FINAL TECHNICAL REPORT

VOLUME III of III

WHITE RIVER FALLS FISH PASSAGE PROJECT

TYGH VALLEY, OREGON

Published By

U.S. Department of Energy
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Division of Fish and Wildlife

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FINAL REPORT

WHITE RIVER FALLS FISH PASSAGE PROJECT

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ENGINEERING ALTERNATIVE EVALUATION

APPENDIX D

BENEFIT/COST ANALYSIS

BY

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Published By

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Bonneville Power Administration
Division of Fish and Wildlife

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VOLUME III

APPENDIX B
FISHERIES REPORT

Prepared By: Oregon Department of Fish & Wildlife

Chapter I

FISHERIES

STREAM HABITAT INVENTORY

A. 1983 Stream Survey (Summer)

In 1983 ODFW surveyed 94 km of the lower reaches of seven tributaries below the boundary of the Mt. Hood National Forest. Streams were surveyed to determine differences among sections of streams using parameters such as pool:riffle ratios, gradient, shade, and substrate. These data were used with similar data from Mt. Hood National Forest surveys to stratify individual streams into reaches of similar habitat characteristics. Resident fish populations and stream habitat were measured at 1 to 4 sites within a reach in 1984 to estimate anadromous fish potential in the White River basin.

Data from the stream survey were also used to identify potential migration barriers for fish, irrigation diversions, and opportunities for enhancement of fish habitat. Spawning gravel for anadromous fish was identified and measured and these data were used in the estimates of anadromous fish potential in the basin. Irrigation diversions in the watershed were inspected in 1984 to estimate the need of and cost for screening the ditches to protect juvenile fish.

Other data gathered in 1983 included visual estimates of general pool characteristics (width, depth, and cover) and length and width of large holding pools.

These data are presented in Tables 1.1 to 1.8.

Detailed measurements of stream habitat were made at 88 sample sites in White River basin in 1984. These data are summarized in POTENTIAL ANADROMOUS FISH PRODUCTION.

B. 1984 Stream Survey (Winter)

A survey of streams was conducted on state and private lands during winter flows in 1984, primarily to estimate potential Steelhead spawning habitat. Other data gathered at the high flows included evaluation of irrigation diversion dams and migration barriers. These data are summarized in Tables 1.9 to 1.12.

C. Water Temperature and Stream Flow

Water temperatures were measured continuously with Partlow thermographs at 3 stations in 1983 and 1984. In addition, submersible Ryan thermographs were placed in seven streams of Mt. Hood National Forest and were operated during summer 1984 by USDA FS personnel. Water temperatures were recorded weekly with Taylor maximum-minimum thermometers at 17 stations in 1983 and at 8 stations in 1984.

Stream flow was measured at four permanent transects in Tygh, Clear, and Boulder creeks and in White River at Barlow Crossing. Standard stream-gauging procedures were used to measure flow (Corbett 1962) and water velocity was measured with a Gurley meter or with a Marsh-McBirney velocity meter. Flows were also measured in White River at a USGS gauging station below White River Falls.

These data are presented in Tables 1.13 to 1.19.

Reach Summary

Key

Cover in pools -	Very low ≤ 20%	Low 21-40%	Moderate 41-60%	High > 60%
Flow regime - (high flow:low flow)	Flashy 2:l	Moderately flashy 1.5:1		Well regulated 1:l
Bank stability - (% erosion present)	Stable ≤ 10%	Moderately stable 11-30x		Unstable › 30%
Channel substrate stability - (% substrate detachment)	Stable ≤ 20%	Moderately Stable 21-50X		Unstable > 50%

Substrate composition -

Type:	Bedrock	Large boulder	Small boulder	Rubble	Gravel	Fine Gravel	Sand-silt
Diameter: (cd		>90	30.6-90	15-30.5	2.5-14.9	0.25-2.4	<0.25

Definitions (Platts, et al. 1983)

Pool: area of water column with slow water velocity, usually deeper than riffles or runs; streambed gradient often near zero and often concave in shape.

Run: rapid, nonturbulent flow; usually too deep to be a riffle and too fast to be a pool.

Cover: material or condition that provides protection to fish (e.g., logs and other large woody debris, boulders, undercut banks, water depth, and overhanging vegetation within 0.3 m of water surface).

Pool feature: condition that formed or is maintaining the pool.

Species listed in the riparian zone were dominant overstory or understory species. Species in parentheses were abundant but not dominant.

Tygh Creek

1. km 0.0 - 8.9

Survey date:	August 17-18
Substrate:	Dominant - rubble and gravel Gravel - 75% 7.5-15 cm Stability - moderately stable
Pools:	Numerous major pools; also small pools and runs Cover - low (average); 15-90X (range) Feature - channel meanders
Barriers:	3 diversion dams - concrete, wood, plastic sheeting; installed April-October (average irrigation season); ditches would require screening; barriers at low flow 1 beaver dam - old, not active
Flow:	Moderately flashy 5.4 cfs (average) Withdrawals - 10-11.5 cfs; 3 ditches, 2 pumps
Banks:	Stable Grazing - heavy around km 6.5 Stream bank rehabilitation project (1974) from km 4.5-8.9 includes rip rap, deflectors, fencing
Riparian zone:	Overstory - poplar-cottonwood, alder; several areas with sparse growth and poor shading Understory - alder, willow, rose

2. km 8.9 - 15.0

Survey date:	August 18-23
Substrate:	Dominant - rubble and gravel Gravel - 75% 7.5-15 cm Rubble composed primarily of 15-20 cm particles Stability - moderately stable
Pools:	Few major pools, channelized section from km 11.0-15.0 Cover - low to moderate (average); 15-80X (range)
Barriers:	Eight retention dams composed of boulders and stream substrate; seasonal darns for pump irrigation. Two diversion dams composed of boulders and stream substrate; seasonal; ditches would require screening; possible barriers at low flow

Flow:	Flashy due to channelization 6 cfs (average) Withdrawals - 4.5-5 cfs; 2 ditches, 8 pumps
Banks:	Stable Grazing - heavy in section km 9.5-11.0 with active bank erosion
Riparian zone:	Overstory - poplar-cottonwood Understory - willow, alder

3. km 15.0 - 24.1

Survey date:	August 23-24
Substrate:	Dominant - rubble and gravel Gravel - 56% 7.5-15 cm; most of gravel above km 17.0 Stability - unstable
Pools:	Numerous, small pools Cover - moderate (average); 15-90x (range) Feature - large woody debris and boulders above km 20.0; large woody debris above km 22.5
Barriers:	1 diversion dam - wood, may be barrier at low flow; ditch would require screening. 1 waterfall of 3.0 m at km 20.2; probably a barrier at all flows. 27 boulder and large woody debris dams some of which may be barriers at low flow or may have a cummulative effect and prevent upstream migration at high flow.
Flow:	Flashy from km 15.0-20.0; moderately flashy above km 20.0 2.5 cfs (average) Withdrawal - 1.5 cfs; 1 ditch
Banks:	Moderately stable Erosion - several areas with 40% above km 20.0; associated with old timber harvests, roads, and some grazing.
Riparian zone:	Overstory - Douglas fir, ponderosa pine Understory - vine maple, alder (snowberry, blackberry, serviceberry, ninebark)

Jordan Creek

1. km 0.0 - 3.5

Survey date:	August 23-25
Substrate:	Dominant - bedrock and boulder Gravel - little present, 50% 7.5-15 cm Stability - moderately stable
Pools:	Several large, deep pools Cover - high (average), 40-75% (range) Feature - plunge pools below falls and bedrock pools
Barriers:	2 waterfalls (7.6 m and 5.2 m) at km 1.4 and km 3.5; barriers at all flows
Flow:	Moderately flashy 6 cfs (average) No withdrawals
Banks:	Moderately stable
Riparian zone:	Overstory - ponderosa pine (alder, oak, Douglas fir) Understory - alder (vine maple, ninebark)

2. km 3.5 - 12.1

Survey date:	August 25-30
Substrate:	Dominant - rubble (35%); boulders and bedrock (42%) Gravel - 60% 2.5-7.5 cm; concentrated above km 8.0; frequency of fine gravel increased above km 8.0 Stability - moderately stable
Pools:	Few major pools; many small pools and runs Cover - moderate (average); 30-85% (range) Feature - boulders and large woody debris; large woody debris more prevalent above km 7.0
Barriers:	3 large woody debris dams; may prevent passage at low flow
Flow:	Flashy 9 cfs (average) No withdrawals
Banks:	Moderately stable; 50% erosion from km 5.0-7.0 due to undercutting of streambank
Riparian zone:	Overstory - Douglas fir, ponderosa pine (oak, grand fir) Understory - snowberry, rose, alder, vine maple

Pen Creek

1. km 0.0 - 3.2

Survey date:	August 31
Substrate:	Dominant - gravel and rubble Gravel - 85% 2.5-7.5 cm Stability - moderately stable
Pools:	Small pools Cover - moderate (average), 30-65% (range) Feature - large woody debris
Barriers:	2 large woody debris dams and 2 small falls that may be barriers at low flow
Flow:	Flashy <0.3 cfs (average); intermittent stream with some flow at the mouth No withdrawals
Banks:	Moderately stable
Riparian zone:	Overstory - ponderosa pine, Douglas fir, grand fir, oak Understory - vine maple

2. km 3.2 - 8.1

Survey date:	August 31 - September 1
Substrate:	Dominant - gravel and rubble Gravel - 80% 2.5-7.5 cm Stability - stable
Pools:	Small pools Cover - moderate Feature - large woody debris
Barriers:	25 large woody debris dams, boulders, and sills, some of which would prevent upstream passage
Flow:	Flashy 0.22 cfs; most of the reach was dry with some spring-fed flow near the headwaters No withdrawals
Banks:	Stable
Riparian zone:	Overstory - Douglas fir, ponderosa pine, grand fir Understory - vine maple, alder

Badger Creek

1. km 0.0 - 4.1

Survey date:	August lo-15
Substrate:	Dominant - rubble and gravel Gravel - 85% 7.5-15 cm Stability - moderately stable
Pools:	Numerous major pools, also small pools and runs Cover - moderate (average), 15-75% (range) Feature - channel meanders; boulders from km 3.0-4.0
Barriers:	2 diversion dams - wood, concrete, and plastic sheeting; installed April-October (average irrigation season); ditches would require screening; barriers at low flows
Flow:	Moderately flashy 6.5 cfs (average); 1.6 cfs at km 0.0, 9.0 cfs above withdrawals Withdrawals - 8 cfs; 2 ditches, 1 pump
Banks:	Moderately stable, some erosion due to grazing and bank undercutting
Riparian zone:	Overstory - oak, alder, ponderosa pine, Douglas fir Understory - willow, alder, roses

2. km 4.1 - 7.2

Survey date:	August 15-16
Substrate:	Dominant - rubble Gravel - 80% 7.5-15 cm Stability - moderately stable
Pools:	Few pools Cover - moderate Feature - boulders
Barriers:	1 diversion dam - wood and plastic sheeting; seasonal operation; ditch would require screening; barrier at low flow
Flow:	Moderately flashy 12.6 cfs (average); 10.5 cfs below and 14.7 cfs above withdrawal Withdrawal - 5 cfs; 1 ditch

Banks:	Moderately stable
Riparian zone:	Overstory - ponderosa pine, Douglas fir Understory - alder, willow, roses Grazing - moderate impact on understory

3. km 7.2 - 9.7

Survey date:	August 16
Substrate:	Dominant - rubble and small boulders Gravel - 80% 7.5-15 cm Stability - moderately stable
Pools:	Few major pools; small pools around boulders Cover - low (average); 20-90% (range) Feature - boulders.
Barriers:	None
Flow:	Moderately flashy 16.4 cfs (average) No withdrawals
Banks:	Unstable Grazing - responsible for most of erosion; heavy grazing noted on private and State land
Riparian zone:	Overstory - ponderosa pine, oak, Douglas fir Understory - willow, alder, ninebark, dogwood Grazing - heavy use on State land (km 9.0-9.7) has impacted the understory

Threemile Creek

1. km 0.0 - 19.3

Survey date:	July 28-August 9
Substrate:	Dominant - gravel and rubble, boulders from km 0.0-2.5 Gravel - 62% 2.5-7.5 cm Stability - moderately stable
Pools:	Numerous pools of varying size Cover - low (average); lo-90% (range) Feature - boulders from km 0.0-2.5; channel meanders and beaver dams from km 2.5-19.3
Barriers:	1 diversion dam - wood and concrete; seasonal operation (April-October); ditch would require screening; barrier at low flow 6 boulder falls (km 0.0-1.1) that may be barriers at all flows
Flow:	Flashy 0.7 cfs (average); 2.0 cfs at mouth Withdrawal - 2.5 cfs; 100% of flow is diverted which leaves a dry channel for 5 km downstream
Banks:	Moderately stable; 3 areas with unstable banks caused by grazing and by a recent burn Grazing - areas of heavy use on private land (km 2.5-4.0 and km 9.0-10.0) and on State land (km 16.0-19.0); 40-60% bank erosion
Riparian zone:	Overstory - ponderosa pine, oak (alder, Douglas fir, poplar-cottonwood) Understory - willow, roses (oak, alder, ninebark, vine maple, hawthorne) Grazing - poor development of riparian zone in sections noted on bank erosion. Wetlands and well-developed riparian zones were present in areas without heavy grazing

2. km 19.3 - 20.5

Survey date:	August 9
Substrate:	Dominant - rubble and gravel Gravel - 79% 2.5-7.5 cm Stability - moderately stable
Pools:	Few pools; no major pools noted

Barriers:	1 diversion dam - wood and concrete; seasonal operation; ditch would require screening: barrier at low flows
Flow:	Flashy 2.5 cfs below diversion; 4 cfs above diversion Withdrawal - 1.5 cfs; 1 ditch
Banks:	Moderately stable Some erosion from grazing
Riparian zone:	Overstory - mixed; cedar, pine, fir, oak, alder Understory - mixed; willow, rose, snowberry, oceanspray Poor establishment of riparian vegetation in old Rocky Burn (1974)

Rock Creek

1. km 0.0 - 4.8

Survey date:	July 13-14
Substrate:	Dominant - boulder Sparse gravel - 80% 2.5-7.5 cm
Pools:	Few pools, mostly large and isolated due to intermittent flow Cover - moderate; all pools with 40% cover
Barriers:	None
Flow:	Flashy Most of reach was dry Withdrawal - 1 pump
Banks:	Moderately stable No evidence of grazing
Riparian zone:	Overstory - oak, ponderosa pine, Douglas fir Understory - willow (ninebark, roses, vine maple)

2. km 4.8 - 10.5

Survey date:	July 14-18
Substrate:	Dominant - sand-silt and fine gravel Gravel - 65% of the gravel > 2.5 cm was 2.5-7.5 cm
Pools:	Numerous, small pools
Barriers:	1 culvert, may be a barrier in low flow
Flow:	Moderately flashy Intermittent - km 4.8-9.7: perrenial - km 9.7-10.5; 1.4 cfs No withdrawals
Banks:	Moderately stable to unstable Grazing - bank erosion of 46-60% on State and private land (km 8.4-10.5)
Riparian zone:	Overstory - ponderosa pine and oak Understory - willow (chokecherry, serviceberry, oceanspray, bitterbrush) Grazing - poorly developed riparian zone due to heavy grazing on State and private land; understory and grasses heavily browsed

Gate Creek

1. km 0.0 - 7.3

Survey date:	July 18-25
Substrate:	Dominant -gravel and rubble Gravel - 57% 2.5-7.5 cm
Pools:	Numerous small pools Cover - moderate Feature - boulders
Barriers:	1 retention dam, 2 large woody debris dams; may be barriers at low flow
Flow:	Flashy Intermittent; 0.5 cfs (average) Withdrawals - 1 pump
Banks:	Moderately stable Grazing - bank erosion evident on 35% of private land from km 5.5-7.5
Riparian zone:	Overstory - ponderosa pine, oak Understory - willow, dogwood, roses, oak

2. km 7.3 - 8.9

Survey date:	July 25
Substrate:	Dominant - gravel and rubble Gravel - 60% 2.5-7.5 cm
Pools:	Numerous small pools; stream braiding and runs also noted (good rearing areas)
Barriers:	1 large woody debris dam
Flow:	Flashy 0.4 cfs No withdrawals
Banks:	Stable; little grazing noted; 15% erosion
Riparian zone:	Overstory - ponderosa pine, oak Understory - willow, rose, hawthorne

Table 1.1. Reach characteristics of streams in the White River system below the boundary of Mt. Hood National Forest, 1983.

Stream	Reach	Transect km	Pool:Riffle	Gradient (%)	Shade (%)
Tygh Cr.	I	0.8	80:20	0.9	25
		1.6	80:20	0.9	25
		2.4	65:35	1.7	20
		3.2	40:60	1.7	--
		4.0	20:80	1.7	75
		4.8	10:90	1.7	70
		5.6	60:40	1.7	25
		6.4	50:50	1.7	10
		7.2	40:60	1.7	5
		8.0	so:50	1.7	20
		8.9	40:60	2.1	30
	II	9.6	30:70	1.7	30
		10.4	40:60	2.6	--
		11.2	40:60	2.6	30
		12.0	40:60	1.7	40
		12.8	35:65	1.7	40
		13.6	25:75	1.7	40
		15.0	30:70	2.6	40
	III	15.2	25:75	4.4	80
		16.0	30:70	4.4	70
		16.8	20:80	4.4	80
		18.4	30:70	3.5	80
		19.2	40:60	2.6	60
		20.0	30:70	3.5	40
		21.6	45:55	2.6	65
		22.4	35:65	2.6	40
		23.2	40:60	2.6	40
		24.1	30:70	3.1	50
Jordan Cr.	I	0.8	40:60	1.7	60
		1.6	40:60	4.4	60
		2.4	40:60	3.5	30
		3.2	40:60	3.5	40
		3.5	40:60	3.5	30
	II	4.8	30:70	2.6	--
		5.6	25:75	2.6	30
		6.4	40:60	2.6	30
		7.2	40:60	2.6	60
		8.0	40:60	2.6	60
		10.4	50:50	3.5	40
		12.1	40:60	2.6	60

Table 1.1. (continued)

Stream	Reach	Transect km	Pool:Riffle	Gradient (%)	Shade (%)
Pen Cr.	I	0.8	40:60	2.6	40
		1.6	40:60	2.6	60
		2.4	a	1.7	40
		3.2	a	1.7	50
	II	4.0	a	5.2	60
		4.8	30:70 b/	4.4	75
		5.6	30:70 b/	5.2	75
		6.4	20:80 b/	5.2	80
		7.2	10:90	7.0	90
		8.1	a	7.9	
Badger Cr.		0.8	65:35	1.7	45
		1.6	40:60	1.7	20
		2.4	40:60	2.6	20
		3.2	30:70	4.4	60
		4.1	40:60	5.2	40
	II	4.8	10:90	0.9	55
		6.4	15:85	1.0	40
		7.2	15:85	1.7	40
	III	8.0	30:70	1.7	50
		8.8	30:70	1.7	40
		9.7	40:60	2.6	30
Threemile Cr.	I	0.8	60:40	7.0	40
		1.6	so:50	5.2	40
		2.4	60:40	2.6	50
		3.2	70:30	1.7	60
		4.0	80:20	1.7	20
		4.8	20:80	1.7	30
		5.6	30:70	3.1	45
		6.4	40:60	1.7	60
		7.2	85:15	1.7	90
		8.0	60:40	1.7	35
		8.8	55:45	2.1	70
		9.6	40:60	1.7	60
		10.4	60:40	1.7	80
		11.2	70:30	1.6	75
		12.0	60:40	1.6	80
		12.8	60:40	1.7	90
		13.6	so:50	1.7	80
		14.4	60:40	1.7	70
		15.2	90:10 b/	2.6	55

Table 1.1. (continued)

Stream	Reach	Transect km	Pool:Riffle	Gradient (%)	Shade (%>
		16.0	a	3.5	10
		17.6	90:10 b/	3.5	30
		18.4	a	3.5	10
		19.2	a	3.5	15
	II	20.0	20:80	4.4	65
		20.5	20:80	4.4	60
Rock Cr.	I	0.8	a	5.2	45
		1.6	a	--	
		2.4	a	--	
		3.2	a	5.2	20
		4.0	80:20 b/	3.5	
		4.8	a	5.2	
	II	5.6	a	3.5	--
		6.4	80:20 b/	1.7	70
		7.2	80:20 b/	1.7	60
		8.0	70:30 b/	3.5	40
		8.8	80:20 b/	1.7	20
		9.6	90:lO	1.7	50
		10.5	80:20	1.7	50
Gate Cr	I	0.8	so:50	4.4	
		1.6	so:50	4.4	80
		2.4	so:50	2.6	70
		3.2	40:60 b_/	2.6	50
		4.0	60:40 b/	1.7	40
		4.8	60:40 b_/	1.7	40
		5.6	80:20 b/	1.7	20
		6.4	65:35	1.7	15
		7.3	65:35	1.7	35
	II	8.0	70:30	1.7	80
		8.9	60:40	1.7	60

a/ No flow in stream channel.
b/ Intermittent flow.

Table 1.2. Pool characteristics of stream survey transects in 7 streams of the White River system, summer 1983.

Stream	Reach (km)	Transect (km)	Pool Characteristics Length (m)	Width (m)	Area (m2)	Pool:riffle
Tygh Cr.	0.0-8.9	0.8	19.3 a/	6.1 a_/	117.7 a/	80:20
		1.6	--	--	--	80:20
		2.4	10.6	3.7	39.2	65:35
		3.2	15.3 a/	5.0 a/	76.5 a/	40:60
		4.0	12.2 a/	3.9 a/	47.6 a/	20:80
		4.8	7.6	4.6	35.0	10:90
		5.6	22.9 a/	13.7 a/	313.7 a_/	60:40
		6.4	16.2 a_/	6.1	98.8 a/	so:50
		7.2	12.2	6.1	74.4	40:60
		8.0	9.1	3.0	27.3	so:50
		8.9	7.6	1.8	13.7	40:60
	8.9-15.0	9.6	9.1	2.5	22.8	30:70
		10.4	12.2 a/	1.2 a/	14.6 a/	40:60
		11.2	9.1 g/	2.5	22.8	40:60
		12.0	11.4 a/	4.6 a/	52.4 a/	40:60
		12.8	7.6	3.7	28.1	35:65
		13.6	--	--	--	25:75
		15.0	3.0	3.0	9.0	30:70
	15.0-24.1	15.2	--	--	--	25:75
		16.0	4.6	3.0	13.8	30:70
		16.8	3.6 a/	2.1 g/	7.6 a/	20:80
		18.4	4.6	2.5	11.5	30:70
		19.2	--	--	--	40:60
		20.0	6.1	4.6	28.1	30:70
		21.6	4.6	1.8	8.3	45:55
		22.4	4.6	1.8	8.3	35:65
		23.2	4.6	2.5	11.5	40:60
		24.1	4.6	2.5	11.5	30:70
Jordan Cr.	0.0-3.5	0.8	7.6 a/	3.4 a/	25.8 a/	40:60
		1.6	--	--	--	40:60
		2.4	6.1	3.0	18.3	40:60
		3.2	--	--	--	40:60
		3.5	6.1	2.5	15.3	40:60
	3.5-12.1	4.8	--	--	--	30:70
		5.6	6.1	4.6	28.1	25:75
		6.4	--	--	--	40:60
		7.2	4.6	6.4	29.4	40:60
		8.0	2.5	2.7	6.8	40:60
		10.4	2.5	2.5	6.3	50:50
		12.1	6.1	3.0	18.3	40:60

Table 1.2. (continued)

Stream	Reach (km)	Transect (km)	Pool Characteristics Length (m)	Width (m)	Area (m2)	Pool:riffle
Pen Cr.	0.0-3.2	0.8	--	--	--	40:60
		1.6	4.6	1.8	8.3	40:60
		2.4	--	--	--	--
		3.2	--	--	--	--
	3.2-8.1	4.0	--	--	--	--
		4.8	1.2	1.2	1.4	30:70
		5.6	2.5	1.6	4.0	30:70
		6.4	0.9	0.9	0.8	20:80
		7.2	0.3	0.3	0.1	20:80
		8.1	--	--	--	10:90
Badger Cr.	0.0-4.1	0.8	17.2 a/	7.6 a/	130.7 a/	65:35
		1.6	7.6	3.0	22.8	40:60
		2.4	--	--	--	40:60
		3.2	4.3	2.5	10.8	30:70
		4.1	5.8 a/	2.1 a/	12.2 a/	40:60
	4.1-7.2	4.8	3.0	1.8	5.4	20:80
		6.4	--	--	--	15:85
		7.2	3.0	1.6	4.8	15:85
	7.2-9.7	8.0	--	--	--	30:70
		8.8	6.5 a/	4.4 a/	28.6 a/	30:70
		9.7	9.1	3.7	33.7	40:60
Threemile Creek	0.0-19.3	0.8	12.2 a/	4.8 g/	58.6 g/	60:40
		1.4	6.1	3.0	18.3	50:50
		1.6	--	--	--	50:50
		2.4	39.3 a/	4.6 a/	180.8 g/	60:40
		3.2	12.2	4.6	56.1	70:30
		4.0	30.4	2.5	76.0	80:20
		4.8	9.1	3.7	33.7	20:80
		5.6	--	--	--	30:70
		6.4	7.6	1.8	13.7	40:60
		7.2	--	--	--	85:15
		8.0	9.1	1.8	16.4	60:40
		8.8	7.6	2.5	19.0	40:60
		9.6	7.6	2.1	16.0	40:60
		10.4	9.1	3.0	27.3	60:40
		11.2	13.7	6.1	83.6	70:30
		12.0	--	--	--	60:40
		12.8	15.3 a/	4.6 g/	70.4 a/	60:40
		13.6	15.3 -	4.6	70.4	50:50
		14.4	8.4 a/	3.9 a/	32.8 a/	60:40
		15.2	1.6	0.6	1.0	90:10
		16.0	3.0	0.6	1.8	40:60

Table 1.2. (continued)

Stream	Reach (km)	Transect (km)	Pool Characteristics Length (m)	Width (m)	Area (m2)	Pool:riffle
		16.9	--	--	--	--
		17.6	3.0	0.9	2.7	40:60
		18.4	3.4	1.6	5.4	30:70
		19.2	5.5 a/	3.7 a/	20.4 a/	30:70
	19.3-20.5	20.1	4.6	2.5	11.5	20:80
		20.5	5.5	3.0	16.5	20:80
Rock Cr.	0.0-4.8	0.8	15.3 a/	7.1 a/	108.6 a/	--
		1.6	--	--	--	--
		3.2	16.0 a/	6.9 a/	110.4 a/	--
		4.0	6.1 a/	6.1 a/	37.2 a/	80:20
	4.8	--	--	--	--	--
	4.8-10.5	5.6	12.2 a/	3.0 a/	36.6 a/	--
		6.4	12.2	2.5	30.5	80:20
		7.2	--	--	--	80:20
		8.0	6.1	3.0	18.3	70:30
		8.8	12.2	3.0	36.6	60:40
		9.6	22.9	2.1	48.1	90:lO
		10.5	30.4	2.1	63.8	80:20
Gate Cr.	0.0-7.3	0.8	3.0	1.6	4.8	so:50
		1.6	6.1	2.1	14.0	so:50
		2.4	4.6	2.1	9.7	so:50
		3.2	15.2	4.6	69.9	40:60
		4.0	--	--	--	60:40
		4.8	16.7	4.6	76.8	60:40
		5.6	--	--	--	80:20
		6.4	10.7	4.6	49.2	65:35
		7.3	6.1	4.6	28.1	65:35
	7.3-8.9	8.0	10.7	2.5	26.8	70:30
		8.9	13.7	2.5	34.3	60:40

a/ Estimates based on average of major pools in transect.

Table 1.3. Potential migration barriers of seven streams in the White River system, summer 1983.

Stream	Location (km)	Type a/	Dimension (m) Length	Dimension (m) Height	Rating b/	Field Notebook ID number
Tygh Cr.	4.5	Diversion dam	--	0.9	3	18
	7.6	Diversion dam	--	0.8	2	--
	8.7	Beaver dam	12.0	0.8	2	31
	8.9	Diversion dam	14.6	1.5	3	32
	9.7	Retention dam	--	--	1	--
	11.4	Diversion dam	19.8	0.9	1	38
	11.6	Diversion dam	15.2	0.8	2	40
	12.2	Retention dam	5.0	0.5	1	45
	12.4	Retention dam	15.2	0.6	2	46
	12.9	Retention dam	5.0	0.5	2	47
	13.2	Retention dam	--	--	1	48
	14.3	Retention dam	10.7	0.5	1	50
	15.4	Natural sill	3.7	0.9	2	53
	15.6	Diversion dam	4.5	2.1	3	54
	15.8	LWD	1.8	0.9	2	56
	15.9	LWD	3.0	1.2	2	57
	15.9	Boulders	4.6	0.8	2	58
	16.0	LWD	1.5	0.9	2	59
	16.3	LWD	--	--	2	60
	16.3	LWD	4.6	0.9	2	61
	16.3	Boulders-series	--	2.0	2	62
	16.4	LWD-Boulders	2.4	1.8	2	63
	16.4	LWD-Boulders	4.6	1.8	2	64
	17.2	Falls	--	2.4	2	66
	17.9	LWD	3.0	1.2	2	68
	18.2	LWD	4.6	1.5	2	69
	18.3	LWD	3.0	1.2	2	71
	20.1	LWD	6.1	0.9	2	72
	20.1	LWD	7.6	1.2	2	73
	20.2	Falls	--	3.1	3	75
	21.1	LWD	1.2	0.5	1	77
	21.6	LWD	12.2	1.5	2	78
	21.6	LWD	10.7	0.8	2	79
	21.8	LWD	9.1	0.9	1	80
	21.9	LWD	9.1	0.6	2	81
	22.0	LWD	9.1	1.2	2	82
	22.4	LWD	12.2	0.9	2	83
	22.4	LWD	9.1	0.6	2	84
	23.2	LWD	7.6	0.6	2	86
	23.5	LWD	12.2	0.9	2	88
	23.7	LWD	13.7	2.0	2	--

Table 1.3. (continued)

Stream	Location (km)	Type a/	Dimension (m) Length	Dimension (m) Height	Rating b/	Field Notebook ID number
Jordan Cr.	1.4	Falls	--	7.6	3	8
	1.6	Chute	--	4.6	3	10
	3.5	Falls	--	5.2	3	18
	10.3	LWD	18.3	1.5	2	24
	10.6	LWD	22.9	1.2	2	26
	10.9	LWD	13.7	1.8	2	28
Pen Cr.	0.6	LWD	5.5	1.2	2	3
	1.4	LWD	5.5	0.9	2	6
	2.9	Falls	--	0.9	2	7
	3.2	Falls	--	1.2	2	8
	3.5	LWD	3.0	0.9	2	9
	3.5	Natural Sill	3.0	0.8	2	10
	4.3	LWD	6.1	0.8	2	11
	4.3	Natural Sill	4.6	1.1	2	12
	4.3	Natural Sill	3.6	0.5	2	13
	4.5	LWD-Boulders	4.6	0.6	2	14
	4.7	LWD	6.1	1.1	2	15
	4.8	LWD	3.0	0.7	2	16
	5.0	LWD	4.6	0.7	2	17
	5.5	LWD	2.7	0.6	2	18
	5.5	LWD	1.5	0.6	2	19
	5.5	LWD	2.4	0.9	2	20
	5.6	Culvert	--	--	2	21
	5.8	LWD	4.6	1.1	2	22
	5.8	LWD	7.6	0.9	2	23
	5.9	LWD	1.8	0.6	2	24
	5.9	LWD	3.7	0.9	2	25
	6.4	LWD-Boulder	1.8	0.6	2	26
	6.4	LWD	1.8	0.8	2	27
	6.6	LWD	4.6	1.5	2	28
	6.8	LWD-Boulder	3.0	1.1	2	29
	7.0	LWD	9.1	1.1	2	30
	7.1	Boulders	--	--	2	31
	7.2	LWD-Boulder	1.8	0.8	2	32
	7.4	LWD-Boulder	1.8	0.9	2	33
Badger Cr.	1.8	Diversion dam	--	0.9	3	10
	2.1	Diversion dam	13.7	0.9	3	12
	7.1	Diversion dam	13.7	0.8	3	25
Threemile Cr.	Mouth	Falls-Chute	--	1.8	3	1
	0.2	Falls-Series	--	0.9	3	2
	0.5	Falls	--	1.2	3	7

Table 1.3. (continued)

Stream	Location (km)	Type a/	Dimension (m) Length	Dimension (m) Height	Rating b/	Field Notebook ID number
	0.6	Falls	--	1.2	3	9
	0.6	Falls	--	0.9	3	10
	1.1	Boulders-Series	--	4.6 c/	2	13
	13.0	Beaver dam	--	--	1	34
	14.3	Culvert	--	--	1	36
	19.2	Divers ion dam	--	0.6	2	37
	19.3	LWD	9.1	1.5	2	38
	20.0	Diversion dam	--	0.6	2	39
Gate Cr.	3.1	Retention dam	--	--	2	4
	6.6	LWD	--	--	2	9
	7.2	LWD	--	--	2	10
	8.0	LWD	--	--	2	
Rock Cr.	5.8	Culvert	--	--	1	16

a/ LWD-large woody debris dam.
b/ l-passable at all flows.
2-singularly may be a barrier at low flow or cumulative effect with other barriers may make it a barrier at all flows.
3-man-made structures that are barriers at low flow or natural features that are barriers at all flows.
c/ Total height of several boulder chutes.

Table 1.4. Total spawning gravel for anadromous fish by stream reach in seven streams in the White River drainage, 1983.

Stream, reach (km)	Spawning gravel (m2)	
	Good	Marginal
Tygh Creek		
0.0- 8.9	1,742	1,571
8.9-15.0	508	296
15.0-24.1	216	199
Jordan Creek		
o.o- 3.5	76	140
3.5-12.1	195	185
Pen Creek		
0.0- 3.2	113	149
3.2- 8.1	43	39
Badger Creek		
o.o- 4.1	550	392
4.1- 7.2	36	286
7.2- 9.7	65	92
Threemile Creek		
0.0-19.3	390	349
19.3-20.5	56	34
Rock Creek		
0.0- 4.8	60	90
4.8-10.5	95	64
Gate Creek		
o.o- 7.3	LO2	104
7.3- 8.9	59	29

Table 1.5. Substrate composition (%) of riffles in seven streams surveyed in the White River system, 1983.

Stream, location (km)	Particle size (cm)							
	Bedrock	>90	30-90	15-30.5	7.5-15	2.5-7.5	0.25-2.5	<0.25
Tygh Creek								
0.0- 8.9	0	0	2	40	38	12	8	0
8.9-15.0	0	0	3	37	41	14	5	0
15.0-24.1	1	3	16	38	20	15	6	1
Jordan Creek								
0.0- 3.5	19	19	24	16	10.5	10.5	1	0
3.5-12.1	19	7	16	35	6.5	6.5	4	6
Pen Creek								
0.0- 3.2	0	0	9	41	7	43	0	0
3.2- 8.1	1	3	17	32	8	34	5	0
Badger Creek								
0.0- 4.1	0	5	18	40	26	4	7	0
4.1- 7.2	2	5	23	50	14	4	2	0
7.2- 9.7	0	5	35	35	16	4	5	0
Threemile Creek								
0.0-19.3	5	6	12	26	12	20	6	13
19.3-20.5	0	0	15	50	6	24	2.5	2.5
Rock Creek								
0.0- 4.8	0	35	20	10	2	8	5	20
4.8-10.5	0	4	14	6	7	14	25	30
Gate Creek								
0.0- 7.3	7	16	20	23	11	14	6	3
7.3- 8.9	0	0	5	30	18	27	20	0

Table 1.6. Water withdrawals from seven streams surveyed in the White River system, 1983.

Stream, location (km)	Type	Water withdrawal (cfs) a/	Pump size (HP) b/
Tygh Creek			
2.1	Pump	0.1	1.5
4.5	Ditch	2.0	15-30
4.5	Pump	0.8-1.6 c/	
7.6	Ditch	3.3	--
9.3	Ditch	4.5	--
9.7	pump	0.8	15.0
11.4	pump	0.8	15.0
11.6	Ditch	1.5	--
12.2	pump	0.1	3.0
12.4	pump	0.3	7.5
12.9	pump	0.8	15.0
13.2	pump	0.2	5.0
14.3	pump	0.1	1.5
15.6	Ditch	1.5	1.5
Badger Creek			
1.8	Ditch	6.0	--
2.1	Ditch	2.0	--
2.4	pump	0.1	1.5
7.1	Ditch	5.0	--
Threemile Creek			
19.2	Ditch	2.5	--
20.0	Ditch	1.5	--
Gate Creek			
3.1	pump	--	--

a/ Approximate discharge rates for pumps based on type and head.
b/ HP = horsepower.
c/ Estimated discharge for pump of unknown size. Pump to main irrigation line estimated at 15-30 HP.

Table 1.7. Inventory of irrigation diversions in the White River watershed that require screens. a/

Stream, ditch system or user	Location (km)	Drum size (inches) length	Drum size (inches) diameter	Estimated costs, 1984
White River				
Ashley	9.0	96	24	$ 3,416
Tygh Creek				
Lindell	4.5	96	24	3,416
Lindell	7.7	48	18	2,320
Highline	9.3	60	18	2,385
Hauser	11.7	60	18	2,385
ODFW	15.7	24	14	1,980
ODFW	24.3	36	14	2,045
Badger Creek				
Highline	1.8	48	18	2,320
Thompson	2.1	48	18	2,320
Harvey	7.0	96	24	3,416
Highland	24.5	96	24	3,416 b/
Threemile Creek				
Threemile	19.2	60	18	2,385 b/
Round Prairie	20.0	60	18	2,385
Gate Creek				
Rock Creek Reservoir	13.8	60	18	2,385 b/
Boulder Creek				
Lost-Boulder	5.0	96	24	3,416
Forest Creek				
Lost-Boulder c/	2.6	60	18	2,385 b/
Clear Creek				
Clear	12.5	(2) 96	30	10,894 d/
Frog Creek				
Clear c/	7.4	96	30	4,697 b/
Total				$57,966

a/ Costs are for materials and ODFW labor; costs would probably be higher if built by a private contractor.
b/ May require additional costs because of difficult access.
c/ May not require screening because ditch is directly connected to adjacent stream and water is not withdrawn between streams.
d/ Includes additional construction costs because of difficult access and size of project.

Table 1.8. Annual cost for operation of irrigation diversion screens in the White River watershed.

Type	Cost, 1984
1. Labor	
(Technician 1 - 6 months)	$ 6,900
2. Labor overhead	$ 2,415
3. Service and supply	
Maintenance equipment	$ 500
Transportation	$ 2,080
4. Direct costs (1, 2, 3)	$11,895
5. Indirect costs (0.215 of 4)	$ 2,557
6. Total cost (4, 5)	$14,452

KAnderson:crw (WP-PJS-5404N)

Table 1.9 Reach summary of seven tributary streams in the White River system, March 1984.

Stream	Reach a/ (km)	Pool:riffle	Stream width (m)	Flow (cfs)	Bank stability (% erosion)	Spawning gravel (m^2) Good	Spawning gravel (m^2) Marginal	Gravel composition (%) <2.5 cm	Gravel composition (%) 2.5-7.6 cm	Gravel composition (%) 7.7-15.2 cm
Tygh	0.0- 8.9	58:42	12.2	179	13	345	338	13	59	28
	8.9-15.0	36:64	7.8	87	19	87	148	11	60	29
	15.0-24.1	36:64	3.9	36	8	145	185	13	52	35
Jordan	0.0- 3.5	40:60	5.5	48	13	53	53	10	70	20
	3.5-12.1	44:56	5.8	58	19	153	152	13	68	19
Pen	0.0- 3.2	38:62	2.8	16	15	11	25	15	50	35
	3.2- 8.1	No survey								
Badger	0.0- 4.1	50:50	9.0	142	5	140	110	10	65	25
	4.1- 7.2	30:70	8.5	139	5	15	50	7	65	28
	7.2- 9.7	33:67	9.5	165	13	50	66	10	65	25
Threemile	0.0-19.3	51:49	3.7	24	19	362	362	14	61	25
	19.3-20.5	40:60	3.0	39	5	58	45	15	45	40
Rock	0.0- 4.8	48:52	7.0	70	7	27	31	20	67	13
	4.8-10.5	50:50	4.3	51	25	20	28	23	47	30
Gate	0.0- 7.3	51:49	4.9	81	23	58	81	15	58	27
	7.3- 8.9	65:35	5.5	72	40	33	41	17	60	23

a/ Summer 1983 reach designations - summer and winter transects overlap between some reaches.

Table 1.10. Transect summary of 1.6 km sections of seven tributary streams in the White River system, March 1984.

Stream	Reach (km)	Transect (km)	Pool:riffle	Stream width (m)	Flow (cfs)	Bank stability (% erosion)	Spawning gravel (m^2) Good	Spawning gravel (m^2) Marginal	Gravel composition (%) <2.5 cm	Gravel composition (%) 2.5-7.6 cm	Gravel composition (%) 7.7-15.2 cm
Tyoh	0.0- 8.9	1.6	80:20		142	15	16		20	20	60
		3.2	50:50		166	20	121	96	10	60	30
		4.8	60:40		203			19	10	60	30
		6.4	60:40	10	127	20	24	45	10	70	20
	below Badger-	7.6	50:50	15	336	10	149	150	10	70	20
	above Badger-	8.0	50:50		102		28	22	20	70	10
	8.9-15.0	9.6	30:70	8	90	12	22	61	15	50	35
		11.2	60:40		76	40	39	46	10	60	30
		13.2	25:75		81	20	20	29	10	60	30
		14.5	25:75		99	15		5	10	60	30
		15.0	40:60		88	10		7	10	70	20
	15.0-24.1	16.1	30:70		23		5		20	70	10
		17.7	30:70	3.5	44	5	13	27	10	50	40
		19.3	40:60		42	15	24	37	10	60	30
		20.9	50:50	3.5	19		34	22	10	40	50
		21.7	40:60		48	10		31	15	35	50
		24.1	25:75	4.5	40	10	52	61	15	55	30
Jordan	0.0- 3.5	1.6	40:60		55	20	39	33	10	70	20
		3.2	40:60	5	40	5	14	20	10	70	20
	3.5-12.1	4.8	40:60	5	41	30	13	28	15	60	25
		6.4	40:60		72	40	8	19	10	60	30
		8.0	40:60		77	15	12	13	10	60	30
		9.6	50:50		38	5	67	44	10	80	10
		12.1	50:50	5	60	5	53	48	10	80	10
Pen	0.0- 3.2	1.6	45:55	2.5	19	10		16	10	50	40
		3.2	30:70			20			20	50	30
	3.2- 8.1		No survey; limited potential in this reach								
Badger	0.0- 4.1	1.6	50:50	9	114	5	98	77	10	60	30
		3.2	50:50	9	170	5	42		10	70	20
	4.1- 7.2	4.8	40:60	8	145	5	10	24	5	70	25
		6.4	20:80	9	133	5		26	10	60	30
		8.0	25:75	10	156	5	12	22	10	60	30
	7.2- 9.7	9.7	40:60	9	173	20	38	44	10	70	20

Table 1.10. (continued)

Stream	Reach (km)	Transect (km)	Pool;riffle	Stream width (m)	Flow (cfs)	Bank stability (% erosion)	Spawning gravel (m^2) Good	Spawning gravel (m^2) Marginal	Gravel composition (%) <2.5 cm	Gravel composition (%) 2.5-7.6 cm	Gravel composition (%) 7.7-15.2 cm
Threemile	0.0-19.3	1.6	50:50	4		0	0	0		--	
		3.2	70:30	4	22	10	34	22	20	70	10
		4.8	60:40	5	28	10	25	23	20	70	10
		6.4	50:50		28	20	76	37	20	60	20
		8.0	40:60		17	25	44	35	10	70	20
		9.6	50:50		20	20	57	45	10	70	20
		11.2	40:60		25	40	21	30	10	60	30
		12.8	60:40		20	10	10	21	20	60	20
		14.4	70:30		17		7	13	10	60	30
		16.0	30:70	3	24	40	33	50	10	50	40
		17.6	40:60	3	22	20	21	39	10	50	40
		19.3	50:50	2.5	26	30	34	47	10	50	40
	19.3-20.5	20.5	40:60		39		58	45	15	45	40
Rock	0.0- 4.8	1.6	35:65		105	5	2		20	80	0
		3.2	50:50	8	a/	7	6	8	20	60	20
	above Gate-	4.8	60:40	6	34	10	19	16	20	60	20
	4.8-10.5	6.4	40:60	5	76	10	15	13	30	60	10
		8.0	50:50		40	20	2	8	20	50	30
		10.5	60:40		37	45			20	30	50
Gate	0.0- 7.3	1.6	35:65		70	10	6	9	10	50	40
		3.2	65:35	5	94	7.5	16	11	10	50	40
		4.8	50:50	4	112	15	5	14	20	70	10
		6.4	55:45	4.5	49	60	31	47	20	60	20
	7.3- 8.9	8.0	60:40	5	a/	40	10	12	15	60	25
		8.9	70:30		72	40	10	12	20	60	20

a/ Flow not estimated due to channel morphology or braided channel.

Table 1.11. Barriers and diversions of seven tributary streams in the White River system during Sumner 1983 and winter 1984.

Stream	km	Type	Height (m)	Winter condition	Upstream passage Sumner	Upstream passage Winter	Ditch screening Sumner	Ditch screening Winter
Tygh	4.5	Diversion dam	0.9	Removed	No	Yes	Yes	No
	7.6	Diversion dam	0.8	Removed	No	Yes	Yes	No
	8.9	Diversion dam	1.5	Removed	No	Yes	Yes	No
	11.6	Diversion dam	0.8	Removed	No	Yes	Yes	No
	15.6	Diversion dam	2.1	Intact	Possible	Yes	Yes	Yes
	20.2	Falls	3.1	--	No	No		
Jordan	1.4	Falls	7.6		No	No		--
	3.5	Falls	5.2	-	No	No	--	--
Badger	1.8	Diversion dam	0.9	Removed	No	Yes	Yes	No
	2.1	Diversion dam	0.9	Removed	No	Yes	Yes	No
	7.1	Diversion dam	0.8	Removed	No	Yes	Yes	No
Threemile	0.0-1.1	Falls/Chutes	0.9-1.2	--	No	Possible	--	
	19.2	Diversion dam	0.6	Removed	No	Yes	Yes	Yes
	20.0	Diversion dam	0.6	Removed	No	Yes	Yes	Yes

Table 1.12. Spawning gravel in seven streams of the White River system surveyed in summer 1983 and winter 1984.

	Spawning gravel (m^2)			
	Good		Marginal	
Stream	Summer	Winter	Summer	Winter
Tygh	2,466	577	2,066	671
Jordan	271	206	325	205
Pen a/	113	11	149	25
Badger	651	205	770	226
Threemile	446	420	383	407
Rock	155	47	154	59
Gate	161	91	133	122
Total	4,263	1,557	3,980	1,715

a/ First reach only (km 0.0-3.2)

Table 1.13. Discharge a/ for White River (5-day averages) measured at the USGS flow station below White River Falls (km 3.2).

	1983												1984											
Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1- 5	616	580	1,216	1,324	600	467	242	150	157	127	176	251	1,291	713	528	666	498	557	312	153	128	127	587	372
6-10	2,886	566	1,438	856	581	364	201	145	140	122	222	274	1,162	580	499	590	436	564	261	145	162	128	395	328
11-15	1,288	1,013	1,786	640	467	315	197	138	141	121	216	594	627	957	654	575	568	483	227	140	131	162	663	375
16-20	862	1,910	1,196	577	473	284	187	132	132	127	334	421	411	901	808	623	507	422	192	142	128	156	465	310
21-25	677	1,806	876	662	582	227	168	124	129	134	313	252 b/	814	700	1,019	549	535	427	171	136	138	159	381	
26-end of month	743	1,477	1,221	602	599	213	157	154	127	135	332	404 b/	1,175	577	867	459	634	382	161	133	130	231	415	

a/ Discharge in cubic feet per second.

b/ 22-31 December 1983, readings were probably affected by ice on control or frozen float.

Table 1.14. Flows at permanent stations in upper White River and selected tributaries and at the USGS gauging station in lower White River.

Year, date	White River (km 59.0)	Tygh Creek (km 1.3)	Clear Creek (km 6.0)	Boulder Creek (km 3.5)	White River (km 3.2)
1983:					
26-28 July	82.4	11.3	23.9	1.5	161.0
8-10 August	79.7	6.3	21.1	2.4	144.0
15-17 August	--	--	--	2.4	134.0
6- 8 September	62.1	6.3	21.1	1.5	139.0
12-14 September	62.1	7.6	19.9	1.5	139.0
14-16 October	52.6	10.5	19.9	1.8	122.0
16-18 November	112.3	81.6	31.2	20.8	328.0
29 November-1 December	119.2	54.1	32.6	14.7	308.0
7- 9 December	--	47.5	--	--	241.0
16-18 December	--	140.3	--	--	471.0
20-22 December	--	81.6	--	--	276.0
1984:					
31 January	--	168.6	--	--	885.0
22-24 February	--	175.6	--	--	687.0
28-29 February	144.5	134.6	--	--	558.0
6 March	--	104.2	--	--	482.0
21 March	355.1	239.8	--	--	1,090.0
30 March	216.6	--	--	--	779.0
6 April	--	115.9	--	--	612.0
2- 7 May	203.9	76.0	73.1	--	482.0
29 May	362.8	115.9	39.1	69.5	620.0
5 June	--	104.2	--	56.9	595.0
18 June	--	64.1	29.8	38.9	415.0
25 June	177.8	60.0	30.7	37.5	403.0
3 July	135.1	42.4	--	14.5	310.0
11-12 July	131.6	25.3	28.8	9.1	234.0
18 July	112.8	14.3	28.3	10.3	198.0
25 July	115.1	9.4	30.7	3.0	167.0
1 August	110.6	7.4	25.4	2.1	161.0
8 August	91.4	5.7	20.9	1.8	141.0
15 August	65.3	3.5	20.2	2.0	137.0
22 August	76.4	4.3	23.6	1.8	136.0
30 August	77.9	4.2	22.3	1.5	130.0
6 September	96.4	5.9	24.1	2.5	153.0
13 September	62.7	4.4	17.5	1.9	131.0
19 September	69.6	3.2	19.5	--	127.0
26 September	62.8	5.8	20.0	1.3	134.0
3 October	51.0	7.8	19.0	1.3	129.0

Table 1.15. Monthly water temperatures in the White River basin, 1983 and 1984.

Location	Date	Mean temperature (°C) Monthly	Min.	Max.	Range ("C) Minimum	Maximum
White River - Barlow Crossing km 59.0	Jul 1983 a/	10.2	8.1	12.8	7.2-9.2	9.7-15.0
	Aug 1983	10.3	8.2	12.6	6.3-10.0	10.0-16.0
	Sep 1983	7.5	5.1	10.6	1.5-8.1	7.1-13.7
	Ott 1983	5.4	3.6	7.4	1.2-6.4	5.9-9.8
	Nov 1983	3.1	2.4	3.7	0.7-5.8	1.1-7.1
	Dee 1983 b/	0.9	0.5	1.3	0.0-1.6	0.0-2.5
	Jan 1984 a/	0.5	0.3	0.8	0.0-1.0	0.0-1.8
	Feb 1984	0.8	0.3	1.4	0.0-1.1	0.4-2.4
	Mar 1984	3.5	2.7	4.6	1.6-3.4	3.2-5.7
	Apr 1984	3.4	2.2	5.0	0.9-3.1	2.3-7.7
	May 1984 b/	4.3	3.0	6.1	2.0-3.9	4.5-8.0
	Jun 1984 c/	6.7	4.7	9.2	4.0-6.5	5.5-13.0
	Jul 1984 -	10.3	7.2	15.0	5.5-9.0	13.0-18.0
	Aug 1984	10.1	7.8	13.0	6.3-9.6	9.5-16.3
	Sep 1984	8.0	7.0	9.1	6.0-9.0	6.5-12.0
	Ott 1984	5.2	4.6	5.8	1.7-7.3	3.0-8.4
	Nov 1984	2.6	2.1	3.1	0.5-3.6	1.5-4.3
White River - Below Falls (Powerhouse) km 3.2	Jul 1983 a/	14.9	12.9	17.1	11.7-15.0	15.0-19.2
	Aug 1983	14.3	12.8	16.0	11.1-15.0	13.1-18.9
	Sep 1983 a/	9.5	8.2	10.9	4.7-10.8	8.6-13.1
	Ott 1983	7.9	7.0	8.9	4.7-9.4	6.1-13.1
	Nov 1983	5.1	4.7	5.6	2.5-7.6	3.6-8.6
	Dee 1983	2.4	2.2	2.7	0.6-3.6	1.4-3.9
	Jan 1984	1.8	1.5	2.2	0.0-3.6	0.0-3.9
	Feb 1984	3.9	3.6	4.2	2.5-4.4	3.5-5.0
	Mar 1984	5.7	5.3	6.1	2.5-6.2	4.8-8.8
	Apr 1984	7.5	6.7	8.5	5.3-8.8	6.8-11.8
	May 1984	9.7	8.8	10.6	7.2-12.0	8.2-15.0
	Jun 1984	12.3	10.7	13.9	8.0-14.5	10.0-18.5
	Jul 1984	16.6	14.1	19.3	12,0-16.5	17.0-22.0
	Aug 1984	16.4	14.3	19.2	12.2-17.0	16.8-22.0
	Sep 1984	12.3	10.8	14.1	6.7-14.0	10.0-17.5
	Ott 1984	7.9	7.1	8.8	4.5-10.7	5.3-13.0
	Nov 1984	4.2	3.9	4.5	2.2-5.2	2.9-6.1

Table 1.15. (continued)

Location	Date	Mean temperature (°C) Monthly	Min.	Max.	Range (°C) Minimum	Maximum
Tygh Creek - Lower (Highway 197) km 1.3	Aug 1983 a/	19.3	14.8	24.4	11.7-18.9	20.8-28.3
	Sep 1983 d/	14.3	11.0	18.7	8.3-12.8	16.1-20.8
	Ott 1983	11.2	9.9	12.7	7.7-13.1	9.4-17.0
	Nov 1983	7.2	6.5	7.9	3.3-9.4	4.7-11.1
	Dee 1983	2.9	2.5	3.4	0.6-3.9	0.8-4.4
	Jan 1984 d/	2.2	1.6	3.1	0.0-3.6	0.6-4.4
	Feb 1984	3.9	2.9	5.1	2.0-4.0	3. 3-6. 7
	Mar 1984	5.8	4.1	8.1	2.0-5.8	5.6-10.6
	Apr 1984	8.2	5.6	11.6	3.0-8.1	5.6-15.8
	May 1984	10.0	7.4	13.1	5.0-11.4	9.2-18.6
	Jun 1984	13.7	10.6	17.3	6.1-15.3	11.1-23.1
	Jul 1984	19.1	15.6	23.1	11.1-19.4	19.4-27.8
	Aug 1984	19.8	15.0	24.7	11.6-18.9	20.6-27.7
	Sep 1984	14.2	10.8	18.3	6.1-15.5	12.8-23.3
	Ott 1984	8.9	7.3	10.8	3.9-10.5	7.2-16.1
	Nov 1984	4.6	3.9	5.4	1.7-6.1	3.1-7.2
Tygh Creek Upper km 25.4 (North-South Rd)	Jul 1984	12.0	11.0	13.1	9.5-13.0	11.5-l)+. 7
	Aug 1984	12.9	12.0	13.6	10.7-13.9	12.2-15.4
	Sep 1984	10.0	9.4	10.6	6.8-11.5	7.8-12.8
Badger Creek (Bonney Crossing) km 18.6	Jul 1984	13.6	12.0	15.1	10.3-14.1	12.5-17.5
	Aug 1984	13.7	12.5	14.7	10.5-14.7	12.5-16.8
	Sep 1984	10.4	9.8	11.1	7.2-12.0	7.9-13.5
Threemile Creek (FS Rd 4811) km 19.3	Jul 1984	12.3	9.3	16.3	7.5-11.5	12.7-19.4
	Aug 1984	13.4	9.9	18.1	8.0-11.8	16.5-20.0
	Sep 1984	10.3	7.8	13.8	4.9-11.0	8.4-17.2
Rock Creek (above reservoir) km 14.9	Jul 1984 c/	18.8	13.2	25.4	11.5-16.8	22.8-28.6
	Aug 1984	18.2	13.9	23.3	10.6-17.0	21.0-25.8
	Sep 1984	14.1	10.7	18.2	7.0-15.1	12.5-22.0
Gate Creek (FS Rd 48) km 10.0	Jul 1984 a/	16.8	14.1	19.6	11.6-16.9	17.8-21.7
	Aug 1984	16.5	14.4	18.8	11.9-17.6	16.0-22.0
	Sep 1984 d/	11.3	9.9	12.8	5.8-13.7	8.6-17.1

Table 1.15. (continued)

Location	Date	Mean temperature ("C) Monthly	Min.	Max.	Range ("C) Minimum	Maximum
Clear Creek	Jul 1984 a/	10.1	8.6	12.0	7.5-9.4	11.0-12.8
(campground)	Aug 1984	9.8	8.7	11.3	7.3-9.9	10.0-12.7
km 6.2	Sep 1984	8.2	7.4	9.0	5.4-9.0	7.0-10.8
Barlow Creek	Jul 1984 a/	10.0	8.6	11.4	7.3-10.3	10.0-15.1
(FS Rd 43-221)	Aug 1984	10.4	9.3	11.3	7.5-10.9	10.1-13.9
km 5.0	Sep 1984	8.8	8.1	9.4	6.4-9.6	8.0-10.4

a/ Data are for last part of month.
b/ Data are for first part of month.
c/ Data are for middle part of month.
d/ Incomplete data throughout month.

