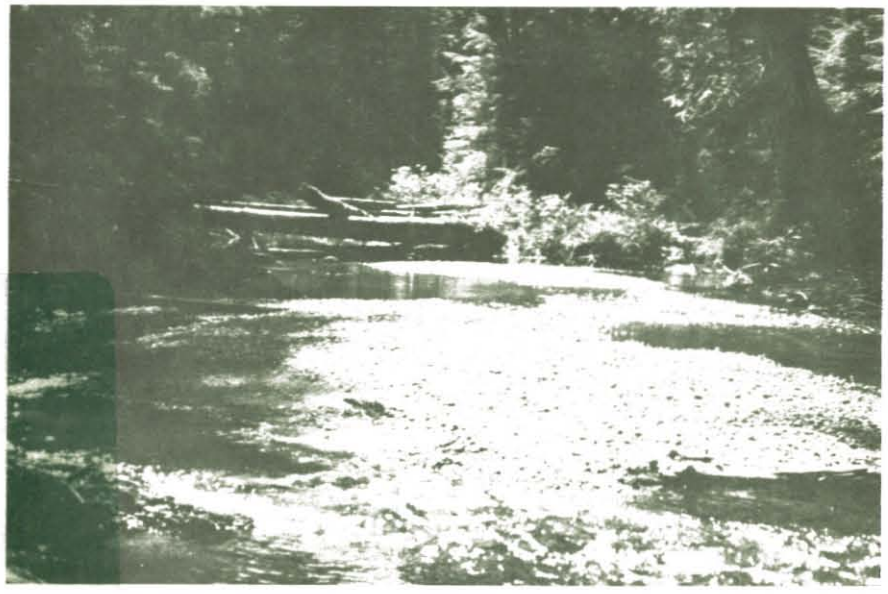
Environment Canada | Environnement Canada
Fisheries and Marine Service | Service des pêches et des sciences de la mer

Biophysical Stream Survey of the Upper Tsitika River

by
K.W. Bond
T. W. Chamberlin
M.J. Brownlee
J.M. Lamb

Technical Report Series No. PAC/T-75-7

Southern Operations Branch
Pacific Region



BIOPHYSICAL STREAM SURVEY OF THE UPPER TSITIKA RIVER

by

K.W. Bond
M.J. Brownlee
T.W. Chamberlin
J.M. Lamb

March, 1975

Department of the Environment
Fisheries and Marine Service
Fisheries Operations
Southern Operations Branch
Habitat Protection Unit

