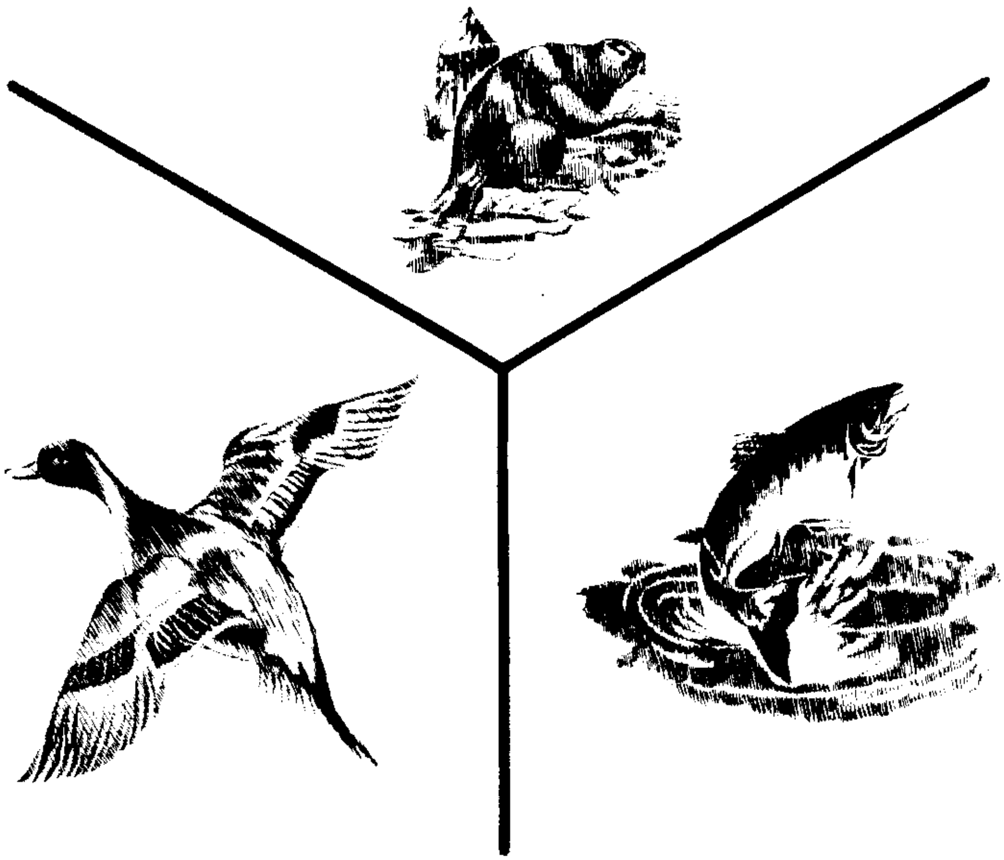
STREAM RESOURCE MAINTENANCE

FLOW STUDIES
1976



DEPARTMENT OF WATER RESOURCES

IDAHO FISH & GAME

IDAHO
DEPARTMENT OF FISH & GAME

Joseph C. Greenley, Director

STREAM FLOW INVESTIGATIONS

Job Performance Report

Project F-69-R-1

(A cooperative report; jointly funded by Idaho Department of Water Resources and federal aid funds from the Dingell-Johnson program)

Job I. Evaluation of Applicability of Water Surface Profile Predictive Modeling in Reference to Stream Resource Maintenance Flow (SRMF) Determinations

Job II. Stream Resource Maintenance Flow Determinations on the Snake River

by

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October, 1976

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JOB PERFORMANCE REPORT

State of Idaho

Project No. F-69-R-1

Job Nos. I and II

Name: STREAM FLOW INVESTIGATIONS

Title: Evaluation of Applicability of Water Surface Profile Predictive Modeling in Reference to Stream Resource Maintenance Flow (SRMF) Determinations

Stream Resource Maintenance Flow Determinations on the Snake River

ABSTRACT

A methodology for determination of stream resource maintenance flows for large, unwadable rivers was evaluated on the Snake River in south central Idaho. The basis of the methodology is the U. S. Bureau of Reclamation water surface profile (WSP) program. Instream techniques were developed for collecting necessary stream parameter data for use with the program.

Stream resource maintenance flows were recommended for Silver Creek and Snake River (Minidoka Dam to C.J. Strike Reservoir). These flows were determined by correlating the predicted data from the WSP program with biological criteria for fish and wildlife species in designated stream sections.

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ACKNOWLEDGMENTS

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RECOMMENDATIONS

1. Develop a more applicable computer model program to determine stream resource maintenance flows.

2. Collect data and develop stream resource maintenance flow recommendations at five additional sites on the Snake River between American Falls Dam and C.J. Strike Reservoir.

3. Initiate a study to determine biological requirements of white sturgeon and other important fish species within Idaho for use in recommending stream resource maintenance flows.

OBJECTIVES

1. Evaluate Water Surface Profile Model as an adequate methodology for determination of stream resource maintenance flows in Idaho streams.

2. Determine stream resource maintenance flows for the Snake River.

INTRODUCTION

This study is a continuation of stream resource maintenance flow studies initiated in 1974 by the Idaho Department of Fish and Game in cooperation with the Idaho Department of Water Resources (Cochnauer and White 1975).

The determination of stream resource maintenance flows in large rivers has not kept pace with those of wadable, cold water streams. The limiting factors have been a lack of knowledge of biological requirements for fish and wildlife populations which inhabit large streams and the absence of techniques for measuring hydraulic parameters used in flow determinations.

White (Cochnauer and White 1975) proposed a methodology for determining stream resource maintenance flows on the Snake River by utilizing the Bureau of Reclamation's water surface profile computer program and by making certain assumptions regarding the biological requirements of some fish species within the Snake River. Techniques had to be developed to collect basic hydraulic data required for use in the computer program.

The section of the Snake River on which data were collected during 1975 was from American Falls Dam to C.J. Strike Reservoir (Fig. 1). Data were also collected on Silver Creek. Stream resource maintenance flow recommendations were made for these two stream sections.

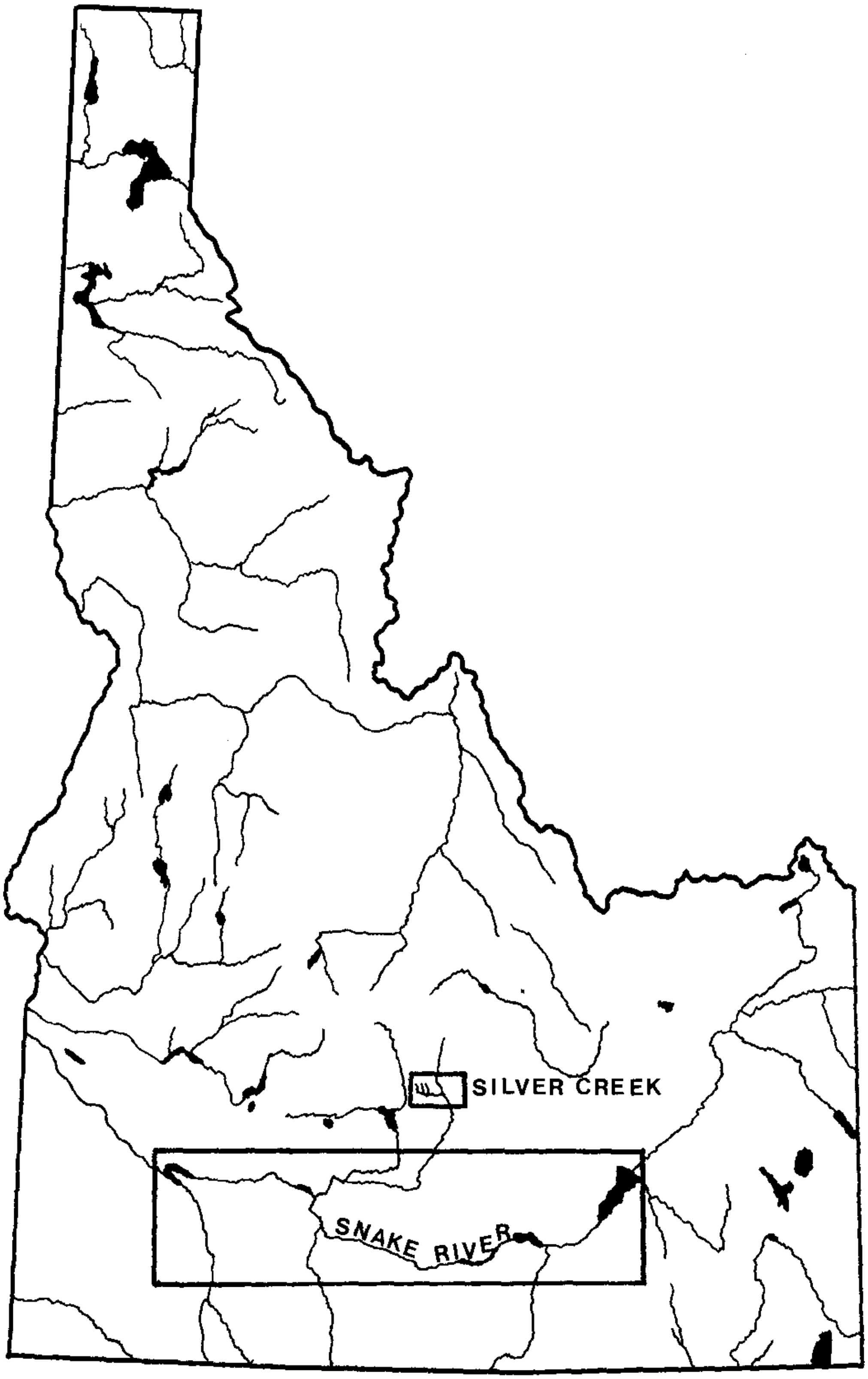

Figure 1. Location of Silver Creek and Snake River study sections.

TECHNIQUES USED

Data

The field data required for the water surface profile computer program include:

1. A minimum of four stations per study site.
2. Relative evaluation of each station at a study site.
3. Thalweg distances between stations.
4. A known discharge at the time of study.
5. Depth profile of stream channel at each station.
6. Description of streambed substrate and identification of points where material changes.
7. Description of bank and overbank material and vegetation.

In addition to the above, velocities were measured on each transect to aid in the determination of roughness coefficients.

Station Location

We chose habitat types to be measured that best evaluated the requirements of the fish and wildlife resources within the stream. The location of each habitat station (spawning site, passage block, etc.) selected was permanently marked with survey stakes, and a permanent bench mark was established at each site for future reference.

At each study (habitat) site, a minimum of four stations were measured (Fig. 2). The most downstream station was designated as a discharge control station and located to most accurately measure the discharge. The middle two stations (976 and 1408 in Fig. 2) should be located on the habitat which may limit the resource (i.e. food production site, passage blockage or spawning site).

The critical stream flow related habitat requirements for the important fish and wildlife species found in the Snake River and in Silver Creek are spawning, passage, rearing, and resting (Table 1).

Equipment

The following pieces of equipment were required for collecting data to be used with the water surface profile program. Those items in the right column are required for unwadable streams but are not necessary for wadable streams such as Silver Creek.

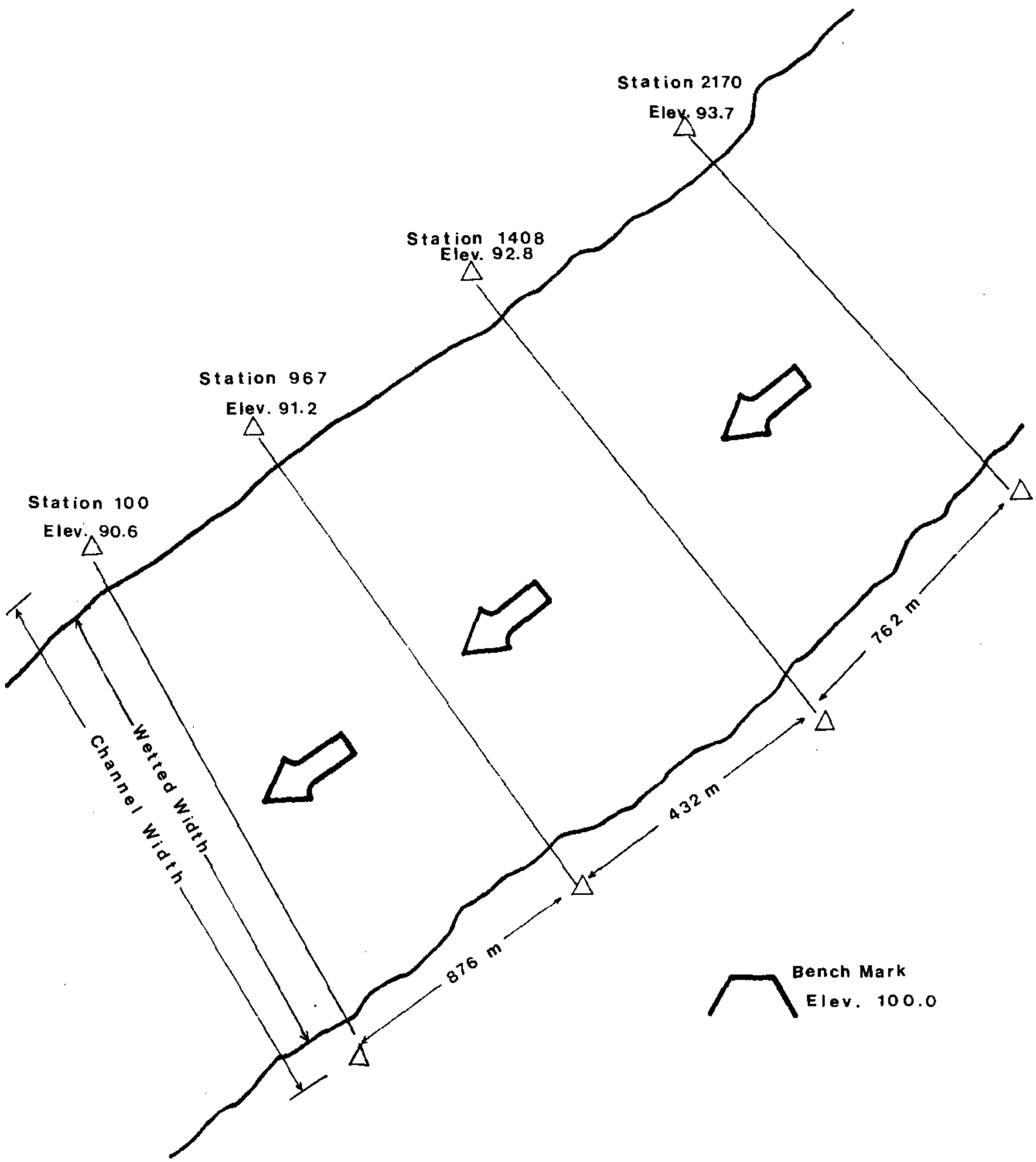

Figure 2. Typical stream study site.

