficient stage and discharge measurements within selected tributaries to develop stage/discharge rating curves covering the full range of conditions experienced during the FY84 open water field season. This information will be used to quantify the contribution of tributaries to the flow regime of the Susitna River and provide baseline flow data necessary for tributary mouth modeling efforts (refer to Section 2.2.2.2).

2) Collect measurements of stage and discharge within selected tributary and tributary mouth habitats to support analyses of fish habitats in these habitat zones.

Placement of stage monitoring stations in tributaries are in areas optimal for the collection of discharge data. Measurements of stage are obtained utilizing both standard staff gages and Omnidata (datapod) recorders with associated pressure transducers. Specific procedures for the installation and monitoring of staff gages and datapods are presented in Part 3 of this section. Specific procedures used in the collection of discharge data are also presented in Part 3 of this section.

2.1.1.2 Site Selection

2.1.1.2.1 Mainstem Habitats

Locations and functions of mainstem staff gages during the FY84 open water field season are presented in Table 2.

These sites were selected for study based on consultations with our hydraulic engineer to:

1) provide mainstem water surface elevation data over the full range of mainstem flow conditions occurring during 1983 open water field season to project engineers for use in calibration various hydraulic models, and

2) provide mainstem water surface elevation data to be used in determining the influence that mainstem discharge has on the hydraulic characteristics of selected side channel, upland and side slough, and tributary habitats.

2.1.1.2.2 Side channel, and Side and Upland Slough Habitats

Measurements of stage and discharge are obtained during the FY84 open water field season at six side channel and 11 slough (upland and side) study sites located in the Talkeetna to Devil Canyon reach (RM 114.4 to

Table 2. FY 84 Mainstem staff gage locations.

Location	River Mile	Location	River Mile
MS at Whiskers Cr. Sl. Mouth[1]	101.2	LRX 31[1,2]	128.7
Talkeetna Fishwheel[1]	103.0	LRX 32[2]	129.8
LRX 9[1]	103.2	LRX 33[2]	130.1
LRX 10.2[2]	105.9	LRX 34[2]	130.6
LRX 10.3[2]	106.4	LRX 35[2]	130.9
LRX 11[2]	106.7	MS at 4th of July Creek	131.1
LRX 12[2]	108.4	LRX 37[3]	131.8
LRX 16[3]	112.4	LRX 40[1,3]	134.3
LRX 18[1]	113.0	Side channel below Sl 11 Mouth[1,3]	135.3
MS below Lane Cr. Mouth[3]	113.6	Side channel above Sl 11 Mouth[1,3]	135.3
MS above Lane Cr. Mouth[3]	113.7	MS at Slough 16B Mouth[1,3]	137.9
		MS at Slough 16B Head[1,3] on (LRX 49)	138.3
MS above Mainstem II[3] Side Channel NW Head	115.5	LRX 50	138.5
MS above Mainstem II[3] Side Channel NR Head (LRX 18.3)	115.9	LRX 51	138.9
		MS at Slough 19[1,3]	139.8
LRX 24[1]	120.7	LRX 53[1,3]	140.1
LRX 28[1]	124.4	MS at mough of Sl 21 side chan[1,3]	140.6
LRX 29[1,3]	126.1	LRX 54[1,3]	140.8
MS above Slough 8A[3]	127.2	LRX 55[3]	141.5
		LRX 56[1,3]	142.1
		LRX 57[1,3]	142.3

[1] Continuation of stage-discharge curves developed from FY 83 data.

[2] Staff gage sites initiated for FY 84 on selected lower river cross section (LRX) sites.

[3] Mainstem staff gage sites adjacent to selected slough, side channel and tributary mouth locations.

RM 140.5; Table 3). These sites were selected for study based on consultations with our hydraulic engineer to:

1) provide baseline water surface elevation and discharge data to assist in determining the various influences that mainstem discharge has on several key hydraulic characteristics of side channel and slough habitats (i.e., breaching, backwater, and flow regime conditions); and

2) provide water surface elevation data to support evaluations of fish habitats in side channel and slough habitats.

Each study site will have stage monitoring stations located at the mouth, discharge monitoring station (i.e., free flowing portion of the side channel), and head. Discharge measurements are also obtained at the discharge monitoring station.

2.1.1.2.3 Tributary Habitats

Measurements of stage and discharge will be obtained during the FY84 open water field season at seven tributaries located between Talkeetna and Devil Canyon (Table 4). These sites were selected for study based on consultations with our hydraulic engineer to provide baseline water surface elevation and discharge data to determine the relative contributions of selected tributaries to the flow regime of the Susitna River between Talkeetna and Devil Canyon and support evaluations of fish habitats by project biologists.

Table 3. FY 84 ADF&G AH slough and side channel stage/discharge monitoring sites.

Study Site	River Mile
Sloughs	
Whiskers Creek Slough	101.2
Slough 6A Slough	112.5
Lane Creek Slough (Slough 8)	113.6
Slough 8A	125.3
Slough 9	128.3
Slough 11	135.3
Slough 16B	137.9
Slough 19	139.7
Slough 20	140.1
Slough 21	141.8
Slough 22	144.2
Side Channels	
Mainstem II	114.5
Side Channel 10	133.8
Lower Side Channel 11	134.8
Upper Side Channel 11	136.0
Side Channel 21	140.6

Table 4. Tributary sites at which ADF&G AH stage/discharge data will be collected during the FY 84 open water field season.

Site	RM	Staff gage	Datapod	Discharge
Whiskers Creek	101.4	X		X
Lane Creek	113.6	X		X
Fourth of July Creek	131.1	X		X
Gold Creek	136.7	X	X	X
Indian River	138.6	X	X	X
Portage Creek	148.9	X	X	X

2.1.1.3 Data Analysis

2.1.1.3.1 Mainstem Habitats

All stage data obtained at mainstem habitats are reduced to true water surface elevations (as referenced to project datum). These data, along with corresponding average daily discharges of the mainstem recorded at Gold Creek (USGS 15292000) are plotted as simple stage-discharge rating curves. The water surface elevation are presented on the y axis and mean daily discharge at Gold Creek on the x axis of the plot with the equation of the line determined from the known points.

2.1.1.3.2 Side Channel and Slough Habitats

All stage data obtained at side channel and slough habitats are reduced to true water surface elevations (as referenced to project datum) and plotted against the mean daily mainstem discharge recorded at Gold Creek (USGS 15292000). In addition, water surface elevation data collected in conjunction with discharge data at the discharge gaging station at each site are plotted as simple stage/discharge rating curves. Water surface elevations (WSEL) are also used in conjunction with cross-sectional and thalweg data (refer to Section 2.1.4).

2.1.1.3.3 Tributary Habitats

Stage data from Indian River and Whiskers, Lane, Fourth of July and Portage Creeks are converted to true water surface elevations (as referenced to project datum) and plotted with measured tributary discharges to form simple stage/discharge rating curves. The continuous record of stage data obtained with the datapod system are reduced to mean daily stage (in feet) and plotted with corresponding estimated and measured tributary discharge to form simple stage/discharge rating curves. These data are also made available to project personnel to support tributary modeling studies and analysis of tributary and tributary mouth fish habitats.

2.1.2 Temperature Studies

2.1.2.1 Study Approach

The overall objective of the continuous temperature monitoring program being conducted during FY84 is to determine the baseline seasonal surface and intragravel water temperature regimes of mainstem, side channel, slough, and tributary habitats of the Susitna River. This information is being used to evaluate the influences that these seasonal water temperature regimes have on biological activity in these various habitats and to support mainstem discharge/surface water temperature modeling efforts and analyses of groundwater by project engineers.

Two types of water temperature data are collected at temperature monitoring stations during FY84: surface and intragravel water temperatures. Surface water temperature is collected at all stations while intragravel water temperature is only collected at selected stations. Water temperatures are monitored utilizing either Peabody-Ryan model J-90 submersible (Ryan) thermographs or Omnidata recorders with associated thermistors (Datapods). The Ryan thermographs are utilized only at stations where surface water temperature will be monitored, while the Datapod temperature recorders are utilized at stations where both surface and intragravel temperatures are monitored. Refer to Part 3 of this section for the installation and monitoring procedures of these instruments.

2.1.2.2 Site Selection

Locations of temperature monitoring stations established in mainstem, side channel, slough, and tributary habitats during FY84 are presented in Table 5. The type of temperature data collected at each site is presented, in addition to the period of measurement.

Sites were selected for study (after consultation with our hydraulic and the Arctic Environmental Information and Data Center environmental engineer assigned to the temperature modeling program), to provide baseline continuous surface water and intragravel temperature data to:

1) project engineers for use in developing various mainstem discharge/surface water temperature and groundwater models, and

2) project biologists for use in evaluating the effect of surface water and intragravel temperature on the various fish resources.

2.1.2.3 Data Analysis

Water temperature data are reduced from the script charts (Peabody-Ryan) and data storage modules (datapods) using procedures outlined in part 3 of this section. Resultant data are presented in tabular form as daily, weekly and monthly minimum, mean, and maximum temperatures. For selected data sets, the data are also presented graphically over time.

Table 5. FY 84 water temperature monitoring stations.

Site	River Mile	Temperature Data Type[1]	Monitoring Period[2]
Mainchannel			
Estuary	5.0	S	OW
Flathorn Station	18.2	S	OW
Susitna Station	25.5	S	OW
Above Deshka River	41.1	S	OW
Parks Highway Bridge	83.9	S	OW
Talkeetna Station	103.0	S	OW
LRX 9	103.3	S,I	OW,IC
Curry Station	120.7	S	OW
LRX 29	126.1	S,I	OW,IC
Below Gold Creek Bridge	136.6	S	OW
Above Gold Creek Bridge	136.8	S	OW
LRX 57	142.3	S,I	OW,IC
Devil Canyon	150.0	S	OW
Above Tsusena Creek	181.6	S	OW
Above Oshetna River	233.4	S	OW
Sidechannel			
Near Slough 10	133.7	S,I	OW,IC
Upstream of Slough 11	136.3	S,I	OW,IC
Downstream of Slough 21	141.1	S,I	OW,IC
Slough			
8A (mid and upper sites)	125.1	S,I	OW,IC
9	128.7	S,I	OW,IC
10	133.9	S,I	OW,IC
11	135.7	S,I	OW,IC
19	140.0	S,I	OW,IC
21 (mouth and upper sites)	141.1	S,I	OW,IC
Tributary			
Yentna River	30.1	S	OW
Talkeetna River	97.2	S	OW
Chulitna River	98.6	S	OW
Fourth of July Creek	131.2	S,I	OW,IC
Gold Creek	136.7	S	OW
Indian River	138.6	S	OW
Portage Creek	148.9	S	OW
Tsusena Creek	181.3	S	OW
Deadman Creek	186.7	S	OW
Watana Creek	194.1	S	OW
Kosina Creek	206.8	S	OW
Goose Creek	231.3	S	OW
Oshetna River	233.4	S	OW

[1] S = Surface water
I = Intragravel water

[2] OW = Open water field season (May - October)
IC = Ice covered field season (November - April)

The temperature data, after being reduced, are also made available to project personnel for use in their biological habitat analyses and temperature modeling studies.

2.1.3 Water Quality Studies

2.1.3.1 Study Approach

The overall objectives of the water quality monitoring program being conducted during FY84 is to determine the baseline water quality conditions that exist in mainstem, side channel, (upland and side) slough, and tributary habitats of the Susitna River and to determine the influence that mainstem discharge has on the water quality conditions present in these habitats. This information is being used to support evaluations of the influences that water quality have on biological activity in these various habitats and to support hydraulic analyses conducted by project engineers.

Two types of water quality study programs are being conducted during FY84. An intense level of monitoring consisting of daily or bimonthly sampling of dissolved oxygen, air and water temperature, pH, conductivity, and turbidity is being conducted at selected mainstem and tributary locations. A less intense monitoring effort, consisting of bimonthly sampling of air and water temperature and turbidity, is being conducted at selected side channel and upland and side slough locations.

2.1.3.2 Site Selection

The locations of mainstem water quality monitoring stations established during FY84 are presented in Table 6. At two of the stations (refer to Table 6) water quality data are collected on a daily basis while at the remaining four sites it is collected twice monthly.

The locations of side channel and upland and side slough habitats water quality monitoring stations for FY84 are presented in Table 7.

The locations of tributary water quality monitoring stations for FY84 are limited to the Chulitna and Talkeetna Rivers and are presented in Table 6 in association with the mainstem water quality monitoring stations.

Sites were selected for study to provide baseline water quality data to:

1) determine the effect that mainstem discharge has on the water quality of mainstem, side channel, and upland and side slough habitats;

2) support analyses of the effect that mainstem discharge has on certain hydraulic characteristics of side channel and upland and side slough habitats; and,

3) support analyses of fish habitats being conducted in these various habitats.

Table 6. FY 84 mainstem Susitna River and tributary water quality monitoring stations.

Location	Habitat	River Mile	TRM[1]	Sample Schedule
Parks Highway Bridge	Mainstem	83.9		Twice monthly
Talkeetna River	Tributary	97.2	0.5	Twice monthly
Chulitna River	Tributary	98.6	2.0	Twice monthly
Talkeetna fishwheel	Mainstem	103.0		Daily
LRX 24	Mainstem	120.7		Twice monthly
LRX 29	Mainstem	126.1		Twice monthly
MS above Gold Creek	Mainstem	136.8		Daily
LRX 57	Mainstem	142.3		Twice monthly
Eddy below Devil Canyon	Mainstem	150.1		Twice monthly

[1] TRM = tributary river mile, determined from the mouth of the tribuary upstream of the study site.

Table 7. Locations of ADF&G AH side channel and upland and side slough water quality monitirong stations for FY 84.[1]

Site	River Mile
Sidechannel	
Mainstem II Side Channel	114.4
Slough 10 Side Channel	133.7
Side Channel 21	140.5
Slough	
Whiskers Creek Slough	101.2
6A	112.3
Lane Creek Slough (Slough 8)	113.7
8A	125.1
9	128.3
19	139.7
20	140.0
21	141.1

1 More detailed water quality studies will be conducted in side channels and sloughs by FHS personnel in conjunction with Fish Habitat studies.

2.1.3.3 Data Analysis

Water quality data collected at mainstem and tributary sites is tabulated and plotted over time with mainstem discharge as determined by the USGS at Gold Creek. If it is determined a relationship may exist between variables, a correlation analysis is run to statistically substantiate the presence of a relationship. Turbidity and surface water temperature data collected in side channels and sloughs is plotted against USGS mainstem Gold Creek (15292000) discharge and water surface elevation. These data are then used to support the determination of flows required to breach the head of a slough or side channel. In addition, these data are used to determine the influence of breaching mainstem flows on the water quality of the site.

2.1.4 Channel Morphology Studies

FY84 channel morphology studies are divided into two segments: thalweg profile studies and cross section profile studies.

2.1.4.1 Study Approach

2.1.4.1.1 Thalweg Studies

Thalweg profiles are determined for selected sloughs, side channels, and tributary mouths located between Talkeetna and Devil Canyon during FY84 with the objectives of:

1. evaluating the influences of mainstem discharge as a factor in itself* on access conditions into and passage conditions within upland and side slough, side channel, and tributary mouth habitats, and

2. illustrating the influence of mainstem discharge on the water surface elevation and formation and extent of backwater zones in slough, side channel, and tributary mouth habitats.

This information is being used to support evaluations of fish habitat as a function of mainstem discharge in these various habitats by project biologists.

Field data collection consists of obtaining data for use in constructing thalweg profiles. Specific data collection procedures used in the collection of thalweg data are presented in section 3.2.1.5.

2.1.4.1.2 Cross Section Studies

Cross section profiles are determined for selected upland and side sloughs, side channels, and tributary mouths located between Talkeetna and Devil Canyon during FY84 with the objectives of evaluating the effects that mainstem discharge has on:

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* The presence or absence of base flow conditions in the habitats evaluated and whether they are influenced by mainstem flow conditions must also be considered as having the potential to buffer the influence of mainstem flows during unbreached conditions.

1. specific access and passage conditions that exist at specified locations within selected upland and side slough, side channel and tributary mouth habitats, and

2. breaching conditions at the head of selected slough and side channel study sites.

This information is being used to support evaluations of fish habitats and hydraulic analyses being conducted in these habitats.

Field data collection consists of obtaining data for the development of cross section profiles at stage monitoring locations and passage reaches within study sites. Specific field data collection techniques and procedures used in the collection of cross section data are presented in Part 3 of this section.

