

**A SALMONID PRODUCTION PLAN FOR THE
COWICHAN VALLEY REGIONAL DISTRICT**

By
Ted Burns
Biologist

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INTRODUCTION

The salmonid production plan for the Regional District of Cowichan Valley is a sub-product of a broader project termed the Cowichan Valley Regional District Urban Salmon Habitat protection Program. The project was initiated in 1996 with the goals of mapping all salmonid habitat and associated Fisheries Sensitive Zones on the East Slope of the CVRD. In addition, all other watercourses and wetlands were mapped and, if fisheries sensitive lands were associated with them, they were also mapped. Initial mapping was at 1:20,000 TRIM. Purpose of the project was to provide land use planners with a basis to develop rational land use zoning and bylaw designations to protect fish and their habitat in this rapidly growing region. This project was funded by the Urban Salmon Habitat Program (USHP).

This product is a compilation of all salmonid production options within the study area (Cassidy to Malahat). For purposes of this assessment, the region was divided into 17 geographical areas termed Operational Management Units. For each of the OMU's, there is a brief overview of land use patterns, factors limiting salmonid production and a prioritized list of production options (enhancement/restoration opportunities). The summary is backed up by a series of files for the individual basins within the OMU's. The files contain data on stream and lake characteristics and fish utilization along with more detailed descriptions of the production options. The options are mapped on the same 1:20,000 TRIM sheets that portray the Fisheries Sensitive Zones and a number of important habitat and land use features.

METHODS

During the course of surveys to document habitat characteristics, the Fisheries Sensitive Zones and important land use features, production options were identified, mapped and described. The surveys occurred between 1982 and 1999. As part of the assessment process, the fisheries literature (previous studies in the region) was reviewed and individuals with historical knowledge of the area were interviewed. During the assessment process, a number of contributing studies were funded by interested government agencies (MOE, DFO) and forest companies (BCFP/TimberWest, Hancock Timber).

RESULTS

A total of 428 production options were identified for the 17 Operational Management Units. A summary is presented in Table 1.

Table 1: A Summary of Production Options by Operational Management Unit

| OMU | AREA | No. |
|-----|-----------------------|-----|
| 1 | Ladysmith North | 20 |
| 2 | Chemainus | 30 |
| 3 | Somenos Basin | 35 |
| 4 | Main (Cowichan River) | 4 |
| 5 | Cowichan Sidechannels | 79 |
| 6 | River North | 13 |
| 7 | Lake Cowichan North | 29 |
| 8 | Cowichan Lake | 4 |

| | | |
|----|------------------------|------------|
| 9 | Lake Cowichan - Youbou | 20 |
| 10 | Lake North | 26 |
| 11 | Lake South | 25 |
| 12 | Lake Southeast | 58 |
| 13 | Lake Cowichan South | 18 |
| 14 | River South | 18 |
| 15 | Koksilah Sidechannels | 10 |
| 16 | Koksilah Basin | 32 |
| 17 | Southend | 9 |
| | TOTAL | 430 |

A substantial number of production options have been developed: fry salvage and accompanying colonization of salvaged fish has been ongoing since 1986 with a plan and much earlier than that on an opportunistic basis. Not all of the coho – trout colonization areas are serviced by the program but this has more to do with logistics and lack of fish than it does with the plan. A number of Cowichan Sidechannels have also been developed as has rearing habitat on Meade, Sutton, Golf Course and Maple Flat Creeks. Beaver Creek, a small stream in OMU 13, has had a very successful ongoing enhancement program since 1983.

However, these activities only make up a small percentage of possible restoration/enhancement options in the region. It will take decades to fully develop all the possibilities.

It is therefore appropriate to present a list of the most beneficial options that can be undertaken in a reasonable time frame. It should be noted that the majority of the options address *Primary* enhancement/restoration needs like providing access and critical period discharge. This is a holistic approach to fish habitat improvement and is a deviation from the opportunistic “sticks and stones” approach that has dominated this area to date. Sticks and stones are *Secondary* options that should only be applied when the *Primary* needs are fulfilled.

Table 2 presents the opportunities which are prioritized on the basis of need and anticipated benefits to the resource. Those options in the Ladysmith North OMU are not listed. Ladysmith North is considered to be in the Nanaimo FsRBC region even though it's in the CVRD.

Table 2: The Top 30 Production Options

| No. | OMU | Location | Activity |
|-----|-----|-------------------------------------|--|
| 1 | 5 | Five Channels | Provide permanent flow to a series of sidechannels |
| 2 | 12 | Robertson Sidechannel | Restore flow to a critical coho spawning area |
| 3 | 3 | Averill Falls | Bypass barrier – provide access |
| 4 | 3 | Averill E and N Culvert | Provide juvenile access |
| 5 | 3 | Averill headwater storage | Provide summer flow |
| 6 | 3 | Bings Falls and associated barriers | Provide adult access |
| 7 | 3 | Quamichan L. outlet control | Allow coho smolt outmigration from lake |
| 8 | 5 | Log Jam Sidechannel | Provide permanent flow |

| | | | |
|----|----|--------------------------------------|---|
| 9 | 14 | Dale's Creek Falls | Provide adult access |
| 10 | 17 | Garnett Creek Stewardship/Mapping | Establish stewardship group, map intrusions |
| 11 | 7 | Oliver Creek Barriers | Improve adult and juvenile access |
| 12 | 16 | Glenora Oxbow | Provide juvenile access |
| 14 | 10 | Shaw Creek Falls | Provide adult access |
| 15 | 12 | Fairservice Lake | Provide summer flow to Halfway Cr. |
| 16 | 15 | Norrie Creek Culvert Removal | Provide adult access |
| 17 | 5 | Bible Camp Oxbow | Control inflow, protect inlet area |
| 18 | 3 | Quamichan Lake Cutthroats | Improve spawning habitat |
| 19 | 5 | Relic Channel above Black Bridge | Provide spawning and rearing habitat |
| 20 | 2 | Wide Bend Sidechannel | Provide access and flow |
| 21 | 3 | Richards Creek headwater storage | Improve base flow in Richards Creek |
| 22 | 6 | Skutz Creek West culvert removal | Provide access |
| 23 | 5 | Remote Run Sidechannel | Increase base flow |
| 24 | 2 | Bonsall Creek headwater storage | Increase base flow especially above Whitehouse |
| 25 | 5 | Bonsall's Slough | Increase base flow |
| 26 | 12 | Mesachie Lake Weir | Provide permanent flow to Mesachie Creek |
| 27 | 10 | Shaw Creek sidechannels | Provide spawning and rearing habitat |
| 28 | 15 | Hellebore Creek headwater storage | Increase base flow |
| 29 | 12 | Steve's Creek | Increase base flow |
| 30 | 10 | Lakehead Creek | Improve spawning habitat |
| | | | |
| | | | |

OPERATIONAL MANAGEMENT UNIT 1: LADYSMITH NORTH

OVERVIEW

Ladysmith North is the drainage area of Ladysmith Harbour and includes five salmonid streams: Thomas, Luke's, Walkers, Bush and Rocky.

The area contains one major lowland riparian unit which has been largely cleared for agricultural purposes and is part of the Cassidy Aquifer at the head of Ladysmith Harbour. Three of the streams are located on this land unit: Thomas, Luke's and Lower Walker. Thomas Creek has been highly impacted by agricultural use, Luke's Creek is largely man made; its upper three reaches were excavated in 1994. Lower walker creek has been much less intruded.

Bush and Rocky Creeks are basically mountain runoff streams. Bush Creek is one of the least intruded streams in the CVRD but Rocky flows through the Town of Ladysmith for 1700 m and has been impacted by urban and agricultural runoff.

LIMITING FACTORS

Main limiting factors are access, low summer flows and riparian quality. Barriers restrict access on Rocky and Bush and summer flows and /or riparian quality are problems on Thomas, Walkers and Lukes. Thomas also lacks quality spawning habitat in its most habitable reach.

PRODUCTION OPTIONS

Twenty opportunities to improve production are present. They are summarized in Table 1.

Table 1: Production Opportunities in Ladysmith North

| No. | Page | Sub-Basin | Type | Priority |
|-------|------|-----------|------------------------------|----------|
| 1 | 2 | Thomas | Spawning habitat improvement | 2 |
| 2 | 2 | | Groundwater development | 1 |
| 3 | 2 | | Rearing pond development | 2 |
| 4 | 2 | | Riparian improvement | 1 |
| 5 | 2 | | LWD addition | 3 |
| 6 | 3 | Lukes | Spawning habitat maintenance | 1 |
| 7 | 3 | | Habitat complexing | 3 |
| 8 | 6 | Walkers | Barrier improvement | 2 |
| 9 | 6 | | Headwater storage | 1 |
| 10 | 6 | | Riparian restoration | 2 |
| 11 | 6 | | LWD addition | 3 |
| 12 | 7 | Bush | Barrier improvement | 2 |
| 13 | 7 | | Coho colonization | 1 |
| 14-18 | 7-8 | | Sidechannel development | 1 |
| 19 | 9 | Rocky | Barrier improvement | 2 |
| 20 | 10 | | Coho colonization | 1 |

Stream Code: 9000641
Stream Name: Thomas Creek
Management Unit: Ladysmith North
CVRD Electoral Area: H

A) Biophysical Overview: Thomas Creek is a small stream that originates in a wetland area near Cassidy Airport and flows south for 3350 m to enter Lady smith Harbour via a small estuarine cove in the northeast corner. Most of its flow is provided by the winter – spring water table (Cassidy Aquifer). Runoff contribution is slight and winter flow fluctuation is minor. Thomas Creek flows through a mix of woodland, farmland and rural residential landscapes.

| | |
|------------------------|---|
| <u>Air Photos</u> | BC 87046 231,232 |
| <u>Toographic Maps</u> | 92G/4, 92G.001 |
| <u>Salmonids</u> | Co to about 2000 m Ct to about 2000 m Possible occ. Cm to 395 m |
| <u>Obstructions</u> | None |
| <u>Max. temp.</u> | 16 R2 (8/19/96) |
| <u>Min. disch.</u> | .002 R2 (8/19/96) .00001 R3 (8/19/96) .0001 L shaped ditch on Davis property (8/19/96) 0 R's 5-9 (8/19/96) except for the following points: |

| | | | |
|----|---------------|------------------|--------|
| 1 | spring | 437229E 543200N | 1547 m |
| 2` | wetland | 437281E 5432166N | 1763 m |
| 3 | pond | 437241E 543235N | 2029 m |
| 4 | spring | 437228E 5432346N | 2219 m |
| 5 | tributary | 437032E 5432535N | 2493 m |
| 6 | pond | 437168E 5432654N | 2589 m |
| 7 | spring | 427046E 5432810N | |
| 8 | airport fence | 436810E 5433063N | |

THOMAS CREEK

| | Channel | | Wetted | | Channel | | Side | | |
|---------|---------------|-------|-----------|-------|-------------|---------|--------|------|----|
| | width | width | Substrate | Slope | Confinement | Channel | Length | Area | |
| Reach1 | 3 | 2 | 2620 | 0.5 | UC | N | 63 | 90 | |
| Reach 2 | 3 | 2 | 2440 | 1.5 | FC | L | 332 | 664 | |
| Reach 3 | 3 | 1 | 9100 | 1.0 | CON | N | 46 | 46 | |
| Reach 4 | ..9 m culvert | | | | | | | 189 | NA |
| Reach 5 | 3 | 0 | 8110 | .5 | FC | L | 442 | 0 | |
| Reach 6 | 15 | 0 | 1000 | .5 | JC | L | 256 | 0 | |
| Reach 7 | 3 | 0 | 9100 | 1.0 | FC | L | 420 | 0 | |
| Reach 8 | 4 | 0 | 8200 | 1.5 | CON | N | 422 | 0 | |
| Reach 9 | 3 | 0 | 9100 | 0.2 | UC | H | 1222 | 0 | |

B) FISH UTILIZATION AND LIMITING FACTORS

Thomas Creek supports remnant populations of coho salmon and cutthroat trout. Juvenile population estimates or spawner counts have never been undertaken but coho fry and cutthroat parr were seen on a stream walk of 8/19/96 and residents still report the occasional spawner of both species. Occasional chums have also been reported.

Production is highly limited by low to nil summer flow, a lack of suitable spawning substrate and poor water quality in Reaches 1 and 2. The upper 2909 m is largely summer dry, there is a general lack of gravel and what there is is highly compacted and there is a serious stockyard runoff problem at Reach 3 along with general deterioration from intensive agricultural use. Riparian condition in Reaches 3 through 7 is poor.

C) PRODUCTION OPPORTUNITIES

1. SPAWNING PLATFORM CONSTRUCTION at 120, 149, 192 and 217 m in R2 and at points in Reaches 7 and 8 would increase coho – cutthroat fry production and may encourage chum production. Chum eggs could be transferred from nearby Bush Creek spawners (Bush Creek supports a healthy run in most years ($r = 200 - 15,000$). Eggs could be eyed at Nanaimo River Hatchery then transferred to the spawning platforms or held to the fry stage (Production Option #1)

2. GROUNDWATER EXPOSURE via excavation of finger channels at springs could provide base flow in Reaches 3-9 and increase base flow in Reaches 1 and 2. Eight potential sites are present in Reaches 2 through 8. It is suggested that a headwater infiltration/upwelling pond also be excavated in Reach 9 near Cassidy Airport. The finger channels and upwelling pool would also provide valuable rearing habitat and could be complexed if they prove viable. Thomas Creek is located on the Cassidy Aquifer, a strong groundwater feature (Production Option #2)

3. REARING POND DEVELOPMENT in Reaches 2 and 5 and 7 through 9 would provide summer rearing refugia. Two of the potential sites are off channel and would provide overwinter habitat as well. These are located at 242 m in Reach 2 and 442 m in reach 5. Five existing ponds are present in Reaches 7 and 8 (Production Option #3)

4. RIPARIAN IMPROVEMENT, particularly in reaches 5 and 7, would improve bank stability and cover. Fencing will be required along with stockyard or channel relocation (Production Option #4)

5. LWD ADDITION: If the above improvements can be undertaken and have some success, LWD addition can begin. Reach 2 has the most critical need because it is and will be the most capable reach. Of course LWD would be added to the relocated channel as a matter of course. Upper reach addition would proceed as base flow is provided (Production Option #5)

D) LAND USE FACTORS

AGRICULTURAL

Approximately 80% of the basin has been cleared for agricultural purposes.

RESIDENTIAL

The basin is in the light rural phase

RISK POTENTIAL

Moderate. Some of the agricultural practices need to be modified considerably to reduce risk.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone which is entirely riparian in nature and seldom wider than 70 m except in the headwater reach (R9) which is largely intact, needs to be protected and allowed to revegetate. Agricultural runoff needs to be much better controlled.

Watershed Code: NA

Stream name: Luke's Creek

Management Unit: Ladysmith North

CVRD Electoral Area: H

- A) **BIOPHYSICAL OVERVIEW:** Luke's Creek (local name) is a partially man-made stream that drains what was an area of wet woodland at the north end of Ladysmith Harbour. Mr. H. A Davis of nearby Code Rd cleared a large area around the creek for pasture in the summer of 1994. In order to drain the land more efficiently, the creek was deepened and lengthened somewhat and several finger channels were excavated tributary to the creek. The creek is entirely fed by the water table (Cassidy Aquifer) and flow fluctuation is very minimal.

Air Photos BC 87046 231-232
Topographic Maps 92G/4, 92G.001
Salmonids Co to 563
Ct to 563
Obstructions 60 cm concrete pipe culvert at 12 m. 15 cm vertical drop and 1.38 MPS at mean winter flows. Walker backfloods it at high flows – it's a juvenile barrier.
Max. temp. 14 (8/23/95)
Min. disch. .035 (8/25/95)

LUKE'S CREEK

| | Channel | Wetted | Substrate | Slope | Confinement | Side | | |
|---------|---------|--------|-----------|-------|-------------|---------|--------|------|
| | Width | width | | | | Channel | Length | Area |
| Reach 1 | 7 | 4 | 3610 | .5 | FC | L | 12 | 48 |
| Reach 2 | 8 | 7 | 9100 | .1 | FC | L | 50 | 350 |
| Reach 3 | 2 | 2 | 8200 | .5 | FC | L | 178 | 356 |
| Reach 4 | 2 | 2 | 7210 | .5 | CON | L | 35 | 70 |
| Reach 5 | 2 | 2 | 9100 | .1 | CON | L | 288 | 576 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout utilize the stream but it is unknown if there is a permanent population.
The stream's small size and sedimentary nature limit production.

C) ENHANCEMENT OPPORTUNITIES

1. SPAWNING PLATFORM MAINTENANCE: Five pools totaling 35 m² and five spawning platforms totaling 5.5 m² were constructed between August 25 and September 28, 1995. Pools were constructed in Reaches 3 and 4. The platforms were constructed in Reach 1 just below Brenton Page road culvert and in Reaches 2 and 3. A pool was also constructed in conjunction with the R1 spawning platform. Subsequent follow up examination revealed that all the platforms except the first two have suffered sedimentation and require cleaning/flushing. Up to 10 cm of silt has accumulated on platforms 3, 4 and 5. Riffles need to be constructed just above the platforms to keep turbulent flow over them to increase flushing (Production Option #6)

2. COVER ADDITION: At least two LWD structures could be added to Reach 3 to increase cover (Production Option #7)

D) LAND USE

Agriculture

Aside from R's 1 and 2, the entire length of the creek was cleared for pasture. However, fencing was established in 1995 and the immediate streambanks are re-vegetating.

E) PROTECTION NEEDS

There is a possible need for fencing on the finger channels (tributary ditches).

Watershed Code: 9203308

Stream Name: Walkers (Perry) Creek

Management Unit: Ladysmith North

CVRD Electoral Area: H

A) Biophysical Overview

Walkers Creek originates on a large flat with several wetland basins at an elevation of approximately 100 m. It flows east-southeast for 4455 m to enter the north end of Ladysmith Harbour in a small estuary. Reaches 1 and 2 base flow is provided by groundwater from the Cassidy Aquifer. Headwater wetlands and the configuration of its headwater basin buffer the stream. Only two small mountain runoff tributaries are present above the primary headwater wetland.

Air Photos: BC 8706 231-232
Topographic Maps 92G/4, 92G.001
Salmonids Co to 3859 m
Ct to 3859 m
Cm to 742 m with an occasional fish to 1417 m
Obstructions Fishway at Island Highway (1988) at 742 m. .4 m vertical drop at outlet. Culvert was previously a point of difficult passage and sometimes had to be sandbagged to allow Co to pass. Series of small falls beginning at 1417 m: 2R5, 2R3 and 2R10. Passable for Co-Ct.
.6 m vertical drop culvert underneath dam at 3859 m
Max. temp. 13.2 R2 (9/11/95)
20 R8 (6/9/97)
20 R7 (8/12/97)
Min. disch. .030 R2 (9/11/97)
0 R3-R5
.0006 R7 (8/12/97) Local residents (Campbell, 5685 Takala: 245-8802) claim that a dam and irrigation reservoir on the nearby Carr property (5735 Takala: 245-4864) cause R7 and reaches below it to dry in mid to late summer during most years. Information passed to Cindy Harlow of DFO by letter (8/4/97).

WALKER CREEK

| | Cannel | | Wetted | | | Side | | |
|---------|--------|-------|-----------|-------|-------------|---------|--------|------|
| | Width | width | Substrate | Slope | Confinement | Channel | Lentgh | Area |
| Reach 1 | 25 | 5 | 4420 | .5 | UC | L | 64 | 320 |
| Reach 2 | 6 | 3 | 2440 | 1.0 | FC | L | 760 | 2280 |
| Reach 3 | 10 | 0 | 6220 | .5 | FC | L | 593 | 0 |
| Reach 4 | 5 | 0 | 1144 | 5.0 | CON | N | 223 | 0 |
| Reach 5 | 2 | 0 | 8110 | 1.0 | OC | L | 706 | 0 |
| Reach 6 | 2 | 0 | 4420 | 1.0 | CON | N | 884 | 0 |
| Reach 7 | 3 | 1 | 1450 | 3.0 | CON | N | 805 | 805 |
| Reach 8 | 3 | 1 | 2620 | 1.0 | CON | N | 420 | 420 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present up to the Carr Dam at 3859 m. Chum salmon spawn in the intertidal zone and up to the middle reaches of R2; occasionally up to the lower section of R4.

Production in Reaches 3 through 7 is limited by low to nil summer flows.

C) ENHANCEMENT OPTIONS

1. BARRIER IMPROVEMENT: Modification of the dam at 3859 m to allow fish passage would allow anadromous fishes (Co-Ct) to utilize another 596 m. It may also be possible to use the reservoir to augment low flows (Production Option #8).

2. RIPARIAN RESTORATION: Bank stabilization, fencing and general riparian improvement is required in Reaches 4, 5 and 6 (Production Option #9).

3. HEADWATER STORAGE: Headwater Storage in Walker Sponge (32 Ha.), the irregular wetland basin that is the primary headwater, would yield .014 CMS for 180 days with 1 m of storage. Because the basin is so irregular and parts are at variable elevations, storage calculations are difficult but its evident that a great deal of improvement would result especially between the bottom end of the wetland and the Island Highway which is summer dry for the most part. 14955 m² of additional wetted area would result. Predicted coho smolt yield @ 1 fry/m² is 1196 (Production Option # 10).

4. LWD ADDITION: Addition of Windfall Logs (LWD): Like most area streams, Walker Creek is deficient in LWD cover. Judicious addition of windfall logs or clusters to Reaches 2 and 7 and, if permanent flow can be provided via headwater storage/summer release, Reaches 3 – 6, would increase the carrying capacity of Walker Creek for coho and cutthroats (Production Option #11).

D) LAND USE FACTORS

Agriculture

Approximately 40% of the basin has been cleared for agricultural use.

Residential

Residential use is still light but sections of Reaches 3 and 6 have been impacted

Forestry

The upper portion of the basin adjacent to Reach 8 is managed forest: early second growth

E) PROTECTION NEEDS

The Fisheries Sensitive Zone includes riparian and ravine lands and the entire headwater wetland which I have termed the Walker Sponge.

Stream Code: 920327900

Stream Name: Bush Creek

Operational Management Unit: Ladysmith North

CVRD Electoral Area: H

- A) BIOPHYSICAL OVERVIEW: A moderate size stream that drains a basin that is relatively broad below the 400 m contour then steepens and narrows above that point. Discharge is partially buffered by a small lake and a number of wetland basins including Little Bush Wetland. Bush Creek holds its flow well: groundwater is an important component of summer base flow. Bush Creek is the least intruded stream in the Nanaimo Lowland portion of the CVRD.

| | |
|--------------------------------|--|
| Air Photos | BC 87046: 231,232 |
| Topographic Map | 92B/13, 92 G/4, 92G.001, 92B.091 |
| Salmonids | Co to 1741 m Cm to 1741 m St to 1741 m Ct to 9130 m plus 3000 m in Coronation Branch and approximately 1000m in Little Bush/ Little Bush Wetland Rb to 9130 m plus 3000 m in Coronation Branch |
| Obstructions | 3XR10 at 1741 m 3XR 12 at 1824 m Series of falls over the Mt. Hayes escarpment: Never Ending Falls (R6): 2R, 4R7, 6R8, 5R7, 20R30, 50R60 and 50R. |
| Max. temp. (C°) | 16 R2 8/20/96 |
| Min. Disch. (m ³) | .0375 R2 8/20/96 |
| Watershed Area | 23 km ² |

BUSH CREEK

| Channel | Wetted | | | Channel | Side | Length | Wetted | |
|---------|--------|-----------|-----------|-------------|---------|--------|--------|-------------|
| Width | Width | Substrate | Slope (%) | Confinement | Channel | (m) | Area | |
| Reach 1 | 20 | 8 | 9100 | .01 | UC | H | 180 | 160 (tidal) |
| Reach 2 | 12 | 8 | 1720 | 1.0 | FC | M | 1277 | 10216 |
| Reach 3 | 10 | 8 | 1450 | 2.0 | CON | N | 227 | 1816 |
| Reach 4 | 6 | 4 | 0163 | 4.0 | ENT | N | 105 | 420 |
| Reach 5 | 9 | 7 | 1360 | 2.0 | CON | N | 2000 | 18000 |
| Reach 6 | 6 | 6 | 0028 | 30.0 | FC | L | 540 | 3240 |
| Reach 7 | 7 | 4 | 1360 | 2.0 | CON | N | 3600 | 14400 |
| Reach 8 | 6 | 4 | 1360 | 7.0 | CON | N | 1200 | 4800 |
| Reach 9 | 3 | 2 | 1270 | 10.0 | CON | N | 1500 | 3000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Bush Creek is utilized by coho and chum salmon, resident and migratory cutthroats, resident rainbows and an occasional steelhead. Production is limited by access.

C) PRODUCTION OPPORTUNITIES

1. **BARRIER IMPROVEMENT:** Improvement of the first falls would provide access to an additional 2000 m of quality habitat for coho, anadromous cutthroats and steelhead. Bob Hurst of DFO did some blasting in 1983 but it was unsuccessful. The obstruction tends to catch large bedload and debris every winter thus renewing itself (Production Option # 12)

2. **COHO COLONIZATION:** Coho colonization in Reach 5 would yield 1440 smolts at the 8% biostandard for coho fry to smolt survival (Production Option # 13)

3. **SIDECHANNEL DEVELOPMENT:** A number of promising sidechannel development opportunities are present adjacent to Reach 2:

- 1) Four opportunities are present in the vicinity of the Island Highway. These would involve excavating existing channels to expose more water and extend their length.
- 2) A relic channel just below the old CZ grade offers opportunity to access groundwater for improved rearing and overwintering

- 3) A relic channel complex on the south side of the stream beginning at 900 m offers potential channel development of approximately 300m².
- 4) A sidechannel /tributary complex at 1135 m provides a very good opportunity to link a damaged network of ponds, sidechannels and an upland tributary to provide an additional 600 m² of quality lateral habitat.
- 5) Another relic channel at 1387 m has considerable development opportunity (Production Options #14-18)

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth; logging will likely resume in mid-basin shortly. The Branch 4 area has been flagged for road location.

Mining

Coal mining was once an important activity in the Lower Basin.

Residential

Residential use is very light and confined to a few residences on the Indian reserve in the Lower Basin.

NOTES

Late Summer Coho Fry Densities (from PBS sampling)

| Year | Site | No. | No./m ² | % Age 0 | Mean FL |
|------|---------------------|------|--------------------|---------|---------|
| 1991 | Island Highway | 198 | - | 100 | 53.2 |
| 1992 | Island Highway | 122 | 1.03 | 97.5 | 70.6 |
| 1993 | Island Highway | 306 | 3.08 | 100 | 54.5 |
| 1994 | Island Highway | 281 | 2.30 | 100 | 55.0 |
| 1995 | Island Highway | 222 | 1.96 | 99.5 | 66.4 |
| 1996 | Island Highway | 492 | 2.42 | 99.8 | 57.1 |
| 1997 | Island Highway | 34 | 0.12 | 77.8 | 81.2 |
| 1995 | End of Christie Rd. | 1240 | 4.10 | 100 | 56.2 |
| 1996 | Upper Christie | 163 | 2.00 | 100 | 51.9 |
| 1997 | Upper Christie | 116 | 1.05 | 89.3 | 59.0 |

E) PROTECTION NEEDS

The most critical areas for protection are the estuarine and riparian lands of the lower basin and the ravine slopes upstream – particularly those adjacent to Reaches 2 and 3. Another strong area of concern is the Little Bush Wetland Complex.

Stream Code: 9203250

Stream Name: Rocky (Tye Creek)

Operational Management Area: Ladysmith North

CVRD Electoral Area: H, G and Town of Ladysmith

- A) BIOPHYSICAL OVERVIEW: Rocky Creek is a moderate sized stream that drains a relatively steep and narrow basin. Flow buffering is limited and the stream is subject to high fall – winter discharge fluctuation. The stream's lower reaches have been highly impacted by urban – industrial encroachment.

Air Photos: BC87046 231-232

Topographic Maps: 92G/4, 92 B/13, 92G.001, 92B.091

Obstructions: Series of man made barriers beginning at 488 m: .8R1.5 ten m into tunnel under old CZ Railroad/logging road followed by .5R1 near top of tunnel, 1R2 just above, .8R1 just below the EN Culvert and .3R at the culvert apron which is shallow and fast. The EN culvert is concrete pipe 4 m in diameter. It joins the Island Highway culvert which is a concrete box structure. Total length of tunnel and culverting is 152 m. There is 20 m of open channel between the tunnel and the EN culvert. It appears that a natural falls was present at the 488 m point before the tunnel was constructed.

A second series of high falls begins at 1700m.

Salmonids: Co to 488 m

Cm to 488 m

Ct to 5830 m

Max. temp. 16 (9/5/96)

Min. disch. .048 R2 (9/5/96)

ROCKY CREEK

| | Channel Width | Wetted width | Substrate | Slope | Confinement | Side Channel | Length | Area |
|----------|---------------|--------------|-----------|-------|-------------|--------------|--------|------|
| Reach 1 | 18 | 18 | .8200 | .01 | CON | N | 204 | 3672 |
| Reach 2 | 5 | 3 | 1360 | 2.0 | CON | N | 284 | 1360 |
| Reach 3 | 4 | 4 | 0019 | 15.0 | CON | N | 172 | 688 |
| Reach 4 | 6 | 3 | 2440 | 3.0 | CON | N | 1040 | 3120 |
| Reach 5 | 5 | 3 | 2341 | 3.0 | CON | N | 350 | 1050 |
| Reach 6 | 5 | 3 | 1144 | 5.0 | ENT | N | 80 | 240 |
| Reach 7 | 6 | 4 | 1450 | 2.0 | FC | L | 1500 | 6000 |
| Reach 8 | 4 | 3 | 1270 | 3.5 | CON | N | 1200 | 3600 |
| Reach 9 | 6 | 4 | 1450 | 2.0 | CON | N | 1000 | 4000 |
| Reach 10 | 3 | 1 | 3610 | 1.5 | CON | N | 1000 | 1000 |
| Reach 11 | 2 | 1 | 1360 | 12.0 | CON | N | 1800 | 1800 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and chum salmon utilize the lower 488 m but 204 m of this area is tidal. Cutthroats are present for 5830 m. Anadromous fish for 488 m of that. Rocky was never a strong coho producer; maximum reported escapement was 65 (1971). Anadromous cutthroats were also very low. No estimate of numbers has ever been made. Chum salmon were the strongest salmonid in Lower Rocky Creek prior to 1972 when their numbers were as high as 1500. The Saltaire Mill (Pacific) was constructed in 1972. It covers the original estuary of Rocky Creek (approximately 6.25 ha) which featured a salt marsh and some quality sections of spawning habitat which were highly utilized by chum salmon in high escapement years, Rocky Creek was diverted to the south in late 1971 to accommodate the mill. The diversion channel lacks quality spawning habitat and is steeper and more constricted than the original channel. Coho, chum and sea-run cutthroat are now at bare survival levels. Only one coho fry was seen in a streamwalk on Sept. 5, 1996. In terms of resident cutthroats between the lower obstructions and the falls at 1700 m, these fish were abundant and as large as 38 cm. Resident cutthroats in Upper Rocky are smaller. Anadromous salmonid production is limited by access and lack of quality spawning habitat. Runoff from the adjacent mill yard and from upstream urbanization has reduced substrate quality.

C) ENHANCEMENT OPPORTUNITIES

1. BARRIER IMPROVEMENT: Passage of fish around the lower obstructions would provide an additional 1212 m of habitat of higher quality that what is now accessible. Indications are that this will be a difficult and expensive task and perhaps impossible for chums. However, if Rocky Creek coho are to survive, it must be at least carefully assessed.

Provision of a spawning platform at the Tunnel Pool and at least two downstream locations should be considered. They will have to be cleaned regularly because of the high sediment input. Ladysmith Sportsmen Club added gravel to the Tunnel Pool in 1990 and placed concrete pylons in the intertidal zone for adult cover. The club also did water quality assessment which resulted in the Town of Ladysmith and Saltaire Mill removing discharges. Contact: Greg Smith 245-3660 (**Production Option # 19**).

2. COHO COLONIZATION: Available above barrier habitat: 15,890 m² ; a stocking rate of 1 fry/m² would yield approximately 1271 smolts (Production Option #20)

D) LAND USE

Urban

Residential development has increased greatly in the last decade and large scale housing projects have intruded on the Rocky Creek Ravine in the Upper Walkem Road area.

Forestry

The upper basin is in advanced stages of second growth. Logging has resumed in the last few years. The area is mostly private land under the management of TimberWest.

E) PROTECTION NEEDS

The most important parts of Rocky Creek are within the Town of Ladysmith where rapid development is occurring near the Rocky Creek Ravine. Generous setbacks from the edge of the ravine are required – a much broader protective corridor could have been applied to Rocky Creek.

OPERATIONAL MANAGEMENT UNIT 2: CHEMAINUS

OMU: 2 Chemainus/T.Burns and B.D. Tutty, 1999

OVERVIEW

The Chemainus OMU stretches from Bonsall Creek in the south to Holland Creek on the north. The unit is a mixture of urban and agricultural uses on the eastern fringe which includes part of Ladysmith and Chemainus, Saltaire and Crofton. The coastal plain is relatively narrow or non-existent and the only major riparian landscape unit is the Chemainus – Bonsall estuary/riparian lowland. Beyond the coastal fringe, the OMU is largely forested upland.

LIMITING FACTORS

Access and low summer flow and, in the case of Chemainus River in particular, lack of stable overwinter habitat are prime limiting factors in terms of trout and salmon production.

PRODUCTION OPTIONS

28 production opportunities are present in OMU 2. They are outlined along with their priority rating in Table 2.

Table 2: Production Options in OMU 2 (Chemainus)

| No. | Page | Sub-Basin | Activity | Priority |
|-------|------|--------------|-------------------------------|----------|
| 1 | 1,2 | Holland | Increase base flow | 1 |
| 2 | 4 | Stocking | Coho colonization | 1 |
| 3 | 4 | | LWD (structural improvement) | 3 |
| 4 | 5 | Porters | Headwater storage | 2 |
| 5 | 5 | | Riparian restoration | 2 |
| 6 | 5 | | Barrier improvement | 2 |
| 7 | 8 | Matthew | Headwater storage – Fuller L. | 2 |
| 8 | 8 | | Water quality improvement | 1 |
| 9 | 8 | | Structural improvement | 2 |
| 10 | 11 | Chemainus | Coho colonization | 1 |
| 11-16 | 11 | | Sidechannel development | 1 |
| 17 | 11 | | LWD addition | 3 |
| 18-19 | 13 | Bonsall | Barrier removal | 2 |
| 20-22 | 14 | | Headwater storage | 1 |
| 23 | 14 | | Riparian restoration | 3 |
| 24 | 14 | | Solly's Lake aeration | 2 |
| 25 | 15 | Whitehouse | Barrier improvement | 2 |
| 26 | 15 | | Riparian restoration | 2 |
| 27 | 16 | | Coho colonization | 1 |
| 28 | 16 | | Flow management/str. Imp. | 1 |
| 29 | 17 | Groves Creek | Coho colonization | 2 |
| 30 | 17 | | LWD addition | 2 |
| | | | | |

OMU: 2 Chemainus/T.Burns and B.D. Tutty, 1999

Stream Code: 920321500

Stream Name: Holland Creek

Operational Management Unit: Chemainus

Municipal: Ladysmith, CVRD Electoral Area G

A) BIOPHYSICAL OVERVIEW: A moderate sized stream that drains a steep, narrow basin that broadens somewhat above the 300 m contour. Holland Creek is somewhat buffered by Holland Lake and a number of small wetland basins. Holland Lake (Company Dam) is a reservoir (550 ha) on the South Fork. It is the main water supply for the Town of Ladysmith. Water is stored in the reservoir (which receives diverted inflow from Banon Creek) and released in South Holland so it can be withdrawn at a small diversion dam at Chicken Ladder Falls some 8500 m downstream.

| | |
|--------------------------------|---|
| Air Photos | BC 87025: 21 - 23 |
| Topographic Map | 92B/13, 92B. 091 |
| Salmonids | Co to 2005 m Ct to 11038 m Rb to 11008 m St to 2005 m Cm to 800 m |
| Obstructions | Bore Hole Falls (14R) at 2005 m Numerous upstream falls including Chicken Ladder at 4538 m |
| Max. temp. (C°) | 15 (9/15/96 – R2) 18.3 (7/26/98 –R2 120 m below Dogwood Rd.) 18.6 (7/21/98 – R5) 16.9 (7/21/98 – R6) 18.9 (8/9/98 – R3) |
| Min. Disch. (m ³) | .0866 (9/5 /96 – R2) .66 (7/21/98 – R7) .0117 (8/9/98 – R3) 0 (7/21/98 for 400 m below Chicken Ladder Falls) Heart Creek R1 .0077 (8/8/98) Stair Creek R2 .0043 (8/9/98) |

HOLLAND CREEK

| Channel | Wetted | | | Channel | Side | Length | Wetted | |
|----------|--------|-----------|-----------|-------------|---------|--------|--------|-------|
| Width | Width | Substrate | Slope (%) | Confinement | Channel | (m) | Area | |
| Reach 1 | 31 | 7 | 4420 | 1.0 | FC | L | 125 | 875 |
| Reach 2 | 16 | 7 | 1720 | 2.0 | FC | L | 820 | 5740 |
| Reach 3 | 13 | 4 | 1450 | 2.0 | CON | N | 1060 | 4240 |
| Reach 4 | 12 | 7 | 1243 | 4.0 | CON | N | 265 | 1855 |
| Reach 5 | 6 | 6 | 1243 | 4.0 | CON | N | 268 | 1853 |
| Reach 6 | 13 | 4 | 1180 | 6.0 | CON | N | 2000 | 8000 |
| Reach 7 | 13 | 10 | 1261 | 3.5 | CON | N | 2200 | 22000 |
| Reach 8 | 7 | 5 | 1261 | 12.0 | CON | N | 600 | 3000 |
| Reach 9 | 7 | 5 | 1450 | 4.0 | CON | N | 500 | 2500 |
| Reach 10 | 6 | 5 | 1351 | 5.0 | CON | N | 3200 | 13000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Holland Creek supports coho and chum salmon and steelhead and cutthroat trout. Resident rainbow trout are present in Company Dam and occasionally find their way down the creek via the spillway. Production is limited by reduced summer flows.

C) PRODUCTION OPPORTUNITIES

1. **INCREASED BASE FLOW:** Production would be improved in the lower 4538 m if some critical period discharge flow could be allotted to Holland Creek. The creek's entire base flow is captured at Chicken Ladder Falls and diverted into the Town of Ladysmith distribution system. The downstream portion of the stream survives the summer on groundwater seepage. Amazingly, by the time the stream reaches its most capable portion for fish in Reach 2, (the confluence of Heart Creek) flow has recovered dramatically. Flow above Chicken ladder was .66 CMS on July 21, 1998. The creek was intermittent (scattered pools, no flow) for approximately 400 m below the dam where flow picked up to 5 LPS. By August 8, this section was dry and the creek was intermittent below it for about 300 m. Flow was highly reduced all the way down to R2 (.0117 CMS) It would be very unrealistic to suggest that a substantial portion of above Chicken Ladder flow be spilled down the creek because most of the flow results from created storage and is needed by the Town of Ladysmith.

Still, if just 10% could be spilled (.066 CMS,) it would nearly double Reach 2 base flow and be 5.6 times as much as R3 flow (**Production Option #1**)

D) LAND USE FACTORS

Forestry

The entire basin is covered by advanced second growth.

Agriculture

Nil

Residential

Although most of the south portion of the Town of Ladysmith is adjacent to the Holland Creek Ravine, the ravine is protected and a trail network is located within it.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone encompasses the ravine and the lower ends of several tributaries. Within the ravine are a number of moist riparian areas and sidehill seepage areas. The Town of Ladysmith appears to have a proactive land use plan for the Holland Creek Ravine. An attractive trail system has been developed which is well utilized by residents of adjoining neighborhoods and the Town in general.

Stream Code: 9203318200

Stream Name: Stocking (Jackman) Creek)

Operational Management Unit: Chemainus North

CVRD Electoral Area: G

- A) **BIOPHYSICAL OVERVIEW:** A moderate size complex stream in terms of terrain and basin form. The basin is narrow and confined below the 60 m contour. It then broadens considerably, particularly between the Island Highway and the 500 kV B.C. Hydro right of way. Above this point (about 120 m ASL), it steepens and narrows as it approaches its origins around the 400 m contour. Stocking Lake is the creek's main headwater source. Its main summer flow source is a spring located some 50 m below the lake. The lake is managed for Saltaire's water supply by the CVRD and only spills during winter. Important tributaries are Caskey, Kerr, Harlow, Towhee and Ladyfern Creeks.

| | |
|------------------|--|
| Air Photos | BC8702 21-23 |
| Topographic Maps | 92B/13, 92B.091, 92B.092 |
| Salmonids | Co to 250 m Cm to 250 m Ct to 5736 m plus approximately 1400 m in Kerr Creek and 900 m in Caskey Creek. |
| Obstructions | 3R4 at 250 m .8D at 259 m 3R6 at 800 m 8R at 840 m periodic upstream falls but resident cutthroat are scattered to Stocking Lake |
| Min. Disch> | .0056 R1 (9/5/96) .0132 R6 (8/9/98) |
| Max. temp. | 15.5 R1 (9/5/96) 15.4 R7 (8/9/98) |

STOCKING CREEK

| Channel Width | Wetted Width | Substrate | Slope (%) | Channel Confinement | Side Channel | Length (m) | Wetted Area | |
|---------------|--------------|-----------|-----------|---------------------|--------------|------------|-------------|------|
| Reach 1 | 11 | 5 | 1810 | .5 | FC | L | 150 | 750 |
| Reach 2 | 10 | 5 | 136R | 1.6 | CON | N | 120 | 600 |
| Reach 3 | 9 | 5 | 1342 | 3.0 | CON | N | 570 | 2850 |
| Reach 4 | 9 | 5 | 1351 | 2.0 | CON | N | 136 | 680 |
| Reach 5 | 8 | 5 | 1450 | 2.0 | FC | L | 960 | 4800 |
| Reach 6 | 6 | 4 | 1252 | 3.0 | CON | N | 500 | 2500 |
| Reach 7 | 6 | 4 | 2620 | 1.5 | FC | L | 700 | 2800 |
| Reach 8 | 4 | 2 | 1360 | 4.0 | CON | N | 800 | 1600 |
| Reach 9 | 4 | 2 | 1360 | 9.0 | CON | N | 1600 | 3200 |
| Reach 10 | 2 | 2 | 1153 | 15.0 | CON | N | 50 | 100 |
| Reach 11 | 2 | 1 | 1450 | 2.0 | CON | N | 100 | 100 |
| Reach 12 | 3 | 0 | 1180 | 4.0 | CON | N | 50 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Stocking Creek is utilized by coho and chum salmon and anadromous and resident cutthroat trout. Coho, chums and sea-run cutthroats are stopped by a falls at 250 m. Resident cutthroats are present up to the Stocking Lake Dam Spillway and in Stocking lake. Lake cutthroats drop down the spillway to spawn in Reach 11. Parr probably move back to the lake in the spring of their second year. There is very little spawning habitat in Reach 11.

Anadromous production is limited by low summer flows and short accessible length. NOTE: Length of the intertidal zone is 380 m. Some chums spawn in the mid to upper levels in Inner Davis Lagoon. Stream data presented here begin at the top of the intertidal zone.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION:** Modification of the lower falls to allow coho – sea-run cutthroat passage has tempted people but its only 550 m to the next barrier which could also be improved but just 40 m upstream is Overhang Falls (8m) which is not subject to improvement. The most capable coho-cutthroat habitat is above these falls in Reaches 4, 5 and 7 (**Production Option #2**).

Coho colonization (fry stocking) is a more appropriate option. Approximately 10,830 m is available for stocking density of 5 fry/m² or 5415 fry and 2800 m is available for 1 fry/m² for a total of 8215 fry. In addition, some production is likely to occur in Lower Kerr and Lower Caskey Creeks as well as Ladyfern and Towhee Creeks. The latter two offer excellent winter/spring habitat conditions. Probable smolt yield: 657.

2. **STRUCTURAL IMPROVEMENT:** LWD addition in R1 would improve coho – cutthroat carrying capacity. I was once told by Ted Epps that Lower Stocking was cleaned of debris to improve chum spawning (**Production Option #3**)

D) LAND USE FACTORS

Forestry

Most of the basin west of the Island Highway is either Crown or private forest. Considerable logging has occurred in 1930-1936 second growth since 1985 and, in particular, since 1990. Logging of a private block adjacent to Reaches 6 and 7 produced some negative impacts from ravine slope erosion. Considerable downstream movement of debris also occurred due to this operation. A logjam composed of this material is present just below the Island Highway. Logging of Crown blocks has been far better in terms of impact.

Agriculture

Some agricultural use below the 60 m contour. Minor impact because most of this area is protected by ravine part of which is regional park.

Residential

Considerable light residential development to the southeast of Reaches 1-5 along the Old Island Highway. Again, negligible impact on the stream because its protected by a ravine in this area. Some commercial – industrial use in a small area west of the Island Highway along Watts Road. Peerless Road Incinerator nearby.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone has been defined for the entire mainstem and important tributaries, No uses should occur within it. Fortunately, much of the most sensitive portion of the creek (between the E and N crossing and the estuary at Davis Lagoon) is located in Stocking Creek Community Park (CVRD). It comprises 7.286 ha of riparian and steep adjacent slope lands and is a mix of CVRD and Crown holdings. It is a nature park with good trails. The park needs to be extended downstream to include the lower falls and Davis Lagoon,

Stream Code: 920314800

Stream Name: Porter Creek

Operational Management Unit: Chemainus

CVRD Electoral Area: G

- A) **BIOPHYSICAL OVERVIEW** A small stream that drains a basin that is relatively narrow below the 20 m contour which is located just below the Old Island Highway (Chemainus Road) and quite broad above that point. The upper basin has been extensively modified for intensive agricultural use. The natural buffering capacity of the upper basin has been highly effected by extensive clearing and drainage. Streamflow response to runoff is now much more direct.

Air Photos BC87024 022.023
Topographic Maps 92B/13, 92B.o92
Salmonids Co to 1783 m and sometimes beyond
Anadromous Ct to 1783 m and sometimes beyond
Res. Ct to irrigation res. @ 444375E 5421370N (R5) and beyond on a seasonal basis
Cm to 1783 m
Obstructions E and N culvert at 1784 m. Concrete arch culvert 28 m long with a .4 m vertical drop at its apron. Migration flow velocities range from 1.5 to 3 MPS
Max. temp. (C°) 16 (R3 9/11/95)
24 (R4 8/10/98)
13.2 @ E and N culvert 9/9/98
Min. Disch. (m³) .000014 (R3 9/11/95)
0 above ditch confluence @ 1920 m but some int. pools remain and there was 2 m of water in Don Porter's irrigation res. 2520 m and 23.5 ° (8/10/98)
.00133 @ E and N culvert 9/9/98

PORTER CREEK

| | Channel Width | Wetted Width | Substrate | Slope (%) | Channel Confinement | Side Channel | Length (m) | Wetted Area |
|---------|---------------|--------------|-----------|-----------|---------------------|--------------|------------|-------------|
| Reach 1 | 4 | 1 | 5320 | 2.0 | CON | N | 35 | 35 |
| Reach 2 | 2 | 2 | 4330 | 3.0 | FC | L | 180 | 320 |
| Reach 3 | 5 | 2 | 2431 | 2.5 | FC | M | 984 | 1968 |
| Reach 4 | 3 | 1 | 4420 | 4.0 | OC | M | 612 | 612 |
| Reach 5 | 2 | 0 | 5410 | 2.5 | CON | N | 875 | 875 |
| Reach 6 | 2 | 0 | 4600 | 1.5 | FC | N | 1175 | 1175 |
| Reach 7 | 2 | 0 | 5410 | 3.0 | CON | M | 200 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroat trout utilize the area below the E and N culvert and chums occasionally reached that point historically. Historical coho escapement ranged between 2 and 50 up to 1975. Chums ranged from none observed to 750. Cutthroats are also present above the E and N culvert in the Porter farm section. A fry salvage crew (Cowichan Fishers' Co-op) caught 1265 Ct fry, 85 parr, 344 smolts and 108 adults between July 21 and 29, 1998. Fish were captured below Chemainus Road (Old Highway). Production is highly limited by low summer flows, substrate quality (agricultural runoff has added a great deal of fine sediment) and lack of instream an overhead cover particularly in the upper basin. There have also been periodic fish kills from high BOD seepage from silos on an upstream farm (Porter's). Most of the upper basin portion of the system has been ditched and important wetlands have been cleared and drained. One 16 Ha wetland survived until about 1990.

C) PRODUCTION OPPORTUNITIES

- 1. HEADWATER STORAGE:** The most important need is provision of more base flow. Heavy irrigation withdrawal is a contributor. A review of irrigation requirements needs to be undertaken and perhaps a well dedicated to maintaining a summer flow of at least 5 LPS should be developed. 1m storage in two headwater wetland basins could yield 1.13 LPS for the 180 day critical discharge period (**Production Option #4**).
- 2. RIPARIAN RESTORATION:** Re-establishment of a riparian corridor in the upper basin along with some instream habitat improvement. Fencing may be required (**Production Option #5**)
- 3. BARRIER IMPROVEMENT: Improved Adult Access:** Improve passage at the E and N culvert (**Production Option #6**)

D) LAND USE FACTORS

Agriculture

The basin, especially the upper 80%, is extensively developed for agricultural use. Irrigation withdrawal has a large impact on streamflow. Natural base flow of Porter Creek is in the order of 1 –2 LPS. During irrigation withdrawal it drops to an almost negligible .14 LPS

Residential

Light

E) PROTECTION NEEDS

The Fisheries Sensitive Zone needs to be completely protected. In some portions of the stream, exact boundaries are difficult to determine so negotiation will be required. Major elements of sensitivity include the small estuary and the ravine that extends almost to the old highway, riparian lands below the E and N grade, former riparian lands on the Porter farm and headwater wetland areas. What this creek needs most is a local stewardship group to take it under its wing and develop a restoration/protection plan.

Stream Code: NA

Stream Name: Matthew Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A small stream that originates in Fuller Lake and discharges into an estuarine marsh and tidal lagoon at the head of Chemainus (Horseshoe Bay). Flows through suburban neighborhoods, a golf course, pasture and wooded ravine. Upper section summer dry, seepage starts summer flow below Cottonwood Road where the stream enters a wetland (Gudal Slough).

| | |
|--------------------------------|---|
| Air Photos: | BC 87024: 022, 023 |
| Topographic Maps: | 92B/13, 92B.092 |
| Salmonids | Occ. Coho to 1685m Anadromous Ct to 1685 m Resident Ct to 2974 m Occ. Rb. Fuller Lake is usually stocked with rainbows and some find their way down the creek SmB Fuller Lake |
| Obstructions | OS (Tsb) 3R4 at 1685 m 2.5 m culvert at Cottonwood Road at 2974 m |
| Max. temp. (C°) | 23 (R3 – 7/22/98) 18.1 (R5 – 7/22/98) 22 (R2 – 7/2/98) |
| Min. Disch. (m ³) | .00221 (R5 – 9/11/96) |

MATTHEW CREEK

| Channel Width | Wetted Width | Substrate | Slope (%) | Channel Confinement | Side Channel | Length (m) | Wetted Area | |
|---------------|--------------|-----------|-----------|---------------------|--------------|------------|-------------|------|
| Reach 1 | 4 | 2 | 9100 | .1 | OC | M | 15 | 30 |
| Reach 2 | 3 | 3 | 4420 | .01 | OC | M | 120 | 360 |
| Reach 3 | 20 | 4 | 8200 | .5 | FC | L | 891 | 3504 |
| Reach 4 | 1 | 1 | 1450 | 3.0 | CON | N | 108 | 108 |
| Reach 5 | 3 | 1 | 2440 | 2.0 | CON | N | 132 | 132 |
| Reach 6 | 1 | .5 | 1000 | 1.0 | CON | N | 904 | 452 |
| Reach 7 | 1 | 1 | 1000 | .5 | OC | M | 443 | 443 |
| Reach 8 | 2 | 0 | 4240 | 5.0 | CON | N | 593 | 0 |
| TOTALS | | | | | | | 3206 | 3292 |

FULLER LAKE

| Area | Elev. | Volume | Max. Depth | Min. Depth | TDS | Perimeter |
|----------|-------|--------------------------|------------|------------|--------|-----------|
| 21.45 ha | 46 m | 1,825,580 m ³ | 17.1 m | 8.5 m | 33mg/L | 2104 m |

B) FISH UTILIZATION AND LIMITING FACTORS

Matthew Creek has supported strong populations of cutthroat trout, especially sea-runs and a few coho salmon. Coho are now very sparse or non-existent. Anadromous cutthroats are still strong.

Production is limited by low summer flows, access and habitat deterioration.

270 m of the stream is located on Mt. Brenton Golf Course where it has been ditched; there is little instream cover or pools and bank vegetation is sparse.

A heavy deposit of iron oxide renders much of Reaches 1, 2 and 3 summer uninhabitable. However, high summer temperatures and low summer oxygen are also strongly limiting in this section.

The falls at 1685 m limit upstream migration of anadromous fish.

C) PRODUCTION OPPORTUNITIES

1. **HEADWATER STORAGE**: Storage and siphoning could be employed at Fuller Lake so that 1 m of water could be utilized to augment critical period discharge. Approximately 10 LPS could be released to Matthew Creek from May through October. In most years the critical discharge period is more likely 100 days which would allow for approximately 18 LPS to be released. The creek's present base flow is 2 – 3 LPS for 80% of its length. (the top 593 m dry). An old dam is present (M+B) adjacent to the Stephen property. It is basically just a pile of rocks although there is a gabion and some bumper guards embedded in it. This structure needs to be replaced by a stop board dam with a siphon hole. A small spawning platform could also be created below the dam's splash plate (**Production Option #7**)
2. **WATER QUALITY IMPROVEMENT**: Removal of the iron oxide problem would return Reaches 1,2 and part of 3 to higher levels of productivity. MacMillan Bloedel has sealed the landfill (which contains large amounts of hog fuel) and installed some perimeter drain (Production Option #8)
3. **STRUCTURAL IMPROVEMENT**: Addition of cover-complexity and spawning gravel would increase productivity in Reaches 3 through 6. A project sponsored by the Chemainus Rod and Gun Club treated a portion of Reach 3 in 1996 to increase cover and bank stability (**Production Option # 9**).

D) LAND USE FACTORS

Industrial

MacMillan Bloedel's Chemainus Mill is located nearby and the company operated a land fill on the west slope of Lower Matthew Creek Valley for a distance of 350 m. Seven small seepage streams are located in this area and three are contaminated by iron oxide and iron bacteria.

Agriculture

Two farm properties are located in the Lower Howe Road area. The main product is hay.

Residential

Housing and Mt. Brenton Golf Course are adjacent to Reaches 5 through 8. Housing is of low density in the Crozier – Cottonwood Road areas where important wetland and seepage areas are located. These are responsible for Matthew Creek's summer flow.

E) PROTECTION NEEDS

It is critical that the central wetland and adjacent seepage areas in the Crozier – Cottonwood neighborhood (locally known as Gudal Slough according to Jamie Stephen of MOE who lives at Fuller Lake) be protected because this wetland IS Matthew Creek in terms of summer flow. The Reach 5 Ravine along Howe road is also a critical part of the Fisheries Sensitive Zone. It walls are very steep and subject to erosion in places and its canopy is an important factor in cooling the stream. For the most part, it is relatively undisturbed but there is a sheep pasture at the Renema Property at 2589 Howe and some damage to the riparian zone and adjacent slopes has occurred. There is also a collapsed wooden box culvert on the property that should be removed (removed in August, 1998 at the request of MOE).

Stream Code: 920303500

Stream Name: Chemainus River

Operational Management Unit: Chemainus

CVRD Electoral Area: F, I Lower 12.5 km North Cowichan

A) BIOPHYSICAL OVERVIEW: A large river system that drains a long narrow basin. The Chemainus is only very lightly buffered by a few small lakes and wetland basins and responds very rapidly to runoff events then recedes quickly. The basin is composed of three general sections: a lower floodplain and extensive estuary below the 20 m contour (just above the Island Highway, a confined section with stretches of deep canyon from the highway up to the Chipman (Boulder) Creek confluence near the 200 m contour, a long upper basin section that is low gradient and semi – confined and extends up to just above the Coates Creek confluence near the 540 m contour. Finally there is a steep and confined upper reach that extends into the alpine area on the east flank of El Capitan. A number of important tributaries are present: Chipman (Boulder) Creek, Solly (Silver) Creek, Banon Creek, Humbird Creek, Holyoak Creek, Rheinhart Creek, South Chemainus and Happy Creek.

| | |
|-------------------------------------|---|
| <u>Air Photos:</u> | BC 87024: 19-22, 37-41 |
| <u>Topographic Maps:</u> | 92B/13, 92C/16, 92B.082, 92B.092, 92B.081, 92C.100 |
| <u>Salmonids:</u> | Ch to Copper Canyon Falls at 13,200 m summer and fall run St to Wightman Falls at 44,700 m spring and summer run Co to Copper Canyon Falls at 13,200 m. An occasional fish may pass Cm to Sandy Pool at 6200 m Ct to Upper Falls at Rb to Upper Falls at |
| Tributaries: | <u>Happy Creek</u> St/Ct to 2R3 falls at 82 m <u>Banon Creek</u> Falls at confluence, resident Ct to 3000 m and 800 m in West Banon <u>Holyoak Creek</u> Steep cascade at Chemainus confluence <u>Solly Creek</u> St/Rb to 5R at 2400 m <u>Humbird Creek</u> St/Rb to 8R at 2000 m lower 400 m dry <u>Chipman (Boulder) Creek</u> St/Rb to 10R at 6400 m also in Lower Careful Creek and Lower Curl Creek <u>Rheinhart Creek</u> St/Rb to 2.5 R at 3000 m on mainstem St/rb to 10R at 800 m on West Fork Resident rainbows are also present in Coates Creek up to Spartan (Sherk) Lake, South Chemainus to 50 m, Paintbrush Creek to 300 m, and Cougar Clem creek to 300 m. Miller Creek, a lower river tributary/sidechannel complex is a very important Co – Ct stream up to and including the wetland on Bald Eagle Campsite which is especially important as winter habitat. Westholme Sidechannel on the Halalt Reserve is a very important Co – Cm spawning area and Co – Ct – St winter habitat. |
| <u>Obstructions</u> | Lower Copper Canyon Falls at 13,200 m – 2R3. Three more falls in the series: 3R5 at 13,500, 3R5 at 13,600 and 3R10 at 13,800. Wightman Falls at 44,700 m Upper Falls at |
| <u>Max. temp. (C°)</u> | 25 R2 (7/29/98) 18.5 R6 (7/29/98) 14 R14 (7/29/98) 21.5 R2 (8/2/96) |
| <u>Min. Disch. (m³)</u> | .071 R3 (12/2/1956) .275 R14 (7/29/98) .605 R6 (7/29/98) .864 R3 (8/2/96) |
| Boulder | .204 R1 (9/21/96) |
| Solly | .044 R1 (9/16/96) |
| Banon | .053 R2 (8/2/96) |

CHEMAINUS RIVER

| | Channel Width | Wetted Width | Substrate | Slope (%) | Channel Confinement | Side Channel | Length (m) | Wetted Area |
|----------|---------------|--------------|-----------|-----------|---------------------|--------------|------------|-------------|
| Reach 1 | 42 | 40 | 4510 | .1 | FC | H | 1300 | 52000 |
| Reach 2 | 35 | 33 | 5410 | .1 | FC | H | 1200 | 39600 |
| Reach 3 | 40 | 10 | 1720 | 1.0 | FC | M | 4000 | 40000 |
| Reach 4 | 35 | 20 | 136R | 1.5 | CON | N | 6800 | 136000 |
| Reach 5 | 22 | 12 | 1252 | 4.0 | CON-ENT | N | 3800 | 45600 |
| Reach 6 | 35 | 15 | 145R | 2.0 | CON | N | 13600 | 204000 |
| Reach 7 | 22 | 12 | 1153 | 5.0 | CON | N | 1000 | 1200 |
| Reach 8 | 55 | 12 | 1450 | 1.5 | FC | M | 1600 | 16000 |
| Reach 9 | 35 | 10 | 1450 | 1.5 | FC | M | 11000 | 110000 |
| Reach 10 | 18 | 10 | 136R | 2.5 | CON | N | 3600 | 36000 |
| Reach 11 | 12 | 6 | 1252 | 5.0 | CON | N | 2000 | 12000 |
| Reach 12 | 18 | 10 | 1450 | 2.0 | CON | N | 828 | 8280 |
| Reach 13 | 11 | 5 | 1225 | 3.0 | CON | N | 666 | 3330 |
| Reach 14 | | | | | | | | |

B) FISH UTILIZATION AND LIMITING FACTORS

Steelhead:

Winter-Spring. Although there are a few typical winter run steelhead that enter the river between late November and March, the majority of the run comes in during late April, May and June and spawns in May and June. They are thought to number less than 200.

Summer: Some summer run fish enter about the same time as the spring run. Their numbers are also very low – less than 200.

Chinooks

A few chinook salmon ascend the river during the spring freshet and hold in the deep canyon pools like The Slot. Their numbers are very low. There is also a fall run which has numbered between 10 and 100 in the last decade but has been as high as 200. There has been much difficulty in maintaining chinook runs despite considerable effort including a hatchery program (Seaspring).

Coho

The Chemainus has never been a strong coho producer but their numbers ranged up to 7500 in high escapement years in the 1950's. In recent years, their number has been less than 100.

Chums

Chemainus chums have remained relatively strong. The run is somewhat unique for the region because of its early nature. Fish begin entering the lower river in late September and most have spawned by late October. As many as 100,000 are present in peak years. Westholme Sidechannel is the safest spawning unit for chums in this highly unstable river.

Sea Run Cutthroats

Unknown but numbers are low

Rainbow

Throughout

Resident Cutthroat

Throughout

All species are limited by low summer flows and the unstable discharge regime. Salmon are limited by access. Less than 30% of the potentially accessible portion of the mainstem is accessible due to the barriers in Copper Canyon. If the potential accessible habitat for coho and chinooks in the tributaries was factored in, the figure would be much higher.

There is a need for more inventory of the Upper Chemainus and Rheinart Creek. There are at least two reaches of the Upper Chemainus above R13 that have not been inventoried as well as lower Coates Creek. More information is also required on Boulder, Solly and Miller Creek.

C) PRODUCTION OPPORTUNITIES

1. BARRIER IMPROVEMENT/ COHO CHINOOK COLONIZATION

Copper Canyon Falls

It might be possible to modify these barriers to allow coho and early chinooks to pass (an occasional coho is able to navigate them at present) but it would be extremely costly and the barriers could easily reform as large boulders wedge in restricted areas. Because steelhead are able to pass the falls and ascend well into the headwaters and because the Chemainus steelhead are so unique, the falls are probably best left as they are with limited coho – chinook colonization above (**Production Option #10**).

2. LATERAL HABITAT DEVELOPMENT

Because the Chemainus is such an unstable river and lacks protected off channel habitat, what little there is of extreme importance. Six important sidechannels have been identified for enhancement and upgrading:

1. Westholme Sidechannel (11)

This major enhancement effort by the Halalt Nation/DFO needs several measures to allow it to continue its role as a very important element of Chemainus River salmonid production. Its upper end needs protection by periodic removal of excess river gravel and reinforcement of the dyke. Provision of a safer method of providing water should be considered as should addition of habitat features such as deeper pools and LWD to increase its winter capability juvenile coho, cutthroat and steelhead.

2. Miller Creek (12)

The wetland portion should be deepened and extended. Consideration should be given to purchasing this property because there is continued temptation to fill in the wetland portion. Alternatively, the most valuable and sensitive portion could be placed in a covenant. It is presently used as a riverfront campsite and has been for at least two decades.

3. Elk Garden Sidechannel (13)

Requires deepening and complexing – an important juvenile steelhead overwintering area.

4. Elk Meadow Sidechannel (14)

Also requires deepening and complexing

5. Tropical Sidechannel (15)

Needs deepening and complexing.

6. Wide Corner Oxbow (16)

A portion of the Upper Chemainus cut off by Copper Canyon Mainline (MacMillan Bloedel). Requires inlet and outlet structures to allow juvenile steelhead access for overwintering and early rearing.

(Production Options # 11-16)

3. HABITAT COMPLEXING

The Upper Chemainus River from the vicinity of the old Copper Canyon Camp to Coates Creek confluence was a sea of logjams in the sixties to mid-seventies. As of 1998, little large debris is left and the river is LWD deficient. Judicious addition of anchored LWD particularly in reaches 9 and 13, is recommended (**Production Option # 17**)

D) LAND USE FACTORS

Forestry

11

The Chemainus, particularly the upper reaches, was logged rapidly in the 1950's through the 1970's with major impact on fish and channel character. Very considerable cross-stream yarding occurred with accompanying bank and channel damage and huge amounts of debris were left in the river. Massive jams formed, backfilled then broke loose resulting in large scale destabilization. The river is still very unstable and its channel is overloaded in many places.

Most of the basin is now covered by advanced second growth and logging has resumed in mid-basin.

Agriculture

The lower basin is extensively farmed but impacts have been light.

Residential

Light

Gravel Removal

The lower river between the bridges had a long history of gravel removal but gravel is seldom taken now.

E) PROTECTION NEEDS

The Chemainus below the Island Highway has a relatively broad floodplain/riparian zone that it shares with Lower Bonsall Creek. This section of the river contains the very important lateral habitat units Miller Creek and its wetland and Westholme Sidechannel as well as the Chemainus Estuary and Swallowfield Channel. The FSZ is very broad in this region but rapidly narrows above the highway as upland closes in. It remains narrow on the river and its tributaries until the river opens again in the Upper Basin where there are sections of floodplain /riparian habitat that include sidechannels and small wetlands.

Stream Code: 920298700

Stream Name: Bonsall Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A moderate sized stream with two basic components: a lowland, low gradient mainstem that originates from seepage springs mainly located above the Island Highway and a headwater wetland above Somenos Road and a mountain component that drains a steep, narrow basin on Mt. Sicker. The mountain component contributes gravel and fall – winter peak flows but is summer dry in its lower end. The lowland basin is heavily farmed below the Island Highway. Bonsall Creek is a very productive stream.

| | |
|--------------------------------|--|
| Air Photos | BC 87024: 037, 038 |
| Topographic Maps | 92B/13, 92B.082 |
| Salmonids | Co to Somenos Rd. at 8823 m Ct to Somenos Rd. Cm to Island Highway @ 7682 m |
| Obstructions | Somenos Rd. culvert: .85m vertical drop Increasing gradient in mountain tributary @ 1000m (Mountain trib. is considered mainstem on maps Island Highway culvert is 66 m long and has offset baffles (30 – 90) every 4 m. |
| Max. temp. (C°) | 16.2 (7/21/94 R2) 15 (7/27/98 R2) 15 (8/23/98 R5) 16.5 (9/3/98 R5) 18.5 (9/3/98 R6) |
| Min. Disch. (m ³) | .001 @ Westholme Rd. 8/12/68 (WSC Gauge) .231 @ Westholme Rd. 7/27/98 .011 @ Highway 8/22/98 .016 @ Highway 9/22/86 .00016 R6 (9/3/98) |
| pH | 6.6 (R2 7/21/94) |
| O ₂ | 5.9 mg/L)R2 7/21/94) |

BONSALL CREEK

| Channel | Wetted | | | | Channel | Side | Length | Wetted |
|---------|--------|-----------|-----------|-----|-------------|---------|--------|----------|
| Width | Width | Substrate | Slope (%) | | Confinement | Channel | (m) | Area |
| Reach 1 | 10 | 10 | 1000 | .2 | OC | H | 880 | 8800 (T) |
| Reach 2 | 12 | 10 | 5500 | 1.0 | FC | M | 3213 | 32130 |
| Reach 3 | 6 | 5 | 7300 | 1.0 | FC | L | 1544 | 7720 |
| Reach 4 | 6 | 3 | 1630 | 1.5 | FC | L | 2045 | 6135 |
| Reach 5 | 6 | 3 | 1540 | 1.5 | FC | L | 169 | 507 |
| Reach 6 | 3 | 1 | 5500 | .5 | FC | L | 722 | 722 |
| Reach 7 | 3 | 0 | 1000 | 1.0 | CON | N | 250 | 0 |
| Reach 8 | 3 | 0 | 1000 | .5 | FC | L | 650 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Bonsall Creek is utilized by coho and chum salmon and resident and anadromous cutthroat trout. Production is limited by low summer flows, restricted access and areas of degraded streambank.

C) PRODUCTION OPPORTUNITIES

1. BARRIER REMOVAL

Removal of Somenos Rd. culvert would add another 650 m (1300 m² with storage release) which calculates to an additional 104 coho smolts at 1 fry/m² and 8% fry to smolt survival.
Improvement to the highway culvert to allow chum salmon passage. (**Production Options # 18,19**)

2. WETLAND IMPOUNDMENT/ HEADWATER STORAGE

Storage of 1 m in the headwater wetland (150,000 m³) would yield .0066 CMS for 180 days. This would add flow to both R7 and R8: 900 m and increase existing R6 base flow by approximately 40 x. In addition, fall coho fry could be stocked in the wetland which represents an additional 1800 coho smolts at a stocking density of .15 fry/m². Other impoundment possibilities are present on Solly Creek where two wetlands have yields of .004 CMS (Mt. Richards West) and 00014 CMS (Upper Solly Wetland) (**Production Options # 20 ,21 and 22**)

3. RIPARIAN RESTORATION

There are still a number of areas that could benefit from streambank planting. Sections of Reach 3 were done during the Bonsall Creek project (1994 – 1995). This work needs to be monitored and extended. (**Production Option # 23**)

4. SOLLYS LAKE AERATION

Sollys Lake is a very productive large pond on Solly's Creek. Unfortunately, oxygen levels become very low in the summer. The lake presently winters fish but they have to leave before July in most years. A grid aeration system could carry coho and trout through the summer which would provide significant production gain (Production Option # 24)

D) LAND USE FACTORS

Forestry

The upland component of the watershed is largely in North Cowichan's Municipal Forest. Considerable logging has occurred since 1990 in the Mt. Sicker – Prevost section with negligible impacts because the FSZ (ravine) was protected.

Agriculture

Approximately 70 % of the lowland portion of the basin is intensively farmed with significant impacts such as channel and riparian modification and nutrient input. Some barnyards are very close to the creek. A program to improve drainage by removing obstacles like beaver dams and debris piles was undertaken in 1994 – 1995. Some bank armoring and berming, riparian planting and fencing and habitat complexing was also accomplished and a large sediment trap pool was excavated. Overall habitat condition in Reach 3 improved.

Residential

Light but development along the north slope of the north lobe of Mt. Richards along Nimmo – Bonsall Road is a concern because of steep slopes which are bisected by several runoff creeks, one of which has produced downstream sedimentation due to land clearing and road construction.

E) PROTECTION NEEDS

Lower Bonsall Creek's riparian zone is very broad – up to 800 m in portions of Reach s 2 and 3 which includes portions of Whitehouse and Solly Creeks. Ideally, much more of this area should be in a natural state than is the case at present. Some places have no riparian cover or only a fringe. A careful study should be undertaken to establish precise protection boundaries in this complex, intensively farmed section.

Stream Code: NA

Stream Name: Whitehouse Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A small stream that features a low gradient, pastoral lower section, a middle section that is considerably steeper and more confined then a broad, low relief upper section before the creek starts to climb the mountain.

Air Photos: BC 87024: 037,038
Topographic Maps 92B/13, 92B.082
Salmonids Co to 2539 m
Act to 2539 m
Cm to 2539 m (Cm are very occasional and, in recent years, tend to spawn in the tributary that carries the hatchery effluent.
Res. Ct to 6798 m

Obstructions Fern Canyon Falls at 2539 m: 2R, 1R followed by a series of small cascades for a total falls of 6R20

Max. temp. (C°) 16 (R3 – 9/17/96)
16 R3 – 9/8/98)
12.8 R2 below south effluent channel (Hatchery effluent water ranges from 9-12 degrees and moderates summer and winter temperatures in Whitehouse downstream of entry points.

Min. Disch. (m³) .03 R3 – 9/17/96 The lower 1500 m dried prior to Seaspring Hatchery (Groves) which started in the early 1970's. After 1990 the hatchery became a year round operation, The effluent supplies .02 to .10 CMS. In the summer months the majority is supplied to the south effluent channel/Holman Creek (approximately a 60:40 ratio) to maximize streamflow benefits to Whitehouse
.016 R3 just above confluence with south effluent channel/Holman Creek (9/8/98)
.1155 R2 a confluence with Groves Creek and Whitehouse (below south effluent confluence)
.1633 R1 @ Island Highway (9/9/98)
.0478, north effluent channel (9/8/98)
.076 south effluent channel (9/8/98)
.0005 R8 @ Cranko Rd. (9/9/98)

WHITEHOUSE CREEK

| Channel | Wetted | | | | Channel | Side | Length | Wetted |
|---------|--------|-----------|-----------|-----|-------------|---------|--------|--------|
| Width | Width | Substrate | Slope (%) | | Confinement | Channel | (m) | Area |
| Reach 1 | 4 | 2 | 9100 | .5 | CON | N | 900 | 1800 |
| Reach 2 | 5 | 3 | 1000 | 1.0 | FC | H | 870 | 2610 |
| Reach 3 | 5 | 3 | 3610 | 1.5 | FC | M | 579 | 1737 |
| Reach 4 | 5 | 3 | 1351 | 2.5 | CON-ENT | N | 284 | 852 |
| Reach 5 | 4 | 2 | 6310 | 3.0 | FC | M | 996 | 1992 |
| Reach 6 | 2 | 1 | 8200 | 2.0 | CON | N | 1080 | 1080 |
| Reach 7 | 1 | 1 | 7300 | 1.0 | FC | L | 1438 | 1430 |
| Reach 8 | 1 | 1 | 1450 | 2.5 | OC | L | 651 | 651 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and chum salmon and sea-run and resident cutthroat trout are present up to Fern Canyon (Carin) Falls, Resident cutthroats are present above the falls well into the headwaters. Chums are not present every year and runs are light. Access and low summer flow limit production.

C) PRODUCTION OPPORTUNITIES

1. BARRIER IMPROVEMENT: If Fern Canyon Falls were made passable, an additional 4259 m (5443 m²) would be available for coho and Sea-run cutthroats (Production Option # 25)

2. RIPARIAN PLANTING would benefit parts of Reaches 1 and 6 (Production Option # 26)

3. **COHO COLONIZATION:** Coho fry outplanting above the falls would yield approximately 435 smolts. The Halalt Band presently stocks some fry from eggs incubated at the Bush Creek Hatchery (Ladysmith Sportsmen s' Club) (Production Option # 27)

4. **FLOW AUGMENTATION/ STRUCTURAL IMPROVEMENT:** Maximization of the habitat value of the hatchery effluent water is perhaps the most important opportunity. It is presently being managed at a high level and is extensively used by overwintering juveniles, especially coho in the north channel which is a Chemainus River relic channel that is subject to flooding. Its summer rearing value could be increased by allowing summer access and adding LWD. Its recruitment value could be improved by adding spawning platforms. Chums may use either of the channels if suitable spawning habitat was present. An occasional chum migrates through the North Channel to spawn upstream near Mt. Sicker Road (**Production Option # 28**).

D) LAND USE FACTORS

Forestry

The forested portion of the basin is part of North Cowichan's municipal forest – advanced second growth.

Agriculture

Agriculture is the primary land use factor. A large percentage of the basin is utilized – about 70%. A massive fish kill occurred July 17, 1981 when liquid fertilizer spilled from a split in a pipe conveying the fertilizer from a pond to a field. A 5 m plume of liquid manure spewed from the pipe for about one hour – approximately 20 LPS. The material ran down a ditch for 120 m then entered the creek wiping out the entire fish population with the exception of some lamprey ammocytes all the way down to Bonsall Creek. The spill occurred on the Groenendyk (Green dike) Farm. Thousands of juvenile coho and cutthroat trout were killed along with a few rainbow trout and many sticklebacks. Previous spills occurred in the summer of 1975 and in April, 1976.

Residential

Light

NOTES

Late Summer Fry Densities (from PBS Sampling)

| Year | Site | Number | No./m ² | % Age 0 | Mean FL |
|------|----------------|--------|--------------------|---------|---------|
| 1991 | Island Highway | 183 | — | 100 | 59.4 |
| 1992 | Island Highway | 109 | 1.33 | 100 | 63.9 |
| 1993 | Island Highway | 413 | 3.47 | 100 | 56.0 |
| 1994 | Island Highway | 223 | 1.97 | 99.5 | 55.0 |
| 1995 | Island Highway | 242 | 3.64 | 100 | 56.8 |
| 1996 | Island Highway | 265 | 4.11 | 100 | 56.6 |
| 1997 | Island Highway | 59 | 0.56 | 98 | 69.1 |

E) PROTECTION NEEDS

Whitehouse Creek has a very broad riparian zone – especially in Reaches 1 and 2. A considerable amount of R 1 riparian land is in intensive agriculture and there is a need to get some of it back. This is also the case in Reaches 6 and 8. Whitehouse Creek needs a stewardship group. Overall it is in a very reasonable state of health considering the long history of intensive agricultural use but this could change and there is a need for area residents to be involved in protection.

Stream Code: NA

Stream Name: Groves Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A very small tributary of Whitehouse Creek that drains a short, relatively steep basin on the north shoulder of Mt. Sicker. Enters Whitehouse Creek from the south at the 1427 m point.

| | |
|--------------------------------|---|
| Air Photos | BC 87024: 037, 038 |
| Topographic Maps | 92B/13, 92B.082 |
| Salmonids | Co to 938 m Ct to 938 m |
| Obstructions | 1.1 dam at 938 m. Prior to 1990, a 1.25 m culvert was present at 178 m, Westcoast Energy (PCEC) lowered it to grade in 1990 when the Vancouver Island Natural Gas pipeline went through. The Groves farm road was a shoo fly (access road) for the pipe gang. |
| Max. temp. (C°) | 17 (R4 – 9/17/96) 15 (R3 – 9/8/98) |
| Min. Disch. (m ³) | 0 for 253 m .00086 from pond up to dam at 938m then dry above |

GROVES CREEK

| Channel Width | Wetted Width | Substrate | Slope (%) | Channel Confinement | Side Channel | Length (m) | Wetted Area | |
|---------------|--------------|-----------|-----------|---------------------|--------------|------------|-------------|-----|
| Reach 1 | 40 | 0 | 9100 | .2 | UC | H | 70 | 0 |
| Reach 2 | 3 | 0 | 2800 | 1.0 | FC | L | 183 | 0 |
| Reach 3 | 15 | 15 | 1000 | 0 | UC (pond) | NA | 60 | 900 |
| Reach 4 | 3 | 1 | 1360 | 3.0 | CON | N | 685 | 685 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present up to the dam at 938 m. Production is limited by low to nil summer flows. Fortunately the pond beginning at 253 m serves as a summer low flow refuge.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION:** Wood Duck Pond, the reservoir behind the dam at 938 m and the pond by the Groves residence have a combined area of 1500 m² (600 for Wood Duck Pond and 900 for Groves Pond). They could be stocked with coho fry at the rate of .15/m² - 225 (**Production Option # 29**)
2. **ADDITION OF LWD** to Reach 4 would provide cover – complexity benefits. This reach becomes very low in the summer months; it needs more cover (**Production Option # 30**)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth

Agriculture

Light

Residential

Light

E) PROTECTION NEEDS

Improved fencing on Reaches 1 and 2 would keep cattle away from the riparian zone and marsh (Reach 1 is an Arum – Rubrus – Carex marsh). Impacts have been light to date. The Reach 3 ravine has some very steep sidewalls (100% plus). It and the Reach 1 marsh are the most sensitive components of the Fisheries Sensitive Zone. Reach 1 is also part of Whitehouse Creek's Fisheries Sensitive Zone.

OPERATIONAL MANAGEMENT UNIT 3: SOMENOS BASIN

OVERVIEW

Somenos Basin is of relatively low relief with extensive riparian lowlands and two lowland lakes: Somenos and Quamichan. It consists of five sub-basins: Quamichan, Somenos, Richards, Bings-Menzies and Averill.

A substantial portion of the basin - approximately 10 percent – is in high density urban use while another approximate 20 percent is in agricultural use of relatively high intensity. In fact, nearly all of the basin below the 100 m contour is utilized to some degree for urban or agricultural uses.

Despite use intensity and some very compromised fish habitat in parts of the basin, a great deal of capability and potential remain – some of the highest in the region.