Table 1. Stream flow requirements for important fish and wildlife species for Snake River and Silver Creek.

	Spawning	Passage	Rearing	Nesting
Snake River				
White sturgeon *Acipenser transmontanus*	X	X	X	
Smallmouth bass *Micropterus dolomieui*	X		X	
Channel catfish *Ictalurus punctatus*	X		X	
Rainbow trout *Salmo gairdneri*			X	
Canada goose *Branta canadensis*				X
Silver Creek				
Rainbow trout *Salmo gairdneri*	X		X	
Brown trout *Salmo trutta*	X		X	
Brook trout *Salvelinus fontinalis*	X		X	

- Transit/level with tripod
- Philadelphia rod
- Measuring tape
- Survey stakes
- Tag line
- Camera
- Standard current meter
- Sounding reel
- Boat with motor
- Direct readout current meter
- CB transceiver

Measurements

At each station, a line-of-sight transect was established by sighting a transit across the stream at right angles to the flow (Fig. 3). Each side of the transect was permanently marked at the high water mark.

A 5-m (16-ft) boat powered by a 115-hp outboard with jet unit was use for taking depth and velocity measurements on the transect. The transit operator at one end of the transect signaled the boat operator as the boat approached the transect (Fig. 3, position A) and again when the boat was o the transect. At this time (Fig. 3, position B) the sounding reel operato lowered the sounding weight and current meter to record the depth, and the adjust the meter depth to record the velocity. If the boat drifted from t transect, the parameters were measured again.

At the time that the boat was on the transect (Fig. 4), the transit operator read the numbers on the stadia rod affixed to the boat console. The readings from the bottom and top hairlines of the transit are recorded The difference between the two readings was multiplied by the stadia const of the instrument being used. For example, if the bottom hairline was on 3.80 m (Fig. 5) and the top hairline read 4.60 m, the distance from the in ment to the rod was 4.60 - 3.80 = 0.80 X 100 (stadia constant) = 80 m. Th boat then was moved over prescribed distances for additional measurement i same manner.

In Silver Creek depths and velocities were measured by establishing t transect with a tag line and recording measurements at prescribed distance on the transect.

Depth and velocities were measured at a minimum of 20 points on each transect in accordance with USGS procedures (U.S. Geological Survey 1969). Velocities were taken at 0.6 of the depth in water less than 75 cm (2.5 ft deep and at 0.8 and 0.2 depth in water over 75 cm (2.5 ft). Any significa drop in depth required additional measurements in that area to insure an a rate identification of the stream channel.

Relative elevations of water levels at each transect were made along thalweg when possible. If not, then elevations were measured on the same of the stream.

Distances between transects were measured by tape or by the use of th transit and stadia rod at the same time relative elevations were made. Wh feasible, transect elevations and established bench mark elevations were measured from one location.

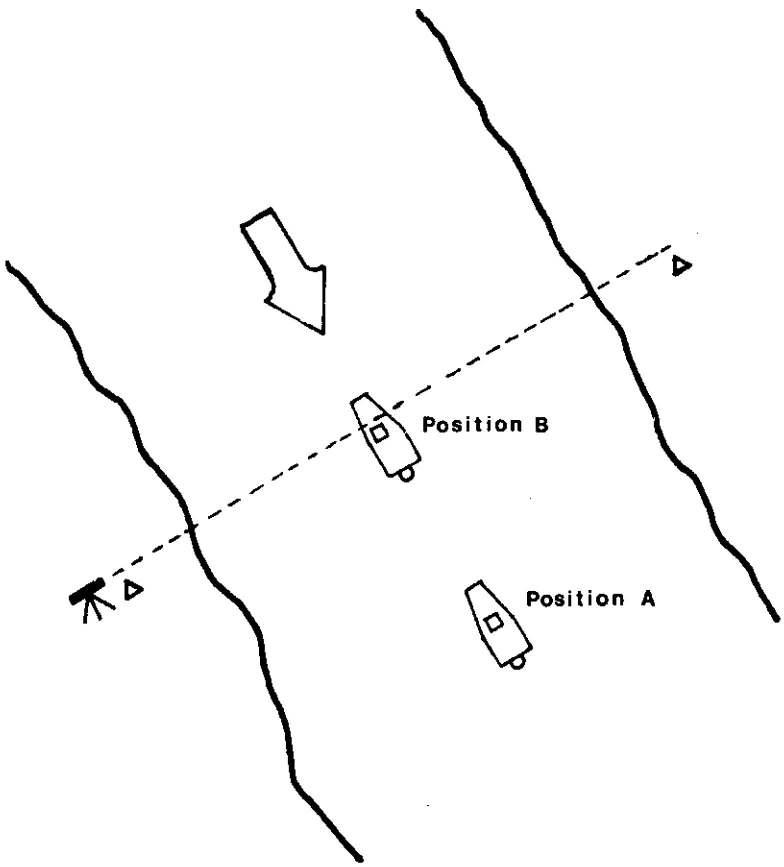

Figure 3. Transect measuring technique.

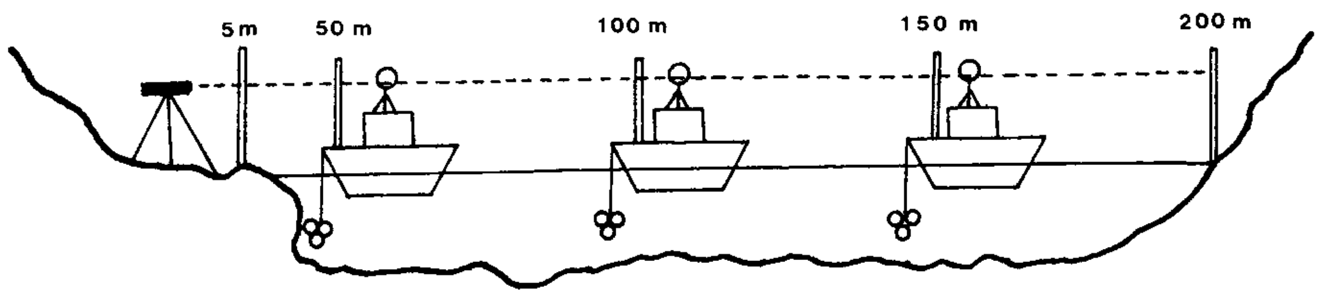

Figure 4. Distance measuring techniques on transect.

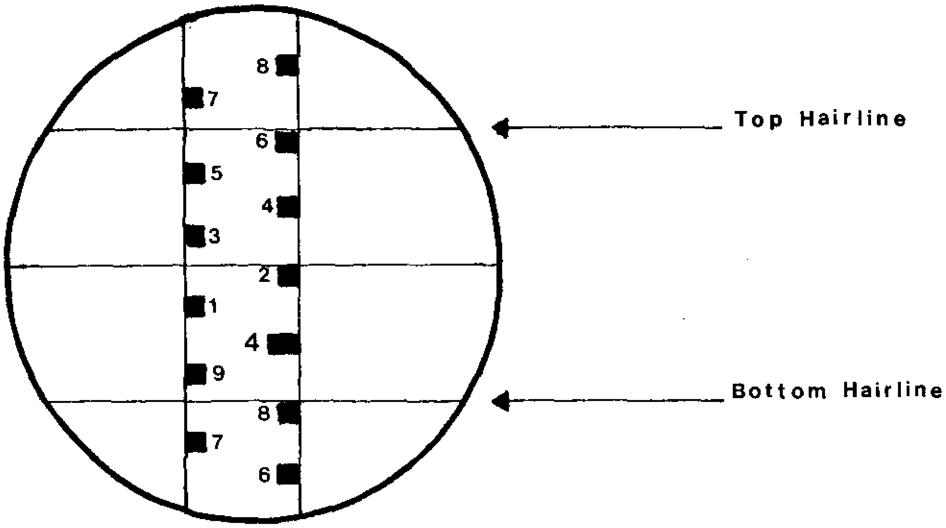

Figure 5. Distance measuring technique using transit stadia.

Depths of the water were recorded from designated high water marks. Overbanks of the streams which were dry at the time of measuring were also measured for relative depth to high water.

Streambed Materials

Streambed substrates were categorized on each transect with notations where the materials changed. The following guidelines were used for identification of substrates.

Bedrock-----------------large mass of solid rock
Boulder-----------------rocks over 30 cm (11.8 in) in diameter
Cobble (rubble)---------rocks 7.6 to 30 cm (3.0-11.8 in) in diameter
Gravel------------------rocks 0.3 to 7.5 cm (.1-3.0 in) in diameter
Sand, silt, clay--------particles less than 0.3 cm (.1 in)
Vegetation--------------describe type

Data Preparation

Distances (X coordinates) and water depths as relative elevations (Y coordinates) were coded into the computer program (Fig. 6) in accordance with Bureau of Reclamation guidelines (U.S. Bureau of Reclamation 1968). Bureau of Reclamation personnel provided assistance in data coding, card punching, computer runs and necessary corrections to insure results that were as accurate as possible.

A maximum of nine segments were designated for each transect and roughness coefficients were estimated for each (Figs. 6 & 7). Each segment is designated by its right most coordinate. The segments were chosen by areas of the stream having relatively similar parameters (substrate, depth, velocity or bank slope).

Average velocities were determined for each segment to correlate with predicted velocities for determination of more accurate roughness coefficients.

The channel configurations were graphed and bottom materials noted (Fig. 7).

Data Output

An example of the computer output is presented in Fig. 8. The three most important parameters in the output are velocity, water surface elevation and wetted perimeter. Velocity and water surface elevation are printed as such. Wetted perimeter for each segment was calculated by dividing the conveyance area by the hydraulic radii, and then adding all segments for a total transect value.

Depths of the stream channel for predicted flows were determined by the predicted water surface elevation being applied to the graphed channel.

Flow Determinations

The output data were correlated with known biological criteria for the various species to determine stream resource maintenance flows.

SUMMARY OF OPTION AND COORDINATE DATA

IDAHO DEPARTMENT OF FISH AND GAME DECEMBER 9, 1975 RUN - 1
STREAM FLOW STUDY SNAKE RIVER AT LOVERBRIDGE LB 16817

STATION 2464	NUMBER OF ROUGHNESS SEGMENTS IN SECTION	ELEVATION OF SEDIMENT DELTA	ELEVATION OF OBSERVED PROFILE	INCREMENTAL DISCHARGE
	9	0.0	0.0	0

NUMBER OF COORDINATE PAIRS - 50
OPTION PARAMETERS OF ZERO INDICATE A REDUNDANCE

RIGHT MOST COORDINATE	ROUGHNESS COEFFICIENT	REACH LENGTH OF CENTROID
22.	.137	2364
93.	.141	2364
179	.066	2364
490	.074	2364
537	.075	2364
796	.064	2364
1092	.061	2364
1442	-.078	2364
1731	.087	2364

X COORDINATES	0.0	5.0	11.0	22.0	43.0	63.0	93.0	121.0	135.0	141.0
Y COORDINATES	50.2	49.2	46.9	43.8	40.8	38.4	38.2	42.4	45.0	44.7
X COORDINATES	179.0	227.0	265.0	299.0	353.0	431.0	465.0	490.0	505.0	520.0
Y COORDINATES	45.2	46.4	47.9	48.0	47.5	47.9	48.4	49.2	50.2	50.5
X COORDINATES	535.0	537.0	574.0	598.0	646.0	712.0	768.0	778.0	796.0	806.0
Y COORDINATES	49.7	49.4	47.7	47.3	46.0	45.5	45.2	45.0	43.0	39.6
X COORDINATES	838.0	880.0	946.0	1002.0	1044.0	1092.0	1148.0	1202.0	1260.0	1334.0
Y COORDINATES	38.1	38.5	36.2	35.6	35.0	35.2	35.3	35.8	35.5	34.4
X COORDINATES	1390.0	1442.0	1514.0	1562.0	1606.0	1626.0	2676.0	1722.0	1726.0	1731.0
Y COORDINATES	34.2	35.5	37.2	41.6	47.2	47.7	47.5	47.2	49.2	50.2

Figure 6. Example of computer input.