2.1.4.2 Site Selection

2.1.4.2.1 Thalweg Studies

Thalweg profiles are being developed for the upland and side sloughs, side channels, and tributary mouths listed in Table 8. Sites were selected to provide data to be used in the determination of access and passage conditions present at study locations as described in Section 2.2.1.

Table 8. Slough (upland and side), side channel, and tributary mouth sites at which thalweg and cross section data will be collected by ADF&G AH during FY 84.

Site	River Mile
Sloughs	
Whiskers Creek Slough	101.2
6A	112.3
8A	125.3
9	128.3
9A	133.2
10	133.8
11	135.3
16	137.7
16B	137.9
19	139.8
20	140.1
21	141.8
22	144.2
Sidechannels	
Mainstem II	114.5
Side Channel 10	133.8
Upper Side Channel 11	136.0
Side Channel 21	140.7
Tributary Mouths	
Lane Creek*	113.5
Fourth of July Creek*	131.1

* Cross section data collected only.

2.1.4.2.2 Cross Section Studies

Cross section profiles are being developed for the upland and side sloughs, side channels, and tributary mouths listed in Table 10. Sites were selected for study to provide data to:

1) assist in determining certain hydraulic characteristics of upland and side slough, side channel, and tributary habitat (i.e., breaching flows, backwater conditions, etc.) and

2) assist in determining access and passage conditions that are present at study sites as described in Section 2.2.1.

At each upland and side slough and side channel study site, data for the development of cross section profiles will be collected at:

1. the stage monitoring station located at the mouth of the study site;

2. the stage monitoring station located upstream of the mouth within the free-flowing portion of the study site not influenced by unbreached mainstem flow conditions;

3. the stage monitoring station located at the head of the study site; and,

4. critical passage reaches within the study site.

Refer to section 2.2.2.2 for the process used in selecting sites at which cross section profiles are obtained in tributary mouths.

2.1.4.3 Data Analysis

2.1.4.3.1 Thalweg Studies

Thalweg survey data consists of a series of elevations representing the deepest part of a stream channel (and the water surface at each thalweg point) transversing the entire length of the study site and distance measurements from the starting point to each elevation obtained from beginning to end. Thalweg survey data are plotted with thalweg elevation on the y axis and the distance measurement on the x axis. Water surface elevations obtained at each thalweg point are graphed in addition to the thalweg data points on the y axis. The water surface elevations plotted cover the full range of water surface elevations observed as a function of observed mainstem and base flow conditions. They are used to delineate any potential access problems associated with the study site as determined by the depth of water at various mainstem flows. This analysis however, does not account for the potential influence of base flow conditions or the possible relationship between unbreached mainstem and base flow conditions. At presence, analysis of local base flow conditions to mainstem flow conditions and their influences on the thalweg analysis is based on the professional judgement of project biologists on our hydraulic engineer. A reach gradient is determined from the survey data by dividing the difference in the elevation between the head and mouth by the length of the thalweg survey. If two or more distinct gradients are apparent in the thalweg profile, reach gradients are determined for each selected series of thalweg points. Substrate types for the side channel are also superimposed beneath the thalweg profile to illustrate the general substrate available.

Potential access problem areas into and passage problem areas within each study site are designated as critical access or passage reaches. The gradient is determined for each of these reaches. The length and water depth on each reach is included for specified mainchannel flows. These are determined by plotting observed water surface elevations obtained from staff gages, on the y axis. The observed water surface elevation (WSEL) is extended upstream and the intersection of the WSEL with the thalweg or a minimum depth of 0.3 feet, indicates the most downstream portion of the critical reach.

The relationship of these thalweg analyses to fish passage is discussed in Section 2.2.1.

2.1.4.3.2 Cross Section Studies

Cross section survey data consists of a series of elevations (observed looking upstream) perpendicular to the stream channel, beginning from the left bank and concluding on the right bank with every major change in topography included. These data are plotted with elevation as the y axis and distance from left bank headpin as the x axis to illustrate the cross section profile of the stream at a specific location. Superimposed on the cross section profile are a series of water surface elevations plotted parallel to the x axis representing the range of water surface elevations observed during the FY84 open water field season.

The cross section profile obtained at the mouth of the study site is used to evaluate access conditions into the study site and presence of backwater in the vicinity of mouth as a function of mainstem discharge.

The cross section profile obtained within the free flowing portion of the study site and at critical passage reaches within the study site is used to evaluate passage conditions within the study site as a function of mainstem discharge.

The relationship of these cross section analyses to fish habitats is presented in Section 2.2.1.

The cross section profile obtained at the head of a study site is used to evaluate the influence of mainstem discharge on breaching conditions of the study site. From each cross section, located at the head of a study site, a point of zero flow (the mainstem flow at which breaching of the study site ceases) is determined.

2.2 Fish Habitat Studies

FY84 Fish Habitat Studies (FHS) are directed towards defining the relationship of stage-related (depth, velocity, surface area) and other physical variables (substrate, surface and intragravel water temperature, water quality, gradient) to the passage, spawning, and incubation life stages of salmon in the various habitat types present in the Susitna River. The FY84 FHS program is comprised of three major study components. These include:

1) Timing, Access, and Distribution Studies;

2) Spawning Habitat Evaluation Studies; and

3) Incubation Studies.

These studies are discussed below.

2.2.1 Timing, Access, and Distribution (TAD) Studies

2.2.1.1 Study Approach

Studies are conducted by AH personnel in conjunction with AA personnel during the FY84 open water field season to determine the timing of salmon migration into the various habitat types of Susitna River (Timing

Studies); the access conditions into and passage conditions within slough and side channel habitats (Access and Passage Studies); and, the distribution of adult salmon within slough and side channel habitats (Distribution Studies). These three studies are discussed below.

2.2.1.1.1 Timing Studies

Adult anadromous mainstem fishwheel and stream survey data are used to determine the timing patterns of salmon migration into and through the mainstem and into the various side habitats of the Susitna River (side channels, upland and side sloughs, tributaries, and tributary mouths) as a function of mainstem discharge, temperature, and turbidity.

2.2.1.1.2 Access and Passage Studies

Adult anadromous stream survey data and observations of FHS field personnel are used in combination with the thalweg and cross section channel morphology data (refer to section 2.1.4) to evaluate access conditions into and passage conditions within various sloughs (upland and side), side channels, tributary mouths, and tributaries as a function of mainstem discharge.

2.2.1.1.3 Distribution Studies

Adult anadromous stream survey data are used in conjunction with the above access and passage data to evaluate the distribution of salmon in

Table 9. ADF&G AH timing, access and distribution study sites for FY 84.

Study Sites	River Mile	Timing Studies	Access Studies	Distribution Studies
Mainstem Sites				
Susitna Station	26.0	X		
Sunshine Station	80.0	X		
Talkeetna Station	103.0	X		
Curry Station	120.0	X		
Sidechannel Sites				
Mainstem II	114.4		X	
Near Slough 10	133.7		X	
Upstream of Slough 11	136.1		X	
Downstream of Slough 21	140.5		X	
Slough (upland and side) sites				
Whiskers Creek Slough	101.2	X	X	X
6A	112.3	X	X	X
8A	125.1	X	X	X
9	128.3	X	X	X
9A	133.8	X	X	X
10	133.8	X	X	X
11	135.3	X	X	X
16B	137.3	X	X	X
20	140.0	X	X	X
21	141.1	X	X	X
22	144.3	X	X	X
Tributary Sites				
Fourth of July Creek	131.1	X	X	
Lane Creek	113.6	X	X	
Indian River	138.6	X		X
Portage Creek	148.9	X		X
Tributary Mouth Sites				
Fourth of July Creek Mouth	131.1	X	X	X
Lane Creek Mouth	113.6	X	X	X

selected sites, plots showing cumulative numbers of live salmon observed by species over time are also presented.

2.2.1.3.2 Access and Passage Studies

Access conditions into and passage within selected sloughs and side channels are evaluated by determining passage reaches at selected mainstem discharges. A passage reach is defined as a portion of the channel within the study site which is potentially limiting to salmon migration into spawning areas. The analysis is accomplished by combining thalweg and cross section data, salmon distribution data, and observations of fish behavior in selected sloughs and side channels. Thalweg profiles are developed depicting water surface elevations at selected mainstem discharge levels (FY84 Procedures Manual, Sections 2.1.4.1 and 3.2.1.5.1, and Phase II Synopsis of the 1982 Aquatic Studies and Analysis of Fish and Habitat Relationships Report (FHR), Appendix B). Lengths of passage reaches are measured directly from the thalweg. Depths are calculated from the available water surface elevation data. Tables of the lengths and depths of passage reaches at selected mainstem discharges are compiled and placed on the thalweg profile. Reaches on the thalweg that are potentially limiting to salmon passage are identified and classified as being either acute or unrestricted (Phase II Synopsis of the 1982 Aquatic Studies and Analysis of Fish and Habitat Relationships Report (FHR), Appendix B).

Reaches having water depths greater than 0.3 ft. (regardless of their length) are not considered to be impassable for adult chum salmon.

Therefore, if the water depth in a slough reach is equal to or less than 0.3 ft. for a distance equal to or exceeding 100 ft., it is considered to be impassable for adult chum salmon and designated as being an "acute" condition. That is, if acute conditions were to exist on a continual basis, the fishery would be critically stressed, and in all likelihood it could not sustain itself. Acute conditions would be such that fish passage would be partially or entirely blocked such as to cause stress to the fish, allow for predation, or prevent the completion of passage to spawning areas. Reaches having water depths greater than 0.3 ft. are designated as "unrestricted" fish passage conditions.

This analysis is based on the requirements of adult chum salmon, since they are the predominant species utilizing the slough and side channel habitat for spawning.

2.2.1.3.3 Distribution Studies

Adult anadromous stream survey data are collected so as to not only be able to rank individual habitats according to their relative importance but also to make it possible to delineate zones of relative importance within each individual habitat. A maximum of 3 zones are designated in each slough or side channel. Selection of zones is based on previous field observations of fish abundance or absence, of flow characteristics within the site, and major changes in habitat type within the site. To determine the relative importance of the various side channels, sloughs, tributaries, and tributary mouths to the salmon fishery, a table is developed which shows the relative abundances of the five salmon species at the sites surveyed. At selected sites of relatively higher importance, maps and tables depicting zones of relative higher abundances are also presented.

2.2.2 Salmon Spawning Habitat Evaluation Studies

Three different analyses are integrated in the evaluation of salmon spawning habitat. These analyses are: Habitat Availability, Habitat Utilization and Habitat Selectivity. The Habitat Availability analysis is used to evaluate the aquatic habitat conditions present at the site, that is to identify and quantify the habitat conditions which are available for the fish to select or reject for spawning as a function flow conditions . The Habitat Utilization analysis is used to describe those hydraulic or other habitat conditions actually used by the spawning fish. The Habitat Selectivity analysis combines the above two analyses in order to quantitatively predict which habitat conditions, within the range of conditions which are available (present), can actually be used by fish for spawning as a function of flow conditions. The step-by-step process followed to implement and coordinate these analyses is shown in Figure 6. A reference outline to provide supportive descriptions of the steps in the flow chart is presented in Appendix A. The flow chart and outline presented is for spawning habitat evaluations conducted in slough and side channel habitats. The tributary mouth analysis follows the same general steps as described in the flow chart, however at a reduced analytical level as discussed in Section 2.2.2.2. These analyses will be discussed in greater depth in the final report.

ALASKA DEPARTMENT OF FISH AND GAME / SU HYDRO
AQUATIC HABITAT AND INSTREAM FLOW (AH)
FY84 APPROACH
FOR EVALUATING SALMON SPAWNING HABITAT
UTILIZATION IN SLOUGHS AND SIDE CHANNELS

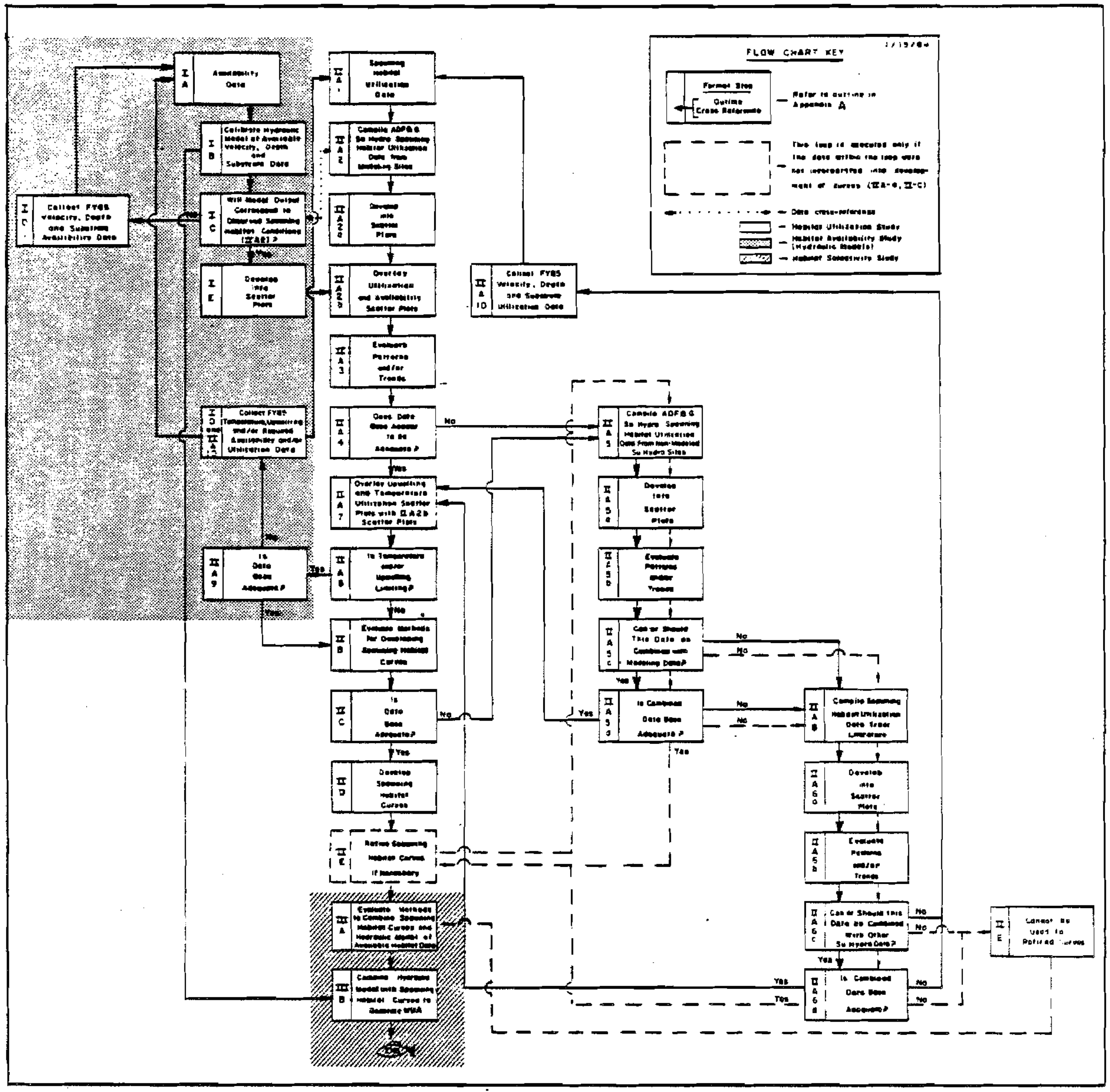

Figure 6. Flow chart depicting analysis approach for evaluating salmon spawning habitat.

2.2.2.1 Side Sloughs and Side Channels

Side sloughs and side channels of the Susitna River are hydraulically similar habitats, so the same study approach and analyses are applied to both habitats. Definitions of side channel and side slough habitats are presented in the introduction to this manual (Figure 2). Generally, both habitat types convey mainstem streamflow during periods of high flow, but may be appreciably dewatered during periods of low flow with side sloughs dewatering at higher mainstem streamflows than side channels. Side sloughs convey clear water from tributaries and/or groundwater sources during low flow periods. Both habitat types are characterized by shallower depths, lower velocities, and smaller streambed materials than those found in the mainstem.

Two computer based hydraulic models (IFG-2 and IFG-4) are used to evaluate available habitat conditions in selected side sloughs and side channels. Both models simulate habitat conditions as a function of streamflow. They can predict distributions of depths and velocities and the amount of substrate available over a range of flows. Recommended extrapolation limits for these models are no more than 40% below and 250% above the field measured discharges. Both models begin to lose reliability at lower flows, however IFG-2 does so more rapidly. Because IFG-4 has more calibration data sets, extrapolation can generally be extended farther than IFG-2. The IFG-4 model requires a minimum of three data sets and is strongly based on field work and observations. The IFG-2 model only requires one set of field data, but it is more difficult if not impossible for the non-engineer to apply properly because it is based on hydraulic theory. Extrapolation ranges are limited by having only one data set, however this range can be extended by collecting additional field data consisting of water surface elevation measurements at the transects (Trihey, 1980).