LIMITING FACTORS

Primary factors limiting production are access and summer water quantity and quality. Barrier waterfalls are present on Lower Quamichan, Richards, Bings and Averill Creeks and all streams become either dry or dangerously low in the July-September critical discharge period. Water quality in the lakes, especially Somenos, becomes very poor.

PRODUCTION OPTIONS

There are 35 Production Options (restoration or enhancement opportunities) in the Somenos Basin. They are presented in brief in Table 3. For more discussion, see the data portion of this section.

Table 3: Somenos Basin Production Options

| No. | Page | Sub-Basin | Type | Priority |
|-----|------|-----------|--|----------|
| 1 | 5 | Quamichan | Coho colonization | 1 |
| 2 | 5 | | Lake level control at outlet | 1 |
| 3 | | | Water conservation | 1 |
| 4 | 5 | | Cuuthroat spawning improvement | 1 |
| 5 | 5 | | Fencing, riparian restoration | 2 |
| 6 | 5 | | LWD addition – R2 | 2 |
| 7 | 8 | Somenos | Lake aeration | 2 |
| 8 | 8 | | Riparian restoration/shade establishment | 3 |
| 9 | 8 | | Summer refuge improvement – Chesterfield Park | 1 |
| 10 | 8 | | Summer refuge establishment- Fun Pacific | 2 |
| 11 | 11 | Richards | Coho colonization (lakes) | 2 |
| 12 | 11 | | Headwater storage | 1 |
| 13 | 11 | | Riparian maintenance and improvement | 3 |
| 14 | 11 | | Coho colonization (creek) | 1 |
| 15 | 14 | Averill | Substrate improvement | 2 |
| 16 | 14 | | Adult barrier bypass | 1 |
| 17 | 14 | | Coho colonization without storage | 4 |
| 18 | 14 | | Juvenile barrier improvement | 1 |
| 19 | 14 | | Headwater storage | 1 |

| | | | | |
|----|-------|-----------------|---|---|
| 20 | 14 | | Coho colonization with storage | 2 |
| 21 | 14 | | Additional flow augmentation (Crofton) | 2 |
| 22 | 14 | Averill (cont.) | Riparian restoration | 2 |
| 23 | 14 | | Groundwater development | 2 |
| 24 | 14 | | Pond stocking coho fry | 2 |
| 25 | 17,18 | Bings | Spawning improvement | 3 |
| 26 | 17,18 | | Coho colonization | 2 |
| 27 | 17,18 | | Adult barrier improvement | 1 |
| 28 | 17,18 | | Juvenile barrier removal | 1 |
| 29 | 17,18 | | Riparian restoration/canopy development | 1 |
| 30 | 17,18 | | Upper reaches riparian restoration | 3 |
| 31 | 19 | Centennial Park | Coho colonization | 3 |
| 32 | 21,22 | Menzies | Coho colonization | 2 |
| 33 | 21,22 | | Headwater storage on West Menzies | 2 |
| 34 | 21,22 | | Riparian restoration | 2 |
| 35 | 21,22 | | Groundwater well | 2 |

Stream Code: 920 2577 057 016

Stream Name: Quamichan Creek

Operational Management Unit: Somenos Basin

Municipal : North Cowichan

A) BIOPHYSICAL OVERVIEW: Quamichan Creek is 1.48 km long, intermittent, lake buffered tributary of Somenos Creek - Fish Gut Alley lateral habitat complex of the Lower Cowichan River.

Air Photos BC 82007 142-143
Topographic Map 92 B/13. 92B. 072
Watershed Area 11 km²
Mainstem Length 1480 m
Obstructions 2.3 m. falls at 368 m
2 m dam at 450 m
Salmonids Quamichn Lake Ct from 450 to 1580 m (spawning and early rearing – fry return to lake late May – June)
Co to 368 m
Anad. Ct to 368 m
Cm to 368
Bt : occ. Ind. To 368 m
Max. Temp. (C°) 15 25/08/87 (R2)
23 (25/05/95 – R3)
21.7 (02/09/98 – R2)
Min. disch. (m³) 0 at 300 m above barrier(10/10/85 & 25/08/87 Tutty and Burns). However scattered pools remain and reach 4 is wetted by standing water. Less than 1 litre/sec groundwater fed pools below barrier with high coho and trout rearing densities during summer.
.000112 cms at 270m (8/25/87).
.000305 cms at 270 m (9/2/98)

QUAMICHAN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m2) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|------------------|
| Reach 1 | 5.0 | 1 | 1000 | .01 | OC | L | 134 | 134 |
| Reach 2 | 6.0 | 2 | 271R | .5 | CON | N | 234 | 468 |
| Reach 3 | 5.0 | 0 | 271R | 1.5 | CON | N | 82 | 0 |
| Reach 4 | 15.0 | 0 | 9100 | .01 | FC | N | 100 | 0 |
| Reach 5 | 5.0 | 0 | 243R | 1.0 | FC | N | 980 | 300 |
| Reach 6 | 40.0 | 3 | 9100 | .001 | UC | H | 100 | 300 |
| Total | | | | | | | 1730 | 1202 |

QUAMICHAN LAKE

| Area (ha) | Elevation (m) | Approx. Volume(m3) | Max. Depth (m) | Total Dissolved Solids (TDS) (mg/L) |
|-----------|---------------|--------------------|----------------|-------------------------------------|
| 310 | 26 | 14,848,873 | 8 | 60-284 |

B) FISH UTILIZATION AND LIMITING FACTORS

OMU 3: Somenos Basin
T. Burns and B.D. Tutty, 1999

During summer, the first 300 m of Quamichan Creek downstream of the 2.3 m. barrier falls supports cutthroats and coho in groundwater fed pools with summer discharge of much less than 1 litre/sec. An occasional brown trout is also reported as were pumpkinseeds in the summer of 1998. Dissolved oxygen was 8.0 ppm. on 25/8/87.

Quamichan Lake cutthroats are known to spawn in sections of Reaches 4 and 5. Lake resident rainbow may also spawn there. Resident trout also spawn in an inlet stream in very small numbers.

Anadromous cutthroat and coho production is strongly limited by low summer discharge, and the short accessible length. The creek becomes nearly intermittent by late May in most years.

This system is a candidate for summer fry salvage. A Cowichan Tribes E Team salvaged 300 coho and a brown trout from Reach 2 in the summer of 1998. Progeny of Quamichan Lake cutthroats also become stranded in drying pools.

Resident spawners are limited by small areas of suitable gravel.

Chum salmon also spawn in reach 2 of Quamichan Creek; particularly in high escapement years and the occasional steelhead is reported.

Quamichan Lake supports cutthroat and rainbow trout colonized coho (1987) and sticklebacks, sculpins and brown bullhead. On 25/08/87 surface temperature was 22°C and dissolved oxygen 8.5 ppm.

MOE, Fisheries Branch stock cutthroat trout annually into Quamichan Lake which support early spring and late fall trout fisheries.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION**: Quamichan Lake is the largest lake in the Cowichan watershed inaccessible to anadromous fish. **As part of a co-operative experiment in 1987, the Fisheries Research branch introduced 60,000 coho fry (Production Option #1)** into the lake to determine if increased coho salmon production can be realized (contact R. Bams, Pacific Biological Station). Similar experiments in 1985 and 1986 in Grant Lake and Kelvin Creek (Koksilah drainage) and in Bings Creek in the Somenos Watershed have proven successful, (Burns et al, 1987). The experiment needs to continue. There was a problem with smolts getting out of the lake because the lake level dropped below the level of the outlet early and it may also be difficult for the fish to find the outlet because it is very indistinct and does't draw much flow during most springs. There is a need to further review the results of the colonization program in Quamichan, relate it to other coho lake stocking program results and design a updated program for Quamichan. Base on the bio –standard of .15 fry /m², the fry requirement would be 465,000 which seems high especially since the lake has a valuable cutthroat trout population.

2. **OUTLET CONTROL**: A low level weir near the outlet of Quamichan Lake (Production Option #2) combined with cutting an improved outlet channel from the weir to the lake would provide:

- a) Increased spring release flows extending into the early summer. Through regulation of the weir, enhanced coho smolt emigration to sea may result. If the coho colonization program benefits are significant, it may be considered as part of the permanent enhancement strategy. The weir should provide an option to siphon the lake.
- b) The weir may also reduce CDP flows in Quamichan Creek and increase its rearing capacity.

NOTE: Allowance for adult and fry passage will be required at the weir

3. **WATER CONSERVATION**: Restrict further consumptive water use unless storage is possible (Production Option # 3)

4. IMPROVE CUTTHROAT RECRUITMENT: Gravel improvement to Quamichan Creek above the falls (Production Option #4) would increase cutthroat recruitment to Quamichan Lake. A backfilled dam at a property at 15805 Jaynes Rd. is a primary spawning area. A 70m² area near its head supports at least 30% of Quamichan Lake's cutthroat spawners. Its gravel needs cleaning and addition of new (Production Option # 3). At least 3 m³ of 2 – 5 cm washed drain rock needs to be added to the site already started (summer 1996) on the Jaynes Rd. property. The spawning platform was going to be mitigation for a land development proposal (Dennis James – Sutton) that was turned down by North Cowichan because of neighbourhood opposition to increased density (senior's housing to replace a single family dwelling). The property owner agreed to some cleaning and addition of new material before the proposal went to council; he is still in agreement with the proposal.

5. RIPARIAN AND WATER QUALITY IMPROVEMENT: Fencing is required on the Van Boven Farm. Stock use the creek as a toilet and linear water hole. Riparian planting should accompany fencing. When flow begins in the fall, the first water is liquid manure from the summer's accumulation in the channel (Production Option #5)

6. LWD ADDITION: Install cross log/windfall log at 135 m point of R2 to increase cover and depth. Observe for one year then continue complexing R2 if appropriate (Production Option # 6)

D) LAND USE FACTORS

Agriculture - Extensive clearing and drainage. At least 40 percent of the basin has been modified for agricultural use.

Residential - Considerable development along the east side of Quamichan Lake (above and below Maple Bay Rd.) and along Lakes Road on the west side.

Risk Potential

Moderate. Quamichan Lake water quality has been enriched considerably. Total dissolved solids increased from 60 MG/L in 1957 to 284 in 1973 (Willis, Cunliffe and Tait, 1974). The lake is highly responsive to eutrophication due to its small catchment area (11 km²), low flushing rate and shallow nature (mean depth 4.8 m). Algae and rooted aquatic plants have increased markedly and limited summer fish kills have been reported. Of Quamichan Lake's eleven inlets, five are polluted by barnyard and pasture run-off. This is reflected in Quamichan Creek which is also impacted by manure runoff from Van Boven's Farm and from Van Boven cattle having free access to the creek

E) PROTECTION NEEDS

Protecting Quamichan Creek and Lake involves nearly all aspects of life in the basin - much more than a protective corridor is involved. Agricultural impacts need to be directly addressed because of nutrient input. A survey of all basin farms could be undertaken to establish waste management needs. The area below Maple Bay Road north of the Garth is still on septic tanks. Is this contributing to Quamichan Lake eutrophication?

For the interim, the shorezone of Quamichan Lake (almost entirely Class 1 with extensive riparian and shallow development but highly intruded) is a high priority. The Quamichan Creek FSZ is also very high priority. It consists of riparian landscape units at the outlet of Quamichan Lake – Reach 6- and at the confluence with Somenos Creek – Reach 1. For most of the rest of the creek, adjacent landscape units are primarily upland and the FSZ is relatively narrow. It is somewhat intruded by urban and agricultural development. There is a strong need to acquire more greenspace/public land in the Quamichan Basin particularly in the Quamichan Lake shorezone, the Quamichan Creek Corridor and on the flanks of Mt. Tzoulaem including the area below Maple Bay Rd. This area is one of the most attractive and ecologically rich components of the Dry Douglas Fir Ecozone and it has been highly intruded.

Fishery Officer Narrative

Stream Code: 9202577057

Stream Name: Somenos Creek

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

- A) **BIOPHYSICAL OVERVIEW:** Enters the Lower Cowichan near the confluence of Quamichan Creek after picking up Fish Gut Alley. A very low gradient stream draining Somenos Basin, a large and complex watershed with wide variation in topography and land use patterns. Cowichan River backfloods the creek and adjacent riparian floodplains extensively. The Somenos Creek floodplain/riparian zone is over 900 m wide in places and is generally at least 200 m wide. The eastern neighbourhoods of Duncan cover much of the combined Lower Cowichan – Somenos floodplain.

| | |
|----------------------------------|---|
| <u>Air Photos</u> | BC 82007 142-143 |
| <u>Topographic Map</u> | 92 B/13, 92B.072, 92B.082 |
| <u>Obstructions</u> | None |
| <u>Salmonids</u> | Co to 3020 m (migrants and seasonal residents). Ct to 3020 m (migrants and seasonal residents) Bt to 3020 m (migrants and seasonal residents) |
| <u>Max. Temp. (C°)</u> | 17 (87/08/25) at Tzouhalem Road. 12 (9/4/85) at Lakes Road. 24 (7/30/97) at lake outlet 23 (7/30/97) at 660 m 22 (7/30/97) at 1660 m 24.5 (7/29/98 at Beverly Street Foot Bridge) 22 (7/29/98 Pumping Station Ditch – this ditch which originates from the Chesterfield Park wetland is a cooler water refuge for Somenos fish during the summer months) |
| <u>Min. Disch(m³)</u> | 0 - cross section of stream remains with standing water. Streamflow is present below Fishgut Alley and consists of background flow from this important Cowichan River Sidechannel and Vancouver Island Hatchery effluent along with minimal residual flow from Somenos Creek. Fishgut Alley enters Somenos Creek at 189 m. |

SOMENOS CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|--------------|-------------------|------------------|-----------|--------|---------------------|--------------|-------------|-------------------------------|
| Reach 1 | 20 | 17 | 9100 | .001 | OC | M | 688 | 11696 |
| Reach 2 | 19 | 17 | 1000 | .001 | OC | L | 2332 | 39644 |
| TOTAL | | | | | | | 3020 | 51340 |

SOMENOS LAKE

| Area (ha) | Elevation (m) | Approx. Volume(m ³) | Max. Depth (m) | Total Dissolved Solids (TDS) (mg/L) | Max Surface Temp. |
|-----------|---------------|---------------------------------|----------------|-------------------------------------|-------------------|
| 98 | 4 | 4,112,960 | 7.8 | 65 | 32.3 (7/29/98) |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, brown trout and sea-run cutthroat pass through Somenos Creek enroute to Bings, Averill and Richards Creek. A few Bings Creek steelhead may also migrate through along with a few chums bound for all three tributaries.

Production has been hindered by high summer temperatures in the upper 2800 m although 1983 channel dredging is believed to have improved groundwater upwelling for several years. See Agriculture Section. Somenos Lake and Creek supported a significant population of summer juvenile coho in 1986 and 1987. Somenos Lake supports resident cutthroat, rainbow and brown bullhead; some brown trout may also be present. Sticklebacks are very abundant. Pumpkinseeds reported in 1997. Fish, particularly coho, become stranded in pockets of Somenos Marsh as water levels fall in the spring. In some years, smolt mortality is significant.

It is very doubtful if Somenos Lake can carry salmonids through the summer in most years. An August 11, 1998 survey revealed that epilimnion temperature is in the 22-24° range and that the epilimnion extends to the bottom in most areas of the lake. Where the metalimnion and hypolimnion are present, oxygen levels are dangerously low.

C) PRODUCTION OPPORTUNITIES

1. SOMENOS LAKE AERATION: Somenos Lake (98 ha) has a coho fry carrying capacity of 147,000 at .15 fry per m². It is subject to occasional fish kills due to low oxygen levels. Such a kill occurred Sept. 3 and 4, 1989. Since it cannot reliably support salmonids through the summer due mainly to low oxygen levels in places where the temperature is favourable, an aeration experiment should be considered to oxygenate the water column in selected areas where depth is sufficient for a thermocline. (Production Option #7)

2. SOMENOS CREEK VEGETATION MANGEMENT, SHADE ESTABLISHMENT: Somenos Creek is now largely uninhabitable for salmonids in the summer months due to temperature and oxygen constraints. Part of this is due to very low flows and lack of flushing which is partly caused by vegetation clogging the channel. The primary reason for the abundance of reed canary grass, sedges, iris, smartweed and other aggressive aquatic vegetation is an abundance of light which also influences summer temperature. If a more complete canopy could be established via the presence of taller trees than the present red osier - willow shrub forest, shading and reduction of instream vegetation could be accomplished. Under present conditions, less than 10% of the stream is shaded. Improvements to upstream agriculture would also result. An experimental planting of cottonwood or hybrid poplar along with Pacific Willow is recommended for a portion of the west side of lower Reach 2. A slight berm may have to be constructed to encourage growth (Production Option #8).

3. SOMENOS CREEK SUMMER REFUGE IMPROVEMENT- CHESTERFIELD WETLAND AND CREEK: A ditch (Chesterfield Creek) that enters Somenos Creek at the 362 m point of R2 (1050 point overall) serves as a summer refuge for coho, cutthroats, sculpins and sticklebacks despite the fact that its temperature and oxygen levels become extremely marginal. Approximately 100 fish spent the summer and early fall of 1998 in the small pool just below Lakes Road despite temperatures of plus 20 degrees (20.2 and as high as 22 °) and oxygen levels of less than 1 mg/L - .88 (Somenos Creek temperatures were plus 24 degrees with almost nil oxygen). The pool at Lakes Road could be enlarged and deepened and the wetland complex behind Chesterfield Park (old BCFS Koksilah nursery property) could be further tapped to produce more flow. A man made pond is present but summer inflow is minimal and upstream excavation could provide more and cooler water. Winter inflow to the wetland (Nov. – March) averages about .098 CMS at 12.5°. Summer flows are the inlet end are unknown but are nil at Lakes Road some 50 m downstream. This habitat unit should receive considerable more study especially in terms of its potential water yield. Fish passage between Lakes Road and the wetland complex may be a problem as could fish survival during the pumping process (Production Option # 9).

4. SOMENOS CREEK SUMMER REFUGE ESTABLISHMENT – FUN PACIFIC: A 160 m long man made stream and a 125 m² are present on the Fun Pacific property in the Beverly St. area of Somenos Marsh. The pond and stream channel were created in 1991 – 92 during construction of the Fun Pacific mini-golf course. Groundwater was exposed and channeled to an existing ditch that runs from the Island Highway to the east end of York Road extension. The existing channel is too shallow (av. depth less than 10 cm.) to support salmonids but it could be deepened and instream cover and streamside canopy could be added to create a summer refuge situation for Somenos Creek salmonids. In addition, another groundwater ditch is present just 22 m west of the Fun Pacific headwater pond. It could be diverted into the pond to increase flow. April 1, 1999 flow in the Fun Pacific stream was 4.1 LPS. Flow in the adjacent ditch was 16.6 LPS. Temperature in the stream was 14.5; ditch temperature was 12.8. Adjacent surface water temperatures were 6 to 7.5. (Production Option # 10)

More research is needed to determine the viability of this option: mid – summer oxygen, temperature and streamflow data is required.

D) LAND USE FACTORS

Agriculture

Somenos Lake/Creek lowlands are intensively farmed. The stream was channelled to fisheries specifications in 1983 to hasten spring de-watering of surrounding agricultural lands around Somenos Lake and upstream adjacent to the 6000 m ditched Richards Creek (Reach 1) below Richards Trail. Mitigation for this activity was located in Reach 2 of Richards Creek on the Valley View Farm.

Residential

Uplands east of Somenos Creek and lowlands west of Lakes Road are major residential areas. Duncan sewage lagoons occupy approximately 12 ha of lowland west of Lower Somenos Creek and discharge into Cowichan River. Residential development in the

Beverly St. /Lakes Rd./ Trunk Road area is located on floodplain – riparian lands that are part of the Cowichan River – Somenos Creek Fisheries Sensitive Zone. In fact, there is very little of Duncan /North Cowichan east of Hospital Hill that isn't located on riparian lowland.

Risk Potential

High due to high oxygen demand stimulated during low summer flow period and high biological activity.

WATER QUALITY AND CHANNEL DATA (7/30/97 SOMENOS MARSH SOCIETY USHP PROJECT)

| SITE | 1 | 2 | 3 |
|-------------------|-------------|---------------|--------------------|
| Location (m) | 660 | 1660 | Lake outlet (3020) |
| Air. Temp. | 22 | 27 | 26 |
| Water temp. | 23 | 22 | 24 |
| Wetted width | 18 | 7 | 8 |
| Wetted depth | 1.53 | 1.5 | 1.1 |
| Bankfull width | 28 | 9 | 11 |
| Bankfull depth | 2.5 | 2 | 2.3 |
| PH | 9.7 | 7.7 | 8.2 |
| Oxygen (mg/L) | 13 | 1 | 4 |
| Turbidity (JTU) | 2 | 20 | 3.5 |
| Canopy | 0 | 0 | 0 |
| LWD | 0 | 0 | 0 |
| Bank stability | Excellent | Excellent | Excellent |
| Riparian | Reeds | Willow, reeds | Willow, reeds |
| Velocity | 0 | 0 | 0 |
| Adjacent land use | Residential | Farm, urban | Marsh, urban |

E) PROTECTION NEEDS

Somenos Lake and Creek have a very extensive Riparian Zone. Parts of it are farmed, largely for forage crops. Very large sections have been lost to developments of very low reversibility: urban uses such as stores and parking lots. Witness the continuing alienation of riparian lands in the Beverly Street area. These uses are entirely incompatible with the high resource values of Somenos Riparian Lands. Of the remaining lands adjacent to Somenos Creek, those in most need of immediate attention are the Chesterfield Creek Wetland and adjacent undeveloped lands. Because of the summer refuge value of water in the creek and wetland complex and the ongoing development aspirations of Chesterfield Park Society, a management plan for this area is a very high priority. The Chesterfield Creek Wetland is the last remnant of the wet woodland component of Somenos Marsh outside Cowichan Tribal Lands.

Stream Code: 920 2577 057 806 565 000

Stream Name: Richards Creek and Crofton Reservoir

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: Richards Creek enters the northeast end of Somenos Lake. It drains Mt. Richards and Maple Mtn. then enters a broad lowland basin before entering Somenos Lake. Its primary flow source is Crofton Lake, a reservoir administered by North Cowichan but numerous springs augment low flow and moderate summer temperature. Flow from Crofton Lake is provided by a 5 cm pipe which discharges into the creek 60 m below the lake. Flow starts out as 22 degree water in July and August then moderates as springs enter

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 142-143 |
| <u>Topographic Map</u> | 92 B/13, 92B.082 |
| <u>Obstructions</u> | A Series of falls begin at 6217 m: 2R3 at 6217, 3R4 at 6231, 2R at 6264 , 3R4 at 6315 and 8R at 6342. |
| <u>Salmonids</u> | (accessible length) Co to 6217m (1,180 m summer productive below obst.) Ct to 6217m (1,180 m summer productive below obst.) Occ. St to 6217)1180 m summer productive below obstruction) Occ. Cm to about 5800 m Ct throughout but more common below the falls. The upstream population is sparse. |
| <u>Max. Temp. (C°)</u> | 20 at Richards Trail culvert (7/8/98) 16.9 410 m above Richards Trail (R2) (7/8/98) |
| <u>Min. disch. (m³)</u> | .0166 m ³ (25/08/87) at Richards Trail .0069 (8/15/98 R6) |
| <u>Dissolved oxygen</u> | 2.0 mg/l (25/08/87) at Herd Road (16° water temp.) 0.40 mg/l (11/08/98) atHerd Rd. (16.8-18.4° water temp.) 9-11 mg/l R's 6-9 (8/15/98) |
| <u>TDS</u> | 18-19 R's 6-9 (8/15/98) |
| <u>PH</u> | 7.36 R's 6-9 (8/15/98) |

RICHARDS CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m2) |
|--------------|-------------------|------------------|-----------|--------|---------------------|--------------|--------------|------------------|
| Reach 1 | 18.0 | 8.0 | 9100 | .001 | UC | H | 4827 | 38,616 |
| Reach 2 | 5.0 | 2.0 | 1540 | 1.0 | FC | L | 1180 | 2,360 |
| Reach 3 | 4.0 | 2.0 | 1270 | 2.3 | CON | N | 82 | 164 |
| Reach 4 | 4.0 | 2.0 | 1162 | 5.0 | ENT | N | 282 | 564 |
| Reach 5 | 3.0 | 2.0 | 1351 | 2.5 | CON | N | 310 | 620 |
| Reach 6 | 3.0 | 2.0 | 6310 | 0.5 | FC | L | 804 | 1608 |
| Reach 7 | 2.0 | 1.0 | 1351 | 3.0 | CON | N | 151 | 151 |
| Reach 8 | 3.0 | 1.0 | 4510 | 1.0 | FC | L | 215 | 215 |
| Reach 9 | 3.0 | 2.0 | 262R | 2.5 | CON | N | 460 | 920 |
| Reach 10 | 3.0 | 2.0 | 1810 | 1.5 | FC | N | 304 | 608 |
| Reach 11 | 3.0 | 2.0 | 3412 | 2.0 | CON | N | 85 | 170 |
| Reach 12 | 3.0 | 2.0 | 3412 | 3.0 | CON | N | 438 | 876 |
| Reach 13 | 3.0 | 1.0 | 7300 | 2.0 | OC | N | 585 | 585 |
| Reach 14 | 2.0 | 1.0 | 6310 | 1.0 | CON | N | 238 | 238 |
| Reach 15 | 3.0 | 0 | 1261 | 5.0 | CON | N | 131 | 0 |
| Total | | | | | | | 10092 | 47696 |

CROFTON RESERVOIR

| Area (ha) | Elevation (m) | Approx. Volume(m3) | Max. Depth (m) | Total Dissolved Solids (TDS) (mg/L) |
|--------------|------------------|-----------------------|-------------------|---|
| 16 | 138 | unknown | unknown | unknown |

B) FISH UTILIZATION AND LIMITING FACTORS

Richards Creek supports coho and cutthroat trout; some trout are anadromous. A few chum salmon are occasionally reported above Richards Trail. Steelhead / rainbow are also said to be present in small numbers.

Production is concentrated in Reach 2 within the small amount of reasonable spawning and rearing habitat (2,360 m²) between the falls and the ditched zone downstream of Richards Trail. Coho fry densities are very high due to swim-ups from Somenos Lake in the spring to escape deteriorating water quality in the lake. As many as 15 fry/m² have been observed in Reach 2.

Water licenses: Stream is fully recorded.

Reach 1 of Richards Creek is very low in summer oxygen and there is generally nil flow (standing water). However, during heavy irrigation demand, Richards Creek R1 reverses flow very noticeably as pumps pull the water upstream to the central part of Reach 1. This phenomenon was observed on many occasions at the Herd Road Bridge in the summer of 1998 which was exceptionally warm and dry.

B) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION : CROFTON RESERVOIR AND BREEN LAKE – Crofton Reservoir is a potential coho colonization site. The impoundment has a surface area of approximately 16 ha. At .15 coho fry/m², the reservoir's potential smolt yield is 1920. If Breen Lake is impounded and stocked, an additional yield of 720 smolts could result (Production Option # 11). It is likely that Breen Lake would have to be stocked in the fall to avoid marginal summer conditions. The same may apply to Crofton Lake.

2. HEADWATER STORAGE – CDP FLOW AUGMENTATION: Breen Lake, a mature wetland at the headwaters of Crofton Lake's inlet has an existing 2.5 m dam at its outlet. This dam is very old and its spillway is in disrepair. The wetland is capable of storing at least 168,000 m³ of water which could yield 7.65 LPS for the 180 day critical discharge period and increase Crofton Lake's useable storage and allow additional spill form Crofton Lake (**Production Option #12**). A new spillway would have to be constructed as well as a flow control structure. Additional flow might improve summer oxygen levels in Reach 1 and make it more habitable. More CDP inflow to Crofton Lake might improve water quality in the lake which is a chronic summer problem. More summer release from Crofton lake would also be possible and the feasibility of installing a larger diameter pipe at a lower level should be investigated. The current discharge pipe draws water from above the thermocline which ranges up to 24°. Downstream groundwater input in Reaches 13 and 14 and below cool present flow but it is still a concern in very warm summers. It may be more difficult for groundwater seepage to cool increased flow from the lake's epilimnion so a deeper summer outlet should be investigated.

3 RIPARIAN MAINTENANCE AND IMPROVEMENT: Instream enhancement in 1983 above Richards Trail on the Valley View Farm property (Vaneuwn) was mitigation for channelizing lower Richards Creek (see Section D – Agriculture). Maintenance of these mitigation works was not being undertaken by Mr. Vaneuwn in 1987 (memo-Tutty to Field 01/09/87). As of July, 1998, most of the cribbing work was still in place but the fencing is in need of repair in places. The riparian setback also needs to be increased somewhat because its generally too narrow to allow development of healthy riparian vegetation (Production Option #13).

4. COHO COLONIZATION –UPPER RICHARDS CREEK: Richards Creek above barrier base flow wetted area = 5991 m² (0.5 to 3.0 % gradient). Coho smolt yield potential: 400 to 2000 smolts. Fry required : 5,000 (Production Option #14).

D) LAND USE FACTORS

Agriculture

The lowland portion of the basin has been totally modified to accommodate crops, grazing and forage production. Habitat compensation in Reach 2 for ditching Somenos and Richards Creek (Reach 1 was undertaken in 1983 by farm fencing, bank restoration, and off-stream cattle watering above Richards Trail (B.D. Tutty - DFO and G. Reid - MOE). Maintenance of cattle fencing by land owner is essential for mitigation plan to work. Observations in 1998 indicate the timber cribbing portion of the compensation is still functioning well but the fencing portion is badly in need of maintenance. The ditched length of Richards Creek extending from Somenos Lake to a point 35 m below Richards Trail has insufficient dissolved oxygen to support fish life during the summer period. Dissolved oxygen at the Herd Road bridge measured 2.0 ppm on 25/08/87 and .04 ppm 8/15/98.

Forestry - Uplands are covered by advanced second growth. Considerable second growth logging adjacent to upper reaches in North Cowichan Municipal Forest.

Risk Potential - Low. Residential expansion into the narrow upland valley could pose future problems.

Notes

Coho Escapement

| | |
|------|------|
| 1990 | 1201 |
| 1991 | 393 |
| 1992 | 124 |
| 1993 | 246 |
| 1994 | 446 |
| 1995 | 372 |
| 1996 | 97 |
| 1997 | 476 |
| 1998 | 746 |
| 1999 | |
| 2000 | |

E) PROTECTION NEEDS

There is a very extensive riparian area adjacent to Reach 1 (which has been divided into 1A and 1B for USHP data analysis). In its natural state, it is largely a red osier – willow shrub forest. However, much of the natural riparian zone has been cleared for agriculture and is now seasonally flooded vegetable or hay fields. In some areas in Reach 1B, the riparian zone is over 600 m wide but there is no more than a fringe of native riparian vegetation along much of it. Most of the channel has been ditched throughout Reach 1. There is a need to return some of this area to a more natural

condition (which has been recommended as an enhancement measure). No further ditching or riparian destruction should be permitted.

Reaches 2 and 3 also feature riparian landscape units, important springs and areas of steep adjacent slopes; these are included in the FSZ.

The FSZ narrows through Reaches 4 and 5 where it averages about 30 m on either side of the stream which flows largely through upland landscape units with a narrow riparian zone which is only a fringe in many areas. Reach 6 features an extensive riparian zone which is over 100 m wide in places, much of it has been cleared. The FSZ narrows to about 20 – 40 m on either side of the creek through Reach 7 although there are broader areas where the riparian zone widens through this is a mainly upland reach. Reach 8 is an upland reach with a narrow FSZ ranging from 20 – 50 m on both sides of the creek but Reach 9 features a narrow riparian band some 15 to 30 m wide on either side of the stream although it widens toward the upper end of the reach. Reach 10 features a broader riparian zone some 50 – 100 m wide. The FSZ narrows again through Reaches 11 and 12 which traverse stable upland landscape units with stable slopes ranging from 12 – 50 %.

Reaches 13 and 14 have wider riparian components and lesser slopes. Reach 15 is bordered by stable upland with gentle slopes except for a segment on the west slope near the upper end of the reach. Reach 15 is summer dry and is the spillway reach between the Crofton lake Spillway and the discharge pipe.

Stream Code: 920 2577 057 806 000

Stream Name: Averill Creek

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) BIOPHYSICAL OVERVIEW: Averill Creek is 5.3 km long and drains the southeast slope of Mt. Prevost; enters Somenos Lake from the West. It is a complex system consisting of two major forks: the mainstem which has its primary origins in several wetland basins near the Island Highway in the vicinity of North Cowichan's Municipal offices and the West Fork which originates on the southwest shoulder of Mt. Prevost and drains southeast through Duncan Lakes Golf Course to enter Averill 2.55 km above Somenos Lake. Important tributaries are Fairview and Herd Creeks which supply Averill's CDP flow, the East Fork and Prevost Creek.

Air Photos BC 82007 142-143
Topographic Map 92 B/13, 92B.072, 92B.082
Salmonids (Accessible length)
Co to .560 m.
Ct.to 1,500 m.
Cm to 560 m.

Obstructions 2.3 m over 6 m at 560 m other minor cascades located immediately upstream.
West Fork: 3 m culvert @ Somenos Rd.(569 m), Pink House Falls: 2R4 @ 1000m, 2R @ 1005 m and 1R2 @ 1015 m. 3R @ 1433 m below Main Pond, an impoundment on the golf course.

Max. Temp. (? C) 19 (8/9/85 R2)
21.9 (7/29/98 R2)
26 (7/29/98 Upper R1 @ below Island Highway culvert)
26.9 (8/11/98 Upper R1 below Island Highway Culvert)
Fairview Creek 20.4 (9/7/98)
Herd Creek 18.4 (9/7/98)

Min. disch. (m³) 0.0022 m³ (8/9/85) E & N culvert. Intermittent upstream of 2,000 meters after July in most years.
Herd Creek .0011 (9/1/96)
Fairview Creek .00121 (9/7/98)

DO .07 (R1 just below Highway culvert 8/11/98)
6.65 (R1 just above E+N culvert 8/11/98)

AVERILL CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 6.0 | 3.0 | 8200 | 0.1 | OC | L | 570 | 1710 |
| Reach 2 | 10.0 | 4.0 | 370R | 0.5 | FC | M | 180 | 720 |
| Reach 3 | 8.0 | 7.0 | 1117 | 2.0 | CON | N | 300 | 2100 |
| Reach 4 | 5.0 | 3.0 | 4231 | 1.0 | CON | N | 1600 | 4800 |
| Reach 5 | 3.0 | .5 | 4330 | .5 | CON | N | 800 | 400 |
| Reach 6 | 3.0 | 1.5 | 370R | 0.5 | CON | N | 500 | 750 |
| Reach 4 | 3.0 | 0 | 2710 | 1.5 | CON | N | 1200 | 0 |
| | | | | | | | 5150 | 10510 |

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat trout, coho and chum salmon utilize the lower 750 m. However, only 150 m of this section has quality spawning and rearing habitat. Numbers are low for all species. Unlike Bings and Richards Creeks, Averill does not get a large swim – up population of coho fry from Somenos Lake. It is thought that the E and N culvert is a velocity barrier to upstream movement. Base flow velocity in the 41 m concrete box structure with a V in the centre is 1.55 MPS. Coho fry were attempting to navigate it on July 29, 1998. They were able to penetrate 20 m into

the culvert because velocity is somewhat less in the lower section. I tried to chase them upstream and they were able to swim approximately 3 m before they tired and turned back. I returned 1 hour later and they were still in the same place holding below a rock that had washed into the culvert. Somenos Lake surface temperature was 32.3 ° and the creek temperature just below the culvert was 26 °. The Island Highway culvert is also problematical. This 24 m concrete box structure features very shallow water at base flows: 1 – 2 cm and fish may be reluctant to swim through it during low flows.

Production is further limited by very low summer flow. The system dries early above 2,000 m where only isolated pools persist from July through September.

C) PRODUCTION OPPORTUNITIES

1. **SUBSTRATE IMPROVEMENT:** It should be possible to improve a 100 m section between the falls and E & N culvert by **gravel restoration (Production Option #15)**. Streamside fencing would also be beneficial. The object is to provide at least one section of quality below barrier spawning habitat in an accessible location so it can be maintained on an annual basis and there would be reasonable coho and chum egg survival in this stream of present low quality substrate particularly in its lower reaches. Averill Creek substrate quality has suffered greatly from upstream development. This project would involve the addition of at least 5 m³ of washed 2-5 cm gravel (drain rock).

2. **BARRIER IMPROVEMENT- ADULT PASSAGE:** The falls could be made passable (**Production Option #16**) but little coho or trout rearing benefit would result due to lack of quality upstream summer habitat. However, headwater storage could alleviate that. There is a small 35 m long bypass channel on the south side of the falls that only carries water in peak flows. At discharge levels of .6 – 1.0 CMS, the channel only flows at about 1LPS. The creek usually only attains this discharge two or three times per winter. The channel needs to be deepened at least 20 cm at its inlet along with widening and deepening at selected spots and two resting pools need to be constructed near its lower end. It is also possible that a small deflector will be necessary above the falls to guarantee sustained flow during the migration period. When the falls are made passable and summer flow increases, it may be advisable to replace the Somenos Road culvert on the West Fork which is a barrier.

3. **COHO COLONIZATION WITHOUT HEADWATER STORAGE:** Nine ponds with a total surface area of 22,500 square metres are present on the West Fork on Duncan Lake's Golf Course. With minor modifications in outlet controls, storage regime and channel structure in outlet streams, these could produce coho smolts from **stocked fall fry**. Fry required: 3375. Estimated smolt yield @ 15% survival: 506 (**Production Option #17**).

4. **BARRIER IMPROVEMENT – FRY PASSAGE:** Placement of baffles or small weirs in the E and N culvert would allow for season I fry/parr passage from Somenos Lake to the most habitable portion of Averill Creek. It may also be advisable to do the same in the highway culvert. Baffles should be placed 2 – 3m apart and consist of the stone set type at 90degree angles. Purpose of the baffles is to deepen and slow the water while not speeding flow near the baffles (Production Option # 18.).

5. **HEADWATER STORAGE:** Because nearly 80% of the mainstem of Averill Creek is summer dry or highly intermittent but is otherwise habitable for salmonids, provision of CDP flow is a primary improvement need. Five wetland basins (Muni, Fry, Alligator, Deer Heaven and Deer City) have a combined storage area of 19.29 ha and ,with 1 m of storage, a 180 day discharge yield of 8.723 LPS (Production Option #19).

6. **COHO COLONIZATION WITH STORAGE AND CDP FLOW:** Available above barrier habitat: 7900 m² , potential smolt yield @ 1 fry/m² and 8% survival: 632. Coho colonization should not be necessary for very long after the falls is made passable but will probably need to be kept up for at least one generation because coho escapement is presently very low (5 – 10) fish in the 1990's. If the headwater wetlands could support fall fry, another 2315 smolts could result (Production Option #20).

7. **ADDITIONAL FLOW AUGMENTATION:** The Crofton Pulp Mill water pipeline passes very close to the Averill headwater wetlands (Deer Heaven and Deer City). The possibility of drawing some water from this source to augment storage should be investigated (Production Option #21).

8. **RIPARIAN RESTORATION:** An area of upper R5 extending from from 1210 – 1335 m on both banks requires treatment as does considerable tributary area in particular the East Fork from Municipal Wetland, a 600 m long stream that flows largely through pasture with denuded banks which are eroding in many places. Its channel is becoming clogged with spike rush and canary grass due to lack of canopy. (Production Option #22)

9. **GROUNDWATER DEVELOPMENT – HERD CREEK, EAST FORK, SNOWBERRY CREEK :** Sloped riparian wetlands and springs near the heads of Herd and Snowberry Creeks on Upper Drinkwater Road are the primary summer headwaters of Averill Creek but flows are very low (base flow 1-2 LPS). A headwater aquifer below North Road on the Mayer Property as well as the springs along Upper Drinkwater may support wells that could provide additional high quality water Existing well logs should be examined and a test drill should be conducted in the summer of 1999. The East Fork flows from Municipal Wetland to join Averill Creek in Reach 5 . There are at least 3 springs on the adjacent Hayhoe Property that appear capable of yielding more summer flow. Winter flow in the main spring was measured 1/14/98 at 1.615 LPS @ 8.9°. This spring flows all summer and is largely responsible for the puddles in Averill Creek between Herd Creek confluence and the East

Fork confluence. Test drills should be conducted in the summer of 1999 and if the well proves out, well heads installed in the fall of 1999 (Production Option # 23).

10. **POND STOCKING**: At least nine ponds with a total surface area of 22,500 m² are present on the West Fork on Duncan Lakes Golf Course. With minor modifications in outlet controls, storage regime and channel structure in outlet streams, these could produce coho smolts from stocked fall fry. Fry required 3375. Smolt yield @ 15% : 506 (**Production Option # 24**)

D) LAND USE FACTORS

Agriculture

Intensive use of most of the basin below the 100 m contour has caused chronic degradation: sedimentation, bank damage, cover removal and pollution from barnyard runoff.

Residential

The area below the 100 m contour is about 10 percent urbanized and residential expansion is becoming rapid (1994). Duncan Lakes Golf Course was constructed in 1990. It covers a major portion of the West Fork Basin.

Risk Potential

High.

Fishery Officer Narrative

E) PROTECTION NEEDS

Averill Creek's Fisheries Sensitive Zone has extensive riparian components many of which have been converted to pasture. The largest riparian component is Somenos Marsh which has a significant inland extension on Averill Creek above the highway – E and N right of way. After the marsh segment, Averill enters a semi – enclosed ravine with steep silt-clay walls in for considerable length, there has been some residential intrusion into the FSZ in this area and adjacent Fairview Creek. The ravine becomes increasingly shallow until it gives way to riparian area above Drinkwater Road. The remainder of the mainstem is largely adjacent to riparian landscape units up to the Fry Swamp - Powerline area. Above this point, the stream climbs up a ravine to its headwater wetland basins. The FSZ also covers tributaries (Fairview – highly intruded, Herd which features ravine and extensive intruded riparian and an important headwater aquifer zone below North road, the West Fork, Municipal Creek (East Fork) and Prevost Creek).

Stream Code: 920 2577 057 669 000

Stream Name: Bings Creek

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) **BIOPHYSICAL OVERVIEW:** Enters Somenos Lake from the west; drains the southeast shoulder of Mt. Prevost.

Air Photos BC 82007 142-144
Topographic Map 92 B/13, 92B.072, 92B.081, 92B.082
Watreshed Area 15.5 km²
Salmonids (Distance Upstream)
Co to 1,882 m.
Anadromous Ct to 1,882 m.
Cm to 1,882 m.
Ct to 5,500 m.
St to 1,882 m.
Bt Unknown but present above and below the falls. Fish above falls are introduced and are now resident while fish below are largely anadromous.

Obstructions

- 3.2 m falls at 1882 m (greatest vertical drop = 2m)
- 2R5 cascade at 1982 m
- 1.5 m falls at 2007 m
- 1.2 m dam at 2107 m
- 1.5 R4 cascade at 2342m
- CN culvert (50M) at 2347 m. Migration velocities over the 6.3 m long apron surpass 3 MPS at times and average 1.85 MPS at normal winter – spring flows. The culvert itself may also require baffles
- A series of three chutes (total vertical drop: 3 m) in a 25 m bedrock zone at 2494 m.
- 0.6 m vertical drop @ OLC Rd. culvert at 5865 m.

Max. Temp. (?C) 15 (8/9/85) Mary Rd. summer temperatures decrease to 9° at the summer headwaters (6,600m).
22 (7/29/98 – Upper R1 @ the Eand N crossing)
20.9 (7/29/98 – R2 at Mary Rd.)

Min. disch. (m³) 0.014 (7/23/70) Mary Road.
0.026 (8/9/85) Mary Road.
0.002 (8/20/85) 10 m above Cowichan Lk. Rd (above Menzies confluence). Upper Bings Creek below the Judge Farm was intermittent at times during August and September of 1987 due to withdrawal for irrigation.
.0259 (8/21/87 R4 at Agira Rd. fence site)
.0307 (R2 – 8/12/98 Mary Rd.)
.003 (R1 – 10/65)

Max. Disch. 14.8 (R1 @ Mary Rd. – 1/14/68)

DO (mg/L) .7 (R1 @ 6.9 m 8/15/98)
2.8 (R1 @ 75 m 8/15/98)
.025 (R1 @ beaver 90 m below Island Highway 8/11/98)
6.6 (R1 @ downstream side of E+N 8/11/98)
8.5 (R1 B @ Mary Rd. 8/11/98)

TDS 54.6 – 90 (R's 1 – 11 8-9/98)

PH 6.94 – 7.6 (R's 1-11 8-9/98)

BINGS CREEK

| Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|

| | | | | | | | | |
|----------|------|-----|------|------|-----|---|-----|------|
| Reach 1 | 6.0 | 4.0 | 1000 | 0.01 | UC | H | 540 | 2160 |
| Reach 1A | 11.0 | 4.0 | 9100 | .1 | CON | N | 39 | 156 |

| | | | | | | | | |
|----------|------|-----|------|-----|-----|---|------|---------|
| Reach 1B | 6.0 | 4.0 | 6400 | .5 | OC | M | 859 | 3436 |
| Reach 2 | 10.0 | 5.0 | 2620 | 1.5 | FC | M | 303 | 1515 |
| Reach 3 | 9.0 | 4.0 | 0127 | 4.0 | CON | N | 327 | 1308 |
| Reach 4 | 10.0 | 5.0 | 1540 | 1.5 | CON | N | 94 | 470 |
| Reach 5 | 7.0 | 5.0 | 1342 | 2.0 | CON | N | 72 | 360 |
| Reach 6 | 6.0 | 4.0 | 1540 | 2.0 | FC | L | 1836 | 7344 |
| Reach 7 | 5.0 | 2.0 | 2800 | 1.3 | FC | L | 692 | 1384 |
| Reach 8 | 4.0 | 2.0 | 1234 | 3.0 | CON | N | 157 | 314 |
| Reach 9 | 5.0 | 3.0 | 2800 | 1.0 | FC | L | 589 | 1767 |
| Reach 10 | 4.0 | 2.0 | 2350 | 1.5 | CON | N | 267 | 534 |
| Reach 11 | 4.0 | 2.0 | 2710 | 0.7 | FC | L | 1158 | 2316 |
| Reach 12 | 4.0 | 0 | 1450 | 2.5 | CON | N | | unknown |

B) FISH UTILIZATION AND LIMITING FACTORS

Bings Creek supports coho and chum salmon and cutthroat trout (residents, sea-run and Somenos Lake spawners). Brown trout have been introduced above the falls and an anadromous population is present up to the falls. Steelhead have also been reported. Some steelhead occasionally ascend the barriers and spawn in Upper Bings or Menzies Creeks. Several steelhead smolts were trapped in May, 1989.

Lower Bings Creek is noted for its large population of coho juveniles; some very large. Densities of 10 fry/m² have been observed and late summer fish as large as 30 cm have been recorded. It is suspected that some coho fry rear in Somenos Lake in the spring months then return to the creek in mid-summer when the lake warms. Some fish, particularly the large ones, return to Somenos Lake in winter. Somenos Lake often becomes summer anoxic. A major fish kill occurred in early Sept. of 1989. Many hundreds of young coho and trout moved into Bings Creek to avoid high temperatures (24 degrees plus) low oxygen (<1 ppm). Beavers sometimes dam Lower Bings and this could prevent upstream access in critical periods. A dam is presently located in Reach 1 just below the highway and should be removed (1998). This dam was first noted in 1994 but has been present for much longer than that. Another dam is present near the top of Reach 1B. Its removal is also necessary.

Introduced brown trout have established as a resident population above the falls. Migrant browns from Somenos Lake or the Lower Covichan are also present. Many of the larger browns (60 cm plus) are anadromous.

Anadromous salmonids are restricted to the lower 1882 m but only 1342 m are quality habitat.

Production is limited by summer flow. The system dries above the 100 m contour. Fortunately, habitat loss is not great because of increasing gradient and decreasing channel width above this point.

C) PRODUCTION OPPORTUNITIES

1. SUBSTRATE IMPROVEMENT: Substrate improvement and replacement in Reach 2 (**Production Option #25**) should increase recruitment. Somenos Lake (98 ha) has a coho fry carrying capacity of 147,000 at .15 fry per m². Bings, Richards and Averill Creeks contain less than 5,000 m² of quality spawning habitat. Like Averill, the object is provide at least one quality spawning site that can be easily maintained. **1998 Note:** Reach 2 has become much less stable since this recommendation was made in 1987. Fine bedload has increased and is much more mobile. This option is now a very low priority.

2. COHO COLONIZATION: Above barrier summer wetted area: 15,797 m². Fry required: 15797 (**Production Option #24**). Theoretical yield: 1263. Actual smolt yields ranged from 862 to 1,700. From 13,000 salvaged fry. If the barriers were made passable, upstream stocking would not be required (**Production Option #26**)

3. BARRIER IMPROVEMENT (ADULT): The series of falls beginning at 1882 m limit anadromous fish to only 22% of suitable habitat. Improvement of the falls at 1882 m, removal of the dam at 2107 m and removal of the CN culvert and apron at 2347 m would allow coho, steelhead and migrant brown trout to utilize 5138 m of additional habitat in Bings Creek and 3756 m of habitat in Menzies Creek (**Production Option #27**).

4. BARRIER REMOVAL (JUVENILE): Because of the critical need for Somenos Lake coho to move into Bings, Averill and Richards to escape dangerous temperature and oxygen conditions in the lake in late spring – really summer, these waterways must be free of even the slightest impediment in their lower segments. Two beaver dams are present dangers to fry migration in Lower Bings: one is located just below the highway at the 458 m point in R1 and the other just below Mary Road at the 1200 m point. The lower dam is probably not a barrier because its very old and quite low but it should still be at least partly removed. The upper dam is more recent and much larger. A local resident lowers it from time to time but beavers rebuild it consistently. This dam is also responsible for considerable flooding in the area and needs to be completely removed. Beavers should be trapped here to discourage dam replacement (**Production Option #28**).

5. CANOPY DEVELOPMENT – SUMMER TEMPERATURE IMPROVEMENT - REACH 1: Reach 1 is choked with Reed Canary Grass and other aggressive aquatic vegetation. This restricts drainage thus prolonging flooding and enhancing pressure to dredge the creek channel and/or Somenos Creek. Establishment of a higher canopy to shade the stream and discourage heavy growth of instream vegetation is required. A

test section should be started in the spring of 1999 using the following species: Pacific Willow, Sitka Willow, Black Cottonwood and hybrid poplar. A berm of more porous soil may be required to elevate some of the species (particularly the poplars) somewhat and discourage lateral flooding in the spring – summer months. To improve the summer temperature regime, selective deepening and instream beaming may be required to extend creek water further out toward the lake and minimize inland lake influence (Production Option # 29)

6. **RIPARIAN IMPROVEMENT: REACH 11:** Portions of Reach 11 have been polluted and physically damaged by cattle access. Although attempts have been made to control the animals, they need to be improved on by moving the fences further back and having the cows cross at bridges rather than through the creek. There are simply too many animals to use the creek safely in environmental terms. On September 25, 1998, cow dung was 12 cm deep on the creek bottom at the cattle crossing at 180 m (Production Option #30).

D) LAND USE FACTORS

Agriculture

A significant portion of the basin below the 100 m contour is utilized for grazing and forage production. Intensity is generally low but a 500 m section that passes through the Judge dairy farm suffers erosion and sedimentation from unrestricted access of cattle into the stream channel in places.

Residential

Generally light above Reach 5 but there have been some serious intrusions below. The worst is the RCMP station which is built squarely on the creek's FSZ on an inland extension of Somenos Marsh.

Forestry

Mainly advanced second growth with some recent logging on the lower slopes of Mt. Prevost. Minimal impact should result from logging this basin because of low relief and municipal management (North Cowichan).

Risk Potential

Moderate to high

E) PROTECTION NEEDS

The lower 1409 m of Bings Creek are highly riparian. The first 520 m are within Somenos Marsh while the remainder of the lower section is within what was once part of the marsh and is still quite wet. The inland extension of Somenos Marsh is known as Misery Meadows. The RCMP building is located on top of Lower Misery Meadows. The Bings Creek FSZ is a combination of riparian areas and small ravines all the way to the headwaters on Mt. Prevost. For the most part, the corridor is in reasonable health but there are significant intrusions in the form of the police station, encroaching residential areas along Mary Rd. and Old Lake Cowichan Road (Reach 10) where there is a small sewage discharge pipe and agricultural encroachment along Reaches 7 (Knight) and Reach 11 (Judge). Much of Reaches 6 – 9 is paralleled by the old railroad grade which serves as a highly utilized trail in a very attractive setting. There is an excellent opportunity to establish a Greenway Corridor here and formalize the trail system.

Historical Notes

Several hundred coho were reported to have made it over the falls in 1956.

Escapement:

| | Co | Cm |
|------|-----|------|
| 1987 | 30 | 1000 |
| 1988 | 150 | 100 |

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Centennial Park Creek

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) **BIOPHYSICAL OVERVIEW:** A small groundwater fed stream partially contained in underground drains; a tributary of Lower Bings Creek. Likely once flowed into Somenos Lake or creek before it was diverted into Bings. A remnant segment is present near the Canadian Tire store on the Beverly Street extension. This creek has a flapgate at its upper end to prevent backflooding and receives considerable storm drain runoff – I have termed it “Green Frog Creek”.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 141-142 |
| <u>Topographic Map</u> | 92 B/13, 92B.072 |
| <u>Salmonids</u> | Coho wintering and early rearing in R1. Fish move up from Bings Creek. |
| <u>Obstructions</u> | No leaps but the stream is in an underground drain for 350 m. from near the end of Duncan St. to the outlet of the lower pond in Centennial Park. |
| <u>Max. Temp. (? C)</u> | 15 in park (R4), 19.2 (R4 – 9/2/98) 22.2 Upper R1 15 m below culverts (7/29/98) |
| <u>Min. disch. (m³)</u> | 0.0022 m ³ (R4) .0056 Upper R1 15 m below culverts (7/29/98) |

CENTENNIAL PARK CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 3.0 | 1.0 | 9100 | 0.1 | CON | L | 798 | 798 |
| Reach 2 | 1.0 | 1.0 | PIPE | 0.01 | CON (PIPE) | | 350 | 350 |
| Reach 3 | 20.0 | 20.0 | 9100 | 0.0 | POND | N | 70 | 1400 |
| Reach 4 | 2.0 | 1.0 | 8200 | 0.1 | FC | N | 25 | 25 |
| Reach 5 | 10.0 | 10.0 | 9100 | 0.0 | POND | N | 35 | 350 |
| Reach 6 | 1.0 | 1.0 | 7300 | 0.5 | CON | N | 200 | 200 |

B) FISH UTILIZATION AND LIMITING FACTORS

Wintering coho parr and early season (April – May) coho fry of the year have been found in Reach 1. Production is limited by poor habitat quality in Reach 1 and lack of access to reaches 4 through 6. Reach 1 becomes anoxic at times in summer. The south culvert at the three at the top end of the reach delivers low quality effluent.

Slight chance of an occasional coho spawner. A pocket of gravel (10 m²) often accumulates just below the culverts at the head of R1 and a pair of coho could spawn there. The gravel largely comes from road runoff and is of marginal quality and shallow.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION:** Stocking coho or anadromous cutthroat fry in reaches 4 to 6 could yield returns. Fry required : stream = 225 at 1 fry /m² and the pond with 262 fry at .15 fry/ m². An incubation box in Reach 7 could supply the fry. Anticipated yield = 70 smolts, 10 adults, 2 adult returns. Adults may have to be trapped at the entrance to the Reach 2 culvert. NOTE: a beaver dam at 84 m in R1 must be monitored in the spring to make sure it is not a fry barrier. (Production Option # 31)

D) LAND USE FACTORS

Reaches 3-6 are in Centennial Park and are thus protected Reach 2 is underground and Reach 1 is an old diversion channel that follows the E and N right of way ..

Risk Potential Moderate

E) PROTECTION NEEDS

Because most of the creek is either in Centennial Park or underground, the only portion with significant protection needs is Reach 1. A narrow band of riparian habitat parallels the creek in Reach 1 and is still productive despite its intruded nature (Railroad, Highway, Canada Ave.). Some of this habitat is west of the E and N Grade which separates it from the creek channel proper. Reach 1 formerly flowed north under the faorgrounds and present Canadian Tire Store to join Somenos Creek in upper Reach 2. There is still a remnant known as Green Frog Creek from Beverly Street to Somenos Creek. A Mr. Grocer store was being constructed on former Somenos Marsh land east of Reach 1 of Centennial Park Creek during the fall and winter of 1998-99.

Stream Code: 920 2577 057 669 418 221 000

Stream Name: Menzies Creek

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters Bings Creek from the northwest 4,388 m above Somenos Lake. Drains the southwest shoulder of Mt. Prevost.

Air Photos BC 82007 142-144

Topographic Map 92 B/13, 92B.072, 92B.081, 92B.082

Salmonids (Length Useable)

Ct to 3579 m.

Bt to 3579 m.

Obstructions None, Reach 4 (65m) is an almost continuous cascade at peak flows but the greatest vertical drop is only .5 m – easily passable. Summer dry at 3579 m. Total stream length is 8838 m.

Max. Temp. (?C) 16.2 R5 (9/27/98)

Min. disch. (m³) 0.023 (8/20/85) Sahtlam Road. Summer flow is ground water seepage .

.0063 R1 (9/27/98)

.0052 R3 (9/27/98)

MENZIES CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 5.0 | 2.0 | 1810 | 1.0 | CON | N | 47 | 94 |
| Reach 2 | 3.0 | 3.0 | 2440 | .5 | CON | N | 123 | 246 |
| Reach 3 | 5.0 | 2.0 | 2800 | 1.2 | FC | L | 1810 | 3620 |
| Reach 4 | 4.0 | 2.0 | 1117 | 2.7 | CON | N | 65 | 130 |
| Reach 5 | 5.0 | 2.0 | 1720 | 1.2 | FC | L | 1096 | 2192 |
| Reach 6 | 4.0 | 2.0 | 1540 | 1.5 | CON | N | 435 | 870 |
| Reach 7 | 4.0 | 0.0 | 1450 | 2.0 | CON | N | - | - |
| Reach 8 | - | - | - | - | - | - | - | - |
| Total | | | | | | | 3756 | 7152 |

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports resident cutthroat and brown trout for 3756 m. Above this point, it dries in summer. Production is also somewhat limited by riparian zone degradation due to livestock access on the Ratcliffe property in reach 3 and, more seriously, on three properties in Reach 5 in the Sahtlam Road area.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION

Potential coho smolt yield : 572, fry required: 7152 (**Production Option #32**). If Bings Creek barriers are removed, colonization won't be necessary .

2. HEADWATER STORAGE (20 ha) on West Menzies (**Production Option # 33**) could provide .008 cms to this stream during its 60 day dry period; 3,000 fry could be supported. This would also increase mainstem minimum flow below the West Fork by a factor of 1.54. West Menzies could also provide additional coho smolts if it were stocked with fry after the fall rains. Possible yield: 240 (Production Option #31).

3. RIPARIAN RESTORATION

Fencing and streamside planting in the impacted zones of Reaches 3 (minor) and 5 would increase productivity in the treated sections. LWD placement could accompany the treatment. Menzies Creek is not LWD deficient but it could use more in the areas requiring riparian treatment.

21

Length requiring treatment is 570 m but only fencing is required for 350 m of this distance (Production Option # 34).

4. GROUNDWATER WELL

There is a small artesian spring just below the Dougan Gravel Pit near Tansor Junction that produces at least .032 LPS of 11° water . It flows into a small tributary of Reach 5. The gravel pit is about to be utilized by Hayes Forest Services. There is a danger that the spring's source could be obliterated if the floor of the pit is paved. It may be possible to increase the spring's output by deepening the well. The spring is presently tapped by a standpipe. The water goes subsurface in the summer but emerges just as the tributary it contributes to enters Menzies Creek at a point about 50 m above Sahtlam Road. In the winter and spring months, there is a constant flow between the well and Menzies. In fact a substantial creek comes out of the pit then and the spring is only a small part of it. Its mean winter flow is about .045 CMS. Much of it came from wetlands that had developed within the pit. These have been removed but the area has not been paved. as yet (Production Option # 35)

Of course, the main improvement measure for Menzies would be the improvement of Bings Creek Falls so that adult coho could utilize the very capable Menzies Creek.

D) LAND USE FACTORS

Agriculture

Small holdings along Cowichan Lake and Sahtlam Roads. Riparian impacts have resulted from excessive clearing and lack of stock control. These lands are on the urban fringe. Temptation to develop will increase.

Urban

Light.

Forestry

Municipal forest. Advanced second growth, some recent logging.

Risk Potential

Low

E) PROTECTION NEEDS

Menzies Creek could be an important component of a larger Greenway Corridor that would start at Somenos Lake and extend up Bings and Menzies to at least Highway 18. The corridor would protect sensitive wetland, riparian and ravine habitats that are part of the Fisheries Sensitive Zone. The Menzies Creek agricultural community needs to be brought into the stewardship concept.

**OPERATIONAL MANAGEMENT UNIT 4: MAIN (COWICHAN
RIVER)**

OMU 4: Main (Cowichan River)
T. Burns and B.D. Tutty, 1999

OVERVIEW

The Cowichan River is the major stream in the CVRD. It is 50.4 kilometres long from the outlet of Cowichan Lake to its estuary.

For a river with such a long history of settlement by B.C. standards, the Cowichan River Corridor is relatively unintruded. The major exceptions are on its estuarine lands where agriculture has extended too far seaward and converted marsh and riparian wet woodland to pasture and intrusive industries are present in the outer estuary and on its lower river riparian lands (especially on the north side) where urban development has alienated some 400 ha of the combined Lower Cowichan – Somenos Riparian Lowlands. Smaller areas of riparian intrusion are present in the Riverbottom Reach where there has been minor residential intrusion and spot dyking and in the Town of Lake Cowichan where residential alienation has occurred along Cowichan Ave. (Money's Wetland and Lower Money's Creek) and between the weir and the Duckpond on the north side of the river. There is also a minor loss in Central Park (fill). A number of other properties in Lake Cowichan have degraded the river bank by stripping riparian vegetation and replacing it with rip rap or concrete bulkheads/retaining walls.

LIMITING FACTORS

The primary limiting factor is summer temperature which often exceeds the optimum or even lethal level for salmonids for several weeks in hot, dry summers when temperatures range between 20 and 24° or more from early July to mid or late September.

PRODUCTION OPTIONS

Cowichan River production options are outlined and prioritized in Table 1.

Table 1: OMU 4 – Cowichan River – Production Options

| No. | Page | Location | Activity | Priority |
|-----|------|--------------|----------------------|----------|
| 1 | 3 | Lake outlet | Cool water discharge | 1 |
| 2 | 3 | Various | fertilization | 2 |
| 3 | 3 | various | LWD | 3 |
| 4 | 3 | Stoltz Bluff | Stabilization | 2 |

Stream Code: 9202577

Stream Name: Cowichan River

Operational Management Unit: Main

A) BIOPHYSICAL OVERVIEW: Flows NW to SE from Cowichan Lake to Cowichan Bay - 50.4 km. Spring through fall discharge regulated by a weir at the outlet of Cowichan Lake. Winter discharge moderated by Cowichan Lake and lack of major direct tributaries to the river. Exceptionally stable and productive by coastal standards. A major salmonid producer and one of the most important recreational fishing waters in the province.

| | |
|-------------------------|--|
| <u>Air Photos</u> | BC 82007 77-80 103-110 134-143 160-163 192-196 |
| <u>Topographic Maps</u> | 92B/12, B/13, C/9, C/16, F/1 |
| <u>Watershed Area</u> | River 343 km ² Lake 608 km ² |
| <u>Salmonids</u> | Co 50,400 m Ch 50,400 m Cm 50,400 m St 50,400 m Rb 50,400 m Ct 50,400 m ACt mainly lower 12,500 m Bt 50,400 m but mainly upper 14,400 m DV 50,400 m but rare |
| <u>Obstructions</u> | 3R30 chute low water chute at 32,500 m in Marie canyon just above the confluence with Mayo Lake Creek impedes low flow migration. Its passable at low flows but causes fish to jam up below it making them vulnerable to poaching and predators. It becomes a 1R3 cascade at higher flows. .5m over 4 cascade at 35,000 m is another low flow impediment. Skutz Falls at 36,000 m has a total drop of 5.4 m over 90 m and is bypassed by two vertical slot fishways. |
| <u>Max. Temp.</u> | 23 (8/15/85). Cowichan River is subject to high temperatures but they are moderated by groundwater seepage and upwelling which lower the temperature and provide numerous refugia for fish. 27 (7/29/98) bifurcation (R3) 23.6 (9/1/98) R11 |
| <u>Min. Disch.</u> | 0.4 (9/10/44). However, since 1958, spring through flows have been regulated to attempt to provide at least 7 CMS below the Crofton Pulp Mill intake at 13,000 m. Regulation usually begins in April or May and extends to Oct. 15. Discharge sometimes falls somewhat below the stipulated minimum after Oct. 15 in years of extended summer drought causing migration difficulties for chinook salmon. |

COWICHAN RIVER

| | Channel | | | | Side | | Length | | Wetted |
|------------------|----------|-----------------|-----------|----------|-------------|---------|--------|-----------------------|-----------|
| | Width(m) | Wetted Width(m) | Substrate | Slope(%) | Confinement | Channel | (m) | Area(m ²) | |
| Reach 1 (N. Fk.) | 25 | 20 | 2710 | ..01 | FC | | M | 4500 | 90000 |
| Reach 2 (S. Fk.) | 25 | 23 | 3610 | .02 | FC | | M | 3000 | 69000 |
| Reach 3 | 100 | 45 | 1810 | 1.0 | FC | | M | 4500 | 202500 |
| Reach 4 | 40 | 30 | 163R | 1.5 | FC | | L | 10000 | 300000 |
| Reach 5 | 60 | 30 | 1720 | 1.5 | FC | | M | 10000 | 300000 |
| Reach 6 | 28 | 20 | 1342 | 1.5 | CON - ENT | | N | 3000 | 60000 |
| Reach 7 | 35 | 25 | 1450 | 1.5 | FC | | L | 1000 | 25000 |
| Reach 8 | 20 | 16 | 1351 | 2.0 | CON - ENT | | N | 1000 | 16000 |
| Reach 9 | 45 | 40 | 1450 | 1.5 | FC | | L | 12500 | 500000 |
| Reach 10 | 70 | 65 | 2530 | .1 | CON | | N | 300 | 19500 |
| Reach 11 | 60 | 55 | 2530 | .5 | CON | | N | 350 | 16500 |
| Reach 12 | 110 | 100 | 2530 | .01 | FC | | L | 250 | 25000 |
| Total | | | | | | | | 50400 | 1,614,000 |

OMU 4: Main (Cowichan River) / Burns and Tutty, 1999

B) FISH UTILIZATION

The Cowichan River supports strong populations of coho, chum and fall chinook salmon. A small population of spring chinooks is present but little is known about these fish except that they were once much stronger. Sockeye and pink salmon are rare. Steelhead are abundant but sea-run cutthroats are not. There is a resident population of cutthroat trout in the Cowichan and some individuals attain large size. They too are rather sparse. Year round resident rainbows are present in very limited numbers but there is a strong seasonal (late fall through spring) population of lake based rainbows in the Upper Cowichan (above Skutz Falls). Brown trout are moderately abundant above Skutz Falls and scattered below. A few sea-run individuals are present. Dolly Varden are found throughout the river but are very rare. An occasional Eastern Brook Trout and white sturgeon are reported

C) LIMITING FACTORS

COHO SALMON

Factors limiting Cowichan River coho production are not evident. However high escapement variability and a large annual variations in summer fry density indicate that ocean factors may be more important than in stream limits. The Cowichan is a remarkably stable river with an abundance of high quality coho habitat for all life history stages. Unlike most coastal rivers, the Cowichan does not suffer from extreme, rapid discharge fluctuations nor does it experience extreme low flows. Winter temperatures are relatively high and anchor or frazil ice are almost non-existent. It is subject to bed load movement in prolonged periods of high flows and its probable that losses of eggs and parr occur at these times.

One possible limiting factor is summer temperatures. In prolonged period of very warm weather, water temperature climbs above 23 degrees and coho sometimes vacate large stretches of river. They were absent from Reach 11 of the Cowichan for a period of at least 44 days from August 1 to October 13. When they returned, they were larger but far less abundant.

CHINOOK SALMON

Instream conditions are similarly ideal for chinooks and it is expected that ocean survival factors are more important than those associated with the river.

Until the early 1990's, Cowichan mainstem chinook habitat was highly underutilized in most years. Escapement declined from a mean of some 6000 prior to 1980 to just 1200 fish in 1986 and 1987. Production has increased since then due to conservation and enhancement activities. **The early chinook run which began entering the river as early as March or April at one time and peaked in June or July, is now barely represented. There are indications that the spring run was once stronger than the fall run.**

CHUM SALMON

Chum production is limited by fall - winter flow conditions. There is an abundance of excellent spawning habitat but fry production varies with winter flow fluctuation. Cowichan chums tend to spawn heaviest in the most unstable areas of the river. They also spawn "high" and many redds are isolated by falling water levels particularly in reaches 3, 5, 7 and 9.

STEELHEAD

Despite fluctuations in escapement and early summer fry density, the late summer juvenile population appears fairly constant. It is suspected that winter and ocean survival are the most limiting. Cowichan steelhead responded remarkably to the imposition of catch and release regulations and escapement in the mid 1980's was very high. The system appeared to be operating near carrying capacity at that time. In the following years, escapement dwindled despite no increase in the catch or significant change in habitat conditions. Thus it is suspected that marine survival factors, especially predation in El Nino years, was a primary survival factor. One obvious instream mortality factor that could be significant in low escapement years is the problem of rapid dewatering when the weir goes on control. Many late run Cowichan steelhead spawn relatively high and their redds are subject to drying during flow reduction to hold storage in the lake. In most years, the redds are re - flooded before a problem develops. But it may be worthwhile to consider delaying storage until the fry emerge in some years.

RESIDENT RAINBOWS

Year round resident rainbows are now very sparse in the river. However, long time anglers report that these fish were once plentiful. It is suspected that heavy fishing pressure in the first three decades of this century decimated the population. Regulations since then, despite their increasingly conservative nature, may have been too liberal to allow recovery; particularly below Skutz Falls. Resident rainbows are barely surviving there. I have been observing a 500 m index section in Reach 5 (Riverbottom) since 1982. Every year about ten 30 to 50 cm fish are present in the early summer. By mid-fall, almost all have been caught and killed. There is a need for a total catch and release regulation on the Cowichan River with the possible exception of the November to April opening between the weir and Greendale trestle which is almost wholly populated by lake based fish in that period. Lake based rainbows enter the river in the fall when the first chinook spawners appear, spend the winter in the river, spawn between February and April and return to the lake when the river begins to warm and drop in mid-May. These fish are relatively strong.

RESIDENT CUTTHROATS

Resident cutthroats are similar to resident rainbows in that they are supplemented by lake fish in the spring and fall and are not as numerous as they once were. Habitat requirements of resident coastal cutthroats in large coastal streams have not been examined in detail. The Cowichan population is unique. They are a special race of cutthroats that can attain large size. There is evidence that resident cutthroats similar to the Cowichan fish were once present in other Island Rivers that are lake headed like the Nanaimo and Little Qualicum. They are very sparse in the Cowichan; even less numerous than resident rainbows. According to old timers, they were once fairly plentiful but not as numerous as rainbows. It is suspected that the same heavy angling mortality that almost killed off the resident rainbows, did the same to the cutthroats.

SEA-RUN CUTTHROATS

Anadromous cutthroats are present in significant numbers in the Lower Cowichan and very uncommon above the White Bridge. Lack of small tributaries above Fishladder Creek is a probable reason. Most production probably occurs in Bings, Averill, Richards Quamichan and Fishladder Creeks and in a few Lower River Sidechannels like Rotary Park - Fish gut Alley and Major Jimmy's. Coho competition is likely the Major limiting factor in these streams.

BROWN TROUT

Occur mainly above Skutz Falls. The population appears relatively stable; about 400 adults. Spawning occurs in Hatchery, Beadnell, Tiny, Stanley, Fairservice and Beaver Creeks and in a few Upper River sidechannels such as Outer Joginder's (Giddes Creek) and the Double D channels adjacent to Block 51. Competition with coho and steelhead juveniles and limited spawning and early rearing habitat are suspected to be the main limiting factors. Brown trout are present below Skutz Falls and in Bings Creek. A resident population is present in Upper Bings and Menzies Creeks and in Lois Lake. Sea-run browns have been caught in the Lower Cowichan and Bings Creek.

DOLLY VARDEN

Dollies are present throughout the Cowichan mainstem but are very rare. They are usually seen or caught in the colder months. It is expected that they drop down from the lake during the main salmon spawning period and a few remain until the river warms in late May. A few are present in all the larger tributaries of Cowichan Lake. A total of 29 fry and parr were salvaged from Robertson River, Nixon, Sutton, Ashburnham and Meade Creeks during the summer of 1986. The Cowichan River population is marginal and limited by competition with other salmonids and warm temperatures.

D) ENHANCEMENT OPPORTUNITIES

Most enhancement opportunities are present in tributaries or sidechannels. See sub - basin and sidechannel sections and the following reports:

Burns, T. and B. D. Tutty 1986. Coho Colonization Potential of the Cowichan - Koksilah Watershed: A Habitat Evaluation. Can. MS Rep. Fish Aquat Sci. No 1865

Burns et. al. 1988. A Detailed Fry Salvage Plan and Coho Colonization Strategy for the Cowichan River Watershed. Can MS Rep Aquat Sci. No. 1985

Burns, T. E. A. Harding and B. D. Tutty 1988. Cowichan River Assessment (1987): The Influence of River Discharge on Sidechannel Habitats. Can. MS Rep. Aquat Sci. No. 1999

Burns, T. and B.D. Tutty 1988. Cowichan River Sidechannel Strategies: Sidechannel Restoration/Development Potential for Increased Salmonid Production. DFO South Coast Div. MS Rep.

Burns, T. Resident Trout and Salmon Fisheries of the Upper Cowichan System: Present Status and Opportunities for Enhancement. B.C. Environment

Harding, T., T. Burns and B. D. Tutty 1992. Assessment of Potential Coho Rearing Above Migration Barriers in the Koksilah Watershed, B.C. in: Proceedings of the 1992 Coho Workshop at the Coast Bastion Inn, Nanaimo. Presented by the Association of Professional Biologists of B.C. and the North Pacific International Chapter of the American Fisheries Society.

Two major production options would benefit the river:

1)**DEEPWATER LAKE DISCHARGE:** Because the Cowichan River becomes so warm in the summer months and because this is primarily due to the fact that the river is drawn from the lake's surface, it is recommended that the possibility of installing a deepwater discharge pipe at the lake's outlet. The thermocline is very deep in Cowichan Lake (15 to 20 m) and the outlet is shallow for a considerable distance – it may be as much as 1200 m before there is sufficient depth to provide a thermocline (**Production Option # 1**)

2)**FERTILIZATION:** The technology of stream fertilization is becoming more refined and, although the Cowichan is a relatively fertile river by coastal standards, this option should be considered (**Production Option # 2**)

3) **LWD ADDITION:** The river lacks this element of habitat in a general way. No specific locations are provided here but close to bank windfall logs could be added at a number of locations but particularly in Reaches 9 and 11 (**Production Option #3**)

4) **STOLTZ BLUFF STABILIZATION :** Stoltz Bluff erosion contributes substantial amounts of fine sediment to the Lower Cowichan River. The lower 27.4 km of river is turbid from the onset of winter flows sometime in late October or early November to the cessation of high flows sometime in April or May. Bioengineering techniques using aggressive riparian vegetation (willow wattle fences, willow racines, willow, cottonwood and red osier cuttings, live pole drains and seeding, fertilization and mulching) can be applied to particularly unstable areas on the face of the silt – clay bluff. An existing channel to the south (A 65 – Stoltz Active Channel) could be modified to receive more water or a new channel could be constructed to the south (**Production Option # 4**).

SIDECANNELS

In terms of sidechannel opportunities, out of a total of 159 sidechannels, 72 have improvement potential in five categories (see **Burns, et. al. 1988**).

1. create semi-natural channel from relic
2. direct flow into sidechannel
3. increase habitat complexity
4. reduce flow in sidechannel
5. improve spawning habitat

Total enhanceable area is 242,622 m² and total species yield is estimated to be the following:

| | |
|---------|-------------------------|
| Coho | 80,388 - 202,024 smolts |
| Chinook | 25,069 smolts |
| Chum | 56,214,500 fry |

Estimates were not made for trout and steelhead but yield would be substantial.

Several sidechannels have been enhanced in recent years including Watercress West-Fallen Log Relic Channel (106R), Inside Relic (107R, Art Watson's Floodchannel (117F) and the Slot Run Relic Channel (Lamb's – 127R).

107R was excavated in 1991 after Outer Double D Sidechannel (97A) became the main channel of the Cowichan River following major floods in 1990 and 1991. The formerly 10-15 m wide channel widened to up to 150 m as it cut new ground. It still is. 107R was excavated as a bleedoff channel to try and relieve winter flow pressure on 97A and draw some water back to the old channel, particularly in the summer. The diversion caused almost complete drying of 1700 m of the old channel as well as 397 m of Inner Double D Sidechannel. Juvenile losses were estimated to be over 100,000. Initial excavation was unsuccessful so the project was undertaken again in 1996 under a USHP grant to the Steelhead Society of B.C. This time the excavation was 2-3 m deeper to expose groundwater.

106R was developed in 1992 as another response to the loss of the old channel to Outer Double D. It involved 540 m of new channel to blend with the wetted portion of 106R and with channel 105R. This channel receives input from Watercress West Creek. The total complex is about 1500 m long. It carries winter flows ranging from about 1.0 to 3.0 CMS. Summer base flow is about .5 CMS. The inlet has to be excavated from time to time as a gravel berm builds. It was last done on August 4, 1996. The inlet is located 140 m down the Cowichan Footpath from the 70.2 trestle.

Art Watson's Floodchannel is an ongoing project by the Watson family. The channel has been hand excavated and the inlet berm strengthened. Nearby Art Watson's Creek (116R), a modified relic channel, is another ongoing project of the Watson's. It consists of dug out ponds near the lower end and a partially excavated channel in the upper portion.

Inner Joginder's Active Channel (Giddes Creek)- 115A is another Upper Cowichan Sidechannel Complex that has received some enhancement effort in the form of substrate improvement. Boulders and cobbles have been moved to expose gravel in a number of areas. This channel receives as many as 400 coho and 50 chum.

In August, 1997, the Slot Run Relic Channel (Lamb's) – 127R was improved by excavation and installation of an inlet pipe from the mainstem.

The first Cowichan River sidechannel to be improved was Bonsall's Slough (23B). It was excavated to improve chum spawning and coho rearing in 1974. It now dries in summer and is in need of scarification and flow improvement. Rotary Park has also been improved (1977,1983,1987).

Tributary sidechannels on Robertson, Meade, Sotton and Nixon Creek have been developed.

STREAMS

A number of improvements have been carried out in the sub-basins (see tributary descriptions for more detail) Table 1;

TABLE 1: SUMMARY OF ENHANCEMENT ACTIVITIES UNDERTAKEN ON TRIBUTARIES

| NAME | YEARS | PROPONENT | ACTIVITY |
|-------------------------|--------------|--|---|
| Miracle Creek | 1997 | CLSES | Spawning platform |
| Swordfern Creek | 1997 | CLSES | Spawning platform |
| Sutton Creek | 1996 | Campbell, CLSES | Groundwater channel |
| Nixon Creek | 1996-1998 | TimberWest | Groundwater channel |
| Beadnell Creek | 1995-96 | CLSES, Valley Fish and Game | Barrier improvement |
| Maple Flat Creek | 1996 | Campbell | Rearing ponds |
| Meade Creek | 1995-96 | CLSES, Campbell | Rearing ponds |
| Golf Course Creek | 1995 | Campbell | Headwater storage, rearing ponds |
| Tiny Creek | 1994 | CLSES | Spawning platform, pool creation |
| Robertson Blind Channel | 1993 | CLSES, DFO | Groundwater channel |
| Nixon West | 1990 | TimberWest | Barrier improvement |
| Holt Creek | 1990 | Cowichan Fish and Game | Barrier improvement |
| Lakehead Creek | 1989 | CLSES, MOE | Spawning platform |
| Swampwater Creek | 1989 | CLSES, MOE | Spawning platforms |
| Beaver Creek | 1983-1997 | CLSES, DFO/MOE, USHP, Valley Fish and Game | Channel and substrate restoration, headwater storage, smolt release dam |
| Skutz East | 1982 | MOE | Barrier improvement |

E) PROTECTION NEEDS

The Cowichan River Recreational Fishing Corridor was established in 1991 (Burns, 1991). The corridor also includes the rivers FSZ

OPERATIONAL MANAGEMENT UNIT 5: COWICHAN
SIDECHANNELS

OVERVIEW

There are 157 Cowichan River Sidechannels. They begin at Marriner's Pool on the North Fork and near Clem Clem Bridge on the South Fork and extend all the way up to Tony Green's near the east boundary of the Town of Lake Cowichan. The sidechannels provide important spawning, rearing and overwintering habitat for the river's trout and salmon and, perhaps more important, many provide cooling and cool water summer refugia to this river that becomes dangerously warm in many summers. There are four types of sidechannels:

FLOOD: Generally only carry water at high flows. Often far out in the floodplain and lack stability – limited fish habitat value.