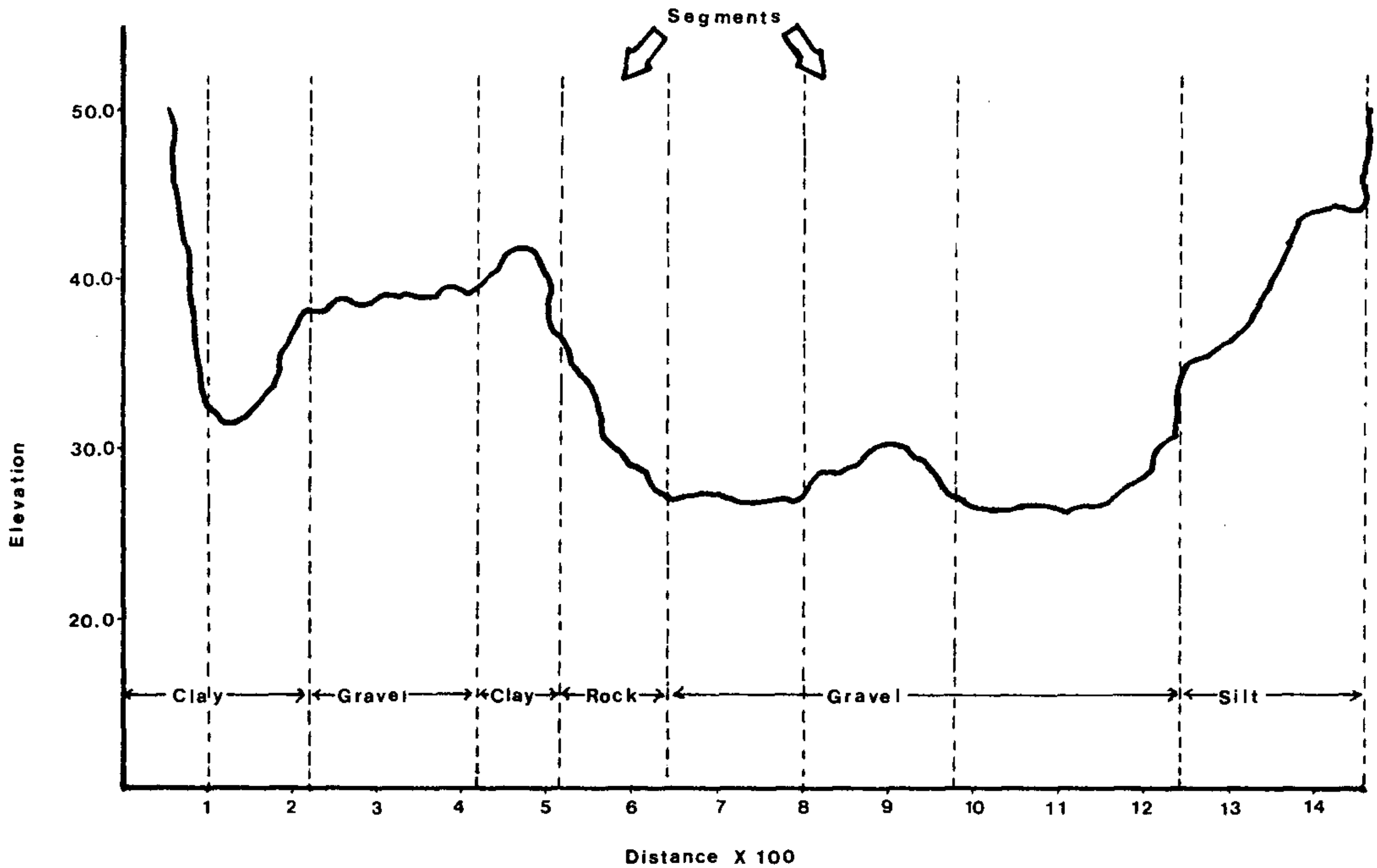

Figure 7. Stream channel configuration.

IDAHO FISH AND GAME DEPARTMENT STREAM FLOW STUDY RUN-1 PAGE NO. 1
SNAKE RIVER AT LOVERBRIDGE LB 16817 DECEMBER 9, 1975

STATION 24 + 64 ENGLISH SYSTEM ASSUMED ELEV. 0.00 THALWEG ELEV. 34.2 THALWEG SLOPE .0002

COMPUTATION LINE HF1 = .08 HV1 = .02 AVG OVERBANK REACHES LEFT = 410. RIGHT = 2364

LENGTH OF CENTROID	CONVEYANCE AREAS	TOP WIDTHS	HYDRAULIC RADII	ROUGHNESS COEFFICIENTS	CONVEYANCE FACTORS	VELOCITIES	DISCHARGES
2364	50	17	2.8	.13700	1080	.28	14
2364	668	71	9.4	.14100	31367	.62	416
2364	519	86	6.0	.06600	38701	.99	513
2364	546	311	1.8	.07400	15991	.39	212
2364	0	1	0	.07500	0	0	0
2364	787	259	3.0	.06400	38353	.65	509
2364	3676	296	12.4	.06100	480053	1.73	6366
2364	4964	350	14.2	-.07800	554604	1.48	7354
2364	1831	284	6.4	.08700	108051	.78	1433
SUM OR AVG	13041	1675			1268200	1.48	16817

THIS SECTION HAS 9 ROUGHNESS SEGMENT OR SEGMENTS. 9 SEGMENT OR SEGMENTS USED FOR THIS DISCHARGE COMPUTATION
LINE HF2 =.42 HV2 = .03 SF VOIDED TOTAL HEAD = .24 CRIT. FLOW NOT REQUIRED W.S. ELEV. = 49.27

Figure 8. Example of computer output.

Due to the lack of knowledge of specific spawning substrate and sites for the Snake River fish species, no spawning sites were selected in the stream. Eight spawning transects were established on Silver Creek.

A range of velocities and minimum depths for fish spawning are presented in Table 2. The channel widths which met the velocity and depth criteria were plotted against discharges to construct a spawning curve. The recommended spawning flows were represented by 80% of the available spawning habitat for each study section (Appendix, Figs. 1-5).

For the section of the Snake River studied, only the white sturgeon population would be limited by natural passage blocks. White (Cochnauer and White 1975) recommends that a minimum continuous depth of 1.5 m (4.9 ft) be maintained over 25% of the length of the potential block. Only one potential block was located and measured in the Snake River. An example of the passage curve constructed by plotting discharge against minimum depth width is shown in Appendix, Fig. 6.

For the section studied on Silver Creek there were no natural passage blocks. There are potential blocks at several diversion dams if flow is significantly reduced.

Fish food production flows in the Snake River were determined by the relationship of the wetted perimeter and discharge (Cochnauer and White 1975). The optimum quantity of water for rearing (food production) was selected near the inflection point where wetted perimeter increases slowly while the discharge increases rapidly (Appendix, Fig. 7-11). Fish food production flows in Silver Creek were determined by maintaining an average of 15 cm (6 in) below undercut banks. Wesche (1973) observed that brown trout exhibited a preference for water 15 cm (6 in) or greater in depth and a preference for undercut banks as cover.

Two-thirds of the spawning flows for each species was determined to be the incubation flow (Thompson 1972).

Transects were located near or at known waterfowl nesting sites. Elevations of these sites (Appendix, Fig. 12) were determined and designated as the maximum allowable water level during the waterfowl nesting period. Minimum water surface levels to maintain the islands were determined from the channel graphs. These elevations were related to predicted discharges to determine minimum and maximum discharges during the waterfowl nesting period.

FINDINGS

Reliability of Computer Program

Due to equipment delays, sufficient data were not collected this year to determine the reliability of the water surface profile computer program output in determinations of stream resource maintenance flows. This portion of the program will be checked during 1976.

Table 2. Spawning criteria for important fish species in the Snake River and Silver Creek.

Species	Velocity minimum-maximum cm/s	(ft/s)	Depth minimum cm	(in)
Rainbow trout	34-89	(1.1-2.9)	15	(5.6)
Brown trout	31-70	(1.0-2.3)	21	(6.8)
Brook trout	9-64	(0.3-2.1)	12	(4.7)
Cutthroat trout	24-79	(0.8-2.6)	12	(4.7)
Smallmouth bass	12-?	(0.4-?)	76	(29.7)
White sturgeon	70-110	(2.3-3.6)	150	(58.6)

Stream Resource Maintenance Flows

All stream resource maintenance flow recommendations made in this report were determined by use of the water surface profile computer program.

Stream resource maintenance flows are presented only for those fish and waterfowl species presently being managed in each stream section. When applicable, stream resource maintenance flows for each life history phase of each species are presented (Appendix, Table 1). Flows are recommended for each period on the basis of the highest minimum or maximum flow for all species, and that state and federal water quality standards are met. When circumstances warrant it, new flow recommendations will be made in future reports.

Silver Creek

Silver Creek is located in south central Blaine County. The stream is formed by springs surfacing south of Gannett and flows into the Little Wood River south of Carey. Seven study sites were designated on the stream (Fig. 9). Station 1R is located approximately 150 m (492 ft) downstream from the confluence of Stocker and Grove creeks with Station 1 25 m (82 ft) downstream of 1R. Station 2 is located 200 m (656 ft) downstream from the Highway 68 bridge west of Picabo. Station 3 is located at the Idaho Fish and Game public access west of Picabo. Station 4 is located approximately 2 km (1.2 mi) east of Picabo. Station 5 is located 4 km (2.5 mi) east of Picabo. Station 6 is located at Lower Priest Campground, 2 km (1.2 mi) north of the Highway 20/26 bridge.

Fish populations in the stream include rainbow trout, brown trout, mountain whitefish and brook trout. Furbearers found in the drainage include muskrat, beaver, otter and mink. There are an estimated 1,200 muskrat trapped from the creek annually (Region 4 files). Great blue herons are numerous and a large active rookery is located near Sullivan's Lake. Approximately 35 pair of Canada geese nest along the stream. Other important species of birds which are found within the drainage include whistling swan, sandhill crane, bald eagle and golden eagle. Life history periodicity for each important species is given in Table 3.

The limiting factors to the fish populations in Silver Creek appear to be in providing sufficient flows to maintain the high density of aquatic vegetation and adequate flows to maintain adequate depths for undercut banks in those sections of the stream where riparian vegetation is sparse.

Stream resource maintenance flows are based on the requirements for each life history period of the fish populations and a minimum depth of 15 cm (6 in) for undercut banks.

Stream resource maintenance flows for Silver Creek are recommended for two sections, above Picabo bridge and below Picabo bridge. The section above the Picabo bridge is characterized by shallow gravel riffles, long heavily vegetated runs and relatively deep pools. Recommended minimum stream resource maintenance flows for the section of Silver Creek above Picabo bridge are as follows:

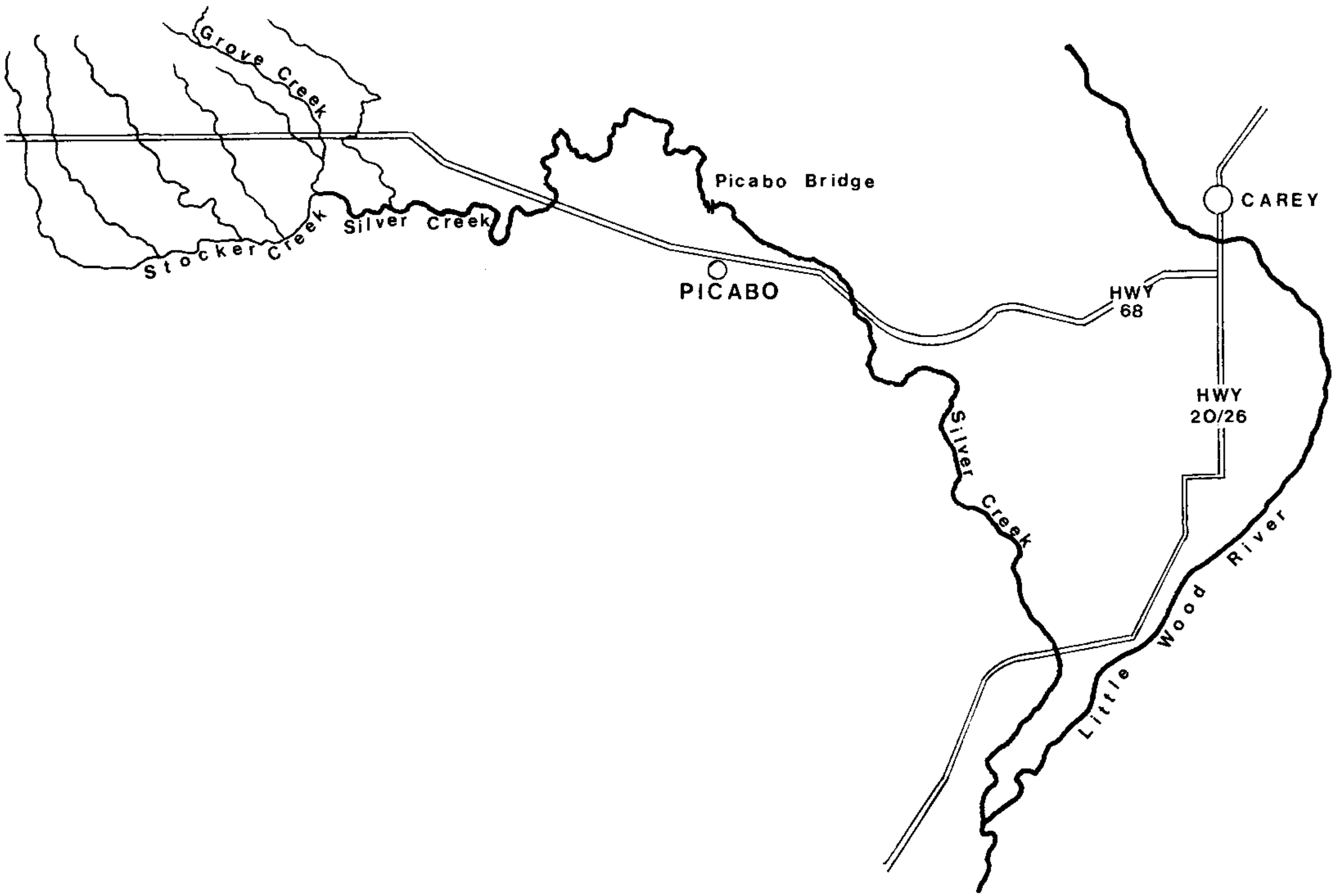

Figure 9. Silver Creek map with locations of study sites.