Table 1.16. Weekly water temperatures in the White River basin, 1983 and 1984.

Locat ion	Year	Date	Mean temp. (“C) Weekly	Min.	Max.	Range (“C) Minimum	Maximum
White River - Barlow Crossing km 59.0	1983	22-28 Jul	10.0	8.1	12.2	7.8-8.6	9.7-14.2
		29 Jul-4 Aug	10.9	8.0	14.2	7.2-9.2	13.6-15.0
		5-11 Aug	10.5	8.5	12.8	7.2-10.0	11.7-14.4
		12-18 Aug	10.2	8.2	12.3	6.7-9.4	11.1-14.2
		19-25 Aug	10.1	8.4	12.4	6.3-9.2	10.0-16.0
		26 Aug-l Sep	9.8	8.0	12.0	7.5-8.7	10.2-14.7
		2-8 Sep	8.6	6.2	11.7	4.9-7.5	9.5-13.7
		9-15 Sep	8.6	5.9	12.0	4.9-7.4	10.0-13.4
		16-22 Sep	6.4	3.9	9.4	2.7-5.7	7.9-11.7
		23-30 Sep	6.5	4.1	9.5	1.5-6.5	7.1-12.1
		l-7 Ott	5.7	3.1	8.6	1.2-4.7	7.3-9.8
		8-14 Ott	5.5	3.8	7.5	2.9-5.0	6.4-9.2
		15-21 Ott	4.8	3.1	6.7	1.7-4.6	6.4-7.6
		22-28 Ott	5.0	3.6	6.7	1.8-5.2	5.9-7.1
		29 Ott-4 Nov	6.0	5.1	6.9	3.7-6.4	6.2-7.6
		5-11 Nov	3.7	2.9	4.3	2.1-3.7	3.7-4.9
		12-18 Nov	3.2	2.5	3.8	1.4-3.4	3.0-4.9
		19-25 Nov	1.8	1.2	2.4	0.7-2.0	2.0-3.2
		26 Nov-2 Dee	1.6	1.2	1.9	0.6-2.2	1.1-2.8
		3-9 Dee	0.8	0.5	1.1	0.0-1.2	0.1-2.0
		lo-16 Dee	1.5	0.9	2.0	0.0-1.6	1.6-2.5
		17-21 Dee	0.2	0.0	0.4	0.0	0.0-0.7
		23-31 Dee a/	--	--	--	--	--
	1984	l-15 Jan a/	--	--	--	--	--
		16-21 Jan	0.0	0.0	0.1	0.0	0.0-o-3
		22-28 Jan	0.8	0.5	1.1	0.0-1.0	0.5-1.8
		29 Jan-4 Feb	0.9	0.4	1.6	0.0-0.7	1.4-1.8
		5-11 Feb	1.1	0.6	1.7	0.0-l .0	0.8-2.4
		12-18 Feb	0.7	0.1	1.3	0.0-0.6	0.8-1.6
		19-25 Feb	0.6	0.2	1.0	0.0-1.1	0.4-1.4
		26 Feb-3 Mar b/	2.4	1.6	3.5	0.0-3.0	1.3-4.7
		4-10 Mar	3.6	2.5	5.2	1.6-3.2	4.5-5.7
		11-17 Mar	3.5	2.8	4.4	2.4-3.2	3.8-5.0
		18-24 Mar	3.5	2.8	4.3	2.2-3.4	3.2-4.8
		25-31 Mar	3.4	2.6	4.6	2.4-3.0	3.4-5.6
		l-7 Apr	3.3	2.4	4.6	1.8-2.8	3.8-5.2
		8-14 Apr	2.8	1.6	4.4	0.9-2.2	2.3-7.7
		15-21 Apr	3.9	2.7	5.6	2.2-3.1	4.8-6.3
		22-28 Apr	3.4	2.0	5.3	1.2-2.8	3.7-7.6
		29 Apr-5 May	3.7	2.5	5.3	2.0-3.2	4.5-5.8
		6-12 May	4.6	3.1	6.7	2.1-3.7	5.1-8.0
		13-14 May	4.7	3.7	6.3	3.4-3.9	5.5-7.0
		15 May-5 Jun a/	--	--	--	--	--

Table 1.16. (continued)

Location	Year	Date	Mean temp Weekly	Mean temp Min.	Mean temp Max.	Range (°C) Minimum	Range (°C) Maximum-
White River - Barlow Crossing km 59.0	1984	6-9 Jun	5.1	4.4	6.4	4.2-4.5	5.5-7.5
		lo-16 Jun	6.6	4.4	9.3	4.0-4.5	7.5-11.0
		17-24 Jun	7.6	5.2	10.5	4.5-7.5	6.0-13.0
		2 Jun-3 Jul a/	--	--	--	--	--
		4-7 Jul	9.4	6.4	13.9	5.5-7.5	13.0-15.0
		8-14 Jul	9.4	6.5	14.0	6.0-7.0	13.0-15.0
		15-21 Jul	10.5	7.4	15.4	6.0-9.0	14.0-17.0
		22-28 Jul	11.0	7.9	15.6	7.0-9.0	14.0-18.0
		29 Jul-4 Aug	11.6	8.5	15.8	7.5-9.6	14.6-17.0
		5-11 Aug	10.2	8.0	12.9	7.5-8.6	11.4-15.7
		12-18 Aug	10.7	7.4	14.8	6.5-8.3	12.7-16.2
		19-25 Aug	9.5	7.3	12.0	6.3-8.4	9.7-14.8
		26 Aug-l Sep	9.0	8.0	10.3	7.0-8.4	9.5-10.8
		2-8 Sep	8.9	7.5	10.4	6.5-9.0	9.0-11.0
		9-15 Sep	8.1	6.6	9.7	6.0-7.5	8.5-12.0
		16-22 Sep	8.5	7.5	9.5	6.3-8.5	7.5-12.0
		23-30 Sep	6.8	6.4	7.1	6.0-7.0	6.5-7.5
		l-7 Ott	7.4	6.8	8.0	6.5-7.2	7.6-8.4
		8-14 Ott	6.5	6.0	7.1	2.9-7.3	4.4-8.4
		15-21 Ott	4.0	3.4	4.7	2.6-4.2	4.2-5.7
		22-28 Ott	3.7	3.0	4.5	1.7-4.3	3.0-5.7
		29-Oc t-4 Nov	3.0	2.5	3.6	1.8-3.2	3.3-4.3
		5-11 Nov	3.2	2.4	3.7	0.5-3.6	2.7-4.3
		12-18 Nov	2.9	2.6	3.4	2.4-3.0	3.1-3.6
		19-25 Nov	2.3	1.9	2.8	1.2-2.7	2.4-3.6
		26 Nov-2 Dee	1.3	0.9	1.8	0.5-1.1	1.5-2.2
		3-9 Dee	1.3	0.8	1.7	0.2-2.0	0.8-2.7
White River - Below Falls (Powerhouse) km 3.2	1983	22-28 Jul	14.8	12.9	16.8	12.2-13.9	15.0-19.2
		29 Jul-4 Aug	15.8	13.7	18.0	12.0-15.0	17.0-18.9
		5-11 Aug	15.4	13.8	17.1	13.3-14.7	15.8-18.3
		12-18 Aug	14.4	12.5	16.4	12.0-13.9	15.6-17.5
		19-25 Aug	13.2	11.8	14.6	11.1-12.8	14.2-15.3
		31 Aug-8 Sep a/	--	--	--	--	--
		9-15 Sep b/	11.3	10.0	12.6	9.4-10.8	11.1-13.1
		16-22 Sep	8.8	7.7	9.9	6.4-9.4	8.6-11.7
		23-30 Sep b/	8.8	7.1	10.5	4.7-8.3	9.4-11.1
		l-7 Ott	9.8	8.6	11.3	7.8-9.4	9.7-13.1
		8-14 Ott	8.9	7.9	9.7	6.1-9.4	7.8-11.4
		15-21 Ott	6.8	5.9	7.6	5.0-6.4	6.4-8.1
		22-28 Ott	6.4	5.7	7.2	4.7-7.7	6.1-7.8
		29 Ott-4 Nov	7.8	7.3	8.3	6.1-8.1	7.8-8.9
		5-11 Nov b_/	5.7	5.3	6.5	4.7-5.6	5.8-6.7
		12-18 Nov	5.3	4.8	5.9	4.4-5.3	5.6-6.4

Table 1.16. (continued)

Location	Year	Date	Mean temp. (°C) Weekly Min.	-Max.		Range (°C) Minimum	Maximum
White River - Below Falls (Powerhouse > km 3.2	1983	19-25 Aug	3.9	3.5	4.2	2.8-4.4	3.9-4.7
		26 Nov-2 Dee b/	3.3	2.9	3.7	2.5-3.6	2.8-4.7
		3-9 Dee	2.4	2.2	2.8	1.7-2.5	2.2-3.3
		LO-16 Dee	3.4	3.1	3.6	2.5-3.6	3.3-3.9
		17-23 Dee	2.1	2.0	2.2	1.4-2.8	1.4-2.8
		24-28 Dee	1.4	1.2	1.6	0.6-1.4	1.4-1.7
		29-31 Dee a/	--	--	--	--	--
	1984	l-3 Jan a_/	--	--	--	--	--
		4-7 Jan	2.4	1.9	2.9	1.1-2.2	2.0-3.3
		8-14 Jan	2.5	2.1	2.9	0.3-3.1	2.0-3.6
		15-21 Jan	0.0	0.0	0.1	0.0	0.0-0.3
		22-28 Jan	2.0	1.6	2.6	0.0-2.5	1.7-3.6
		29 Jan-4 Feb	3.2	3.0	3.6	1.7-3.6	2.0-3.6
		5-11 Feb	4.1	3.9	4.3	3.6-4.2	3.9-4.7
		12-18 Feb	4.1	3.9	4.4	3.1-4.4	3.5-5.0
		19-25 Feb	3.8	3.4	4.2	3.0-3.8	3.6-5.0
		26 Feb-3 Mar	4.1	3.6	4.7	2.5-4.5	3.5-5.8
		4-10 Mar	5.0	3.9	6.3	2.5-6.0	4.8-8.8
		11-17 Mar	6.0	5.8	6.2	5.0-6.2	6.0-6.2
		18-24 Mar	6.2	6.2	6.2	6.0-6.2	6.2-6.3
		25-31 Mar	6.1	6.0	6.2	5.8-6.2	6.0-6.7
		l-7 Apr b/	6.9	6.5	7.3	6.2-6.7	7.0-7.6
		15-21 Apr	8.5	7.4	9.9	6.2-8.8	9.0-11.0
		22-28 Apr b/	7.7	6.7	8.8	5.3-7.8	7.2-11.8
		29 Apr-5 May	8.1	7.9	8.4	7.1-8.5	7.3-8.9
		6-12 May	9.4	8.9	LO.2	8.0-9.8	8.5-11.9
		13-19 May	9.6	8.8	10.3	7.2-10.0	9.3-11.8
		20-26 May	9.6	8.6	10.9	8.0-9.8	9.8-13.0
		27 May-2 Jun	11.1	9.5	12.7	8.0-12.0	11.0-15.0
		3-9 Jun	9.9	9.1	10.5	8.0-11.0	10.0-11.5
		lo-16 Jun	12.2	10.4	14.1	9.0-12.5	12.0-16.0
		17-23 Jun	12.5	10.6	14.6	8.0-12.0	12.0-16.5
		24-30 Jun	15.0	13.1	17.0	11.0-14.5	15.5-1.8.5
		l-7 Jul	15.7	13.5	18.2	12.0-14.5	17.5-19.0
		8-14 Jul	15.6	13.1	18.1	12.5-14.0	l-7.0--19.0
		15-21 Jul	17.2	14.5	20.0	13.0-16.5	19.0-21.0
		22-28 Jul	17.5	14.9	20.1	13.5-16.5	18.0-22.0
		29 Jul-4 Aug	17.9	15.3	20.6	15.0-16.0	20.0-21.0
		5-11 Aug	17.6	14.8	20.6	13.5-17.0	19.0-22.0
		12-18 Aug	16.5	14.6	19.4	13.0-16.0	18.0-20.5
		19-25 Aug	15.3	13.4	18.2	13.0-14.2	17.2-19.0
		26 Aug-l Sep	15.2	13.6	17.5	12.7-15.0	16.3-18.7
		2-8 Sep	14.2	12.7	16.3	11.9-13.5	13.8-17.5
		9-15 Sep	12.4	10.9	14.2	9.5-12.5	12.7-15.8

Table 1.16. (continued)

Location	Year	Date	Mean temp. (°C) Weekly	Min.	Max.	Range (°C) Minimum	Maximum
White River - Below Falls (Powerhouse) km 3.2	1984	16-22 Sep	13.5	11.8	14.9	9.5-14.0	12.0-16.3
		23-30 Sep	9.5	8.0	10.9	6.7-9.3	10.0-12.5
		1-7 Oct	10.7	9.4	12.0	8.5-10.0	11.3-13.0
		8-14 Oct	10.1	9.2	11.0	7.0-10.7	8.5-12.5
		15-21 Oct	6.1	5.4	6.8	5.0-6.0	6.3-7.5
		22-28 Oct	5.9	5.2	6.7	4.5-6.5	5.3-8.8
		29 Oct-4 Nov	4.8	4.4	5.2	3.5-5.0	4.5-6.0
		5-11 Nov	4.8	4.7	5.0	4.1-5.0	4.9-5.0
		12-18 Nov	4.7	4.3	5.1	3.5-5.2	4.1-6.1
		19-25 Nov	3.7	3.3	4.0	2.5-4.9	3.0-5.5
		26 Nov-2 Dec	2.9	2.6	3.2	2.0-3.4	2.3-3.9
Tygh Creek - Lower (Highway 197) km 1.3	1983	9-11 Aug	21.5	17.3	26.3	16.1-18.3	25.0-28.3
		12-18 Aug	20.7	15.3	26.6	13.6-18.9	25.6-27.8
		19-26 Aug	17.4	13.4	21.7	11.7-15.0	20.8-23.3
		27 Aug-7 Sep a/	--	--	--	--	--
		8-15 Sep b/	14.8	11.7	19.0	9.4-12.8	16.1-20.8
		16-23 Sep a/	--	--	--	--	
		24-25 Sep	12.6	8.8	17.5	8.3-9.2	17.2-17.8
		26-30 Sep a/	--	--	--	--	--
		1-7 Oct	13.5	12.0	15.6	10.0-13.1	13.6-17.0
		8-14 Oct	11.7	10.5	13.6	9.7-11.1	12.2-14.4
		15-21 Oct	11.0	9.7	12.5	8.3-10.8	11.4-13.3
		22-28 Oct	9.0	8.1	10.0	7.7-9.4	9.4-10.6
		29 Oct-4 Nov	9.6	8.9	10.4	8.1-9.4	9.7-11.1
		5-11 Nov	8.6	7.9	9.4	6.7-8.6	8.3-11.1
		12-18 Nov	7.3	6.7	7.9	5.6-7.2	7.2-8.3
		19-25 Nov	5.6	5.1	6.3	4.4-5.6	5.6-7.2
		26 Nov-2 Dec	4.7	4.1	5.5	3.1-5.6	4.2-7.7
		3-9 Dec	3.1	2.6	3.6	2.2-3.1	2.8-4.2
		10-16 Dec	3.5	3.1	4.0	2.5-3.9	3.3-4.4
		17-21 Dec	1.5	1.1	1.9	0.6-2.0	0.8-2.5
		22-31 Dec a/	--	--	--	--	--
	1984	1-3 Jan a/	--	--	--	--	--
		4-7 Jan	3.0	2.4	3.7	1.1-2.8	3.1-4.2
		8-14 Jan	2.4	2.0	2.9	0.0-3.6	1.1-4.2
		15-17 Jan	.05	0.0	1.5	0.0	0.6-2.2
		18-25 Jan a/	--	--	--	--	--
		26-28 Jan	2.2	1.2	3.3	0.6-1.7	2.2-4.4
		29 Jan-4 Feb	2.9	2.0	4.1	1.1-2.8	3.3-4.7
		5-11 Feb	3.9	3.1	5.2	2.5-3.9	3.6-6.4
		12-18 Feb	3.9	2.8	5.0	2.0-3.9	3.9-6.4
		19-25 Feb	4.2	3.1	5.3	2.0-4.0	3.9-6.7
		26 Feb-3 Mar b/	4.6	3.1	6.4	2.2-4.2	5.0-7.8
		4-10 Mar	5.6	3.6	8.2	2.0-5.8	6.7-9.7

Table 1.16. (continued)

Location	Year	Date	Mean temp. (“C) Weekly	Min.	Max.	Range (“C) Minimum	Maximum
Tygh Creek - Lower (Highway 197) km 1.3	1984	11-17 Mar	5.6	4.2	7.3	3.1-5.3	5.6-9.7
		18-24 Mar	6.2	4.7	8.2	3.3-5.8	6.7-9.4
		25-31 Mar	6.2	4.2	8.8	3.1-5.6	5.8-10.6
		1-7 Apr	7.6	5.4	10.5	3.9-7.2	7.8-12.2
		8-14 Apr	7.2	4.7	10.3	3.9-5.8	5.6-15.8
		15-21 Apr	9.8	7.1	13.3	5.8-8.1	11.1-15.6
		22-29 Apr	8.3	5.2	12.3	3.0-7.1	9.0-15.7
		29 Apr-5 May	9.1	6.6	12.3	4.4-7.8	10.6-14.7
		6-12 May	9.9	7.1	13.3	5.6-7.8	10.6-14.4
		13-19 May	9.6	7.0	12.3	5.0-8.1	10.3-14.2
		20-26 May	9.3	7.3	12.0	6.7-7.7	9.2-15.3
		27 May-2 Jun	11.7	8.4	15.5	6.1-11.4	13.3-18.6
		3-9 Jun	10.2	8.0	13.1	6.7-9.4	11.1-19.7
		LO-16 Jun	13.5	9.8	17.6	7.2-12.7	15.0-20.1
		17-23 Jun	14.8	11.4	18.5	9.2-13.3	13.3-21.7
		24-30 Jun	17.1	13.9	20.8	10.0-15.3	18.0-23.1
		1-7 Jul	16.9	13.2	20.6	11.1-15.0	20.0-21.4
		8-14 Jul	18.3	15.8	20.5	12.8-19.4	19.4-21.1
		15-21 Jul	19.7	16.1	23.3	14.4-18.3	22.2-24.4
		22-28 Jul	20.7	16.9	26.4	15.0-19.4	23.7-27.8
		29 Jul-4 Aug	20.9	16.6	26.3	16.1-17.7	25.0-27.8
		5-11 Aug	20.7	16.3	26.2	14.4-18.9	24.4-27.7
		12-18 Aug	19.7	15.2	25.0	13.9-17.2	23.3-25.6
		19-25 Aug	18.5	13.4	24.1	12.8-14.4	21.5-25.3
		26 Aug-l Sep	17.8	13.7	22.5	11.6-15.6	20.6-24.5
		2-8 Sep	16.6	13.1	20.9	11.7-14.4	16.7-23.3
		9-15 Sep	14.5	10.7	18.5	8.9-13.3	15.6-21.1
		16-22 Sep	15.3	11.8	19.2	9.4-15.5	15.0-21.7
		23-30 Sep	10.7	7.8	14.6	6.1-9.4	12.8-16.1
		1-7 Ott	11.2	8.6	15.0	7.7-9.7	13.9-16.1
		8-14 Ott	10.0	8.6	12.0	6.4-10.5	7.8-15.0
		15-21 Ott	7.5	6.4	9.0	3.9-8.1	7.7-11.1
		22-28 Ott	7.8	6.6	8.8	5.8-7.8	7.7-11.1
		29 Ott-4 Nov	6.1	5.3	7.0	4.4-6.1	6.4-7.8
		5-11 Nov	5.1	4.2	6.0	3.3-5.0	5.6-6.7
		12-18 Nov	4.9	4.3	5.4	2.8-5.6	4.2-6.7
		19-25 Nov	4.1	3.4	4.9	2.8-5.3	3.6-6.1
		26 Nov-2 Dee	2.8	1.9	3.5	0.3-3.6	1.7-4.7
		3-9 Dee	1.5	0.9	2.1	0.3-2.0	1.4-4.2

Table 1.16. (continued)

Location	Year	Date	Mean temp. (“C) Weekly	Min.	Max.	Range (“C) - Minimum	Maximum
Tygh Creek - Upper (North-South Rd) km 25.4	1984	3-7 Jul	10.8	9.6	11.9	9.5-10.1	11.5-12.0
		8-14 Jul	11.8	10.7	13.0	9.9-12.3	l-2.1-14.5
		15-21 Jul b/	12.1	11.0	13.1	10.2-11.1	12.1-13.7
		22-28 Jul	12.5	11.5	13.6	10.5-12.5	l-2.1-14.6
		29 Jul-4 Aug	13.5	12.5	14.4	11.7-13.2	l-4.0-14.8
		5-11 Aug	13.4	12.4	14.3	11.4-13.9	1.3.2-15.4
		12-18 Aug	12.8	12.0	13.6	11.5-12.7	1.3.0-14.2
		19-25 Aug	12.3	11.6	13.1	11.2-12.0	13.0-13.5
		26 Aug-l Sep	12.3	11.7	12.9	10.7-12.7	12.2-13.9
		2-8 Sep	11.6	10.9	12.2	10.2-11.3	11.2-12.8
		9-15 Sep	10.2	9.6	10.7	8.8-11.0	1.0.0-12.0
		16-22 Sep	10.7	9.9	11.3	8.3-11.5	9.7-12.4
		23-30 Sep	7.8	7.3	8.2	6.8-8.0	7.8-8.8
		l-7 Ott	8.4	7.9	8.8	7.1-8.5	8.1-9.3
Badger Creek (Bonney Crossing km 18.6	1984	6-7 Jul	11.9	11.0	13.0	10.6-11.3	12.8-13.2
		8-14 Jul	12.3	10.7	13.9	10.3-11.1	12.5-1S.O
		15-21 Jul	14.0	12.2	15.5	11.2-13.4	14.0-16.9
		22-28 Jul	14.4	12.7	16.0	11.1-14.1	14.0-17.5
		29 Jul-4 Aug	15.0	13.4	16.3	12.6-14.3	15.4-16.9
		5-11 Aug	14.6	13.1	15.7	11.9-14.7	14.5-16.8
		12-18 Aug	13.7	12.4	14.8	11.4-13.3	13.7-15.8
		19-25 Aug	12.9	11.8	13.8	11.3-12.3	13.0-14.4
		26 Aug-l Sep	12.7	IL.9	13.4	10.5-12.8	12.5-14.3
		2-8 Sep	11.9	11.2	12.5	10.6-12.0	11.2-13.0
		9-15 Sep	10.5	9.9	10.9	9.0-11.2	10.1-12.5
		16-22 Sep	11.3	10.5	12.0	8.6-12.0	10.4-13.5
		23-30 Sep	8.1	7.7	8.9	7.2-8.2	7.9-10.2
		l-7 Ott	8.9	8.5	9.3	7.8-9.1	8.5-9.7
Threemile Creek (FS Rd 8411) km 19.3	1984	6-7 Jul	10.2	7.9	13.5	7.5-8.2	13.4-13.5
		8-14 Jul	10.8	8.1	14.5	7.8-8.8	12.7-15.3
		15-21 Jul	12.5	9.6	16.5	8.5-11.0	15.5-17.4
		22-28 Jul	13.5	10.0	17.9	8.8-11.0	16.0-19.4
		29 Jul-4 Aug	14.2	10.7	18.5	9.8-11.5	18.0-19.2
		5-11 Aug	14.1	10.5	18.8	9.3-11.8	17.5-20.0
		12-18 Aug	13.3	9.9	18.2	9.0-10.7	17.3-19.1
		19-25 Aug	12.7	9.2	17.6	8.7-10.0	17.0-18.3
		26 Aug-l Sep	12.8	9.6	17.4	8.0-10.8	16.5-18.7
		2-8 Sep	11.9	9.2	15.6	8.5-10.3	12.7-16.8
		9-15 Sep	10.5	7.9	14.4	7.1-9.3	13.3-16.2
		16-22 Sep	11.0	8.6	14.0	6.2-11.0	8.4-17.2
		23-30 Sep	7.9	5.7	11.2	4.9-7.0	9.9-12.3

Table 1.16. (continued)

Location	Year	Date	Mean temp. ("C) Weekly	Min.	Max.	Range ("C) Minimum	Maximum
Rock Creek (above reservoir) km 14.9	1984	lo-14 Jul	18.0	12.1	24.6	11.5-13.5	22.8-25.4
		15-21 Jul	19.3	13.8	25.9	11.8-16.8	23.5-28.6
		22-24 Jul	18.9	13.6	25.4	12.2--15.5	23.2-27.0
		25 Jul-7 Aug a/	--	--	--	--	--
		8-11 Aug	19.9	15.9	24.5	15.1-17.0	22.0-25.8
		12-18 Aug	18.3	13.8	23.5	12.3-15.5	22.4-24.7
		19-25 Aug b/	17.8	13.2	23.0	12.1-14.5	21.2-23.8
		26 Aug-l Sep	17.2	13.0	22.5	10.6-14.8	21.0-24.3
		2-8 Sep	16.2	12.5	20.7	11.0-14.7	16.4-22.4
		9-15 Sep	14. L	10.4	18.7	9.0-12.7	16.9-21.4
		16-22 Sep	15 .4	11.7	19.5	9.3-15.1	14.0-22.9
		23-30 Sep	10.8	8.2	14.0	7.0-10.0	12.5-15.4
		1-7 act	12.1	9.6	15.0	8.3-10.8	1.3.0-16.4
Gate Creek (FS Rd 48) km 10.0	1984	lo-14 Jul	15.3	12.4	18.2	11.6-13.1	17.8-18.6
		15-21 Jul	17. L	14.4	19.9	13.0-16.3	17.8--21.7
		22-28 Jul	17.2	14.6	19.9	12.3-16.9	17.8-21.5
		29 Jul-4 Aug	18.0	15.7	20.3	14.6-17.0	19.6-21.0
		5-11 Aug	17.6	15.3	20.1	13.4-17.6	18.4-22.0
		12-18 Aug	16.5	14.5	18.6	13.1-16.2	17.8-19.6
		19-25 Aug	15.1	13.1	17.4	12.5-14.4	16.0-18.8
		26 Aug-l Sep b/	15.3	13.5	17.5	11.9-15.2	16.3-18.7
		2-8 Sep	14.2	12.5	15.9	11..3-13.7	13.4-17.1
		9-13 Sep	12.0	10.6	13.5	8.7-12.8	12.0-15.5
		14-21 Sep a/	--	--	--	--	--
		22-30 Sep	8.3	7.1	9.6	5.8-8.3	8.6-11 .0
		l-7 Ott	9.5	8.2	10.7	7.4-9.0	9.7-11.8
Clear Creek (campground) km 6.2	1984	lo-14 Jul	9.6	7.9	11.6	7.5-8.1	11.3-11.8
		15-21 Jul	10.2	8.7	12.1	8.0-9.4	11.2-12.8
		22-28 Jul	10.2	8.7	12.0	7.8-9.2	11.0-12.5
		"9 Jul-4 Aug	10.4	5.2	12.0	9.0-9.7	11.2-12.5
		5-11 Aug	10.2	8.9	11.8	8.2-9.9	10.5-12.7
		12-18 Aug	10.0	8.7	11.5	8.0-9.5	11.0-12.6
		19-25 Aug	9.4	8.3	10.9	7.6-8.8	10.3-11.3
		26 Aug-l Sep	9.5	8.5	10.7	7.3-9.1	10.0-11.1
		2-8 Sep	9.1	8.3	10.1	7.8-9.0	9.2-10.8
		9-15 Sep	8.3	7.7	9.1	6.8-8.9	8.6-10.1
		16-22 Sep	8.6	7.8	9.3	6.6-9.0	7.8-10.0
		23-30 Sep	6.6	5.9	7.3	5.4-6.8	7.08.0
		l-7 Ott	7.4	4.8	8.1	6.2-7.2	7.9-8.3

Table 1.16. (continued)

Locat ion	Year	Date	Mean temp. (“C) Weekly	Min.	Max.	Range (“C) Minimum	Maximum
Barlow Creek	1984	lo-14 Jul	8.9	7.5	10.2	7.3-7.9	10.0-10.4
(FS Rd 43-221)		15-21 Jul	9.9	8.5	11.3	7.7-9.5	10.4-12-l
km 5.0		22-28 Jul	10.3	9.0	11.6	8.0-10.3	10.7-12.4
		29 Jul-4 Aug	11.2	9.8	12.7	9.0-10.4	11.5-15.1
		5-11 Aug	10.9	9.6	11.9	8.7-10.9	11.0-12.9
		12-18 Aug	10.5	9.4	11.3	8.5-10.3	11.0-11.6
		19-25 Aug	9.8	8.7	10.6	8.0-9.6	10.3-11.0
		26 Aug-l Sep	9.8	9.0	10.6	7.5-9.6	10.0-11.2
		2-8 Sep	9.1	8.3	9.7	7.6-9.0	8.5-10.4
		9-15 Sep	8.2	7.5	8.7	6.4-8.7	8.0-9.8
		16-20 Sep	9.2	8.5	9.8	7.7-9.6	9.9-10.4

a/ Thermograph not working.
b/ Incomplete data.

Table 1.17. Maximum and minimum water temperatures(°C) recorded by maximum-minimum thermometers in White River basin, 1983.

Stream, Location (km)	20-26 July	27 July-1 Aug	2-8 Aug	9-15 Aug	16-22 Aug	23-30 Aug	31 Aug-6 Sept	7-13 Sept
Tygh Creek								
1.3	26.7/15.0	a	26.7/15.0	26.7/14.4	26.1/16.1	a	23.9/13.9	21.7/12.2
9.3		23.0/16.0	a	20.0/15.0	a	a	20.0/14.5	18.0/13.0
25.9	--	14.0/12.0	a	15.0/11.0	a	a	21.0/8.5	12.0/9.0
Jordan Creek								
0.2	--	25.0/16.0	--	--	--	--	--	19.4/11.1
Badger Creek								
2.1	22.8/12.2	23.3/12.8	22.0/13.9	22.2/12.8	a	a	21.7/11.1	17.8/8.9
21.6	--	16.3/8.3	a	22.2/12.8	a	a	13.9/7.7	10.0/7.7
Threemile Creek								
9.8	--	18.3/7.8	a	18.9/7.8	a	a	19.4/6.1	11.1/8.9
20.0	--	20.0/10.0	a	18.9/8.9	a	a	17.2/8.9	15.6/5.6
Rock Creek								
17.7		26.0/10.0	a	22.0/11.0	a	a	21.0/9.0	16.5/8.0
Gate Creek								
8.7	--	25.0/14.0	a	26.0/11.0	a	a	22.0/11.0	18.0/9.0
10.3	--	20.0/15.0	a	21.5/7.7	a	a	20.0/10.5	15.5/9.5
Clear Creek								
5.5	12.2/6.7	12.2/6.7	12.8/7.8	12.2/7.7	a	a	12.2/7.8	10.6/7.8
Boulder Creek								
2.5	12.2/6.7	12.8/6.7		--	a	a	13.9/7.8	11.7/7.7
Barlow Creek								
0.2	12.8/5.6	13.3/6.7	13.3/8.9	13.9/7.7	12.2./6.7	a	11.1/5.6	9.4/5.0
Bonney Creek								
2.4	--	a	a	13.0/7.5	a	a	12.0/8.0	10.0/7.5
White River								
27.4	--	--	--	17.2/10.0	a	a	15.6/10.0	--

a/ Thermometer remained in the stream through this period but temperatures were not recorded until a later date.

Table 1.18. Weekly maximum and minimum water temperatures ("C) at five stations in Tygh Creek, 1984.

Ending date	Maximum and minimum water temperature (°C)				
	km 1.3 a/	km 4.5 b/	km 7.7 b/	km 9.3 b/	km 25.4 a/
6 June	16.1/6-l	14.5/6-O		15.5/6.5	--
13 June	17.0/10.0	14.5/7-o	--	17-O/6.5	--
20 June	20-l/13.4	18-O/9.0		20.0/9.0	
27 June	23.1/15.3	20-O/9.0		23.0/8-O	--
4 July	21.6/10.0	21-O/9.0	--	23.0/11.0	12-O/9.5 c/
11 July	21-l/12.2	22.0/11.0	--	24.0/11.0	12.5/9.5
18 July	24.4115.5	25.0/14.0	26.5111.5	25-O/11.0	14.5/10.1 c/
25 July	27.8/14.4	29.0/11-O	25.5/12.0	23-O/11.5	14.6/10.2
1 August	27.8/16-l	--	26..5/14.0	--	14.8/11.5
8 August	26.9/14.4	27.0/15.0	25.5/14.0	24.0/12.0	14.6111.4
15 August	27.7/13.9	26.0/13.0	25.5/18-O	23.0/12.0	15.4/11.5
22 August	25.6/12.8	24.0/14.0	24.5113.3	21.5/11-O	13.9/11.3
30 August	24.5/11.6	23.0/12.0	24.5112.0	20.0/10.0	13.9/10.7
5 September	22.3/11.7	22.0/12.0	22.2/12.0	18.5/10.5	12.8/11.0
13 September	23.3/9.4	21.0/10.0	23.0/11.0	18.0/10.0	12.5/9.0
19 September	21.718.9	20.0/11.0	21.0/11.0	17.0/10.0	12.4/8.8
26 September	17.816.1	18.0/8.5	19.5/8.5	17.0/8.0	12.1/7.1
3 October	16-l/6.6	17.0/8.5	16.518.5	15-o/7.0	9-O/6.8

a/ Thermograph
b/ Maximum-minimum thermometer
c/ Incomplete data

Table 1.19. Weekly maximum and minimum water temperatures (°C) recorded by maximum-minimum thermometers above and below irrigation diversion dams in Tygh and Badger Creeks, 1984.

Ending date	Tygh Creek						Badger	
	Lindell (km 4.5)		Lindell (km 7.7)		Highline (km 9.3)		Highline (km 1.8)	
	Below	Above	Below	Above	Below	Above	Below	Above
6 June	16.0/7.2	14.5/6.0			17.0/6.0	15.5/6.5	12.5/6.5	13.0/4.5
13 June	17.0/7.5	14.5/7.0			17.5/7.5	17.0/6.5	14.0/5.5	14.0/5.0
20 June	20.0/9.0	18.0/9.0			22.0/9.0	20.0/9.0	16.5/8.0	16.0/8.0
27 June	--	20.0/9.0			23.0/8.5	23.0/8.0	19.0/8-0	19.0/8.0
4 July	22.0/10.0	21.0/9.0			19.0/11.0	23.0/11.0	19.0/11.0	20.0/9.0
11 July	22.0/12.0	22.0/11.0	--		24.0/12.0	24.0/11.0	21.0/11.0	20.5/11.0
18 July	24.0/13.0	25.0/14.0	26.5/11.5	26.5/11.5	26.0/13.5	25.0/11.0	24.0/12.0	--
25 July	23.0/14.0	29.0/11.0	24.5/13.0	25.5/12.0	21.5/14.0	23.0/11.5	24.0/13.0	23.0/12.5
1 August	23.0/11.5		L25.5/20.0	26.5/20.0				
8 August	22.0/11.0	27.0/15.0	24.5/13.5	25.5/14.0	21.0/15.0	24.0/12.0	24.0/14-0	23.0/14.0
15 August	23.0/15.0	26.0/13.0	25.5/18.0	25.5/18.0	21.0/15.0	23.0/12-0	24.0/14.0	25.0/13.0
22 August	21.0/11.0	24.0/14.0	25.0/14.5	24.5/13.5	20.5/15.0	21.5/11.0	23.0/13.5	22.5/13.0
30 August	20.0/16.0	23.0/12.0	25.5/11.5	24.5/12.0	19.0/14.0	20.0/10.0		21.0/12.0
5 September	19.0/16.0	22.0/12.0	24.5/12.0	22.0/12.0	19.5/14.0	18.5/10.5		19.5/12.0
13 September	18.0/15.0	21.0/10.0	--	23.0/11.0	17.0/12.0	18.0/10.0	--	19.0/10.0
19 September	18.0/13.0	20.0/11.0	20.0/11.0	21.0/11.0	17.0/12.0	17.0/10.0		18.0/9.0
26 September	18.0/11.0	18.0/8.5	19.5/8.0	19.5/8.5	17.0/9.0	17.0/8.0		17.0/13.0
3 October	17.0/11.0	17.0/8.5	18.0/8.0	16.5/8.5	16.0/10.0	15.0/7.0		14.0/7.0

Chapter II

POTENTIAL ANADROMOUS FISH PRODUCTION

Methods

I. FIELD SAMPLING TECHNIQUES

A. Site Selection

Streams in White River basin were divided into reaches based on general stream characteristics such as gradient, pool-riffle ratio, and change in flow (confluence of tributaries). Eighteen streams in the basin were divided into 45 reaches. Reach designations were based on data from stream surveys of ODFW (Schroeder and Lindsay 1983; see STREAM HABITAT INVENTORY), Mt. Hood National Forest (Heller et al. 1983), and BLM (1980).

Within each stream reach, 1 to 4 sites were selected that typified the habitat of the reach. Personnel from USDA FS assisted in selecting representative sites in streams located in the Mt. Hood National Forest. Sites were selected away from campgrounds and road crossings to avoid areas where fishing pressure may have affected fish abundance. Most sites consisted of 2 or 3 pools and riffles; in large streams a site consisted of a single pool and riffle.

B. Surface Area

Equally spaced transects were established at each site (Platts et al. 1983). The widths of pool, riffle, slow run, pocketwater, fast run, backwater, and side channel (Irving et al. 1983) were measured to the nearest 0.05 m. The sum of the transect widths were multiplied by the distance between transects (transect spacing) to calculate surface area of a site. Average site area within a reach was expanded to estimate surface area of a reach by the proportion:

$$\frac{\text{mean site length within a reach}}{\text{reach length}}$$

Reach estimates were summed to estimate surface area of the White River system. Estimates of surface area in Threemile, Rock, and Gate Creeks were adjusted downward because the streams are intermittent. Stream sections in which we did not find fish were excluded from the expansions. These sections were found in Tygh, Threemile, Rock, and Gate creeks.

C. Other Habitat Measurements

Several habitat parameters were measured to evaluate whether sites were representative of a reach. Other parameters were measured for possible use in alternative estimates of anadromous fish potentials but were not used in the final estimates. Stream depths were measured on each transect at the shoreline and at l/4, l/2, and 3/4

the width of the transect. Undercut banks were measured at points of the furthest bank protrusion and the furthest undercut at each transect. Major cover features for fish were classified by six types (l-logs, boulders, debris below surface; 2-logs, boulders, debris above surface; 3-overhanging vegetation <0.3 m of surface; 4-aquatic vegetation; 5-undercut banks; 6-depth with surface turbulence). Cover area was measured, and cover in the site was estimated as a percentage of the total surface area of the site. Points were measured on each transect where stream depth was 0.15 m and 1.0 m to estimate usable stream >0.15 m and <l.O m deep. Gradient of the site was measured with a hand-held clinometer. Substrate in the uppermost riffle of each site was classified on three transects. The riffle length was divided by 4 to obtain the transect spacing. At each transect 25 point measurements were taken and the substrate was classified by an 8-rank system (Table 2.1). Substrate was reported as an average particle size by rank and substrate composition was reported by percentages within the particle size classes.

All habitat data were recorded on a habitat field form (Figure 2.1). Sites were mapped on the back of the form and showed major habitat features as well as transect-specific features. "Left" and "right" banks were determined when facing downstream.

D. Fish Abundance and Biomass

Except in lower White River populations of fish were estimated in all other streams with multiple pass removal methods (Zippen 1958; Seber and Whale 1970) by using backpack electrofishers, and blocking nets at upstream and downstream boundaries of the sites. In larger streams a Dirago 1000 electrofishing unit mounted in a small pram was used to capture fish. In order to attain confidence limits of less than 10 percent of estimated abundance, passes with electrofishers were continued until we reached about a 75 percent reduction in fish numbers from the preceding pass. Each salmonid was measured to the nearest 1.0 mm (fork length). Weights to the nearest 0.1 gm were taken on every fish in sites with fewer than 100 fish. In sites with more than 100 fish random weights of at least 50 fish were measured. Lengths were not measured on nonsalmonid species. An average weight by species for nonsalmonids was estimated by dividing total weight by sample number. Abundance of salmonids in lower White River (km 5.8 to km 9.0) was estimated with a modified Schnabel method of multiple mark and recapture sampling (Ricker 1975) by using electrofishing gear mounted in a driftboat to capture fish. Weights of salmonids in this area were measured to the nearest 1.0 gm. Data were recorded on a fish density fieid form (Figure 2.2). Biomass of fish was estimated from population estimates and mean weights. Mean fish abundance and biomass in sites within a reach were expanded to calculate estimates for the reach by the proportion:

Table 2.1 Classification of stream substrate in riffles by particle size (Konopacky, 1984)

Rank	Particle Size (diameter in mm)	Particle Description
1	--	Organic cover (over 50% of bottom surface)
2	Less than 2	Sand
3	2-5	Pea gravel
4	5-25	Small gravel
5	25-50	Large gravel
6	50-100	Small cobble
7	loo-250	Large cobble
8	Greater than 250	Boulder

Figure 3.1 Data form for habitat measurements at sample sites in the White River basin

WR-2

HABITAT MEASUREMENTS

Stream _____ Reach _____ Site _____ Date _____

Crew _____ Time _____ Temp:Air _____ Water _____

Site length (thalweg)

Pool length
Riffle length

Trans	Point Measurement: Type	Point Measurement: Special type	Point Measurement: Pool depth 0.15 m	Point Measurement: Pool depth 1.0 m	Bank	Stream Depth 1/4	Stream Depth 1/2	Stream Depth 3/4	Stream Depth Bank	Undercut bank
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

Types

P = Pool
R = Riffle

Special types

Pool

SR = Slow run
PW = Pocketwater

Riffle

FR = Fast run

Other

BW = Backwater
SC = Side channel

COVER

Type	X = Area			Type	X = Area		

Types

1 - Logs, boulders, debris below surface.
2 - Logs, boulders, debris above surface.
3 - Overhanging vegetation <0.3 m of surface
4 - Aquatic vegetation.
5 - Undercut banks.
6 - Depth (w/turbulence).

SUBSTRATE

	Transect 1 downstream	Transect 2 midpoint	Transect 3 upstream
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Particle size (mm)/type

1 - organic cover
2 - <2 (sand)
3 - 2-5 (pea gravel)
4 - 5-25 (sm gravel)
5 - 25-50 (lg. gravel)
6 - 50-100 (sm. cobble)
7 - 100-250 (lg cobble)
8 - >250 (boulder)

Figure 2.2 Data form for fish abundance and biomass measurements in sample sites in the White River basin

WR-1

ELECTROFISHING FIELD FORM

Stream _____ Location _____

Sample area ___ ___ ___

Date _____ Start time _____ End time _____

Crew _____ Temp: Water _____ Air _____

	Sp ____ FL (mm)	No. R/S	Sp ____ FL (mm)	No. R/S	Sp ____ FL (mm)	No. R/S	Sp ____ FL (mm)	No. R/S	Sp ____ FL (mm)	No. R/S
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										

Scale Summary

	Size Group (mm)			
	0-49	50-99	100-149	≥ 150
Random				
Selective				

COMMENTS: _____

$$\frac{\text{mean site length within a reach}}{\text{reach length}}$$

Reach estimates were summed to estimate fish abundance and biomass for the basin. Population and biomass expansions were recorded on a summary form (Figure 2.3) and use of this form is demonstrated in Figure 2.4.

II. METHODS FOR ESTIMATING POTENTIAL PRODUCTION

A. Steelhead - Table 2.2

1. The estimated abundance of resident trout >-15 cm in White River basin was used as an estimate of potential production of Steelhead smolts.

   Rationale: Steelhead smolts in the Warm Springs River range from 14-22 cm with a 7-year mean of approximately 18 cm. Deschutes River smolts also range from 14-22 cm.

   Discussion: This estimate would likely be conservative if resident trout that are older and larger than Steelhead smolts are occupying habitat that could be used by juvenile Steelhead. The method is also based on abundance of trout in late summer whereas many of the trout ≥ 15 cm would have migrated in the previous spring if they were Steelhead.

2. Biomass densities of age 1 resident trout in White River streams were matched with biomass densities of age 1 Steelhead mainly from 5 eastern Oregon river systems (Maciolek 1979 and NMFS unpublished data). We also used Steelhead biomass densities from other Oregon streams (U.S. Fish and Wildlife Service, umpublished data); Washington streams (Crawford et al. 1984; U.S. Fish and Wildlife Service, unpublished data); and Idaho streams (Reiser and Bjornn 1979; Gamblin 1984). Surface area (m^2) of White River streams were then multiplied by the numercial densities (fish/m2) of age 1 Steelhead from the matched Steelhead streams with similar biomass densities to estimate potential production of age 1 and older Steelhead. Because this was a summer estimate, a 60 percent overwinter survival (Maciolek and Needham 1952; Reimers 1957) was used to estimate the number of age 2 fish (smolts) the following spring.

   Example: White River stream = 2.5 g/m^2 and 0.15 fish/m2; Steelhead stream = 2.5 g/m2 and 0.25 fish/m2. Therefore, multiply the surface area in the White River stream by 0.25 fish/m2 to estimate the potential for Steelhead of age 1 and older.

WHITE RIVER POPULATION AND BIOMASS EXPANSION

I. IDENTIFICATION

A. Stream _____ B. Reach _____ c. Sites _____

D. Reach length 1. _____ m 2. _____ mi

E. Reach description _____

_____

II. POPULATION AND BIOMASS

A. Site averages (habitat)

1. Number of sites in reach _____
2. Average site length _____ m
3. Average surface area _____ m^2
4. Average stream width at sites _____ m

	Rb	Other	Salmonids	cot
B. Site sums				
1. Population	_____	_____	_____	_____
2. Biomass (gm)	_____	_____	_____	_____
3. Numerical density	_____	_____	_____	_____
4. Biomass density	_____	_____	_____	_____
c. Site averages (IIBl-4)'(IIAl)				
1. Population	_____	_____	_____	_____
2. Biomass (gm)	_____	_____	_____	_____
D. Reach expansions				
1. Expansion factor (F): (IIA2)+(ID)	_____			
2. Surface area (IIA3)÷F	_____ m^2			
3. Population (IICl)+F	_____	_____	_____	_____
4. Biomass (IIC2)÷F	_____	_____	_____	_____
5. Numerical density (IID3)÷(IID2)	_____	_____	_____	_____
6. Biomass density (IID4)÷(IID2)	_____	_____	_____	_____

Figure 2.3. Data summary form for reach expansion of fish abundance and biomass.

WHITE RIVER POPULATION AND BIOMASS EXPANSION

I. IDENTIFICATION

A. Stream Tygh B. Reach I C. Sites 1-3

D. Reach length 1. 7,680 m 2. 4.8 mi

E. Reach description Mouth to Badger Creek confluence

II. POPULATION AND BIOMASS

A. Site averages (habitat)

1. Number of sites in reach 3
2. Average site length 114.67 m
3. Average surface area 992.75 m^2
4. Average stream width at sites 9.48 m

	Rb	Other		Salmonids	Cot
B Site sums					
1. Population	642				470
2. Biomass (gm)	9,030.16				1,268.88
3. Numerical density	0.71				0.35
4. Biomass density	9.22				0.95
C Site averages (IIB1-4)÷(IIA1)					
1. Population	214				156.67
2. Biomass (gm)	3,010.05				422.96
D Reach expansions					
1. Expansion factor (F): (IIA2)÷(ID) 0.0149 (114.67 ÷ 7,680)					
2. Surface area (IIA3)÷F 66,627.52 m^2					
3. Population (IIC1)÷F	14,362.42				10,514.77
4. Biomass (IIC2)÷F	202,016.78				28,386.58
5. Numerical density (IID3)÷(IID2)	0.22				0.16
6. Biomass density (IID4)÷(IID2)	3.03				0.43

Figure 2.4. Example of reach expansion.

Rationale: Biomass of resident fish observed in the White River system should be a measure of carrying capacity of the watershed under existing conditions. Assumptions about the carrying capacity of the watershed are that the sample sites typify the habitat of the watershed and that the trout abundance was not below normal because of low water flows, poor spawning success, fishing pressure, unusual land use practices (such as stream dredging), or other causes. An assumption about the use of available habitat by resident trout and Steelhead is that both fish have similar rearing requirements. The age 2 smolt migration was chosen because of its predominance in the Deschutes River (55 percent age 2 compared to 29 percent age 1; 14 percent age 3; 2 percent age 4 - from Fessler et al. 1976) and in the John Day River (56 percent age 2 compared to 5 percent age 1; 39 percent age 3 - from personal communication on 28 November 1984 with Leslie Lutz, Oregon Department of Fish and Wildlife, Corvallis, OR).

Discussion: As with all the estimates of production, it is difficult to anticipate how the introduced Steelhead might move within the system and migrate from it. In this case it was assumed all the age 1 and older Steelhead will migrate the following spring althouth some will hold over until age 3 before smolting and some age 1 fish may smolt. This method uses biomass of fish in the White River basin to estimate potential production of Steelhead rather than fish abundance and is probably closer to estimating potential than Method 1. The abundance of resident trout in a tributary stream, as used in Method 1, is probably lower than the abundance of Steelhead would be in that stream because habitat used by larger resident trout may be used by a higher number of juvenile Steelhead. The biomass of fish produced in a stream, as used in Method 2, is an estimate of the potential of the stream to produce resident trout or Steelhead. It was assumed the biomass represented by older and larger rainbow would be replaced with a greater number of juvenile Steelhead if the habitat requirements are similar for larger rainbow and juvenile Steelhead. Habitat presently used by the bigger rainbow in the mainstem of White River, where the big rainbow are occupying deep, fast water, may not be suitable for juvenile Steelhead. The White River system appears to be a productive watershed based on densities of resident trout when compared to Steelhead streams in Oregon, Washington, and Idaho.

3. Similar to Method 2 except age 0 fish were used. Because these are age 0 fish in summer the survival was estimated at 35 percent to age 1 (Bjornn 1978, Marshall et al. 1983) and 60 percent over-winter to age 2.

Discussion: This method is likely less accurate because two survival rates were needed to predict the number of Steelhead smolts White River would support. Also, abundance of age 0 trout is more difficult to estimate than abundance of age 1 and older trout because the small fish are more difficult to capture with electrofishing gear. Consequently, estimates by this method are probably conservative.

4. Similar to Method 1 except age 1 populations (8.1-14.9 cm) of resident trout were used. Survival to smolt was estimated by using a 60 percent over-winter survival rate.

   Discussion: The abundance of age 1 resident trout was estimated by subtracting the abundance of trout >15 cm from the abundance of age 1 and older trout. The size break between age 0 and age 1 trout (8.0 cm) was estimated from scale analysis of resident trout. This estimate may be conservative because older resident trout in the basin would have migrated as smolts the previous spring, and these older trout may be occupying habitat that could be used to rear more yearling Steelhead. The combined estimate of Methods 1 and 4 (2,609 adults) has conservative assumptions (based on number of fish and not biomass) and liberal assumptions (all fish >8.0 cm in the summer will migrate as smolts the following spring).

5. Rearing area required per smolt was estimated at 40 m^2 in the mainstem and 20 m2 in the tributaries. These estimates were divided into the stream area of the White River watershed.

   Rationale: The 20 m^2 per smolt estimate is from Reiser and Bjornn (1979). The 40 m^2 per smolt is an average of the Idaho tributary streams (20 m^2) and the observed area per resident fish (>15 cm) in the mainstem White River (60 m^2).

   Discussion: Information on rearing area requirements is generally lacking, particularly in larger streams. The estimate using this method is between the estimates of Methods 1 and 2 which were considered conservative and liberal, respectively.

6. Similar to Method 5 except 20 m2/smolt was used for the entire watershed. May be somewhat liberal because 56 percent of the surface area in the basin is in the mainstem which had an area of 60 m^2 per resident trout >15 cm.

7. Smolt densities of 0.02 and 0.03 smolts/m^2 from British Columbia (Marshall et al. 1983) and Washington (Johnson 1983) were multiplied by the estimated stream area of the White River watershed.

