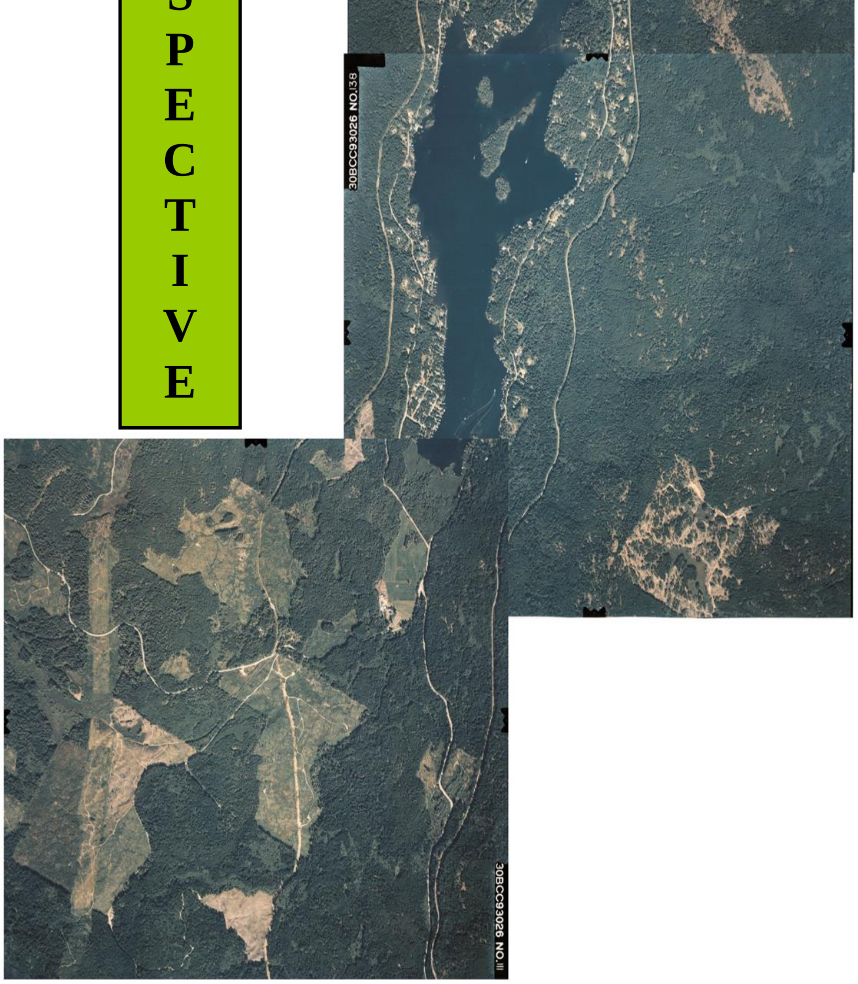
# Shawnigan Creek Watershed

## A FISHERIES PERSPECTIVE



"In witness thereof, observe the existing Shawnigan community. The people hereabouts have not despoiled the land, polluted the water or butchered the forest, as men have done in other places. They have jealously guarded their joint estate by a silent pact amongst themselves, a sort of unofficial constitution, all the stronger because it is voluntary."

Bruce Hutchison,
preface to "Green Branches and Fallen Leaves"

"Not everyone can live upstream"

60's bumper sticker

# Abstract

Fisheries habitat is under pressure from development throughout the rapidly urbanizing areas of eastern Vancouver Island and the lower Mainland. Quality instream coho habitat is becoming increasingly rare in this region, for it is the small to tiny streams the coho prefer which are the ones that are most easily crippled by the effects of urbanization. The Urban Salmon Habitat Program, provincially funded through the Ministry of Environment, Lands, and Parks, was developed to assess the state of existing fisheries habitat in urban areas of BC, recommend sensible options for restoration/enhancement, and fund habitat enhancement work in selected areas.

This report began as part of a Group Sustainability Project for the Camosun College Environmental Technology Program in the spring of 1999. The original intention was to perform an assessment of lower Shawnigan Creek for the USHP. A standard USHP assessment was conducted over the entire length of the lower mainstem of Shawnigan Creek, from the outlet of Shawnigan Lake to the estuary in Mill Bay. After completing the USHP assessment we expanded the scope of the project to include an overview of the entire watershed. The original written report was submitted to Camosun in July, 2000. Since that time, the students involved have all graduated or left the program. I have rewritten the original report and added some additional data and discussion, with the intention of submitting it to the USHP, as well as any government agencies, community groups, or private citizens who might have an interest in this charming little ecosystem.

The methods we used to gather USHP data, crunch the numbers, and display the results, is covered in Section 2. Results, discussion, and recommendations of the USHP assessment are presented in Section 3, along with a more detailed description of the creek. Additional fisheries issues, not directly addressed by the USHP assessment, are discussed on Section 4. A series of appendices are included as well, which cover some aspects of the report in greater detail, and support the body of the report with maps and graphs.

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## A Fisheries Perspective

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## Introduction

Southern Vancouver Island has experienced radical environmental change in the past 150 years. Almost all of the magnificent old growth Douglas fir forest that once blanketed the hillsides has been logged off. More recently, the majority of the land area along the east coast of the island has been cleared of native trees and converted to residential, agricultural, and commercial use. Many of these activities have had negative impacts on fish habitat.

Attempts to introduce salmon into watersheds where they never existed in the past are usually thought of as something that happens in other provinces, or countries, or hemispheres. Although there have been a few successes (such as introducing chinook into a few New Zealand rivers), most attempts have ended in failure. As runs of coho in urban areas of BC dwindle due to continuing habitat loss and degradation, few Vancouver Island residents realize that one of the success stories involving artificial creation of salmon runs is being played out in the heart of the most heavily populated region of the island, in between the major urban centers of Duncan and Victoria.

Although Shawnigan Creek has never supported coho in its natural state - due to the impassible falls located at its outlet into Mill Bay - a run has been established here by stocking the creek with coho fry from the nearby Goldstream hatchery. Through the considerable efforts of volunteers, returning adult cohos are captured every year when they return to the falls, and are then trucked to release points upstream. If a sustainable coho run can be established here, Shawnigan Creek would represent a substantial compensation for instream coho habitat that has been degraded, or has disappeared entirely, throughout the more heavily populated areas of southern BC.

A race of native kokanee salmon also survives in Shawnigan Lake, in the middle of the watershed. These are landlocked descendents of sockeye that were trapped in the lake when ocean levels dropped after the last great ice sheets melted away. Relieved of that enormous weight, Vancouver Island "rebounded" upwards some 200m in elevation – like a freighter that has offloaded its cargo. In the process, the falls now found along lower Shawnigan Creek were exposed above sea level. The other salmon species that presumably once thrived in this watershed could no longer migrate to the sea, and could not survive as adults in the limited confines of the lake. Only the kokanee were able to endure there – an isolated and dwarfed version of their magnificent brothers and sisters, who range over the north Pacific, and pass by in schools of thousands every summer a few kilometers to the east, on their way down the Strait of Georgia to the Fraser River.

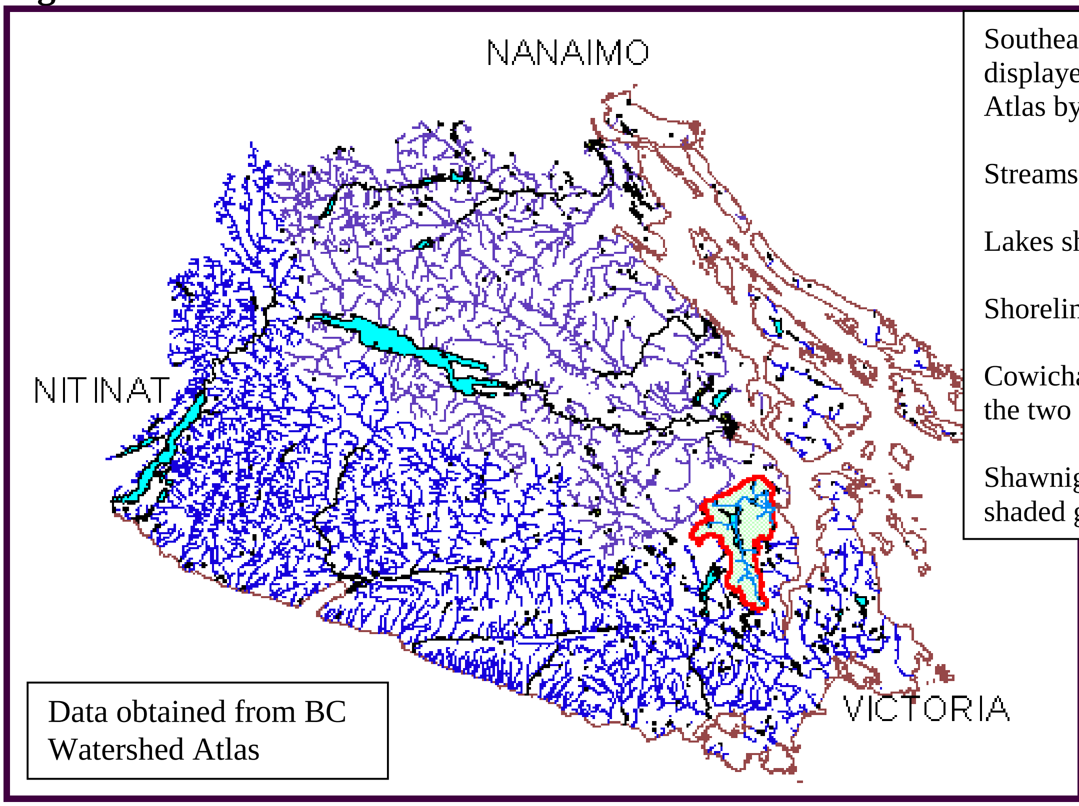
These two unique salmon populations – one so ancient, and the other only 20 years old – offer a refreshing contrast to the normal fate of salmon in the face of urban sprawl. USHP suggested that an assessment of the Shawnigan watershed from a fisheries perspective would be a good topic for a Group Sustainability Project, required of every student in the Camosun College Environmental Technology Program. A group of students including Lucas Philp, Darryl Huculak, Don Merry, and myself – Richard Best – were asked by BC Ministry of Environment to perform a USHP assessment of the mainstem of Shawnigan Creek, and to review all information and issues involving the fisheries resource in this watershed.

We completed recording the USHP assessment data by walking up the creek from the mouth at Mill Bay to the source at Shawnigan Lake in a series of expeditions during May/June 1999. Lucas did much of the actual USHP assessment work himself, due to the fact that the rest of us were unable to take time off work during the week. Lucas graduated from the Camosun ET program in summer, 1999, after presenting a preliminary discussion of the results. Subsequently Darryl, Don, and I expanded our efforts to research issues that affect the larger watershed, since everything that happens upstream may eventually impact the areas we had surveyed below. Don later withdrew from Camosun – to get married and buy a house among other things. Darryl and I presented our part of the Group Sustainablilty Project at a public gathering at Camosun in June, 2000, and in written form shortly thereafter.

Since that time I have tied up some loose ends, done more research on some issues, and included some additional commentary, graphs, photos, and GIS screen captures. I am posting this report on the internet in the hopes that it may be a useful resource for government agencies, community groups, and concerned individuals. I am also posting other pertinent information I come across concerning the watershed in a series of linked appendices. Any opinions expressed in the report section are my own.

Before proceeding any further, I would like to thank some of the many people who contributed time and effort to the project: Lucas, Darryl, and Don, who helped walk the creek, gather the data, and crunch the numbers; the entire Camosun Environmental Tech program, especially Barry Weaver, our project supervisor, Mike Corry, retired chairman of the program, and Peter Marshall, who managed the equipment and the computers for our project; Tracy Michalski, George Reid, and Lew Carswell of Nanaimo Ministry of Environment, who look after the USHP program and the fish trapping permits; the staff at BC Fisheries (where I was first a coop student and later a contractor) who provided me with a great deal of training and advice in regard to loading our data into GIS format so that it could be displayed and queried; David Sulz, a local resident who helped set G-traps and record data in summer 2000, Gerald Harris, another local resident who helped pole seine in 2001; and finally, to the many other individuals I have met over the past few years who are all working in their own ways to preserve and improve fisheries habitat within the Shawnigan watershed.

**Figure 1: Southeast Vancouver Island streams and lakes.**




Southeast Vancouver Island, as displayed in the BC Watershed Atlas by ArcView

Streams shown in dark blue

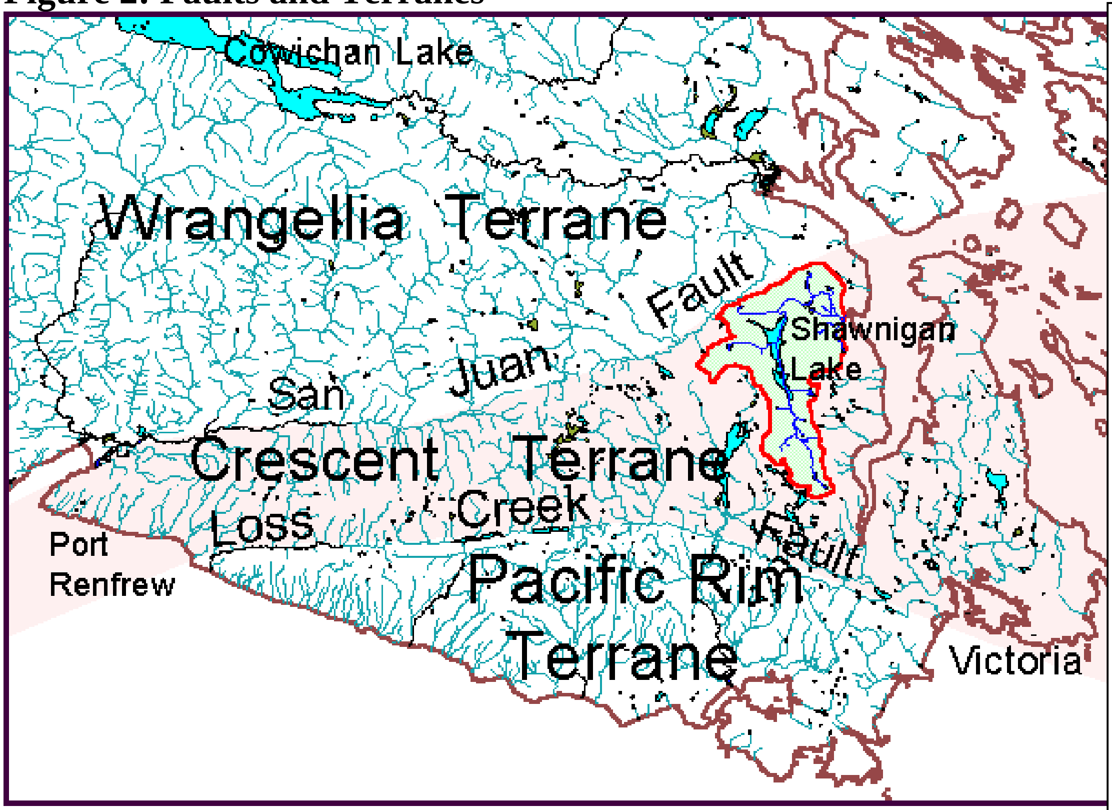
Lakes shown in light blue

Shoreline shown in brown

Cowichan and Nitinat Lakes are the two largest lakes shown.

Shawnigan Creek watershed is shaded green and outlined in red

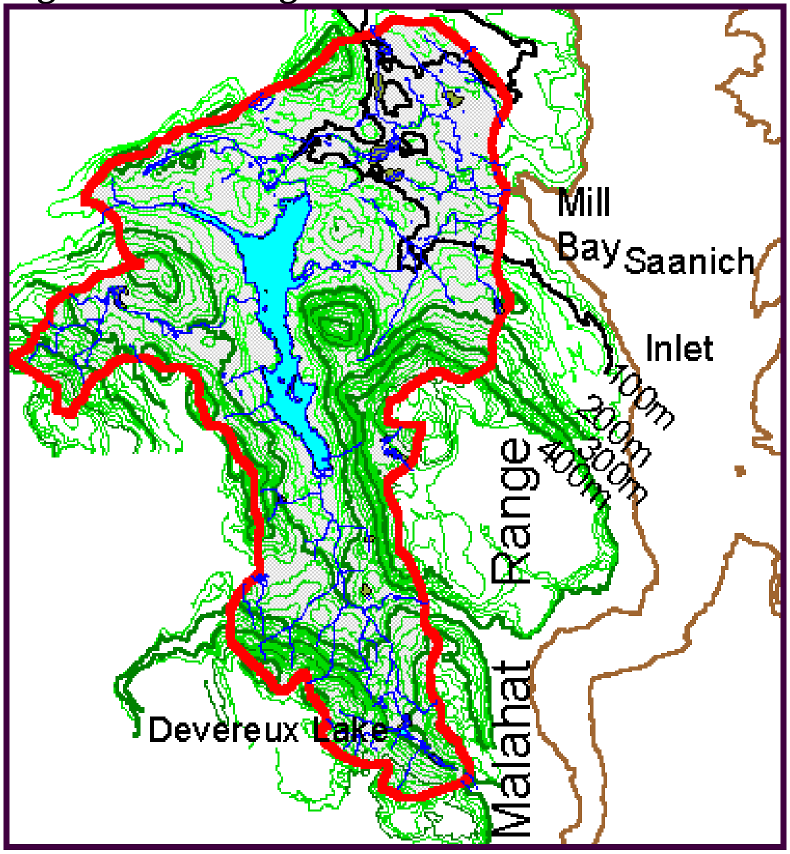
**Figure 2: Faults and Terranes**




The faults and terrane units of southern Vancouver Island are clearly visible in the stream linework of the BC Watershed Atlas.

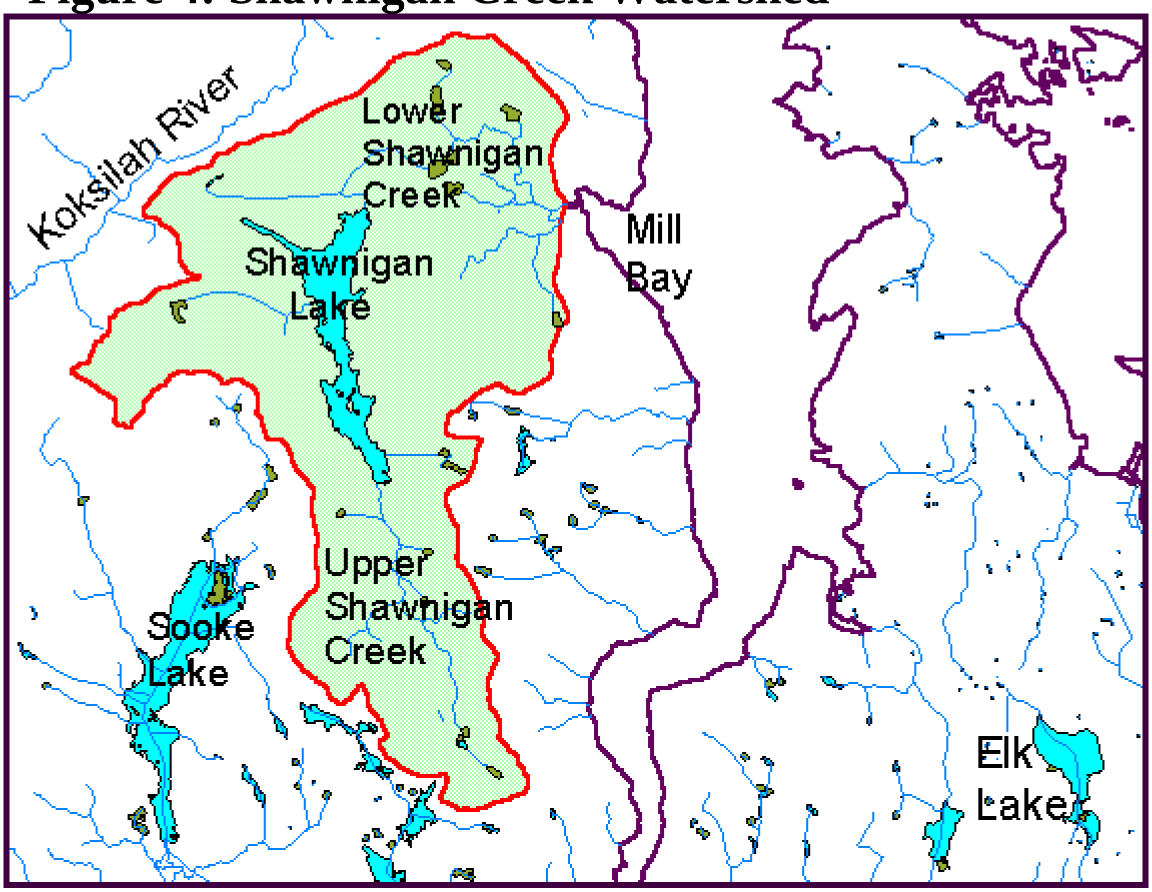
The majority of Vancouver Island consists of Wrangellia Terrane. The Crescent Terrane was accreted later. The San Juan and Koksilah Rivers now flow along the San Juan Fault where these two terranes are joined. At a later date, the Pacific Rim Terrane collided with North America, and was driven under both earlier terranes along the line of the Loss Creek Fault. Loss Creek and Goldstream River now flow down the valleys created by this fault.

**Figure 3: Shawnigan Watershed TRIM contours**




Upper Shawnigan Creek begins as the outflow from Devereux Lake, and then flows north into Shawnigan Lake. Lower Shawnigan Creek flows out of the lake and turns to the east. It enters the ocean at Mill Bay, Saanich Inlet. Low mountains surround upper Shawnigan Creek and the upper part of the lake. The lower part of the lake and lower Shawnigan Creek are surrounded by gently rolling landscape , covered in gravelly debris left behind after the Fraser Glaciation.

## Figure 4: Shawnigan Creek Watershed



# Section 1: Site Description

If George Orwell had been a stream biologist, he might have said of the Shawnigan Valley: “All watersheds are unique, but some are more unique than others.”