Spawning habitat utilization data are collected at specific redd sites. These data are then used to develop utilization curves for input to the habitat model.

The habitat selectivity analyses uses a computer to link the availability data from the hydraulic models with the utilization data to generate Weighted Usable Area (WUA).

2.2.2.1.1 Habitat Availability Study

Study approach

Using the IFG-2 and IFG-4 computer models, the hydraulic modeling analysis is conducted to determine the relationship between side slough/side channel discharge and the availability of side slough/side channel hydraulic conditions for salmon spawning.

Hydraulic data collected for model input include: depth, velocity, substrate, and water surface elevation along transects. Field work for the IFG-4 models consists of collecting hydraulic data at slough study sites established during FY83 at discharges necessary to complete calibration of the models for these sites and the establishing of transects and initiating of hydraulic data collection in side channel sites selected for study during FY84. Specific data collection techniques incorporated in the collection of IFG-4 model data are presented in Bovee and Milhouse, 1978 and Trihey and Wegner, 1981.

IFG-2 field work consists of collecting hydraulic data at a side channel site selected for study during FY84. Specific data collection techniques incorporated in the collection of IFG-2 model data are also found in Bovee and Milhous, 1978 and Trihey and Wegner, 1981.

Site selection

IFG-4

IFG-4 habitat availability studies continue at sloughs 8A, 9, and 21 (refer to Figure 4). These sloughs were initially chosen for study during FY83 based on their relative importance to the salmon resource and the relatively large data base available for these sloughs from studies done in previous years.

The side channels selected for IFG-4 hydraulic modeling during FY84 are the side channels located downstream of Slough 21, upstream of Slough 11, and near the mouth of Slough 10 (refer to Figure 4). The side channels near Sloughs 11 and 21 were chosen because of their proximity to sloughs which are important to the salmon resource. The side channel near Slough 10 was chosen because it is known to support a significant amount of rearing salmon and is a potential site for a mitigation demonstration study to evaluate whether the habitat can be enhanced to support spawning.

IFG-2

The side channel selected for IFG-2 hydraulic modeling during FY84 is located downstream of Slough 11 (refer to Figure 4). It was chosen based on its proximity to Slough 11 which is important to the salmon resource. An IFG-2 model is used for this site rather than an IFG-4 model because of manpower limitations and the large channel size.

Data analysis

Data collected in conjunction with the IFG-4 and IFG-2 studies are analyzed and presented as described by the Instream Flow Group (Milhous et al. 1981) and in the Phase II Fishery Habitat Relationships Report (ADF&G 1983).

In addition, scatter plots of available habitat are developed to illustrate depth versus velocity with substrate indicated as acceptable (+) or unacceptable (-). These scatter plots are used in developing utilization habitat curves by overlaying them with utilization scatter plots.

To develop the scatter plots the following steps must first be taken:

1) Staff gage readings collected during utilization data collection are used to determine the discharge occurring in the modeling site when redd measurements were recorded.

2) Hydraulic model output for these flows are generated, if possible, in order to determine available depth, velocity, and substrate.

2.2.2.1.2 Habitat Utilization Study

Spawning habitat utilization curves are developed for use in the habitat selectivity analyses. The same curves can be used with both IFG-4 and IFG-2 models.

Study Approach

Spawning habitat utilization data are collected at active salmon redds for use in developing spawning habitat utilization curves. Measurements collected at salmon redds include: water depth, velocity, substrate composition, surface and intragravel water temperature, and presence or absence of upwelling.

Modeling sites - Spawning habitat utilization data collected at modeling sites are used in developing curves by comparing utilized versus available habitat in side sloughs and side channels. In addition to measurements collected at redds, staff gage readings are obtained in the modeling site in order to determine discharge occurring in the site during utilization on data collection.

Non-modeling sites - Utilization data collected at non-modeling sites are used in expanding and/or refining the modeling site curves. These data are also used to develop criteria of salmon spawning conditions for tributary, tributary mouth, and mainstem spawning sites. These data will be of use to evaluate the feasibility of mainstem, side channel, and side slough habitats as mitigation options for supporting what are now considered tributary spawners such as chinook and coho salmon (See also Section 2.2.2.3).

Literature - Literature data may be used to expand and/or refine the curves.

Site selection

Spawning habitat utilization studies are conducted at as many upland and side sloughs and side channels located between Talkeetna and Devil Canyon as possible during FY84. Efforts are concentrated on those side sloughs and side channels being evaluated in the spawning habitat availability studies.

Data analysis

Provided that the data collected are sufficient, spawning habitat utilization curves are developed for utilized spawning depths, velocities, substrates, and intragravel water temperatures using procedures as described in Figure 6 and Appendix A.

Modeling Sites - Scatter plots of spawning habitat utilization data collected at IFG-4 modeling sites are developed which illustrate:

1) depths vs. velocities with acceptable (+) or unacceptable substrate (-);

2) depths vs. differences in surface and intragravel water temperature and;

3) depths vs. velocities with upwelling presence (+) or absence (-).

Trends shown by these scatter plots will be evaluated. Scatter plots of available habitat and utilization habitat will be overlayed and evaluated for use in developing spawning habitat utilization curves.

Non-modeling sites - Scatter plots will be developed from non-modeling site data. These will be overlayed with scatter plots of available habitat data and modeling site utilization data and evaluated for use in expanding or refining the curves developed using the modeling site data.

Literature - In addition, scatter plots from literature data may also be developed and evaluated for use in expanding or refining the above curves.

2.2.2.1.3 Habitat Selectivity Study

Study approach

Utilization curves developed in the habitat utilization study are used in combination with the hydraulic models to determine the weighted usable area (WUA) available at modeled slough and side channel sites at a variety of mainstem discharges. Programs used in linking the curves with models are presented in the PHABSIM Manual (Milhous 1981).

Site selection

Habitat models are executed for those sites at which habitat availability data were collected.

Data analysis

Approaches for linking spawning utilization habitat curves with hydraulic models are evaluated. WUA calculations considered (refer Appendix A for specific reference for each calculation approach) are:

1) standard calculation using 3 matrices;

2) lowest limiting factor;

3) geometric mean;

4) multi-variate calculation; and

5) optimum, preferred, utilized, and available categories of ADF&G AH 1983 analysis.

The appropriate method of calculation is then used in the habitat model to generate WUA.

2.2.2.2 Tributary Mouths

Habitat availability at selected tributary mouth sites is evaluated using a lower level regression and graphic analysis.

Spawning habitat utilization data is collected at active redd sites and will be used in developing future preference curves for tributary mouth habitat.

These data will be analyzed in a similar method to that developed in the ADF&G Susitna Hydro Aquatic Studies Phase II Synopsis of the 1982 Aquatic Studies and Analysis of Fish and Habitat Relationships Report (FHR) (ADF&G, 1983).

2.2.2.2.1 Habitat Availability Study

Study approach

Studies conducted during FY84 are designed to evaluate and quantify the tributary mouth habitats available for salmon spawning at various levels of mainstem and tributary discharges. Field data consist of the collection of availability data at a variety of mainstem and tributary discharges. In order to evaluate stage and discharge relationships of the mainstem and tributary at each tributary mouth study site, staff gages are installed and monitored. At each study site, a sufficient number of transects are established for the collection of availability data in order to represent the various habitat conditions present at tributary mouth/mainstem confluence zones at each measured mainstem discharge. Habitat parameters measured include: water depths and velocities and substrates. From these data, depth and velocity isoplethic maps and substrate maps are constructed. (An isopleth is a line on a map connecting points that have equal or corresponding values with respect to certain variables, such as isotherm lines or topographical contour lines.) The parameter-specific surface area considered to be within the range of acceptable values for spawning salmon is defined on each map. The three maps (substrate, depth isoplethic and velocity isoplethic) at a particular discharge are overlaid. The surface area where all three parameters are acceptable is defined as utilizable salmon spawning habitat. These areas are measured using a digitizer to quantify utilizable habitat present at each measured mainstem streamflow. Locations of wetted areas, mixing zones, pools, riffles, and upwelling areas are also noted on scale drawings.

Site selection

Tributary mouth/mainstem confluences investigated include Fourth of July Creek and Lane Creek. These sites have been chosen based on their importance as salmon spawning areas and their feasibility for data collection.

Data analysis

For each tributary mouth study site the following data are presented:

1) Black and white aerial photographs of the study site obtained at various mainstem streamflows. (These photographs are a product of our hydraulic engineer consultant as part of his firm's habitat mapping support work);

2) Scale drawings of the study site illustrating the distribution of substrates, spawning areas, streambed elevation contours, and utilizable habitat at each mainstem streamflow sampled;

3) Tabular summary of tributary and mainstem streamflows;

4) Location map;

5) Comparative tabulation of mainstem velocities for different streamflows at Gold Creek.

The following topics are addressed:

1) The surface area of each tributary mouth habitat studied is plotted against mainstem and tributary discharge to evaluate the relative significance of tributary and mainstem flows in determining available and utilizable habitat.

2) Graphical comparisons of measured depths, velocities, and substrates available at a variety of mainstem flows are presented to evaluate whether similar habitat conditions exist under different mainstem flow conditions.

2.2.2.2.2 Habitat Utilization

Study approach

Tributary mouth areas used by salmon for spawning are evaluated using the same method as used in sloughs and side channels. Hydraulic and temperature measurements are collected at active redds to be used in developing future preference curves.

Site selection

Utilization data is collected at specific active redd sites within the tributary mouth sites where availability data is collected.

Data analysis

Analysis of data from tributary mouth study sites are similar to that developed in the Fishery Habitat Relationships Report (ADF&G 1983). In addition, scatter plots of spawning habitat utilization data are developed which illustrate:

a) depths vs velocities with acceptable (+) or unacceptable substrate (-);

b) depths vs differences in surface and intragravel water temperature and;

c) depths vs velocities with upwelling presence (+) or absence (-).

Trends shown by these scatter plots are evaluated.

The habitat preference data scatter plots for tributary mouth spawners are compared to the habitat preference data scatter plots for sloughs and side channels to evaluate whether it is necessary to develop a unique set of habitat preference curves for tributary mouth spawners.

2.2.2.3 Tributary Utilization Study

2.2.2.3.1 Study Approach

Utilization data (depth, velocity substrate and intragravel water temperature) are collected at salmon redds in tributaries to the Susitna River. These data are collected in order to document the hydraulic conditions preferred by the species spawning in tributaries. This information can in turn be used to determine if adequate hydraulic conditions could be present in the mainstem and side channel habitats of the Susitna River at low Susitna River discharges. These data are also used, if possible, to refine side slough and side channel spawning habitat curves.

2.2.2.3.2 Site Selection

Tributaries investigated include the upper reaches of Portage Creek, Indian River, Fourth of July Creek, and Lane Creek. These sites have been chosen based on their importance as salmon spawning areas.

2.2.2.3.3 Data Analysis

Preliminary curves may be developed in order to define the range of habitat parameters utilized in the tributary habitat. This analysis will follow the techniques outlined in Bovee and Cochnauer 1977.

2.2.3 Incubation Study

2.2.3.1 Study Approach

The study conducted during FY84 evaluates and compares the in situ incubation habitat conditions present in side slough, side channel, and tributary habitats of the Susitna River between Talkeetna and Devil Canyon. It consists of three segments: 1) measuring surface and intragravel water quality conditions using intragravel standpipes, 2) determining survival of embryos to 100% hatch, and 3) determining substrate conditions in each habitat type.

Intragravel standpipes are used to evaluate intragravel and adjacent surface water quality conditions (dissolved oxygen, temperature, conductivity, and pH) in areas of salmon spawning activity (redds) and in areas of "potential" spawning where fish were not observed spawning. Areas are considered "potential" spawning areas if depth, velocity, and substrate conditions are within acceptable ranges for spawning as determined during the 1982 and 1983 study of salmon spawning habitat in side sloughs and side channels. Detailed methods are described in Section 3.2.2.1 of this section.

At standpipe locations, embryo incubation chambers (modified Whitlock-Vibert boxes, WVBs) containing fertilized eggs from chum salmon are installed under different intragravel habitat conditions. This information is used to determine the differential survival of embryos under various intragravel habitat conditions. Detailed methods are described in Part 3 of this section.

At selected standpipe locations, substrate samples are collected and analyzed to:

1. determine the character of substrates in terms of particle size distribution at areas of egg deposition; and,

2. determine the quantity and particle size distribution of fines (substrates less than 0.5 inches in diameter) that accumulate in incubation chambers over the course of embryo development.

To determine the particle size distribution of substrates occurring in areas of salmon egg deposition, substrate core samples are collected at selected sites using a modified McNeil substrate sampler and sifted, on site, using a series of substrate seives. In addition, the amount and particle size distribution of fine (less than 0.5 inch diameter) sediments accumulated inside incubation chambers is evaluated by sifting the contents of the incubation chamber through a series of substrate seives. This information is used as an index of the fines present in the surrounding substrates. Specific data collection techniques incorporated in the collection and processing of substrate samples are presented in Section 3.2.2.2.2.

2.2.3.2 Site Selection

Sites at which incubation studies are being conducted during FY84 are presented in Table 10 (refer to Figure 4). These sites are selected based on their relative importance as spawning areas for salmon during 1982 and 1983 open water season.

2.2.3.3 Data Analyses

Seasonal trends in intragravel and surface water quality will be determined from data collected at standpipe locations. Comparisons of surface and intragravel water quality conditions are made within study sites (i.e., river-side bank versus land-side bank; and, areas of spawning versus areas of non-spawning), among study sites of like habitat (i.e., side channel downstream of Slough 21 versus side channel upstream of Slough 11), and between study sites of different habitat type (side channels versus side sloughs).

Embryo development and survival (% survival to 100% hatch) is compared within, among, and between study sites as discussed above. In addition, survival of embryos is correlated with physical and chemical habitat variables of the intragravel environment (e.g. temperature, dissolved oxygen, % fines in substrate) measured at each standpipe.

Table 10. Sites at which incubation studies on chum salmon are conducted by ADF&G (AH) during FY84.

LOCATION		WATER QUALITY		SURVIVAL AND DEVELOPMENT			SUBSTRATE[a]
Study Site	River Mile	Standpipes with WVBs	Standpipes without WVBs	Number of WVBs for Survival	Number of WVBs for Development	Source of eggs	
Mainchannel							
Downstream of Gold Creek	136.1	3	-	-	15	Slough 11	-
Upstream of Gold Creek	136.8	-	3	-	-	-	-
Downstream of Slough 17	138.7	-	3	-	-	-	-
Sidechannel							
Near Slough 10	133.7	19	-	38	-	Fourth of July Creek	X
Upstream of Slough 11	136.1	3	-	-	15	Slough 11	-
Downstream of Slough 21	140.5	33	-	60	-	Slough 21	X
Slough							
8A	125.1	-	3	-	-	-	-
9	128.3	-	3	-	-	-	-
9A	133.8	-	3	-	-	-	-
10	133.8	20	-	40	-	Fourth of July Creek	X
11	135.3	23	-	40	15	Slough 11	-
11 (Control Site)	135.3	15	-	30	-	All sites[c]	X
17	138.9	-	3	-	-	-	-
21	141.1	16	6	30	-	Slough 21	X
Tributary Mouth							
Fourth of July Creek	131.1	15		30[b]	-	Fourth of July Creek	X
Indian River	138.6	-	3	-	-	-	-

[a] Substrate from McNeil and WVB samples (the symbols "X" and "-" refer to sites sampled and not sampled, respectively).

[b] Pink salmon included.

[c] Eggs from Fourth of July Creek, Slough 11 and Slough 21.

Substrate samples are analyzed to determine the range of substrate conditions associated with embryo incubation and development. This information is used to detect differences in substrate composition within, among, and between study sites as discussed above.

2.3 Quality Assurance and Laboratory Operations (QUALO)

Because of the large and varied support requirements of the AH project, a coordinating sub-project element, Quality Assurance and Laboratory Operations (QUALO), is required to ensure consistency in data collection, laboratory analysis methods, and data reduction and transfer. This objective of the QUALO sub-project element is to:

> Assist the other AH sub-project elements in support operations such as assuring quality control; coordinating data reduction; categorization and data transfer; providing laboratory support; equipment calibration; and repair for AH and RJ habitat instruments.