Table 3. Silver Creek fish and wildlife periodicity chart.

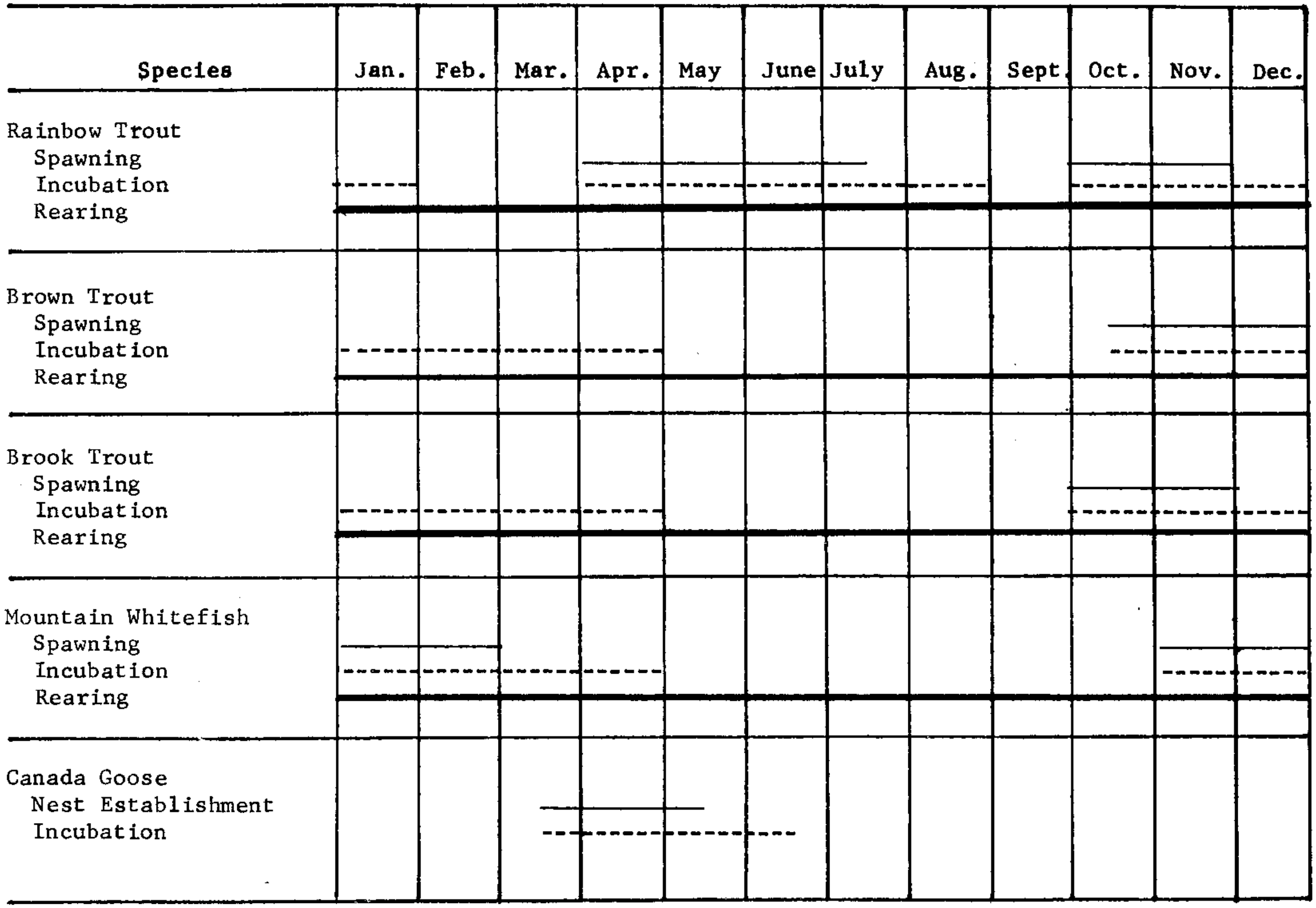

Table 3. Silver Creek fish and wildlife periodicity chart (continued).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mallard Duck												
Nest Establishment				—	—	—						
Incubation				---	---	---	---					

	Jan.	Feb.	Mar.	Apr.	May	June
cfs	120	120	120	148	148	148
cu m/s	3.4	3.4	3.4	4.2	4.2	4.2

	July 1-15	July 16-31	Aug.	Sept.	Oct. 1-15	Oct. 16-31	Nov.	Dec.
cfs	148	99	99	85	148	180	180	180
cu m/s	4.2	2.8	2.8	2.4	4.2	5.1	5.1	5.1

The section below the bridge is characterized by sparse vegetation, deep pools and rubble riffles. Recommended minimum stream resource maintenance flows for the section of Silver Creek below Picabo bridge are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June
cfs	74	74	74	92	92	92
cu m/s	2.1	2.1	2.1	2.6	2.6	2.6

	July 1-15	July 16-31	Aug.	Sept.	Oct. 1-15	Oct. 16-31	Nov.	Dec.
cfs	92	74	74	74	92	106	106	106
cu m/s	2.6	2.1	2.1	2.1	2.6	3.0	3.0	3.0

Snake River

The section of the Snake River included in this study is 387 km (240 mi) of the stream from American Falls Dam to C.J. Strike Reservoir Dam in southern Idaho (Fig. 10). Study sites were located below American Falls Dam (AM), below Minidoka Dam (MM), above Twin Falls (MB), below Kanaka Rapids north of Buhl (BB), at the head of Bliss pool (BK), at King Hill (KG), at Glenns Ferry (GF), below Glenns Ferry (GL), and at Loveridge Bridge south of Mountain Home (LB).

Due to problems with the computer processing of the data collected at Station AM, stream resource maintenance flow recommendations for the river stretch between American Falls Dam and Minidoka Dam are not available this year.

Periodicity charts for fish and wildlife species found in this stream section are presented in Table 4. Stream resource maintenance flows are based on rearing flows for fish populations and waterfowl nesting flows.

Minidoka Dam to Milner Dam

From Minidoka Dam to Milner Dam, approximately 19 km (12 mi) of the 55-km (34-mi) stretch is free flowing. The river is characterized by long shallow gravel riffles. The best fishery is located just below the dam.

Fish populations within this reach include rainbow trout, brown trout, mountain whitefish, largemouth bass, and channel catfish. Wildlife populations

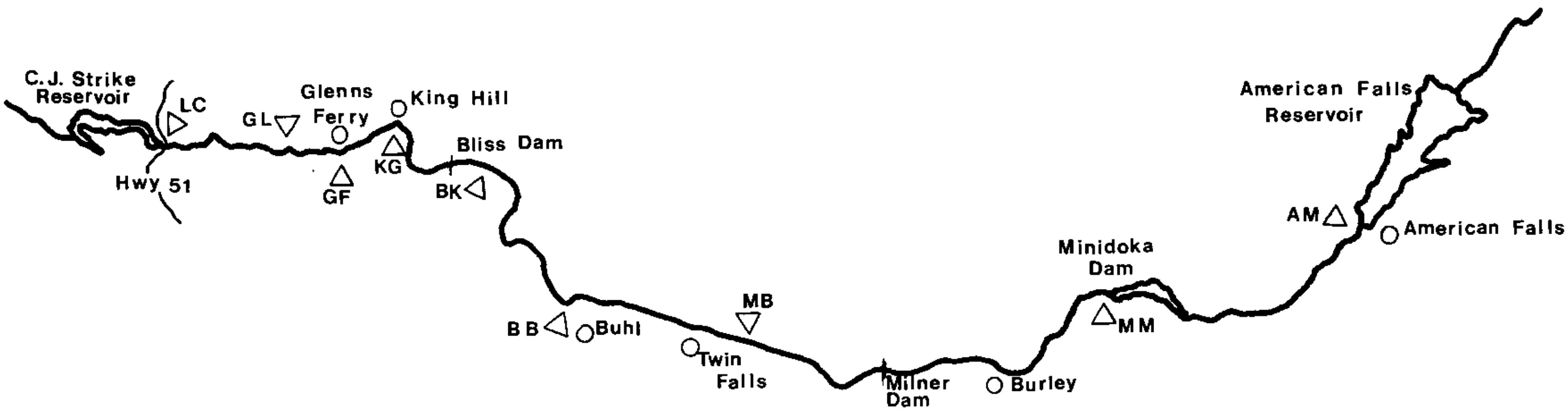

Figure 10. Snake River map with locations of study sites.

Table 4. Snake River (Minidoka Dam to C.J. Strike) fish and wildlife periodicity chart.

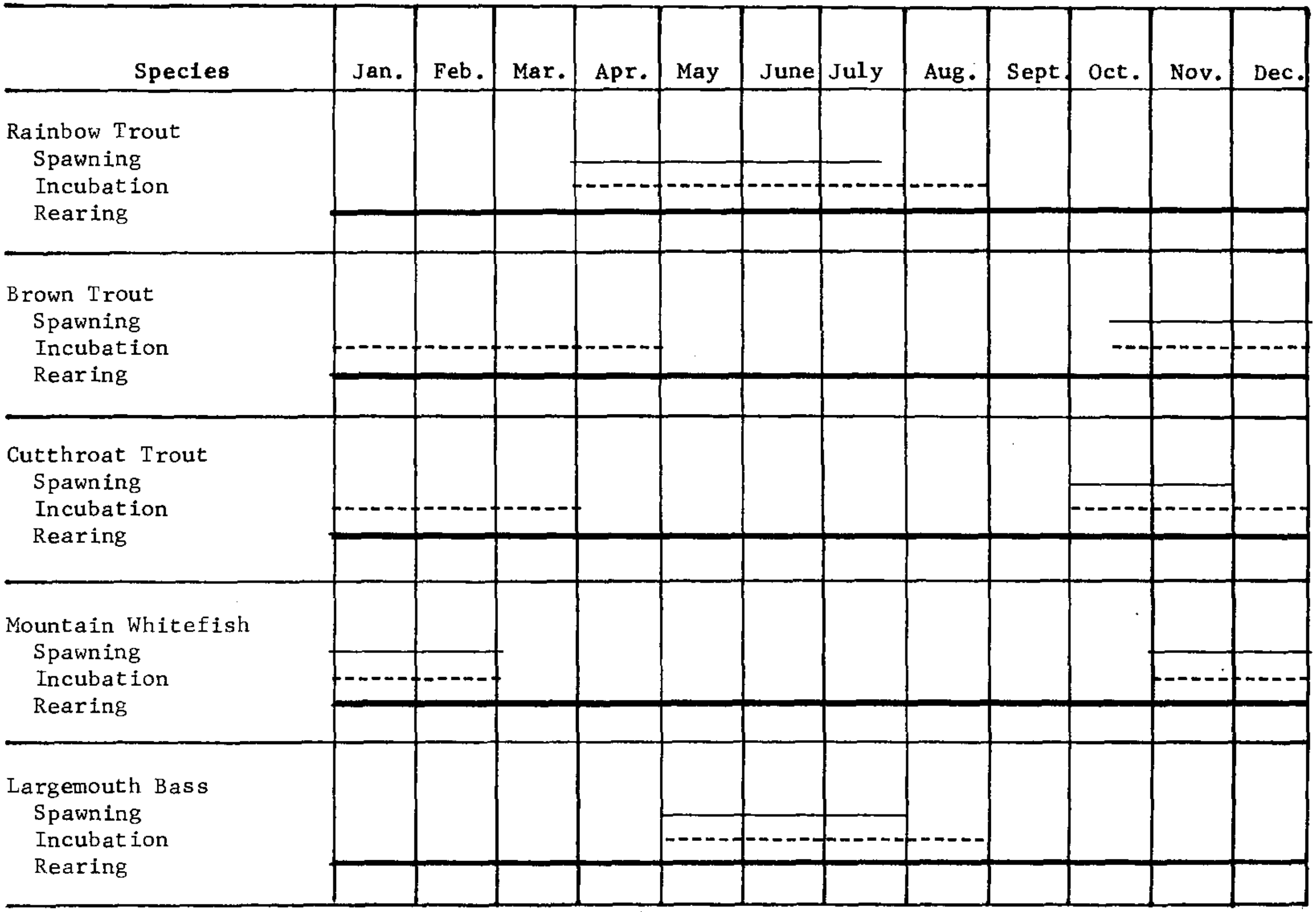

Table 4. Snake River (Minidoka Dam to C.J. Strike (fish and wildlife periodicity chart (continued).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Smallmouth Bass												
Spawning					———	———	———					
Incubation					-----	-----	-----	-----				
Rearing	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══
Channel Catfish												
Spawning						———	———					
Incubation						-----	-----	-----				
Rearing	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══
White Sturgeon												
Spawning					———	———						
Incubation					-----	-----	-----	-----				
Passage		xxx	xxxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxx	
Rearing	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══
Canada Goose												
Nest Establishment			———	———								
Incubation			-----	-----	-----							
Mallard Duck												
Nest Establishment				———	———							
Incubation				-----	-----	-----						

include beaver, muskrat, otter and mink. Other important wildlife species include bald eagles, golden eagles, osprey, peregrine falcons, green herons and cattle egrets. The 1976 winter waterfowl count totaled 3,615 birds and included 266 Canada geese. The 1975 Canada goose nest survey revealed 21 nests associated with the islands in this section.