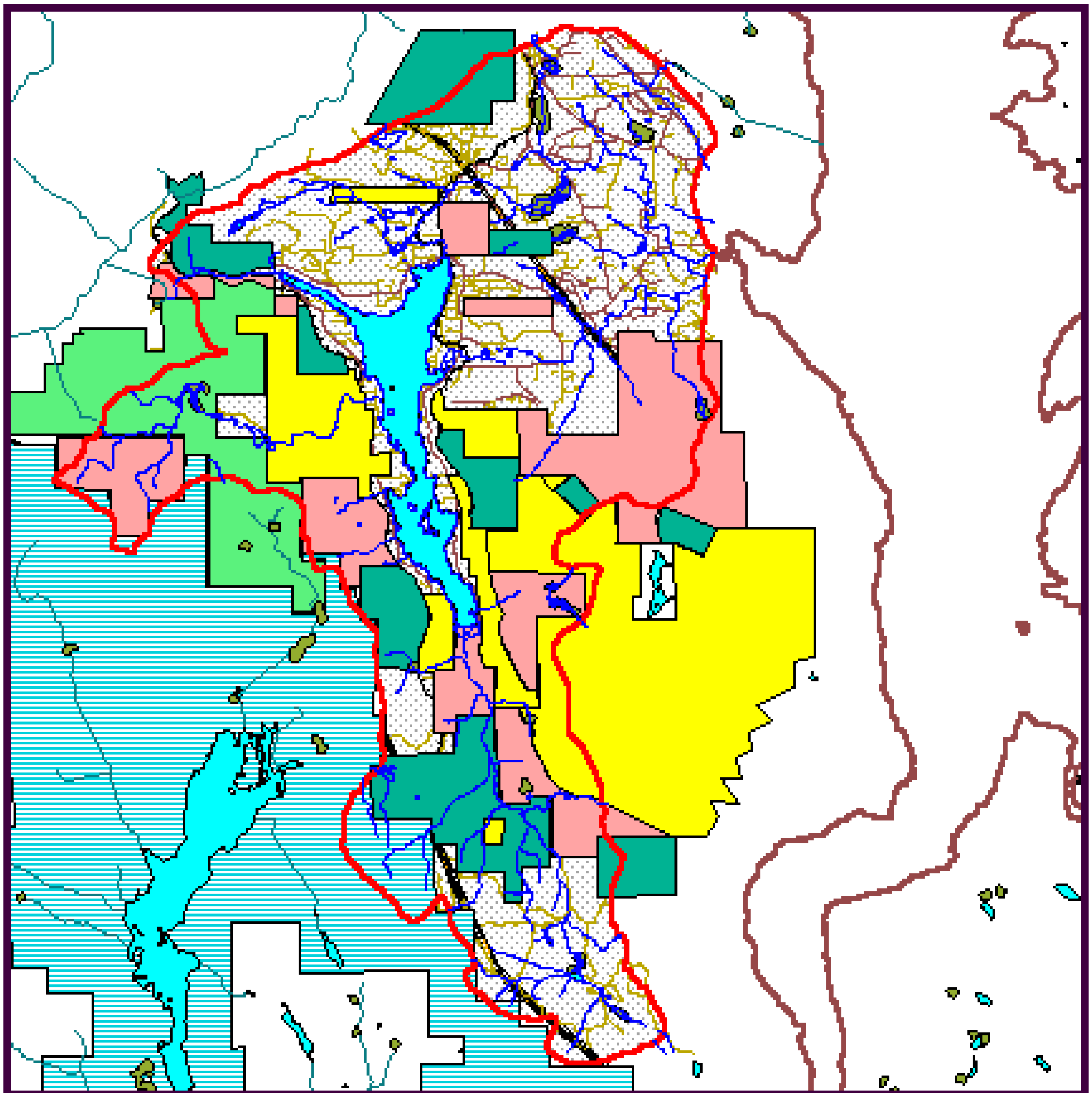
Shawnigan Creek (coded 920-235800 in the BC Watershed Atlas) is a relatively small stream located on the east coast of southern Vancouver Island, between Victoria and Duncan. The main portion of the watershed is separated from the coast by the Malahat Range, until it curves around the northern end of these mountains and enters the ocean at Mill Bay. It is surrounded by the Koksilah River watershed to the north and west, the Sooke River watershed to the west and south, the Goldstream watershed to the south, and a number of small creeks to the east that drain directly into Saanich inlet. The basin slopes first to the north and then east into tidewater at Mill Bay, Saanich Inlet.

The Shawnigan watershed is bounded to the north by the San Juan Fault, and is therefore underlain by rocks of the Crescent Terrane. (See Figure 2) From the headwaters of Upper Shawnigan Creek down to approximately the middle of Shawnigan Lake the soil is underlain by metamorphic Wark and Colquitz gneiss - ancient rocks from the Paleozoic era. From the middle of the lake down Lower Shawnigan Creek to the top end of the Cameron/Taggert swamp the underlying rocks are mid-Jurassic Bonanza Group volcanics. From the swamp on down to the ocean the creek runs through recent glacial deposits – first Vashon Drift and then Quadra Sands – with occasional exposures of bedrock in the creek channel. Shortly before reaching Mill Bay, the creek runs off the edge of the glacial deposits and cuts steeply down through the igneous, mid-Jurassic Island Intrusions group to tidewater. The entire watershed has been recently glaciated. (Yorath, 1995)

According to the BC Watershed Atlas, the Shawnigan watershed has an area of 113,201,336$m^2$ ( = >113 million $m^2$ = > 11,300 ha), and a perimeter of 63,695m (= > 63 km). The entire watershed lies within the CDFb biogeoclimatic zone (Coastal Douglas Fir – wet). This region experiences warm dry summers and mild moist winters. Annual precipitation averages about 120cm, of which about 95cm falls during the winter months from October-March. (Addendum to 1953 Report: “Shawnigan Lake Flood Control”) This leaves only 15cm of precipitation, about 20% of the total, that falls from April-September, when human demand and evaporation – and fish growth - is greatest. The combination of low elevations found throughout the watershed along with the moderate, Mediterranean-style climate results in a typically low level of snowpack, which melts away early in the spring. From June through October the water table drops because there is no more snowmelt and limited precipitation, and flow down the creek diminishes.

The upper part of the watershed, including slopes surrounding the upper part of the lake, is characterized by low mountains with ice-scoured slopes and valley bottoms filled with an assortment of glacial debris. Below the lake the valley opens out onto a rolling plain with kettle/moraine relief, before draining into the submerged river valley that is now Saanich Inlet. The entire surrounding ecosystem was once dominated by Douglas fir forest, almost all of which was logged off in the past century. Another generation of Douglas fir now covers most of the landscape, and is being harvested once again.

# Figure 5: Shawnigan Watershed Land Tenure




This image a "cartoon" drawn in ArcView from an old topographic map. It is intended to provide a rough idea of land tenure in and near the watershed.

More accurate GIS mapping files exist, but they are much to expensive for the public to obtain and use - even though the public often pays for them in the form of taxes or subsidies.

Both Timberwest and Weyerhauser own large private landholdings within the watershed. Parts of Timberwest Tree Farm License #46 also extend within the western boundary. Significant portions of crown-owned forest land also remain within the watershed. The area along the lakeshore has now largely been converted to lawns, flowers, and summer cabins. Urban development and population density are greatest around the north end of the lake. Most of the lower (and flatter) part of the watershed downstream of the lake is a privately owned mixture of agricultural and residential properties. Large agricultural fields also cover much of the lower part of the watershed.

The new Vancouver Island Highway crosses over Shawnigan Creek on a high double bridge, located just upstream of the creek's outfall into the ocean in Mill Bay. The village of Mill Bay has developed around this site. Shawnigan Lake once served as a convenient booming ground for logs from the surrounding forests, and the village of Shawnigan Lake developed along with the sawmills operating on its shores during the early part of the 20th Century. Railroads were also built through the valley, one along the east side of the lake (the track of the current E+N Railway) and another (now inactive, its bed converted into a hiking trail) up the west side. The sawmills are long gone now, and the area now serves as a bedroom community for the cities of Victoria and Duncan. The lake is a popular recreational attraction for summer cabin owners, and especially for growing numbers of increasingly higher-powered and higher-velocity watercraft. (See composite aerial photo of the Shawnigan Creek watershed in Appendix 1)

**<u>The Shawnigan watershed is composed of three major habitat units:</u>** Upper Shawnwigan Creek, Shawnigan Lake, and Lower Shawnigan Creek. (See Figure 4)

**A) <u>Upper Shawnigan Creek</u>**

Upper Shawnigan Creek originates as a drainage from Devereaux Lake (BC WSA WaterBody ID: 00215VICT, area: 28,245 $m^2$ [= > 2.8 ha]) and a group of surrounding wetlands located in the hills between the Malahat to the east and Sooke Lake reservoir to the west, at an elevation of about 375m. Upper Shawnigan Creek then flows north and slightly west at a relatively steep gradient for about 7 km before discharging into Shawnigan Lake, the second major unit in the watershed. This stretch of the creek is steep, rocky, and heavily forested, except where recent clearcuts have removed large cutblocks of trees. The lower reaches of Upper Shawnigan Creek serve as important spawning and rearing habitat for salmonids migrating up from the lake, until they are stopped by a falls upstream.

**Figure 6: Upper Shawnigan Creek**

The lower region of Upper Shawnigan Creek (blue line) is undergoing extensive timber harvesting

Large cutblocks of MacMillan + Bloedel (now Weyerhaeuser) private land have been logged here in recent years. There are also large parcels of crown-owned forest land within the upper watershed, as well as blocks of Timberwest private lands. (See Figure 5)

**B) Shawnigan Lake**

Shawnigan Lake (WSA WaterBody ID: 00091VICT - See Figure 7) is the largest natural lake on the southern end of Vancouver Island, south of Cowichan Lake. With an area of 5,270,391$m^2$ (= 527 ha), this lake comprises an unusually large 8% of the total watershed area. The registered elevation of Shawnigan Lake is 116m, although the lake level actually fluctuates over a range of nearly 3m, depending upon the season and the weather. It has a perimeter of 27,981m (=< 28 km). Total volume is calculated at 64 million $m^3$. The main lake basin runs in the same generally northerly course as the inflow valley, with one long arm leading to the west. In addition to the inflow from upper Shawnigan Creek, the lake is also fed by a number of smaller, seasonal creeks, the largest of which is McGee Creek on the western side.

Unlike most of the lakes along the lowlands of eastern Vancouver Island, which tend to be shallow (10-20m) depressions, or "kettles", in a rolling plain of glacial debris, Shawnigan is much deeper, with a maximum depth of 52m. Unlike most other lakes nearby, Shawnigan contains a high proportion of solid bedrock shoreline and bottom. Unlike most other low elevation lakes in the region, which are usually described as being of kettle origin, the origins of Shawnigan lake have been described as "Ice Scour" (Lucey and Jackson, 1983). Unlike most other lakes on the coastal plain below, which are described as being either eutrophic (nutrient-rich) or mesotrophic (middle-of-the-road), Shawnigan is described by most researchers as being oligotrophic (nutrient-poor).

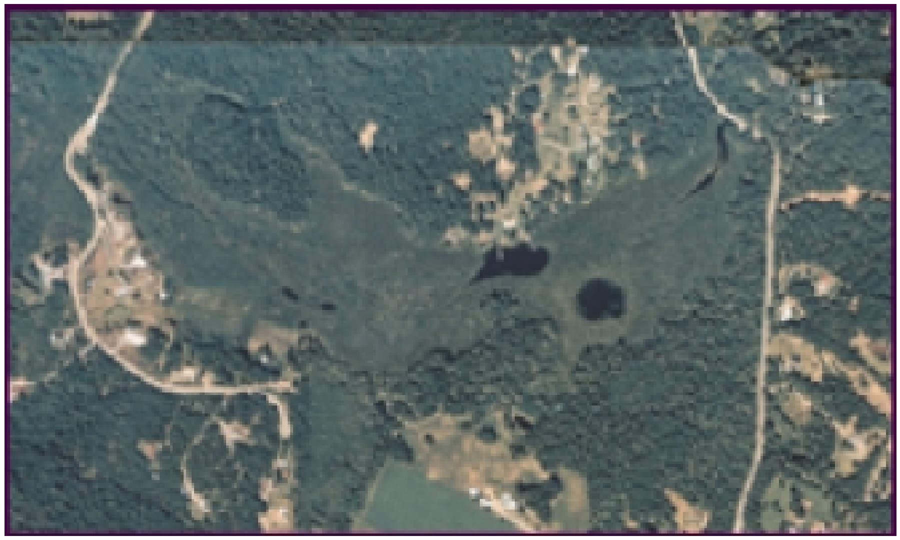
**C) Lower Shawnigan Creek**

The lake flows out at its northern end into Lower Shawnigan Creek, the third major habitat unit in the watershed, and the one we surveyed for USHP (See Figure 9). The creek here circles in an easterly direction until it reaches the ocean at the top end of Mill Bay, 5 km to the east. Due to the winding course, the actual instream length of the lower mainstem is closer to 11 km. The gradient of this section is generally less steep (and more fish friendly) than that of the lake tributaries. However, the creek below the lake is punctuated by a series of bedrock falls which are total or near-total barriers to all fish passage, and which break the lower creek into distinct habitat sub-units. Most important: the largest of these falls occur just above tidewater, where they form an impassible barrier to the migration of fish from the sea. Therefore, this watershed is also unusual, in comparison to most other coastal streams of similar size on Vancouver Island, in that it has never historically supported runs of salmon or any other anadromous fish.

A second unusual feature of the lower watershed is the large wetland located near the midpoint of the lower mainstem, above the Cameron/Taggert Road bridge (See Figure 7). This wetland, locally known as "Cameron/Taggert swamp" (Watershed Atlas WaterBody ID: 00081VICT), has an area of 251,079$m^2$ (= > 25 ha), and a perimeter of 2858m (= > 2.8 km). It is almost entirely covered with unidentified species of willow (Salix sp?) rooted in shallow standing water. There are two areas of deep open water in this wetland, coded as lakes in the WSA. The largest (WaterBody ID: 00083VICT) is teardop shaped, area 3,752 $m^2$ (= 0.38 ha), perimeter 289m. The second (WaterBody ID 00084VICT) is slightly to the east, nearly round, area 2,875 $m^2$ (=0.29ha), perimeter 196m. The habitat throughout this large swamp is exactly the opposite of the shallow, rocky/gravelly, pool/riffle habitat which characterizes the rest of Upper and Lower Shawnigan Creek.

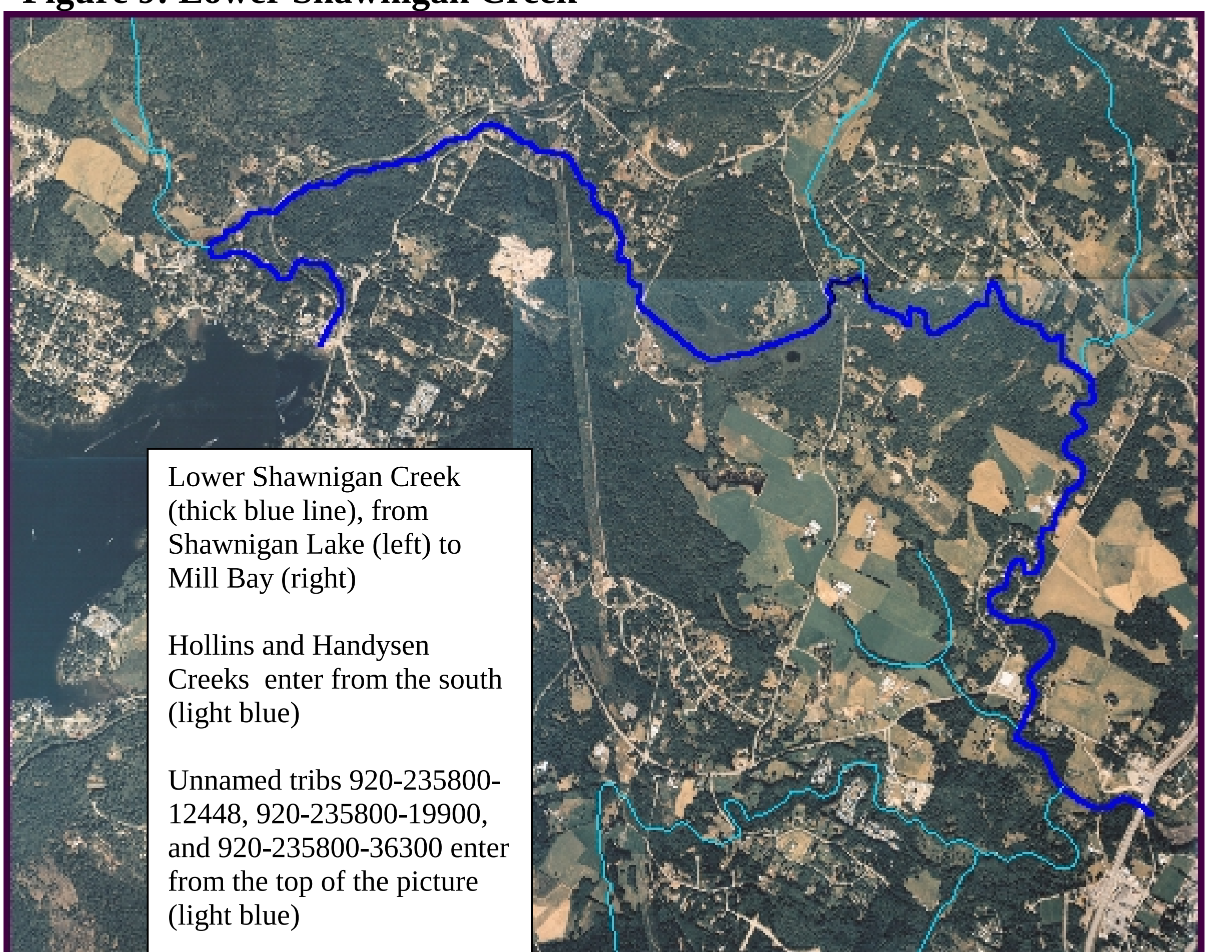
## Figure 7: Shawnigan Lake

## Figure 8: Cameron/Taggert Swamp



The focus area for this report:
Shawnigan Lake (left)
Lower Shawnigan Creek (below)
Cameron/Taggert Swamp (above)

## Figure 9: Lower Shawnigan Creek



Lower Shawnigan Creek (thick blue line), from Shawnigan Lake (left) to Mill Bay (right)

Hollins and Handysen Creeks enter from the south (light blue)

Unnamed tribs 920-235800-12448, 920-235800-19900, and 920-235800-36300 enter from the top of the picture (light blue)

# Section 2) Methods

Before crossing over the private property of landowners along the creek we made an attempt to contact them all and explain our intentions. We were mostly successful in making contact, although we occasionally blundered into places without asking. We had no problems with any property owners, or with gaining access to any part of the creek we wished to survey.

Pool/riffle chainages and other distance measurements were recorded with a re-windable 50 meter tape measure. Depth measurements were recorded with a measured dipstick. Instream temperatures, dissolved oxygen levels, and total dissolved solids were recorded with the Camosun Environmental Technology Program's YSI meter. Stream velocity was measured by timing a barely floating object (e.g. orange) in repeated passes over a fixed distance. Some images were captured with the Camosun College digital camera. Others were recorded on a cheap 35mm camera and later scanned.

Fry trapping was conducted with "G-traps" (screen mesh cages with cone-shaped entrances, similar to the familiar prawn traps), baited with cat food and/or canned tuna. The G-traps unclip and come apart into halves, so that all fish can be released unharmed. My brief foray into the world of G-trapping was cut short when I found out how attractive the traps are to thieves. After losing 2 traps in 2 days I decided to wait until next year, and perhaps switch to beach seines.

A brief attempt to record GPS measurements with a handheld Trimble unit proved to be unfeasible due to heavy forest cover.

The USHP data was collected in pencil in a "write-in-the-rain" notebook. At a later date this data was loaded in to the USHP Excel spreadsheet. USHP data is collected in units called reaches – continuous stretches of the stream with similar habitat characteristics. The USHP spreadsheet contains entry boxes for all the data types collected. It also contains algorithms, in the form of built-in macros, which compute the data and return ratings for the instream and riparian habitat of each reach, as well as the maximum number of coho fry the computer thinks the stream could support. These ratings can then be summed to define ratings for the creek as a whole, or compared for the purposes of rating one reach against another, or against habitat in another watershed. (See Appendix 2 for Shawnigan Creek USHP Reach Summaries.)

USHP format involves measurement of lengths of all pools and riffles, widths of all pools. At 100m and 200m intervals a more detailed set of measurements is taken which include cross-section flow area and velocity, substrate composition, temperature, dissolved oxygen, and conductivity. Riparian data is also recorded at these intervals, including percent canopy cover, slope, land use, livestock access and other disturbed sites. The junction of all tributaries is noted. In addition to the required USHP data, we recorded the location of all cascades of 1m or greater, log jams, and visible water withdrawal systems (functional or not).