Discussion: Although the British Columbia and Washington streams are coastal, the estimates are within the range of estimates obtained by other methods.

8. Estimated densities (fish/m2) of age 0 Steelhead from the Warm Springs River (0.08) were multiplied by surface area of the mainstem and upper tributaries of White River; estimated densities of age 0 Steelhead from 5 eastern Oregon river systems (0.28) were multiplied by the estimated stream area of lower tributaries of White River. Survival rates of 35 percent age 0 to age 1 and 60 percent over-winter were used to estimate smolts.

   Rationale: Based on general stream characteristics, streams of White River were matched with streams that have Steelhead populations, and numerical densities from the Steelhead streams were then multiplied by the stream area of White River.

   Discussion: The streams in the upper White River watershed are similar to streams in the Warm Springs basin and the streams in the lower White River basin are generally similar to the streams in the eastern Oregon study (Maciolek 1979; National Marine Fisheries Service, unpublished data). Although the density of age 0 Steelhead in the Warm Springs (U.S. Fish and Wildlife Service, unpublished data) is likely conservative for the upper tributaries of White River, it may be liberal for the mainstem. The density from the eastern Oregon rivers is probably liberal for the upper reaches of the lower tributaries. This estimate may be conservative however, because streams in the White River basin appear to be more productive than the Warm Springs basin. Total dissolved solids measured in White River and tributaries were 100 percent to 150 percent higher than these measured in the Warm Springs system. Also, the estimated density of Steelhead in the Warm Springs tributaries was from limited data, and was low when compared to other Steelhead streams in the Northwest.

9. The methodology of this estimate was the similar to Method 8 except that numerical densities of age 1 and older Steelhead from the Warm Springs (0.05) and eastern Oregon streams (0.18) were used to estimate production of Steelhead in White River. The estimated density of age 1 and older Steelhead was 0.05 fish/m^2 in the Warm Springs and was 0.18 fish/m^2 in the eastern Oregon streams. An over-winter survival of 60 percent was used to estimate the number of Steelhead smolts.

Discussion: This estimate may be somewhat liberal because the density used for the lower watershed (0.18 fish/m2) appears to be slightly higher than the density of age 1 and older resident trout measured in the lower tributaries (0.15 fish/m2).

10. Data on returning adults per unit area (ODFW 1977) for Squaw Creek (Deschutes) and Tex Creek (John Day) were multiplied by the stream area of the White River watershed. Values were 0.00036 returning adults/ft^2 for Squaw Creek and 0.00025 returning adults/ft^2 for Tex Creek.

    Discussion: This method was not used in the final estimate of Steelhead production because the data base for the ODFW manual is not known.

11. Gravel area required per pair of spawners was divided into estimated areas of spawning gravel using values of 4.4 m2/pair and 19.6 m2/pair (Reiser and Bjornn 1979). Life history data applied to the estimated redd production were: 4,000 eggs/female; 85 percent egg to swim-up fry survival (Bjornn 1978; Reisenbichler and McIntyre 1977); 8 percent fry to yearling survival (Bjornn 1978); 60 percent over-winter survival to smolt; 20 percent reduction to account for resident fish; 4 percent smolt to adult survival.

    Discussion: The estimate is based on measurements of usable spawning gravel and on gravel area requirements for spawners; both are unable to be assessed with accuracy. This method was not used in the final estimate of Steelhead production

Other methods that were investigated but were not used to estimate Steelhead production were: habitat quality indexes (Binns and Eiserman 1979; Gamblin 1984); a Steelhead model for Vancouver Island streams (Slaney 1981); methodologies for Steelhead escapement in Washington (Johnson 1983); a carrying capacity study for northern California streams (Burns 1971) and the USDA FS smolt habitat capability index for the Malheur, Umatilla, and Wallowa-Whitman National Forests.

General Discussion: No single estimate was selected as the most accurate estimate of potential production of Steelhead above White River Falls. The final estimate of Steelhead production was from nine methods (Methods 1 to 9). The range of estimates was narrowed to 1,500 to 2,500 adults after evaluating the methods and the data base from which the estimates were made. A smolt to adult survival rate of 4 percent is based on data from Round Butte Hatchery returns to the Deschutes River so the estimates of adults represent returns to the Deschutes before an in-river fishery. Smolt estimates include a 20 percent reduction to account for resident fish remaining in the streams after an introduction of Steelhead (Bjornn 1978).

The estimates assumed use of Tygh and Badger Creeks above six diversion dams on the lower reaches of these creeks. It was assumed that irrigation diversions would be screened to protect juvenile migrants. All other dams as well as waterfalls on the tributaries were considered to be barriers.

Method 2 is probably closest to defining a theoretical limit to biomass production in the watershed. However, there is no way to ascertain exactly how resident trout biomass would translate into Steelhead numbers. Methods 1 to 4 were based on measured populations of resident trout and survival rates were used to estimate the production of Steelhead. Methods 5 to 8 were based on measured surface areas of streams of White River and densities of Steelhead from other streams were used to estimate Steelhead potential.

B. Chinook - Table 2.3

1. John D. McIntyre (1983) developed a relationship between smolt production (Sm) and mean daily flow in September (cfs) based on data from the Warm Springs, John Day, Lemhi, and Yakima rivers and from Lookingglass Creek:

$$Sm = 102{,}186.65 \ln(cfs/57) + 7330.$$

The mean September flow of 124 cfs (1970 to 1984 average) that was used in the model was measured at a USGS gauging station near the mouth of White River. A 2.5 percent survival rate of migrant to adult was used and is from data on chinook in the Warm Springs River.

Discussion: The estimate from this method resulted in the highest adult production of the seven preferred methods. Steps in the model development were identified that did not take into account some aspects of juvenile life history and the effects of irrigation withdrawals on flow. The model has not been tested and some assumptions in using the model are that September flow limits production, that streams have the same inherent productivity, and that streams used in the model were seeded to capacity.

2-4. Direct comparisons to the Warm Spring River were used to estimate the production of migrants and adults in White River. Mean run sizes of chinook in the Warm Springs River were prorated by the proportion of drainage area, September flow, and spawning gravel in White River.

Example:

$$\text{White River chinook} = \frac{\text{(White R. drainage area)}}{\text{(Warm Springs drainage area)}} \times \text{(average run of chinook in Warm Springs)}$$

Only those years believed to have a good escapement of spring chinook in the Warm Springs were used to estimate production. Migrant production averaged 75,000 (combined fall and spring migrants) and adult runs to the Deschutes River averaged 2,000 in years with good escapement. Drainage areas are 1,362 km^2 for the Warm Springs and 1,080 km^2 for White River. The September flow used in the comparisons was 248 cfs (1976-1982) in the Warm Springs and 124 cfs (1970-1984) in White River. Spawning gravel in the Warm Springs was estimated at 11,000 m^2 (telephone conversation on 11 December 1984 with Brian Cates, USFWS, Vancouver, WA). Spawning gravel in White River was estimated for three areas based on possible use by spring chinook: (a) no restrictions (9,818 m^2) means Tygh and Badger creeks are fully used despite maximum water temperatures that exceed 25°C, low flows, and six diversion dams in the lower reaches of the creeks; (b) limited use (8,720 m^2) of lower Tygh and Badger creeks because of the above reasons but access is available to the upper reaches of the creeks; (c) no use (6,715 m2) of the Tygh Creek system. Only spawning gravels in the lower reaches of White River below km 28.0 was used because of glacial silt deposition in the upper river.

Rationale: Warm Springs River is an adjacent watershed that flows from the east side of the Cascades and that has a run of spring chinook.

Discussion: Assumptions of these methods are that chinook production is related to the variable used for comparison and that the inherent capacities of the White and Warm Springs rivers to produce chinook are comparable. However, most of the tributaries in White River have total dissolved solids 100 to 150 percent higher than those measured in the Warm Springs River indicating White River is more productive. The mainstem of White River is glacial which could reduce the rearing potential whereas the Warm Springs is spring-fed. In general the flows of the Warm Springs and tributaries are more stable than those of White River, and the Warm Springs does not have irrigation diversions.

5. Spawning gravel area and redd counts in the primary spawning sections of the Warm Springs were used to calculate a density of 5 redds/100m^2. The density was based on three years that were believed to have good escapements. The area of spawning gravel in White River was multiplied by the redd density with: (a) no restrictions; (b) limited use of Tygh; and (c) no use of Tygh. Life history data from the Warm Springs

River were applied to the estimated redd production of White River at: 3,000 eggs per female; 3.5 percent egg to migrant survival; 2.5 percent migrant to adult survival back to the Deschutes River (Jonasson and Lindsay 1983). The survival rates are from years with good seeding rates in the Warm Springs. Data used in the calculations are:

Stream	Gravel (m2)	Redds 1977	Redds 1978	Redds 1982
Warm Springs	7,890	390	620	309
Beaver Creek	1,880	126	119	72
Mill Creek	1,212	25	49	25
White River:				
No restrictions	9,703		485 a/	
Limited use of Tygh	8,605		430 a/	
No use of Tygh	6,715		336 g/	

a/ predicted

Rationale: Although the ability to accurately classify and measure usable spawning gravel is questionable, the method is based on the use of gravel in the Warm Springs River by chinook spawners. It is believed inaccuracies in classifying and measuring usable spawning gravel is inherent in most surveys, therefore data on spawning gravel in the White and Warm Springs rivers would have similar biases and would be comparable. The use of a redd density to estimate potential utilization of gravel by spawners is more accurate than the use of area required per spawner because redd density would reflect the selection of usable gravel by spawners and territorial behavior of spawners.

Discussion: Method 5 used a density of redds and would reflect the actual use of gravel by spawners and area requirements of spawners. Method 5 assumed adequate seeding of the Warm Springs by salmon in 1977, 1978, and 1982. The estimate may be conservative because the average redd density from the Warm Springs was based on limited data and was as higher in the more important streams (Beaver Creek and Warm Springs). In addition, the predicted number of redds in White River (485) was used to predict a density of redds per stream length (3.9 redds/km) which was similar to densities in the John Day River. Densities of redds in extensive surveys of eight areas in the John Day system were 3.8 redds/km and 4.0 redds/km in 1978 and 1979, respectively (Burck et al. 1980). However, it is believed the John Day had inadequate escapement in those years. Consequently, the estimated production of chinook by Method 5 may be conservative.

6. Numerical densities from two tributaries of the Warm Springs River (U.S. Fish and Wildlife Service, unpublished data) were used to calculate chinook production in the estimated rearing areas of White River. The densities were for age 0 fish at summer flows therefore 60 percent over-winter survival and 2.5 percent migrant to adult survival were used to estimate adult production.

   Rationale: Warm Springs is a neighboring watershed on the east side of the Cascades and should provide some measure of potential production in White River.

   Discussion: Density estimates in the Warm Springs were based on limited data and are low when compared with other streams in the Northwest, therefore the estimated production in White River is likely to be conservative. This is particularly true with full use of the Tygh Creek system because those streams are probably more productive than the Warm Springs tributaries. However, use of the lower Tygh system may be limited because of high water temperatures from July to September. Data from the John Day River indicates survival of juvenile chinook from July to April of the following years was 25 to 29 percent (Lindsay et al. 1981). In the Warm Springs River approximately 55 percent of the juvenile migration occurs from October through December. These fall migrants apparently over-winter in the Deschutes and migrate as smolts in the spring. Assuming a similar fall migration of White River chinook, survival over the winter would likely to be higher than that of John Day chinook.

7. The method was similar to Method 6 except use of the Tygh system was assumed and an average density from the John Day River of 0.19 fish/m^2 (Burck et al. 1979, 1980; Lindsay et al. 1981) was used in that system. The 0.05 fish/m^2 from the Warm Springs (U.S. Fish and Wildlife Service, unpublished data) was used in the remainder of the White River basin.

   Rationale: The Tygh system is quite different in general stream characteristics than the upper tributaries of the Warm Springs and appears to be more productive based on measurements of total dissolved solids and on the densities of fish measured in the system.

   Discussion: This method accounts for the more productive nature of the Tygh system but it assumes use of the system by adults and successful rearing of juveniles in the lower reaches despite low flow and high water temperatures in summer. Because of these assumptions the estimate is likely somewhat liberal.

8. & 9. Chinook potentials calculated from the ODFW Manual for Fish Management (ODFW 1977) and from spawner requirements were not used to estimate production of chinook for reasons mentioned in Methods 10 and 11 of the Steelhead estimates. Data on returning adults per unit area were from Granite and Clear creeks and the mainstem of the John Day River system. The values were 0.00041 returning adults/ft^2 for Granite and Clear creeks and 0.00013 adults/ft^2 for the upper main John Day. Values for gravel area required per pair of spawners were 3.3m2 and 13.4m^2/pair (Reiser and Bjornn 1979). Life history data applied to the estimated redd production were: 3,000 eggs/female, 3.5 percent egg to migrant survival, and 2.5 percent migrant to adult survival.

Other methods that were investigated but were not used to estimate chinook production were: habitat quality indexes (Binns and Eiserman 1979; Gamblin 1984); a carrying capacity study of spring chinook streams in central Idano (Sekulich 1980); and the USDA FS smolt habitat capability index for the Malheur, Umatilla, and Wallawa-Whitman National Forests.

General Discussion: Variation in the chinook estimates is due, in part, to uncertainty about the use of the Tygh system, which will depend on migration timing of the adult run and on effects on chinook of high water temperatures in lower Tygh Creek from mid-July to September. Uncertainty about the timing of the adult run and migration within White River basin makes it difficult to predict the areas chinook will use. Access to the Tygh system as well as other tributaries would be difficult because of low flows if adult chinook do not migrate to the spawning areas until late August as is the case in the Warm Springs (Confederated Tribes of the Warm Springs Indians, unpublished data). Summer water temperatures and late summer flows were used to help determine which streams would probably be used by chinook. Little Badger, Threemile, Rock, Gate, Iron, Bonney, and Buck creeks and the upper reaches of White River and Frog Creek were not used to estimate potential production of chinook.

Data used to make production estimates of Steelhead and salmon are in Tables 2.2 to 2.10. The baseline data on fish habitat and resident fish populations are in Tables 2.11 to 2.22. The location of sample sites in the White River basin are shown on maps in Figures 2.5 to 2.16.

Table 2.2. Estimated production of Sumner Steelhead in the White River system. a/

Method		Smolts b/	Adults
1. Abundance of resident trout 215 cm	Below barriers	23,166	927
	Above barriers	6,834	273
2. Numerical densities of age 1 and older Steelhead	Below barriers	77,302	3,092
	Above barriers	26,644	1,066
3. Numerical densities of age 0 Steelhead	Below barriers	28,348	1,134
	Above barriers	8,960	358
4. Abundance of age 1 resident trout	Below barriers	42,042	1,682
	Above barriers	15,094	604
5. Rearing area required per smolt	Below barriers	46,209	1,848
	Above barriers	12,729	509
6. Rearing area required per smolt (20 m2/smolt)	Below barriers	64,215	2,569
	Above barriers	12,729	509
7. Smolts per unit of area	Below barriers	25,686- 38,529	1,027-1,541
	Above barriers	5,092- 7,637	204- 305
8. Numerical age 0 densities from Warm Springs River and eastern Oregon rivers	Below barriers	35,427	1,417
	Above barriers	10,553	422
9. Numerical age 1 and older densities from Warm Springs and eastern Oregon rivers	Below barriers	64,252	2,570
	Above barriers	19,294	772
10. Returning adults per unit area	Below barriers		4,320-6,221
	Above barriers		856-1,233
11. Spawning gravel requirements per pair of spawners	Below barriers	61,363-273,523	2,445-10,941
	Above barriers	9,009-40,082	360- 1,603

a/ Assumes access to and use of the Tygh Creek system above diversion dams. Survival figures used: 35X age 0 to age 1 (Sumner); 60% over winter: 4% smolt to returning adult (to Deschutes River). In Method 11 survival calculated at: 85% egg to swim-up fry: 8% fry to yearling; 60% over winter.
b/ Reduced by 20% to account for resident rainbow trout (Bjornn 1978).

Table 2.3. Estimated production of spring chinook in the White River system. g/

Method		Migrants	Adults
1. Smolt Productivity Index (entire watershed)		86,753	2,169
2. Comparison to Warm Springs River - drainage area b/ (entire watershed)		59,471	1,586
3. Comparison to Warm Springs River - September flow b/ (entire watershed)		37,500	1,000
4. Comparison to Warm Springs River - spawning gravel b/			
a. no restrictions on use of Tygh system	Below barriers	65,836	1,756
	Above barriers	5,666	151
b. limited use of lower Tygh, passage at dams	Below barriers	58,350	1,556
	Above barriers	5,666	151
C. no use of Tygh system	Below barriers	45,464	1,212
	Above barriers	116	
5. Potential use of spawning gravel in White River based on Warm Springs data			
a. no restrictions on use of Tygh system	Below barriers	50,715	1,268
	Above barriers	4,410	110
b. limited use of lower Tygh, passage at dams	Below barriers	44,940	1,124
	Above barriers	4,410	110
C. no use of Tygh system	Below barriers	34,965	874
	Above barriers	105	3
6 Rearing densities of Warm Springs			
a. no restrictions on use of Tygh system	Below barriers	42,743	1,069
	Above barriers	7,118	178
b. no use of Tygh system	Below barriers	33,980	850
	Above barriers	2,324	58
7 Rearing densities of Warm Springs and John Day rivers--assumes use of Tygh	Below barriers	67,279	1,682
	Above barriers	20,541	514

Table 2.3. Estimated production of spring chinook in the White River system. a/ (Continued)

Method		Migrants	Adults
8. Returning adults per unit area			
a. no restrictions on use of Tygh system	Below barriers	--	1,994-6,288
	Above barriers	--	332-1,047
b. no use of Tygh system	Below barriers	--	1,585-4,999
	Above barriers	--	108- 342
9. Spawning gravel requirements per pair of spawners			
a. no restrictions on use of Tygh system	Below barriers	75,705-307,230	1,893-7,681
	Above barriers	6,510- 26,460	163- 662
b. no use of Tygh system	Below barriers	52,290-212,205	1,307-5,305
	Above barriers	105- 525	3- 13

a/ Survival figures used: 3.5% egg to migrant; 2.5% migrant to returning adult (Deschutes River); 60% over winter.

b/ Mean run sizes of Warm Springs chinook were prorated using average runs of 75,000 migrants and 2,000 adults.

Table 2.4. Length of streams in the White River basin that were used to estimate the production of steelhead and chinook.

Stream	Stream length (km)			
	Steelhead		Chinook	
	Below barriers	Above barriers	Below barriers	Above barriers
White River	65.6	--	61.3 (28.0)a/	--
Tygh Creek b/	20.2	8.6	20.2	8.6 (5.3) a/
Jordan Creek b/	1.4	20.5	1.4	20.5 (14.6) a/
Badger Creek c/	24.5	5.7 d/	24.5	5.7 d/
		5.0		5.0
Little Badger Creek	9.1	0	0	0
Threemile Creek	16.1 e/	--	0	
Rock Creek f/	5.3 e/	9.6	0	0
Gate Creek	13.4 e/	--	0	--
South Fork	2.9	--	0	--
Boulder Creek	17.6	--	17.6	--
Forest	2.6	--	0	--
Clear Creek c/	12.5	6.4	12.5	6.4
Frog Creek c/	7.4	5.1	7.4 (5.6) a/	0
Barlow Creek	10.2		10.2	--
Mineral Creek	4.9	--	4.9	--
Iron Creek	4.3	--	0	--
Buck Creek	3.2	--	0	--
Bonney Creek	1.6	--	0	--
Total	222.8	60.9	160.0 (124.9)a/	46.2 (37.0)a/

a/ Stream length in parenthesis is potential for spawning; area outside parenthesis is rearing potential.

b/ Barrier on creek is a major waterfalls.

c/ Barrier on creek is a diversion dam.

d/ Stream above diversion dam and below waterfalls.

e/ Stream length adjusted for dry and intermittent sections, and for section with no resident fish.

f/ Barrier is a reservoir dam.

Table 2.5. Estimated production of Steelhead smolts in the White River basin based on expanded population estimates of resident trout ≥15 cm, Method 1.

Stream, location	Resident trout > 15 cm	Estimated smolts a/
White River	11,433	9,146
Tygh Creek		
below falls	2,282	1,826
above falls	578	462
Jordan Creek		
below falls	282	226
above falls	3,302	2,642
Badger Creek		
below Highland Ditch	3,399	2,719
Highland to falls	1,308	1,046
above falls	1,128	902
Little Badger Creek		
below falls	269	215
Threemile Creek	4,464	3,571
Rock Creek		
below reservoir	309	247
above reservoir	750	600
Gate Creek	743	594
Boulder Creek	2,145	1,716
Clear Creek		
below diversion	1,735	1,388
above diversion	764	611
Frog Creek		
below diversion	417	334
above diversion	714	571
Barlow Creek	814	651
Mineral Creek	172	138
Iron Creek	494	395
Total below barriers		23,166
above ditches		2,228
above falls		4,006
above reservoir		600

a/ Twenty percent reduction from number of resident trout used to account for resident trout remaining after introduction (Bjornn 1978).

Table 2.6. Data summary of Steelhead estimate for the White River basin based on numerical densities of age 1 Steelhead from Northwest streams, Method 2.

Stream, location	White River streams Biomass density (gm/m^2)	Numerical density ($fish/m^2$1	Numercial density of Steelhead streams a/	Estimated Steelhead (age 1) b/
White River				
lower (Reach I)	3.70	0.03	0.14	22,702
middle and upper (II-IV)	1.32	0.03	0.04	29,526
Tygh Creek				
below falls	2.88	0.11	0.13	16,124
above falls	3.63	0.15	0.14	3,332
Jordan Creek				
below falls	5.99	0.19	0.31	2,177
above falls	5.91	0.23	0.31	24,626
Badger Creek				
below Highland Ditch	3.57	0.14	0.14	22,545
Highland to falls	4.89	0.11	0.25	8,239
above falls	4.89	0.11	0.25	7,104
Little Badger Creek				
below falls	3.05	0.18	0.13	3,369
Threemile Creek	9.27	0.33	0.46	20,872
Rock Creek				
below reservoir	2.97	0.10	0.13	1,540
above reservoir	4.50	0.20	0.20	5,402
Gate Creek	2.48	0.07	0.10	3,701
Boulder Creek	3.02	0.12	0.13	10,286
Clear Creek				
below diversion	2.34	0.10	0.10	9,136
above diversion	1.69	0.08	0.06	4,648
Frog Creek				
below diversion	1.63	0.09	0.06	2,462
above diversion	0.73	0.02	0.04	2,158
Barlow Creek	1.90	0.07	0.10	3,961
Mineral Creek	2.33	0.12	0.10	1,520
Iron Creek	3.97	0.13	0.20	2,472
Buck Creek	0.82	0.05	0.04	363
Bonney Creek	0.14	0.01	0.01	51
Total below barriers				161,046
above barriers				15,045
above falls				35,062
above reservoir				5,402

a/ From Steelhead streams in eastern Oregon and other Northwest streams with biomass densities similar to White River streams.

b/ Survival rates - 60% (over-winter); 20% reduction of smolts to account for resident trout; 4% (smolt to adult).

Table 2.7. Data summary of Steelhead estimate for the White River basin based on numerical densities of age 0 Steelhead from Northwest streams, Method 3.

Stream, location	White River streams Biomass density (am/m^2>	White River streams Numerical density (fish/m^{2}1	Numercial density of Steelhead streams a/	Estimated Steelhead (age 0) b/
White River	0.04	0.01	0.02	18,006
Tygh Creek				
below falls	0.59	0.15	0.33	40,931
above falls	0.35	0.16	0.21	4,998
Jordan Creek				
below falls	0.69	0.23	0.39	2,739
above falls	0.51	0.15	0.33	24,626
Badger Creek				
below Highland Ditch	0.40	0.12	0.24	38,649
Highland to falls	0.11	0.03	0.09	2,966
above falls	0.11	0.03	0.09	2,557
Little Badger Creek				
below falls	0.46	0.28	0.28	7,256
Threemile Creek	0.91	0.33	0.53	24,048
Rock Creek				
below reservoir	1.91	0.44	0.74	8,765
above reservoir	1.11	0.36	0.53	14,314
Gate Creek	0.11	0.03	0.09	3,331
Boulder Creek	0.14	0.05	0.09	7,121
Clear Creek				
below diversion	0.06	0.03	0.05	4,568
above diversion	0.06	0.02	0.05	3,873
Frog Creek				
below diversion	0.21	0.17	0.14	5,744
Barlow Creek	0.22	0.09	0.14	5,545
Mineral Creek	0.07	0.02	0.05	761
Buck Creek	0.09	0.03	0.09	816
Bonney Creek	0.10	0.03	0.09	458
Total below barriers				168,738
above ditches				6,839
above falls				32,181
above reservoir				14,314

a/ From Steelhead streams in eastern Oregon and Washington with biomass densities similar to White River streams.

b/ Survival rates - 35% (age 0 to age 1); 60% (over-winter); 20% reduction of smolts to account for resident trout; 4% (smolt to adult).

Table 2.8. Estimated production of Steelhead smolts in the White River basin based on expanded population estimates of age 1 resident trout, Method 4.

Stream, location	Resident trout age 1 and older	Resident trout age 1 a/	Estimated smolts b/
White River	26,793	15,360	7,373
Tygh Creek			
below falls	13,673	11,391	5,468
above falls	3,706	3,128	1,501
Jordan Creek			
below falls	1,323	1,041	500
above falls	16,895	13,593	6,525
Badger Creek			
below Highland Ditch	21,791	18,392	8,828
Highland to falls	3,718	2,410	1,157
above falls	3,205	2,077	997
Little Badger Creek			
below falls	4,763	4,494	2,157
Threemile Creek	14,999	10,535	5,057
Rock Creek			
below reservoir	1,235	926	444
above reservoir	5,500	4,750	2,280
Gate Creek	2,628	1,885	905
Boulder Creek	9,836	7,691	3,692
Clear Creek			
below diversion	9,013	7,278	3,493
above diversion	5,833	5,069	2,433
Frog Creek			
below diversion	3,750	3,333	1,600
above diversion	1,071	357	171
Barlow Creek	2,740	1,926	924
Mineral Creek	1,897	1,725	828
Iron Creek	1,605	1,111	533
Buck Creek	431	431	207
Bonney Creek	69	69	33
Total below barriers			42,042
above ditches			3,761
above falls			9,023
above reservoir			2,280

a/ Smolt-size resident trout subtracted from estimate of age 1 and older resident trout.

b/ Survival rates - 60% over-winter; 20% reduction to account for resident trout.

Table 2.9. Estimated surface area and spawning gravel area of streams used to estimate production of Steelhead in the White River basin, Methods 5 to 11.

Stream, location	Surface area (m^2)	Spawning gravel (m^2) a/
White River	900,301	3,847 b/
Tygh Creek		
below falls	124,033	503 c/
above falls	23,801 d/	415 e/
Jordan Creek		
below falls	7,022	39 c/
above falls	74,625	510 e/
Badger Creek		
below Highland Ditch	161,038	610 e/
Highland to falls	32,955	115 f/
above falls	28,414	99 f/
Little Badger Creek		
below falls	25,913	90 f/
Threemile Creek	45,374 g/	747 e/
Rock Creek		
below reservoir	11,844 d/	63 g/
above reservoir	27,008	74 g/
Gate Creek (South Fork)	37,010 d/	363 e/
Boulder Creek (Forest Creek)	79,120	1,533 f/
Clear Creek		
below diversion	91,361	514 f/
above diversion	77,469	17 f/
Frog Creek		
below diversion	41,026	361 f/
above diversion	53,950	122 f/
Barlow Creek	39,605	405 f/
Mineral Creek	15,203	12 r/
Iron Creek	12,361	8 f/
Buck Creek	9,070	98 f/
Bonney Creek	5,087	27 f/
Total below barriers	1,605,368	9,220
Total above barriers	318,222	1,352

a/ Classified as good spawning gravel.
b/ Reduction in gravel counted by BLM to reflect winter/spring conditions and to reflect gravels suitable for Steelhead.
Cl Based on winter/spring survey by ODFW.
d/ Reduction in area for sections with intermittent flow and sections without fish.
e/ Based on winter/spring survey by ODFW in lower reaches and summer survey by USDA FS in upper reaches.
f/ Based on summer survey by USDA FS.

Table 2.10. Estimated surface area and spawning gravel area of streams used to estimate production of chinook in the White River basin, Methods 4 to 9.

Stream, location	Surface area (m^2)	Spawning gravel (m^2) a/
White River		
Reach I-III	871,805	3,973 b/
Tygh Creek		
below falls - limited spawning c/	124,033	1,048
below falls - no restrictions -	124,033	1,896
above falls	23,801 d/	170 e/
Jordan Creek		
below falls	7,022	69
above falls	74,625	430 e/
Badger Creek		
below Highland Ditch - limited spawning c/	161,038	773
below Highland - no restrictions	161,038	1,023
Highland to falls	32,955	115
above falls	28,414	99
Boulder Creek (without Forest Creek)	73,668	1,444
Clear Creek		
below diversion	91,361	514
above diversion	77,469	17
Frog Creek		
below diversion	41,026	320 e/
Barlow Creek	39,605	405
Mineral Creek	15,203	12
Total below barriers		
limited spawning	1,424,761	8,558
no restrictions	1,424,761	9,656
Total above barriers	237,264	831

a/ Classified as good spawning gravel in summer stream surveys by ODFW and USDA FS.
b/ Gravel in White River below km 28.0.
a Limited use of spawning gravel in lower reaches because of high water temperatures.
d/ Reduction in area for stream reach without resident fish.
e/ Does not include gravel in upper reaches: Tygh-above km 25.5; Jordan-above km 16.0; Frog-above km 5.6.

Table 2.11. Location and description of stream reaches in the White River basin.

Stream	Reach	Location RM	Location km	Description
White River	I	2.1-6.5	3.4-10.4	White R. Falls to canyon above Mt. Fir mill
	II	6.5-32.6	10.4-52.2	Canyon section
	III	32.6-40.4	52.2-64.6	To confluence of Mineral Cr.
	IV	40.4-43.1	64.6-69.0	Mineral Cr. to Iron Cr.
Tygh	I	0.-4.8	0.0-7.7	Mouth to Badger Cr.
	II	4.8-9.3	7.7-14.9	Badger Cr. to Jordan Cr.
	III	9.3-15.9	14.9-25.4	Jordan Cr. to North-South Rd (FS Rd 27)
	IV	15.9-18.2	25.4-28.8	To RM 18 (FS Reach 1, 2, 3)
	V	18.2-20.0	28.8-32.0	To RM 20 (FS Reach 4)
Jordan	I	0.-2.2	0.-3.5	Mouth to second falls
	II	2.2-8.0	3.5-12.8	Second falls to North-South Rd (FS Rd 27)
	III	8.0-14.5	12.8-23.2	North-South Rd to headwaters
Badger	I	0.-2.5	0.-4.0	Mouth to Fairgrounds Rd.
	II	2.5-4.5	4.0-7.2	Fairgrounds Rd to Harvey's Farm
	III	4.5-8.0	7.2-12.8	Harvey's Farm to above L. Badger Cr.
	IV	8.0-15.3	12.8-24.5	Above L. Badger Cr. to Highland Ditch diversion
	V	15.3-22.0	24.5-35.2	Highland Ditch diversion to Badger Lake
Little Badger	I	0.-4.2	0.-6.7	Mouth to above FS Rd 2710 (FS Reach 1 - 1982 & 1983)
	II	4.2-7.5	6.7-12.0	To headwaters (FS Reach 2 & 3 - 1982)
Threemile	I	0.-12.0	0.-19.3	Mouth to Threemile Ditch diversion
	II	12.0-14.9	19.3-23.8	Threemile Ditch to above Rocky Burn (FS Reaches 1 and 2)
	III	14.9-19.2	23.8-30.7	Above Rocky Burn to headwaters (FS Reaches 3 and 4)
Rock	I	0.-3.0	0.-4.8	Mouth to Gate Cr.
	II	3.0-8.3	4.8-13.3	Gate Cr. to Rock Cr. Reservoir
	III	8.3-14.3	13.3-22.9	Above Rock Cr. Reservoir

Table 2.11. (continued)

Stream	Reach	Location RM	Location km	Description
Gate	I	0.-4.5	0.-7.3	Mouth to Hazel Hollow
	II	4.5-8.8	7.3-14.1	Hazel Hollow to above Souva Cr. (FS Reaches 1 and 2)
	III	8.8-13.0	14.1-20.8	To headwaters (FS Reaches 3 and 4)
South Fork Gate	I	0.-l.8	0.-2.9	Mouth to upper habitat limit
Boulder	I	0.-2.3	0.-3.7	Mouth to above Forest (Cedar) Cr.
	II	2.3-8.5	3.7-13.6	Forest Cr. to Boulder Lake outlet stream
	III	8.5-11.0	13.6-17.6	Boulder L. outlet stream to headwaters
Forest	I	0.-l.6	0.-2.6	Mouth to Forest. Ditch diversion
Clear	I	0.-l.5	0.-2.4	Mouth to above Camas Cr.
	II	l.5-7.8	2.4-12.5	Above Camas Cr. to Clear Cr. Ditch diversion
	III	7.8-11.8	12.5-18.9	Clear Cr. Ditch diversion to Clear Lake
Frog		0.-4.6	0.-7.4	Mouth to Frog Cr. Ditch diversion
	II	4.6-7.8	7.4-12.5	Diversion to 0.7 mi below Frog Lake
Barlow	I	0.-2.7	0.4.3	Mouth to end of White River floodplain
	II	2.7-5.4	4.3-8.6	White R. floodplain to above Palmateer Cr.
	III	5.4-6.4	8.6-10.2	Above Palmateer Cr. to Devil's Halfacre Campground
Mineral	I	0.-3.0	0.-4.8	Mouth to upper habitat limit
Iron	I	0.-2.7	0.-4.3	Mouth to upper habitat limit
Buck	I	0.-2.0	0.-3.2	Mouth to upper habitat limit
Bonney	I	0.-l.0	0.-l.6	Mouth to upper habitat limit

Table 2.12. Abundance and biomass of resident fish in the White River watershed above the falls, 1984.

Stream	Reach (length-m)	Abundance Rb	Abundance Other	Abundance Salmonids	Abundance Cot	Biomass (gm) Rb	Biomass (gm) Other	Biomass (gm) Salmonids	Biomass (gm) Cot	Surface area(m^2)
White Rive	I(7,040)	4,426	461 1/	4,887 -	7/	468,272	123,220 1/	591,492 -	7/	162,156
		5,348	450 2/	5,809 3/	--	484,658	86,176 2/	607,878 3/	--	
	II(41,760)	25,952		25,952	37,381	816,919		816,919	282,105	576,000
	III(12,480)	7,818	91 4/	7,909	8,455	149,740	2,382 4/	152,118	38,945	133,649
	IV(4,320)	735	88 4/	824	59	39,983	1,582 4/	41,566	682	28,496
Total	(65,600)	38,931 -	461 1/	39,572 -	45,895	1,474,914 -	123,220 1/	1,602,095 -	321,732	900,301
		39,853	450 2/	40,494 5/		1,491,300	86,176 2/	1,618,481 3/		
			179 4/				3,964 4/			
Tygh	I(7,680)	14,362		14,362	10,515	202,017		202,017	28,387	66,628
	II(7,200)	12,969		12,969	35,434	180,632		180,632	114,416	42,983
	III(10,560)	10,859		10,859	13,594	110,552		110,552	42,934	31,981
	IV(3,360)	2,083		2,083	833	34,563		34,563	4,725	6,560
	V(3,200)	0		0	0	0		0	0	4.783
	(0)									
Total	(32,000) a/	40,273		40,273	60,376	527,764		527,764	190,462	152,935 a/
	(28,800) b/									(148,152) b/
Jordan	I(3,520)	7,438		7,438	25,781	129,859		129,859	103,495	15,638
	II(8,320)	17,690		17,690	0	203,917		203,917	0	34,198
	III(10,080)	5,789		5,789	0	182,605		182,605	0	31,811
Total	(21,920)	30,917		30,917	25,781	516,381		516,381	103,495	81,647
Badger	I(4,000)	9,021		9,021	18,840	144,008		144,008	53,702	27,479
	II(3,200)	6,660		6,660	21,250	140,515		140,515	67,816	27,048
	III(5,600)	12,586		12,586	22,523	160,012		160,012	101,986	44,311
	IV(11,680)	14,677		14,677	27,016	217,508		217,508	129,080	62,200
	V(10,720)	8,846		8,846	0	305,632		305,632	0	61,369
Total	(35,200)	51,790		51,790	89,629	967,675		967,675	352,584	222,407

Table 2.12. (continued

Stream	Reach (length-m)	Abundance Rb	Abundance Other	Abundance Salmonids	Abundance Cot	Biomass (gm) Rb	Biomass (gm) Other	Biomass (gm) Salmonids	Biomass (gm) Cot	Surface area (m^2)
Little Badger	I(6,720)	10,246		10,246	246	74,083		74,083	1,230	19,961
	II(5,280)	3,828		3,828	0	39,162		39,162	0	11,511
Total	(12,000)	14,074		14,074	246	113,245		113,245	1,230	31,472
Threemile	I(19,300) a/	29,310 a/	17,241 b/	29,310 a/	0	596,886 a/	55,690 b/	596,886 a/	0	49,924 a/
	(11,600) b/	(17,345) b/	10,204) b/	(17,345) b/		(353,259) b/	(32,259) b/	(353,259) b/		(29,547) b/
	II(4,480)	12,612		12,612	0	107,009		107,009	0	15,827
	III(6,880)	0		0	0	0		0	0	18,582
	(0) b/									(0) b/
Total	(30,660) a/	41,922	17,241 b/	41,922	0	703,895 a/	55,690 b/	703,895 a/	0	84,333 a/
	(16,080) b/		(10,204) b/	(29,957) b/		(460,268) b/	(32,959) b/	(460,268) b/		(45,374) b/
	I(4,800)	60		60	0	157		157	0	12,871 a/
	(0) b/	(0) b/		(0) b/		(0) b/		(0) b/		(0) b/
	II(8,480) a/	10,098 a/		10,098 a/	0	88,147 a/		88,147 a/	0	18,812 a/
	(5,280) b/	(6,358) b/		(6,358) b/		(55,500) b/		(55,500) b/		(11,844) b/
	III(9,600)	15,250		15,250	35,250	153,110		153,100	119,850	27,008
Total	(22,880) a/	25,408 a/		25,408 a/	35,250	241,414 a/		241,414	119,850	58,691 a/
	(14,680) b/	(21,608) b/		(21,608) b/		(208,610) b/		(208,610) b/		(38,852) b/
Gate	I(7,300) a/	0		0	0	0		0	0	21,136 a/
	(0) b/									(0) b/
	II(6,720)	1,333		1,333	733	25,489		25,489	2,493	15,499
	III(6,720)	3,095		3,095	1,905	62,344		62,344	6,476	16,254
S. Fork Gate	I(2,880)	366		366	1,463	7,818		7,818	4,976	5,257
Total	(23,620) a/	4,794		4,794	4,101	95,651		95,651	13,945	58,146 a/
	(16,320) b/									(37,010) b/

Table 2 2 continued

Stream	Reach (length-m)	Abundance Rb	Abundance Other	Abundance Salmonids	Abundance Cot	Biomass (gm) Rb	Biomass (gm) Other	Biomass (gm) Salmonids	Biomass (gm) Cot	Surface area (m^2)
Boulder	I(3,680)	2,456		2,456	0	51,782		51,782	0	18,497
	II(9,920)	6,927	52 4/	6,979	0	110,331	833 4/	111,167	0	40,437
	III(4,000)	968	1,290 4/	1,828	0	15,252	32,929 4/	35,974	0	14,734
Forest (Cedar)	I(2,560)	2,442		2,442	0	50,937		50,937	0	5,452
Total	(20,160)	12,793	1,342 4/	13,705	0	228,302	33,762 4/	249,860	0	79,120
Clear	I(2,400)	2,857	422 4/	3,279	4,416	58,836	8,666 4/	67,524	10,597	21,175
	II(10,080)	2,568	5,811 4/	7,973	11,081	55,562	100,722 4/	149,797	26,595	70,186
	III(6,400)	625	7,083 4/	7,708	4,792	18,418	118,978 4/	126,846	11,500	77,469
Total	(18,880)	6,050	13,316 4/	18,960	20,289	132,816	228,366 4/	344,167	48,692	168,830
Frog	I(7,360)	278	10,417 4/	10,694	17,778	194	81,806 4/	75,717	42,667	41,036
	II(5,120)	0	1,071 4/	1,071	0	0	39,289 4/	39,289	0	53,950
Total	(12,480)	278	11,488 4/	11,765	17,778	194	121,095 4/	115,006	42,667	94,976
Barlow	I(4,320)	2,542		2,542	2,542	26,523		26,523	14,259	19,931
	II(4,320)	3,146		3,146	56	48,879		48,879	315	16,025
	III(1,600)	600		600	0	9,240		9,240	0	3,649
Total	(10,240)	6,288		6,288	2,598	84,642		84,642	14,574	39,605
Mineral	I(4,880)	2,069	345 4/	2,241	0	28,448	10,379 4/	36,445	0	15,203
Iron	I(4,320)	1,605		1,605	0	49,079		49,079	0	12,361
Buck	I(3,200)	517	172 4/	690	0	5,778	2,500 4/	8,276	0	9,070

Table 2 2. continued

Stream	Reach (length-m)	Abundance Rb	Abundance Other	Abundance Salmonids	Abundance Cot	Biomass (gm) Rb	Biomass (gm) Other	Biomass (gm) Salmonids	Biomass (gm) Cot	Surface area(m^2)
Bonney	I(1,600)	208		208	208	1,223		1,223	1,875	5,087
White River watershed a/	(319,640)	277,917 - 278,839	461 1/ 450 2/ 26,842 4/ 17,241 6/	304,212 - 305,134 5/	302,151 7/	5,171,421 5,187,807	123,220 1/ 86,176 2/ 400,066 4/ 55,690 6/	5,656,818 - 5,673,204 5/	1,211,106 7/	2,014,184

1/ Hatchery rainbow trout
2/ Whitefish
3/ Rainbow only
4/ Brook trout
5/ Rainbow and brook trout
6/ Largemouth bass
7/ No estimate of cottids in White River, Reach I
a/ Based on total stream length
b/ Based on stream sections with summer flow or with resident fish

Table 2.13. Abundance and biomass of resident fish above and below barriers in the White River watershed (above White River Falls), 1984.

	eam	Ab	e		Biomass (gm)				Surface
	h (	BT	a		Rb	BT	Salmonids	Cot	area (m^2)
Tygh Cr. Falls									
(20.2)									
Below	20,000	32,476	32,476	52,978	429,699		429,699	165,347	124,033
Above	11,800 a/	7,657	7,657	7,144	97,027		97,027	24,270	28,584 a/
	(8,600) b/								(23,801) b/
Jordan Cr. Falls									
(1.4)									
Below	1,400	2,907	2,907	10,239	44,705		44,705	32,559	7,022
Above	20,520	28,010	28,010	15,542	471,676		471,676	70,936	74,625
Highland Ditch (24.5) and Badger Cr. Falls c/									
(30.2)									
Below Highland	24,480	42,944	42,944	89,629	662,043		662,043	352,584	161,038
Above (to falls)	5,760	4,750	4,750	0	164,124		164,124	0	32,955
Above falls	4,960	4,096	4,096	0	141,508		141,508	0	28,414
L. Badger Cr. Falls d/									
(9.1)									
Below	9,120	11,965	11,965	246	91,671		91,671	1,230	22,321
Above	2,880	0	0	0	0		0	0	5,720
Rock Cr. Reservoir									
(13.3)									
Below	13,280 a/	10,158 a/	10,158 a/	0	88,304 a/		88,304 a/	0	31,683 a/
	(5,280) b/	(6,358) b/	(6,358) b/		(55,500) b/		(55,500) b/		(11,844) b/
Above	9,600	15,250	15,250	35,250	153,110		153,110	119,850	27,008
Clear Cr. Diversion Dam									
(12.5)									
Below	12,480	5,425	6,233	11,252	15,497	114,398	109,388	217,321	37,192	91,361
Above	6,400	625	7,083	7,708	4,792	18,418	118,978	126,846	11,500	77,469

Table 2 3 continued

Barrier (km)	Stream length (m)	Abundance Rb	Abundance BT	Abundance Salmonids	Abundance Cot	Biomass (gm) Rb	Biomass (gm) BT	Biomass (gm) Salmonids	Biomass (gm) Cot	Surface area (m^2)
Frog Cr. Diversion Dam (7.4)										
Below	7,360	278	10,417	10,694	17,778	194	81,806	75,717	42,667	41,026
Above	5,120	0	1,071	1,071	0	0	39,289	39,289	0	53,950

a/ Based on total stream length.

b/ Based on stream sections with summer flow or with resident fish.

c/ No measurements above barrier-assumes stream habitat is similar to sample sites in Reach V below falls and is based on % of stream length in Reach V above and below falls.

d/ One site above barrier-limited potential.

Table 2.14. Summary of habitat and fish data of areas above and below barriers a/ in the White River watershed (above White River Falls), 1984.

Parameter	Below barriers	%	Above barriers	%
Stream length (m)	252,600 b/ (229,600) c/	79	67,040 b/ (60,960) c/	21
Surface area (m^2)	1,685,459 b/ (1,624,107) c/	84 b/ 85 c/	328,725 b/ (295,528) c/	16 b/ 15 c/
Abundance				
Rb	217,990 b/ (202,225) c/	78 b/ ,77 c/	60,388	22 b/ 23 c/
Salmonids d/	236,131 (220,366)	77 b/ 76 c/	68,542	23 b/ 24 c/
cot	246,567	82	55,584	18
Biomass (gm)				
Rb	4,133,751 b/ (3,857,320) c/	80 b/ 79 c/	1,045,863	20 b/ 21 c/
Salmonids d/	4,471,431 b/ (4,195,000) c/	79 b/ 78 c/	1,193,580	21 b/ 22 c/
cot	984,550	81	226,556	19

a/ Includes major barriers (waterfalls on Jordan, Tygh, Badger, and Little Badger creeks; Rock Creek Reservoir dam) and diversion dams on upper Badger, Clear, and Frog creeks.
b/ Based on total stream length and area.
c/ Based on stream sections with summer flow or with resident fish.
d/ Native and hatchery rainbow trout and brook trout.

Table 2.15. Estimated abundance and biomass of age 0 trout and age 1 and older trout in the White River basin, 1984.

			0 (<8.0 cm)				1 and older (>8.1 cm			
				h/m^2	Biomass	m/m^2	Number	Fish/m^2	Biomass	Gm/m^2
White River	I	162,156	173	0.001	842	0.01	5,175	0.03	599,454	3.70
	II	576,000	11,190	0.02	33,971	0.06	14,762	0.03	784,593	1.36
	III	133,649	1,818	0.01	2,667	0.02	6,091	0.05	150,110	1.12
	IV	28,496	59	0.002	274	0.01	765	0.03	41,294	1.45
Total		900,301	13,240	0.01	37,754	0.04	26,793	0.03	1,575,451	1.75
Tygh	I	66,628	8,367	0.13	37,584	0.56	5,996	0.09	162,535	2.44
	II	42,983	7,031	0.16	27,972	0.65	5,938	0.14	153,295	3.57
Below Falls	III	14,422	3,406	0.24	6,430	0.45	1,739	0.12	41,209	2.86
Above Falls	III	17,241	2,951	0.17	6,230	0.36	2,623	0.15	55,295	3.21
	IV	6,560	1,000	0.15	2,200	0.34	1,083	0.17	32,367	4.93
	V	4,783	0	--	0	--	0	--	0	-
Below Falls Total		124,033	18,804	0.15	71,986	0.58	13,673	0.11	357,039	2.88
Above Falls Total (with fish)		23,801 a/	3,951	0.16	8,430	0.35	3,706	0.15	87,662	3.63
Jordan, Below Falls	I	7,022	1,584	0.23	4,877	0.69	1,323	0.19	42,052	5.99
Above Falls	I	8,616	2,389	0.28	9,127	1.06	2,212	0.26	82,854	9.62
	II	34,198	8,016	0.23	26,855	0.79	9,683	0.28	177,406	5.19
	III	31,811	789	0.02	2,108	0.07	5,000	0.16	180,516	5.67
Above Falls Total		74,625	1,194	0.15	38,090	0.51	16,895	0.23	440,776	5.91
Badge	I	27,479	5,335	0.19	21,230	0.77	3,686	0.13	119,009	4.33
	II	27,048	2,695	0.10	10,090	0.37	3,965	0.15	135,187	5.00
	III	44,311	7,445	0.17	24,943	0.56	3,438	0.08	95,079	2.15
	IV	62,200	4,549	0.07	8,588	0.14	10,702	0.17	226,358	3.64
Below Falls	V	32,955	1,033	0.03	3,634	0.11	3,718	0.11	161,108	4.89
Above Falls	V	28,414	890	0.03	3,133	0.11	3,205	0.11	138,907	4.89
Below Falls Total		193,993	21,057	0.11	68,485	0.35	25,539	0.13	736,741	3.80

Table 2.15. (continued)

Stream	Reach	Area (m^2)	0 (<8.0 cm) Number	Fish/m^2	Biomass	Gm/m^2	1 and older (>8.1 cm) Number	Fish/m^2	Biomass	Gm/m^2
Little Badger	I	19,961	6,148	0.31	10,258	0.51	4,061	0.20	63,581	3.19
Below Falls	II	5,952	982	0.17	1,729	0.29	702	0.12	15,502	2.60
Above Falls	II	5,720	0	--	0	--	0	--	0	--
Below Falls Total		25,913	7,130	0.28	11,987	0.46	4,763	0.18	79,083	3.05
Threemile	I	29,547 a/	7,346	0.25	29,423	1.0	9,999	0.34	323,592	10.95
	II	15,827	7,612	0.48	11,852	0.75	5,000	0.32	96,998	6.13
	III	18,582	0	--	0	--	0	--	0	--
Total (with fish and flow)		45,374 a/	14,958	0.33	41,275	0.91	14,999	0.33	420,590	9.27
Rock	I	12,871	60	0.005	157	0.01	0	--	0	--
	II	11,844	5,123	0.43	22,633	1.91	1,235	0.10	35,224	2.97
Above reservoir	III	27,008	9,750	0.36	29,933	1.11	5,500	0.20	21,400	4.50
Below reservoir Total (with fish and flow)		11,844 a/	5,183	0.43	22,760	1.91	1,235	0.10	35,224	2.97
Gate	I	21,136	0	--	0	--	0	--	0	--
	II	15,499	400	0.03	1,300	0.08	933	0.06	24,193	1.56
	III	16,254	833	0.05	2,836	0.17	2,262	0.14	59,869	3.68
South Fork	I	5,257	0	--	0	--	366	0.07	7,817	1.49
Total (with fish and flow)		37,010	1,233	0.03	4,136	0.11	2,628	0.07	91,879	2.48
Boulder	I	18,497	585	0.03	1,875	0.10	1,871	0.10	50,216	2.71
	II	40,437	2,344	0.06	7,464	0.18	4,635	0.11	103,953	2.57
	III	14,734	591	0.04	910	0.06	1,237	0.08	35,171	2.39
	I	5,452	349	0.06	1,162	0.21	2,093	0.38	49,772	9.13
		79,120	3,869	0.05	11,411	0.14	9,836	0.12	239,112	3.02

Table 2.15. (continued)

Stream	Reach	Area (m^2)	0 (<8.0 cm) Number	Fish/m^2	Biomass	Gm/m^2	1 and older (>8.1 cm) Number	Fish/m^2	Biomass	Gm/m^2
Clear	I	21,175	682	0.03	2,256	0.11	2,662	0.13	65,739	3.10
	II	70,186	1,892	0.03	3,600	0.05	6,351	0.09	147,777	2.11
Above diversion	III	77,469	1,875	0.02	4,806	0.06	5,833	0.08	131,290	1.69
Below diversion Total		91,361	2,574	0.03	5,856	0.06	9,013	0.10	213,516	2.34
Frog, Below diversion	I	41,026	6,944	0.17	8,467	0.21	3,750	0.09	66,715	1.63
Above diversion	II	53,950	0	--	0	--	1,071	0.02	39,289	0.73
Barlow	I	19,931	1,750	0.09	3,594	0.18	792	0.04	22,872	1.15
	II	16,025	1,348	0.08	4,063	0.25	1,798	0.11	44,878	2.80
	III	3,649	450	0.12	1,251	0.34	150	0.04	7,361	2.02
Total		39,605	3,548	0.09	8,908	0.22	2,740	0.07	75,111	1.90
Mineral	I	15,203	345	0.02	1,103	0.07	1,897	0.12	35,352	2.33
Iron	I	12,361	0	--	0	--	1,605	0.13	49,079	3.97
Buck	I	9,070	259	0.03	861	0.09	431	0.05	7,414	0.82
Bonney	I	5,087	139	0.03	493	0.10	69	0.01	729	0.14

a/ Excludes stream sections with no summer flow or with no resident fish.

Table 2.16. Sumnary of abundance and biomass of resident trout in sample sites in the White River basin, 1984.