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

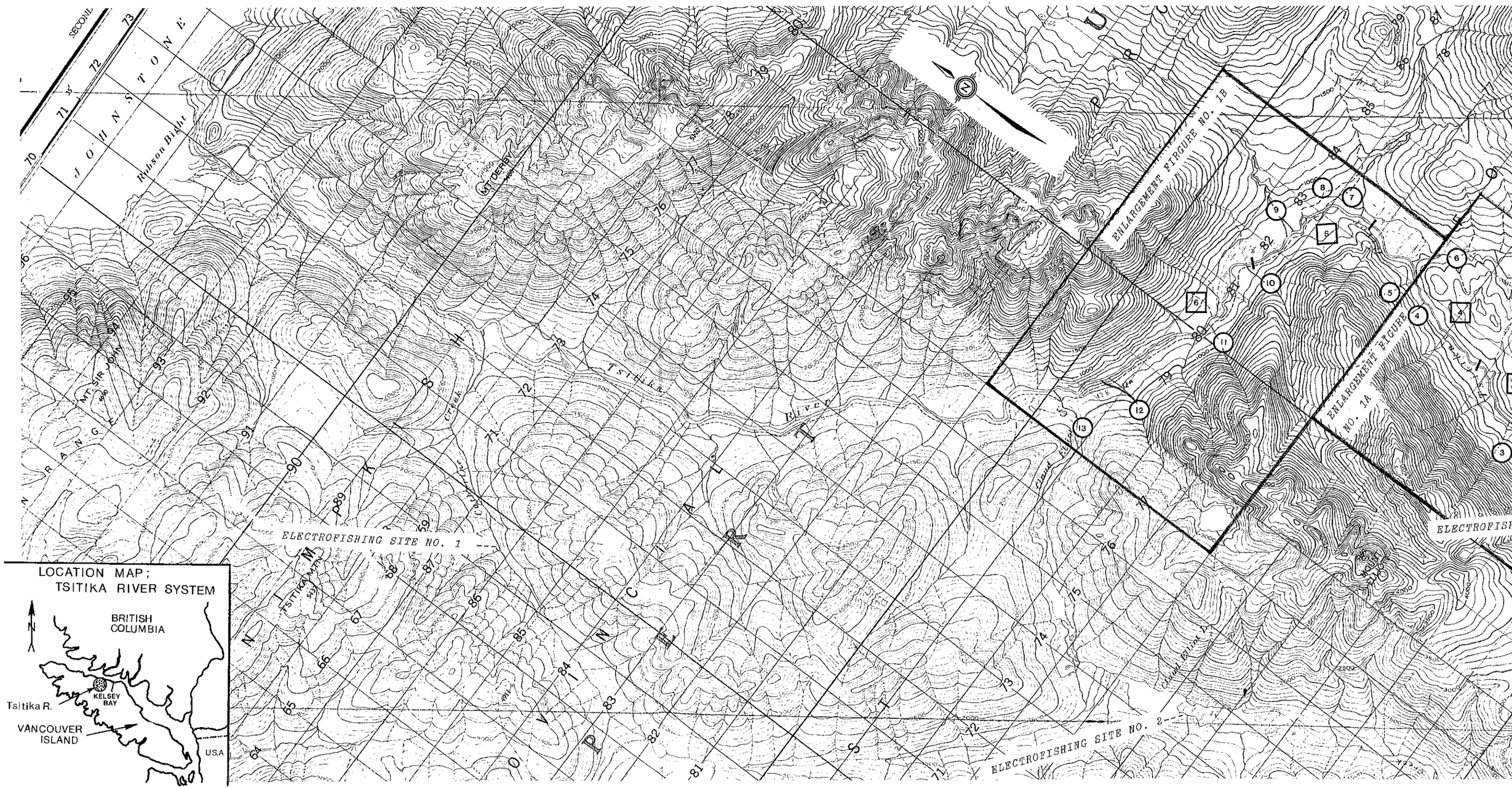
INTRODUCTION

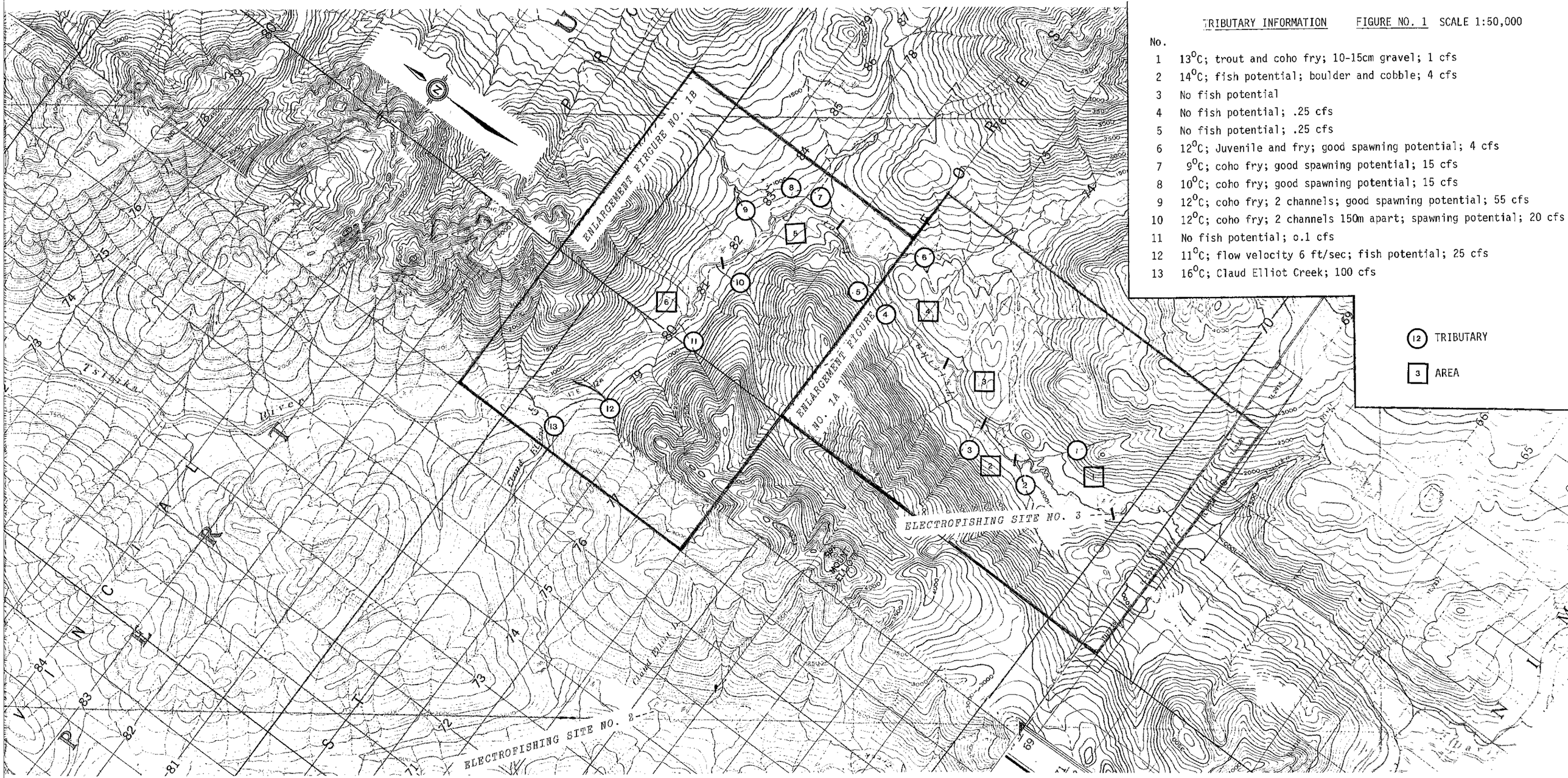
The Tsitika River is located 73 km. (45 mi.) north of Kelsey Bay on Vancouver Island (Figure 1). The system is approximately 45 km. (28 mi.) in length, and contains two major tributaries, Catherine Creek and Claud Elliot Creek. Two major lakes are located on Claud Elliot Creek, one on Catherine Creek, and one on the unnamed creek immediately upstream from Claud Elliott Creek. The Tsitika system arises near Mount Cain in the Sutton Range, and drains into Robson Bight in Johnstone Strait.

The gradient of the upper Tsitika River (above Claud Elliot Creek) is low below the thousand foot level, dropping 92 m.(300 feet) in 16 km. (10 miles). The gradient increases in the lower Tsitika from Claud Elliot Creek to tide water, dropping 215 m. (700 feet) in 18 km. (11 mi.).

Historically, anadromous fish species have included up to 10,000 pink salmon (*Oncorhynchus gorbuscha*), 2,000 chum salmon (*O. keta*), an undetermined number of coho salmon (*O. kisutch*), steelhead trout (*Salmo gairdneri*), and dolly varden char (*Salvelinus malma*). Resident stream and lake populations include rainbow trout (*S. Gairdneri*), dolly varden char, cutthroat trout (*Salmo clarki clarki*), and the prickly sculpin

FIGURE 1


LOCATION MAP;
TSITIKA RIVER SYSTEM
BRITISH COLUMBIA
KELSEY BAY
Tsitika R.
VANCOUVER ISLAND
U.S.A.
ELECTROFISHING SITE NO. 1
ELECTROFISHING SITE NO. 2
ENLARGEMENT FIGURE NO. 1B
ENLARGEMENT FIGURE NO. 1A
MT. DERBY
MT. SIR JOHN
TSITIKA MTN.
Tsitika River
Rubson Bight
JOHNSTONE
STRAIT
NORTH
VANCOUVER
ISLAND
RANGE



TRIBUTARY INFORMATION FIGURE NO. 1 SCALE 1:50,000

No.