Stream resource maintenance flows are based on adequate rearing flows for fish food production. Flows for waterfowl nesting in this section will be determined at a later date. Recommended minimum stream resource maintenance flows for the Snake River from Minidoka Dam to Milner Dam are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June
cfs	4,414	4,414	4,414	4,414	4,414	4,414
cu m/s	125	125	125	125	125	125

	July	Aug.	Sept.	Oct.	Nov.	Dec.
cfs	4,414	4,414	4,414	4,414	4,414	4,414
cu m/s	125	125	125	125	125	125

Milner Dam to Buhl Gage Station

This stretch of the Snake River is 69 km (43 mi) in length. Slack water occurs behind Twin Falls power diversion and Shoshone Falls power diversion. Station MB is located 1 km (0.6 mi) upstream of the Twin Falls diversion. This section is dewatered completely at times during the irrigation season. The stretch is characterized by long, deep pools and rubble riffles. The river is regenerated below Twin Falls by inflow of springs on the north side of the canyon and irrigation returns.

Fish populations include rainbow trout, cutthroat trout, white sturgeon and brown trout. Wildlife populations include muskrat, beaver, mink, weasel, otter and a variety of waterfowl.

Stream resource maintenance flows are based on rearing flows for fish food productions. The recommended monthly minimum stream resource maintenance flows are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June
cfs	2,190	2,190	2,190	2,190	2,190	2,190
cu m/s	62	62	62	62	62	62

	July	Aug.	Sept.	Oct.	Nov.	Dec.
cfs	2,190	2,190	2,190	2,190	2,190	2,190
cu m/s	62	62	62	62	62	62

Buhl Gage Station to King Hill

This section of the Snake River is 83 km (51 mi) in length with pool areas located behind Upper Salmon Falls Dam, Lower Salmon Falls Dam, and Bliss Dam. The section is characterized by deep pools and bedrock/rubble riffles. Trout escapement from several fish hatcheries add to the fishery in this section. Fishing for trout is generally limited to the areas near spring inflows. Station BB is located 4 km (2.5 mi) downstream of the Buhl Gage Station and station BK is located at the old Bliss Bridge.

Fish populations include rainbow trout, cutthroat trout, smallmouth bass, largemouth bass, mountain whitefish, channel catfish, and white sturgeon. Wildlife populations include beaver, muskrat, mink, Canada goose, and a variety of other waterfowl.

A 1975 creel census study (Gibson and Mate 1976) estimated that anglers spent 6,800 hours to harvest 2,717 fish from this section. Included in this catch were 1,548 rainbow trout, 95 smallmouth bass, and 74 white sturgeon. The sturgeon were released after capture.

Spawning of game fish in the main river is limited to the white sturgeon, channel catfish and possibly smallmouth bass. Stream resource maintenance flow recommendations are based on rearing flows for fish food production. The recommended minimum stream resource maintenance flows are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June
cfs	4,520	4,520	4,520	4,520	4,520	4,520
cu m/s	128	128	128	128	128	128

	July	Aug.	Sept.	Oct.	Nov.	Dec.
cfs	4,520	4,520	4,520	4,520	4,520	4,520
cu m/s	128	128	128	128	128	128

King Hill to C.J. Strike Dam

The river stretch from King Hill to C.J. Strike Dam is 90 km (56 mi) in length with 60 km (37 mi) free flowing. The river is characterized by long, wide, shallow gravel riffles, deep pools and a large number of islands. This section of the river is an important resting and nesting area for waterfowl and other bird species. Station KG is located at the bridge at King Hill. Station GF is located approximately 2 km (1.2 mi) downstream of the I-80 bridge at Glenns Ferry. Station GL is located 9 km (5.6 mi) downstream from the I-80 bridge at Glenns Ferry. Station LB is located at Loveridge Bridge south of Mountain Home.

Fish populations include smallmouth bass, largemouth bass, white sturgeon, mountain whitefish and channel catfish.

Wildlife populations include beaver, mink, muskrat, otter, Canada goose, and other waterfowl. Other important wildlife species include golden eagles and great blue herons. The 1975 Canada goose nest survey conducted by the

Idaho Department of Fish and Game totaled 48 nests in this section, with all but seven associated with the island. Thirty-five of these nests were located in the C.J. Strike Wildlife Management Area near Loveridge Bridge. A large great blue heron rookery is also located in this area.

Stream resource maintenance flows are based on rearing flows for fish food production and waterfowl nesting.

Recommended stream resource maintenance flows for this section of river are as follows:

King Hill to Glenns Ferry

	Jan.	Feb.	Mar.	Apr.	May	June
Min. cfs	4,344	4,344	4,344	4,344	4,344	4,344
Min. cu m/s	123	123	123	123	123	123

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Min. cfs	4,344	4,344	4,344	4,344	4,344	4,344
Min. cu m/s	123	123	123	123	123	123

Glenns Ferry to C.J. Strike Reservoir

	Jan.	Feb.	Mar.	Apr.	May	June
Min. cfs	4,202	4,202	4,202	4,202	4,202	4,202
Min. cu m/s	119	119	119	119	119	119

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Min. cfs	4,202	4,202	4,202	4,202	4,202	4,202
Min. cu m/s	119	119	119	119	119	119

	Mar.	Apr.	May
Max. cfs	18,999	18,999	18,999
Max. cu m/s	538	538	538

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A P P E N D I X

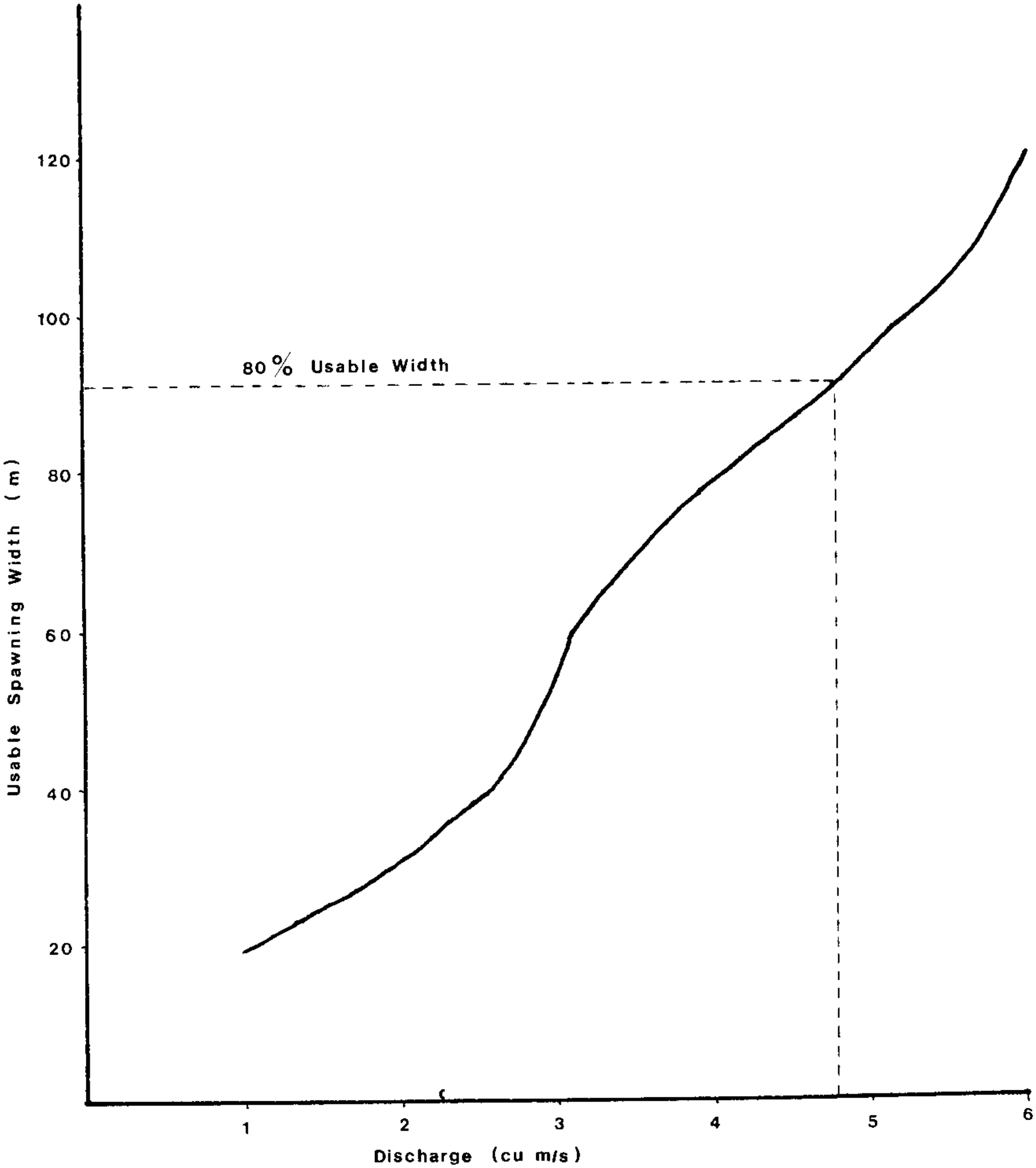

Figure 1. Rainbow trout spawning curve for Silver Creek above Picabo bridge.

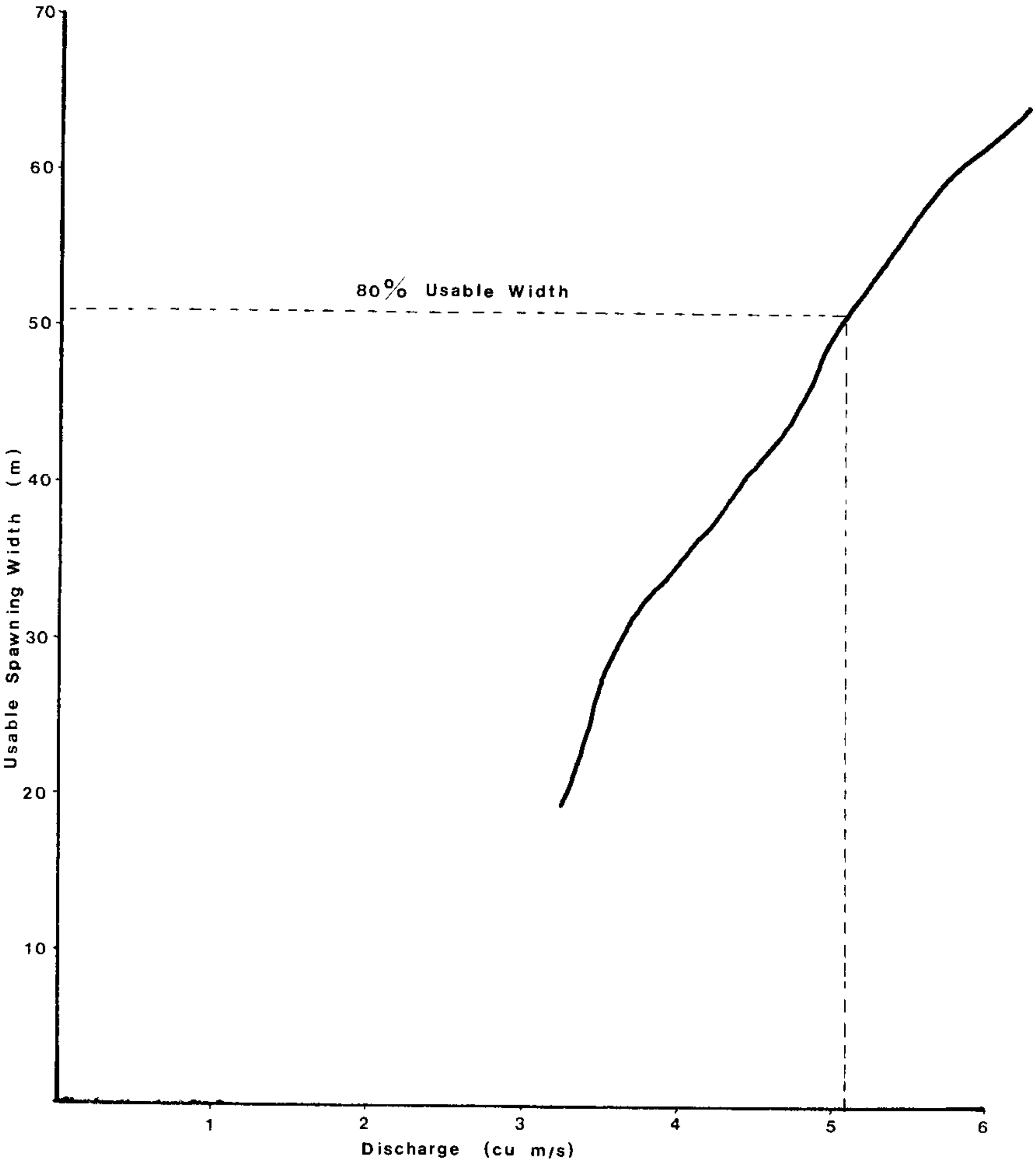

Figure 2. Brown trout spawning curve for Silver Creek above Picabo bridge.