Specific procedures utilized in meeting the above tasks are presented in Part 3 of this section.

3.0 TECHNICAL PROCEDURES

3.1 Introduction

This section is organized to present procedures utilized by each subproject in the collection and analysis of field data. Due to the nature of the instream Flow Evaluation Study, a complete listing of the procedures utilized during FY84 are presented. The Fish Habitat Studies and Quality Assurance and Laboratory Operations sections contain only those procedures and techniques that are not included in or that have been changed from those presented in the Phase I or Phase II ADF&G Su Hydro Aquatic Studies Procedures Manuals (ADF&G 1982).

3.2 New FY84 Procedures

3.2.1 Instream Flow Evaluation Procedures

3.2.1.1 Stage Monitoring Procedures

Measurements of stage are obtained utilizing either standard staff gages or continuous data recorders with associated pressure transducers (datapods).

3.2.1.1.1 Staff Gages

Stage data obtained using standard Leopold and Stephens (0.0-3.3 ft) staff gages are determined to the nearest one-hundredth of a foot. An assigned elevation, which is referenced to a temporary benchmark (TBM), is determined for each gage using the basic survey technique of differential leveling (Bovee and Milhous, 1978; Trihey and Wegner, 1981). All TBM's are surveyed to a known elevation (project datum) so that the resultant stage readings can be converted to true water surface elevations (WSEL).

A compass reading on true north to the TBM from each gage is determined as well as the distance from the gage to the TBM. This is done to insure accurate replacement of gages lost during high flows. True north is determined from magnetic north by using the appropriate mean declination information available on USGS topographic quadrangles, 1:63,360 series. For example, an approximate mean easterly declination of 25.5° for USGS topographic quadrangles of the Susitna River from river mile 0.0 to 22.0 would be subtracted from the magnetic north bearing (360°) to determine the true north bearing (360°) to determine the true north bearing (360°-25.5° = 334.5°).

Staff gages are installed as follows:

1) Select a location where hydraulic conditions reflect what is to be examined and where gages will have a reasonable chance of representing low and high water conditions (without washing away during high water conditions). Keep in mind these areas may be navigated by boats.

2) Install a necessary number (two to five) of six to seven foot steel fence post in an upright, vertical position (leaving an adequate amount of post to secure a three foot gage to along an imaginary transect perpendicular to the flow. Keep in mind that the gages have to overlap (.5 feet), to prevent data gaps when determining the water surface elevation over the full range of stage events (Figure 7).

3) Attach standard staff gages firmly to each post with wire, being sure that the gages can not move up and down on the post.

4) Securely attach a painted fluorescent orange float to each post and paint the top of the post to help insure that boaters are aware of the gage locations.

5) Number each gage, both on the back of the gage and on the painted float according to the numbering and identification system illustrated in Figure 8.

3.2.1.1.2 Datapod Stage

The datapod system used to continually monitor and record stage incorporates a pressure transducer and electronic interface unit (designed by Dryden and LaRue Consulting Engineers; Anchorage, Alaska) to record depth of water over the transducer probes in millivolts (mV). Every

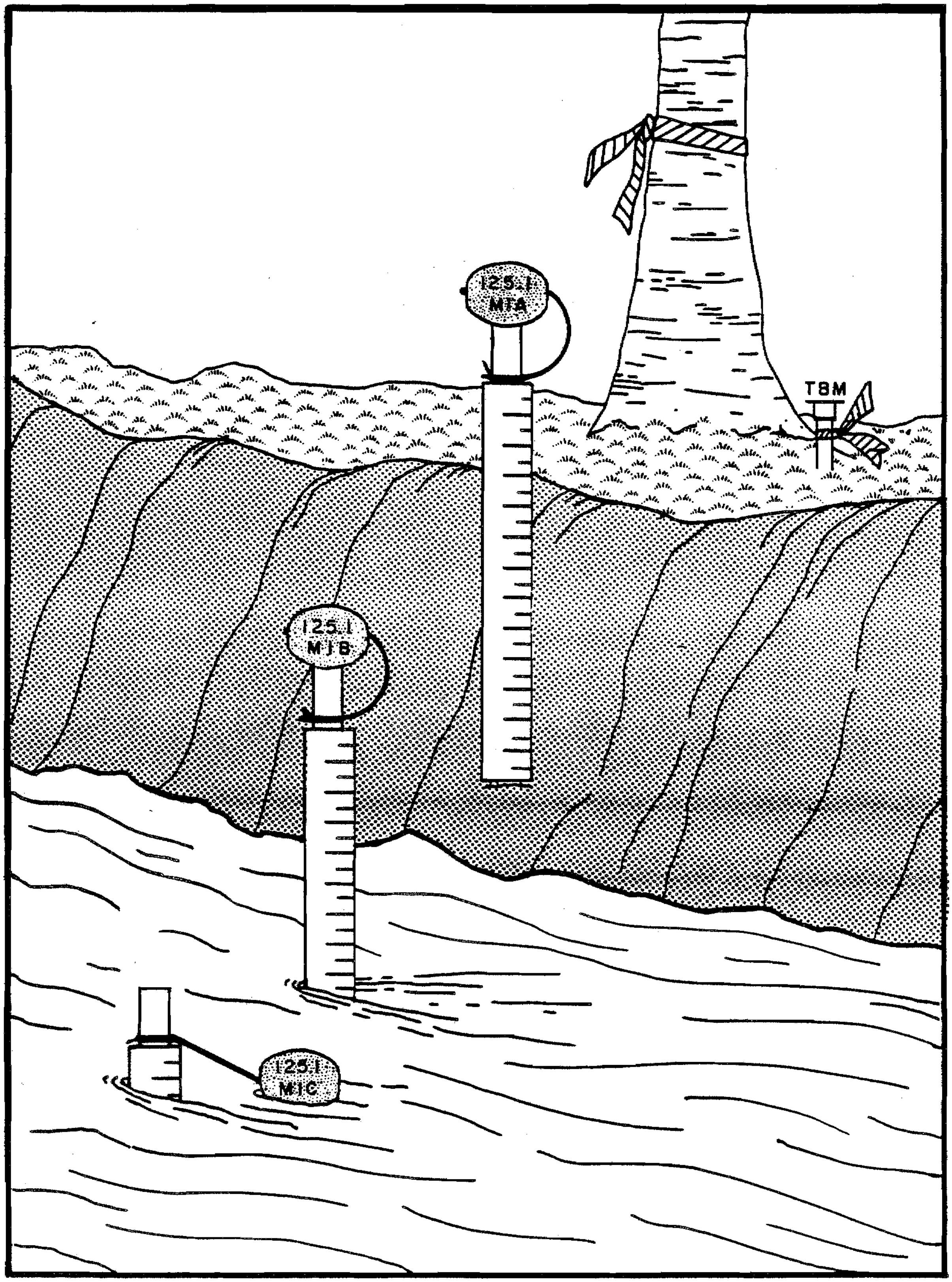

Figure 7. ADF&G staff gage installation procedure.

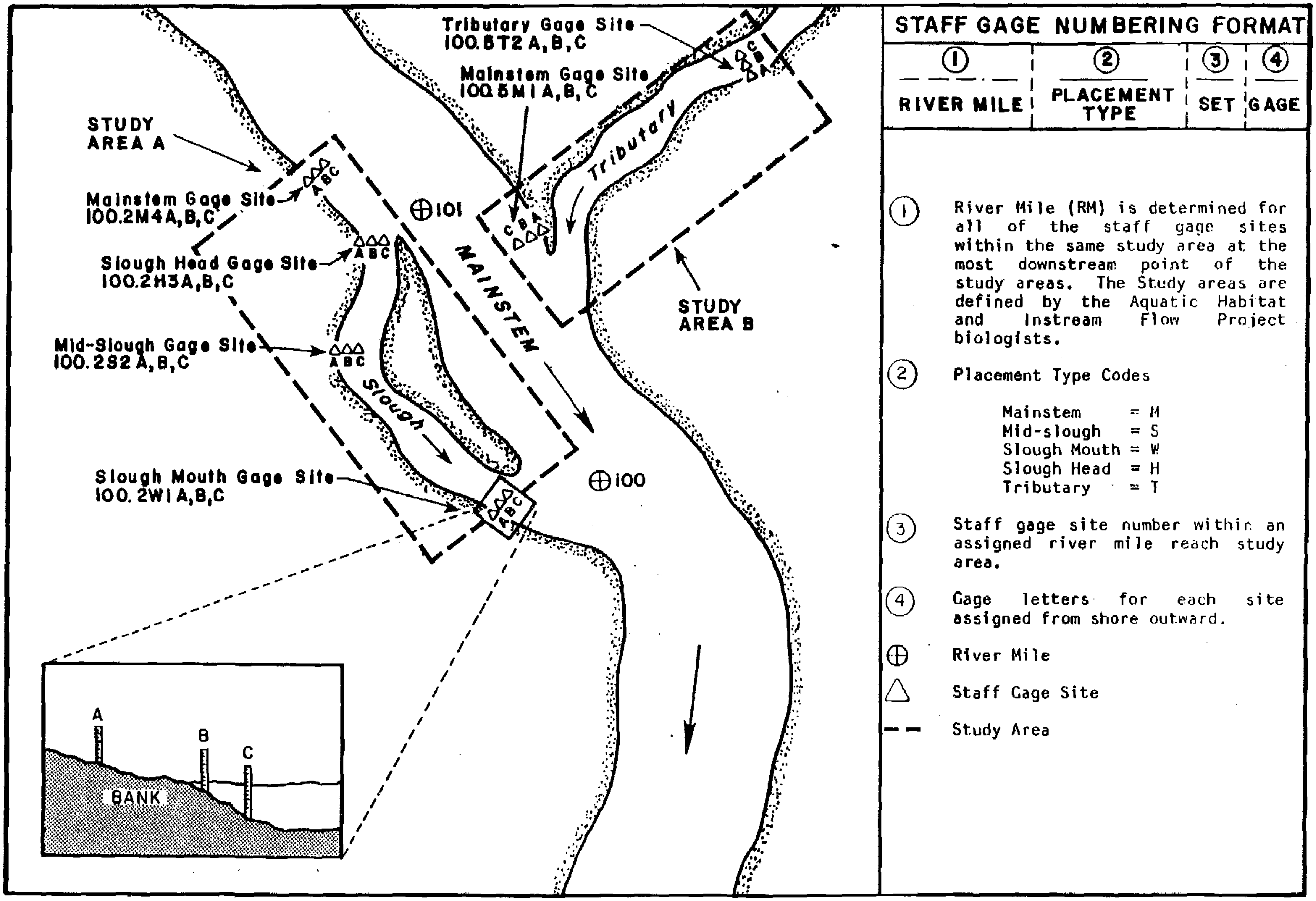

Figure 8. ADF&G staff gage identification system.

0.5mV represent 1.0 inch of water depth over the transducer probe. The transducer probes utilized have a range of 0 to 80 inches of water with an accuracy of 0.2mV (i.e., 0.4 inches of water).

To monitor stage, the datapod (model DP211) and associated pressure transducer probe will be installed (whenever possible) in a straight channel segment of near rectangular cross section just upstream of a hydraulic control. the pressure transducer probes are installed by slipping the brass transducer housing over a 30 inch length of 1/2 inch rebar that has previously been pounded into the streambed. An allen screw built into the housing secures the transducer to the rebar at the streambed. The probe is then connected to the datapod which is stored with the interface unit in a waterproof container on the streambank above the water surface elevation of high flows.

A staff gage is also installed at each site and surveyed to a nearby TBM. Discharges are also obtained periodically at the site to establish a rating curve for the gage. Used in conjunction with this rating curve, the datapod recordings of stage give a continuous record of streamflow for each site.

The stream gage datapods are programmed to record average millivolt readings at 60 minute intervals on a UV-erasable, solid state Data Storage Module (DSM). Using a 60 minute recording interval, the DSM reaches capacity in 40 days and then must be exchanged for an erased (clean) DSM.

Every two weeks the stream gage datapods are checked for accuracy by:

1) measuring the depth of flow over the transducer with a staff gage held vertically over the top of the probe housing, and

2) reading gage height of installed staff gage.

3) to ensure continuous accuracy, a short display sequence is recorded. A short display sequence is initiated by pressing the grey exterior button. The following messages are displayed: current readings, number of errors, minutes left until next recording and storage module space used.

An ongoing record of the data obtained at field checks is kept on file.

3.2.1.2 Discharge Procedures

Gaging stations for the measurements of discharge data are placed in areas where conditions are maximized for obtaining discharge and corresponding stage measurements. Gaging stations are to be located in a free flowing portion of the stream, removed from any backwater influences created by the mainstem within a uniform channel with a stable substrate where water column velocities parallel each other and are at right angles to the cross section total discharge measurements will be made by the current-meter method using standard USGS techniques employing either a Price AA or Pygmy meter (Carter and Davidson, 1968).

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Susitna Hydroelectric Project

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Procedures Manual
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discharge is then determined as the summation of the products of cell area and mean cell column velocity.

3.2.1.3 Temperature Procedures

Two instruments are used to monitor and record temperatures Peabody-Ryan model J-90 submersible thermographs and datapod two channel recorders and associated thermistor probes.

3.2.1.3.1 Peabody-Ryan Thermographs

Peabody-Ryan model J-90 thermographs continuously record temperatures on a 90-day strip charts. Instrument accuracy, as stated by the manufacturer, is ±0.6°C. Prior to field installation each instrument will be screened at two temperatures (0°C and between 10-16°C) using a calibrated American Society for Testing and Manufacturing (ASTM) thermometer as a standard. Thermographs found in error by more than 2°C at either temperature are returned to the manufacturer for calibration.

Field installation procedures for Peabody-Ryan thermographs are as follows:

1) Select a location where hydraulic conditions allow that the temperatures being recorded are representative of the study area (e.g. absence of tributary influence).

2) Open the thermograph by removing the coupling and separating the two halves of the casing.

3) Install a strip chart assembly and record the surface water temperature [with a calibrated Brooklyn Mercury thermometer submerged for a sufficient length of time to allow equilibation (2-3 minutes)], date, serial number of thermograph, location, time, and the sampler(s) initials on the chart.

4) Gently adjust the pen point on the chart to the proper time, and mark with a pencil on the chart to how the beginning. Do not move the pen manually.

5) Check the battery and then TURN ON THE INSTRUMENT.

6) Be sure the "O" ring is clean and properly lubricated (silicone vacuum lube) and close the thermograph with the coupler clamp. Use a paper clip or "clamp lock" to secure the coupler.

7) Attach a thermograph weight to the thermograph at the holes located in each end of the thermograph casing. Loop a 1/4 inch plastic coated wire cable through both ends of the thermograph and through the weight. Close the loop and secure with two cable clamps.

Field installation procedures for the datapod system are as follows (refer to Figure 9):

1) Install a fence post on the stream bank out of the range of flood flows and attach a waterproof storage box to the post.

2) Install a datapod recorder in the waterproof storage box.

3) To obtain surface water temperatures, attach the thermistor probe to either a weight or a spike so that the thermistor fan monitor the temperature of the lower portion of the water column. Then run the probe cable along the streambed/streambank to the datapod, concealing the cable so it cannot be damaged by debris or wildlife.

4) To obtain intragravel water temperatures, insert and secure the thermistor probe into an 18" slotted, steel tube which has been pounded into the substrate to a depth of approximately 15". Two rubber grommets are used to secure the thermistor in the steel tube and to prevent direct contact with the tube. The probe cable is then questioned to the correct depth and secured either by inserting a #9 cork in the top of the steel tube or inserting a conduit cap into the top of the tube and securing it with set screws. The probe cable is then attached to the top of the tube using a wire tire. Run the probe cable along the streambank/streambed to the datapod, concealing the cable so it cannot be damaged by debris or wildlife.

Cross sections at discharge sites are divided into a minimum of 20 cells to ensure that each velocity obtained measures no more than five percent of the total flow. The observed depth at each cell are determined using either a four or six foot top setting wading rod graduated into one-tenth foot increments. Mean water column velocities, measured as feet/second (fps), are obtained at each cell using a two point or a six-tenths depth method. At depths less than or equal to 2.5 feet, mean all water column velocity is measured at six-tenths of the depth from the surface while at depths exceeding 2.5 feet, water column velocities are measured at two-tenths and eight tenths of the depth from the surface and then averaged to yield a mean cell water column velocity. At depths less than six-tenths of a foot or velocities less than 2.5 fps, the Pygmy meter is utilized while at greater depths and velocities a Price AA meter is to be used. When velocities are observed not to be at right angles to the discharge transect, the velocity vector component normal to the measuring section is determined.