1 13°C; trout and coho fry; 10-15cm gravel; 1 cfs
2 14°C; fish potential; boulder and cobble; 4 cfs
3 No fish potential
4 No fish potential; .25 cfs
5 No fish potential; .25 cfs
6 12°C; Juvenile and fry; good spawning potential; 4 cfs
7 9°C; coho fry; good spawning potential; 15 cfs
8 10°C; coho fry; good spawning potential; 15 cfs
9 12°C; coho fry; 2 channels; good spawning potential; 55 cfs
10 12°C; coho fry; 2 channels 150m apart; spawning potential; 20 cfs
11 No fish potential; o.1 cfs
12 11°C; flow velocity 6 ft/sec; fish potential; 25 cfs
13 16°C; Claud Elliot Creek; 100 cfs

(12) TRIBUTARY

[3] AREA

(Cottus asper). The Pacific lamprey (Entosphenus tridentatus), is also present in the system.

Pink and chum salmon are confined to the lower reaches by the presence of a canyon and 1.3 m. falls located 3.2 km. (2 mi.) from tide water. Upstream from the canyon to Claud Elliot Creek, the lower Tsitika River consists of a boulder/cobble substrate creating a continuous riffle with few pools (Chamberlin, 1973). Numerous unstable cut banks located on the outside of meander curves are present from Claud Elliot Creek downstream 4.8 km. (3 mi.) (Reid, 1973).

There are no precipitation records for the Tsitika watershed. However, the annual precipitation for Alert Bay, 28 km. (18 m.) north, is 142 cm. (56 in.) of which 51 cm. (20 in.) is snow (Kennedy and Waters, 1974). Recent records from Steele Creek and Ida Lake, approximately 20 km. (12 mi.) west of the Tsitika watershed, indicate an annual precipitation of 190 cm. (75 in.). (E.L.U.C. Secretariate, 1975).

The watershed is presently unlogged, and is the largest, undeveloped watershed on the east coast of Vancouver Island. The watershed is within MacMillan Bloedel Limited's Tree Farm Licence 39 and Canadian Forest Product Limited's Tree Farm Licence 37. This survey is in response to the British Columbia Forest Service moratorium on development placed on the watershed for resource inventory purposes.

Objectives:

The Tsitika survey was designed with three major objectives:

1. To provide an aquatic resources data base leading to recommendations for forest management.

2. To further refine stream inventory methodology applicable to the developing B.C. Forest Service resource folio planning system.

3. To present stream inventory data in a form which can be easily adapted to computer based data management systems.

PROCEDURES

The survey was conducted from August 27 to August 29, 1975. Access to the system was via helicopter with stops at Catherine Creek, Claud Elliot Creek, and the upper Tsitika River for fish sampling (Figure 1). Fish presence and diversity were determined from samples taken with a Smith-Root Type V Electrofisher (Table 1).

The inventory of the upper Tsitika River and the lower reaches of associated tributaries commenced 33.2 km. (20.6 mi.) from tidewater, and extended downstream for 15.5 km. (9.6 mi.) to the Claud Elliot-Tsitika confluence. Streams were walked (Figures 1A and 1B), with information recorded in coded form for 29 sections displaying similar physical characteristics (Table 2). These sections were combined into 6 areas on the basis of similar substrate composition (Table 3).

The following categories of information were recorded: stream substrate type and extent, bank-stream interface type and extent, fish habitat, pool/riffle ratio, stream gradient, mean stream width, discharge estimation, obstructions, location of secondary and flood channels, water temperature, and fish presence and species diversity.

TABLE 1

TSITIKA RIVER ELECTROFISHING RESULTS

August 27, 1974

CATHERINE CK. - SITE NO. 1 (50 m. reach)

Weight (gm.)	Length (mm.)	Species	Age (yr.)
5.13	76	Dolly Varden	0+
2.62	62	Dolly Varden	0+

CLAUD ELLIOT CREEK - SITE NO. 2 (75 m. reach)

1.86	50	Coho	0+
0.97	40	Coho	0+
0.38	30	Cutthroat	0+
5.53	75	Prickly Sculpin	
4.92	72	Prickly Sculpin	

UPPER TSITIKA RIVER - SITE NO. 3 (80 m. reach)