BACK: Backwatered by the river. Generally wetted at all seasons but more so in the winter months. Often high value fish habitat particularly in winter when they provide an important element of stability.

ACTIVE: Usually flow all year and have more or less direct connection to the river, often groundwater influenced – almost always important fish habitat.

RELIC: Removed from river inundation except perhaps in special circumstances. Generally wetted by the winter water table and perhaps some upland seepage or runoff. Often have high potential for fish with modification.

LIMITING FACTORS

Primary factors limiting sidechannel production are stability, access and summer discharge. Secondary factors are habitat features such as spawning gravel and cover.

PRODUCTION OPTIONS

Of the river's 157 sidechannels, 79 provide opportunities to improve their capability – productivity for salmonids. These options are outlined in Table 1. More information is provided in a sidechannel catalogue which will be provided on request. The catalogue features site maps and drawings of individual sidechannels along with more discharge data.

Table 1: Cowichan Sidechannel Production Options

| No. | Page | S.C. ID | Activity | Priority |
|-----|-----------------------|-------------------------------------|---|----------|
| 1 | 9 | 5A | Excavate high spot | 3 |
| 2 | 11 | 6R | Excavate, provide inlet | 2 |
| 3 | 14 | 7A | Improve inlet | 2 |
| 4 | 16,17,24,25, 32,33 | B8, ASF8, A11,ASF1 1,R18, R19 | Provide year round water, add habitat features | 1 |

| | | | | |
|-------|-------|--------|------------------------------------|---|
| 5 | 18 | R9 | Excavate | 2 |
| 6 | 20,21 | A10/1 | Provide lateral access | 2 |
| 7 | 23 | FSF10 | Infiltration pool | 4 |
| 8 | 24 | A11 | Provide lateral connector | 2 |
| 9,10 | 27 | F13 | Improve inlet or provide diversion | 2 |
| 11 | 28 | F14 | Improve inlet via porous berm | 2 |
| 12 | 29 | F15 | diversion | 1 |
| 13 | 30 | F16 | Connection to Fish Gut | 1 |
| 14 | 31 | B17 | Connection to Fish Gut | 1 |
| 15 | 34 | R20 | Excavate, inlet berm | 2 |
| 16 | 35 | F21 | Buried drain | 3 |
| 17 | 36 | R22 | Excavate, inlet berm | 1 |
| 18 | 37 | B23 | Scarify, improve inlet | 1 |
| 19 | 40 | F26 | Improve inlet | 5 |
| 20 | 41 | R27 | Link to A28 | 2 |
| 21,22 | 42 | A28 | Improve inlets | 2 |
| 23 | 47 | A33 | Improve inlet, raise berm, LWD | 2 |
| 24 | 48 | R34 | Link with A35/1 | 2 |
| 25 | 49 | A35/1 | Improve inlet | 1 |
| 26 | 50 | B/35/2 | Improve inlet | 2 |
| 27 | 51 | F36 | Improve inlet | 3 |
| 28 | 53 | F38 | Improve inlet | 4 |
| 29 | 54 | F39/1 | Improve inlet | 4 |
| 30 | 56 | F41 | Improve inlet | 5 |
| 31 | 57 | A42 | Improve inlet | 2 |
| 32 | 61 | A45/2 | Buried drain | 2 |
| 33 | 63 | R47 | Excavate, provide berm | 2 |
| 34 | 64,65 | R48 | Excavate, install inlet | 2 |
| 35 | 66 | F49 | Excavate, berm, inlet | 5 |
| 36 | 69 | F52 | Excavate, berm | 4 |
| 37 | 70 | F53 | Excavate | 4 |
| 38 | 71 | R54 | Excavate | 4 |
| 39,40 | 73 | A55/2 | Excavate, sp. pl. | 2 |
| 41 | 77 | F58 | Excavate, inlet control | 3 |
| 42 | 78 | F59 | Improve inlet | 2 |
| 43 | 84 | F64 | Excavate, berm | 4 |
| 44 | 85 | A65 | Improve inlet | 3 |
| 45 | 86 | F66 | Excavate, berm | 4 |
| 46 | 87 | F67 | Excavate, berm | 4 |
| 47 | 89 | R69 | Spawning platforms | 3 |
| 48 | 94 | A72 | Improve inlet | 1 |
| 49 | 95 | R73 | Improve inlet | 3 |

**Side Channel I.D. tB1 Back Tidal MARRINER'S
BACKCHANNEL (1)**

| | | |
|--------------------------|---------|--------------|
| Average Wetted Width (m) | 15 | % slough 100 |
| Channel Width (m) | 15.00 | |
| Minimum Flow | Unknown | |
| Channel Length (m) | 350.0 | |
| Debris (%) | 5 | |
| Gradient | .01 | |
| Elevation (m) | 0 | |
| Turbidity (cm) | nil | |

Site Location: 150 m. below head Date: 87/6/12 Crew: TB Air
Photo Location No. BCC 394 nos. 148,149
Weather: clear Air Temp. 25 Water Temp. 15 Access Tzouhalem Rd.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

Possibility of wintering coho; coho rearing

Enhancement Assessment

No improvement required.

Side Channel I.D. tBsf1 Back Tidal LOG POND TIDE CHANNEL
(2)

| | | | |
|--------------------------|---------|----------|-----|
| Average Wetted Width (m) | 0 - 10 | % Pool | 0 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Water Flow Class | Unknown | % Run | 0 |
| Channel Length (m) | 1100.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | | | |

Site: Tzouhalem Rd. Date: 86/10/23 Crew: TB
Air Photo Location N.: BCC 394 no. 148,149 Weather: clear, cool
Air Temp. 10

Substrate Composition Last Updated
 Updated By

Fines 9 %
Gravel 1 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

Transient use by chinooks and chums during estuarine phase. *Neomysis* are very abundant in Doman's log storage pond.

Enhancement Assessment

No evident improvement possibilities.

Side Channel I.D. tB2 Back Tidal NEAR PIMBURY (3)

| | | | |
|--------------------------|---------|----------|----|
| Average Wetted Width (m) | 4 | % Pool | 0 |
| Channel Width (m) | 15.00 | % Riffle | 10 |
| Minimum Flow | Unknown | % Run | 0 |
| Channel Length (m) | 210.0 | % Glide | 0 |
| Debris (%) | 20 | % Slough | 90 |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | | | |

Site Location: Near Outlet Date: 87/6/12 Crew: TB Air Photo
Location No. BCC 394 Photo nos. 148,149
Weather: cloudy, mild Air Temp. 21 Water Temp. 15 Access:
from dyke near Pimbury Bridge

| Substrate Composition | | Last Updated | Updated By |
|-----------------------|-----|--------------|------------|
| Fines | 8 % | | |
| Gravel | 2 % | | |
| Cobbles | 0 % | | |
| Boulders | 0 % | | |
| Bedrock | 0 % | | |
| Compaction | H | | |

Fish Utilization

No salmonids have been observed in this channel. It becomes very low during low tide and even dries in places in the summer. It carries more water in the winter and may support coho then.

Enhancement Assessment

No enhancement required.

Side Channel I.D. tBsf2 Back Tidal RODENBUSH TIDE CHANNEL

(4)

| | | | |
|--------------------------|---------|----------|-----|
| Average Wetted Width (m) | 0 - 8 | % Pool | 0 |
| Channel Width (m) | 8.00 | % Riffle | 0 |
| Minimum Flow Class | Unknown | % Run | 0 |
| Channel Length (m) | 340.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 100 |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | | | |

Site: near culvert Date: 86/10/23 Crew TB Air Photo Location
no: BCC 394 no. 148, 149
Weather: clear, cool Air Temp.: 10 Access: Tzouhalem Rd.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Chum, chinook and coho fry/smolts find their way into this channel. Long term use is doubtful with the possible exception of wintering coho.

Enhancement Assessment

No Improvement opportunities are evident.

**Side Channel I.D. tF3 Flood Tidal FLOOD CHANNEL NEAR
PIMBURY (5)**

| | | | |
|--------------------------|---------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow Class | Unknown | % Run | NA |
| Channel Length (m) | 160.0 | % Glide | NA |
| Debris (%) | | % Slough | NA |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | | | |

Site Location: Date: 8/7/12 Crew: TB Air
Photo Location No. BCC 394 Photo Nos. 148,149
Weather: cloudy, warm Air Temp. 21 Access: from dyke near
Pimbury bridge

Only wetted at high flows - high tides.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |

| | |
|------------|-----|
| Fines | 7 % |
| Gravel | 3 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Fish Utilization

None other than possible transient use by coho fry.

Enhancement Assessment

None evident

Side Channel I.D. tBsf3 Back Tidal SNOWBERRY TIDE CHANNEL (6)

| | | | |
|--------------------------------|---------|----------|-----|
| Average Wetted Width (m) 0 - 8 | | % Pool | 0 |
| Channel Width (m) 8.00 | | % Riffle | 0 |
| Minimum Flow Class Unknown | | % Run | 0 |
| Channel Length (m) 840.0 | | % Glide | 0 |
| Debris (%) 15 | | % Slough | 100 |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | | | |

Site: 150 m. above outlet Date: 86/10/23 Crew: TB Air Photo
Location No. BCC 394 Photo No. 148-149
Weather: clear, cool Access: Tzouhalem Rd.

Prior to dyking the North Fork, this channel carried North Fork overflow for several months(1978-1984). It is still wetted by the winter water table and has water of its own until May or June.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

Possibility of wintering coho.

Enhancement Assessment

No evident improvement possibilities.

Side Channel I.D. tB4 Back Tidal PRIESTS' BACKCHANNEL (7)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 30 | % Pool | 0 |
| Channel Width (m) | 30.00 | % Riffle | 0 |
| Minimum Flow | tidal | % Run | 0 |
| Channel Length (m) | 200.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near head Date: 8/7/12 Crew:TB Air Photo
Location NO. BCC 394 Photo nos. 148,149
Weather: cloud and sun Air Temp. 25 Water Temp. 15 Access:
Tzouhalem Rd.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho rearing and wintering

Enhancement Assessment

No improvement required.

Side Channel I.D. tBsf4 Back Tidal BLACKBERRY TIDE CHANNEL (8)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 - 8 | % Pool | 0 |
| Channel Width (m) | 8.00 | % Riffle | 0 |
| Minimum Flow | tidal | % Run | 0 |
| Channel Length (m) | 220.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site: 50 m. above outlet Date: 86/10/23 Crew: TB Air Photo
Location no.: BCC 394 Photo No. 148,149
Weather: clear, cool Air Temp.: 10 Access: Tzouhalem Rd.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

None

Enhancement Assessment

No improvement possibilities

Side Channel I.D. A5 Active PRIESTS' MARSH (9)

| | | | |
|--------------------------|--------|----------|-----|
| Average Wetted Width (m) | 30 | % Pool | 0 |
| Channel Width (m) | 100.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 1500.0 | % Glide | 0 |
| Debris (%) | NA | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: 200 m. above outlet to backchannel portion Date: 87/6/12 Crew: TB Air Photo Location No.1 BCC 394 Photo nos. 148,149

Weather: cloud and sun Air Temp. 22 Water Temp. 15 Access: Faint track from Tzouhalem Rd. through field

Not a true sidechannel; Best description: A backwater marsh- wet woodland complex, wetted mainly by the winter water table. This system is largely independent of river flow.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 9 % | |
| Gravel | 1 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho summer rear and overwinter in the backchannel portion. Its suspected that many also winter upstream in the marsh - wet woodland section of this complex. Holtby found densities of 6.18 Co/m² and .11 Ct/m² in Dec. 1986.

Enhancement Assessment

Dredging a high area about 200 m above the backchannel may provide better egress for coho that might winter in the upper part of the complex

Production Option #1
Rank not ranked

Side Channel I.D. tBsf5 Back Tidal FAR FIELD TIDE CHANNEL
(10)

| | | | |
|---------------------------------|-------|----------|-----|
| Average Wetted Width (m) 0 - 10 | | % Pool | 0 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | tidal | % Run | 0 |
| Channel Length (m) | 155.0 | % Glide | 0 |
| Debris (%) | 15 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site: near Head Date: 86/10/23 Crew: TB Air Photo Location
No. BCC 394
Weather: clear, cool Air Temp. 10 Water Temp. 12 Access:
Boy's Rd. to hatchery then thru fields.

Tide channel wetted by tidal surge and depleted by tidal ebb. Some winter
backflooding from the river.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 9 % | |
| Gravel 1 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

None other than the possibility of a few overwintering coho.

Enhancement Assessment

No improvement possibilities.

Side Channel I.D. R6 Relic BLOCKED RELIC CHANNEL (11)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 15.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 750.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient Class | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 87/8/8 Crew: TB Air Photo Location No. BCC 147,148
Weather: clear,hot Air Temp. 35 Water Temp. 20 Access:
Tzouhalem Rd., Quamichan Village Rd., Dyke Rd.

Wetted by winter water table.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None. Channel is inaccessible and does not hold water long enough to be a production factor.

Enhancement Assessment

If Black Creek could receive permanent flow, a diversion to this channel would be beneficial. The outlet requires a culvert under the dyke at the very least, this channel could winter coho fry.

Wetted area increase = 11,250 m²
Yield Potential = 900 Co smolts

A drain under the upper dyke and some excavation of the upper channel area is also necessary.

**Production Option #2
Rank**

Side Channel I.D. tBsf6/1 Back Tidal WHITEFACE TIDE-RELIC CHANNEL (12)

| | | | |
|--------------------------|---------|----------|-----|
| Average Wetted Width (m) | 0 - 7.2 | % Pool | 0 |
| Channel Width (m) | 7.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 480.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient Class | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site: Central Date: 86/10/15 Crew: TB Air Photo Location
 No.: BCC 394 Photo nos. 148,149
 Weather: clear, cool Air temp. 10 Access: cattle trails from
 Tzouhalem Rd.

Wetted by tidal surge and winter back flooding; otherwise dry and almost always
 dry in the upper 200 m. which is relic and somewhat dyked.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction M | |

Fish Utilization

None

Enhancement Assessment

No viable enhancement options.

Side Channel I.D. tRsf6/2 Relic Tidal (13)

| | | | |
|--------------------------|------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 0.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 0.0 | % Glide | NA |
| Debris (%) | 0 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|---|
| Fines | % |
| Gravel | % |
| Cobbles | % |
| Boulders | % |
| Bedrock | % |
| Compaction | |

Fish utilization

Enhancement Assessment

**Side Channel I.D. A7 Active QUAMICHAN VILLAGE
SIDECHANNEL (BLACK CREEK) (14)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 4.76 | % Pool | 0 |
| Channel Width (m) | 15.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 400.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 100 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near outlet Date: 87/7/24 Crew: TB Air Photo
 Location No. BCC 394 135,136
 Weather: cloudy, isolated showers Air Temp. 22 Water Temp. 21
 Access: Tzouhalem Rd., Quamichan Village Rd., Dyke Rd.

A major sidechannel that I thought never dried. It was flowing at .3 cms at minimum river flow in 1986. Either its inlet berm increased in elevation and compaction last winter (unlikely) or recent high evapotranspiration (ETP) has caused abnormal drying.

| Substrate Composition | Last Updated | Updated By |
|--------------------------------|--------------|------------|
| Fines 2 % | | |
| Gravel 8 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

Coho and chums spawn in this channel along with occasional steelhead and chinooks. Coho likely overwinter; steelhead may too. Chum and chinook fry and coho and steelhead smolts leave well before drying but some coho fry are trapped, mainly in the large pool. They probably survive.

1986 fry densities(from Holtby, Pers. Comm)
 21/8/86 Co 1.179 Rb .019
 16/12/86 Co .014 Ct parr .004

Enhancement Assessment

Permanent wetting could easily be provided with a French Drain or buried waterline

Wetted area increase = 5190 m²
 Yield potential = 1660 Co smolts

**Production Option #3
Rank**

Side Channel I.D. Fsf7 FloodSOUTH FORK BAR FLOOD CHANNEL (15)

| | | | |
|--------------------------|----------|----------|-----|
| Average Wetted Width (m) | 0 - 0.17 | % Pool | 100 |
| Channel Width (m) | 7.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site: South Fork Bar Date: 8/7/12 Crew: TB Air Photo
Location No.: BCC 394 Photo Nos. 148,149
Weather: cloudy, warm Air Temp.: 21 Water Temp.: 21 Access:
North Fork Dyke

Three pools remain: 1x5, 1x2, 2x5 = 17m². The bar and channel are inundated in high flows.

Substrate Composition Last Updated
Updated By

Fines 3 %
Gravel 7 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

This channel is inundated in high flows and dries quickly with falling river levels; it doesn't attract many fish. A few coho and chum fry may be trapped in some years.

Enhancement Assessment

No improvement possible.

Side Channel I.D. B8 Back MAJOR JIMMY'S SIDETCHANNEL (16)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 6.8 | % Pool | 38 |
| Channel Width (m) | 14.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 583.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 62 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 600 m. above confluence Date: 8/7/30 Crew: TB
 Air Photo Location No. BCC 394 135,136
 Weather: mostly cloudy Air Temp. 17 Water Temp. 15 Access:
 off Dyke Rd. from Boys Rd.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho and chum spawning, steelhead also said to spawn here. Coho rearing and overwintering.

Upper Site Sept. 17/86 Co 14/m²
 St/Ct 3.1/m²
 Dec. 9/86 not calculated

Lower Site Sept. 17/86 Co 2.62/m²
 St/Ct .18/m²
 Oct. 9/86 Co .27/m²
 St/Ct .02/m²

Enhancement Assessment

Part of the Lower River South Side Complex. Which is sometimes called Five Channels. By providing additional summer flow at its uppermost point (Silver Bridge Relic Channel), 45,932 m² more summer wetted area would result in the six channels that make up the complex. Major Jimmy's would gain 8692 m² Fry salvage required (FS1)

Production Option #4 Rank

Side Channel I.D. Asf8 Active DUCKWEED ACTIVE CHANNEL(17)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 11 | % Pool | 100 |
| Channel Width (m) | 15.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 785.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 87/8/10 Crew: TB Air Photo
Location No. BCC 394 Photo Nos. 147,148
Weather: clear, hot Air Temp.: 35 Water Temp.: 17 Access:
Boys RD., Dyke Rd. to hatchery then drive along field edge

Substrate Composition Last Updated
Updated By

Fines 5 %
Gravel 5 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

Coho and chum spawning, coho rearing and wintering

Wetted By:

1. Winter water table;
2. Seepage from Major Jimmy's
3. Hatchery effluent(summer flow is greatly reduced when the hatchery is not operating)
4. Back flooding especially during high flow-high tides

Enhancement Assessment

Part of the South Side Sidechannel Complex often termed Five Channels(lower river). By providing flow at the head of the Silver Bridge Relic channel, 45,932 m2 of additional summer wetted area could result; Duckweed would add 3140. This improvement is discussed in more detail on 19R

Production Option #4

**Rank 1 in combo with the five other channels in the Southside Complex (FIVE CHANNELS),
13 as a stand alone**

**Side Channel I.D. R9 Relic RELIC COMPLEX ON MAJOR
JIMMY'S ISLAND (18)**

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 7.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 1000.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location near head of main channel Date: 8/7/9 Crew: TB
 Air Photo Location No. BCC 394 135,136
 Weather: clear,hot Air Temp. 34 Access: Boy's Rd., Cross MVR.
 Jimmy's Slough @ Dyke Rd. access, bushwack true north

Wetted by:

- 1: Back flooding(lower 200 m.)
- 2: Winter water table
- 3: Occasional spill from the mainstem in large floods

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
|-----------------------|--------------|------------|

| | | |
|------------|-----|--|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

Coho overwintering and spring rearing.

Enhancement Assessment

Excavation from the mainstem could result in permanent flow which would benefit coho and chum salmon. Chinook rearing should also benefit

| | |
|----------------------|----------------------|
| Wetted area increase | =7000 m ² |
| Yield potential | = 2240 Co smolts |
| | = 1120 ch smolts |
| | 3 500 000 Cm fry |

**Production Option #5
Rank 4**

Side Channel I.D. Bsf9 Back BIFURCATION BACKCHANNEL (19)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 4 | % Pool | 0 |
| Channel Width (m) | 6.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 150.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 87/6/12 Crew: TB Air Photo Location No.: BC 394 Photo nos. 148, 149
Weather: cloudy, warm Air Temp. 21 Water Temp. 10 Access Off end of dyke
Tidal

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction H | | |

Fish Utilization

Coho rearing and wintering

Enhancement Assessment

No improvement required

**Side Channel I.D. A10/1 Active ROTARY PARK ACTIVE
CHANNEL (20)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 5.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 600.0 | % Glide | NA |
| Debris (%) | 1 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: First bridge Date: 87/7/30 Crew: TB Air Photo
 Location No. BCC 394 136,137
 Weather: clear, warm Air Temp. 26 Access: Dobson and
 McKinstry Roads.

This assessment provides before and after data on this channel which was deepened and slightly widened late this summer (1987) as dyking mitigation. 3000 m² of permanent habitat was gained in Rotary Park Channel along with approximately 9600 m² in Fish Gut Alley. Rotary Park was also excavated slightly in 1977 and 1983.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho and chum spawning. Prior to enhancement, 1000-5000 coho were trapped and required salvage (Burns et. al. 1987, Elliot, 1987)
 Coho also overwinter in this channel. 10,579 smolts were produced in 1976 and 19,121 in 1975. However, most probably came from the pond and below which is Fish Gut Alley.
 Large numbers of steelhead juveniles winter in Rotary Park and cutthroat trout are also present.
 Winter water temperatures are surprisingly high (up to 14 degrees). It appears that summer river water slowly seeps into the channel and that there is a lag time of several months.
 Coho Escapement: 1977 719, 1989 242, 1990 553, 1991 155, 1992 69, 1993 111, 1994 69, 1995 10, 1996 31.

Enhancement Assessment

Summer wetted area has been increased by 8750 m² by deepening Rotary Park Channel. The last excavation occurred in 1987. The channel now dries or withdraws to standing water pools above the pond – excavation is required again. Fry salvage is also necessary(FS2)

The possibility of providing lateral access from the river for overwintering coho should be investigated. Dyke construction cut off two channels that linked Rotary Park with the mainstem. There is evidence that the culverts at the outlet of Rotary Park Pond are restricting juvenile coho access. **Production Option #6**

Side Channel I.D. F10/2 Active INNER FISHGUT ALLEY
ACTIVE CHANNEL (21)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 0 - 2 | % Pool | 62 |
| Channel Width (m) | 10.00 | % Riffle | 12 |
| Minimum Flow | .019 | % Run | 0 |
| Channel Length (m) | 1200.0 | % Glide | 26 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | ..01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/8 Crew: TB Air Photo
 Location No. BCC 394 137,138
 Weather: clear, hot Air Temp. 33 Access: Marchmont Rd., sewage lagoons dyke.

Substrate Composition Last Updated
Updated By

Fines 3 %
 Gravel 6 %
 Cobbles 1 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho and chum spawning. Coho rearing and overwintering. Rainbow and cutthroat trout are present and steelhead spawning occurs.

Enhancement Assessment

Summer wetted area has been increased by 9600 m² by deepening Rotary Park Channel. Minimum summer discharge has increased by .702 cms. No further improvement required.

Side Channel I.D. Fsf10 Flood BIFURCATION FLOOD CHANNEL (22)

| | | | |
|--------------------------|----------|----------|-----|
| Average Wetted Width (m) | 0 - 2.06 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 150.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient Class | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 87/6/12 Crew: TB Air Photo
 Location No. BC 394 Photo nos. 148,149
 Weather: cloudy, warm Air Temp. 21 Water Temp. 14 Access
 Off dyke from Pimbury or wade river

Three pools remain: 10 m², 200 m² and 100m²

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 3 % | |
| Gravel | 7 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawn in this channel and attempt to rear in it. Wetted area is drastically reduced when mainstem flows fall to summer levels. Many fry are lost during this period.

Enhancement Assessment

Excavation of a deep pool near the inlet and periodic dredging of the lower channel would provide permanent wetting

Wetted area increase = 855 m²
 Yield potential = 273 Co smolts

Production Option #7 Rank

Side Channel I.D. A 11 Active JOHN'S CREEK (23)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 5 | % Pool | 39 |
| Channel Width (m) | 6.00 | % Riffle | 10 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 1600.0 | % Glide | 20 |
| Debris (%) | 10 | % Slough | 31 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Behind John Charlie's Date: 87/6/29 Crew: TB

Air Photo Location No. BCC 394 146, 147

Weather: clear, warm Air Temp. 26 Water Temp. 16.5 at RD.Xing, 22.5 in slough section Access: Road from JC's via Boy's Rd.

Wetted by:

1. Winter-spring water table
2. Spill from the trailer park ponds at mainstem flows greater than 60 cms.
3. Under the dyke seepage via Relic Channels

Substrate Composition Last Updated
Updated By

Fines 2 %
Gravel 8 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

Light coho and chum spawning; considerable coho wintering and spring rearing in some years. Access may be limited by marginal connection with Major Jimmy's. The lower sections of Johns Creek have been excavated on occasion to facilitate access but are subject to plugging due to lack of flushing. Major backhoe work is required to guarantee access.

Enhancement Assessment

This channel, in combination with the Trailer Park Ponds, Major Jimmy's Slough, Dyke Rd. and Duckweed Sidechannels has the greatest enhancement potential in the system. If .1 cms could be introduced at the Silver Bridge Relic Ch, 45,932 m² would be enhanced in this complex.

Releasing effluent from Vancouver Island Hatchery (.07 cms, 10 degrees) would also provide considerable benefit by moderating temperature. It reaches 23 degrees in Johns Creek which would benefit by 6400 m².

Accessing at least one relic-flood channel connector (see plan view) may help coho find this channel in winter and add 1200 m² of summer wetted area. This would require an open drain under the dyke(#8)

Production Options #4,8
Rank 1 as part of Southside Combo

Side Channel I.D. Asf11 Active DYKE ROAD ACTIVE
CHANNEL (24)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 - 0 | % Pool | NA |
| Channel Width (m) | 5.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 610.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 8/7/88 Crew: TB Air Photo
 Location No. BCC 394 Photo Nos. 147,148
 Weather: clear,hot Air Temp. 34 Access: Dyke Rd.

Wetted by winter water table and seepage from Major Jimmy's Slough. Prior to this summer, I had never seen the channel dry; stagnant appearing and intermittent but more wet than dry. High FE content in area. Flow influenced by tides.

Substrate Composition Last Updated
 Updated By

Fines 5 %
 Gravel 5 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction M

Fish Utilization

Coho and chum spawning, coho rearing(spring, early summer) and overwintering. Many coho densities are as high as 7/m² in this channel and salvage is required (**FS3**)

Possible Yield: 21,350

Enhancement Assessment

Part of the South Side Sidechannel Complex that could be wetted from the top end: six channels would benefit

Production Option #4
Rank 1 as part of Southside Combo (Five Channels)

Side Channel I.D. F12 Flood JOHN'S FLOODCHANNEL (25)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 6.6 | % Pool | 60 |
| Channel Width (m) | 8.00 | % Riffle | 5 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 138.0 | % Glide | 0 |
| Debris (%) | 0 | % Slough | 35 |
| Gradient | .8 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 87/6/28 Crew: TB Air Photo
Location No. BCC 394 146,147
Weather: clear, warm Air Temp. 27 Water Temp. 24.5 in int.
pools, 18 in backwater Access: along dyke via John Charlies's Rd.

Coho, chinook and chum fry are highly attracted to this channel because its backwater section provides refuge in an area where there is little. Chinooks and chums leave before the pools close but many coho are trapped. 6000 were salvaged on June 25, 1987.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 2 % | | |
| Gravel 8 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Coho, chinook and chum fry are attracted to this channel's backwater section because it provides refuge in an area where there is little. Chinooks and chums usually leave before the pools close but many coho are trapped. 6000 were salvaged on June 25, 1987.

Enhancement Assessment

No enhancement necessary or possible. Annual fry salvage required(**FS4**)

**Side Channel I.D. F13 FloodOUTER FISH GUT ALLEY
FLOODCHANNEL (26)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 300.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 87/5/24 Crew: 23 Air Photo
 Location No. BCC 394 035,036
 weather:clear,warm Air Temp. 23 Access Trunk Rd., Marchmont
 Lagoon Rd., Fish Gut Connector

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 6 % | | |
| Gravel 4 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

Coho and chum spawning, early chinook and coho rearing. 1000-3000 fry are trapped and require salvage(FS5).

Enhancement Assessment

Construction of an improved berm and buried drain could provide permanent flow. This channel is readily accessible and a good one to test improvement methods **Production Option #9**
 Another possibility is diversion from Inner Fish Gut which can now afford to lose some flow **Production Option # 10**

| | |
|----------------------|-----------------------|
| Wetted area increase | = 2400 m ² |
| Yield potential | = 768 Co smolts |

Rank 43

**Side Channel I.D. F14 Flood FISH GUT ALLEY
CONNECTOR FLOODCHANNEL (27)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 2 | % Pool | 100 |
| Channel Width (m) | 5.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 190.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/4/2 Crew: TB Air Photo
Location No. BCC394 135,136

Substrate Composition: A thin veneer of gravel over clay.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 3 % | | |
| Gravel 7 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Coho, chinook and chum fry find their way into this channel and become trapped requiring salvage. 500 chums and 25 chinooks were taken on April 2, 1987. However, recent cat work has filled the pools; future salvage may not be necessary because of this and the possibility of permanent flow.

Enhancement Assessment

If permanent flow can be achieved in outer Fish Gut, the same can be done for this channel with the installation of a porous inlet berm of 20 to 30 cm diameter angular rock. The present berm is too unstable to control high flows **Production Option # 11**

Wetted area increase = 950 m²
Co smolt yield potential = 76

Rank

**Side Channel I.D. F15 FloodFISH GUT ALLEY SPILL CHANNEL
(28)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 220.0 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/8/4 Crew: TB Air Photo Location No. BC394 136,137
Weather: clear, warm Air Temp. 25 Access: McKinstry Rd., Dyke

A former spill channel from Rotary Park Pond, Fish Gut Alley. Its now cut-off by the dyke. Water flowed into and out of the pond via this channel and some upstream connectors. Flow began when mainstem discharge surpassed 50 cms measured at Lake Cowichan. The channel still flows but its lost its connection with Rotary Park Pond. It still connects with Fish Gut Alley 5 m. below the Rotary Park Pond outlet culverts when mainstem flows are above 93 cms. measured at station 08HA002 (Lake Cowichan).
Upstream fry passage is questionable due to culvert velocities.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 6 % | | |
| Gravel 4 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

Chum spawning in years of high return-adequate flow. 276 chum carcasses were counted in 1988. All eggs were probably lost because the channel was dry most of the incubation period. However, the major function of this channel may have been to provide access to Rotary Park Pond for wintering salmonids - especially coho. 10,599 to 18,928 coho smolts were trapped below the pond in the late 1970's (Argue, et. al 1979).

Enhancement Assessment

Diversion from Fish Gut Alley could provide permanent wetting. It may be most appropriate to provide winter water only for chum spawning and incubation. Fish Gut Alley is better rearing habitat. However, this channel may have provided overwintering coho and trout important access to Rotary Park-Fish Gut Alley **Production Option #12**

| | |
|-----------------------|-----------------------|
| Increased wetted area | = 2200 m ² |
| Potential | = 1,100,000 Cm fry |

Rank 18

Side Channel I.D. F16 Flood BATHTUB OUTLET CHANNEL
(29)

| | | | |
|--------------------------|------|----------|-----|
| Average Wetted Width (m) | 2 | % Pool | 100 |
| Channel Width (m) | 5.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 60.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 87/10/10 Crew: TB Air Photo

Location No. BCC 394 136,137

Weather: clear, warm Air Temp. 20 Water Temp. 14 Access:
Trunk Rd, McKinstry Rd., Dyke, short spur Rd., path

A flood channel in technical terms but also wetted by the winter water table, backflooding and lateral percolation through the bar.

Substrate Composition Last Updated
Updated By

Fines 5 %
Gravel 5 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

Coho rearing and wintering. Coho fry that enter the channel become trapped by June; they number 100-200 and must be salvaged. Salvage conditions are difficult because of debris and vegetation (**FS6**).

Enhancement Assessment

Connection Bathtub to Fish Gut Alley would provide permanent flow

Wetted area increase = 300 m²
Yield potential = 108 Co smolts

Production Option # 13
Rank 67

Side Channel I.D. B17 Back BATHTUB BACKCHANNEL (30)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 5 | % Pool | 0 |
| Channel Width (m) | 6.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Head Date: 8/7/8 Crew: TB Air Photo
 Location No. BCC 394 136,137
 Weather: clear,hot Air Temp. 35 Water Temp. 20 Access: Trunk
 Rd., McKinstry Rd., Dyke, short spur Rd and path

Wetted by the winter water table and mainstem backflooding during high flows;
 possibility of some lateral infiltration from the river at high discharge.

Substrate Composition Last Updated
 Updated By

Fines 8 %
 Gravel 2 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction H

Fish Utilization

Coho fry rearing and wintering. Fry become trapped when outflow ceases in early summer. Although the channel remains wetted over the summer, it becomes shallow and warm. No coho fry survive this period and salvage is required. Numbers range between 600 and 1200 based on early May densities of 1-2 fry/m² (FS7)

Enhancement Assessment

Excavation of a connector channel to the mainstem of Inner Fish Gut active channel would provide replenishment water and insure survival of coho fry. Very little diversion would be required. This would be far better than salvage because salvage is very difficult in this channel due to the presence of escape cover, algae, debris and sediment.

Wetted area increase = 600 m²
 Yield potential = 192 Co smolts

**Production Option # 14
 Rank**

Side Channel I.D. R18 Relic TRAILER PARK PONDS (31)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 15 | % Pool | 0 |
| Channel Width (m) | 18.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 900.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 100 |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/9 Crew: TB Air Photo
Location No.BCC 145,146
Weather:clear, hot Air Temp. 35 Water Temp. 23 Access: Boys
Rd.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 7 % | | |
| Gravel 3 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Occasional coho and chum spawning and coho rearing and wintering. Nearly all summer rearing coho are lost to predation or inhospitable conditions (Burns, 1982). Occasional large chum escapement prior to Trailer Park establishment, owner dislikes carcasses and smell.

Enhancement Assessment

Part of the Lower River South Side Sidechannel complex which comprises six sidechannels. Addition of summer water at the head of Silver Bridge Relic would add 45,232 m² to the base wetted area, an increase of 158%
This sidechannel would gain 2700 m² . However this figure is misleading because the present residual wetted area is not habitable due to stagnation. A better estimate is 18,200.

**Production Option # 4
Rank 1**

**Side Channel I.D. R19 Relic SILVER BRIDGE RELIC
CHANNEL (32)**

| | | | | |
|--------------------------|-------|-------|----------|----|
| Average Wetted Width (m) | 0 | | % Pool | NA |
| Channel Width (m) | 14.00 | | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA | |
| Channel Length (m) | 325.0 | | % Glide | NA |
| Debris (%) | 5 | | % Slough | NA |
| Gradient | .1 | | | |
| Elevation (m) | | | | |
| Turbidity (cm) | nil | | | |

Site Location: 100m below head Date: 87/1/20 Crew TB Air
Photo Location No. BCC 394 138,139

Part of an extensive sidechannel system that was cut-off in the 1950's by construction of the present Island Highway. Since then, its been further isolated by dyking. The channel is now only sporadically wetted by the winter water table. It is the uppermost of Five Channels but if it was used to access water, the highway would have to be bored (1995 cost est: \$80,000)

**Substrate Composition Last Updated
 Updated By**

Fines 4 %
Gravel 5 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

None

Enhancement Assessment

Introducing water at the channel head would increase downstream wetted area by the following amounts in the Lower River South Side Sidechannel Complex:

1. Silver Bridge Relic (19R) 4550 m²
2. Trailer Park Slough (18R) 18200
3. John's Creek (11A) 7600
4. Major Jimmy's (8B) 8692
5. Dyke Road (sf11A) 3050
6. Duckweed (sf8A) 3140

Total = 45,232 m²
Yield potential = 14,698 co smolts

**Production Option #4
Rank 1**

Side Channel I.D. R20 Relic RELIC CHANNEL ABOVE BLACK BRIDGE (INSIDE) (33)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 14.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 500.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 150 m. below head Date: 87/1/20 Crew: TB Air
 Photo Location No. BCC394 138,139
 Access: Allenby or Trunk Rds. to IR Rd.

Substrate Composition Last Updated
 Updated By

Fines 4 %
 Gravel 5 %
 Cobbles 1 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

None

Enhancement Assessment

Good potential for a chum spawning channel width an length are not limited to present dimensions but have been utilized to calculate yield. Complete excavation up to the inlet berm is necessary.

Wetted area increase = 7000 m²
 Yield potential = 3,500,000 cm fry
 = 2240 co smolts
 = 1120 ch smolts

**Production Option #15
 Rank 3**

Side Channel I.D. F21 FloodGARBAGE BEND FLOOD-BACK CHANNEL (34)

| | | | |
|--------------------------|------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 0 |
| Channel Width (m) | 5.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 84.0 | % Glide | 0 |
| Debris (%) | 30 | % Slough | 100 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/10/8 Crew: TB Air Photo
 Location No. NA
 Weather: clear, cool Air Temp. 18 Water Temp. 15 Access:
 Boys Rd., E & N Rail.

This channel is as much a backchannel as it is a flood channel.

Substrate Composition Last Updated
 Updated By

Fines %
 Gravel %
 Cobbles %
 Boulders %
 Bedrock %
 Compaction

Fish Utilization

Chance of coho overwintering in backchannel portion. A few coho also summer rear in this segment.

Enhancement Assessment

A buried drain could be installed below the inlet berm to provide year round flow.

Wetted area increase = 290 m²
 Yield potential = 104 Co smolts

**Production Option #16
 Rank 68**

Side Channel I.D. R22 Relic RELIC CHANNEL ABOVE BLACK BRIDGE (OUTSIDE) (35)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 920.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/1/20 Crew: TB Air Photo Location No. BCC 394 138,139

Access: Allenby or Trunk Rds. to IR Road

Substrate Composition Last Updated
 Updated By

Fines 4 %
 Gravel 5 %
 Cobbles 1 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

None

Enhancement Assessment

Good potential for a chum spawning channel. Length and width are not limited to channel dimensions. The floodplain lobe here is approximately 7.5 hectares and offers perhaps half that area as potential chum spawning area. Complete excavation up to the inlet berm is required.

Wetted area increase = 2560 m²
 Yield potential = 1,280,000 Cm, 816 Co, 409 Ch

**Production Option #17
 Rank**

Side Channel I.D. B23 Back BONSALL'S SLOUGH (36)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 14 | % Pool | 0 |
| Channel Width (m) | 15.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 200.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 8/7/24 Crew: TB Air Photo
Location No. BCC 394 139,140
Weather: clear Air Temp. 22 Water Temp. 15 Access: Indian
Rd., Side Rd.

Wetted by winter water table and percolation through the bar.

Substrate Composition Last Updated
 Updated By

Fines 6 %
Gravel 4 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

Chum spawning, coho wintering.

Enhancement Assessment

Scarification and inlet maintenance required periodically. If enough flow could be provided to flush the channel, 4155 m² of chum spawning habitat would result. If some flow persisted through the summer, so could coho fry. Most leave the channel by May.

Yield potential = 2,077,500 cm fry
 = 1,329 coho smolts

Construction of a more porous inlet system (French drain?) is required.

Production Option #18
Rank

Side Channel I.D. F24 Flood CHANNEL BELOW S POOL
(37)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 135.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Near Inlet Date: 87/5/16 Crew: TB Air Photo
Location No. BCC 394 141
Access: rough rd. from Indian Rd., wade river

Substrate Composition Last Updated
 Updated By

Fines 3 %
Gravel 7 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

None

Enhancement Assessment

No enhancement potential.

Side Channel I.D. F25 FloodS POOL FLOODCHANNEL (38)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 113.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/9 Crew: TB Air Photo Location No. BCC 394 141
Weather: clear, hot Air Temp. 34 Access: Rough Rd. from
Indian Rd.

Substrate Composition Last Updated
 Updated By

Fines 1 %
Gravel 8 %
Cobbles 1 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

Possibility of chum spawning.

Enhancement Assessment

No opportunities for improvement are present.

Side Channel I.D. F26 FloodREDBONE FLOODCHANNEL (39)

| | | | |
|--------------------------|------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 3.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 98.0 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 8/7/16 Crew: TB Air Photo
Location No. BCC 404 036.037
Access: Riverbottom Rd.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

A few coho fry enter the channel in April

Enhancement Assessment

Installation of a drain under the berm could provide permanent flow.

| | |
|----------------------|----------------------|
| Wetted area increase | = 294 m ² |
| Yield potential | = 23 Co smolts |

**Production Option #19
Rank**

Side Channel I.D. R27 Relic RELIC CHANNEL NEAR BAHR POOL
(40)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 4.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 320.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/8/8 Crew: TB Air Photo Location No. BCC 404 036,037
Weather: clear, hot Air Temp. 34 Access: wade river or hike
Footpath from Holt Creek

This channel may not dry every year.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho wintering and spring rearing.

Enhancement Assessment

It may be possible to link this channel with Bahr Pool active channel.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1600 m ² |
| Yield potential | = 512 Co smolts |

Production Option #20
Rank

Side Channel I.D. A28 Active BAHR POOL ACTIVE
CHANNEL (TWIN CREEKS) (41)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 4 | % Pool | 54 |
| Channel Width (m) | 16.00 | % Riffle | 32 |
| Minimum Flow | .079 | % Run | 0 |
| Channel Length (m) | 370.0 | % Glide | 14 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/8 Crew: TB Air Photo
 Location No. BCC 404 036,037
 Weather: clear, hot Air Temp. 32 Water Temp. 17-21.5 Access:
 Cowichan Footpath from Holt Cr. or wade river

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho, steelhead and chum spawning; coho summer rearing.

Enhancement Assessment

Buried drains under the inlet berms could provide more summer flow.

Wetted area increase = 5180 m² square
 Yield potential = 1657 Co smolts

Or excavation of pools which would be much cheaper and accomplish the same result.

Production Options #21,22
Rank

Side Channel I.D. A29 Active TZARTLAM ACTIVE
CHANNEL (42)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 2 | % Pool | 76 |
| Channel Width (m) | 5.00 | % Riffle | 24 |
| Minimum Flow | .01 | % Run | 0 |
| Channel Length (m) | 500.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near upper end Date: 87/8/4 Crew: TB Air
 Photo Location No. BCC 404 037,038
 Weather: clear, warm Air Temp. 29 Water Temp. 12 Access:
 Riverbottom Rd., then path that leads to Picnic Pool.

Wetted by:

1. winter water table
2. seepage from upland
3. occasional light spill from mainstem
4. Tzartlam Cr. (Nov. - May, lower 10 m)

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho and chum spawning, coho summer rearing and overwintering. Tzartlam channel produced 1.04 coho smolts per square meter in 1976 (Argue et. al, 1979). They called it "Cowichan Sidechannel."
 A few Cutthroat trout and lampreys are also present.

Fry densities(m²) from Holtby (pers. comm.)
 16/9/86 Co 2.5 Ct 1.0
 12/10/86 Co .225 Ct .13

Enhancement Assessment

No improvement necessary.

Side Channel I.D. R30 Relic PERCHED RELIC CHANNEL

| | | | |
|----------------------|-------|----------|-----|
| (43) | | | |
| Average Wetted Width | 0.009 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 550.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 100m below channel head Date: 8/7/8 Crew: TB
Air Photo Location No. BCC 404 036,037
Weather: clear, Hot Air Temp. 32 Access: Cowichan footpath
from Holt Cr. or wade or boat across river in Picnic Pool area

No connection with river; inaccessible.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 9 % | |
| Gravel | 2 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

None

Enhancement Assessment

No opportunities exist.

**Side Channel I.D. A31 Active EAGLE'S ROOST ACTIVE
CHANNEL (44)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 7 | % Pool | 39 |
| Channel Width (m) | 12.00 | % Riffle | 17 |
| Minimum Flow | .282 | % Run | 0 |
| Channel Length (m) | 400.0 | % Glide | 14 |
| Debris (%) | 10 | % Slough | 30 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 8/7/8 Crew: TB Air Photo
 Location No. BCC 404 037,038
 Weather: Clear,hot Air Temp. 32 Water Temp. 17.5 Access:
 Riverbottom Rd., road and path to Tzartlam and Picnic Pool or
 Cowichan footpath.

Substrate Composition Last Updated
 Updated By

Fines 1 %
 Gravel 7 %
 Cobbles 1 %
 Boulders 1 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho and chum spawning, coho spring - summer rearing and overwintering.
 Cutthroat trout also spawn and rear in this channel.

Enhancement Assessment

No improvement required.

Side Channel I.D. F32 Flood EAGLE'S ROOST FLOOD
CHANNEL (45)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 160.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 50 m. above outlet Date: 87/5/16 Crew: TB Air
 Photo Location No. BCC 404 037,038
 Weather: warm, dry Air Temp. 20 Access: Cowichan footpath
 from Holt Cr.

A true flood channel only flowing in floods. May go several years without carrying water.

Substrate Composition Last Updated
 Updated By

Fines 7 %
 Gravel 3 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

None.

Enhancement Assessment

Not suitable for enhancement.

**Side Channel I.D. A33 Active ACTIVE CHANNEL BELOW
BIBLE CAMP BRIDGE (46)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 3 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 270.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/8/9 Crew: TB Air Photo Location No. BCC 404 038,039
Weather: clear,hot Air Temp. 33 Water Temp. 13-17 Access:
Riverbottom Rd., Bible Camp, bridge, path

Wetted by:

1. Mainstem spill (Nov.-April)
2. Winter Water Table
3. Groundwater Upwelling

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho, steelhead and chum spawning, coho and steelhead rearing. Fry salvage required. Usual yield: 500-1000 coho.

Enhancement Assessment

Installation of a buried drain underneath the inlet berm could provide permanent flow. The berm should also be raised and more cover (LWD) added to the channel.

Wetted area increase = 2052 m²
Yield potential = 656 Co smolts

**Production Option #23
Rank**

Side Channel I.D. R34 Relic WALL'S RELIC CHANNEL (47)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 20.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 270.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/1/21 Crew: TB Air Photo Location No. BCC 404
038,039

An overmature channel long removed from river influence. A few puddles surface during high river flows.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 9 % | |
| Gravel | 1 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None

Enhancement Assessment

This channel could be linked with the Bible Camp Backchannel to provide additional winter habitat for coho. Minor excavation and a small culvert(.3 m.) would allow backflooding.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 5400 m ² |
| Yield potential | = 5400 Co smolts |

**Production Option #24
Rank**

| | | | |
|--------------------------------|---------------|-------------------------|----|
| Side Channel I.D. A35/1 | Active | BIBLE CAMP OXBOW | |
| (48) | | | |
| Average Wetted Width (m) | 2 | % Pool | 80 |
| Channel Width (m) | 50.00 | % Riffle | 15 |
| Minimum Flow | .0015 | % Run | 0 |
| Channel Length (m) | 730.0 | % Glide | 5 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .002 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/9 Crew: TB Air Photo
 Location No. BCC 404 039, 040
 Weather clear, warm Air Temp. 33 Water Temp. 14 River
 Bottom Rd., Bible Camp

An active channel within a relic channel. Average active channel width is 4 m.
 Aug. 6-11/87 drawdown caused the loss of 740 m² of wetted area.

| | | |
|-----------------------|-----|--------------|
| Substrate Composition | | Last Updated |
| | | Updated By |
| Fines | 7 % | TB/AL 2/98 |
| Gravel | 3 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho spawning, overwintering and summer rearing. This channel produced 2870 coho smolts in 1976 (Argue et. al, 1979); .98/m²

Fry densities(m²) from Holtby (pers.comm)
 16/9/86 Co 4.0 Ct .096
 12/7/86 Co 24.0 Ct .19

Enhancement Assessment

The entire channel could be excavated for chum spawning resulting in 36,500 m². However, the channel is best suited for coho production .Installation of a drain beneath the inlet berm might provide permanent flow. NOTE: Upper portion of channel on Hooper property. River bank has lost approximately 7.6 m at a point just upstream. Anthony Lee is living on the property (1998). DFO considered development (1990) but M.Hooper wanted minimal change while DFO wanted considerable. Inlet berm eroded away by early winter 1998. Channel now open to flooding and spill water is turbid. It is evident that considerable work will be required to defend the inlet and the bank upstream.

Wetted area increase = 2360 m²
 Yield potential = 755 additional Co smolts

Installation of inlet berm and drain. Install deflector logs upstream to defend bank and start willow bundles behind logs. Use combination of bundles and stakes

(cuttings). Some rebar may be necessary to stake bundles. Start cottonwood forest behind bundles.

Production Option #25

**Side Channel I.D. B35/2 Back LOWER PART OF BIBLE
CAMP OXBOW (49)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 9 | % Pool | 0 |
| Channel Width (m) | 20.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 100 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/8/9 Crew: TB Air Photo Location No. BCC404 Nos. 039,040

Weather: clear,hot Air Temp. 34 Access: Riverbottom Rd.

Wetted by water table, back flooding and occasional spill from the river via a breakout channel.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 6 % | |
| Cobbles | 2 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho and chum spawning; coho rearing and wintering.

| Coho fry densities(/m2) | |
|--------------------------|-----|
| 15/9/86 | 3.7 |
| 7/12/86 | 3.3 |

Enhancement Assessment

A buried drain under the breakout channel berm might provide permanent wetting.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1190 m ² |
| Yield potential | = 95 Co smolts |

This channel was partially excavated in 1983 by an EBAP crew.

**Production Option #26
Rank**

Side Channel I.D. F36 Flood ACROSS FROM BIBLE CAMP FLOOD CHANNEL (50)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0.143 | % Pool | 0 |
| Channel Width (m) | 40.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 350.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 100 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/8 Crew: TB Air Photo
 Location No. BCC 404 039, 040
 Weather: clear, hot Air Temp. 34 Water Temp. 20 Access:
 Riverbottom Rd., Bible Camp Bridge

Wetted by winter water table and spill. Also by a tributary channel and upland run-off and seepage. Lower 100 m backfloods.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 5 % | | |
| Gravel 3 % | | |
| Cobbles 2 % | | |
| Boulders 1 % | | |
| Bedrock TR % | | |
| Compaction L | | |

Fish Utilization

Chum spawning, coho spring-summer rearing in backwater segment.
 Fry salvage required. Usual yield: 500 -1000 Cm.

Enhancement Assessment

Not suitable for improvement due to instability. However, if flood defense measures were incorporated, this channel could yield important benefits.

| | |
|----------------------|-------------------------|
| Wetted area increase | = 13,500 m ² |
| Yield potential | = 4320 Co smolts |
| | = 2160 Ch smolts |
| | = 6,750,000 chum fry |

Note: This production is questionable because chum spawn naturally in this channel. However, in most years, very high egg loss occurs due to drying. In the 1982-1988 period, flows were not high enough in one year (1983) to permit good survival.

Production Option #27 Rank

Side Channel I.D. R37 Relic WHITE FENCE RELIC CHANNEL
(51)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 415.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/1/22 Crew: TB Air Photo
Location No. BCC 404 039,040
Access: Riverbottom Rd.

An old post - glacial channel far removed from river influence. Wetted by the winter water table and upland runoff in periods of very high flow. Spills across Riverbottom Rd. at the White Fence and just east of the Sandy Pool access road.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 7 % | TB/AL 2/98 |
| Gravel 3 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

None except slight chance of wintering coho moving in at high flows

Enhancement Assessment

Beyond the range of river influence and enhancement.

Side Channel I.D. F38 FloodBIBLE CAMP BREAKOUT CHANNEL
(52)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 100.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/1/21 Crew: TB Air Photo
Location No. BCC 404 039,040
Access: Riverbottom Rd.

Substrate Composition Last Updated
 Updated By

Fines 2 %
Gravel 6 %
Cobbles 1 %
Boulders 1 %
Bedrock 0 %
Compaction

Fish Utilization

None

Enhancement Assessment

Installation of a buried drain in the berm could provide permanent wetting.

Wetted area increase = 600 m²
Yield potential = 192 co smolts

Production Option #28
Rank

**Side Channel I.D. F39/1 Flood FLOOD CHANNEL
 TRIBUTARY TO ACROSS FROM BIBLE CAMP FLOODCHANNEL
 (53)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 180.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: upper section Date: 87/8/8 Crew: TB Air
 Photo Location No.BCC404 Nos. 039,040
 Weather: clear, hot Air Temp. 34 Access: Riverbottom Rd.,
 Bible camp

Wetted by a temporary stream, the winter water table, groundwater seepage from the upland and occasional spill from the mainstem.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 5 % | | |
| Gravel 4 % | | |
| Cobbles 1 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Coho and chum spawning, coho and chinook spring rearing and coho wintering. Fry salvage required. Usual yield: 500 Co, 50 Ch, 1000 cm.

Enhancement Assessment

Excavation of a deep pool near the head of the breakout channels and a buried drain might provide permanent flow.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 2160 m ² |
| Yield potential | = 688 co smolts |
| | = 345 ch smolts |

**Production Option #29
 Rank**

Side Channel I.D. R40 Relic RELIC CHANNEL TRIB. TO FLOODCHANNEL TRIB. TO FLOODCHANNEL ACROSS FROM BIBLE CAMP (54)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 5.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 250.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/4/20 Crew: TB Air Photo
 Location No. BCC 404 039,040

A very mature channel that has not carried flow for many years. A few puddles are present in mid-winter when the water table is high.

Substrate Composition Last Updated
 Updated By

Fines 9 %
 Gravel 1 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction H

Fish Utilization

None

Enhancement Assessment

Not subject to improvement without very high cost.

Side Channel I.D. F41 Flood THIN SLICE FLOODCHANNEL (54)

| | | | |
|--------------------------|----------|----------|-----|
| Average Wetted Width (m) | 0.32 | % Pool | 100 |
| Channel Width (m) | 4.00 | % Riffle | 0 |
| Minimum Flow | 0 (int.) | % Run | 0 |
| Channel Length (m) | 65.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .3 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 60 m. below inlet Date: 8/7/8/9 Crew: TB Air
 Photo Location No. BCC 404 039,040
 Weather: clear,hot Air Temp. 34 Water Temp. 17 Access:
 Riverbottom Rd., Wade or Boat River at Powerline or hike from
 Bible Camp

Wetted by the winter water table and river flows above
 16 cms. Becomes int. when the mainstem drops below 16 cms.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |
| Fines 3 % | |
| Gravel 4 % | |
| Cobbles 2 % | |
| Boulders 1 % | |
| Bedrock 0 % | |
| Compaction M | |

Fish Utilization

Coho spring-early summer rearing.

Enhancement Assessment

Possible to provide permanent wetting by excavating an inlet pool and removing
 high spots.

| | |
|----------------------|----------------------|
| Wetted area increase | = 788 m ² |
| Yield potential | = 248 Co smolts |

**Production Option #30
 Rank**

Side Channel I.D. A42 Active POWERLINE ACTIVE
CHANNEL (55)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 3 | % Pool | 59 |
| Channel Width (m) | 14.00 | % Riffle | 14 |
| Minimum Flow | .00174 | % Run | 0 |
| Channel Length (m) | 200.0 | % Glide | 27 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 80 m. above outlet Date: 87/8/9 Crew: TB Air
 Photo Location No. BCC 404 038,040
 Weather: clear, hot Air Temp. 34 Water Temp. 21 Access:
 Riverbottom Rd., wade River or hike from Bible Camp
 This channel is in close phase with mainstem discharge.

Substrate Composition Last Updated
 Updated By

Fines 1 %
 Gravel 6 %
 Cobbles 2 %
 Boulders 1 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho and chum spawning, coho spring-summer rearing. Some coho likely winter in this channel but its capability is not high due to high freshet flows and lack of groundwater input.
 Many coho fry were lost to drying and predation when the river was lowered to 4.48 cms. on Aug.9, 1987.

Enhancement Assessment

It might be possible to strengthen the inlet berm to buffer high flows and install a drain beneath it to enhance low flows.

Wetted area increase = 2900 m²
 Yield potential = 428 Co smolts

Production Option #31
Rank

Side Channel I.D. R43 Relic MASSEY'S (56)

| | | | |
|--------------------------|------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 5.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 70.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |

Gradient

Elevation (m)

Turbidity (cm) nil

Site Location: Relic channel near dry bend. Date:87/6/17

Crew: TB Air Photo Location No. BCC 404 038,040

Weather: clear Air Temp. 19 Access: Riverbottom Rd., private road near powerline crossing

Wetted by winter water table and backflooding from the mainstem. Possibility of some coho wintering.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

Fines 8 %

Gravel 2 %

Cobbles 0 %

Boulders 0 %

Bedrock 0 %

Compaction H

Fish Utilization

Possibility of coho wintering.

Enhancement Assessment

Could be excavated to prolong wetting but little benefit would result.

**Side Channel I.D. F44 Flood FLOODCHANNEL OPPOSITE
 DRY BEND (57)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0.33 | % Pool | 25 |
| Channel Width (m) | 15.00 | % Riffle | 25 |
| Minimum Flow | .023 | % Run | 0 |
| Channel Length (m) | 120.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 50 |
| Gradient | 2.0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: flood channel opposite dry bend Date: 87/6/17

Crew: TB Air Photo Location No. BC 404 039,040

Weather: clear Air Temp. 18 Water Temp. 15 Access:

Riverbottom Rd., Massey's.

Lower 60 m. flowing slightly (1LPS). One 50 m² pool at 40 m.; contained 50 coho fry

Channel inundated by flood flows.

Substrate Composition Last Updated
 Updated By

Fines 1 %
 Gravel 5 %
 Cobbles 2 %
 Boulders 2 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho fry utilize the approximate lower half of this channel from emergence to autumn. Overwintering is doubtful due to probable high turbulence and lack of groundwater. The possibility should not be discarded however; especially in the backwater section.

Enhancement Assessment

No improvement necessary or possible. The berm could be lowered but this would allow the full force of flood flows and it would soon rebuild. Installing a pipe beneath the berm is impractical due to the unstable nature of the berm.

Side Channel I.D. R45/1 Relic (58)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 15 | % Pool | 0 |
| Channel Width (m) | 20.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 80.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/8/4 Crew: TB Air Photo Location No. BCC404 Nos. 040,041

Weather: clear, warm Air Temp. 30 Water Temp. 13 Access: wade river or hike footpath from Bible Camp

A small backchannel at the confluence of dry bend active channel and the mainstem.

Substrate Composition Last Updated
Updated By

Fines 8 %
Gravel 2 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

Coho rearing and wintering. Lesser use by chinook, chum, steelhead and cutthroat fry.

Enhancement Assessment

None required.

Side Channel I.D. A45/2 Active DRY BEND (CARSON'S CORNER) ACTIVE – RELIC COMBINATION CHANNEL (59)

| | | | |
|--------------------------|----------|----------|-----|
| Average Wetted Width (m) | 9 | % Pool | 100 |
| Channel Width (m) | 18.00 | % Riffle | 0 |
| Minimum Flow | 0 (.015) | % Run | 0 |
| Channel Length (m) | 900.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near Beaver Dam. Date: 87/8/4. Crew: TB Air
 Photo Location No. BCC404 040,041
 Weather: clear,warm Air Temp. 30 Water Temp. 13 Access: Wade
 River or hike footpath form Bible Camp

Four Reaches:

1. 20(20)0 8200 60-80 m - Backwater
2. 7(0) .01 4600 70 m - Channel Below Beaver Dam
3. 20(20) 0 8200 350 - Beaver Pond
4. 20(0) .01 8200 400 - Relic

Dry Bend Creek, the winter water table and back flooding provide wetting. The creek is permanent but the channel dries below the dam. Streamflow is captured by gravel underlying the pond.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|-----|
| Fines | 6 % |
| Gravel | 4 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | M |

Fish Utilization

Coho salmon spawning, summer rearing and overwintering. Spawning occurs on the creek mouth fan.
 Enhancement Assessment

Excavation and a buried drain would provide permanent wetting to the relic portion and, quite likely to the reach below the beaver dam.

Production Option #32

Side Channel I.D. F46 Flood DRY BEND FLOODCHANNEL (60)

| | | | |
|--------------------------|------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Length | 200 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient (%) | .1 | | |
| Elevation | | | |
| Turbidity | nil | | |

Site Location: Lower end. Date: 8/7/18 Crew: TB

Air Photo Location No. BCC 404 040-041

Weather: Cloudy, cool, showers AT 15 Access: wade river or hike footpath from Bible Camp

Only wetted in floods, may not flow for several years

Substrate Composition Last Updated

| | |
|----------|----|
| Fines | 6% |
| Gravel | 4% |
| Cobbles | 0% |
| Boulders | 0% |
| Bedrock | 0% |

Fish Utilization

None

Enhancement Assessment

No practical options.

Side Channel I.D. R47 Relic DRY BEND RELIC CHANNEL (61)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 260.0 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near outlet Date: 8/7/18 Crew: TB Air Photo
Location No. BCC404 040,041
Weather: cloudy, cool, showers Air Temp. 15 Access: Boat from
Asha's or hike from Bible Camp
I have never observed flow in this channel.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

None

Enhancement Assessment

Channel excavation and construction of an inlet berm could provide permanent wetting. It would also provide benefit to 45A.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1560 m ² |
| Yield potential | = 499 Co smolts |
| | = 780,000 Cm fry |
| | = 249 ch smolts |

**Production Option #33
Rank**

Side Channel I.D. R48 Relic RIVERSTONE RELIC CHANNEL (DURRANCE-WHITEHEAD)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 9.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 452.0 | % Glide | NA |
| Debris (%) | L | % Slough | NA |
| Gradient | .2 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 50 m. below head Date: 8/7/29 Crew: TB Air
 Photo Location No. BCC404 040,041
 Weather: clear, warm Air Temp. 25 Access: Riverbottom Rd. to
 Durrance Property 6.1 km west of Old Lake Cowichan Road. Path downstream
 to Bergstrom's and Whitehead's.

A few low spots are wetted by the winter water table. Permanent groundwater is present at variable depths. One pool remains throughout summer: Lizze's Duckpond. Occasional winter flow in lower end on Whitehead property but mostly from two tiny tributaries (Hodding and Whitehead Creeks). Bruce Hodding now lives on Durrance (Forbe's) property (1997). He has or will soon be purchasing it from his mother (Elizabeth Forbes).

Substrate Composition Last Updated 6/1/98
 Updated By TB

| | |
|------------|-----|
| Fines | 3 % |
| Gravel | 6 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | M |

Fish Utilization

None

Enhancement Assessment

Channel excavation would provide coho and chum spawning and coho rearing and wintering. The dyke provides an excellent inlet berm. Some erosion of the rip rap dyke occurred in the winter of 1996-97. Needs reinforcement. Best method of wetting would likely be a buried pipe that could extend from the river to Lizze's Duckpond. It is hoped that little excavation work should be required on the channel except at the bottom end on the Whitehead Property. However, the river level at the inlet is rather low and considerable excavation could be necessary. Spawning capability should be added in several places in the upper channel while the lower channel would have higher spawning potential and likely attract chums as well as coho.

Whitehead Creek could be diverted into the channel because it presently runs into the Cowichan via the lower horse pasture on the Williams Property (Rancho Del Rio) where some impact usually results. This is a very low priority item.

Wetted area increase = 4068 m² (residual water is not habitable or accessible)

Yield potential = 1301 Co smolts = 2,034,000 Cm fry

= 650 Ch smolts
= 2,034,000 cm fry

Production Option #34

Rank

Note: Channel was examined by Russ Doucette and Mel Sheng on May 28, 1998. Too much excavation would be required to access water, this wouldn't be acceptable to property owners.

Side Channel I.D. F49 Flood RIVERSTONE FLOODCHANNEL
(63)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 11.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 140.0 | % Glide | NA |
| Debris (%) | 2 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 20 m. below head Date: 87/6/29 Crew: TB Air
 Photo Location No. BCC404 040,041
 Weather: clear, warm Air Temp. 25 Access: Riverbottom Rd. to
 Durrance Property
 Only wetted during high winter flows.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Chum spawning in most years. Eggs are usually lost however because the channel is dry at normal winter water levels.
 Twenty-two chums spawned in this channel between Dec.1 and 10, 1987. By Dec. 20, it was dry. It didn't flow again before spring.

Enhancement Assessment

Lowering the inlet and installing a drain will prolong wetting. The berm above it should be strengthened.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1540 m ² |
| Yield potential | = 777,000 cm fry |

Object of enhancement should be to prolong wetting until chum fry emerge. Providing permanent flow is impractical and the channel has low capability for rearing.

Production Option #35
Rank

Side Channel I.D. A 50 Active ASHA'S SIDETCHANNEL (64)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 2 | % Pool | 40 |
| Channel Width (m) | 8.00 | % Riffle | 30 |
| Minimum Flow | .004 | % Run | 0 |
| Channel Length (m) | 600.0 | % Glide | 30 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 30 m. above confluence Date: 8/7/17 Crew: TB
 Air Photo Location No. BCC404 040,041,042
 Weather: clear,warm Air Temp. 22 Water Temp. 14 Access:
 Boat or wade Cowichan at bottom of Asha's Run or hike footpath
 from Dale's Cr.

Part of the largest sidechannel complex in the system.
 Located on a 20 HA flat laced with relic channels.
 Wetted by groundwater that likely originates from the river
 aquifer because flow fluctuates in phase with river discharge.
 However, flow recedes somewhat following minimum mainstem low
 water so other groundwater also contributes.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 3 % | |
| Gravel | 5 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawn and overwinter in this channel. Spawning is heavy some years 100-300 m. above the confluence. Cutthroat trout and lampreys are present. Both spawn in this channel.

Fry densities(m²) from B. Holtby
 15/8/86 Co 2.3 Ct .99
 12/4/86 Co .186 Ct .40

Enhancement Assessment

None practical. It would be possible to provide more direct access for river flow by trenching but cost would be high and extra winter flow might reduce habitat value. Networking with relic channels might be feasible with extra summer flow. This possibility requires more study as does the entire question of providing more flow to this sidechannel. This would be a very high priority channel if a practical method of supplying flow could be discovered.

Side Channel I.D. R51 Relic LEANNE'S SIDETCHANNEL (65)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 1 | % Pool | 30 |
| Channel Width (m) | 10.00 | % Riffle | 30 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 200.0 | % Glide | 40 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 150 m. above outlet Date: 8/7/17 Crew: TB Air
Photo Location No. BCC404 040,041,042
Weather: clear, warm Air Temp. 22 Water Temp. 14 Access:
Boat or wade across Asha's Run on Riverbottom Rd.
Upper 78 m. is a flood channel that is seldom wetted. The
functional length of this channel is 122 m.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 6 % | |
| Gravel | 3 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho fry utilize this channel in winter, spring and early summer. By late summer, only one 40 m. square pool remains as a refuge for less than 100 fish. Other pools are present but too small and shallow to hold fry.

Enhancement Assessment

Excavation of a deep infiltration pool at 122 m. would, in combination with spot trenching, might provide permanent flow. But yield could not justify cost.

Side Channel I.D. F52 FloodSAMMY'S FLOODCHANNEL (66)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 230.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .3 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near bottom end Date: 8/7/9 Crew: TB Air
 Photo Location No. BCC404 041,042
 Weather: clear, hot Access: Wade or boat asha's run
 Wetted by winter water table and large freshets; may not
 flow in low run-off winters.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

Coho fry find their way into the lower end during the winter and early spring. Since the channel dries by May or early June, some are lost. Number is usually less than 100.

Enhancement Assessment

The channel could be excavated for combination chum spawning - coho rearing but priority should be low due to benefits and because better sites are present.

| | |
|-----------------------|-----------------------|
| Increased wetted area | = 1560 m ² |
| Yield potential | = 499 co smolts |
| | = 249 ch smolts |
| | = 780 000 cm fry |

Inlet berm modification will be necessary.

**Production Option #36
Rank**

**Side Channel I.D. F53 Flood WASHOUT FLOODCHANNEL
(BUSTER'S) (67)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 20.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 200.0 | % Glide | NA |
| Debris (%) | 1 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near centre Date: 85/3/5 Crew: TB Air Photo
 Location No. BCC404 041,042
 Weather: cloudy, cool Air Temp. 10 Access: from Riverbottom
 Rd. Its possible to drive down this channel most of the year
 Only wetted in high flows. At "normal" winter discharge
 (approx. 60 cms), a few shallow pools are present. Much of this channel is on
 Buster Rowan's property.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 3 % | |
| Gravel | 5 % | |
| Cobbles | 2 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None

Enhancement Assessment

It would be possible to excavate this channel. Chum salmon would benefit most
 but coho advantages should also result.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 4000 m ² |
| Yield potential | = 1280 Co smolts |
| | = 2,000,000 cm fry |
| | = 640 Ch smolts |

**Production Option #37
Rank**

Side Channel I.D. R54 Relic RELIC CHANNEL ACROSS FROM MONK'S OXBOW (68)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 4.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 310.0 | % Glide | 0 |
| Debris (%) | 15 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Central Date: 87/7/17 Crew: TB Air Photo

Location No. BCC404 041,042

Weather: Mostly clear, warm Air Temp. 25 Access: Boat or wade from Kakalatza

Substrate Composition Last Updated
Updated By

Fines 7 %
Gravel 3 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

Coho wintering and spring rearing in the lower 60 m.

Enhancement Assessment

Excavation could produce a small chum salmon spawning channel and improved coho rearing. The berm should be left intact.

Wetted area increase = 1240 m²
Yield potential = 396 Co smolts
= 620,000 Cm fry
= 198 Ch smolts

**Production Option #38
Rank**

Side Channel I.D. F55/1 Flood (69)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 0 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 50.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 5 m. below Riverbottom Rd. Date: 8/7/98 Crew: TB
Air Photo Location No. BCC404 Nos. 041,042
Weather: clear,hot Air Temp. 33 Access: Riverbottom Rd.
Backflooded by moderate to high river flows, dries in late summer.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction | | |

Fish Utilization

Coho wintering and spring, early summer rearing.

Enhancement Assessment

Enhancement of 55A will provide permanent wetting of the channel centre.

Side Channel I.D. A55/2 Active **MONK'S OXBOW**
(70)

| | | | |
|--------------------------|--|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 610.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | NIL (lower end turbid at high flows due to river backflooding) | | |

Site Location: near outlet Date: 8/7/9/17 Crew: TB Air Photo

Location No. BCC 404 041,042

Weather: clear, hot Air Temp. 33 Access: Riverbottom Rd. , Carolyn Rd.

Outlet area rip rapped by Archibald-Chamberlain as part of downstream property defense (1994)

Wetted by

1. Winter water table
2. Winter back flooding (lower 50 m.) when Cowichan discharge is > 93 CMS at the Lake Cowichan stream gauge
3. Three small groundwater tributaries
4. A temporary tributary system that originates near Stoltz Hill

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|-----|
| Fines | 6 % |
| Gravel | 3 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | M |

Fish Utilization

Coho spawning, overwintering and spring – early summer rearing, chum spawning. 32 chums spawning Nov.26, 1991. CLSES set three minnow traps 4/27/1998: 20 coho smolts, one rainbow, one chinook and two sticklebacks. Channel is fry salvaged by Cowichan Hatchery. 1997 results: 1850 Co, 2650 Cm and 70 trout. Obviously St and Ct also winter in the channel.

Enhancement Assessment

A deep infiltration pool and spot excavation might provide permanent wetting. Construction of spawning platforms near upper end would increase chum yield. As many as 300 chums use this channel in high escapement years.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 6000 m ² |
| Yield potential | = 1920 Co smolts |

Production Option #39,40
Rank

Side Channel I.D. R56 Relic KAKALATZA RELIC CHANNEL
(71)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 200.0 | % Glide | NA |
| Debris (%) | NA | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near river Date: 87/9/18 Crew: TB Air Photo
Location No. BCC404 041,042

Weather: clear, warm Air Temp. 28 Access: Riverbottom Rd.

An old post-glacial channel long removed from active status;
never wetted except by spill from Monk's during very high flows. Such was the
case on Feb. 24, 1998 when water was running across the road and down this
channel.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
|-----------------------|--------------|

| | |
|------------|-----|
| Fines | 8 % |
| Gravel | 2 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Updated By

Fish Utilization

None - channel never wetted.

Enhancement Assessment

Beyond the range of enhancement.

Side Channel I.D. F57 Flood KAKALATZA FLOOD CHANNEL
(72)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 265.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 8/7/1 Crew: TB Air Photo Location No. BCC 404
041,042

Weather: clear, warm Air Temp. 29 Access: Riverbottom Rd.
Inundated by floods.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
|-----------------------|--------------|------------|

| | | |
|------------|-----|--|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho, chinook and chum fry enter the channel from its lower end in April and May but become trapped when water recedes in May and June. Fish are very difficult to salvage and annual losses approximate 100-300 fry; mostly coho.

Enhancement Assessment

The area is too unstable to support most measures.

Side Channel I.D. F58 Flood WILDWOOD FLOODCHANNEL (73)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 12.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 194.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .3 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: central Date: 87/4/1 Crew: TB Air Photo
Location No. BCC404 042,043
Weather: cloudy Air Temp. 10 Access Riverbottom Rd., Wildwood Rd.
Only occasionally wetted during freshets.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 7 % | |
| Gravel | 3 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Chum spawning especially in years of high escapement.

Enhancement Assessment

Conditions are favourable for chum salmon spawning if a channel were excavated. An inlet control structure would be necessary as would protection from mainstem lateral cutting and inundation.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 2328 m ² |
| Yield potential | = 1,164,000 chum fry |

It would be impractical to provide permanent flow to this channel. It need only persist until May.

Production Option #41 Rank

Side Channel I.D. F59 FloodDALE'S FLOODCHANNEL (74)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 348.0 | % Glide | NA |
| Debris (%) | 5 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: central Date: 87//1 Crew: TB Air Photo

Location No. BCC404 042,043

Weather: clear, hot Air Temp. 30 Access: Skutz Falls - Holt

Cr. Rd., CN Tracks, Cow. Footpath. Link rd. from Skutz Falls BCFS Rd. deactivated 1995. Alternate access via Dave Hignall's cable car. New footbridge from park proposed for Davie Corner (Loren Duncan, 2/99)

Flow provided by the winter water table and spill from the mainstem. Channel was not flowing above the sample site 2/22/97. Approximately 20 LPS was upwelling at the site. Mainstem discharge at Lake Cowichan was 66 CMS.

Substrate Composition Last Updated 2/22/97
Updated By TB

| | |
|------------|-----|
| Fines | 3 % |
| Gravel | 6 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | L |

Fish Utilization

Coho and chum salmon spawning. Coho rearing until early summer. 300-700 are lost to drying which usually occurs from late May to late June.

Enhancement Assessment

Excavation of an infiltration gallery near the inlet combined with drainage under the inlet berm should provide permanent wetting.

Wetted area increase = 948 m²
Yield potential = 1136 Co smolts
= 1,740,000 cm fry

Production Option #42

Rank

Side Channel I.D. R60 Relic STOLTZ RELIC CHANNEL (75)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 900.0 | % Glide | NA |
| Debris (%) | NA | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near head Date: 87/4/1 Crew: TB Air Photo
 Location No. BCC404 043,044
 Weather: cloudy Air Temp. 10 Access: Riverbottom Rd.
 A post-glacial channel long removed from river influence.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines % | | |
| Gravel % | | |
| Cobbles % | | |
| Boulders % | | |
| Bedrock % | | |
| Compaction | | |

Fish Utilization

None

Enhancement Assessment

No improvement possible

**Side Channel I.D. B61/1 Back DAVIE CORNER LAGOON
(76)**

| | | | |
|--------------------------|--------|----------|-----|
| Average Wetted Width (m) | 35 | % Pool | 0 |
| Channel Width (m) | 100.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 70.0 | % Glide | 0 |
| Debris (%) | 40 | % Slough | 100 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | 20 | | |

Date: 87/5/26 Crew: TB Air Photo Location No. BCC404
043,044

Water Temp. 14 Access: Skutz Falls - Holt Cr., Access Rd.
Backfloods in winter, becomes detached in spring or early
summer but receives permanent (albeit small) inflow from
groundwater seepage.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

Coho wintering and summer rearing. Brown trout are said to favour the lagoon at
times.

Enhancement Assessment

No improvement required.

Side Channel I.D. R61/2 Relic DAVIE CORNER RELIC NO.2
(77)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0.58 | % Pool | 57 |
| Channel Width (m) | 11.00 | % Riffle | 32 |
| Minimum Flow | .0018 | % Run | 0 |
| Channel Length (m) | 180.0 | % Glide | 11 |
| Debris (%) | 15 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/8/9 Crew: TB Air Photo Location No. BCC404 043,044
 Weather: clear,hot Air Temp. 32 Water Temp. 12 Access:
 Skutz Falls - Holt Cr. Rd., Cow footpath

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho spring-summer rearing and probability of overwintering.

Enhancement Assessment

No improvement required.

Side Channel I.D. R62 Relic DAVIE CORNER RELIC NO.1 (78)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 300.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 8/7/4/6 Crew: TB Air Photo Location No. BCC404 043,044

Wetted by the winter water table and backflooding.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

Possibility of coho wintering but smolt emigration is questionable.

Enhancement Assessment

Not subject to enhancement - no practical opportunities present.

**Side Channel I.D. F63 Flood FLOODCHANNEL ABOVE DAVIE
CORNER (79)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 65.0 | % Glide | NA |
| Debris (%) | 2 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near head Date: 87/4/6 Crew: TB Air Photo
Location No. BCC404 Nos. 043,044
Wetted only very occasionally by mainstem spill.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

None

Enhancement Assessment

No improvement opportunities are present.

**Side Channel I.D. F64 Flood STOLTZ BAR FLOODCHANNEL
(80)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 8.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 400.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 100m above outlet Date: 87/4/4 Crew: TB Air
 Photo Location No. BCC404 043,044
 Weather: cloudy, cool Air Temp. 7 Water Temp. 8 Access:
 from Stoltz Rd.
 Only flows in highwater.

Substrate Composition Last Updated
 Updated By

Fines 4 %
 Gravel 6 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho, chinook and chum fry enter this channel from its bottom end in the spring. Numbers may be high in years of early emergence. 500 chinook fry, 300 coho fry, 500 chum fry and 5 coho pre-smolts were salvaged between April 4 and 28, 1987.

312 chums spawned in this channel between Dec.6 and 10, 1987. An additional 221 spawned in the upper reach which is the road to Benellack's Pool. All eggs were lost to drying.

Enhancement Assessment

No practical enhancement options. The channel could be excavated to prolong flow but benefits would be very temporary due to the unstable nature of the channel and adjacent bar. However, it may be possible to defend a channel against most floods. More study required.

Wetted area increase = 3200 m²
 Yield potential = 1 600 000 Cm fry
 = 512 Ch smolts

**Production Option #43
 Rank**

Side Channel I.D. A65 Active STOLTZ ACTIVE CHANNEL (81)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 5 | % Pool | 66 |
| Channel Width (m) | 12.00 | % Riffle | 29 |
| Minimum Flow | .0054 | % Run | 0 |
| Channel Length (m) | 435.0 | % Glide | 5 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/4 Crew: TB Air Photo
 Location No. BCC404 043, 044
 Weather: clear,hot Air Temp. 33 Water Temp. 15.5 Access:
 Skutz Falls - Holt Cr. Rd. or wade river

A major sidechannel; carries heavy discharge in freshets.

Substrate Composition Last Updated
 Updated By

Fines 1 %
 Gravel 5 %
 Cobbles 4 %
 Boulders 1 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho and chum salmon spawning, coho summer rearing. The overwintering capability of this channel is suspect due to heavy flushing and bedload transport at times.

Enhancement Assessment

Excavation of an infiltration pool near the inlet might provide permanent wetting, particularly in conjunction with a buried pipe or French Drain. To reduce erosion at the toe of Stoltz Bluffs which are immediately downstream, a small diversion/training weir at the inlet should also be investigated. If this option is selected, it will reduce the winter habitat value of the channel.