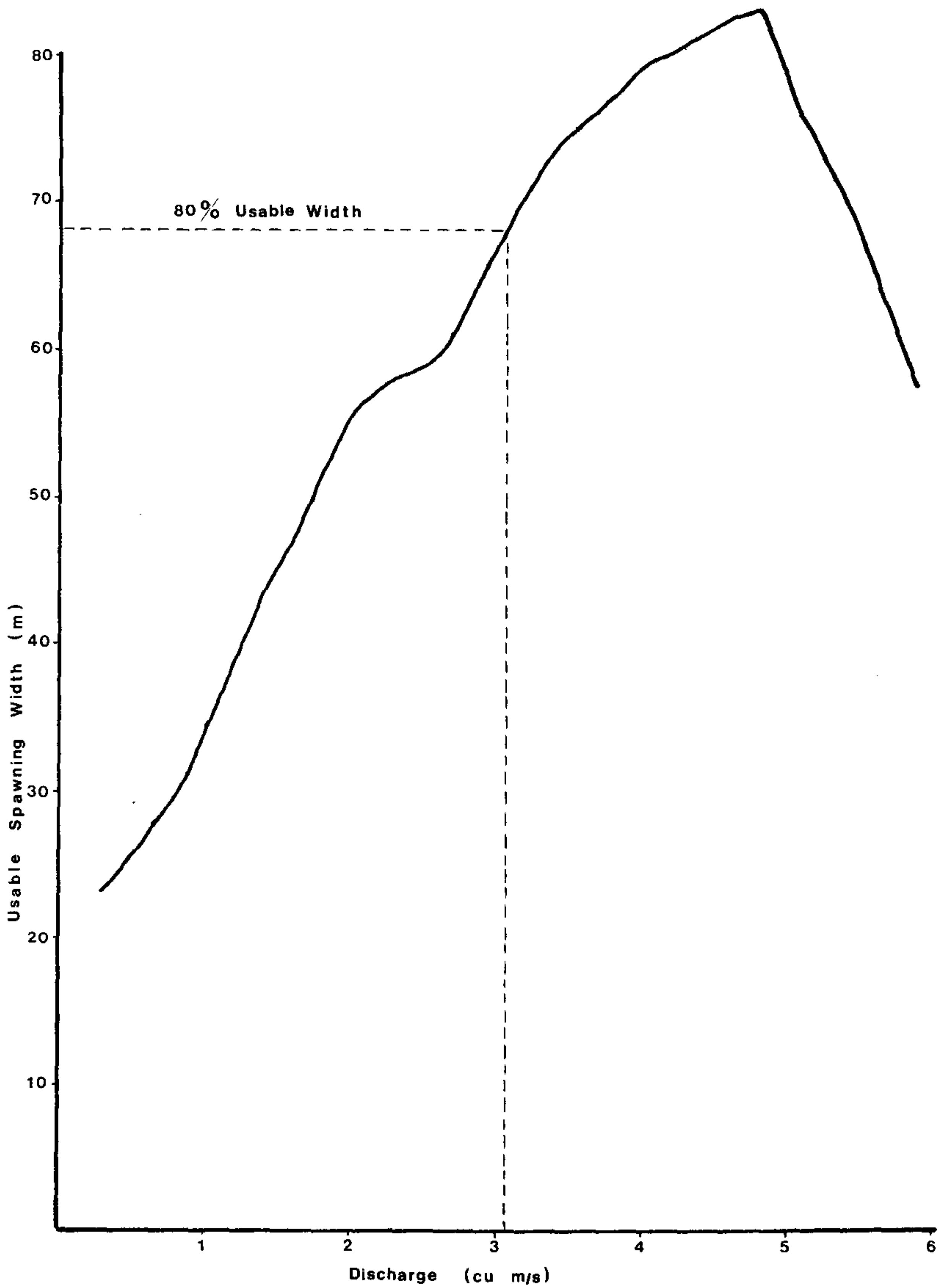

Figure 3. Brook trout spawning curve for Silver Creek above Picabo bridge.

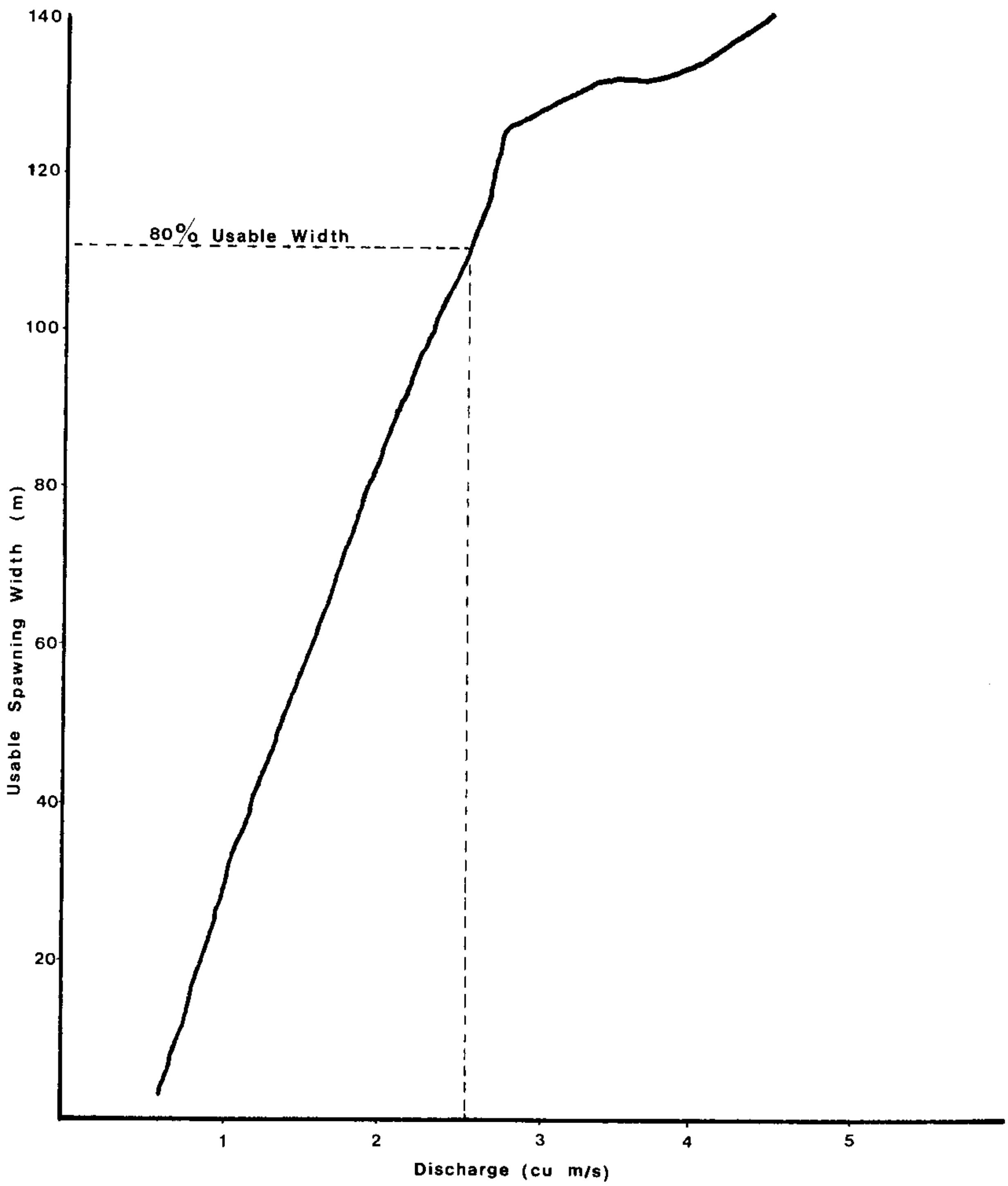

Figure 4. Rainbow trout spawning curve for Silver Creek below Picabo bridge.

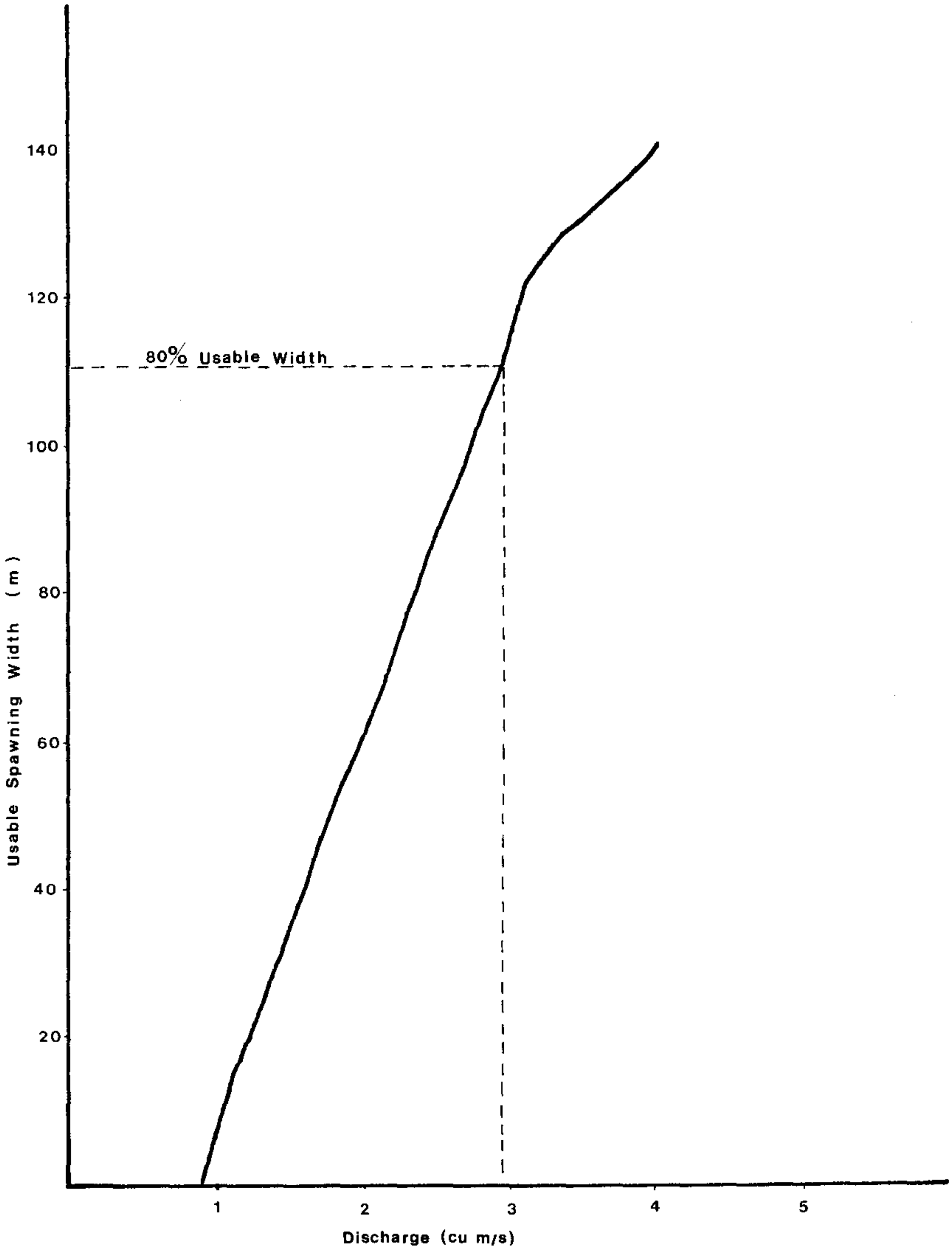

Figure 5. Brown trout spawning curve for Silver Creek below Picabo bridgde.

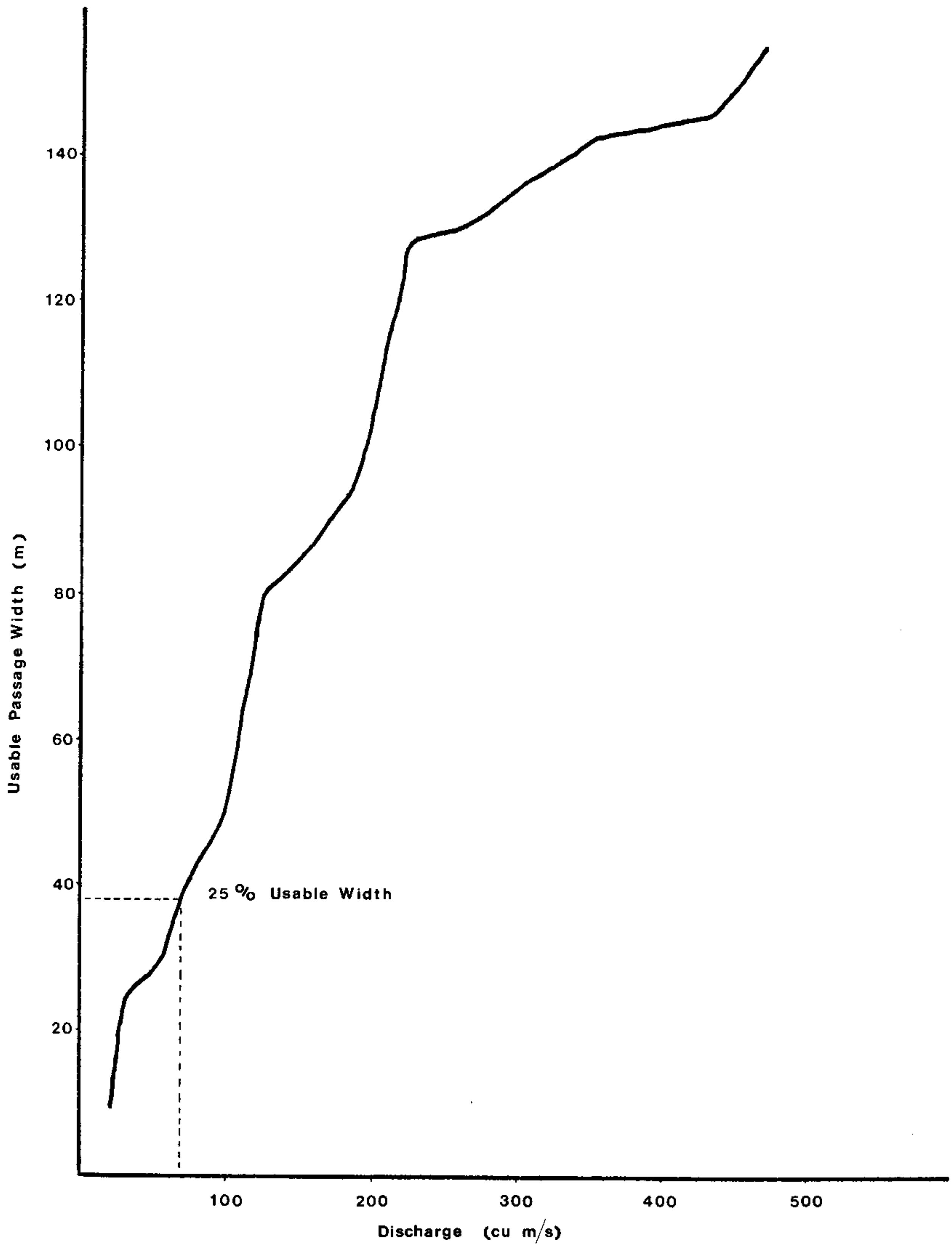

Figure 6. White sturgeon passage curve for Snake River at King Hill.