2.09	52	Coho	0+
1.87	50	Coho	0+
1.03	42	Coho	0+
4.05	134	Pacific Lamprey	

Sites refer to Figure No. 1

FIGURE 1A

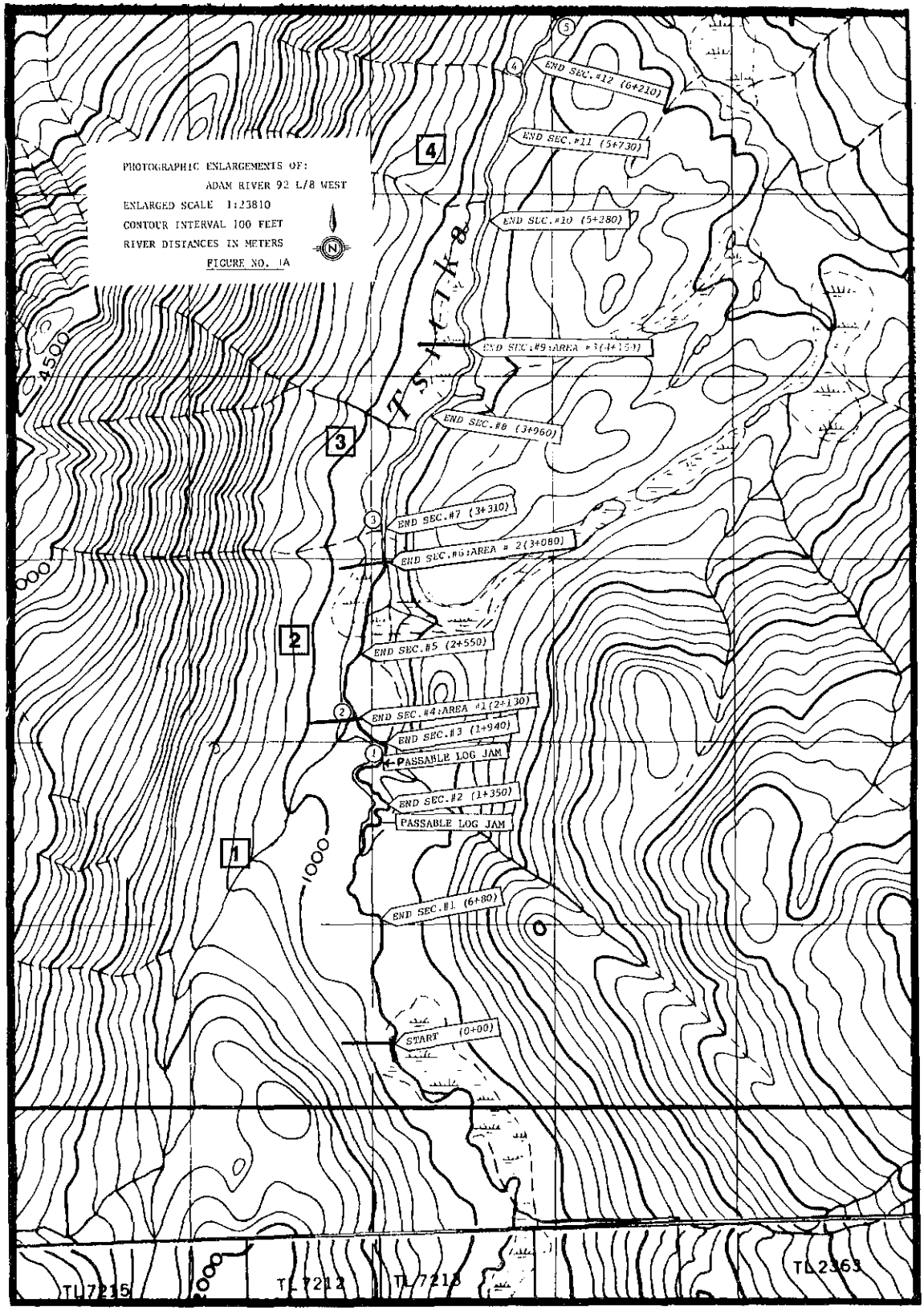
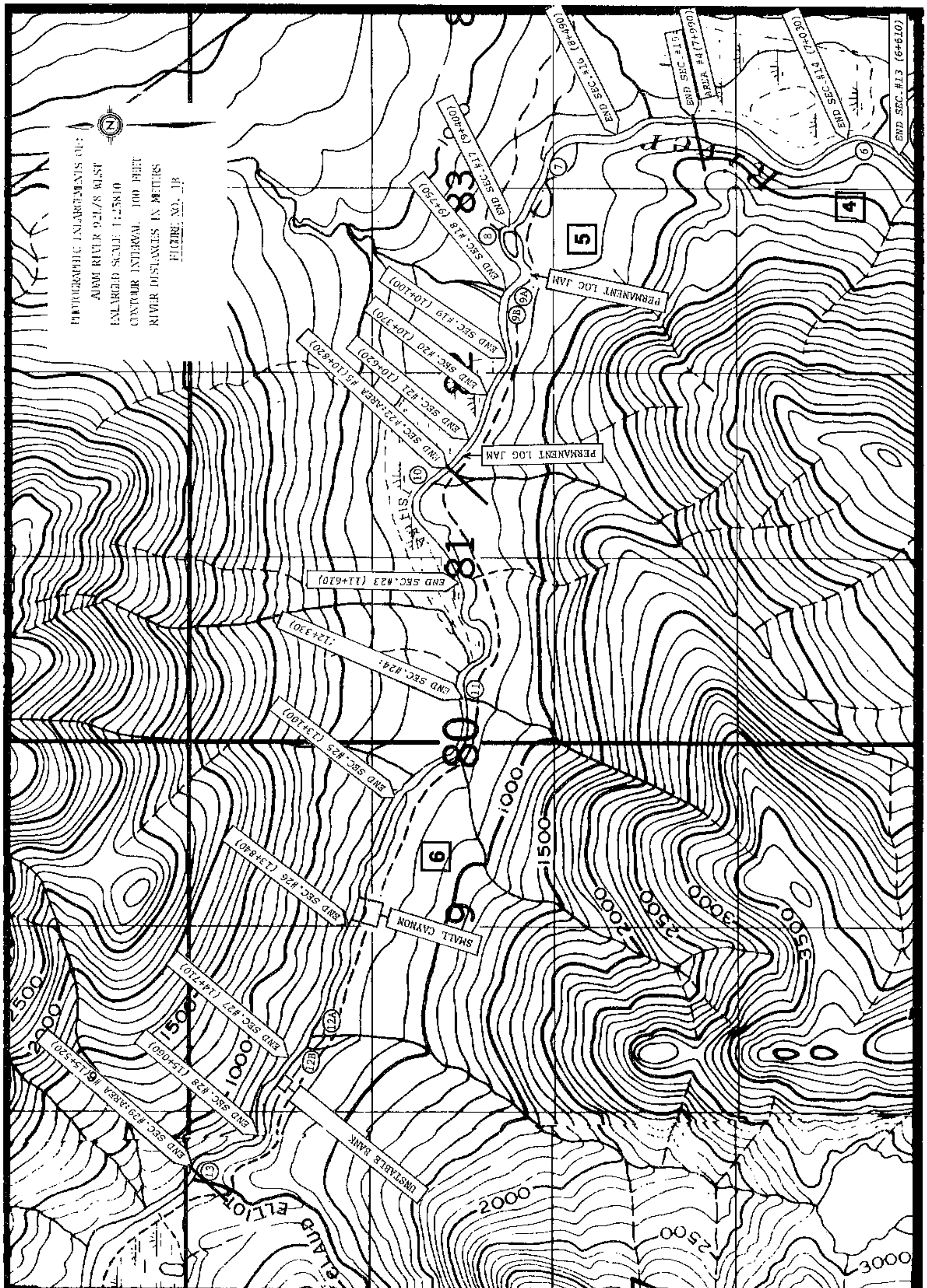