Wetted area increase = 6903 m²
 Yield potential = 2208 Co smolts

Improvement of the inlet berm would reduce scour. It would have to be removed if 65A were used to reduce bluff erosion.

Production Option #44 Rank

Side Channel I.D. F66 FloodSTOLTZ FLOODCHANNEL "A"
 (82)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 5.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 20 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 87/4/6 Crew: TB Air Photo Location No. BCC404 043,044
 Weather: cloudy, cool Air Temp. 12 Water Temp. 8 Access:
 Skutz Falls - Holt Cr. Rd.

Wetted by the winter water table and occasional spill from the river.

Substrate Composition Last Updated
 Updated By

Fines 2 %
 Gravel 8 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Light coho and chum spawning; 450 chum and 50 coho fry were salvaged 6/4/87.

Enhancement Assessment

Excavating an infiltration pool near the inlet may prolong wetting. Additional measures are not justified. This would guarantee chum fry survival.

Wetted area increase = 500 m²
 Yield potential = 250,000 cm fry

Production Option #45
Rank

**Side Channel I.D. F67 Flood STOLTZ FLOODCHANNEL
"B"**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 5.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 200.0 | % Glide | NA |
| Debris (%) | 1 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 87/6/4 Crew: TB Air Photo Location No. BCC404
043,044

Weather: cloudy, cool Air Temp. 12 Access: Skutz Falls - Holt
Creek Rd.

A difficult channel to characterize. Wetted by flooding but on an infrequent basis; once in 5 to 10 years.

Substrate Composition Last Updated
Updated By

Fines 3 %
Gravel 7 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction M

Fish Utilization

None

Enhancement Assessment

Major excavation would be required to bring this channel into production. It has fair potential as a chum spawning channel and could also rear coho as a secondary benefit.

Wetted area increase = 1000 m²
Yield potential = 500,000 chum fry
= 320 coho smolts
= 160 chinook smolts

**Production Option #46
Rank**

Side Channel I.D. F68 Flood MOSQUITO RUN
FLOODCHANNEL (84)

| | | | | |
|--------------------------|-------|-------|----------|-----|
| Average Wetted Width (m) | 6 | | % Pool | 100 |
| Channel Width (m) | 8.00 | | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 | |
| Channel Length (m) | 140.0 | | % Glide | 0 |
| Debris (%) | 2 | | % Slough | 0 |
| Gradient | .3 | | | |
| Elevation (m) | | | | |
| Turbidity (cm) | nil | | | |

Date: 8/7/84 Crew: TB Air Photo Location No. BCC404 082,083
 Weather: clear,hot Air Temp. 30 Water Temp. 20.5 Access:
 Skutz Falls - Holt Cr. Rd., Cowichan footpath

Substrate Composition Last Updated
 Updated By

Fines 2 %
 Gravel 7 %
 Cobbles 1 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho spring and early summer rearing.

Enhancement Assessment

No enhancement opportunities are present. The inlet is too unstable for modification to hold.

Side Channel I.D. R69 Relic MOSQUITO RUN RELIC CHANNEL
(85)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 7.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 180.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: 150 m. above lower end Date: 87/6/27 Crew: TB
 Air Photo Location No. BCC404 082,083
 Weather: clear,warm Air Temp. 21 Access: Baahem Rd. than path
 from W. Riverbottom Rd. Some private properties in this alcove including a
 UVIC cabin.

Sustains standing or slowly flowing water from Nov. to early May. Wetted by
 seepage from the upland and the winter water table.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

A few chums spawn in this channel. As many as 30-40 are seen in high
 escapement years.

Enhancement Assessment

Addition of several spawning platforms would benefit chum spawning. The
 channel is highly deficient in quality gravel.

Yield potential = 50,000 Cm fry

Production Option #47
Rank

Side Channel I.D. A70/1 Active KILLDEER LAGOON (86)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 15 | % Pool | 100 |
| Channel Width (m) | 15.00 | % Riffle | 0 |
| Minimum Flow | .017 | % Run | 0 |
| Channel Length (m) | 50.0 | % Glide | 0 |
| Debris (%) | 0 | % Slough | 0 |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/6/27 Time: 1500 Crew: TB Air Photo Location No.
BCC404 084,085
Weather: clear, warm Air Temp. 25 Water Temp. 15 Access:
Cowichan footpath

A unique groundwater upwelling basin. 20% of its flow is supplied by groundwater (on this date) - 86/6/27. Coho, steelhead, cutthroat and brown trout fry were present

Co 45-65 mm. Ct 38 mm.
St 35 mm. Bt 44 mm.

Substrate Composition Last Updated
 Updated By

Fines 3 %
Gravel 6 %
Cobbles 0 %
Boulders 0 %
Bedrock 1 %
Compaction L

Fish Utilization

Coho, cutthroat, steelhead and brown trout fry are summer residents. Its suspected that they are progeny of spawners because the lagoon enters a steep riffle just above Marie Canyon and its outlets are swift in the spring (.33 and .5 m/sec on June 27/87). Strong possibility of overwintering by all resident species.

Enhancement Assessment

None necessary

**Side Channel I.D. A70/2 Active KILDEER LAGOON'S MAIN
INLET (87)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 2 | % Pool | 20 |
| Channel Width (m) | 3.00 | % Riffle | 80 |
| Minimum Flow | .0057 | % Run | 0 |
| Channel Length (m) | 30.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 87/6/27 Crew: TB Air Photo
 Location No. BC404 Nos. 084,085
 Weather: clear,warm Air Temp. 25 Water Temp. 16.5 Access:
 Cowichan R. footpath

Spring - summer flow provided by seepage through the inlet
 berm which is occasionally overtopped by winter flows.

Substrate Composition Last Updated
 Updated By

Fines 1 %
 Gravel 4 %
 Cobbles 5 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Supports about 40 coho fry in summer. Very slight chance of a few coho
 spawners. Overwintering capability is considered nil.

Enhancement Assessment

No improvement required. Accessing the inlet berm to mainstem flow could
 reduce the capability of this highly unique complex.

**Side Channel I.D. A70/3 Active KILDEER LAGOON'S
SECOND INLET (88)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0.5 | % Pool | 30 |
| Channel Width (m) | 2.00 | % Riffle | 70 |
| Minimum Flow | .0017 | % Run | 0 |
| Channel Length (m) | 120.0 | % Glide | 0 |
| Debris (%) | 30 | % Slough | 0 |
| Gradient | .3 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 87/6/17 Air Photo Location
No. BC404 Nos. 084,085
Weather: Clear and warm Air Temp. 26 Water Temp. 10.5 Access:
Cowichan footpath from Skutz Falls or wade river at lower Horseshoe Bend

Primary flow source is upland seepage and the winter water table. Flood flows may occasionally wet the upper 90 m.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 3 % | | |
| Gravel 7 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Too small for coho spawning or summer rearing; possible coho winter habitat.

Enhancement Assessment

Excavation of a deep infiltration pool near the berm may provide enough summer flow for coho rearing. However, only 240 fry could be carried and there is no access for heavy equipment.

Side Channel I.D. R71 Relic TOP OF CANYON RELIC (89)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 3.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 112.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: 50 m. above outlet Date: 87/4/2 Crew: TB Air
Photo Location No. BCC404 084,085

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
|-----------------------|--------------|------------|

| | | |
|------------|-----|--|
| Fines | 7 % | |
| Gravel | 0 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

None

Enhancement Assessment

No practical improvement opportunities.

Side Channel I.D. A72 Active LOWER HORSESHOE BEND
ACTIVE CHANNEL (90)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 3.7 | % Pool | 55 |
| Channel Width (m) | 10.00 | % Riffle | 40 |
| Minimum Flow | .002 | % Run | 0 |
| Channel Length (m) | 314.0 | % Glide | 10 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient | 1.0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/8/8 Crew: TB Air Photo
 Location No. BCC4 04 084,085
 Weather: clear, warm Air Temp. 30 Water Temp. 12.5 Access:
 Mayo Rd., BCFS Rec. Site Rd., trail

This channel is wetted by subsurface water through the berm and laterally through the bar.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 5 % | |
| Cobbles | 3 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

This channel supports coho and chum spawning and coho summer rearing. A few (<500) coho fry are trapped in the middle section between May and July. Fry densities from Holtby (pers. comm.)

Co .67 10/9/86
 Co 4.90 12/4/86

Enhancement Assessment

Peak flows are far too high and summer discharge is too low. Raising the inlet berm and excavating the upper 30 m. could reduce high flows and increase summer discharge.

Wetted area increase = 2305 m²
 Yield potential = 737 Co smolts

Production Option #48
Rank

Side Channel I.D. R73 Relic MILE 11 SIDCHANNEL (91)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 7.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 266.0 | % Glide | NA |
| Debris (%) | 30 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 8/6/11 Crew: TB Air Photo Location No. BCC404
Weather: cloudy, cool Air Temp. 8 Access: Cowichan footpath

Substrate Composition: Gravel and cobbles underneath

Wetted by winter water table(a few pools) and occasional light spill from the mainstem in very high water. Lower 20 m. backfloods.

Substrate Composition Last Updated
 Updated By

Fines 8 %
Gravel 1 %
Cobbles 1 %
Boulders 0 %
Bedrock 0 %
Compaction

Fish Utilization

A few coho may utilize the backwater portion of this channel in the spring; chinooks also.

Enhancement Assessment

Excavation of a deep infiltration pool below the inlet berm could provide permanent wetting.

Wetted area increase = 1862 m²
Yield potential = 595 Co smolts
 = 297 Ch smolts

**Production Option #49
Rank**

**Side Channel I.D. A74 Active HORSESHOE BEND ACTIVE
CHANNEL (92)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 8 | % Pool | 100 |
| Channel Width (m) | 12.00 | % Riffle | 0 |
| Minimum Flow | int. | % Run | 0 |
| Channel Length (m) | 250.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Mid-channel constriction Date: 87/8/8 Crew:
TB Air Photo Location No. BCC404 085,086
Weather: clear, hot Air Temp. 32 Water Temp. 18 Access:
Mayo Rd.

The channel is buffered by a mature berm.

Substrate Composition Last Updated
 Updated By

Fines 2 %
Gravel 5 %
Cobbles 2 %
Boulders 1 %
Bedrock 0 %
Compaction M

Fish Utilization

Coho spawn, rear and winter in this channel; 22 spawned here in 1985. A few chums also utilize this channel.

Enhancement Assessment

No physical modification is required but, due to very high spring - early summer coho fry densities, thinning is necessary to prevent large scale attrition over the summer. Early summer fry usually number about 10,000 (3.3 per m²) and late summer carrying capacity @ 1 fry/m² is 1250, 8750 coho fry should be salvaged in most years. 6750 were salvaged in 1986 (Burns, et.al 1987).

**Side Channel I.D. F75 FloodHORSESHOE BEND
FLOODCHANNEL (93)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 1 | % Pool | 100 |
| Channel Width (m) | 6.00 | % Riffle | 0 |
| Minimum Flow | int. | % Run | 0 |
| Channel Length (m) | 150.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient | 1.0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near outlet Date: 87/8/8 Crew: TB Air Photo
 Location No. BCC404 085,086
 Weather: clear, hot Air Temp. 32 Water Temp. 20 Access:
 Mayo Rd.

Upper 80 m. dry early but lower 70 are permanent as long as mainstem flows are above 5 CMS.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 1 % | | |
| Gravel 5 % | | |
| Cobbles 2 % | | |
| Boulders 2 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Supports coho and chum spawning; heavy chum spawning in high escapement years. Chum fry salvage is usually necessary; 45,000 were rescued on April 25, 1987.

Enhancement Assessment

It may be possible to increase the height of the inlet berm and excavate an infiltration pool below it to reduce high flows (peak flows are about 50% too high) and increase summer flow.

| | |
|----------------------|----------------------|
| Wetted area increase | = 750 m ² |
| Yield potential | = 240 Co smolts |

**Production Option #50
Rank**

Side Channel I.D. F76 FloodHOCKEY POOL FLOODCHANNEL
(93)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 130.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | 1.0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near inlet Date: 87/4/25 Crew: TB Air Photo
 Location No. BCC404 085,086,
 Weather:clear,mild Air Temp. 15 Water Temp. 9 Access: Mayo
 Rd., W. Riverbottom Rd.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 3 % | |
| Cobbles | 3 % | |
| Boulders | 3 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Some coho and chum spawning in some years. Considerable early coho fry rearing into the lower 50 m. which is a backwater in the spring. Approximately 200 to 400 become trapped. Salvage is difficult because of the boulder substrate.

Enhancement Assessment

No opportunities evident.

Side Channel I.D. R77 Relic BOTTLECAP SIDECHANNEL

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 0.5 | % Pool | 30 |
| Channel Width (m) | 3.00 | % Riffle | 10 |
| Minimum Flow | .00081 | % Run | 0 |
| Channel Length (m) | 236.0 | % Glide | 20 |
| Debris (%) | 30 | % Slough | 40 |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 5 m. below culvert on Cowichan Footpath Date: 87/6/27 Crew: TB Air Photo Location N.o BC404 086,087
Weather: clear, warm Air Temp. 20.5 Water Temp. 13 at outlet, 9 at source Access: Cowichan footpath from Skutz Falls

Culvert at 15 m. prevents access. Good possibility of coho overwintering if it were replaced (a 1 m. arch culvert would do the job).
Bottle cap Spring, the channel's main source, flows steady at approximately .02 cms between 9 and 10 degrees. Sidechannel flow is independent of river flow but is not reflective of source discharge.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 7 % | |
| Gravel | 3 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None

Enhancement Assessment

Replacement of a culvert underneath the Cowichan Footpath (15 m. from the river) would allow entry of coho fry for overwintering. A 1 m. diameter arch culvert set flush with the stream would do the job. This channel is excellent winter habitat-little flow fluctuation and 9 degree water. Fish may have trouble finding it however because of its size and adjacent river velocity.

Yield potential= 705 coho smolts

Production Option #51
Rank

Side Channel I.D. R78 Relic LORENZO'S RELIC CHANNEL
(94)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 0 |
| Channel Width (m) | 3.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 500.0 | % Glide | 0 |
| Debris (%) | 20 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: 30 m. from mainstem Date: 8/7/27 Crew: TB Air
Photo Location No. BCC404 086,087
Weather: clear, warm Air Temp. 21 Access: Skutz Falls-Holt
Creek Rd. branch, path

Flows from November to April-May; Independent from river. Coho fry have been observed in winter.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
|-----------------------|--------------|

| | |
|------------|-----|
| Fines | 9 % |
| Gravel | 1 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Updated By

Fish Utilization

A few coho fry have been observed in late winter; The channel is excellent winter habitat.

Enhancement Assessment

No evident opportunities for improvement. The channel is wetted by periodic upland seepage and the winter water table.

**Side Channel I.D. F79 Flood FLOODCHANNEL COMPLEX
ACROSS FROM BEAR CREEK (95)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | 30 |
| Channel Width (m) | 6.00 | % Riffle | 50 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 265.0 | % Glide | 10 |
| Debris (%) | 10 | % Slough | 10 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/6/27 Time:1600 Crew: TB Air Photo Location No.
BC404 086,087

Weather: clear, warm Air Temp. 22 Access: footpath from upper
campground at Skutz Falls.

A flood channel complex featuring three channels. The two innermost are only completely wetted in floods but the winter water table wets their lower ends. The outer channel carries flow from November through July or early August.

Substrate Composition Last Updated
 Updated By

Fines 2 %
Gravel 7 %
Cobbles 1 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

A few coho spawn in the outer channel and some mainstem fry enter it in the spring. About 500 coho fry become trapped by mid-July. Chum spawning.

Enhancement Assessment

Excavation of a deep infiltration pool near the head of the channel might provide continuous summer rearing. Fry salvage is not practical because of low numbers available, access and catchability difficulties.

Wetted area increase = 1590 m²
Yield potential = 508 Co smolts

**Production Option #52
Rank**

Side Channel I.D. R80 Relic ABOVE BEAR CREEK RELIC
CHANNEL (97)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 140.0 | % Glide | 0 |
| Debris (%) | 40 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near outlet Date: 8/7/13 Crew: TB Air Photo
 Location No. BCC404 086,087
 Weather: cloudy, light rain Air Temp. 17 Water Temp. 9
 Access Mayo Rd., Holt Cr. Rd.(BCFS), Old Grade, wade Bear Cr., Old
 Grade, Bushwhack

Wetted by:

1. winter water table
2. seepage from the upland in winter and spring
3. very occasional bank overtopping from the river

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines | 8 % |
| Gravel | 2 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Fish Utilization

Coho winter in this channel and a few early fry enter it to rear. Coho smolts leave before it dries but 100-500 fry are trapped.

Enhancement Assessment

Excavation of a deep infiltration pool near the inlet could improve rearing capability, summer and winter.
 This channel is relatively inaccessible for heavy equipment.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1400 m ² |
| Yield potential | = 448 Co smolts |

Production Option #53
Rank

Side Channel I.D. A81 Active HARDING'S CHANNEL (98)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 7.5 | % Pool | 55 |
| Channel Width (m) | 9.00 | % Riffle | 13 |
| Minimum Flow | .011 | % Run | 0 |
| Channel Length (m) | 410.0 | % Glide | 6 |
| Debris (%) | 15 | % Slough | 26 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 20 m. above outlet Date: 8/7/88 Crew: TB Air
 Photo Location No. BCC404 086,087
 Weather: clear, hot Air Temp. 30 Water Temp. 19 (pockets of
 11 degree groundwater) Access: Cowichan Footpath from Skutz Falls

Main channel branches off the log jam backchannel. Its stable and of very low gradient. A flood channel from the lower log jam backchannel contributes winter - spring flow as does a breakout channel 130 m. downstream.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawn and summer rear in this channel. Winter capability is moderate to high. **Note: Large numbers of coho in high escapement years.**
 Chums also utilize this channel, particularly in years of heavy escapement.

Enhancement Assessment

No improvement required.

Side Channel I.D. F82 Flood ABOVE BEAR CREEK
FLOODCHANNEL (99)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0.01 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 215.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .2 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/5/26 Crew: TB Air Photo Location No. BCC404
 086,087

Weather: cloudy, drizzle Air Temp. 17 Water Temp. 9 Access:
 Mayo Rd., Holt Cr. Rd., Old Grade, wade Bear Cr., Old Grade,
 Bushwhack

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 8 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawn in this channel and spring fry attempt to rear.
 Peak flow velocities are too high for wintering coho.
 Chum also spawn here, especially in big years like 1985 and 1987.

Enhancement Assessment

If the inlet berm could be raised and an infiltration pool could be excavated near the inlet, summer and winter rearing value would be improved.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 2150 m ² |
| Yield potential | = 688 Co smolts |

Production Option #54
Rank

| Side Channel I.D. R83/B | Back | LOG JAM (backchannel portion) | |
|--------------------------|-------|-------------------------------|-----|
| (100) | | | |
| Average Wetted Width (m) | 7 | % Pool | 0 |
| Channel Width (m) | 30.00 | % Riffle | 0 |
| Minimum Flow | .0091 | % Run | 0 |
| Channel Length (m) | 150.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/17 Crew: TB Air Photo Location No. BCC404 Nos. 087,088

Weather: clear,warm Access: Cowichan footpath, Bushwhack from top of 81A

Backflooded at all but minimum flows. Does not dry.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho rearing and wintering.

Enhancement Assessment

None required.

Side Channel I.D. A83 Active LOG JAM ACTIVE PORTION (101)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 4 | % Pool | 68 |
| Channel Width (m) | 5.00 | % Riffle | 31 |
| Minimum Flow | .0091 | % Run | 0 |
| Channel Length (m) | 500.0 | % Glide | 1 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/17 Crew: TB Air Photo Location no. BCC404 087,088
Weather: clear, warm Air Temp. 20 Water Temp. 9.5 Access:
Cowichan footpath

A very complex channel system. Prior to the mid 1960's, a portion of the river was said to flow through the jam area providing excellent rearing and over wintering habitat for coho and resident trout juveniles. Brown trout were said to be especially abundant. L. Erickson of MOE Nanaimo is very knowledgeable about the history of this channel. Some of the logs are remnants of the old turn of the century log drives. The log jam area is now seldom wetted even during high mainstem flows. It has a perimeter channel system (documented here) that is almost totally independent of river flow and a lagoon wetted by the perimeter stream and backflooding of the mainstem.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho use this channel for summer rearing and wintering. A few spawners are also present.

Enhancement Assessment

The upper 800 m. is now relic but could be wetted from the Drop Off Pool Flood Channel by breaching the 0.5 m. berm that separated them and excavating a deep infiltration pool just below. Assuming a minimum wetted width of 4 m., 3600 m² of additional habitat might be produced.

Yield potential = 1,800,000 Cm fry
= 1152 Co smolts

Production Option #55

Rank

**Side Channel I.D. F84/1 Flood ABOVE BEAR CREEK
COMBO FLOOD/ACTIVE CHANNEL (102)**

| | | | |
|--------------------------|----------|----------|-----|
| Average Wetted Width (m) | 7 | % Pool | 0 |
| Channel Width (m) | 8.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 60.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 100 |
| Gradient | .0001/.1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 60 m. above outlet, Backchannel Date: 87/5/13
 Crew: TB Air Photo Location No. BCC404 Nos. 086,087
 Weather: cloudy, light rain Air Temp. 17 Water Temp. 9
 Access: Mayo Rd., BCFS Holt Cr. Rd., Old Bear Cr. grade, wade
 creek., old grade, bushwhack

This channel is often wetted by high mainstem flow but
 velocity is usually low.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction | | |

Fish Utilization

A few coho fry enter the backchannel portion of this channel in the spring; 17
 were counted on May 13, 1987. Some may also winter in the channel.

Enhancement Assessment

Excavation of an infiltration pool near the inlet could provide summer flow
 throughout the channel.

| | |
|----------------------|----------------------|
| Wetted area increase | = 630 m ² |
| Yield Potential | = 201 Co smolts |

**Production Option #56
Rank**

Side Channel I.D. A85 Active SAWDUST PILE POOL
CUTOFF NO.2 (103)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 5 | % Pool | 48 |
| Channel Width (m) | 11.00 | % Riffle | 34 |
| Minimum Flow | .049 | % Run | 0 |
| Channel Length (m) | 647.0 | % Glide | 18 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 100m below inlet Date: 8/7/8 Crew: TB Air

Photo Location No. BCC404 087,088

Weather:clear,warm Air Temp. 31 Water Temp. 18.0 Access: BK 51 Rd. from Skutz Falls Rd., wade river, bushwhack. Possible to hike down from Campbell Group(Hancock Timber) Bear Creek Rd. at a point .7 km from gate.

A major sidechannel. The lower 170 m are influenced by a tributary which provides gravel and cool water. In 1991, the river cut- off the upper 400 m of this channel which now carries about 50% of the Cowichan River's winter flow.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 6 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

This channel supports coho and steelhead spawning. It carries numerous coho fry(approx. 3/m²) over the summer and may sustain even more through winter. A few cutthroat fry are also present in the summer and brown trout fry have been reported (Burns, 1987).

Large numbers of chum salmon utilize this channel in big years.

NOTE: THIS CHANNEL NOW CARRIES ABOUT HALF THE RIVER'S FLOW AND IS THE SOURCE OF UPSTREAM TURBIDITY, THE SECOND MAJOR SOURCE AFTER STOLTZ BLUFF.

Enhancement Assessment

No improvement is required and its doubtful any is feasible - a meander cut-off channel subject to high winter velocities. However, its possible the river could take this course and strengthening the berm may be prudent. Two other possible breakout points are present nearby(see plan view). 4800 m square of habitat would be lost if the Cowichan took a short cut here.

NOTE: THIS IS NOW THE CASE. RIVER DIVERTED IN FEB.1991.

**Side Channel I.D. F86 Flood FLOOD-RELIC COMBO ABOVE
DROP OFF POOL (104)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 3 | % Pool | 46 |
| Channel Width (m) | 6.00 | % Riffle | 42 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 190.0 | % Glide | 12 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: centre Date: 87/5/11 Crew: TB Air Photo
 Location No. BCC404 087,088
 Weather: rain Air Temp. 15 Water Temp. 15 Access: Cowichan
 footpath

Relic segment is 150 m.
 6(0)E .01 8200

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 4 % | |
| Gravel | 5 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho fry enter this channel in the spring and there is some coho spawning in most years. Almost all fry leave before the channel dries. Why fry are able to exit some channels before drying while others are trapped in similar situations is a mystery.

Chums use this channel in high escapement years. 189 carcasses were counted in Jan./1988. They were so thick in places that growths of the filamentous bacterium *Sphaerotilus* were present.

Enhancement Assessment

Permanent wetting might be provided by excavating an infiltration pool at the head of the relic section. Assuming a minimum wetted width of 2 m., 680 m² of additional habitat would result.

| | |
|----------------------|-------------------------------|
| Wetted area increase | = 680 + 1020(1140-120) = 1700 |
| Yield potential | = 544 co smolts |

**Production Option # 57
Rank**

**Side Channel I.D. F87 Flood COUGAR RUN FLOODCHANNEL
(105)**

| | | | |
|--------------------------|------|----------|----|
| Average Wetted Width (m) | 2 | % Pool | 47 |
| Channel Width (m) | 3.00 | % Riffle | 50 |
| Minimum Flow | .002 | % Run | 0 |
| Channel Length (m) | 60.0 | % Glide | 3 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: centre Date: 87/5/11 Crew: TB Air Photo
Location No. BCC404 087,088
Weather: cloudy, rain Air Temp. 15 Water Temp. 15 Access:
Cowichan footpath

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 2 % | | |
| Gravel 5 % | | |
| Cobbles 2 % | | |
| Boulders 1 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

A few (<50) coho fry enter this channel in the spring.

Enhancement Assessment

No improvement is necessary.

Sidechannel I.D. B87 Back COUGAR RUN BACKCHANNEL (106)

| | | |
|---|----------|-----|
| Average Wetted Width (m) 0 (int. pools in summer) | % Pool | 0 |
| Channel Width (m) 50.00 | % Riffle | 0 |
| Minimum Flow .0002 | % Glide | 0 |
| Channel Length (m) 400 | % Run | 0 |
| Debris (%) 5 | % Slough | 100 |
| Gradient (%) 0 | | |
| Elevation (asl) 118 | | |
| Turbidity (cm) nil | | |

Site location: centre, Date: 2/9/95, Crew: TB, AP loc. BCC 404 087,088
Weather: cloudy, AT: 5, WT: 6, Access: Cowichan Footpath

Prior to Feb., 1991, this was the main channel. Since then, it has been a backchannel that is completely wetted by mainstem backflooding in winter but is summer intermittent. This channel was a sharp meander.

Substrate Composition Last Updated :
 Updated by:

Fines 3 %
Gravel 6 %
Boulders1 %
Bedrock 0 %
Compaction L

Fish Utilization

Coho overwintering and partial summer rearing, early chum rearing. Coho, chinook and chum fry become trapped by falling water levels; fry salvage is necessary.

Enhancement Assessment

None.

Side Channel I.D. A88 Active SAWDUST PILE POOL
CUTOFF NO. 1 (107)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 5 | % Pool | 35 |
| Channel Width (m) | 10.00 | % Riffle | 37 |
| Minimum Flow | .083 | % Run | 0 |
| Channel Length (m) | 120.0 | % Glide | 28 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 30 m. below inlet Date: 87/8/8 Air Photo
 Location No. BCC404 087,088
 Weather: clear, hot Air Temp. 32 Water Temp. 20 Access:
 BK51 access Rd. from Skutz Falls Rd., wade or boat river,
 bushwhack or cut down from Hancock Rd. .7 km in from gate

Was a meander cut-off channel. Inlet berm was subject to considerable winter force. It was breached in Feb. of 1991. This channel and **85A** some 100 m south now share the Cowichan's flow.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawning and summer rearing. Steelhead summer rearing. The channel's winter capability is believed to be nil because of high flows. This was a cut - off channel with winter velocities higher than the mainstem. It is now the mainstem (1995).
 Brown trout fry have been reported from this channel (Burns,1987).
 Large numbers of chums spawned in some years.

Enhancement Assessment

Strengthening the inlet berm might have reduced winter flows and increased winter habitability for coho and steelhead. It probably wouldn't have saved the channel. The bend was too sharp.

Side Channel I.D. R89 Relic SAWDUST PILE CREEK (108)

| | | | |
|--------------------------|--------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 15.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 1700.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | 100 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 200 m. above outlet Date: 8/6/9/25 Crew: TB Air
 Photo Location No. BC81009 057,058
 Weather: NA Air Temp. NA Access: from Skutz Falls Rd. to BK51 and BK57
 (TimberWest)

An old post-glacial channel complex well removed from the present river regime except in the lower 500 m. where the winter water table provides sporadic wetting and intermittent flow. This channel is also connected to a temporary creek.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None. There is excellent coho winter habitat in the lower portion for this complex but it is not wetted until late winter and a steep riffle at the confluence prevents coho fry from entering.

Enhancement Assessment

There are no improvement opportunities evident at this point. A number of small wetland basins are located in the headwater zone of a temporary tributary. Their impoundment might provide permanent flow in the tributary and about 500 m. of the sidechannel. **More detailed assessment is required however.**
 It may also be possible to wet the lower 500 m by division of 90A.

Side Channel I.D. A90 **Active** **REMOTE** **RUN** **ACTIVE**
CHANNEL (109)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 5 | % Pool | 75 |
| Channel Width (m) | 10.00 | % Riffle | 20 |
| Minimum Flow | .002 | % Run | 0 |
| Channel Length (m) | 360.0 | % Glide | 5 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Upper (88 m. below inlet) Lower(outlet) Date:
87/8/8 Crew: TB Air Photo Location No. BC1009 057,058
Weather: clear, warm Air Temp. 32 Water Temp. 16.5 Access:
BK 51, BK 57 access.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 3 % | |
| Gravel | 6 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho summer rearing and the probability of overwintering in Reach 1. High probability of coho spawning. Chums also spawn in this channel.

Enhancement Assessment

High winter flows limit habitability. A breakout channel near the inlet could be bermed to limit high flows. Deepening the infiltration pool could increase summer flow.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1800 m ² |
| Yield potential | = 576 co smolts |

Excavation of high spots may also be necessary.

Upper Site

Upper site is difficult to measure in low flows while the lower site is impossible to monitor in high flows.

Production Option #58
Rank

Side Channel I.D. F91 Flood (110)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 5 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 60.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 0 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/25 Crew: TB Air Photo Location No. BCC404
087,088

Weather: mostly cloudy, cool Air Temp. 17 Water Temp. 12
Access: from Skutz Falls Rd. through BK 51

Another channel is sometimes present on the point bar at the top of the meander. The bar changes annually so this occasional channel has not been mapped. In years when its present, its very temporary and not a production factor.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|-----|
| Fines | 1 % |
| Gravel | 8 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | L |

Fish Utilization

Coho fry are trapped in this channel, 100 to 300. In some years, water persists until autumn and about half survive. In other years, drying occurs by late July or August.

Enhancement Assessment

No enhancement practical. Salvage is not even a worthwhile option because of numbers and the difficulty of catching fry here. A willow tangle is present on the deep side of the channel and fish hide quickly.

Side Channel I.D. R92 Relic (111)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 320.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: 30 m. below upper end Date: 87/5/13 Crew: TB
Weather: Partly cloudy, cool Air Temp. 14 Water Temp. NA
Access: hike up from Bear Cr. or wade/boat across from BK 57,
river only wadeable <7

Wetted by winter water table and occasional bank overtopping. **NOTE: THIS CHANNEL WAS ELIMINATED IN FEB. 1991.**

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
|-----------------------|--------------|------------|

| | | |
|------------|-----|--|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

None

Enhancement Assessment

It might be advantageous to wet this channel via a buried pipe or french drain. At least 640 m square of coho summer rearing habitat would result but, more importantly, bleeding off some water here would remove some pressure from the two meander cut-off channels just downstream and lessen the chance of a major mainstem breakout. **CHANNEL LOST IN 1991.**

Side Channel I.D. R93 Relic THREE FIRS RELIC CHANNEL
(112)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 4 | % Pool | 100 |
| Channel Width (m) | 6.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 115.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/4/2 Crew: TB Air Photo Location No.
BCC404 089,090

Wetted by the winter water table and backflooding (40 m.).

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

Chance of overwintering coho in lower 40 m. which is a backchannel.

Enhancement Assessment

No practical opportunities for improvement.

Side Channel I.D. R94/1 Relic OLD STUMP RELIC (113)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 20.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 298.0 | % Glide | NA |
| Debris (%) | NA | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near head Date: 87/9/8 Crew: TB Air Photo Location No. BCC404 Nos. 089,090
Weather: clear, warm Air Temp. 25 Water Temp. NA Access: Skutz Falls Rd., BK 51 Rd.

An old post glacial relic channel that is never wetted. Tributary to One Pool Relic Channel.

Substrate Composition Last Updated
Updated By

Fines 8 %
Gravel 2 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction

Fish Utilization

None

Enhancement Assessment

No enhancement is possible

| Side Channel I.D. R94/2 | Relic | ONE POOL RELIC | |
|--------------------------------|--------------|-----------------------|-----|
| (114) | | | |
| Average Wetted Width (m) | 0.05 | % Pool | 100 |
| Channel Width (m) | 4.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 180.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: lower Date: 87/9/8 Crew: TB Air Photo Location No. BCC404
Nos. 089,090

Weather: clear, warm Air Temp. 25 Access: Skutz Falls Rd., BK 51 Rd.

Carries minor flow in high water. Main source of winter wetting is water table.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

Fines 2 %
Gravel 6 %
Cobbles 1 %
Boulders 1 %
Bedrock 0 %
Compaction M

Fish Utilization

A few coho fry enter from the Maple Tree Pool flood channel in April. Most are lost to drying.

Enhancement Assessment

Excavation is possible but impractical.

Side Channel I.D. F95 **FloodMAPLE** **TREE** **POOL** **FLOOD**
CHANNEL (115)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 8 | % Pool | 10 |
| Channel Width (m) | 22.00 | % Riffle | 80 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 10 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient | 1.0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 10 m. downstream from head Date: 87/5/12 Crew: TB Air
 Photo Location No. BCC404 089,090 Weather: partly cloudy Water Temp. 13
 Access BK51 Rd. from Skutz Falls Rd.

Inundated by high winter flows.

Substrate Composition Last Updated
 Updated By

Fines 2 %
 Gravel 6 %
 Cobbles 1 %
 Boulders 1 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Early coho fry are attracted in large numbers. An estimated 2400 were present on May 12, 1987. Unfortunately I was not able to determine if they left before the channel dried. Because it dries from the upstream end, its likely most escaped. Early emergent steelhead fry also use this channel Steelhead spawn within 10 m. of the inlet.

Enhancement Assessment

No improvement necessary. The bar could be lowered to prolong summer flow but this would open the channel to the erosive effects of high winter discharge.

Side Channel I.D. A96/1 Active CLAYBANK SPRING
SIDCHANNEL (116)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 1.5 | % Pool | 80 |
| Channel Width (m) | 4.50 | % Riffle | 20 |
| Minimum Flow | .0073 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Reach 1 Date: 87/6/4 Crew: TB Air Photo Location No. BCC404 Nos. 089,090 Weather: clear Air Temp. 17 Water Temp. 10 Access: BK 51

6(2) E.1 6400 100m. Backs up in winter.

Substrate Composition Last Updated
 Updated By

Fines 6 %
 Gravel 4 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho summer rearing and wintering.

Enhancement Assessment

No improvement required

Side Channel I.D. A96/2 Active CLAYBANKS SPRING
SIDCHANNEL (117)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 1.5 | % Pool | 64 |
| Channel Width (m) | 4.50 | % Riffle | 28 |
| Minimum Flow | .0073 | % Run | 0 |
| Channel Length (m) | 50.0 | % Glide | 8 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: reach 2 Date: 87/6/4 Crew: TB Air Photo
 Location No. BCC404 Nos. 089,090 Weather: clear Air Temp. 17 Water
 Temp. 10 Access: BK51

3(1) E.5 2350 50 m.

Seeps through berm and picks up groundwater seepage; some
 gentle winter overtopping of mainstem.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

Fines 2 %
 Gravel 3 %
 Cobbles 5 %
 Boulders 0 %
 Bedrock 0 %
 Compaction L

Fish Utilization

Coho summer rearing and wintering.

Enhancement Assessment

No improvement required.

Side Channel I.D. A97 Active OUTER DOUBLE D
SIDCHANNEL (118)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 10.5 | % Pool | 31 |
| Channel Width (m) | 13.00 | % Riffle | 38 |
| Minimum Flow | .62 | % Run | 8 |
| Channel Length (m) | 1300.0 | % Glide | 23 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 150 m. above outlet Date 87/8/17 Crew: TB Air Photo
 Location No. BC 81009 055,056 Weather: clear, hot Air Temp. 33 Water
 Temp. 19.5 Access: Skutz Falls Rd. BK.51 Rd., wade or boat Maple Tree Pool.
 Alternate access: hike down from south side of 70.2 trestle on paths and old
 grades: approximately 40 minutes to south side of Maple Tree Pool (Jap Camp).

A major side channel: the largest in length and wetted area. **IN FEB. 1991, THIS CHANNEL BECAME THE MAINSTEM. The channel is now up to 150 m wide and is still cutting. An erosion bank extends 200 m upstream from the channel head and is over 6m high in places. About 3500 m of the original channel was dewatered in the summer by this diversion. Flow has since been returned to all but the upper 300 m by excavating a channel upstream (105R).**

| | | |
|-----------------------|-----|--------------|
| Substrate Composition | | Last Updated |
| | | Updated By |
| Fines | 1 % | |
| Gravel | 6 % | |
| Cobbles | 2 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho, steelhead, cutthroat and brown trout spawn, summer rear and winter in this channel. Late summer coho fry density is approximately 7/m² in pools and glides. **THIS IS NOW THE MAIN CHANNEL (1995).**

Enhancement Assessment

No enhancement necessary.

**Side Channel I.D. A98 Active INNER DOUBLE D
SIDECHANNEL (119)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 8.6 | % Pool | 32 |
| Channel Width (m) | 13.00 | % Riffle | 33 |
| Minimum Flow | 1.58 | % Run | 20 |
| Channel Length (m) | 397.0 | % Glide | 15 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | 1.5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/88 Crew: TB Air Photo Location No. BCC404 050,051 Weather: clear, hot Air Temp. 33 Water Temp. 20.5 Access: Skutz Falls Rd., BK 51 Rd., boat or wade Cowichan.

This channel carries more flow than any other; but its a heavy flow with difficult wading even at minimum discharge. Riffle and run velocities range from 1-3 m/sec. Pools are short and turbulent. Inner double D is a meander cut-off channel that was likely started by a log jam. If another were to form below its inlet (unlikely), the mainstem could be isolated. **SINCE OUTER DOUBLE D IS NOW THE MAINSTEM, THIS CHANNEL CARRIES LESS WATER AND HABITAT CONDITIONS HAVE LIKELY IMPROVED, PARTICULARLY IN WINTER. NEEDS UPDATE ASSESSMENT.**

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 5 % | |
| Cobbles | 3 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Supports coho and steelhead spawning and summer rearing; brown trout fry have also been reported (Burns, 1987). Production is limited by high velocities which restrict rearing to pools and glides and probably preclude overwintering.

Enhancement Assessment

No practical opportunities exist. It would be advantageous to create a strong berm at the inlet. This would be costly and difficult and might not yield high benefits in the short term. In the long term, it may prevent the meander from being completely cut-off and diverted. The habitat value of the meander is much superior to that of the sidechannel. **DISREGARD, SITUATION CHANGED BY 97A CAPTURING RIVER.**

Side Channel I.D. R99 Relic Y POOL RELIC CHANNEL
(120)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0.29 | % Pool | 100 |
| Channel Width (m) | 4.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 112.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 0 |
| Gradient | .2 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 112 m. above outlet Date: 8/7/98 Crew: TB Air Photo Location
No. BCC404 050,051 Weather: clear, warm Air Temp. 23 Water Temp. 16.5
Access: Skutz Falls Rd., BK51 Rd.; wade, boat or swim Cowichan at Y pool or
Above Y Pool

The upper 84 m. of this channel is relic; Flood waters never reach it. The lower 112 m. is semi-active, wetted by the winter water table.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 6 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawn in this channel; numbers are low. Some fry attempt to rear over the summer but most are lost due to drying. Approximately 500 survive in the infiltration pool.

Enhancement Assessment

Excavation could provide permanent flow in the lower 112 m.

NOTE: Requires update since 97A diversion of 2/91

| | |
|----------------------|----------------------|
| Wetted area increase | = 318 m ² |
| Yield potential | = 101 Co smolts |

Production Option #59
Rank

Side Channel I.D. R100 Relic ABOVE Y POOL RELIC CHANNEL (121)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0.51 | % Pool | 18 |
| Channel Width (m) | 7.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 210.0 | % Glide | 0 |
| Debris (%) | 3 | % Slough | 82 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 140 m above outlet Date: 87/5/12 Crew: TB Air Photo Location No. BCC404 050,051 Weather: clear,warm Air Temp. 17 Water Temp. 12 Access: Skutz Falls Rd., BK51 Rd., Branch Rd. to Above Y Pool, swim, boat or wade Cowichan

A rather complex channel. The upper 70 m. is mainly relic with no clearly defined channel, three small flood channels 2-3 m. wide are present on an old floodplain about 50 m. wide. These consolidate 140 m. above the confluence to form an intermittent section 84 m. long followed by a 56 m. backwater.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 2 % | |
| Cobbles | 5 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

A few coho fry enter this channel in April and rear over the summer. Only the top pool dries. A 56x6 m. backwater is present at the lower end and is responsible for most of the rearing.

Enhancement Assessment

It would be possible to prolong flow by deepening an infiltration pool near the inlet and excavating the relic portion of the channel.

| | |
|-----------------------|-----------------------|
| Increased wetted area | = 1058 m ² |
| Yield potential | = 338 Co smolts |

**NOTE: Requires update since 97A diversion (2/91)
Production Option #60
Rank**

**Side Channel I.D. B101/1 Back WATERCRESS EAST BACK
CHANNEL (122)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 8 | % Pool | 0 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | .0074 | % Run | 0 |
| Channel Length (m) | 50.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | 0 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 051,052 Weather: clear, warm Air Temp. 30 Water Temp. 16, 12.5 in creek, 22 in river Access: Skutz Falls Rd., BK 51 Rd., Cowichan footpath

This channel is fed by Watercress East Creek, a complex groundwater system that, in part, occupies a very old relic channel.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 8 % | |
| Gravel | 2 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | H | |

Fish Utilization

This channel may be utilized by overwintering coho and trout and is heavily utilized by coho fry in the spring and summer.

Enhancement Assessment

No evident enhancement opportunities.

Side Channel I.D. R101/2 Relic UPPER WATERCRESS EAST (123)

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 8 | % Pool | 0 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum Flow | .0074 | % Run | 0 |
| Channel Length (m) | 50.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 100 |
| Gradient | | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Substrate Composition Last Updated
 Updated By

Fines 8 %
Gravel 2 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction H

Fish Utilization

Coho spawners and fry

Enhancement Assessment

None required

Side Channel I.D. A102 Active POOL ABOVE Y ACTIVE CHANNEL (124)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 2 | % Pool | 66 |
| Channel Width (m) | 6.00 | % Riffle | 44 |
| Minimum Flow | .0040 | % Run | 0 |
| Channel Length (m) | 160.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: central Date: 87/7/1 Crew: TB Air Photo
 Location No. BCC404 051,052
 Weather: clear,warm Air Temp. 20 Water Temp. 15.5 Access:
 BK51 Road network then footpath

Winter flows are substantial. This channel operates like a flood channel and would be classed as such if it dried.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 1 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

This channel supports coho spawning in its lower 50 m. Some 300 coho fry rear in it over the summer. Its winter carrying capacity is judged to be nil due to variable high flows and lack of cover. The channel is almost straight with no undercut banks, deep pools, log jams, etc. Winter flow velocities often exceed 1 m./sec.

Enhancement Assessment

There is no opportunity for enhancement. More summer water would be beneficial but its doubtful if it could be provided without increasing winter flow. This channel could be eliminated by a large flood.

NOTE: Update required since 97A diversion

**Side Channel I.D. R103 Relic BREAKFAST POOL RELIC
CHANNEL (125)**

| | | | | |
|--------------------------|-------|-------|----------|----|
| Average Wetted Width (m) | 0 | | % Pool | NA |
| Channel Width (m) | 6.00 | | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA | |
| Channel Length (m) | 120.0 | | % Glide | NA |
| Debris (%) | | | % Slough | NA |
| Gradient | .01 | | | |
| Elevation (m) | | | | |
| Turbidity (cm) | | | | |

Date: 8/7/1 Crew: TB Air Photo Location No. BCC404 051,052
 Weather: clear, warm Air Temp. 24 Water Temp. NA Access:
 wade river just above Pool Above Y

Wetted sporadically by winter water table.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

None

Enhancement Assessment

Excavation of a deep infiltration pool near the inlet could provide summer flow.
 Additional downstream excavation may be required.

| | |
|----------------------|-----------------|
| Wetted area increase | = 720 m2 |
| Yield potential | = 230 Co smolts |
| | = 115 ch smolts |

**Note: Update required since 97A diversion
 Production Option #61
 Rank**

**Side Channel I.D. R104 Relic RELIC CHANNEL BELOW
INNER DOUBLE D INLET (126)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 2 | % Pool | 100 |
| Channel Width (m) | 5.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 130.0 | % Glide | 0 |
| Debris (%) | 20 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 8/7/1 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, warm Air Temp. 24 Water Temp 19.5 Access:
cross bottom of Maple Tree Pool, hike Old Grade, cross head of
outer Double D or wade river.

Wetted by winter water table. Occasional light spill from river in floods.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 6 % | |
| Gravel 4 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction M | |

Fish Utilization

Coho spawn in this channel; mainly in the lower 80 m. Approximately 300 fry are trapped in isolated pools. Losses are low however because pools persist until autumn and temperature does not exceed 20 degrees. There is some slight near surface groundwater seepage and the channel is completely shaded. Coho may winter in this channel.

Enhancement Assessment

A buried pipe that would provide slight flow and not allow high winter flow could optimize the yield of this channel.

Wetted area increase = 390 m2
Yield potential = 124 Co smolts

**NOTE: Update required since 97A diversion
Production Option #62
Rank**

Side Channel I.D. R105 Relic **WATERCRESS WEST RELIC CHANNEL – FINN’S (Active as of August, 1993) (127)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 2.2 | % Pool | 69 |
| Channel Width (m) | 40.00 | % Riffle | 18 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 500.0 | % Glide | 13 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near outlet Date: 87/8/8 Crew: TB Air photo
 Location No. BCC404 051,052
 Weather: clear, hot Air Temp. 32 Water Temp. 10 Access:
 BK51, Cowichan footpath

This channel is occupied by a groundwater creek in its lower 220 m.

Substrate Composition Last Updated: 2/3/95, 12/21/96
 Updated By: TB

| | | |
|-------------|-----|---|
| Fines | 8% | 2 |
| Gravel | 2 % | 6 |
| Cobbles | 0 % | 2 |
| Boulders0 % | 0 | |
| Bedrock | 0 % | 0 |
| Compaction | L | L |

Fish Utilization

Coho - cutthroat spawning, rearing and wintering. Following excavation of the upper end and more winter water, chum salmon also spawn in this channel. 60 coho holding near the culvert which is located 70 m below the inlet (12/21/96). 100 chum carcasses in upper 500 m of channel (12/21/96).

Enhancement Assessment

No improvement necessary. Channel is operating near capacity.

UPDATE

This channel was extended upstream by 545 m in 1993 to provide wetting to a 3.5 km section of the Cowichan that has been dewatered by the diversion of the mainstem into Outer Double D Sidechannel in Feb. 1991. Flow is captured at a point some 140 m below the 70.2 trestle and flows through an excavated channel to join 105R which is now 105A. Winter flows range from about .3 cms to approximately 2.8 cms. 12/21/96 flow was 1.8 CMS. Length of new channel is 545 m. Berm occasionally forms at upper end of channel. It had to be excavated by hand on August 4, 1996.

New channel dimensions are 10 (9) CON 1..0 2620. Flow can become very low if the berm builds up and cuts off input from the Cowichan. It was nearly 0 before the berm was removed in August of 1996.

Production Option # 63

| | | | |
|------------------------------|-------|---------------------------------|----|
| Side Channel I.D. R106 (128) | Relic | FALLEN LOG RELIC CHANNEL | |
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 50.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 400.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient Class | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/8 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, hot Air Temp. 32 Access: BK51, Cowichan footpath

Wetted by water table and, as of Aug.,1993, 105A. Minimum flows are now in the order of .6 - .9 CMS.

Substrate Composition Last Updated: 2/3/95
Updated By: TB

Fines 8 %
Gravel 2 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction H

Fish Utilization

Coho and trout overwintering.

Enhancement Assessment

Excavation might provide permanent flow, particularly if combined with mainstem diversion. Head will pose a problem for diversion. **Diversion accomplished via 105.**

UPDATE

Channel is now summer wetted by 105A.

Wetted area increase = 20 000 m²
Yield potential = 6400 Co smolts
= 3200 Ch smolts
= 10,000,000 Cm fry

Production Option #64
Rank

| | | | |
|--------------------------|-------|-------------------------------------|----|
| Side Channel I.D. R107 | Relic | INSIDE (Ann's) RELIC CHANNEL | |
| (129) | | | |
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 15.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 370.0 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | .001 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 30 m. above mainstem Date: 87/8/8 Crew: TB Air
 Photo Location No. BCC404 051,052
 Weather: clear,hot Air Temp. 32 Access: BK51, Cowichan
 footpath

This channel is wetted by the winter water table and minor
 back flooding from the river.

| | | | |
|-----------------------|-----|----------------------|---|
| Substrate Composition | | Last Updated: 2/3/95 | |
| | | Updated By: TB | |
| Fines | 8 % | 1 | 2 |
| Gravel | 2 % | 4 | 6 |
| Cobbles | 0 % | 5 | 2 |
| Boulders | 0 % | 0 | 0 |
| Bedrock | 0 % | 0 | 0 |
| Compaction | H | L | L |

Fish Utilization

Coho overwintering and spring -early summer rearing. **UPDATE:** Channel no longer has rearing value; its dry 90% of the time. A few chums waste their eggs by spawning in this channel.

Enhancement Assessment

Excavation and mainstem diversion could provide permanent wetting.

UPDATE 2:

A new channel was constructed in 1991 in the approximate position of 107R. It was intended to provide some wetting to the section of the mainstem cut off by the Feb., 1991 diversion of the river down Double D Sidechannel and reduce the river's tendency to take the southern route. The channel is now dry except during very high flows and only serves a few chum spawners.

UPDATE 3:

Channel was re-excavated and re-positioned further downstream and more toward the river in the summer of 1996 via a USHP grant to Joe Saysell and the Steelhead Society. Channel was cut down several metres and is now wet throughout the winter. 78 chums spawned in Dec., 1996. Channel is now 6(0) CON .2 2620 280 m. Last examined 12/21/96. Now called Joe's or Saysell's
Production Option # 65

Side Channel I.D. R108 Relic OTTER SPRING CHANNEL

| | | | |
|--------------------------|--------|----------|----|
| (130) | | | |
| Average Wetted Width (m) | 3 | % Pool | 93 |
| Channel Width (m) | 5.00 | % Riffle | 2 |
| Minimum Flow | .00079 | % Run | 0 |
| Channel Length (m) | 140.0 | % Glide | 5 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/8 Crew: TB Air Photo Location No. BCC404 051,052

Weather: clear,hot Air Temp. 32 Water Temp. 9.5 Access:
wade Cowichan from footpath or hike down from 70.2 trestle

Wetted by:

1. Seepage through the inlet berm
2. Winter water table
3. Upland seepage
4. Very occasional surface run-off

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 6 % | |
| Gravel | 4 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho summer rearing and probable overwintering.

Enhancement Assessment

No improvement required.

Erosion bank above the diversion (97A) is working its way up to this channel which is the first one on the south side of the river above 97A.

NEEDS UPDATE

**Side Channel I.D. F109 Flood JUNGLE CREEK
FLOODCHANNEL (131)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 1.6 | % Pool | 50 |
| Channel Width (m) | 7.00 | % Riffle | 50 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 110.0 | % Glide | 0 |
| Debris (%) | 2 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/1 Crew: TB Air Photo Location No. BCC404 051,052
 Weather: clear,warm Air Temp. 24 Access: hike up from outer
 Double D after crossing the river at lower Maple Tree. Easier to hike down from
 CN Grade near 70.2 trestle on faint path.

Upper 60 m. is permanently wetted. The lower 50 m. is only wetted by winter
 flows.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines | 1 % |
| Gravel | 7 % |
| Cobbles | 1 % |
| Boulders | 1 % |
| Bedrock | 0 % |
| Compaction | L |

Fish Utilization

Coho spawning and spring-early summer rearing.

Enhancement Assessment

No evident opportunities. Channel is inundated by the river for much of the
 winter, dry the rest of the year

Side Channel I.D. R110 Relic RELIC TRIBUTARY TO
WATERCRESS WEST (132)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 15.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 2000.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/30 Crew: TB Air Photo Location No. BCC404 051,052
 Weather: rain Air Temp. 10 Water Temp. 7 Access: Skutz
 Falls Rd., BK51 Rd.

A groundwater creek (Watercress West) occupies this channel. The stream is permanent below 650 m. (from the mainstem) but highly intermittent above. It dries completely by June in most years.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction M | |

Fish Utilization

Coho - cutthroat wintering.

Enhancement Assessment

No improvement possible without extensive excavation and channel improvement.

**Side Channel I.D. A111 Active FAIRSERVICE SIDETCHANNEL
(133)**

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 7 | % Pool | 70 |
| Channel Width (m) | 8.00 | % Riffle | 30 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 280.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 87/6/15 Crew:Tb Air Photo

Location No. BC81009 003,004

Weather: cloud and sun Air Temp. 18 Water Temp. 12 Access:

Hudgrove Rd. or CN Tracks, walk down path from small parking area near 70.2 trestle.

Flow is from seepage through the inlet berm which is occasionally overtopped in winter. There is also winter - spring back flooding from Fairservice Creek.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 3 % | |
| Gravel | 6 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

An important coho spawning, rearing, and wintering channel. Fish enter from Fairservice Creek. Chum spawning in big years.

Enhancement Assessment

Deepening at the upper end may provide permanent flow along with some excavation of high spots.

Wetted area increase = 560 m²
Yield potential = 176 Co smolts.

**Production Option #66
Rank**

Side Channel ID. R112 Relic ABOVE BRIDGE RELIC CHANNEL (134)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 15.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 382.0 | % Glide | NA |
| Debris (%) | 10 | % Slough | NA |
| Gradient | | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: 100m below inlet Date: 87/8/7 Crew: TB Air
 Photo Location No. BC81009 001,002
 Weather: clear, hot Air Temp 34 Access: Cowichan footpath
 from BK51 or wade river from end of Hudgrove Road

Unlike many relic channels, this one is never wetted except for some short stretches near its outlet where it becomes soggy and hosts a few puddles supplied by the winter water table.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

None

Enhancement Assessment

Trenching the top end, installing pipe, burying it and excavating below it could create a viable active channel.

Wetted area increase = 5730 m²
 Yield potential = 2,865,000 cm fry
 = 1833 Co smolts
 = 916 Ch smolts

Production Option #67 Rank

Side Channel I.D. F113 Flood ABOVE BRIDGE FLOOD
CHANNEL (135)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 264.0 | % Glide | NA |
| Debris (%) | 1 | % Slough | NA |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: central Date: 87/8/7 Crew: TB Air Photo
 Location No. BC81009 001,002
 Weather: clear,hot Air Temp. 34 Access: Cowichan Footpath
 from BK51 or wade river from end of Hudgrove Rd.

A relatively stable flood channel.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines | 2 % | |
| Gravel | 7 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho and chinook fry were present in the two pools still remaining on May 4, 1987, ten coho, ten chinooks. Although coho spawning is possible, its probable the fish entered from the mainstem. The bar adjacent to this channel is an important coho, steelhead and chinook spawning site. Chum spawning in some years.

Enhancement Assessment

Excavation might provide permanent flow. The channel is relatively stable and far enough removed from the river that improvement should persist.

| | |
|----------------------|-----------------------|
| Increase wetted area | = 1584 m ² |
| Yield potential | = 792,000 cm fry |
| | = 506 Co smolts |
| | = 253 Ch smolts |

Production Option #68
Rank

| | | | |
|-------------------------------|---------------|-------------------------|----|
| Side Channel I.D. A114 | Active | OUTER JOGINDER'S | |
| (136) | | | |
| Average Wetted Width (m) | 2 | % Pool | 60 |
| Channel Width (m) | 6.00 | % Riffle | 20 |
| Minimum Flow | .012 | % Run | 0 |
| Channel Length (m) | 720.0 | % Glide | 20 |
| Debris (%) | 20 | % Slough | 0 |
| Gradient | .4 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Cowichan confluence Date: 87/5/27 Crew: TB Air Photo
 Location No. BC81009 003,004
 Weather: cloudy, cool Air Temp. 14 Water Temp. 8 Access:
 Hudgrove Rd. from near Brotherston's.

Portion of flow is from a sidehill spring at 600 m. It accounts for 29 percent of winter flow but a large proportion of summer discharge.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines 7 % | |
| Gravel 2 % | |
| Cobbles 1 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction M | |

Fish Utilization

Coho spawn, rear and winter in this coldwater channel. Brown trout fry have been reported (Burns, 1987).

Enhancement Assessment

No improvement necessary. However, gravel is limited and spawning platform construction would increase fry yield.

Side Channel I.D. A115 Active INNER JOGINDER'S (GIDE'S CREEK)

| | | | |
|--------------------------|--------|----------|----|
| Average Wetted Width (m) | 10 | % Pool | 60 |
| Channel Width (m) | 13.00 | % Riffle | 10 |
| Minimum Flow | .204 | % Run | 0 |
| Channel Length (m) | 1080.0 | % Glide | 30 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .3 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Inner Joginders Date: 87/5/27 Crew: TB Air
 Photo Location No. BC81009 003,004
 Weather: mostly cloudy Air Temp. 14 Water Temp. 12 Access:
 Hudgrove Rd.

A major side channel; springs provide much of its flow during the summer. Their mean discharge approximates .086 cms.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 2 % | |
| Gravel | 6 % | |
| Cobbles | 1 % | |
| Boulders | 1 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho, steelhead and brown trout spawn, summer rear and winter in this channel. Chum salmon are also common in many years. As many as 400 coho and 50 chums have been observed.

Enhancement Assessment

Spawning habitat is limiting despite the high escapements. Construction of at least five spawning platforms would provide considerable benefit. Art and Len Watson have been adding gravel on a limited basis. A large beaver dam near the Cowichan confluence requires periodic maintenance for fish passage. The Watson's installed a page wire access pass in late 1992.

**Production Option #69
 Rank**

| | | | |
|-------------------------------|-----------------------|---------------------------|----|
| Side Channel I.D. R116 | Relic | ART WATSON'S CREEK | |
| (138) | | | |
| Average Wetted Width (m) | 1 | % Pool | 87 |
| Channel Width (m) | 4.00 | % Riffle | 13 |
| Minimum Flow | 0 >260 m , .01 <260 m | % Run | 0 |
| Channel Length (m) | 960.0 | % Glide | 0 |
| Debris (%) | 20 | % Slough | 0 |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: Art Watson's Creek Date: 87/4/7 Crew: TB Air
 Photo Location No. BC81009 003,004
 Weather: rain Air Temp. 7 Water Temp. 7 Access: Hudgrove Rd.

Dug-out ponds at lower end used for domestic rainbow rearing.on occasion

| | | |
|-----------------------|-----|--------------|
| Substrate Composition | | Last Updated |
| | | Updated By |
| Fines | 5 % | |
| Gravel | 5 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | L | |

Fish Utilization

Coho spawning and overwintering. A few brown trout fry are present in the dug out ponds which also serve as a temporary holding area for coho fry salvaged in this area. Chums also utilize this creek as do cutthroats.

1987 escapement:
 Co 60
 Cm 50

Enhancement Assessment

Extending excavation upstream and adding spawning gravel could yield considerable benefit

Wetted area increase = 46200 m²
 Yield potential = 1478 Co smolts
 = 2,310,000 Cm fry

Production Option # 70
Rank

**Side Channel I.D. F117 Flood ART WATSON'S
FLOODCHANNEL (139)**

| | | | |
|--------------------------|-------|----------|-----|
| Average Wetted Width (m) | 0 | % Pool | 100 |
| Channel Width (m) | 4.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 190.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near outlet Date: 87/8/8 Crew: TB Air Photo
 Location No. BC81009 003,004
 Weather: sunny,hot Air Temp. 32 Water Temp. NA Access:
 Hudgrove Rd.

Wetted by river seepage through the berm and the water table.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines | 1 % |
| Gravel | 8 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | L |

Fish Utilization

Coho and chum salmon spawn in this channel and early coho fry enter it from the mainstem to rear. A few coho overwinter in this channel and small numbers of chinook fry rear in it in the spring. Up to 18,000 coho fry have been salvaged from this 760 m² channel. 1987 salvage figures were 5000 coho fry, 70 coho pre-smolts, 600 chum fry and 250 chinook fry - pre-smolts.

Enhancement Assessment

This channel was created by pick and shovel labour to provide water to steelhead redds subject to drying when mainstem flows dropped. It could be further improved by more excavation and the addition of a buried water line

$$\begin{aligned} \text{Wetted area increase} &= 750 \text{ m}^2 \\ \text{Yield potential} &= 240 \text{ Co smolts} \end{aligned}$$

**Production Option #71
Rank**

| | | | |
|---------------------------------|------------------|--------------------|----|
| Side Channel I.D. A118/1 | Active | BELOW MURKY | |
| (140) | | | |
| Average Wetted Width (m) | 3 | % Pool | 75 |
| Channel Width (m) | 6.00 | % Riffle | 25 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 385.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | 30 in lower 100m | | |

Site Location: central Date: 8/7/87 Crew: TB Air Photo
 Location No. BCC404 052,053
 Weather: clear, hot Air Temp. 32 Water Temp. 13 Access :
 hike Cowichan footpath from BK51 or wade/boat river from Hudgrove
 Rd points.

Wetted by seepage through the inlet bar and the winter water table. Surface flow is not a factor except in extreme floods. Even then, flows are not abrasive.

| Substrate Composition | | Last Updated |
|-----------------------|-----|--------------|
| | | Updated By |
| Fines | 6 % | |
| Gravel | 3 % | |
| Cobbles | 1 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Coho fry winter and summer rear in this channel. There is a high probability of spawning. A few cutthroat fry were seen on August 7, 1987.

Enhancement Assessment

Excavation of a deep infiltration pool at the upper end of wetting would improve summer flow.

Wetted area increase = 1155 m²
 Yield potential = 396 coho smolts

Production Option #72

Rank

Side Channel I.D. R118/2 Relic MURKY SIDETCHANNEL
(141)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 6.00 | % Riffle | NA |
| Minimum Flow | .0012 | % Run | NA |
| Channel Length (m) | 200.0 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Date: 87/8/7 Crew: TB Air Photo Location No. BC81009 Nos
001,002

Weather: clear, hot Air Temp. 32 Access: Cowichan footpath
from BK 51 or wade river at Art Watson's

This channel is obscure and rather ill defined. I debated whether or not to include it. It is never wetted except for backflooding in extreme mainstem flows, even then water only backs up for less than 30 m.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|-----|
| Fines | 5 % |
| Gravel | 5 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Fish Utilization

None

Enhancement Assessment

In the long, long view, this channel could provide permanent flow by trenching the berm, installing a pipe or french drain, reconstructing the berm, then excavating the channel.

| | |
|----------------------|------------------|
| Wetted area increase | = 1200 m2 |
| Yield potential | = 384 Co smolts |
| | = 192 Ch smolts |
| | = 600,000 Cm fry |

Production Option #73
Rank

| | | | |
|-------------------------------|---------------|----------------------------|----|
| Side Channel I.D. A119 | Active | LOWE'S SIDETCHANNEL | |
| (142) | | | |
| Average Wetted Width (m) | 18 | % Pool | 70 |
| Channel Width (m) | 20.00 | % Riffle | 30 |
| Minimum Flow | .0224 | % Run | 0 |
| Channel Length (m) | 70.0 | % Glide | 0 |
| Debris (%) | 0 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Date: 8/7/15 Crew: TB Air Photo Location No. BC81009
003,004 Weather: sun and cloud, cool Air Temp. 16 Water Temp. 17
Access: Hudgrove Rd. to Art Watson's Rd.

Inundated at high flows.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 2 % | | |
| Gravel 8 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction L | | |

Fish Utilization

Supports coho spawning and summer rearing. Early steelhead fry also rear here along with a few parr.

This is an important coho holding pool during upstream migration- a good brood stock collection site. Heavy chum spawning in some years.

Enhancement Assessment

No improvement required

| | | | |
|-------------------------------|--------------|-----------------------------|-----|
| Side Channel I.D. R120 | Relic | LOWRY'S SIDETCHANNEL | |
| (143) | | | |
| Average Wetted Width (m) | 0.69 | % Pool | 100 |
| Channel Width (m) | 10.00 | % Riffle | 0 |
| Minimum flow | 0 | % Run | 0 |
| Channel Length (m) | 240.0 | % Glide | 0 |
| Debris (%) | 10 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | 0 | | |

Site location: near inlet Date: 87/8/8 Crew: TB Air Photo Location No. BC81009 002,003 Weather: clear, hot Air Temp. 30 Access: Hudgrove Rd. turn left at bottom of big hill 3.2 km from start of gravel and proceed to fifth driveway (the easternmost of two- it has a cable across it)

A berm has been bulldozed near the inlet. A single pool remains through the summer.

| | | |
|-----------------------|-----|--------------|
| Substrate Composition | | Last Updated |
| | | Updated By |
| Fines | 3 % | |
| Gravel | 7 % | |
| Cobbles | 0 % | |
| Boulders | 0 % | |
| Bedrock | 0 % | |
| Compaction | M | |

Fish Utilization

Important coho- cutthroat winter habitat. 600 coho pre-smolts, 50 cutthroats (including a 30 cm. fish) and 50 sticklebacks were seined April 4, 1986. The coho parr ranged from 60 to 100 mm. Fish were in a 10 m² pool. near the lower end known as the Iris Pool. Usual seasonal fry salvage results: 2000-4000 Co fry, several hundred pre-smolts and up to 5,000 chum fry. Chum spawning in most years.

Enhancement Assessment

A buried pipe, deeper infiltration pool and spot excavation could provide permanent flow. Care must be taken to insure winter flows remain low. Breakout from the river is a possibility in this channel. A new berm may be required to protect channel. Examined by Russ Doucete and Mel Sheng in June, 1998.

| | |
|----------------------|-----------------------|
| Wetted area increase | = 3600 m ² |
| Yield potential | = 1152 Co smolts |
| | = 576 Ch smolts |
| | = 1,800,000 Cm fry |

Production Option #74
Rank

**Side Channel I.D. R121 Relic RELIC CHANNEL NEAR
CABIN POOL (144)**

| | | | | |
|--------------------------|-------|-------|----------|-----|
| Average Wetted Width (m) | 0 | | % Pool | 100 |
| Channel Width (m) | 6.00 | | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 | |
| Channel Length (m) | 400.0 | | % Glide | 0 |
| Debris (%) | 20 | | % Slough | 0 |
| Gradient Class | .01 | | | |
| Elevation (m) | | | | |
| Turbidity (cm) | nil | | | |

Site Location: Between Ross and Cabin Pools Date: 87/6/9
 Crew: TB Air Photo Location No. BC81009 003,004
 Weather: cloudy Air Temp. 16 Water Temp. 10 Access:
 Cowichan footpath from Ripps Rd. entrance.

Backfloods 70 m. in winter then is sporadically wetted by high water table during normal winter flows. In floods, there is occasional light spill from the mainstem. Three pools remain until early summer. Only one persists until fall rains begin. It is fed by a tiny upwelling of groundwater.

Substrate Composition Last Updated
 Updated By

Fines 8 %
 Gravel 2 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction

Fish Utilization

A few coho fry enter this channel during high flows but become trapped when flow ceases in February, March or April. Less than 100 survive the summer. None survived the summer of 1987.
 Seven steelhead parr wintered in the channel in 1986-87. They were trapped by April and salvaged to the mainstem along with a few coho pre-smolts.

Enhancement Assessment

A buried drain underneath the berm followed by a deep infiltration pool and spot excavation would provide permanent flow.

Wetted area increase = 2400 m²
 Yield Potential = 768 Co smolts
 = 384 Ch smolts
 = 1,200,000 cm fry

**Production Option #75
 Rank**

Side Channel I.D. A122 Active ROSS POOL ACTIVE CHANNEL

| | | | |
|--------------------------|-------|----------|----|
| (145) | | | |
| Average Wetted Width (m) | 10 | % Pool | 30 |
| Channel Width (m) | 10.00 | % Riffle | 70 |
| Minimum Flow | .002 | % Run | 0 |
| Channel Length (m) | 100.0 | % Glide | 0 |
| Debris (%) | 1 | % Slough | 0 |
| Gradient | .5 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near inlet Date: 87/6/9 Crew: TB Air Photo
Location No. BC81009 003,004 Weather: cloudy, cool Air temp. 16 Water
Temp. 16 (10 at upwelling spots) Access: Cowichan Footpath from Ripps Rd.
entrance

Inundated in floods.

Substrate Composition Last Updated
Updated By

Fines 3 %
Gravel 6 %
Cobbles 1 %
Boulders 0 %
Bedrock 0 %
Compaction L

Fish Utilization

Heavily utilized by coho for spring - summer rearing. Densities approach 10/m²
around groundwater upwelling sites after mid-July. Chinook fry and pre-smolts
also use this channel. A chinook smolt was captured on June 9, 1987 .

Enhancement Assessment

No improvement necessary. It might be possible to provide some annual short
term gains by breaching the inlet berm. It closes when mainstem flow falls below
6 CMS. Because its composed of fine, loose gravel, a shovel would do the job.
However, wetted area loss is minimal when the bar closes and the channel is only
accessible by foot so this measure is probably not worthwhile.

Side Channel I.D. R123 Relic PRINCESS AND ROSS POOLS **RELIC CHANNEL BETWEEN**

| | | | | |
|--------------------------|-------|-------|----------|----|
| (146) | | | | |
| Average Wetted Width (m) | 0 | | % Pool | NA |
| Channel Width (m) | 6.00 | | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA | |
| Channel Length (m) | 190.0 | | % Glide | NA |
| Debris (%) | NA | | % Slough | NA |
| Gradient | .1 | | | |
| Elevation (m) | 0 | | | |
| Turbidity (cm) | | | | |

Date: 87/6/9 Crew: TB Air Photo Location No. BC81009 003,004
 Weather: cloudy,cool Air Temp. 16 Water Temp. NA Access:
 Cowichan Footpath from Ripps Rd.

Wetted by winter water table, back flooding and occasional light spill from mainstem. Coho winter in the lower 70 m. and a few are sometimes trapped. One pool remained on 4/19/87. It contained three coho parr.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |
| Fines 8 % | |
| Gravel 2 % | |
| Cobbles 0 % | |
| Boulders 0 % | |
| Bedrock 0 % | |
| Compaction H | |

Fish Utilization

Coho fry enter from the lower end during high water. Most leave before flow ceases in late winter or early spring but a few are trapped. One pool remained on April 19, 1987; it held three coho parr-pre-smolts.

Enhancement Assessment

It should be possible to provide permanent wetting with a buried drain underneath the berm and downstream excavation.

Wetted area increase = 1140 m²
 Yield potential = 364 Co smolts
 = 182 Ch smolts
 = 570,000 Cm fry

Production Option #76 Rank

Side Channel I.D. R124 Relic LONG WALK RELIC
CHANNEL (147)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 300 | % Glide | NA |
| Debris (%) | 15 | % Slough | NA |
| Gradient | .1 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near outlet Date: 86/9/28 Crew: TB Air Photo Location No. BC 81009 003,004 Weather: cloudy, cool Air Temp. 14 Access: Hudgrove Rd. or wade river

Wetted by the winter water table and back flooding.

Substrate Composition Last Updated
 Updated By

Fines 7 %
 Gravel 3 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction H

Fish Utilization

None

Enhancement Assessment

Could be excavated to provide permanent flow.

Wetted area increase = 3000 m2
 Yield potential = 960 Co smolts
 = 480 Ch smolts
 = 1,500,000 cm fry

Production Option #77
Rank

| Side Channel I.D. B125 | Back | BASS POOL LAGOON | |
|--------------------------|-------|------------------|-----|
| (148) | | | |
| Average Wetted Width (m) | 13 | % Pool | 0 |
| Channel Width (m) | 20.00 | % Riffle | 0 |
| Minimum Flow | NA | % Run | 0 |
| Channel Length (m) | 40.0 | % Glide | 0 |
| Debris (%) | 5 | % Slough | 100 |
| Gradient Class | 0 | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | nil | | |

Site Location: near centre Date: 8/7/18 Crew TB Air Photo
 Location No. BC81009 004,005 Weather: clear,warm Air Temp. 23 Water
 Temp. 20 Access: trails from Old L.C. Road.

One of a number of protected backwaters on the Upper Cowichan.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 8 % | | |
| Gravel 2 % | | |
| Cobbles 0 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction M | | |

Fish Utilization

Heavily utilized by chinook and early coho fry. Coho use continues through the summer and fall and perhaps the winter.

Cutthroat fry are present in the tiny groundwater tributary for a distance of 40 m.

Enhancement Assessment

No improvement required.

Side Channel I.D. F126 Flood JOHNNY S FLOODCHANNEL
(149)

| | | | |
|--------------------------|---------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 105.0 | % Glide | NA |
| Debris (%) | 50 | %Slough | NA |
| Gradient Class | Unknown | | |
| Elevation (m) | 0 | | |
| Turbidity (cm) | 0 | | |

Site Location: near outlet Date: 8/7/20 Crew: TB Air Photo
Location No. BC81009 004.005 Weather: clear, warm Air Temp. 23 Access:
Hudgrove Rd.

Inundated by high flows.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 5 % | | |
| Gravel 3 % | | |
| Cobbles 1 % | | |
| Boulders 1 % | | |
| Bedrock 0 % | | |
| Compaction H | | |

Fish Utilization

None, although there is a chance of some overwintering coho.

Enhancement Assessment

Improvement is not possible. The channel is too close to the mainstem and is inundated by high flows.

**Side Channel I.D. R127 Relic SLOT RUN RELIC CHANNEL
(LAMB'S) (150)**

| | | |
|-------------------|----------------------------------|----------|
| Ave. wetted width | 0 | % pool |
| Channel width | 5/4 | % riffle |
| Min. flow | 0 (one pool remains @ low flows) | % glide |
| Length | 355 | % run |
| Debris | 10 | |
| Gradient | .5 | |

Site Location: near centre Date: 87/9/20 Crew: TB Air Photo
Location No. BC 81009 004,005
Weather: clear., warm Air Temp. 22 Access: Hudgrove Rd.

Wetted by winter water table and light spill from the mainstem in high water.
Flow ceases by late April or early May. Scattered pools remain until August.

Substrate Composition Last Updated: 10/16/97 Flow: .188

| | | | |
|------------|-----|---|---|
| Fines | 6 % | 2 | 1 |
| Gravel | 3 % | 6 | 3 |
| Cobbles | 1 % | 2 | 6 |
| Boulders | 0 % | 0 | 0 |
| Bedrock | 0 % | 0 | 0 |
| Compaction | M | L | L |

Fish Utilization

Coho spawning and overwintering, cutthroat and steelhead overwintering. Coho fry emergence is very early in this sidechannel. Some are often out by late March - early April.

New residential development is occurring in this area (1994). During construction of a house in 1995-1996, a ditch was excavated that drained a wetland above Hudgrove Rd. and carried considerable silt/clay into the lower end of the sidechannel.

Enhancement Assessment

Fry salvage is required. 1997 results: Co 250, Ch 1, Ct 41.
1996 results: Co 5000, Ct 100, some Co smolts
Excavation could provide permanent wetting

| | |
|----------------------|-----------------------|
| Wetted area increase | = 1120 m ² |
| Yield potential | = 358 Co smolts |
| | = 179 Ch smolts |
| | = 560,000 Cm fry |

Note: Channel was excavated down 1-3 m in August,1997. A 10" inlet pipe was installed to provide permanent flow (89.5 LPS 8/26/97). Channel's winter capability may be compromised. Channel now has three reaches: R1 5(3) CON .3 6310 129 m, R2 4(3) CON 1.0 2620 161 m, R3 3(0) CON 1.5 1360 65 m. The intake pipe is contained in R3 which is wetted by river spill when the Cowichan exceeds approximately 110 CMS. An 18" overflow pipe is located above the

intake pipe. A berm approximately 15 m long and 2 m high should have been constructed at the inlet. The channel needs more cover and spawning habitat.

Production Option #78
Rank

| Side Channel I.D. R128 (151) | Relic | LUCKY'S RELIC CHANNEL | |
|---------------------------------|-------|-----------------------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 8.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 155.0 | % Glide | NA |
| Debris (%) | 20 | % Slough | NA |
| Gradient Class | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | nil | | |

Site Location: near centre Date: 8/7/20 Crew: TB Air Photo
 Location No. BC 81009 005,006 Weather: clear,warm Air Temp. 22 Access
 Hudgrove Rd. Lucky Berner's Driveway and river access.

Wetted by winter water table. Flow ceases by April or early May. Isolated pools remain until late May or June. Minor backflooding.

| Substrate Composition | Last Updated |
|-----------------------|--------------|
| | Updated By |
| Fines | 7 % |
| Gravel | 2 % |
| Cobbles | 1 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Fish Utilization

Possibility of overwintering coho.

Enhancement Assessment

Excavation may provide permanent wetting but at high cost.

| | |
|------------------------|---------------------|
| Wetted area increase = | 1240 m ² |
| Yield potential | 396 Co smolts |
| | 198 Ch smolts |
| | 620,000 cm fry |

Production Option #79
Rank

| | | |
|---------------------------------|--------------|-----------------------------|
| Side Channel I.D. R129/1 | Relic | COOK'S RELIC CHANNEL |
| (152) | | |
| Average Wetted Width (m) | 0 | % Pool NA |
| Channel Width (m) | 12.00 | % Riffle NA |
| Minimum Flow | 0 | % Run NA |
| Channel Length (m) | 360.0 | % Glide NA |
| Debris (%) | 20 | % Slough NA |
| Gradient Class | .01 | |
| Elevation (m) | | |
| Turbidity (cm) | | |

Site Location: road crossing Date: 87/3/12 Crew: TB Air
 Photo Location No. BC81009 004,005 Weather: cloudy, cool Air Temp. 10
 Access: Cooks driveway from Cowichan Lake Road

Lower 100m wetted by the winter water table and back flooding from the river via Diespecker's Backchannel.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

Fines 8 %
 Gravel 2 %
 Cobbles 0 %
 Boulders 0 %
 Bedrock 0 %
 Compaction H

Fish Utilization

None, although there is chance of overwintering coho at the confluence with Diespecker Pool Backchannel.

Enhancement Assessment

There are no evident enhancement opportunities.

| | | |
|---------------------------------|-------------|---------------------------------|
| Side Channel I.D. B129/2 | Back | DIESPECKER'S BACKCHANNEL |
| (153) | | |
| Average Wetted Width (m) | 10 | % Pool 0 |
| Channel Width (m) | 25.00 | % Riffle 0 |
| Minimum Flow | na | % Run 0 |
| Channel Length (m) | 70.0 | % Glide 0 |
| Debris (%) | 1 | % Slough 100 |
| Gradient Class | 0 | |
| Elevation (m) | | |
| Turbidity (cm) | nil | |

Date: 8/7/10 Crew: TB Air Photo Location No. Bc81009
005,006

Weather: partly cloudy, cool Air Temp. 17 Water Temp. 21
Access: Private Drive from Cowichan Lake Rd.

A large backchannel that is in direct phase with river flow. Little eddying occurs even at high flows.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

Fines 8 %
Gravel 2 %
Cobbles 0 %
Boulders 0 %
Bedrock 0 %
Compaction H

Fish Utilization

Heavily utilized by newly emergent fry - coho, chinook and steelhead. Coho remain over the summer. High probability of coho and steelhead overwintering.

Enhancement Assessment

No improvement necessary.