An ArcView GIS project was created for the watershed, based on a variety of data layers (anything I could scrounge up). Included are streams, lakes, wetlands, and coastline, from the BC Watershed Atlas, a georeferenced bathymetric map of Shawnigan Lake from BC

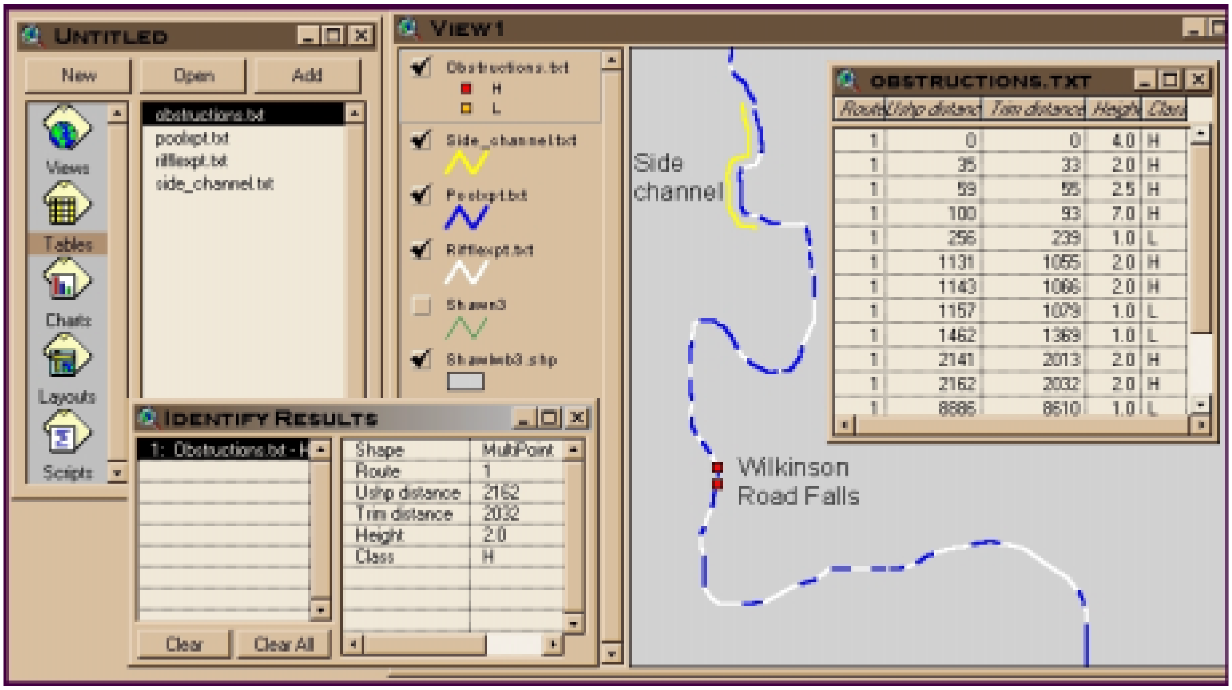
Ministry of Fisheries, and TRIM layers for water, roads, and contours. Some of the data collected in the course of the USHP assessment was also loaded into the ArcView project, so that it could be displayed on a computer, queried and printed out as screen captures. A primary technique used here was “dynamic segmentation”, in which linear themes such as streams are converted into “routes” in ArcInfo. Routes have a start and an end, so that distances can be calculated along them. USHP data was loaded into Excel tables as specific data sets associated with specific chainage distances. These tables were then saved as text/tab delimited, loaded into ArcView, and displayed as route event themes. Route events can be displayed as either points (e.g. Falls), linear themes (e.g. Pools), or linear-offset themes (e.g. Off-channel Habitat.) (see Figure 10)

Routes were first created on the TRIM lines for the mainstems of Lower Shawnigan, Cedar, and Handysen Creeks. (Route themes for any stream in BC which is included in the 1:50,000 BC Watershed Atlas may be obtained for free off the BC Ministry of Fisheries website. We chose to attach data to the more detailed and more accurate 1:20,000 TRIM water layer, so we took the lines for lower Shawnigan, Cedar, and Handysen Creeks out of TRIM and built routes upon them in ArcInfo. The new 1:20,000 BC Watershed Atlas, based on TRIM, is currently under construction by BC Fisheries. In order to display the USHP chainage measurements on the GIS map, our measurements needed to be converted to match route distances generated by ArcView. These numbers will never match – nor will route distances calculated by any two different projections, or by two different groups of USHP surveyors over the same stream. We could have simply multiplied our chainages by the differential between our calculated total length and the one generated by ArcView, but this would have allowed for too much distortion in the middle. Instead, we tied our measurements to specific intervals, marked by easily visible “control points” (in this case the mouth at Mill Bay, the outlet from the lake, and three intervening bridges), by creating conversion formulas in Excel that would “scrunch” our numbers to make the bridges and lake outlet fall into the right place on the map. The accuracy of “pinpointing” our chainage measurements to the correct location on the stream will deccrease the farther they are from one of the control points.

A display of some basic dynamic segmentation themes in ArcView is presented in Figure 10. Data tables built in Excel and saved as text (tab delimited) are added to the ArcView project for Pools, Riffles, Side-channels and Obstructions (visible in the tables menu, upper left). The first part of the .txt table for Obstructions is displayed in the upper right. These tables are then linked to the Shawn3 theme by using the “Add Event Theme” option in ArcView, creating new themes (e.g. Obstructions.txt). When the Obstructions theme is activated, clicking on a given feature with the “i” button (identify) will return all the data in the table which is associated with that feature. In this case the “i” button has been clicked on the red square which displays the upper of the two cascades that make up the falls near the Wilkinson Road footbridge. Data for this feature is displayed in the “Identify Results” table at lower left. Users can add new fields to the .txt tables, in order to record any types of data they choose. A “Calculate Route Measure” tool is also available in ArcView. Once it is installed into the project, it is possible to click on any spot along the route with this tool and return the distance from the zero-measure (in this case the mouth of the creek).

ArcView was also used to retrieve data from themes (eg areas and perimeters from the BC Watershed Atlas) and for calculating elevations, distances, and gradients. A freeware tool called “Print Key 2000” was used to capture ArcView screen shots, and load them into MS Word as color maps. A cheap and dirty homemade “orthophoto” was also created covering the major part of the watershed. Color aerial photos were scanned into digital format and then appended together with Paintshop Pro. This photo is not "ortho" (corrected for parallax, etc.), but it is surprisingly handy. A true color orthophoto of the entire watershed would cost thousands of dollars. An attempt to georeference this composite air photo into the GIS project with a freeware ArcView script was unsuccessful.

## Figure 10: Dynamic Segmentation




An illustration of the use of "dynamic segmentation" to display individual features along a linear theme. Three types of route event theme are shown here: point (Obstructions), linear (Pools, Riffles), and linear-offset (Side-channel). Each theme in the view is shown in a list running down the middle of this ArcView screen capture, with its title appearing above its symbol. Over a greyed background (Shawlwb3.shp - the BCWSA polygon theme for the Shawnigan watershed) the route theme Shawn3 (built from the TRIM water layer) is added to the view. Although it is not turned on (no check mark beside it, so it is not visible) it serves as framework for the other "route event themes".

# **Section 3.0) USHP Assessment**

**Caveat emptor:**
Before interpreting the data it is important to note two major gaps in the database. There is no riparian data for Reach 15. This reach is extremely short, only 83m. It happened to fall in between the 200m riparian measurements required by USHP protocol, and the riparian measurements for this reach were never recorded. Thus it receives a perfect zero score in the riparian ratings. This is not to be interpreted as an indication of perfect riparian habitat, but rather as a lack of data. The actual riparian rating for this reach is more likely to resemble the rating for the reach immediately downstream.

The next reach above this one, Reach 16, is the Cameron/Taggert swamp - the large pond/swamp wetland located halfway down the mainstem, above the Cameron/Taggert Road Bridge. It proved to be impossible for us to sample. In years past it was apparently possible to navigate this swamp by boat, and those who did enjoyed good trout fishing in the beaver dam pools in its interior (B. Finnegan, pers. comm.). We tried to canoe up into the swamp, following the lead of open water that curves up from Cameron/Taggert Road bridge. The channel continued to narrow, squeezed in by hectares of surrounding willow. After a few hundred meters the channel disappeared completely in an endless maze of 2-3m tall willow stalks and branches. Only the stub ends of branches cut off years ago were left to indicate where people had cut an access into the middle of the swamp in years past. The water here is too deep to wade (1.5m+), and the willow is so thick that it would be hard to move through it even if it grew on dry land. We were forced to turn back. Trying to penetrate this willow swamp from the top end, off the Shinrock Road bridge, looked as hopeless, or worse, so we gave up on trying to record data though this section of the creek.

Since we could only record data at the top and bottom of the swamp, the USHP values are very dubious for this reach, which is recorded as one single pool (Pool # 143) in the data. Because the swamp was impassible we could not record chainage through it, which created a gap in our measurements. At the time we were gathering the data we did not yet have the skills to query the watershed atlas in ArcView in order to find the length of the swamp. So we estimated the upper end of the swamp, where the creek runs into it under the Shinrock Road bridge, at 7,391m from tidewater and began recording chainages again from this point. This allowed for 1,197m of chainage through the swamp. In ArcView we later calculated the length of the swamp, from bridge to bridge, at 1,303m – 106m more than the length we had allowed for, and probably more accurate.

The narrowest part of the middle of the swamp was calculated in ArcView at 210m, a truly awesome wetted width. The wetted width we entered into the USHP Excel calculations was only 8m This does not reflect the actual extent of the swamp, but avoids what would have likely been a unrealistically gigantic figure for the projected fry capacity of this reach. How many fry this swamp can actually support requires a much more extensive investigation than we have made, and any values generated by USHP from our limited data for Reach 16 should probably be excluded from consideration at this point.

# Section 3.1) Reaches and Macro-reaches

We recorded 27 reaches in Lower Shawnigan Creek (See Figure 13: Lower Shawnigan Creek USHP Reaches). For the purposes of discussion and interpretation, these 27 reaches have been combined into "macro- reaches" – groupings of one or more consecutive reaches that share similar habitat characteristics throughout. (See Figure 14: Lower Shawnigan Creek Macro-reaches) Eight macro-reaches were defined along lower Shawnigan Creek for the purposes of this assessment. Reasons for defining the macro-reaches, and interpretation and discussion of the results, are presented as follows in this section.

**Lower Shawnigan Creek Macro-reaches:**

**Macro Reach I )** Reaches 1 + 2
Chainage: 0 – 256 m
Length: 256 m

**Macro Reach II)** Reaches 3, 4, 5, and 6
Chainage: 256 - 1131 m
Length: 875 m

**Macro Reach III)** Reach 7
Chainage: 1131 - 2141 m
Length: 1010 m

**Macro Reach IV)** Reaches 8, 9, 10, 11, 12, 13, 14, and 15
Chainage: 2141 – 6194
Length: 4053 m

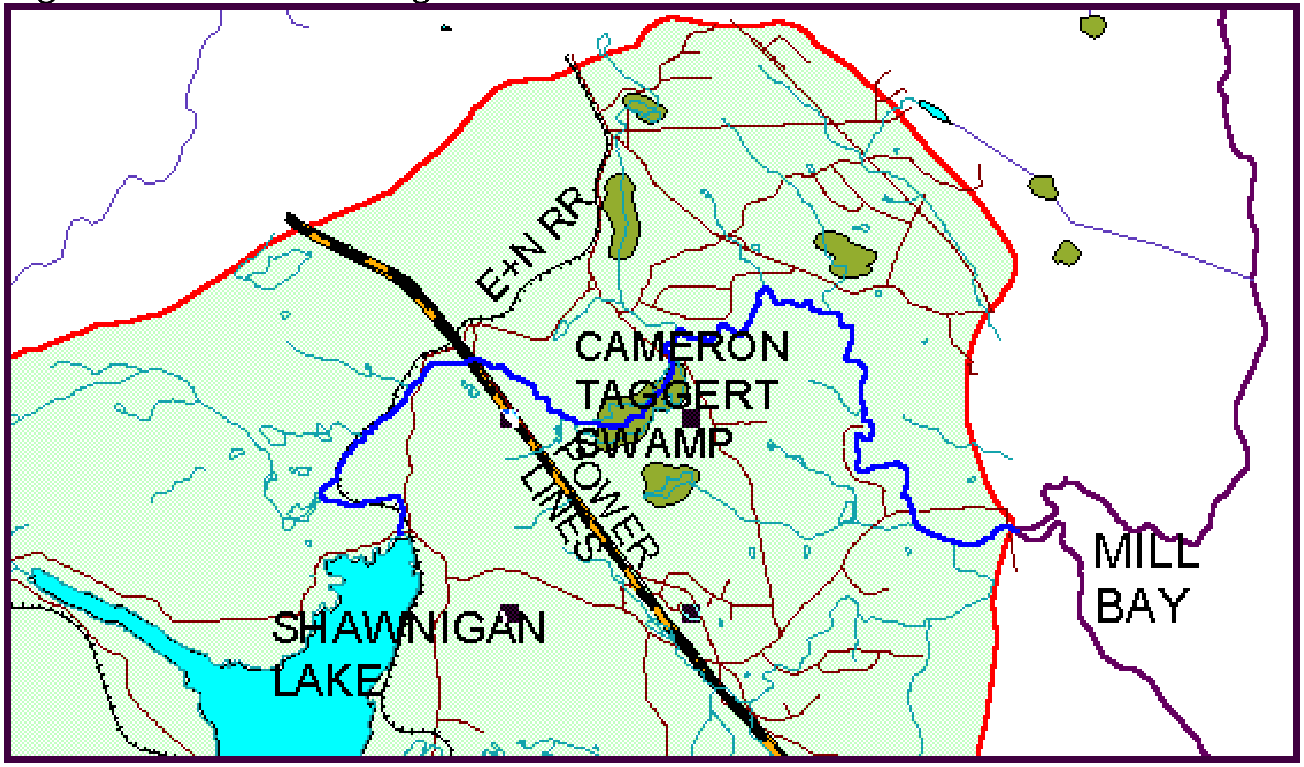
**Macro Reach V)** Reach 16
Chainage: 6194 – 7391 m
Length: 1197 m

**Macro Reach VI)** Reaches 17, 18, 19, 20, and 21
Chainage: 7391 – 9241 m
Length: 1850 m

**Macro Reach VII)** Reaches 22, 23, 24, 25, 26
Chainage: 9241 – 10979 m
Length: 1738 m

**Macro Reach VIII)** Reach 27
Chainage: 10979 – 11471 m (Shawnigan Lake)
Length: 492 m

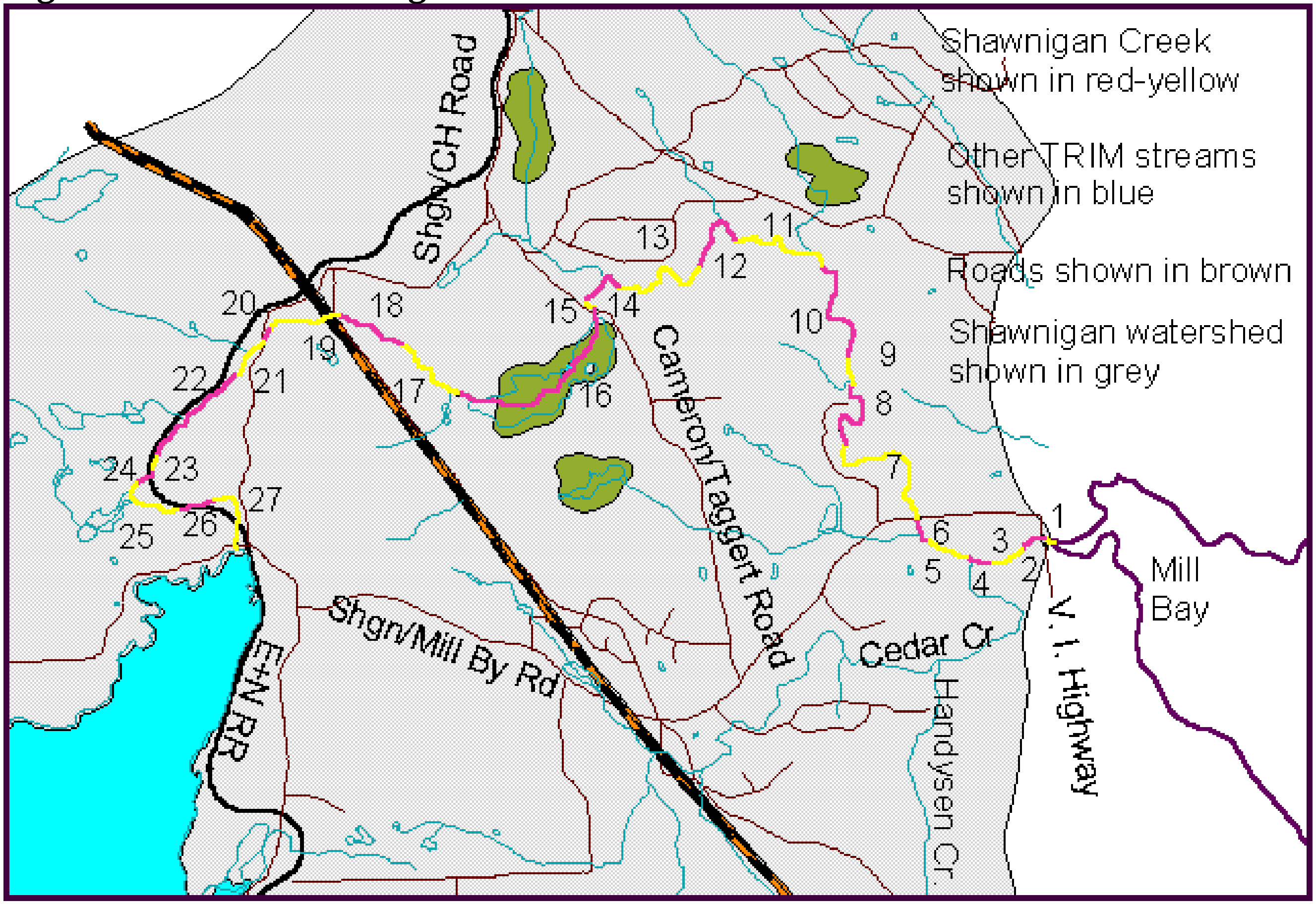
**Figure 11: Lower Shawnigan Creek**




Shawnigan Creek watershed boundary shown in red
Roads shown in brown.

**Figure 12: Lower Shawnigan Creek watershed "orthophoto"**

**Figure 13: Lower Shawnigan Creek USHP Reaches**




Lower Shawnigan Creek – USHP Reaches 1-27

**Figure 14: Lower Shawnigan Creek Macro-reaches**

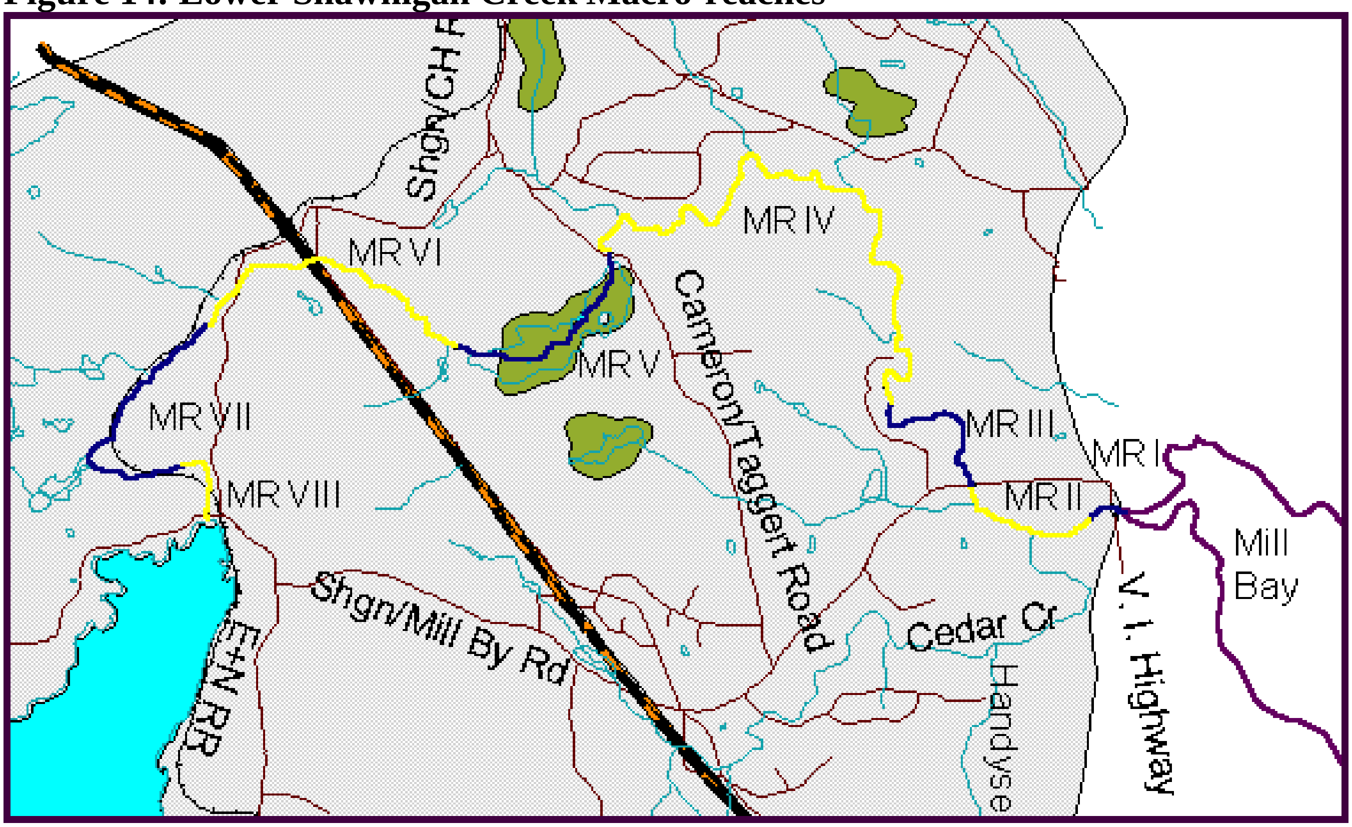


**Figure 15: MRI, MRII, and MRII**

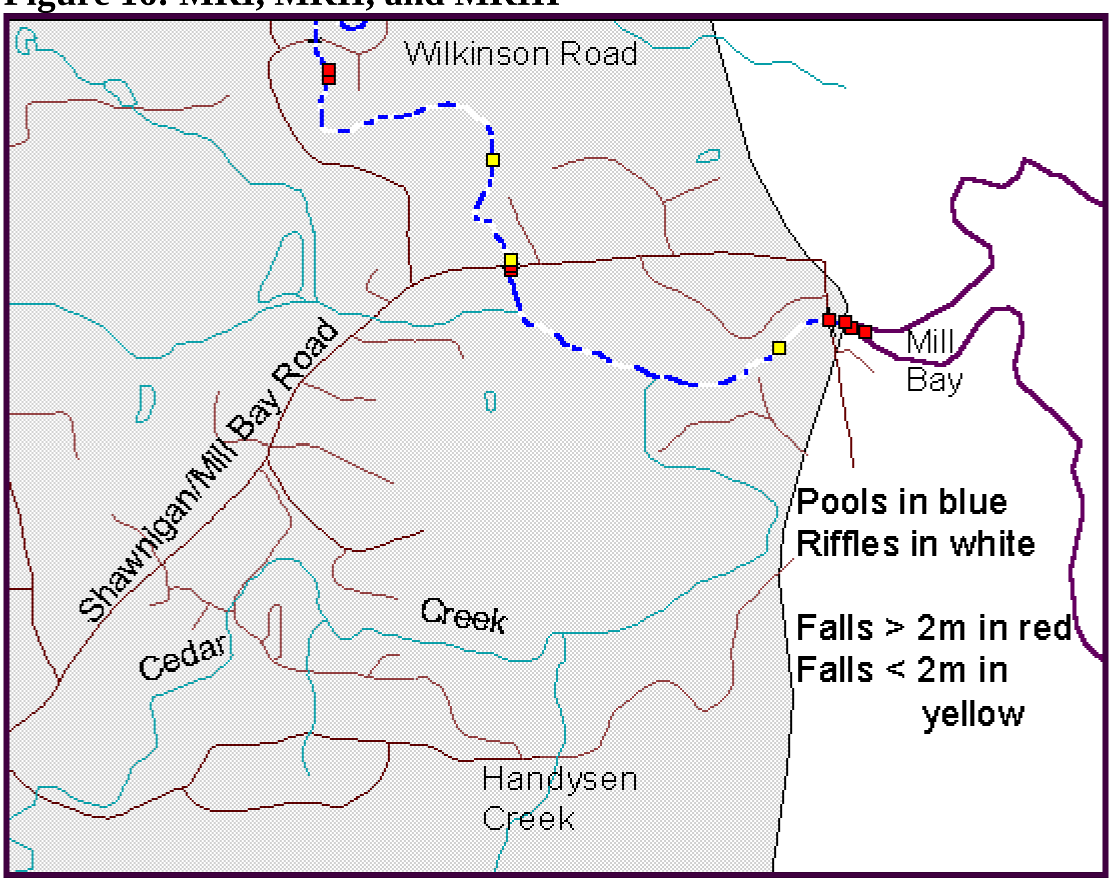
Shawnigan Creek (dark blue) enters the ocean at Mill Bay (lower right – the tidal mudflats are visible in this photo).