PHOTOGRAPHIC ENLARGEMENTS OF:
ADAM RIVER 92 L/8 WEST
ENLARGED SCALE 1:23810
CONTOUR INTERVAL 100 FEET
RIVER DISTANCES IN METERS
FIGURE NO. 1A
END SEC.#12 (6+210)
END SEC.#11 (5+730)
END SEC.#10 (5+280)
END SEC.#9 AREA #3 (4+150)
END SEC.#8 (3+960)
END SEC.#7 (3+310)
END SEC.#6 AREA #2 (3+080)
END SEC.#5 (2+550)
END SEC.#4 AREA #1 (2+130)
END SEC.#3 (1+940)
PASSABLE LOG JAM
END SEC.#2 (1+350)
PASSABLE LOG JAM
END SEC.#1 (6+80)
START (0+00)
TSALTAUA
4500
3000
2000
1000
TL7215
TL7212
TL7218
TL2363

FIGURE 1B


PHOTOGRAPHIC ENLARGEMENTS OF:
ADAM RIVER 92L/8 WEST
ENLARGED SCALE 1:25810
CONTOUR INTERVAL 100 FEET
RIVER DISTANCES IN METERS
FIGURE NO. 1B
PERMANENT LOG JAM
PERMANENT LOG JAM
END SEC. #23 (11+610)
SMALL CANYON
UNSTABLE BANK

TSITIKA RIVER CODED OBSERVATIONS

Description of coding contained in Appendix A

Table 2

CARD	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 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
1	2 7 2 9 8 7 5 1 1 1 1 2 2 5 1 5 0 4 5 5 2 6 5 1 1
2	1 1 1 0 5 0 2 1
3	5 5 8 1 0 3 0 1 5 4 5 3 3 3 3 1 0 0 1 8 1 5 3 1
2	2 1 1 1 0 0 4 1
3	8 0 2 0 3 0 1 0 6 0 3 4 4 3 1 1 7 0 0 1 9 1 5 5 1
2	3 1 1 0 5 0 6 1
3	8 0 2 0 2 0 2 0 6 0 3 4 4 3 1 1 5 0 0 1 9 1 5 7 1
2	4 1 1 0 5 0 8 1
3	8 0 2 0 2 0 2 0 6 0 3 4 4 3 9 0 0 1 9 1 6 9 1
2	5 2 1 0 1 0 1 0 1
3	6 0 1 0 1 0 6 0 1 5 2 5 3 3 3 0 1 0 0 1 9 2 0 1 1 1
2	6 2 1 0 1 0 1 2 1
3	5 0 2 0 1 0 5 0 2 5 2 5 3 2 3 1 1 0 0 2 8 2 0 1 3 1
2	7 3 1 1 0 0 1 4 1
3	2 0 5 0 1 6 7 7 4 0 4 0 1 0 1 0 2 3 3 1 3 0 0 2 1 1 2 2 1 5 1
2	8 3 1 1 0 0 1 6 1
3	2 0 5 0 1 0 1 0 1 0 2 0 6 0 1 0 1 0 2 3 3 1 3 4 2 1 1 2 8 1 7 1
2	9 3 1 1 0 0 1 8 1
3	2 0 6 5 5 5 5 2 0 2 0 1 0 5 0 3 3 2 0 1 0 0 1 1 1 2 8 1 9 1
2	1 0 4 1 0 1 0 2 0 1
3	1 0 2 0 4 0 1 0 1 0 1 0 2 5 1 2 2 5 1 3 2 5 3 2 2 0 3 0 0 1 1 1 3 0 2 1 1
2	1 1 4 1 0 1 0 2 2 1
3	1 0 2 5 2 5 1 0 1 0 3 0 3 0 3 0 1 0 2 2 2 0 1 0 0 1 1 1 3 0 2 3 1
2	1 2 4 1 0 1 0 2 4 1
3	3 5 3 5 1 0 1 0 4 0 3 0 1 5 1 5 2 2 2 0 1 0 0 1 1 1 3 0 2 5 1
2	1 3 4 1 0 0 5 2 6 1
3	3 5 2 0 1 5 1 5 1 0 2 5 4 0 2 5 3 2 2 0 1 1 5 0 2 1 2 3 0 2 7 1
2	1 4 4 1 0 0 5 2 8 1
3	3 0 2 5 1 0 1 0 2 5 1 0 3 0 3 0 3 0 2 2 3 0 5 0 2 8 4 0 2 9 1
2	1 5 4 1 0 1 0 3 0 1
3	3 5 3 5 1 0 1 0 1 0 1 0 4 0 1 0 4 0 2 3 1 0 2 0 1 1 5 5 5 3 1 1
2	1 6 5 1 0 5 0 3 2 1
3	1 0 7 5 5 5 5 1 0 4 0 1 0 4 0 3 3 2 1 4 0 0 1 1 2 5 5 3 3 1
2	1 7 5 1 1 0 0 3 4 1
3	1 0 5 0 2 0 1 0 1 0 7 6 5 8 2 0 3 3 2 3 3 0 0 1 1 2 1 0 0 3 5 1
2	1 8 5 1 2 0 0 3 6 1
3	1 0 5 0 2 0 2 0 7 6 5 2 0 8 3 3 3 4 1 3 3 0 0 2 1 8 1 3 0 3 7 1
2	1 9 5 1 1 0 0 3 8 1
3	1 0 6 0 2 0 1 0 1 0 7 0 1 0 1 0 3 3 1 4 5 0 0 1 2 1 1 7 5 3 9 1
2	2 0 5 1 0 5 0 4 0 1
3	3 0 3 0 4 0 3 0 3 0 4 3 2 4 7 0 0 1 1 5 1 7 5 4 1 1
2	2 1 5 1 1 0 0 4 2 1
3	1 5 6 0 1 5 1 0 6 0 1 5 2 5 3 3 3 4 1 2 5 0 0 1 2 1 1 8 0 4 3 1
2	2 2 5 1 0 5 0 4 4 1
3	4 0 4 0 1 0 1 0 7 0 1 0 2 0 3 3 2 0 5 0 0 1 2 1 2 2 5 4 5 1
2	2 3 6 1 0 1 0 4 6 1
3	1 5 2 5 2 5 1 0 1 0 4 0 1 0 4 0 3 3 3 1 5 0 0 1 2 4 2 3 0 4 7 1
2	2 4 6 1 0 1 0 4 8 1
3	8 8 2 5 9 2 5 2 5 5 5 3 0 3 0 3 0 3 3 3 3 0 2 0 0 1 2 1 2 3 0 4 9 1
2	2 5 6 1 0 1 0 5 0 1
3	3 0 4 0 1 0 1 0 1 0 3 0 4 0 1 5 1 5 4 2 2 0 1 0 0 2 2 4 2 3 5 5 1 1
2	2 6 6 1 0 1 0 5 2 1
3	1 5 2 5 1 5 1 5 1 5 3 0 3 0 1 0 3 0 2 4 3 0 3 0 0 2 1 5 2 4 0 5 3 1
2	2 7 6 1 0 1 0 6 0 0 1 8 0 0 1 1 0 0 2 2 5 4 1
3	1 0 5 0 1 0 1 0 1 0 1 0 5 0 2 0 1 0 1 0 3 2 2 0 1 0 0 2 2 1 3 0 0 5 5 1
2	2 8 6 1 0 0 5 5 6 1
3	1 0 5 0 2 5 5 1 0 6 0 1 0 1 0 1 0 3 2 3 0 1 0 0 2 1 5 3 0 0 5 7 1
2	2 9 6 1 0 0 5 5 8 1
3	6 5 5 1 0 1 0 7 0 1 0 1 0 1 0 3 3 2 0 1 0 0 2 1 5 3 0 0 5 9 1