Stream	Reach	Site	Area(m^2)	Number Estimate	Number 95% C.L. (%)	Biomass Estimate	Biomass 95% C.L. (%)
White River	I	182	78,991	2,610	13	292,646	<1
	II	1	1,872	63	8	2,454	7
		2	549	46	7	977	7
	III	1	881	52	12	770	8
		2	591	35	6	904	5
	IV	1	621	13	0	569	6
		2	347	15	0	844	4
Tygh Creek	I	1	766	214	3	2,596	7
		2	761	218	2	2,230	6
		3	1,450	210	6	4,204	6
	II	1	327	103	4	872	7
		2	645	161	3	2,293	7
		3	563	199	2	3,284	5
	III	1	116	34	12	273	19
		2	83	37	5	380	20
		3	70	35	3	319	13
		4	140	33	6	443	14
	IV	1	34	25	0	415	12
		2	45	0	--	0	--
	V	1	45	0	--	0	--
Jordan Creek	I	1	324	134	6	2,061	7
		2	177	104	4	2,095	5
	II	1	145	86	3	1,146	6
		2	143	86	6	825	8
		3	143	51	4	598	11
	III	1	58	17	6	496	10
		2	64	5	0	198	8
Badger Creek	I	1	656	152	7	3,481	5
		2	411	198	2	2,107	5
	II	1	643	159	6	2,945	5
		2	741	182	6	4,250	7
	III	1	523	159	4	2,086	10
		2	598	107	5	1,260	5
		3	302	138	4	1,790	8
	IV	1	548	110	3	1,484	4
		2	224	72	4	1,213	9
	V	1	160	26	4	1,175	5
		2	319	43	5	1,209	8

Table 2.16. (continued)

Stream	Reach	Site	Area(m^2)	Number Estimate	Number 95% C.L. (%)	Biomass Estimate	Biomass 95% C.L. (%)
Little Badger Creek	I	1	69	62	5	210	20
		2	174	63	10	693	8
	II	1	67	49	8	501	12
		2	80	0	--	0	--
Threemile Creek	I	1	160	62	5	1,021	8
		2	128	108	10	2,441	4
	II	1	150	128	3	1,116	9
		2	63	41	15	318	19
	III	1	84	0	--	0	
		2	79	0	--	0	
Rock Creek	I	1	144	1	0	3	0
		2	71	0	--	0	--
	II	1	108	59	17	238	15
		2	85	44	11	661	14
	III	1	108	61	5	612	11
Gate Creek	I	1	123	0	--	0	
	II	1	135	9	0	132	19
		2	98	11	9	251	11
	III	1	73	17	12	308	13
		2	63	9	11	216	8
South Fork	I	1	43	3	0	64	14
Boulder	I	1	377	45	4	1,134	5
		2	256	39	5	636	8
	II	la	202	24	8	200	17
		lb	114	27	0	346	9
		2	173	40	10	446	10
		3	276	42	2	1,142	6
	III	1	153	30	30	595	8
		2	121	4	175	75	43
Forest	I	1	47	21	0	438	7

Table 2.16. (continued)

Stream	Reach	Site	Area(m2)	Number Estimate	Number 95% C.L. (%)	Biomass Estimate	Biomass 95% C.L. (%)
Clear	I	1	329	44	5	861	8
		2	323	57	5	1,219	5
	II	1	295	55	9	1,029	6
		2	224	4	0	80	26
	III	1	536	60	5	1,134	5
		2	580	51	18	847	6
Frog	I	1	101	28	4	290	13
		2	194	49	12	255	23
	II	1	302	6	33	220	7
Barlow	I	1	300	41	27	399	18
		2	179	20	10	237	21
	II	1	158	25	12	364	14
		2	127	31	26	507	11
	III	1	73	12	17	185	23
Mineral	I	1	88	13	15	211	11
Iron	I	1	103	13	0	398	7
Buck	I	1	105	8	0	96	15
Bonney	I	1	74	3	0	18	33

Table 2.17. Habitat summary of sample sites in the White River basin, 1984.

Stream	Reach	Site	Site length (m)	Area (m^2) a/ P	R	BW	SC	Total	Mean depth (m)	Mean width (m)	Volume (m^3)
Wh R er	I	1	225	3,176	2,589	387	0	6,152	0.47	27.7	2,892
		2	148.5	1,242	1,035	166	0	2,443	0.69	16.9	1,685
	II	1	117	874	860	138	0	1,872	0.37	16.6	692
		2	54.5	161	358	30	0	549	0.43	10.6	236
	II	1	79	112	755	14	0	881	0.27	11.3	238
		2	58	64	326	28	73	591	0.34	7.9	201
	IV	1	86	62	547	3	9	621	0.29	7.3	180
		2	61	44	278	25	0	347	0.31	5.9	108
ygh		1	89	353	270	143	0	766	0.23	8.5	176
		2	86	310	378	73	0	761	0.26	8.6	198
		3	169	1,002	91	93	264	1 450	0.30	7.2	374
		1	59	144	126	47	10	327	0.13	5.5	43
		2	104.5	252	371	22	0	645	0.14	6.2	90
		3	93.5	219	260	84	0	563	0.17	6.0	96
		1	44	67	47	2	0	116	0.12	2.7	14
		2	29.2	36	41	6	0	83	0.11	2.8	9
		3	28	27	38	5	0	70	0.14	2.5	10
		4	36	74	52	14	0	140	0.18	3.9	25
		1	19	11	16	7	0	34	0.15	2.5	5
		2	21.3	16	17	12	0	45	0.10	2.2	5
		1	30	8	32	5	0	45	0.07	1.6	3
Jordan	I	1	64.5	103	208	13	0	324	0.20	5.1	65
		2	48	85	66	26	0	177	0.22	4.0	39
	II	1	30	73	56	16	0	145	0.21	5.0	30
		2	36	76	60	7	0	143	0.21	4.0	30
		3	39	54	84	5	0	143	0.18	4.1	26
	III	1	20	25	27	6	0	58	0.20	3.0	11
		2	19	32	32	0	0	64	0.18	3.4	12

Table 2.17. (continued)

Stream	Reach	Site	Site length (m)	Area (m^2) a/ P	R	BW	SC	Total	Mean depth (m)	Mean width (m)	Volume (m^3)
Badger	I		89	269	175	158	54	656	0.29	7.6	190
		2	66	141	241	29	0	411	0.24	6.4	97
	II		87	220	330	93	0	643	0.21	7.8	135
			77	231	450	60	0	741	0.22	9.7	163
	III		61	203	290	30	0	523	0.18	8.9	94
		2	73.2	280	222	96	0	598	0.28	8.3	167
			46	114	160	28	0	302	0.25	7.0	76
	IV		95	379	152	17	0	548	0.23	6.5	126
		2	50	103	95	26	0	224	0.29	4.9	65
			34.7	86	50	24	0	160	0.38	5.0	61
		2	49	170	146	3	0	319	0.23	7.5	73
Little Badger	I		27.6	35	15	19	0	69	0.11	2.8	8
			55	47	87	35	5	174	0.14	3.3	24
	II		27	44	18	5	0	67	0.18	2.8	12
		2	40.3	37	39	4	0	80	0.14	2.3	11
Threemile	I		58	104	37	19	0	160	0.22	2.8	35
		2	55	111	8	9	0	128	0.20	2.4	26
	II		42	88	42	20	0	150	0.26	3.5	39
		2	18	22	29	12	0	63	0.19	3.5	12
	III		30	20	59	5	0	84	0.17	3.2	14
		2	30	19	39	19	2	79	0.15	3.1	12
Rock	I		47	137	3	4	0	144	0.28	3.0	40
		2	33	59	7	5	0	71	0.13	2.2	9
	II		44	88	17	3	0	108	0.21	2.6	23
		2	42	55	24	6	0	85	0.21	2.1	18
	III		38	43	49	16	0	108	0.12	2.9	13

Table 2.17. (continued)

Stream	Reach	Site	Site length (m)	Area (m^2) a/ P	R	BW	SC	Total	Mean depth (m)	Mean width (m)	Volume (m^3)
Gate	I	1	42	93	3	27	0	123	0.13	2.9	16
	II	1	61	80	33	22	0	135	0.12	2.2	16
		2	40	86	8	4	0	98	0.14	2.4	14
	III	1	30	26	28	19	0	73	0.20	2.5	15
		2	27	20	33	10	0	63	0.17	2.5	11
South Fork	I	1	23.6	25	15	3	0	43	0.10	2.0	4
Boulder	I	1	70	252	92	33	0	377	0.24	5.5	90
		2	56	193	43	20	0	256	0.13	5.5	33
	II	1a	51	77	41	3	81	202	0.12	2.8	25
		1b	56.3	93	21	0	0	114	0.15	2.1	17
		2	36.5	78	84	11	0	173	0.23	5.2	42
		3	48	154	108	14	0	276	0.23	5.8	63
	III	1	41	63	85	5	0	153	0.25	4.0	38
		2	33	61	34	26	0	121	0.20	4.1	24
Forest	I	1	22	26	21	0	0	47	0.12	2.0	6
Clear	I	1	31	107	148	31	43	329	0.33	11.9	109
		2	42.9	164	126	26	7	323	0.48	8.4	155
	II	1	42.1	95	173	27	0	295	0.39	7.1	115
		2	33	154	48	22	0	224	0.22	6.5	49
	III	1	36.8	476	49	11	0	536	0.31	14.6	166
		2	55	253	196	131	0	580	0.43	10.9	249
Frog	I	1	23	85	16	0	0	101	0.23	4.5	23
		2	29.7	118	31	17	28	194	0.16	6.8	31
	II	1	28.5	235	52	15	0	302	0.21	10.5	63

Table 2.17. (continued)

Stream	Reach	Site	Site length (m)	Area (m^2) a/ P	R	BW	SC	Total	Mean depth (m)	Mean width (m)	Volume (m^3)
Barlow		1	58	127	162	11	0	300	0.23	5.4	69
		2	45.4	79	100	0	0	179	0.19	4.1	34
		1	43	107	46	5	0	158	0.24	4.1	38
		2	33.5	60	52	4	1	127	0.20	3.9	25
		1	32	34	36	3	0	73	0.11	2.3	8
Mineral	I	1	28	41	40	7	0	88	0.20	3.3	18
Iron	I	1	35	24	70	9	0	103	0.33	3.2	34
Buck	I	1	37	22	66	13	4	105	0.13	3.0	14
Bonney	I		23	28	43	3	0	74	0.13	3.5	0

a/ P - pool; R - riffle; BW - backwater; SC - side channel.

Table 2.18. Summary of fish cover measurements in sample sites in the White River basin, 1984.

Stream	Reach	Site	Mean cover (%)	Cover type (%) a/ 1	2	3			
White River	I	1	7.4	4.0	8.9	0.4	0.2	0.8	85.7
		2	9.9	16.6	0.7	14.6	0.5	4.3	63.3
	II	1	2.4	6.3	3.2	5.4	0	13.9	71.2
		2	1.8	19.5	78.9	1.6	0	0	0
	III	1	3.0	32.6	49.8	11.5	0	30.0	3.1
		2	8.1	2.7	3.9	2.7	0.2	28.1	62.4
	IV	1	4.9	20.5	47.1	9.9	0	22.5	0
		2	2.2	15.4	74.9	0	0	9.8	0
	AVERAGE		8.0	14.7	33.4	5.8	0.1	10.3	35.7
Tygh	I	1	16.3	21.1	0	12.8	65.7	0.4	0
		2	6.0	11.4	2.6	46.9	39.1	0	0
		3	12.3	19.2	16.2	15.1	47.4	1.9	0.2
	II	1	5.1	3.0	29.2	62.0	4.0	1.8	0
		2	9.0	44.0	5.0	36.7	0	14.2	0.2
		3	5.7	17.7	10.8	70.1	0	1.2	0.2
	III	1	9.5	6.5	36.8	43.7	0	4.0	9.1
		2	12.9	24.4	33.9	14.8	1.1	21.2	4.6
		3	19.3	27.6	48.6	12.7	0	8.9	2.2
		4	21.9	7.0	50.9	9.1	0	32.5	0.5
	IV	1	16.8	21.4	26.5	27.7	0	0	24.4
		2	16.9	24.6	43.5	0	0	29.5	2.4
		1	14.0	31.3	24.9	0	0	41.9	1.9
	AVERAGE		12.7	19.9	25.3	27.0	12.1	12.1	3.5
Jordan	I	1	6.7	10.9	23.7	29.4	0	28.0	8.0
		2	13.8	26.8	26.2	8.0	21.4	3.7	14.0
	II	1	7.7	50.2	31.0	5.0	5.0	0	8.8
		2	9.3	38.6	32.1	8.5	0	3.0	17.8
		3	13.5	7.7	19.2	29.2	0	10.0	33.9
	III	1	6.0	29.3	16.7	0	0	15.3	38.7
		2	23.3	52.6	24.1	0	0	23.3	0
	AVERAGE		11.5	30.9	24.7	11.4	3.8	11.9	17.3

Table 2.18. (continued)

Stream	Reach	Site	Mean cover (%)	Cover type (%) a/ 1	2	3	4	5	6
Badger	I	1	9.9	34.3	7.7	25.0	13.4	14.7	4.9
		2	13.1	58.8	7.2	0	0	10.0	24.0
	II	1	12.8	83.7	0.1	3.1	1.8	9.7	1.6
		2	8.4	55.7	7.0	6.2	4.6	0.2	26.3
	III	1	9.3	7.0	12.1	78.3	0	2.3	0.4
		2	4.2	39.5	20.7	0	0.7	0	39.1
			18.3	78.3	3.9	1.4	0	0	16.4
	IV	1	13.0	29.7	34.0	2.3	0.1	12.7	21.2
		2	7.7	20.1	11.1	0.6	1.4	2.3	64.6
	V	1	16.6	46.0	4.1	0	0	0	49.9
		2	10.9	15.9	20.5	0	0	43.0	20.6
	AVERAGE		3	42.6	7	0.6	2.0	8.6	24.5
Little Badger	I	1	21.2	95.0	1.6	0	0	2.7	0.7
		2	9.6	30.6	43.7	2.2	0	23.5	0
	II	1	18.6	41.0	16.3	3.1	8.8	13.4	7.4
		2	10.5	37.0	29.0	3.8	0	17.2	3.0
	AVERAGE		15.0	50.9	22.7	4.8	2.2	14.2	5.3
Threemile	I	1	13.2	3.6	6.2	48.0	37.2	5.0	0
		2	40.6	0	5.4	50.5	4.8	39.3	0
		3	--	1.0	0	25.9	0	73.1	0
	II	1	13.3	16.0	6.7	6.0	3.8	49.3	18.2
		2	11.4	39.8	0	12.0	22.6	2.1	23.5
	III	1	17.4	18.7	31.7	5.4	0	14.6	29.5
		2	13.0	19.5	53.4	3.5	0	7.6	16.1
	AVERAGE		8.2	4.	4.8	21.6	9.8	27.3	2.5

Table 2.18. (continued)

Stream	Reach	Site	Mean cover (%)	Cover type (%) a/ 1	2	3	4	5	6
Rock	I	1	13.0	2.0	5.4	48.3	26 5	17.8	0
		2	23.3	1.2	0	98.2	0	0.7	0
	II	1	14.9	9.5	7.1	83.4	0	0	0
		2	22.7	4.5	11.6	33.3	11 3	39.3	0
	III	1	7.4	37.5	42.3	17.1	0	1.2	1.9
	AVERAGE		16.3	10.9	13.3	56.1	7.6	11.8	0.4
Gate	I	1	5.0	32.5	2.4	65.0	0	0	0
	II	1	14.1	0	1.0	90.1	8.9	0	0
		2	13.1	7.4	77.0	0	0	15.6	0
	III	1	16.2	18.7	44.5	0	0	28.1	8.6
		2	30.7	7.1	49.7	0	0	32.2	1.0
	AVERAGE		15.8	13.1	34.9	1.8	15.2	3.9	
South Fork	I	1	25.3	32.2	36.2	14.7	17.0	0	0
Boulder	I	1	9.9	34.8	22.6	0.3	0	0	42.3
		2	14.0	44.3	22.0	0	0	0.7	33.0
	II	1a	21.1	2.3	34.5	14.9	0	48.0	0.3
		1b	20.1	27.9	24.0	14.2	0	31.7	2.2
		2	20.2	17.8	16.3	4.0	0	13.3	48.6
		3	10.5	37.8	1.1	0	0	9.5	42.4
	III	1	35.0	7.7	12.3	0	58 0	22.0	0
		2	14.3	27.7	25.7	4.8	16 2	25.6	0
	AVERAGE		18.1	25.0	19.8	4.8	9.3	18.9	21.1
Fores	I	1	48.0	21.0	72.8	0	0	6.2	0

Table 2.18. (continued)

Stream	Reach	Site	Mean cover (%)	Cover type (%) a/ 1	2	3	4	5	6
lear	I	1	30.1	15.7	6.8	53.1	0	0	24.4
		2	34.2	18.2	17.9	12.6	0.9	0.2	50.1
	II	1	65.7	16.6	8.5	6.0	60.9	2.7	5.3
		2	27.0	0	6.7	49.5	31.9	4.9	7.0
	III	1	66.9	16.7	0.2	19.6	59.8	3.7	0
		2	58.4	8.1	0	30.2	61.6	0.1	0
	AVERAGE		47.1	12.6	6.7	28.5	35.9	1.9	14.5
Frog	I	1	42.4	4.6	61.7	5.2	0	18.4	0
		2	68.0	6.4	21.6	0.9	59.7	11.4	0
	II	1	48.0	9.2	21.3	2.8	19.3	35.4	2
	AVERAGE		52.8	13.4	34.9	3.0	26.3	21.7	0.7
Barlow	I	1	16.5	42.5	5.5	3.6	2.1	20.5	26.0
		2	30.6	8.6	11.2	23.3	1.8	48.7	6.4
	II	1	13.8	16.7	20.6	6.9	0	37.0	18.8
		2	12.9	5.6	13.8	26.6	30.2	22.3	1.5
	III	1	28.5	16.8	12.0	49.5	5.3	16.4	0
	AVERAGE		20.5	18.0	12.6	22.0	7.9	29.0	10.5
Mineral	I		6.5	56.6	24.2	0	0	0	19.2
Iron	I	1	34.9	6.1	1.2	0	0	36.7	56.0
Buck	I		2.5	10.2	14.7	17.4	0	52.0	5.7
Bonney	I	1	19.8	29.7	33.4	0	0	36.9	0

a/ Cover types:
1 - logs, boulders, debris below water surface
2 - logs, boulders, debris above water surface
3 - overhanging vegetation <0.3 m above water surface
4 - aquatic vegetation
5 - undercut banks
6 - depth with surface turbulence

Table 2.19. Composition of riffle substrate in sample sites in the White River basin, 1984.

Stream	Reach	Site	Mean substrate rank a/	Substrate composition by rank (%) a/ 1	2	3	4	5	6	7	8
White River			6.3	0	0	0	1.3	14.7	40.0	44.0	0
		2	5.8	0	0	1.3	6.7	24.0	49.3	18.7	0
	II		6.1	0	16.0	0	2.7	5.3	21.3	22.7	32.0
			6.0	0	32.0	0	0	1.0	0	4.0	64.0
	III		4.5	0	29.3	13.3	5.3	12.0	14.7	22.7	2.7
			7.3	0	4.0	1.3	2.7	1.3	2.7	24.0	64.0
	IV		6.4	0	2.7	4.0	6.7	8.0	24.0	24.0	30.7
			5.3	0	12.0	4.0	16.0	14.7	26.7	18.7	8.0
	AVERAGE		6.0	0	12.0	3.0	5.1	10.1	22.3	22.5	25.2
Tygh			6.3	0	2.7	2.7	5.3	8.0	24.0	52.0	5.3
		2	6.3	0	0	0	2.7	14.7	38.7	41.3	2.7
		3	5.8	0	1.3	1.3	5.3	22.7	44.0	25.3	0
	II		5.2	0	6.7	4.0	26.7	16.0	26.7	13.3	6.7
		2	6.3	0	0	0	5.3	12.0	36.0	40.0	6.7
			6.2	0	0	2.7	10.7	14.7	16.0	52.0	4.0
	III		6.6	0	2.7	0	4.0	9.3	17.3	46.7	20.0
		2	5.4	0	4.0	6.7	6.7	32.0	25.3	0	0
		3	5.5	0	5.3	9.3	12.0	13.3	26.7	33.3	0
			5.9	0	0	1.3	8.0	17.3	48.0	24.0	1.3
	IV		6.5	0	0	0	4.0	21.3	18.7	26.7	29.3
			5.3	0	1.3	9.3	30.7	17.3	16.0	9.3	16.0
			4.4	4.0	1.3	48.0	48.0	21.3	6.7	10.7	0
	AVERAGE		5.8	0.3	1.9	3.5	13.0	16.9	26.5	30.8	7.1
Jordan	I		6.2	0	5.3	1.3	5.3	8.0	24.0	48.0	8.0
			6.5	0	2.7	9.3	2.7	9.3	13.3	24.0	38.7
	II		6.4	0	0	0	8.0	13.3	25.3	41.3	12.0
		2	6.8	0	0	0	5.3	6.7	16.0	44.0	28.0
		3	6.7	0	0	0	4.0	12.0	25.3	26.7	32.0
	III		7.1	0	0	0	4.0	4.0	9.3	40.0	42.7
		2	5.8	0	0	4.0	25.3	9.3	22.7	24.0	14.7
	AVERAGE		6.5	0	1.1	2.1	7.8	8.9	19.4	35.4	25.2

Table 2.19. (continued)

Stream	Reach	Site	Mean substrate rank a/	Substrate composition by rank (%) a/ 1	2	3	4	5	6	7	8
Badger	I		5.8	0	0	2.7	16.0	16.0	29.3	36.0	0
		2	6.7	0	0	0	1.3	10.7	26.7	44.0	17.3
	II		6.4	0	1.3	0	6.7	16.0	25.3	32.0	18.7
			6.3	0	1.3	5.3	6.7	6.7	25.3	41.3	13.3
	III		6.3	0	2.7	2.7	10.7	6.7	20.0	42.7	14.7
		2	7.0	0	0	5.3	5.3	1.3	9.3	34.7	44.0
			7.5	0	0	1.3	1.3	1.7	9.3	14.7	70.7
	IV	1	6.8	0	0	0	6.7	6.7	14.7	41.3	30.7
		2	6.7	0	0	0	1.3	6.7	10.7	22.7	58.7
			7.6	0	0	0	4.0	1.3	4.0	12.0	78.7
		2	7.2	0	0	0	2.7	6.7	12.0	40.0	50.7
	AVERAGE		6.8	0	0.5	1.6	5.7	7.3	17.0	32.9	36.1
Little Badger	I		5.9	0	10.7	6.7	2.7	13.3	14.7	30.7	21.3
		2	6.3	1.3	0	5.3	8.0	5.3	24.0	40.0	16.0
	II	1	6.9	0	0	4.0	6.7	2.7	10.7	32.0	44.0
			6.5	0	1.3	4.0	6.7	8.0	26.7	16.0	37.3
	AVERAGE		6.4	0.3	3.0	5.0	6.0	7.3	19.0	29.7	29.7
Threemile	I		6.3	0	5.3	2.7	4.0	17.3	18.7	18.7	33.3
		2	4.9	4.0	2.7	20.0	17.3	29.3	32.0	0	
			5.9	0	4.0	4.0	8.0	12.0	28.0	44.0	0
	II		5.9	2.7	1.3	1.3	4.0	20.0	30.7	36.0	4.0
			6.1	0	0	0	8.0	10.7	44.0	36.0	1.3
	III		7.0	0	1.3	1.3	1.3	5.3	20.0	25.3	45.3
		2	6.2	0	2.7	9.3	9.3	9.3	14.7	24.0	30.7
	AVERAGE		6.0	1.0	2.5	3.0	7.8	13.1	26.5	30.9	16.4

Table 2.19. (continued)

			Mean substrate	Substrate composition by rank (%) a/							
Clear	I	1	7.4	0	0	1.3	1.3	0	13.3	16.0	68.0
		2	7.3	0	0	0	5.3	1.3	8.0	30.7	54.7
	II	1	6.0	6.7	4 0	4.0	5.3	4.0	26.7	20.0	29.3
		2	6.0	0	0	0	13.3	24.0	24.0	28.0	10.7
	III	1	2.9	12.0	40 0	20.0	13.3	2.7	2.7	5.3	4.0
		2	6.3	6.7	0	1.3	8.0	9.3	17.3	25.3	32.0
	AVERAGE		6.0	4.2	7.3	4.4	7.8	6.9	15.3	20.9	33.1
Frog	I	1	5.8	0	0	0	20.0	29.3	34.7	14.7	1.3
		2	4.7	0	8.7	17.3	18.7	8.0	9.3	10.7	7.3
	II	1	5.0	2.7	1.3	16.0	20.0	14.7	22.7	20.0	2.7
	AVERAGE		5.2	0.9	6.7	11.1	19.6	17.3	22.2	15.1	7.1
Barlow	I	1	6.7	0	0	0	6.7	13.3	14.7	36.0	29.3
		2	6.1	0	0	0	6.7	22.7	25.3	41.3	4.0
	II	1	6.1	0	4.0	2.7	6.7	20.0	20.0	24.0	22.7
		2	6.2	0	1.3	8.0	8.0	4.0	30.7	28.0	20.0
	III	1	4.4	0	0.7	7.3	22.7	26.7	18.7	2.7	1.3
	AVERAGE		5.9	0	3.2	5.6	10.2	17.3	21.9	26.4	15.5
Mineral	I	1	6.8	0	0	2.7	1.3	10.7	17.3	37.3	30.7
Iron	I	1	6.8	0	0	0	6.7	5.3	20.0	34.7	33.3
Buck	I	1	6.5	0	0	0	5.3	4.7	24.0	41.3	4.7
Bonney	I	1	6.2	0	1.3	2.7	1.3	17.3	34.7	28.0	14.7

a/ Substrate ranks:

1 - organic cover
2 - <2 mm (sand)
3 - 2-5 mm (pea gravel)
4 - 5-25 mm (small gravel)
5 - 25-50 mm (large gravel)
6 - 50-100 mm (small cobble)
7 - 100-250 mm (large cobble
8 - >250 mm (boulder)

KAnderson:paw (WP-PJS-5433N)

Table 2.20. Total dissolved solids and conductivity measured in streams in the White River basin, 1984.

Stream, location (km)	Date	Total dissolved solids (mg/l)	Conductivity (micromhos/cm)
White River:			
Lower (5.8)	10 September	149	86
Barlow Crossing (59.0)	12 July	104	57
	8 August	204	64
	14 August	188	69
	18 August	193	68
	11 September	161	66
Tygh Creek:			
below Badger Creek (1.6)	14 November	328	62
above Badger Creek (9.3)	9 November	169	77
above Jordan Creek (15.0)	14 November	107	54
Jordan Creek: near mouth (0.1)	9 November	159	75
Badger Creek (1.8)	9 November	195	50
Threemile Creek (20.5)	9 November	112	57
Rock Creek:			
below reservoir (12.7)	9 November	170	77
Gate Creek:			
above Rock Creek (9.6)	14 November	157	59
Boulder:			
above Forest Creek (4.6)	9 November	115	37
Forest Creek (2.1)	9 November	129	47
Clear Creek:			
above Frog Creek (6.2)	9 November	183	56
Frog Creek (5.6)	9 November	150	35
Barlow Creek (0.1)	9 November	128	33

Table 2.21. Total dissolved solids and conductivity measured in streams in the Warm Springs River basin and in Shitike Creek, 1973 and 1974. a/

Stream, location (km)	Date	Total dissolved solids (mg/l)	Conductivity (micromhos/cm)
Warm Springs River:			
near Kah-Nee-Ta (13.0)	10 September 1973	82	95
above Kah-Nee-Ta (14.4)	10 September 1973	73	81
Mill Creek:			
Potter's Pond (9.6)	5 June 1973	55	54
Old Mill Camp (14.4)	6 June 1973	59	54
Beaver Creek:			
near Simnasho (12.0)	31 May 1973	79	84
Shitike Creek:			
water supply diversion (9.9)	30 July 1974	44	55

a/ From CH2M Hill (1982)

Table 2.22. Characteristics (gradient and pool:riffle ratio) of streams in the White River basin from stream surveys and habitat measurements.

Stream	Reach	Gradient % 1983 a/	Gradient % 1984 b/	Pool:riffle 1983 a/	Pool:riffle 1984 Site b/	Pool:riffle 1984 Transect c/
White River	I	0.4 d/	0.9	50:50 e/	52:48	55:45
	II	1.5 f/	1.0	10:90 f/	28:72	41:59
	III	2.0	1.3	10:90	17:83	15:85
	IV	3.0	2.0	20:80	1:99	12:88
Tygh Creek	I	1.5	1.7	49:51	64:36	60:40
	II	2.1	1.3	35:65	46:54	46:54
	III	3.4	2.1	32:68	49:51	51:49
	IV	6.3	6.0	53:47	72:28	46:54
	V	6.0	5.0	50:50	12:88	21:79
Jordan Creek	I	3.3	2.3	40:60	35:65	44:56
	II	2.7	3.0	40:60	51:49	51:49
	III	6.0	3.1	30:70	54:46	49:51
Badger Creek	I	1.7	1.3	43:57	46:54	49:51
	II	1.2	1.9	13:87	42:58	37:63
	III	1.0	1.0	50:50	34:66	46:54
	IV	3.0	1.7	30:70	46:54	62:38
	V	6.0	3.5	30:70	40:60	58:42
Little Badger Creek	I	5.0	2.5	40:60	47:53	52:48
	II	7.0	5.2	35:65	45:55	60:40
Threemile Creek	I	2.2	1.0	56:44	82:18	84:16
	II	4.0	3.5	30:70	57:43	55:45
	III	10.0	8.9	40:60	15:85	29:71
Rock Creek	I	4.8	1.7	80:20	85:15	94:6
	II	2.2	1.0	80:20	71:29	77:23
	III	4.0	2.6	40:60	56:44	47:53
Gate Creek	I	2.5	1.0	58:42	92:8	97:3
	II	1.0	1.0	60:40	40:60	81:19
	III	5.0	5.2	40:60	43:57	45:55
South Fork Gate	I	3.0	1.0	70:30	59:41	62:38
Boulder Creek	I	4.0	3.0	40:60	45:55	78:22
	II	3.0	2.9	30:70	49:51	66:34
	III	2.0	1.0	50:50	53:47	53:47
Forest Creek	I	2.0	3.5	60:40	55:45	56:44

Table 2.22. (continued)

Stream	Reach	Gradient % 1983 a/	Gradient % 1984 b/	Pool:riffle 1983 a/	Pool:riffle 1984 Site b/	Pool:riffle 1984 Transect c/
Clear Creek	I	4.0	7.4	30:70	33:67	50:50
	II	3.0	2.2	40:60	29:71	56:44
	III	2.0	1.7	70:30	65:35	74:26
Frog Creek	I	2.0	1.4	65:35	84:16	82:18
	II	2.0	1.5	70:30	56:44	82:18
Barlow Creek	I	2.0	1.5	70:30	50:50	44:56
	II	3.0	1.7	40:60	45:55	62:38
	III	3.0	1.7	70:30	58:42	48:52
Mineral Creek	I	3.5	1.7	60:40	36:64	51:49
Iron Creek	I	3.0	3.0	20:80	33:67	25:75
Buck Creek	I	5.0	4.4	40:60	40:60	25:75
Bonney Creek	I	2.0	3.9	60:40	19:81	40:60

a/ From stream surveys of ODFW and USDA FS.
b/ From measurements along the thalweg of sample sites.
c/ From measurements at lo-15 transects in sample sites.
d/ Estimated from topographic map.
el Estimated from March 1985, stream survey, adjusted for low flow.
f/ From BLM survey (1980) and USDA FS survey (1983).

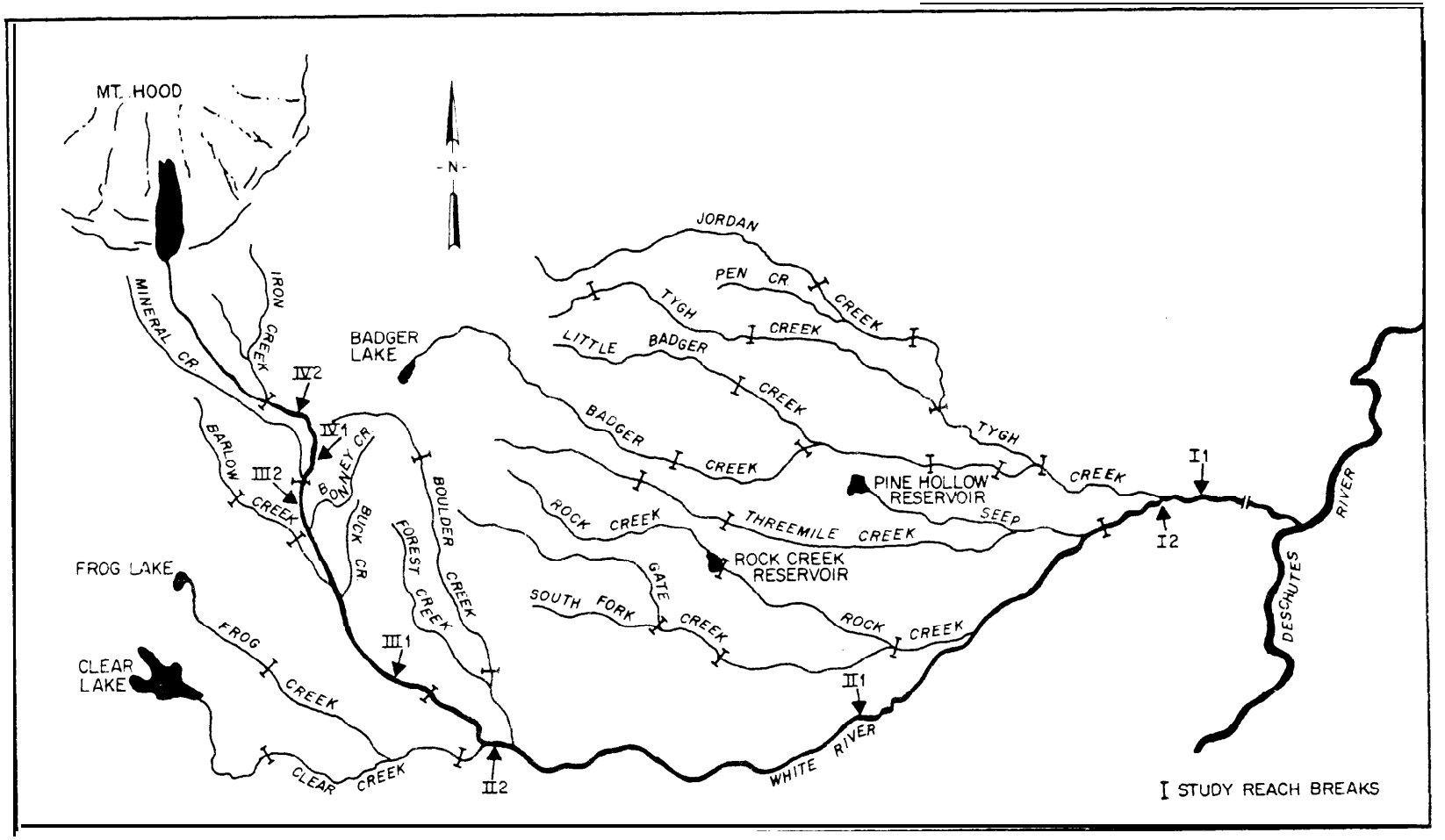


Figure 2.5 Sample sites in White River, 1984

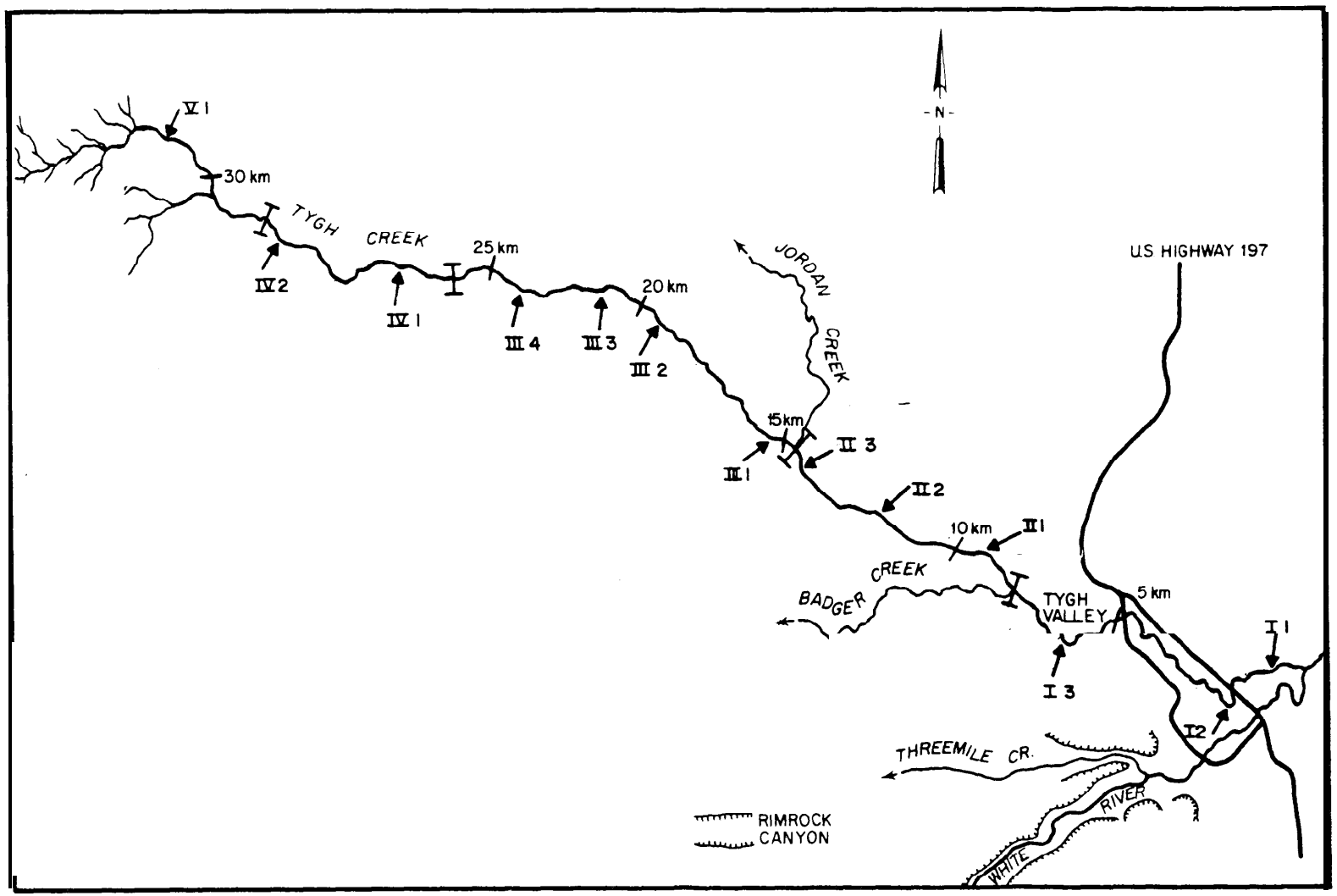


Figure 2.6 Sample sites in Tygh Creek, 1984

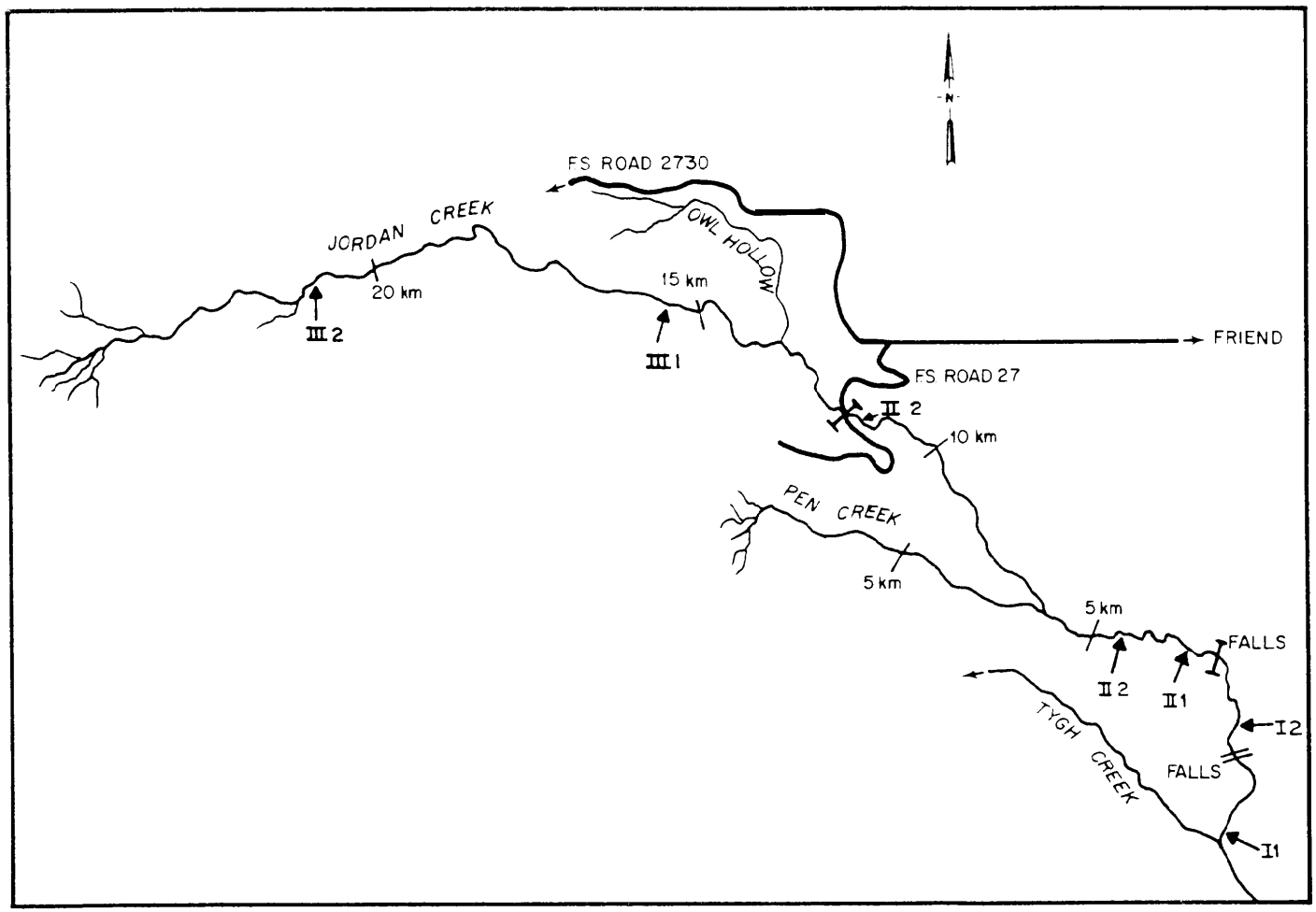


Figure 2.7 Sample sites in Jordan Creek, 1984

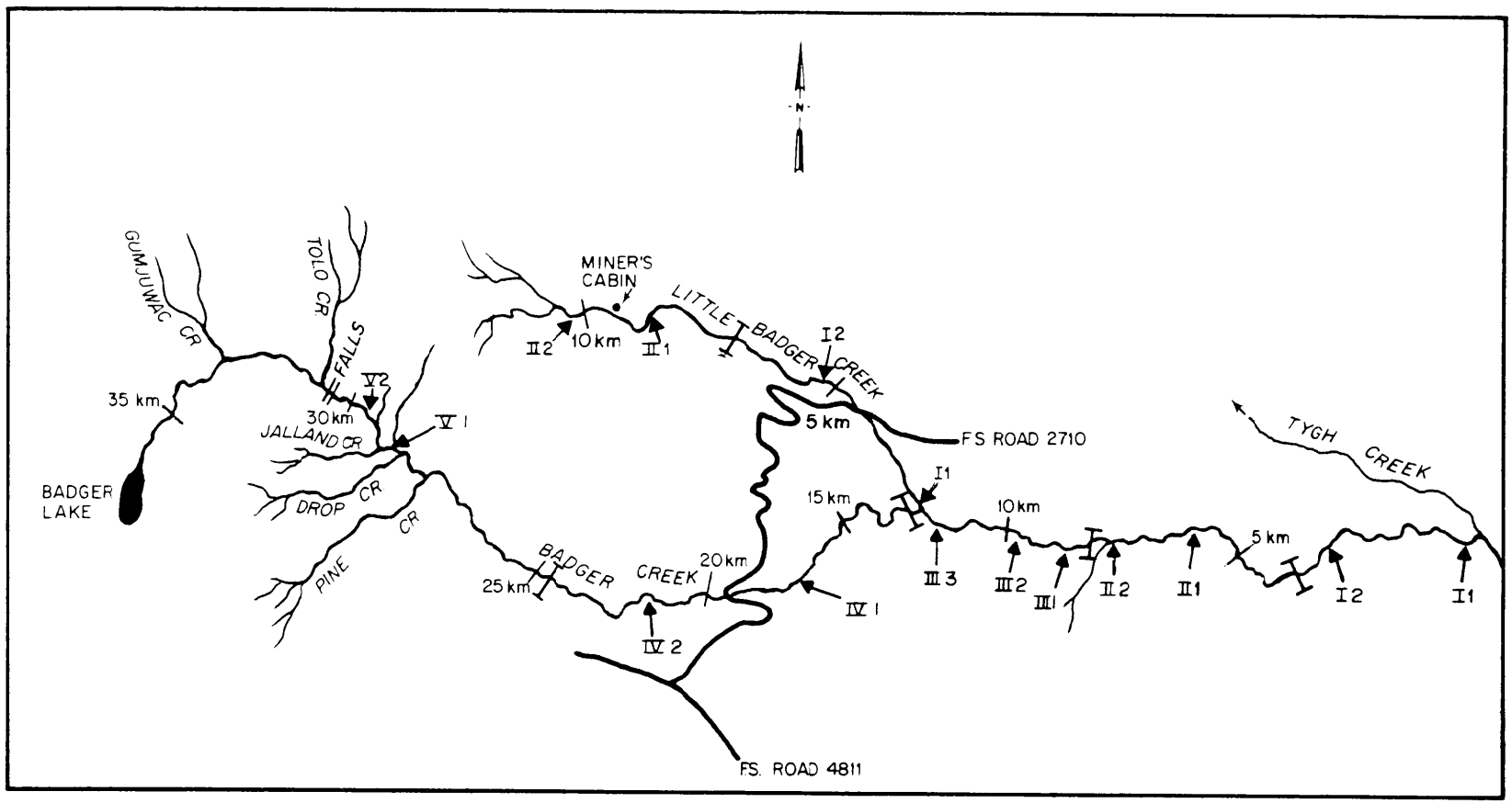


Figure 2.8 Sample sites in Badger and Little Badger creeks, 1984

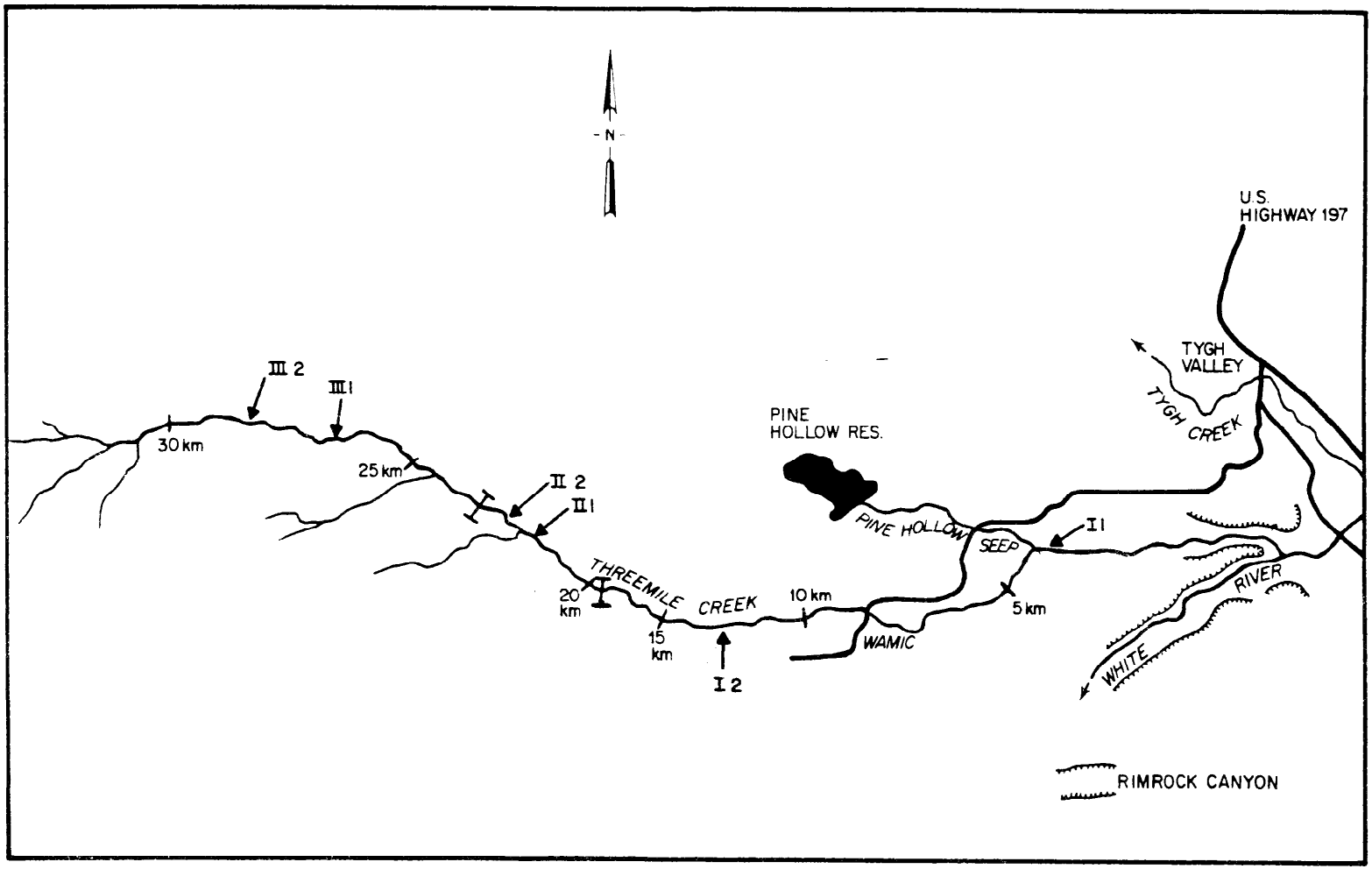


Figure 2.9 Sample sites in Threemile Creek, 1984

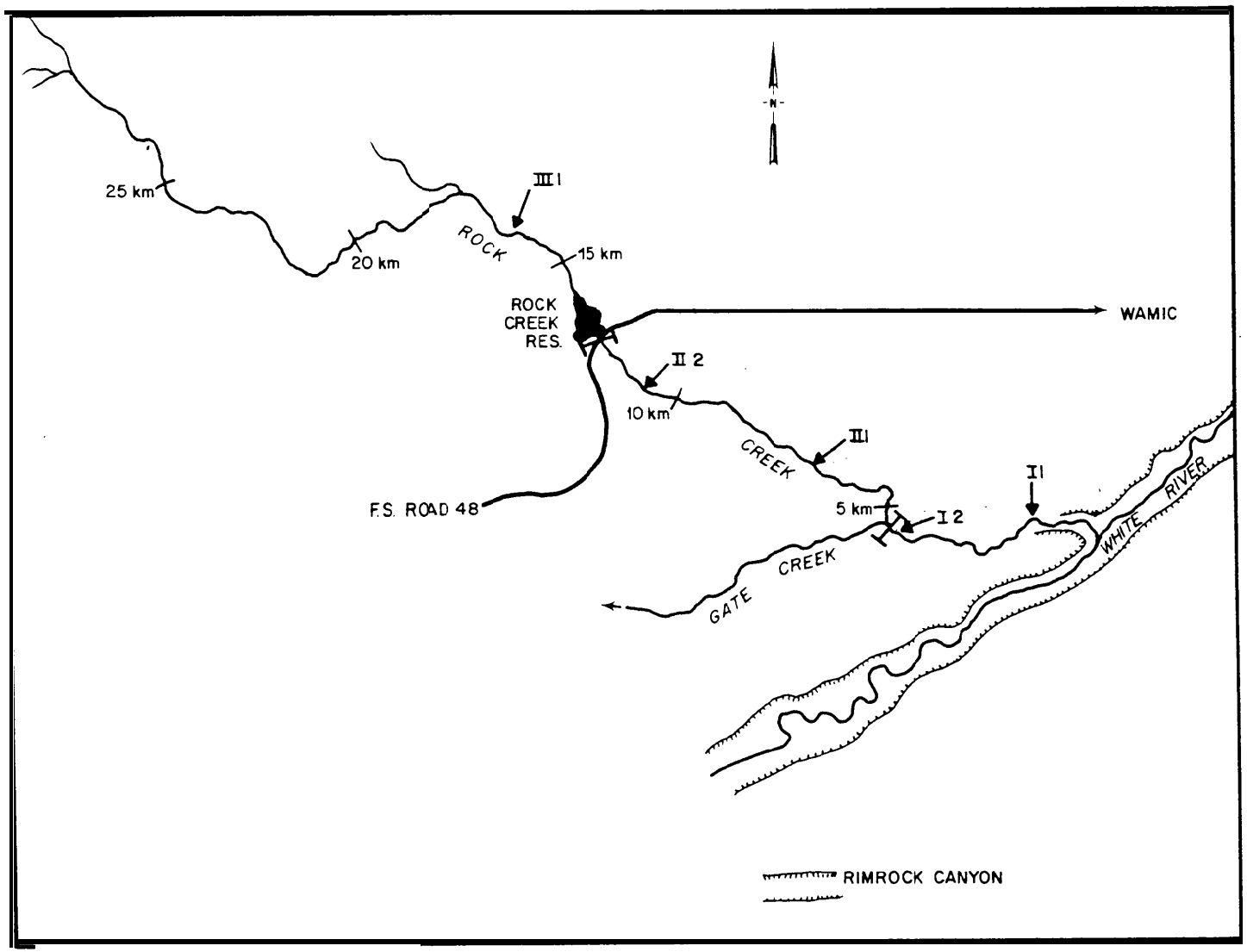


Figure 2.10 Sample sites in Rock Creek, 1984

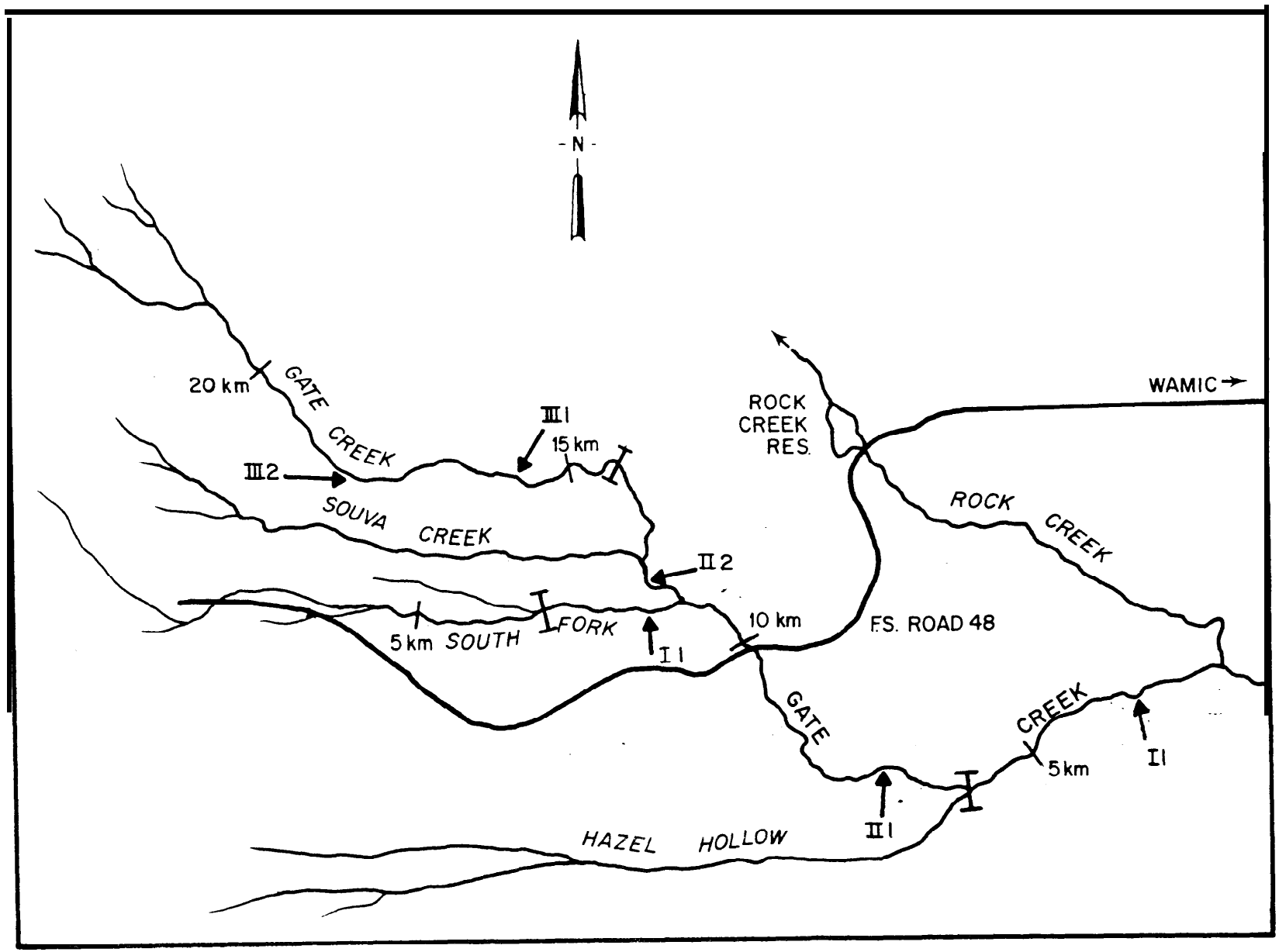
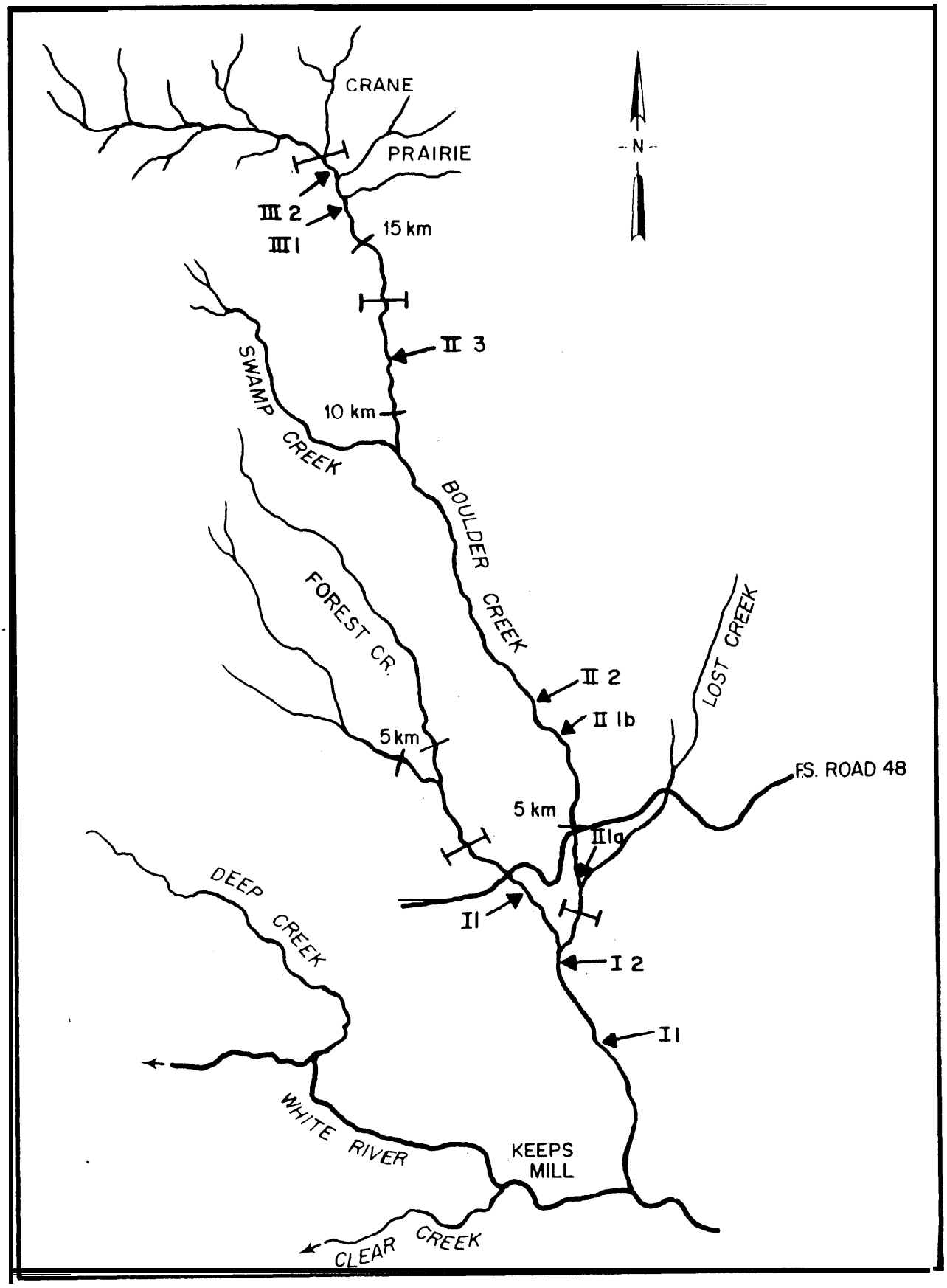