The creek passes under the Island Highway bridge immediately above Mill Bay.

Hollins and Handysen creeks (light blue, lower) and an unnamed stream (light blue, upper) enter from the southwest.

Near the top center of the picture is the Wilkinson Road footbridge, the end of MRIII.

**Figure 16: MRI, MRII, and MRIII**



# Section 3.2) Macro Reach I

**Reaches 1 + 2   Chainage: 0 (Mill Bay) – 256 m   Length: 256**

Macro Reach I (hereafter referred to as MRI) begins at the outlet of Shawnigan Creek into the ocean. It consists of the combined Reaches 1 and 2 in our USHP survey data. The dominant feature of this reach is a series of falls, some of which are impassable to upstream migration of all fish, and a number of large pools scoured into the bedrock. Below the first set of falls the creek flows into the top end of Mill Bay. Almost all of the area visible in the bay from the falls goes dry on a big low tide, becoming a gravel flat with the creek channel running through it. A deep plunge pool is located at the very end of Mill Bay, under the waterfall (see Figures 17 and 18).

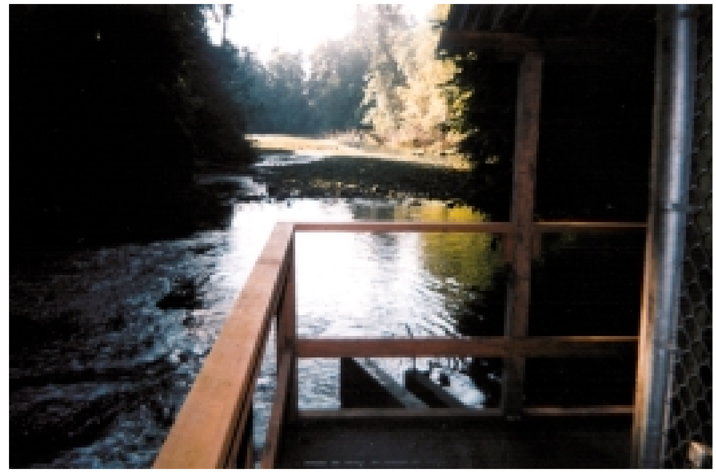
The stream enters the sea over a steep bedrock falls with a vertical drop of about 4 m (see Figure 19). These falls form a formidable barrier to fish passage on their own, especially during high flows. After two short scour pools and two more bedrock falls, one 2m and the other 2.5m (see Figure 20), the creek becomes a large deep pool under the Vancouver Island Highway bridge. This was the end of our Reach 1.

Another important feature to be noted along Reach 1 is the coho capture and transport facility, constructed and operated by local volunteers with DFO supervision. As mentioned previously, no salmon runs had existed in Shawnigan Creek since the sea level dropped (relative to east Vancouver Island) after the last Ice Age, thousands of years ago, exposing impassable falls near the mouth. Recognizing the amount of quality coho habitat that this watershed contains, these local volunteers have been working for nearly two decades to create and maintain a run of cohos in Shawnigan Creek. The run was initiated by stocking the creek with coho fry obtained from the nearby Goldstream hatchery. Fry that survived to the smolt stage later migrated down the creek, over the falls, and into the ocean. In fall, when the adult coho home in on their native stream, the volunteers capture the returning Shawnigan spawners (if possible), which are schooled up below the falls they cannot leap. Cohos lucky enough to get caught are quickly trucked to release sites upstream, above the falls. Those that aren’t fortunate enough to get a free ride by the volunteers cannot access the stream. They may get eaten by seals in Mill Bay, or give jumping at the Shawnigan Falls and swim off to spawn in other another stream.

A shed has been built over a hollow in the bedrock at the tideline beside the waterfall (see Figures 18 and 21). A large diameter heavy-duty plastic pipe with a flow control valve has been cemented into place in Pool #1 above, from which water is diverted into the hollow below the shed, creating a pool. Returning adult coho, stymied at the base of the falls, will (presumably) follow the fresh water inflow into the pool below the shed. A trap door in the floor allows volunteers to scoop up these fish with dipnets (see Figure 22). They are then put into tubs, which are hauled up the steep bluff on metal rails. The cohos are finally transferred into water-filled tubs in the back of waiting pickup trucks, transported upstream, and released at different spots along the lower mainstem of Shawnigan Creek. At the start of Reach 2 the Vancouver Island Highway bridge passes high over a large, deep scour pool of smooth bedrock. This is Pool #3 in the data. It is 25m long, and perhaps 5m deep. A cement pumphouse sits on the west bank (visible on the left in Figures 20 and 23), apparently the site from which Mill Bay Waterworks withdraws water from the creek, under permit from their water license on

**Figure 17: Estuary**

**Figure 18: Estuary**



Shawnigan Creek Falls, into Mill Bay, Saanich Inlet.

Left: High flow, medium tide.

Above Right: Low flow, low tide. Note the plunge pool below the falls, and extensive gravel flats in the estuary at low tide.

**Figure 19: First falls**


**Figure 20: Second falls**

**Figure 21: Stairway and coho shed**

First falls, and plunge pool into Mill Bay. Beside is the stairway to the coho capture shed

**Figure 22: Coho capture shed**

Don Merry, standing beside the trap door in the floor of the coho shed.

**Figure 23: Third falls**

Shawnigan Creek falls. This photo shows Pool # 3 in our survey, directly under the Vancouver Island Highway bridge. Mill Bay Waterworks pumphouse (?) is on the left, and pipeline on the right. Above Pool #3 is Riffle #4, an impassible falls which is a barrier to all fish passage.

Shawnigan Creek. This pumping facility does not seem to be very active now, as one would expect if most of the water stored under Mill Bay's storage license is now being withdrawn from Shawnigan Lake instead (see Section 5H).

Above Pool 3 is a long bedrock slide or falls (Riffle # 4 in the data), with a gradient of about 45%, and a vertical drop of about 7m (see Figure 23). If the falls at tidewater do not stop migrating fish, this one will. Above this falls, the creek continues through two more scoured bedrock pools to another falls (Riffle #6). At 1m in height, this is the last in the set of falls that step the creek up over the steep rock bluffs along the ocean to the gentler sloping benchland of glacial debris above. We made this falls the end of our Reach 2. It also defines the end of the entire series of falls and scour pools that characterize MRI.

The possibility of installing fishways over the falls located in MRI, along with those in MRIII, has been assessed by Ian Ross, P.Eng., Sr. Project Engineer with Biolgical & Engineering Support Division, Habitat & Enhancement Branch, Fisheries and Oceans Canada. (This report is reprinted here as Appendix 8). According to Mr. Ross' judgment, the cost of building a fishway to DFO standards over the falls at Riffle #4 alone would cost approximately a quarter of a million dollars, and this would have to be accompanied by a fishway over the other falls located just above tidewater, which would cost even more. Mr. Ross felt that the cost-benefit ratio (when balanced against the estimated maximun expected salmon returns) of installing fishways in Shawnigan Creek did not compare favorably with that which could be obtained at many other fish barrier sites in BC, so building fishways here would not be a DFO priority in the near future.

**Recommendations:**
MRI would also seem to be a low priority in terms of enhancement. Existing fish production here is likely very limited, and enhancement potential is low. The pools are almost all disconnected by major falls. Fish movement is basically one directional in MRI – downstream. Any small fish that end up here are likely to get swept down to sea in the next high water event. No fish, large or small, were ever observed in MRI while we were around. There is deep water here, but little shelter, almost no LWD, and few boulders. There is little within MRI in fact but scoured bedrock. During high flows the current velocities here are enormous.

Reach 1 received poor marks in the USHP assessment for altered stream sites and lack of fines in the bed. Both Reaches 1 and 2 received poor marks for lack of LWD. But anchoring any kind of logs or rootwads here well enough to withstand the maelstrom that is MRI during a flood would be a daunting task. Any boulder smaller than a car placed in the stream here is likely to get washed right over the falls. Spawning gravel would be scoured right out of these reaches if it was added. Although the banks have been cleared under the highway bridge, and a bit of erosion might occur here occasionally, any negative effects this might create in the way of temperature (from lack of shade) or turbidity (from erosion) will have no impact on downstream habitat, because there isn't any. It all washes over the falls into the ocean a few meters below.

It is probably best to leave MRI as it is, a "chute" which delivers migrating salmonids to the sea. There are enhancement opportunities to be found elsewhere in this watershed that offer much greater potential for salmonid production.

# Section 3.3) Macro Reach II

**Reaches 3, 4, 5, and 6** **Chainage: 256 - 1131 m** **Length: 875 m**

MRII begins above the last falls in MRI, and extends to the falls at the start of MRIII, which are located just upstream of the Shawnigan Mill Bay Road bridge. MRII is 875m long, and consists of the combined Reaches 3, 4, 5, and 6 in our survey data. It has a much lower gradient than MRI, a much higher percentage of gravel/cobble substrate, and contains no obstructions to fish passage. It appears to have much more to offer salmonids in the way of habitat than MRI. The “weighted average” (a combination of the ratings for all the reaches that make up MRII, pro-rated according to the percentage of the length of the total macro-reach that each individual reach contains) instream rating for MRII was 28.0. It received generally poor marks for lack of LWD and boulder cover, as well as Percent Wetted Area (the poor scores for this last category may have been due to our unfamiliarity with the USHP survey techniques). Reaches 3 and 5 also received failing marks for Percent Pool Area.

Instream temperatures in summer were always found to be cooler here than those below the outflows of Shawnigan Lake and the Cameron/Taggert swamp. The falls upstream in MRIII contribute dissolved oxygen to the water, and help cool its temperatures during summer. Crown cover and riparian depth are excellent here, as the creek flows under a dense canopy of mixed deciduous and coniferous second growth.

MRII also includes the confluence of Shanwigan Creek’s largest tributary, Hollins Creek (WS Code: 920-235800-01800). (This creek is referred to in this report by its gazetted name of Hollins Creek. Locally, it is often known as “Cedar Creek”.) This stream, along with its tributary Handysen Creek (WS Code: 920-235800-01800-27600), is low gradient, pool-and-riffle type habitat, ideal for coho (see Figure 24). Both of these tributary streams flow all summer, and have visible populations of salmonids. Adult cohos captured by volunteers which are released within MRII can access both Hollins and Handysen Creeks, as well the Shawnigan mainstem, for spawning and rearing. However, other than a few years when adult cohos were released into lower MRII during a study by Barry Finnegan of DFO’s Pacific Biological Station, the adult release points have always been upstream of MRII. It is possible that some coho juveniles may drop down from the mainstem reaches upstream from MRII and swim up into Hollins Creek. These two tribs represent the largest section of easily accessible, high quality coho habitat within the watershed that we did not cover in our USHP assessment. They may quite likely contain the highest quality coho habitat within the entire watershed. As such, they should be a high priority with any future USHP assessments.

It is important to note that MRII will not make a contribution to the fish stocks in the Shawnigan Lake. It ends at a set of impassible falls that block access to upstream habitat.

**Recommendations:**
MRII represents a prime candidate for enhancement. The gentler velocities would allow for secure LWD placement. The substrate here is no longer the shelving bedrock found in MVI, but unconsolidated cobbles, gravels, and fines, which might scour into some deeper holes if the current were constricted by the addition of stumps or boulders. This might increase ratings for Percent Pool Area in the process. Added LWD would also serve to capture and hold carcasses of spent spawners, until they could be recycled by benthic

invertebrates. A number of off-channel habitat sites were identified along MRII as well. These might be investigated for enhancement potential.

These Hollins/Handysen tribs run cooler than the mainstem during summer, and appear to be superb coho habitat. Numerous fry were observed in Hollins Creek in the summers of both 1999 and 2000 (more in 1999). There were many that appeared to be larger than the fry visible in the lower mainstem or Upper Shawnigan Creek, suggesting that they might have been coho fry. However, the only salmonid caught in a G-trap in Hollins Creek in 1999 was a cutthroat, and the G-trap set in summer 2000 was immediately stolen. Pole seine sets in Holllins Creek during summer 2001 returned only cutthroat fry. There is a hung culvert about halfway up Hollins Creek (see Figure 25). It is interesting to note that fry were observed both above and below this culvert in good numbers during summer 1999. We also spoke with a local resident who said he had observed coho spawning above this culvert in the past. They may be able to pass this culvert at some flow levels.

The Cedar/Handysen drainage has not been subject to USHP assessment yet. It should be one of the highest priorities for future USHP assessments in the south island region. It may provide the best opportunity for coho and trout enhancement in the entire Shawnigan watershed. Instream and riparian habitat appear to be superb, and there is surprisingly little development near the creek except for a couple of mobile home parks. If access to the old log bridge above the highway could be arranged, one would only have to transport the captured adult cohos a few hundred meters upstream from the capture shed at tidewater before release. From here the fish could access all of MRII, as well as the Cedar/Handysen system.

Perhaps even more important than performing a USHP assessment would be an attempt to document fish distribution and population densities within the watershed. A systematic electrofishing or even pole seine survey, conducted after a year of successful coho escapement (such as 2000), might provide a lot of insight about where the coho actually do spawn and rear in this watershed. Summer 2000 was not a good time to sample for coho juveniles, because there were no coho present in the system, due to the failure of the capture effort during the preceding 1999 fall coho run.

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**Figure 24: Hollins Creek**

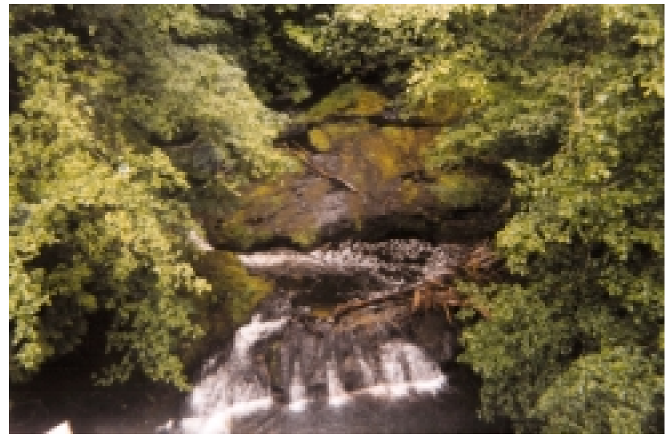
Hollins Creek, at the mobile home park, Richard standing downstream.

**Figure 25: Hollins Creek**

Hollins  Creek, Don standing on hung culvert. This creek looks like excellent coho habitat.

**Figure 26: Shgn/Mill Bay Road Falls**

**Figure 27: Shawnigan/MB Road Falls**



Shawnigan/Mill Bay Road falls.

High flow, left. Don Merry standing on right.

Low flow, above.

These falls are the second major barrier to fish passage in the Shawnigan Creek mainstem, after the series of falls near the mouth in Mill Bay.

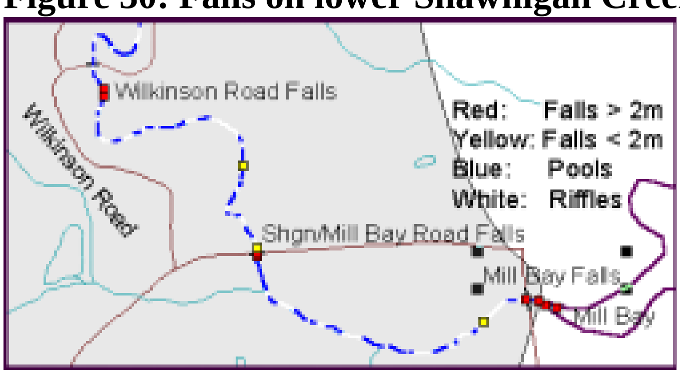
**Figure 28: Wilkinson falls**

Don beside Wilkinson Road falls, high flow

**Figure 29: Wilkinson falls**

Wilkinson Road falls, low flow.

**Figure 30: Falls on lower Shawnigan Creek**




Three main sets of falls block fish migration in Lower Shawnigan Creek. All are located within the first 2200m above the ocean. These are the falls (shown in red) assessed by Ian Ross of DFO: the multiple falls near Mill Bay, a pair of falls near Shawnigan Mill Bay Road, and another pair near Wilkinson Road.

# Section 3.4) Macro Reach III

**Reach 7 Chainage: 1131 - 2141 m Length: 1010 m**

MRIII begins at the Shawnigan / Mill Bay Road falls (Riffles # 22 and 23 - see Figures 26 and 27), and extends 1010m upstream to another set of falls located just downstream of the footbridge which has replaced the former Wilkinson Road auto bridge (Riffles # 46 and 47 – see Figures 28 and 29). A map showing the locations of all the falls which form complete barriers to fish passage is presented in Figure 30. This macro-reach is identical with the single reach we called Reach 7 in our survey. Both of these major falls are two-stepped jumps of about 2m in height (4m total), with a shallow pool located between the jumps. Both sets of falls represent total or near-total barriers to upstream migration of fish. Thus, the intervening MRIII is a self-contained unit, with no possibility of migration of fish from the reaches below, and no possibility that the fish it contains can migrate upstream to the stream reaches or the lake above. In addition to the major falls at each end, it is characterized by numerous smooth bedrock pools, as well as a number of smaller jumps and slides. Two of these are at least 1m high, and were recorded in our GIS data. On the western side of the creek, the flat bluff above the forested creek ravine is dominated by the Kerry Park Recreation Center and its associated playing fields and paved parking lots. Further upstream the land use becomes residential – infrequent houses on large, heavily forested acreages. The creek is cutting down into a small gorge here. The houses of upland owners are seldom visible from the stream below, and appear to have little direct impact on the stream habitat.

Ian Ross of DFO assessed these sets of falls in his report as well. He estimated the cost of installing fishways over these two sets of falls at much less than the cost for the falls near Mill Bay - about $115,00-140,000 total, compared to a total of $500,000-600,000 total for all the falls near Mill Bay.

**Recommendations:**
MRIII probably does not contribute a lot to coho production in this system, and is not likely to offer a lot of potential for enhancement. It contained a healthy population of small native cutthroat when we surveyed it. We caught and released a number of these gorgeous little trout, up to about 7” (18cm), on a single barbless spinner as we went along our USHP survey. A creekfront property owner we met said he fishes this stretch regularly, and that as soon as the biggest trout get up to about 9” the otter comes by, and the size of the biggest fish goes back down to 6-7”. Addition of instream cover might give these resident fish a place to hide from the otters.

MRIII received an instream rating of 29, with poor marks for Percent Pool Area, LWD, and – again – Percent Wetted Area. There are some nice looking pools in MRIII, but they are shallow. Anchoring LWD would create cover, but not much scour here, since the pool bottoms are almost always solid bedrock. No adult coho are released into MRIII, and none can jump the falls to enter it from below, so there is likely no spawning occurring here. Any coho fry (as well as trout or kokanee fry or adults ranging down from the lake above) that enter MRIII from upstream can never return to the habitat they came from. Addition of LWD would improve habitat for the native cutts, as well as providing cover for the downmigrating coho juveniles these cutthroats will try to catch and eat. But the time and expense involved would be likely be better spent elsewhere in the watershed.