TABLE 2

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

SUMMARY OF DATA FOR STREAM AREAS

	Area #1 Sections 1 to 4 0+00 to 2+130 m.	Area #2 Sections 5 and 6 2+130 to 3+080 m.
Dominant substrate material	gravel < 5 cm.	boulder/cobble
Stream-bank interface	stabilized silt	boulder/cobble
Mean stream width	9 m.	9 m.
Estimated discharge	15 cfs	20 cfs
Pool/riffle ratio	5:1	1:1
Stream gradient	1%	2%
Obstructions	2 passable log jams	none
Secondary and flood channels	extensive	limited
Rearing habitat	extensive	limited
Rearing coho	high density	low density
Unstable areas	none	none

	Area #4 Sections 10 to 15 4+510 to 7+990	Area #5 Sections 16 to 23 7+990 to 11+610
Dominant substrate material	boulder/cobble/gravel	gravel 5 - 10 cm.
Stream-bank interface	boulder/cobble/gravel	boulder/cobble
Mean stream width	11 m.	17 m.
Estimated discharge	35 cfs	175 cfs
Pool/riffle ratio	1:2	4:1
Stream gradient	1%	1%
Obstructions	waterfalls 1 m. high	2 permanent, passable log
Secondary and flood channels	limited	extensive
Rearing habitat	moderate	extensive
Rearing coho	low density	high density
Unstable areas	none	none

Area 2

Area 4

Area 6

TABLE 3

SUMMARY OF DATA FOR STREAM AREAS

	Area #1 Sections 1 to 4 0+00 to 2+130 m.	Area #2 Sections 5 and 6 2+130 to 3+080 m.	Area #3 Sections 7 to 9 3+080 to 4+510 m.
Dominant substrate material	gravel < 5 cm.	boulder/cobble	gravel 10 to 15 cm.
Stream-bank interface	stabilized silt	boulder/cobble	silted cobble/gravel
Mean stream width	9 m.	9 m.	11 m.
Estimated discharge	15 cfs	20 cfs	28 cfs
Pool/riffle ratio	5:1	1:1	1:1
Stream gradient	1%	2%	2%
Obstructions	2 passable log jams	none	none
Secondary and flood channels	extensive	limited	extensive
Rearing habitat	extensive	limited	extensive
Rearing coho	high density	low density	high density
Unstable areas	none	none	none

	Area #4 Sections 10 to 15 4+510 to 7+990	Area #5 Sections 16 to 23 7+990 to 11+610	Area #6 Sections 24 to 29 11+610 to 15+520
Dominant substrate material	boulder/cobble/gravel	gravel 5 - 10 cm.	bedrock, boulder, cobble
Stream-bank interface	boulder/cobble/gravel	boulder/cobble	bedrock, boulder, cobble
Mean stream width	11 m.	17 m.	20 m.
Estimated discharge	35 cfs	175 cfs	250 cfs
Pool/riffle ratio	1:2	4:1	2:1
Stream gradient	1%	1%	2%
Obstructions	waterfalls 1 m. high	2 permanent, passable log jams	none
Secondary and flood channels	limited	extensive	none
Rearing habitat	moderate	extensive	moderate
Rearing coho	low density	high density	low density
Unstable areas	none	none	two banks, one extensive

SUMMARY OF OBSERVATIONS

Rearing Territory

Coho fry and juveniles were distributed throughout the upper Tsitika River system. Greater numbers of rearing salmonids were observed in Areas 1, 3 and 5 (Figure 1A and 1B) which can be attributed to the presence of abundant secondary and flood channels, as well as extensive reaches of high quality spawning gravel and instream rearing habitat. About 10 adult steelhead, 30 dolly varden, and 20 cutthroat trout were observed in a pool 1.5 km. above Claud Elliot Creek. Electrofishing results and topography suggest that the upper limit of coho distribution in the mainstream is approximately 1.5 km. upstream from electrofishing site number 3 (Figure 1).

Bank Stability

Throughout Areas 1 to 5, cutbanks on the outside of meander curves are stabilized by coniferous and deciduous root growth. Area 6 contains two major, unstable banks at 11+610 m. and 14+900 m. The bank at 14+900 m. is estimated to be 21 m. in height, exposing an area of soil approximately 3,000 sq. m. on the outside of a meander curve.

Substrate

Areas 2, 4 and 6 are comprised principally of boulder/cobble substrate. One small canyon, consisting of bedrock, occurs in Area 6 from 13+600 m. to 13+800 m. (Figure 1B). Predominant gravel sizes in Areas 1, 3 and 5 are 0.6 - 5 cm., 10 - 15 cm. and 5 - 10 cm. respectively.