Side Channel I.D. R130/1 Relic HOLMES POOL
 (154)

| | | | |
|--------------------------|-------|----------|----|
| Average Wetted Width (m) | 0 | % Pool | NA |
| Channel Width (m) | 10.00 | % Riffle | NA |
| Minimum Flow | 0 | % Run | NA |
| Channel Length (m) | 250.0 | % Glide | NA |
| Debris (%) | 21 | % Slough | NA |
| Gradient Class | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: near head Date: 87/6/11 Crew: TB Air Photo Location No. 81009 Nos. 006,007

Weather: cloudy,warm Air Temp. 24 Access: Hudgrove Rd., BR28 logging road

Wetted by winter water table which produces a slight flow: .064 cms (2.25 cfs) at 30 cms in the mainstem. Coho wintering conditions are excellent but none have been seen. Becomes int. by early to mid-April in most years.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |

| | |
|------------|-----|
| Fines | 8 % |
| Gravel | 2 % |
| Cobbles | 0 % |
| Boulders | 0 % |
| Bedrock | 0 % |
| Compaction | H |

Fish Utilization

None. Winter conditions are conducive to coho rearing but the channel dries early - long before smoltification.

Enhancement Assessment

No practical opportunities are evident.

| Side Channel I.D. R130/2 (155) | Relic | BLOCK 28 RELIC | |
|-----------------------------------|-------|----------------|-----|
| Average Wetted Width (m) | 0.05 | % Pool | 100 |
| Channel Width (m) | 11.00 | % Riffle | 0 |
| Minimum Flow | 0 | % Run | 0 |
| Channel Length (m) | 360.0 | % Glide | 0 |
| Debris (%) | 15 | % Slough | 0 |
| Gradient Class | .01 | | |
| Elevation (m) | | | |
| Turbidity (cm) | | | |

Site Location: central Date: 8/7/11 Crew: TB Air Photo
 Location NO. 81009 Nos. 006,007
 Weather: cloudy, warm Air Temp. 24 Water Temp. 1 Access:
 Hudgrove Rd., BR28 logging Rd. or sewer pipeline rd.

Wetted by:

1. Backflooding
2. Winter water table
3. Occasional light spill from the mainstem
4. Upwelling in lower 50 m.

Becomes INT. by mid-April in most years.

| Substrate Composition | Last Updated | Updated By |
|-----------------------|--------------|------------|
| Fines 7 % | | |
| Gravel 2 % | | |
| Cobbles 1 % | | |
| Boulders 0 % | | |
| Bedrock 0 % | | |
| Compaction H | | |

Fish Utilization

Possibility of overwintering coho. Light spawning and summer rearing in lower 50 m. where upwelling provides summer wetting and there is patchy gravel.

Enhancement Assessment

No opportunities apparent. Excavation of an infiltration pool would not provide permanent flow.

| | | |
|-------------------------------|---------------|------------------------|
| Side Channel I.D. A131 | Active | GREEN'S CHANNEL |
| (156) | | |
| Average Wetted Width (m) | 7 | % Pool 30 |
| Channel Width (m) | 8.00 | % Riffle 51 |
| Minimum Flow | .0021 | % Run 0 |
| Channel Length (m) | 237.0 | % Glide 19 |
| Debris (%) | 0 | % Slough 0 |
| Gradient Class | .5 | |
| Elevation (m) | 0 | |
| Turbidity (cm) | nil | |

Site Location: 40 m. below inlet Date: 8/7/82 Crew: TB Air
 Photo Location No. BC81009 006,007 Weather: clear, warm Air Temp. 24
 Water Temp. 21.5 Access: Greendale Rd., Trevor and Yvonne Green's driveway.

The channel is cut off by the berm in some years. When it happens, the Greens lower the berm because the channel is their water supply. Berm elevation varies somewhat between years but is easily modified due to the fine nature of its gravel.

Wetted by the river and a small spring 50 m. above the outlet. Beavers occasionally place a dam near the lower end.

| | |
|-----------------------|--------------|
| Substrate Composition | Last Updated |
| | Updated By |
| Fines 1 % | |
| Gravel 7 % | |
| Cobbles 1 % | |
| Boulders 1 % | |
| Bedrock 0 % | |
| Compaction L | |

Fish Utilization

Coho, steelhead and cutthroat fry are present as summer residents. The channel flows swiftly in fall-winter but has reasonable winter habitat capability. Spawning has not been reported except for steelhead in some years. Coho and chums likely spawn in this channel as well and perhaps brown trout and resident rainbow.

Enhancement Assessment

Creation of a larger, more stable berm and increasing channel complexity - cover could enhance rearing value. But, in the main this channel is doing just fine on its own with occasional help from the Greens.

Sidechannel I.D. 132 A Active **TONY GREEN'S SIDETCHANNEL**
(157)

| | | | |
|--------------------------|------------------|----------|-----|
| Average Wetted Width (m) | 7 | % pool | 100 |
| Channel Width | 8 | % riffle | 0 |
| Channel Length | 128 (119 wetted) | % glide | |
| Debris (%) | 1 | % run | |
| Gradient | .1 | % slough | |
| Elevation | | | |
| Turbidity | nil | | |

Site Location: central Date: 9/1/98 Crew: TB Air photo location No: BCC 81009:
06, 07

Weather: clear and hot AT 30. WT 19.1 Adjacent river 24.6 Access: thru Tony
Green's

Wetted by: Water table and winter flooding. Inundated in high flows. For most of
the winter, the channel is simply part of the river. Tony cleared the riparian zone
of this channel in 1990 and was charged by Trevor Fields of DFO. The riparian
zone extends inland some 50 m from the north edge of the channel to the inland
edge of a small slope that separates the upland from the riparian/floodplain. No
development was placed in the FSZ and it has been allowed to re-vegetate. Some
gravel spills into the downstream end of the channel from nearby Stanley Creek.

Substrate Composition:

| | |
|----------|----|
| Fines | 8 |
| Gravel | 2 |
| Cobbles | Tr |
| Boulders | 0 |
| Bedrock | 0 |

Fish Utilization

Coho and chum spawning, coho and trout rearing.

Enhancement Assessment

Selective deepening might improve summer conditions – not a priority.

**Reminder: More information is available in a sidechannel catalogue that
was prepared in conjunction with the 1987 sidechannel assessment – (Burns
et. al. 1988)**

OPERATIONAL MANAGEMENT UNIT 6: RIVER NORTH

OVERVIEW

River North runs up the north side of the Cowichan Valley from the western part of the Somenos Basin (Menziess Creek) to the eastern flanks of the Town of Lake Cowichan. This OMU is entirely rural in character with small areas of settlement at Sahtlam (Upper and Lower), Paldi, Skutz Falls and Three Mile. The streams drain Hill 60 and associated bench lands.

The area is largely upland but there are some significant lowland riparian and wetland areas along Inwood Creek, Currie Creek, Mayo Lake Creek (especially above the lake), Skutz East and West, Watercress East and West and Josiah Creeks.

Aside from the above mentioned creeks, the OMU contains the following other salmonid streams or streams with the potential to support trout and salmon: Wake, Tzartlam, Bluff, Lagoon and Green Timbers East and West.

LIMITING FACTORS

Primary limiting factors are access and low summer flows. For example, Inwood and Mayo Lake Creeks have large waterfalls not subject to improvement at their lower ends and Currie Creek dries almost completely.

PRODUCTION OPTIONS

A total of 13 production options are present on the 15 streams in the OMU. Five streams – Watercress West, Lagoon, Last and Green Timbers East and West have no viable enhancement options. The options are briefly outlined in Table 4.

Table 4: River North Production Options

| No. | Location | Activity | Priority |
|-------|---------------------|--|----------|
| 1 | Inwood Creek | Coho colonization | 2 |
| 2 | | Headwater storage | 3 |
| 3 | Currie Creek | Headwater storage – Coho colonization | 2 |
| 4 | Wake Lake and Creek | Coho colonization | 3 |
| 5 | Tzartlam Creek | Headwater storage | 4 |
| 6 | Bluff Creek | Slope stabilization | 3 |
| 7 | Mayo Lake Creek | Improve cutthroat recruitment | 2 |
| 8 | Skutz East | Improve barrier | 3 |
| 10 | Skutz West | Barrier removal (2) | 1 |
| 11,12 | Watercress East | Base flow improvement : excavation and headwater storage | 1 |
| 13 | Josiah Creek | Pond stocking coho or brown trout | 1 |
| | | | |
| | | | |

Stream Code: 9202 577149200

Stream Name: Inwood Creek

Operational Management Unit: River North

CVRD Electoral Area: E and North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan at the S pool 15.5 km above the estuary. Drains a broad, low relief basin.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 140-141 |
| <u>Topographic Map</u> | 92 B/13. 92 B.071, 92B.072, 92B.081 |
| <u>Salmonids</u> | Co to 200 m. Ct to 5,200 m. Cm to 55 m. St to 200 m. |
| <u>Obstructions</u> | A 7.6 m falls 200 m upstream and a 70 m long culvert with an outlet velocity of 1-2 m/sec. at 6,000 m. Two falls 3 m over 4 and 2 m over 5 - at 8,500 and 8,520 m. |
| <u>Max. Temp. (C)</u> | 15 (8/20/85) |
| <u>Min. disch. (m³)</u> | 0.000025 (8/20/85) Menzies Road. (Reach 3) |

INWOOD CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 12.0 | 0 | 1720 | 1.5 | CON | N | 55 | 0 |
| Reach 2 | 12.0 | 3 | 1315 | 2.0 | EN | N | 145 | 435 |
| Reach 3 | 12.0 | 3 | 1234 | 1.0 | CON | N | 2500 | 7500 |
| Reach 4 | 12.0 | 3 | 2431 | 0.5 | OC | L | 2500 | 7500 |
| Reach 5 | 6.0 | 2 | 1360 | 1.5 | OC | L | 3000 | 6000 |
| Reach 6 | 4.0 | 2 | 1117 | 10.0 | CON | N | 200 | 400 |
| Reach 7 | 4.0 | 2 | 4600 | 0.5 | OC | L | 1880 | 3760 |
| Reach 8 | 1.5 | 0 | 1360 | 13.0 | CON | N | 1500 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 55 m is subject to dewatering. This section is followed by 145 m of wetted habitat, largely bedrock. Resident cutthroats are present above the falls for 8,000 m.

Production is limited by low late summer discharge and short accessible length for anadromous salmonids.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Barrier to anadromous fish at 200 m. **Above barrier coho smolt yield potential:** 1,980 - 9,900/Fry requirement: 24,760 (**Production Option # 1**). Coho fry should be stocked in the fall to avoid the possibility of drying. However, Reach 7 can be stocked in the spring or summer because it never dries.

2. HEADWATER STORAGE: **Headwater storage potential** of 10 HA (surface area) at the head of a tributary that enters at 7500 m. (**Production Option # 2**). Impoundment of 1 m could provide 0.009 cms for 180 days. This would significantly increase minimum flow and add 10,000 m² of rearing habitat.

An additional 8.2 HA of **impoundment opportunities** are located further downstream: (**Production Option # 3**).

1.2 HA at the headwaters of Hillcrest Creek

2.5 HA at the head of a tributary that enters at 4,500 m.

3.2 HA adjacent to the mainstem at 5,700 m.

OMU 6: River North – Burns and Tutty, 1999

The development of Hillcrest Creek would add an additional 0.007 cms and make Hillcrest Creek habitable in the summer period adding another 2,000 m² of habitat. The amount of additional wetted channel could provide 960 - 3,840 additional coho smolts. If the reservoir habitat were also colonized with coho fry, 984 additional smolts might result from stocking at 1500 fry per hectare.

D) LAND USE FACTORS

Agriculture

A significant portion of the basin is in agricultural production. Hillcrest Creek, a ephemeral tributary that enters 2,000 m upstream, has been highly modified. Potential impacts to Inwood Creek are considered minimal.

Residential

Light development along Cowichan Lake and Hillcrest Roads.

Forestry

Outside the agricultural zone, most of the basin is covered by advanced second growth although logging has resumed on a small scale.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The Reaches 1 and 2 are contained by ravine/canyon and are within the Cowichan Corridor. Reach 3 is also relatively well confined with a narrow FSZ. Reaches 4,5 and 7 have significant riparian components and broader FSZ's.

Stream Code: 9202577149000

Stream Name: Currie Creek

Operational Management Unit: River North :

CVRD Electoral Area: E

- A) BIOPHYSICAL OVERVIEW: Currie Creek enters Inwood Creek from the west 2,500 m above the Inwood Creek - Cowichan River junction. The drainage area is a broad, low relief basin with a southeast aspect.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 139-141 |
| <u>Topographic Map</u> | 92 B/13, 92B.071, 92B.072, 92B.081 |
| <u>Salmonids</u> | Ct migrate from Inwood Creek in the spring they perish in most summers but a few survive in isolated pools in wet summers. |
| <u>Obstructions</u> | none |
| <u>Max. Temp. (C)</u> | N/A |
| <u>Min. disch. (m³)</u> | 0 |

CURRIE CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 6.0 | 0 | 1540 | 1.0 | CON | N | 1000 | 0 |
| Reach 2 | 4.0 | 0 | 1450 | 1.0 | FC | L | 6500 | 0 |
| Reach 3 | 4.0 | 1 | 1450 | 0.5 | FC | L | 500 | 500 |

- B) FISH UTILIZATION AND LIMITING FACTORS

Currie Creek dries almost completely most summers. In wet years, it retains a few isolated pools and Reach 3 maintains a slight flow. Amazingly, a few cutthroat trout fry and parr can still be found resident in these pools and in R3.

- C) PRODUCTION OPPORTUNITIES

1.IMPOUNDMENT AND COHO COLONIZATION(Production Option # 3) of a 25 HA headwater wetland basin (Mowat Swamp) to a depth of 1 m could provide 0.011 cms for 180 days and wet 3 m of channel width for 6,000 m providing 18,000 m² of quality rearing habitat in the stream. This could potentially yield from 1,440 -5,760 smolts from **colonized coho fry (Production Option # 4)**. If Mowat Swamp could carry coho fry through the year, another 300 smolts could result from a stocking rate of .15 fry/m². Twelve other wetlands are present in the basin and could also be utilized to augment CPD.

- D) LAND USE FACTORS

Agricultural

A few small holdings. Minimal impact.

Residential

Clusters along Cowichan Lake Road between Sahtlam and Paldi townsites. Light impact.

Forestry

Aside from the Cowichan Lake Road - Upper Riverbottom Road strip and Paldi townsites, the basin is covered by advanced second growth.

Fishery Officer Narrative

OMU 6: River North – Burns and Tutty, 1999

Stream Code: 9202577204

Stream Name: Wake Creek and Lake

Operational Management Unit: River North

CVRD Electoral Area: E

- A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north 19.7 km above the estuary. The system is composed of Wake Lake, a small, mature lake situated on a bench at an elevation of 105 m, several wetland basins and Wake Creek, a very small temporary stream that is inaccessible to anadromous salmonids.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 140-141 |
| <u>Topographic Map</u> | 92 B/13, 92B.071, 92B.072 |
| <u>Salmonids</u> | None |
| <u>Obstructions</u> | Two culverts at reservoir outlets 500 and 600 m below the lake - the lower has a 3 m vertical drop; the upper, a drop of 4 m. High gradient for the first 300 m prevents anadromous fish access. |
| <u>Max. Temp. (C)</u> | N/A |
| <u>Min. disch. (m³)</u> | 0 |

WAKE CREEK

| | Channel width | Wetted width | Substrate | Slope | Confinement | Side Channel | Length | Wetted Area |
|---------|---------------|--------------|-----------|-------|-------------|--------------|--------|-------------|
| Reach 1 | 2.0 | 0.0 | 1360 | 30.0 | CON | N | 300 | 0 |
| Reach 2 | 1.5 | 0.0 | 6400 | 2.0 | CON | N | 600 | 0 |

WAKE LAKE

| Area | Elevation | Volume | Max. depth | TDS |
|------|-----------|--------|------------|-----|
| 23 | 105 | | | |

- B) FISH UTILIZATION AND LIMITING FACTORS

The system contains no fish. The stream dries early and the lake is privately owned.

- C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Wake Lake has a coho smolt yield potential of 1,840 - 7,360 (**Production Option #4**). However, two small reservoirs are present on the Duncan property 500 m below the lake. Their levels could drop below their outlet culverts before smolts reach them.

- D) LAND USE FACTORS

Agricultural

Light

Forestry

Advanced second growth.

Risk Potential

Low, if spring water levels are high enough to permit smolts to migrate out.

Fishery Officer Narrative
Stream Code: N/A

Stream Name: Tzartlam Creek

Operational Management Unit: River North

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan from the north 19.5 km above the estuary via the lower end of Tzartlam Active Channel. Drains a low gradient basin containing two wetlands.

| | |
|------------------------------------|-------------------------------|
| <u>Air Photos</u> | BC 82007 140-141 |
| <u>Topographic Map</u> | 92 B/13, 92B.071 |
| <u>Salmonids</u> | None |
| <u>Obstructions</u> | Increasing gradient at 530 m. |
| <u>Max. Temp. (C)</u> | N/A |
| <u>Min. disch. (m³)</u> | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

This stream supports no fish due to summer dewatering.

C) PRODUCTION OPPORTUNITIES

1. HEADWATER WETLAND IMPOUNDMENT (4 HA) could yield 0.002 cms for 180 days which would provide considerable benefit in the small channel of Tzartlam Creek (**Production Option # 5**).

D) LAND USE FACTORS

Forestry

Mainly advanced second growth; some logging has resumed.

Risk Potential

Low.

Stream Code: N/A

Stream Name: Bluff Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The creek enters the Cowichan from the north through a gap in Stoltz Bluffs 2.5 km downstream from the confluence of Mayo Lake Creek with the Cowichan. A steep, largely groundwater fed stream. Several small wetlands at headwaters near Old Lake Cowichan Road.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 139-140 |
| <u>Topographic Map</u> | 92 B/13, 92B.071 |
| <u>Salmonids</u> | Co to 100 m. Ct to 100 m. |
| <u>Obstructions</u> | Small log jams and steepening gradient above 100 m. |
| <u>Max. Temp. (C)</u> | 15 (8/6/86) |
| <u>Min. disch. (m³)</u> | 0.048 (8/6/86) |

BLUFF CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4 | 1.5 | 3340 | 3.0 | ENT | Nil | 100 | 150 |
| Reach 2 | 3 | 1 | 3340 | 6.0 | ENT | Nil | 300 | 300 |
| Reach 3 | 3 | 1 | 1360 | 4.0 | CON | Nil | 1000 | 1000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present for the first 100 m. A total of 23 coho fry and 7 cutthroat fry were counted on August 6, 1986.

Production is limited by accessible length, high gradient, small channel size and a high proportion (30 percent) of substrate fines. Probable summer rearing habitat only.

C) PRODUCTION OPPORTUNITIES

1. SLOPE STABILIZATION ON THE RAVINE WALLS: Bluff Creek is a part of the Stoltz Bluff complex that contributes seasonal turbidity and sedimentation to the Cowichan River and to itself. Productivity would improve both in the creek and in the river. One stabilization project has already been accomplished on an approximate 600 m² slope failure adjacent to lower reach 1. Slope failures are also responsible for obstructing fish passage in Bluff Creek. (Production Option # 6)

D) LAND USE FACTORS

Forestry - advanced second growth covers most of the basin.

Residential - light use along Old Lake Cowichan Road.

Risk Potential - Low at present. Future logging could pose substantial impact. The lower 400 m of Bluff Creek flows through a very unstable ravine.

E) PROTECTION NEEDS

Reaches 1 and 2 are located in a highly unstable ravine that features sidewalls that are nearly vertical in places. A number of small slope failures are present along with areas of soil creep. One area was partly stabilized with willow wattles but many more remain. The FSZ includes the ravine and approximately 30 m of upland on either side. It also includes the lower end of Little Bluff Creek, a tributary from the east that has a mini ravine of its own.

OMU 6: River North – Burns and Tutty, 1999

Stream Code: 9202577366

Stream Name: Mayo Lake Creek

Operational Management Unit: River North

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** The creek enters the Cowichan from the northwest 32.5 km above the estuary. The Mayo Lake drainage area includes the southeast toe of Hill 60, an area high in groundwater. The stream receives thirteen tributaries below the lake. The basin is of low relief. Mayo Lake is a shallow, eutrophic reservoir. Above the lake, much of the creek has been impounded by beavers and some very large beaver ponds are located there.

Air Photos BC 82007 139-140

Topographic Map 92 B/13, 92 B.071, 081

Salmonids Rb to 4,000 m.(sparse).

Ct to 4,000 m. Ct are also present in Club and LePage Creeks for a distance of 1000m.

Obstructions A series of seven falls and cascades 0 - 100 m above the Cowichan. Total drop: 20 m. Greatest vertical drop: 3 m. Two culverts at Mayo Road: both are barriers to upstream fry movement but may be passable for yearling trout at higher flows. Vertical drop is .5 - .6 m for both at normal winter flows.

Max. Temp. (C) 19.1 R2 50 m above Riverbottom Road 8/16/97

Min. disch. (m³) 0 (int. in very dry summers), Aug. 16, 1997: .0153 R2, Lower Club .002 17° and Lower LePage .007 20°.

Upper Mayo Lake Creek is now wetted during the summer due to increased beaver impoundment.

R1 Upper Mayo Lake Creek: .0003168 (9/23/98)

MAYO LAKE CREEK

| | Channel Width | Wetted Width | Substrate | Slope (%) | Confinement | Side Channel | Length | Wetted Area |
|---------|---------------|--------------|-----------|-----------|-------------|--------------|--------|-------------|
| Reach 1 | 10.0 | 0.0 | 1117 | 20.0 | EN | N | 100 | 0 |
| Reach 2 | 15.0 | 5.0 | 1630 | 1.5 | FC | L | 1000 | 5000 |
| Reach 3 | 8.0 | 5.0 | 1720 | 1.2 | FC | L | 3000 | 15000 |
| Reach 4 | 5.0 | int | 5500 | 0.5 | FC | M | 150 | 0 |
| Reach 5 | 12 | 1.0 | 6310 | 0.5 | FC | L | 500 | 500 |
| Reach 6 | 15 -150 | ponds | 9100 | 0.2 | OC | H | 2400 | variable |

MAYO LAKE

| Area | Elevation | Volume | Max. depth | TDS |
|------|-----------|--------|------------|-----|
| 3.5 | 175 | | 3 | |

B) FISH UTILIZATION AND LIMITING FACTORS

Rainbow and cutthroat trout are present in Mayo Lake (a reservoir). Rainbows are stocked, cutthroats are natural. The lake was drained 9/10/86. 205 Ct and 15 Rb were salvaged. Occasional monitoring of catch suggests that rainbow and cutthroats are caught in about equal numbers.

The creek diminishes to isolated pools late in dry summers. Numerous cutthroat fry are trapped. Many are thought to be progeny of Mayo Lake spawners and are probably unable to enter the lake until their second year because of culverts at Mayo Road and a beaver dam at the lake's outlet. These are judged to be velocity barriers to trout smaller than 10 cm. The beaver dam was replaced by a concrete dam with a stop board spillway in August of 1997. The dam apron is impassable to fry (.2 m) but larger juveniles could probably negotiate it. It is likely that the dam will always have at least one stopboard which would produce an impassable condition.

Possibility of some spawning in a 80 m section of Mayo Lake's inlet below Skutz Falls Rd. No fry have been observed and the gravel is patchy, angular and compacted. This stream has dried by mid - June or early July in the 1970 - 1990 period. However, increasing headwater storage in the form of beaver impoundments provided minor summer flow last year (1997).

OMU 6: River North - Burns and Tutty, 1999

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION** : Mayo Lake (3.5 HA) has a potential coho smolt yield potential of 2,800 - 14,000. However, because of its high sport fishing value (outstanding spring and fall trout fishing) it is not recommended for coho colonization.

2. **IMPROVE RECRUITMENT POTENTIAL – MAYO LAKE**: Since trout fry returns from outlet spawning below Mayo Lake may not be possible, inlet gravel improvement could improve recruitment and reduce or eliminate stocking. Many adult trout kelts are now prevented from re-entering Mayo Lake after their first spawning reducing the number of adult trout larger than 20 - 30 cm in the lake. However, it is suspected that some yearling trout, mainly cutthroats, return to the lake in the spring of their second year when outlet culvert passage might be possible. This possibility could be improved by constructing a wing dam at the outlet of the main culvert pool or at the pool below an overflow culvert on a tributary just upstream (**Production Option # 7**) to raise levels thus reducing culvert flow velocity and vertical drop. An alternative enhancement option would be to improve the spawning habitat in the inlet stream (**Production Option # 8**) and to reduce the need for upstream migration into the lake.

An increase in Mayo Lake storage would render Mayo Creek more habitable in summer dry periods(a dam was constructed by MOE in the summer of 1996).

Annual trout fry salvage from Mayo Lake Creek could also reduce or eliminate stocking need.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth but logging has resumed in a minor way. Fifteen HA have been harvested since 1982.

Residential

A 1,500 m strip between Highway 18 and Cowichan Lake Road has been subdivided into two hectare parcels. Most are occupied. Five seasonal streams cross the development but impact has been minimal. There has been some minor impact from residential development along Maclean Road. Some residents have cleared to the streambank which has accelerated local bank erosion.

Risk Potential

Low

E) PROTECTION NEEDS

Mayo Lake Creek receives a large number of very small tributaries, most from the north: many of these drain pocket wetlands and moist woodland. They need to be avoided in forestry or land development projects. Reach 2 is bordered by some moist slopes with a number of seepage zones that should remain undisturbed. The riparian zone in Reach 2 and parts of Reaches 3 through 6 is active and very moist in places. A zone of steep slopes is adjacent to the lower 400m of Club Creek.

Stream Code: 9202577416

Stream Name: Skutz Creek (East)

Operational Management Unit: River North

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** This stream enters the Cowichan from the north 50 m below Skutz Falls. The drainage area includes the bench at the southeast end of Hill 60. The stream originates in a maze of small wetlands on this bench before dropping down to the Cowichan in Reach 3. Summer flow provided by groundwater seepage.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 139-140 |
| <u>Topographic Map</u> | 92 B/13. 92B.071, 92B.081 |
| <u>Salmonids</u> | Ct from 20 to 800 m. |
| <u>Obstructions</u> | A series of falls at Cowichan confluence: 5 m over 17. Greatest vertical drop 0.7 m. |
| <u>Max. Temp. (C)</u> | 8.5 (8/21/85) |
| <u>Min. Temp. (C)</u> | 5 (2/85) |
| <u>Min. disch. (m³)</u> | .022 m ³ /sec (8/21/85). |
| <u>Max. disch. (M³)</u> | .44 m ³ /sec (3/4/87). |

SKUTZ CREEK (East)

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 2.0 | 1.0 | 0109 | 25.0 | EN | N | 20 | 20 |
| Reach 2 | 2.0 | 1.0 | 1540 | 1.0 | OC | L | 780 | 780 |
| Reach 3 | 2.0 | 0.0 | 1440 | 2.0 | CON | N | 1000 | 0 |
| Reach 4 | 3.0 | 0.0 | 4600 | 0.2 | OC | L | 2000 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few resident cutthroat trout are present above the falls. Production is limited by low summer flow, narrow channel width and lack of deep pools.

Anadromous salmonids cannot utilize the stream because of a series of small falls at its confluence with the Cowichan.

C) PRODUCTION OPPORTUNITIES

1 **FURTHER BARRIER IMPROVEMENT/BROWN TROUT COLONIZATION:** The Provincial Fish and Wildlife Branch improved the falls in 1982 so that colonized brown trout would return. Observation of the falls at optimal flow suggests that adult browns should be able to navigate them but with considerable difficulty. The probability that they cannot and that annual fry stocking will be required, should be considered. Several minnow trapping efforts in Reach 2 caught no browns (Production Option # 9).

D) LAND USE FACTORS

Forestry

Advanced second growth covers most of the basin but logging has resumed. 10 HA has been logged since 1980.

Residential

Light.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

A large number of wetlands are present in the upper basin of Skutz East along with a network of tiny seasonal tributaries and moist soils. Careful treatment is required in any forestry or land development operation. Reach 3 is located in a ravine where adjacent slopes are near 70% in places and there are areas of high soil moisture. Adjacent logging has caused major blowdown of streamside and adjacent slope trees here.

Stream Code: N/A

Stream Name: Skutz Creek (West)

Operational Management Unit: River North

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** This stream enters the Cowichan at Skutz Falls. The drainage area includes the southeast end of Hill 60. Summer flow provided by groundwater seepage. The stream originates in a number of wetlands near TimberWest's Block 51 Road.

Air Photos BC 82007 139-140

Topographic Map 92 B/13, 92B.071

Salmonids Ct to 1,000 m

Co to 35 m

Cm to 35 m

Obstructions Culvert at 35 m: velocity barrier. Velocity at mean winter discharge = 1.79 MPS. This is a wood stave culvert 17 m long and 1.4 m in diameter. Attempts have been made to backflood it but the angle is too steep. 1 m culvert at 485 m.

Min. Temp. (C) 4 (2/85)

Max. Temp. (C) 12 (8/21/85)

Min. disch. (m³) 0.023 (8/21/85)

Max. disch. (m³) 0.36 (3/4/87)

Mean winter .08

SKUTZ CREEK (West)

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3.0 | 1.0 | 1450 | 2.0 | CON | N | 35 | 35 |
| Reach 2 | 2.0 | 1.0 | 1720 | 1.2 | OC | L | 450 | 450 |
| Reach 3 | 2.0 | 0 | 2620 | 2.5 | CON | N | 750 | 0 |
| Reach 4 | 6.0 | 0 | 1000 | 0.2 | OC | L | 800 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and an occasional chum utilize the lower 35 m where a culvert blocks passage.

Resident cutthroats are present in the lower 1,000 m. The cutthroat are present in low numbers because of the lack of cover low summer flows and lack of winter habitat.

Anadromous salmonid access is blocked by a culvert at 35 m which is a velocity barrier. The culvert is an old wooden structure 17 m long. Velocities are approximately 1.6 to 2.0 m/sec at moderate to high flows. The stream dries during the summer, at a point 20 m above the second culvert at 485 m upstream.

C) PRODUCTION OPPORTUNITIES

1. **BARRIER IMPROVEMENT:** The Fish and Wildlife Branch back flooded the culvert pool in 1982. Their objective was to allow brown trout passage at high flows. It was unsuccessful. Brown trout colonization at 1 fry/m², would require 970 fry. Removal of the first culvert or diversion of the stream to an old channel 50 m east. Diversion would add 150 m² of summer habitat (**Production Option #10**). **There is a barrier (1.53 R) at the confluence with the Cowichan that would also require minor improvement for fish passage.**

Above barrier coho smolt yield potential: 80 - 400. Fry required: 1000 .

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth, logging has resumed on a small scale.

OMU 6: River North – Burns and Tutty, 1999

Residential

Very light.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Skutz West is very similar to its counterpart, Skutz East. Its upper basin features a number of small wetlands and an extensive riparian area and its Reach 3 is a ravine with sensitive slopes which need protection along with the Reach 4 riparian zone and wetlands,

Stream Code: N/A

Stream Name: Watercress Creek East

Operational Management Unit: River North

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** A complex groundwater system supplied by upland seepage and perhaps by Cowichan River groundwater. Recent beaver activity in the mid-basin has increased storage and the opportunity to improve summer flow which is nil for nearly 70% of the stream's accessible length. Partially located in a post-glacial relic channel of the Cowichan. The lower 100m is Cowichan back channel 101B - see sidechannel catalogue.

Air Photos BC 82007 138-139
Topographic Map 92 B/13, 92B.071, 92B.081
Co to 872 m.
Ct to 872 m.
Obstructions None. Dries at 872 m.
Max. Temp. (C) 8 (9/20/85)
Min. disch. (m³) .014 to 872 m (9/12/86)
0.006 Upper 500 m of 872 m (9/20/85)

WATERCRESS EAST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 10 | 8 | 8200 | .001 | CON | N | 101 | 808 |
| Reach 2 | 12 | 2 | 2800 | .5 | FC | L | 471 | 942 |
| Reach 3 | 6.5 | 1.5 | 3700 | .5 | FC | L | 300 | 450 |
| Reach 5 | 5.0 | 0 | 1630 | 2.0 | FC | N | 1400 | 0 |
| Reach 6 | 25.0 | 0 | 1000 | .1 | OC | H | 400 | 0 |
| Reach 7 | 4.0 | 0 | 3700 | .5 | OC | H | 350 | 0 |
| Reach 8 | 3.0 | 0 | 1450 | 15.0 | CON | N | 1200 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present throughout the stream's wetted length. Production is limited by low summer flow.

C) PRODUCTION OPPORTUNITIES

- SUMMER FLOW IMPROVEMENT - EXCAVATION:** Habitable area might be extended upstream by excavation. A few isolated pools are present for 300 m above the end of summer flow. **Excavation** may also increase flow (**Production Option # 11**). Wells should also be considered. A well that provides 6 C water at four litres per second is located 1000 metres downstream (Kennedy's Well).
- SUMMER FLOW IMPROVEMENT - HEADWATER STORAGE:** Recent beaver (1997) beaver impoundment in Reaches 6 and 7 has provided an opportunity to provide downstream summer flow to 1800 m of summer dry habitat. The largest impoundment has an estimated volume of 88,400 m³. This would provide 11.36 LPS for three months. Estimated wetted area increase would be 5400 m² which could produce an estimated 432 coho smolts (Production Option # 12).

D) LAND USE FACTORS

Forestry

The area is covered by advanced second growth. Approximately 20 hectares adjacent to the stream were logged in the early 1980's. A large percentage of the mid-basin was logged by the Doman (Aldermere) Group in the latter part of the 1980's and early 1990's.

Residential

Very light however the Doman Group (Aldermere) have proposed a land development that could effect part of the basin.

OMU 6: River North – Burns and Tutty, 1999

Fishery Officer Narrative

E) PROTECTION NEEDS

A very large portion of the stream adjacent lands (SAL) are fisheries sensitive. The upper basin (R8) because of steep adjacent lands on the most precipitous portion of Hill 60 Ridge where slopes are vertical in places. Fortunately, they are largely bedrock slopes. All other reaches except Reach 5 are sensitive because of extensive riparian lands including marsh and swamp. Reach 5 is a transitional reach between the lowland reaches on the Cowichan Floodplain and the bench reaches (6 and 7) at the toe of Hill 60.

Stream Code: N/A

Stream Name: Watercress Creek West

Operational Management Unit: River North

CVRD Electoral Area: F

- E) BIOPHYSICAL OVERVIEW: Enters the Cowichan from the northwest 300 m west of Watercress East. Another complicated groundwater system located in a complex of post glacial relic channels of the Cowichan River. Upland groundwater seepage contributes to low summer stream flow. Blends into Finn's Channel and is an important factor in wetting and cooling the old Cowichan River Channel between the Double D diversion and the Maple Tree Pool.

Air Photos BC 82007 138-139
Topographic Map 92 B/13, 92B.071, 92B.081
Salmonids Co to 750 m.
Ct to 750 m.
Obstructions None. Dries above 750 m.
Max. Temp. (C) 10 (8/8/87)
Min. disch. (m³) .0631 (8/8/87)

WATERCRESS WEST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4 | 4 | 7300 | 0.01 | CON | L | 500 | 2000 |
| Reach 2 | 5 | 2.2 | 2610 | 0.5 | CON | N | 250 | 550 |
| Reach 3 | 15 | 0 | 8200 | 0.01 | OC | NA | 490 | 0 |

E) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few cutthroat are present for about 750 m. The amount of wetted channel varies somewhat between wet and dry years.

E) PRODUCTION OPPORTUNITIES

It might be possible to capture groundwater by excavation or with a well but these would be costly gambles for little benefit.

E) LAND USE FACTORS

Forestry

Advanced second growth covers most of the basin. 20 HA of early regeneration are present adjacent to reach 2. Logged in 1976.

Risk Potential

Low.

E) PROTECTION NEEDS

Rather extensive riparian lands are located in the Watercress East Basin.

Stream Code: 9202577545

Stream Name: Josiah Creek

Operational Management Unit: River North

CVRD Electoral Area: F

- A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north, five kilometres below Cowichan Lake. Its flow comes from a complex network of seepage channels along the toe of Hill 60.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, B13. 92B.081, 92C.090

Salmonids Co to 1260 m.

Ct to 1260 m.

Obstructions 1 m over 2 cascade at 1260 m, sharply increasing gradient above. E & N culvert at 200 m on the West Fork is a velocity barrier (1.7 m/sec). 1 m vertical drop culvert outfall is present at Cowichan Lake Road (250 m) on the West Fork.

Max. temp. (C) 12.5 (5/7/87). Maximum temperatures usually occur in the first heat of the season when surface water is still contributing to the run-off. When the contribution from surface run-off is reduced, Josiah Creek falls back to 9.5 C.

Min. disch. (m³) 0.007 (8/31/85).

JOSIAH CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4.0 | 2.0 | 1360 | 6.0 | ENT | N | 50 | 100 |
| Reach 2 | 5.0 | 2.0 | 7200 | .5 | OC | M | 780 | 1560 |
| Reach 3 | 3.0 | 1.0 | 3700 | 1.0 | FC | L | 330 | 330 |
| Reach 4 | 2.0 | 1.0 | 1450 | 3.0 | CON | N | 100 | 100 |
| Reach 5 | - | - | - | 25.0 | ENT | N | 1500 | - |

WEST FORK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 2.0 | 1.0 | 3700 | 1.0 | CON | L | 200 | 200 |
| Reach 2 | 2.0 | 1.0 | 2810 | 3.0 | CON | N | 50 | 50 |
| Reach 3 | - | - | - | 45.0 | CON | N | 1500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Josiah Creek supports a small population of resident cutthroats and sporadic coho runs. No coho fry were observed between 1982 and 1986. On April 19, 1987, about 5,000 coho fry were counted by walking the stream margin.

Production is limited by a small area of useable habitat.

C) PRODUCTION OPPORTUNITIES

OMU 6: River North – Burns and Tutty, 1999

1. **COHO PONDING: Two backyard ponds**, 60 m² each, are present in reach 4. In the spring of 1986, the Cowichan Lake Salmonid Enhancement Society stocked the ponds with 16,000 1 gm. coho fry, a rate of 133 gm/m² (surface area). The fish were doing well until predators decimated them. Two thousand survived and smolted (**Production Option # 13**).

2. **BROWN TROUT PONDING AND STOCKING** : If 12,000 1 gm brown trout were stocked (100 gm/m² is the recommended rate - Clemmons, 1985) and predator control measures undertaken; the ponds should be capable of yielding some 6,000 yearlings. It would also be worthwhile to **stock brown trout fry** in Josiah Creek at 1 fry/m² and 10 percent survival to age 1,234 yearlings would be provided to the upper Cowichan from the 2,090 m² of suitable habitat in Josiah and 250 in its West Fork (2,340 total) (**Production Option # 14**).

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. Logging will resume in the next decade.

Residential

Light. Scattered along Cowichan Lake Road.

Risk Potential

Moderate due to the number of small seepage streams that provide much of the flow. Ten have been located. How far they extend up Hill 60 is unknown. Very careful pre-logging reconnaissance will be required. Each should be flagged. The area near the creek will be skidder logged so the impact potential is significant. Soils in the lower basin are moist with high organic and clay content.

E) PROTECTION NEEDS

Josiah Creek Basin contains a large number of seepage areas, tiny tributaries and pocket wetlands. These need to be included in DPA's or special zoning . They are so numerous and so small that only a mapping program at the scale of 1:1,000 or more would portray them.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Lagoon Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Description: A very small groundwater fed stream tributary to Bass Pool Lagoon, a Cowichan River Backchannel No. 125A.

Air Photos BC 82007 138-139
Topographic Map 92 C/16, 92 C.090
Salmonids Ct 40 m
Obstructions A 6 m over 20 cascade at 40 m
Max. Temp. (C) 13 (9/18/87)
Min. Disch. (m) 0.0007 (9/18/87)

LAGOON CREEK

| | Channel | Wetted | | | Channel | Side | Length | Wetted |
|---------|-----------|-----------|-----------|--------|-------------|---------|--------|------------------------|
| | width (m) | width (m) | Substrate | Slope% | Confinement | Channel | (m) | Area (m ²) |
| Reach 1 | 1 | .5 | 3620 | .5 | FC | N | 40 | 20 |
| Reach 2 | 1 | .5 | 1360 | 4.0 | CON | N | - | - |

B) FISH UTILIZATION AND LIMITING FACTORS

A few cutthroat fry utilize the first 40 m. Production is limited by small usable area.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Area forest cover is advanced second growth.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The most sensitive portion is located in the Cowichan Corridor. The FSZ extends upstream to cover steep adjacent slopes. The stream is located in a steep ravine for much of its length on Hill 60.

Stream Code: N/A

Stream Name: Last Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Overview: A small, groundwater fed stream tributary to the north side of Cowichan River 100 m above Bass Pool Lagoon.

Air Photos BC 82007 138-139
Topographic Map 92 C/16, 92C.090
Salmonids Ct 120 m
Obstructions 2 m falls at 120 m
Max. Temp. (C) 13 (9/18/87)
Min. Disch. (m) 0.0096 cms (9/18/87)

LAST CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 2 | 1.0 | 2710 | .5 | FC | N | 60 | 60 |
| Reach 2 | 1.5 | .8 | 1720 | 3.0 | CON | N | 500 | 400 |

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat fry and parr utilize the lower 120 m. Production limited by small productive area.

C) PRODUCTION OPPORTUNITIES

This stream is a good candidate for small-scale incubation measures and is a good location for brown trout but no specific measures are recommended. The stream is very small and access is difficult.

D) LAND USE FACTORS

Undeveloped forest - advanced second growth.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Stream Code: N/A

Stream Name: Green Timbers East

Operational Management Unit: River North

CVRD Electoral Area: F

- A) Biophysical Overview: Enters the Cowichan from the north 4250 m below the weir. Drains a steep, narrow basin on the south face of Hill 60.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, 92C.090

Co to 428 m

Ct to 800 m

Bt to 428 m

Obstructions Culvert at Cowichan Lake Road is a velocity barrier.

Max. Temp. (C) 13 (10/17/87)

Min. Disch. (m) 0.0092 (8/10/87) a 65 m section between 343 and 408 m dried in August, 1987.

GREEN TIMBERS EAST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3 | 1 | 1540 | 2.0 | CON | N | 428 | 428 |
| Reach 2 | 3 | 1 | 1360 | 4.0 | CON | N | 300 | 300 |
| Reach 3 | 2 | 1 | 136R | 10.0 | ENT | N | 1500 | 1500 |

EAGLE EYE CREEK (E FORK)

| | | | | | | | | |
|---------|---|---|------|-----|-----|---|-----|-----|
| Reach 1 | 2 | 1 | 1430 | 2.0 | FC | L | 100 | 100 |
| Reach 2 | 1 | 1 | 1360 | 5.0 | CON | N | - | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroats, coho and few brown trout have been reported. A survey on August 9, 1987 revealed only cutthroat fry and parr (35 - 70 mm). Densities were high (2.7/m) and it is suspected Cowichan River cutthroat spawn in this stream. Fry emergence is exceptionally early (April 15 in 1987) which indicates spawning probably occurs in November or early December as it does in Beadnell Creek.

Production is limited by short accessible length.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Approximately 40 percent of the stream's length was logged in 1987. The remainder is scheduled to start in 2020.

Risk Potential Moderate.

E) PROTECTION NEEDS

For much of its length and in particular, above R2, the creek is in a steep walled ravine/gully that will require careful forest development planning in terms of road and landing location and yarding set up.

OMU 6: River North – Burns and Tutty, 1999

Stream Code: N/A

Stream Name: Green Timbers West (Exeter Creek)

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Overview: Enters the Cowichan from the north 3250 m below the weir. Drains a steep, narrow basin on the south face of Hill 60.

Air Photos BC 82007 138-139
Topographic Map 92 C/16, 92C.090
Salmonids Co, Ct, Bt 280 m
Obstructions E & N culvert at 280 m (1m vertical drop)
Max. Temp. (C) 10 (6/17/87)
Min. Disch. (m) 0.017 (6/17/87)

GREEN TIMBERS WEST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3 | 1 | 1360 | 3.0 | CON | N | 280 | 280 |
| Reach 2 | 3 | 1 | 1270 | 5.0 | CON | N | 320 | 320 |
| Reach 3 | 3 | 1 | 127R | 10.0 | ENT | N | 1500 | 1500 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, cutthroats and brown trout are present in small numbers.

Production is limited by the small accessible area and relatively high gradient. Spawning potential is minimal.

C) PRODUCTION OPPORTUNITIES

Removal of E&N culvert would provide an additional 300 square metres of habitat.

D) LAND USE FACTORS

Forestry

Logging is under way in the lower basin. The upper watershed is scheduled for logging in 2020. Pacific Forest Products logged a 40 Ha setting just to the west in 1994.

Residential

A few residences along and below Old Lake Cowichan Rd.

Risk Potential

Low.

E) PROTECTION NEEDS

The FSZ is rather narrow (15m) below Highway 18 but the stream enters a steep sided ravine above the highway and this landscape unit is included in the FSZ.

OMU 6: River North – Burns and Tutty, 1999

OMU 6: River North – Burns and Tutty, 1999

OPERATIONAL MANAGEMENT UNIT 7: LAKE COWICHAN
NORTH

OVERVIEW

OMU 5 consists of the north side of the Town of Lake Cowichan and nearby Greendale Road which is technically not part of the town but is only somewhat less “townlike” and adjacent uplands. Aside from riparian lowlands along Greendale Road that front on Tiny Creek and the Cowichan River (the Cowichan has an OMU of its own and is not part of this one) and riverine riparian lowlands adjacent to Reaches 11 and 12 of the Cowichan (Park Road area and adjacent to the Upper Pool along Wavell Rd.), most of the unit is upland and part of the Hill 60 Complex. A significant upland riparian landscape unit forms the summer headwaters of Oliver Creek and is just below Teleglobe Canada. The OMU contains 8 streams: Tiny, Stanley, Birdcage Spring, Atchison, Beadnell, Oliver (Hatchery), Tern and Maple Leaf Brook. Maple Leaf Brook exists as a remnant only. Tern and Beadnell have been highly compromised by urban development. Maple Leaf Brook and tern were never major producers but Beadnell was a very good coho-cutthroat producer.

LIMITING FACTORS

Access and low summer flow are the prime limiting factors in this OMU. Urban runoff/water quality are also factors.

PRODUCTION OPTIONS

29 production options are present in the OMU. They are presented in Table 5.

Table 5: Lake Cowichan North Production Options

| No. | Sub-Basin | Activity | Priority |
|-------|-----------------|---------------------------------|----------|
| 1 | Tiny Creek | Instream incubation | 2 |
| 2 | | Spawning platforms | 1 |
| 3 | | Cover addition | 2 |
| 4 | | Headwater reconnection | 2 |
| 5 | | Runoff retention | 1 |
| 6 | Stanley Creek | Fry salvage | 1 |
| 7 | | Spawning platforms | 5 |
| 8 | | Pool maintenance | 1 |
| 9 | Birdcage Spring | Fry stocking | 1 |
| 10-11 | | Incubation boxes | 1 |
| 12 | Beadnell Creek | Flume removal | 1 |
| 13 | | Flume improvement | 1 |
| 14 | | Neva Cr. barrier removal | 2 |
| 15 | | Annual refuge pool construction | 1 |
| 16 | | Lower Neva channel improvement | 3 |

| | | | |
|-------|-------------------|--------------------------------|---|
| 17 | | Selective excavation – Reach 3 | 2 |
| 18 | | LWD addition | 2 |
| 19 | Oliver (Hatchery) | Adult barrier removal | 1 |
| 20-24 | | Juvenile barrier removal | 2 |
| 25 | | LWD addition | 1 |
| 26 | Tern Creek | Spawning platform | 1 |
| 27 | | Incubation boxes | 1 |
| 28 | | Juvenile barrier removal | 1 |
| 29 | | Coho colonization | 1 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Stream Code: N/A

Stream Name: Tiny Creek (Little Creek, Greendale Brook)

Operational Management Unit: Lake Cowichan North

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** Enters the Cowichan 2,500 m below the weir; a groundwater stream that originates in springs near Old Lake Cowichan Road. Original course continues up Hill 60 above Highway 18. It was diverted into Stanley Creel during construction of Highway 18 in early 1970's.

Air Photos BC 82007 138-139
Topographic Map 92 C/16, 92C.090
Salmonids Co to 489 m.
Ct to 489 m.
Bt to 489 m.

Obstructions E&N culvert; .5m vertical drop. Stream originates from seepage areas near the E+N Grade and upstream along Old Lake Cowichan Road. Some of the water comes from an area under residential development (1992-1994...). The creek used to originate on the slopes of Hill 60 but Highway 18 construction (1970 –1972) diverted the upper portion into nearby Stanley Creek.

Max. Temp. (C) 9 (8/31/85)
14.5 R2 (8/5/98)

Min. disch. (m³) 0.0025 (8/31/85) at Greendale Rd. The lower 224 m dries in most years (Greendale Rd. to the Cowichan River).

TINY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 1.0 | 0 | 1720 | 1.0 | OC | L | 224 | 0 |
| Reach 2 | 1.0 | 0.5 | 2710 | 0.5 | CON | N | 265 | 128 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, resident cutthroats and brown trout use the stream. Occasional chums are also reported and a few steelhead were present prior to diversion of the upper portion of the creek into Stanley Creek. According to area residents, chums were sometimes very numerous in this little stream and they helped keep its gravel clean and loose. Tiny Creek is one of only five Cowichan tributaries used by brown trout. Major production limits are size and length. Gravel quality and instream cover are also somewhat limiting. Up to 100 coho have been counted in Tiny Creek. Runs since 1985 have generally averaged around 20 but in 1997, escapement was even less than that. Migratory cutthroat trout from the Cowichan River or Cowichan Lake also spawn in Tiny Creek, sometimes very early similar to Beadnell Creek. A spawning pair was observed on Nov. 24, 1998.

C) PRODUCTION OPPORTUNITIES

1. **SUPPLEMENTAL INCUBATION:** Well suited for a small hatchery or incubation boxes. Flow fluctuation is minimal and temperatures generally range between 3 and 9 (**Production Option #1**)

2. **GRAVEL ADDITION/SPAWNING PLATFORMS:** Gravel quantity was reduced above Greendale Road. Only about 20 m² of high quality spawning habitat remained in this section. CLSES added new gravel (8 cubic metres) in the summer of 1994. **More gravel restoration work is required. Three spawning platform sites are located in upper Reach 2 at:**

1. The point just below Tiny turns into a .5 m ditch before it turns and follows the E and N grade: gravel required – 1.2 m³
2. A point 17 m downstream, gravel required - .6 m³
3. A site 24 m downstream from the upper site and 11 m below the middle location. Gravel required - .6m³

Production Option #2). Most fry likely emigrate to the Cowichan to rear although this creek does support rearing and overwintering coho and trout.

3.COVER ADDITION: Instream cover improvement is required (**Production Option #3**). CLSES dug a pool in the summer of 1994 and about 15 cutthroat trout ranging between 15 and 30 cm now reside there more or less permanently. Gord Mutch and Trudy Amman, the property owners, feed them. Optimal areas for cover addition are in lower Reach 2 adjacent to the lawn section of the Mutch-Amman Property and upper Reach 2 adjacent to the proposed sites for additional spawning habitat .

OMU 7: Lake Cowichan North/Burns and Tutty,1999

4. **LINK STREAM WITH HEADWATERS**: Restore the diverted section of the channel by simply removing the low berm constructed to divert the stream, re-constructing the channel and installing a small weir to allow peak flows to enter Stanley Creek (**Production Option #4**). This measure would probably double the early summer rearing area of Tiny Creek. Unfortunately, it wouldn't change minimum late summer flows because this 300 m long portion of the creek dries in mid to late summer. It would also improve flushing and gravel quality.

5. **CONSTRUCT RUNOFF RETENTION POND**: A runoff retention pond is needed to detain stormwater runoff from Lake Park Estates. This development has been a problem since 1993. Problems with runoff are somewhat less now that most construction is finished but a retention pond is still needed. (**Production Option # 5**)

D) **LAND USE FACTORS**

Agricultural Light.

Residential Light over the lower basin but Lake Park Estates, a residential development located adjacent to Old Lake Cowichan Rd. and the headwaters of Tiny Creek, has been a problem since construction began in the spring of 1993. The present headwaters of Tiny Creek are a series of seeps in the ditch between the property and Old Lake Cowichan Rd. Runoff from construction activities has entered the stream on many occasions between the spring of 1993 and the winter of 1997. The developer (Wayne R. Allen, 988 Khenipsen, Duncan, 746-7825) has been contacted on a number of occasions as has DFO, the Village and the Ministry of Environment. The major problem with this development is that it went ahead without a plan or contract so there are no clear lines of responsibility. The secondary problem is that the contractors have been working in periods of heavy runoff.

Risk Potential Low. The stream normally receives little surface runoff. However there has been a good deal of it since the winter of 1993-94 when developers attempted to work in unsuitable weather.

E) **PROTECTION NEEDS**

Much of Tiny Creek Basin is riparian /floodplain some of which is covered by housing and a small farm. There have been and will be attempts to drain and fill the moister portions of these lands. A property to owner on the west side of Tiny Creek (Scholey) has attempted to drain the lower portions of his property on at least two occasions. On the latest attempt, a ditch was constructed. Fill should not be permitted and any drainage measures should be very carefully considered. It is quite likely that significant drainage improvement is impossible given the nature of the land.

F) **Historical Notes**:

Coho escapement has ranged between 12 and 100 in the 1986 to 1998 interval. 1988 escapement was 100. The 1998 (80) return is typical of the manner in which coho spawners utilize the stream. The first wave of fish consisted of 22 which entered on Nov. 24 in a period of high water. 98 mm of rain fell in the previous three days and 72 mm fell on Nov. 24. Tiny Creek does not fluctuate much with runoff events but it is so small that any increase is significant in terms of coho migration. There were 38 fish in the next group which entered on Dec. 12, after another period of substantial rain. Rainfall had dropped off between Nov. 25 and Dec. 12. The last run (20 fish) came in between Jan. 5 and Jan. 8. This was not a rainy period although 27 mm did fall on Jan. 8. Chris Morley documented the 1998 return. Coho spawners have entered Tiny Creek as late as Jan. 16.

Stream Code: 9202577584

Stream Name: Stanley Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan River 1.75 km below the Cowichan Lake outlet and weir. Stanley Creek basin is steep and highly responsive to runoff.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, 92C.090

Salmonids Co to 1721 m.

Ct to 1721 m.

Bt to 1721 m.

DV to 1721 m.

St to 1721 m.

Cm to 421 m.

Obstructions A culvert with a vertical drop of 0.5 m is present at Cowichan Lake Road (421 m) and is passable at high flows. The Youbou Road culvert (921 m) appears to limit coho migration. Few fish are observed above it. Outlet velocity averages 0.55m/sec. at moderate flow and its vertical drop is minor. It is 24 m long and 1.5 m in diameter. It is probable that few pass it because of lack of spawning habitat above it. Adjacent resident Jim Edwards constructed a small weir at the outlet of the culvert pool and backflooded the small drop that was present. The culvert is now easily passable for both adults and juveniles. 1 and 2 m dams are present at 1,700 and 1,900 m respectively and a series of falls begins at 2,100 m.

Max. Temp. (C) 13 (8/26/85)

18.1 8/1/98 (R4 at highway)

Min. Disch. (m³) 0.00013 (8/26/85) 20 m above Youbou Road.

0.11 (8/31/85) Greendale Road.

In most summers, Stanley Creek dewater from 20 m below Youbou Rd. to the Cowichan R. however, in many years a little water remains, especially in Reach 1 below Greendale Rd. where water often stays in the culvert pool.

Max. disch. 2.33 CMS (11/25/98)

STANLEY CREEK

| | Channel Width | Wetted Width | Substrate | Slope | Confinement | Sidechannel | Length | Area |
|---------|---------------|--------------|-----------|-------|-------------|-------------|--------|------|
| Reach 1 | 6.0 | 2.0 | 1540 | 1.0 | CON | N | 229 | 458 |
| Reach 2 | 6.0 | 2.0 | 1360 | 1.0 | CON | N | 192 | 384 |
| Reach 3 | 6.0 | 0.0 | 1360 | 2.0 | CON | N | 500 | 0 |
| Reach 4 | 5.0 | 1.5 | 1360 | 3.0 | CON | N | 800 | 1200 |
| Reach 5 | - | - | - | 25.0 | CON | N | 1800 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Stanley Creek supports small numbers of a diverse number of fish species including: coho and chum salmon, resident cutthroats, brown trout and occasional steelhead and Dolly Varden. High diversity but low numbers although the creek once supported healthy numbers of coho and there is an occasional year when 100 or more chums arrive.

Production is limited by low summer flows and drying (a 500 m section between Youbou and Cowichan Lake Road dries early with heavy coho fry loss in high escapement years) and high fall - winter discharge fluctuation. By late summer of most years, the entire creek below Youbou Road Culvert pool is dry. Spawning habitat is sparse above 300 m.

C) PRODUCTION OPPORTUNITIES

1. FRY SALVAGE: Fry salvage in the zone subject to drying (**Production Option #6**)

Salvaged fry yield in 1986 and 1987 was:

| | <u>CO</u> | <u>Ct</u> | <u>Bt</u> | <u>Rb</u> |
|------|-----------|-----------|-----------|-----------|
| 1986 | 180 | 10 | 2 | 10 |
| 1987 | 584 | 50 | 20 | 46 |

2. **MAINTENANCE OF GREENDALE ROAD POOL:** Annual deepening and damming of the Greendale Road Pool will provide additional summer habitat, particularly in years of extreme drying (**Production Option #7**). Residents have volunteered to feed the fish in this pool.

3. **SPAWNING PLATFORMS:** Because spawning habitat is limited above 300 m a boulder weir was installed in the summer of 1987 to attempt to trap gravel. It was successful and 5.5 cubic meters of gravel was captured and utilized by spawning coho. Two more spawning platforms were installed in the summer of 1988. These structures washed out in the flood of 1990 but were surprisingly durable until then. It is likely that spawning platforms may last several normal winters and, with periodic maintenance (**Production Option #8**),

D) LAND USE FACTORS

Forestry

Advanced second growth.

Residential

Minor subdivision along Neva and Greendale Roads. Townhouse development in 1992-93 at Neva. An old box culvert was replaced by CSP which resulted in loss of habitat at the culvert site (a well covered pool was lost – the most habitable pool on the creek) and downstream scour and lateral erosion increased after the new pipe was installed.

Risk Potential

There are zones of steep, saturated soils adjacent to the stream above 1,500 m. Logging and road construction must be carefully planned along upper Stanley Creek. Impact would not only be expressed in the creek but more importantly, in the Cowichan River. A 1986 Village of Lake Cowichan proposal to log a small area adjacent to upper Stanley Creek generated so much local concern that it was dropped and the area has been protected under a conservation covenant (Nov. 1996) which only permits recreational uses.

E) PROTECTION NEEDS

A top of slope setback should protect steep adjacent slopes above the 1,500 m point. These slopes are at least 140% in places and contain areas of seepage. Undeveloped lands in the Town of Lake Cowichan should be protected by a Greenway corridor of whatever greenspace remains Stanley Creek is a very high energy stream and future urban development should stay well away from it.

Stream Code: N/A

Stream Name: Birdcage Spring

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan

- A) BIOPHYSICAL OVERVIEW: A short, inaccessible groundwater spring in the Town of Lake Cowichan. It enters the Cowichan River at the E + N trestle after originating in a spring behind Peter's Mall (1993) and crossing under Cowichan Lake Rd.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, 92C.090

Salmonids None although the spring pond is sometimes stocked with coho or cutthroat fry. Local people have been shocked to find trout living in this inaccessible pond that only measures 3 by 13 m and is only 25 cm deep.

Obstructions A long steep culvert at 12 m.

Max. Temp. (C°) 13 (8/2/98)

Min. disch. (m³) 0.00214 (8/5/98)

BIRDCAGE SPRING

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 1.0 | 0.5 | 2710 | 2.0 | CON | N | 12 | 6 |
| Reach 2 | 1.0 | 0.5 | 0009 | 20.0 | CULVERT | N | 60 | NIL |
| Reach 3 | 3.0 | 2.0 | 9100 | .01 | FC | N | 35 | 70 |
| Reach 4 | 1.0 | 0.5 | 2710 | 1.0 | CON | N | 15 | 7.5 |

B) FISH UTILIZATION AND LIMITING FACTORS

Contains no fish because the stream is inaccessible.

C) PRODUCTION OPPORTUNITIES

1. **FRY STOCKING:** Reach 3 is two ponds 15 to 40 cm deep and well covered with watercress and water parsley. Coho fry have been stocked with excellent results. They are fed by the property owners - Mr. and Mrs. Duke. Brown trout could also be planted. Recommended number of coho or browns: 700 fry if fed, 200 if not. Coho survival to smolts has been estimated at 70%. Coho smolt yield potential of 490 fish. Brown trout yearling yield potential 16 - 490 (**Production Option #9**).

2. **SUPPLEMENTAL INCUBATION:** There is room for a spawning platform in Reach 1 and incubation boxes in Reach 3 at the outlet of the ponds (**Production Option #10 and 11**).

D) LAND USE FACTORS

This is a backyard spring almost in the centre of the town but residents value and protect it.

Risk Potential Low. A small mall was constructed in 1993; impact was minimal.

E) PROTECTION NEEDS

The Town of Lake Cowichan OCP recognizes Birdcage Spring as a watercourse protection area (DPA).

Stream Code: N/A

Stream Name: Atchison Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan

- A) BIOPHYSICAL OVERVIEW: Enters the Cowichan River from the north between Beadnell Creek and Birdcage Spring. A backyard groundwater fed stream which is buried in a pipe above 35 m.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, 92C.090

Salmonids Co to 35 m.

Obstructions Buried in a pipe above 35 m.

Max. Temp. (C) 13 (8/31/98)

Min. disch. (m³) .0037 (8/31/98). The pipe under Cowichan Lake Road must continue up the east side of McDonald Road where seepage points can be seen on the surface in the winter as far up as Oak Lane. And all year along the north side of the driveway of the third house up McDonald on the east side.

ATCHISON CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 1.0 | 1.0 | 2430 | 2.5 | CON | N | 35 | 35 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are occasionally observed spawning in this creek. Production is limited by lack of quality gravel and small area. This stream is only 35 m long.

C) PRODUCTION OPPORTUNITIES

1. **SUPPLEMENTAL INCUBATION:** Incubation measures for coho, cutthroat or brown trout and creation of spawning platforms would be beneficial. Approximately 90% of coho eggs incubated in a milk container survived to the fry stage in 1988-89 (**Production Option #12**).

D) LAND USE FACTORS

The stream is buried in a pipe above 35 m. so it receives no surface run-off. The lower 35 m. flows through a backyard. Residents care for the stream.

Risk Potential Low.

E) PROTECTION NEEDS

The Town of Lake Cowichan's OCP recognizes Atchison Creek as a protected watercourse DPA.

Stream Code: N/A

Stream Name: Beadnell Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

- A) **BIOPHYSICAL OVERVIEW:** This stream enters the Cowichan from the north 1,200 m below the Cowichan Lake weir. The upper basin of the main stem is steep and narrow but the portion below the 260 m contour is relatively broad. Summer flow is supplied by groundwater seepage. Winter flow fluctuation is minimal. The west branch parallels the base of the west end of Hill 60 picking up seepage.

Air Photos BC 82007 137-138

Topographic Map 92 C/16, 92C.090

Salmonids Co to 1819 m.

CM to 94 m.

Ct to 1819 m.

Bt to 1819 m.

Obstructions 25 m concrete section in Upper R1 which starts @ 75m. Migration period velocity in the lower 11 m of this section is about 2 MPS.

Cowichan Lake Road culvert at 98 m (passable). Culvert is 65 m long concrete box 3 m wide. It is just passable for adult coho, cutthroats and brown trout. It passes under Cowichan lake Road and the west portion of Cowichan Esso (Romeo's). 500 m concrete flume with 3% slope (passable). Baffles added to aid fish passage 1994 –1998.

Sharply increasing gradient above 1819 m.

Series of small drops on W.Fork in R2. Greatest vertical drop: .5 m. 1 m falls at 400 m on Neva Creek.

Max. Temp. (C) 12 9/19/87 R1

18.5 (R3 at highway 8/1/98)

15.2 West Fork R1 (9/12/98)

13.4 R5 (9/12/98)

Min Disch. (m³) .0025 (9/19/87) R1

R2 0

R3 0

R4 0 for the first 100 m in very dry years

R4 .00045 (8/26/85)

R4 .0035 @ 50 m (9/12/98)

R5 .0029 @ Hancock Logging Road (9/12/98)

West Fork R1 .000032 (9/12/98)

Max. Disch. 5.4 CMS (11/25/98)

BEADNELL CREEK

| Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|

Mainstem

| | | | | | | | | |
|---------|-----|-----|------|-----|-----|---|------|------|
| Reach 1 | 4.0 | 1.0 | 145R | 1.0 | CON | N | 98 | 98 |
| Reach 2 | 3.0 | 0 | R | 3.0 | ENT | N | 500 | 0 |
| Reach 3 | 5.0 | 0 | 2710 | 1.2 | FC | M | 310 | 0 |
| Reach 4 | 3.0 | 1.0 | 1450 | 2.0 | FC | L | 755 | 755 |
| Reach 5 | 1.0 | 1.0 | 1540 | 3.5 | CON | N | 160 | 160 |
| Reach 6 | 1.0 | 1.0 | 1450 | 7.0 | CON | N | 1000 | 1000 |

West Branch (enters Beadnell at 1230 m)

| | | | | | | | | |
|---------|-----|-----|------|-----|-----|---|-----|-----|
| Reach 1 | 2.0 | 1.0 | 1630 | 2.0 | FC | L | 72 | 72 |
| Reach 2 | 1.0 | 1.0 | 1270 | 7.0 | CON | N | 35 | 35 |
| Reach 3 | 2.0 | 1.0 | 1630 | 2.5 | CON | N | 500 | 500 |

East Branch (Neva Creek)

| | | | | | | | | |
|---------|-----|-----|------|-----|-----|---|-----|-----|
| Reach 1 | 3.0 | 0 | 2610 | 2.0 | FC | L | 300 | 0 |
| Reach 2 | 1.0 | 0.3 | 1540 | 4.0 | ENT | N | 350 | 105 |
| Reach 3 | 1.0 | 0 | 1540 | 8.0 | CON | N | 900 | 0 |

¹ One 30 m² pool at the highway culvert survived the 1987 drought. In more usual years, several to numerous small pools may persist through the summer.

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, migrant cutthroats and brown trout utilize the lower 1819 m along with resident cutthroats. These fish also utilize the first 330 m of Neva Creek. Migrant cutthroats sometimes enter the stream as early as late October and have been observed spawning as early as late November and as late as late April. Peak of migration is late February – early March. 19 fish were observed opposite the hatchery on Feb. 28, 1998.

Production is limited by summer drying in the 910 m section between the top of R1 and 100 m above the highway (100 m into R4). Note: drying does not occur every year and it is quite variable when it does occur. The 910 m of drying is in extreme years only. Loss of habitat in the flume section also reduces productivity. The flume is thought to have been constructed in 1954.

C) PRODUCTION OPPORTUNITIES

1. FLUME REMOVAL/CONTINUED FLUME IMPROVEMENT/COWICHAN LAKE ROAD CULVERT IMPROVEMENT AND UPPER R1 CONCRETE SECTION IMPROVEMENT: Elimination of the flume could restore 1500 m² of stream (Production Option #13). Flume access improvement began with the Fish and Wildlife Branch placing concrete bags at staggered points along the sides in the mid-seventies. CLSES began constructing baffles in 1994 and they were completed to the top of the flume by 1998. However, a few more baffles are required near the bottom of the flume (Production Option # 14) and either baffles or large, flat bottomed boulders should be placed in the Cowichan lake Road culvert. The concrete in Upper R1 should be removed and replaced with boulder weirs. Cowichan River swim-up fry need to be able to access as much of Beadnell as possible in hot summers when upper river temperatures stay in the 20-25 degree range for weeks. When the concrete stream section on the Nieser property is removed, work should begin on improving fry access through the Cowichan Lake Road culvert and up the flume.

2. NEVA CREEK BARRIER REMOVAL: Removal of the 1 m falls on Neva Creek (backfilled root wad) would access another 100 m² of stream (Production Option #15).

3. REFUGE POOL: Excavation of a pool at Highway 18 provided 30 m² of wetted area in the summer of 1987. Fry salvaged downstream were placed in it and experienced good survival. This pool must be re-created every year (Production Option #16). June is the favoured month but the pool could be created as necessary. The Dept. of Highways used to do the work but private individuals or JJM (the local contractor for highways maintenance) would have to do the work post 1987. The pool has been hand created with sandbags and poly on two occasions since 1987 but results were not as good and the work took over a day instead of a couple of hours.

4. LOWER NEVA RESTORATION: Lower Neva Creek was damaged by a developer in 1993. A section of channel is in need of restoration (Production Option #17).

Note: Channel section restored, 1996 however it needs better quality gravel.

5. SELECTIVE EXCAVATION OF LOWER REACH 3: Excavation of Lower Reach 3 of Beadnell would expose groundwater and provide better channel confinement (Production Option #18). Valley Fish and Game Club worked on this section in the summer of 1994.

CLSES hatchery constructed in 1991-92.

New baffles were placed in part of the flume in Sept 1994 and September, 1995. The job was completed to the top of the flume in August of 1998. There still remains an area near the bottom of the flume that could use several baffles.

6. COVER IMPROVEMENT: LWD placement: there is a suitable site at the 262 m point of R4. A windfall log should be placed along a cut bank on a corner pool and anchored with two large rocks and tied to two old cedar logs on the bank which can be doubled up to provide the necessary ballast. LWD lack is not a strong limiting factor in Beadnell which has a rather rich inventory of LWD but there are sections that are somewhat deficient (Production Option #19)

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. Logging started again in the late 1980's.

A cedar mill (F. Doidge) is located in an old gravel pit at 1,100 m. it operates sporadically.

Residential

The lower 600 m flows through Lake Cowichan Town. Five hundred meters have been enclosed in a concrete flume adjacent to MacDonald Road.

Risk Potential

Moderate.

E) HISTORICAL NOTES

Neave (1949) reports Beadnell Creek produced an average of 6,000 coho smolts between 1939 and 1946. Mean egg survival was 27%. Fry production ranged from 22,971 to 173,360.

1987 fry salvage: CO 240
Ct 255
Bt 1005

Coho Escapement

| | |
|---------|-----|
| 1939-40 | 433 |
| 1940-41 | 74 |
| 1942-43 | 78 |
| 1943-44 | 354 |

Fishery Officer Narrative

E) PROTECTION NEEDS

Most of the portion of stream within the Town of Lake Cowichan is fully developed. The part that isn't is recognized by the Official Community Plan and protected. This section is very sensitive and requires a large buffer zone to conserve its riparian zone and prevent extensive blowdown, which has occurred in the past due to adjacent land clearing for future residential use. Above Youbou Road, Beadnell Creek enters an equally sensitive zone which consists of a narrow riparian flat and small ravine with steep, moist slopes. The top of the ravine is 30 to 60 m from the creek. Recent adjacent logging and land clearing did not invade the ravine but there has been considerable alder blowdown because of these activities.

Stream Code: 9202577600000

Stream Name: Oliver (Hatchery) Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

- A) **BIOPHYSICAL OVERVIEW:** Oliver Creek enters the Cowichan River from the northwest 1,100 m below the Cowichan Lake weir draining a broad, low relief basin. Temperature and flow are relatively stable, groundwater is the primary flow source.

Air Photos BC 82007 137-138

Topographic Map 92 C/16, 92C.090

Salmonids Co to 1000 m.

Ct to 4000 m.

Bt to 4000 m.

Rb to 4000 m.

Obstructions Highway 18 culvert at 1,000 m, cross log at 50 m (juveniles), potential obstructions in Cowichan Lake Road Culvert at 60 m, Darnell Road Culvert (1993) at 529 m and an old dam at 582 m.

Max. Temp. (C) 15.5 (7/21/85)

18.1 R1 at Second Footbridge (8/3/98)

Min. Disch. (m³) 0.018 (8/24/85)

0.0175 (8/3/98) Darnell Rd.

0.0115 (8/30/87) Darnell Rd.

.00096 (8/30/87) West Fork below wetland confluence of West Fork and Krossa Creek at bridge.

OLIVER CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4.0 | 2.0 | 2620 | 1.0 | FC | L | 1000 | 2000 |
| Reach 2 | 3.0 | 2.0 | 2620 | 1.0 | FC | L | 1500 | 3000 |

West Fork

| | | | | | | | | |
|---------|-----|-----|------|-----|-----|---|------|------|
| Reach 1 | 3.0 | 1.0 | 2710 | 1.0 | CON | L | 1500 | 1500 |
|---------|-----|-----|------|-----|-----|---|------|------|

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, brown trout, resident cutthroats and a few rainbow and cutthroat spawners from Cowichan Lake/Upper Cowichan River utilize the stream. Oliver Creek is the main spawning stream for Cowichan River brown trout.

The limiting factors are available rearing area and access. Oliver Creek provides ideal coastal stream habitat in terms of flow and temperature fluctuation and physical structure. The Highway 18 culvert limits coho, and possibly migratory rainbows and cutthroats to the lower 1000 m (25%). In addition, barriers to juvenile salmonid movement are present at Darnell Road Culvert (.25 m vertical drop at outfall and .22 m at the join point with a concrete box culvert 9.7 m upstream) and at an old backfilled dam that serviced the original Cowichan Hatchery. The dam's vertical drop is .8 m. Its located 53 m above Darnell Road. In addition, there is a cross log at the 50 m point with a .35 m vertical drop. The most important potential obstruction is the Cowichan Lake Road Culvert some 60 m from the Cowichan River. It is a concrete box culvert with a series of utility pipes suspended at various heights. Debris jams often form at these structures. When this happens, fish passage is extremely difficult because of the shallow water below the jams. At present (Sept./1997) there is a .65 m jam for the entire width of the culvert at the 8 m point It was felt that this might have been blocking passage for several years. Coho returns have been extremely low for the past few years. Only four were counted in 1996-97. However, Don Palmer, who owns the property on the east side of the creek at its confluence with the Cowichan (this is the property the sewage pipe services), removes any blockage that forms at the pipe and the blockage was not present during last year's coho migration. The barrier was removed by R. Nott's biology class this fall.

Coho fry emergence is among the earliest in the province beginning as early as the first week in March.

C) PRODUCTION OPPORTUNITIES

1. **ADULT ACCESS:** The Highway 18 culvert at 1,000 m is generally impassable to coho although there have been reports of them passing it. Coho smolt yield potential above it is 480 - 2,400. However, the B.C. Fish and Wildlife Branch would like to preserve the resident brown trout of this area from coho competition (Reid, pers. comm.). Brown trout fry are sometimes stocked above the culvert (Axford, pers. comm.). The culvert is 2 m in diameter and 49 m long. Average low flow velocity is 1.225 m/sec. but, during migration flows, it ranges between 2 and 3 m/sec. **Baffle placement could make it navigable (Production Option #20).** 1986 survey information reveals the presence of rainbow and cutthroat trout above the culvert but no coho. Brown trout were first captured by the author on May, 27, 1999.
2. **JUVENILE ACCESS:** The jam 8 m into the Cowichan Lake Road culvert should be removed immediately and strong consideration should be given to removing or modifying the pipe at this location. Small baffles should be placed in the structure to aid fry passage. The other barriers at 50 m (cross log), Darnell Road (culvert at two places) and 53 m above Darnell Road should also be removed. (The Darnell Road culvert will require backflooding by downstream weirs). These are juvenile barriers. When Upper Cowichan water becomes warmer than about 21 degrees, juvenile trout and coho seek refuge in cooler water. Oliver Creek could play an important role (**Production Option #21, 22, 23**)
3. **COVER IMPROVEMENT:** LWD placement is possible at a number of locations. The most appropriate site is just above Darnell Road in the Darnell Road glide. A windfall log approximately 12 m long and .5 m in diameter would be tied into an existing LWD structure that is aging. Purpose: to provide cover for both adults and juveniles and help retain gravel at this important spawning site, especially for large browns. Two large browns (70 cm plus) spawned at this location Dec. 17 - 20, 1997 and were harassed unmercifully by local youths (**Production Option # 24**).
4. **RIPARIAN RESTORATION:** A 75 m section of upper R2 has been damaged by cattle. The entire understory has been destroyed for Distances of 15 m on the west and 25 m on the east. Top of slope fencing is required to protect this area which is part of the creek's FSZ and was an important spawning and rearing area prior to the loss of overhang (**Production Option # 25**)

D) LAND USE FACTORS

Forestry

Advanced second growth. A considerable portion of the basin has been logged since 1983. Deep, moist soils and small wetlands are common. They present considerable impact potential. Little has occurred to date however even though some of the areas were skidder yarded in the winter. There has been a noticeable change in bedload stability since 1990. Stability is less as more gravel moves downstream. No obvious sources are present.

Agricultural

Felix Doidge of 7250 Wilson Rd. Lake Cowichan, has grazed a small herd of Black Angus cattle in his pasture between Highway 18 and Lower Beaver Rd. since the late 1980's. The animals have destroyed the understory vegetation along the pasture (75 m). The overstory hasn't been cleared in the steam ravine but the cattle have more or less free range in it and have grazed or trampled away all streamside vegetation understory. Top of slope fencing is required to protect the FSZ in this area which is about 15 m on the west and 25 m on the east side of the stream.

Residential

The lower 1,000 m flow through Lake Cowichan Town. Development pressure was light until 1992 when clearing began for what became me housing. In the summer of 1994, clearing progressed much closer to the creek and exposed two springs which ran over raw ground for some time.

Risk Potential

Low.

E) PROTECTION NEEDS

A riparian zone is present for most of the mainstem and the upper portion of the West Fork. It must be protected. A ravine is present on the mainstem from the upper portion of Reach 1 into lower reach 2, a distance of about 250 m. A similar situation is present on the West Fork for the lower 400 m.

The former School District 66 lands are in the process of being transferred to the Cowichan Land Trust but there has been considerable foot dragging on the part of the new school district (#79).

Friendship Park and Fisheries Trail were set aside by the village and School District 66 in 1989. The park protects approximately 380 m of stream.

F) HISTORICAL NOTES

A hatchery operated on this stream from 1910 to 1933. It was located on Stanley Road near the old R.C.M.P. building.

Escapement

| <u>Year</u> <u>CO</u> | |
|-----------------------|-----|
| 1938 | 330 |
| 1939 | 665 |
| 1940 | 481 |
| 1941 | 890 |
| 1942 | 307 |
| 1943 | 394 |
| 1944 | 258 |
| 1945 | 249 |
| 1989 | 528 |
| 1990 | 811 |
| 1991 | 97 |
| 1992 | 5 |
| 1993 | 330 |
| 1994 | 306 |
| 1995 | 95 |
| 1996 | 5 |
| 1997 | 14 |
| 1998 | 109 |

Stream Code: N/A

Stream Name: Tern Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan , CVRD Area F

- A) **BIOPHYSICAL OVERVIEW:** a very small groundwater fed stream that originates in a seepage zone near Beaver Road (Lake Cowichan) and enters the Cowichan River from the north 520 metres below the weir.

Air Photos BC 82007: 137-138

Topographic Map 92 C/16, 92C.090

Salmonids Co to 268 m.

Ct to 268 m.

Obstructions Steep culvert at 268 m. followed by a rapid increase in gradient and another steep culvert. Minor obstructions in R1 (backfilled roots etc).

Max. Temp. (C °) 15

18.1 R2 (8/3/98)

19.0 R1 (9/1/98)

Min. disch. (m³) Much of the stream dried in August of 1988. Usual minimum flow is about one litre per second.

TERN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 2.0 | 0.1 | 8200 | 0.1 | CON | N | 218 | 218 |
| Reach 2 | 1.0 | 0.5 | 2710 | 1.5 | CON | N | 50 | 25 |
| Reach 3 | 1.0 | 0.5 | 1360 | 10.0 | CON | N | 100 | 50 |
| Reach 4 | 1.0 | 0.5 | 8200 | 0.5 | UC | L | 250 | 125 |

B) FISH UTILIZATION AND LIMITING FACTORS

Occasionally coho spawners are reported in very low numbers. Coho fry from the upper Cowichan migrate upstream in May in high numbers. A few resident cutthroat trout are present in a pond at the beginning of reach 2. Cutthroat spawners from the Upper Cowichan have also been seen in December. Cutthroat fry emergence in Reach 2 began on May 8th in 1989.

Production is limited by a lack of quality spawning substrate (the bed in reach 1 is almost totally mud and silt), low summer flow and small wetted area. Iron bacteria become a problem in most summers.