# Section 3.5) Macro Reach IV

**Reaches 8,9,10,11,12,13,14, and 15 Chainage: 2141 – 6194 Length: 4053 m**

MRIV begins above the Wilkinson Road falls, and extends up through an unbroken string of pools and riffles to the beaver dam that forms the outlet control for the Cameron/ Taggert swamp, just below the Cameron/Taggert Road Bridge (see Figure 31 and 32). At 4053m it is the longest of all the macro reaches in this assessment. It consists of the sum of reaches 8-15 in our USHP data. Although 8 reaches were registered in our survey along it, there are no obstacles to fish passage in MRIV. In fact – other than a few small jumps of 1m or less – There are no more major obstacles to fish passage between the falls at the bottom end of MRIV and the weir located downstream from the Shawnigan Lake outlet. Bedrock exposure is limited to occasional riffles here, as the stream courses through a rolling plain of glacial deposits. As a result, the smooth bedrock pools and slides tend to be replaced by cutbank pools and gravel riffles. MRIV contains some of the best fish habitat in the lower mainstem.

Along the lower reaches of MRIV land use continues to be scattered residential acreages. In Reach 10 the stream enters a large agricultural clearing. It follows along the edge of the clearing under full or partial canopy. Unfortunately, after this point we were not able to accompany Lucas when he gathered the USHP data on the remaining reaches of MRIV. The rest of MRIV was surveyed by Lucas alone.

On the aerial photo Reaches 10-15 are seen to pass through an almost unbroken cover of dense forest (see Figure 32). It is rare to find a stream of this size, surrounded by a population so large, and so near to major metropolitan areas, that is as undeveloped as the MRIV section of Shawnigan Creek. This heavy timber, combined with a gentler gradient and a more erodable substrate, might be expected to produce larger, deeper pools. The ArcView printout of MRIV shows a number of long pools (see Figure 31). This part of the creek is intriguing, and worthy of further study. I wish I had been able to accompany Lucas on his survey, and I would like to go back and see it for myself, perhaps in a canoe some day.

A short ways above the Wilkinson Road footbridge is a long (37m), deep, dogleg-shaped cutbank pool (Pool #54) – the biggest, deepest pool encountered since Pool #3, way down below the Island Highway bridge. It is the first in a series of long pools which characterize this reach. It is followed in succession by Pool 63 (43m), Pool 67 (46m), Pool 76 (44m), Pool 79 (45m), Pool 82 (55m), Pool 85 (47m), Pool 86 (41m), Pool 88 (53m), Pool 100 (40m), and the awesome 236m length of Pool 103. This is recorded as a single pool in Lucas' data - almost 3 times as long as any other pool in the creek, other than the Cameron/Taggert swamp. Following Pool 103 are Pool 104 (45m), Pool 105 (47m), Pool 107 (59m), Pool 113 (56m), Pool 123 (80m), and Pool 124 (48m). MRIV undoubtedly contains the finest holding pools for large salmonids (e.g. coho) in the entire Shawnigan system.

One interesting site we noticed was a long side channel in Reach 9. This was an old main channel on the west bank, extending 165m into the edge of a pasture and back to the mainstem. The owner of the pasture had built a small dam of rocks across side channel at the downstream confluence, which backed up the water a little deeper. We thought we saw a large school of coho or cutthroat fry in this channel, but on closer inspection they turned out to be stickleback, sheltering from the current of the mainstem. This side channel may provide important habitat for salmonids at other times of the year, and offers the potential of being upgraded into a superb coho or cutthroat spawning bed.

MRIV received a weighted average instream rating of 23.7, tied with MRVII for the best rating of any macro reach. Still, LWD scores were very poor thoughout, and some reaches received poor marks for lack of boulder cover and high levels of fines. Two reaches also received a 5 point rating due to altered stream sites. However, it is questionable how much damage these altered sites are actually causing to the health of the creek. (One is a place where cattle come to drink – a few footprints on the sand and no sign of erosion – and the other is a lawn surrounded by forest.).

Perhaps a more serious concern in MRIV is the quality of the water draining out of the Cameron/Taggert swamp in summer. Our USHP survey measurements here were taken in spring, before these summer drought conditions would have occurred. They do not reflect the conditions found here in late summer. The outflow from the C/T swamp is the water that feeds MRIV. In August of both 1999 and 2000, after prolonged hot spells, the C/T swamp outflow was found to be very warm (almost 21C in 1999), and critically low in DO (0.7-1.5 mg/l). The effects of riffles and shade downstream of the swamp no doubt act to improve these unhealthy temperature and DO levels, after the creek leaves the swamp. However, while the effect of this warm, O-depleted water on the downstream aquatic community in MRIV has not been measured, it cannot be beneficial.

A number of small tribs enter the mainstem along MRIV (4 show in the TRIM streams layer, 2 in the BC Watershed Atlas, and 2 were identified in the survey data). None of these were examined upstream of their confluence during this survey except for the last, an unnamed stream, WS Code: 920-235800-19900 (shown as a straight “construction line” [= a watercourse of unknown location] in the BC WSA). It drains the 14.8 ha wetland 00071VICT. The outflow from this wetland flows though a culvert under Lovers Lane. Below the culvert this creek’s channel has been excavated into a ditch approximately 1.5 m wide and 2-3m deep, with vertical walls, as if cut by a backhoe. The apparent intention was to drain the large wetland above, which is now a pasture or hay field. The remains of the this trib, now a straightened ditch, flow through this field with little or no shade other than tall grass. In summer of 2000, when flows were extremely low, we set a G-trap in the ditch below Lovers Lane. We caught cutthroat and stickleback, which were both quite plentiful in the shade of their little backhoe-created canyon. We did not follow this creek further down to its confluence with the mainstem. This creek forks in wetland 00071VICT, and the west channel was dry in summer 2000 where it crosses under the Shawnigan/Cobble Hill Road.

The other coded trib entering MRIV is 920-235800-124480, also shown as a construction line in the BC WSA. This trib was not recorded in Lucas’ notes. Its confluence with the mainstem in TRIM is shown more than 200m upstream of the WSA confluence location. In both TRIM and the WSA this creek is shown to drain the 11.3 ha wetland 00076VICT. (This wetland is now a cultivated field). The more detailed TRIM data shows a creek draining into this wetland from the northwest. Although one may drive over this creek without knowing it, it may run all summer, and provide some limited coho habitat.

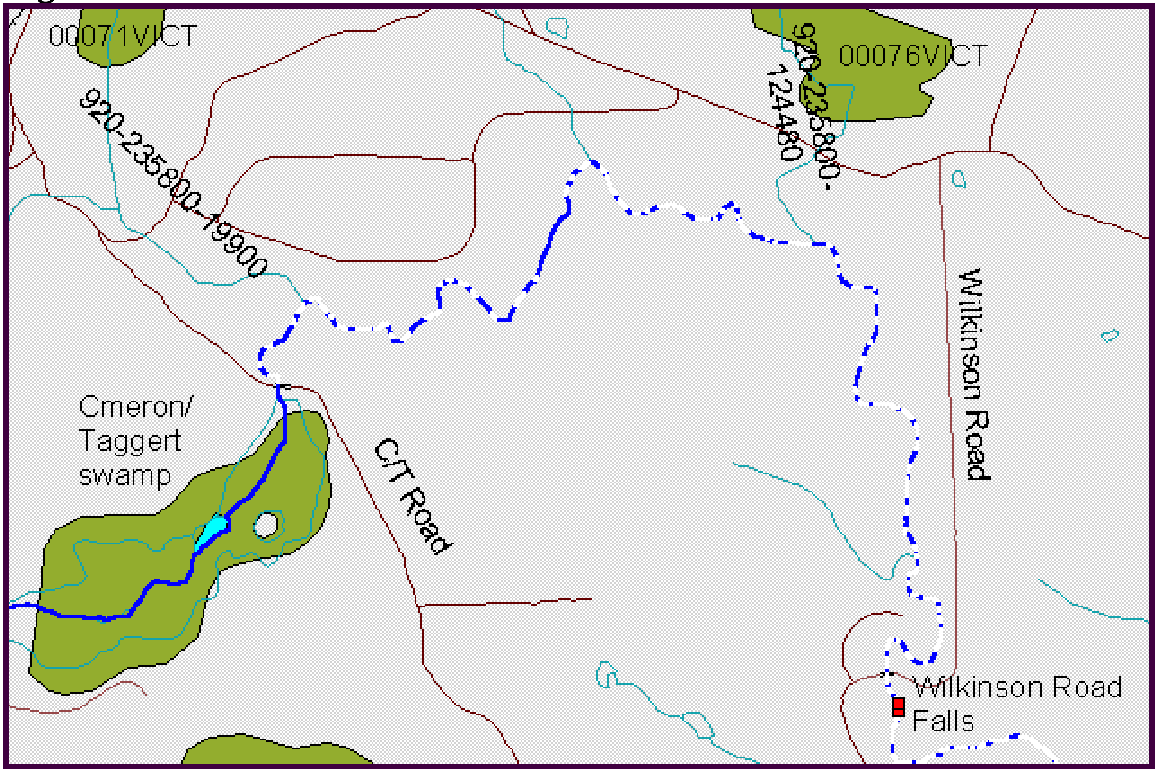
A last important feature to note about MRIV is that it begins above the last of the falls which block access to fish migration in lower Shawnigan Creek. Spawning cutthroat, rainbow, or kokanee can swim downstream into MRIV. Adult cohos, released after capture and transport over the falls, can swim up from MRIV into and through Shawnigan Lake, to spawn in the tribs above – as they have been reported to do on occasion.

**Recommendations:**
MRIV represents the best target for enhancement in Lower Shawnigan Creek. Although there is little or no public access to this long stretch, frequent driveways and private roads, including a few private bridges, would allow for easy access to the lower reaches if the landowners were willing. Access to the densely forested upper reaches might be more difficult. Addition of some LWD and boulders in the right places here could really be expected to produce scour in the unconsolidated stream bed of MRIV, creating deeper water, and more fish.

It might be worthwhile to monitor temp and DO levels at the top of MRIV, downstream of the C/T swamp, during the summer drought. Perhaps some kind of remedial action (an oxygenator or bubbler installed in the creek?) might be beneficial here in the heat of summer.

It might be prudent to contact the owners of the large tract of farmland attached to Reach 10, thank them for the care they have taken in preserving stream habitat, and remind them of the damage cattle can do to a stream in a worst case situation. It might also be wise to investigate the ownership of the large, unbroken tract of heavy forest along Reaches 10, 11, 12, 13, 14, and 15. This property would seem to be a logger's and developer's dream. The value of the timber alone must be enormous. If major changes in land use occurred here – say, if the whole block of forest were blitzed and converted into tract housing – fisheries habitat in the creek could suffer.

**Figure 31: MRIV and MRV**




MRIV (Wilkinson Falls – Cameron/Taggert Road) and MRV (Cameron/Taggert swamp)

**Figure 32: MRIV and MRV**

The same area as in Figure 30 above - note that the photo is not oriented to true north.

# Section 3.6) Macro Reach V

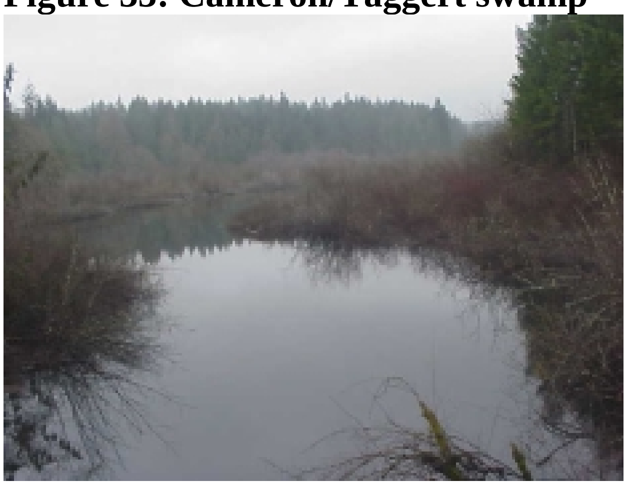
**Reach 16** **Chainage: 6194 – 7391 m** **Length: 1197 m**

MRV is the Cameron/Taggert swamp (see Figures 8, and 31-34), coded as wetland 00081VICT in the BC WSA. The extent of this wetland is listed as 251,079 $m^2$ (= 25.1 ha), at least 95% of which is a uniform, trackless jungle of willow swamp. With an area of 25ha it is the largest waterbody in the entire watershed, aside from Shawnigan Lake itself. MRV is identical to Reach 16 in our USHP data, and also identical to the single pool # 127. This pool begins at the top of the riffle located just below the Cameron/Taggert Road Bridge, and extends more than 1,000m upstream through impenetrable willow swamp to the Shinrock Road Bridge. The level of this wetland is maintained by a gravel riffle located a few meters below the Cameron/Taggert bridge. An intermittent beaver dam at the head of this riffle backs the water up slightly higher when it is "operational".

Although it is mostly a dense thicket of willows, this wetland contains a number of pockets of open water. Five areas of open water are visible in the aerial photo and the TRIM water layer: the narrow lead up from the Cameron/Taggert Road bridge (see Figure 32), two small ponds located about 1/3 of the way down from the top end of swamp (at the end of the visible channel leading down from the Shinrock Road bridge, See Figure 6), and two larger ponds or small lakes. This largest waterbody is teardop shaped, and appears on the aerial photo to be deep open water. It is registered to the WB ID: 00083VICT, with an area of 3.8 ha. The second (WaterBody ID 00084VICT) is slightly to the east, nearly round, area 2,875 $m^2$ (=0.29ha), perimeter 196m.

The upper end of the C/T swamp is the area where Shawnigan Creek crosses a geological border. Above this point – ever since leaving the lake - the creek has been flowing over Bonanza Group volcanics - igneous bedrocks laid down long ago, before the Crescent Terrane they form a part of ever joined the North American continent. Below this point the creek enters onto the rolling plain of debris left behind after the retreat of the recent Fraser Glaciation, less than 15,000 years ago. It courses through this gently

**Figure 33: Cameron/Taggert swamp**



Cameron/Taggert swamp outlet at Cameron/ Taggert Road. This lead of open water soon ends in disappears into a dense willow swamp.

**Figure 34: C/T swamp**

Looking north from Shinrock road across the Cameron/Taggert swamp, over hectares of trackless willow.

rolling wasteland of glacial rubbish from the top of the C/T swamp until it reaches the bluffs near Mill Bay. Above the swamp the gradient of the creek steepens. The predominant substrate shifts away from the gravels and fines found downstream, and towards coarser bedrock and boulders.

We were unable to actually measure MRV, or even penetrate very far into it. It is impossible to walk through or over, or swim through, or crawl through, due to deep standing water and dense willows. A channel of open water leads upstream from the Cameron/Taggert Road Bridge (see Figure 33) but soon disappears into the willows, which grow out of water that is 1.5m and more deep. We tried to force our way in with a canoe, but had to turn back. We took USHP measurements near the bridges at both ends of the swamp, and loaded the data into the USHP Excel program. However, these resulting ratings are not likely to be in any way representative of the true habitat conditions in the C/T swamp. It is better to ignore our USHP data for MRV, and make some broad generalizations:

1) The summer instream temperature, which drops steadily as the creek leaves the lake and flows downstream, rises dramatically in the C/T swamp. Even in August 1999, when lake outflow temperatures reached 24C, the creek temperature had dropped to 19.7C at the Shawnigan/Cobble Hill Road bridge, and to 19.1C at the Shinrock Road bridge where the swamp begins. At the swamp outflow however, the instream temperature was 21.7C, an increase of 2.6C from a temperature which was already higher than optimal for salmonids. A similar temperature rise through the swamp was observed in summer 2000, although the lake outflow temp was a bit lower all summer.

2) Perhaps more important, dissolved oxygen levels were found to be critically low at the swamp outflow. In August 1999, DO was measured at 7.0 mg/l at the Shawnigan Lake outflow, 7.2 mg/l at Shawnigan/Cobble Hill Road, and 5.6 mg/l at Shinrock Road. Repeated samples at Cameron/Taggert Road, the swamp outflow, ranged between 0.7 and 1.5 mg/l. Riffles and shade will act to inject oxygen and lower instream temperatures after the creek leaves the swamp. How far downstream the impacts of this degraded water quality are felt, and how big an impact they have, is unknown. Within the swamp itself during summer, there are sure to be trout in the deeper, open water areas. Whether any juveniles rear in the shallow, warm, stagnant willow flats during summer is unclear.

3) The effects of the poorer (for salmonids) water quality are illustrated by the fish species in the swamp. Although we did see the occasional small trout rising in the open lead above Cameron/Taggert Road in May (and actually caught a few cutthroat up to 15cm with fly and spinning rods when we tried to canoe up into the swamp), none were observed rising there in mid-summer. This doesn't mean there are none there. But the spot looks like classic trout water, where there should be big ones slurping everywhere – and we saw no indication of that. In the course of setting G-traps throughout the watershed in summer 2000, we caught or saw cutthroat trout and crayfish almost everywhere (see Appendix 3). But we seldom caught sticklebacks (only in two other locations - the mini-canyon formed by the ditch that drains wetland 00071VICT, and far downstream under the Shawnigan/Mill Bay Road bridge) – except when we trapped around the swamp. In repeated sets at both the inflow and outflow of the swamp we caught hordes of sticklebacks, but no trout. Large schools of sticklebacks were observed in both locations, including schools of juveniles (1cm) under the Cameron/Taggert bridge. Even more intriguing, one G-trap set at Shinrock Road caught a small (6cm) pumpkinseed sunfish. This is evidence that sunfish have migrated downstream from the

lake, and set up a new home in the warm, stagnant water of the C/T swamp – an ideal habitat for this opportunistic species.

The combination of deep water, thick bush, and vast extent would seem to suggest that this wetland may be one of the most “natural” areas in southeastern Vancouver Island – because no one can get into it to mess it up. The land surrounding the wetland is apparently all private, and the “waterfront” is all trackless willow. The only exception to this is along the north shore of the largest, teardrop-shaped pond. Here the deep water fronts against dry land, and there are two small docks visible in the aerial photo jutting into the pond. This would seem to be an excellent spot to launch from in order to conduct water quality studies, or for an attempt to penetrate into the heart of the swamp. We were given to understand that the property along the north shore of this pond was owned by a nudist colony, which does not appreciate visitors. As relative strangers to the area, we decided to respect their privacy, and turned our investigations in other directions.

**Recommendations:**

So little is known about the habitat conditions in the interior of the swamp that it is dubious to speculate on the role MRV plays in salmonid production, at least in the summer. Suffice it to say that it is wise not to be overly optimistic about any USHP computer projections predicting the numbers of fry it might produce. In the winter however, when flow levels and DO levels are much higher, and temps are much lower, this swamp might provide vital off-channel habitat – likely enough to support every juvenile salmonid between here and the lake, and more. At 25ha, it dwarfs the rest of the tiny, postage-stamp sized areas of potential off-channel that we identified over the rest of the creek.

This swamp is also doubtless host to any number of weird amphibians, insects, birds, exotic plants, and other critters great and small. Other than within restricted areas like the Sooke Lake watershed, I doubt if there are many 25 hectare polygons that could be drawn at low elevations anywhere on southern Vancouver Island which are visited by humans less than the willow thickets of the Cameron/Taggert swamp. There is little that might be done to improve salmonid habitat in the swamp. However, it would probably take only a few hours work with an excavator below the Cameron/Taggert Road bridge to drain this wetland, and turn most of it into a hay field. I like it better with the willows, even if I can’t get in to see it.

# Section 3.7) Macro Reach VI

**Reaches 17, 18, 19, 20, and 21 Chainage: 7391 – 9241 m Length: 1850 m**

MRVI begins at the Shinrock Road bridge, and extends up through Reaches 17, 18, 19 20, and 21. We combined the survey data for these reaches as a single unit, because the habitat is fairly similar all the way along it, and there are no major obstacles to fish passage. Also, the creek still runs in a fairly natural course through MRVI, unlike in MRVII above, where it often appears to have been displaced by the railroad. The gradient in MRVI is not as steep as in the reaches above, nor as flat as the non-existent gradient over 1,000m of swamp below. Land use along MRVI is primarily residential/large acreages, and the riparian area is still almost entirely forested.

On the ArcView printout of MRVI (see Figure 35) one can see a fairly even distribution of pools and riffles along the upper reaches of MRVI (Reaches 18-21). Reach 17, which extends from the Shinrock Road bridge to the bridge at the end of Filgate Road (now a private driveway), is notable for the two long riffles at each end. The first of these, Riffle 128, is 89m long, while the second, Riffle 136, is 196m long. These endless, boring riffles are perhaps an illustration of the loss of pool/riffle complexity that is often the result of logging and urbanization. Between these two long riffles the creek runs through a large private lot, mainly cow pasture, on which the owner has expended great effort to recreate a more natural pool/riffle complex, resulting in a series of deep, cutbank pools (Pools 128-135) divided by short, productive-looking riffles. This stretch <u>looks</u> like trout water, and large trout were observed swirling in the tailouts of some pools here when we visited the site at the end of March, 2000. (These were probably cutthroat spawners migrating down from the lake - the only large fish we ever saw in the creek.) Just above Reach 136 is another superb deep pool, again created by scour resulting from human intervention - in this case the relict cribbing from a dismantled bridge. The remaining reaches of MRVI show a better mix of pools and riffles. Again, this was a part of the creek that was surveyed by Lucas alone, and I have never seen most of these pools.

MRVI received an overall weighted average USHP instream rating of 29.0, with poor marks for LWD everywhere, percentage of pool area and boulder cover in Reach 17 (where the 2 long riffles are located), and percentage of wetted area (this last may be partly due to our unfamiliarity with the sampling protocol).

No tributaries are shown along MRVI in the BC WSA. Only one is visible in TRIM, joining the mainstem just above the Shinrock Road bridge. This is labeled as “Uncoded Trib” in Figure 35. It flows in through the top end of the C/T swamp, which is just as impenetrable as the rest of this wilderness of willow. We did not attempt to investigate this trib.