Figure 2.11 Sample sites in Gate and South Fork Gate creeks, 1984

Figure 2.12 Sample sites in Boulder and Forest creeks, 1984



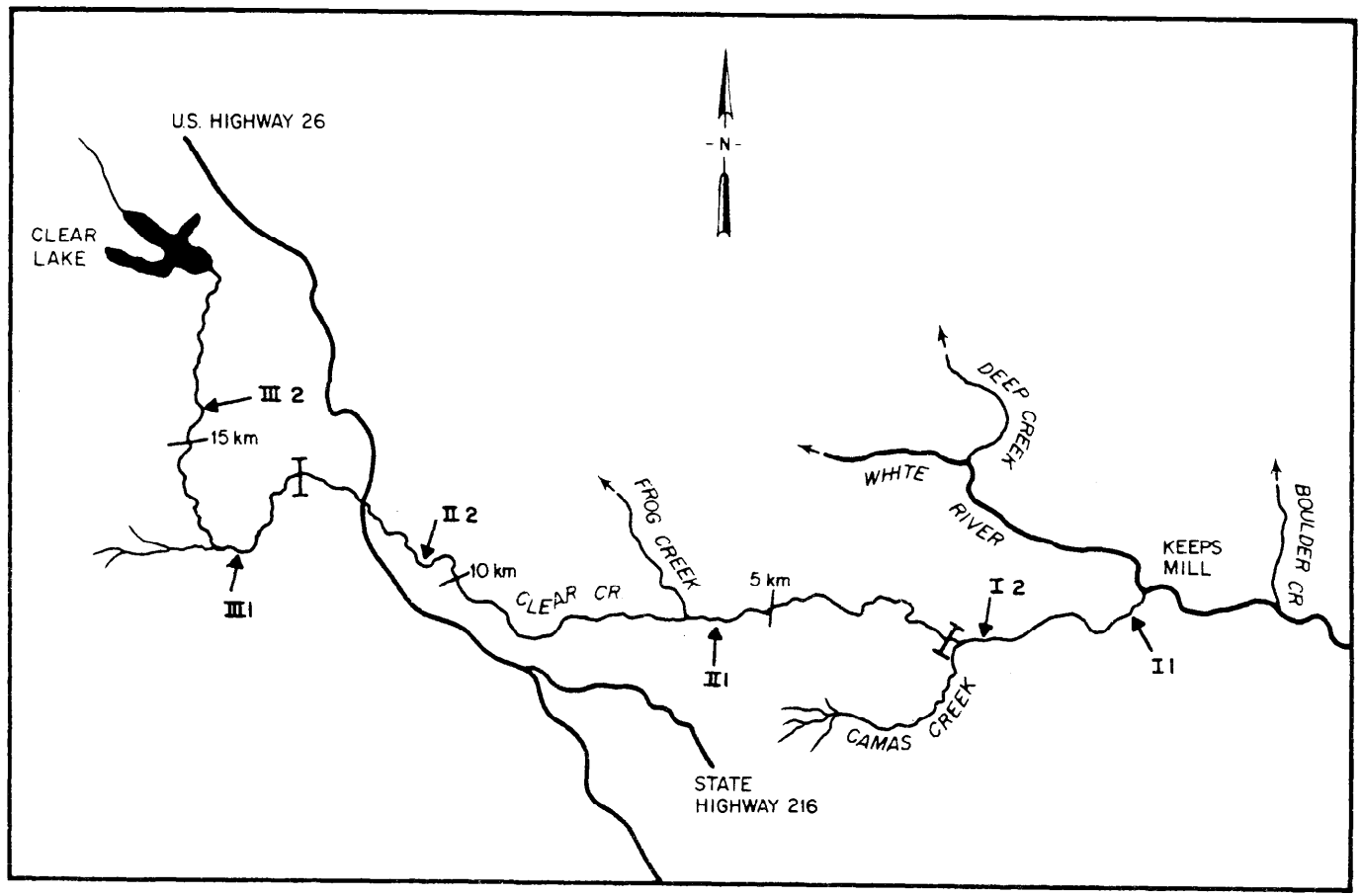
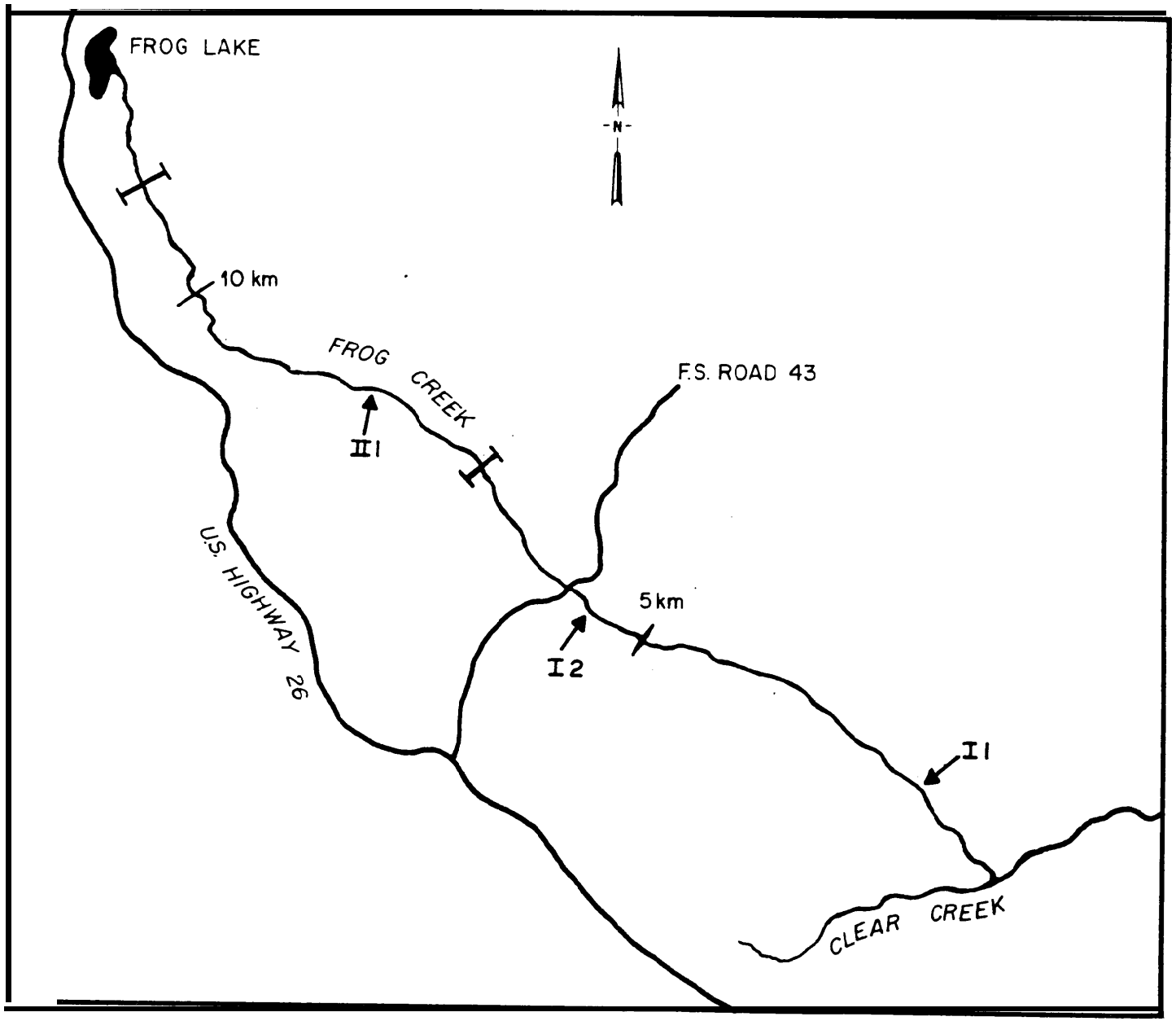


Figure 2.13 Sample sites in Clear Creek, 1984

Figure 2.14 Sample sites in Frog Creek, 1984



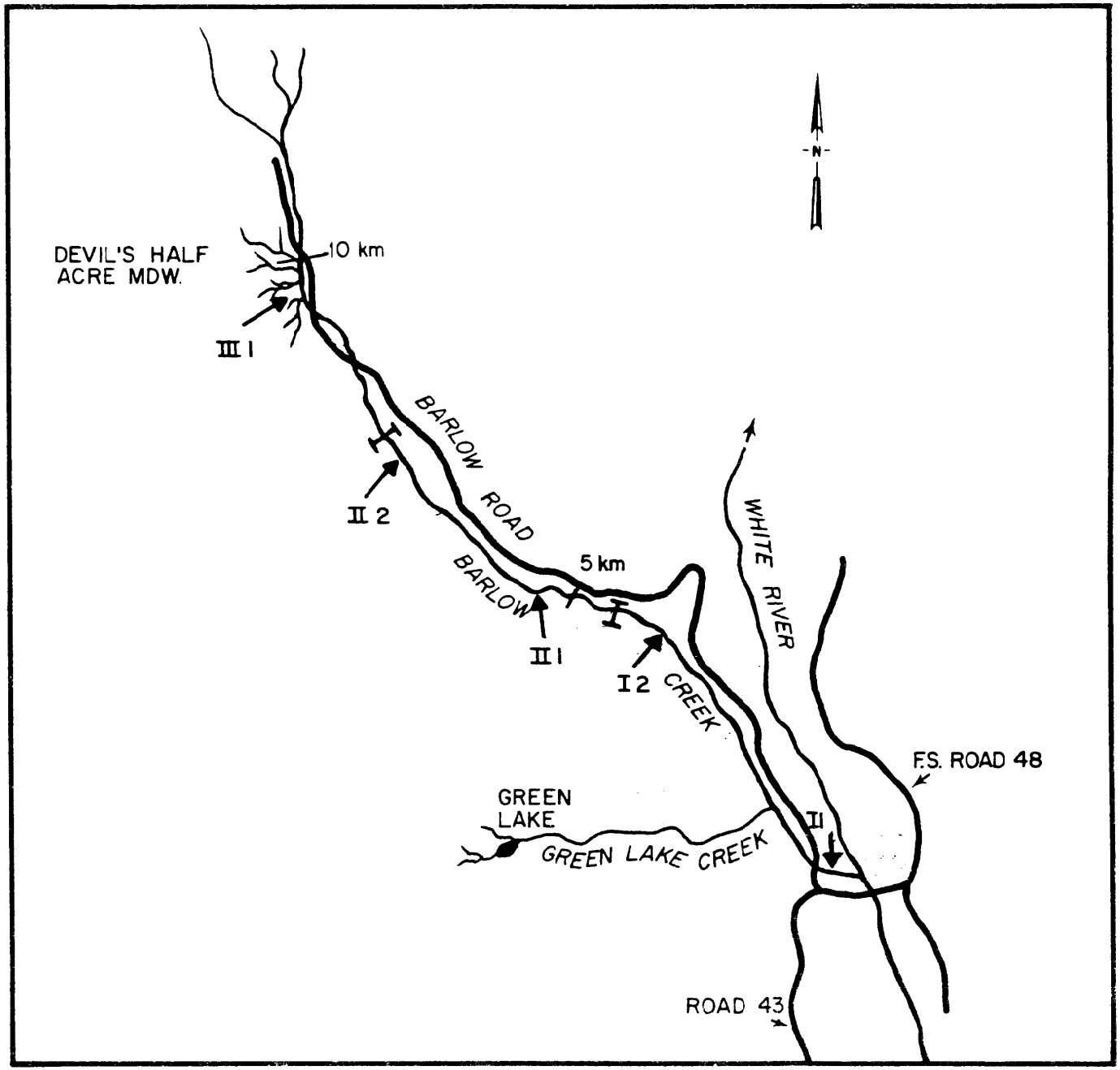
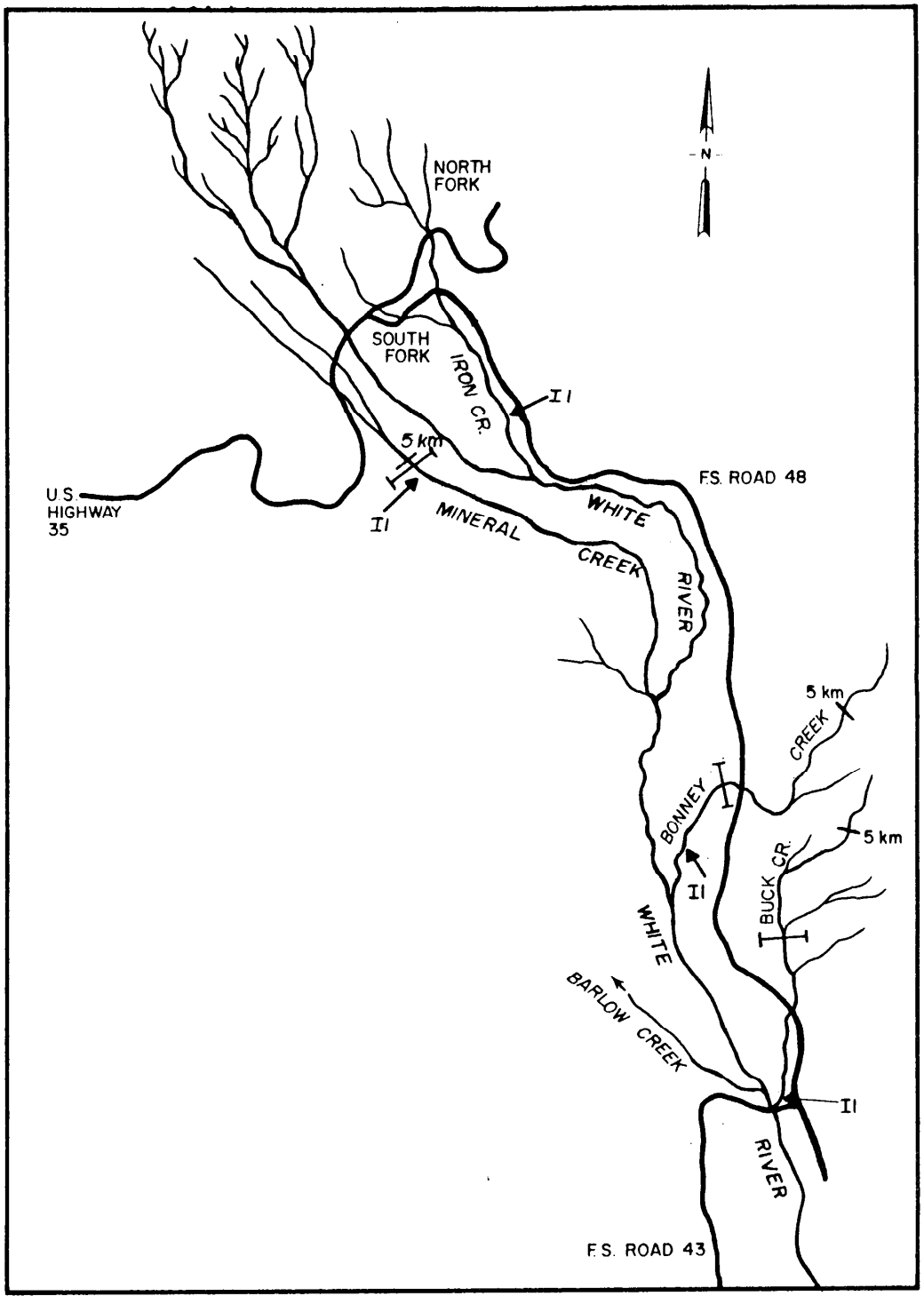


Figure 2.15 Sample sites in Barlow Creek, 1984

Figure 2.16 Sample sites in Mineral, Iron, Buck, and Bonney creeks, 1984



Chapter 111

EFFECTS OF GLACIAL SILT

A. Gravel Quality

Spawning gravel was sampled with a freeze-core sampler and analyzed by methods of Everest and Sedell (1983). Generally a "f redle index" that is greater than 5 to 7 indicates good quality gravel. Nine core sample:, were collected in lower and upper White River and one sample was collected in Barlow Creek at the mouth (Table 3.1). Composition of riffle substrate was also determined with a substreterating system (SEEE POTENTIAL ANADROMOUS FISH PRODUCTION).

B. ReariTs of Resident Fish

Resident fish were sampled at two sites in the mainstem during a period of turbidity and siltation from seasonal melting of White River Glacier, and at one site in Barlow Creek, a clear water tributary. Data were used to determine the impacts of glacial silt on the rearing of resident fish in the mainstem. Fish in lower White River were collected with electrofishing gear mounted in a driftboat and fist1 in upper White diver were collected with a Dirago 1000 electrofisher mounted in a pram and backpack shockers. Fish in Barlow Creek were collected with backpack shockers. Blocking nets were used on the lower boundary of the sample sites in upper White River and in Barlow Creek to prevent fish from migrating from the site. Sample time, number of fish, fork length, and weight were recorded.

In addition to sampling resident fish, data was collected on food availability (insect drift) and food use by fish (stomach samples) during periods of glacial melt. Insect drift samples were collected in lower and upper White River in August and September. The 20 x 30 cm drift nets were spaced on a riffle from the bank to the thalweg. Nets were set with 2.5 cm remaining above the water surface to catch adult aquatic and terrestrial insects. Mesh size of drift nets was increased from 0.33 mm2 to 0.50 mm^2 in September. Nets in lower White River were set in Allgust for 2 hours at noon, mid-afternoon and dusk, and for 1 hour in September at dusk; nets in upper White River were set for 1 hour at dusk. Drift samples were sorted, identified, and each taxa was counted and weighed. Stomachs were removed from rainbow trout captured in White River during glacial silt evaluations. Contents of each s tomach were iden t if ied, enumerated, and weighed. These data are presented in Tables 3.2 through 3.7.

Table 3.1. Substrate composition by freeze-core sampling in lower and upper White River and in Barlow Creek (control), September 1984.

Sample and depth	Geometric mean diameter (mm)	Fines <l mm (%)	Sorting coefficient	Fredle index
Lower White River-l				
O-10 cm	22.3	2.4	1.68	13.26
LO-20 cm	14.3	9.7	2.48	5.75
20-30 cm	11.3	13.7	2.74	4.13
Lower White River-2				
O-10 cm	17.3	6.1	2.21	7.81
LO-20 cm	1.6	51.1	2.84	0.55
20-30 cm	0.8	71.2	1.61	0.48
Lower White River-3				
O-10 cm	15.6	2.6	1.74	8.97
lo-20 cm	15.0	8.6	2.18	6.87
20-30 cm	19.1	9.1	1.77	10.76
Lower White River-4				
O-10 cm	34.1	0.4	1.40	24.42
lo-20 cm	25.4	3.4	1.59	15.93
20-30 cm	13.9	3.4	2.43	5.71
Upper White River-l				
O-10 cm	11.9	16.1	2.44	4.87
lo-20 cm	9.5	19.3	4.60	2.06
20-30 cm	13.4	12.8	2.83	4.74
Upper White River-2				
O-10 cm	9.7	18.3	3.26	2.98
lo-20 cm	7.1	22.7	4.87	1.46
20-30 cm	9.4	20.4	4.32	2.17
Upper White River-3				
O-10 cm	1.3	52.3	8.41	0.16
lo-20 cm	7.7	20.3	4.82	1.59
20-30 cm	6.2	28.1	6.82	0.91
Upper White River-4				
O-10 cm	10.9	17.0	4.60	2.37
lo-20 cm	11.7	14.4	3.27	3.57
20-30 cm	7.7	18.8	4.20	1.84
Upper White River-5				
O-10 cm	0.9	72.6	2.18	0.41
lo-20 cm	0.9	74.3	1.86	0.48
20-30 cm	9.1	25.1	6.96	1.31
Barlow Creek-l				
O-10 cm	24.9	5.1	1.55	16.15
LO-20 cm	16.5	17.9	4.48	2.34
20-30 cm	11.7	16.5	3.23	3.63

Table 3.2. Sampling of resident rainbow trout in two sites in White River and in one site in Barlow Creek (control), 1984.

Location, date	Number of fish	Sample time (min)	Catch rate	Mean fork length (cm)	Mean weight (gm)	K a/
Lower White River:						
09 August	26	40	0.65	22.3	157.2	1.297
27 August	47	45	1.04	20.6	136.0	1.304
10 September	40	48	0.83	18.0	112.5	1.267
25 September	65	44	1.48	17.9	103.2	1.242
08 October	33	35	0.94	20.2	166.1	1.285
Upper White River:						
08 August	28	22	1.27	12.4	26.5	1.052
14 August	17	22	0.77	10.8	17.8	1.075
28 August	23	23	1.00	10.7	23.8	1.072
11 September	13	21	0.62	12.6	27.5	1.042
26 September	7	19	0.37	8.2	7.3	1.128
10 October	27	21	1.29	10.2	14.2	1.001
Barlow Creek:						
08 August	16	23	0.70	8.6	11.0	1.095
14 August	20	36	0.56	6.8	6.7	1.129
28 August	18	23	0.78	7.1	6.7	0.941
11 September	25	36	0.69	7.0	7.11	0.985
26 September	58	48	1.21	5.4	3.9	0.912
10 October	33	32	1.03	7.3	7.9	0.866

a/ $K = [\frac{(wt/l^3) \times 100}{n}]$

Table 3.3. Mortality and condition of resident trout held in live boxes in White River (test) and in Barlow Creek (control), 1984.

		Test					Control				
Test	Date	Mortality	N a/	Mean fork length (cm)	Mean weight (sm)	K	Mortality	N	Mean fork length (cm)	Mean weight (gm)	K
1	11 Sep	--	14	14.0	32.2	1.035	--	20	11.9	22.5	1.051
	18 Sep	11 b/	14	14.1	34.7	1.076	0	20	12.1	21.3	0.945
2	03 Oct	--	18	12.3	24.2	1.026	--	22	11.3	17.9	1.026
	10 Oct	3 c/	18	12.4	22.9	0.941	0	22	11.3	16.9	0.952

a/ Excludes mortalities that were too decomposed for accurate weights.

b/ Includes six decomposed mortalities (7.7 cm).

c/ Decomposed (8.1 cm).

Table 3.4. Relative importance (%) by weight and by number of food items in stomachs of rainbow trout in lower and upper White River, 1984.

Location		Food Item	Relative Importance (%) Weight	Number
Lower White River	09 Aug.	Ephemeroptera	57.8	30.6
		Plecoptera	31.1	2.9
		Trichoptera	4.7	19.8
		Terrestrial insects	3.2	5.4
		Diptera	1.2	34.5
		Other aquatic insects	0.6	4.6
		Miscellaneous	1.4	2.2
	27 Aug.	Ephemeroptera	87.2	16.4
		Trichoptera	4.9	53.9
		Miscellaneous	4.2	1.2
		Diptera	1.0	16.6
		Terrestrial insects	1.0	5.7
		Other aquatic insects	1.7	6.2
	10 Sep.	Hempitera a/	55.2	61.7
		Ephemeroptera	32.9	8.0
		Trichoptera	3.5	3.4
		Coleoptera	2.7	6.5
		Diptera	2.2	17.0
		Other aquatic insects	2.4	1.2
		Terrestrial insects	0.5	0.3
		Miscellaneous	0.6	1.9
Upper White River	14 Aug.	Terrestrial insects	71.0	50.0
		Trichoptera	11.9	6.6
		Ephemeroptera	6.1	14.5
		Plecoptera	4.7	5.2
		Coleoptera	2.6	2.6
		Other aquatic insects	1.9	14.5
		Miscellaneous	1.8	6.6
	11 Sep.	Terrestrial insects	79.8	72.7
		Diptera	16.0	9.1
		Ephemeroptera	4.2	18.2

a/ Found in 1 of 9 stomachs

Table 3.5. Relative importance (%) by weight and by number of insects in drift samples in lower and upper White River, 1984.

Location		Insects	Relative importance (%) Weight	Number
Lower White River	08 Aug.	Diptera	27.2	78.8
		Terrestrial Insects	24.4	1.6
		Trichoptera	20.5	4.0
		Ephemeroptera	19.9	6.2
		Coleoptera	5.2	3.5
		Other aquatic insects	1.7	1.7
		Miscellaneous	1.1	4.2
	11 Sep.	Trichoptera	29.9	3.2
		Diptera	26.1	63.1
		Ephemeroptera	21.5	22.2
		Plecoptera	15.6	5.8
		Coleoptera	6.2	4.0
		Terrestrial insects	0.2	0.1
		Other aquatic insects	0.2	0.2
		Miscellaneous	0.3	1.4
Upper White River	12 Sep.	Terrestrial insects	51.3	2.3
		Diptera	19.7	56.1
		Trichoptera	19.5	5.2
		Ephemeroptera	7.1	26.9
		Plecoptera	1.6	8.7
		Other aquatic insects	0.6	0.5
		Miscellaneous	0.2	0.3

Table 3.6. Sumnary of food items in stomachs of rainbow trout in lower and upper White River, 1984.

Location, fork length	Date	Number of stomachs	Food item	Weight (mg)	Number
Lower White River					
<150 m	09 Aug		Ephemeroptera		
			Ephemerella hecuba	240.0	15
			Ephemerella grandis	1.0	1
			Tri choptera		
			Rhyacophila angelita	2.0	1
	27 Aug	2	Trichoptera		
			Hydroptilidae	16.06	161
			Hydropsvche sp.	7.45	8
			Glossosoma sp.	0.95	1
			Ephemeroptera		
			Ephemerella hecuba	16.0	1
			Ephemerella sp.	6.0	1
			Coleoptera		
			Dytiscidae	7.0	14
			Elimidae	0.25	1
			Plecoptera		
			Chloroperlidae	6.40	3
			Diptera		
			Chironomidae	2.10	35
			Tipulidae	1.45	1
			Nematocera (lower flies)	1.44	16
			Simuliidae	0.36	2
			Hymenoptera		
			Braconidae a/	1.85	8
			Formicidae a/	0.40	1
			Lepidoptera		
			Pyralidae	1.0	1
			Hemiptera a/	0.50	1
	10 Sep	3	Ephemeroptera	2.40	4
			Ephemerella hecuba	64.0	4
			Ephemerella sp.	4.0	1
			Coleptera		
			Dytiscidae	5.0	3
			Diptera		
			Tipulidae	1.0	1
			Chironomidae	0.66	11
			Nematocera (lower flies)	0.09	1
			Trichoptera		
			Hydropsyche sp.	1.5	1
			Hydroptilidae	0.1	1
			Lepidoptera		
			Pyralidae	1.5	2

Table 3.6. (continued)

Location, fork length	Date	Number of stomachs	Food item	Weight (mg)	Number
Lower White River					
150-200 mm	09 Aug	9	Ephemeroptera	2.45	3
			Ephemerella hecuba	386.10	23
			Ephemerella sp.	8.45	6
			Tricorythidae	12.0	12
			Baetis sp.	3.31	8
			Plecoptera		
			Pteronarcys sp.	338.65	5
			Trichoptera		
			Hydropscychidae	0.22	3
			Hydropscyche sp.	35.05	29
			Limnephilidae	3.0	1
			Hydroptilidae	0.20	2
			Coleoptera		
			Carabidae a/	30.0	1
			Scolytidae a/	4.50	3
			Dytiscidae	1.95	3
			Hydrophilidae	1.0	1
			Diptera		
			Simuliidae	7.90	24
			Nematocera (lower flies)	3.16	35
			Chironomidae	2.0	25
			Tipulidae	0.45	1
			Gastropoda		
			Physa sp.	9.40	1
			Hemiptera		
			Cicadellidae	3.40	3
			Corixidae	2.20	2
			Miridae	1.20	1
			Hymenoptera	0.10	1
			Formicidae a/	1.25	1
			Braconidae a/	1.10	4
			Lepidoptera		
			Pyralidae	0.35	1
			Atari (water mite)	0.12	2
	27 Aug	1	Ephemeroptera		
			Ephemerella hecuba	48.0	3
			Tricorythodes	2.25	3
			Trichoptera		
			Hydropscyche sp.	15.0	6
			Hydroptilidae	8.7	87
			Gastropoda		
			Physa sp.	12.0	1

Table 3.6. (continued)

Location, fork length	Date	Number of stomachs	Food item	Weight (mg)	Number
Lower White River					
150-200 mm	27 Aug (cant)	1	Coleptera		
			Dytiscidae	3.0	6
			Scolytidae a/	1.5	1
			Hymenoptera a/	4.5	18
			Hemiptera a/	1.0	1
			Corixidae	3.3	3
			Diptera		
			Nematocera (lower flies)	2.34	26
			Simuliidae	1.44	8
			Chironomidae	0.36	6
			Lepi dopt ra		
			Pyraidae	1.0	
	10 Sep	1	Ephemeroptera		
			Ephemerella hecuba	16.0	1
			Coleptera		
			Elmidae	0.27	1
			Diptera		
			Nematocera (lower flies)	0.09	1
Lower Whit e River:					
>200 ml	09 Aug	2	Ephemeroptera		
			Ephemerella hecuba	214.0	15
			Ephemerella sp.	0.90	
			Cinyqmula sp.	1.40	
			Pl ecoptera		
			Pteronarcys sp.	128.0	2
			Chl oroperlidae	0.95	
			Trichoptera		
			Hydropsvche sp.	24.1	16
			Rhyacophila anqelita	5.50	3
			Gastropoda		
			Physp .	12.1	2
			Hymenoptera		
			Formicidae a/	6.0	
			Di ptera		
			Tipulidae	3.70	2
			Simuliidae	1.14	5
			Chironomidae	0.12	2
			Nematocera (lower flies)	0.18	2
			Coleoptera		
			Dytiscidae	3.0	3
			Elmidae	0.54	2
			Hem1 ptera		
			Corixidae	1.05	
			Atari (water mite)	0.06	

Table 3.6. (continued)

Location, fork length	Date	Number of stomachs	Food item	Weight (mg)	Number
Lower White River					
>200 mm (cont)	27 Aug	4	Ephemeroptera		
			Ephemerella hecuba	1,360.0	85
			Gastropoda		
			Physa sp.	57.0	6
			Trichoptera		
			Hydropsyche sp.	24.0	16
			Hydroptilidae	3.90	39
			Lepidostoma sp.	3.0	
			Glossosoma sp.	0.90	
			Diptera		
			Tipulidae	6.75	3
			Brachycera (higher flies)	0.44	
			Nematocera (lower flies)	0.09	
			Coleoptera		
			Elateridae a/	4.0	2
			Dytiscidae	2.0	3
			Elmidae	0.50	2
			Hemiptera		
			Corixidae	3.3	3
			Hymenoptera		
			Formicidae a/	2.5	2
	10 Sep	4	Hemiptera		
			Corixidae	220.0	200
			Ephemeroptera	4.75	8
			Ephemerella hecuba	32.0	2
			Ephemerella sp.	1.0	
			Tricorythodes sp.	5.85	8
			Paraleptophlebia bicornuta	1.0	
			Trichoptera	7.6	
			Hydropsyche sp.	4.25	4
			Hydroptilidae	0.40	4
			Coleoptera a/	2.0	1
			Dytiscidae	2.85	7
			Elmidae	2.47	10
			Diptera		
			Chironomidae	3.80	28
			Brachycera (higher flies)	2.0	
			Nematocera (lower flies)	0.84	11
			Tipulidae	0.50	
			Plecoptera		
			Pteronarcys sp.	4.0	
			Chloroperlidae	2.0	
			Lepiodotera		
			Pyralidae	2.0	2
			Gastropoda		
			Physa	1.0	
			Pelycepoda	1.0	
			Acari (water mite)	0.45	4

Table 3.6. (continued)

Location, fork length	Date	Number of stomachs	Food item	Weight (mg1	Number
Upper White River					
<150 mm	14 Aug	3	Coleoptera a/	33.30	5
			Dytiscidae	1.80	1
			Hydroptilidae	1.55	1
			Lepidoptera a/	36.0	11
			Trichoptera		
			Ecclisomyia sp	6.90	1
			Rhyacophilangelita	1.75	1
			Ephemeroptera	2.25	4
			Heptageniidae	3.50	4
			Baetis sp.	2.0	2
			Diptera		
			Brachycera (higher flies) a/	4.35	10
			Nematocera (lower flies)	1.25	8
			Brachycera	1.0	1
			Plecoptera		
			Chloroperlidae	6.0	4
			Hymenoptera		
			Formicidae g/	5.70	1
			Arachnida	1.60	1
			Hemiptera		
			Cicadellidae a/	0.85	2
			Oligochaeta	0.70	3
			Psocoptera		
			Psocidae	0.50	1
			Neuroptera		
			Hemerobiidae a/	0.50	1
			Atari (water mite)	0.06	1
Upper White River					
150-200 mn	14 Aug	1	Hymenoptera		
			Formicidae a/	6.55	3
			Ichneumonidae a/	1.30	1
			Trichoptera		
			Dicosmoecinae	4.50	1
			Lepidostoma roafi	2.10	2
			Hemiptera		
			Aphidae a/	1.0	2
			Psocoptera		
			Psocidae	0.70	1
			Diptera		
			Chironomidae	0.12	2
			Ephemeroptera	0.05	1

Table 3.6. (continued)

Location, forklenth	Date	Number of stomachs	Food item	Weight (mg)	Number
Upper White River					
150-200 mn	11 Sep	2	Hymenoptera a/	44.5	7
			Formicidae a/	6.0	1
			Diptera		
			Tipulidae	10.15	1
			Ephemeroptera	2.65	2

a/ Terrestrial insect.

Table 3.7. Summary of insects in drift samples in lower and upper White River, 1984.

Location, sample time	Date	Number of nets	Insect	Weight (mg)	Number
Lower White River					
1200-1440	8 Aug	3	Ephemeroptera	3.0	3
			Ephemerella hecuba	32.0	1
			Ephemerella sp.	2.55	4
			Baetis sp.	2.69	9
			Cinygmula sp.	2.50	3
			Tricorythidae	0.02	1
			Diptera		
			Chironomidae	15.54	257
			Nematocera (lower flies)	12.33	137
			Tipulidae	4.0	5
			Syrphidae a/	3.0	1
			Simuliidae	1.44	8
			Braconidae a/	0.25	1
			Coleoptera		
			Elmidae	10.92	44
			Dytiscidae	1.05	2
			Acari (water mite)	1.68	28
			Hemiptera		
			Aphidae a/	0.50	1
			Miridae a/	0.50	1
			Corixidae	0.35	1
			Arachnida	1.25	6
			Trichoptera		
			Hydropsyche sp.	0.40	8
			Hydroptilidae	0.26	3
			Lepidoptera		
			Pyralidae	0.05	2
			Nematoda	0.05	1
Lower White River					
1500-1740	8 Aug	4	Orthoptera a/	132.0	1
			Diptera		
			Nematocera (lower flies)	27.59	364
			Chironomidae	9.39	187
			Simuliidae	1.27	13
			Coleoptera		
			Hydrophilidae	4.0	2
			Elmidae	3.69	12
			Curculionidae a/	1.70	1
			Ephemeroptera	7.05	7
			Tricorythidae	0.15	3
			Baetis sp.	0.10	1

Table 3.7. (continued)

Location, sample time	Date	Number of nets	Insect	Weight (mg)	Number
Upper White River					
1500-1740	8 Aug (cant)	4	Hemiptera		
			Aphidae a/	2.0	4
			Corixidae	1.10	
			Cicadellidae a/	0.70	
			Atari (water mite)	2.15	36
			Psocoptera		
			Psocidae a/	0.70	
			Plecoptera	0.55	20
			Lepidoptera		
			Pyralidae	0.25	
			Nematoda	0.10	2
			Thysanoptera		
			Thripidae	0.05	
Lower White River					
1930-2130	8 Aug	5	Trichoptera		
			Hydropsyche sp.	119.65	47
			Hydroptilidae	1.51	21
			Diptera		
			Nematocera (lower flies)	67.66	660
			Chironomidae	16.38	273
			Tipulidae	3.35	2
			Simuliidae	2.44	14
			Ephemeroptera	53.20	72
			Baetis sp.	15.99	33
			Cinygmula sp.	1.54	10
			Tricorythidae	0.95	5
			Ephemerella sp.	0.10	
			Paraleptophlebia temporalis	0.01	
			Coleoptera		
			Elmidae	4.05	16
			Hydrophilidae	4.0	2
			Dytiscidae	3.45	4
			Scolytidae a/	2.0	2
			Chrysomelidae a/	0.90	5
			Plecoptera	3.38	9
			Chloroperlidae	1.50	
			Perlodidae	0.05	
			Hemiptera		
			Aphidae a/	2.0	5
			Corixidae	0.35	
			Lepidoptera		
			Pyralidae	2.05	5

Table 3.7. (continued)

Location, samle time	Date	Number of nets	Insect	Weight (mg)	Number
Lower White River 1930-2130 (cent)	8 Aug	5	Hymenoptera		
			Formicidae a/	1.60	5
			Braconidae a/	0.25	1
			Atari (water mite)	1.60	29
			Nematoda	0.10	2
			Thysanoptera		
			Thripidae	0.05	1
Lower White River 2007-2112	11 Sep	3	Trichoptera		
			Hydropsyche sp.	72.65	29
			Glossosoma sp.	23.40	13
			Hydroptilidae	0.24	4
			Diptera		
			Nematocera (lower flies)	78.93	883
			Simuliidae	4.50	26
			Chironomidae	4.44	74
			Tipulidae	2.20	1
			Dixidae	0.25	1
			Ephemeroptera		
			Baetis sp.	41.80	240
			Cinygmula sp.	19.10	75
			Ephemerellidae	0.75	10
			Ephemerella	8.0	2
			Paraleptophlebia bicornuta	4.0	5
			Paraleptophlebia temporalis	0.9	13
			Tricarythidae	0.10	2
			Plecoptera		
			Perlodidae	51.99	27
			Taeniopterygidae	1.90	63
			Nemouridae	0.03	1
			Coleptera		
			Elmidae	16.62	56
			Dytiscidae	5.0	7
			Hemiptera		
			Corixidae	0.70	2
			Clcadellidae a/	0.70	1
			Atari (water mite)	0.80	19
			Gastropoda		
			Physa sp.	0.25	3
			Lepldoptera		
			Pyralidae	0.05	1

Table 3.7. (continued)

Location, sample time	Date	Number of nets	Insect	Weight (mg)	Number
Lower White River 1945-2050	12 Sep	3	Coleoptera		
			Carabidae a/	44.8	1
			Diptera		
			Nematocera (lower flies)	12.33	137
			Chironomidae	2.17	36
			Simuliidae	1.89	42
			Dixidae	1.60	8
			Tipulidae	0.20	2
			Trichoptera		
			Lepidostoma sp.	12.30	6
			Rhyacophila angelita	4.60	4
			Micrasema sp.	1.0	8
			Ecclisomyia sp.	0.10	1
			Glossosoma sp.	0.05	2
			Ephemeroptera		
			Baetis sp.	5.34	81
			Ephemerella sp.	0.55	12
			Cinygmula sp.	0.30	9
			Epeorus sp.	0.30	1
			Paraleptophlebia temporalis	0.30	5
			Plecoptera		
			Nemouridae	0.70	30
			Peltoperlidae	0.50	2
			Chloroperlidae	0.15	2
			Leuctridae	0.15	1
			Hemiptera		
			Cicadellidae a/	0.70	1
			Aphidae a/	0.50	2
			Psocoptera		
			Psocidae	0.80	2
			Arachnida	0.50	2
			Oligochaeta	0.23	1
			Thysanoptera		
			Thripidae	0.05	1

a/ Terrestrial insect

KAnderson:crw (WP-PJS-5404N)

Chapter IV

RESIDENT FISH AND DISEASE

A. Inventory

A three-person crew conducted an inventory of resident fish species throughout the White River basin in 1983 to determine species composition, distribution, and relative abundance. Sampling or resident fish was conducted at 168 sites from *lb* .July to 20 October. Tributaries were sampled intensively tram 14 July to 8 September.

Tributaries were sampled at 1 .6 km intervals with backpack electrofishing gear. The average site was 23 m long and the average sampling time was 23 minutes. Fork lengths and numbers of rainbow and brook trout were recorded in five size ‹ atagories (Figure *4.1)* and fish were returned to the stream.

In addition to the inventory in 1983, data on resident fish were collected in *1984* (see POTENTIAL ANAFROMOUS FISH PRODUCTION).

Data on resident fish inventory is presented in Tables 4. I to *4.11.* Locat ions of the 1983 inventory sites are shown on maps in Figures *4.2* to 4.13.

B. Scale Analysis

Scales were collected from resident trout in 11 areas throughout the White River basin in 1984 (Table *4.12).* Fish were sampled with elecrofishing gear and a random collect ion of scales was taken from fish in 4 size groups *(0-49, 50-99, 100-149,* and >150 mm). Approximately 30 scale samples were collected in each size group. Scales were sampled selectively when the total number of samples desired in each size group was not obtained randomly. Samples were identified on scale envelopes by species, sample area, sample number, fork length, and by random or selective colleciton. Data were recorded on an elecrofishiong field form (Figure 4. 14), and the data were summarized on a sepat-ate form (Figure *4.15)*

Scales were mounted on glass slides and were projected at 88x magnification for measurement (in millimeters) of nucleus center to nucleus radius, of nucleus center to scale margin, and of nucleus center to each annulus. Scale radius was used to determine body length-scale radius relationships using the least squares method to estimate the intercept and slope of a linear regression equation. The regres sion equation was then used to back-calculate meal-1 length at each annul us from scale radius. Mean annual growth for each year of life for each sample group was determined. Growth years were tested for significant differences between age classes for each sample group with a one-way analysis of variance and honestly significant difference (Sokal and Rohlf 1969) pairwise comparisons. Age classes were then pooled within growth years and tested for differences in mean annual growth between sample groups with the samestat methods as above.

Figure 4.1 Data form for inventory of resident fish in the White River basin

ELECTROFISHING FORM

Stream: _____ Stream Mile: _____

Site: _____ Number: _____ Site Description _____

Landmarks: _____

Date: _____ lime: _____ Crew: _____

Fish Species, Size and Abundance

Number Per Size Group (cm)

Species	0-5	5-10	10-15	15-20	≥20	Scale Sample Number

Comments : _____

Table 4.1. Fish species in the White River system above White River Falls, 1983 and 1984.

Common name	Scientific name	Number sampled
Rainbow trout	*Salmo gairdneri*	I.,747
Eastern brook trout	*Salvelinus fontinalis*	237
Mountain whitefish	*Prosopium williamsoni*	54
Sculpins	*Cottus spp* a/	I.,084
Longnose dace	*Rhinicthys cataractae*	s
Largemouth bass	*Micropterus salmoides*	5

a/ *C. beldingi* and *C. confusus* were identified; *C. rhotheus* and *C. bairdi* may also be present.

Table 4.2 . Fish inventory of principal stream systems within the White River basin, 1983 (backpack electrofishing).

Stream system	Number of sites	Rainbow trout		Brook trout		Whitefish		Sculpins	Dace	Largemouth bass
		<15 cm	≥15 cm	<15 cm	≥15 cm	<15 cm	≥15 cm			
White River - Lower	2[a]	111	149	0	0	11	43	78	0	0
White River - Upper mainstem and tributaries above Clear Cr.	16	167	27	8	3	0	0	46	0	0
Tygh Creek	64	646	105	0	0	0	0	741	0	0
Threemile-Rock creeks	50	375	55	0	0	0	0	32	5	5
Boulder Creek	17	104	18	15	2	0	0	0	0	0
Clear Creek	19	92	10	200	9	0	0	187	0	0
Total	168	1,495	364	223	14	11	43	1,084	5	5

[a]Most of lower White River sampled with boat electrofishing gear.

Table 4.3 Range of resident fish[a] in the White River system, 1983.

Stream	Total sites	Stream length (km)	Upper range (km) Rb	Bt	Cot	Misc.
Tygh Cr.	18	36.4	27.8		25.4	-
Badger Cr.	18	38.0	38.0		28.7	-
trib.	1	2.4	1.3[b]			-
trib.	1	3.2	61 m[b]			-
trib.	1	0.5	27 m[b]			-
Pine Cr.	2	4.8	61 m[b]			-
Drop Cr.	1	3.7				-
Jalland Cr.	1	3.4				-
Tolo Cr.	1	3.2	-			-
Gumjuwac Cr.	1	3.5	0.2[b]			-
Little Badger Cr.	6	15.0	9.5	-	5.6	-
Jordan Cr.	12	26.7	23.5[b]			-
Pen Cr.	1	7.7	3.2			-
Owl Hollow Cr.	Dry	6.6	c	c	c	c
Threemile Cr.	10	33.2	24.6			61 m[b]-Dace
trib.	5	3.9	1.6			-
trib.	1	4.0	110 m[b]			-
Pine Hollow seep	2	7.2 (reservoir)	5.8[b]			5.8[c]-Dace
Rock Cr.	11	27.4	22.5		61 m	14.5-LB
trib.	1	2.9	1.6			
Wildcat Cr.	Not sampled	3.5	c	c	c	c
Gate Cr.	12	25.3	24.1		11.9	-
Hazel Hollow Cr.	Dry	8.9	c	c	c	c
South Fork Cr.	3	6.9	3.9			-
Souva Cr.	3	8.9	3.4			-
Boulder Cr.	12	20.8	17.5[b]	17.5[b]		-
Swamp Cr.	1	4.7	-			-
Cedar Cr.	3	12.4	2.7[b]			-
Deep Cr.	1	5.1				-
Lost Cr.	Dry	4.3	c	c	c	c
Clear Cr.	19	21.9 (lake)	8.0	21.9	21.9	-
Camas Cr.	2	2.9	1.0[b]			-
Frog Cr.	8	14.2 (lake)	0.6	11.4	5.8	-
Barlow Cr.	7	13.0	9.5	4.8	4.8	-
Green Lake Cr.	1	4.0		1.6[b]	-	

Table 4.3 continued

Stream	Total sites	Stream length (km)	Upper range (km) Rb	Bt	cot	Misc.
Upper White R. trib.						
Unnamed Cr.	2	3.4	1.6.	-	-	-
Bonney Cr.	3	5.8	2.3'	-	-	-
Iron Cr.	2	10.1	7.9	-	-	-
White River		80.0				
Upper	2	(Km 40-80)	66.0[b]	66.0[b]	66.0[b]	-
Lower	2	(Km 0-40)	27.5[b]	27.5[b]	27.5[b]	8.0[b]-WF

[a]Rb - rainbow trout; BT - brook trout, Cot - Cottids; LB - Largemouth bass, WF - Mountain whitefish.

[b]Present at this point, upper range uncertain.

'Not sampled.

Table 4.4 Catch rate (fish/minute) of rainbow trout sampled with electrofishing gear, 1983.

Stream system	Elevation (m)	Size group (cm)			
		o-4.9	5-9.9	1044.9	215
Tygh Cr.	300- 549	0.11	0.12	0.17	0.09
	550- 799	0.23	0.22	0.19	0.02
	800-l ,049	0.12	0.10	0.12	0.08
	1,050-1,299	0.00	0.04	0.10	0.02
	1,300-1,549	0.05	0.05	0.08	0.00
Threemile and Rock Cr.	350- 549	0.01	0.39	0.02	0.09
	550- 749	0.07	0.15	0.09	0.03
	750- 949	0.10	0.16	0.09	0.05
	950-1,149	0.03	0.03	0.17	0.02
	1,150-1,349	0.00	0.00	0.09	0.00
	1,350-1,549	0.00	0.04	0.08	0.00
Boulder Cr.	750- 899	0.22	0.08	0.14	0.00
	900-1,049	0.02	0.09	0.15	0.04
	1,050-1,199	0.05	0.06	0.06	0.05
	1,200-1,349	0.13	0.04	0.04	0.05
Clear Cr.	750- 849	0.06	0.12	0.11	0.03
	850- 949	0.04	0.13	0.06	0.03
	950-1,049	0.00	0.00	0.00	0.00
	1,050-1,149	0.00	0.00	0.00	0.00
White River and tributaries above Barlow Crossing	300- 549	0.03	0.23	0.39	0.88
	550- 799	0.10	0.23	0.05	0.03
	800-1,049	0.26	0.22	0.16	0.07
	1,050-1,299	0.08	0.10	0.07	0.10
White River system - total	300- 499	0.08	0.16	0.18	0.22
	500- 699	0.09	0.23	0.12	0.04
	700- 899	0.20	0.20	0.14	0.06
	900-1,099	0.04	0.07	0.08	0.04
	l,lOO-1,299	0.03	0.04	0.08	0.04
	1,300-1,499	0.03	0.05	0.08	0.00

Table 4.5 Catch rate (fish/minute) of brook trout sampled with electrofishing gear, 1983.

Stream system	Elevation (m)	Size group (cm)			
		o-4.9	5-9.9	10-14.9	≥ 15
Clear Cr.	750- 849	0.00	0.02	0.02	0.00
	850- 949	0.06	0.29	0.20	0.02
	950-1,049	0.03	0.21	0.19	0.03
	1,050-1,149	0.16	0.24	0.04	0.04
White River system (total)	300- 499	0.00	0.00	0.00	0.00
	500- 699	0.00	0.00	0.00	0.00
	700- 899	0.00	0.01	0.005	0.002
	900-1,099	0.02	0.08	0.07	0.01
	l,lOO-1,299	0.02	0.03	0.01	0.01
	1,300-1,499	0.00	0.00	0.00	0.00

Table 4.6 Catch rate (fish/minute) of sculpins sampled with electrofishing gear in the White River system, 1983.

Elevation (m)	Catch rate
300- 499	0.69
500- 699	0.25
700- 899	0.15
900-1,099	0.12
l,lOO-1,299	0.00
1,300-1,499	0.00

Table 4.7 Catch of rainbow trout (number and fish/minute) with electrofishing gear in the White River system, 1983.