Water Temperature

Maximum water temperatures of 17° C were observed in slow velocity, open canopy areas (Table 1); however, many tributaries contributed large volumes of cooler water, diluting the mainstream water temperatures. It is also hypothesized that ground water influxes are large, resulting in the observed reduction in mainstream temperature.

Obstructions

All obstructions in the upper Tsitika River appear to be passable to adult salmonids at high water. Log jams were found in Areas 1 and 5 at 1+250 m., 1+750 m., 9+650 m., and 10+720 m. respectively, with the third one being extensive (5,000 sq. m.) and permanent. A rock fall 1 m. high was located in Area 4 at 7+030 m.

Tributaries

Catherine Creek is 13 km. (8 mi.) in length, and enters the Tsitika mainstream 6.5 km. (4 mi.) from Robson Bight (Figure 1). The substrate is boulder, cobble, and large gravel, interspersed with small pockets of 5-10 cm. gravel. Electrofishing results (no coho present, Table 2) combined with the lack of spawning gravel and the steep gradient, indicates relatively poor coho potential for this stream. However, the stream does display good cutthroat and dolly varden potential.

Claud Elliot Creek is 16 km. (10 mi.) in length, and enters the mainstream 18 km. (11 mi.) from tide water (Figure 1). In Claud Elliot Creek, electrofishing results (Table 2), the presence of good quantities of spawning gravel above Claud Elliot Lake, and the existence of excellent rearing habitat, indicate a good potential for coho production. The portion of the stream below the lakes is of steep gradient with boulder/cobble substrate. The upper extent of coho migration is 1.5 km. above Claud Elliot Lake where the stream gradient increases and spawning gravel is lacking.

Tributaries 1, 6, 7, 8, 9 and 10 (Figure 1) exhibited coho presence, and good salmonid spawning and rearing habitat. Tributaries 2 and 12B display salmonid spawning and rearing potential.

DISCUSSION

The high present fisheries values represented in the Tsitika River system warrant the maintenance of a high level of water quality, particularly with respect to suspended sediment and organic debris. Due to steep, rapidly-drained slopes, the potential for sediment and debris transport is high.

The high water temperatures (17° C) observed in the mainstream, together with the dillution effect of the tributaries, indicate the necessity for maintenance of riparian shade species on appropriate banks (southern) of the lower gradient tributary reaches and the Tsitika mainstream.

Indications are that a substantial percentage of the precipitation in the Tsitika watershed falls in the form of snow. Accordingly, cutting plans should be developed to avoid the unfavourable synchronization of snow melt and resulting accelerated erosion, sediment transport and increased peak flows.

RECOMMENDATIONS

INTRODUCTION

These recommendations have the objective of focusing attention on the most sensitive aspects of the Tsitika River watershed, as indicated in the survey and discussion material above. Not every

eventuality is considered, nor should it be in a reconnaissance report.

We anticipate that the majority of problems will be derived from road development. To alleviate these, an intensive application of the road planning, construction and maintenance sections of the Coast Logging Guidelines and standard P-1 clauses will be necessary.

In addition to standard protection measures, extra planning time will be required to gain engineering soils data, identify unstable zones on projected road lines, and generally ensure a minimum of trial and error methodology. We strongly recommend that development intensity be adjusted to accommodate these goals.

The following specific recommendations should be considered additional to the general comments above.

GENERAL DEVELOPMENT INTENSITY

1. Normal current guidelines suggest that 50% of commercial timber may be removed in the first pass, or harvesting sequence. We recommend that for the Tsitika watershed this be reduced to 25%, and that a period of not less than ten years be allowed between each of these four periods for recovery and stabilization.

2. We further recommend that openings for the first pass, and their associated roads, be restricted to half of the watershed area. This recommendation is intended to reduce the impact of roads required for a totally dispersed cutting plan.

Road Location

1. Mainline access should be on the west side of the Tsitika River to avoid steep slopes near Claud Elliot Creek and marshy areas along the east bank (Figure 1).

2. Access into the Claud Elliot watershed should be along the south side of Claude Elliot Creek.

3. Roads running parallel to fish-occupied waters should be located a minimum of 50 m. from the streambank. Additionally, such zones should be considered as intensive management areas subject to deferment, selective logging (overmature only) and possible timing restrictions.

Road Construction

1. It is recommended that ballast be of clean rock or gravel and that ballasting be kept as current as possible with subgrade construction. In particular, no subgrade should be left for extended periods, without ballast protection.

2. When, on the basis of soils information, construction will intersect erodible or unstable areas, the scheduling of operations for periods of low soil water content is recommended.

3. The cleaning of organic debris from culvert inlets, trash racks, and tributaries as a part of regular maintenance; should be initiated as soon as possible, following right-of-way falling.

Drainage and Stream Crossings

1. In general, culverts should be provided for every intermittent water course to a projected 25 year runoff event capacity.

2. Where fish-bearing waters are crossed, log or box culverts which maintain natural bed and slope, should be used, and designed to a 50 year event capacity.

3. Culvert outfalls on steep or unstable terrain should be protected by log or boulder riprap.

4. All crossings of the minstream should be bridged to a 100 year design capacity.

5. Mainstream crossing sites should be on stable material such as is located at stations 13+800 to 13+600 and 4+510 to 5+280.

6. Machine activity in streams is prohibited without prior approval of the appropriate agency, and will normally be permitted only during periods of low water.

Cutting Unit Location

1. Consistent with the General Development Intensity Recommendations above, standard habitat protection recommendations for cutting unit location and methods should be applied.

a. tributaries used as cutting unit boundaries.

b. yarding away from tributaries and uphill, wherever possible.

c. maintenance of all immature coniferous and deciduous trees within 20 m. of all perennial stream banks.

2. Cutting units should be located to avoid an over-concentration of openings in one elevation zone within a 10 to 20 year time span.

Timber Extraction Methods

1. Long-distance yarding systems should be used wherever possible. Tension skidders or skyline systems in particular should be considered where appropriate deflections exist.

2. Leaners on fish-bearing or fish potential streams should be left unless a high probability of windthrow exists, in which case they should be removed at the time of cutting. Consultation with this agency or the Fish and Wildlife Branch will be necessary in areas of unstable banks.