The velocity vector component is determined by measuring the cosine of the horizontal angle (figure measurements of horizontal angles) by holding the discharge measurement note sheet in a horizontal position with the point of origin (0) on the left edge over the tag line, bridge rail, or any other future parallel to the cross section. With the long side parallel to the direction of flow, the tag line will intersect the value of the cosine of the angle (a) on the top, bottom, or right edge. Multiply the measured velocity by the cosine of the angle to determine the velocity vector component normal to the measuring section. Total

8) Secure the other end of the cable to a large tree located well above the high water mark to ensure the tree won't be washed away by high water.

9) Submerse the thermograph in an area which will adequately represent the temperature regime to be sampled and avoid damaging instrument due to velocity, erosion or rocks.

Thermographs are checked at least twice monthly at which time the date, time, and water temperature at the time of checking are noted on the strip chart. Check to make sure the seal is not leaking, the battery is functioning, and the instrument contains a sufficient amount of strip chart to record temperatures until the next scheduled checking. If it is necessary to replace the strip chart, remove the old strip chart and record on it the location, instrument serial number, time and date, water temperature, sampler's initials, and the word "END". Install a new strip chart following the procedures listed in step 2 above. Return the removed chart to the office for processing.

Necessary equipment for the above procedures includes: one small screw driver, spare "O" rings, couplings, lubricant, charts, pen assemblies and batteries. The Peabody Ryan operating instructions are to be carried into the field for reference.

Upon return to the office, thermograph strip charts will be carefully screened for anomalous temperatures which may be caused by siltation or dewatering of the instrument or instrument failure. All screening efforts are supported by field notes.

A correction value for each strip chart will be determined as the difference between the water temperature obtained with a calibrated thermometer with an accuracy of ±0.1°C and the thermograph reading at the time the strip chart was removed. The correction value is determined at the time of the strip chart removal rather than installation because equilibration time varies with each installation.

Techniques employed in the reduction of strip charts are presented in Section 3.2.3.

3.2.1.3.2 Datapod Temperature Recorders

Datapod two channel recorders are also used to monitor and record intragravel and/or surface water temperatures using TP10V temperature probes. Instrument accuracy, as stated by the manufacturer, Omnidata International, is ±0.1°C. Data is recorded on an ultraviolet erasable miniature electronic memory chip or data storage module (DSM). Temperatures are measured every 5 minutes and the average, minimum, and maximum are recorded every 6 hours on the DSM. A DSM has a storage capacity of 2047 readings and thus replacement is necessary every 84 days. Prior to installation each probe must be calibrated by Dryden and LaRue Engineers and assigned a correction value.

5) Attach the probe cable(s) to the datapod. Flag any intra-gravel cables near their connection with the datapod to distinguish them.

6) Check the operation of the datapod and probes. To ensure the datapod and probes are operating normally a short data display sequence must be activated. This is done by pressing the grey exterior button. The following information is then displayed: errors made in storage, number of storage points used, minutes until the next recording and current temperatures. Surface water temperature will be measured with a calibrated thermometer with an accuracy of ±0.1°C at the surface water probe and compared to the Datapod temperature. All information will be recorded on an Instantaneous Datapod Readings form.

7) Close the waterproof storage box, making sure it is properly sealed and secured.

Units are monitored twice monthly after installation. Probes and cables will be checked for physical damage, siltation, or dewatering. The short data display sequence are activated and recorded, and the surface water temperature are measured with a calibrated Brooklyn thermometer. Data are recorded on an Instantaneous Datapod Readings form. Data storage modules are changed if necessary. They are replaced when nearly full or sooner if the data are required prior to scheduled replacement.

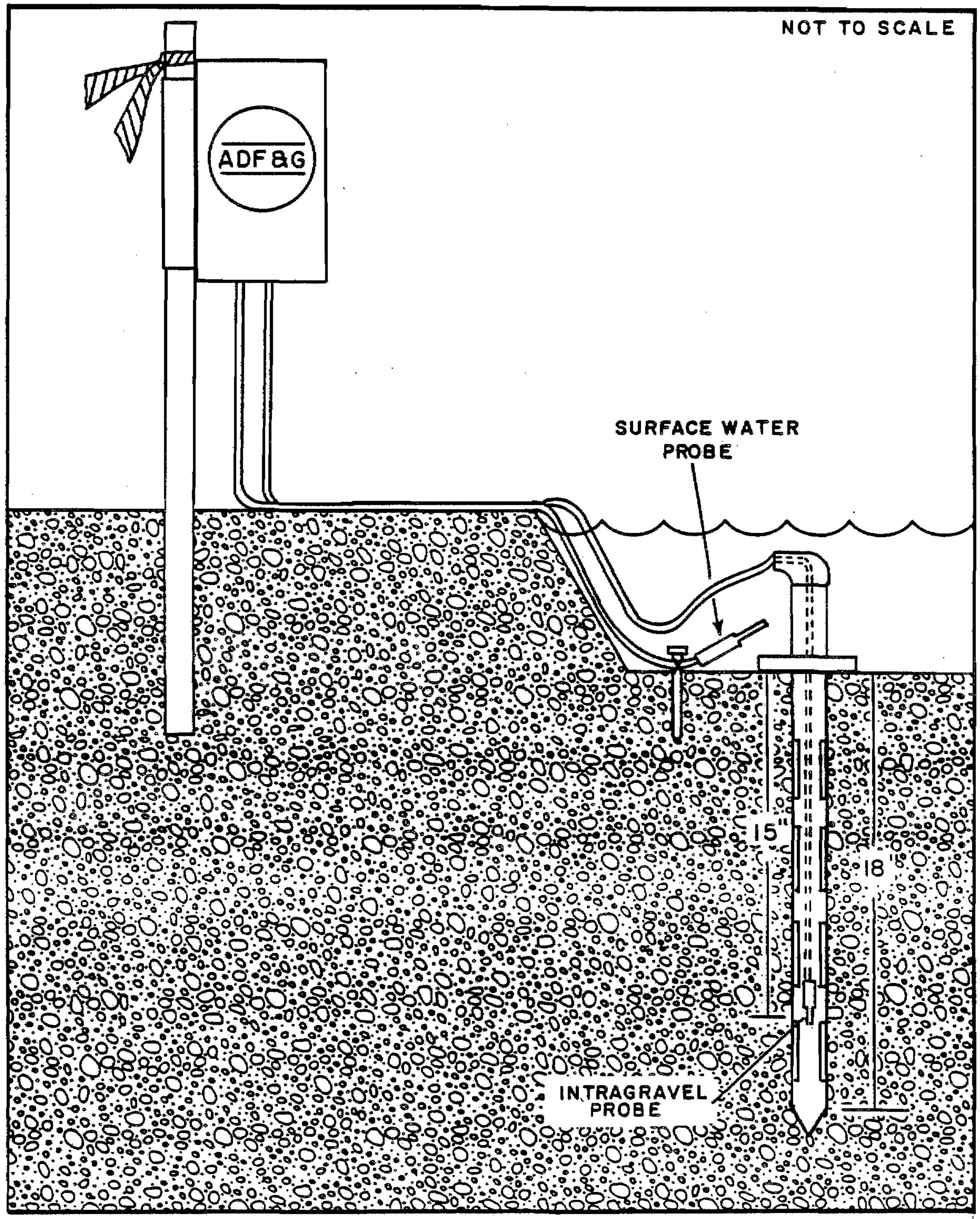

Figure 9. Field installation procedures for the datapod systems for obtaining surface and intragravel water temperatures.

taken from a sample of stream water contained in the well rinsed sonde cup. Following field use a post field calibration is necessary to check for and adjust the instrument drift.

3.2.1.4.2 Turbidity

Turbidity samples are collected in 250 ml bottles filled approximately two-thirds full and stored in a cool, dark location prior to analysis (no longer than 6 days). Turbidity samples are analyzed in the field don a HF Instruments DRT-15 turbidity meter according to instructions outlined in Appendix IX of the Phase I ADF&G Su Hydro Aquatic Studies Procedures Manual (ADF&G 1981). The measurement bottle is rinsed thoroughly with sample water being careful not to touch the vial where the instrument light shines. The outside of the vial should be free of sample water and other contaminants using only lint-free wipes to wipe the bottle clean. Place the sample vial into sample slot and turn instrument on. If the reading is too high for instrument range, the sample must be diluted to under 40 Nephlometric Turbidity Units (NTU), (ideal measurement value). To dilute use only turbid free water. Water is turbid free once it is passed through a .45 micron pore size filter and placed in a well rinsed container. The sample will be diluted with an equal volume of turbid free water and a dilution factor determined from the number of additions. To dilute the samples by a factor of 10, the procedure is to place 1 ml in 9 ml of turbid free water; to gain a factor of 100 dilution, take 1 ml of the factor 10 dilution and add another 9 ml of turbid free water. Continue dilution until you have an instrument reading of under 40 NTU. This value will be multiplied by

Techniques employed in the reduction of DSM temperature data are presented in section 3.2.3.

3.2.1.4 Water Quality

3.2.1.4.1 Basic Field Parameters

The basic water quality field parameters of dissolved oxygen (DO), pH, water temperature, and conductivity (specific conductance) are measured in the field using a Hydrolab model 4041 protable multiparameter meter. The four parameters are measured simultaneously at the sonde unit (under water unit) and the readings are displayed in an indicator unit. Each hydrolab is calibrated prior to entering the field except for temperatures which is calibrated by the manufacturer. Refer to the FY83 Procedures Manual-Appendix VIII for manufacturers instructions on the use and calibration of the Hydrolab model 4041.

To obtain measurements of the above parameters with a Hydrolab model 4041, the sonde unit should be placed in slow moving and well mixed water, such as back water areas behind boulders or behind an anchored boat. This will eliminate streaming potential on the pH probe and insure proper water mixing for DO probe. The instrument should remain in the water before taking measurements at least five minutes. This allows for instrument equalization. The DO function should be in the "ON" position during this equalization process to allow the probe to stabilize. If streaming potential cannot be minimized, then pH can be (such as tops and bottoms of riffles, pools, junction of two channels, and existing study transects). Information to be collected at each thalweg point includes elevation, water surface elevation (WSEL), substrate, reason for point selection (i.e., riffle, pool, junction of channels, etc.), and distance between points. Water surface elevations (WSEL) are obtained by a direct reading of the depth by the rod person at the time of the thalweg elevation is determined. The water depth is added to the thalweg elevation to produce the WSEL. The substrate for the area around a thalweg point is determined by the rod person, at the time of survey, based on the general substrate classifications presented in Section 3.2.2.2.1 (Table 11).

Distances between points are to be determined to the nearest foot either by 1) direct measurement with a fiberglass tape, 2) reading the stadia on the survey rod, or 3) utilizing trigonometric functions. When reading the stadia to determine distances, the level must be located along the thalweg to ensure that the distances measured is that of the thalweg. In utilizing trigonometric functions, distance from the level (either direct measurement of stadia) and the included angle between points must be recorded. A program for the HP 11C allows computation of the distances between points. Method 1 or 2 of measuring distances are preferred. The mouth and the head of the slough are determined utilizing existing cross sections (R&M or ADF&G) or the position of the slough/mainstem innerface. This can be somewhat difficult and arbitrary at mouths that have a definite backwater affect. The mainstem Q as measured at the USGS gaging station at Gold Creek, should be recorded.

This can be accomplished in the field by direct reading of the staff gages and comparison with established rating curves. All the data collected will be analyzed later to compile graphical representations of the thalwegs.

3.2.1.5.2 Cross Section Profile Study Procedures

The following procedures are employed in the collection of cross section data:

1. Two headpins are installed to form a cross section perpendicular to the stream channel. If a staff gage is present at the site, it is to be included on the transect.

2. A measuring tape is zeroed over the left bank headpin and stretched across the stream channel to the right bank headpin. The tape is not to be attached directly to the headpins but is secured immediately behind the headpin so as not to allow tension on the headpin, which may move it.

3. When the headpins are installed and the tape is stretched over the stream channel and secured, elevations of the ground and streambed are determined through differential leveling.

4. Beginning at the zero point (left bank headpin) elevations are obtained for the headpin, ground beside the headpin (GB) and

3.2.2 Fish Habitat Study Procedures

3.2.2.1 Incubation Study Procedures

3.2.2.1.1 Intragravel Standpipe Water Quality Study Procedures

Installation procedures

Dissolved oxygen, temperature, conductivity, and pH are measured inside (intragravel water) and outside (surface water) of the polyvinyl chloride (PVC) standpipes that are driven into the streambed. Standpipes are driven into the substrate using a driving rod and sledge hammer (Plate 1). The adopted design for the driving rod and standpipe were modified from previous designs (Gangmark and Bakkala 1959, McNeil 1962) which had the advantages of being relatively inexpensive and easy to install (Plate 2 and Figures 10 and 11). The inside diameter of each standpipe is 1.5 inches (3.81 cm) and contains 48 holes (1/8-inch-diameter; 0.32 cm) that are evenly spaced in four bands (12 holes per band). The four bands are spaced one inch (2.54 cm) apart with the lowest band being placed three inches (7.62 cm) from the bottom of the standpipe.

Each standpipe is pounded into the substrate to a depth of 14.5 inches (36.83 cm), centering the (bands of) holes ten inches (25.40 cm) into the substrate. This depth was selected because ten inches (25 cm) is the estimated mean depth at which chum salmon (Kogl 1965; Merritt and the dilution factor to give the sample NTU value. To calibrate the turbidity instrument, the use of a known turbidity standard are used before each sample measurement. The standard must be in the NTU range of the sample to be measured to calibrate the instrument. For example, if measuring a sample of 30 NTU, a turbidity standard of 10 NTU will be used. Standards will be purchased or can be made from formazin solution which is diluted with turbid free water to get the calculated standard value. Standard tubes are made of quartz glass to insure equal light passage and will be sealed with teflon tape and a seal on the outside to insure against air getting into the standard.

3.2.1.5 Channel Morphology

3.2.1.5.1 Thalweg Profile Study Procedures

The thalweg is defined as "the line following the deepest part or middle of the bed or channel of a river or stream" (Arnette, J.J. 1975). To determine a thalweg, the elevation of the deepest portion of the streambed is surveyed utilizing the standard surveying techniques of differential leveling (Bovee, K.D. and R. Milhous 1978).

Utilizing an existing temporary bench mark (TBM) such as a headpin on an R&M or ADF&G cross section, or establishing a TBM, which is to be tied to project datum later, a survey is conducted starting either at the mouth or head of the channel and progressing the entire length of the channel. Thalweg points are the low points at areas of significance at major breaks in topography which include the top of the left bank, midway to the left bank, bottom of the left bank, left edge of water, left water surface elevation, streambed, right edge of water, right water surface elevation, bottom of right bank, midway of right bank, top of right bank, ground beside right bank headpin (GB), and right bank headpin.

The horizontal distance from the left bank headpin is noted by the rod-man when each vertical measurement (elevation) is obtained. Vertical measurements are determined to the nearest .01 foot and horizontal measurements to within 0.1 foot. Figure 12 is an example of the field notes for a cross section profile survey.

3.2.1.5.3 Procedures Used to Determine Breaching Flows

Cross section surveys, staff gage readings, and on site observations are used in conjunction to determine the mainstem discharge necessary to breach the head of a side channel or side slough. Cross section surveys are made at the head of the channel where the streambed elevations control flow into the side channel or slough. The lowest representative elevation, on each cross section are labeled the "point of zero flow" (PZF). The water surface elevation of the mainstem at the head of the side channel or side slough must be greater than the PZF before mainstem water can enter the head of the side channel or slough. Staff gages are installed on the cross section as close as possible to the PZF so that the elevation of the bottom of the staff gage provides a good check on the accuracy of the PZF determined from the cross section surveys. Mainstem water surface elevations necessary to breach the head are obtained from these gages.

Field observations are also used to document the mainstem discharge required to breach selected study side channel and sloughs. However, even as field crews observe a site just as it is breached, does not mean that the exact mainstem discharge required for breaching of that side channel or slough had been identified. Observations of breaching and staff gage readings obtained to determine breaching flows are referenced to the average daily mainstem streamflow at Gold Creek (USGS 15292000). The gaging station is located up to 20 miles from various sites where breaching data will be collected. Since the accuracy of the relationship between breaching and Gold Creek discharge is dependent on the rate that the river is rising or falling, the range of flows required for breaching is determined from a combination of the above methods.

Plate 2. Installation of standpipes for monitoring intragravel water quality in Slough 11.