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Tygh	T_1	76 m (250 ft)	323 (1,060)	30	5	0.17	5	0.17	0	0.00	0	0.00
	T_2	1.3 (0.8)	326 (1,070)	30	1	0.03	5	0.17	0	0.00	3	0.10
	T_3	2.7 (1.7)	329 (1,080)	30	2	0.07	0	0.00	0	0.00	2	0.07
	T_4	4.2 (2.6)	329 (1,080)	20	5	0.25	2	0.10	0	0.00	2	0.10
	T_5	5.8 (3.6)	335 (1,100)	30	0	0.00	3	0.10	1	0.03	2	0.07
	T_6	6.9 (4.3)	341 (1,120)	35	0	0.00	1	0.03	3	0.09	9	0.26
	T_7	7.5 (4.7)	341 (1,120)	30	0	0.00	1	0.03	3	0.10	1	0.03
	T_8	8.7 (5.4)	354 (1,160)	20	1	0.05	3	0.15	4	0.20	4	0.20
	T_9	12.4 (7.7)	378 (1,240)	30	0	0.00	2	0.07	5	0.17	2	0.07
	T_{10}	14.0 (8.7)	396 (1,300)	30	8	0.27	3	0.10	10	0.33	5	0.17
	T_{11}	15.6 (9.7)	427 (1,400)	30	6	0.20	8	0.27	2	0.07	0	0.00
ordan	J_1	0.6 (0.4)	408 (1,340)	30	4	0.13	2	0.07	8	0.27	2	0.07
	J_2	1.4 (0.9)	427 (1,400)	30	2	0.07	3	0.10	13	0.43	3	0.10
	J_3	2.4 (1.5)	427 (1,400)	25	1	0.04	6	0.24	12	0.40	2	0.08
	J_4	3.9 (2.4)	488 (1,600)	20	0	0.00	13	0.65	13	0.65	0	0.00
Badger	B_1	0.8 (0.5)	354 (1,160)	30	1	0.03	3	0.10	9	0.30	3	0.10
	B_2	1.6 (1.0)	360 (1,180)	45	7	0.16	2	0.04	11	0.24	2	0.04
	B_3	2.3 (1.4)	366 (1,200)	40	2	0.05	1	0.03	11	0.28	9	0.23
	B_4	3.2 (2.0)	378 (1,240)	35	0	0.29	1	0.03	4	0.11	1	0.03
	B_5	6.6 (4.1)	439 (1,440)	40	1	0.03	1	0.03	5	0.13	10	0.25
	B_6	8.0 (5.0)	451 (1,480)	45	6	0.13	4	0.09	2	0.04	0	0.00

Table 4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
	B_7	10.6 (6.6)	482 (1,580)	30	13	0.43	4	0.13	0	0.00	2	0.07
Trib.	$B5T_{1A}$	1.3 (0.8)	463 (1,520)	15	0	0.00	2	0.13	1	0.07	0	0.00
Threemile	TM_1	0.6 (0.4)	354 (1,160)	45	0	0.00	13	0.29	0	0.00	2	0.04
	TM_2	3.9 (2.4)	384 (1,260)	30	0	0.00	12	0.40	1	0.03	3	0.10
	TM_3	7.6 (4.7)	499 (1,637)	20	0	0.00	5	0.25	0	0.00	4	0.20
Pine Hollow Seep	PH_1	2.9 (1.8)	499 (1,637)	15	0	0.00	0	0.00	0	0.00	0	0.00
Rock	R_1	61 m (200 ft)	396 (1,300	25	3	0.12	14	0.56	0	0.00	0	0.00
White River-lower	WR_1	5.5-9.0 (3.4-5.6)	311-323 (1,020-1,060)	120	0	0.00	21	0.18	67	0.56	144	1.20
-middle	WR_2	28.0 (17.4)	457 (1,500)	50	5	0.10	18	0.36	0	0.00	5	0.10
		Total	300-499 m	1,005	83	0.08	158	0.16	185	0.18	222	0.22
Tygh	T_{12}	18.7 (1.6)	542 (1,780)	20	7	0.35	5	0.25	3	0.15	0	0.00
	T_{13}	21.7 (13.5)	622 (2,040)	25	13	0.52	5	0.20	4	0.16	0	0.00
Jordan	J_5	6.0 (3.7)	530 (1,740)	20	1	0.05	5	0.25	2	0.10	0	0.00
	J_6	8.0 (5.0)	555 (1,820)	25	5	0.20	13	0.52	9	0.36	0	0.00
	J_7	12.1 (7.5)	682 (2,240)	20	3	0.15	4	0.20	6	0.30	0	0.00
Badger	B_8	16.3 (10.1)	579 (1,900)	35	5	0.14	2	0.06	3	0.09	0	0.00
	B_9	19.3 (12.0)	646 (2,120)	25	3	0.12	8	0.32	6	0.24	0	0.00
	B_{10}	20.0 (12.4)	658 (2,160)	20	1	0.05	4	0.20	6	0.30	1	0.05
Little Badger	LB_1	1.1 (0.7)	542 (1,780)	15	2	0.13	9	0.60	6	0.40	3	0.20
	LB_2	2.4 (1.5)	591 (1,940)	25	6	0.24	9	0.36	2	0.08	0	0.00

Table 4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Threemile	TM_4	10.1 (6.3)	530 (1,740)	15	0	0.00	32	2.13	4	0.26	6	0.40
	TM_5	12.7 (7.9)	579 (1,900)	15	1	0.07	3	0.20	7	0.47	2	0.13
Pine Hollow Seep	PH_2	5.8 (3.6)	524 (1,720)	20	0	0.00	4	0.20	0	0.00	1	0.05
Rock	R_2	4.3 (2.7)	518 (1,700)	25	0	0.00	0	0.00	0	0.00	3	0.12
	R_3	6.4 (4.0)	560 (1,840)	20	0	0.00	0	0.00	0	0.00	0	0.00
	R_4	8.7 (5.4)	591 (1,940)	20	0	0.00	0	0.00	0	0.00	0	0.00
	R_5	10.3 (6.4)	604 (1,980)	25	0	0.00	0	0.00	0	0.00	0	0.00
	R_6	11.6 (7.2)	621 (2,040)	20	0	0.00	2	0.10	0	0.00	2	0.10
	R_7	14.5 (9.0)	652 (2,140)	25	1	0.04	7	0.28	0	0.00	0	0.00
Gate	G_1	0.4 (0.25)	524 (1,720)	10	0	0.00	0	0.00	0	0.00	0	0.00
	G_2	2.6 (1.6)	573 (1,880)	20	0	0.00	0	0.00	0	0.00	0	0.00
	G_3	3.9 (2.4)	591 (1,940)	15	0	0.00	0	0.00	0	0.00	0	0.00
	G_4	5.6 (3.5)	610 (2,000)	15	0	0.00	0	0.00	0	0.00	0	0.00
	G_5	8.7 (5.4)	652 (2,140)	25	0	0.00	8	0.32	1	0.04	1	0.04
	G_6	11.9 (7.4)	671 (2,200)	30	2	0.07	2	0.07	3	0.10	0	0.00
		Total	500-699 m	530	50	0.09	122	0.23	62	0.12	19	0.04
Tygh	T_{14}	25.4 (15.8)	756 (2,480)	20	4	0.20	8	0.40	6	0.30	1	0.05
	T_{15}	26.6 (16.5)	811 (2,660)	20	0	0.00	4	0.20	5	0.25	3	0.15
	T_{16}	27.8 (17.3)	890 (2,920)	20	6	0.30	1	0.05	7	0.35	4	0.20
Jordan	J_8	14.3 (8.9)	768 (2,520)	25	0	0.00	0	0.00	4	0.16	1	0.04
	J_9	16.6 (10.3)	823 (2,700)	25	12	0.48	7	0.28	4	0.16	3	0.12

Table4. 7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Pen	P_1	4.8 (3.0)	786 (2,580)		0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_{11}	22.7 (14.1)	719 (2,360)	25	14	0.56	1	0.04	3	0.12	0	0.00
	B_{12}	25.6 (15.9)	799 (2,620)	25	9	0.36	0	0.00	3	0.12	2	0.08
	B_{13}	28.7 (17.8)	869 (2,850)	25	11	0.44	1	0.04	0	0.00	2	0.08
Little Badger	LB_3	5.6 (3.5)	707 (2,320)	30	6	0.20	12	0.40	7	0.23	2	0.07
	LB_4	7.6 (4.7)	823 (2,700)	20	3	0.15	5	0.25	4	0.20	0	0.00
Threemile	TM_6	19.8 (12.3)	719 (2,360)	25	11	0.44	5	0.20	3	0.12	1	0.04
	TM_7	20.3 (12.6)	738 (2,420)	25	4	0.16	4	0.16	3	0.12	3	0.12
	TM_8	22.5 (14.0)	799 (2,620)	30	0	0.00	5	0.17	2	0.07	1	0.03
	TM_9	24.6 (15.3)	896 (2,940)	20	0	0.00	1	0.05	2	0.10	2	0.10
Trib.	TM_{8T1A}	21 m (70 ft)	805 (2,640)	20	1	0.05	4	0.20	0	0.00	1	0.05
	TM_{8T1B}	0.2 (800 ft)	835 (2,740)	20	2	0.10	4	0.20	6	0.30	1	0.05
	TM_{8T1C}	1.2 (.75)	890 (2,920)	20	2	0.10	0	0.00	2	0.10	1	0.05
Rock	R_8	17.7 (11.0)	713 (2,340)	30	2	0.07	16	0.53	10	0.33	1	0.03
	R_9	21.1 (13.1)	841 (2,760)	30	8	0.26	12	0.40	5	0.17	2	0.07
Trib.	R_{8T1A}	1.6 (1.0)	835 (2,740)	15	0	0.00	0	0.00	0	0.00	2	0.13
	R_{8T1B}	2.3 (1.4)	853 (2,800)	10	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_7	15.9 (9.9)	768 (2,520)	20	6	0.30	6	0.30	4	0.20	3	0.15
South Fork	SF_1	2.4 (1.5)	762 (2,500)	20	2	0.10	5	0.25	2	0.10	1	0.05
	SF_2	3.9 (2.4)	799 (2,620)	25	0	0.00	8	0.32	1	0.04	1	0.04
Souva	S_1	1.9 (1.2)	841 (2,760)	20	0	0.00	4	0.20	0	0.00	0	0.00

Table 4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Boulder	Bou_1	31 m (100 ft)	756 (2,480)	25	3	0.12	1	0.04	4	0.16	0	0.00
	Bou_2	1.4 (0.9)	829 (2,720)	25	8	0.32	3	0.12	3	0.12	0	0.00
Clear	CL_1	0.1 (450 ft)	768 (2,520)	35	0	0.00	5	0.14	6	0.17	2	0.06
	CL_2	1.6 (1.0)	817 (2,680)	30	4	0.13	3	0.10	1	0.03	0	0.00
	CL_3	4.7 (2.9)	878 (2,880)	30	3	0.10	4	0.13	3	0.10	2	0.07
Camas	CAM_1	0.4 (.25)	853 (2,800)	15	2	0.13	7	0.47	4	0.27	0	0.00
Upper White River tributaries												
Barlow	Bar_1	53 m (175 ft)	890 (2,920)	25	28	1.12	7	0.28	3	0.12	1	0.04
Unnamed	UN_1	61 m (200 ft)	890 (2,920)	20	8	0.40	5	0.25	2	0.10	0	0.00
White R.-upper	WR_3	48.3 (30.0)	768 (2,520)	40	4	0.10	9	0.23	2	0.05	1	0.03
	WR_4	59.5 (37.0)	890 (2,920)	20	0	0.00	13	0.65	7	0.35	5	0.25
		Total	700-899 m	835	163	0.20	170	0.20	118	0.14	49	0.06
Jordan	J_{10}	18.3 (11.4)	921 (3,020)	20	0	0.00	4	0.20	5	0.25	2	0.10
Badger	B_{14}	31.1 (19.3)	963 (3,160)	30	2	0.07	3	0.10	1	0.10	2	0.07
	B_{15}	33.0 (20.5)	1,073 (3,520)	35	0	0.00	4	0.11	2	0.06	2	0.06
Pine	PC_1	61 m (200 ft)	933 (3,060)	20	0	0.00	0	0.00	2	0.10	3	0.15
Trib.	B_{14T1A}	61 m (200 ft)	994 (3,260)	15	0	0.00	0	0.00	1	0.07	0	0.00
Drop	DC_1	0.2 (0.1)	1,000 (3,280)	15	0	0.00	0	0.00	0	0.00	0	0.00
Jalland	JC_1	76 m (250 ft)	1,006 (3,300)	20	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	B_{14T2A}	27 m (90 ft)	1,036 (3,400)	15	0	0.00	0	0.00	0	0.00	1	0.07

Table 4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Tolo	$Tolo_1$	0.2 (0.1)	1,073 (3,520)	15	0	0.00	0	0.00	0	0.00	0	0.00
Little Badger	LB_5	9.5 (5.9)	957 (3,140)	15	0	0.00	2	0.13	5	0.33	2	0.13
	LB_6	10.6 (6.6)	1,036 (3,400)	15	0	0.00	0	0.00	0	0.00	0	0.00
Threemile	$TM_{9.5}$	26.7 (16.6)	1,036 (3,400)	20	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	TM_{8T1D}	1.6 (1.0)	927 (3,042)	25	9	0.36	1	0.04	0	0.00	0	0.00
	TM_{8T1E}	3.2 (2.0)	1,036 (3,400)	10	0	0.00	0	0.00	0	0.00	0	0.00
	TM_{9T1A}	0.1 (360 ft)	902 (2,960)	10	0	0.00	0	0.00	2	0.20	0	0.00
Rock	R_{10}	23.5 (14.6)	1,012 (3,320)	20	3	0.15	0	0.00	3	0.15	2	0.10
Gate	G_8	20.3 (12.6)	975 (3,200)	20	0	0.00	1	0.05	5	0.25	0	0.00
	G_9	21.7 (13.5)	1,061 (3,480)	15	0	0.00	2	0.13	9	0.60	0	0.00
South Fork	SF_3	5.8 (3.6)	951 (3,120)	5	0	0.00	0	0.00	0	0.00	0	0.00
Souva	S_2	3.4 (2.1)	914 (3,000)	20	0	0.00	0	0.00	1	0.05	1	0.0
	S_3	4.8 (3.0)	1,024 (3,360)	10	0	0.00	0	0.00	0	0.00	0	0.0
Boulder	Bou_3	3.4 (2.1)	902 (2,960)	30	1	0.03	3	0.10	4	0.13	0	0.0
	Bou_4	4.0 (2.5)	939 (3,080)	25	1	0.04	3	0.12	5	0.20	0	0.0
	Bou_5	5.3 (3.3)	963 (3,160)	20	0	0.00	5	0.25	6	0.30	0	0.0
	Bou_6	6.9 (4.3)	1,012 (3,320)	25	1	0.04	2	0.08	2	0.08	2	0.0
	Bou_7	8.5 (5.3)	1,061 (3,480)	20	1	0.05	1	0.05	3	0.15	3	0.1
Cedar	Ce_1	0.8 (0.5)	939 (3,080)	20	0	0.00	0	0.00	1	0.05	1	0.0
	Ce_2	2.7 (1.7)	1,000 (3,280)	20	0	0.00	1	0.05	5	0.25	3	0.1
	Ce_3 east	5.3 (3.3)	1,097 (3,600)	15	0	0.00	0	0.00	0	0.00	0	0.0

Table4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
	Ce_3 west	4.5 (2.8)	1,073 (3,520)	35	0	0.00	0	0.00	0	0.00	0	0.00
Deep	D_1	1.9 (1.2)	951 (3,120)	10	0	0.00	0	0.00	0	0.00	0	0.00
Clear	CL_4	6.1 (3.8)	902 (2,960)	35	0	0.00	0	0.00	0	0.00	0	0.00
	CL_5	8.0 (5.0)	914 (3,000)	35	0	0.00	0	0.00	0	0.00	2	0.06
	CL_6	11.9 (7.4)	963 (3,160)	25	0	0.00	0	0.00	0	0.00	0	0.00
	CL_7	13.8 (8.6)	988 (3,240)	20	0	0.00	0	0.00	0	0.00	0	0.00
	CL_8	16.4 (10.2)	1,024 (3,360)	20	0	0.00	0	0.00	0	0.00	0	0.00
	CL_9	19.8 (12.3)	1,049 (3,440)	20	0	0.00	0	0.00	0	0.00	0	0.00
Camas	CAM_2	1.0 (0.6)	902 (2,960)	15	0	0.00	12	0.80	4	0.27	2	0.13
Frog	F_1	0.6 (0.4)	914 (3,000)	30	3	0.10	2	0.07	0	0.00	0	0.00
	F_2	1.9 (1.2)	927 (3,040)	35	0	0.00	0	0.00	0	0.00	0	0.00
	F_3	4.0 (2.5)	963 (3,160)	25	0	0.00	0	0.00	0	0.00	0	0.00
	F_4	5.8 (3.6)	988 (3,240)	40	0	0.00	0	0.00	0	0.00	0	0.00
	F_5	7.4 (4.6)	1,012 (3,320)	15	0	0.00	0	0.00	0	0.00	0	0.00
	F_6	8.4 (5.2)	1,024 (3,360)	20	0	0.00	0	0.00	0	0.00	0	0.00
Upper White R. tributaries												
Barlow	Bar_2	2.4 (1.5)	927 (3,040)	35	2	0.06	8	0.23	3	0.09	2	0.0
	Bar_3	3.5 (2.2)	939 (3,080)	20	3	0.15	4	0.20	5	0.25	1	0.0
	Bar_4	4.8 (3.0)	945 (3,100)	20	2	0.10	3	0.15	4	0.20	2	0.1
	Bar_5	7.2 (4.5)	1,000 (3,280)	20	7	0.35	2	0.10	3	0.15	2	0.1
	Bar_6	9.5 (5.9)	1,097 (3,600)	25	8	0.32	8	0.32	3	0.12	5	0.2

Table4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Bonney	Bon_2	2.3 (1.4)	1,027 (3,360)	15	0	0.00	0	0.00	3	0.20	1	0.07
Unnamed	Un_2	1.6 (1.0)	939 (3,080)	20	0	0.00	0	0.00	1	0.05	0	0.00
		Total	900-1,099 m	1,080	43	0.04	71	0.07	88	0.08	41	0.04
Tygh	T_{17}	31.7 (19.7)	1,225 (4,020)	15	0	0.00	0	0.00	0	0.00	0	0.00
Jordan	J_{11}	21.4 (13.3)	1,128 (3,700)	25	0	0.00	2	0.08	4	0.16	0	0.00
	J_{12}	23.4 (14.6)	1,256 (4,120)	15	0	0.00	0	0.00	5	0.33	1	0.07
Badger	B_{16}	34.5 (21.4)	1,164 (3,820)	30	0	0.00	0	0.00	3	0.10	0	0.00
	B_{17}	36.1 (22.4)	1,219 (4,000)	30	0	0.00	1	0.03	5	0.17	0	0.00
Pine	PC_2	1.6 (1.0)	1,177 (3,860)	10	0	0.00	0	0.00	0	0.00	0	0.00
Gumjuwac	Gum_1	0.2 (0.1)	1,170 (3,840)	25	0	0.00	1	0.04	1	0.04	1	0.04
Threemile	TM_{10}	28.6 (17.8)	1,219 (4,000)	20	0	0.00	0	0.00	0	0.00	0	0.0
Rock	R_{11}	25.4 (15.8)	1,177 (3,860)	15	0	0.00	0	0.00	0	0.00	0	0.0
Gate	G_{10}	23.3 (14.5)	1,219 (4,000)	20	0	0.00	0	0.00	5	0.25	0	0.0
Boulder	Bou_8	9.7 (6.0)	1,109 (3,640)	30	0	0.00	4	0.13	2	0.07	1	0.0
	Bou_9	11.6 (7.2)	1,158 (3,800)	40	6	0.15	6	0.15	4	0.10	4	0.1
	Bou_{10}	13.7 (8.5)	1,195 (3,920)	35	3	0.09	0	0.00	2	0.06	1	0.0
	Bou_{11}	15.9 (9.9)	1,262 (4,140)	30	4	0.13	1	0.03	1	0.03	2	0.0
	Bou_{12}	17.5 (10.9)	1,280 (4,200)	25	3	0.12	1	0.04	1	0.04	1	0.0
Swamp	SW_1	76 m (250 ft)	1,116 (3,660)	15	0	0.00	0	0.00	0	0.00	0	0.0
Frog	F_1	11.4 (7.1)	1,109 (3,640)	25	0	0.00	0	0.00	0	0.00	0	0.0

Table 4.7 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Size group (cm) 0-4.9 No.	0-4.9 CPUE	5-9.9 No.	5-9.9 CPUE	10-14.9 No.	10-14.9 CPUE	≥15 No.	≥15 CPUE
Upper White R. tributaries												
Barlow	Bar7	11.6 (7.2)	1,777 (3,860)	10	0	0.00	0	0.00	0	0.00	0	0.00
Bonney	Bon3	3.5 (2.2)	1,219 (4,000)	15	0	0.00	0	0.00	0	0.00	0	0.00
Iron	$Iron_1$	7.2 (4.5)	1,158 (3,800)	25	0	0.00	4	0.16	3	0.12	7	0.23
	Iron2	7.9 (4.9)	1,201 (3,940)	20	1	0.05	0	0.00	2	0.10	0	0.00
Green Lake Cr.	GL_1	1.6 (1.0)	1,219 (4,000)	20	0	0.00	0	0.00	0	0.00	0	0.00
		Total	1,100-1,299 m	495	17	0.03	20	0.04	38	0.08	18	0.04
Tygh	T_{18}	33.6 (20.9)	1,341 (4,400)	15	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_{18}	37.0 (23.0)	1,341 (4,400)	25	2	0.08	2	0.08	3	0.12	0	0.00
Gate	G_{11}	24.1 (15.0)	1,366 (4,480)	14	0	0.00	1	0.07	2	0.14	0	0.00
	G_{12}	24.9 (15.5)	1,402 (4,600)	10	0	0.00	0	0.00	0	0.00	0	0.00
		Total	1,300-1,499 m	64	2	0.03	3	0.05	5	0.08	0	0.00
White River system total				4,009	358	0.09	544	0.14	496	0.12	349	0.09

Table 4.8 Catch of brook trout and sculpins (number and fish/minute) with electrofishing gear in the White River system, 1983.

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Tygh Cr.	T_1	76 m (250 ft)	323 (1,060)	30	6	0.20	0	0.00	0	0.00	0	0.03	0	9.90
	T_2	1.3 (0.8)	326 (1,070)	30	9	0.30	0	0.00	0	0.00	0	0.00	0	0.00
	T_3	2.7 (1.7)	329 (1,080)	30	2	0.07	0	0.00	0	0.00	0	0.00	0	0.00
	T_4	4.2 (2.6)	329 (1,080)	20	7	0.35	0	0.00	0	0.00	0	0.00	0	0.00
	T_5	5.8 (3.6)	335 (1,100)	30	17	0.57	0	0.00	0	0.00	0	0.00	0	0.00
	T_6	6.9 (4.3)	341 (1,120)	35	43	1.23	0	0.00	0	0.00	0	0.00	0	0.00
	T_7	7.5 (4.7)	341 (1,120)	30	12	0.40	0	0.00	0	0.00	0	0.00	0	0.00
	T_8	8.7 (5.4)	354 (1,160)	20	17	0.85	0	0.00	0	0.00	0	0.00	0	0.00
	T_9	12.4 (7.7)	378 (1,240)	30	37	1.23	0	0.00	0	0.00	0	0.30	0	0.00
	T_{10}	14.0 (8.7)	396 (1,300)	30	47	1.57	0	0.00	0	0.00	0	0.00	0	0.00
	T_{11}	15.6 (9.7)	427 (1,400)	30	17	0.57	0	0.00	0	0.00	0	0.00	0	0.00
Jordan	J_1	0.6 (0.4)	408 (1,340)	30	33	1.10	0	0.00	0	0.00	0	0.00	0	0.00
	J_2	1.4 (0.9)	427 (1,400)	30	7	0.23	0	0.00	0	0.00	0	0.00	0	0.00
	J_3	2.4 (1.5)	427 (1,400)	25	17	0.68	0	0.00	0	0.00	0	0.00	0	0.00
	J_4	3.9 (2.4)	488 (1,600)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_1	0.8 (0.5)	354 (1,160)	30	40	1.33	0	0.00	0	0.00	0	0.20	0	0.00
	B_2	1.6 (1.0)	360 (1,180)	45	98	2.18	0	0.00	0	0.00	0	0.00	0	0.00
	B_3	2.3 (1.4)	366 (1,200)	40	71	1.78	0	0.00	0	0.00	0	0.00	0	0.00
	B_4	3.2 (2.0)	378 (1,240)	35	37	1.23	0	0.00	0	0.00	0	0.00	0	0.00
	B_5	6.6 (4.1)	439 (1,440)	40	45	1.13	0	0.00	0	0.00	0	0.00	0	0.00
	B_6	8.0 (5.0)	451 (1,380)	a5	31	0.69	0	0.00	0	0.00	0	0.00	0	0.00
	B_7	10.6 (6.6)	482 (1,580)	30	23	0.77	0	0.00	0	0.00	0	3.00	0	0.00

Table 4.8 continued.

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Trib.	B_{5T1A}	1.3 (0.8)	463 (1,520)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threemile	TM_1	0.6 (0.4)	354 (1,160)	45	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_2	3.9 (2.4)	384 (1,260)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_3	7.6 (4.7)	499 (1,637)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pine Hollow Seep	PH_1	2.9 (1.8)	499 (1,637)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Rock	R_1	61 m (200 ft)	396 (1,300)	25	1	0.04	0	0.00	0	0.00	0	0.00	0	0.00
White River-lower	WR_1	5.5-9.0 (3.4-5.6)	311-323 (1,020-1,060)	120	53	0.44	0	0.00	0	0.00	0	0.00	0	0.00
-middle	WR_2	28.0 (17.4)	457 (1,500)	50	25	0.40	0	0.00	0	0.00	0	0.00	0	0.00
		Total	300-499 m	1,005	695	0.69	0	0.00	0	0.00	0	0.00	0	0.00
Tygh	T_{12}	18.7 (11.6)	542 (1,780)	20	15	0.75	0	0.00	0	0.00	0	0.00	0	0.00
	T_{13}	21.7 (13.5)	622 (2,040)	25	24	0.96	0	0.00	0	0.00	0	0.00	0	0.00
Jordan	J_5	6.0 (3.7)	530 (1,740)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	J_6	8.0 (5.0)	555 (1,820)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	J_7	12.1 (7.5)	682 (2,240)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_8	16.3 (10.1)	579 (1,900)	35	18	0.51	0	0.00	0	0.00	0	0.00	0	0.00
	B_9	19.3 (12.0)	646 (2,120)	25	27	1.08	0	0.00	0	0.00	0	0.00	0	0.00
	B_{10}	20.0 (12.4)	658 (2,160)	20	3	0.15	0	0.00	0	0.00	0	0.00	0	0.00
Little Badger	LB_1	1.1 (0.7)	542 (1,780)	15	13	0.87	0	0.00	0	0.00	0	0.00	0	0.00
	LB_2	2.4 (1.5)	591 (1,940)	25	11	0.44	0	0.00	0	0100	0	0.00	0	0.00

Table 4.8 continued.

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Threemile	TM_4	10.1 (6.3)	530 (1,740)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.90
	TM_5	12.7 (7.9)	579 (1,900)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pine Hollow seep	PH_2	5.8 (3.6)	524 (1,720)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Rock	R_2	4.3 (2.7)	518 (1,700)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_3	6.4 (4.0)	560 (1,840)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_4	8.7 (5.4)	591 (1,940)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_5	10.3 (6.4)	604 (1,980)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_6	11.6 (7.2)	621 (2,040)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_7	14.5 (9.0)	652 (2,140)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_1	0.4 (0.25)	524 (1,720)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_2	2.6 (1.6)	573 (1,880)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_3	3.9 (2.4)	591 (1,940)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_4	5.6 (3.5)	610 (2,000)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_5	8.7 (5.4)	652 (2,140)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_0	11.9 (7.4)	671 (2,200)	30	21	0.70	0	0.00	0	0.00	0	0.00	0	0.00
		Total	500-699 m	530	132	0.25	0	0.00	0	0.00	0	0.00.	0	0.00
Tygh	T14	25.4 (15.8)	756 (2,480)	20	5	0.25	0	0.00	0	0.00	0	0.00	0	3.30
	T_{15}	26.6 (16.5)	811 (2,660)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	'16	27.8 (17.3)	890 (2,920)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Jordan	J_o	14.3 (8.9)	768 (2,520)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Table 4.8 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
	J_9	16.6 (10.3)	823 (2,700)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pen	P_1	4.8 (3.0)	786 (2,580)	5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_{11}	22.7 (14.1)	719 (2,360)	25	8	0.32	0	0.00	0	0.00	0	0.00	0	0.00
	B_{12}	25.6 (15.9)	799 (2,620)	25	1	0.04	0	0.00	0	0.00	0	0.00	3	0.00
	B_{13}	28.7 (17.8)	869 (2,850)	25	0	0.00	0	0.00	0	0.00	0	0.00	9	0.00
Little Badger	LB_3	5.6 (3.5)	707 (2,320)	30	0	0.00	0.	0.00	0	0.00	0	0.00	0	0.00
	LB_4	7.6 (4.7)	823 (2,700)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threemile	TM_6	19.8 (12.3)	719 (2,360)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_7	20.3 (12.6)	738 (2,420)	25	0	-0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_8	22.5 (14.0)	799 (2,620)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_9	24.6 (15.3)	896 (2,940)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	TM_{IT1A}	21 m (70 ft)	805 (2,640)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_{8T1B}	0.2 (800 ft)	835 (2,740)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_{8T1C}	1.2 (.75)	890 (2,920)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Rock	R_8	17.7 (11.0)	713 (2,340)	30	10	0.33	0	0.00	0	0.00	0	0.00	0	0.00
	R_9	21.1 (13.1)	841 (2,760)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	R_{8T1A}	1.6 (1.0)	835 (2,740)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	R_{8T1B}	2.3 (1.4)	853 (2,800)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_7	15.9 (9.9)	768 (2,520)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
South Fork	SF_1	2.4 (1.5)	762 (2,500)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Table 4.8 continued.

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
	SF_2	3.9 (2.4)	799 (2,620)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Souva	S_1	1.9 (1.2)	841 (2,760)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Boulder	Bou_1	31 m (100 ft)	756 (2,480)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_2	1.4 (0.9)	829 (2,720)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Clear	CL_1	0.1 (450 ft)	768 (2,520)	35	36	1.03	0	0.00	1	0.03	0	0.00	0	0.00
	CL_2	1.6 (1.0)	817 (2,680)	30	8	0.27	0	0.00	0	0.00	1	0.03	0	0.00
	CL_3	4.7 (2.9)	878 (2,880)	30	32	1.07	0	0.00	4	0.13	1	0.03	0	0.00
Camas	Cam_1	0.4 (.25)	853 (2,800)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Upper White River tributaries														
Barlow	Bar_1	53 m (175 ft)	890 (2,920)	25	10	0.40	0	0.00	1	0.04	0	0.00	1	0.04
Unnamed	Un_1	61 m (200 ft)	890 (2,920)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
White R.-upper	WR_3	48.3 (30.0)	768 (2,520)	40	2	0.05	0	0.00	0	0.00	0	0.00	0	0.00
	WR_4	59.5 (37.0)	890 (2,920)	20	13	0.65	0	0.00	1	0.05	2	0.10	1	0.05
		Total	700-899 m	835	125	0.15	0	0.00	7	0.01	4	0.05	2	0.002
Jordan	J_{10}	18.3 (11.4)	921 (3,020)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_{14}	31.1 (19.3)	963 (3,160)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	B_{15}	33.0 (20.5)	1,073 (3,520)	35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pine	PC_1	61 m (200 ft)	933 (3,060)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	B_{14T1A}	61 m (200 ft)	994 (3,260)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Table 4.8 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Drop	DC_1	0.2 (0.1)	1,000 (3,280)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Jalland	JC_1	76 m (250 ft)	1,006 (3,300)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	B_{14T2A}	27 m (90 ft)	1,036 (3,400)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Tolo	$Tolo_1$	0.2 (0.1)	1,073 (3,520)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Little Badger	LB_5	9.5 (5.9)	957 (3,140)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	LB_6	10.6 (6.6)	1,036 (3,400)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threemile	$TM_{9.5}$	26.7 (16.6)	1,036 (3,400)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Trib.	TM_{8T1D}	1.6 (1.0)	927 (3,042)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_{8T1E}	3.2 (2.0)	1,036 (3,400)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TM_{9T1A}	0.1 (360 ft)	902 (2,960)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Rock	R_{10}	23.5 (14.6)	1,012 (3,320)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_8	20.3 (12.6)	975 (3,200)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_9	21.7 (13.5)	1,061 (3,480)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
South Fork	SF_3	5.8 (3.6)	951 (3,120)	5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Souva	S_2	3.4 (2.1)	914 (3,000)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	S_3	4.8 (3.0)	1,024 (3,360)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Boulder	Bou_3	3.4 (2.1)	902 (2,960)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_4	4.0 (2.5)	939 (3,080)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_5	5.3 (3.3)	963 (3,160)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_6	6.9 (4.3)	1,012 (3,320)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_7	8.5 (5.3)	1,061 (3,480)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Table 4.8 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Cedar	Ce_1	0.8 (0.5)	939 (3,080)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Ce_2	2.7 (1.7)	1,000 (3,280)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Ce_3 east	5.3 (3.3)	1,097 (3,600)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Ce_3 west	4.5 (2.8)	1,073 (3,520)	35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Deep	D_1	1.9 (1.2)	951 (3,120)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Clear	CL_4	6.1 (3.8)	902 (2,960)	35	22	0.63	10	0.29	39	1.11	21	0.60	0	0.00
	CL_5	8.0 (5.0)	914 (3,000)	35	34	0.97	1	0.03	7	0.20	9	0.26	3	0.09
	CL_6	11.9 (7.4)	963 (3,160)	25	0	0.00	0	0.00	4	0.16	3	0.12	2	0.08
	CL_7	13.8 (8.6)	988 (3,240)	20	3	0.15	0	0.00	9	0.45	4	0.20	1	0.05
	CL_8	16.4 (10.2)	1,024 (3,360)	20	2	0.10	0	0.00	4	0.20	4	0.20	0	0.00
	CL_9	19.8 (12.3)	1,049 (3,440)	20	3	0.15	0	0.00	3	0.15	7	0.35	0	0.00
Camas	Cam_2	1.0 (0.6)	902 (2,960)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Frog	F_1	0.6 (0.4)	914 (3,000)	30	9	0.30	1	0.03	2	0.07	7	0.23	0	0.00
	F_2	1.9 (1.2)	927 (3,040)	35	11	0.31	0	0.00	5	0.14	1	0.03	0	0.00
	F_3	4.0 (2.5)	963 (3,160)	25	12	0.48	3	0.12	4	0.16	2	0.08	0	0.00
	F_4	5.8 (3.6)	988 (3,240)	40	15	0.38	2	0.05	12	0.30	15	0.50	2	0.07
	F_5	7.4 (4.6)	1,012 (3,320)	15	0	0.00	1	0.07	1	0.07	0	0.00	0	0.00
	F_6	8.4 (5.2)	1,024 (3,360)	20	0	0.00	0	0.00	1	0.05	0	0.00	0	0.00
Upper White R. tributaries														
Barlow	Bar_2	2.4 (1.5)	927 (3,040)	35	14	0.40	0	0.00	0	0.00	1	0.03	0	0.00
	Bar_3	3.5 (2.2)	939 (3,080)	20	4	0.20	0	0.00	0	0.00	0	0.00	0	0.00
	Bar_4	4.8 (3.0)	945 (3,100)	20	3	0.15	0	0.00	0	0.00	0	0.00	1	0.05

Table 4.8 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Barlow	Bar_5	7.2 (4.5)	1,000 (3,280)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bar_6	9.5 (5.9)	1,097 (3,600)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Bonney	Bon_2	2.3 (1.4)	1,027 (3,360)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Unnamed	Un_2	1.6 (1.0)	939 (3,080)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	9.00
		Total	900-1,099 m	1,080	132	0.12	18	0.02	91	0.08	74	0.07	9	0.01
Tygh	T_{17}	31.7 (19.7)	1,225 (4,020)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Jordan	J_{11}	21.4 (13.3)	1,128 (3,100)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	J_{12}	23.4 (14.6)	1,256 (4,120)	15	0	0.00	0	0.00	0	0.00	0	0; 00	0	0.00
Badger	B_{16}	34.5 (21.4)	1,164 (3,820)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	B_{17}	36.1 (22.4)	1,219 (4,000)	30	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pine	Pi_2	1.6 (1.0)	1,177 (3,860)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GumJuwac	Gum_1	0.2 (0.1)	1,170 (3,840)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threemile	TM_{10}	28.6 (17.8)	1,219 (4,000)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.30
Rock	R_{11}	25.4 (15.8)	1,177 (3,860)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_{10}	23.3 (14.5)	1,219 (4,000)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Boulder	Bou_8	9.7 (6.0)	1,109 (3,640)	30	0	0.00	0	0.00	1	0.03	0	0.00	0	0.00
	Bou_9	11.6 (7.2)	1,158 (3,800)	40	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Bou_{10}	13.7 (8.5)	1,195 (3,920)	35	0	0.00	2	0.06	4	0.11	0	0.00	0	0.00
	Bou_{11}	15.9 (9.9)	1,262 (4,140)	30	0	0.00	3	0.10	1	0.03	1	0.03	1	3.03
	Bou_{12}	17.5 (10.9)	1,280 (4,200)	25	0	0.00	0	0.00	2	0.08	1	0.04	i	0.03

Table 4.8 continued

Stream	Site	Km (RM)	Elevation m (ft)	Sample time (min)	Sculpins		Brook trout - Size group (cm) 0-4.9		5-9.9		10-14.9		≥15	
					No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Swamp	SW_1	76 m (250 ft)	1,116 (3,660)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Frog	F_7	11.4 (7.1)	1,109 (3,640)	25	0	0.00	4	0.16	6	0.24	1	0.04	1	0.04
Upper White R. tributaries														
Barlow	Bar_7	11.6 (7.2)	1,177 (3,860)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Bonney	Bon_3	3.5 (2.2)	1,219 (4,000)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Iron	$Iron_1$	7.2 (4.5)	1,158 (3,800)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	$Iron_2$	7.9 (4.9)	1,201 (3,940)	20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Green Lake Cr.	GL_1	1.6 (1.0)	1,219 (4,000)	20	0	0.00	0	0.00	1	0.05	2	0.10	0	0.00
		Total	1,100-1,299 m	495	0	0.00	9	0.02	15	0.03	5	0.01	3	0.01
Tygh	T_{18}	33.6 (20.9)	1,341 (4,400)	15	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Badger	B_{18}	37.0 (23.0)	1,341 (4,400)	25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Gate	G_{11}	24.1 (15.0)	1,366 (4,480)	14	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	G_{12}	24.9 (15.5)	1,402 (4,600)	10	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
		Total	1,300-1,499 m	64	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
White River system total				4,009	1,084	0.27	27	0.01	113	0.03	83	0.02	14	0.003

Table 4.9 Length of salmonids in White River, 1983 (backpack electrofishing gear).

Stream system	Species	Mean fork length (mm)	Standard deviation	Size range (mm)	Sample number	Sample dates
Tygh Cr.	Rb	96.1	48.9	20-253	729	Jul. 14-Aug. 24
Threemile and Rock Cr.	Rb	90.3	44.9	26-280	368	Jul. 21-Aug. 10
Boulder Cr.	Rb	97.6	47.6	22-197	122	Aug. 24-Aug. 30
	BT	78.0	42.2	41-180	17	Aug. 24-Aug. 30
Clear Cr.	Rb	87.8	39.7	31-191	71	Aug. 31-Sep. 8
	BT	89.4	34.4	36-179	209	Aug. 31-Sep. 8
Upper White River tributaries (above Barlow Crossing)	Rb	84.1	48.7	28-212	153	Aug. 31-Sep. 8
	BT	134.4	70.8	54-259	7	Aug. 31-Sep. 8
White River - tributaries	Rb	93.1	47.5	20-280	1,443	Jul. 14-Sep. 8
	BT	89.9	37.2	36-259	233	Aug. 24-Sep. 8
Mainstem Whtie River - middle and upper[a]	RB	89.8	47.3	39-191	69	Oct. 20
	BT	127.5	42.6	69-171	4	Oct. 20
- lower[b]	Rb	185.3	69.0	84-370	227	Sep. 23
	Wf	189.4	75.8	120-392	54	Sep. 23

[a]Sampling limited to 1 site in middle White River and 2 sites in upper White River.

[b]Sampling conducted with boat electrofishing gear.

Table 4.10. Native salmonids sampled with boat electrofishing gear in lower White River, 1983 and 1984.

	Rainbow trout			Whitefish		
--Date---	Number sampled-	Catch rate (fish/minute)	Mean fork length (cm)	Number sampled	Catch rate (fish/minute)	Mean fork length (cm)
23 September- 1983	227	1.42	18.5	54	0.34	18.9
29 March 1984	6	0.11	26.2	16	0.29	33.5
15 May 1983	6	0.11	24.2	9	0.16	
19 June 1984	40	0.38	19.5	35	0.33	30.4
19 July 1984	67	0.86	19.5	29	0.37	17.8
09 August 1984	160	0.98	20.6	61	0.37	15.8
27 August i 984	170	1.13	20.1	60	0.40	15.8
10 September 1984	221	1.28	18.3	32	0.18	20.1
25 September 1984	278	1.65	18.5	68	0.40	18.7
05 October 1984	215	1.16	18.5	74	0.40	19.0
08 October 1984	146	0.95	20.2	66	0.43	18.8
01 November 1984	88	0.69	20.4	a7	0.68	25.1

Table 4.11. Percentage and number of legal trout 015.2 cm or 6 in) in the White River basin, 1984. Wild rainbow trout except where noted.

Stream	Reach	Site	legal trout (%) Site	Reach mean	Reach expansions Number	Lenqth (ml	Area (m²)
White River	I	182	84	84	4,105	7,040	162,156
	II	1	23				
		2	18	21	5,450	41,760	576,000
	III	1	10				
		2	24	17	1,329	12,480	133,649
	IV	1	64				
			79	72	529	4,320	28,496
Tygh Creek	I	1	2				
		2	1.				
		3	19	7	1,005	7,680	66,628
	II	1	2				
		2	5				
		3	10	6	778	7,200	42,983
	III	1	3				
		2	8				
		3	0				
		4	9	5	543	10,560	31,981
	IV	1	12				
		2	No fish	6	125	3,360	6,560
	V	1	No fish			3,200	4,783
Jordan Creek	I	1	8				
		2	18	13	967	3,520	15,638
	II	1	5				
		2	2				
		3	6	4	718	8,320	34,198
	III	1	24				
		2	40	32	1,852	10,080	31,811
Badger Creek	I	1	18				
		2	3	11	992	4,000	27,479
	II	1	12				
		2	12	12	799	3,200	27,048
	III	1	7				
		2	4				
		3	6	6	755	5,600	44,311
	IV	1	4				
		2	13	9	1,321	11,680	62,200
	V	1	40				
		2	21	31	2,742	10,720	61,369

Table 4.11. (continued)

Stream	Reach	Site	Legal trout (%) Site	Legal trout (%) Reach mean	Reach expansions Number	Reach expansions Length (m)	Reach expansions Area (m^2)
L. Badger Creek	I	1	0				
		2	3	2	205	6,720	19,961
	II	1	6				
		2	No fish	3	115	5,280	11,511
Threemile Creek	I a/	1	21				
		2	21				
		3	23	22	3,816	11,600	29,547
	II	1	2				
		2	8	5	631	4,480	15,827
	III	1	No fish				
		2	No fish			6,880	18,582
Rock Creek	I a/	1	0 b/				
		2	No fish	0	0	0	0
	II a/	1	0				
		2	12	6	381	5,280	11,844
	III	1	5	5	763	9,600	27,008
Gate Creek	I a/	1	No fish				
		2	No fish			0	0
	II	1	0				
		2	18	9	120	6,720	15,499
	III	1	18				
		2	11	15	464	6,720	16,254
S. Fork Gate	I	1	0	0	0	2,880	5,257
Boulder	I	1	27				
		2	8	18	442	3,680	18,497
	II	1	4				
		2	7				
		3	5				
		4	26	11	762	9,920	40,437
	III	1	7 (17 c/)				
		2	50 (0 c/)	29 (9 c/)	281 (116 c/)	4,000	14,734
Forest	I	1	14	14	342	2,560	5,452
Clear	I	1	13 (18 c/)				
		2	19 (0 c/)	16 (9 c/)	457 (38 c/)	2,400	21,175
	II	1	21 (6 c/)				
		2	0 (25 c/)	11 (16 c/)	282 (930 c/)	10,080	70,186
	III	1	100 b/ (11 c/)				
		2	29 (8 c/)	65 (10 c/)	406 (708 c/)	6,400	77,469

Table 4.11. (continued)

Stream	Reach	Site	Legal trout (%) Site	Legal trout (%) Reach mean	Reach expansions Number	Reach expansions Length (m)	Reach expansions Area (m^2)
L. Badger Creek	I	1	0				
Frog	I	1	0 (4 c/)				
		2	0 (2 c/)	0 (3 c/)	0 (313 c/)	7,360	41,026
	II	1	0 (67 c/)	0 (67 c/)	0 (718 c/)	5,120	53,950
Barlow	I	1	4				
		2	11	8	203	4,320	19,931
	II	1	4				
		2	20	12	378	4,320	16,025
	III	1	18	18	108	1,600	3,649
Mineral	I	1	0 (50 c/)	0 (50 c/)	0 (173 c/)	4,880	15,203
Iron	I	1	31	31	498	4,320	12,361
Buck	I	1	0	0	0	3,200	9,070
Bonney	I	1	0	0	0	1,600	5,087

a/ Numbers of fish, reach length, and reach area are adjusted to account for intermittent sections of stream.

b/ Only one fish in site.

c/ Brook trout.

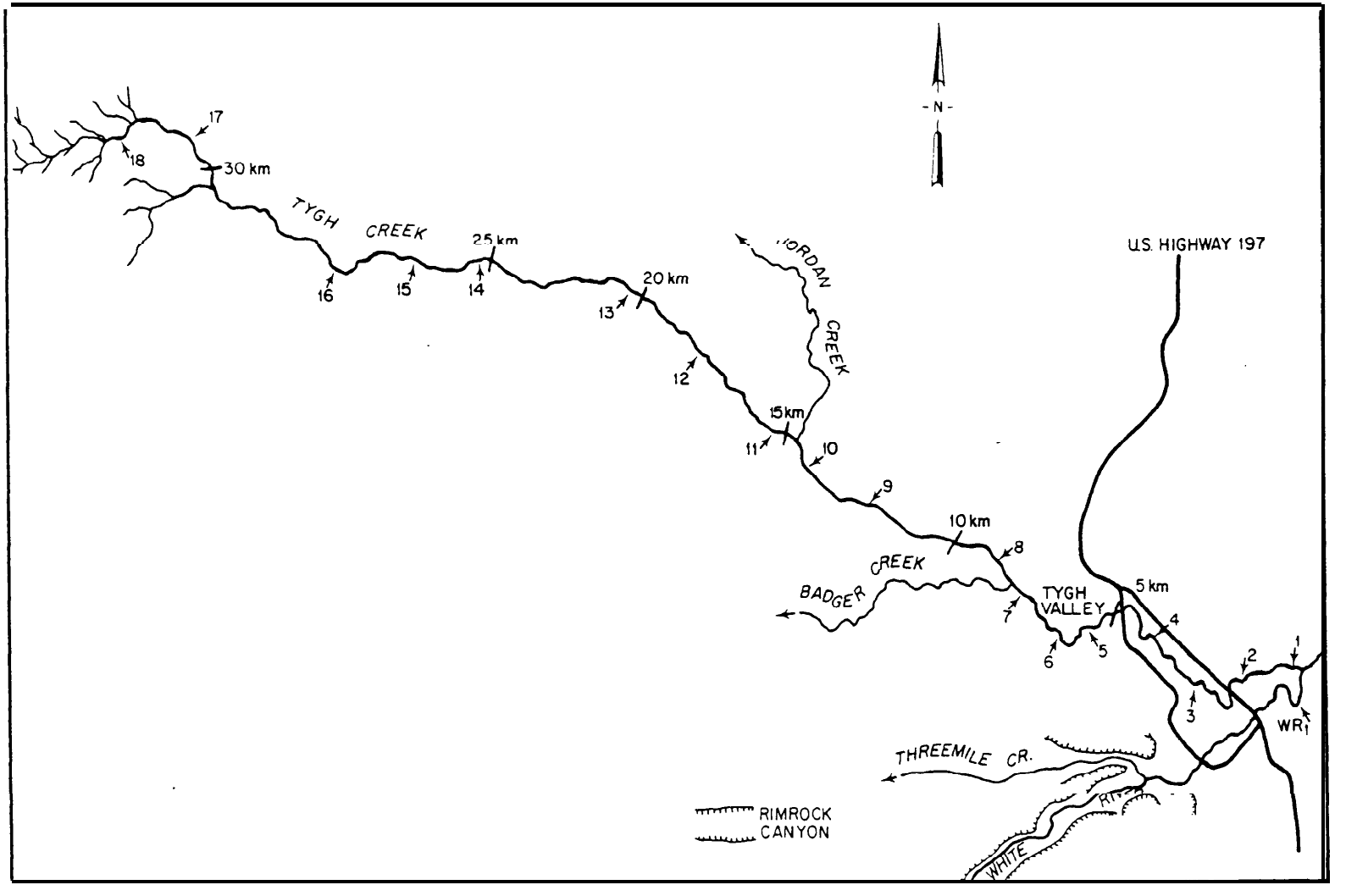


Figure 4.2 Resident fish inventory sites in Tygh Creek and lower White River, 1983