C) PRODUCTION OPPORTUNITIES

1. **SPAWNING IMPROVEMENT:** Construction of gravel platforms in Reaches 1 and 2 (Production Option #26)
2. **INSTREAM INCUBATION:** Incubators in Reach 2 (Production Option #27)
3. **JUVENILE ACCESS:** Removal of fry barriers in Reach 1 (Production Option #28)
4. **COHO COLONIZATION:** 50 coho fry are normally stocked in Olsen's Pond at 47 North Shore Rd. (Production Option # 29)

D) LAND USE FACTORS

Most of the stream is located within the Town of Lake Cowichan. It appears that all the culverting and channel alteration to accommodate property development has taken place.

Risk Potential

Moderate. Development of the headwater seepage zone must be monitored.

Fishery Officer Narrative

E)PROTECTION NEEDS

The Town of Lake Cowichan 's OCP recognizes Tern Creek as a watercourse protection DPA. The entire accessible portion aside from road rights of way, is private property in people's backyards.

Stream Code: N/A

Stream Name: Maple Leaf Brook

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

- A) **BIOPHYSICAL OVERVIEW:** A small, groundwater fed stream in the moist slope zone between the weir and Meade Creek Road entering Cowichan Lake 100 m. west of the weir. This stream originates in a series of seepage points about 170 m. above Cowichan Lake. The Cowichan Lake Salmonid Enhancement Society Hatchery was located on Reach 1.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 138-139 |
| <u>Topographic Map</u> | 92 C/16, 92C.090 |
| <u>Salmonids</u> | None, but returns from the hatchery occurred in 1989. |
| <u>Obstructions</u> | CN railway culvert located 100 m. |
| <u>Max. Temp. (C)</u> | 14 (late summer) |
| | mean November to April temp = 5 C |
| <u>Min. Disch. (m³)</u> | 0.0005 (late summer) |
| | mean November to April discharge = .002 m ³ /sec |

MAPLE LEAF BROOK

| | Channel | Wetted | | | Channel | Side | Length | Wetted |
|---------|-----------|-----------|-----------|--------|-------------|---------|--------|------------------------|
| | width (m) | width (m) | Substrate | Slope% | Confinement | Channel | (m) | Area (m ²) |
| Reach 1 | 2 | 1.0 | 9100 | 0.1 | CON | N | 70 | 70 |
| Reach 2 | 1 | 0.5 | 2710 | 2.0 | CON | N | 50 | 25 |
| Reach 3 | 0.5 | 0.5 | 1620 | 20.0 | CON | N | 50 | 25 |

EAST FORK OF MAPLE LEAF BROOK

| | | | | | | | | |
|---------|---|-----|------|------|-----|---|----|----|
| Reach 1 | 1 | 0.5 | 1620 | 20.0 | CON | N | 60 | 30 |
|---------|---|-----|------|------|-----|---|----|----|

B) FISH UTILIZATION AND LIMITING FACTORS

No fish utilization at present but returns (coho and cutthroat) will begin in 1989. These will be fish that escaped from the hatchery.

There is no accessible spawning habitat; some should be created to accommodate these fish and in order to sustain the runs.

Some steelhead trout, rainbow trout, brown trout, and Dolly Varden Char fry also escaped from the hatchery between 1985 and 1988.

C) PRODUCTION OPPORTUNITIES

Creation of spawning platforms in Reach 1. Present bed material is composed of mud and silts. Considerable effort will be required to maintain the gravel platforms due the low gradient of the stream and the potential for silting in of the platforms. There is room for approximately 8 m² of spawning gravel which could accommodate 4 coho females (8,000 eggs). At 10% survival 800 fry would migrate to Cowichan Lake resulting in the production of 160 smolts at 20% survival.

The hatchery has ceased operation but an incubation box at the present site and at the site of the flow collection box at 120 metres (Reach 2) will maintain this streams role as an egg incubator. Two incubation boxes at 5,000 eggs each would yield 8,000 fry at 80% survival and 1600 smolts at 20% survival in the lake. Most fry would rear in Cowichan Lake.

A 100 m² reservoir is present at the head of reach 3. It could support 1000 fed coho fry and yield 500 smolts at 50 percent survival.

NOTE: STREAM WAS ELIMINATED BY UPLAND DEVELOPMENT IN 1990

D) LAND USE FACTORS

Upland slopes are covered by advanced maple-alder-cedar-fir-hemlock second growth. They are moist and unstable in places due to fine-grained soils with a high silt-sand-clay content. Logging and road building could have high impact.

Risk Potential

Stream was eliminated by upland development in 1990.

Fishery Officer Narrative

Watershed Code: 9202577

COWICHAN LAKE

BIOPHYSICAL DESCRIPTION

A large, deep oligotrophic lake. Framed by steep mountains in a zone of high precipitation, the lake is not very productive. Its flushing rate is high and its shore zone is, for the most part, very narrow. Much of the shore zone is composed of rather exposed gravel which is not conducive to benthic community development

| Elevation (m) | Area (m ²) | Volume (m ³) | Mean Depth. | Max. Depth. | Perimeter |
|---------------|------------------------|--------------------------|-------------|-------------|-----------|
| 158-162 | 62,043,000 | 3,109,138,000 | 50.1 | 152 + | 102,740 + |

REACHES

Cowichan Lake's shore zone is composed of 85 reaches and sub-reaches. Reaches are designated on the basis of exposure to wave attack, slope, substrate character and width of the shoal zone and riparian zone (Table 1).

Table1: Cowichan Lake Shore Zone Reach Characteristics

| No. | Name | Class | Exp. | Slope | Subst. | Rip. | Shoal | Length | Comm. |
|-----|------------------|-------|------|-------|--------|------|-------|--------|-------------|
| 1 | Beaver W/L | 1 | 1 | .01 | 1000 | H | H | 200 | |
| 2 | Island Shake | 2 | 1 | 1 | 9100 | M | M | 500 | Cons. Fill |
| 3 | Pt. Ideal | 1 | 1 | .01 | 8110 | H | H | 450 | |
| 4 | Lakeview | 3 | 2 | 2 | 5320 | L | L | 260 | Scalp |
| 4a | Cedar Spit | 2 | 2 | 1 | 9100 | L | M | 40 | |
| 5 | Lakeview W. | 2 | 2 | 3 | 4321 | L | L | 9200 | |
| 5a | Old Dump | 1 | 1.5 | .5 | 9100 | L | M | 220 | Old debris |
| 5b | Plantation Bight | 1 | 1 | .5 | 9100 | M | M | 150 | |
| 6 | Forestry Pen. | 3 | 3 | 1 | 5320 | L | H | 500 | |
| 7 | South pen. | 2 | 2 | 1 | 6310 | L | M | 900 | |
| 8 | Bear L. | 1 | 1 | .01 | 9100 | H | H | 2300 | Yards in SZ |
| 9 | Ashburn | 2 | 2 | 1 | 1720 | M | M | 1815 | BH |
| 9a | Solmie | 1 | .5 | .01 | 1000 | M | M | 200 | |
| 9b | Watson Folly | 1 | 1 | .5 | 1000 | H | H | 485 | Fill |
| 9c | Sort/New Town | 3 | 3 | 2 | 4510 | L | L | 1100 | Fill |
| 10 | Honey E. | 2 | 2 | 1 | 8200 | L | M | 400 | Much mod. |
| 11 | Honey W. | 1 | 1 | .1 | 9100 | M | M | 400 | Fill |
| 12 | Walton | 3 | 3 | 2 | 4600 | L | M | 1700 | BH, scalp |
| 13 | Gordon | 2 | 1.5 | 1.5 | 8200 | L | M | 400 | Imp. |

| | | | | | | | | | |
|-----|-------------------|---|-----|-----|------|---|---|------|----------|
| | | | | | | | | | Beach |
| 14 | Gordon O. | 3 | 2 | 1.5 | 2521 | L | M | 400 | |
| 15 | Narrows | 5 | 4 | 80 | 0037 | L | L | 1100 | |
| 16 | Narrows W. | 4 | 4 | 2 | 2332 | L | L | 2400 | |
| 17 | Copper | 3 | 2 | 1.5 | 3322 | L | L | 2700 | |
| 17a | Lagoon | 1 | 0 | .01 | 1000 | L | H | 600 | |
| 18 | Misery Fan | 5 | 5 | 2 | 1630 | L | L | 700 | |
| 19 | Misery W. | 4 | 4 | 3 | 1243 | L | L | 3400 | |
| 20 | Croft W. | 3 | 3 | 2 | 3700 | L | M | 3800 | |
| 20a | Caycuse Sort | 3 | 3 | 3 | 2620 | L | L | 400 | Fill, BH |
| 21 | Inner Caycuse | 1 | 1 | .1 | 9100 | M | H | 150 | |
| 22 | Outer Caycuse | 2 | 2 | 1.5 | 3700 | M | M | 1600 | |
| 22a | Rusty Bight | 2 | 2 | 1 | 9100 | L | M | 200 | |
| 23 | Nixon E. | 1 | 2 | .5 | 9100 | H | H | 600 | |
| 24 | Outer Nixon | 2 | 3 | .5 | 2710 | H | H | 1000 | |
| 25 | Inner Nixon | 1 | 1 | .1 | 1000 | H | M | 1300 | |
| 25a | Nixon Rec. | 2 | 2.5 | 2 | 3700 | L | M | 150 | |
| 26 | Rockcut | 5 | 2.5 | 70 | 0082 | N | N | 1000 | |
| 27 | Islands | 1 | 1 | 1 | 9100 | L | M | 600 | |
| 28 | W. Islands | 2 | 1.5 | .5 | 9100 | L | M | 700 | |
| 29 | Hemm | 1 | 1.5 | .5 | 9100 | L | M | 1000 | |
| 30 | Outer Hemm | 3 | 2 | 40 | 0055 | N | L | 440 | |
| 30a | Little Hemm | 3 | 3 | 2 | 1261 | L | L | 100 | |
| 30b | Outer Little Hemm | 2 | 2 | 2 | 2800 | L | L | 60 | |
| 31 | Long W. | 2 | 2 | 1.5 | 2710 | L | M | 2500 | |
| 31a | CZ | 3 | 2.5 | 3 | 2710 | N | L | 210 | BH |
| 32 | Heather | 3 | 3 | 2 | 2800 | L | M | 800 | |
| 33 | Slide | 4 | 3 | 30 | 1171 | L | L | 2000 | |
| 34 | Little Shaw | 2 | 2 | 1.5 | 2710 | M | M | 1400 | |
| 35 | Shaw | 3 | 3 | 6 | 1153 | N | L | 1200 | |
| 36 | Shaw Bay | 1 | 1 | .5 | 1000 | L | H | 380 | |
| 37 | Outer Shaw | 2 | 2 | 2 | 2710 | L | L | 260 | |
| 38 | Outer Shaw E. | 3 | 2 | 1.5 | 2350 | L | M | 1500 | |
| 38a | Pocket | 3 | 3 | 3 | 2800 | L | L | 100 | |
| 39 | Hawes | 3 | 2 | 2 | 2710 | L | M | 300 | |
| 40 | Hawes Marsh | 1 | 1 | .5 | 1000 | L | M | 300 | |
| 41 | Marguerite | 4 | 3 | 2 | 2710 | L | L | 3000 | BH |
| 41a | McKay Bight | 2 | 2 | 1 | 3700 | L | M | 600 | |
| 42 | McKay Fan | 4 | 4 | 2.5 | 2530 | L | M | 880 | |

| | | | | | | | | | |
|-----|-----------------|---|-----|------|------|---|---|------|-------------|
| 43 | E. McKay | 2 | 2 | 2.5 | 1540 | L | M | 880 | |
| 44 | Wardroper | 2 | 2 | 2 | 2620 | L | M | 2900 | Scalp |
| 45 | Maple Grove E. | 2 | 2 | 1 | 4420 | L | H | 500 | |
| 46 | Roberts | 3 | 2.5 | 2 | 2800 | L | M | 500 | Mod. |
| 47 | Cowan | 1 | .5 | .2 | 9100 | M | H | 2000 | |
| 48 | Cott.W. | 5 | 5 | 3 | 2620 | L | L | 1800 | |
| 49 | Cott. E. | 3 | 3 | 2 | 2620 | L | L | 1600 | |
| 50 | Mill | 2 | 2 | 3 | 2350 | L | L | 660 | |
| 51 | Inner Mill Bay | 2 | 1 | 1 | 7300 | L | M | 400 | |
| 52 | Youbou W. | 3 | 3 | 3 | 2710 | L | L | 2800 | BH, scalp |
| 52a | Inner Youbou W. | 2 | 2 | 1.5 | 3610 | L | M | 100 | |
| 53 | Saseenos | 5 | 4 | 4 | 1522 | L | L | 700 | Scalp, mod. |
| 54 | Saseenos E. | 2 | 2 | 1 | 2800 | L | M | 600 | BH, scalp |
| 55 | Motel Bay | 1 | 1 | .01 | 1000 | M | H | 300 | Marina |
| 56 | Youbou E. | 2 | 2 | 3 | 3610 | L | M | 1600 | BH, scalp |
| 57 | Price-Miracle | 2 | 2.5 | 3.5 | 2710 | L | L | 1500 | |
| 58 | Miracle E. | 2 | 1.5 | 1.5 | 2620 | L | L | 3000 | |
| 59 | Sunset | 4 | 4 | 1.5 | 2800 | L | M | 700 | |
| 60 | Springs | 2 | 2 | 1.5 | 3610 | L | H | 500 | |
| 61 | Bald N. | 4 | 2 | 2-20 | 1234 | L | L | 5400 | |
| 62 | Outer Bald | 5 | 5 | 80 | 0019 | N | N | 3200 | |
| 63 | Bald Rec. | 3 | 3 | 2 | 2710 | L | L | 400 | |
| 64 | Bald E. | 4 | 4 | 60 | 1153 | N | L | 1200 | |
| 65 | Trans. | 2 | 3 | 3 | 1630 | N | L | 400 | |
| 66 | Trail | 3 | 2 | 2 | 2620 | L | M | 2000 | |
| 67 | Marble | 1 | .5 | .01 | 9100 | H | H | 2400 | |
| 68 | Meade E. | 2 | 2 | 2 | 2710 | L | L | 4000 | BH, scalp |
| 68a | IR | 1 | 1 | 1 | 9100 | M | M | 50 | |

Fish Utilization and Limiting Factors

Cowichan Lake is utilized by rainbow and cutthroat trout, Dolly Varden char and kokanee, coho and chinook salmon. A few chum salmon also rear a short time in the lake and an occasional shore spawning chum is reported. Very occasional coho shore spawning is also reported. Sturgeon are also reported very occasionally as are Eastern Brook trout.

Production is limited by low nutrients and the lack of quality shore zone fish habitat. Only 14.53% of the lake's shorezone is Class 1 habitat. The shore zone is largely narrow, fairly exposed and lacking in cover/complexity. It is speculated that, with the large reduction in log storage, an important element of cover is lacking: log booms and associated elements like boomsticks protecting storage areas and the associated debris that accumulated in the shorezone as sunken and floating/semi-floating wood.

Enhancement Options

1. INCREASE SHORE ZONE COVER-COMPLEXITY : 38,765 m (37.7 %) of Cowichan Lake's shorezone is Class 2 habitat subject to improvement. It is probable that a good deal of this area could be upgraded to Class 1 with the addition of cover-complexity. This option should be explored on an experimental basis.

2. IMPROVE FERTILITY : Fertilization is another option. Cowichan Lake has a large population of kokanee that mature at approximately 15cm. If these fish could grow 5-10 cm larger, they could attract a sport fishery.

3. NEW SPECIES: The introduction of piscivorous rainbow trout such as Anderson Lake rainbow may also add an additional element of attraction to Cowichan Lake and help crop the kokanee somewhat.

Land Use Factors

Urban

Residential housing has increased along the lake in the last decade, especially in the east portion of the basin in the Honeymoon Bay and Youbou areas. Considerable shorezone impact has resulted from residential expansion. Lakeshore residences now tend to be year round homes instead of summer residences. Clearing and filling of riparian shorezones has been the major impact.

Fortunately, much of the land around Cowichan Lake is managed forest in the FLR and this will help limit residential expansion into sensitive areas of shorezone.

Cowichan Lake's shorezone is private land, mostly held by TimberWest/Pacific which complicates management/protection

Forestry

The volume of log handling in the lake is very small compared to two decades ago when numerous log dumps and booming areas were present around the lake. The majority of wood is handled at the TimberWest Honeymoon Bay Dryland Sort.

Protection Needs

The OCP's for CVRD electoral areas I and F are currently under review. In this process, lands suitable for residential development need to be sorted from resource lands and development directed toward appropriate land units. Class 1 and 2 shorezone reaches require complete protection and should receive special zoning. The entire lakeshore should be deemed a development permit area.

**OPERATIONAL MANAGEMENT AREA 9: LAKE COWICHAN –
YUBOU**

OVERVIEW

This OMU stretches west from the west edge of the Town of Lake Cowichan to the western edge of Youbou but not including the mill. It ends at Youbou Creek. Adjacent uplands on Mt. Good and Mt. Holmes are included. In fact, the majority of the unit is upland. The only major lowland riparian area is on the Meade Creek fan – Marble Bay area which is more associated with the Cowichan Lake OMU than with Lake Cowichan – Youbou OMU.

Eleven salmonid streams are located in the OMU: Don Fern's, Castaway, Meade, Bald Mountain, Miracle, Swordfern, Andy's, Price, Utility, Pond and Coonskin. Some of these streams are not regular producers.

LIMITING FACTORS

Access, low summer flow and, in the case of Meade Creek, lack of stable lateral habitat, are important limiting factors.

PRODUCTION OPTIONS

A total of 18 production options are present in the OMU. They are outlined in Table 6. More detail is present in the streamfiles on the following pages.

Table 6: Lake Cowichan –Youbou Production Options

| No. | Page | Location | Activity | Priority |
|-------|------|------------------|--------------------------------------|----------|
| 1 | 1 | Don Fern's Creek | Spawning platforms | 3 |
| 2 | 1 | | Instream incubators | 2 |
| 3 | 2 | Castaway Creek | Spawning platforms | 1 |
| 4 | 2 | | Fry stocking | 1 |
| 5 | 2 | | Coho colonization | 1 |
| 6 | 2 | | Barrier Improvement | 1 |
| 7 | 4 | Meade Creek | Fry salvage and colonization | 1 |
| 8 | 4 | | Early run chinook colonization | 2 |
| 9 | 5 | | Sidechannel development | 1 |
| 10 | 7 | Miracle | Instream incubation | 2 |
| 11 | 9 | Swordfern | Spawning platforms/and or incubators | 1 |
| 12 | 12 | Price | Spawning platforms | 1 |
| 13 | 12 | | Arnold spring reconnection | 1 |
| 14 | 13 | Utility | Spawning platforms | 1 |
| 15 | 13 | | Fry salvage | 1 |
| 16,17 | 14 | Pond | Spawning platforms/incubators | 2 |
| 18 | 14 | | Spring reconnection | 1 |
| 19 | 15 | Coonskin | Fry salvage | 1 |
| | | | | |

Stream Code: N/A

Stream Name: Don Fern's Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** A small groundwater fed stream that originates from a seepage zone about 400 metres above Cowichan Lake. The stream enters Cowichan Lake in the South Arm 1000 metres west of the weir.

Air Photos BC 82007 138-139

Topographic Map 92 C/16, 92C.090

Salmonids Co to 377 m.

Bt to 377 m.

Ct to 377 m.

Obstructions None. The stream divides into three forks at 377 m. each too small to support salmonids.

Max. Temp. (C) 16

Mean November to April = 5

Min. Disch. (m³) Usually dry July-Oct.

Mean November to April = .030 m³/sec

DON FERNS CREEK

| | Channel | Wetted | | | Channel | Side | Length | Wetted |
|---------|-----------|-----------|-----------|--------|-------------|---------|--------|------------------------|
| | width (m) | width (m) | Substrate | Slope% | Confinement | Channel | (m) | Area (m ²) |
| Reach 1 | 2 | 0 | 3610 | 1.5 | FC | N | 32 | 0 |
| Reach 2 | 1 | 0 | 0009 | 1.5 | CULVERT | N | 36 | 0 |
| Reach 3 | 2 | 0 | 1360 | 2.0 | CON | N | 42 | 0 |
| Reach 4 | 2 | 0 | 2620 | 1.5 | CON | N | 267 | 0 |

- B) **FISH UTILIZATION AND LIMITING FACTORS**

Coho salmon, brown trout and cutthroat trout spawn in this stream. Most fry migrate to the lake by late May-early June. Production is limited by summer drying and lack of high quality spawning gravel.

- C) **PRODUCTION OPPORTUNITIES**

1. **SPAWNING PLATFORMS:** Construction of spawning platforms in Reaches one, two and three (Production Option #1).

2. **INSTREAM INCUBATORS:** Art Watson's incubators have been installed at Don Ferns in the past with success. They need occasional maintenance from fine debris build up. Eyed eggs only. (Production Option # 2)

- D) **LAND USE FACTORS**

50% of the basin was recently logged with no apparent impact. The remainder is advanced second growth except for a fringe of houses along the North Shore Road.

Risk Potential Low

- E) **PROTECTION NEEDS**

The lower portion of the stream flows through Don Fern's. Above North Shore Road, the stream enters a small ravine/gully which comprises its FSZ.

Fishery Officer Narrative

OMU 9: Lake Cowichan - Youbou / Burns and Tuty, 1999

Stream Code: N/A

Stream Name: Castaway (Manzini's or Encounter) Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** A small low gradient system of three components: a short, narrow boulder dominated channel, a .42 Ha man-made pond and a largely seepage fed headwater system. Enters Cowichan Lake 1750 m. west of the weir.

Air Photos BC 82007 137-138
Topographic Map 92 C/16, 92C.090
Salmonids Co, Bt, Ct, Rb (introduced)
Obstructions North Shore Road culvert (.8m) at 123 m, 2R6 concrete spillway at pond outlet (140 m), E & N culvert at 440 m. Fish get through the North Shore Road culvert but are stopped at the spillway immediately upstream.
Max. Temp. (C) 18 (8/19/88)
Min. Disch. (m³) 0.001 CMS (8/19/88)

CASTAWAY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 2 | 1 | 1360 | 3.0 | CON | N | 123 | 123 |
| Reach 2 | 30 | 30 | 9100 | 0.0 | NA | N | 140 | 4200 |
| Reach 3 | 2 | 1 | 4500 | 1.0 | PC | L | 400 | 400 |
| Reach 4 | 2 | 1 | 1450 | 1.5 | CON | N | 510 | 510 |
| Reach 5 | 2 | 1 | 8200 | .1 | ENT | N | 400 | 400 |

- B) **FISH UTILIZATION AND LIMITING FACTORS**

Coho along with an occasional cutthroat and brown trout spawn in reach one. Production is highly limited by lack of gravel and short accessible length.

Summer rearing does not occur due to very low flow and lack of pool - glide habitat. Fry migrate to Cowichan Lake soon after emerging.

- C) **PRODUCTION OPPORTUNITIES**

1. SPAWNING PLATFORMS: Creation of spawning platforms would increase spawning capability and egg survival (**Production Option #3**). There is room for 6 platforms in Reach 1, 3 were constructed in the summer of 1994 with a total area of 18 m².

2. FRY STOCKING: Stocking coho and cutthroat fry in the 4200 m² pond could yield downstream migrants (**Production Option #4**). At .15 coho fry/m², 50 coho smolts could result. The pond has been stocked with rainbow by the owner (Joe Vasko, 2963 Scott St., VICTORIA V8R 4J7: 598-6467). A spillway fence has been installed to prevent their escape. It must be removed. 100 rainbows were stocked in 1989, few remain. Mr. Vasko saw six in 1994. Rises were noted on Feb. 7, 1995.

3. COHO COLONIZATION: Fry could also be introduced to the upper reaches of the stream which include another small pond (2,000 m²). Total habitable area is estimated to be 3310 m² which could yield 264 coho smolts at 1 fry/m² (**Production Option #5**).

4. BARRIER IMPROVEMENT: If the culvert/spillway could be made passable, Options 2 and 3 would not be required. The trick to this obstruction is how to remove it without losing the pond? (**Production Option #6**)

- D) **LAND USE FACTORS**

There is the possibility of suburban/industrial development in the upper watershed. A number of residences are present along North Shore Rd. Johel Brothers located their work yard on a headwater tributary in about 1988.

Risk Potential: Moderate

E) PROTECTION NEEDS

Reach 1 of Castaway (Formerly called Encounter) is in the backyard of Manzini's and the former Castaway Property. A runoff pipe enters the creek from the Castaway Property but one of the owners assured me it was local runoff from roofs and driveway. It looked septic to me and I suspected it was a laundry room drain. Above North Shore Road, the creek enters Vasko's Pond then enters a moist ravine with a high degree of sensitivity. Clark Atchison owns much of this area and has recently constructed a house on the upland. Proceeding upstream, the suburban area along North Shore Rd. in the area of Meade Creek Rd. drains into Castaway. Then the creek splits and one branch drains the Johel Bros. Yard where it has been filled along with a small wetland. The other fork is ditched up to the highway and drains an area that Highways has used to stockpile gravel. This area has been discussed as a possible industrial site. This would be a marginal choice because of high soil moisture levels. The Meade Creek industrial site is just across the road.

Stream Code: 920 2577 652

Stream Name: Meade Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** This stream enters Cowichan Lake from the north. Drains a steep, narrow basin that is highly responsive to precipitation.

Air Photos BC 82007 104-106
Topographic Map 92 C/16, 92C.090, 0100
Salmonids Co to 8000 m.
St to 8000 m.
Rb to 15,500 m. plus 2,500 m of tributary water
DV to 8000 m.
Ct to 8000 m.
Cm an occasional individual uses the sidechannel and lower Meade in some years
Obstructions 2 m falls at 8,000 m.
Max. Temp. (C) 15.5 (8/11/85)
Harding Ponds 15 (9/8/98)
Min. Disch. (m³) 0.28 (8/11/85)
0 below 1500 m

MEADE CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area |
|----------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------|
| Reach 1 | 30.0 | 0.0 | 1540 | 1.5 | FC | L | 1500 | 0 |
| Reach 1A | 15.0 | 0.0 | 1450 | 1.0 | FC | L | 1500 | 0 |
| Reach 2 | 12.0 | 6.0 | 1360 | 2.5 | CON | N | 2500 | 30000 |
| Reach 3 | 30.0 | 15.0 | 1360 | 1.5 | FC | L | 800 | 12000 |
| Reach 4 | 12.0 | 5.0 | 136R | 3.0 | ENT | N | 3200 | 16000 |
| Reach 5 | 12.0 | 5.0 | 136R | 4.0 | CON | N | 7500 | 37500 |

- B) **FISH UTILIZATION AND LIMITING FACTORS**

Coho and steelhead utilize the lower 8,000 m including a 1,500 m flood channel (Reach 1) which supports up to 100 coho spawners. Early run chinooks used Meade Creek but have not been reported since 1960 (Deleeuw, pers. comm.). A resident population of small rainbows (<18 cm) is present in the upper 7,500 m. A few cutthroat trout and Dolly Varden Char from Cowichan Lake spawn in the creek but very little is known about these fish. Chum salmon fry have been salvaged from the sidechannel.

The lower 1,500 m of the mainstem usually dries by late July or early August. The 1,500 m flood channel carries water in high flows; parts of it dry in winter or early spring. Coho fry are trapped and must be salvaged to survive. The flood channel (known as Abernethy Creek locally) is a major coho spawning stream in its lower 500 m.

Overall productivity is limited by high fall - winter discharge. Coho and Kokanee beach spawning occurs near the mouth of Abernethy Creek where ground water seepage and upwelling is present at Springs Beach.

- C) **PRODUCTION OPPORTUNITIES**

1. **STEELHEAD – COHO FRY SALVAGE AND COLONIZATION:** Best option is stocking steelhead and coho fry salvaged from the lower 1,500 m and the flood channel (Production Option #7) to the 7,500 m reach above the falls and a 2,000 m tributary reach. If possible, salvaged coho should be separated into lake and stream type with lake fish going to Cowichan Lake.

2. **CHINOOK STOCKING:** It would also be worthwhile to introduce early run chinook fry to Reach 2 (Production Option #8) to try to re-establish the population. Obtaining donor stock may be difficult.

Above barrier coho smolt yield potential:

Meade 1,500 smolts - 15,000 fry required.
Tributary 320 smolts - 1,600 fry required.

TOTAL 1,820 smolts - 16,600 fry required.

Above barrier chinook colonization is also possible. Smolt yield is 1500 and fry requirements are 15,000. Cutthroat and Dolly Varden colonization should be considered. Meade Creek is not quality cutthroat habitat, particularly above the falls, but is typical Dolly Varden habitat. Dolly Varden parr were more numerous in Meade Creek than in any other Cowichan Lake tributary in the summer of 1986.

3. **GROUNDWATER CHANNEL DEVELOPMENT:** Groundwater sidechannel development potential exists in relic channel complexes adjacent to reaches 1 and 3. Reach 3 sites are under investigation by The Campbell Group, CLSES and DFO (1994) (Production Option # 9). A 147 m long sidechannel was constructed by the Campbell Group under the direction of Ted Harding in the summer of 1995. The channel contains three ponds with a total area of 350 m². Coho fry were using the channel in Nov., 1995.

Minnow Trapping Results, 9/8 to 9/10, 1996

| | Co | Rb |
|-------------|----|----|
| Lower Pond | 22 | 15 |
| Middle Pond | 5 | 12 |
| Upper Pond | 2 | 12 |

The Middle Pond fish were completely removed in September 1996 to accommodate deepening. Catch was 270 Co and 10 Rb.

D) LAND USE FACTORS

Forestry

Basin cover is mainly advanced second growth with large areas of early immature above the 500 m contour. Second growth logging is well underway in the Lower Basin (1994 - Campbell Group/Hancock).

Difficult logging conditions are present in a 2,500 m canyon section of the main stem and a 2,000 m zone of a tributary due to steep slopes featuring cliffs, talus and thin soils.

Residential

Considerable residential use of the delta; some residences located in flood prone areas. Dyke protection may be required. Habitat value is low in this area due to summer drying and bed instability.

Risk Potential

Moderate

E) PROTECTION NEEDS

Forestry

Careful logging will be required in the canyon section and other high slope areas of the basin. Large areas of the canyon should not be logged by any means because of the extreme slopes and high impact potential.

There is a need to restrict development on the Meade Creek Fan. Flood potential is high in areas close to the creek and its floodchannel (Abernethy Creek).

Fishery Officer Narrative

Miscellaneous Counts

| Year | Species | Number |
|------|---------|---------|
| 1978 | Co | 300-400 |

Stream Code:N/A

Stream Name: Bald Mountain Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

- A) BIOPHYSICAL OVERVIEW: A small, steep, unstable creek that drains a narrow basin on the north side of Bald Mountain; a granitic peninsular hill that separates the North and South arms of Cowichan Lake.

Air Photos BC 82007 105-106

Topographic Map 92 C/16, 92C.090

Salmonids A possibility of coho spawning in Reach 1 (85 m.).

Obstructions A 4 metre falls over 10 metres at 155 metres upstream then rapidly increasing gradient.

Max. Temp. (C) 15°

Min. Disch. (m³) 0 for 155 m. then .0024 above (7/29/87)

BALD MOUNTAIN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4.0 | 0 | 1360 | 3.0 | CON | N | 85 | 0 |
| Reach 2 | 3.0 | 0 | 1360 | 4.0 | CON | N | 70 | 0 |
| Reach 3 | 2.0 | 1 | 127R | 10.0 | CON | N | 500 | 500 |

- B) FISH UTILIZATION AND LIMITING FACTORS

There is a possibility that a few coho salmon spawn in reach one. Production is limited by substrate instability and dewatering.

- C) PRODUCTION OPPORTUNITIES

None

- D) LAND USE FACTORS

Advanced second growth.

Risk Potential

Moderate.

Fishery Officer Narrative

Stream Code:

Stream Name: Miracle Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** Enters Cowichan Lake from the north 2.5 km east of Youbou. Entirely groundwater fed by a complex seepage system that incorporates several small feeders between the rail road and Highway 18. The majority of the flow emanates from a rock fall seepage area of some 2.5 Ha located about 200 m above the highway.

Air Photos BC 82007 105-106
Topographic Map 92 C/16, 92C.090
Salmonids Co to 250 m.
Ct to 250 m.
Obstructions Rapidly increasing gradient at 250 m (no habitat above this point).
Max. Temp. (C) 9 (8/25/86)
Min. Disch. (m³) 0.1 (8/25/86)
Mean winter disch. approx. .16 cms
Mean winter temp. approx. 8.5

MIRACLE CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 2.5 | 2.0 | 1900 | 0.1 | OC | L | 250 | 500 |
| Reach 2 | 2.5 | 1.0 | 127R | 10.0 | CON | N | 200 | 200 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few resident cutthroats are present. Spawning conditions are optimal but habitable area is only 500 m². Rearing capacity is low due to shallow depth and lack of cover. This stream is best described as a coho spawning channel that supplies Cowichan Lake with fry. Miracle Creek has the highest density of coho spawners per area of spawning habitat I have encountered. 1985 - 1987 mean is .42 fish/m².

C) PRODUCTION OPPORTUNITIES

1) **INSTREAM INCUBATORS:** 1986 - 1987 winter temperature averaged 7 . Stable discharge of approximately 0.1 cms. Ideal conditions for incubation boxes or a small hatchery (**Production Option #10**). Because the entire accessible length of the stream is utilized by spawners, offset incubation will be required. Based on 100,000 eggs and egg to fry survival of 80%, 80,000 enhanced coho fry could be produced. Natural fry production is estimated to be 42,000 based on 103 females, 2,000 eggs per female and 20% egg to fry survival. Normal egg to fry survival is 15% but, due to the favourable incubation conditions in this stream, I have increased it 5%. A spawning platform was added in the summer of 1997 by the UFAW crew of CLSES. Its located on the old CN grade which is utilized by B.C. Tel's fibre optic line. It was utilized by a pair of coho spawners in Nov.,1997.

D) LAND USE FACTORS

Forestry

The basin is in the advanced second growth stage.

Risk Potential

Low.

Urban

MacMillan Bloedel Ltd. has developed a subdivision in the area (1988- 1994...). Clearing began in the fall of 1988 and by 1994, most of the lots were sold and developed. No measureable impact to the stream but substantial lake shoe zone clearing occurred in front of many of the properties despite restrictive covenants.

E) HISTORICAL NOTES

Escapement (CO): Miracle Creek is one of the few Cowichan Basin streams where the late run usually dominates

1985 300 (late)
1986 180
1987 150 (early 50, late 100)
1990 6 early, 100 late
1996 6 early, 16 late
1997 16 early

Fishery Officer Narrative

F) PROTECTION NEEDS

A larger buffer zone with some upland forest component should have been retained in the subdivision development. The riparian area was protected but has suffered much blowdown due to wind exposure. The water table is high and the alders are shallow rooted. The area above the road should be developed very carefully if at all because of the complex drainage system there.

Stream Code:

Stream Name: Swordfern Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** This stream enters Cowichan Lake from the north 2.4 km east of Youbou; a groundwater stream. Most of it originates in a seepage zone of approximately 1 Ha which is located between the CN tracks and the highway. The rest comes from another seepage area located near the base of an old rock slide some 200 m above highway 18.

Air Photos BC 82007 105-106

Topographic Map 92 C/16, 92C.090

Salmonids Co to 160 m.

Ct to 160 m.

Obstructions None. The stream divides into several small, muddy seepage channels at 100 m.

Max. Temp. (C) 9 (8/30/86)

Min. Disch. (m³) .03 (8/30/86)

SWORDFERN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3.0 | 1.0 | 3700 | 1.0 | FC | N | 70 | 70 |
| Reach 2 | 3.0 | 1.0 | 9100 | 0.1 | OC | M | 90 | 90 |
| Reach 3 | 2.0 | 1.0 | 9100 | 0.1 | OC | M | 278 | 278 |
| Reach 4 | 1.0 | 0.5 | 127R | 10.0 | CON | N | 200 | 100 |

B) FISH UTILIZATION AND LIMITING FACTORS

Swordfern Creek supports coho and a few resident cutthroat trout. Production is limited by its short length and lack of quality spawning habitat. The substrate is largely much-detritus, sand-silt and fine gravel. A few spawning sites totalling 20 m² are present in reach one but gravel quality is low. Approximately 40% of winter flow comes from the CN grade ditch which collects water from the west portion of the wet woodland area that contributes flow. Springs are located 175, 190, 205 and 220 m west of the mainstem. Coho occasionally spawn in the ditch. The catchment area below the highway is in park (CVRD).

C) PRODUCTION OPPORTUNITIES

1) **SPAWNING PLATFORMS AND/OR INSTREAM INCUBATORS:** Additional gravel to improve coho fry recruitment to Cowichan Lake or utilization of incubators. Temperature - discharge variation is minimal in this groundwater stream. The differences between summer and winter temperature means is only 2°C (7 to 9 degrees). The difference between summer and winter discharge is .00454 m³/sec. This is an ideal stream for incubation boxes. In previous years, Yount Elementary School students in Youbou have placed boxes in or near Coonskin Creek, a turbulent runoff stream. Future efforts should be in Swordfern. Probable fry yield based on 100,000 eggs at 80% survival is : 80,000 fry. **Spawning platforms should be constructed at 5, 10 and 55 m in reach 1 (Production Option # 11). A spawning platform was constructed at 55m in the summer of 1997 (CLSES).**

D) LAND USE FACTORS

Risk Potential

MacMillian Bloedel has developed an 83 lot subdivision in Block 5 which encompasses the entire basin. Careful planning has protected the stream and its water sources.

Historical Notes

Swordfern Creek was discovered in 1985.

Escapement (Co)
1985 4
1986 2
1987 4
1997 4

Fishery Officer Narrative

E) PROTECTION NEEDS

The wetlands and stream corridor have been zoned out of the development and CVRD has a park that comprises the corridor and the major wetland. Wet areas are present between the old CN grade and the highway and these are in the FSZ as are seepage zones above the highway.

Stream Code: N/A

Stream Name: Andy's Creek

Operational Management Unit: Youbou

CVRD Electoral Area: I

- A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north near the east boundary of Youbou. Drains a short, steep basin.

Air Photos BC 82007 105-106
Topographic Map 92 C/16, 92C.090
Salmonids Co spawners to 50 m.
Obstructions Rapidly increasing gradient above 50 m.
Max. Temp. (C) N/A
Min. Disch. (m³) 0

ANDY'S CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4.0 | 0.0 | 1450 | 1.5 | CON | N | 100 | 0 |
| Reach 2 | 3.0 | 0.0 | 1360 | 3.5 | CON | N | 100 | 0 |
| Reach 3 | 3.0 | 0.0 | 1270 | 4.0 | CON | N | 200 | 0 |
| Reach 4 | 2.0 | 0.0 | - | 50.0 | CON | N | 800 | 0 |

- B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn in the first 50 m. Spawning conditions become very marginal above this point and the stream dries early. Fry rear in Cowichan Lake. 35 coho entered the stream in 1985/86. It is doubtful that all spawned successfully since there is only enough suitable gravel for approximately 10 redds. In January, 1988, Andy's Creek was dry for nine days.

- C) PRODUCTION OPPORTUNITIES

Creation of spawning platforms in Reach 1 would increase fry yield. However, it is likely that they would wash out soon. This measure is not recommended.

- D) LAND USE FACTORS

Forestry

Advanced second growth. Logging in the general area began in 1996-97.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Price Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) BIOPHYSICAL OVERVIEW: A very small groundwater stream from a seepage area at the east end of Youbou. Enters Cowichan Lake from the north.

Air Photos BC 82007 105-106
Topographic Map 92 C/16, 92C.090
Salmonids Co to 65 m.
Ct to 65 m.
Obstructions CN railway culvert at 30 m.
Max. Temp. (C)
Min. Disch. (m³) approximately 1 LPS

PRICE CREEK

| Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|

EAST BRANCH

| | | | | | | | | |
|---------|-----|-----|------|-----|----|---|----|----|
| Reach 1 | 1.0 | 1.0 | 1910 | 1.0 | FC | N | 30 | 30 |
|---------|-----|-----|------|-----|----|---|----|----|

WEST BRANCH

| | | | | | | | | |
|---------|-----|-----|------|-----|----|---|----|----|
| Reach 1 | 1.0 | 0.5 | 8200 | 0.5 | FC | L | 35 | 17 |
|---------|-----|-----|------|-----|----|---|----|----|

- B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn and cutthroat trout are present. As many as forty coho spawners have been reported in a total area of 65 m² (winter wetted width). Production is limited by a lack of suitable spawning sites in this tiny stream system.

- C) PRODUCTION OPPORTUNITIES

1) **SPAWNING PLATFORMS OR INSTREAM INCUBATORS:** Spawning platforms and incubators should insure a high fry yield from this very stable stream. **Two spawning platforms and two 2000 egg incubators should yield 6000 - 7000 coho or cutthroat fry. Most fry rear in Cowichan Lake (Production Option # 12).**

2) **ARNOLD SPRING CAPTURE:** Re-diversion of Arnold Spring (which is located some 50 m west of the end of the West Fork). Arnold Spring was originally part of West Price and made up the major part of its flow. It was diverted down Arnold Road ditch into Cowichan Lake in the early 1990's to avoid the possibility of it being contaminated by a septic tank field (**Production Option # 13**).

- D) LAND USE FACTORS

A protected backyard stream.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: 920 2577 756

Stream Name: Utility Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This is a small, stable groundwater fed creek located within the Village of Youbou.

Air Photos BC 82007 105 - 106

Topographic Map 92 C/16, 92C.090

Salmonids Co to 300 m.

Ct to 300 m.

Obstructions Rapidly increasing gradient at 300 m.

Max. Temp. (C) 14 (8/26/85)

Min. Disch. (m³) 0 (8/26/85). Stream contained standing pools above 50 m but no apparent flow. The lower 50 m. was dry.

UTILITY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3.0 | 1.0 | 2800 | 1.0 | FC | L | 50 | 0 |
| Reach 2 | 3.0 | 1.0 | 3610 | 0.5 | UC | L | 250 | 250 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few resident cutthroats utilize the stream; possibility of a few Cowichan Lake cutthroat spawners.

Production is limited by habitable area and limited spawning gravel.

C) PRODUCTION OPPORTUNITIES

Stable flow and an average winter temperature of 5 favour various incubation strategies .

1) **SPAWNING PLATFORMS:** Additional gravel will increase recruitment. **Spawning platforms should be constructed at 35m in R1 and at 15, 22 and 35m in R2 (Production Option # 14).**

2) **FRY SALVAGE:** Fry salvage is required in the lower 50 m (**Production Option # 15**). Fish can be released in the lake at the creek mouth.

D) LAND USE FACTORS

Forestry

Advanced second growth covers the entire basin.

Residential

The stream passes through three properties. A backwater portion of the creek along the CN grade was partially removed when CN sold the right-of-way to adjacent residents.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Pond Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

- A) **BIOPHYSICAL OVERVIEW:** A very small groundwater fed system from the Youbou seepage zone. Enters Cowichan Lake from the north.

Air Photos BC 82007 105-106

Topographic Map 92 C/16, 92C.090

Salmonids Co to 100 m.

Ct to 100 m.

Obstructions None. There is a .45 m leap onto a concrete apron at the CN culvert outlet at 10 m. but it is passable for adults.

Max. Temp. (C)

Min. Disch. (m³) less than 1 LPS

POND CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 1.0 | 0.5 | 3700 | 1.0 | FC | N | 10 | 5 |
| Reach 2 | 30.0 | 20.0 | 9100 | 0.0 | UC | NA | 20 | 500 |
| Reach 3 | 1.0 | 1.0 | 2700 | 1.5 | CON | N | 70 | 70 |

- B) **FISH UTILIZATION AND LIMITING FACTORS**

Coho salmon and cutthroat trout are present. Some Cowichan Lake cutthroats are thought to spawn in this stream. Production is limited by lack of quality spawning gravel and small wetted area.

- C) **PRODUCTION OPPORTUNITIES**

1) **SPAWNING PLATFORMS AND INCUBATORS:** Spawning platforms and incubators would increase fry yield. There are three good sites for platforms and at least two 2,000 egg incubators could be installed for a yield of 6,000 to 8,000 coho or cutthroat fry (**Production Options # 16, 17**).

2) **SPRING CAPTURE:** Re-diversion of some spring water to the east into Pond Creek. About 30% of the stream's flow has been diverted across the CN grade and is now wasted in a small ditch to Cowichan Lake at the Bigelow property (**Production Option # 18**)

- D) **LAND USE FACTORS**

Pond Creek is a backyard stream. Modifications are likely to take place.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: 920 2577 768

Stream Name: Coonskin (Coon) Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

- A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north. The drainage area includes the steep, narrow south face of Mt. Holmes.

Air Photos BC 82007 105 - 106

Topographic Map 92 C/16, 92C. 089

Salmonids Co to 300 m.

Ct to 300 m.

Obstructions Rapidly increasing gradient and a series of falls beginning at 300 m and a 10 m dam at 350 m

Max. Temp. (C) 11 (8/26/85)

Min. Disch. (m³) 0.004 (8/26/85) The lower 240 m dry.

COONSKIN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 7.0 | 0.0 | 2710 | 1.0 | CON | N | 50 | 0 |
| Reach 2 | 6.0 | 2.0 | 1360 | 5.0 | CON | N | 200 | 0 |
| Reach 3 | - | - | - | 33.0 | CON | N | 1500 | - |
| Reach 4 | - | - | - | 10.0 | CON | N | 1000 | - |
| Reach 5 | - | - | - | 30.0 | CON | N | 500 | - |

- B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroats utilize the lower 300 m. 12 coho utilized the stream in 1979 and 75 in 1985/86. In many years, the creek doesn't get any coho spawners but fry swim up from Cowichan Lake in late spring or early summer.

Fish production is limited by the short accessible length and high gradient along with summer drying.

- C) PRODUCTION OPPORTUNITIES

Spawning platform construction in Reach 2 could improve egg survival but this option is not recommended because durability/stability is low.

1) **FRY SALVAGE:** Fry Salvage is required in Reach 1 (**Production Option # 18**).

- D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. The upper portion was logged between 1981 and 1985. Considerable turbidity resulted but impact was minimal due to the low capability of the stream and its high flushing capacity.

Residential

The lower 250 m of Coonskin Creek flow past residences but impact is minor.

Risk Potential

Moderate.

Stream Code: 920 24577 780

Stream Name: Youbou Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north near the west boundary of Youbou. The drainage area is confined to a steep, narrow basin.

Air Photos 82007 105 - 106
Topographic Map 92 C/16, 92C.089
Salmonids Co spawners for 100 m in occasional years.
Obstructions Rapidly increasing slope above 100 m. a 10 m dam at 200 m.
Max. Temp. (C) N/A
Min. Disch. (m³) 0

YOUBOU CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 6.0 | 0.0 | 1630 | 2.0 | CON | M | 50 | 0 |
| Reach 2 | 5.0 | 0.0 | 1360 | 3.0 | CON | N | 50 | 0 |
| Reach 3 | - | 0.0 | - | 40.0 | CON | N | 2500 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawn in the lower 50 m. Egg survival is usually low due to violent fall - winter discharge fluctuation. The entire stream dries in late spring or early summer.

C) PRODUCTION OPPORTUNITIES

Spawning platforms could be constructed in Reaches 1 and 2 but the possibility of washout is high.

D) LAND USE FACTORS

Forestry

Advanced second growth.

Residential

The lower 100 m bisects a residential area, however to date the impact has been nil.

Risk Potential

Low.

Fishery Officer Narrative

OPERATIONAL MANAGEMENT UNIT 10 : LAKE NORTH

OMU 10: Lake North
T. Burns and B.D. Tutty, 1999

OVERVIEW

Lake North OMU extends from Cottonwood – Widow Creek on the east to Hall Creek on the west. It includes all Cowichan Lake north shore tributaries west of Youbou.

For the most part, this OMU is composed of mountainous highlands with steep slopes adjacent to the streams and their networks of feeder tributaries which often flow in steep walled gullies and ravines. Riparian landscape units are generally narrow, often not much more than fringes adjacent to mainstems. Noteworthy exceptions are the Shaw – Little Shaw deltaic fan which features a much broader riparian unit that includes two small tributaries, along with several sidechannels and wetlands and the Hall Creek fan, another broad lowland riparian unit.

Human settlement in the OMU is minimal and is largely limited to seasonal residences clustered from just west of the Cottonwood Fan to just east of the Wardroper Fan. There are some year round residents in the Pine Point/ Roberts Road/Cowan Bay area and there has been some discussion of limited residential use of the Cottonwood Fan which is the only landscape feature in the OMU that has significant human settlement capability.

Land use is dominated by forestry. Most of the OMU was logged between the 1920's and 1950's although there are still scattered blocks of old growth at upper elevations. Second growth logging has been underway since the mid – 1980's.

LIMITING FACTORS

Primary production limits are access, low summer flows and high stream gradients.

PRODUCTION OPTIONS

There are 25 production options in the 11 anadromous trout and salmon streams in the OMU; they are outlined and prioritized in Table 1.

Table 1: Lake North OMU Production Options

| No. | Page | Location | Activity | Priority |
|-----|------|------------------|--|----------|
| 1 | 1 | Cottonwood Creek | Barrier improvements | 2 |
| 2 | 1 | | Coho colonization | 2 |
| 3 | 1 | | Small stream incubators in groundwater trib. | 1 |
| 4 | 4 | Pine Point One | Fry salvage | 1 |
| 5 | 4 | | Spawning platforms | 2 |
| 6 | 5 | Cowan Brook | Spawning platforms | 1 |
| 7 | 5 | | Small stream incubators | 1 |
| 8 | 6 | Wardroper Creek | Fry salvage | 3 |

| | | | | |
|-------|----|-------------------|---|---|
| 9 | 8 | McKay Creek | Barrier improvement | 3 |
| 10-12 | 8 | McKay Cr. (cont.) | Coho, chinook or steelhead colonization | 3 |
| 13 | 11 | Shaw Creek | Barrier improvement | 1 |
| 14-16 | 11 | | Juvenile stocking, colonization | 2 |
| 17-19 | 11 | | Sidechannel development | 1 |
| 20 | 11 | | Fry salvage | 1 |
| 21,22 | 13 | West Shaw | Juvenile colonization | 2 |
| 23 | 15 | East Shaw | Coho colonization | 4 |
| 24,25 | 17 | Little Shaw | Fry salvage/coho colonization | 2 |
| 26 | 19 | Hall Creek | Fry salvage | 1 |
| | | | | |
| | | | | |
| | | | | |

Stream Code: 9202577788

Stream Name: Cottonwood Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

- A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake from the north 3 km west of Youbou. Drains the southern end of the Vancouver Island ranges - three alpine summits – meltwater is a runoff factor especially between May and July. The basin is steep and narrow.

Air Photos BC 82007 80-81, 106-107
Topographic Map 92 C/16, 92C.089. 099
Salmonids Co 2,750
St 2,750
Rb 7,000
DV 7,000
Obstructions Two 2 m falls at 2,750, two 1 m falls at 4,750.
Max. Temp. (C) (8/14/85) R1 16, R2 13, R3 12.5
Min. Disch. (m³) (8/14/85) R1 .40, R2 .40, R3 at 1,500 m .30, R3 above Lomas 0.112, .2276 8/1/97

COTTONWOOD CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 14.0 | 8.0 | 1360 | 2.0 | FC | M | 1000 | 8000 |
| Reach 2 | 9.0 | 8.0 | 1234 | 3.0 | ENT | N | 1750 | 14000 |
| Reach 3 | 12.0 | 8.0 | 127R | 3.5 | CON | N | 4250 | 34000 |
| Reach 4 | 10.0 | 5.0 | 1360 | 5.5 | CON | N | 2500 | 12500 |
| Reach 5 | - | - | - | 30.0 | CON | N | 1000 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Cottonwood Creek supports modest populations of coho and steelhead. There is a possibility of some rainbow and cutthroat spawners from Cowichan Lake in the lower 2,000 m. Kokanee spawning has been reported along the edge of the Cowichan Lake deltaic fan. Resident rainbow and Dolly Varden trout are present for 4,000 m. The resident rainbow population is supporting a light fishery, although no fish larger than 25 cm have been observed. In addition, there is a fall movement of Cowichan Lake rainbows into the creek along with a few Dolly Varden and a very occasional eastern brook trout up to 40 cm.

Production is limited by high fall - winter discharge, limited access for anadromous fish and high gradient..

C) PRODUCTION OPPORTUNITIES

1. **BARRIER REMOVAL:** Removal of falls at 2,750 m and 4,750 m could provide 34,000 m² of additional steelhead - coho habitat (Production Option #1)

2. **COHO COLONIZATION:** Stocking coho fry above these barriers could yield 1,360 to 13,600 smolts; fry required 17,000 (Production Option #2).

Steelhead, cutthroat, Dolly Varden and chinook fry could also be stocked in this stream. Smolt yield potentials include: steelhead 544 smolts from 6800 fry and chinook 6120 smolts from 17,000 fry. Cottonwood Creek could support early run chinooks. Along with Shaw and McKay Creeks, it does not usually have a dry area on it's delta in late summer or fall .

3. **SMALL STREAM INCUBATOR:** A groundwater tributary at 3750 m (Spring Bar Creek) could support incubators. This tributary is above the first falls and could supply a 2000 m section (16,000 m²) with fry (Production Option #3).

D) LAND USE FACTORS

Forestry

Most accessible old growth has been cut. Second growth logging (mostly hardwoods on moist slopes below the 500 m contour) is well under way. There is a zone of steep, moist soils between 3,500 and 6,500 m. that will require special treatment to avoid impact to fisheries.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Because the majority of basin slopes are very steep with considerable area of high soil moisture as evidenced by numerous springs and salmonberry – Devil's Club on 60 – 80% slopes and there is an abundance of steep gullies on the sidehills, impact potential from physical disturbance - especially road building and ground yarding - is very high. TimberWest is beginning to use helicopters more frequently on high slope settings.

Riparian flats are uncommon and when they occur are typically very narrow and moist. They are also usually at the base of very steep slopes, They should not be disturbed.

Fishery Officer Narrative

Micellaneous Counts

| Date | Species | No. | Area |
|----------|---------|-----|--------------------------|
| 1/12/79 | Co | 368 | Mouth to North Shore Rd. |
| 11/23/80 | Co | 23 | Above old camp |

Stream Code: 9202577788254

Stream Name: Widow Creek (Tributary of Cottonwood)

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cottonwood Creek from the east approximately 2.8 km upstream from the mouth. The drainage area is a steep, narrow basin.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 106-107 |
| <u>Topographic Map</u> | 92 C/16, 92C.089, 92 C.090, 92C.099, 92C.100, |
| <u>Salmonids</u> | Rb to 3,500 m. DV to 3,500 m. |
| <u>Obstructions</u> | Chute - 1 m over 3 - at 50 m, 5 m falls over 15 at 3,500 m, 2 m falls at 4,100 m and 5 m falls at 4,700 m. |
| <u>Max. Temp. (C)</u> | 10.5 (8/28/85) |
| <u>Min. Disch. (m³)</u> | 0.116 (8/28/85) |

WIDOW CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 9.0 | 5.0 | 127R | 3.0 | CON | N | 1200 | 6000 |
| Reach 2 | 6.0 | 3.0 | 127R | 9.0 | CON | N | 2300 | 6900 |
| Reach 3 | 6.0 | 3.0 | 127R | 10.0 | CON | N | 3000 | 9000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Resident rainbow and Dolly Varden are present for 3,500 m. There is the possibility of steelhead in the lower 1,200 m since they occasionally ascend Cottonwood Falls. The Dolly Varden Char may be the progeny of spawners from Cowichan Lake.

Gradient and high fall - winter discharge, limit production.

C) PRODUCTION OPPORTUNITIES

Although there are 6,000 m² of habitat with 3 percent gradient in the lower 1,200 m which could be colonized, this is not recommended.

D) LAND USE FACTORS

Forestry

Little accessible old growth remains; the basin is covered by a mixture of slash and early to mid stages of second growth. A severe fire occurred on the north side of the basin between 1,200 and 1,400 m (stream length); present regeneration is sparse.

Risk Potential

Low.

E) PROTECTION NEEDS

The steep and narrow nature of the basin makes it susceptible to slope damage from roads and yarding. The Widow Creek Road that linked Widow Creek with Coates Creek (Upper Chemainus tributary) has been washed out for several years. Heli logging is the most suitable harvesting method for most of the basin.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Pine Point One

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A small, seasonal stream with a primary flow source of runoff but somewhat buffered by near surface winter - spring seepage. The upper basin is steep and narrow. Enters Cowichan Lake in the extreme eastern portion of BCFS Pine Point Recreational Site. A similar stream known as Pine Point Two enters the lake some 250 m to the west in the western portion of the campsite. Very occasional coho spawners utilize this creek.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 105 -106 |
| <u>Topographic Map</u> | 92C/16, 92C.089 |
| <u>Salmonids</u> | Co |
| <u>Obstructions</u> | Rapidly increasing gradient above North Shore Road (530 m). |
| <u>Max. Temp. (C)</u> | N/A. Dries early. |
| <u>Min. Disch. (m³)</u> | 0 |

PINE POINT ONE

| | Channel width (m) | Wetted width (m) | Substrate | Slope % | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|---------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 1.0 | 0.0 | 3700 | 1.5 | CON | N | 95 | 0 |
| Reach 2 | 1.0 | 0.0 | 4600 | 2.0 | CON | N | 60 | 0 |
| Reach 3 | 3.0 | 0.0 | 6400 | 0.5 | OC | H | 100 | 0 |
| Reach 4 | 1.0 | 0.0 | 2710 | 0.5 | CON | N | 250 | 0 |
| Reach 5 | 0.5 | 0.0 | 6400 | 10.0 | CON | N | 500 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawn in reaches one and two. Production is limited by short accessible length, marginal gravel quality and sediment input from North Shore Road.

C) ENHANCEMENT OPPORTUNITIES

1. **FRY SALVAGE:** Fry salvage is required (Production Option # 4). The creek dries early but a few pools persist until late summer. Fish should be salvaged early and released in Cowichan Lake. If fish are caught after the lake warms, they can be released into the lake at Springs Beach.

2. **SUBSTRATE IMPROVEMENT:** At least three spawning platforms could be constructed in Reach 1 (Production Option #5).

D) LAND USE FACTORS

Forestry

Reaches 1 through 3 are in Pine Point BCFS Recreation Area. The upper basin is advanced second growth. Some second growth logging has already occurred (mid - eighties). Part of the creek runs down the logging road for some 50 m.

Risk Potential

Low

E) PROTECTION NEEDS

The stream has a riparian component that must be protected along with the steep adjacent slopes in the reaches above North Shore Road. **NOTE: Pine Point 1 flows in the North Shore Road ditch for 100 m.**

Fishery Officer Narrative

DFO does not monitor this creek.

Stream Code: N/A

Stream Name: Cowan Brook

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) Biophysical Description: A very short groundwater stream tributary to Cowichan Lake. Cowan Brook receives virtually no overland runoff in its lower reach. Flow originates high on the mountain then goes underground for some 300 m before reappearing in reach 1.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 106-107 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | CO Spawning. Ct have been seen in the creek with coho but it is not known if they were spawners. |
| <u>Max. Temp. (C)</u> | 11 |
| <u>Min. Disch. (m³)</u> | .02 |

COWAN BROOK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 1 | 1 | 1900 | 2.0 | CON | N | 45 | 45 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn in Cowan Brook. As many as 12 have been reported. Cutthroats also enter the stream but they may not be spawners. They follow the coho.

Production is limited by short length and lack of spawning sites. The stream is totally composed of clean gravel of ideal size but, because of gradient and the narrow channel, there are only a few "flats" suitable for spawning. Summer rearing is also limited but, as is the case with most short, groundwater tributaries of Cowichan Lake, most fry rear in the lake.

C) PRODUCTION OPPORTUNITIES

1. **SUBSTRATE IMPROVEMENT:** Creation of spawning platforms would aid recruitment (**Production Option #6**).
2. **SMALL STREAM INCUBATORS:** The stream is ideal for incubation boxes or a small hatchery (**Production Options #7**). There is room for two (2,000 egg) incubators which would yield 6400 fry at 80% egg to fry survival.

D) LAND USE FACTORS

Cowan Brook is located in a small, long established rural subdivision. Some residents draw their water from it and all value it highly.

Risk Potential

Low.

E) PROTECTION NEEDS

The stream and its riparian zone must remain undisturbed. Upper component of Cowan Brook supplies Roberts Road residents with water.

Fishery Officer Narrative

Stream Code: 9202577868000

Stream Name: Wardroper Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north, approximately 7 km west of Youbou. The drainage basin is short and steep.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 79-80 |
| <u>Topographic Map</u> | 92 C/16, 92C.099 |
| <u>Salmonids</u> | Co to 1,000 m. Ct from 1,000 m to 1,500 m. |
| <u>Obstructions</u> | Rapidly increasing gradient and periodic log jams above 1,500 m. |
| <u>Max. Temp. (C)</u> | 13 (8/7/85) |
| <u>Min. Disch. (m³)</u> | <0.03 (6/22/76) The lower 100 m. dries early in the summer. |

WARDROPER CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 10.0 | 0.0 | 1360 | 4.0 | CON | N | 1000 | 0 |
| Reach 2 | 9.5 | 2.0 | 118R | 8.0 | CON | N | 500 | 1000 |
| Reach 3 | 9.0 | 2.0 | 118R | 14.0 | CON | N | 3500 | 7000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Very limited coho spawning occurs in the lower 1,000 m. Egg survival is low due to bedload movement in freshets. Fry migrate to Cowichan Lake before the area dries.

Resident cutthroat are present between 1,000 and 1,500 m. Resident Dolly Varden are also suspected to be present and there is the possibility that some Dolly Varden from Cowichan Lake use this stream for spawning.

Production is limited by slope and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. **FRY SLAVAGE:** Fry salvage is required IN Reach 1 which dries surprisingly early in dry springs. Yield is minimal because Wardroper Creek is a very marginal coho stream and cutthroats seldom emerge from Reach 1 before it dries if, in fact any spawn there. (**Production Option #8**).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Wardroper Creek drains a steep and narrow basin. In some areas, there are moist stream adjacent slopes well over the 30% limit considered safe for road building and ground yarding. These areas are included in the FSZ.

Stream Code: 920 2478 867

Stream Name: McKay Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: McKay Creek enters Cowichan Lake from the north about 8.5 km west of Youbou. The drainage basin is steep and narrow. Alpine summits are present in the upper basin and meltwater is a runoff factor.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 79-80, 107-108 |
| <u>Topographic Map</u> | 92 C/16, 92C.099 |
| <u>Salmonids</u> | Co to 1,000 m. St to 2,500 m. Rb to 5,000 m. DV to 1,000 to possibly 5,000 m. |
| <u>Obstructions</u> | A 3 m falls at 1000 m. A 5 m falls at 2,500 m. A 2.5 m falls at 5,000 m. A 5 m falls at 5,030 m. A 10 m falls at 6,500 m. |
| <u>Max. Temp. (C)</u> | 14 (8/14/85) |
| <u>Min. Disch. (m³)</u> | 0.18 - 250 m above mouth, east fork 0.06, main stem 50 m above east fork - 0.12 (8/19/85). |

McKAY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 150.0 | 0.0 | 2440 | 0.5 | UC | H | 50 | 0 |
| Reach 2 | 12.0 | 5.0 | 136R | 2.0 | CON | N | 950 | 4750 |
| Reach 3 | 12.0 | 5.0 | 1252 | 3.5 | CON | N | 4030 | 20150 |
| Reach 4 | 13.0 | 4.0 | 1360 | 2.5 | OC | L | 1470 | 5880 |
| Reach 5 | 9.0 | 4.0 | 136R | 5.0 | CON | N | 2245 | 8980 |
| Reach 6 | 6.0 | 3.0 | - | 20.0 | CON | N | 1255 | 3765 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho utilize the lower kilometre; steelhead are present for 2.5 kilometres. Resident rainbow occur in the first 5 kilometres.

Production is limited by short accessible length and high fall - winter discharge and relatively steep grades.

C) PRODUCTION OPPORTUNITIES

1. **BARRIER IMPROVEMENT:** The falls at 1 and 2.5 kilometres could be improved for fish passage (Production Option #9). Both feature wedged boulders as major obstructions. However, probability of recurrence is high and access is difficult.

2. **ABOVE BARRIER COLONIZATION:** Stocking coho or steelhead fry in the upper 8,000 m is a more appropriate strategy (Production Options #10 and #11). Smolt yield potential:1,400 - 14,000: 17,500 fry required for coho. McKay Creek is also a chinook colonization candidate. Chinook smolt yield from 17,500 fry is 6300 smolts (Production Option #12).

D) LAND USE FACTORS

Forestry

Old growth logging is still in progress but in areas distant from the stream. Second growth logging began in 1996 in the lower valley and is located closer to the creek. There are areas of steep, moist soils (salmonberry - swordfern ecotype) adjacent to the stream between 1 and 5 km. This zone is now advanced second growth.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Because of the basin's structure, much of its slopes are susceptible to accelerated erosion from roads and yarding impacts. A number of rather large, very steep tributaries are present and these are especially vulnerable to road and yarding impacts. The mainstem FSZ accounts for steepness as well as high soil moisture in riparian zones some of which are not contiguous to the stream.

Fishery Officer Narrative

Stream Code: 920 2478 943

Stream Name: Shaw Creek (Mainstem & Middle Fork) including Shaw Lake

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Shaw Creek enters Cowichan Lake from the north 15 km west of Youbou. This stream which has three main sub-basins: West, Middle and East Forks. It is the largest tributary to Cowichan Lake. It's basin is steep and only very lightly buffered. It drains extensive alpine uplands and meltwater is an important runoff component.

Air Photos BC 82007 78-79

Topographic Map 92 C/16, 92 F/1, 92 C. 098, 92C.099, 92F.008.

Salmonids (CH) to 3,000 m.

Co to 3,000 m.

St to 6,500 m.

Rb to 6,500 m.

Ct to 3,000 m.

DV to 6,500 m

(Cm) to 1900 m

Obstructions A 2.5 m falls at 3,000 m.

A 3 m over 10 cascade at 3,300 m (passable via a sidechannel on the west side)

A series of chutes, cascades and small falls from in a narrow gorge from 4200 to 4800 m (R5).

A 3 m falls at 6,500 m.

A 1 m falls at 8,000 m. 1 m falls at 8,050 m. and rapidly increasing gradient at 13,500.

Max. Temp. (C) 1,800 m below North Shore Road: 15 (8/14/85). 1,700 m above falls: 11 (8/13/85). 100 m below East Fork: 14 (8/14/85).

Min. Disch. (m³) 1,800 m below North Shore Road: 0.54 (8/14/85).

1,700 m above falls: 0.50 (8/14/85)

150 m below East Fork: 0.22 (8/14/85)

1,000 m above lake: 0.42 (10/23/86)

SHAW CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 50.0 | 0 | 1720 | 0.2 | FC | M | 300 | 0 |
| Reach 2 | 30.0 | 15.0 | 1540 | 1.5 | FC | M | 1600 | 24000 |
| Reach 3 | 20.0 | 15.0 | 1351 | 1.8 | CON | N | 1000 | 15000 |
| Reach 4 | 25.0 | 15.0 | 1360 | 1.5 | FC | L | 600 | 9000 |
| Reach 5 | 12.0 | 10.0 | 1243 | 2.5 | ENT | N | 1400 | 12600 |
| Reach 6 | 25.0 | 15.0 | 1450 | 1.8 | FC | M | 800 | 12000 |

MIDDLE FORK

| | | | | | | | | |
|---------|------|------|------|------|-----|---|------|-------|
| Reach 1 | 25.0 | 14.0 | 1540 | 1.5 | FC | L | 300 | 4200 |
| Reach 2 | 20.0 | 15.0 | 1360 | 2.0 | CON | N | 300 | 4500 |
| Reach 3 | 12.0 | 12.0 | 1252 | 3.5 | CON | N | 200 | 2400 |
| Reach 4 | 20.0 | 14.0 | 136R | 3.0 | CON | N | 1400 | 19600 |
| Reach 4 | 12.0 | 10.0 | 136R | 3.0 | CON | N | 5200 | 52000 |
| Reach 6 | 8.0 | 8.0 | 127R | 10.0 | CON | N | 1200 | 9600 |
| Reach 7 | 4.0 | 4.0 | 127R | 15.0 | CON | N | 2000 | 8000 |
| Reach 8 | - | - | - | 56.0 | CON | N | 500 | |

SHAW LAKE FORK OF MIDDLE FORK

| | | | | | | | | |
|---------|-----|-----|------|------|-----|---|-----|-----|
| Reach 1 | 5.0 | 3.0 | 1252 | 40.0 | CON | N | 250 | 750 |
| Reach 2 | 4.0 | 3.0 | 136R | 2.5 | CON | N | 170 | 510 |

Reach 3 4.0 4.0 1450 0.5 FC L 30 120

SHAW LAKE

| Area (ha) | Elevation (m) | Approx. Volume(m ³) | Max. Depth (m) | Total Dissolved Solids (TDS) (mg/L) |
|-----------|---------------|---------------------------------|----------------|-------------------------------------|
| 10 | 821 | | | |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 3,000 m. Steelhead pass the first falls in some years and migrate another 4,000 m. Cowichan Lake rainbow and cutthroat trout and Dolly Varden Char also utilize the lower 3,000 m for spawning. A few rainbows may utilize to the 6,500 m point. Occasional chinooks and chums are reported. It is surmised that Shaw Creek was once an important spawning stream for the now nearly extinct spring – early summer chinook run.

Coho also utilize two tributaries that enter Reach 2 from the west. The first stream is known as Hidden Creek. Its potentially accessible for 340 m but a .65 m vertical drop culvert is present under the logging road at the confluence of Shaw and Hidden. It is probable that coho can make this leap and pass the culvert but beavers often plug its upper end and the fish cannot get through. Resident rainbows are present and Dolly Varden Char are suspected present for the first 6,500 m. The next tributary is a combination stream/sidechannel that enters Shaw just upstream – it is known as Crabapple Creek. Accessible length is approximately 600 m. It is also wetted by a 160 m long floodcahnnel from Shaw Creek when Shaw flows are greater than 10 CMS.

A sidechannel complex known as the Elk Garden Sidechannels is located adjacent to Reach 2. The outer sidechannel is 270 m long and has limited improvement potential because it is very exposed to the mainstem. The inner sidechannel is 320 m long and is more protected from floods. Some improvement in flow duration is likely possible by excavating the lower 200 m. The outer channel is strictly a flood channel while the inner channel is wetted by flooding and the winter water table;

Production is limited by access, high fall - winter flow fluctuation and cool summer temperatures.

Shaw Lake rainbows spawn in several gravel patches in Reaches 2 and 3 of the outlet (Trib. to Upper Middle Fork) immediately below the lake.

C) PRODUCTION OPPORTUNITIES

1. BARRIER IMPROVEMENT: Falls at 3,000 and 5,000 m could be improved (Production Option #13). Cost may be high with some probability of recurrence due to boulder jamming. Removal of these barriers would open up 26 percent of above barrier stream habitat. Fry stocking may be a more appropriate alternative .

2. JUVENILE STOCKING/COLONIZATION: Chinook fry could be stocked in the lower four reaches of the mainstem and in Reach #1 of the Middle Fork (Production Option #14). Coho are more appropriate for 3,000 - 7,000 m (Production Option #15) and also for Shaw Lake although there is presently a population of rainbow stocked in Shaw Lake in 1960. Spawning platform construction in Reaches 2 and 3 of Shaw Lake Fork could improve rainbow fry recruitment to the lake. However, the lake's carrying capacity is low and the present level of recruitment appears to be sufficient at the low level of angling pressure. Fish as large as 40 cm are reported.

Steelhead colonization is possible for the entire above barrier portion of the system (Production Option # 16).

| | | |
|------------------------|-----------|--|
| Smolt yield potential: | Coho | 1,400 to 14,000 smolts from 17,500 fry |
| | Chinook | 28,980 smolts from 80,500 fry |
| | Steelhead | 700 smolts from 17,500 fry |

3. SIDECHANNEL DEVELOPMENT: Development of the lower portion of Wren Creek could provide considerable benefit, especially to coho (Production Option # 17). This channel carries winter flow and is utilized by coho spawners but dries early in most years which places eggs and fry at risk. The channel is largely fed by the winter water – spring water table. Present usable length adjacent to the road is 160 m. This could possibly be extended with excavation. Excavation, particularly an infiltration pool, might provide permanent wetting . A culvert could also be installed under the road to facilitate migration above the road (upper 370 m of creek).

The CSP culvert at the confluence of Hidden and Shaw Creeks should be replaced by a more passable structure such as a cedar log box culvert (**Production Option # 18**).

Excavation of the lower 200 m of Inner Elk Garden Sidechannel could prolong flow (Production Option # 19).

4. **FRY SALVAGE:** Fry salvage is required in Wren Creek, the Elk Garden Sidechannels and, on occasion, Reach 1 of the mainstem (Production Option # 20).

D) LAND USE FACTORS

Forestry

The majority of the basin is advanced second growth but extensive old growth remains above the 700 m contour. Approximately 200 HA of slash and early regeneration above 700 m (1987).

Risk Potential

Low.

Fishery Officer Narrative

Notes

Coho Escapement

1990 1626
1991 1161
1992 591
1993 573
1994 1588
1995 701
1996 365
1997 89
1998 302
1999

Older Records

| Date | Species | Number | Location |
|----------|----------|--------------|--|
| 11/3/78 | Co Ck | 300-500 1 | Mouth to falls |
| 12/1/979 | Co | 781 | |
| 12/6/84 | Co | 63 | |
| 12/10/85 | Co | 720 | Between Hidden Creek and North Shore Rd. |

E) PROTECTION NEEDS

There are substantial floodplain – riparian landscapes adjacent to Reaches 1 and 2, virtually the entire valley floor is taken up with lands subject to flooding and /or moist riparian landscape units. The FSZ is broad here. It narrows in upper Reach 2 and reach 3 as upland and canyon lands are present. The FSZ widens somewhat in Reach 4 as some riparian landscape units are present. Reach 5 is largely canyon but there are some moist sidehill areas on the west slope where a number of small seasonal creeks and perched wetlands and riparian units are present. Reach 6 is less contained with some significant riparian zones with a number of sidechannels.

The Middle Fork features steep and often moist adjacent slopes and a number of tributaries subject to torrenting. Very careful road construction and yarding techniques will be required. Heli logging should be favoured over mid-slope roads.

Stream Code: 920 2478 943 361

Stream Name: West Shaw

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Enters Shaw Creek 6 km above Cowichan Lake. Valley floor is relatively broad for 5 km; very little floodplain however. It does feature some open meadows that are sometimes partly riparian. These are important elk habitat. Drains alpine sub-basins on Heather Mountain via Cable and Snowhole Creeks and the upper mainstem. Spring – early summer meltwater is an important runoff factor.

Air Photos BC 82007 78-79
Topographic Map 92 C/16 F/1, 92 C.98, 92C.99, 92F.008
Salmonids Rb to 8800 m.
Ct to 8800 m.

Obstructions The Spout: series of 3 small falls and cascades at 5500 m: 2R3, 2R3 and 1R3. Technically this is not an obstruction because the population is non-migrating. However, there is a chance of steelhead utilization. Its not likely this constriction would be barrier to them because the fish would have surmounted larger falls to get this far. 8R20 @ 7300 m.

Max. Temp. (C) 11 (8/14/85) 1,500 m.
Min. Disch. (m³) 0.28 (8/14/85) 1,500 m.
0.05 (8/14/85) 6,200 m.

WEST SHAW

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 16.0 | 8.0 | 136R | 1.5 | FC | L | 5000 | 40000 |
| Reach 2 | 10.0 | 5.0 | 1261 | 5.0 | CON | N | 700 | 3500 |
| Reach 3 | 12.0 | 5.0 | 1360 | 3.5 | CON | N | 1200 | 6000 |
| Reach 4 | 8.0 | 5.0 | 1261 | 8.0 | CON | N | 400 | 2000 |
| Reach 5 | 6.0 | 4.0 | 136R | 5.0 | CON | N | 1500 | 6000 |
| Reach 6 | 3 | 1.0 | 1261 | 50.0 | CON | N | 1000 | 1000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Rainbow and cutthroat trout for 8800 m. maximum size: 25 cm.

Production limited by low (groundwater)summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. **JUVENILE COLONIZATION:** Coho colonization (**Production Option #21**) smolt yield potential:4,000 - 24,000/50,000 fry required. Chinook and steelhead are also colonization candidates with the potential of 18,000 chinook smolts from stocking 50,000 fry (**Production Option #22**) and 960 steelhead smolts from stocking 12,000 fry (**Production Option #22**). Colonization would not be required if falls on the mainstem were made passable.

D) LAND USE FACTORS

Forestry

Most old growth has been logged. The basin is largely in advanced second growth. One block of recent logging in the upper basin (450 HA, 1978) and above the 700 m contour on the ridge separating West and Middle Shaw.

Risk Potential Low.

E) PROTECTION NEEDS

West Shaw's Valley is relatively broad in most areas. Steep adjacent slopes are uncommon until Reach 2. However, some of the tributaries are more subject to slope impacts; particularly Cable and Snowhole Creeks. It is hoped that heli logging will be employed in these and other areas susceptible to slope impacts from roads and yarding. There are several areas of steep, moist slopes adjacent to the mainstem in Reaches 2 – 5 especially middle Reach 3 which is also important elk habitat and features an interspersed of old growth timber and deciduous groves and semi-openings.

Stream Code: N/A

Stream Name: East Shaw

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: East Shaw Creek enters Middle Shaw 2 km above its confluence with West Shaw. The drainage basin is steep and narrow for 4,000 m then broadens at Gillespie Lake.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 78-79 |
| <u>Topographic Map</u> | 92 C/16, 92C.099 |
| <u>Salmonids</u> | Rb to 3,000 m and in Gillespie Lake |
| <u>Obstructions</u> | 10 m over 15 falls at 3,000 m, high gradient and numerous falls above. |
| <u>Max. Temp. (C)</u> | 15 (8/13/85) |
| <u>Min. Disch. (m³)</u> | 0.033 (8/13/85) 50 m above Middle Fork. |

EAST SHAW

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 11.0 | 5.0 | 127R | 3.5 | CON | N | 3000 | 5000 |
| Reach 2 | 10.0 | 4.0 | 127R | 10.0 | CON | N | 800 | 3200 |
| Reach 3 | - | - | - | 20.0 | CON | N | 600 | - |
| Reach 4 | - | - | - | 22.0 | CON | N | 900 | - |

Gillespie Lake

| Area (ha) | Elevation (m) | Approx. Volume(m ³) | Max. Depth (m) | Total Dissolved Solids (TDS) (mg/L) |
|-----------|---------------|---------------------------------|----------------|-------------------------------------|
|-----------|---------------|---------------------------------|----------------|-------------------------------------|

| | | | | |
|----|-----|--|--|--|
| 10 | 820 | | | |
|----|-----|--|--|--|

B) FISH UTILIZATION AND LIMITING FACTORS

Resident rainbows are present in the lower 3,000 m. Gillespie Lake is periodically stocked with rainbow trout; there is minor natural recruitment from outlet gravel patches. In moist summers, an inlet also provides some recruitment.

Stream production is limited by high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Reach 1 coho colonization (Production Option # 23) smolt potential:400 - 4,000/5,000 fry required. Gillespie Lake coho colonization smolt yield potential: 3,000 smolts from 15,000 fry required. Gillespie Lake sustains a small sport fishery. Rainbow trout were introduced in the 1930's by Ken Gillespie of Lake Cowichan. The Fish and Wildlife Branch stocked the lake in the 1960's and 70's. The present population maintains itself at a low level from outlet spawning and possibly some inlet spawning. Some very large rainbows were reported caught in Gillespie Lake prior to 1970. Stocking may have reduced the possibility of producing big fish.

D) LAND USE FACTORS

Forestry

Most of the basin has been logged in the last twenty years. Large areas of slash and early regeneration above the 400 m contour. A slope failure is present at 500 m (stream length). A large area of old growth is located on very steep slopes (65%) for 1,500 m adjacent to Reach 1.

Careful road construction and logging will be required here.

Risk Potential

Moderate.

Notes

E) PROTECTION NEEDS

Steep country borders much of the stream and adjacent slopes are often greater than 80%. Very careful road building and yarding will be required and significant leave zones may be required in some areas. Heli logging should be widely employed.