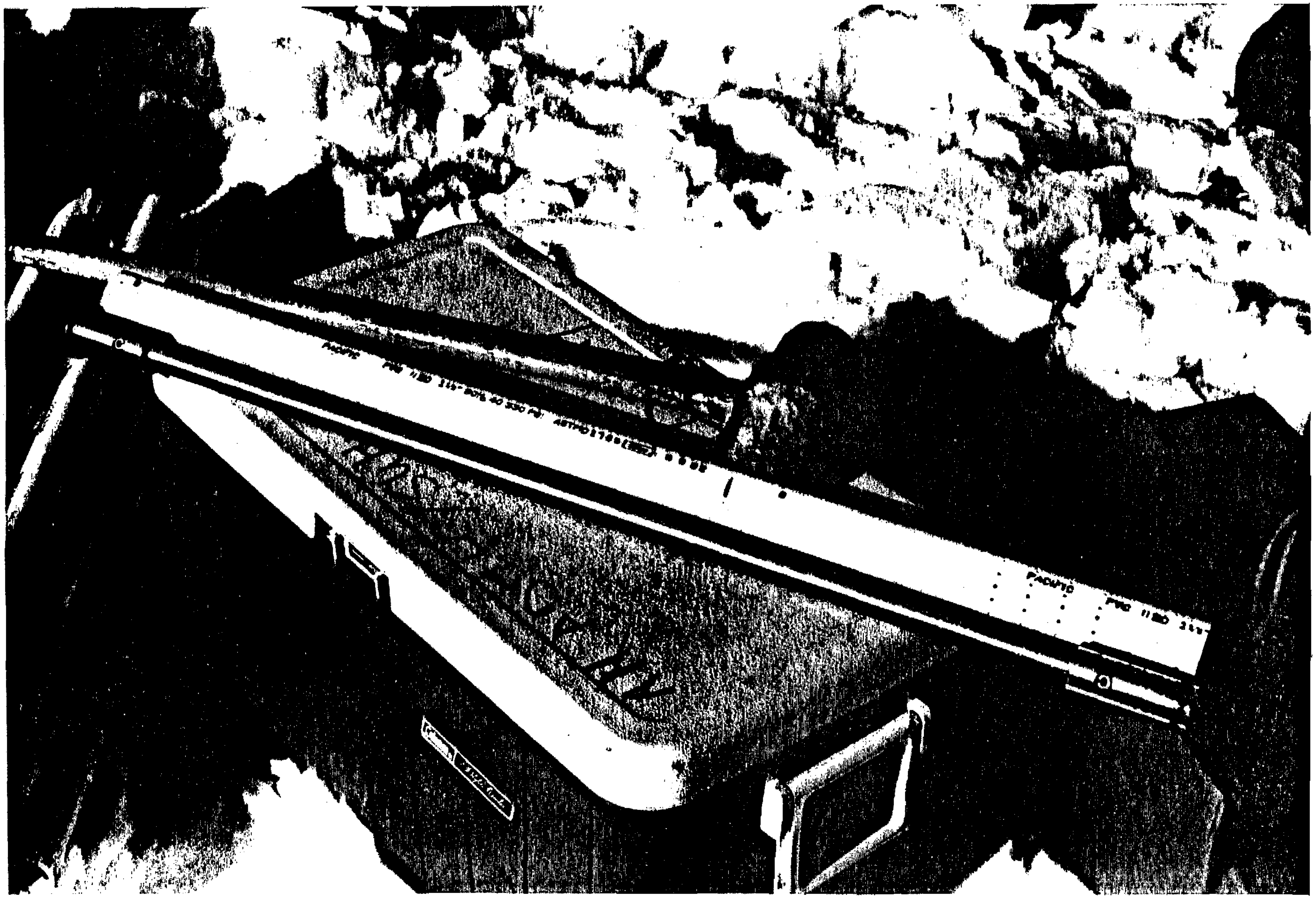

Plate 1. Standpipe (with 48 one-eighth inch holes) used for monitoring intragravel water qualilty and driver used for installation.

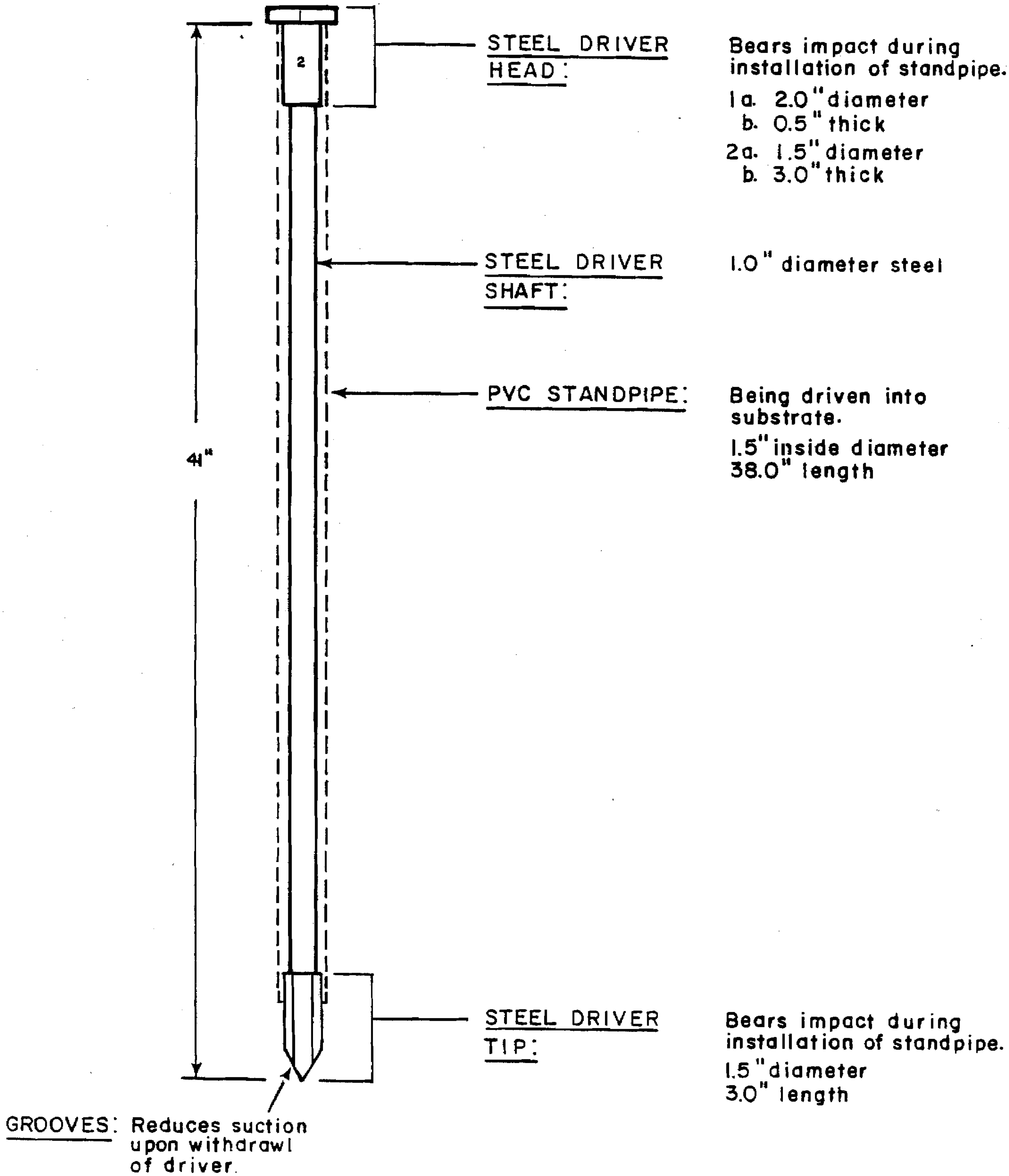

Figure 11. Scaled drawing of the steel driver used by ADF&G to install polyvinyl chloride (PVC) standpipes into gravel substrates.

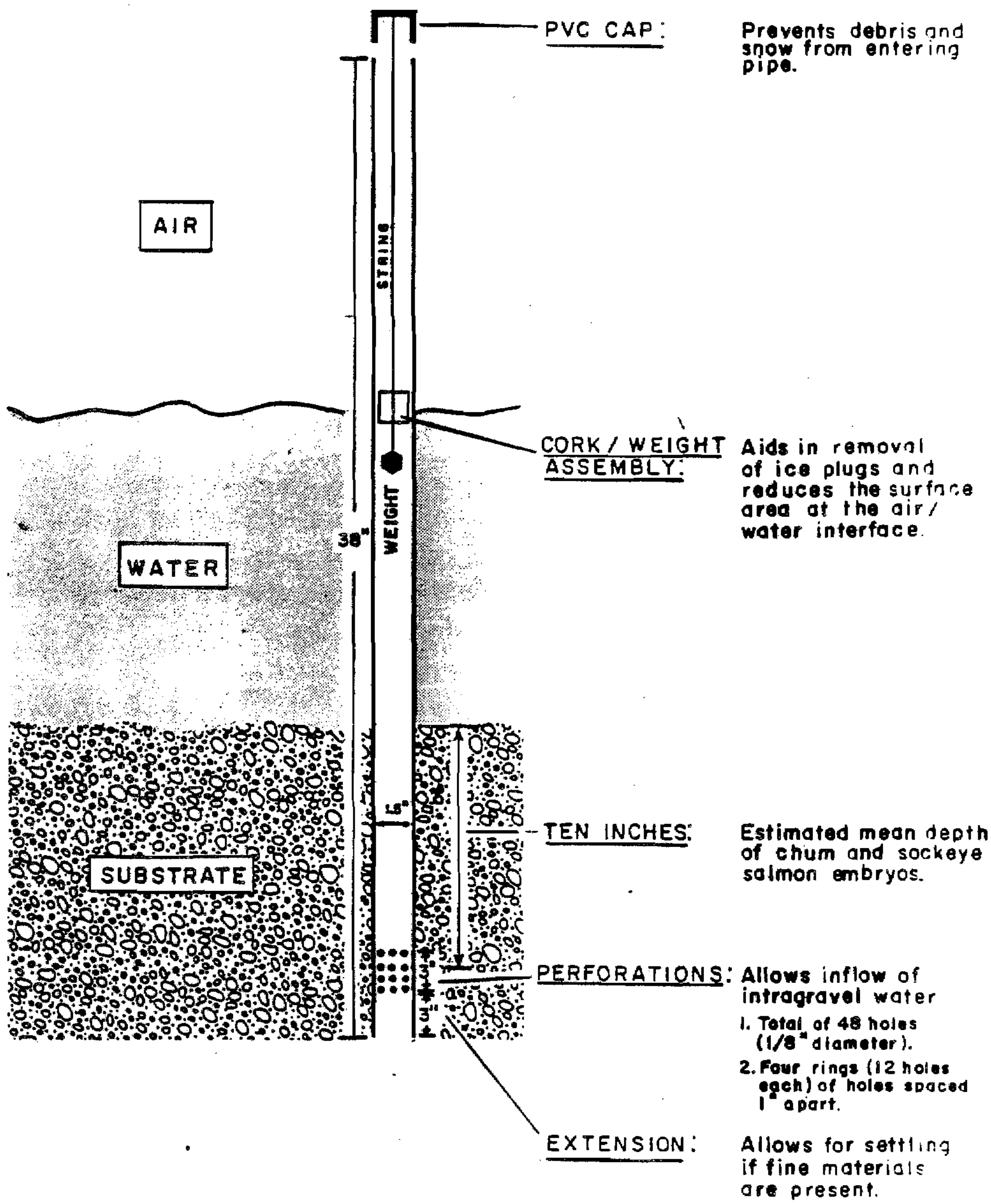

Figure 10. Diagram of a polyvinyl chloride (PVC) standpipe installed by ADF&G in substrate.

fresh source and that the water samples can be obtained at the desired depth in all standpipes.

After water refills the pipes and a minimum of one hour elapses, measurements of temperature, dissolved oxygen, conductivity, and pH are obtained within each pipe. In addition, corresponding measurements are obtained outside each standpipe approximately half way between the substrate and water surface beside each pipe.

The following procedures are used to obtain measurements of dissolved oxygen, temperature, conductivity, and pH.

Dissolved Oxygen

Dissolved oxygen measurements are obtained using a Yellow Springs Instrument (YSI) model 57 dissolved oxygen/temperature meter. This meter has a probe that is the proper diameter to fit inside the standpipe. The meter is calibrated at each sampling site by adjusting the observed reading to match that of a calibrated Hydrolab.

After the YSI meter is calibrated, measurements are collected by lowering the probe inside the standpipe to the desired depth (33.5 inches from the top of the pipe). After lowering to the proper depth, the probe is gently agitated to ensure circulation of water over the membrane and measurements are recorded when the meter indicator stabilizes.

Raymond 1981; Kent Roth pers. comm.) place their eggs in some Alaskan and British Columbian systems.

After the pipes are properly installed, a cork/weight assembly is placed inside each pipe to aid in removal of ice plugs formed during freezing weather conditions. This assembly consists of a weight and cork that is attached by a nylon cord to a cap which covers the exposed end of the pipe (Figure 11). The cork floats at the air/water interface and reduces the amount of surface area available for oxygen diffusion. Preliminary studies conducted with standpipes during FY84 showed that the cork also serves to station the weight in a position that caused the ice plug to freeze around it. Ice plugs are removed by gently heating a small metal heat shield attached to the exterior of the PVC pipe at the water surface. The metal shield is then gently heated with a propane torch while exerting upward pressure on the pipe cap. After a few minutes of heating the ice plug begins to melt and the cork/weight assembly and attached ice plug are then withdrawn.

Procedures for the measurement of water quality

Following the initial installation of standpipes, water quality sampling is not begun for a minimum of 24 hours. This allows substrate materials to "resettle". Following the resettlement period, sampling at each pipe is conducted after the interior of the pipe is pumped out using a hand-diaphragm pump (manufactured by PAR of JABSCO; Springfield, Ohio 45501; model 45800-000) to remove fine sediments that settled inside the pipe. This procedure ensures that the water that refills the pipes is from a

Readings obtained with the YSI meter are not temperature compensated to 25°C, therefore all readings must be adjusted to 25°C using standard procedures presented in Standard Methods (1980).

pH

Measurements of pH are obtained with a Hydrolab model 4041 water quality meter. Measurements obtained at each incubation study site are: one surface water measurement near the middle of the study site and three intragravel measurements from selected standpipes located in the lower, middle, and upper portions of each incubation study site. Intragravel samples are obtained by withdrawing a water sample with a Geofilter peristaltic pump (Geotech Environmental Equipment, Denver, Colorado) and measuring the pH with the Hydrolab following procedures described in the manufacturers operating manual.

3.2.2.1.2 Embryo Survival Study Procedures

Modified Whitlock-Vibert Boxes (WVBs) are installed in the substrate to determine survival of salmonid embryos under varying intragravel conditions. The WVBs was developed as a tool to assist fishery managers and fish enthusiasts to plant artificially spawned embryos of fish into their natural environment (Whitlock, 1978). The basic design for the box was originated in 1950 by Dr. Richard Vibert and later modified to meet problems encountered when embryos were incubated in less than ideal substrate conditions (Whitlock, 1978).

The meter and probe are kept inside an ice-chest equipped with handwarmers to prevent them from freezing. If movement of the meter is required in order to sample standpipes at another location, the YSI meter is hand carried by foot or in a helicopter. However, if transport is required by snowmachine, the YSI meter is recalibrated upon arrival at the next sampling location.

Temperature

Temperature measurements are obtained with a YSI model 57 dissolved oxygen/temperature meter according to procedures presented in the manufacturers operations manual. On each sampling day the YSI meter is calibrated with a Hydrolab model 4041 water quality meter. In the event of a discrepancy between the meters, a hand-held Brooklyn thermometer is used to detect the source of error.

Conductivity

Conductivity is measured with a YSI model 33 S-C-T meter according to procedures presented in the manufacturers operations manual. Because factory calibration of this meter is not always reliable or possible prior to field use, a calibration curve is developed over the full range of values expected to be encountered during measurement. The calibration curve is developed by comparing specific conductance values obtained with the YSI meter to those obtained with a calibrated Hydrolab model 4041 water quality meter. All values measured in the field are then adjusted on the basis of the calibration curve.