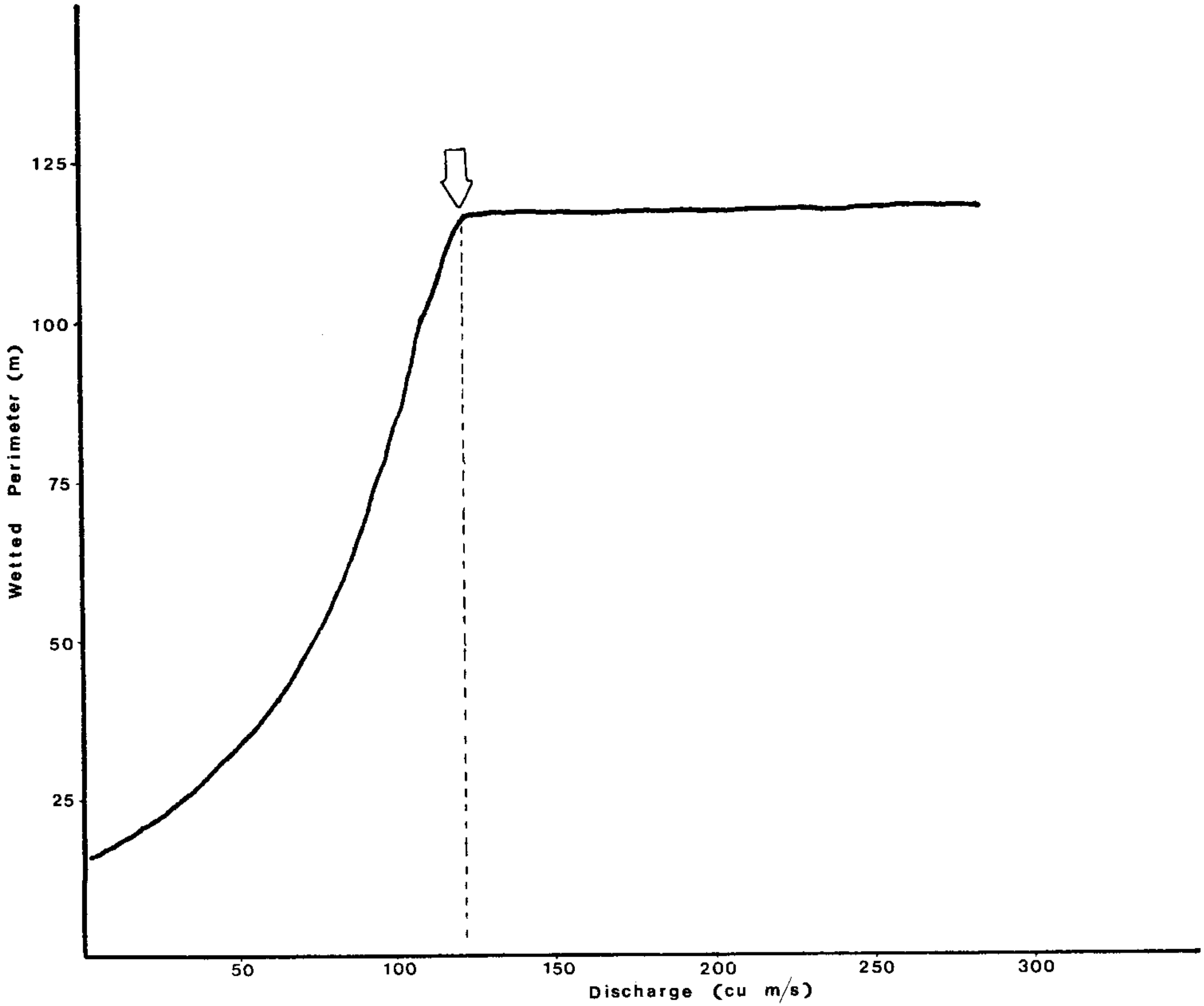

Figure 7. Rearing flow curve for Snake River at Minidoka Dam.

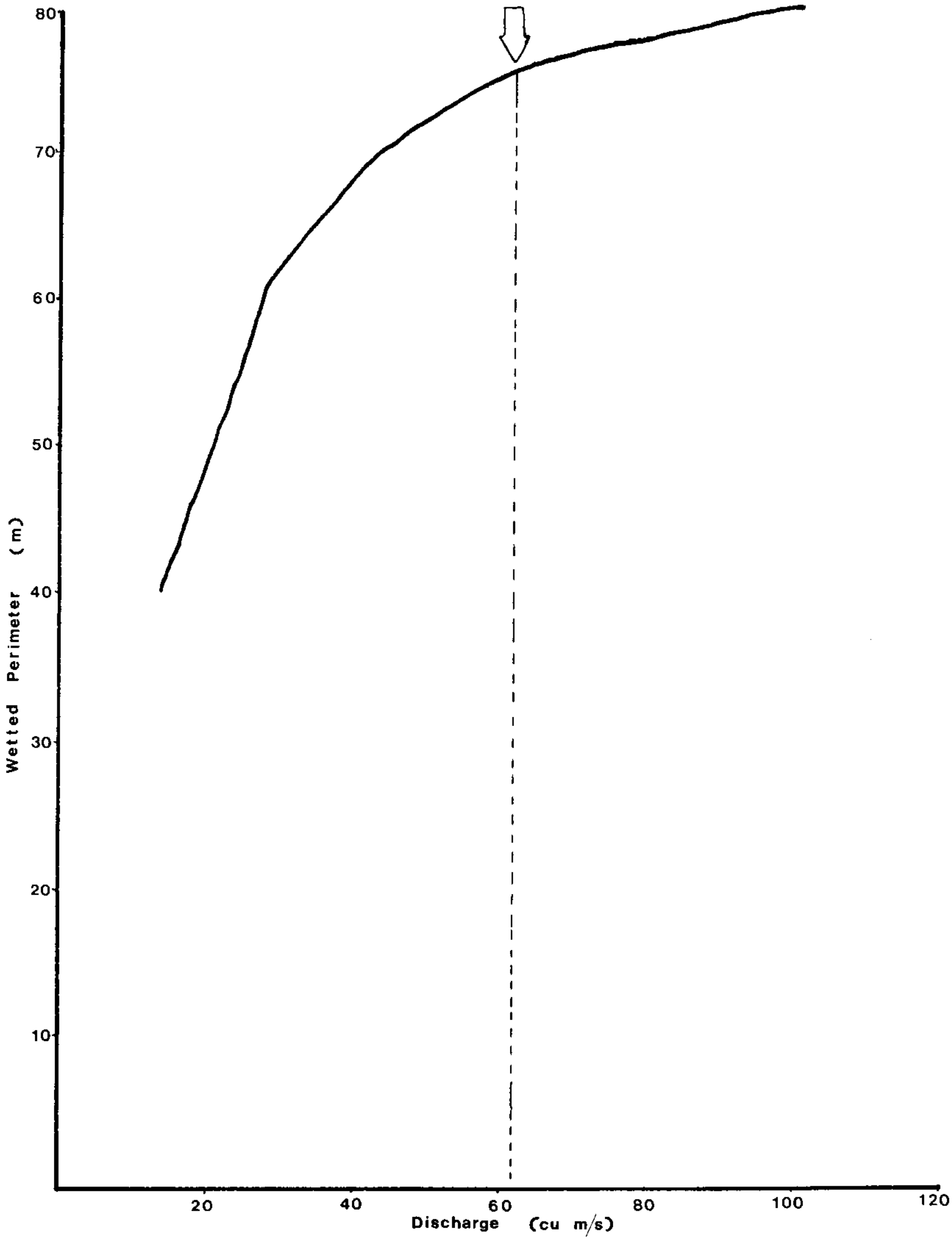

Figure 8. Rearing flow curve for Snake River above Twin Falls.

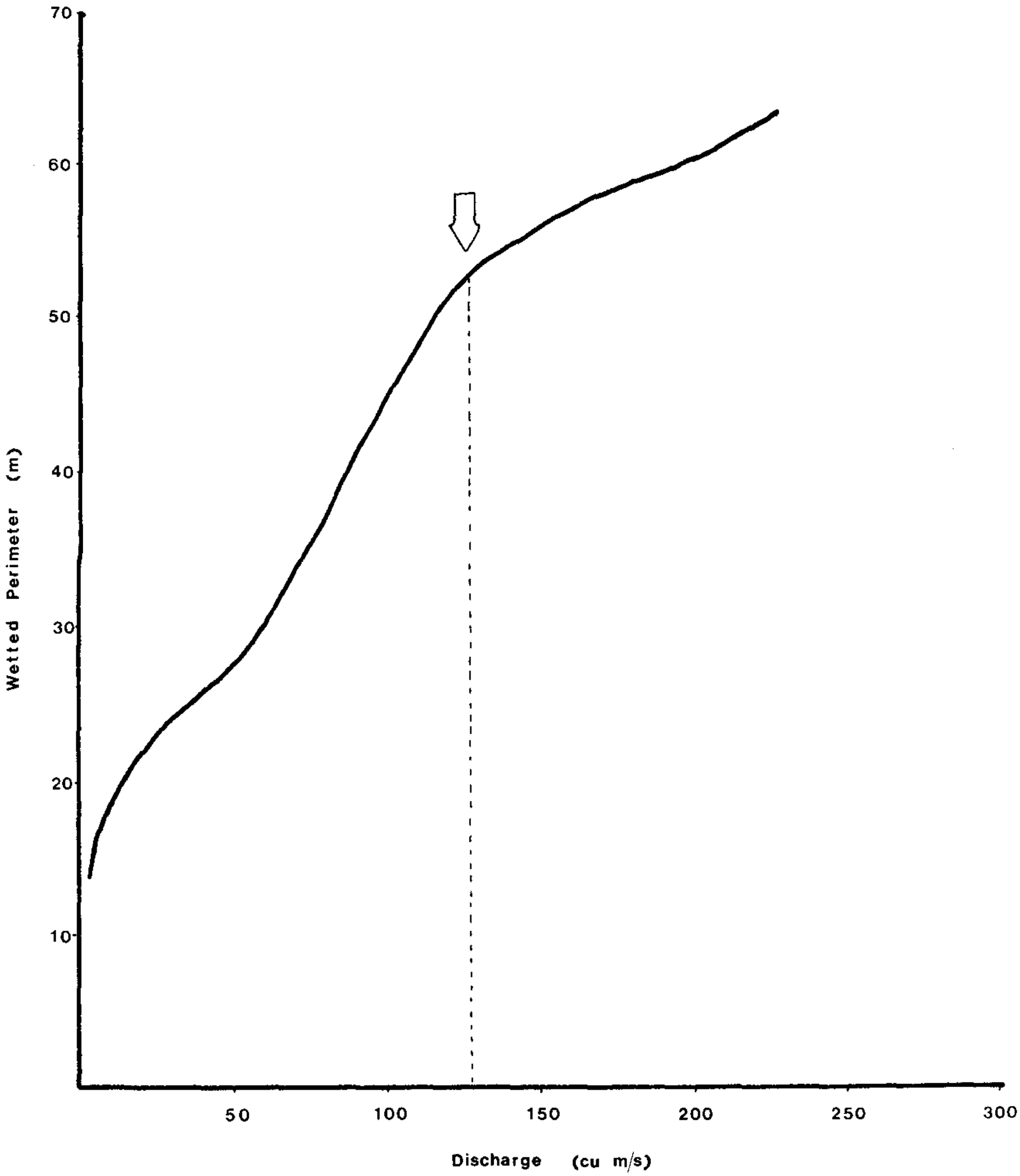

Figure 9. Rearing flow curve for Snake River at Kanaka Rapids.