3. In Areas 1, 3, 5 and the unstable sections of Area 6, total deferement of all timber within 20 m. of the high wetted stream perimeter is recommended.

4. All organic debris introduced to tributary streams shall be removed by hand at the time of cutting unless otherwise indicated by the appropriate agency.

BIBLIOGRAPHY

1. Chamberlin, T.W. 1973. Tsitika River Survey. Memorandum, Government of Canada, Fisheries Service, Vancouver, B.C.

2. E.L.U.C. Secretariate. Unpublished data on Kokish watershed precipitation. Climate and Data Services Division, Resource Analysis Unit, Victoria, B.C.

3. Kennedy, K. and Waters, B.R., 1974. Tsitika River Estuary. Province of British Columbia, Fish and Wildlife Branch, Nanaimo, B.C.

4. Reid, G., 1973. Tsitika River Swim. Province of British Columbia, Fish and Wildlife Branch, Nanaimo, B.C.

APPENDIX A

CODING FOR BIOPHYSICAL STREAM AND LAKE SURVEY INFORMATION

CARD NO.	COLS.	DEFINITION	CODE	DEFINITION
N.B. Blank =	no values obtained/not applicable ≠	zero		
1	1-10	Stream I.D. Code		
	11-8	Date of Inventory		
	11-12	day started	01 to 31	day
	13-14	day ended	01 to 12	month
	15-16	month	00 to 99	year
	17-18	year		
	19	Inventory Agency	1	D.O.E.-S.O.B. H.P.U. etc.
	20-29	10 Yr. Avg. Escapement of:	0 to 199	Actual # x 10^{-3} (i.e.2000=2)
	20-21	Chinook		
	22-23	Chum		
	24-25	Coho		
	26-27	Sockeye		
	28-29	Pink		
	30-31	Lake Length	1-99	Kilometers
	32-33	Lake Width	1.0 - 9.0	Kilometers
	34-36	Maximum Lake Depth	1-999	Meters
	37-38	Depth of Thermocline	1-99	Meters
	39-40	Maximum Lake Water Temperature	1-99	Degrees Celsius
		Estuary		
	41-43	Intertidal Area	1-999	Hectares
	44-46	Vegetated Intertidal Area		
	47-49	Estuarine Area Alienated by Development		

CARD NO.	COLS.	DEFINITION	CODE	DEFINITION
1	50-51	Stream Length	1-99	Kilometers
	52-55	Stream and Tributary Length utilized by:	1-99	Kilometers
	52-53	Anadromous Fish		
	54-55	Resident Fish		
	55-74	Additional Coding		
	75-79	Reference No.	1-99999	
	80	Carry Over Code	Blank	Begin Again
			1	Carry Over
2	1-3	Stream Section	1-999	
	4-6	Stream Area	1-999	
	7-72	Species Presence		
i.e.	7-8	Species I.D.		
	9-11	Fry and Juvenile Density	0.01-9.00	Fry & Juvenile/ Sq. Meter
	12-14	Adult Density		Adults/Sq. Meter
	75-79	Reference No.	1-99999	
	80	Carry Over Code	Blank	Begin Again
3	1-20	Substrate Type		
	1-2	Bedrock	1-99	% Extent
	3-4	Boulder/Cobble	0	100%
	5-6	Gravel 10-15 cm. (clean)		
	7-8	Gravel 10-15 cm. (silted)		
	9-10	Gravel 5-10 cm. (clean)		
	11-12	Gravel 5-10 cm. (silted)		
	13-14	Gravel $<$5 cm. (clean)		
	15-16	Gravel $<$5 cm. (silted)		
	17-18	Sand		
	19-20	Silt/Mud/Clay		

CARD NO.	COLS.	DEFINITION	CODE	DEFINITION
3	21-32	Stream Bank Interface		
	21-22	Bedrock		
	23-24	Boulder/Cobble		
	25-26	Gravel		
	27-28	Sand		
	29-30	Silt/Mud		
	31-32	Clay		
	33-36	Fish Rearing Habitat	0	None
	33	Overhang	1	Trace
	34	Pools	2	Some
	35	Logs	3	Intermittent
	36	Secondary and Flood Channels	4	Continuous
	37-42	Obstructions	1-99	Number
	37-39	Log Jams	1-9	Max. Height in meters
	40-42	Waterfall		
	43-45	Pool/Riffle Ratio		
			9.00	9:1
			8.00	8:1
			7.00	7:1
			6.00	6:1
			5.00	5:1
			4.00	4:1
			3.00	3:1
			2.00	2:1
			1.00	1:1
			0.50	1:2
			0.34	1:3
			0.25	1:4
			0.20	1:5
			0.16	1:6
			0.14	1:7
			0.12	1:8
			0.11	1:9
			0	1:0
	46-47	Stream Gradient	0-99	%
	48-49	Mean Stream Width	0-99	Meters
	50-52	Flow at time of Survey	0-900	0-900 cfs.
			901	900 + cfs.

CARD NO.	COLS.	DEFINITION	CODE	DEFINITION
3	53-58	Riparian Vegetation	1-99 0	% Extent 100%
	53-54	Deciduous Shrub		
	55-56	Deciduous Tree		
	57-58	Coniferous		
	59-61	Unstable Stream Cut Banks	1-9 1-99	Number % Extent
	60-61	% Extent	0	100%
	62-74	Additional Coding		
	75-79	Reference No.	1-99999	
	80	Carry Over Code	Blank 1	Begin Again Carry Over

SPECIES LIST

1.	Coho	(Oncorhynchus kisutch)
2.	Chinook	(O. tshawytscha)
3.	Sockeye	(O. nerka)
4.	Pink	(O. gorbuscha)
5.	Chum	(O. keta)
6.	Steelhead	(Salmo gairdneri)
7.	Rainbow	(Salmo gairdneri)
8.	Cutthroat	(S. clarki clarki)
9.	Kokanee	(O. nerka)
10.	Dolly Varden	(Salvelinus malma)
11.	Prickly Sculpin	(Cottus asper)

TO BE EXPANDED AS NECESSARY