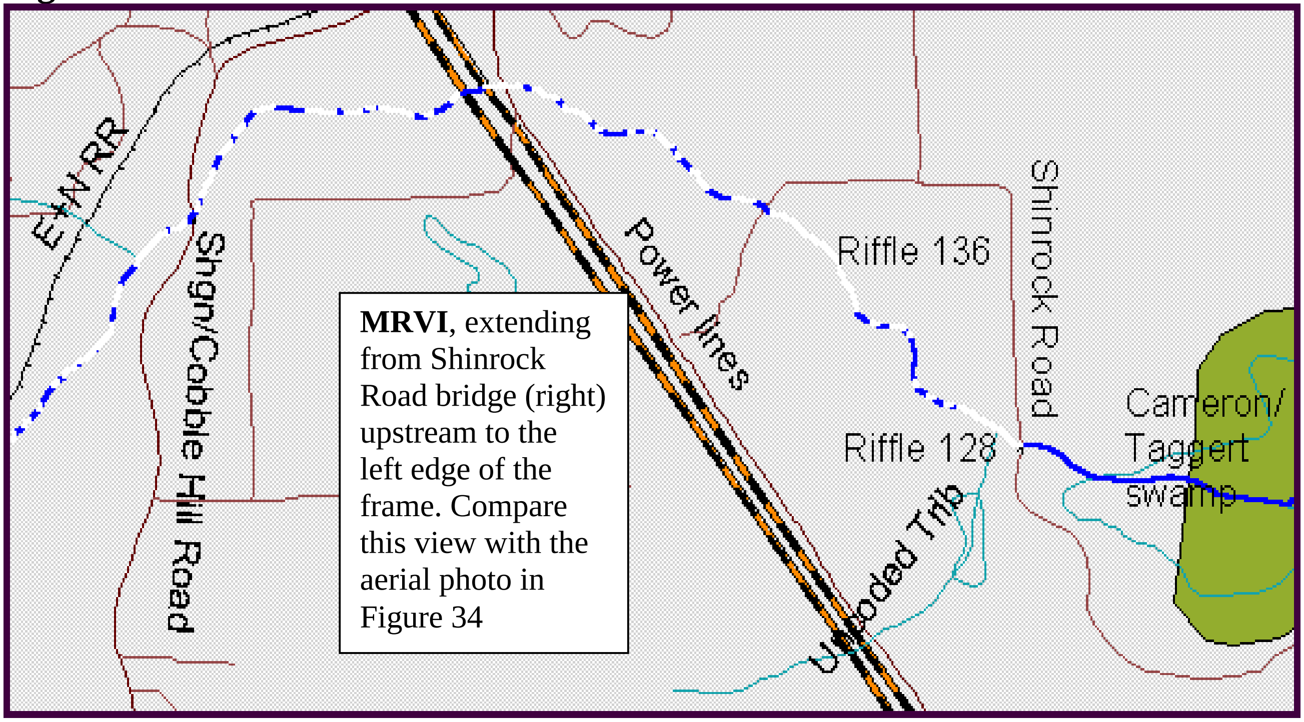
**Recommendations:**
MRVI is likely to be the most important rearing habitat within the mainstem for coh juveniles, as well as the offspring of cutthroat (and perhaps rainbow as well) trout that migrate out of the lake to spawn every spring. Many of the lake-run fish may also spawn in the faster, more riffle dominated MRVII above, or even pass through the C/T swamp to spawn in MRIV below. Since there appears to be limited rearing capacity within MRVII, many juveniles from this zone would likely be forced to move down into the better habitat of Reach VI to rear if summer flows out of the weir ebb to a trickle, and the

steeper regions of MRVII become shallow or dry up. All of MRVI provides potential top quality coho habitat. The substrate here seemed to be more unconsolidated, like that in MRIV, with more cutbank pools and fewer solid bedrock pools below cascades. This situation may change in the upper reaches of MRVI, which were only walked by Lucas.

For these reasons – the importance of existing habitat and the potential for enhancement – MRVI, along with MRIV, are recommended as the two prime targets for instream restoration work along the Shawnigan mainstem. The perfect set of failing grades received by all reaches within MRVI in the category of LWD makes them an obvious target for habitat complexing. Stumps, boulders, and log cribbing could create scour, deep water, cover, and traps for organic material washing downstream (e.g. carcasses of dead salmonid spawners). You might really get some bang for your buck with enhancement work in MRVI. In particular, the habitat within the 2 long riffles in Reach 17 could be upgraded immensely by scour and habitat complexing.

Land use along MRVI, as well as MRIV and top end of MRIII, is primarily residential on large acreages. The riparian owners can have significant impacts on the fish habitat in the creek, so it might be good to organize some kind of public awareness campaign that would both identify who the riparian owners are and where the lot boundaries run, and emphasize to them the importance of respecting the fisheries values here.

**Figure 35: MRVI**




**MRVI**, extending from Shinrock Road bridge (right) upstream to the left edge of the frame. Compare this view with the aerial photo in Figure 34

**Figure 36: MRVI**

MRVI: Land use is residential, large acreages. Much of the land area is cleared, but the riparian zone is still largely forested. The origin of the large clearing to the left of the powerline is unknown.

The orientation of the photo is not true north. Compare the swath of the powerline running through the middle of the photo with the powerline shown on the ArcView map in Figure 34, which is oriented north/south.

**Figure 37: MRVII and MRVIII**

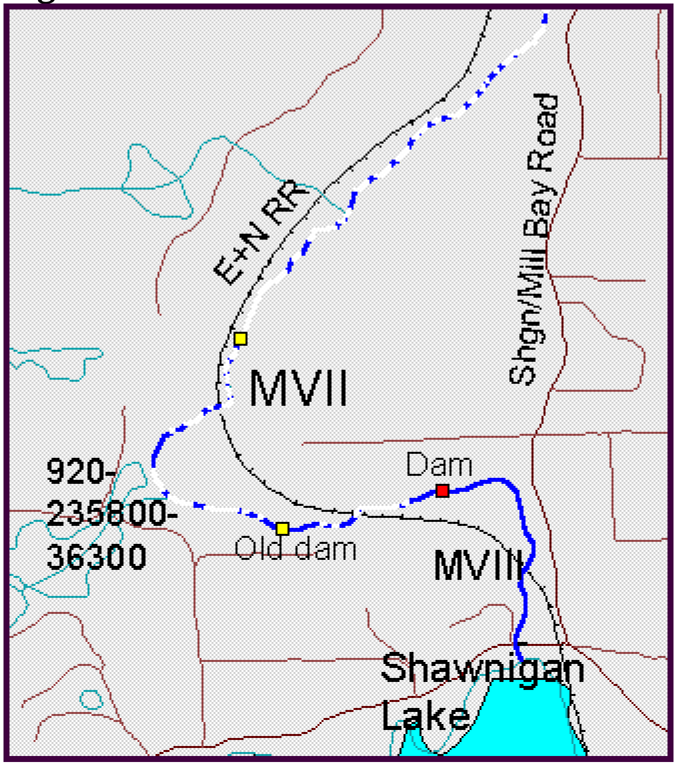



**Figure 38: MRVII and MRVIII**

MVII, and MVIII: The red square indicates the location of the Shawnigan Lake dam. Orientation of map is true north (photo is shifted to the east). The most prominent features in the photo are the broad curve of the E+N Railway (center) and S-bend shape of Shawnigan/Cobble Hill Road (right).

# Section 3.8) Macro Reach VII

**Reaches 22, 23, 24, 25, 26** **Chainage: 9241 – 10979 m** **Length: 1738 m**

MRVII begins at the start of Reach 22 (see Figures 13, 14, 37 and 38). The nature of the habitat within this stretch differs fundamentally from that in MRVI below in a number of ways:

1) The land use changes: The stream enters an area where there is little residential or agricultural development near the stream. Dense, unbroken forest cover predominates here, and few residences are visible from the creek itself.

2) Human impacts are greater: In spite of the dense surrounding forest, MRVII is more heavily impacted by human development than any other stretch of the creek. A portion of the original stream bed appears to have been filled in by the creation of the E+N railroad grade. The creek here now runs in a fairly straight course parallel to the trackbed along much of MRVII. One gets the feeling that the natural S-bend shape of the creek was changed to an "I" shape, as the creek was shoved over to one side of its little valley to make way for the railroad. Further upstream, some of the old channel bends remain, as the creek winds under 3 rail bridges made of cut stone blocks. (Two are located within MRVII, at chainages 10141m and 10741m/ These bridges are similar to the one shown in

Figure 39, which is actually a picture of the third rail bridge, located in MRVIII at chainage 11191m). Finally, at the top end of MRVII the creek approaches a bedrock sill, which is the control point for the water flowing out of Shawnigan Lake. This is also the logical site for a dam to control lake levels.

Over the years there have been a variety of structures installed along the top end of MRVII to control the lake outflows. No trace remains of the earliest dams referred to in the literature I read. At 10655m are the remains of an old dam (see Figure 40) built along much the same lines as the one currently in use: a cement wall poured on bedrock, with a slot in the middle into which timbers could be inlaid to control the pool level above. There have been no stoplogs placed in this dam for many years, and the creek flows freely through the gap in the middle of the dam, down the cement apron, and into the pool below. At a distance of over 1,000m below the present lake outlet, and a height of only about 1m, it is not likely that this dam ever had much influence on lake levels – if any.

Further upstream, at 10979m, is the dam which forms the present lake control structure (see Figures 41, 42, and 43), and the end of MRVII.

<u>3) The gradient steepens</u>: MRVII is mostly fast water - when it is running. Whether as a result of the construction of the rail bed (the logical result of taking the bends out of a channel is that it covers the same vertical drop in a shorter distance, and runs faster) or simply the natural lay of the land, it is evident in the ArcView printout of MRVII that whitewater predominates here, and there are few of the long pools found in MRIV and MRVI below (see Figure 37).

<u>4) The substrate changes:</u> The longer pools that do exist in MRVII are generally shallow, with a bedrock bottom. The predominant riffle substrate is boulder and cobble, with little of the gravels and fines found downstream. There are a few nice long pools in Reach 25, in areas where the creek swings away from the railbed for a short ways. When it runs directly below the rail grade the creek now runs so straight down a confined channel that there is seldom enough of a bend to produce scour and depth. These areas are now long straight rapids during moderate flows, and dry boulder runs during low flows.

<u>5) Lake outflow:</u> Another important feature to note is that MRVII begins at the outflow of the Shawnigan Lake dam. Flow levels and water quality within MRVII are almost entirely determined by what flows over (or through) the dam. Further downstream, the creek flow is more influenced by additions from tributaries and groundwater. During the summer drawdown period in Shawnigan Lake, MRVII will experience the brunt of the impacts of low flows and poor water quality that result from very restricted releases of warm surface water out of the lake. The combination of extremely low flows, extremely high temperatures, and possibly low nutrient levels as well, during the most productive part of the growing season, must limit the fish habitat within MRVII.

MRVII received a weighted average USHP instream rating of 23.8, lower than most of the other parts of the creek. This should be an indication of better habitat quality. However, I would be skeptical of the ratings for this reach. Again, the LWD ratings were all 5, the worst possible score. While MRVII actually scored better (=lower) than MRVI in percentage of pool area, most pools here are tend to be very short and shallow - some of them may have been recorded as riffles if the survey had been conducted during lower flows. MRVII scored much better than MRVI in percentage of boulder cover. Some of this boulder is natural, while some is likely sidecast from the construction of the railbed. But the boulder cover provides little benefit to habitat if the creek dries up in the summer. The percentage of fines is much lower here as well. The abundant whitewater contains many clean gravel riffles. This stretch likely provides important spawning beds for spawning trout (and perhaps kokanee?) that drop down from the lake.

Even thought the steep gradient and abundant whitewater in MRVII might not provide a lot in the way of deep pools, these factors may contribute a large measure of cooling and aeration to the creek during summer, when lake outflow water quality becomes a critical limiting factor in salmonid habitat downstream. The benefit of this impact to MRVI and other reaches downstream should not be underestimated. When we measured the lake outflow temperature at 25 C in August 1999, the instream temperature at the Shawnigan/Cobble Hill Road bridge, 2,500m downstream and one reach below the bottom end of MRVII, was found to be a much more salmonid-friendly 19.7 C. This 5.3C drop in instream temp, along with an associated increase in dissolved oxygen level, may be a bigger contribution to overall salmonid production in Shawnigan Creek than all the fry MRVII could ever produce within its borders.

The first trib to join the mainstem below the Shawnigan Lake is unnamed stream 920-235800-36300 (displayed as another straight “construction line” in the BC WSA - the actual course of this creek is shown more accurately in TRIM.). It originates far to the west, as the outflow from a pair of small lakes located near the divide into the Koksilah watershed (lake 00085VICT, 11.9 ha, and lake 00086VICT, 11.0 ha). This srteam flows at a low gradient through an area that appears in the aerial photo to be fairly undeveloped. This is the trib recorded at 10,285m in Lucas’ data, and marks the division between Reaches 24 and 25. We did not investigate it any further upstream. This creek would be a good target for further assessment. It is likely to provide significant salmonid habitat if fish migration into it is not blocked by falls or culverts. Two other tiny tribs are shown in TRIM entering from the west along MRVII. Neither was noted in the survey data. They are quite short, and not likely to provide a lot in the way of fish habitat.

**Recommendations:**
Addition of spawning gravel at the appropriate spots could be beneficial along MRVII. Lucas fished the spring cutthroat run in MRVII long before he ever attended Camosun, and we noticed other anglers fishing there during spring, 2000. Instream velocities are high here in winter however, and some thought would have to be given about where to put the gravel, to keep it from washing away. Since this part of the creek is fed only by the lake outflow, there will never be much natural replenishment of the spawning gravels in MRVII. The E+N rail tracks run immediately above a good portion of MRVII, and provide easy access to the entire length of these reaches. If restoration work were to occur here, and if agreement could be reached with the railroad, it would be easy to deliver equipment, boulders, LWD, etc to the site. The steeper gradient, higher velocities, and shallow exposures of bedrock which characterize MRVII make me feel that this is a reach where any attempt to install habitat complexing - LWD, boulders, or other cover/scour type objects – would be tricky business. You might accomplish a lot here, but you might also see all your work blown away in a flood. Any restoration prescriptions here should be written by professionals with experience in fast water habitat.

**Figure 39: First rail bridge**

First E+N rail bridge below Shawnigan Lake, located at chainage 11,191m in MRVIII. There is flow through MRVIII when the lake is high. Flow stops here when the lake drops, and all of MRVIII becomes stagnant.

**Figure 40: Old dam, August 2000**

The remains of an old dam, located at chainage 10655m in MRVII. Notice the extremely low flow level, typical of summer conditions here in 2000.

**Figure 41: Shawnigan Lake dam**

The current Shawnigan Lake dam, or "weir", located at chainage 10,979m, looking upstream. Low flow on left, moderate flow on right.

**Figure 42: The dam**

**Figure 43: The dam**

Shawnigan Lake dam, looking downstream, low flow, summer 2000. The flashboards can be seen propped against the posts of the walkway.

**Figure 44: Shawnigan Lake**

Shawnigan Lake outlet, 11471m. We ended our USHP survey here.

# Section 3.9) Macro Reach VIII

**Reach 27 Chainage: 10979 – 11471 m (Shawnigan Lake) Length: 492 m**

MRVIII begins at 10979m, at the Shawnigan Lake dam, or "weir", and extends approximately 500m to actual lake outlet itself at 11471m (see Figure 44). It is identical with Reach 27 in the USHP data, and also identical with the single Pool #203. The construction and operation of the dam is a subject that is too complicated to get involved with in this section of the report. For a more detailed discussion of issues regarding the dam see Section 5.3.

The water level in MRVIII is identical with the level of the lake itself. The stretch from the lake to the dam is simply an arm of Shawnigan Lake, except during extreme drawdown, when riffles or sandbars under the highway bridge and third rail bridge (at 11191m – see Figure 39) may become exposed. Duart McLean expressed the opinion that the entire length of MRVIII may have once been part of the open body of the lake during historical times. He thought that the present narrow channel which now forms MRVIII, with banks overgrown by bush and trees, is the result of infilling by railbed construction and other human activity, as well as sedimentation caused by constriction of the lake outflow channel as it flows through the road and rail bridges (McLean, 1954).

After lake levels drop in spring, and the flashboards are installed in the dam (see Section 5.4), MRVIII becomes an essentially stagnant pool, with depths approaching 2m in places. The bottom is almost entirely mud. I have visited MRVIII on numerous occasions, and canoed down its length twice. In spite of what appears to be excellent habitat - at least for sunfish and baby bass, if nothing else - I have seldom observed fish of any kind present in this long pool other than a few salmonid fry rising in summer 2001. The exception to this is the area closest to the lake outflow, above the Renfrew Road bridge. This shallow flat is more sandy than muddy, and serves as a spawning zone for pumkinseed sunfish in the spring. Kokanee – one of the few truly "natural" fish left in this lake - were also observed spawning in the lake outflow in 1999 (T. Michalski, pers. comm.).

The USHP instream rating for MRVIII was a very respectable 27, even after including the expected worst possible scores for the categories of LWD and percentage of fines. However, this unique habitat may be too complicated to grade accurately from a single morning's assessment. Conditions here change radically from month to month and year to year, depending of lake levels and flow levels through the dam. The kokanee that spawned on the lake outflow in 1999 may have had to look elsewhere in fall 2,000. In that year of near record-low precipitation during the late summer and fall, the lake level stayed so low that there was little outflow until through MRVIII until December. Instead of being an attractive, steadily-flowing kokanee spawning bed in the fall of 2,000, this area may have been stagnant until December.

**Recommendations:**
Fish habitat conditions within MRVIII are entirely dependent on flows through the dam. This is a very complicated issue, which involves balancing not only the concerns of fisheries habitat specialists, but also those of a number of other interest groups. In particular, the legal rights of waterfront property owners and licensed water supply owners must be respected. This topic is discussed in greater detail in Sections 5.7 and 5.8.

# Section 3.10) USHP Riparian Ratings

To me, the most surprising part of our USHP survey was the state of the riparian habitat. The creek and its riparian strip are a separate little world, hidden in the hustle and bustle of the Victoria/Duncan metro area. In spite of sprawling residential and agricultural development which surrounds lower Shawnigan Creek, the banks are almost entirely forested in dense stands of mixed second growth coniferous and deciduous trees. There were few sites anywhere in our survey that were not covered by 75-100% canopy. Most residential landowners have paid great respect to the integrity of the riparian corridor. Banks and upland slopes are stable and well vegetated, and we saw little sign of erosion. Flash flood events are moderated by the lake upstream, so this stretch of creek does not suffer the impacts of debris torrents or huge flushes of moving gravel common to many other coastal streams. A log boom at the lake outlet prevents large driftwood from exiting the lake, so there are no big trees with rootwads plowing down the channel during floods. This also means that there is little replenishment of either LWD or spawning gravel in this creek (which is often reflected in the USHP instream habitat ratings) But it helps sustain a positive riparian environment.

USHP riparian ratings are summarized in Appendix 2. Riparian data was not collected for Reaches 15 and 16 (for reasons explained earlier), so averages were calculated by dividing total scores by 25 instead of 27. The average ratings for all reaches were quite balanced, with the exception of extremely low scores for Livestock Access. Cattle have access to the lower mainstem at only a few sites, and their impact on the environment of this stream to date is very minor.

**Figure 44: USHP Average Riparian Ratings**

| AVERAGE - ALL REACHES | | |
|---|---|---|
| Land Use | | 11.4 |
| Livestock | | 1.5 |
| Slope | | 10.8 |
| Stability | | 15.0 |
| Totals | | 38.8 |

The average scores for Land Use (11.4), Slope (10.0), and Stability (13.9) were all fairly similar. Reaches receiving the highest scores (= the poorest riparian habitat) were Reach 7 (116) and Reach 11 (106). The big factor in Reach 7 is the slope (56). The riparian zone is steep along most of Reach 7, as the creek begins to cut a small canyon. But there was little evidence of erosion, or even potential for major erosion, visible along Reach 7. The major factor in building up the riparian score along Reach 11 was Stability. Lucas did this part of the survey alone. I have never walked it, so I am not in a position to speculate about the stability of the banks there. Perhaps more ominous are the high scores for Land Use recorded in Reaches 7 (26), 8 (24), 11 (32), 17 (26), 18 (18), 19 (24), and 27 (22). These are a reflection of the increasing development in the watershed, as farms and subdivisions creep up on the creek. Perhaps they are a sign of things to come. On the other hand, most land owners appear to be excellent stewards of the riparian zone, and some have put in positive effort to improve fisheries habitat.

The agriculture, logging, residential development and other forms of land clearing that are so obvious in the aerial photo are still mostly confined to the uplands in this watershed. All things considered, I think the problems with the riparian habitat along lower Shawnigan Creek are minor in comparison to the problems involving instream habitat, water quality, and summer low flows. Preservation of the existing habitat here seems more important than restoration or enhancement. This is a stream deserving SHIM-inspired bylaw protection of the riparian zone.

# Section 4.0) Water Quality

The USHP assessment format is targeted to record certain data sets, which are intended to serve as indicators of salmonid productivity for streams in BC. No matter how well designed a survey may be, it can never be 100% accurate in capturing all the information involved in determining salmonid habitat quality. Since the USHP method is a one-off, “snapshot” type of assessment, it only records data for conditions that existed at the time of the survey. It is USHP protocol to record data only under “ideal” summer conditions, but there may be important changes occurring during extreme conditions which are not captured in the USHP data set. For a stream like lower Shawnigan Creek, with its extreme variations in flows, the USHP assessment may not identify some of these other limiting conditions.

After getting to know the watershed better, and reading some of the many reports that have been written about it in the past, I have attempted to identify a number of other issues that I feel might have important influence on the fisheries habitat here, in addition to those pointed out by the USHP assessment. Sections 4, 5, and 6 will attempt to address the issues – not with any intention of solving the problems, but rather with the intention of gathering pertinent information, condensing it into a format that ordinary members of the public might be able to understand, and laying all the cards out on the table for all to see.

# Section 4.1) Instream Temperature and D/O

In spite of the excellent forest cover which shades most of the riparian area, salmonid habitat in lower Shawnigan Creek is limited by warm instream temperatures in summer. This is due to the effects of the two large bodies of standing water which feed it - Shawnigan Lake and the Cameron/Taggert swamp. The heated surface waters that drain out of these waterbodies may be stressful for salmonids dowstream. The USHP assessment only records temperature values captured on a single day. I went back to the creek later in the summer in an attempt to document extremes in water temperature and dissolved oxygen.