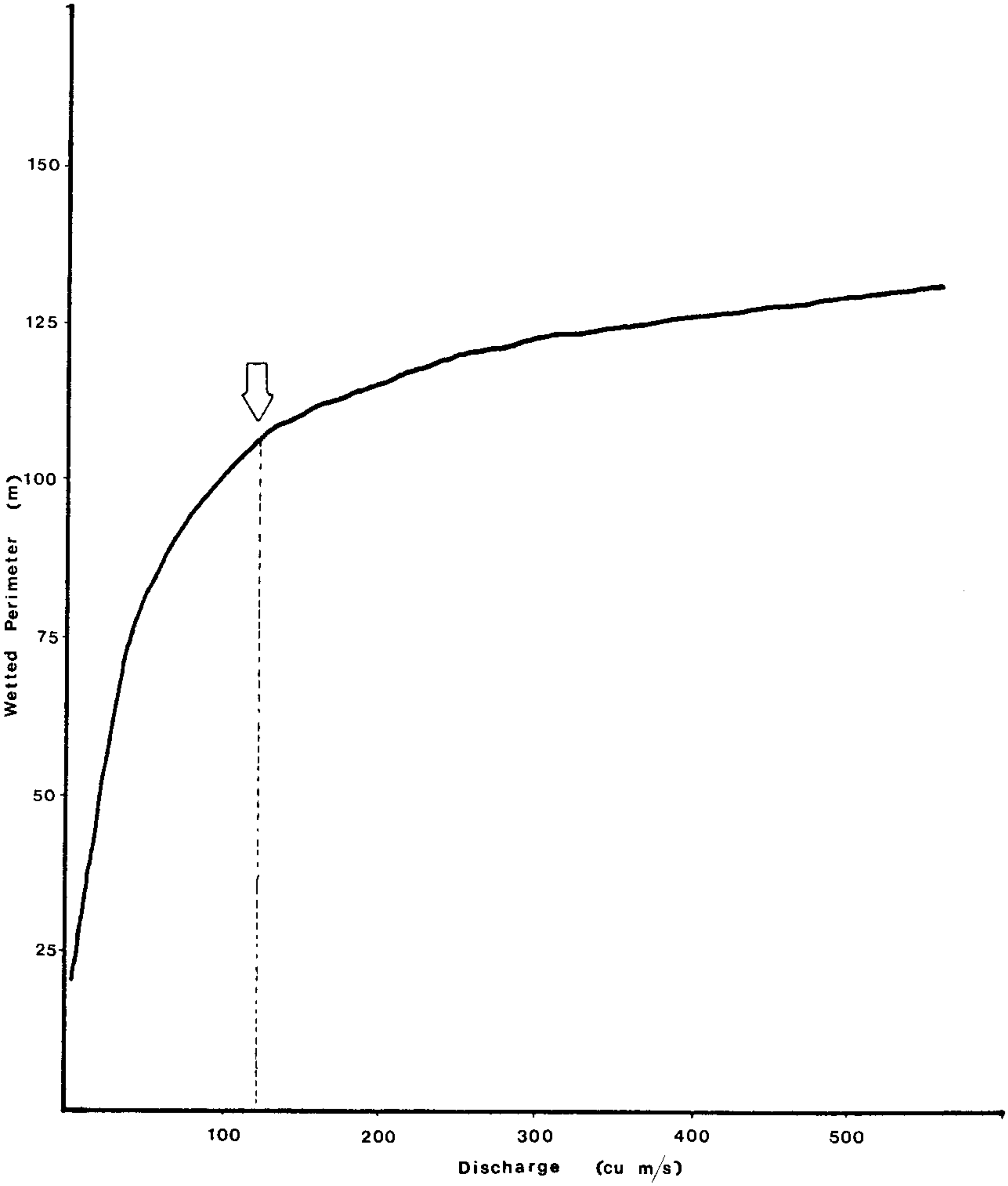

Figure 10. Rearing flow curve for Snake River at King Hill.

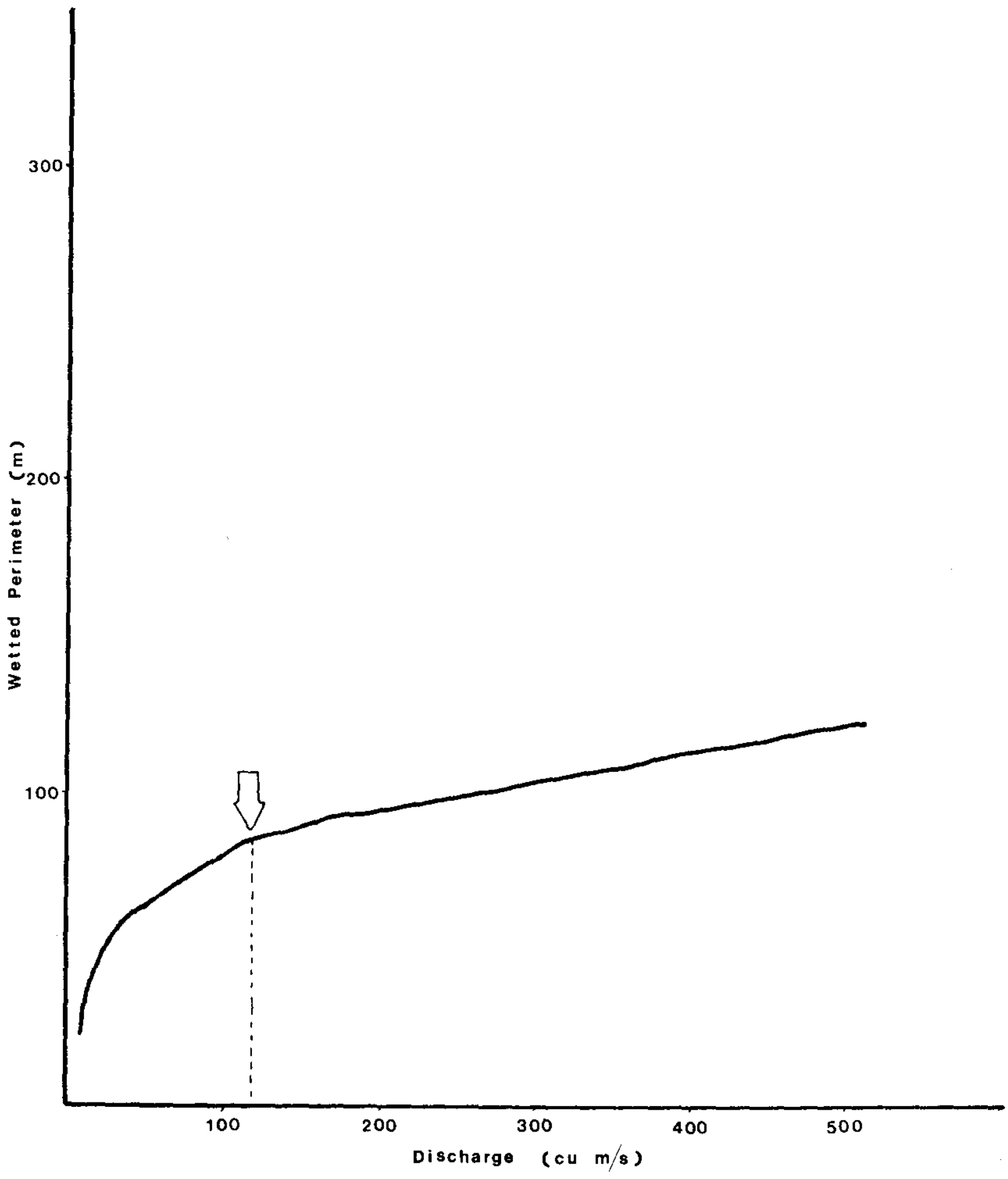

Figure 11. Rearing flow curve for Snake River downstream of Glenns Ferry.

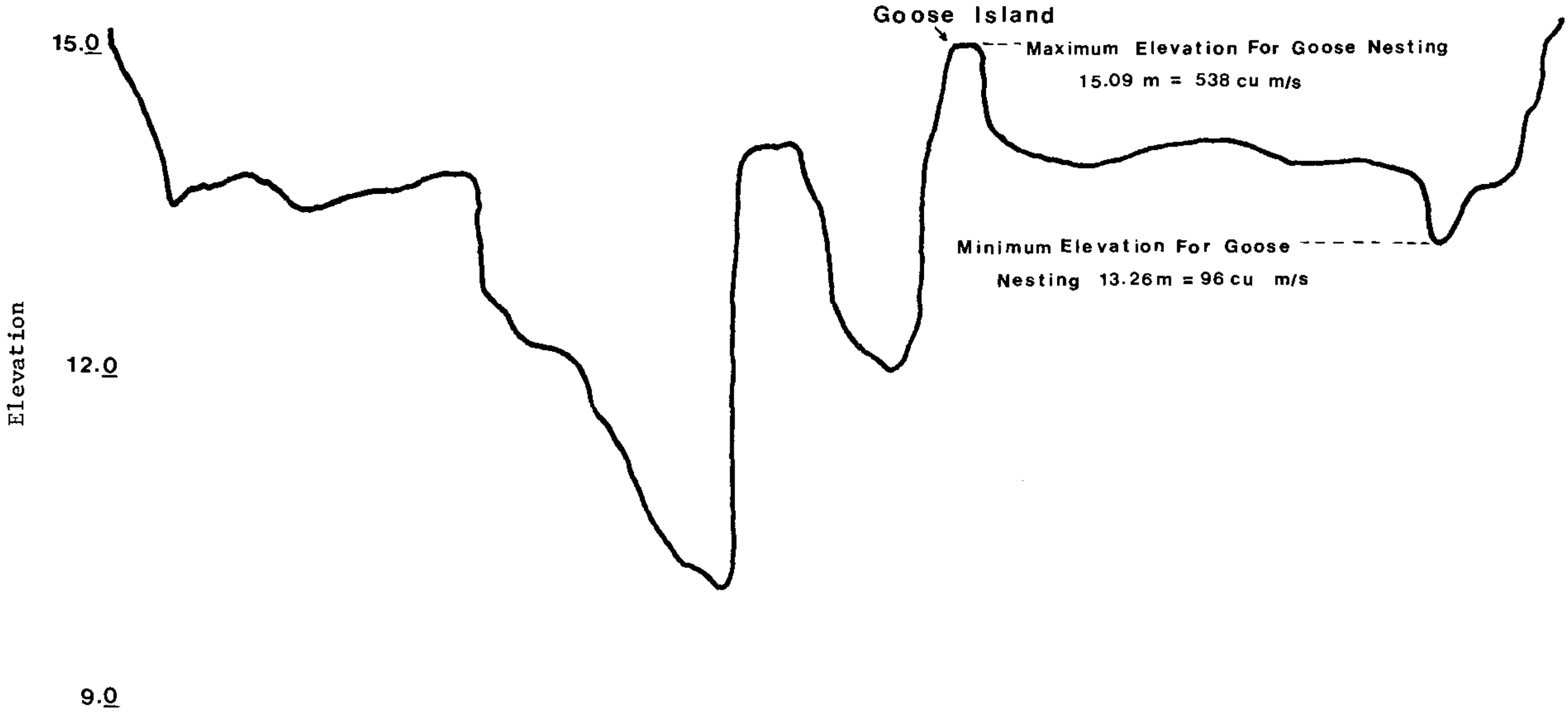

Figure 12. Waterfowl determination on the Snake River at Loveridge Bridge.

Table 1. Stream resource maintenance flows (cu m/s) for life history phases of important fish species in Silver Creek.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Picabo Bridge												
Rainbow trout												
Spawning				4.2'4.2	4.2'4.2	4.2'4.2	4.2'			4.2'4.2	4.2'4.2	
Incubation	2.8'			2.8'2.8	2.8'2.8	2.8'2.8	2.8'2.8	2.8'2.8		2.8'2.8	2.8'2.8	2.8'2.8
Brown Trout												
Spawning										'5.1	5.1'5.1	5.1'5.1
Incubation	3.4'3.4	3.4'3.4	3.4'3.4	3.4'3.4						'3.4	3.4'3.4	3.4'3.4
Brook Trout												
Spawning										3.1'3.1	3.1'3.1	
Incubation	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1						2.1'2.1	2.1'2.1	2.1'2.1
All Species												
Rearing	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4	2.4'2.4
Recommended flows	3.4'3.4	3.4'3.4	3.4'3.4	4.2'4.2	4.2'4.2	4.2'4.2	4.2'2.8	2.8'2.8	2.4'2.4	4.2'5.1	5.1'5.1	5.1'5.1
Below Picabo Bridge												
Rainbow Trout												
Spawning				2.6'2.6	2.6'2.6	2.6'2.6	2.6'			2.6'2.6	2.6'2.6	
Incubation	1.7'1.7			1.7'1.7	1.7'1.7	1.7'1.7	1.7'1.7	1.7'1.7		1.7'1.7	1.7'1.7	1.7'1.7
Brown Trout												
Spawning										'3.0	3.0'3.0	3.0'3.0
Incubation	2.0'2.0	2.0'2.0	2.0'2.0	2.0'2.0						'2.0	2.0'2.0	2.0'2.0
All Species												
Rearing	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1	2.1'2.1
Recommended flows	2.1'2.1	2.1'2.1	2.1'2.1	2.6'2.6	2.6'2.6	2.6'2.6	2.6'2.1	2.1'2.1	2.1'2.1	2.6'3.0	3.0'3.0	3.0'3.0

Table 2. Stream resource maintenance flows (cu m/s) for life history phases of important fish and wildlife species in Snake River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Station MM												
Fish species												
Rearing	125	125	125	125	125	125	125	125	125	125	125	125
Canada Goose												
Nesting (Max.)					TO BE DETERMINED							
Incubation (Max.)					TO BE DETERMINED							
Station MB												
Fish species												
Rearing	62	62	62	62	62	62	62	62	62	62	62	62
Station BB												
Fish species												
Rearing	128	128	128	128	128	128	128	128	128	128	128	128
Station BK												
White sturgeon												
Spawning					TO BE DETERMINED							
Incubation					TO BE DETERMINED							
Passage					TO BE DETERMINED							
Fish species												
Rearing	128	128	128	128	128	128	128	128	128	128	128	128
Station KG												
White sturgeon												
Spawning					TO BE DETERMINED							
Incubation					TO BE DETERMINED							
Passage	70	70	70	70	70	70	70	70	70	70	70	70
Fish species												
Rearing	123	123	123	123	123	123	123	123	123	123	123	123
Canada Goose												
Nesting (Max.)					TO BE DETERMINED							
Incubation (Max.)					TO BE DETERMINED							

Table 2. Stream resource maintenance flows (cu m/s) for life history phases of important fish and wildlife species in Snake River (continued).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Station GF												
White sturgeon												
Spawning					TO BE DETERMINED							
Incubation					TO BE DETERMINED							
Passage					TO BE DETERMINED							
Fish species												
Rearing												
Canada Goose												
Nesting (Max.)												
Incubation (Max.)												
Station GL												
Fish species												
Rearing	119	119	119	119	119	119	119	119	119	119	119	119
Canada Goose												
Nesting (Max.)												
Incubation (Max.)												
Station LB												
Fish species												
Rearing												
Canada Goose												
Nesting (Max.)			538	538	538							
Incubation (Max.)			538	538	538							
Nesting (Min.)			96	96	96							
Incubation (Min.)			96	96	96							

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