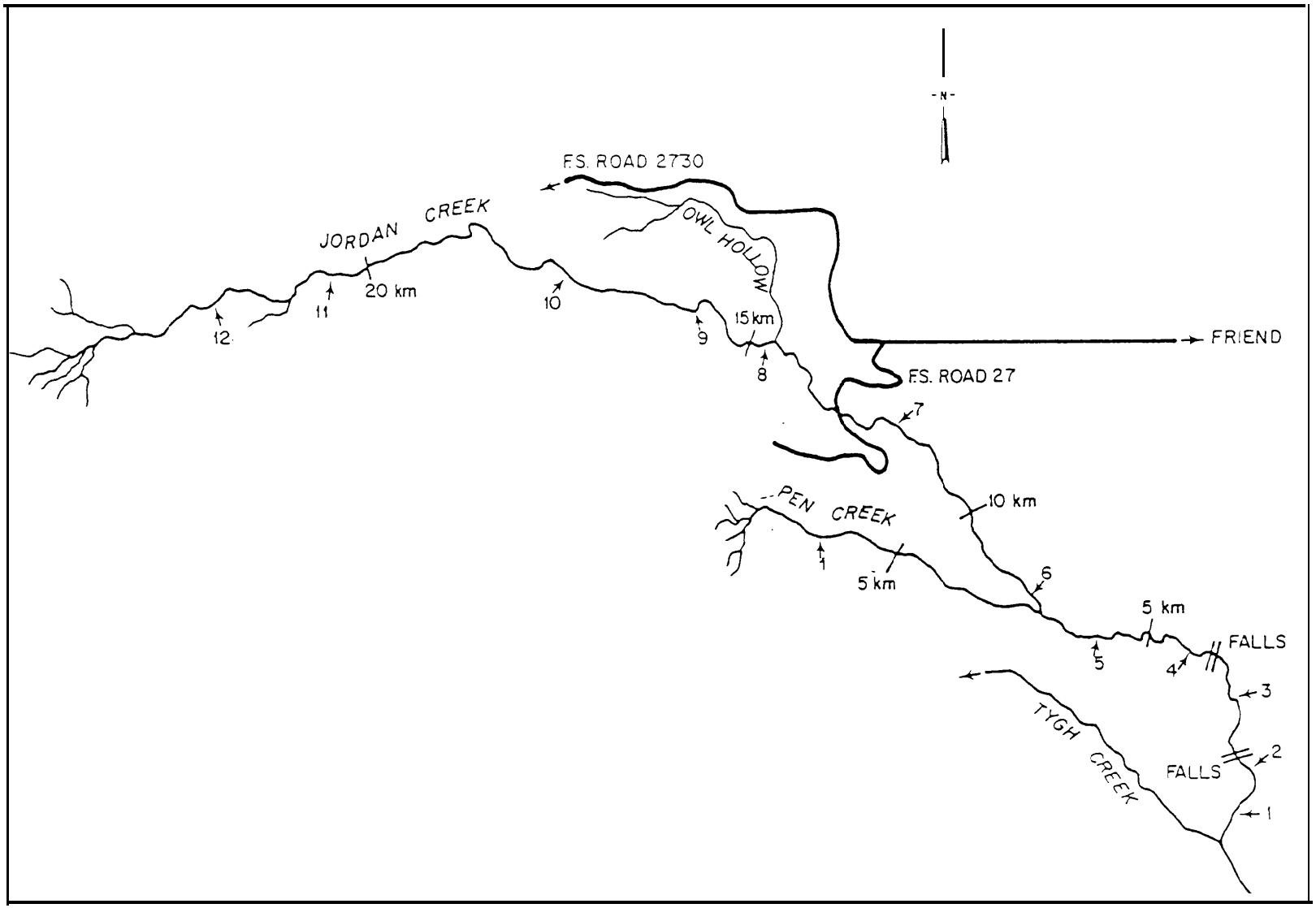


Figure 4.3 Resident fish inventory sites in Jordan and Pen creeks, 1983

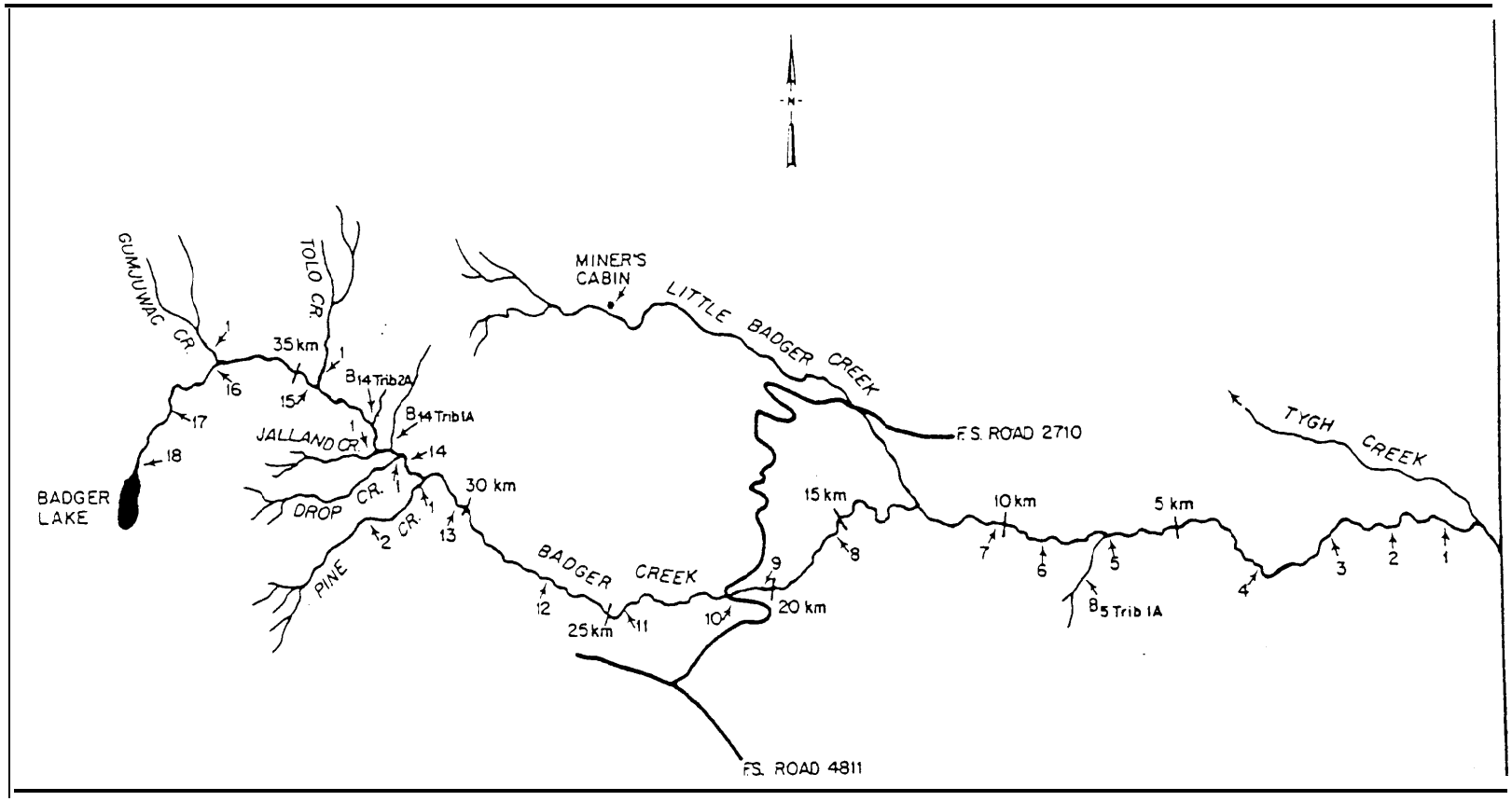


Figure 4.4 Resident fish inventory sites in Badger Creek, 1983

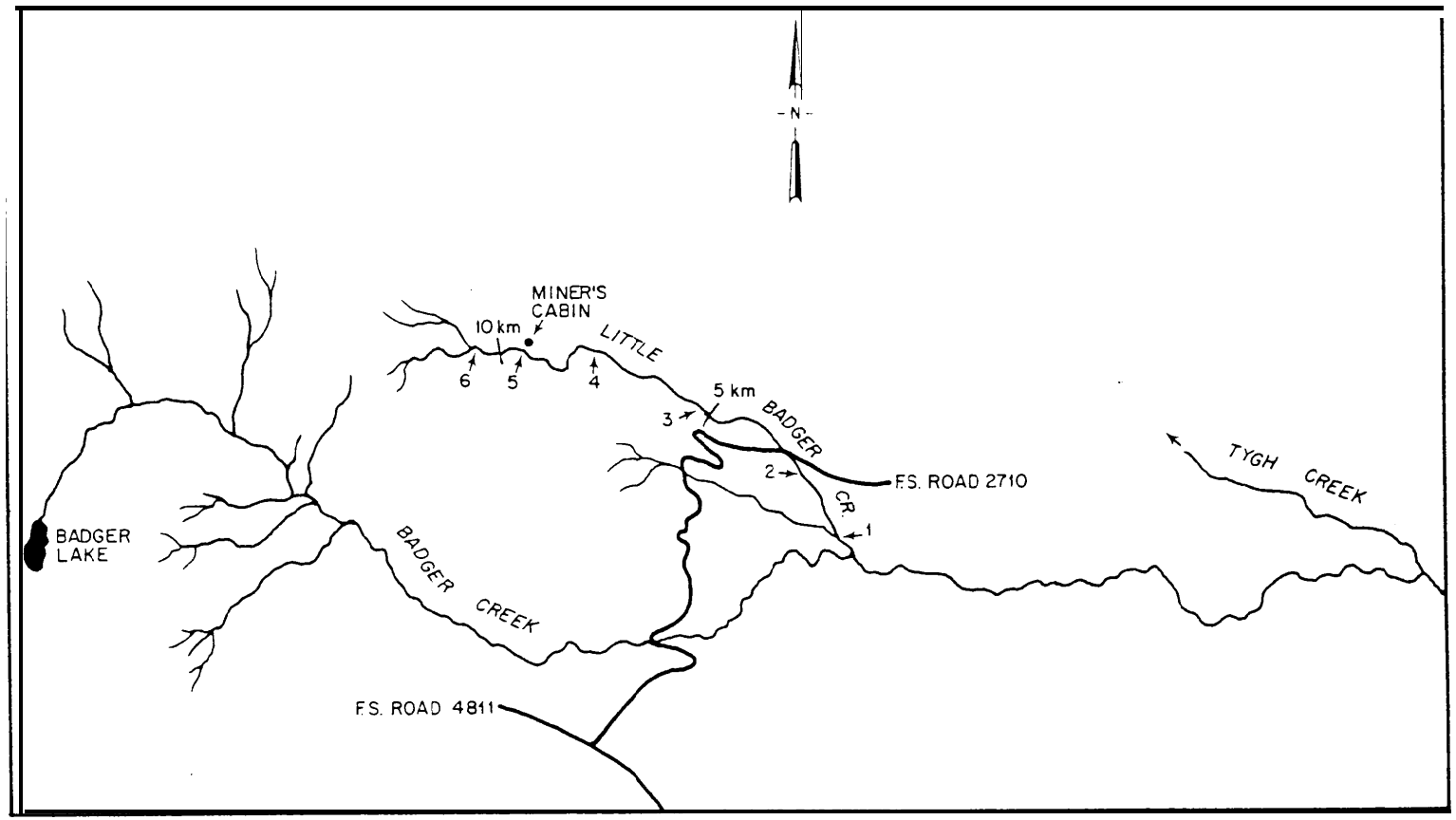


Figure 4.5 Resident fish inventory sites on Little Badger Creek, 1983

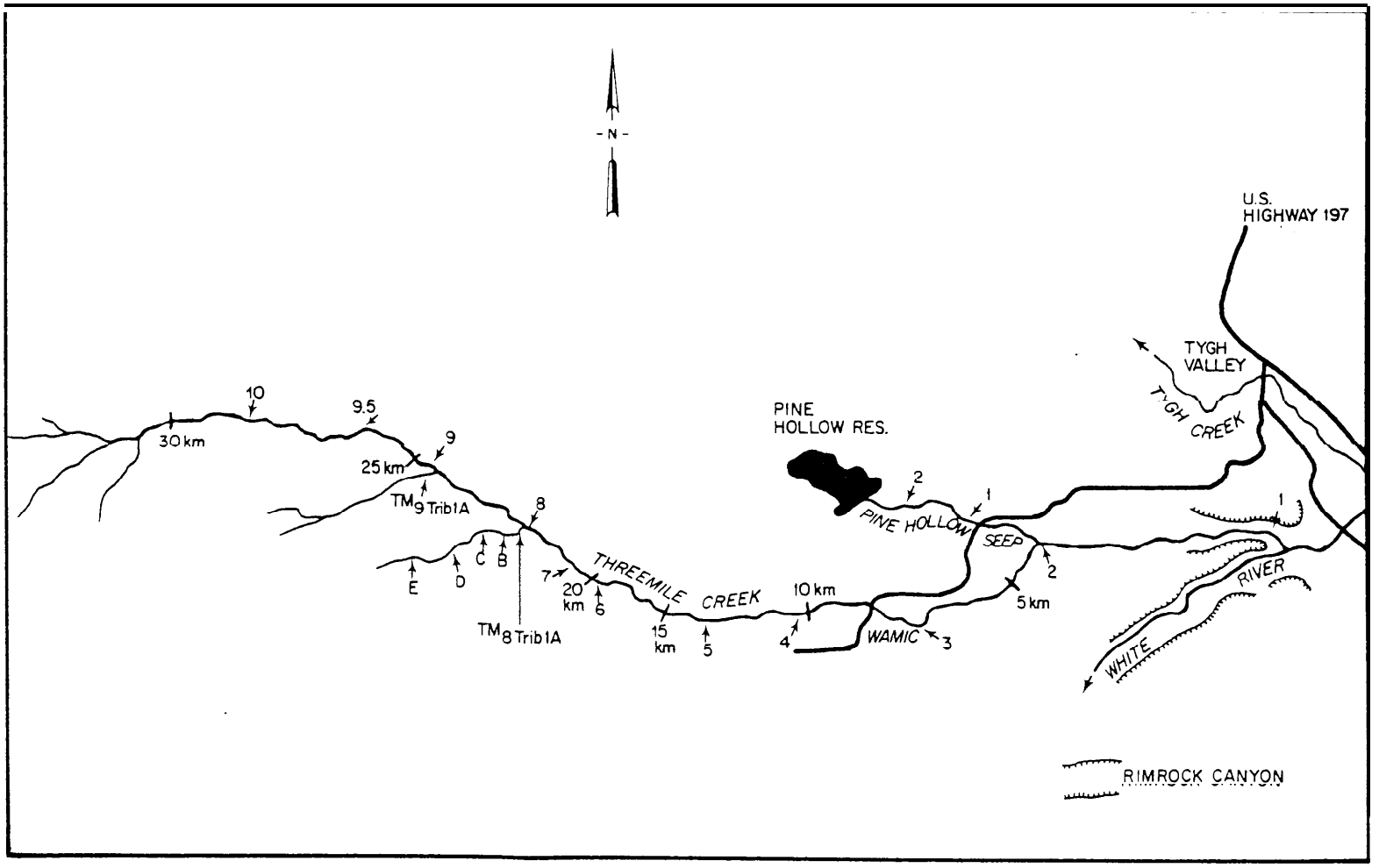


Figure 4.6 Resident fish inventory sites in Threemile Creek, 1983

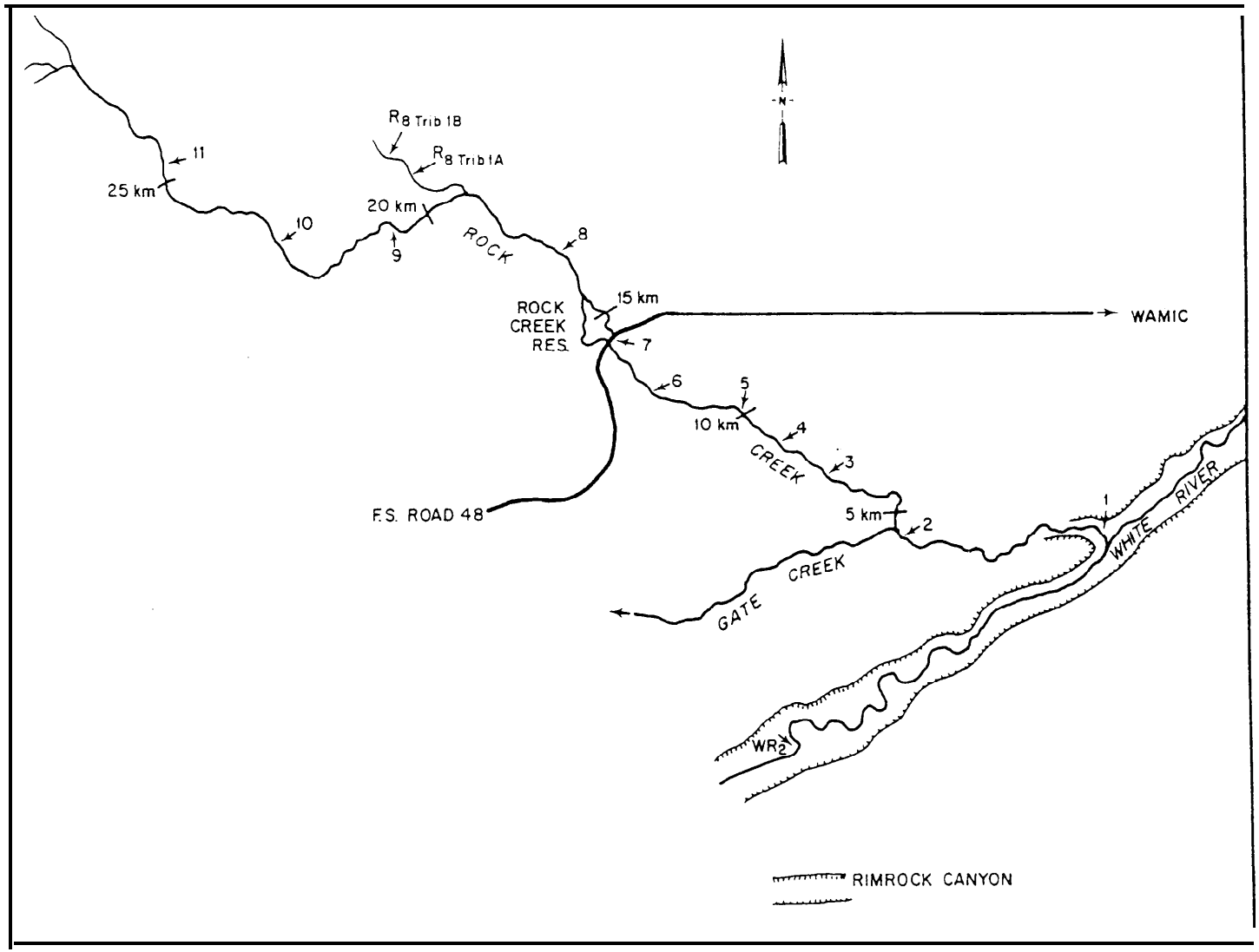


Figure 4.7 Resident fish inventory sites in Rock Creek and in the middle White River, 1983

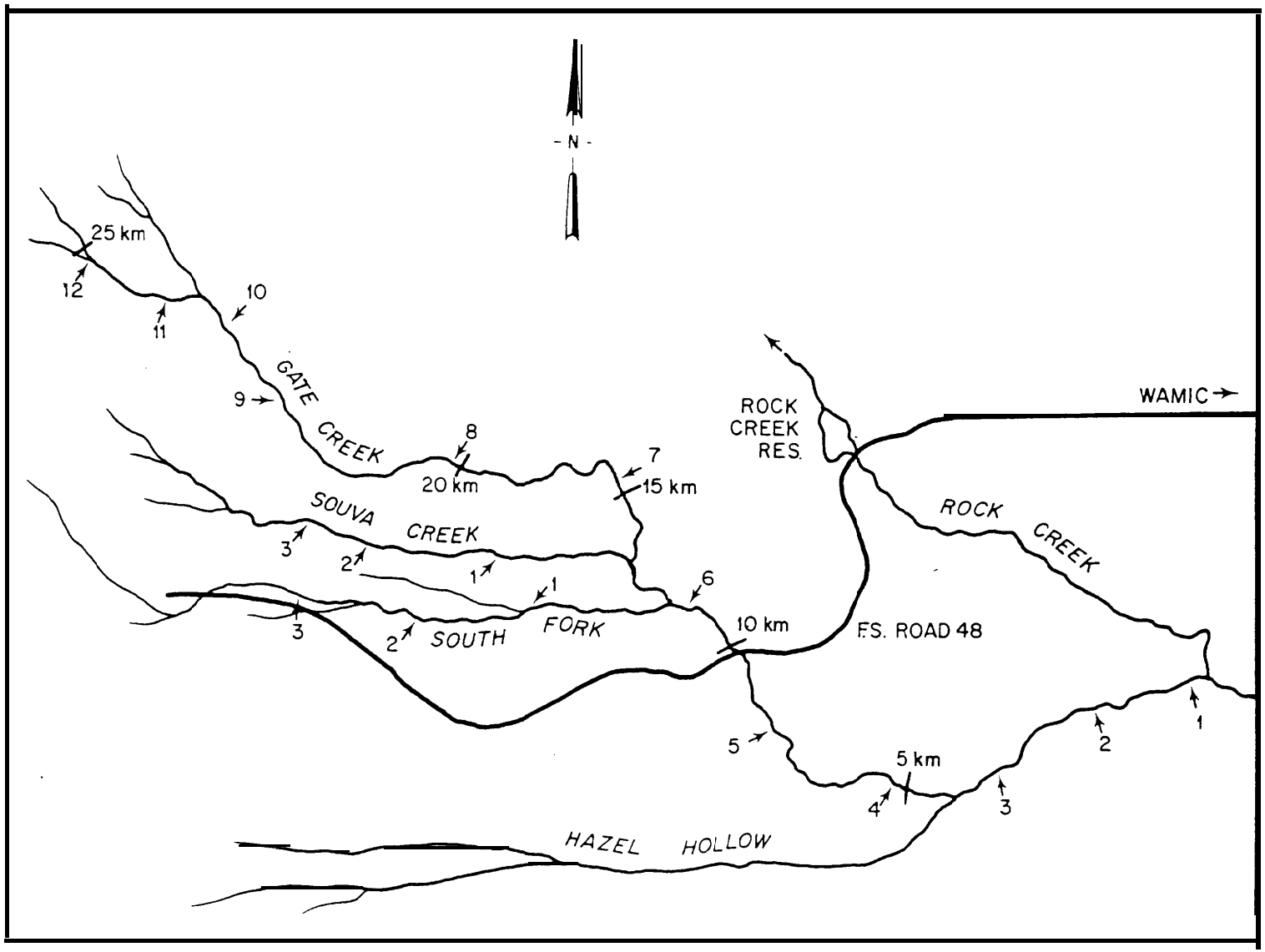


Figure 4.8 Resident fish nventory sites in the Gate Creek system, 1983

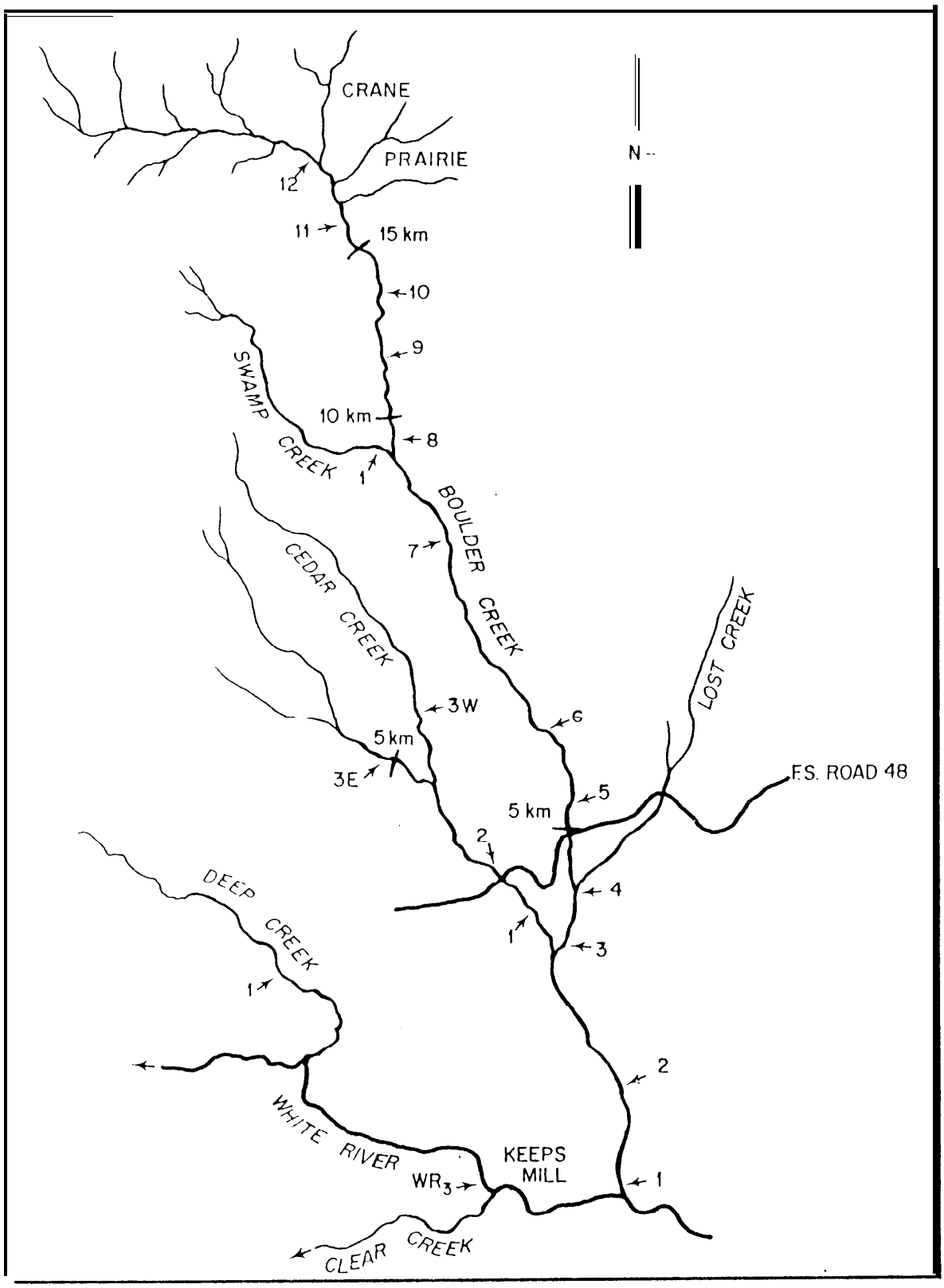


Figure 4.9 Resident fish inventory sites in the Boulder Creek system, 1983

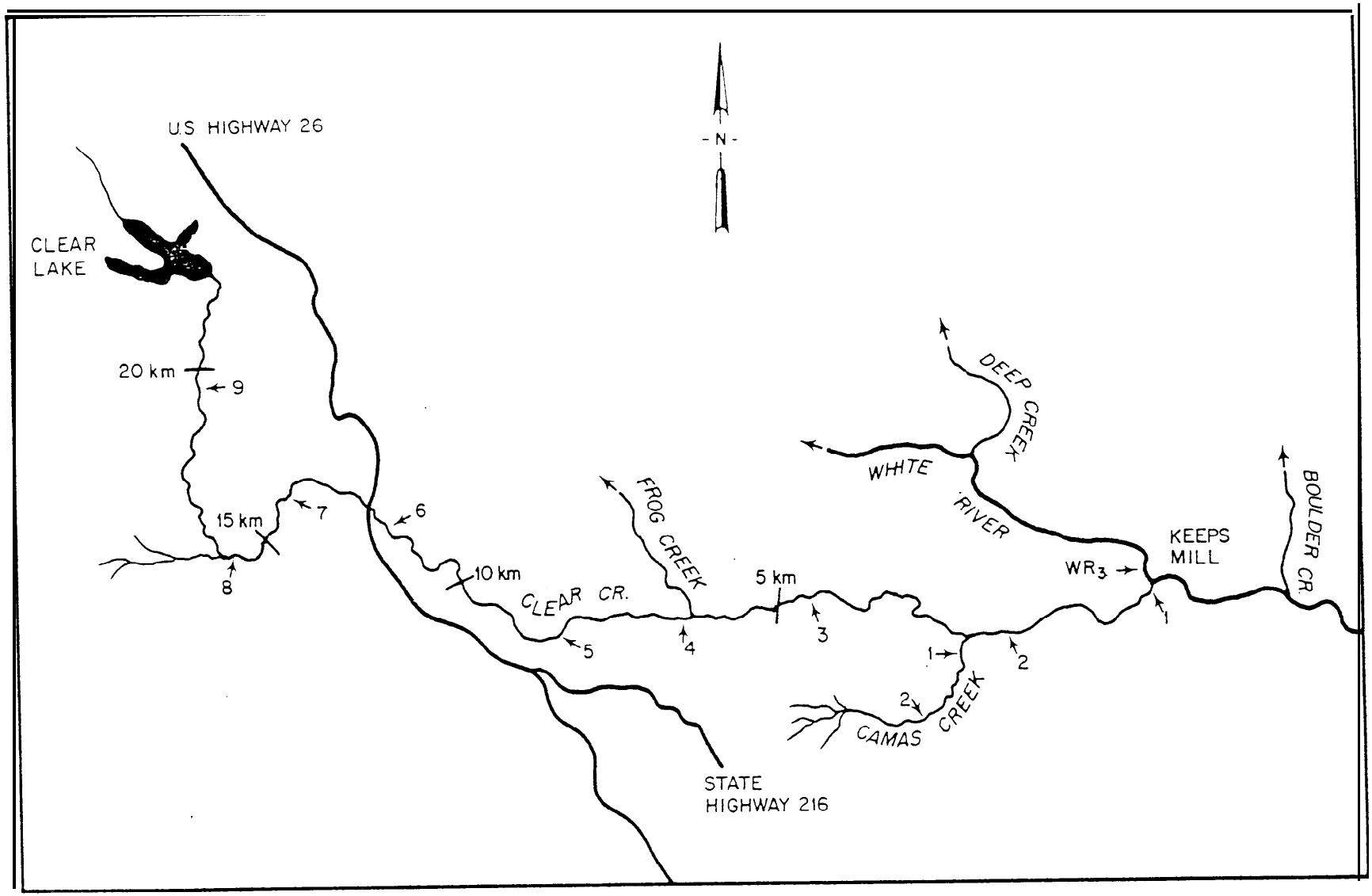


Figure 4.10 Resident fish inventory sites in Clear Creek and upper White River, 1983

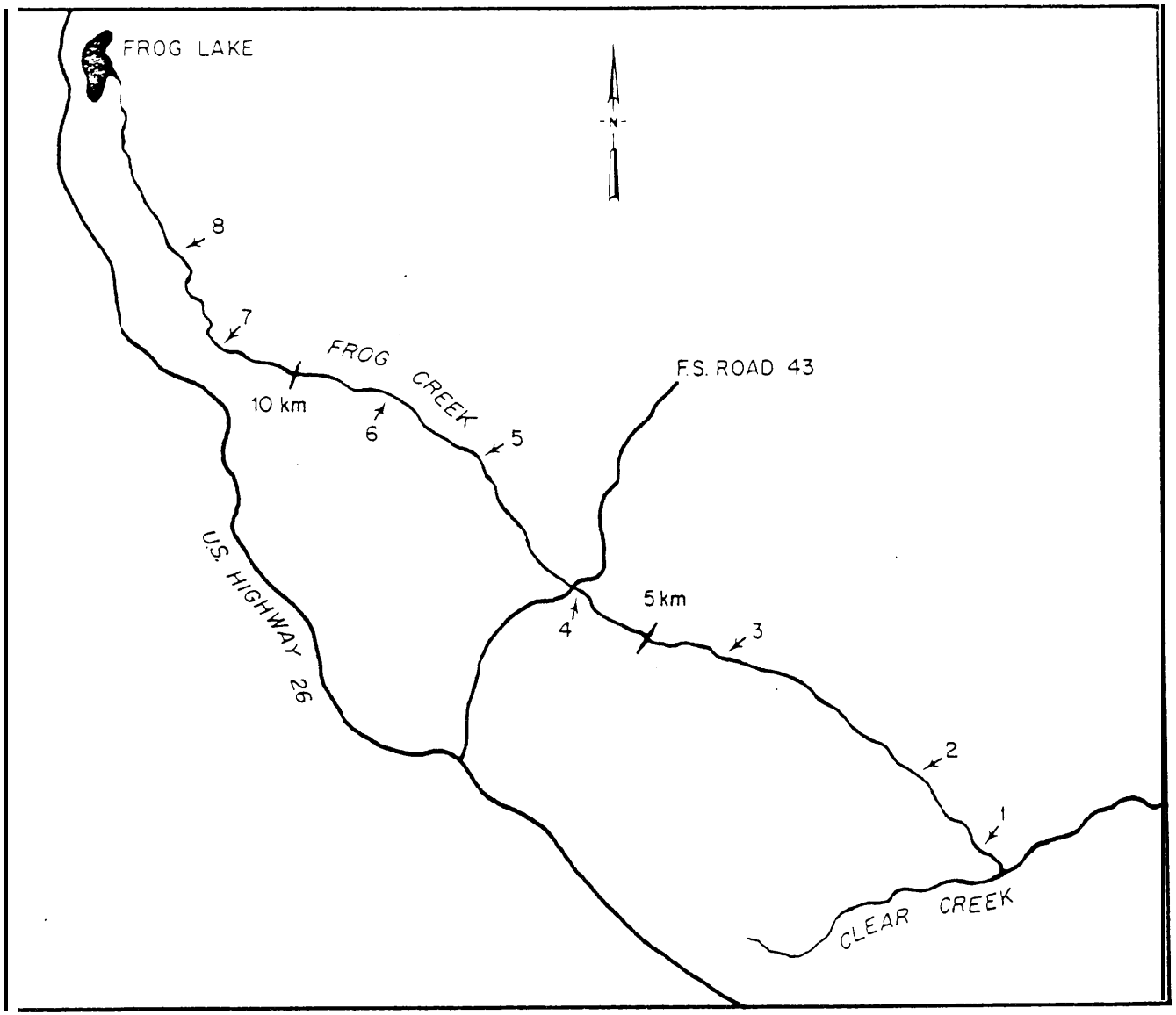


Figure 4.1 Resident fish inventory sites in Frog Creek, 1983

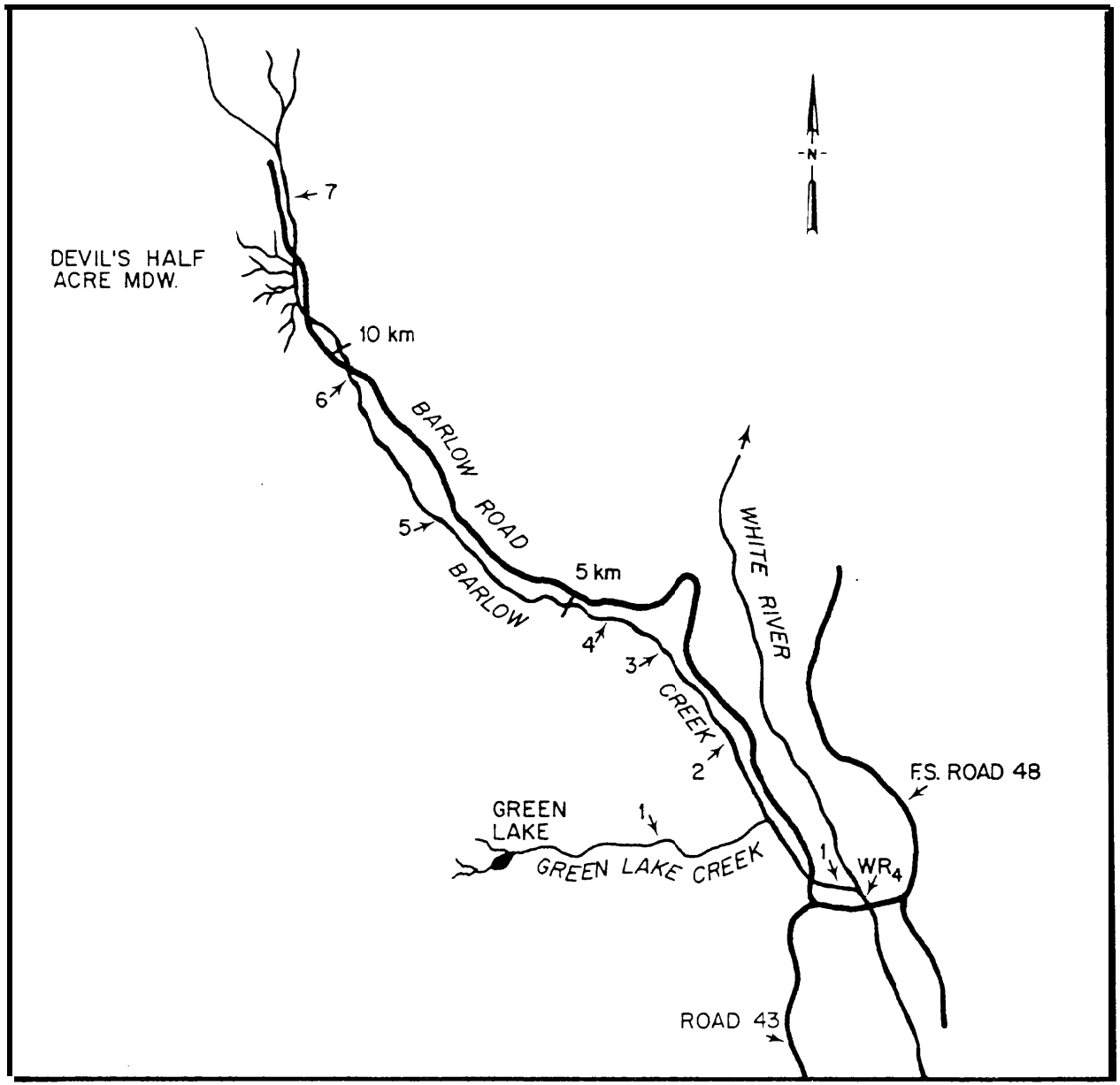


Figure 4.12 Resident fish inventory sites in Barlow Creek, 1983

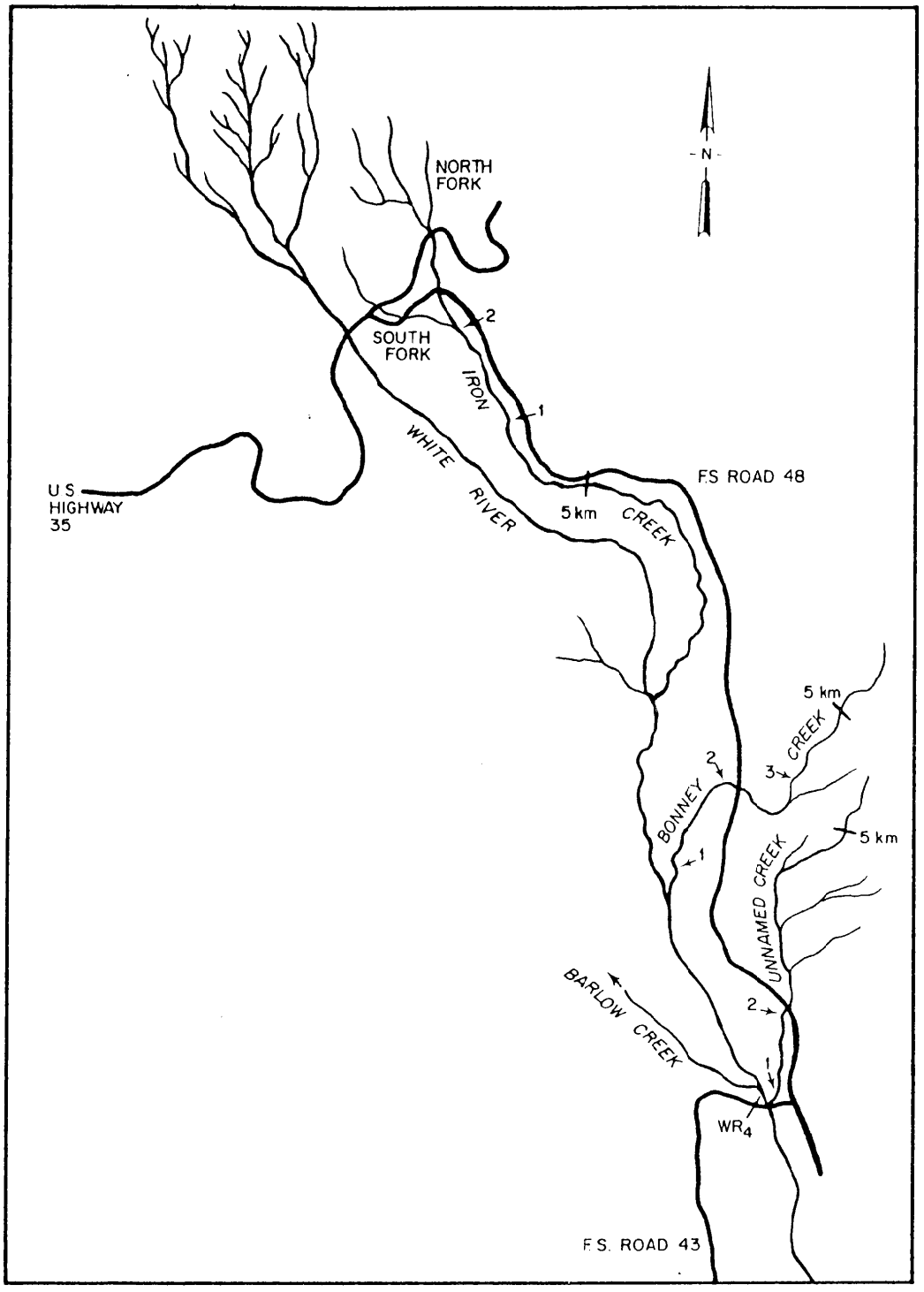


Figure 4.13 Resident fish inventory sites in Iron, Bonney, Buck (unnamed) creeks, and in upper White River, 1983

Table 4.12. Location of sample areas in the White River basin where scales were collected, 1984.

Name of sample area	Stream sections included in sample area
Lower White River	Mainstem White River below Clear Creek
Upper White River	Mainstem White River above Clear Creek
Lower Tygh Creek system	Tygh Creek below falls (km 20.2) Jordan Creek below lower falls (km 1.4) Badger Creek below Bonney Crossing
Upper Tygh Creek	Tygh Creek above falls (km 20.2)
Upper Jordan Creek	Jordan Creek above upper falls (km 3.5)
Upper Badger Creek	Badger Creek above Bonney Creek Little Badger Creek
Threemile Creek	Threemile Creek and tributaries
Rock and Gate creeks	Rock, Gate creeks and tributaries
Boulder Creek	Boulder Creek and tributaries
Clear and Frog creeks	Clear, Frog creeks and tributaries
Upper White River tributaries	Tributaries above Clear Creek confluence Barlow Bonney, Iron

Figure 4.14 Data form for scale collections from resident trout in the White River basin

WR-3

ELECTROFISHING FIELD FORM

Stream _____ Location _____

Sample area ___ ___ ___

Date _____ Start time _____ End time _____

Crew _____ Temp: Water _____ Air _____

	Sp ____ FL (mm)	No. R/S		Sp ____ FL (mm)	No. R/S		Sp ____ FL (mm)	No. R/S		Sp ____ FL (mm)	No. R/S		Sp ____ FL (mm)	No. R/S	
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

Scale Summary

	Size Group (mm)			
	0-49	50-99	100-149	≥ 150
Random				
Selective				

COMMENTS: _____

Figure 4.15 Summary form for collection of scales from resident trout

Scale Collection Summary Form

River System ____________________ Species ____________________

Year ____________________

Location	Date	Sample area	Scale No. R/S	Length	Location	Date	Sample area	Scale No. R/S	Length

Data on analysis of scales from resident trout are in Tables 4.13 to 4.16.

C. Genetic Characteristics

Resident rainbow trout were collected from 9 populations in 16 locations in the White River basin in 1984 (Table 4.17). During May and June 460 trout were collected with backpack shockers and frozen wihtin 1 to 2 hours. These fish were delivered to Oregon State University where they were analyzed by electrophoresis (Currens 1985) to determine the genetic characteristics of the rainbow trout in the White River basin. Otoliths were also collected from the fish and stored. These may be used to differentiate between resident rainbow and juvenile steelhead in future evaluations of anadromous fish introductions. These data are presented in Tables 4.18 to 4.24.

D. Fish Disease

Resident trout were collected in the White River basin during three different time periods and were examined for disease. III 1983 269 rainbow trout and 200 brook trout were collected from 12 areas during the spawning period for brook trout. Fish were collected with backpack shockers in streams and with gill nets in lakes. These fish were examined for viruses, bacteria, and parasites. Fifty-four rainbow in spawning condition were collected in May 1984 and were examined for viruses. Thirty-five rainbow were collected from the lower reaches of the watershed in September and were examined for- parasites and bacteria.

Whether Ceratomyxa Shasta is present in White River was determined by holding 100 susceptible trout (Roaring River stock) in a live box in White River for 3 weeks. In addition, 100 resident trout from the White river basin were held for 3 weeks in the Deschutes River, which is known to have C. Shasta (Ratliff 1983). A control group of 20 susceptible trout (Roaring River stock) was also held in the Deschutes. After exposure, the fish were transported live to the Fish Disease Laboratory at Corvallis and reared in 68L tanks with pathogen-free well water at 12°C. Mortalities were removed daily and examined for C. Shasta spores. After 81 days at the laboratory, the survivors were killed and examined for spores.

Data on diseases found in fish from the White River basin are in Tables 4.25 to 4.27.

Table 4.13. Mean back-calculated fork lengths (cm) of rainbow trout collected in the White River system, 1984.

Sample area	Age 1	2	3	4	5
Lower White River	11.9	18.1	30.1 a/	--	--
Upper White River	10.1 a/	15.4 a/	--	--	--
Rock-Gate creeks	9.3	13.6	19.6 a/	19.6 a/	22.5 a/
Lower Tygh Creek	9.0	13.2	17.7	23.1	31.8 a/
Upper White R. tributaries	8.6	12.3	16.2	--	--
Boulder Creek	8.4	11.5	14.1	15.5 a/	17.3 a/
Clear-Frog creeks	8.1	11.9	14.6	--	--
Upper Jordan Creek	7.6	10.7	14.4	17.5 a/	--
Upper Tygh Creek	7.5	11.5	13.9	--	--
Upper Badger Creek	7.1	10.4	13.9	16.9	17.7 a/
Threemile Creek	6.8	10.9	13.0	16.3 a/	--

a/ Sample size of fewer than five fish.

Table 4.14. Mean annual growth (cm) of rainbow trout in the White River system at growth years 1 and 2.

Sample area	Growth Year 1		Growth Year 2	
	Sample size	Mean growth	Sample size	Mean growth[b]
Lower White River	42	11.9	--	--
Rock-Gate creeks	75	9.2	--	--
Lower Tygh Creek	77	8.9	--	--
Upper White River tributaries	74	8.6	9	3.8
Boulder Creek	94	8.4	9	3.0
Clear-Frog creeks	93	8.1	24	3.2
Upper Jordan Creek	75	7.6	10	3.4
Upper Tygh Creek	76	7.4	10	3.5
Upper Badger Creek	95	7.1	17	2.8
Threemile Creek	76	6.8	10	3.0

Table 4.15. Pairwise comparisons of mean annual growth of rainbow trout in the White River system at growth year 1.

	Location	2	3	4	5	6	7	8	9	10
1.	Lower White River	2 691 a/	2.986 a/	3.316 a/	3.561 a/	3.846 a/	4.313 a/	4.477 a/	4.824 a/	5.102 a/
2.	Rock-Gate creeks		0.295	0.625	0.870 a/	1.155 a/	1.622 a/	1.786 a/	2.133 a/	2.411 a/
3.	Lower Tygh Creek			0.330	0.575	0.631	1.327 a/	1.491 a/	1.898 a/	2.116 a/
4.	Upper White R. tributaries				0.245	0.530	0.997 a/	1.161 a/	1.508 a/	1.786 a/
5.	Boulder Creek					0.285	0.752 a/	0.916 a/	1.263 a/	1.541 a/
6.	Clear-Frog creeks						0.467	0.631	0.978 a/	1.256 a/
7.	Upper Jordan Creek							0.164	0.511	0.789 a/
8.	Upper Tygh Creek								0.347	0.625
9.	Upper Badger Creek									0.278
10	Threemile Creek									

a/ Significant at P <0.05.

Table 4.16. Pairwise comparisons of mean annual growth of rainbow trout in the White River system at growth year 2.

	Location	2	3	4	5	6	7
1.	Upper White R. tributaries	0.641	0.101	0.544	0.132	0.785 a/	0.254
2.	Boulder Creek		0.540	0.004	0.773 a/	0.144	0.895 a/
3.	Clear-Frog creeks			0.544	0.233	0.684	0.355
4.	Upper Jordan Creek				0.777 a/	0.140	0.899 a/
5.	Upper Tygh Creek					0.917 a/	0.122
6.	Upper Badger Creek						1.039 a/
7.	Threemile Creek						

b/ Significant at P <0.05.

Table 4.17. Populations and sampling locations of rainbow and Steelhead trout in the Deschutes and White rivers, 1984.

Name of sample area	Stream sections included in sample area
Lower White	Lower White River above White River Falls
Lower Tygh	Tygh Creek upstream from the confluence of Tygh Creek and White River
Jordan	Jordan Creek above the second waterfall
Upper Tygh	Tygh Creek above the waterfall
Little Badger	Little Badger Creek
Threemile	Threemile Creek
Rock	Rock Creek (primarily above reservoir)
Gate	Gate Creek
Barlow	White River at Barlow Creek, Barlow Creek and Buck Creek
Deschutes	Mainstem of the Deschutes River at Nena Creek
Round Butte	Round Butte Hatchery (Steelhead)

Table 4.18. Enzymes, abbreviations, and number of loci used in electrophoretic analysis of rainbow trout populations in White River and rainbow and Steelhead trout in the Deschutes River.

Enzyme	Abbreviation	Loci
Aconitase	ACO	1
Adenosine deaminase	ADA	1
Alcohol dehydrogenase	ADH	1
a-glycerophosphate dehydrogenase	AGP	4
Creatine kinase	CK	2
Glutamate-oxalacetate transaminase	GOT	4
Isocitrate dehydrogenase	IDH	3
Lactate dehydrogenase	LDH	5
Malate dehydrogenase	MDH	4
Malic enzyme	ME	4
Phosphoglucose isomerase	PGI	3
Phosphomannose isomerase	PMI	1
Peptidase (glycyl-leucine dipeptide)	GL	2
Peptidase (leucyl-glycyl-glycine tripeptide)	LGG	1
Peptidase (l-phenylalanyl-l-proline)	PHAP	1
Phosphose glucomutase	PGM	2
Phosphoglycerate kinase	PGK	2
Sorbitol dehydrogenase	SDH	2
Superoxide dismutase	SOD	2

Table 4.19. Genetic distance, genetic identity, and average heterozygosity of rainbow trout in the White and Deschutes rivers and of steelhead trout from Round Butte Hatchery. Nei's genetic distance above diagonal. Average heterozygosity on the diagonal in parentheses. Genetic identity below the diagonal. (Currens 1985).

Population	1	2	3	4	5	6	7	8	9	10	11
1. Lower White	(.067	0045	002 2 a	00500 c	.00661 c/	.00674 b/	.00636 b/	.00663	.00815 c/	.01055 c/	00533 c
2. Lower Tygh	.9955	062	0045	00395 c	004	00448	00710 b/	.00182	.01495 c/	.01533 c/	01215 c/
3. Jordan	.9979	.9955	(.0457)	.01984 c/	.00992 c/	01004 a/	00389 a/	.00[illegible]	01136 c/	.01912 c/	0120 c
4. Upper Tygh	.9950	.9961	.9804	(.0196	.00701 c/	00657 c/	00466 c/	.00371 c/	.06569 c	.01635 c/	00992 c/
5. Little Badger	.9934	.9959	.9901	9930	(0446	.00167	01288 c/	.00382 b/	.00204	.0103 c/	0103 c/
6. Threemile	.9933	.9955	.9900	.9935	.9983	(.0494)	00968 c/	.0020[illegible]	00103	.00964 c/	00963 c/
7. Ro k	.9937	.9929	.9961	.9954	.9872	.9904	0595)	.0078[illegible]	0117 c/	.02238 c/	01473 c/
8. Gate	.9934	.9982	.9926	.9963	.9962	.9980	9922	(.0476)	.0033	.01457 c/	0122 c/
9. Bar ow	.9919	.9851	.9887	.9364	.9990	.9980	9889	.9967	(.0483)	.01280 c/	01247 c/
10. Deschutes	.9895	.9848	.9811	.9838	.9899	.9904	9779	.9855	.9873	(.0981)	0077 c/
11. Round Butte	.9947	.9879	.9881	.9901	.9897	.9904	9854	.9879	.9876	.9923	044

a/ Genetic distance significantly different from 0 (P < .05)
b/ Genetic distance significantly different from 0 (P < .01)
c/ Genetic distance significantly different from 0 (P < .005

Table 4.20. Loci at which statistically significant differences in isozyme frequencies occur in comparison of White River and Deschutes River rainbow trout populations. Numbers in table are the level of significance at: P<0.05, P<0.01, and P<0.005 (Currens 1985).

	Locus											
Population	ACD	ADH	AGPD-1	IDH 3,4	LDH 4	MDH 1,2	MDH 3,4	ME 3	PEP-GL	PGI 2	PGM 2	SOD
Lower White	.005	.05	.05	.05	.005		.005		.05		.05	.005
Lower Tygh	.005			.05	.005		.005					.05
Jordan	.005			.005	.005	.005	.005		.05			.005
Upper Tygh	.005		.01	.005	.005				.01			.01
Little Badger	.005		.05	.005	.005	.005			.05			.05
Threemile				.005	.005							
Rock	.005	.05		.005	.005		.005	.05			.005	.005
Gate				.05	.005							
Barlow				.005	.005		.05		.05	.005		.05

Table 4.21. Loci at which statistically significant differences in isozyme frequencies occur in comparison of White River rainbow trout populations and Round Butte steelhead. Numbers in table are the level of significance at: P<0.05, P<0.01, and P<0.005 (Currens 1985).

	Locus											
Population	ACD	ADH	AGPD-1	IDH 3,4	LDH 4	MDH 1,2	MDH 3,4	ME 3	PEP-GL	PGI 2	PGM 2	SOD
Lower White					.005		.005		.05		.05	.05
Lower Tygh					.005		.005					.05
Jordan	.005	.05	.05		.005			.005	.005			.005
Upper Tygh	.005		.05	.005	.005		.005		.005			.005
Little Badger	.01		.05	.005	.005	.005	.05				.05	.01
Threemile	.01		.05	.05	.005							
Rock	.005		.05	.005	.005		.05	.05	.05		.005	.005
Gate					.05							
Barlow	.01		.05	.005	.005		.005		.005			.05

4.2 2 Date of earliest recorded introduction, total numbers released, mean number- released per year of stocking for rainbow trout in lakes and stream in the White River drainage.

Location	Earliest Introduction	Total Number	Mean Number/ Year Stocked
Badger Creek	1934	86,008	3,909
Badger Lake	1939	169,213	6,267
Baker Ponds	1982	6,094	2,031
Boulder Lake	1966	49,506	24,753
Clear Creek	1952	16,540	1,378
Clear Lake	1953	1,491,535	55,242
Cody Ponds	1967	18,180	9,090
Frog Lake	1952	241,323	9,653
Jean Lake	1983	500	500
Pine Hollow Reservoir	1970	693,918	53,378
Rock Creek Reservoir	1953	333,904	11,514
Smock Prairie Reservoir	1976	17,563	2,509
Tygh Creek	1936	85,000	28,333
White River	1934	592,976	16,026

4.2 3 Date of earliest recorded introductoin total numbers released, mean number released per year of stocking for brook trout in lakes and stream in the White River drainage.