Stream Code: N/A

Stream Name: Little Shaw Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This tributary enters Cowichan Lake from the north 500 m east of the mouth of Shaw Creek. The drainage basin is a narrow and precipitous.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 78-79 |
| <u>Topographic Map</u> | 92 C/16, 92 C.098 |
| <u>Salmonids</u> | Co to 900 m. Rb to 900 m. |
| <u>Obstruction</u> | A series of falls beginning at 900 m. 2 m vertical drops. |
| <u>Max. Temp. (C)</u> | 9 (9/22/85) 100 m above North Shore Road. |
| <u>Min. Disch. (m³)</u> | 0 - 0.046 |

LITTLE SHAW CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 12.0 | 0.0 | 1450 | 0.5 | OC | L | 70 | 0 |
| Reach 2 | 12.0 | 3.0 | 1360 | 7.0 | CON | N | 830 | 2100 |
| Reach 3 | 10.0 | 4.0 | 1162 | 16.0 | CON | N | 1700 | 6800 |
| Reach 4 | 6.0 | 2.0 | 1360 | 2.5 | CON | N | 1000 | 2000 |
| Reach 5 | - | - | - | 50.0 | CON | N | 400 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Little Shaw Creek supports small numbers of coho and resident rainbow. A few Cowichan Lake rainbow and cutthroat trout may spawn in the lower 70 m. Most coho fry migrate to Cowichan Lake prior to drying of the lower 200 m by mid-July.

Production is limited by accessibility, low summer flow and violent fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. FRY SALVAGE/COHO COLONIZATION Above barrier coho colonization (Reach 4) smolt yield potential:80 - 100/1,000 fry required (Production Option # 24, 25). Fry salvage usually required in the lower 70 m.

D) LAND USE FACTORS

Forestry

Most of the basin above the 500 m contour was logged in the 1970's and is early stages of regeneration. Extensive cross-stream yarding caused bank damage and in-stream channel debris. A huge 5 m high log jam formed 50 to 150 m above North Shore Road. It was cleared in 1983 but some remnants still remain. Pacific Logging were charged and successfully prosecuted by the Fish and Wildlife Branch in 1973.

Risk Potential

Moderate.

E) PROTECTION NEEDS:

The majority of the basin is steep and vulnerable to slope and subsequent stream damage from road and yarding impacts. Roads will need to be carefully located and deactivated as soon as possible if in fact roads are the chosen method of access. Heli harvesting will be required in many locations in the Upper Basin.

Reach 1 is on a deltaic fan .

Stream Code:

Stream Name: Hall Creek (Lakehead North)

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: One of several small streams tributary to the west end of Cowichan Lake. In the lower 200 m of the stream the basin is relatively broad with low relief. Above this point, it narrows and steepens.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 78-79 |
| <u>Topographic Map</u> | 92 C/16, 92C.098 |
| <u>Salmonids</u> | Co to 1,500 m. |
| <u>Obstructions</u> | 1.8 m over 3 cascade at 1,300 m. An old cedar log culvert under the Nitinat Camp Road at 1,100 m is in danger of collapsing (1985). This culvert was replaced in 1990. |
| <u>Max. Temp. (C)</u> | 13 (7/30/86) |
| <u>Min. Disch. (m³)</u> | Dries in summer for 260 m. 0.04 above dry zone (10/22/86) 0.029 @ 460 m (9/13/97) |

LAKEHEAD NORTH (HALL) CREEK

| | <u>Channel</u> | | | | <u>Side</u> | | <u>Length</u> (m) | <u>Wetted</u> Area (m ²) |
|---------|------------------|------------------|------------------|---------------|--------------------|----------------|----------------------|---|
| | <u>width (m)</u> | <u>width (m)</u> | <u>Substrate</u> | <u>Slope%</u> | <u>Confinement</u> | <u>Channel</u> | | |
| Reach 1 | 3.0 | 0.0 | 3700 | 0.5 | FC | L | 260 | 0 |
| Reach 2 | 2.0 | 2.0 | 136R | 1.5 | CON | N | 1040 | 2080 |
| Reach 3 | - | 0.0 | - | 8.0 | CON | N | 500 | - |
| Reach 4 | - | 0.0 | - | 40.0 | CON | N | 700 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho and cutthroats including a few spawners from Cowichan Lake. Production is limited by low summer flow in the 1800 m² area of summer habitat. Mainly a spawning stream. Most fry rear in Cowichan Lake.

C) PRODUCTION OPPORTUNITIES

1. FRY SALVAGE: Reach 1 fry salvage is required most years (**Production Option # 26**). Reach 1 dries very early, often in April. A spawning platform was constructed in lower R1 in the summer of 1998.

D) LAND USE FACTORS

Forestry

Seventy percent of the basin is covered by advanced second growth. The remainder is slash and early regeneration.

Risk Potential

Low.

E) PROTECTION NEEDS

Reach 1 and lower Reach 2 are part of an extensive riparian area featuring some very large maples and very unstable stream channels and banks. The entire riparian zone is included in the FSZ. Progressing upstream, steep adjacent slopes are common and they are very moist in some areas. The stream splits into three forks just below Heather Mountain's Branch 1 Road and the stream becomes less subject to damage from adjacent activities because slope levels off somewhat until the ground becomes so steep that it prevents logging except for some small heli shows.

OPERATIONAL MANAGEMENT UNIT 11: LAKE SOUTH (SOUTH SHORE TRIBUTARIES – WEST)

OMU 11: Lake South (South Shore Tributaries – West
T. Burns and B.D. Tutty, 1999

OVERVIEW

Lake South OMU (South Shore Tributaries: West) extends from Lakehead (Junction) Creek on the west to Gordon Bay Creek on the east. For the most part, the OMU is mountainous upland with little human settlement. TimberWest's Caycuse Camp (once an active community and industrial site) and its immediate area (Gilgan Rd., Couch Farm) still holds a few families but that's the extent of human settlement in the OMU. Forestry is the primary land use.

Most of the streams are small and drain steep mountain basins with little riparian lowland. The Fisheries Sensitive Zones of these streams are almost entirely slope related. However, there are several significant exceptions. Lakehead (Junction) Creek mainstem is an overmature, low gradient stream surrounded by a substantial riparian landscape unit. Caycuse 1, 2 and 3 Creeks also have significant riparian landscapes in their lowland reaches. Caycuse 3 originates from an *upland* riparian landscape unit. The Nixon Creek Corridor is highly riparian in Reaches 1 and 2.

LIMITING FACTORS

Primary limiting factors are access, lack of quality spawning habitat in some areas, lack of high quality winter habitat and low summer flows. Precipitation is highest in this OMU but summer drought conditions still lower streamflows substantially and many streams are summer dry in their lower reaches.

PRODUCTION OPTIONS

A total of 23 production improvement opportunities are present in the Lake South OMU. They are outlined and prioritized in Table 1. More detail is provided in the streamfiles on pages 1- 37.

Table 1: Lake South OMU Production Options

| No. | Page | Location | Activity | Priority |
|-----|------|----------------|------------------------------|----------|
| 1 | 1 | Lakehead Creek | Substrate improvement | 1 |
| 2 | 1 | | Sediment control | 1 |
| 3 | 1 | | Instream incubators | 4 |
| 4 | 4 | Mossy Creek | Fry salvage | 2 |
| 5 | 6 | Nixon Creek | Coho colonization | 3 |
| 6 | 6 | | Chinook stocking | 2 |
| 7 | 6 | | Fry salvage | 1 |
| 8 | 6 | | Sidechannel development | 1 |
| 9 | 6 | | Reach 1 channel excavation | 2 |
| 10 | 7 | Toms Creek | Fry salvage | 1 |
| 11 | 8 | Nixon West | Coho colonization | 3 |
| 12 | 8 | | Barrier improvement (assess) | 1 |

ii

| | | | | |
|-------|----|--------------|--------------------------------|---|
| 13 | 10 | Nixon East | Coho colonization | 4 |
| 14 | 13 | Black Lagoon | Upwelling pool | 1 |
| 15 | 13 | | Fry salvage | 2 |
| 16 | 16 | Caycuse 3 | Restore original channel | 3 |
| 17 | 18 | Helpful | Fry salvage | 1 |
| 18 | 21 | Dusty | Fry salvage | 1 |
| 19 | 22 | Cutthroat | Fry salvage | 2 |
| 20 | 23 | Misery | Fry salvage | 1 |
| 21 | 25 | Miserable | Fry salvage | 2 |
| 22 | 26 | Grassy Bay | Adult/juvenile barrier removal | 2 |
| 23 | 27 | Gordon Bay | Headwater storage | 1 |
| 24,25 | 27 | | Fry salvage/Coho colonization | 1 |
| | | | | |
| | | | | |
| | | | | |

Stream Code: N/A

Stream Name: Lakehead (Junction) Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** This is a spring fed tributary to the west end of Cowichan Lake. The mainstem drainage basin is moist and of very low gradient. This small but productive stream has an overmature substrate and flows through a significant riparian landscape unit dominated by Salmonberry – Swordfern.

| | |
|------------------------------------|-------------------|
| <u>Air Photos</u> | BC 82007 77-78 |
| <u>Topographic Maps</u> | 92 C/16, 92 C.098 |
| <u>Salmonids</u> | Co and Ct |
| <u>Obstructions</u> | None |
| <u>Max. Temp. (C)</u> | 9 R1 (9/22/85) |
| <u>Min. Disch. (m³)</u> | 0.04 R1 (9/22/85) |

LAKEHEAD (Junction) CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 5.0 | 3.0 | 5500 | 0.5 | FC | M | 450 | 1350 |
| Reach 2 | 150.0 | 30.0 | 1000 | 0.1 | UC | H | 320 | 9600 |
| Reach 3 | 3.0 | 2.0 | 2800 | 1.0 | FC | M | 990 | 1980 |
| Reach 4 | 1.0 | 1.0 | 2800 | 2.0 | FC | L | 300 | 300 |

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho, resident cutthroat and Cowichan Lake cutthroat spawners.

Production is sub-optimum due to the high proportion of substrate fines, especially in Reach 1. This is an overmature stream with considerable beaver activity.

C) PRODUCTION OPPORTUNITIES

1. **SUBSTRATE IMPROVEMENT:** Periodic addition and maintenance of spawning gravel in Reach 1 (Production Option #1) would be beneficial as would spawning platforms. Two sites were constructed in 1989 and have been heavily utilized since. The sites are located 150 and 180 m upstream of the logging road junction. A total of 6.4 cubic metres of 3-8 cm washed gravel was added to the two sites. The stream is very stable. Nearby lower Nixon Creek (7.5 km) is a suitable gravel source.

2. **SEDIMENT CONTROL:** Some method of sediment control is required to prevent sediment runoff from the logging road (Nitinat Main) which is very close to the stream and two small tributaries (Production Option #2)

3. **INSTREAM INCUBATORS:** A strong spring is located near the headwaters of this stream (1760 m). It is very accessible and has good potential for a small hatchery or other incubation measures (Production Option #3).

D) LAND USE FACTORS

Forestry

The basin is in an advanced second growth stage; its lower portion is dominated by hardwoods. Conifers are unlikely to establish over much of it due to high soil moisture.

This stream receives considerable silt-laden runoff from the nearby logging road.

Risk Potential

Moderate

E) PROTECTION NEEDS

Nearly the entire valley floor is very moist riparian habitat, Logging would cause a good deal of disturbance, The riparian zone should remain intact.

Stream Code: N/A

Stream Name: Log Dump Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the southwest 2 km southeast of Lakehead Creek where it drains a steep, narrow basin.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 77-78 |
| <u>Topographic Map</u> | 92 C/16, 92C.088, 92C.098 |
| <u>Salmonids</u> | Co to 145 m. Ct to 1,500 m. |
| <u>Obstructions</u> | Falls at 175 m: 2 m over 4,1 m culvert at 190 m,(culvert replaced with a bridge, summer of 1997) series of small chutes and cascades at 250 - 310 m, 1 m dam at 315 m and rapidly increasing gradient at 1,500 m. |
| <u>Max. Temp. (C)</u> | 9 (9/22/85) |
| <u>Min. Disch. (m³)</u> | 0.013 (9/22/85) The lower 50 m. is dry. |

LOG DUMP CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 4.0 | 0 | 1360 | 1.5 | CON | N | 50 | 0 |
| Reach 2 | 4.0 | 1.5 | 136R | 1.5 | CON | N | 250 | 375 |
| Reach 3 | 4.0 | 1.0 | 1126 | 5.0 | ENT | N | 60 | 60 |
| Reach 4 | 50.0 | 1.0 | 2710 | 0.5 | UC | H | 100 | 100 |
| Reach 5 | 4.0 | 1.0 | 136R | 5.0 | CON | N | 1500 | 1500 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho fry occur in the lower 175 m. Resident cutthroats are present for 1,500 m. Some of these cutthroat could be spawners from Cowichan Lake.

Production is limited by access, low summer flow and high fall - winter discharge. The lower 50 meters is dry during the summer.

C) PRODUCTION OPPORTUNITIES

None. Coho fry could be stocked above the barriers but habitat is marginal and may not support them.

D) LAND USE FACTORS

Forestry

The basin is in advanced stages of second growth; almost ready for harvest.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The stream is contained in a small gully for most of Reaches 1 – 3. Reach 4 is a backfilled dam. Above this point ,is a small amount of riparian then a steep walled ravine for much of the creek's its length, Logging must be set back from the edge of the ravine and gully.

Stream Code: N/A

Stream Name: Mossy Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the southwest 1.5 km west of the mouth of Nixon Creek. The drainage basin is short and steep.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 108-109 |
| <u>Topographic Map</u> | 92 C/16, 92C.099 |
| <u>Salmonids</u> | Co to 150 m. Ct to 200 m. |
| <u>Obstructions</u> | Increasing gradient and log jams at 200 m. |
| <u>Max. Temp. (C)</u> | 11 (9/5/86) |
| <u>Min. Disch. (m³)</u> | 0 for 75 m then 0.0013 (9/5/86) |

MOSSY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 2.5 | 0 | 1360 | 2.5 | CON | N | 75 | 0 |
| Reach 2 | 2.5 | 2 | 1270 | 3.5 | CON | N | 125 | 250 |
| Reach 3 | - | - | - | 16.0 | CON | N | - | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are present for 150 m; cutthroat for 200.

Production is limited by summer drying (the lower 75 m) and high fall - winter discharge.

C) PRODUCTION OPTIONS

1. FRY SALVAGE: Coho fry salvage is required in the lower 75 m (Production Option #4). The few fish present should be transferred to Cowichan Lake.

D) LAND USE FACTORS

Forestry

The entire basin is covered by advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

The primary element of Mossy Creek's FSZ is steep adjacent slopes above R2.

Stream Code: 9202577919

Stream Name: Nixon Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Nixon Creek enters Cowichan Lake from the southwest, 2 km northwest of Caycuse Camp. This stream drains an area of relatively low mountains (<1,000 m). Relief is less than North Shore basins of Cowichan Lake tributaries. Even so, the Nixon basin is relatively steep and narrow and flow is essentially non-buffered. Nixon is subject to high fall – winter discharge and bedload movement.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 108-109 |
| <u>Topographic Map</u> | 92 C/16, 92C.088, 089, 099 |
| <u>Salmonids</u> | Ch reported in past years, a slight possibility remains that some may still be present. Chinook fry were captured by a fry salvage crew in R2 in May, 1998 Co to 11,000 m. St to 11,000 m. Ct to 11,000 m. DV to 11,000 m. Rb to 11,000 m. |
| <u>Obstructions</u> | 6 m. falls at 11,000 m. |
| <u>Max. Temp. (C)</u> | 11 (9/22/85 - 2,000 m above South Shore Road – R2) |
| <u>Min. Disch. (m³)</u> | 14.8 (8/7/98 R4) 0.225 (2,000 m. above South Shore Road - 9/22/85) 0.043 (200 m above falls - 9/26/85) 0.024 total of three tributaries between the falls and Raymond Creek -9/26/85. 0.088 total of two tributaries (Nixon E & W) between Raymond Creek and the point 2,000 m above South Shore Road on the main stem - 9/26/85. 0.12 Raymond Creek at Caycuse Main - 9/26/85 The lower 2,000 m. of Nixon Creek dries early and rapidly. |

NIXON CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 60.0 | 0.0 | 2440 | 0.5 | UC | L | 2000 | 0 |
| Reach 2 | 40.0 | 10.0 | 1450 | 1.5 | FC | H | 5000 | 50000 |
| Reach 3 | 16.0 | 8.0 | 136R | 2.5 | CON | N | 4600 | 36800 |
| Reach 4 | 10.0 | 4.0 | 127R | 4.0 | CON | N | 1800 | 7200 |
| Reach 5 | - | - | - | 20.0 | CON | N | 1500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead, rainbow, cutthroats and Dolly Varden are present for 11,000 m. Sporadic chinook spawning is reported. Chinook were last reported on November 26, 1973 when 400 were seen , a location was not provided.

Production is limited by summer drying (the lower 2,000 m) and high fall - winter discharge.

Fry production is highly variable in Nixon Creek. In 1987 late August fry densities (fish/m²) for coho, rainbow-steelhead and cutthroat were .016, .0045 and .002 respectively. However, in 1951, it was estimated that 100,000 coho fry "perished in one small reach" (Burns et. al. 1987) and Reach I coho fry salvage has been as high as 23,150 or .38 fry/m². It is estimated that only 60 percent of Reach I coho fry can be salvaged.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION:** Above barrier coho colonization smolt yield potential:160 - 1,600/200 fry required (**Production Option # 5**).

2. **CHINOOK REINTRODUCTION:** Chinook fry stocking (**Production Option #6**). Chinook could be stocked in Reaches 2 to 4. Only very occasional chinook fry have been found in Nixon Creek during fry salvage operations (1986 to 1998) and no chinook have been reported in earlier salvages (Burns et. al., 1987). Nixon Creek does however have the capability for chinook rearing and spawners have been reported. Reach 1 is often dry during the fall chinook period. Spring run fish have the best chance of survival in Nixon Creek.

3. **FRY SALVAGE:** Fry salvage in Reach 1 (**Production Option #7**).

4. **SIDCHANNEL DEVELOPMENT:** An extensive network of complex sidechannels is adjacent to a 2600 m section of Reach 2 between Lush and Lagoon Creeks. These channels are an important component of Nixon Creek's coho production. They are a combination of active, flood and relic channels and some are strongly influenced by small tributaries and groundwater. These channels presently provide approximately 8500 m² of habitat. Unfortunately, a large portion of it is subject to both drying and peak flow inundation. If the at risk portion of Nixon's lateral habitat could provide safe summer rearing and overwintering, much more benefit would result (**Production Option #8**). Fry salvage is carried out in parts of some of the channels. NOTE: In the summer of 1997, approximately 170 m of new channel was constructed by DFO (Habitat Restoration). Channel width is 3-5 m and it was excavated to a depth of 2-3 m. Minimum flow in the channel was .5 LPS 24 m below the inlet and 2.13 LPS 10 m below the outlet berm on 8/6/97. Temperature was 10.1. The channel was extended upstream in the summer of 1998. Coho spawners were reported in Dec. 1998. Temperature then was 9 degrees, 3 degrees warmer than the mainstem. The 1998 extension was 163 m plus a 100 m long spur channel. The main channel (known as Jenny Wren Channel) is 334 m long. Main channel flow was .0338 CMS at its lower end 6/1/99. Its temperature on that day was 7°. Spur channel flow was .0287 at the lower end and temperature was 7.5°

5. **EXCAVATION:** Reach 1 of Nixon dries in early summer resulting in huge fry and parr losses. Because of its remoteness and length of area requiring salvage (2000m), salvage is difficult. Pools are deep for the most part which also makes salvage difficult. When they begin to get shallow enough to salvage, drying is very rapid. Excavation of excess bedload might be a more suitable option. If summer drying could be prevented, approximately 120,000 m² of habitat would be returned to production. It is also possible that early run chinooks may spawn in Nixon again if water was available earlier in the fall. As many as 400 chinooks have been seen spawning in Nixon by E. Hall, former Fisheries Guardian. It is assumed they were early run fish. TimberWest has applied to FRBC for this project. Cost was estimated at \$435,000 (Voller, pers. comm.) (**Production Option # 9**)

D) LAND USE FACTORS

Forestry

Ninety percent of the basin is covered by advanced second growth. A very rich hardwood community dominates the floodplain and many areas of lower slopes adjacent to it.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Reaches 1 and 2 are highly riparian and flood prone; they also contain significant lateral habitat such as sidechannels and the lower ends of groundwater tributaries. The Nixon Corridor is very broad here and extends up tributaries to the extent of their riparian or steep adjacent slope landscape units. Upland riparian landscape units are common in the Nixon Corridor. Moist soils with Salmonberry – Swodfern or even Salmonberry – Ladyfern - Equisetum are located on slopes as steep as 35 – 40 %. These are the most sensitive units in Nixon's FSZ. Above Reaches 1 and 2, the FSZ is primarily composed of oversteep slopes. There is a strong need to protect the floodplain – riparian zones and steep adjacent slopes.

Stream Code: N/A

Stream Name: Tom's Creek

Operational Management Unit: Lake South (South Shore Tributaries-West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Nixon Creek from the west 2.5 km upstream of Cowichan Lake and drains a steep, narrow basin. It dries early in Reach 1.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 108-109 |
| <u>Topographic Map</u> | 92 C/16, 92C.088, 92C.089 |
| <u>Salmonids</u> | Co to 1,200 m. Ct to 1,200 m. |
| <u>Obstructions</u> | Old box culvert with plank decking at Caycuse main - passable but will likely need replacing within a few years. Series of falls at 1,200 m totalling 100 m over 200 m. |
| <u>Max. Temp. (C)</u> | 12 (7/30/86) |
| <u>Min. Disch. (m³)</u> | 0.07 (7/30/86) 0 for 700 m from July - October. |

TOM'S CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 10 | 0 | 1450 | 1.0 | CON | L | 700 | 0 |
| Reach 2 | 5 | 2 | 136R | 2.5 | CON | L | 300 | 600 |
| Reach 3 | 5 | 2 | 1252 | 3.0 | ENT | N | 200 | 400 |
| Reach 4 | 3 | 1 | 1252 | 17.0 | CON | N | 2500 | 2500 |

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 1200 m support coho and resident cutthroats, some of the cutthroats may be progeny of spawners from Cowichan Lake. Production limited by high - fall winter discharge, summer drying (700 m) and cool temperatures.

C) PRODUCTION OPTIONS

1. FRY SALVAGE : Fry salvage in Reach 1 (Production Option # 10).

D) LAND USE FACTORS

Old growth has been logged. Most of the basin is now covered by advanced second growth. Difficult areas along canyons (700 stream length). Most were not logged.

Risk Potential

Moderate

Fishery Officer Narrative

E)PROTECTION NEEDS

Much of Reach 1 is located in the Nixon Creek Corridor because of its riparian nature, Above R1, the FSZ is mainly composed of steep adjacent slopes including some precipitous tributary ravines with high impact potential if carelessly logged or roaded.

Stream Code: N/A

Stream Name: Nixon Creek (West)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Nixon Creek from the west 5 km above Cowichan Lake draining a narrow, steep basin.

| | |
|-------------------------|---|
| <u>Air Photos</u> | BC 82007 108-109 |
| <u>Topographic Map</u> | 92 C/16. 92C.088 |
| <u>Salmonids</u> | Co to 1,000 m. Ct to 1,000 m. |
| <u>Obstructions</u> | A culvert with a 0.6 m vertical drop at 100 m -passable but should be replaced; This culvert was replaced about 1990.A 3 m falls at 1,000 m. The falls was worked on in 1990. Upstream assessment is required to determine is fish can navigate it. |
| <u>Max. Temp. (C)</u> | 9 (9/26/85) |
| <u>Min. Disch. (m3)</u> | 0.042 (9/26/85) |

NIXON CREEK WEST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 7.0 | 2.0 | 136R | 3.0 | CON | N | 1000 | 2000 |
| Reach 2 | 6.0 | 2.0 | 1252 | 6.0 | CON | N | 500 | 1000 |
| Reach 3 | 6.0 | 2.0 | 127R | 4.5 | CON | N | 2000 | 4000 |
| Reach 4 | - | - | - | 8.0 | CON | N | 500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 1,000 m support coho and resident cutthroats.

Production is limited by access and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Above barrier coho colonization smolt yield potential:160 - 1,600/2,000 fry required (**Production Option #11**).

2.BARRIER IMPROVEMENT: TimberWest and MOE worked on the falls at 1000m in 1990. A follow up assessment is required to determine if fish can now ascend the falls. This assessment should take place in the summer of 1999 (**Production Option # 12**)

D) LAND USE FACTORS

Forestry

Most old growth (90%) has been cut. The basin is covered with advanced second growth except for a small area (<10%) on the ridge top to the north which has been recently logged.

Risk Potential

Low.

E) PROTECTION NEEDS

Some riparian habitat adjacent to R1. This is in the Nixon Creek Corridor (FSZ). Above R1, the FSZ is mainly steep adjacent slopes including some sensitive tributary ravines and gullies.

Stream Code:N/A

Stream Name: Nixon Creek (East)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Nixon Creek from the east 6 km upstream of Cowichan Lake draining a steep and narrow basin.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 |
| <u>Topographic Map</u> | 92 C/16, 92C.088 |
| <u>Salmonids</u> | Co to 50 m. Ct to 50 m. |
| <u>Obstructions</u> | A 2 m over 3 falls at 20 m. A culvert with a 2 m outlet drop at 250 m. Rapidly increasing gradient at 1,270 m. |
| <u>Max. Temp. (C)</u> | 12 (7/7/85) |
| <u>Min. Disch. (m³)</u> | 0.046 (9/26/85) |

NIXON CREEK EAST

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 5.0 | 2.0 | 136R | 3.0 | CON | N | 20 | 40 |
| Reach 2 | 5.0 | 2.0 | 136R | 3.0 | CON | N | 230 | 460 |
| Reach 3 | 6.0 | 2.0 | 1360 | 3.0 | CON | N | 1000 | 2000 |
| Reach 4 | - | - | - | 30.0 | CON | N | 1260 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroat fry utilize the lower 20 metres and may utilize up to 250 metres.

Production is limited by access and high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Potential above barrier coho colonization smolt yield: 80 - 800/1,000 fry required (**Production Option #13**).

D) LAND USE FACTORS

Forestry

Ninety-nine percent of old growth has been cut. The basin is covered by advanced second growth except for a very small patch of recent logging at its extreme upper end.

Risk Potential

Low.

Fishery Officer Narrative

E.) PROTECTION NEEDS

Some riparian is adjacent to R 1 but the main feature of the FSZ is steep adjacent slopes including those of tributary streams.

Stream Code: 9202577919559

Stream Name: Raymond (Lacey) Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Raymond Creek enters Nixon Creek from the west 6 km upstream from Cowichan Lake. The drainage basin is narrow but main stem gradient is relatively low.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 109 - 110 |
| <u>Topographic Map</u> | 92 C/15, 92C/16, 92C.088 |
| <u>Salmonids</u> | Co to 5,000 m. Ct to 5,000 m. St to 5,000 m. DV to 5,000 m. |
| <u>Obstructions</u> | Increasing gradient near headwaters, . |
| <u>Max. Temp. (C)</u> | 10 (9/22/85), 17.5 (8/14/97) |
| <u>Min. Disch. (m³)</u> | 0.12 (9/22/85), .132 (8/14/97) |

RAYMOND CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 20.0 | 5.0 | 1450 | 2.0 | FC | L | 85 | 425 |
| Reach 2 | 11.0 | 8.0 | 136R | 2.0 | CON | L | 5000 | 25000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead, cutthroat and Dolly Varden are present for 5,000 m. It is possible that some of the cutthroat and Dolly Varden are spawners from Cowichan Lake.

Production is limited by high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None apparent. This stream needs more study.

D) LAND USE FACTORS

Forestry

Ninety-five percent of the basin is covered by advanced second growth.

Risk Potential Low.

E) PROTECTION NEEDS

Although there is a fair amount of lowland riparian landscape in the corridor adjacent to the creek, the bulk of the FSZ is composed of steep adjacent slopes on both the mainstem and tributaries. A feature of the Raymond FSZ that is somewhat unique is the presence of what can be termed upland riparian landscapes. There are significant areas of moist riparian landscape units on slopes as high as 35% where extensive sidehill seepage is present. These units are extremely sensitive to disturbance.

Stream Code:

Stream Name: Black Lagoon Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

- A) BIOPHYSICAL OVERVIEW: For 80% of its length, Lagoon Creek is a steep, non-buffered runoff course. However, when the stream reaches the Nixon Creek floodplain, it intercepts groundwater from upwelling, sidechannels and the slope toe to form a productive stream/sidechannel complex. Which features a 60 m² upweeling lagoon.

| | |
|-------------------------|--|
| <u>Air Photos</u> | BC 82007 108, 109 |
| <u>Topographic Maps</u> | 92C/16, 92C. 088, 089, 099 |
| <u>Salmonids</u> | Co to 200 m |
| <u>Obstructions</u> | Rapidly increasing gradient with small backfilled jams above 200 m |
| <u>Max. Temp.</u> | 10.0 (8/14/97) |
| <u>Min. Disch.</u> | R3 = 0 (6/27/96) |

BLACK LAGOON CREEK

| | Channel | | | | Channel Confinement | Side Channel | Length (m) | Wetted | |
|---------|-----------|-----------|-----------|-----------|---------------------|--------------|------------|------------------------|--|
| | Width (m) | Width (m) | Substrate | Slope (%) | | | | Area (m ²) | |
| Reach 1 | 4 | 2 | 1810 | 1.0 | FC | M | 55 | 220 | |
| Reach 2 | 3 | 1 | 2800 | 0.5 | FC | M | 95 | 285 | |
| Reach 3 | 3 | 0 | 1720 | 1.0 | FC | M | 50 | 0 | |
| Reach 4 | 2 | 0 | 1360 | 15.0 | CON | N | 80 | 0 | |
| Reach 5 | 2 | 1 | 2530 | 5.0 | CON | N | 300 | - | |
| Reach 6 | | | | | | | 400 | - | |

- B) FISH UTILIZATION AND LIMITING FACTORS

Coho fry densities very high on 6/27/96 in Reaches 1 and 2. Numerous redds were located in Reaches 2 and 3. Production is limited by low summer flows. Reach 3 dries early.

- C) PRODUCTION OPPORTUNITIES

1. PROVIDE UPWELLING POND : Excavation of an upwelling pond at the end of Reach 3 should provide more water downstream. Present flow is provided by an upwelling pond in Reach 2 and seepage through the floodplain (**Production Option #14**)

2. FRY SALVAGE: Fry salvage is required in a 60 m section of creek water that flows along a Nixon Creek bar. This could be considered Reach 1 but it belongs more to Nixon than Lagoon for most of the year (**Production Option #15**)

- D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth coniferous except along the lower reaches where hardwoods dominate. The area was railroad logged many years ago.

Risk Potential

Moderate

- E) PROTECTION NEEDS

Steep adjacent slopes, especially in Reaches 5 and 6, should not be disturbed. Of special importance is the slope break adjacent to Reach 4 between the floodplain and the upland. Reaches 1-3 are riparian and are within the Nixon Creek Corridor.

Stream Code:

Stream Name: Lush Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Reach 2 of Nixon Creek 3.8 km from Cowichan Lake. Drains a short, steep non-buffered basin. Adjacent slopes are sensitive, especially in R1 due to steepness and moisture content.

Air Photos BC 82007 108,109
Topographic Maps 92C/16, 92C.088, 089,
Co to 280 m
Salmonids Ct to 280 m
Obstructions 2R3 at 50 m, passable. Partially backfilled log jam at 80 m, point of difficult passage. 40R60 impassable falls at 280 m.
Max.Temp.
Min. Disch.

LUSH CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|----------------------|---------------------|-----------|------------------------|-----------------|---------------|---------------------------|
| Reach 1 | 5 | 3 | 127R | CON | L | 280 | 840 |
| Reach 2 | 3 | 3 | 1161 | ENT | N | 100 | 300 |
| Reach 3 | 4 | 2 | 127R | CON | N | 600 | 1200 |
| Reach 4 | 3 | 2 | 127R | CON | N | 600 | 1200 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout inhabit Reach 1. Production is limited by high gradient and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth

Risk Potential

Moderate due to steep adjacent slopes

E) PROTECTION NEEDS

Slopes adjacent to Reach 1 are very steep - 60 to 90 % - and relatively moist. The stream is named for the luxuriant cover along the tiny floodplain and adjacent lower slopes of Reach 1. Vegetation is dominated by a heavy understory of Swordfern, Ladyfern, Salmonberry and Devil's Club. The canopy is largely maple and alder. No logging should occur within 15 m of the top of the slopes adjacent to Reaches 1 and 2. Harvesting should be similarly set back from steeper portions of slopes adjacent to Reaches 3 and 4.

Stream Code: N/A

Stream Name: Third Creek (Caycuse 3)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The western most of a group of three little streams that enter Cowichan Lake within 150 m of each other in a bay at Caycuse Camp. Drains a short, low gradient basin. Summer flow is provided by groundwater seepage. Caycuse 3 headwaters is a strong sidehill spring at 800 m. There is adjacent upland riparian landscape in this area.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 108 - 109 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co to 500 m. Ct to 500 m. |
| <u>Obstructions</u> | Culvert and fishway at 30m. The stream becomes too small to support salmonids at the 500 m point. NOTE: FISHWAY HAS BEEN REPLACED WITH A CULVERT (1994) Increasing gradient and small jams at 500 m. |
| <u>Max. Temp. (C)</u> | 13 (9/5/86) |
| <u>Min. Disch. (m³)</u> | 0.01 (9/5/86) |

THIRD CREEK (Caycuse 3)

| | <u>Channel</u> | | | | <u>Side</u> | | <u>Length</u> (m) | <u>Wetted</u> Area (m ²) |
|---------|------------------|------------------|------------------|---------------|--------------------|----------------|----------------------|---|
| | <u>width (m)</u> | <u>width (m)</u> | <u>Substrate</u> | <u>Slope%</u> | <u>Confinement</u> | <u>Channel</u> | | |
| Reach 1 | 2.5 | 1 | 2800 | 1.0 | CON | L | 30 | 30 |
| Reach 2 | 2.5 | 1 | 1630 | 1.5 | CON | L | 470 | 470 |
| Reach 3 | 2.0 | 0 | 3520 | 1.0 | CON | L | 200 | 0 |
| Reach 4 | - | 0 | - | 60.0 | CON | N | 500 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

As many as coho 284 spawners have returned to this stream. Caycuse residents had to carry them across the road when a new culvert was installed that was impassable. Cowichan Lake cutthroat spawning has been reported. Production is limited by small size.

C) PRODUCTION OPPORTUNITIES

1. RESTORATION OF ORIGINAL CHANNEL: This stream was relocated in the 1940's. Restoring it to its original channel would increase its length by some 250 m (**Production Option # 16**).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging resumed in the lower basin in 1996.

Risk Potential

Low. Run-off from Caycuse Bypass Road has placed eggs at risk. The situation was at its worst in the winter of 1996-97. TimberWest has since (1997 summer) taken measures to improve the situation.

Fishery Officer Narrative

E) PROTECTION NEEDS

A significant amount of riparian landscape is adjacent to R's 1 and 2 and again in the headwaters where the creek originates from a sidehill spring. In between, there are areas of steep adjacent slope.

Stream Code: N/A

Stream Name: Second Creek (Caycuse 2)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This is the middle stream of three that enter Cowichan Lake in a bay at Caycuse Camp. Drains a short, steep basin.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 108 - 109 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co to 120 m. Ct to 371m and 60 m in West Fork. |
| <u>Obstructions</u> | A culvert with .2 m drop at Caycuse bypass road. Structure is .8M CSP with an average migration flow velocity of 1.3 MPS. Its 19.3 m long. Increasing gradient above 371 m. |
| <u>Max. Temp. (C)</u> | 12 (9/5/86) |
| <u>Min. Disch. (m³)</u> | .008 (9/5/86) |

SECOND CREEK

| | Channel width | Wetted width | Substrate | Slope | Confinement | Side Channel | Length | Wetted Area |
|---------|---------------|--------------|-----------|-------|-------------|--------------|--------|-------------|
| Reach 1 | 1 | 1 | 1720 | 1.0 | FC | N | 37 | 37 |
| Reach 2 | 2 | 1 | 1720 | 1.6 | CON | N | 83 | 83 |
| Reach 3 | 2 | 1 | 2710 | 1.5 | FC | L | 169 | 169 |
| Reach 4 | 2 | 1 | 1630 | 2.5 | CON | N | 82 | 82 |
| Reach 5 | 1 | 1 | 1450 | 15.0 | CON | N | | |
| | | | | | | | | |
| | | | | | | | | |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and progeny of Cowichan cutthroats are present for 120 m. Resident cutthroats are present for 371 m and for 60 m in the West Fork.

Production is limited by size and access.

C) PRODUCTION OPPORTUNITIES

1. BARRIER REMOVAL: Replacement of Caycuse Bypass Road culvert at 120 m would allow coho and cutthroat spawners from Cowichan Lake to utilize another 251 m plus 60 m in the West Fork (1 (l) FC .5 2710). Reach 3 is the most suitable spawning reach (Production Option # 17)

NOTE: The culvert on the lower road was removed in the summer of 1998 adding 17 m of habitat to R2.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Runoff from Caycuse Bypass Road was silting the creek badly at times in the winter of 1996-97. TimberWest took remedial measures in the summer of 1997.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Caycuse 2 has a small amount of riparian zone in R's 1 – 4 and some steep adjacent slopes above. An extensive riparian zone is adjacent to the West Fork which enters R 4 at 70 m. Perhaps the stream's biggest threat is the Caycuse Bypass Road which has been a more or less chronic source of sediment since it was constructed. It is especially bad in periods of winter thaw. A potential settling pond is present between Caycuse 2 and 3. Road runoff should be diverted into it. This creek serves as the community water supply for Caycuse.

Stream Code: N/A

Stream Name: First Creek (Caycuse 1)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

- A) BIOPHYSICAL OVERVIEW: The eastern most of three streams that enter Cowichan Lake in a bay at Caycuse Camp. Drains a short, steep basin.

| | |
|------------------------------------|----------------------------|
| <u>Air Photos</u> | BC 82007 108 - 109 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co to 88 m. Ct to 88 m. |
| <u>Obstructions</u> | 1.3 m falls at 88 m |
| <u>Max. Temp. (C)</u> | 11 (9/5/86) |
| <u>Min. Disch. (m³)</u> | .006 (9/5/86) |

FIRST CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3 | 1 | 2530 | 1.5 | CON | L | 88 | 88 |
| Reach 2 | 3 | 1 | 1360 | 5.0 | CON | N | 100 | 100 |
| Reach 3 | - | - | - | 50.0 | CON | N | 700 | - |

- B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats utilize the lower 88 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners.

Production is limited by size and access.

- C) PRODUCTION OPPORTUNITIES

None.

- D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Runoff from Caycuse Bypass Road was silting the stream in the winter of 1996-97. TimberWest took steps to remedy the problem in the summer of 1997.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Helpful Creek

Operational Management Unit : Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake at the Caycuse Camp dry land sort. The stream drains a steep, narrow basin.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 107 - 108 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co and Ct to 200 m. |
| <u>Obstructions</u> | A 1 m culvert at 200 m, 1 m culvert at 300 m, increasing gradient above. |
| <u>Max. Temp. (C)</u> | 13 (9/5/86) |
| <u>Min. Disch. (m³)</u> | .01 (9/5/86) above 100 m. |

HELPFUL CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 5 | 0 | 1360 | 2.5 | CON | N | 100 | 0 |
| Reach 2 | 5 | 1 | 1360 | 2.5 | CON | N | 100 | 100 |
| Reach 3 | 4 | 1 | 1270 | 3.0 | CON | N | 100 | 100 |
| Reach 4 | - | - | - | 20.0 | CON | | 1000 | - |
| Reach 5 | - | - | - | 11.0 | CON | | 1250 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present for 200 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners.

Production is limited by accessible length, low summer flow and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. FRY SALVAGE: Coho fry salvage in Reach 1 (**Production Option #17**). 300 were salvaged on July 7, 1986.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

Stream Code: 9202577845

Stream Name: Croft Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep, narrow basin, enters Cowichan Lake from the south 3 km southeast of Helpful Creek. This stream is subject to early drying.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 107 - 108 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Chance of coho spawning in the lower 150 m. No adults or fry have been seen. No trout are present. |
| <u>Obstructions</u> | Increasing gradient at 200 m, 2 m culverts at South Shore Road @ 280 m, 10 m falls at 750 m. |
| <u>Max. Temp. (C)</u> | 11 (9/5/86) |
| <u>Min. Disch. (m³)</u> | 0 for 600 m, .001 for 100 m below falls |

CROFT CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 5 | 0 | 1450 | 1.0 | CON | N | 50 | 0 |
| Reach 2 | 4 | 0 | 1360 | 3.0 | CON | N | 150 | 0 |
| Reach 3 | 4 | 0 | 1270 | 6.0 | CON | N | 450 | 0 |
| Reach 4 | 4 | 1 | 127R | 6.0 | CON | N | 100 | 100 |
| Reach 5 | - | - | - | 40.0 | CON | N | 1500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Chance of coho spawning in lower 150 m, stream usually dries before fry emergence.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. TimberWest's Caycuse Campsite is located along lower Croft.

Risk Potential

Low.

Stream Code: N/A

Stream Name: Rowdy Creek

Operational Management Unit: Lake South (South Shore tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep narrow basin, enters Cowichan Lake from the south 1.3 km southeast of Croft Creek.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 107 - 108 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Resident cutthroats with a strong rainbow influence are present in the summer habitable area - Reach 2 (300 m). |
| <u>Obstructions</u> | Series of falls beginning at 700 m - 40 m over 60 m. |
| <u>Max. Temp. (C)</u> | 13 (9/5/86) |
| <u>Min. Disch. (m³)</u> | 0 for 250 m, then .007 |

ROWDY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 5 | 0 | 1360 | 3.0 | CON | N | 250 | 0 |
| Reach 2 | 5 | 3 | 1360 | 3.5 | CON | N | 300 | 900 |
| Reach 3 | - | - | - | 30.0 | CON | N | 2250 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Resident cutthroat and rainbow in Reach 2. Slight chance of coho and Cowichan Lake cutthroat trout spawners in Reach 1.

Production limited by violent channel and substrate disturbance from high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Steep adjacent slopes are the primary aspect of Rowdy Creek's FSZ. Some residual slope damage from the first cut remains.

Stream Code: N/A

Stream Name: Dusty Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep, narrow basin, enters Cowichan Lake from the south 100 m southeast of Rowdy Creek.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 107 - 108 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Ct to 1200 m. |
| <u>Obstructions</u> | A steep 12 m long box culvert with a .3 drop at 100 m. Passable but coho do not migrate more than 20 m above it because of increasing gradient and lack of spawning sites. 5 m falls at 1200 m. |
| <u>Max. Temp. (C)</u> | 14 (9/6/86) |
| <u>Min. Disch. (m³)</u> | 0 for 500 m, then .05 |

DUSTY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4 | 0 | 1360 | 2.0 | CON | N | 120 | 0 |
| Reach 2 | 3 | 2 | 1360 | 3.5 | CON | N | 380 | 0 |
| Reach 3 | - | - | - | 20.0 | CON | N | 2500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are present for 120 m. Resident cutthroats to 25 cm utilize 1200 m. Production is limited by drying in the coho spawning zone and high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1. FRY SALVAGE : Fry salvage in the lower 120 m (**Production Option #18**). 200 coho fry were salvaged in July, 1986.

D) LAND USE FACTORS

Forestry

Advanced second growth covers the entire basin.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Steep adjacent slopes are the main element of Dusty Creek's FSZ. Residual impacts from the first logging pass remain in the form of road related slope damage.

Stream Code: NA

Stream Name: Cutthroat (12Km) Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) Biophysical Description: A 1728 m long small tributary of the South Shore of Cowichan Lake. Drains a short, relatively steep, non-buffered basin just west of Misery Creek. Summer flow is provided by groundwater seepage. Subject to high fall-winter discharge and bedload movement. Bedload is particularly unstable below South Shore Road (400m). Subject to summer drying in this section.

| | |
|------------------------|---|
| <u>Air Photos</u> | BC 82007 107-108 |
| <u>Topographic Map</u> | 92C/16, 92C.089 |
| <u>Obstructions</u> | Increasing gradient and small cascades at 730 m |
| <u>Salmonids</u> | Ct (resident and Cowichan Lake spawners) |
| <u>Max. Temp.</u> | 14.9 (8/7/97- R2 30m upstream South Shore Road) |
| <u>Min. Disch.</u> | .00656 (8/7/97 R2 30 m upstream South Shore Road) |

CUTTHROAT CREEK

| | Channel Width | Wetted Width | Substrate | Slope(%) | Confinement | Sidechannel | Length | Area |
|---------|---------------|--------------|-----------|----------|-------------|-------------|--------|------|
| Reach 1 | 3 | 3 | 1360 | 2.0 | CON | N | 356 | 0 |
| Reach 2 | 3 | 1 | 1360 | 3.0 | CON | N | 207 | 207 |
| Reach 3 | 2 | 1 | 1261 | 8.0 | CON | N | 60 | 60 |
| Reach 4 | 3 | 1 | 1360 | 2.5 | CON | N | 105 | 105 |
| Reach 5 | 2 | 1 | 1261 | 15.0 | CON | N | 1000 | 1000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat trout fry and parr are present for 730 m. Fry density ($1.5/m^2$) strongly suggests that this is a spawning stream for Cowichan Lake cutthroats.

Production is limited by summer drying in the lower 356 m (Reach 1), unstable bedload and the small size of the creek.

C) PRODUCTION OPPORTUNITIES

1. **FRY SALVAGE:** Fry salvage in the lower 356 m should yield approximately 500 fry for release to Cowichan Lake at the stream mouth. Salvage should occur before July 1 before lake temperatures become significantly higher than stream temperatures. Salvage will be difficult in the boulder dominated channel (Production Option # 19)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging has resumed on the west side of the creek above South Shore Road. A leave zone that varies from 15-50 m has been retained up to Reach 4.

Risk Potential

Moderate

E) PROTECTION NEEDS

A top of the bank leave strip needs to be retained to the headwaters and to the headwaters of the East Fork which enters at 730 m unless trees can be felled away from the creek on slopes less than 30%. However there should be considerable discretion left to the forest companies on site treatment.

Stream Code: N/A

Stream Name: Misery Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Misery Creek, a steep and narrow basin, enters Cowichan Lake from the south 2 km east of Dusty Creek.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 107 - 108 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | CO to 1200 m. Ct to 1200 m. |
| <u>Obstructions</u> | A culvert with a .8 m drop at 300 m, 2 m falls at 1200 m, 3 m falls at 1600 m, 2 m culvert at 1900 m. |
| <u>Max. Temp. (C)</u> | 12 (9/7/86) |
| <u>Min. Disch. (m³)</u> | 0 for 500 m, then .07 (9/7/86) |

MISERY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 7 | 0 | 1360 | 2.0 | CON | N | 800 | 0 |
| Reach 2 | 6 | 2 | 136R | 5.0 | CON | N | 1000 | 2000 |
| Reach 3 | - | - | - | 25.0 | CON | N | 2000 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroat are present for 1200 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners.

Their numbers are sparse due to high fall - winter discharge and a shortage of spawning habitat.

C) PRODUCTION OPPORTUNITIES

1. **FRY SALVAGE:** Fry salvage in the lower 800 m (**Production Option #20**). 100 coho fry and 7 cutthroat fry were salvaged in July, 1986.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Misery Creek's FSZ is nearly 100% slope related. This is a steep, narrow valley with some very steep sideslopes that are moist and unstable in places. Some residual road related slope damage remains from the first cut, especially in the Upper Basin.

Stream Code: NA

Stream Name: Grosskleg's Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL DESCRIPTION: This small, seasonal stream dries in its lower three reaches, It drains a steep, narrow basin and is non-buffered.

| | |
|-------------------------|---|
| <u>Air Photos</u> | BC 82007 106-107 |
| <u>Topographic Maps</u> | 92C/16, 92C.090 |
| <u>Salmonids</u> | Co 196 m |
| <u>Obstructions</u> | 1 m culvert at South Shore Road, 1 m backfilled log jam at 567 m, combination falls/log jam at 747 m with total vertical drop of 5 m. Sharply increasing gradient upstream. |
| <u>Max. Temp.</u> | 15 8/3/96 |
| <u>Min. Disch.</u> | 0 for 553 m then int. for 265 m then 3LPS 8/3/96 |

GROSSKLEGG'S CREEK

| | Channel width(m) | Wetted width(m) | Substrate | Slope(%) | Channel Confinement | Side Channel | Length (m) | Wetted Area(m ²) |
|---------|------------------|-----------------|-----------|----------|---------------------|--------------|------------|------------------------------|
| Reach 1 | 4.0 | 0.0 | 1540 | 1.8 | CON | N | 196 | 0 |
| Reach 2 | 4.0 | 0.0 | 1630 | 2.0 | CON | N | 161 | 0 |
| Reach 3 | 4.0 | 0.0 | 1450 | 2.5 | CON | N | 196 | 0 |
| Reach 4 | 4.0 | 1.0 | 1360 | 3.0 | CON | N | 180 | 180 |
| Reach 5 | 3.0 | 1.0 | 1162 | 15.0 | CON | N | 1000 | 1000 |
| Reach 6 | 2.0 | 1.0 | 1162 | 35.0 | CON | N | 500 | 500 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawners use the creek in years when Cowichan coho escapement is high. Egg survival is questionable due to very early drying including the possibility of winter drying, mobile substrate and sedimentation from South Shore Road. Production highly limited by the above factors and access.

C) PRODUCTION OPPORTUNITIES

The culvert at South Shore Rd. (196 m) could be removed but little gain would occur due to the low productivity of the stream above it and the relatively short distance to the next barrier (371 m).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth (approx. 60 - 70 years old). Recent logging in the west part of the lower basin (1996).

Risk Potential

Low

E) PROTECTION NEEDS

Portions of the stream are contained in steep walled ravines with unstable slopes, these areas should be avoided. Road building should be highly curtailed in the high slope portion of the upper basin.

Stream Code: N/A

Stream Name: Miserable Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream drains a steep, narrow basin and enters Cowichan Lake from the south 6 km northwest of Honeymoon Bay.

Air Photos BC 82007 106 - 107
Topographic Map 92 C/16, 92C.089
Salmonids Co to 1,300 m.
Ct to 1,300 m.
Obstructions A 4 m falls at 1,300 m.
Max. Temp. (C) 8 (9/22/85)
Min. Disch. (m³) 0 for 292 m then .0135 (8/3/96)

MISERABLE CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 4.0 | 0.0 | 1540 | 2.2 | CON | N | 292 | 0 |
| Reach 2 | 3.0 | 1.0 | 136R | 3.5 | CON | N | 800 | 800 |
| Reach 3 | 2.0 | 1.0 | 1135 | 25.0 | CON | N | 2000 | 2000 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroat utilize the lower 1,300 m. It is possible that some of these cutthroats could be progeny of Cowichan Lake spawners.

Production is limited by access, gradient, low summer flows (the lower 292 m dry) and high fall -winter discharge.

C) PRODUCTION OPPORTUNITIES

1. **FRY SALVAGE:** Fry salvage could be undertaken in the lower 292 m. Fish could be released in Cowichan Lake if they can be caught early enough (**Production Option # 21**)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. 1,500 m of stream is effected by South Shore Road (Grossleg's Hill) runoff which carries considerable sediment.

Risk Potential

Low.

E) PROTECTION NEEDS

Steep adjacent slopes are present above R2. Some are very moist – upland riparian – units. Some residual slope damage remains in the upper reaches.

Stream Code: NA

Stream Name: Grassy Bay Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake from the south some 300 m west of a small island and just west of Logger Bill's Lagoon. Drains a short, steep basin. Flow partially buffered by a groundwater tributary that enters from the east at 285 m.

Air Photos BC 87024 043, 044
Topographic Maps 92C/16, 92C. 089
Salmonids Co to 180 m, possibly to 390 m at times
Obstructions 2 m backfilled logjam at 180 m, 10R20 falls at 390 m
Max. Temp.
Min. Disch.

GRASSY BAY CREEK

| | Channel Width (m) | Wetted width (m) | Substrate | Slope(%) | Channel Confinement | Side Channel | Length (m) | Wetted area (m ²) |
|---------|----------------------|---------------------|-----------|----------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 2 | 0 | 2710 | 0.5 | FC | L | 55 | 0 |
| Reach 2 | 2 | 1 | 1720 | 2.0 | CON | N | 335 | 335 |
| Reach 3 | 2 | 1 | 1243 | 30.0 | CON | N | 400 | 400 |

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho utilize the lower 180 m. Some may navigate the log jam and proceed to the base of the falls at 390 m. Production is limited by stream size, low summer flows and high fall - winter discharge. On June 24, 1996 - a very damp spring - the lower 35 m were dry. The upper 15 m of this zone had just dried. Flow above this point was 3 LPS.

C) PRODUCTION OPPORTUNITES

1. LOG JAM REMOVAL: Removal of the log jam at 180 m (**Production Option #22**).

D) LAND USE FACTORS

Forestry

Most of the basin is in advanced second growth. A small amount of logging occurred adjacent to mid-Reach 3 in the early 1990's. A new road (TimberWest) was constructed from Chicken Joe's to Grossklegg's Creek in 1991. The road contributes small amounts of sediment to the creek.

E) PROTECTION NEEDS

The creek's small deltaic fan should not be disturbed - the creek sometimes spills across it. About .5 Ha is involved. Steep slopes adjacent to Reach 3 and to the groundwater tributary need to be retained in buffer zones.

Stream Code: NA

Stream Name: Gordon Bay Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A small, temporary stream that originates near the old Cowichan Copper Mine and enters Cowichan Lake at Gordon Bay.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 106 - 107 |
| <u>Topographic Map</u> | 92 C/16 |
| <u>Salmonids</u> | Co |
| <u>Obstructions</u> | A culvert with a 1 m drop at 100 m (passable at high flows), increasing gradient and a number of small falls at 400 m, 2 m falls at 960 m. |
| <u>Max. Temp. (C)</u> | N/A |
| <u>Min. Disch. (m³)</u> | 0 |

GORDON BAY CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 5 | 0 | 1360 | 1.0 | CON | Nil | 100 | 0 |
| Reach 2 | 2 | 0 | 1810 | 1.0 | CON | Nil | 200 | 0 |
| Reach 3 | 1.5 | 0 | 136R | 8.0 | CON | Nil | 970 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Gordon Bay Creek dries early each year. Reach 1 sometimes dewatered during winter dry spells. Nonetheless, coho spawned in the fall/winter of 1995-96 and approximately 1000 fry were salvaged.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: A 5040 m² impoundment at 970 m could be colonized with coho fry (**Production Option #23**).
Carrying capacity: CO ~ 750

The impoundment was created by Cowichan Copper. It's the lowermost of five. Those above it have filled with tailings. The mine closed in 1962 and, although the pond still has a blue green tinge, it supports plankton, vegetation and frogs. There is a 2 m² patch of silty gravel in the accessible portion of the inlet that could be improved to sustain an early spawning resident cutthroat population.

2. HEADWATER STORAGE: In order to insure coho smolt migration, the impoundment should be raised 20 cm. (**Production Option #24**). The stream often dries before June 1. On February 26, 1988, the lower 100 m was dry except for its first 10 m and the rest was discharging .02 cms. Depth over the pond's outlet sill was only 2 cm.

3. FRY SALVAGE: Although it is uncertain whether Gordon Bay receives regular escapement, it should be checked every spring between early April and mid-May for coho fry. If they can be caught early enough, they can be released in Cowichan Lake or Gordon Bay Pond which has a carrying capacity of 750. If fish are released in the pond, their survival should be monitored by summer temperature and oxygen measurements, minnow traps and, if its clear that some have survived, a smolt trap the following spring (Production Option # 25)

D) LAND USE FACTORS

Forestry

The basin is mixed second growth (20 - 40 years).

Mining

Cowichan Copper ceased operation in 1962. The mine was known as the Blue Grouse.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Gordon Bay Creek flows through a small valley with both riparian and slope components to its FSZ. There are areas of high sensitivity above R2.

OPERATIONAL MANAGEMENT UNIT 12: LAKE SOUTHEAST

OMU 12: Lake Southeast (South Shore Tributaries – East)
T. Burns and B.D. Tutty, 1999

OVERVIEW

Lake Southeast OMU extends from Sutton Creek – Gordon Bay on the west to Halfway Creek and the west boundary of the Town of Lake Cowichan on the east. The OMU has also been termed South Shore Tributaries – East. Urban development is light consisting of two small communities: Mesachie Lake and Honeymoon Bay. Agricultural use is very light with activity on the March farm on the Sutton Creek Delta and even less activity on the Robertson River Delta. Forestry dominates land use in the OMU. Almost no old growth remains but second growth is advanced and logging is well underway. The OMU is rich in streams and there are a substantial number of significant riparian landscape units in their Fisheries Sensitive Zones: The Maple Flat area of Lower Sutton Creek, Golf Course Creek above the logging road, Patricia Creek's lower and middle reaches, the Robertson River Corridor especially from Coho Heaven to Roach's Bridge, Mesachie Creek Wetland and the Mesachie Sponge Zone of Halfway Creek and the Upper Halfway Wetlands including Fairservice(Cook's) Lake.

LIMITING FACTORS

Production is limited by low summer flows, lack of quality winter habitat and, in some cases, low habitat diversity/complexity.

PRODUCTION OPTIONS

Fortunately, there are numerous opportunities to mitigate production limits in OMU 12. They are outlined and prioritized in Table 1 and discussed in more detail in the streamfiles (pages 1-31).

Table 1: Production Options in OMU 12 (Lake Southeast)

| No. | Page | Location | Activity | Priority |
|-------|------|---------------------|------------------------------|----------|
| 1 | 1 | Sutton Creek | Sidechannel development | 1 |
| 2,3 | 2 | | Coho or chinook colonization | 3 |
| 4 | 2 | | Fry salvage | 1 |
| 5 | 3 | Millar Creek | LWD complexing | 3 |
| 6 | 5 | Five Culverts Creek | Coho Colonization | 4 |
| 7 | 5 | | LWD complexing | 2 |
| 8 | 7 | South Sutton Creek | Coho colonization | 3 |
| 9 | 9 | Slippery Creek | Coho colonization | 3 |
| 10,11 | 10 | Maple Flat Creek | Sidechannel development | 2 |
| 12 | 10 | | Barrier removal | 1 |
| 13 | 10 | | Spawning platform | 3 |
| 14,15 | 10 | | Headwater storage/coho col. | 2 |
| 16,17 | 12 | Golf Course Creek | Headwater storage, sp.pl. | 2 |
| 18,19 | 12 | | Fry salvage, coho col. | 1 |

ii

Stream Code: 9202577608

Stream Name: Beaver Creek and Lake

Operational Management Unit: Lake Cowichan South

CVRD Electoral Area: F

- A) BIOPHYSICAL OVERVIEW: This stream flows from Beaver Lake to Cowichan Lake skirting the west portion of Lake Cowichan Village. Beaver Creel drains a broad, low relief basin. Beaver Lake is a mature lowland lake of 19.3 Ha.

Air Photos BC 82007 137 - 138
Topographic Map 92 C/16, 92C.090
Salmonids Co to 2,740 m and Beaver Lake.
Ct to 2,740 m and Beaver Lake.
Smallmouth Bass formerly reported in Beaver Lake, but very few. None have been seen or captured in the period CLSES has been involved with the system (since 1983).
Obstructions Fry cannot gain access into the lake due to a low level dam at the outlet.
Max. Temp. (C) 19 ((8/9/85)
20.5 (R1 – 7/27/98)
Min. Disch. (m³) 0.007 (8/9/85) at 1,900 m. However the creek can dry if flow through the beaver dam at the lake outlet is not maintained.
.1052 (R1 – 9/2/98)

BEAVER CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 5.0 | 2.0 | 8200 | 0.1 | UC | H | 280 | 560 |
| Reach 2 | 4.0 | 2.0 | 2440 | 1.5 | CON | N | 223 | 446 |
| Reach 3 | 4.0 | 2.0 | 5410 | 1.0 | FC | L | 1900 | 3800 |
| Reach 4 | 20.0 | 5.0 | 8200 | 0.01 | UC | H | 292 | 1460 |

Beaver Lake

| Area (ha) | Elevation (m) | Volume (m ³) | Max. Depth (m) | TDS (mg/l) | Max. Surface Temp. |
|-----------|---------------|--------------------------|----------------|------------|--------------------|
| 19.31 | 184 | 67,200 | 7.5 | 34 | 27.9 (7/28/98) |

B) FISH UTILIZATION LAND LIMITING FACTORS

Coho and cutthroat trout utilize the system along with an occasional brown trout. Brown trout fry were introduced to the creek in 1988. A few smallmouth bass were present in Beaver Lake prior to 1987 but none have been seen or reported since.

Prior to 1983 Beaver Creek was in an advanced stage of maturity. The upper 2,200 m of channel was muck - detritus with three small zones of low quality gravel (18 m²) in Reach 2 which dried by May in most years. In August of 1983, the Cowichan Lake Salmonid Enhancement Society rehabilitated 1,900 m of this reach by removing muck - detritus overburden and adding gravel, boulders and drop logs. Spawning capability, hydraulic cover and habitat complexity were vastly improved. A low dam was constructed 350 m below Beaver Lake in 1984. It provided 1 m storage and delivered flows of 0.02 to 0.007 cms through the very dry summer of 1985. The dam was been taken over by beavers then replaced by a concrete structure with stopboards in 1996 for purposes of continued flow management and coho smolt release (Beaver Lake often dropped below the level of the beaver dam before the smolts were able to leave the lake). The dam stores an additional 30 cm above the level of the beaver dam to provide smolt release water.

A six inch pipe under the dam and complex of Big O pipes in the lake provide CDP flow.

Reach 1 was extended by 50m in 1984. In 1987, a secondary channel was excavated through Saywell Park. Coho fry increased from almost nil to about 2,000 in Reach 1. The secondary channel was removed in 1989.

Reach 2 was improved from 1986-88 by adding small weirs to increase pool depth and area. Wetted area was increased by 480 percent and coho fry numbers went from virtually none to approximately 2,500.

A diversion pipe from Upper Halfway Creek to Beaver Lake was added in 1991. Upper Halfway once flowed to Beaver Lake but was diverted to the Mesachie system many years ago so its deltaic fan could be utilized for a sawmill. The pipe was 8" in diameter and carried flows averaging 10 LPS. That pipe was replaced by a 20" pipe in 1994. The objective is to provide Beaver Lake with enough water to produce enough spill down Beaver Creek to attract spawners and provide some flushing and to keep Beaver Lake full for as long as possible. Upper Halfway Creek dries by early July or sooner in most years. Beaver Lake is water short without Halfway flow because its inlet streams are very small and ephemeral. The diversion also benefits Mesachie Creek by reducing flooding.

Five new spawning platforms were added to Leo's Loop in 1996 and a flow control-smolt release dam was built just below the Beaver lake Beaver dam in the late summer of 1996.

Coho also spawn in two Beaver Creek tributaries: Bartel Creek and Coho Road Creek. Spawners are present for 100 m in Bartel and 180 m in Coho Road. Both streams dry early. In some years like 1998, Coho Road Creek dies before fry emergence even begins.

C) PRODUCTION OPPORTUNITIES

1. **CONTIUED SUBSTRATE UPGRADES:** Careful addition of new substrate, particularly spawning gravel (Production Option #1) and cover will optimize structural quality of Beaver Creek.

2. **DAM IMPROVEMENT AND A WORKING AGREEMENT WITH THE LANDOWNERS:** Continued improvement in the 1996 dam to add to its safety and ability to allow smolt release from the lake (Production Option # 2, 3). An agreement for long term management of the system should be worked out with the land owners. It should include maximum allowable storage in Beaver Lake, guaranteed access to the stream and lake and agreement on future improvements. The present arrangement is based on good relations between the Cowichan Lake Salmonid Enhancement Society and Pacific Logging/TimberWest. and Gerry Quennville.

3. **WETLAND IMPOUNDMENT / CDP FLOW RELEASE:** Additional storage potential of 3 Ha is present in tributary wetland basins which could provide about .6 L/sec. for 180 days (Production Option # 4).

4. **CONTINUED BEAVER LAKE FRY STOCKING** The stream's potential coho smolt yield based on 1 fry/m of summer stream area and 8 percent fry to smolt survival, is 333. Lake yield should approximate 14,475 at .15 fry/m and 50 percent fry to smolt survival. Some Beaver Creek fry also rear in Cowichan Lake. **Beaver Lake is usually stocked with fry salvaged from Robertson Sidechannel in April or with hatchery fry from Beaver Creek adults. Stocking rate has been 29,000 but should be reduced to 15,000. Smolts were somewhat undersized at the higher stocking rate. Cutthroat fry or parr should also be stocked in Beaver Lake. The lake has a huge stickleback population which needs to be cropped. The present trout population is low because the beaver dam and smolt relaease dam have prevented normal spawner and fry movements out of and into the lake. The beaver dam was modified to permit normal movement in 1998 but there is a fear that the smolt release dam may hinder spawner movement out of the lake.(Production Option #5).**

5. **HALFWAY DIVERSION ADJUSTMENT:** Periodic adjustment of the Upper Halfway diversion pipe is required as stream conditions change (Production Option #6). The pipe needed to be lowered in the summer of 1995. Berms are sometimes constructed below the pipe to increase flow to Beaver Lake.

6. **BEAVER CREEK BEAVER DAM MONITORING:** Periodic maintenance of beaver dams along the creek is also required. They sometimes become high enough to block migration (Production Option # 7).

7. **INCREASED COMPLEXITY VIA LWD ADDITION:** Addition of LWD in portions of Reach 3, especially in Leo's and Ted's Loops and in the sub-reach just below Fairservice Main would provide cover – complexity benefits (Production Option #8)

8. **BEAVER LAKE CUTTHROAT IMPROVEMENT:** The Beaver Lake cutthroat trout population is low and the stickleback population is extremely high. There is a need to increase cutthroats for their own sake because this lake is excellent cutthroat habitat and to control the stickleback population somewhat so rearing coho have a better survival chance. Its probable that the Beaver Lake Dam is interfering with normal cutthroat use patterns, particularly their downstream spawning migration. At the time most of the trout would drop down from the lake to spawn in Beaver Creek, the dam is at or near maximum height and the trout are likely reluctant to navigate the drop of 1.25 m. Measures to improve trout fry recruitment like establishing spawning habitat in the Halfway Diversion, modifying the dam drop by installing a slide or collecting Beaver Lake brood stock and rearing their eggs in the hatchery, need to be examined (Production Option # 9).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. A cedar mill is located on Beaver Lake. A logging road crosses the creek near the 1900 m. point. Log hauling in the winter of 1988-89 produced an almost continuous flow of sediment which greatly reduced egg survival in Upper Beaver Creek. The road was repaired in 1990 and there were no problems until Nov. 1998 when a contractor plugged the lower end of Coho Road Creek. The problem was quickly solved and Pacific/TimberWest provided an additional 7m³ of gravel to the sub-reach below Fairservice Main (Frank's Loop).

Residential

The lower 400 m flow through Lake Cowichan and are subject to urban runoff. A fish kill occurred in the fall of 1993. Some 300 coho parr and 5 juvenile cutthroats perished in lower reach 2.

Risk Potential Moderate, due the potential sediment input from the logging road. This road was upgraded in 1990 and is seldom a problem.

E) Historical Notes

Beaver Creek coho escapement increased from a base of perhaps 10 prior to improvement to 150 in 1986, 250 in 1987 and 600 in 1988.

CO Escapement:

| | |
|------|-----|
| 1986 | 150 |
| 1987 | 250 |
| 1988 | 600 |
| 1989 | 168 |
| 1990 | 297 |
| 1991 | 40 |
| 1992 | 10 |
| 1993 | 127 |
| 1994 | 250 |
| 1995 | 70 |
| 1996 | 48 |
| 1997 | 100 |
| 1998 | 262 |

E) PROTECTION NEEDS

Beaver Creek has three basic areas of sensitivity : the deltaic wetlands on the fan (Reach 1 and Reach 1 of Cowichan Lake's Shorezone), the adjacent slopes greater than 30 % most of which are located on the east side of the valley in Reach 3 although there is a short section in Reach 2 and extensive riparian lands which are most substantial in Reaches 3 and 4. All these lands are included in the Fisheries Sensitive Zone. The portion of the creek in the Town of Lake Cowichan is protected under development permit regulations and parks and institution designation.

Stream Code: 9202577582

Stream Name: Kwassin and Grant Lakes and their outlet streams including Money's Creek

Operational Management Unit: Lake Cowichan South

A) BIOPHYSICAL OVERVIEW: This system includes two shallow lakes with a combined area of 7 HA; connected by a ditch. They receive drainage from numerous small wetlands to the southeast and west. The lakes drain to the Cowichan River via a man-made spill channel which was blasted out in 1971 and Money's Creek, a tiny stream that has been almost destroyed by the Town of Lake Cowichan and adjacent landowners. Money's Creek is now fed entirely by local seepage. Prior to 1971, it was a very important coho-cutthroat system. Juvenile coho and cutthroats still rear in Money's Wetland which is a remnant riparian wetland resulting from Cowichan River backflooding and runoff from Money's, South Money's/ Greenwell/100 Houses and Ravine Creeks. These streams are no longer fish bearing and are largely culverted in the Town of Lake Cowichan.

Air Photos BC 82007 137 - 138
Topographic Map 92 C/16, 92C.090
Salmonids Co, Ct
Obstructions Money's Creek effectively ends at Pine St. due to culverting. Its summer headwaters is 50 m above Cottonwood Street.
Max. Temp. (C) 17 (8/31/85)
19 (7/31/97, 8/22/97)
22.8 (7/29/98)
Min. Disch. (m³) 0.002 (8/31/85 R1)
.001 (9/20/96 R1)
.00042 (9/6/97 R1)
0 (8/10/98)
0 Money's Wetland outlet (8/31/98)

MONEY'S CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 4.0 | 1.0 | 5410 | .2 | FC | L | 27 | 27 * |
| Reach 2 | 6.0 | 5.0 | 1000 | .01 | OC | M | 22 | 110 * |
| Reach 3 | 3.0 | 3.0 | 1000 | .1 | CON | N | 118 | 354 * |
| Reach 4 | 1.5 | .5 | 2710 | 1.5 | CON | N | 240 | 120 (0 late summer 1998) |
| Reach 5 | 1.0 | 0 | 9100 | .1 | CON | N | 400 | 0 |

* = wetland reaches

DITCH

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 3.0 | 1.0 | 6310 | 10.0 | ENT | N | 50 | 50 |
| Reach 2 | 3.0 | 1.0 | 6310 | 2.0 | ENT | N | 150 | 150 |
| Reach 3 | 3.0 | 1.0 | 7300 | 1.0 | FC | L | 100 | 100 |
| Reach 4 | 3.0 | 1.0 | 8200 | 0.5 | UC | NA | 100 | 100 |

Kwassin Lake

| Area (ha) | Elevation (m) | Volume (m ³) | Max. Depth (m) | TDS (mg/l) |
|-----------|---------------|--------------------------|----------------|------------|
| 1.4 HA | 180 | 18,420 | 2.5 | 20 |

Grant Lake

2.2 HA 180 43,000 2.5 24

B) FISH UTILIZATION LAND LIMITING FACTORS

Angling and snorkel surveys in 1985 and 1986 revealed a large population of sticklebacks but no other fishes. In 1979 the Fish and Wildlife Branch lake survey, netting yielded no fish.(Kwassin and Grant Lakes).

Prior to diversion of its headwater flow, Money's Creek supported a strong population of coho which spawned in the creek and the connector channel between the two lakes. Spawning also occurred in the inlet to Grant Lake. There's a good possibility that coho also used Greenwell Creek and the South Fork of Moneys. Greenwell Creek originates in wetlands behind 100 Houses and enters a culvert near the top of Pine Street. It joins Money's in its culvert at the junction of Pine and Cowichan Avenues. South Money's originates in wetlands south of the E&N right of way and used to flow north to join Money's near Eldred and Grant's Lake Road; a remnant remains near Boundary and Comiaken but present flow of South Money's has been diverted west along the E&N right of way from near the end of Boundary Road to Greenwell Creek. Rainbow and cutthroat trout were also present in the original Moneys Creek.

All that remains of Moneys Creek is a remnant wetland at its confluence with the Cowichan. Large numbers of coho winter in the wetland and a substantial number of spring fry swim up from the Cowichan River to early rear. Most leave before mid – July when oxygen and temperature levels become dangerous to survival. In 1997, substantial numbers of coho fry stayed all summer despite oxygen levels in the 2 – 4 mg./l range. In, the very hot summer of 1998, Money,s Wetland became virtually anoxic in late July and all fish left or perished. Aside from one reading of 2.24 mg./l at the confluence of the West Lobe, all readings were .04 - .06 mg/l on 8/10/98. Even sticklebacks vacated the wetland. The water became very rusty coloured and stagnant. By August 29, outflow from the wetland had ceased as had flow in Ravine Creek which, along with Money's Creek itself, is the last of the wetland influent creeks to dry. In my tenure in Lake Cowichan (since 1981) the wetland outflow has never dried.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Combined coho smolt yield potential of Kwassin and Grant Lakes: 2,700 smolts; fry required: 5,400. Best source: Robertson Sidechannel. Fry must be stocked early in the spring (before May) or in the fall (after mid - October) (**Production Option #9**). Lake surface temperatures reach 24 on hot summer days although there is a spring on the west side of the lake that allows for later stocking.

2. MONEYS CREEK RESTORATION: The possibility of restoring Moneys Creek and providing controlled discharge should be investigated (Production Option #10**).** It presently flows all year in most years in its lower 400 m due to seepage. Residents have stocked and fed a few coho fry at times in the mid-1980's and CLSES maintained instream incubators at a site near 32 Cottonwood St. where fish had spawned in previous years. A mobile home was placed over the creek in this location in 1990. At least 17 private lots would be involved if restoration was to proceed. If South Money's was included, 11 more lots would be involved.

3. SUBSEQUENT MONEYS CREEK IMPROVEMENT: If restoration is undertaken, creation of pools and substrate improvement in Money's Creek (Production Option #11**) would increase spawning and rearing value. Addition of cover in the form of small windfall logs should also improve yield. This is a very small, shallow stream. As of 1994, it had almost disappeared. Moneys Creek coho smolt yield potential with 1m wetted width is 51. In order to maintain summer flow, a small weir with a siphon hole would need to be constructed at the outlet. .5 m of storage would yield 1.2 LPS for 120 days with a .3m evaporation loss. This could be supplemented by siphoning deeper in the lake in the area influenced by the spring.**

4. HEADWATER STORAGE AND CDP FLOW RELEASE FOR MONEY'S WETLAND: Money's Wetland could be improved by headwater storage on South Money's/Greenwell Creek where five wetland basins with a combined water yield of 3.86 LPS for 90 days are present (**Production Option # 12**)

5. MONEYS WETLAND EXTENSION: If permanent flow through the wetland can be established, extension can occur through excavation (**Production Option # 13**).

6. DITCH WALL STABILIZATION: Sections of the walls of Kwaasin Ditch (1971) are unstable and subject to failure. Willow wattle fencing and terracing could be employed to increase stability in this dangerous place (**Production Option # 14**).

D) LAND USE FACTORS

The lakes originally drained through Lake Cowichan Town and Money's Creek to enter the river 1,000 m below the weir. They now drain north via a ditch and enter the Cowichan River 4,000 m. downstream from the outlet. The ditch was constructed through a

zone of clay which lines 150 m of it and contributes small amounts of sediment to the Cowichan River's most important spawning zone during high runoff periods. The ditch was created by excavation and blasting in July, 1971. Lowering the lake level allowed more housing development. Not only Money's Creek has been filled but a significant portion of the shorezones of the two lakes have been filled.

Risk Potential

High.

Fishery Officer Narrative

E)PROTECTION NEEDS

The most important parts of Money's Creek system – Kwassin and Grant Lakes, Money's Creek and Money's Wetland are within the Town of Lake Cowichan. In the past, a great deal of damage was done to the system through land development in South Lake Cowichan: the diversion channel, filling of the creek and wetlands surrounding Kwassin and Grant Lakes and filling much of Money's Wetland. The Town even wanted to construct low cost housing around Money's Wetland which likely would have involved more filling. The system is now protected in the new Official Community Plan via water course protection area (DPA), floodplain and park designation (Money's Wetland). The possibility that Quamichan Ave. could be extended to King George as South Lake Cowichan develops, should be considered. If this happened, the Town might need to fill a portion of the wetland to extend the existing right of way. This should not be permitted.

Stream Code: 9202577512

Stream Name: Fairservice Creek and Lost Lake

Operational Management Unit: Lake Cowichan South

A) BIOPHYSICAL OVERVIEW: Fairservice Creek enters the Cowichan River from the southwest 7,500 m below the Cowichan Lake weir. The basin is steep and narrow above the 250 m contour then broadens over a gravel terrace before descending to the Cowichan River floodplain.

Air Photos BC 82007 138 - 139
Topographic Maps 92 C/16, 92C.090
Salmonids Co to 4,000 m.
St to 4,000 m.
Ct to 400 m.
Bt to 400 m.
Obstructions Rapidly steepening gradient at 4,000 m.
Max. Temp. (C) 11 (8/7/84)
Min. Disch. (m³) 0.003 - 0.02 (8/7/84) - Lower 400 m.
With the exception of R5, the entire stream dries above 400 m; often before May 1.

FAIRSERVICE CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|---------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | N/A | N/A | 1720 | 0.4-0.5 | UN | H | 200 | 800 |
| Reach 2 | 7.0 | 2.0 | 1360 | 1.0 | CON | N | 200 | 400 |
| Reach 3 | 7.0 | 0.0 | 1360 | 1.0 | CON | N | 3600 | 0 |
| Reach 4 | 5.0 | 0.0 | 127R | 5.0 | CON | N | 1000 | 0 |
| Reach 5 | 4.0 | 1.0 | 127R | 20.0 | CON | N | 1500 | 1500 |

Fairservice Creek is not well defined at its delta to the Cowichan Floodplain.

Lost Lake*

| Area (ha) | Elevation (m) | Volume (m ³) | Max. Depth (m) | TDS (mg/l) |
|--------------|------------------|-----------------------------|-------------------|---------------|
| 2 | 185 | | | |

*Lost Lake is not in the Fairservice Creek watershed. A low berm separates them. It contains a small population of SmB which mature at 30 - 35 cm. however only 2 adults were seen on nests in the 1985 spawning period during a snorkel survey.

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead spawners utilize 4,000 m of Fairservice Creek. Resident cutthroats and a few young brown trout are present in the lower 400 m. The entire stream dries except for the first 400 m and the last 1500 m. where summer flow is provided by seepage.

Production is also limited by high fall - winter discharge.

NOTE: Three chinook smolts were salvaged near Fairservice Main in May, 1996. One was tagged (net pen release)

C) PRODUCTION OPPORTUNITIES

Lost Lake has no outlet. This is unfortunate because it could yield 1,500 CO smolts. But it could also contribute smallmouth bass to the Cowichan.

1. **WETLAND IMPOUNDMENT:** Thirteen wetlands (**Production Option #15**) larger than 1 HA are present on the gravel bench portion of the basin (180 - 200 m). Utilizing them for storage and low flow release might provide 0.14 cms in the critical discharge period. Subsequent observation reveals they dry about the same time as the creek and may not be capable of holding very much water.

2. **FRY SALVAGE:** Fry losses are sometimes high; especially coho. On the basis of 1/m in the summer dry accessible area (25,200 m), 25,200 coho fry might be available for fry salvage (**Production Option #16**). Numbers are usually less however. In the spring of 1989, an average escapement year, only 500 fry were present in the area of reach 3 salvaged. However, as many as 10,000 fry were salvaged in the early 1990's and 37,000 fry were salvaged in 1996. Numbers are highly dependent on flow duration. In years when the creek flows long enough to permit full emergence, numbers can be very high.

3. **INCREASE COVER - COMPLEXITY:** If more CDP water can be provided, there is an abundance of opportunity to improve habitat via LWD delivery. Much of Reach 3 is LOD starved. (**Production Option # 17**)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging and thinning began in the early 1990's.

Risk Potential

Low.

E) PROTECTION NEEDS

Reach 1 is on the Cowichan Floodplain where it blends with Fairservice Sidechannel (111A) then fans into the Cowichan River. This highly sensitive riparian unit is included in the Cowichan Corridor. Reach 2 of Fairservice along with part of Reach 3 is in a shallow ravine which is in the FSZ. The upper reaches flow largely through upland landscapes but there are adjacent riparian areas and extensive wetlands are located on tributaries from the west. There is a fear that some of these wetlands will be lost in the next wave of residential expansion by the Town of Lake Cowichan. Some are located in Block 200.

OPERATIONAL MANAGEMENT UNIT 14 : RIVER SOUTH

OVERVIEW

River South OMU includes all the anadromous salmonid streams on the south side of the Cowichan River east of Fairservice Creek but not including the Koksilah. There are a total of nine: Jungle (Marwood), Cameron, Double D, Lodge (Ernie's Gulch), Dry Bend, Holt and Fish Ladder.