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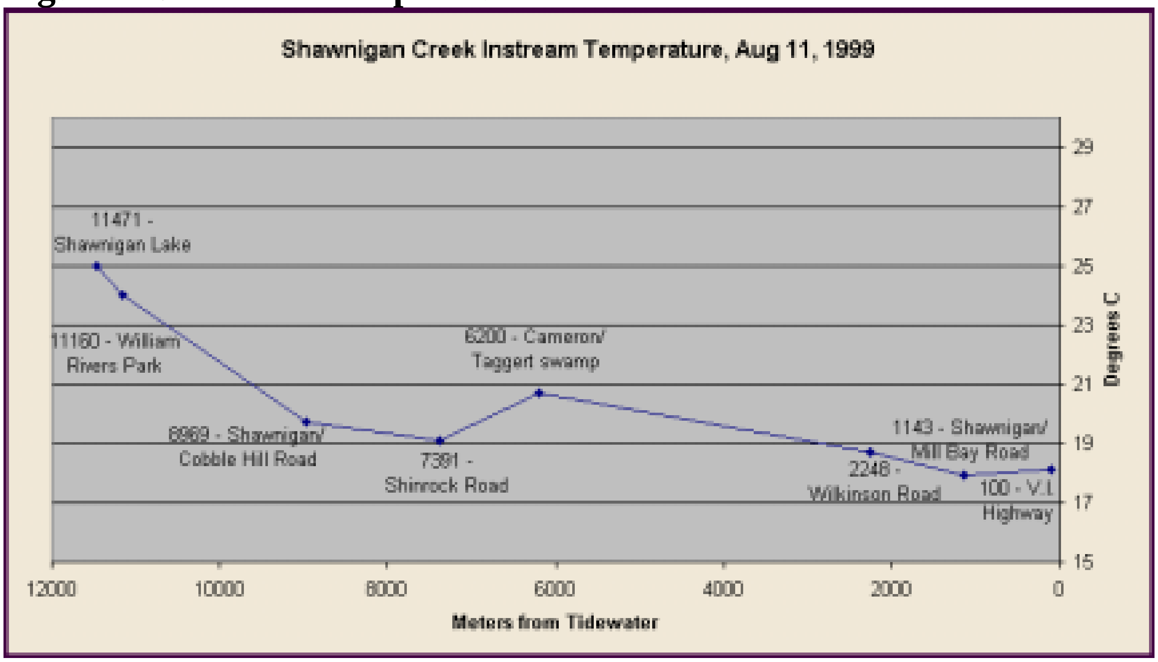
The source for the lower mainstem is Shawnigan Lake – more specifically the extreme surface layer of the lake, which is what flows down the outflow channel to form the creek. In summer 1999, which was notable for being unusually cool, I recorded a temperature of 25C at the lake outflow on August 11. During a more prolonged heat wave during a hotter summer the outflow to the creek will likely be warmer still. As it flows downstream, shade from the riparian canopy and the cooling effect of riffles and rapids act to chill the stream. On the same afternoon when the lake outflow was recorded at 25C, the instream temperature had been reduced to 19.7C at the Shawnigan/Cobble Hill Road bridge about 2,500m downstream, and to 19.1C at the Shinrock Road bridge 1,500m further below.

Below of the Shinrock bridge is the Cameron/Taggert willow swamp. This vast expanse of shallow, stagnant, dark water – 1,300m long and 25 ha in extent - acts as a heat sink.

On the same afternoon in 1999 when I recorded the summer maximum temperatures, the instream temperature was back up to 20.7 C as it flowed over the beaver dam at the bottom end of this swamp. Perhaps even more important, the level of dissolved oxygen, which had been running at around 7 mg/L in different sites above the swamp, registered a dismal 0.7-1.5 mg/L in repeated tests at the swamp outlet. Maybe this is a result of intense biologocal oxygen demand created by rotting vegetation in the shallow waters of the swamp?

Canopy and riffles again exert a cooling effect downstream from the swamp. At Shawnigan/Mill Bay Road Bridge, about 5,000m below the swamp, the instream temperature on this afternoon in 1999 was a more salmonid-friendly 17.9C. This site is directly below a falls, which was no doubt responsible for the increased dissolved oxygen readings of 8.5-9 mg/L recorded there - the highest we recorded anywhere in the watershed on that summer day.

**Figure 45: Instream temperatures**




These temperatures probably represent nearly the maximum highs encountered in the watershed during 1999. By comparison, on the same afternoon Upper Shawnigan Creek (the inflow to the lake) recorded an instream temperature of only 17.4 C, cooler than anywhere in the lower mainstem. This temperature was recorded a few hundred meters up from the lake, and this creek would likely get cooler as it gets further upstream. Unlike the lower mainstem where fish were scarce, the upper creek was absolutely plugged with salmonid fry. Two days later on August 13, after a change to cooler weather, 1999, instream temperatures in the range of 14-16 C were recorded in various locations in Hollins and Handeysen Creeks. Judging by this limited bit of sampling, it would appear that summer maximum temperatures are not likely to be a problem for salmonids in either the Upper Shanwigan Creek or Hollins Creek watersheds. The lower mainstem is a different story. The reaches immediately downstream of the lake and the C/T swamp may become very borderline salmonid habitat during hot summer months, due to the effects of instream temperatures and DO levels alone.

# Section 4.2) Water Quality: Aquatic Nutrients

Since the lower mainstem is fed by the lake's outflow, it starts out with the same load of nutrients found in the lake's surface water. Unlike most other low elevation Vancouver Island lakes, Shawnigan is classed as oligotrophic. "From the data on nutrients and phytoplankton, the lake would clearly be considered unproductive (oligotrophic)." – (Nordin, 1984)

During summer, stratification causes the lake to "split" into two layers, or strata, which are divided by a boundary zone called the thermocline. The warmest water "floats" to the surface to form a layer known as the epilimnion. Meanwhile, the majority of the nutrients in a deep lake like Shawnigan are locked in the lower layer, the hypolimnion, and will never be available to feed surface plankton again until the lake layers mix again, or "turn over", in the fall. No mixing occurs across the thermocline during summer. Plankton consume and deplete the nutrients in the epilimnion as the summer passes. As more and more nutrients are consumed, the lake's surface water becomes clearer because there is less plankton living in it. It is this plankton in the surface layers which forms the basis of the food chain in the lake. Without abundant plankton in the water column there is little for plankton-grazing organisms to eat. Without large numbers of these grazers, there is little for higher order predators to feed on. It is this very warmest, most nutrient-depleted layer of the lake that finally spills down the lake outflow in summer to form lower Shawnigan Creek.

Phosphorus is the limiting factor in algal productivity in Shawnigan Lake. The two elements which usually limit productivity in any lake are nitrogen and phosphorus. It is generally accepted that when N:P levels are less than 15:1 the lake is N limited. "Algae normally require nitrogen to phosphorus in the ratio of 5-10 : 1 (by weight). At N:P ratios greater than 12 or 15:1 phosphorus is generally considered limiting…When N:P ratios are less than 5:1 it is generally considered that nitrogen is the limiting element. In Shawnigan Lake the ratio of total nitrogen to total phosphorus was approximately 212:6 or 35:1. The ratio of inorganic nitrogen to total dissolved phosphorus was 28:1 at spring overturn, and 15:1 for the annual mean. What these ratios imply is that the supply of phosphorus is extremely small in relation to nitrogen and is likely to be the factor limiting algal growth in Shawnigan Lake." (Nordin, 1984)

Shawnigan Lake has been a growing community for over a century. Increasing urbanization is usually associated with increased nutrient loads and eutrophication of lakes. This is especially true in areas that do not have sewer systems, but instead contain growing numbers of old, poorly maintained septic fields. Especially if these fields drain directly into the lake. Especially if the lake regularly floods low-lying areas. Shawnigan Lake meets all these criteria. For this reason alone one would expect the nutrient load in this lake to be increasing over the past three decades.

In a series of reports written for the BC Ministry of Environment, N.K. Nagpal noted that the soils in the watershed are characterized by a tendency to bind phosphorus (Nagpal, 1981). This tends to pull phosphorus, including human-generated P-loading from septic fields, out of a short period nutrient cycle, and lock it up for long periods in the earth.

In 1976 Nordin noted that "In examining spatial and temporal changes of total phosphorus in the lake, it appears that total phosphorus showed little variation." Surely one would expect to find evidence of increased nutrient levels in the lake after another 20 years of increasing urban development, and the aging of existing lakeside septic fields. But in fact, there appears to have been a <u>decrease</u> in nutrient levels in recent years. As noted by G. B. Holms in "State of Water Quality of Shawnigan Lake 1976-1995":

1) (Total phosphorus) "values have decreased between 1976 and 1995 … and were less than the minimum detectable limit between 1992 and 1996."

2) "Average turbidity values have decreased between 1977 and 1995."

3) "This ratio indicates (N:P>15) that phosphorus was the limiting factor for algal growth in Shawnigan Lake. There was an increase in the N:P ratio over time due to the decline in total phosphorus in the lake. The dissolved ammonia:nitrate ratio decreased over time due to the decline in ammonia in the lake."

4) "The trends in the ratios indicate that there are changes occurring in the lake systems (e.g., land use, biological activity) which affect water quality."

5) "This may be attributed to a decrease in nutrients entering the lake or to an increase in biological production." (Holms, 1996)

Nordin also noted that ": Nitrogen also displayed low concentrations for all forms….Total nitrogen like total phosphorus showed only minor changes throughout the year and with depth. There appears to be no regular annual cycle of concentration in the surface waters…" (Nordin, 1984)

The relatively large size of the incoming watersheds and consequent large volume of inflow means that Shawnigan Lake is "flushed" much faster than many other, more eutrophic lakes in the region. The flushing rate (the average amount of time water remains in the lake before getting flushed downstream) has been calculated at 2.12 years for the more eutrophic Langford Lake to the south, as opposed to 1.37 years for Shawnigan (Lucey and Jackson, 1983). Nordin also noted that "The lake has a favourable water residence time (Flushing rate) of one year which tends to "flush" a significant portion (approximately half) of the phosphorus loading through the outlet." (Nordin,1984) In this case "favourable" means favourable for clear drinking water, not fish production. Nordin calculated the flushing rate at 1.08 years for Shawnigan Lake. Even though it is much deeper than Langford Lake (which would tend to increase retention time), Shawnigan has a much larger cachement basin and much higher inflows.

What these figures imply is that in Shawnigan, compared with many other local lakes, a smaller fraction of the total nutrients entering the lake are available to be used by algae. In summer, when biological productivity is greatest, most of the nutrients the lake has received in the past year are long gone down the creek. Nordin also notes that coastal BC watersheds differ from those in most of the rest of Canada, where the highest runoff (and greatest nutrient input to lakes) tends to occur after spring snowmelt – just in time to load watersheds with nutrients before the long days, warm temperatures, and high growth rates of summer. Here, the highest runoff occurs in fall and winter when productivity is low. Shawnigan watershed gets relatively little snowpack, and peak runoff occurs with the heavy rains of late fall and winter. "the major input of nutrients is in the late autumn…. Since the nutrients enter the lake in late autumn or early winter there is not the response by algae to this input, as there might be in the spring or summer, since light is limiting their growth." **– (**Nordin, 84)

Much of this winter input of nutrients is flushed downstream before algal productivity increases the following spring. Soon afterwards, as the lake surface warms, a thermomcline sets up. All of the nutrients in the deeper water are locked in the hypolimnion for the rest of the growing season. Due to the deep basins in Shawnigan Lake there is less productive shoal area, and a greater proportion of the total lake volume is located below the thermocline than in shallower lakes. The nutrients in this water are unavailable for summer algae production. For instance, here is a comparison of Shawnigan with its more eutrophic neighbor, Langford Lake:

| | **Shawnigan** | **Langford** |
|---|---|---|
| Max. depth: | 47m (sic – now measured at 52m) | 16m |
| Percent shoal area: | 40% | 65% |

(Figures from Lucey and Jackson, 1983)

Human population around the lake is most concentrated around the north end, near the lake outlet. Most of the nutrient loading generated from this community spends comparatively little time in the lake. Rather, it tends to get flushed through the outlet and down the creek, instead of being spread throughout the lake as would be the case if it had been introduced at the south end.

Another factor influencing lake productivity is the history of land use in the watershed. Until the past century, Shawnigan Lake was surrounded by old growth Douglas fir forest, loaded with rotting organic debris. This system was in balance, and total nutrient inputs equaled outputs. Since then, almost the entire watershed tributary to the lake has first been clearcut, and later grown back as second growth fir forest. There tends to be a short term spike in nutrient loads in a watershed after logging, especially if the cutblock involved was later slash-burned. (Carnation Creek Workshop, a 10 Year Review, 1982). Nutrients from small organic debris generated by the logging and ashes from slash burns are washed into the streams in the first year or two following logging. Later, the regenerating forest tends to rob the soils of nutrients. The dense and fast-growing stands of second growth Douglas fir that now dominate the watershed may convert a greater percentage of available soil nutrients into wood fiber before they can build up in the soil to the point where they wash downhill into the lake, to get converted into algae and fish. In an old growth forest, all the trunks of the big, old trees eventually fall and get recycled into soil and nutrients. In a forest managed for wood fibre, all the trunks of the big old trees are harvested and shipped out of the watershed. Perhaps this situation might contribute to the lower-than-expected nutrient load described in Shawnigan Lake.

Shawnigan Lake has been described as oligotrophic (nutrient-poor) by the authors of most reports. Low nutrient levels in the water column result in low levels of micro-algae in the lake. Lack of algae results in the outstanding degree of water clarity that Shawnigan Lake swimmers and boaters enjoy. The lack of micro-algae is also responsible for the low levels of zooplankton, and the higher trophic level herbivores and predators which feed on them. Chlorophyll "a" levels are much lower in oligotrophic lakes. "Shawnigan Lake exhibits low surface productivity (0.1 ug/l) increasing to 0.4 ug/l at 12 meters…Langford Lake surface data (1m) shows a value of 6.5 ug/l which increases to 31 ug/l between 5m and 7m.” (Lucey + Jackson, 1983)

Phytoplankton that do not get eaten will die and sink to the bottom, taking their nutrient load with them. These nutrients are lost in the hypolimnion until fall overturn, or fixed permanently into sediments. During summer, areas of the lake that contain above average nutrient levels may be subject to intense algal blooms. These blooms tend to further strip the nutrient load from the surface layer of the lake. It is this same oligotrophic, P-depleted surface water that feeds Lower Shawnigan Creek.

Another factor which may have an impact on the ecology of the surface layer of Shawnigan Lake is the effect of the scores of high-powered watercraft that now churn it up all summer. The placid lake I read about in documents from 50 and 75 years ago - when up to 50 rental rowboats full of day tripping E+N passengers could be seen on the lake at one time - are long gone. Nowadays this lake rocks all summer long in a continuous, heaving, rolling swell - from 8AM when the first ski boats appear, until after dark when the ski boats with headlights finally give up. It sometimes seems more like Long Beach than a Vancouver Island Lake. Thousands of horsepower rip the lake on summer days, shredding its surface like a giant blender. Burned and unburned hydrocarbons and additives in the fuel are vented through the propwash of the outboard motors. What effect, if any, this activity has on the nutrient loads and plankton community in the lake’s surface layers is anyone’s guess.

Although Nordin mentioned that “The phytoplankton biomass data…show no obvious periods of higher biomass.”, he also found that “Shawnigan Lake has a hypolimnetic oxygen depletion which is unexpectedly large… The oxygen depletion is out of character with the other limnological parameters for the lake, and is an area of particular concern for the general condition of the lake.” “…wood waste seems the likely source of this unusual oxygen deficit.” (Nordin, 1984) Like other researchers, Nordin attributes this situation to the effects of the forest industry, which operated extensive log booming grounds in the lake and sawmills along the shore during the early and mid 1900’s. Huge amounts of timber were processed into lumber here in the past century. Large areas of the lake bottom near the site of the old sawmills are still covered in old slabs and boards (Ross-Smith, G., pers. comm.). More important perhaps, during the years the mills were cutting lumber it seems that environmental regulations were less strict than they are today. The most convenient place to dump the sawdust was straight into the lake, and that is where the sawdust conveyors from the mills dumped their load. Old timers tell of days when the entire lake was covered with sawdust as far as the eye could see.

No one knows how much wood waste went into the lake, but it cannot have been beneficial. While snorkeling here I noticed that, although the water was quite clear, even the gravel bars were covered in a few inches of soft grey goo, like a layer of pudding a few centimeters thick that roils up in clouds at the slightest disturbance. There seems to be a lot more goo on the bottom of this lake than I see in most other lakes I have snorkeled on the south island. Could this goo be the remains of the floating sawdust that once spewed from the mills? Could this decomposing sediment be robbing oxygen from the lake depths?

# Section 5.0) Water Quantity

All streams on the west coast are subject to annual extremes which tend to stress the fish populations within them. High flows in fall, winter, and early spring may wash fish out of their home areas, alter and degrade the stream bed, and cause siltation. Low flows in late summer and early fall create a shrinkage in the total amount of habitat available, and make it easier for predators to capture fish. Low flows may also result in degraded water quality. For this reason it is important to attempt to document peak conditions within a watershed, as well as documenting the “ideal” conditions which are targeted by the USHP assessment.

# Section 5.1) Shawnigan Creek Flow

Flow levels in the lower mainstem of Shawnigan Creek are determined by outflow from Shawnigan Lake, which feeds it. The only major tributary, Hollins Creek, enters far downstream near the ocean. In summer, the flow down almost the entire length of the lower mainstem is controlled by lake outflow and groundwater seepage.

Like all of coastal BC, this watershed is characterized by precipitation levels that are high in winter and low in summer. Lake levels have always been controlled by the natural constriction of the outflow channel during the winter. During the summer dry period, Shawnigan Lake water losses (outflow plus evaporation) exceed inflows (from streams plus groundwater), and the lake level drops until it reaches a bedrock sill located about 500m downstream from the present outlet of the main body of the lake itself. This sill then becomes the outflow control point for the lake. When the lake level reaches the bedrock sill flow down the lower mainstem of Shawnigan Creek is reduced to a trickle. Even before the urbanization of the watershed in the latter part of the $20^{th}$ century, the outflow creek would sometimes run dry in summer. “For a period of 67 days in 1915 there was no outflow from the lake” (Knewstubb, 1924). Duart McLean refers to lake reports from 1914-17 which “substantiate verbal reports that there is no surface outflow from the lake during several months at the end of most summers.”

The natural summer drawdown in the lake is exaggerated by urbanization. The community of Shawnigan Lake is largely dependent on water withdrawn from the lake. An even larger waterworks system feeds the expanding subdivisions around the north end. The increasing summer population of lakeside residents, many of whom rely on private water systems pumping directly out of the lake, adds to the water deficit during the time when outflows are naturally the lowest.

After fall rains have saturated soils in the watershed, the inflow from tributaries to the lake increases and the lake level begins to rise. Now it is no longer just the level of the sill that determines outflow. One must add in the frictional co-efficients of water trying to force its way down a narrow winding channel with low gradient, constrictions, and brushy banks. Peak winter rainfall events are backed up in the lake before they can escape down the outflow creek. The result is a lake with a naturally fluctuating level over a normal range of approximately 1.5m. Talbot supplies records of lake levels from 1970-82 (see Appendix 5). These levels range from a minimum of 115.552m (Oct. 21, 1982) to a maximum of 118.188m (Dec.26, 1972), a range of 2.636m (= 8.65 feet). Earlier reports recorded a range of 9.5 feet (Addendum to 1953 McLean Report, 1967). The most recent high-water event occurred in February 1999, when the lake reached 118.2m, flooding the basements of some waterfront residents, and drawing a brief flurry of TV news cameras. Minimum low levels normally occur in late September-early October and peak high levels may occur any time from November to March.

As human population has grown around the shore, the fluctuation in the lake's level has become an increasing concern. "When the water level drops too low, boat hazards, mud beaches and domestic water intakes are exposed. When the level rises above the treeline, lakeshore residents become concerned that beaches are inundated and that the high water causes damage to their property." (Talbot, 1985). Since the middle of the past century there have been increasing calls for modification of the lake control structure: widening and deepening the outflow channel to increase winter flows and reduce maximum lake levels, and constructing a dam that would maintain higher lake levels in late spring and early summer so that water could be released gradually to provide stable summer downstream flows.

# Section 5.2) Pioneers

The community of Mill Bay was founded around the falls at the outlet of Shawnigan Creek, and the power that could be generated from them. The original "Mill" that the town was named after was used to grind wheat and other produce from the surrounding agricultural areas. The site of this original mill has been drastically altered by the Vancouver Island Highway and other types of urban activity. The power generation potential offered by the falls at Mill Bay is no longer harnessed.

In 1924 F.W. Knewstubb, Field Engineer for the Water Rights Branch, produced a report detailing the feasibility of a power generation development on Shawnigan Creek. This rather elaborate scheme involved diverting the upper Koksilah River through Shawnigan Lake. A quick look at a contour map suggests that the present west arm of Shawnigan Lake may be an extinct main channel of the Koksilah River. It is less than 2,000m (calculated in ArcView) from the end of the west arm of Shawnigan Lake to the present main channel of the Koksilah - as the crow flies. If one follows the low pass between the hills, more or less along the path of the old railroad grade, the distance is about 3,000m. If one follows a second low draw leading southwest out of this pass, the distance to the Koksilah is closer to 4,000m. Most important, the elevation where the last route meets the Koksilah is higher than the level of Shawnigan Lake. If a connection along this route were established between the Koksilah and the lake, it would be gravity-feed all the way. Knewstubb concluded that "it would be quite possible to divert the medium and low flows of about 66 square miles of Koksilah River watershed into the said lake by means of a dam and flume." He proposed a flume of 150 cfs capacity, over a distance of "about 2 miles long" (= 3,000m). Shawnigan Creek could then be diverted below the lake to tap this increased flow, which Knewstubb proposed to run down another overland flume, in order to maintain a good head, until it could be funneled downhill at Mill Bay to generate electricity for sawmills there. (See Figure 47) This project never came to pass, and the steelhead in the upper Koksilah are probably glad.