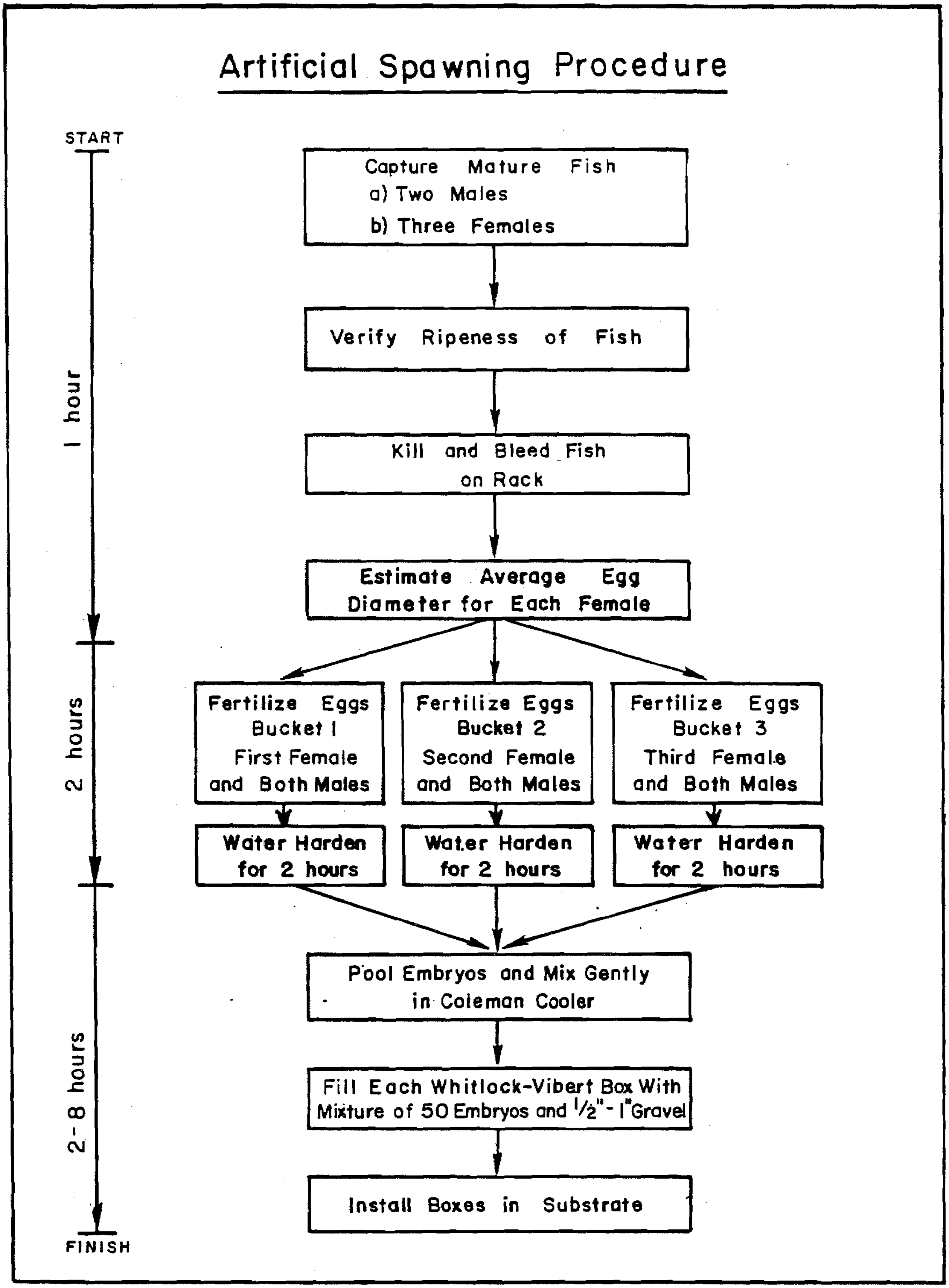

Figure 12. Flow chart depicting procedure for artificial spawning of salmon.

The WVB is constructed from polypropylene and is 145 x 90 x 60 mm in size. It has two chambers, an upper incubation chamber and nursery chamber below. In principal, the incubation chamber protects the eggs until hatching at which time the resulting sac-fry pass through slots in the floor of the box into the nursery chamber below. The sac-fry remain in the protective nursery chamber until absorption of the yolk sac permits them to pass through narrow slots in the side of the nursery chamber to the surrounding stream gravels.

The WVBs have been modified based on personal communications with Dudley Reiser (Bechtel, Inc.; San Francisco, CA) and Robert White (Montana State University; Bozeman, MT). They had encountered silting problems in the box when used as stated above. By removing the interior partitions, thereby creating one large compartment, and filling the box with 1/2 to 1 inch diameter gravel, siltation problems are reduced.

Procedures for obtaining eggs

Methods used in this study for obtaining and fertilizing chum salmon eggs primarily follow methods presented in Smoker and Kerns (1977). These methods are tailored to meet the basic objectives of this study and are consistent with those presented in McNeil and Bailey (1975) and Lietritz and Lewis (1976).

The basic approach that is followed at each study site is outlined in Figure 12. At each study site, eggs from three females are fertilized

Excess slime, blood, and water is removed from each fish. Females are cut from the anal vent to gills while held over a plastic bucket allowing the eggs to gently drop into the bucket. Eggs from each female are placed into separate buckets and fertilized with sperm from two males. Milt is stripped directly into the buckets containing the eggs. As one person strips a male, another person adds one cup of water, obtained from the study site, to each bucket and gently swirl the bucket to assure that eggs and sperm are adequately mixed.

Immediately following the fertilization process, excess sperm is rinsed from the eggs by repeatedly dipping water obtained from the study site and decanting until decanted water appears clear. Fertilized eggs from each bucket are gently poured into a common container (a small cooler). The entire mixture is then gently, but thoroughly mixed. The cooler is then placed in a shaded area to allow the fertilized eggs to water harden for 2 hours (Bakkala 1970). During water hardening, fertilized eggs are highly sensitive to even mild agitation, but once hardened are more resistant to shock for a six to eight hour period (Bakkala 1970).

After the fertilized eggs are water hardened, the eggs are ready for charging WVBs. WVBs are charged (using procedures presented in the following section) and stored in a large cooler placed in the stream until all placement sites have been prepared. This keeps charged WVBs at a constant temperature until they can be placed into the streambed.

with sperm from two males. Fish are captured with a small mesh beach seine. Ripeness of captured males and females are assessed as follows.

Females

Grasp the female by the caudal peduncle (thin part of the tail) with your left hand. A strong grip is needed - cotton gloves help. With your right hand under her belly, cradle the fish against your chest or stomach. Then, with your left hand, cock her tail up, and with your right hand apply a gentle pressure to her belly. If the eggs fall readily, the fish is ripe.

Males

The fish is held in the same manner as the female. Strip the male by squeezing along his belly with the thumb and forefinger of your right hand, pushing toward the tail. If milt is produced readily, the fish is ripe.

All fish are killed by a sharp blow to the head with a club and bled to prevent blood from contaminating eggs and milt. The tail of each fish is cut on the dorsal side until the knife severs the backbone. This severs the caudal artery and allows blood to drain quickly. Fish are then placed on a rack with head higher than the tail and allowed to bleed (15 - 20 minutes). The bleeding rack is then placed in a shaded area to keep fish body temperatures below 50°F.

best results. Keep bath shielded from direct sunlight or strong ultraviolet electric lights.

2. Immerse a dozen or more WVBs in the cold-water bath, and allow time for them to cool down to bath temperature. A few pieces of ice will keep the bath temperature constant.

3. Have fertilized eggs at the same temperature as the water bath. If they are colder, gradually pour small amounts of bath water over them so that the temperature change-rate averages one degree per 5 minutes.

4. Cull the bad eggs just before or while you are counting them to place in the WVB incubators. Use a plastic spoon, or feather to remove the bad ones. Be ruthless in culling as any bad eggs may cause others to die during WVB incubation.

5. Suspend eggs in water bath and transfer a small lot into a plastic margarine bowl - about 1/3 bowl full and water. Water is the best shock absorber and transfer mechanism you can use.

6. After the dead eggs have been culled, add a single layer of 1/2-1 inch gravel to the bottom of the WVB. Then, while holding the box underwater, count 25 eggs into the box. Repeat additions of gravel and eggs until each box contains a total of 50 eggs.

7. To aid in counting eggs, count eggs in small lots (approximately 5 eggs) while keeping count on a tally wacker.

8. When each incubator is filled carefully, snap the lid locked, keeping the box level under water until locking. If boxes are to be planted within a short time, settle the eggs by slowly leveling and shaking the WVB under water. Settle them evenly on the floor of the incubator. Drain water out, holding box level. Stack and store in ice box of same temperature.

9. A good, sturdy ice box with hinged lid, drain, and two handles (such as Igloo or Coleman coolers) makes an ideal storage and transport box. Outside temperatures and light do not come in contact with the eggs.

Procedures for planting the modified WVB in the substrate

The following procedures are utilized for the planting of the modified WVB in the substrate. Specific sites for the placements of Whitlock-Vibert boxes and standpipes will be based on random generated grid coordinates.

1. Assemble WVB planting personnel, equipment, and charged WVB at a convenient place at waterside. Teams of three or four people work most efficiently for planting each box.

Standpipe installation

One standpipe is installed at each WVB placement site at the time of installation. Procedures for obtaining water quality measurements (dissolved oxygen, temperature, conductivity, and pH) in standpipes are presented in the previous section. Conditions measured inside the standpipes are assumed to represent conditions at the corresponding WVB.

Substrate analyses

Analyses of substrate are performed at the intensive level at the locations designated for placement of modified WVBs. Procedures used in the collection and analysis of substrate samples are presented in section 3.2.2.2.

Removal of WVBs

Whitlock-Vibert boxes are removed by locating each metal spike and cord and tracing the nylon cord lead back to the point where the cord enters the substrate. Gentle upward pressure on the cord and simultaneous removal of substrate materials allows the box to be freed from the substrate. Upon removal, the box is placed in a plastic container to retain draining fine materials. Embryos are removed and preserved at the stream side (if weather conditions permit) and substrate material are placed in plastic bags for later analyses. In freezing weather conditions WVB's are removed, placed inside a two liter ziplock plastic

Percent fertilization is determined by taking 100-200 fertilized eggs and placing them into a temporary incubation tray at each study location. Trays are placed under a dark sun shield in a clean riffle area and left for two to five days, then preserved in Stockard's solution.

Percent fertilization is estimated by examining a sample of eggs during the first few days after fertilization. The early cell divisions in salmon embryogenesis forms large cells (blastomeres) which can readily be distinguished from the germinal disk of unfertilized eggs with low power magnification (Velsen 1980).

Procedures for charging of WVBs

The following procedures for use of the modified WVB are a distillation of methods presented in the literature (Peterson and Barnhart 1978, Whitlock 1978, Barnhart 1979) modified by suggestions obtained from professional fishery biologists that have used the WVB.

The following procedure is utilized in the loading of the modified WVB (modified from Whitlock 1978).

1. Prepare a 45-50°F, natural-water bath, an inch or so deeper than the height of the WVB, in a sink or large tub. Use ice to cool pure natural water. Do not use distilled or city tap water! Use water from a well, spring, stream, or rain for

2. Designate areas for teams to cover, and give each team an appropriate number of WVBs to plant.

3. Run over check list for each team's equipment.

4. Adjust WVBs in ice boxes at streamside to stream temperature by removing ice and pouring small amounts of stream water over boxes. Adjust temperature one degree each five minutes. Keep the ice box drain open so excess water does not accumulate in the box. Keep the box lid closed except to pour water over the boxes. This egg tempering usually takes 30 minutes or less. Through the planting periods, continue to keep WVB eggs in the ice box at the same temperature as the stream water. A good system is to pour stream water over the boxes every tim you remove one for planting.

5. Advance teams to WVB planting sites.

6. After the implantation site is located, substrate mater will be loosened and removed. After thoroughly loosenin substrate surface, a 5 gallon bottomless plastic buck placed on the substrate surface and the contents are ext for a depth of 10 to 12 inches. The bucket prevents su ing substrate from collapsing into the excavated hole.

7. If necessary, two small handfuls of pea-sized gravel are placed into the hole to provide a level base for placement of two modified WVB.

8. A nylon anchor line is tied to each the WVB and the boxes are placed inside the hole and gently seated on the gravel base with a rock placed between the boxes to keep the boxes separated.

9. Carefully extend the nylon line approximately 12 inches and anchor it to a 12 inch steel spike located approximately 18 inches to the left of the box.

10. While the box is held steady, another team member carefully pushes the excavated gravels over and around the box, continuing until the box is almost completely covered. The bucket is then gently removed and substrate is added to cover the site completely.

11. Attach fluorescent survey tape to the spike for easy location and an aluminum tag with a sample number for future identification.

12. The location (angle and distance from a known reference point) of each planting site is determined with standard survey gear.

3.2.2.2 Substrate Study Procedures

3.2.2.2.1 General Substrate Analyses

The size classes and codes used in the collection and analyses of substrate samples by all ADF&G personnel during FY84 are modified from those used during FY83. The modification consists of dividing the gravel classification into two separate categories (fine and coarse gravel) as shown below (Table 11). These modified substrate size classes and codes are used for visual assessments of substrate at general substrate study sites.

Table 11. FY83 and FY84 substrate size classes.

Substrate Size Classes and Codes used during FY83			Substrate Size Classes and Code to be used during FY84		
SILT	SI	very fines	SILT	1	very fines
SAND	SA	fines	SAND	2	fines
GRAVEL	GR	1/4-3"	FINE GRAVEL	3	1/4-1"
			COARSE GRAVEL	4	1-3"
RUBBLE	RU	3-5"	RUBBLE	6	3-5"
COBBLE	CO	5-10"	COBBLE	5	5-10"
BOULDER	BO	10"	BOULDER	7	10"

bag, and placed inside a large cooler. After all boxes are removed, the cooler is transported to a heated work space, at which time embryos and sediments are processed in the same manner as at stream side.

Control

To assess embryo mortality due to handling, three additional WVBs are charged with fertilized eggs and handled in an identical manner at each study site. These WVBs are placed in an area that is believed to represent highly favorable incubation conditions. After two to ten days, one of the three WVBs from each study site is assessed in the same manner as previously presented for assessing percent fertilization. Any differences in percent fertilization between eggs not handled (i.e., in stream incubation trays) and those handled during placement of WVBs (i.e., the first control box removed) is attributed to handling mortality. One of the remaining two WVBs is removed at eye-up stage and the other at 100 percent hatch stage. These survival estimates are assumed to represent survival under optimal incubation conditions.

Embryo/alevin preservation

All unhatched embroys will be preserved in Stockards Solution. A non-buffered solution of 10% Formalin will be used to preserve all alevins.

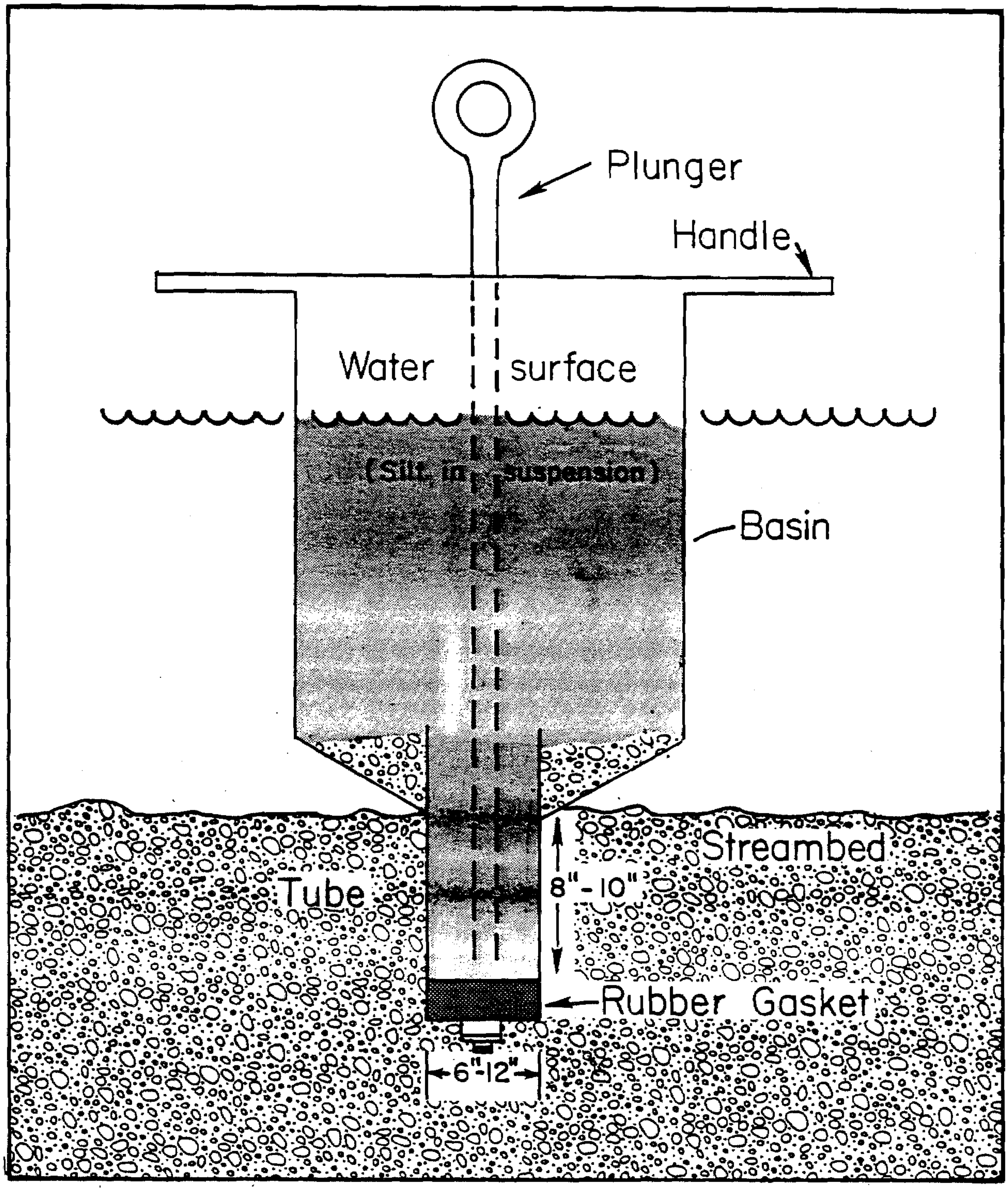

Figure 13. McNeil streambed core sampler.