This OMU is relatively undeveloped. There is some rural residential and agricultural development in the Glenora – Deerholme area which influences Fish Ladder Creek but from there upstream, the area is industrial forest. There are forestry related impacts to streams in this section where second growth logging is well underway and there are impacts remaining from the first cut, the BC Hydro powerline right of way and the CN grade. For the most part, these are not significant.

LIMITING FACTORS

Primary limiting factors in the River South OMU are fish access and low summer flows. Secondary limits are lack of cover – complexity in some areas of streams and winter habitat.

PRODUCTION OPTIONS

There are 14 production improvement opportunities in the River South OMU. They are outlined and prioritized in Table 1.

Table 1: River South Production Options

| No. | Page | Location | Activity | Priority |
|-------|------|-------------------|---------------------------------------|----------|
| 1 | 1 | Jungle Creek | Link with wetland | 1 |
| 2 | 1 | | LWD addition | 1 |
| 3 | 3 | Cameron Creek | Inc. summer flow/controlled diversion | 1 |
| 4 | 7 | Bear Creek | Steelhead colonization | 2 |
| 5,6 | 7 | | Coho colonization/headwater storage | 3 |
| 7 | 8 | Dale's Creek | Barrier improvement | 1 |
| 8 | 9 | | Fry salvage/coho colonization | 1 |
| 9 | 9 | | LWD addition | 3 |
| 10 | 12 | Holt Creek | Barrier monitoring | 1 |
| 11-13 | 12 | | coho colonization | 1 |
| 14 | 13 | | Flow augmentation | 2 |
| 15 | 14 | Fish Ladder Creek | Sidechannel development | 2 |
| 16-17 | 14 | | Spawning platforms | 3 |
| 18 | 14 | | Monitor fishway | 2 |

Stream Code: 9202577701

Stream Name: Sutton Creek

Operational Management Unit: South Shore Tributaries: East

CVRD Electoral Area: F

- A) **BIOPHYSICAL OVERVIEW:** Enters Cowichan Lake 1.5 km west of Honeymoon Bay town site. Drains a relatively broad basin of comparatively low relief. A complex stream system with a number of important tributaries. Relatively lightly buffered and subject to high fall – winter discharge fluctuation.

Air Photos BC 82007 135 - 136
Topographic Map 92 C/16,92C.079, 92C.089, 92C.090
Salmonids Co to 10,500 m.
St to 10,500 m.
Rb to 10,500 m.
Ct to 10,500 m.
DV to 10,500 m.
Occ. Cm lower reaches
Obstructions Steep gradient and falls beginning at 10,500 m.
Max. Temp. (C) 18.5 (7/26/96) Reach 3
18.2 (7/28/98) R 3
Min. Disch. (m³) 0.16 (Reach 3) 250 m above the mouth of Millar Creek (8/26/96)
0.061 (Reach 4) 50 m above South Sutton (8/26/85)

SUTTON CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 30.0 | 0.0 | 3610 | 0.1 | CON | N | 365 | 0 |
| Reach 2 | 16.0 | 0.0 | 1540 | 1.0 | FC | L | 1000 | 0 |
| Reach 3 | 25.0 | 6.0 | 1450 | 1.0 | FC | M | 2500 | 5000 |
| Reach 4 | 10.0 | 6.0 | 1270 | 2.0 | ENT | N | 300 | 1500 |
| Reach 5 | 12.0 | 4.0 | 1360 | 1.5 | FC | L | 4000 | 16000 |
| Reach 6 | 8.0 | 4.0 | 1270 | 4.0 | CON | N | 2700 | 10000 |
| Reach 7 | 4.0 | 2.0 | 1144 | 16.0 | CON | N | 2500 | 5000 |
| Reach 8 | - | - | - | 8.0 | CON | N | 1500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Sutton Creek supports populations of coho, steelhead, resident rainbow and resident cutthroat trout and Dolly Varden Char. A few chum salmon are also present on an intermittent basis and early run chinook salmon are occasionally reported. Three were seen in early May, 1985. 75 chinooks (presumably fall run) were reported in Reach 2 on November 26, 1973. The large Cowichan Lake cutthroat trout spawn in Sutton Creek but their numbers are extremely low and spawning locations are unknown. The creek was also known as an important spawning stream for Cowichan Lake Dolly Varden which are also scarce. Individuals as large as 6 kg. were reported prior to the 1950's.

Production is limited by high fall - winter discharge and low summer flow. The lower 1,365 m dry. Gordon Main logging road contributes a good deal of sediment for much of the fall -winter.

C) PRODUCTION OPPORTUNITIES

1. **SIDECHANNEL DEVELOPMENT:** There is sidechannel development potential in Reaches 3 and 5, it is especially high in the Maple Flat/Big Split area of reach 3 (Production Option #1).

OMU 12: Lake Southeast
T. Burns and B.D. Tutty, 1999

Cold Spring, a 185 m relic-active channel on the west side of Maple Flat, was selectively excavated in 1996 to increase depth and area and draw groundwater. Base flow ranges from .69 LPS at the beginning of the channel to 15.16 LPS at the confluence with a Sutton Creek sidechannel (8/24/98). Temperatures ranged from 9.9 at the start to 11.9 at the end (8/21/98). The inlet end of this channel requires some defense. Other options are present in this riparian complex. The east side of Maple Flat has a number of possibilities in the area above Maple Flat Creek. The Cold Spring Channel has further development opportunity in the form of complexing and creating lateral ponding. This channel was developed by Hancock Timber/Campbell Group and Ted Harding/CLSES.

2. COHO AND CHINOOK COLONIZATION: Coho and chinook fry stocking in the headwaters (Production Options #2 and #3). Coho escapement and subsequent fry density is generally so low that the creek can be considered a colonization candidate in Reaches 6 and 7. Chinooks could be stocked in reaches 3 - 7.

3. FRY SALVAGE: Fry salvage is required in the lower 1365 m (Production Option # 4). Yield is usually 10 - 20,000.

D) LAND USE FACTORS

Forestry

Eighty percent of the basin is covered by advanced second growth. The remainder is early regeneration. Considerable second growth logging has occurred in the late 1980's and 1990's.

Residential/Golf Course

There is considerable development along South Shore Road including March Meadows Golf Course. Some of the housing and part of the golf course is within the riparian/floodplain zone of Sutton Creek and at risk from flooding. Aside from the loss of part of the riparian zone, there is intermittent pressure to channel and dredge the creek. When a large flood and property damage occurs, this will increase.

Risk Potential

Low to moderate.

Fishery Officer Narrative

E) PROTECTION NEEDS

No further urban invasion of Sutton Creek's riparian lands should occur. This not only applies to Reaches 1 - 2 but to upstream Reaches as well. Significant riparian areas are located adjacent to Reach 3 particularly in The Maple Flat/Big Split Area and lesser areas are located along Reach 5 and lower Reach 6. Beginning at Reach 6, Sutton Creek adjacent slopes steepen and there are a number of seepage points along these slopes which need to be avoided. Most of the tributaries also have this feature especially the pair at Mile 11 which feature very steep and moist slopes with salmonberry - Devil's Club landscape units on ravine walls.

Stream Code: 9202577701113

Stream Name: Millar Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Millar Creek enters Sutton Creek 1.5 km above Cowichan Lake. Summer flow is provided by groundwater seepage.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 106 to 107 |
| <u>Topographic Map</u> | 92 C/16, 92C.089, 92C.090 |
| <u>Salmonids</u> | Co to 3,000 m. Ct to 3,000 m. |
| <u>Obstructions</u> | A huge log jam at 2,500 m. The stream dries above this point. Old debris is present below this jam which periodically also forms barriers. |
| <u>Max. Temp. (C)</u> | 17.5 (8/26/96) |
| <u>Min. Disch. (m³)</u> | 0.010 (8/26/96 – R1) |

MILLAR CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 6.0 | 2.0 | 1450 | 1.5 | OC | L | 3000 | 6000 |
| Reach 2 | 4.0 | 0.0 | 127R | 30.0 | CON | N | 1500 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroat trout are present for 2.5 km. A few Cowichan Lake cutthroats may spawn in this creek.

Access is occasionally blocked by log jams.

C) PRODUCTION OPPORTUNITIES

1. LWD COMPLEXING: Lower Reach 1 could be improved by adding LWD. Upper portions of the Reach are rich in large woody material (although much of it is very old) and there is no lack overall but Lower Reach 1 is lacking and is very accessible above and below Gordon Main. At least two test sites should be established immediately above and just below the road and monitored for before and after utilization and post installation changes (Production Option #5).

D) LAND USE FACTORS

Forestry

The watershed is covered by advanced second growth. Steep moist slopes (salmonberry -swordfern -alder) adjacent to the stream from 500 - 2,300 m. Seepage points are present throughout this reach.

Risk Potential

Moderate.

Fishery Officer Narrative

E) PROTECTION NEEDS

Millar Creek is located in a ravine for much of its length. The walls are steep and moist in most areas. The ravine and lower delta comprise the FSZ.

Stream Code: NA

Stream Name: Five Culverts Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Sutton Creek 5,000 m above Cowichan Lake; drains two steep, narrow basins.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 135-136 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co to 100 m. Ct to 100 m. |
| <u>Obstructions</u> | A 5 m over 30 cascade at 100 m. |
| <u>Max. Temp. (C)</u> | 15.0 R! – 8/24/98 |
| <u>Min. Disch. (m³)</u> | West Fork 0.021 (9/26/85) East Fork 0.002 (9/26/85) Mainstem 0.023 (9/26/85) Mainstem 0.0108 (8/24/98 R1) |

FIVE CULVERTS CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 6.0 | 2.5 | 1360 | 1.5 | FC | L | 65 | 162 |
| Reach 2 | 9.0 | 2.5 | 2710 | 1.0 | CON | N | 60 | 150 |

WEST FORK

| | | | | | | | | |
|---------|-----|-----|------|------|-----|---|------|------|
| Reach 1 | 5.0 | 2.5 | 1360 | 2.5 | FC | L | 500 | 1000 |
| Reach 2 | 4.0 | 2.0 | 1360 | 8.0 | CON | N | 500 | 1000 |
| Reach 3 | 5.0 | 2.5 | 136R | 2.5 | CON | N | 500 | 1250 |
| Reach 4 | 4.0 | 2.0 | 127R | 40.0 | CON | N | 1000 | 2000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroat utilize the lower 100 m. There is a possibility that some of the cutthroat in this stream are progeny of cutthroat from Cowichan Lake. Coho numbers are surprisingly high in some years and brood fish have been taken from this creek. Main spawning area 10m upstream of Gordon Main. Gravel is quite compacted (1994).

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION : Potential above barrier smolt yield:100 - 1,000/1,250 fry required (**Production Option #6**). This stream should be considered as a brood stock source and, if warranted by escapement numbers, at least two females could be taken for fry outplants in the Sutton drainage.

2. LWD COMPLEXING: Reach 1 is sparse in LWD and is very accessible. Two good sites for single or double windfall logs are present above Gordon Main. The installations need to be monitored because they could jam the culverts under Gordon Main that give this creek its name (Production Option # 7).

Consideration should be given to removing these culverts but they have trapped gravel upstream which provides excellent spawning habitat.

D) LAND USE FACTORS

Forestry

Ninety five percent of the basin is covered by advanced second growth. The rest is early immature and new regeneration.

Steep, moist slopes (70 percent) are present adjacent to both forks for 2,000 m.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Large portions of the stream above the falls where it forks into two branches, are contained in steep, moist ravine landscape units. Logging should be well set back from ravine edges. There is some moist riparian landscape adjacent to Reach 1, especially to the south near Gordon Main.

Stream Code: 9202577701418

Stream Name: South Sutton Creek

Operational Management Unit: South Shore Tribs: East

- A) BIOPHYSICAL OVERVIEW: This moderate sized stream enters Sutton Creek from the south 6 km above Cowichan Lake. Drains two steep, narrow basins.

Air Photos BC 82007 135 - 136
Topographic Map 92 C/16, 92C.089
Salmonids Co to 1000 m.
St to 1000 m.
Ct to 1000 m.
DV to 1000 m.
Obstructions A 3 m falls at 1,000 m.
Max. Temp. (C) 9 (9/17/85)
Min. Disch. (m³) 0.11 (9/17/85)
West Fork:0.065
East Fork:0.045

SOUTH SUTTON CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 14.0 | 4.0 | 1540 | 1.5 | FC | L | 700 | 2800 |
| Reach 2 | 9.0 | 6.0 | 136R | 2.5 | CON | N | 300 | 1800 |
| Reach 3 | 5.0 | 2.0 | 1360 | 4.5 | CON | L | 1500 | 3000 |
| Reach 4 | - | - | - | 20.0 | CON | N | 1500 | - |

- B) FISH UTILIZATION AND LIMITING FACTORS

The lower 1,000 m are utilized by coho, steelhead, cutthroats and Dolly Varden.

Production is limited by high fall - winter flows and cool summer temperatures.

- C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION : Above barrier coho colonization smolt yield potential (West Fork):120 - 1,200/1500 fry required (Production Option #8).

- D) LAND USE FACTORS

Forestry

Fifty percent of the basin is in advanced second growth. The rest is early regeneration and early immature. The north slope of the East Fork is extremely sensitive to logging and road building. 50 stream courses are present on unstable soils on 70% slopes for 3,500 m - nearly the entire length of the stream.

Risk Potential

High.

E) PROTECTION NEEDS

There are large areas of stream adjacent ravine lands in this basin and many small tributaries that enter both forks through this landscape type. This is especially true of the north slope of the East Fork where many little tributaries enter over slopes that are greater than 70 % in many areas. Logging will have to be very carefully conducted here (likely summer only) and road building should be avoided in favour of heli – logging in the steeper parts of the basin.

Stream Code: 9202577701277

Stream Name: Slippery Creek

Operational Management Unit: South Shore Tribs: East

A) BIOPHYSICAL OVERVIEW: This stream drains a steep and narrow basin, enters Sutton Creek from the southeast 4,000 m above Cowichan Lake.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 135 - 136 |
| <u>Topographic Map</u> | 92 C/16, 92C.089 |
| <u>Salmonids</u> | Co to 100 m. Ct to 850 m. |
| <u>Obstructions</u> | A 3 m over 5 falls at 100 m. A 7 m falls at 850 m.4 |
| <u>Max. Temp. (C)</u> | 9 (9/17/85) |
| <u>Min. Disch. (m³)</u> | 0.09 (9/17/85) |

SLIPPERY CREEK

| | <u>Channel</u> | | | | <u>Side</u> | | <u>Length</u> (m) | <u>Wetted</u> Area (m ²) |
|---------|------------------|------------------|------------------|---------------|--------------------|----------------|----------------------|---|
| | <u>width (m)</u> | <u>width (m)</u> | <u>Substrate</u> | <u>Slope%</u> | <u>Confinement</u> | <u>Channel</u> | | |
| Reach 1 | 7.0 | 2.0 | 136R | 1.5 | OC | L | 100 | 200 |
| Reach 2 | 4.0 | 2.0 | 127R | 3.0 | CON | N | 750 | 1500 |
| Reach 3 | - | - | - | 25.0 | CON | N | 2500 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho and resident cutthroat in its lower 100 m and resident cutthroat for another 750 m.

Production is limited by access, high fall - winter discharge and cool summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. COHO COLONIZATION: Above barrier coho colonization smolt yield potential of 60 smolts based on 1,500 m² of upstream habitat at 0.5 fry/m²: fry required 750 (Production Option #9).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Reach 1 is on the Sutton Creek floodplain and is thus in the Sutton Creek FSZ. Portions of the upstream reaches are bordered by steep slopes where seepage is occasionally present. Logging should be set back from the edges of ravine portions of the valley, especially those where high soil moisture is present.

Stream Code: NA

Stream Name: Maple Flat Creek

Operational Mgmt. Unit: South Shore Tribs: East

A) Biophysical Description: Steam consists of two components: a lower section that's part of a sidechannel complex on the Sutton Creek floodplain and an upland segment that is groundwater fed from a strong sidehill spring.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 87024 42,43,44 |
| <u>Topographic Map</u> | 92 C/16, 92 C.089 |
| <u>Salmonids</u> | Co 327 Ct 327 |
| <u>Obstructions</u> | 1 m backfilled log @ 360 m, appears to be passable at high flows. |
| <u>Max. Temp. (C)</u> | 17.6 (8/25/96) |
| <u>Min. Disch. (m³)</u> | .0009 (R1 8/25/96) Flow drops to .0005 in Lower R2 then stream is intermittent for 112 m before flow increases to .003 CMS in Upper R2 where temperature decreases to 15 |

MAPLE FLAT CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|------------------------|
| Reach 1 | 12 | 3 | 1540 | .5 | OC | M | 70 | 0 |
| Reach 2 | 3 | 2 | 2120 | 1.0 | FC | L | 257 | 514 |
| Reach 3 | 3 | 1 | 2810 | 4.0 | CON | N | 70 | 70 |
| Reach 4 | 5 | 1 | 3700 | .5 | FC | L | 175 | 175 |
| Reach 5 | 20 | 1 | 9100 | .001 | UC | M | 50 | 50 |
| Reach 6 | 15 | 1 | 2800 | 3.0 | UC | M | 30 | 30 |
| Reach 7 | 2 | 1 | 1270 | 10.0 | CON | N | 500 | 500 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for at least 360 m. Their numbers are limited by critical period drying - the lower portion of the floodplain dries and, to a much lesser degree by access.

C) PRODUCTION OPTIONS

1. **SIDECHANNEL DEVELOPMENT:** It should be possible to provide more summer flow to Reach 1 and lower Reach 2 by excavation of a relic channel at 166 m. The lower 50 m of this 95 m long channel could be excavated with an infiltration pool at the 50m point. This channel is summer wet in most years but does not provide any flow. Similarly, excavation of a small channel at the base of the escarpment (327 m) could provide extra critical period water to the stream below this point (Production Options #10,11)

2. **BARRIER REMOVAL:** Removal of a barrier log at 360 m would provide access to an additional 257 m of habitable water which includes some spawning habitat which could be improved (Production Option #12).

3. **SUBSTRATE IMPROVEMENT:** The addition of at least two spawning pads to Reach 3 would extend recruitment upstream (Production Options #13).

4. **IMPOUNDMENT AND COHO COLONIZATION:** Reach 5 could be impounded to store approximately 2000 m³ and serve as additional rearing space. Stock with fry salvaged from Lower Sutton or Golf Course Creek (Production Options # 14, 15).

D) LAND USE FACTORS

Forestry

Area second growth is being logged.

Risk Potential

Low

E) PROTECTION NEEDS

Reaches 1 and 2 are on the combined Maple Flat – Sutton Creek floodplain which is a rather unique riparian landscape unit featuring large old growth maples as the dominant tree. This unit is highly utilized by the Sutton Creek elk herd and is deserving of special management status. Hancock Timber (the landowners) have, to their credit, logged around it on adjacent uplands but have not come close to this landscape unit. Above the floodplain, the creek enters a short ravine then another riparian reach before it climbs toward its headwaters. The ravine and upper riparian areas (Reaches 3, 4, and 5) are within the FSZ. The upper reaches are more stable and less sensitive.

STREAM CODE: NA

STREAM NAME: Golf Course Creek

OPERATIONAL MGNT. UNIT: South Shore Tribs: East

A) Biophysical Overview: A small Sutton Creek tributary that drains the lower slopes of the Seymour Range. Enters Sutton in Reach 1 at 500 M. near the North Boundary of March Meadows Golf Course.

Air Photos BC 87024 42,43,44
Topographic Map 92 C/16, 92 C.090
Salmonids Co 1000 m.
Ct 1000 m.
Cm occasional individuals to 730 m.
Obstructions 1 m over 2 cascade at 730 m (usually passable for adults but a juvenile barrier).
1.4 m backfilled log at 795 m. - passable
Max. Temp. (C) 15 but 22 in East Fork lower pond (7/26/96)
Min. Disch. (m3) .0005 7/26/96 lower 830 m dries.
.0003 East Fork
.0002 West Fork

GOLF COURSE (MANY FORKS CREEK)

| | Channel width (m) | Wetted width(m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|-------------------|-----------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 3 | 0 | 1720 | 1.3 | CON | N | 100 | 0 |
| Reach 2 | 8 | 0 | 8200 | .2 | FC | L | 240 | 0 |
| Reach 3 | 3 | 0 | 2710 | 1.0 | FC | L | 490 | 0 |
| Reach 4 | 4 | 1 | 2710 | 1.5 | FC | L | 285 | 285 |

EAST FORK

| | | | | | | | | |
|---------|----|----|------|-----|-----|---|------|------|
| Reach 1 | 8 | 2 | 9100 | .5 | OC | L | 70 | 140 |
| Reach 2 | 15 | 15 | 1000 | 0 | UC | N | 50 | 750 |
| Reach 3 | 2 | 1 | 9100 | 1.0 | FC | N | 185 | 185 |
| Reach 4 | 30 | 30 | 1000 | 0 | UC | N | 80 | 2400 |
| Reach 5 | 30 | 0 | 1000 | .01 | UC | M | 50 | 0 |
| Reach 6 | 1 | 0 | 1360 | 8.0 | CON | N | 1000 | 0 |

WEST FORK

| | | | | | | | | |
|---------|---|----|------|-----|----|---|-----|-----|
| Reach 1 | 2 | .5 | 5500 | 1.0 | OC | M | 280 | 140 |
|---------|---|----|------|-----|----|---|-----|-----|

B) Fish Utilization and Limiting Factors

Coho and resident cutthroats for at least 1000 m. Production limited by nil summer flow in the lower 830 m and very low to nil flow above this point.

The lower 20 m of Reach 1, all of Reach 2 and the lower 240 m of Reach 3 are subject to winter drying and egg mortality.

C) Enhancement Opportunities

1. HEADWATER STORAGE, SPAWNING PLATFORMS: Two impoundments on the East Fork (Reaches 2 & 4) store 2295 cubic meters of water for summer release and headwater stocking of coho fry. They were constructed in the summer of 1994 by the Campbell Group (Ted Harding). Two more pools with spawning pads can be created at 35 and 56 m on the West Fork (Production Option # 16)

2. GULVERT REMOVAL: Culvert removal is also required at the 235 m. point on the West Fork (Production Option # 17). Coho fry were present in The East Fork Ponds on July 26, 1996 despite a surface temp. of 22. Fish were active.

2. FRY SALVAGE/ COHO COLONIZATION: Fry salvage required in the lower 830 m. 1996 was the first year it was undertaken. Yield was 6000. Stream is subject to very early drying. Stock fry in East Fork headwater ponds if none have entered on their own (Production Options # 18, 19).

3. **OBSTRUCTION REMOVAL:** the cascade at 730 m can be improved by backflooding a pool at its base and creating a purchase point on its north edge. It appears to be passable at peak flows which approximate 1.5 cms (Production Option # 20).

4. **STRUCTURAL IMPROVEMENT:** If Golf Course Creek coho runs improve to the point where many spawners are ascending the falls, it will be prudent to improve the West Fork's carrying capacity/recruitment potential by complexing habitat via the addition of LWD and adding several spawning platforms in this gravel deficient reach. An old grade leads into the basin from Gordon Main and should be improved as a hiking trail/Streamkeepers access route (Production Options # 21, 22).

D) Land Use Factors

FORESTRY

Most of the basin is covered by advanced second growth. Logging has resumed along much of the creek.

GOLF COURSE

The lower 360 m is located on March Meadows Course where portions have been cleared to the banks.

Risk Potential

Low

E) PROTECTION NEEDS

The majority of Reach 1 is on March Meadows Golf Course. This portion of the stream is very unproductive and subject to rapid drying *even in the winter*. Above Gordon Main, there is extensive riparian zone adjacent to the creek as well as a small ravine before the stream splits into its two forks. Most of the riparian zone and the ravine is in the FSZ as is riparian habitat above the forks. There is extensive moist riparian area adjacent to the West Fork. This area is utilized by the Sutton Creek elk herd and is within the FSZ.

Stream Code: 9202577699

Stream Name: Ashburnham Creek

Operational Management Unit: South Shore Tribs - East

CVRD Electoral Area: F

A) **BIOPHYSICAL OVERVIEW:** This stream enters Cowichan Lake from the south at Honeymoon Bay. It drains a steep, narrow, non-buffered basin and is highly responsive to runoff.

| | |
|------------------------------------|---|
| <u>Air Photos</u> | BC 82007 135 - 136 |
| <u>Topographic Map</u> | 92 C/16, 92C.090, 079, 080 |
| <u>Salmonids</u> | Co to 1,500 m. Ct to 3,000 m. Rb to 3,000 m. DV to 1,500 m. |
| <u>Obstructions</u> | A 5 m dam at 1,500 m. A 3 m high 5 m long falls at 1,635 m. A 12 m falls at 3,000 m. |
| <u>Max. Temp. (C)</u> | 8 (9/26/85), 14 (9/1/97) Summer temperatures are higher in years when there is more flow and groundwater makes up a smaller portion of the flow. 15.1 (7/28/98 R2) |
| <u>Min. Disch. (m³)</u> | 0 (9/26/85) R1 (R1 is generally dry from mid-July to October) 0.043 (9/26/85) R4 60 m above the reservoir 0.007 (9/26/85) R5 50 m above the falls |

ASHBURNHAM CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-------------------------------|
| Reach 1 | 9.5 | 0.0 | 1720 | 1.0 | FC | L | 250 | 0 |
| Reach 2 | 10.0 | 0.0 | 1360 | 1.5 | CON | N | 950 | 0 |
| Reach 3 | 9.0 | 3.0 | 1270 | 4.0 | CON | N | 300 | 900 |
| Reach 4 | Reservoir | | | | | | | |
| Reach 5 | 7.0 | 3.0 | 127R | 5.0 | CON | N | 1500 | 4500 |
| Reach 6 | 6.0 | 2.0 | 127R | 8.0 | CON | N | 1500 | 3000 |
| Reach 7 | - | - | - | 40.0 | CON | N | 1000 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident rainbow and cutthroat utilize the lower 1,500 m. Resident trout are also present in the water supply reservoir and for 1,500 m above it. Dolly Varden are also present in the lower 1500 m and may be progeny of Cowichan Lake spawners. Cowichan Lake cutthroat spawners have been reported. An occasional steelhead may also utilize the stream.

Production is limited by low summer flows (the lower 1,200 m dry), access, high fall - winter discharge and cold groundwater summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. **COHO COLONIZATION:** Above barrier coho colonization smolt yield potential:224 - 1,120/2,800 fry required (Production Option # 23).

2. **FRY SALVAGE:** Fry salvage in Reach 1. (Production Option #24).

3. **STRUCTURAL IMPROVEMENT:** Addition of LWD to debris starved Reach 3 would improve its capability for coho and trout rearing. Reach 3 is the only accessible (to anadromous fish) Reach that isn't summer dry (Production Option # 25).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Most logging scars from the first cut have healed although a few slope failures remain that could receive some remedial work.

Water Supply

Ashbunham Creek is Honeymoon Bay's water supply. A reservoir is located at the 1,500 m point services the community via a pipeline. The system was constructed by the mill in the 1950's. The pipeline was recently replaced. The reservoir fills with gravel and sediment every 3- 5 years and cleaning is required.

Risk Potential

Low.

E) PROTECTIVE NEEDS

Portions of the mid and upper basin are very steep. These areas will require leave zones where they are adjacent to the creek and very careful road building and yarding. They are included in the FSZ along with areas in the lower basin that are enclosed by steep ground or at risk from erosion with streamside vegetation removal.

Stream Code: 9202577685

Stream Name: Robertson River

Habitat Mgmt. Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Bear Lake (a Cowichan Lake backwater) near Mesachie Lake Village. Drains a relatively low relief basin which is comparatively broad in its lower end.

| | |
|------------------------------------|--|
| <u>Air Photos</u> | BC 82007 136 - 137 |
| <u>Topographic Map</u> | 92 C/9, C/16 |
| <u>Salmonids</u> | Co 10,000 m. St 10,000 m. CM 5,000 m. Ch 5,000 m. Rb 15,000 m. Ct 15,000 m. Or 10,000 m. |
| <u>Obstructions</u> | Falls: 7 m over 10 at 10,000 m. |
| <u>Max. Temp. (C)</u> | 13 (8/25/85) |
| <u>Min. Disch. (m³)</u> | 0.0 for 5,000 m. 0.28 at 6,000 m. (8/24,25/85) 0.084 at 10,500 m. (8/24,25/85) 0.075 at 14,000 m. (8/24/85) |

ROBERTSON RIVER

| | Channel width (m) | Wetted Width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|----------------------|---------------------|-----------|--------|------------------------|-----------------|---------------|---------------------------|
| Reach 1 | 30.0 | 0.0 | 1720 | 0.5 | FC | M | 1500 | 0 |
| Reach 2 | 60.0 | 0.0 | 1720 | 0.8 | FC | M | 1000 | 0 |
| Reach 3 | 28.0 | 0.0 | 1630 | 1.0 | FC | L | 2500 | 0 |
| Reach 4 | 15.0 | 8.0 | 1360 | 1.5 | FC | L | 5000 | 40000 |
| Reach 5 | 10.0 | 6.0 | 136R | 2.5 | FC | L | 5000 | 30000 |
| Reach 6 | 8.0 | 2.0 | 1243 | 10.0 | CON | N | 1500 | 3000 |
| Reach 7 | 4.0 | 1.0 | 1243 | 0.5 | FC | L | 1000 | 1000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 10,000 m. Occasional chinooks (250 - 300 were noted on Nov. 26. 1973) have been reported in the lower 5,000 m. Resident rainbow and cutthroat are present for 15,000 m. Spawning runs of rainbow, cutthroat and Dolly Varden from Cowichan Lake are also present. Robertson River is the main spawning stream for the large race of Cowichan Lake cutthroats but their numbers are very low (<50).

Production is limited by low summer flows (the lower 5,000 m. and 2,500 m. of sidechannel dry in most summers) and high fall - winter discharge. 175,000 square metres of main channel and 7,500 square metres of sidechannel habitat are estimated lost to drying. Low complexity in the lower 5,000 m. limits steelhead production. General instability is also limiting in the lower 5,000 m., particularly in reach 2.

C) ENHANCEMENT OPPORTUNITIES

- FRY SALVAGE- COHO COLONIZATION:** Potential above barrier colonization coho smolt yield: 8,000 - 12,000/15,000 fry required. Fry salvage is required in the lower 5 km. Robertson River salvage yields are very high; often highest in the watershed and in the order of 50,000 to 150,000 (Production Options #26).
- GRAVEL REMOVAL/ FLOODWAY MANAGEMENT:** Removal of gravel in the lower 5000 m could expose flow (there is approximately 3 m of overburden). There has been periodic gravel removal for years by the Robertsons and Pacific. It needs to be coordinated into a plan for long term improvement (Production Option # 27).

3. **SIDECHANNEL DEVELOPMENT:** Sidechannel development on the west side of the river adjacent to Reaches 2 and 3 is feasible. The Coho Heaven Complex in upper R3 has considerable promise. (Production Option #28). A 370 m long groundwater channel now known as Blind Channel was excavated on the east side of upper Reach 2 in the summer of 1994. Further refinement will be undertaken to hold brood stock and provide spawning, rearing and overwintering (Production Option #29). A number of groundwater sidechannel development opportunities are present on the deltaic fan where the river enters Bear Lake. Several other relic channels are present to the west on the McKenzie Bay portion of the fan. These channels extend upstream to the middle section of Reach 1 and include a portion of river channel that was filled in the 1950's (Production Option #30).

D) LAND USE FACTORS

Forestry

Most of the watershed is advanced second growth - early immature above 500 m. Logging has resumed in many lowland areas.

Flood Control

The lower 1500 m are partially dyked. More work is anticipated as bed elevation is increasing. The South Shore Bridge was undermined in the Jan. 1986 freshet and again in March of 1997. There is low intensity residential-agricultural- industrial use of the floodplain.

Risk Potential

Moderate. A comprehensive flood control program could benefit fish production.

Notes

E) PROTECTION NEEDS

Robertson River has a very extensive floodplain adjacent to Reaches 1 through 4. It starts at the base of Surprise Canyon at the upstream end and continues downstream in varying widths and levels of stability. Areas of special concern are the Sixteen Creek Fan and Reach 1 of Sixteen Creek, Roache's Sidechannel and the East Robertson Fan which includes Reach 1 of East Robertson River, Choke Rope Sidechannel - Coho Heaven, Thistle Hell, the Nineteen Creek Confluence area and several areas downstream including the lobe of floodplain on the east side of the river between Nineteen Creek confluence and the Blind Channel, the Patricia Creek confluence area, the residential area along South Shore Road including the bridge bottleneck and Lower Reach 1 including the river delta particularly on the east side. There is a need for very careful logging and residential setbacks on the Robertson Floodplain because of the danger of major flooding and river breakout and because productive fish habitat is present.

Above the floodplain, there are areas of steep, moist slopes where road construction and harvesting will have to allow for slope and soil moisture considerations. These areas are too numerous to mention in any detail but they are included in the FSZ or Robertson River Corridor as are the floodplain - riparian components.

Stream Code: 9202577685102

Stream Name: Pastuch (Patricia) Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the west 1,500 m above Bear Lake. Drains a broad, low relief basin for 60% of its length; the upper 40% is steep and narrow. The Lower Basin is broad and moist. The stream divides into two forks at the 700 m point. The North Fork is very broad and unconfined with a wide riparian zone that holds its water well below a large beaver dam but is either dry or very close to it above the dam. North Fork flow is mostly water table water. There is only a small upland runoff component. Although both forks are relatively stable, the North Fork is remarkably so. The South Fork originates in a steep basin and is subject to summer drying in its middle reaches which are rather unstable

| | |
|------------------------|--|
| <u>Air Photos</u> | BC 82007 136-137 |
| <u>Topographic Map</u> | 92 C/16, 92C 080, 090 |
| <u>Salmonids</u> | Co 3000 m St/Rb occasional individuals CT 3000 m Cm occasional |
| <u>Obstructions</u> | 4 m falls at 3000 m Two 2 metre vertical drops with no resting pool between |
| <u>Max. Temp.</u> | 17 (8/26/85) |
| <u>Min. Disch.</u> | 0.024 100 m above Robertson (8/26/85) |

PASTUCH (PATRICIA) CREEK

| | Channel width(m) | Wetted width(m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|------------|------------------|-----------------|-----------|--------|---------------------|--------------|------------|------------------------|
| Reach 1 | 8.0 | 3.0 | 2800 | 1.0 | FC | L | 236 | 708 |
| Reach 2 | 60.0 | 4.0 | 1000 | .01 | UC | H | 464 | 1856 |
| North Fork | | | | | | | | |
| Reach 1 | 70 | 70 | 1000 | .01 | UC | H | 1100 | 77000 |
| Reach 2 | 60 | 3 | 1000 | .01 | UC | H | 500 | 1500 |
| South Fork | | | | | | | | |
| Reach 1 | 60 | 3 | 1000 | .01 | UC | H | 1400 | 4200 |
| Reach 2 | 20 | 0 | 2710 | .5 | OC | H | | |
| Reach 3 | 6 | 2 | 1540 | 2.0 | FC | L | | |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for 3000 m. Some of the large race of Cowichan Lake cutthroats use this stream along with residents and the smaller race of lake fish.

Production is limited by low summer flows but not to the extent of other area streams.

C) ENHANCEMENT OPPORTUNITIES

1. **HEADWATER STORAGE:** Headwater wetlands offer storage and ponding for low flow improvement and possible increased rearing space. Five HA are available and could provide 0.0007 cms for 180 days (Production Option # 31).

LAND USE FACTORS

Forestry

The basin is covered by advanced second growth.

Agriculture

Pasture adjacent to the lower 1000 m.

Notes

DFO operated smolt traps on Lower Pastuch in 1975 and 1976. Coho smolt catches were 4305 and 3996.

Coho Escapement

| | |
|------|------|
| 1977 | 816 |
| 1989 | 1106 |
| 1990 | 1320 |
| 1991 | 550 |
| 1992 | 274 |
| 1993 | 320 |
| 1994 | 715 |
| 1995 | 366 |
| 1996 | 78 |
| 1997 | 79 |
| 1998 | 627 |
| 1999 | |

Risk Potential

Low

E) PROTECTION NEEDS

The lowland portions of Patricia Creek are very moist in places and the stream is very poorly confined, especially the South Branch which wanders through a swamp forest of willow – red osier that is next to impenetrable in places. The mid area of the Robertson Farm is very representative of soil moisture levels. This portion of the farm is more marsh than pasture. The broad riparian zone in the lowland portion of the system is included in the FSZ along with portions of steep ravine lands in the upland portion of the system.

Stream Code: 9202577685230

Stream Name: Nineteen Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the west 3,500 m upstream. Drains a steep , narrow basin with a generally northeast aspect.

| | |
|------------------------|--|
| <u>Air Photos</u> | BC 82007 136-137 |
| <u>Topographic Map</u> | 92 C/16, 92C.080 |
| <u>Salmonids</u> | Co 8700 m St 8700 m Ct 8700 m DV 8700 m |
| <u>Obstructions</u> | Rapidly steepening gradient above 8700 m |
| <u>Max. Temp.</u> | 10.5 (8/30/85) |
| <u>Min. Disch.</u> | 0.212 (8/30/85) |

NINETEEN CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|----------------------|---------------------|-----------|-------|------------------------|-----------------|---------------|---------------------------|
| Reach 1 | 18.0 | 0 | 1450 | 1.0 | FC | L | 100 | 0 |
| Reach 2 | 11.0 | 5.0 | 1360 | 1.5 | FC | L | 1200 | 6000 |
| Reach 3 | 10.0 | 5.0 | 136R | 2.5 | CON | N | 5500 | 27500 |
| Reach 4 | 7.5 | 5.0 | 127R | 8.0 | CON | N | 2000 | 10000 |
| Reach 5 | - | - | - | 22.0 | CON | N | 1000 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead and resident rainbows, cutthroats and Dolly Varden are present for 8700 m. Resident cutthroats are also present in the lower reaches of at least three small tributaries. Cowichan Lake cutthroats and Dolly Varden spawn in this creek. In some years, steelhead and migrant cutthroats become landlocked above the 100 m section that dries on the fan

Creek Nineteen as many locals call it , holds its base flow quite well and is not as susceptible to CPD deficiencies as other streams in the system such as the mainstem Robertson. Gravel bedload has not accreted substantially despite considerable input from upslope logging disturbances..

C) ENHANCEMENT OPPORTUNITIES

1. **FRY SALVAGE:** Reach 1 fry salvage in dry years (**Production Option # 32**).

2. **LWD ADDITION:** Nineteen Creek is LWD starved but peak flows may be too high to sustain LWD. A test addition at the tote road crossing below Ashburnham Main Bridge is recommended. If successful for more than two winters, several more complexes can be added in Reach 2 (Production Option # 33)

3. **FERTILIZATION:** Nineteen Creek is a good candidate for fertilization because of its very low productivity (the creek is essentially non-buffered and faces north east) and ease of segmentation for comparative purposes (**Production Option # 34**)

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. Logging resumed on lowland sites in 1983. There are several problem areas on the south slope of Nineteen Creek that resulted from the old road – rail system. At least two streams were sluiced out by debris avalanches originating from old road crossings that were left intact.

Some clay - compact basal till on steep slopes (40 -80%) adjacent to the stream; poorly drained and subject to mass movement. An especially sensitive area is present on the north side of the creek at 3100 m. The old north side road cut through it and a slope failure resulted.

Risk Potential

Moderate

Notes

E) PROTECTION NEEDS

Nineteen Creek is relatively stable for most of its length in terms of both channel and bank integrity. However there are some areas of steep, moist slopes adjacent to the creek beginning in Reach 2 and persisting to various degrees well into the headwaters. There are some deeply incised tributaries in these areas that have ravines of their own with sidewalls over 100% in places. Careful road location and construction will be necessary to avoid problem areas. Some very sensitive zones will possibly require heli – logging or no logging.

Stream Code: 9202577685291

Stream Name: Easy Creek

Operational Management Unit: South Shore Tribs :East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the southwest 4,100 above Bear Lake. Drains a short, steep and narrow basin. Highly responsive to runoff. The lower portion of the stream traverses the Robertson Flats where it dewateres in early summer.

| | |
|-------------------------|--|
| <u>Air Photos</u> | BC 82007 136-137 |
| <u>Topographic Maps</u> | 92 C/16, 92C 080 |
| <u>Salmonids</u> | Co 1,500 Ct 1,500 |
| <u>Obstructions</u> | 3 m falls at 1,585 m .5 m vertical drop at Hillcrest Main culvert outfall (455 m) at mean winter - spring flows (.5 CMS): juvenile barrier |
| <u>Max. Temp.</u> | 11.5 (8/25/85), 14.9 (9/4/97) |
| <u>Min. Disch</u> | 0 for 585 m 0.0023 at 600 m (8/25/85) 0.0133 at 585 m (9/4/97) |

EASY CREEK

| | <u>Channel</u> | | | | <u>Wetted</u> | | | | <u>Length Area</u> | |
|---------|-----------------|-----------------|------------------|---------------|--------------------|---------------------|-------------|------------|--------------------|------------------------|
| | <u>Width(m)</u> | <u>width(m)</u> | <u>Substrate</u> | <u>Slope%</u> | <u>Confinement</u> | <u>Side Channel</u> | <u>LOD%</u> | <u>STR</u> | <u>(m)</u> | <u>(m²)</u> |
| Reach 1 | 7.0 | 0.0 | 2710 | 1.0 | FC | L | 1 | 6 | 110 | 0 |
| Reach 2 | 5.0 | 0.0 | 1450 | 1.5 | CON | N | 0 | 6 | 475 | 0 |
| Reach 3 | 5.0 | 1.0 | 127R | 3.5 | CON | N | 1 | 4 | 1000 | 1000 |
| Reach 4 | 4.0 | 1.0 | 127R | 40.0 | CON | N | 1 | 6 | 1500 | 1500 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats utilize the lower 1,585 m, Cowichan Lake cutthroats spawn in this stream.

Production is limited by nil to low summer flows and high fall-winter discharge. The bottom and banks are very unstable, especially in reach 1.

C) ENHANCEMENT OPPORTUNITIES

1. FRY SALVAGE: Fry salvage is required in Reach 1 and yield can be surprisingly high. The culvert pool at Hillcrest Main has produced up to 10,000 coho fry and over 100 smolts along with 30 trout parr and a cutthroat kelt (Cowichan Lake spawner) (Production Option #35).

Reach 1 dries very abruptly sometime in June in most years.

2. JUVENILE BARRIER IMPROVEMENT: Backflooding or replacement of the Hillcrest Main culvert would allow juvenile trout and coho from the lower creek to move upstream into summer wetted habitat. Most of the spawning habitat is located below the culvert while the only permanent rearing habitat is above it. There is also a movement of Robertson River coho fry into Lower Easy Creek in some years and it would be beneficial if some of these fish could move through the culvert rather than becoming trapped by drying and either being salvaged or perishing. The culvert was set flush with the substrate when it was installed but scour has lowered the streambed. Production Option # 36)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth except on steep, rocky slopes above 600 m. Difficult road building conditions in the Upper Basin.

Risk Potential

Low

Notes

Reach 2 has been ditched. The consequences are slight because of rapid drying and low overall habitat value in Lower Easy.

E) PROTECTION NEEDS

Steep terrain in the Upper Basin calls for very careful road building and fast de-activation and some heli-logging. A 15 m leave zone adjacent to reaches 1, 2 and lower reach 3 should suffice except for that portion of Reach 1 which is in the Robertson River Corridor.

Stream Code: NA

Stream Name: Benny's Creek

Operational Management Area: South Shore Tribs: East

CVRD Electoral Area: F

- A) Biophysical Overview: A very small groundwater stream wetted by the winter water table. The stream was partly created by excavation to build the original Robertson River Valley railroad grade. Drains a moist riparian flat adjacent to Lower Reach 4 of the Robertson near One Log Bridge Pool and Truck Road 2.

Air Photos: BC82007 156, 157
Topographic Maps: 92C/16, 92C.080
Salmonids: Co to 290 m
Ct to 290 m
Obstructions: None
Max. temp.
Mean Nov. – March temp: 7
Min. Disch:
Mean Nov. March Disch: .100 CMS (R!), .0114 (R3), .012 North Fork

BENNY'S CREEK

| | Channel Width | Wetted Width | Substrate | Slope | Confinement | Side Channel | Length | Area |
|---------|---------------|--------------|-----------|-------|-------------|--------------|--------|------|
| Reach1 | 1 | | 9100 | 1.5 | CON | N | 28 | |
| Reach 2 | 8 | | 1000 | .1 | OC | M | 104 | |
| Reach 3 | 2 | | 2710 | 1.0 | CON | N | 26 | |
| Reach 4 | 4 | | 1000 | .5 | CON | N | 132 | |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn and overwinter in the stream. Two redds were found at 0 and 12 m of R3 on Feb. 21, 1999. Cutthroat parr also winter in the channel. This stream has not been assessed during the summer but it likely dries or comes very close to it.

C) PRODUCTION OPTIONS

- 1) EXCAVATION: Excavation beginning at the upper end of R3 could provide more flow (**Production Option # 37**). **The stream will be assessed in the late summer of 1999 to determine if it carries water then. A test dig can occur at that time.**

D) LAND USE

Forestry

Within TimberWest/Pacific Cowichan Woodlands Division – advanced second growth. The surrounding timber is being logged.

D) PROTECTION NEEDS

Within the Robertson River FSZ Corridor. Although there is a small amount of upland between Benny's Creek and the Robertson, the entire unit from about 100 m west of Hillcrest Main to the Robertson should be retained. It is highly riparian and mostly deciduous.

Stream Code: 9202577685500

Stream Name: Sixteen Creek

Operational Management Unit: SouthShore Tribs.:East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the northwest 7,500 M. above Bear lake. Drains a steep, narrow basin.

Air Photos BC 82007 136 - 137
Topographic Map 92 C/9, C/16, 92C.080
Salmonids Co 4,500 m.
St 4,500 m.
Ct 6,000 m.
Rb 6,000 m.

Obstructions 2 m over 6 combination falls - log jam at 3,000 m.
Cascades at 6,000 m. Rapidly increasing gradient above.

Max. Temp. (C) 11 (8/25/85 – R4)
15.1 (8/24/98 – R2)

Min. Disch. (m3) 0 for 232 m July – early Oct. – R1
.0066 50 m point – R2 (8/24/98)
0.528 R4 (8/25/85)

SIXTEEN CREEK

| | Channel width | Wetted Width(m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|---------------|-----------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 16.0 | 0 | 1450 | 2.0 | OC | H | 232 | 0 |
| Reach 2 | 15.0 | 3.0 | 1360 | 2.5 | FC | M | 672 | 2016 |
| Reach 3 | 9.0 | 8.0 | 1252 | 2.5 | CON | N | 140 | 1120 |
| Reach 3 | 13.0 | 3.0 | 127R | 2.5 | FC | L | 3500 | 10500 |
| Reach 4 | 10.0 | 3.0 | 127R | 3.0 | CON | N | 1500 | 4500 |
| Reach 5 | 6.0 | 2.0 | 127R | 10.0 | CON | N | 1500 | 3000 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead and resident rainbow and cutthroat are present for 4,500 m.

Production is limited by low summer flows, high fall - winter discharge and cool summer temperatures. The lower 232 m dry.

C) ENHANCEMENT OPPORTUNITIES

1. **BARRIER REMOVAL:** Removal of the combination falls - log jam at 4,500 m. would provide another 4,500 square meters of accessible habitat. Coho fry colonization annually could be undertaken in lieu of this. Access to the site is difficult for heavy equipment (Production Option # 38)

2. **SIDECHANNEL DEVELOPMENT:** Steve's Creek, a 404 m long stream fed by a series of six springs and occasionally by spill from Sixteen Creek via a flood channel that enters at the 300 m point, an enhancement candidate. It provides stable winter habitat for Sixteen Creek and Robertson River. It also provides spawning. Productivity could be improved by berming off the flood channel and deepening the upper end of the stream at its headwater spring. It may also be worthwhile to extend the stream somewhat. There is a 192 m relic portion above the headwater spring and some of that could be excavated. More study at low flows is necessary to determine best treatment. This stream has not been viewed in the summer months. It was discovered by Steve Voller on April 4, 1999 (**Production Option # 39**).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth except for some steep slopes and mountain tops above the 600 m contour. The west slope of the mountain that parallels the stream above the 5000 m point is very sensitive to logging and road construction. Twenty-two small creeks are present in a 2500 m section of this slope which is characterized by highly erodible surficial materials.

Risk Potential

Moderate

E) PROTECTION NEEDS

Steep adjacent slopes and those of several tributaries require leave zones as do floodplain segments adjacent to Reach 1 and lower Reach 2. The FSZ is over 100 m wide in places on the south side of the creek in R1 and R2. Steve's Creek, a groundwater fed sidechannel, is present here as are a number of springs and flood channels. This area could be destabilized by clearcutting and roads. Road re-construction in the Upper Basin must be very carefully considered. A good deal of fines entered the creek from the first pass and subsequent erosion of roads left to themselves.

Stream Code: NA

Stream Name: Swampwater Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

- A) Biophysical Overview: Enters Sixteen Creek from the south 1,400 m. above Robertson River. Drains a broad, low relief basin containing two wetlands of significant size.

Air Photos BC 82007 136 -137
Topographic Map 92 C/9, 92.080
Salmonids Co 50 m but usually to 1,450 m
Ct 1,450 m
Obstructions Two 23 m long culverts at 50 m. They are velocity barriers at times
Max. Temp. (C) 12 (8/25/85)
Min. Disch. (m3) 0.0017 (8/25/85)

SWAMPWATER CREEK

| | Channel width (m) | Wetted Width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 5.5 | 2.5 | 136R | 2.0 | CON | N | 50 | 125 |
| Reach 2 | 5.5 | 0.0 | 1450 | 1.0 | CON | N | 80 | 0 |
| Reach 3 | 5.0 | 3.0 | 2440 | 0.5 | FC | L | 1500 | 4500 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present throughout. Coho utilization occasionally limited by a pair of culverts at 50 m. Cowichan Lake cutthroats spawn in this stream.

Production is limited due to culvert access and low summer flows. A section between 50 and 130 m dries.

C) ENHANCEMENT OPPORTUNITIES

1. BARRIER REMOVAL: Removal of the culverts from an unused section of logging road would provide 4,580 square meters of additional coho habitat that would be accessible in all conditions and to juveniles (Production Option # 40).

2. HEADWATER STORAGE: Headwater storage would increase minimum summer flow from 0.0017 cms to 0.0021 cms and might provide continuous flow throughout the lower reach. Drying is at least partly caused by bedload damming behind culverts. Beavers occasionally further complicate the situation by building dams at the culvert inlets (Production Option #41).

3. SUBSTRATE IMPROVEMENT: Quality gravel is limited; addition at selected sites would improve egg survival and spawning potential. A 2.31 m3 spawning platform was constructed in the summer of 1989. Upgrading this platform and the addition of two more would provide considerable benefit (Production Option # 42).

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. A lower portion of the creek was logged in 1996.

Risk Potential

Low

E) PROTECTION NEEDS

The most important protection needs for Swampwater is protection of the riparian lands and small seasonal feeder streams that surround its headwater wetlands and maintenance of the canopy/streamside vegetation. Both Lens Main and Hillcrest Main are close to Reach 3 and sometimes contribute sediment during rain or melt especially when hauling is in progress.

Stream Code: 9202577685437

Stream Name: East Robertson River

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the east 6,500 m. above Bear Lake. Drains a steep, narrow basin which broadens and becomes less steep above the 600 m. contour.

| | |
|------------------------|--|
| <u>Air Photos</u> | BC 82007 136 - 137 |
| <u>Topographic Map</u> | 92 C/16, 92C.080 |
| <u>Salmonids</u> | Co 1,350 m St 1,350 m |
| <u>Obstructions</u> | 1 m over 6 m cascade at 400 m; passable 1.5 m falls at 1,200 m; passable 40 m falls at 1,350 m |
| <u>Max.Temp.</u> | 15 (8/24/85) |
| <u>Min. Disch.</u> | 0 first 50 m 0.073 at 1,500 m (8/24/85) |

EAST ROBERTSON RIVER

| | Channel width | Wetted width | Substrate | Slope | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|---------------|--------------|-----------|-------|---------------------|--------------|------------|------------------------|
| Reach 1 | 15.0 | 0 | 1450 | 1.8 | FC | M | 50 | 0 |
| Reach 2 | 15.0 | 8.0 | 1360 | 2.0 | FC | M | 300 | 2400 |
| Reach 3 | 12.0 | 10.0 | 1261 | 2.5 | CON | N | 950 | 9500 |
| Reach 4 | 18.0 | 8.0 | 127R | 2.0 | CON | N | 1000 | 8000 |
| Reach 5 | 16.0 | 8.0 | 127R | 2.5 | CON | N | 1000 | 8000 |
| Reach 6 | 15.0 | 8.0 | 127R | 8.0 | CON | N | 2500 | 20000 |
| Reach 7 | 8.0 | 3.0 | 136R | 3.0 | CON | N | 1700 | 5100 |
| Reach 8 | 7.0 | 3.0 | 127R | 5.5 | CON | N | 400 | 1200 |
| Reach 9 | 6.0 | 2.0 | 1342 | 4.5 | CON | N | 1750 | 3500 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 1350 m. One brown trout fry was captured in Reach 1 in 1982.

Production is limited by high fall-winter discharge and low summer flows

C) ENHANCEMENT OPPORTUNITIES

1. COHO COLONIZATION: Above barrier coho smolt yeild potential: 984 - 6640 to 9750 fry required (Production Option #43).

2. FRY SALVAGE: REACH 1 AND ROACHE'S SIDECHANNEL: Fry salvage is required in reach 1 which is associated with a sidechannel complex of the Robertson (Roache's Sidechannel, a 340 m long sidechannel complex that generally dries by June or July. However, in wet summers it is sometimes flowing in its lower 140m). Yeild is generally less than 1,000 fry (Production Option # 44).

D) LAND USE FACTORS

Forestry

Most old growth has been harvested or burned in wild fires. Regen has been spotty on slopes between 2,500 and 4,500 m (stream length) due to a combination of fire history and low site productivity

Risk Potential

Low

E) PROTECTION NEEDS

The deltaic fan (Reaches 1 and 2) is unstable and contains a number of flood channels along with Roache's Channel; its part of the Robertson River FSZ. Above Reach 2 the river enters a canyon then is bordered by steep lands well into the headwaters.

Stream Code: 9202577685268

Stream Name: March Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

- A) Biophysical Overview: Enters Robertson River from the southeast 4,000 m above Bear Lake. Drains a steep, narrow basin – non – buffered and subject to high fall – winter discharge fluctuation.

| | |
|------------------------------------|---------------------------------|
| <u>Air Photos</u> | BC 82007 136 - 137 |
| <u>Topographic Map</u> | 92 C/16, 92C.080 |
| <u>Salmonids</u> | Co 1238 m. Ct. 1,238 m. |
| <u>Obstructions</u> | 3 m falls - log jam at 1,200 m. |
| <u>Max. Temp. (C)</u> | 15 (8/24/85) |
| <u>Min. Disch. (m³)</u> | 0.0056 (8/24/85) |

MARCH CREEK

| | Channel width (m) | Wetted Width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m ²) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|------------------------|
| Reach 1 | 9.0 | 0.0 | 1540 | 1.8 | FC | N | 38 | 6 |
| Reach 2 | 6.0 | 2.0 | 1360 | 3.5 | CON | N | 1200 | 2400 |
| Reach 3 | - | - | - | 35.0 | CON | N | 1300 | - |

B) FISH UTILIZATION AND LIMITING FACTORS

Resident cutthroats are present for 1,238 m. Coho can also access this distance but densities are very low. This portion of the stream was inaccessible to coho for an unknown period prior to 1987 due to an impassable culvert at 106 m . The culvert under Trace's Main is (a combination twin 1.3 m CSP and cedar log box culvert) is still subject to plugging. When this happens, flow sometimes diverts into a 1987 spill channel that runs south for 70 m before going under the road and into Robertson River.

Production is limited by low summer flow and high fall - winter discharge.

C) ENHANCEMENT OPPORTUNITIES

1. FRY SALVAGE: A few coho fry are often available for salvage in Reach 1 and are picked up by the Robertson River crew to be stocked in Upper Robertson River (Production Option # 45).

2. LWD ADDITION: Very little LWD remains in March Creek. It is recommended that a windfall log complex be added to Reach 2 at a point just upstream of TimberWest's stream sample station 981220201 which is located 138 m above Trace's Main and 244 m above Robertson River. If the material persists more than one winter, more complexing can occur (Production Option # 46).

D) LAND USE FACTORS

Forestry

Thirty percent of the basin is covered by advanced second growth, logging resumed in 1987. The remainder is in early stages of regeneration on thin soils and rock. There is a scattering of upper elevation old growth Douglas fir.

Risk Potential

Low.

E) PROTECTION NEEDS

March Creek's main protection needs are related to steep adjacent slopes that begin in mid to upper Reach 2 and extend well upstream into headwater tributaries.

Stream Code:

Stream Name: Robertson Sidechannel - Mayo Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) Biophysical Overview: A complex system with two major components: a steep mountain stream that flattens on the Robertson River floodplain where it gathers winter and early spring groundwater from the river aquifer to serve as an extremely important spawning and early rearing channel, especially for coho.

| | |
|-------------------------|--|
| <u>Air Photos</u> | BC 82007 136-137 |
| <u>Topographic Map</u> | 92 C/16, 92C.080,090 |
| <u>Salmonids</u> | Co 2500 m Ct 2500 m Cm 1680 m |
| <u>Obstructions</u> | 2 m combination falls - log jam at 2500 m.; series of high falls (200 m over 300 m) at 2600 m. |
| <u>Max. Temp. (C)</u> | 13 (8/15/86) in permanent section above 2000 m. |
| <u>Min. Disch. (m3)</u> | 0 for 2000 m then .008 (8/15/86) |

ROBERTSON SIDETCHANNEL - MAYO CREEK

| | Channel width | Wetted width | Substrate | Slope% | Channel confinement | Side channel | Length (m) | Area (m2) |
|---------|---------------|--------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 4 | 0 | 4510 | 0.5 | CON | N | 360 | 0 |
| Reach 2 | 8 | 0 | 2710 | 1.0 | CON | M | 1320 | 0 |
| Reach 3 | 3 | 0 | 1360 | 1.5 | CON | N | 200 | 0 |
| Reach 4 | 3 | 1 | 136R | 2.5 | CON | N | 500 | 500 |
| Reach 5 | 3 | 1 | 1252 | 35.0 | CON | N | 2620 | 2620 |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for 2500 m. Coho far outnumber cutthroats which are only common in the upper 500 m of accessible habitat. Possible reason: the lower 2000 m dry before cutthroat fry emergence. A few chums also spawn in the sidechannel in some years. Portions of the lower 2000 m dry before full coho fry emergence. In most years, many eggs and alevins are lost for this reason. Portions of Reach 2 now commonly dry in winter and the entire reach usually dries before May. Very large numbers of fry are trapped. The channel is excellent spawning habitat. Isolated from the extreme flows and temperatures of winter and nearly ideal substrate composition, it formerly hosted more than 1000 coho spawners on many occasions.

Extreme early drying is relatively recent (last 5 years). Prior to the 1960's, the sidechannel usually flowed until sometime in July.

C) ENHANCEMENT OPTIONS

1. FRY SALVAGE (PRODUCTION OPTION #47)

10,000-30,000 coho fry are trapped by diminishing flows. Most can be salvaged. Salvage conditions are very good but the channel dries early and fast. Careful monitoring is required between late March and May. Fry numbers are dropping fast as the number of spawners diminishes because flows are sometimes not present in spawning time.

2. PROLONGED FLOW VIA EXCAVATION (PRODUCTION OPTION #48)

It should be possible to prolong flow in Robertson Sidechannel by gravel removal to access the winter - spring water table. At least 1M of material will have to be removed. A large pit (trap) should be excavated above the removal area to catch annual accretion and prevent recurrence of the bedload build-up. The trap should be installed just below the upper access road by the dryland sort. Cross logs could be installed in the excavated section to create scour and hydraulic cover. Flow could also be extended by linking a relic portion of the sidechannel which is sometimes called the West Fork to a new channel (Blind Channel) that was excavated in 1994. This 320 m long channel accesses the winter water table and discharges to the Robertson River. The connector channel would be 325 m long. Another option is to connect the sidechannel to the river via a 500m long relic channel. The basic problem with the sidechannel is that the winter water table no longer serves it and flow is only provided by Mayo Creek. The creek's flows are far too low to supply the sidechannel except in periods of high runoff.

Note: It may be necessary to return a portion of the excavated gravel to the channel if underlying materials are mostly fines.

3.GRAVEL MANAGEMENT (PRODUCTION OPTION #49)

Improvement in gravel quality is necessary in Reach 1 where recent channelling has removed surface gravel and exposed fines. Several spawning pads should be constructed here.

A large gravel bar frequently forms at the confluence of the sidechannel and the river. Fry have a difficult time navigating it and it exposes them to heavy predation. It must be removed periodically. The landowner has done this on his own in recent years.

D) Land Use Factors

Forestry and Fire

The lower half of the basin is covered by advanced second growth. However, the upper half is in early stage of regeneration from logging, fire and a slope failure. Extensive areas of bedrock have been exposed by fire and erosion.

Risk Potential

Moderate but decreasing.

E) PROTECTION NEEDS

The riparian zone (approximately 20 Ha adjacent to the Lower Channel and Lower Robertson River) should be left intact and logging and road construction in the steep upper basin should be highly limited.

F) Notes

Coho Escapement

| | |
|------|---|
| 1977 | 1575 |
| 1978 | 1220 plus 400-600 holding at mouth on count day |
| 1986 | 366 |
| 1987 | 393 |
| 1988 | 285 |
| 1989 | 475 |
| 1990 | 621 |
| 1991 | 199 |
| 1992 | 30 |
| 1993 | 217 |
| 1994 | 57 |
| 1995 | 83 |
| 1996 | 22 |
| 1997 | 0 |

Stream Code: 9202577685023

Stream Name : Mesachie (Bear) Creek and Lake

Operational Management Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) Biophysical Overview

A small, low gradient stream well buffered by Mesachie Lake. The original stream course meandered through an extensive wetland between Mesachie and Bear Lakes. The present channel is relatively straight and much shorter. The new channel is likely an improvement in terms of recruitment potential because it has considerable gravel and some gradient. The old streambed was largely muck-detritus.

| | |
|------------------------|---|
| <u>Air Photos</u> | BC82007 136-137 |
| <u>Topographic Map</u> | 92 C/16, 92C.090 |
| <u>Salmonids</u> | Co, Ct, Rb, Ko |
| <u>Obstructions</u> | None |
| <u>Max. Temp.</u> | 22 (7/20/88) |
| <u>Min. Disch.</u> | 0 (generally from mid- July to the onset of fall rain although a few pools sometimes remain) |

MESACHIE CREEK

| | Channel width | Wetted width | Substrate | Slope% | Channel confinement | Sidechannel | Length (m) | Area (m ²) |
|---------------|---------------|--------------|-----------|--------|---------------------|-------------|------------|------------------------|
| SC Reach 1 | 8 | 0 | 9100 | .001 | FC | H | 30 | 0 |
| SC Reach 2 | 3 | 0 | 2800 | 1.0 | FC | H | 75 | 0 |
| Old Channel | 5 | 0 | 3700 | .01 | FC | N | 115 | 0 |
| Mainstem | 6 | 0 | 2800 | 0.5 | FC | N | 375 | 0 |
| SC 2 | 5 | 0 | 2800 | 0.2 | CON | H | 94 | 0 |
| Trib. Channel | 5 | 0 | 9100 | .01 | FC | H | 157 | 0 |

GUNDERSON'S POND

| | | | |
|--------|-------|------------|-----------|
| Area | Elev. | Max. Depth | Perimeter |
| .25 HA | 167 | 6m | 228m |

MESACHIE LAKE

| | | | | |
|------|-------|------------|-----------|------------|
| Area | Elev. | Max. Depth | Perimetre | Volume |
| 59.3 | 168 | 32m | 4050m | 11,450,000 |

B) Fish Utilization and Limiting Factors

Coho, kokanee and a few rainbows and cutthroats spawn in Mesachie Creek. The fry rear until the onset of drying. Coho spawning is heavy in years of high escapement. Incubation and early rearing conditions are very good but fry must leave the creek by early July thus limiting stream production. A survey on June 18, 1988 revealed that only 526 fry remained in the creek (514 coho and 12 cutthroat) - average of .16 per square meter; about 16% of carrying capacity at full wetted area. Lampreys, sculpins and sticklebacks also utilize the creek.

Four Mesachie Lake cutthroats (40-50 cm) spawned in Mesachie Creek between April 16 and May 5, 1989. Kokanee from both Cowichan and Mesachie Lakes spawn in the creek. Mesachie fish are somewhat larger (20-28cm as opposed to 15-18cm). Spawning peaks in late Nov. In 1989, 750 spawners from Mesachie Lake spawned in the top 200m. Occasionally rainbow spawners from both lakes utilize the creek and, on very rare occasions, steelhead are reported. These are likely returnees to the nearby net pens. A very occasional brown trout is also reported.

C) Enhancement Opportunities

1. MESACHIE LAKE STORAGE (Production Option #50)

One meter of storage in Mesachie Lake would yield .016 cms for Mesachie's Creek average dry period of 130 days. If evaporation loss is 30%, flow would be reduced to .012 cm. Ideal Mesachie Creek flow is .100 cms. This is not achievable without much greater storage. More than 10m of storage would be necessary to maintain this flow. Cook's Lake (a wetland at the head of Halfway Creek) storage of 2m would add another .002 cms for a total of .0132, only 13% of ideal. Nevertheless, a

survey on July 20, 1988 when Mesachie Creek was flowing at .002 cm, revealed significant numbers of coho and trout fry (258 and 100). Mesachie Creek's theoretical smolt yield is 263.

2. MESACHIE LAKE FRY STOCKING (Production Option # 51)

In 1976, Mesachie Lake produced 45,489 coho smolts (Argue, et.al. 1979). A decade later, yields have been about 13% of that figure. It was thought that salvaged fry stocked in Mesachie Lake may have helped account for high yields but, according to the records, Mesachie Lake has only been stocked once: 40,000 in 1985. However, Bear Lake was stocked in 1975, 1977 and 1978 (Burns et.al.1987) and some fish could have moved up to Mesachie.

Bear Lake Coho Fry Stocking:

| <u>YEAR</u> | <u>NO.</u> | <u>SOURCES</u> |
|-------------|------------|--|
| 1975 | 6,850 | Robertson River, & Sidechannel |
| 1977 | 41,290 | Robertson River, & Sidechannel, Meade Creek, Sutton Creek |
| 1978 | 15,126 | Robertson River, & Sidechannel, Sutton Creek |

Even so, these fish could not have added significantly to 1976 smolt production.

1975 was a high escapement year in the Cowichan System (40,000 spawners) and Mesachie Lake draws fish from other sources. Robertson River is probably a major source. The lower 500 m of the mainstem and 300 m of Robertson Sidechannel are vacated by coho fry in most years. Similarly, many coho fry leave Halfway Creek by June. There is also a fall movement of juvenile coho into Mesachie Lake.

If Mesachie Lake's productive capacity is 45,489 smolts, then 569,862 fry are required. It is highly unlikely that escapement is capable of supplying these fish. It is recommended that salvaged fry from Robertson River supplemented by hatchery fry be utilized to stock Mesachie Lake. Coho fry utilize the margin of Mesachie Lake in the spring and early summer. Minnow trap catches provide a rough estimate of numbers. In June, 1988, minnow trap catch indicated a fry population of 7/m² of shoreline (4,050m) - 28,350 fry; a shortfall of 541,512. Annual surveys should be carried out to determine fry stocking requirements.

D) Land Use Factors

Urban intrusion and second growth logging are threats. Risk potential is considered to be moderate. There has already been some loss of wetland near the creek and in Bear Lake's shorezone. The developer has also modified portions of the creek. Mesachie Lake is owned by Camp Imadene, a private religious group that desires to keep the lake as pristine as possible. The creek and its riparian zone along with the associated section of Bear Lake's shorezone are the property of Gary Gunderson.

E) PROTECTION NEEDS

All land use activities must be excluded from the riparian zone of Mesachie Creek which is known as the Mesachie Wetland and the riparian shorezones of Bear and Mesachie Lakes.

ESCAPEMENT DATA (COHO)

1941 1291
1942 999
1943 1826
1944 3292
1977 1697
1984 1153
1986 291
1987 431
1988 170
1989 156
1990 574
1991 77
1992 13
1993 41
1994 133
1995 373
1996 26
1997 47
1998 602
1999

2000
 2001
 2002
 Stream Code: N/A

Stream Name: Plantation Creek

Operational Management Unit: Lake South :East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A small, temporary stream draining the B.C. Forest Service Research area near Mesachie Lake.

| | |
|------------------------------------|--------------------|
| <u>Air Photos</u> | BC 82007 136 - 137 |
| <u>Topographic Map</u> | 92 C/16, 92C.090 |
| <u>Salmonids</u> | Co |
| <u>Obstructions</u> | None. |
| <u>Max. Temp. (C)</u> | N/A |
| <u>Min. Disch. (m³)</u> | 0 |

PLANTATION CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Wetted Area (m ²) |
|---------|----------------------|---------------------|--------------|--------|------------------------|-----------------|---------------|----------------------------------|
| Reach 1 | 3 | 0 | 2710 | .1 | CON | N | 35 | 0 |
| Reach 2 | 2 | 0 | 1726 | .2 | CON | N | 560 | 0 |
| Reach 3 | 100 | 0 | 9100 | 0 | UC | N | 500 | 0 |
| Reach 4 | 1-20 | 0 | 1810-91000.1 | | UC-CON | N | 750 | 0 |

B) FISH UTILIZATION AND LIMITING FACTORS

A total of 645 coho fry and 1 smolt were seined from Reaches 1 and 2 on April 26, 1988. Emergence was not complete so its probable that more fry could be produced. But spawning sites are very limited and the total is unlikely to exceed 1,000.

The creek dries by July but most coho fry rear in the lake.

C) PRODUCTION OPPORTUNITIES

1. **HEADWATER STORAGE:** It may be possible to maintain permanent flow by storing water (Production Option #142) in two wetland basins which have a combined surface area of 6.5 Ha and a theoretical storage capacity of 19.5 m could yield .0026 cm for 180 days and support 10,500 coho fry (Production Option # 53)

2. **SUBSTRATE IMPROVEMENT:** Spawning platforms in Reach 2 (Production Option #54) would improve fry yield in this very stable stream. However, it's unlikely that numbers would satisfy the carrying capacity of the wetlands so stocking will be required if the wetlands are impounded.

3. **FRY SALVAGE:** Fry salvage is required in Reach 1 (Production Option #53).

D) RISK POTENTIAL

Low. Most of the watershed is provincial research forest.

F) PROTECTION NEEDS

Plantation Creek is almost entirely within the BCFS Research Station Area. Several small wetlands are present and they require protection.

STREAM CODE:

STREAM NAME: Pawlik's (Mill) Creek

- A) Biophysical Description: A small run-off stream that dries very early in its lower reaches. Tributary to Mesachie Lake.

| | |
|------------------------|--|
| <u>Air Photos</u> | BC 82007 137-138 |
| <u>Topographic Map</u> | 92 C/16, 92C.090 |
| <u>Salmonids</u> | Co, Ct |
| <u>Obstructions</u> | Increasing gradient and small debris jams above 600 m. |
| <u>Max. Temp. (C)</u> | 14 |
| <u>Min. Disch.</u> | 0 in Reaches 1 & 2 |

PAWLIK'S CREEK

| | Channel width (m) | Wetted width (m) | Substrate | Slope% | Channel confinement | Side Channel | Length (m) | Area (m2) |
|---------|-------------------|------------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 1.5 | 0 | 4600 | 1.0 | FC | N | 98 | 0 |
| Reach 2 | 1.5 | 0 | 3610 | .1 | CON | N | 280 | 0 |
| Reach 3 | 5 | 0 | 2710 | 1.5 | FC | N | 190 | 0 |
| Reach 4 | 2 | 1 | 1360 | 3.0 | CON | N | 300 | 300 |
| Reach 5 | 2 | 1 | 1360 | 8.0 | CON | N | 700 | 700 |

- B) Fish Utilization and Limiting Factors

An occasional coho spawns in Reaches 1-3 in years of high escapement and high flow. Most takes place in Reach 2 - which parallels South Shore Rd. A few resident cutthroats are present in Reach 4. Production is highly limited by water availability. In many years, the stream is dry in Reaches 1-3 at spawning time.

- C) Enhancement Opportunities

Creation of spawning platforms in the lower part of Reach 4 might provide some benefit if coho spawned there. They could also be constructed in Reach 1 which also holds water better than Reach 2. However, this is not recommended because Pawlik's Creek is very marginal fish habitat.

- D) Land Use Factors

The entire basin is advanced second growth.

- E) Risk Potential

Moderate.

STREAM CODE:

STREAM NAME: Halfway Creek

OPERATIONAL MANAGEMENT UNIT: South Shore Tributaries: East

A) Biophysical Overview

A complex stream system subject to high fall-winter discharge fluctuation and extensive summer drying. Summer flow provided by three small tributaries where groundwater surfaces in their lower reaches.

Air Photos BC 82007 136-137
Topographic maps 92 C/16, 92C.090
Salmonids Co,Ct,Rb,DV,Ko
 None. South Shore Road culvert at 2,000 m
 is a velocity barrier at high flows.
Max. temp. (C) 15 (8/20/87)
Min. discharge (m3) 0

MAINSTEM

| | Channel Width | Wetted Width | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|---------------|--------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 5 | 0 | 3700 | 0.001 | CON | N | 30 | 0 |
| Reach 2 | 9 | 0.534 | 2800 | 1.0 | FC | L | 600 | 267 |
| Reach 3 | 30 | 0 | 7300 | 0.01 | UC | H | 720 | 0 |
| Reach 4 | 8 | 0 | 2800 | 1.5 | ENT | N | 800 | 0 |
| Reach 5 | 4 | 0 | 1450 | 1.5 | CON | N | 155 | 0 |
| Reach 6 | 3 | 0 | 1450 | 2.1 | CON | N | 362 | 0 |
| Reach 7 | 4 | 0 | 8200 | .5 | FC | N | 50 | 0 |
| Reach 8 | 12 | 0 | 1000 | .1 | OC | M | 448 | 0 |

GROUNDWATER TRIBUTARY 1

Salmonids Co, Ct, DV 495 m
Obstructions 2 m over 4 falls at 595 m
Min. disch. .0007 @ 50 m (9/23/87)

| | Channel Width | Wetted Width | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|---------------|--------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 7 | 2 | 2800 | 1.0 | CON | L | 40 | 80 |
| Reach 2 | 6 | 2 | 2620 | 1.5 | CON | N | 280 | 560 |
| Reach 3 | 5 | 1 | 4600 | .5 | UC | M | 105 | 105 |
| Reach 4 | 30 | 0 | 1810 | .5 | UC | H | 75 | 0 |
| Reach 5 | 5 | 0 | 1630 | 1.0 | CON | N | 75 | 0 |
| Reach 6 | 2 | 0 | 136R | 2.5 | ENT | N | 140 | 0 |
| Reach 7 | 1.5 | 0 | 136R | 20.0 | ENT | N | 500 | 0 |

GROUNDWATER TRIBUTARY 1 EAST BRANCH (T1B1)

Salmonids Co,Ct 250
Obstructions None. Gradient increases sharply above 600 m. Very doubtful that fish would migrate this far. Stream is subject to winter drying above 400 m.
Min. Disch. .0001 (8/24/96.)

| | Channel Width | Wetted Width | Substrate | Slope% | Channel Confinement | Side Channel | Length (m) | Area (m2) |
|---------|---------------|--------------|-----------|--------|---------------------|--------------|------------|-----------|
| Reach 1 | 4 | 1 | 2710 | .5 | FC | L | 200 | 200 |
| Reach 2 | 8 | 1 | 9100 | .5 | UC | H | 100 | 100 |

| | | | | | | | | |
|---------|---|---|------|-----|-----|---|-----|-----|
| Reach 3 | 3 | 1 | 2710 | .5 | FC | L | 100 | 100 |
| Reach 4 | 3 | 0 | 2710 | .5 | FC | L | 100 | 0 |
| Reach 5 | 3 | 0 | 1540 | 3.0 | CON | N | 200 | 0 |

TRIBUTARY 2

Salmonids
Obstructions Co,Ct, DV
South Shore Road culvert at 1000 m - a velocity barrier in high flows. Increasing gradient at 1800 m.
Min. disch. .0003 lower 435 m (9/23/87)

| | Channel | | Wetted | | Substrate | Slope% | Channel | | Length (m) | Area (m2) |
|---------|---------|-------|--------|-------|-----------|--------|-------------|--------------|------------|-----------|
| | Width | Width | Width | Width | | | Confinement | Side Channel | | |
| Reach 1 | 4 | 2 | 2710 | 1.0 | UC | M | 435 | 870 | | |
| Reach 2 | 8 | 0 | 6400 | 1.0 | FC | L | 100 | 0 | | |
| Reach 3 | 10 | 0 | 7300 | .1 | UC | M | 600 | 0 | | |
| Reach 4 | 3 | 0 | 3700 | 1.5 | CON | N | 400 | 0 | | |
| Reach 5 | 2 | INT | 1630 | 3.0 | CON | N | 300 | 0 | | |
| Reach 6 | 1.5 | INT | 1270 | 15.0 | ENT | N | 500 | M | | |

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and resident cutthroat trout are present. Migrant spawning cutthroat, Dolly Varden and Kokanee from Mesachie (and possibly Bear and Cowichan Lakes) also use the stream.

Production is highly limited by summer drying. In 1987, only 2022 square meters of wetted area remained in the system; 267 in the mainstem, 885 in trib. 1 and 870 in trib. 2. Some water was also likely present in Groundwater Trib. 1 East Branch (more often known as T1 – B1 but it was not inventoried until 1996, not a particularly dry summer. 400 square metres of wetted habitat were present then.

C) ENHANCEMENT OPPORTUNITIES

1. **FRY SALVAGE:** It is estimated that approximately 2000 fry could be salvaged in most years and utilized to stock Mesachie Lake (**Production Option # 55**).

2. **HEADWATER STORAGE** (Production Option # 56)

Storage and flow release from Fairservice (Cook's) Lake could yield .0023 cms for Halfway Creek's approximately 150 day dry period. Cook's Lake is a 2.1 ha marsh (Carex - Spirea - a headwater wetland basin of the mainstem) that usually dries by late spring. Storage required: 2 m. Some minor modification of the west inlet will also be required to prevent some inflow from being lost to Halfway Creek below the damsite. Inflow is critical. There are 9 inlets but 7 only flow during heavy runoff periods and the remaining two are small and seasonal. They generally only flow until mid-spring and even then they often go sub-surface before they reach the lake. Columbine Creek, the largest inlet which drains a large percentage of the north face of Mayo Mtn. goes underground 440 m above Fairservice Lake except during periods of high runoff. Above this point Columbine Creek flows well into the summer. It is not known whether 2.3 LPS will be enough flow to wet Upper Halfway significantly. This water may simply go underground as well.

3. **CHANNEL IMPROVEMENT** (Production Option # 57)

Reaches 4 & 5 of Groundwater tributary 1 and Reach 2 of its East Branch and Reach 3 of tributary 2 could be deepened and channelled to expose groundwater and concentrate flow. Channel organization is poor and summer flow is highly diffused in the gravel - sediment - detritus overburden. The same treatment could also be applied to R4 of T1B1.

D) LAND USE FACTORS

FORESTRY

The basin is covered by advanced second growth; some of which is being logged. An extensive thinning program is currently underway (1994).

SUBURBIA

A large subdivision was proposed (1988) for the ridge between Halfway Creek and Cowichan Lake. A good deal of groundwater seeps out of this area and it forms a significant percentage of the creek's catchment area.

RISK POTENTIAL

Moderate

E) PROTECTION NEEDS

Much of the lowland portion of the Halfway Creek Basin is part of the old bed of Mesachie Lake. This area is poorly drained with areas of moist organic soils and small wetlands. Nearly the entire area is salmonberry - swordfern or salmonberry - ladyfern - arum. Alder is the dominant overstory. I call this broad riparian area the " Mesachie Sponge" and consider it to be one of the most important fisheries sensitive zones in the region. All land use activities except perhaps highly selective seasonal logging should be excluded.

Portions of the upper reaches of some of the tributaries are very steep and deeply incised. They should be avoided by road construction and yarding.