Location	Earliest Introduction	Total -Number	Mean Number/ -Year Stocked
Boulder Lake	1938	110,557	4,607
Little Boulder Lake	1953	20,982	1,049
Catalpa Lake	1952	8,744	1,093
Clear Creek	1938	10,000	10,090
Clear Lake	1934	417,236	26,077
Frog Lake	1934	78,870	9,858
Green Lake	1953	3,232	1,077
Jean Lake	1938	32,467	1) 433
Upper Twin Lake	1939	18, 104	2,012
Lower Twin Lake	1953	38,850	3,532

Table 4.24 A Stocking History of the White River Basin from 1934-1984.[a/]

		Rainbow Trout				Brook Trout			
Location	Year	Number	Weight	Length	Hatchery[b]	Number	Weight	Length	Hatchery[b]
BADGER CREEK	1934	20000	-	-	-				
	1936	15000	-	-	-				
	1937	20000	-	-	-				
	1952	1100	500	10-12	-				
	1953	1000	638	12-14	OS				
	1954	2243	318	6-8	OS				
	1955	750	100	6-9	OS				
	1955	900	220	8-10	OS				
	1956	1489	339	8-10	OS				
	1957	1958	409	6-8	OS				
	1958	1410	325	6-8	OS				
	1959	1540	270	6-8	OS				
	1960	913	268	10-12	OS				
	1961	3075	1150	8-10	OS				
	1962	990	300	10-12	OS				
	1963	600	300	10-12	OS				
	1966	1005	437	10-12	OS				
	1967	1008	280	10-12	OS				
	1968	1000	278	8-10	OS				
	1969	2000	800	10-12	OS				
	1970	2000	625	8-10	OS				
	1971	4024	982	8-10	OS				
	1972	2003	607	8-10	OS				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
BADGER LAKE	1939	12000	-	2-4	-				
	1952	15362	145	2-4	-				
	1952	4961	1574	10-12	-				
	1953	1000	100	6-8	-				
	1954	1501	386	-	-				
	1955	2000	400	-	OS				
	1956	2001	556	-	OS				
	1957	10010	286	2-4	-				
	1958	10001	274	2-4	HR				
	1959	10000	500	2-4	OS				
	1960	3024	694	8-10	-				
	1961	2000	800	8-10	-				
	1962	2839	811	8-10	OS				
	1963	3000	1500	10-12	OS				
	1964	1560	3020	9-14	OS				
	1965	1110	300	8-10	OS				
	1966	4003	1092	8-10	OS				
	1967	5071	1793	8-10	OS				
	1967	250	500	14-16	OS				
	1968	6003	1607	8-10	OS				
	1969	6012	1810	8-10	OS				
	1970	126	932	18+	OS				
	1970	6001	2272	8-10	OS				
	1971	6574	2391	8-10	OS				
	1972	7999	3700	8-10	OS				
	1973	11572	2575	10-12	WZ				
	1974	6303	1910	8-10	OS				
	1975	6933	2830	8-10	OS				
	1980	5995	2914	10-12	OS?				
	1982	6620	3800	10-12	OS?				
	1984	5383	-	-	OS?				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Weight	Length	Hatchery[b]	Brook Trout Number	Weight	Length	Hatchery[b]
BAKER PONDS	1982	1050	36	2-4	-				
	1982	4004	143	2-4	-				
	1984	1040	-	2-4?	-				
BOULDER LAKE	1938					10000	-	-	
	1939					10000	-	2-4	HR
	1952					1350	10	2-4	
	1953					4950	40	2-4	HR
	1954					2086	16	2-4	HR
	1955					2100	7	2-4	HR
	1958					1878	6	2-4	-
	1959					1985	6.5	2-4	
	1960					1929	5.2	2-4	-
	1961					1920	6	2-4	-
	1962					2164	8	2-4	
	1963					1890	6	2-4	HR
	1964					2040	6	2-4	
	1965					2125	5	0-2	HR
	1966	48506	2063	4-6	HR	1998	6	2-4	HR
	1966					4329	13	2-4	HR
	1966					40050	178	2-4	FR
	1967					1995	7	2-4	HR
	1968					2040	4	0-2	FR
	1969					1920	8	2-4	FR
	1970					1900	5	0-2	FR
	1971					2000	5	0-2	FR
	1972					1850	5	2-4	FR
	1975					2000	10	0-2	-
	1980					4050	10	0-2	
	1983	10002			DS				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
LITTLE BOULDER LAKE	1953					1984	16	2-4	HR
	1955					900	3	2-4	HR
	1959					918	3	2-4	-
	1963					945	3	2-4	HR
	1964					1020	3	2-4	HR
	1965					1062	2.5	2-4	HR
	1966					999	3	2-4	HR
	1967					997	3.5	2-4	HR
	1968					1020	2	0-2	FR
	1969					960	4	0-2	FR
	1970					1140	3	0-2	FR
	1971					800	2	0-2	FR
	1972					740	2	2-4	FR
	1975					1000	5	0-2	-
	1976					1000	3	0-2	-
	1977					1969	4	0-2	-
	1978					1001	3	0-2	-
	1979					1015	2.25	0-2	-
	1980					1012	3	0-2	-
	1983					500	2	2-4	FR
CATALPA LAKE	1952					1350	10	2-4	-
	1953					992	8	2-4	-
	1954					1040	8	2-4	-
	1955					1500	5	2-4	-
	1959					918	3	2-4	-
	1960					964	2.6	2-4	-
	1961					960	3	2-4	-
	1968					1020	2	0-2	FR
CLEAR CREEK	1938					10000	-	-	-
	1952	1016	635	10-12	-				
	1953	1301	1092	12-14	OS				
	1954	1901	289	6-8	OS				
	1955	700	100	6-8	OS				
	1955	800	171	8-10	OS				
	1956	1628	342	6-8	OS				
	1957	1509	313	6-8	OS				
	1958	1472	339	6-8	OS				
	1959	1458	295	6-8	OS				
	1960	1465	375	8-10	OS				
	1961	760	250	8-10	OS				
	1962	500	200	10-12	OS				
	1962	680	180	8-10	OS				
	1963	1350	600	10-12	OS				

Table 4.2 4 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
CLEAR LAKE	1934					22500	-	-	-
	1935					25000	-	-	-
	1936					10000	-	-	-
	1938					10000	-	-	-
	1953	1004	80	t-a	-	9920	150	2-4	-
	1954	1000	200	6-8	-				
	1955	2004	334	s-9	-	9900	33	2-4	-
	1956	5010	150	4-h	OS				
	1957	15000	150	2-4	OS	15120	-	-	-
	1958	42750	1350	;-a	HR				
	1959	15105	570	2-4	OS				
	1959	40936	602	2-4	BV				
	1959	20040	600	2-4	HR				
	1960	11993	1043	6-8	HR				
	1961	5346	405	4-6	OS	50160	209	2-4	FR
	1961	50029	1174	4-6	HR				
	1962	54450	1040	Z-4	HR	100224	384	2-4	FR
	1963	25052	960	2-4	OS	46000	920	2-4	OS
	1963	25027	413	Z-4	WZ				
	1964	24792	2148	4-i	OS	18139	610	2-4	FR
	1964	32200	1400	4-h	HR				
	1965	51720	915	Z-4	HR	1216	4	2-4	HR
	1965	49907	211	M-2	FR				
	1966	48506	2603	2-4	HR	44379	191	2-4	HR,FR
	1967	37200	600	2-4	HR				
	1967	300	750	18+	OS				
	1968	25025	325	2-4	OS	4270	14	0-2	FR
	1969	50064	1043	2-Q	WZ				
	1970	25020	556	Z-4	OS				
	1970	11660	212	2-4	KL				
	1970	23500	125	e-2	KL				
	1971	400	200	IO-12	HR				
	1971	213800	54	M-2	OS				
	1971	14912	796	2-Q	OS				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
CLEAR LAKE (CONTINUED)	1971	2921	1172	10-12	OS				
	1972	5135	247	2-4	HS	35020	206	0-	OS(?)
	1972	40088	978	2-4	OS				
	1972	30936	2410	4-6	OS				
	1972	26598	2725	6-8	OS				
	1972	721	3022	18-22	OS				
	1973	49972	1833	2-4	OS				
	1973	188	1175	BROOD	OS				
	1974	65007	2120	4-6	OS				
	1974	21001	6429	8-10	OS				
	1975	75040	938	2-4	OS				
	1975	199	1375	6-9	OS				
	1976	74930	1270	6-9	OS				
	1976	775	2845	BROOD	OS				
	1978					15098	117	2-4	
	1982	20435	10970	10-12	-				
	1984	20737	-	-	-				
OSV PONDS	1967	3100	50	2-4	-				
	1969	15080	760	2-4	-				

Table 4.24 (continued)

Locat ion	Year	Rainbow Trout Number	Weight	Length	Hatchery[b]	Brook Trout Number	Weight	Length	Hatchery[b]
FROG LAKE	1934					10250	-	-	-
	1935					18000	-	-	-
	1937					30000	-	-	-
	1938					5000	-	-	-
	1939					4000	-	2-4 -	HR
	1952	2035	185	6-8	-				
	1953	2540	780	6-9	-				
	1954	3999	636	6-8		5070	39	2-4	-
	1955	7000	1639	6-8		4500	15	2-4	-
	1956	2040	340	6-8	HR	2052	12	2-4	-
	1956	3000	750	8-10	HR				
	1956	5010	150	4-6	OS				
	1957	20018	575	4-6					
	1958	1015	188	8					
	1958	3006	550	8	HR				
	1958	1004	186	8	OS				
	1958	988	760	12	OS				
	1959	3020	660	8	HR				
	1959	6778	1324	6-8	OS				
	1960	10170	2775	8-10	HR				
	1961	10250	3450	8-10	OS				
	1961	2080	800	10+	HR				
	1962	10053	2938	8-10	HR				
	1963	6000	3000	10-12	OS				
	1963	3527	912	8-10	HR				
	1964	8520	2200	8-10	OS				
	1964	3513	814	8	HR				
	1965	3800	950	8-10	HR				
	1965	6012	2433	8-10	OS				
	1965	999	555	11	OS				
	1965	150	150	14	OS				
	1966	2932	872	8-10	HR				
	1966	8004	2993	8-10	OS				
	1968	3000	732	9-10	HR				
	1968	9121	2610	9-10	OS				
	1969	9162	3223	8-10	HR				
	1969	4016	1130	8-10	OS				
	1970	150	1093	BROOD	OS				
	1970	6651	2874	10	HR				
	1970	4001	1467	8-10	OS				
	1971	6000	2725	8-10	HR				
	1971	4008	1195	8-10	OS				
	1972	100	420	20	OS				
	1972	5994	2067	10-12	HR				
	1972	3813	1895	10-12	OS				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
FROG LAKE (CONTINUED)	1973	10007	3304	8-10	WZ				
	1973	690	300	10	OS				
	1973	99	700	24+	OS				
	1974	10200	3038	8-10	OS				
	1975	10824	3248	8-10	OS				
	1975	137	1013	24+	OS				
	1980	8599	3700	8-10	OS?				
	1980	141	1062	24+	OS?				
	1982	7000	5025	10-12	OS?				
	1982	147	1325	24+	OS?				
GREEN LAKE	1953					992	8	2-4	HR
	1954					1040	8	2-4	HR
	1955					1200	4	2-4	HR
JEAN LAKE	1938					5000	-		
	1939					6000	-	2-4	HR
	1952					1350	10	2-4	-
	1953					992	8	2-4	-
	1954					1040	8	2-4	-
	1955					900	3	2-4	-
	1957					1050	2.5	2-4	-
	1959					918	3	2-4	-
	1960					964	2.6	2-4	-
	1963					945	3	2-4	HR
	1965					1062	2.5	2-4	HR
	1966					997	3	2-4	HR
	1967					997	3.5	2-4	HR
	1968					1020	2	0-2	FR
	1969					960	4	0-2	FR
	1970					1140	3	2-4	FR
	1971					800	2	2-4	FR
	1972					740	2	0-2	FR
	1975					2000	10	2-4	-
	1976					1000	3	2-4	-
	1977					1074	3	2-4	-
	1978					1001	3	2-4	-
	1979					1015	2.3	2-4	-
	1983	5007	-	-	OS				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Weight	Length	Hatchery[b]	Brook Trout Number	Weight	Length	Hatchery[b]
PINE HOLLOW RESERVOIR	1970	10004	3072	8-10	OS				
	1970	50112	976	2-4	OS				
	1971	49430	770	2-4	OS				
	1972	50044	863	2-4	OS				
	1972	10010	910	6-8	OS				
	1972	4000	1600	10-12	OS				
	1972	7000	2500	8-10	OS				
	1973	49950	675	2-4	OS,WI?				
	1974	95089	2078	2-6	OS "				
	1975	75123	1688	2-4	OS "				
	1976	75250	1505	2-4	OS "				
	1977	29971	697	2-4	OS "				
	1977	7000	2800	8-10	OS "				
	1978	30000	970	2-4	OS "				
	1978	9952	3784	8-10	OS "				
	1979	30030	455	2-4	OS "				
	1979	8516	3240	9-10	OS "				
	1980	30074	940	2-4	OS?				
	1980	5499	2242	10	OS?				
	1982	30004	1154	2-4	OS?				
	1982	7000	2450	8-10	OS?				
	1984	21000	-	2-4?	OS?				
	1984	8860	-	8-10?	OS?				

Table 4.24 (continued)

Locat ion	Year	Rainbow Trout Number	Weight	Length	Hatchery[b]	Brook Trout Number	Weight	Length	Hatchery[b]
ROCK CREEK RESERVOIR	1953	5986	2586	6-8	-				
	1954	1818	835	6-8	-				
	1954	4184	1492	6?	-				
	1955	5964	2720	6-8	-				
	1956	1998	370	6-8	OS				
	1956	7891	920	8-10	OS				
	1957	6001	992	6-8	OS				
	1958	6123	1055	6-8	OS				
	1959	5260	900	6-8	OS				
	1960	949	2306	18+	OS				
	1960	4080	900	8-10	OS				
	1961	6187	1761	8-10	OS				
	1962	4980	1500	8-10	OS				
	1962	630	760	10-12	OS				
	1963	5600	2000	10	OS				
	1964	5100	1700	8-10	OS				
	1964	4410	210	4-6	OS				
	1965	4002	1334	2-4	OS				
	1965	4340	2250	10-12	OS				
	1965	75	75	12-14	OS				
	1966	5001	1667	10-12	OS				
	1967	5026	1436	8-10	OS				
	1967	150	300	14	OS				
	1967	105	420	18+	OS				
	1968	8006	2065	8-10	OS				
	1968	15400	385	2-4	OS				
	1969	21484	4117	8-10	OS				
	1969	140	560	22	OS				
	1970	186	1302	BROOD	OS				
	1970	10020	167	2-4	OS				
	1970	6003	2012	9-10	OS				
	1971	25114	474	2-4	OS				
	1971	10003	3064	8-10	OS				
	1971	190	890	24+	OS				
	1972	30030	462	2-4	OS				
	1972	6999	2540	8-10	OS				
	1973	39960	540	2-4	OS				
	1973	8001	2450	8-10	OS,WZ				
	1974	7507	2121	8-10	OS,WZ				
	1975	10021	3794	8-10	OS.WZ				
	1975	233	1708	BROOD	OS,WZ				
	1976	7577	2595	8-10	OS,WZ				
	1977	318	1455	BROOD	OS,WZ				
	1978	7536	2839	8-10	OS.WZ				
	1978	648	1640	BROOD	OS,WZ				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
ROCK CREEK RESERVOIR (CONTINUED)	1979	6139	2710	8-10	OS,WZ				
	1979	398	2701	BROOD	OS,WZ				
	1980	6004	2229	8-10	OS?				
	1980	127	993	BROOD	OS?				
	1982	6234	3152	8-10	OS?				
	1982	140	1300	BROOD	OS?				
	1984	7202	-	8-10?	OS?				
	1984	324	-	BROOD	OS?				
SMOOK PRAIRIE RESERVOIR	1976	1500	30	2-4	OS				
	1977	1575	45	2-4	-				
	1978	1008	72	2-4	-				
	1978	200	200	12-14	-				
	1979	1050	35	2-4	-				
	1980	2002	398	2-4	-				
	1982	5012	179	2-4	OS?				
	1982	2100	60	2-4	OS?				
	1984	2080	-	2-4	OS?				
	1984	1036		8-10	OS?				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
TWIN LAKES	1939					4000	-	2.5	HR
(NORTH/UPPER)	1953					1994	15	3	HR
	1955					2100	7	2	HR
	1955					2125	5	2	HR
	1967					1995	7	2-4	HR
	1968					2040	4	0-2	FR
	1969					1920	8	0-2	FR
	1970					1140	3	0-2	FR
	1971					800	2	2	FR
(SOUTH/LOWER)	1953					1984	16	3	HR
	1956					2100	7	2	HR
	1964					1020	3	2	HR
	1965					5100	12	2	HR
	1966					3996	12	2	HR
	1967					3970	14	2-4	FR
	1968					4080	8	0-2	FR
	1969					3600	15	0-2	FR
	1970					3800	10	2	FR
	1971					4000	10	2	FR
	1972					5180	14	0-2	FR
TYGH CREEK	1936	15000	-	-	-				
	1937	20000	-	-	-				
	1938	50000	-	-	-				

Table 4.24 (continued)

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
WHITE RIVER	1934	40000			-				
	1935	80000			-				
	1936	50000			-				
	1937	65000			-				
	1938	100000			-				
	1939	15000		4-6	OS				
	1939	12760		4-6	OS				
	1939	33000		2-4	OS				
	1939	21450		2-4	OS				
	1952?	7798	2800	6-8	-				
	1953	3447	2239	10-12	OS				
	1953	2040	170	6-8	OS				
	1954	795	120	6-8	OS				
	1954	3280	600	8-10	OS				
	1954	2847	1295	10-12	OS				
	1955	2007	439	8-10	OS				
	1955	3933	1662	10-12	OS				
	1956	2100	350	6-8	-				
	1956	3386	753	8-10	-				
	1956	525	150	8-10	-				
	1957	3733	961	6-8	OS				
	1957	1491	298	6-8	OS				
	1958	6045	1395	6-9	OS				
	1959	2424	496	6-8	OS				
	1959	850	170	8-10	OS				
	1959	600	100	6-8	OS				
	1960	1630	420	8-10	OS				
	1960	1512	360	8-10	OS				
	1961	2175	870	10-12	OS				
	1961	3998	1250	8-10	OS				
	1962	1750	700	10-12	OS				
	1962	4700	1170	8-10	OS				
	1963	6240	2885	10-12	OS				
	1963	1125	375	8-10	OS				
	1964	4614	1155	8-10	OS				
	1965	1345	2867	10-12	OS				
	1966	1007	438	10-12	OS				
	1966	2000	800	10-12	OS				
	1966	1000	358	10-12	OS				
	1967	2012	575	8-10	OS				
	1967	2016	560	8-10	OS				
	1967	1000	345	8-10	OS				
	1968	1000	250	8-10	HS				
	1968	1000	303	8-10	OS				

Table 4.24

Continued from previous page.

	1968	1000	244	8-10	HR

Location	Year	Rainbow Trout Number	Rainbow Trout Weight	Rainbow Trout Length	Rainbow Trout Hatchery[b]	Brook Trout Number	Brook Trout Weight	Brook Trout Length	Brook Trout Hatchery[b]
WHITE RIVER									
	1968	3002	654	8-10	OS				
	1969	5009	1323	8-10	HR				
	1970	5002	1926	8-10	HR				
	1971	5198	1729	8-10	HR				
	1972	5008	1640	8-10	HR				
	1973	5001	1821	8-10	WZ				
	1974	5003	1883	8-10	OS				
	1975	7577	3061	8-10	OS				
	1976	4956	1794	8-10	OS				
	1977	7012	2330	8-10	-				
	1978	7204	2553	8-10	-				
	1979	7069	2690	8-10	-				
	1980	6417	2618	8-10	-				
	1982	6107	2705	8-10	OS?				
	1984	7866	-	8-10?	OS?				

a/Records of annual releases for eleven years from 1940 to 1952 have not been included. Records of releases for some locations are not complete.

b/Hatchery codes: BV = Bonneville, FR = Fall River, HR = Hood River, KL = Klamath, OS = Oak Springs, WZ = Wizard Falls.

c/10,00 cutthroat trout were planted in 1934. Data on size of fish at release and the hatchery where fish were reared were not available.

Table 4.25. Parasites and bacterial pathogens found in rainbow and brook trout in the White River basin, 1983.

Location	Species a/	Sample number	Parasites observed	Culture b/ TSA	Culture b/ Cytophaga	Stains c/ Gram	Stains c/ FA
White River (lower)	Rb	1	*Myxosoma squamalis* *Nanophyetus salmincola*				
		2	*N. salmincola*	-	-	-	
		3	*M. squamalis*	-	-	-	
		4	Microsporidians	-	-	-	
		5	Hexamita	-	-	-	
		6	Microsporidians *M. squamalis*, *N. salmincola*	-	-	-	
		7-10 d/		-	-		-
	Wf	1	None	-	-	-	e/
		2	None	-	-	-	e/
Tygh Creek	Rb	1	*Crepidostomum*, strigeids	-	-	-	-
		2	*Crepidostomum*, strigeids	-	-	-	-
		3	*Crepidostomum*	-	-	-	-
		4	None	-	-	-	-
		5	Strigeids	-	-	-	-
Jordan Creek	Rb	1	None	-	-	-	-
		2	Microsporidians	-	-	-	-
		3-10	None	-	-	-	-
Badger Lake	Rb	1	None	-	-	+f/	
		2	*Gyrodactylus*	-	-	-	
		3-5	None	-	-	-	
		6	Copepods	-	-	-	
		7-10 d/		-	-	-	
	BT	1-3	None	-	-	-	-
		4	None	-	-	-	e/
		5	*Crepidostomum*	-	-	-	-
		6	None				-
		7 d/					-
		8 d/					e/
		9-10 d/					-
Threemile Creek	Rb	1	None				-
		2	*Gyrodactylus*				-
		3	*Gyrodactylus*				-
		4	*N. salmincola*, *Crepidostomum*				-
		5	*N. salmincola*, *Crepidostomum*				
		6	*Gyrodactylus*				
		7-10 d/					

Table 4.25. (continued)

Location	Species a/	Sample number	Parasites observed	Culture b/ TSA	Culture b/ Cytophaga	Stains c/ Gram	Stains c/ FA
Rock Creek	Rb	1	None				
		2	Crepidostomum				
		3-4	None		-	-	
		5	Crepidostomum		-	-	
Gate Creek	Rb		Gyrodactylus, Crepidostomum		-	-	-
		2	None	-	-	-	-
		3	Gyrodactylus, strigeids	-	-	-	-
		4	Crepidostomum	+g/	-	-	-
		5	None	-	-	-	-
Boulder Creek	Rb		Gyrodactylus, Crepidostomum, nematodes	-	-	-	e/
		2	Crepidostomum				
		3	Gyrodactylus, Crepidostomum	-	-	-	-
		4	None	-	-	-	-
		5	Gyrodactylus, Crepidostomum	-	-	-	-
		6	Crepidostomum, nematodes	-	-	-	-
		7-9 d/		-	-	-	-
		10 d/		-	-	-	+
	BT	1-2	None	-	-	-	-
		3	Crepidostomum, nematodes	-	-	-	-
		4	Trycophrya, Gyrodactylus, Crepidostomum, nematodes	-	-	-	-
		5	Trycophrya, Crepidostomum	-	-	-	-
		6	Trycophrya, Gyrodactylus	-	-	-	-
		7-8 d/		-	-	-	-
		9 d/		-	-	-	+
		10 d/		-	-	-	-
Clear Creek	Rb		Crepidostomum	-	-	-	-
		2	Crepidostomum	-	-	-	-
	BT		Chloromyxum, Crepidostomum	-	-	-	-
		2	Crepidostomum	-	-	-	-
		3	Microsporidians, Crepidostomum	-	-	-	+
		4	Crepidostomum, nematodes	-	-	-	-
Clear Lake	Rb	1	Crepidostomum	-	-	-	-
		2	None	-	-	-	-
		3	Trycophrya, Chloromyxum, Crepidostomum	-	-	-	-
		4	None	-	-	-	-
		5	Crepidostomum	-	-	-	-
		6-8 d/		-	-	-	-

Table 4.25. (continued)

Location	Species a/	Sample number	Parasites observed	Culture b/ TSA	Culture b/ Cytophaga	Stains c/ Gram	Stains c/ FA
Clear Lake (cont.)	BT	1	Trycophrya	-	-	-	+
		2	Trycophrya	-	-	-	-
		3	Trycophrya, Chloromyxum, Crepidostomum	-	-	-	-
		4	Trycophrya, Chloromyxum	-	-	-	-
		5	Trycophrya	-	-	-	-
		6	Trycophrya, Chloromyxum	-	+h/	-	+
		7-9 d/		-	-	-	-
		10 d/		-	-	-	+
Barlow Creek	Rb	1	M. squamalis	-	-	-	-
		2	Nematodes	-	-	-	-
		3	Chloromyxum, nematodes	-	-	-	+
		4	Crepidostomum	-	-	-	-
		5	Nematodes	-	-	-	-
		6	Chloromyxum, nematodes	-	-	-	-
		7-10 d/		-	-	-	+
	BT	1	None	-	-	-	-
		2	Nematodes	-	-	-	-
		3	Gyrodactylus	-	-	-	-
		4	None	-	-	-	-
		5	Nematodes	-	-	-	-
		6	Gyrodactylus, nematodes	+i/	+i/	-	-
		7-8 d/		-	-	-	-
		9-10 d/		-	-	-	+
		11 d/		-	-	-	-

a/ Rb-rainbow trout, Wf-whitefish, BT-brook trout.
b/ Cultures of kidney tissue on tryptic soy and cytophaga agars. - negative for bacteria; + positive for bacteria.
c/ Stains of kidney smears by Gram method and by fluroescence antibody technique for bacterial kidney disease
d/ No parasite examinations, kidney cultures and smears only.
e/ Test not conducted.
f/ Gram negative rods.
g/ Aeromonas sp. and Lactobacillus sp.
h/ Cytophaga psychrophila (cold water disease bacterium)
i/ Lactobacillus sp.

Table 4.26. Parasites found in rainbow trout in the lower White River basin, 1984.

Location	Sample number	Fork length (cm)	Parasites observed
White River a/ (lower)	1	19.0	Myxosoma squamalis, trophozoites
	2	18.5	M. squamalis, Crepidostomum
	3	23.5	Gyrodactylus, M. squamalis,
	4	9.0	Scyphidia, Epistylis
	5	20.9	M. squamalis, Epistylis, Gyrodactylus
	6	17.1	M. squamalis, Gyrodactylus, nematode
	7		Gyrodactylus, Epistylis, Crepidostomum, trophozoites
	8		Gyrodactylus, Crepidostomum, trophozoite
Tygh-Jordan creeks	1	7.5	None
	2 b/	17.5	Epistylis, Scyphidia, trematodes, Crepidostomum, Nanophyetus salmincola
	3	16.0	N. salmincola, Crepidostomum
	4	11.0	Crepidostomum
	5	11.0	N. salmincola, Crepidostomum
	6	6.5	Trematode, Crepidostomum
	7	11.7	Epistylis, Gyrodactylus, N. salmincola, Crepidostomum
	8	20.2	Epistylis, Gyrodactylus, Crepidostomum
	9	11.2	Epistylis

a/ No parasites found in two whitefish (13.0 cm); no bacteria seen in gram stains of kidney smears in any samples.
b/ Aeromonas sp. found in culture: no bacteria found in cultures of other samples from Tygh-Jordan; no bacteria seen in gram stains of kidney smears in an samples.

Table 4.27. Tests of Ceratomyxa shasta infection in rainbow trout exposed to waters of the Deschutes and White rivers, 1984.

Exposure site	Stock	Exposure dates	Mean water temp. (°C)	Examination dates	Number at start	Mortalities		Survivors	
						Positive	Negative	Positive	Negative
Deschutes River (km 75)	Roaring River	25 May-20 June	13	20 June-9 September	20	14	1	4	0
	Wild White R.	24 May-20 June	13	20 June-9 September	80	62	6	12	0
White River (km 5.6)	Roaring River	25 May-20 June	11	20 June-9 September	99	(1) a/		0 b/	50 b/

a/ Mortality had too much fungus to be examined for C. shasta.
b/ A subsample of the 98 survivors was examined for C. shasta.

Chapter V

DOWNSTREAM PASSAGE AT WHITE RIVER FALLS

Methods

Survival of juvenile salmonids that passed over White River Falls was measured during high and low flow periods in 1983 and 1984. Tests were conducted from mid-April to mid-June (high flows) and in October (low flows). These periods approximate the timing of migrations of juvenile salmonids in the Deschutes River. Spring chinook and summer steelhead from Round Butte Hatchery were released above and below White River Falls and were recpatured in a modified Humphrey scoop trap 0.5 km below all three falls.

Each release group was uniquely marked with a freeze brand and a subsample of fish was measured to the nearest 1.0 mm (fork length). Fish were transported to White River in a portable fish tank or in plastic garbage cans with oxygenated water and were released at test and control sites.

Test groups were released at various locations 30 to 50 m from the lip of the uppermost falls in areas protected from the current. Upstream passage of test fish was blocked by a concrete dam 2.5 m high. Control fish were released in a large pool below all three falls or in a large pool below the upper two falls.

Comparisons between recapture rates of release groups were made with a two-way analysis of variance. Missing values owing to unequal replications were estimated by methods in Snedecor and Cochran (1980) and Steel and Torrie (1980).

Estimates of steelhead that did not migrate in 1983 were made by mark and recapture techniques. Steelhead were captured with a seine and by hook and line, marked with a partial caudal fin clip, and returned to the river. Recaptures were made with the same gear on subsequent days and estimates were calculated by the Schnabel or Petersen method (Ricker 1975).

These data are presented in Tables 5.1 to 5.20.

Table 5.1 Summary of 1982 brood juvenile chinook from Round Butte Hatchery released in White River to estimate survival at White River Falls, 1983.

Treatment and date	Number released	Release location a/	Brand ( ) position	Fork length (mm)
Fast-incubated b/				
9 May	502	South Main	RD-1	96.5
	510	Below Falls	LD-1	97.5
18 May	422	South Main	LA-1	103.8
	433	North Channel	LA-2	104.1
	423	Below Falls	RA-1	102.0
7 .June	510	South Main	RD-3	
	510	North Channel	RD-4	
	511	Below Falls	LD-3	--
13 June	515	South Main	LA-3	
	486	North Main	--	--
	509	Below Falls	RA-3	
Total-Ave.	5,331			101.8
Slow-incubated c/				
10 October	329	South Main	LD-1	128.8
	322	North Main	RD-2	131.6
	325	Below Falls	RD-1	140.1
17 October	314	South Main	RA-2	128.1
	322	North Main	LA-2 d/	129.1
	326	Penstock	LA-1	124.0
	322	Below Falls	RA-1	121.0
24 October	346	South Main	LA-3	124.7
	320	North Main	LD-3	127.1
	319	Penstock	RD-3	121.0
	314	Below Falls	RA-3	121.0
31 October	315	South Main	RD-4	122.0
	317	North Main	LD-2	123.3
	320	Penstock	RA-4	130.1
	318	Below Falls	LD-4	125.6
Total-Ave.	4,839			126.5

a/ South Main, North Channel, North Main, and Penstock are test release sites above the falls; Below Falls is a control release site below all three falls.
b/ Marked Ad+CWT, Tag Code 07-28-36.
c/ Marked Ad+CWT, Tag Codes 07-28-41 and 07-28-42.
d/ Some fish were branded LA-4.

Table 5.2. Percentage recapture of juvenile chinook released at high flows in White River, 1983.

Date of Release	Location of release		
	South Main a/	North Main and North Channel a/	Below falls b/
09 May	25.1	--	19.6
18 May	27.5	23.1	24.3
07 June	21.2	23.9	24.1
13 June	13.2	15.6	9.4

a/ Experimental release sites above White River Falls.
b/ Control release site below all three falls.

Table 5.3. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls at high flows, 1983.

Source of variation	Degrees of freedom	sum of squares	Mean square	F
Replications	3	273.12	91.04	
Treatments	2	13.80	6.90	0.93
Error	4	37.07	7.41	

Table 5.4. Percentage recapture of juvenile chinook released at low flows in White River, 1983.

Date of Release	Location of release		
	South Main a/	North Main and North Channel a/	Below falls b/
10 Ott	15.2	23.3	37.5
17 Ott	24.5	25.4	48.5
24 Ott	18.2	27.4	36.6
31 Ott	16.8	26.2	41.2

a/ Experimental release sites above White River Falls.
b/ Control release site below all three falls.

Table 5.5. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls at low flows, 1983.

Source of variation	Degrees of freedom	sum of squares	Mean square	F
Replications	3	89.63	29.88	3.15
Treatments	2	1,040.24	520.12	54.81 a/
Error	6	56.94	9.49	

a/ Significant at $P < 0.01$.

Table 5.6 Summary of 1983 brood juvenile chinook from Round Butte Hatchery released in White River to estimate survival at White River Falls, 1984.

Treatment and date	Number released	Release location a/	Brand ( ) position	Fork length (mm)
Fast-incubated b/ (delayed fertilization)				
08 May	300	South Main	LD-2 c/	103.9
	300	North Main	RD-3	103.9
	300	Penstock	RD-1	103.9
	300	Powerhouse	LD-1	103.9
16 May	300	South Main	RA-1	105.9
	299	North Main	RA-3	105.9
	300	Penstock	RA-2	105.9
	300	Powerhouse	LA-1	105.9
21 May	300	South Main	LP-2	109.4
	300	North Main	LD-4	109.4
	300	Penstock	LD-3	109.4
	239	Powerhouse	RD-4	109.4
23 May	300	South Main	LA-2	110.2
	300	North Main	LA-4	110.2
	300	Penstock	LA-3	110.2
	300	Powerhouse	RA-4	110.2
'Total-- Ave.	4,798			107.4
Slow-incubated d/ (ladder release)				
15 Oct	238	South Main	RD-1	140.0
	300	Penstock	LA-1	135.8
	300	Powerhouse	RA-1	138.2
	300	Below Falls	LD-1	134.6
17 Ott	300	South Main	RD-2	145.5
	300	Penstock	LA-2	148.9
	300	Powerhouse	RA-2	149.6
	300	Below Falls	LD-2	145.0
22 act	300	South Main	RD-3	143.4
	300	Penstock	LA-3	150.1
	300	Powerhouse	RA-3	145.2
	300	Below Falls	LD-3	145.0

Table 5.6 (continued)

Treatment and date	Number released	Release location a/	Brand (> position	Fork length (mm)
24 Ott	299	South Main	LD-4	136.9
	300	Penstock	LA-4	140.3
	300	Powerhouse	RA-4	141.1
	300	Below Falls	RD-4	135.7
30 Ott	300	South Main	RP-4	140.1
	300	Penstock	LP-4	149.6
	298	Powerhouse	LP-1	134.5
	300	Below Falls	RP-1	141.4
Total-Ave.	5,995			142.0

a/ South Main, North Main, and Penstock are release sites above White River Falls; Powerhouse is a control release site below the upper two falls; Below Falls is a control release site below all three falls.
b/ No additional marks.
a 15% of fish were branded RD-2.
d/ Marked Ad+CWT, Tag codes 07-31-30 and 07-31-31.

Table 5.7. Percentage recapture of juvenile chinook released at high flows in White River, 1984.

Date of release	Location of release			
	South Main a/	North Main a/	Penstock a/	Powerhouse b/
08 May	31.7	28.7	29.3	35.3
16 May	26.0	24.7	26.7	34.3
21 May	30.3	29.3	34.3	34.1
23 May	23.3	24.0	16.7	32.3

a/ Experimental release sites above White River Falls.
b/ Control release site below the upper two falls.

Table 5.8. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls at high flows, 1984.

Source of variation	Degrees of freedom	sum of squares	Mean square	F
Replications	3	157.33	52.44	
Treatments	3	146.83	48.94	5.59 a/
Error	9	78.85	8.76	

a/ Significant at P X0.05.

Table 5.9. Percentage recapture of juvenile chinook released at low flows in White River, 1984.

Date of release	Location of release			
	South Main a/	Penstock a/	Powerhouse b/	Below Falls c/
15 act	53.7	43.0	51.7	36.7
17 Ott	38.7	51.3	60.3	57.0
22 Ott	38.3	45.3	52.3	47.3
24 Ott	32.8	49.0	59.7	54.3
30 Ott	42.7	49.3	48.3	37.7

a/ Experimental release sites above White River Falls.
b/ Control release site below the upper two falls.
c/ Control release site below all three falls.

Table 5.10. Analysis of variance between recapture rates of juvenile chinook released above and below White River Falls at low flows, 1984.

Source of variation	Degrees of freedom	sum of squares	Mean square	F
Replications	4	136.78	34.20	
Treatments	3	442.21	147.40	2.91 a/
Error	12	608.88	50.74	

a/ Significant at P 10.10.

Table 5.11. Mean fork length of juvenile chinook released in White River and recaptured in a floating scoop trap, 1983 and 1984.

Year	Flow	Location of release a/	Fork Length (mm) Release	Recapture
1983	Low	South Main	125.8	128.0
		North Main	127.9	134.5
		Penstock	124.6	128.8
		Mean b/	126.4	131.0
		Below Falls c/	125.9	125.4
1984	High	South Main	107.4	107.5
		North Main	107.4	107.9
		Penstock	107.4	108.1
		Mean c/	107.4	107.8
		Below Falls c/	107.4	107.4
1984	Low	South Main	141.2	141.9
		Penstock	145.1	144.4
		Mean c/	143.1	143.2
		Powerhouse	141.7	145.3
		Below Falls	140.3	143.9
		Mean c/	141.0	144.6

a/ South Main, North Main, and Penstock are experimental release sites above White River Falls; Below Falls is a control release below all three falls; Powerhouse is a control release below the upper two falls.

b/ Fork length of fish at release differed significantly ($P < 0.05$) from fork length at recapture.

c/ Fork length of fish at release did not differ significantly from fork length at recapture.

Table 5.12. Summary of 1982 brood juvenile Steelhead from Round Butte Hatchery a/ released in White River to estimate survival at White River Falls, 1983.

Date	Number released	Release location b/	Brand (> position	Fork length (mm)
10 May	350	South Main	Cl	182.0
	351	Below Falls	d/	181.3
17 May	993	South Main	LA-1	180.0
	1,002	Below Falls	RA-1	182.9
01 Jun	1,006	South Main	RD-1	183.3
	1,032	North Channel	RD-2	187.1
02 Jun	1,027	Below Falls	LD-1	--
06 Jun	1,031	South Main	LA-3	--
	1,021	North Channel	LA-4	--
	1,027	Below Falls	RA-3	--
14 Jun	1,000	South Main	RD-3	--
	1,050	Below Falls	LD-3	--
Total-Ave.	10,890			182.7

a/ Marked 50% LP, 50% RP finclips, 6 fish/pound.
b/ South Main and North Channel are test release sites above the falls; Below Falls is a control release site below all three falls.
Cl RP finclip.
d/ LP finclip.

Table 5.13. Summary of 1983 brood juvenile Steelhead from Round Butte Hatchery a/ released in White River to estimate survival at White River Falls, 1984.

Date	Number released	Release location b/	Brand (> position	Fork length (mm)
20 Apr	589	South Main	RD-1	208.4
	600	Below Falls	LD-1	207.0
24 Apr	597	South Main	RA-1	216.2
	598	Below Falls	LA-1	214.4
26 Apr	604	South Main	RD-2	219.5
25 Apr	604	Below Falls	LD-2	217.1
30 Apr	450	South Main	RA-3	212.9
	441	Below Falls	LA-3	216.4
01 May	419	South Main	RD-3	214.4
	439	Below Falls	LD-3	222.2
Total-Ave.	5,341			214.7

a/ Marked Ad RV finclips, 4.3 fish/pound.
b/ South Main is a test release site above the falls; Below Falls is a control release site below all three falls.

Table 5.14. Percentage recapture of juvenile chinook released at high flows in White River, 1983.

Date of release	Location of release		
	South Main a/	North Channel a/	Below Falls b/
10 May	9.1	--	9.4
17 May	3.3	--	5.7
01 Jun	0.7	1.0	1.2
06 Jun	0.2	0.7	0.2
14 Jun	0.0	0.0	0.0

a/ Experimental release sites above White River Falls.
b/ Control release site below all three falls.

Table 5.15. Analysis of variance between recapture rates (arc sine transformation) of juvenile Steelhead released above and below White River Falls at high flows, 1983.

Source of variation	Degrees of freedom	sum of squares	Mean square	F
Replications	3	391.22	130.41	
Treatments	2	4.91	2.46	1.89
Error	4	5.20	1.30	

Table 5.16. Percentage recapture of juvenile Steelhead released at high flows in White River, 1984.

Date of Release	Location of release	
	South Main a/	Below Falls b/
20 April	7.0	7.7
24 April	11.9	3.7
26 April	16.7	15.6
30 April	15.3	9.3
01 May	11.9	16.9
Mean c/	12.6	10.6

a/ Experimental release site above White River Falls.
b/ Control release site below all three falls.
c/ Recaptures of group released above the falls did not differ significantly from control group.

Table 5.17. Capture and recapture data of nonmigrating Steelhead from survival tests at White River Falls, spring 1983.

Location	Date	Captured (Ct)	Recaptured (Rt)	Marked	Available for recapture (Mt)	(Ct Mt)
Control pool	24 June	166	--	166	--	---
	27 June	165	22	143	166	27,390
	29 June	103	45	58	309	31,827
Above falls	29 June	74	--	69	--	---
	05 July	28	2	--	69	---

Table 5.18. Estimation of nonmigrating Steelhead from survival tests at White River Falls, spring 1983 (Ricker 1975).

Location	Estimation		
	Method	Population estimate	95% CL
Control pool	Schnabel (modified)	871	689-1,097
Above falls	Petersen (modified)	677 a/	248-1,692

a/ Negative statistical bias with R <3.

Table 5.19. Mean fork length of juvenile Steelhead released at high flows in White River and recaptured in a floating scoop trap, 1984.

Location of release a/	Fork length (mm)	
	Release	Recapture
South Main b/	214.3	216.3
Below Falls b/	215.4	214.8

a/ South Main is an experimental release site above White River Falls; Below Falls is a control release below all three falls.

b/ Fork length of fish at release did not differ significantly from fork length at recapture.

Table 5.20. Sumnary of resident fish captured in a floating scoop trap below White River Falls during tests to estimate survival at the falls, 1983 and 1984.

Flow	Date	Number						
		Rb (<15cm) a/	Rb (>15cm) a/	Wf b/	Dace	Sucker	Sculpin	Other
High	May-Jun 1983	3	3 c/	0	699	1	1	1-bluegill
	Apr-Jun 1984	24	41 d/	5	503	57	3	1-bluegill
		(11.4 cm)						2-squawfish
Low	Oct-Nov 1983	171 e/	30 f/	25	7	27	4	0
		(11.9 cm)						
	Oct 1984	344 g/	58 h/	33	0	2	0	1-chiselmouth
		(11.1 cm)	(19.2 cm)					5-chinook i/

a/ Rb - rainbow trout (mean length in parentheses).
b/ Wf - Whitefish.
c/ 2 rainbow, 1 wild Steelhead smolt
d/ 8 native rainbow (23.7 cm), 7 wild Steelhead smolts (16.4 cm), 26 hatchery rainbow (21.9 cm).
e/ Includes 26 fish with smolt-like appearance.
f/ 25 native rainbow (17.5 cm) includes 8 fish with smolt-like appearance; 5 Steelhead from spring 1983 survival tests (20.8 cm: 18.3 cm at release)
g/ Includes 30 fish with smolt-like appearance.
h/ Includes 4 tagged rainbow from White River above the falls and 6 fish with smolt-like appearance.
i/ From spring 1984 survival tests (12.1 cm: 10.7 cm at release).

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VOLUME III

APPENDIX C
ENGINEERING ALTERNATIVE EVALUATION

Prepared By: OTT Water Engineers, Inc.

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ENGINEERING ALTERNATIVE EVALUATION

General

Twelve alternative passage methods were considered in this study. These methods include:

- Denil Fishway
- Lock System
- Waterfall Modification
- Tunnel
- Fishway with Bridge
- Trap and Cable car (with and without power project)
- Fishway (with and without power project)
- Trap and Haul (with and without power project)
- Trap and Haul Downstream of Powerhouse Site

Each alternative was evaluated considering its applicability, economic feasibility, constructability, and operation. As a result of the initial evaluation, the first 7 of the 12 alternatives were eliminated and the latter 5 were considered for further study. A report was submitted to BPA in the fall of 1983 by Ott Water Engineers, Inc. that explained the various alternatives in some detail; that report is summarized in the following sections.

Denil Fishway

The Denil or Denil-type ladders (including Alaska Steep Pass) are an open channel with baffled walls and floor. The baffles are arranged in such a way to create return flow at the walls and floor which slows the core flow. The ladder can then be set on a relatively steep slope, six horizontal to one vertical (6H:lV), and maintain a core velocity of no more than 4 fps. In general, fishway slopes are set at 10H:lV. There are no resting areas in Denil sections, and designs must provide resting areas after approximately 30 feet of run. The salient features of the Denil are its relatively steep slope and availability of prefabricated sections.

The Denil Fishway alternative involves providing passage around falls three with a Denil Fishway. Falls three is approximately 15 feet high and would require three 30-foot sections of Denil ru and two resting pools. Passage around falls one and two would then be provided by a conventional ladder.

There are two key difficulties that caused this alternative to be eliminated. When fish enter a ladder there is an associated delay and fallback. If fish are required to enter two ladders, these problems would be compounded. Finally, construction of a fishway beginning at the base of falls two would be difficult at best. The area is virtually inaccessible with nearly vertical canyon walls. The costs of construction alone eliminate this alternative.

Lock System

Lock systems operate by trapping fish at the base of a barrier in a chamber, closing the chamber and filling it to a level sufficient to pass the barrier. One lock design, the Borland lock, is essentially a large diameter pipe with a trap and valving system at the lower end and an exit gate at the upper end. A typical 1 hour cycle begins with the lock empty. Approximately 10 cfs pass through the conduit and trap at the bottom. The water flowing through the trap provides attraction for fish. At the end of 25 minutes the trap is closed and the lock is allowed to fill. Once the lock is filled, water is passed through it for approximately 25 minutes to prompt fish to leave the system. Finally, the lower gate is opened, the lock empties and the cycle is repeated. The entire cycle time is 1 hour.

The alternative would involve a Denil or conventional type passage facility around falls three, sin e it would be placed at the base of falls two and transport fish to an elevation just below the existing diversion weir crest. An open channel would pass fish from the lock to a point just beyond the diversion weir. This system would require two locks to be side by side; while one lock was filling the other would attract fish, keeping them continually motivated and not interrupt their migration.

The advantage of this alternative is that fish need not expend the energy in ascent as in a conventional fishway. The difficulty in construction at falls two and possible fallback at both falls two and three facilities make this alternative unattractive. Problems also exist with clearing fish from the Locks ; Clay (1961) considers this the most apparent weakness of Columbia River fish locks. These disadvantages, along with high operation and maintenance costs, have led to the elimination of this alternative.

Waterfall Modif icat ion

For some low obstructions such as waterfalls, it is more economical to remove or modify the obstruction than construct conventional passage facilities. In the case of a waterfall, explosives may be used to reduce the gradient or steps may be blasted into the fall.

The waterfall modification alternative involves blasting 15 pools into the left bank of falls three. Each pool would be 10 feet wide by 5 feet long and approximately 2 feet in depth. This would provide passage around falls three; passage around falls one and two could be provided with a conventional fishway or a lock system as described in the previous alternative.

Like the two earlier alternatives, waterfall modification has the advantage of a shorter ladder and reduced construction costs for passage around fal 1 s three. The principal disadvantage, however, is the removal of a waterfall within the State Park. Additionally, the construction problems at falls two would still exist. In light of the aesthetic damage to the waterfall, construction costs and operation difficulties, this alternative was eliminated.

Tunnel

Contrary to intuition, fish will swim through darkened passages if the flow is attractive, on the order of 2 fps (U.S. Fish and Wildlife Service 1959). Tunnel fishways have been successfully operated in the Northwest including Castille Falls on the Klickitat River, Ice harbor on the Snake River, Selway Falls on the Selway River, and Granite Falls on the Stillaguamish.

The tunnel alternative would be used to extend the forebay of NWCPUD's power project. A conventional fish ladder would be constructed from the proposed location of NWCPUD's powerhouse and proceed up Devil's Half Acre Creek Canyon to the tunnel portal. The tunnel portal would be located at elevation 1,025 feet. A 7-foot diameter tunnel would be driven approximately 1,200 feet to the power project intake structure. A second run of conventional fishway would be constructed above ground from the tunnel entrance to a point upstream of the intake and diversion weir.

The advantage of this alternative is that the fishway would not have to cross the White River to proceed upstream to the head of falls one. Further, a fish-way out of the park area may have less pressure from vandals and poachers. The apparent disadvantage is added expense; the conventional fishnay sections in this alternative would be approximately 3,000 feet long, slightly less than a left bank fishway, but require a 1,200-foot funnel at roughly $1,200 per foot. This alterantive is obviously not cost effective.

Fishway with Bridge

In conjunction with NWCPUD's powerhouse a conventional fish ladder would be constructed form the powerhouse tailrace up the right bank to approximately elevation 875, just below falls three. From this point, a 170-foot span bridge would convey the fishway to the left bank. The ladder would then continue up the Left bank to exit just beyond the diversion weir above falls one.

This alternative was dismissed as the added expense of a bridge could be avoided by crossing from the right bank to the left bank of the White River at a barrier dam just upstream of NWCPUD's powerhouse. The barrier dam is necessary to prevent Fish from moving upstream and passing the ladder entrances in the tailrace. Further, the canyon on the right bank downstream of the proposed bridge is steep and construction in this area would be difficult.

Trap and Cable Car

The trap and cable car alternative would operate with a trap located at NWCPUD's powerhouse or falls three. Fish attracted to and collected at the trap would be transpor-ted around the barriers, along the west bank, in a cable car (much like a ski lift operation). Fish would be tiff-loaded upstream of the diversion weirs in a holding pool. Fish would remain in the holding pool until they regained their propensity to futher migrate. Similar systems were successfully used at lower Baker and Ice Harbor Dams.

Advantages of a trap and cable car include a minimum of water loss for the purpose of hydropower generation; fully automated, the system could function as required by fish and not operator schedules. Disadvantages of high capital and maintenance costs, and aesthetics, have led us to dismiss this alternative.

Fishway

Conventional fishways operate as a series of pools with water flowing from pool to pool over weirs or through vertical slots. The objective of the fishway is to create an artificial stream gradient, around barriers, which fish are capable of negotiating. The series of pools provide adequate volume for energy dissipation and areas for fish to rest while swimming.

One of the most effective fishway designs is the vertical slotted type. The slotted fishway is fashioned with vertical openings or slots, usually 12 inches wide, that will pass debris, bed load, and fish, as well as regulate flow over a wide range of tail and headwater fluctuations. The slope of the slotted fishway is set such that the maximum head loss between pools is 1 foot. Performance characteristics of the vertical slotted ladder make it the appropriate choice for the White River Falls site.

There are two reasonable fishway alternatives for the site. The first is without a consideration for power production that has the fishway entrance at the base of falls three. The fishway continues from falls three up the left bank and exists at the left abutment of the existing diversion weir.

The second fishway alternative favors hydropower development by NWCPUD. The fishway would originate at NWCPUD's tailrace, cross the White River at a barrier dam just upstream from the tailrace and continue up the left stream bank to the diversion weir.

Both fishway alternatives have the advantage of simple operation, relatively low operation and maintenance costs, and the ability of adequately passing adult anadromous fish. The principle disadvantage, common to both, is high capital cost. These alternatives were selected for further study; a detailed discussion of each is provided in Volume I along with scale drawings of main features. Preliminary estimates of construction costs are provided in Volume I as well.

Trap and Haul

Trap and haul is perhaps the most successful technique for transporting fish around extremely high barriers or to areas otherwise inaccessible by fish. The system operates by attracting fish (at a natural or manmade barrier) to a holding pool, collecting or crowding the fish into an elevator or hopper, raising the fish to a level that they can be loaded into a tank truck and hauling the fish in the truck to a desired off-loah area in the watershed. Fish trucks are generally fitted with cooling and aeration systems to insure fish safety during hauling.

Three trap and haul alternatives were considered at White River Falls. The first alternative is a trap located at falls three. The falls would serve as a natural barrier. The haul road out of the canyon traverses up the north slope, adjacent to falls three, and meets State Highway 216 approximately 1,000 feet east of the State Park entrance.

The second trap and haul alternative is compatible with NWCPUD's hydropower development. A barrier dam would be placed just upstream of the powerhouse tailrace forcing fish to move into the tailrace. Trap entrances would then be placed in the tailrace; the trap facility would be adjacent to the powerhouse. Fish trucks would use the powerhouse access road.

The third trap and haul alternative is unique in that it would be compatible with or without hydropower development and could be constructed immediately. This alternative requires a barrier dam and trap be constructed at or below the proposed powerhouse. If the dam were placed downstream of the power plant, it should be placed far enough downstream to insure the backwater does not cause NWCPUD to lose head for power generation. Unfortunately, there does not appear to be any expectional sites downstream of the proposed powerhouse to construct a barrier dam and trap and have relatively easy access for construction and fish hauling. The site of the proposed powerhouse, however, is a natural candidate. The barrier dam, trap and appurtenances could also be constructed in such a way to be adaptable to latter construction of a powerhouse and truck access is possible through Devil's Half Acre Creek Canyon.

Trap and haul alternatives have the advantage of relatively low capital costs and a well understood operation that will effectively pass fish around White River Falls. The principal disadvantage of trap and haul, however, is operation and maintenance costs required for operators, trucks, and trap equipment. The first two trap and haul alternatives discussed above clearly depend upon a decision by NWCPUD to develop or not develop the hydropower potential of White River Falls. The third trap and haul alternative is, in effect, the same as the second trap and haul alternative. As a result, only the first two trap and haul alternatives are discussed in greater detail in Volume I.

VOLUME III

APPENDIX D
BENEFIT/COST

Prepared By: Buell & Associates

Summary of Benefits Calculations

Spring Chinook

	963 fish	(harvestable surplus)
X	0.5	(proportion of benefits beginning in year 3)
X	0.55	(proportion of harvest in sport catch)
X	$143 fish	(net economic value)
X	25.003	(P/A, 3 percent, 47 yehrs)
X	0.9151	(P/F, 3 percent, 3 years)
=	$866,474	Present value

	963 fish	(harvestable surplus)
X	0.25	(proportion of benefits beginning in year 7)
X	0.55	(proportion of harvest in sport catch)
X	$143 fish	(net economic value)
X	23.957	(?/A, 3 percent, 43 years)
X	0.8131	(P/F, 3 percent., 7 years)
=	$369,120	Present value

	963 fish	(harvestable surplus)
X	0.25	(proportion of benefits beginning in year 11)
X	0.55	(proportion of harvest in sport catch)
X	$143 fish	(net economic value)
X	22.789	(P/A, 3 percent, 39 years)
X	0.7224	(P/F, 3 percent, 11 years)
=	$311,722	Present value

	963 fish	(harvestable surplus >
X	0.5	(proportion of benefits beginning in year 3)
X	0.45	(proportion of harvest in commercial and Indian ceremonial catch j
X	$34.80 fish	(net economic value)
X	25.003	(P/A, 3 percelit, 47 years)
X	0.9151	(P/F, 3 percent, 3 years)
=	$172,524	Present value

	963 fish	(harvestable surplus)
X	0.25	(proportions of benefits beginning in year 7)
X	0.45	(proportion of harvest in commercial and Indian ceremonial catch)
X	$34.80 fish	(net economic value)
X	23.957	(P/A, 3 percent, 43 years)
X	0.8131	(P/F, 3 percent, 7 years)
=	$73,440	Present value

	963 fish	(harvestable surplus>
X	0.25	(proportion of benefits beginning in year 11)
X	0.45	(proportion of harvest in commercial and Indian ceremonial catch)
X	$34.80 fish	(net economic value)
X	22.789	(P/A, 3 percent, 39 years)
X	0.7224	(P/F, 3 percent, 11 years)
=	$62,067	Present value

	$1,855.347	Total Spring Chinook Benefit

Summer Steelhead

	1,400 fish	(harvestable surplus)
X	0.3	(proportion of benefits beginning in year 3)
X	$144 fish	(net economic value)
X	25.003	(P/A, 3 percent, 47 years)
X	0.9151	(P/F, 3 percent, 3 years)
=	$1,383,797	Present value

	1,400 fish	(harvestable surplus)
X	0.2	(proportion of benefits beginning in year 4)
X	$144 fish	(net economic value)
X	24.761	(P/A, 3 percent, 46 years)
X	0.8885	(P/F, 3 percent, 4 years)
=	$887,046	Present value

	1,400 fish	(harvestable surplus)
X	0.25	(proportion of benefits beginning in year 6)
X	$144 fish	(net economic value)
X	24.238	(P/A, 3 percent, 44 years)
X	0.8375	(P/F, 3 percent, 6 years)
=	$1,023,086	Present value

	1,400 fish	(harvestable surplus)
Y*	0.25	(proportion of benefits beginning in year 8)
X	$144 fish	(net economic value)
X	23.667	(P/A, 3 percent, 42 years)
x	0.7894	(P/F, 3 percent, 8 years)
=	$941,610	Present value

Total Summer Steelhead Benefit: $4,235.539

Total Project Benefit: $6.090.886

Summer Steelhead

	1,400 fish	(harvestable surplus)
X	0.3	(proportion of benefits beginning in year 3)
X	$144 fish	(net economic value)
X	25.003	(P/A, 3 percent, 47 years)
X	0.9151	(P/F, 3 percent, 3 years)
=	$1,383,797	Present value

	1,400 fish	(harvestable surplus)
X	0.2	(proportion of benefits beginning in year 4)
X	$144 fish	(net economic value)
X	24.761	(P/A, 3 percent, 46 years)
X	0.8885	(P/F, 3 percent, 4 years)
=	$887,046	Present value

	1,400 fish	(harvestable surplus)
X	0.25	(proportion of benefits beginning in year 6)
X	$144 fish	(net economic value)
X	24.238	(P/A, 3 percent, 44 years)
X	0.8375	(P/F, 3 percent, 6 years)
=	$1,023,086	Present value

	1,400 fish	(harvestable surplus)
X	0.25	(proportion of benefits beginning in year 8)
X	$144 fish	(net economic value)
X	23.667	(P/A, 3 percent, 42 years)
X	0.7894	(P/F, 3 percent, 8 years)
=	$941,610	Present value

Total Summer Steelhead Benefit: $4.235.539

Total Project Benefit: $6.090.886