3.2.2.2.2 Intensive Substrate Analyses Procedures

McNeil substrate analyses procedures

A modified McNeil streambed core sampler (Figure 13) is used to obtain substrate core samples for particle size distribution (Corley and Newberry 1981). A modified version of the McNeil streambed core sampler was selected over other samplers because it is easy and quick to operate and is relatively maintenance free. Substrate core samples obtained with the modified McNeil core sampler are twelve inches in diameter and will be obtained to a depth of 8 to 10 inches.

Core samples are sieved at the sampling site according to particle sizes that correspond to those recommended by Platts (1983) (Table 12) for smaller particle sizes and those previously used for visual assessments of larger particle sizes by ADF&G personnel (Table 11) (refer to the previous section and the FY83 Procedures Manual). Sieve size selection is based upon those shown to be important for survival of incubating salmonid embryos (Platts 1983) and those previously used by ADF&G for assessments of substrate material. The sieving process consists of flushing the core samples with water through the series of sieves. The contents of each particle size class is then volumetrically measured based on water displacement (Figure 14). The amount of water displaced determines the volume of the sediment plus the volume of any water retained in the pore space in the sediment. Because there is a differential retention of water at various particle sizes, wet volumes

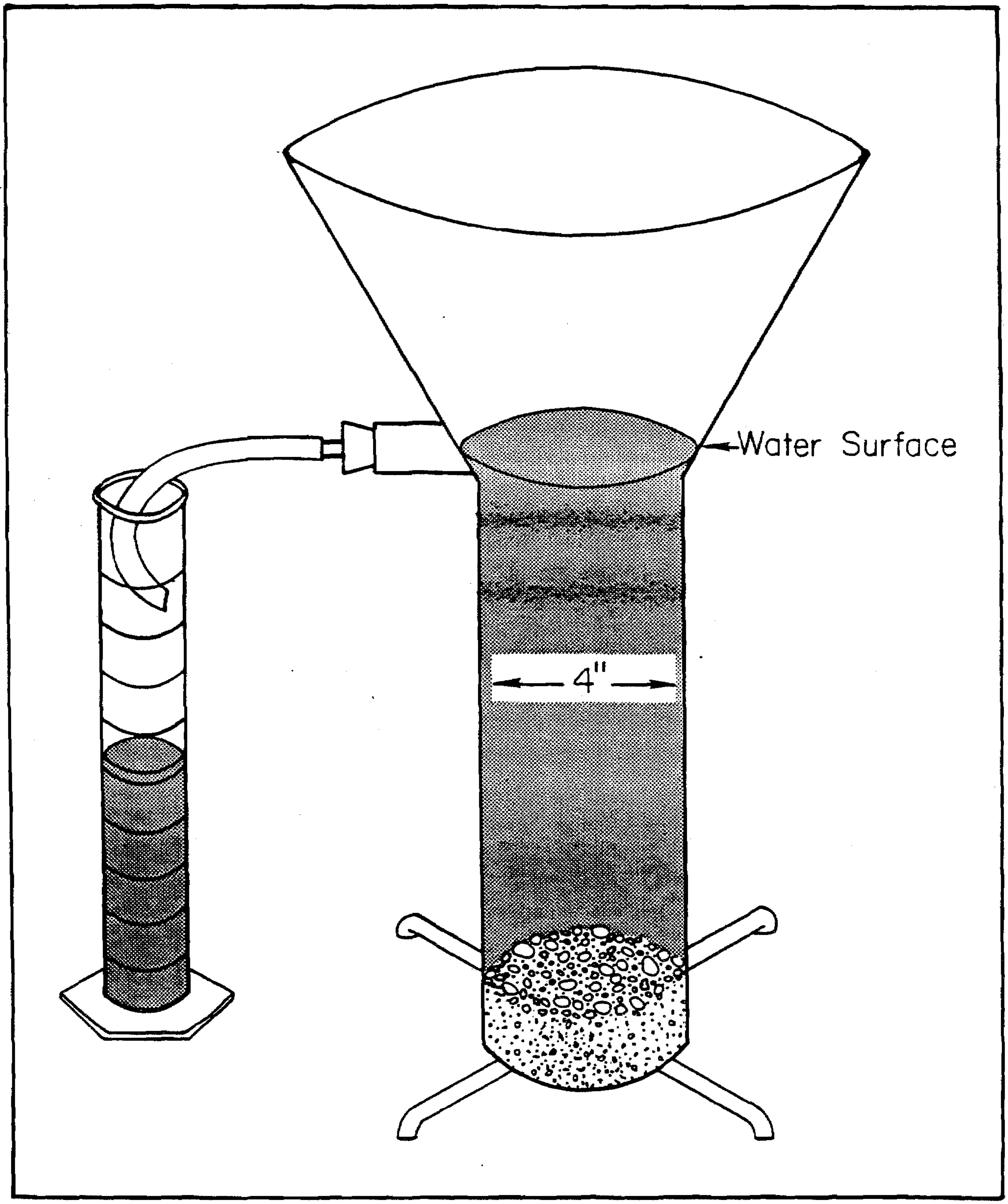

Figure 14. Apparatus used to volumetrically measure substrate samples.

Table 12. Sieve sizes to be used in the processing of McNeil substrate core samples.

Sieve Size	Particle size passed through sieve	reference*
0.062mm (0.002")	0.000 - 0.061mm (0.000 - 0.002")	1
0.500mm (0.020")	0.062 - 0.499mm (0.002 - 0.020")	1
2.000mm (0.079")	0.500 - 1.999mm (0.020 - 0.079")	1
25.000mm (0.984")	2.000 - 24.999mm (0.079 - 0.984")	1
76.000mm (3.000")	25.000 - 75.999mm (0.984 - 3.000")	2
127.000mm (5.000")	76.000 - 126.999mm (3.000 - 5.000")	2
254.000mm (10.000")	127.000 - 253.999mm (5.000 - 10.000")	2

* references used 1: Platts 1980
2: ADF&G 1983

Table 13. Water gained in a wet sieving process and the factor for correcting volumetric data.

Sieve size		Gram water gained / gram dry gravel			Correction factor applied to wet sieved gravel		
		p=2.2[1]	p=2.6	p=2.9	p=2.2	p=2.6	p=2.9
inches	mm						
3	76.2	0.02	0.01	0.01	0.97	0.96	0.96
	64	.02	.02	.01	.96	.96	.96
2	50.8	.02	.02	.02	.96	.96	.95
	32	.02	.02	.02	.95	.95	.94
1	25.4	.03	.02	.02	.94	.94	.94
	16	.03	.03	.03	.93	.93	.92
1/2	12.7	.04	.03	.03	.92	.92	.91
	8	.05	.04	.04	.91	.90	.89
1/4	6.35	.05	.05	.05	.89	.88	.88
	4	.07	.06	.06	.87	.86	.85
1/8	3.18	.08	.07	.07	.86	.85	.84
	2.0	.10	.09	.08	.83	.81	.81
1/16	1.59	.11	.10	.09	.81	.80	.79
	1.0	.13	.12	.12	.77	.76	.75
1/32	.79	.15	.14	.13	.75	.73	.72
	.50	.19	.18	.17	.70	.69	.67
1/64	.40	.21	.20	.19	.68	.66	.65
	.25	.27	.25	.23	.63	.61	.59
1/128	.20	.30	.28	.26	.60	.58	.57
	.125	.38	.35	.33	.54	.52	.51
1/512	.10	.43	.39	.37	.52	.50	.48
	.063	.54	.49	.47	.46	.44	.42

[1]p=gravel density.

are corrected for each particle size class using the correction table provided by Platts (1983) (Table 13).

After each sample has been sieved and separated by particle size, the amount of suspended solids remaining in the water that passed through all the sieves is determined by allowing a one liter sample of the water to settle out in a tapered Imhoff cone. The amount of settled suspended solids is then measured and extrapolated to yield the total amount of suspended solids in the water sample.

Results of each sample are reported as geometric means (Shriazi and Seim 1979); that is, the particle size that has 50 percent of the particles larger and 50 percent smaller than itself. Reporting data as geometric means, has the advantages of being a conventional statistical measure used by several disciplines and it relates to the permeability and porosity of the sediments and to embryo survival (Platts 1983). However, Lotspeich and Everest (1981) have shown that use of the geometric mean alone can lead to erroneous conclusions. A summary of advantages/disadvantages of this and alternative methods can be found in Platts (1983).

QUALO staff oversees the calibration of instruments to insure consistent techniques are being employed.

Some of the older model Hydrolabs (S/N's 0890C, 0890Q) must have measured conductivities corrected. This is done using a "calibration curve" developed from the lab calibration data. A linear regression program has been developed for the HP-41C calculator which can be used to correct conductivity values.

Thermograph calibration procedures

Ryan thermographs

To ensure accuracy of temperature data collected, each Ryan thermograph is screened at two temperatures (0°C and between 11-16°C) prior to installation using a calibrated Brooklyn or American Society for Testing and Manufacturing (ASTM) thermometer as a standard. Thermographs found to be in error by more than 3°C at either screening temperature are not used and are returned to the manufacturer for calibration.

After installation, thermographs are monitored and serviced (if necessary) twice monthly, except those located above Devil Canyon which are monitored on a monthly basis.

To ensure proper calibration of temperature readings, surface water temperatures are obtained using a calibrated thermometer at the time of installation and removal of each thermograph from each site. A unique

3.2.3 Quality Assurance and Laboratory Operations (QUALO)

3.2.3.1 Instrument Calibration, Maintenance and Repair Procedures

To insure that sampling equipment is in proper working condition, QUALO oversees equipment calibration, maintenance, and repair procedures.

3.2.3.1.1 Instrument Calibration

In general, standard procedures listed in the manufacturer's owner's manual are followed for calibration of equipment. However, there have been cases where it has been necessary to develop special calibration procedures or quality screening methods; or, to expand upon the manufacturer's listed procedures. Deviations from standard procedures listed by the manufacturer are made only after consultation with the manufacturer, their representative, or other qualified person or agency. Any adaptations in procedures that have been adopted in the past can be found in the FY82 or FY83 Procedures Manual. Adaptations to be adopted during FY84 for calibrating hydrolabs and thermographs follow.

Hydrolab calibration procedures

Hydrolabs are calibrated according to the instructions described in the revised Hydrolab Operation and Maintenance Manual presented in Appendix B. Hydrolabls are calibrated by field personnel prior to field use.

To obtain surface water temperatures with a datapod, the associated thermistor is attached to a weight and placed upon the substrate of the stream channel. Each thermistor probe is calibrated prior to field installation by Dryden and LaRue Consulting Engineers (distributors of the instruments) and assigned a calibration factor which is labeled on the probe. The surface water temperature probe (see Section 2.2.1.2.2) associated with the same recorder. Immediately after installation of the recorder and prior to removal of the DSM, a surface water temperature is obtained with a calibrated mercury thermometer. In addition, surface water temperature is obtained from a "short data dump" which the recorder is programmed to yield. The "short data dump" is a listing of data which also includes errors accumulated, numbers of data points stored, minutes to next recording and intragravel water temperature. The two surface water temperatures are compared, taking into consideration probe calibration factors, to ensure accuracy of the instrument. The data is retrieved from the DSM via an Omnidata model 217 Datapod/Cassette Reader and printed as 6-hour maximum, minimum and mean temperatures.

3.2.3.1.2 Equipment Maintenance and Repair

Equipment checked out to the various sub-projects are maintained by the respective users. All damage to equipment, lost equipment, or equipment malfunctions must be reported to QUALO on the Equipment Loss/Damage Form. Repair arrangements are the responsibility of sub-project personnel. All correspondence regarding the repairs are cc'd to the QUALO department.

calibration factor is then determined for each thermograph chart collected. This factor is calculated as the difference in the readings between the surface water temperature obtained with the thermograph and the calibrated thermometer at the time of thermograph removal. The calibration factor is determined from data at the time of thermograph chart removal rather than the time of installation because response time after installation varies for each thermograph. The calibration factor is then used to correct 2-hour point temperature readings from each recording chart. From these corrected 2-hour point temperatures mean, maximum and minimum temperatures are computer calculated for each 6-hour period. The installation and service methods are outlined in the Phase II ADF&G Su Hydro Aquatic Studies Procedures Manual (ADF&G 1982).

Datapod calibration procedures

The datapods and associated thermistors used to continuously monitor surface water temperatures are capable of simultaneously recording both surface and intragravel water temperature with an error of 0.1°C. The datapod incorporates a non-volatile, ultraviolet (UV) erasable, solid state data storage module (DSM) to record data. The DSM is capable of approximately three months data storage recorded in 6-hour intervals as minimum, maximum and mean water temperatures. The units are virtually maintenance-free but must be periodically checked for low battery charge and disturbance by wildlife.

1. After the data has been reduced and checked as stated above, the data is transmitted to the Data Coordinator (DC).

2. The DC checks for obvious errors and proper format and corrects problems (after consultation with field crews). The DC transfers a photocopy of the data to DP for processing onto the project computer. The original copies of the data are categorized and filed by QUALO staff by site and activity (i.e., form number) in chronological order.

3. The data is processed onto the project computer by the DP staff.

4. DP returns a printout of the processed data to the DC for checking and editing by QUALO staff, sub-project leaders, and field personnel.

5. The checked and edited printout is returned to the DC for transmittal to DP.

6. DP corrects the data as necessary.

3.2.3.2.3 Data Categorization

QUALO staff have the responsibility for categorizing and filing all original data forms after reduction and checking. The data base is

Instructions for maintenance of all AH equipment are contained in Appendix IX of the Phase I ADF&G Su Hydro Aquatic Studies Procedures Manual (ADF&G 1982).

3.2.3.2 Data Reduction, Processing and Categorization Procedures

3.2.3.2.1 Field Data Reduction and Checking

Quality control for reduction and checking of field data prior to its final entry onto the project computer is the shared responsibility of all personnel involved in the data process as described below:

Field personnel have the responsibility of checking data for accuracy, completeness, and legibility.

Sub-project leaders have the responsibility of checking the data from completeness, questionable entries and correct format.

QUALO staff have the responsibility of checking the data for obvious omissions, questionable entries, and proper format.

3.2.3.2.2 Data Entry

The following general procedures are followed when transmitting field data to the Data Processing (DP) staff.

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categorized and filed by site and activity (i.e., form number) in chronological order.

3.2.3.3 Data/Information Requests or Transmittal Procedures

All data/information requests or transmittals to groups outside AH must go through the Project Leader or Assistant Project Leader. In addition, all data/information requests or transmittals to persons/agencies outside ADF&G/Su Hydro must go through the ADF&G Aquatic Studies Coordinator.

A complete copy of all data transmitted and a copy of the transmittal letter/memo will be kept on file in the AH QUALO files. In addition, a log is maintained which provides a record of all transmittals.

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