During the course of our survey we noted an old cement dam located at chainage 10655m, or 324m downstream of the present dam, between the middle and lower rail bridges (see Figure 39). This design is very similar to the current dam: a cement wall about 0.5m thick and 1m high (from the deepest part of the channel), with a 3m slot in the middle to allow for placement of stop-logs. An apron of poured cement extends downstream from the slot to protect the creek bed from scour. Since it has no stop-logs, the structure no longer appears to be a barrier to passage for fish of any size at any time. (We included it in the ArcView display of man-made obstructions anyway.) This dam is old and mossy, and does not appear to have been in use for many years. None of the reports about the watershed that I have read make any mention of it. The crest elevation is unknown. But since it is only about 1m high, and is located over 800m downstream of the lake, it is not likely that this dam was ever used to control lake levels.

In 1954, Duart McLean, Hydraulic Engineer for the Ministry of Environment, prepared a report to address the issue of fluctuating lake levels. He noted that 80% of the precipitation in the watershed falls between October and March, leaving only 20% for the period from April through September when it is needed most. McLean was of the opinion that human development, especially the construction of the rail and highway crossings, had greatly impacted the area around the lake outlet. “The original outlet of the lake was probably…900 feet downstream from the present lake outlet under the highway bridge. The Esquimalt and Nanaimo Railway cut across the flats at the lake outlet and so created a dyke…This caused silting above the railway fill..”. McLean proposed blasting and dredging the entire channel from the lake to the small falls below the third rail bridge, in preparation for building a dam which would eliminate the threat of flooding around the lake. He concluded that it was necessary to:

a) "Lower the elevation of the rock rim mentioned above."

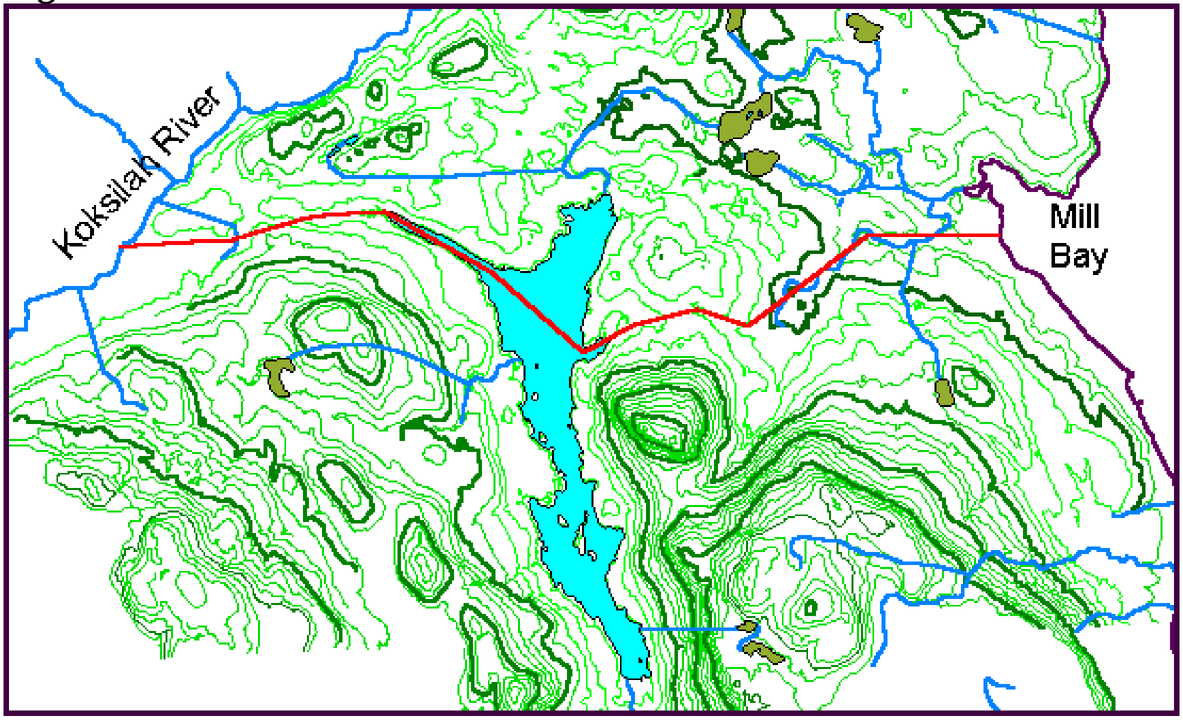
b) "Widen and deepen the creek channel from the present lake outlet to the above rim control."

c) "Remove any obstructions below the rock rim which may produce backwater flow.”

(McLean, 1954)

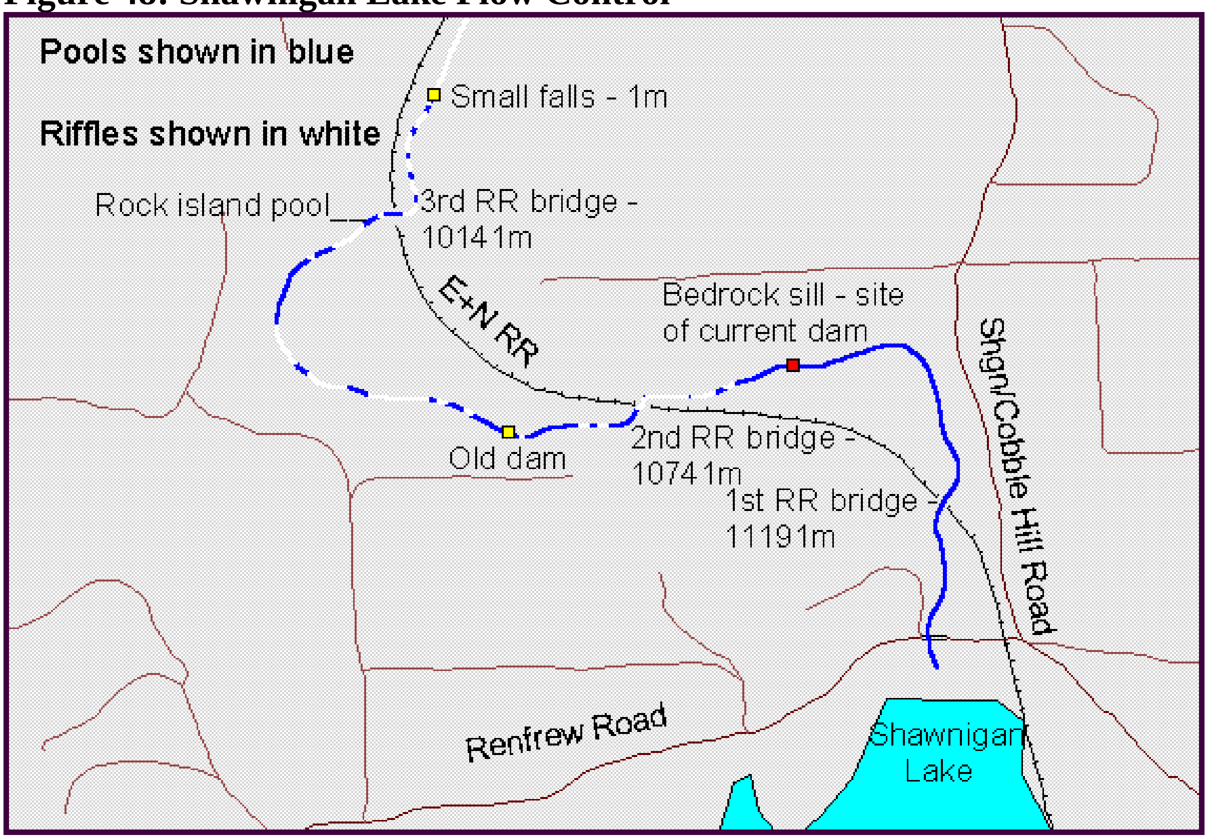
McLean’s report outlined four options, all of which involved blasting and excavating the lake outlet channel to lower the rock rim control level. He recommended Option A, which required lowering the channel bottom by 4 feet (1.2m). This excavation would have to be continued downstream of the present lake outlet until the elevation of the new channel bottom met up again with the level of the creek bed, over a kilometer downstream. This rather drastic Option A would have required blasting and excavating over 1,000m of existing creek bed (including removing a rock island that disrupted McLean’s free flow), and converting it into a channel 10-12m wide. The excavation would have had to proceed underneath all three rail bridges without disturbing them. In light of the fact that it also would have required removing and re-installing the existing highway bridge and relocating a house, McLean’s total cost estimate of $20,100 for excavating the new channel and building a new dam seems a bit conservative, even by 1954 standards. No action was taken to implement McLean's recommendations

**Figure 47: Possible Route of Knewstubb's Koksilah Connector?**




F.W. Knewstubb proposed diverting the upper Koksilah River through Shawnigan Lake, and then diverting the lake outflow through an overland flume to Mill Bay.

**Figure 48: Shawnigan Lake Flow Control**



# Section 5.3) The current dam

The legal technicalities surrounding the diversion and use of water in BC are very complicated. I am not an expert in this field. I will try to present here some of the basics, to the best of my understanding, as they apply to Shawnigan Creek, in the hope that it may provide a background for members of the public who are just as curious and uninformed about this subject as I am.

It is any citizen's right to obtain water from the public domain. Regulations allow for the owner of any dwelling to withdraw up to 500 gallons per day (as long as all the water available in that lake or stream is not already under license). Individuals, industries, or community groups that require larger volumes, and wish to guarantee their supply, must apply for a provincial water license. To date, almost 200 water licenses have been issued for withdrawal of water from the Shawnigan Creek watershed. Most are small volume licenses to private homeowners. But by far the greatest volume, over 75% of the total, have been issued to three community waterworks: Mill Bay Waterworks (serving the village of Mill Bay), Lidstech Holdings (serving the village of Shawnigan Lake), and Sherwood Waterworks (now taken over by Cowichan Valley Regional District, and serving the residential subdivisions around the north end of Shawnigan Lake.).

The Lidstech and Sherwood licenses were issued to allow for withdrawals directly out of the lake, while the Mill Bay license is for withdrawals from the bottom end of the creek. (from the pumphouse beside Pool #3, under the Island Highway bridge – see Figure 23) Since summer flow out of the lake was minimal in its natural state, and since summer drawdown of the lake would be increased due to the licenses issued on the lake, Mill Bay applied for and received a water storage license on Shawnigan Lake. This license allows Mill Bay to store up to 1,000 acre-feet of water in the lake. In order to store the water, the license also allowed for construction of a dam near the lake outlet. MBWW proceeded to construct a dam or "weir" across Shawnigan Creek, downstream of the lake outlet. "In 1964 a simple two foot high concrete wall was constructed to elevation 115.90 GSC datum, on the bedrock at the control point in the outlet channel, about 450 meters downstream of the lake, by the Mill Bay Waterworks District, as shown in Drawing 4984-88, Figure 3. That dam, with a 3 m wide stoplog opening and a sill elevation of 115.29 m, was designed by Ker Priestman and Associates to store 2 feet under the District's Conditional Water License 27948." (Talbot, 1985). This dam site was chosen because it offered the shallowest exposure of smooth bedrock. (The bedrock is deeper under the channel between here and the lake, and is overlain by glacial till, and possibly also by sediments resulting from rail and roadbed construction.) The creek bed at this spot was excavated, and a cement base was poured directly onto bedrock. The intent of the dam was to provide a means to hold back some of the spring runoff, while allowing for a relatively free outflow in winter. The water held back in the lake during spring could be allowed to flow out down the creek at a later date, to be withdrawn near the mouth by the Mill Bay Waterworks, who paid for the construction.

# Section 5.4) Operation of the current dam

This dam is still in operation, and is still the primary mechanism for managing summer lake levels and downstream flows in Shawnigan Creek. The dam is operated under a “provisional rule curve”. The rule curve is an attempt to estimate where the lake level should be at any time of the summer, in order that it will keep dropping at a steady rate until it reaches the level of the base of the dam in late September. (See Appendix 5) Discharge is determined by comparing the lake level on any given date against a graph which shows where the level should be on that date, if the lake is to recede at a gradual and even rate throughout the summer, until it reaches base level in late September. This rule curve shows the same basic shape as one would expect from a graph of the lake levels in their natural state – dropping gradually throughout the summer – but it’s slope is less extreme, and the spikes generated by rainfall events eliminated.

Lake levels are checked regularly in summer. If they are below the rule curve level for that date, flow through the dam is reduced if possible. If the level is too high, more water is allowed out of the dam. Lake levels are controlled by stoplogs, flashboards, and a small gate. The stoplogs are sawn 8x8” timbers that fit across the 10 foot gap in the center of the cement base of the dam. The small gate on right side of the dam is intended to allow for accurate control of low flows, but is it only marginally effective. A pair of vertical 6x6” posts straddle the dam at each end, and also in the middle, forming support for a footbridge about 2m above the dam. They also create support for the flashboards - wooden sheets inserted above the crest level of the dam to hold the lake back at a higher level in spring. (See Figures 41 and 43)

All stoplogs and flashboards are removed in winter, to keep lake levels low by allowing as much water as possible to escape downstream. (See Figure 42) The stoplogs are normally installed in late March, after the end of winter rains, in order to begin reducing outflow from the lake. The flashboards are installed in April, to retain as much water as possible as the dry season progresses. Eventually the lake recedes below the flashboards, to the level of the top of the stoplogs. The flashboards are now removed, since they serve no more purpose. Later, in combination with the ever present leakage, flows are controlled by the gate, and by removing the stoplogs one by one.

It is important to note that the flashboards have never acted as a true dam, totally stopping the flow. In spring 1999 when we viewed them, the flashboards consisted 4x8 sheets of used ¼” plywood and OSB board, held in place by the pressure of the water itself jamming them against the 6x6 upright posts of the walkway. It was rather amazing that this rickety pile of scrap - bent, bowed, and concave between the uprights - could be holding back millions of cubic meters of one of the biggest lakes on the south island. The whole situation looked very haywire, not to mention dangerous should anyone happen to be on the downstream side if one of the 4x8 sheets gave way. Because the sheets of plywood were square, and did not conform to the slope of the slope of the channel banks, there was always water rushing out around the ends. This seemingly careless design actually allowed for fish passage downstream during high flows. Since maintenance of the dam has been transferred to the Cowichan Valley Regional District the level of the top of the flashboards was much lower – about 0.5 m – and the whole operation looked much more secure.

Operation and maintenance of the dam had been performed by the nearby Sherwood Waterworks until July, 1999, when these duties were assumed by the Cowichan Valley Regional District. CowVRD Engineering Department continues to manipulate outlet flows according to instructions received from Bruno Blecic, Water Management Officer for the Victoria Region, Ministry of Environment, who makes decisions about outflows based upon the provisional rule curve. As of early June, 2000, the lake level had dropped 25cm below the top of the flashboards, and flow around the ends of the flashboards had stopped completely. Remaining flow was occurring mainly through gaps between the plywood and the dam (see Figure 41). Later in summer the outflow diminished even more, often to miniscule levels (See Figure 40). In spring 2001 the flashboard arrangement looked to be much the same as in 2000, except that the control gate seemed to be functioning much better. Concern about a summer drought in 2001 seems to have resulted in the lake level held back a bit longer into summer. In any case, a steady flow though the gate was observed all summer, with no evidence of the extreme low flows seen in 2000.

# Section 5.5) Problems with the dam

The current weir/dam arrangement is faced with many problems, some of which I will list here to the best of my understanding:

1) The dam is surrounded by private property, and was built without easement or written consent of the owner. It is possible that neither CowVRD nor even the Ministry of Environment has the legal right to access the site, except perhaps by helicopter. Although the present owners are quite willing to allow access to the dam for operation and maintenance, there is apparently no legal reason that they must continue to do so. Bruno Blecic of MELP was of the opinion that there was at least a possibility that the upland owners might have the legal right to order the dam's removal at any time.

2) Since the site is not owned by the operators there is little security. The dam is located in a forested gully, and is not visible to anyone except the people in the private house above. However, it is easily accessed by a short walk down the rail tracks on the other side of the creek. It is undoubtedly a great place for local kids to go and fool around. If the stoplogs or flashboards are dislodged, they may float downstream and be lost forever. The flashboard/stoplog arrangement has been purposefully dismantled in the past – either by vandals, or by locals upset with the level of the lake (H. Elbe, pers. comm.). The crude nature of the dam makes it impossible to replace the stoplogs during high flows (= until most of the stored water has drained out of the lake) once they have been removed.

3) There would also seem to be a liablilty issue. If I were 13 years old, I would probably love to stand under the dam, play in the squirting water, and poke and pry at the flashboards and stoplogs. The rickety flashboard arrangement in 1999 was quite frankly scary for us to be around. If a 4x8 sheet were to give way while backing up a full load of water, a wall of water over a meter high would come crashing down the creek instantly. The flashboards in 2000 and 2001 were much lower and more secure. It might be expected that an operation which is a vital and

vulnerable, and possibly dangerous, as this would be surrounded by a fence with a gate, but this not very feasible here because the land the fence would have to be built on is not owned by the crown.

4) The current flashboard arrangement is difficult to manipulate at high flows. The flashboards are basically all-or-nothing, and cannot be adjusted at all during high flows. At times, leakage thru and around the flashboards may be more than is needed to maintain adequate downstream flow, and represents a waste of water that could be used later in the summer or fall.

5) Fish passage thru the dam site is inadequate. As soon as the stoplogs go in the dam becomes an obstacle to fish passage. The flashboard arrangement as of June 2000 appeared to present a total barrier to fish passage of any kind. (See Figures 41 and 43) Water escaping around the ends of the flashboards might allow for passage downstream, but would pose a serious obstacle for upstream passage of adults, and a total barrier for upstream passage of juveniles - due to high velocities, a steep vertical jump, and lack of any kind of deep water "jump pool" below the dam. After the flashboards are removed later in the summer, the stoplogs still pose an apparent total barrier to passage of juveniles, and an obstacle to passage of adults. The small gate used in summer was not designed to allow fish passage.

As soon as the lake dropped much below the level of the top of the flashboards in summer, 2000, outflow through the dam was reduced to minimal levels. When I visited the site in June, 2000, the biggest source of flow through the dam seemed to be occurring through a large nail hole in one of the sheets of plywood. It would take an extremely tiny fish - not to mention one with extremely accurate aim in jumping - to pass through this nail hole. Since there is no deep water "jump pool" under the dam, adult fish are unlikely to be able to leap over the flashboards. From June until the onset of fall rains, the existing dam appears to block the passage of all fish at all times.

Significant migrations of fish pass thru this damsite. The lower mainstem represents one of the two main spawning options for the salmonids in the lake (upper Shawnigan Creek being the other). I was not able to locate any published information documenting timing or volume of these runs. (This might be a good subject for study.) We observed large salmonids, probably cutthroat migrants from the lake, swirling in the tailouts of deep pools downstream of the lake on March 30, 2000. Do any of these migrating trout remain in the creek after the flashboards are installed in the dam, making fish passage back into the lake increasingly difficult and finally impossible? At best, any late returnees that are trapped below the dam may become otter food in the confined environment of the creek. At worst, they may be forced to hunt down and eat their own offspring in order to survive through the summer in limited habitat.

It is likely that many juvenile fish once migrated in and out of the lake all summer long (in years when the creek flowed all summer), scouting for the best habitat. This option is now lost. Young fish are now locked into whichever habitat they were in – lake or stream – when the flashboards are put in place. The lake's native kokanee may also utilize the lower mainstem as a spawning ground, and the resulting fry would have to make it back up into the lake in order to find rearing habitat. (O. nerka fry generally rear only in lakes, not in streams.) I could find no information about the volume or timing of the Shawnigan kokanee spawning run, or subsequent upstream migration of fry the following spring. The Shawnigan kokanee still exist however. They are occasionally caught by anglers or in sample nets, and were observed in fall, 1999, spawning in the outflow channel near the highway bridge at the lake outlet. (Michalski, T., pers. comm.)

It appears that the issue of fish passage has been considered when the dams were designed here in the past. While looking up data for past Habitat Conservation Trust Foundation projects to be entered into the Fisheries Project Registry website (my current job), I noticed that there was a 1989 HCTF project titled "Alternative Fishway Design". This project was intended to design and test innovations in "fish ladder" techniques. Shawnigan was one of the 5 lakes originally included in the proposal for this project (along with Cowichan, and Tom Browne Lakes on the south island, St. Mary's Lake on Saltspring Island, and Puntzi Lake in the interior). But Shawnigan was dropped from the plan before it was ever undertaken. To my knowledge, there has been no further research into the subject of installing a fishway at Shawnigan Lake, by any branch of government.

6) Mill Bay Waterworks, the original lead proponent for the dam, has subsequently located aquifers and drilled wells, from which it can now supply much of its own demands. (Bruno Blecic thought that they may still be using some creek water for irrigation, but not for drinking water systems.) So it no longer currently needs or uses all of the 91 million gallons/year of water it is allowed to store and withdraw under its licenses. Under a rather complicated agreement, Mill Bay WW allowed the large lake withdrawal licensees - Sherwood WW and Shawnigan Lake Village WW – to "piggy-back" on its storage license. In trade for getting to use the stored water that Mill Bay does not need, Sherwood agreed to take over operation and maintenance of the dam. As a result, Sherwood did not have to build a higher or more efficient dam in order to store the water for its licenses.

   This has the effect of circumventing one of the original intentions of the dam: to ensure a good, stable flow all the way down lower Shawnigan Creek to the mouth in Mill Bay during the dry months of summer. This agreement, along with the dam and its maintenance, has been inherited by CowVRD, which now manages the affairs of what used to be Sherwood WW. This agreement effectively diverts the critical summer low flows out of Shawnigan Creek (= fish habitat) and into the lawns and bathtubs of the people living around the north end of the lake. I have been told that Fisheries and Oceans Canada filed a protest about the increasing withdrawals of water from Shawnigan Creek some years ago, but that there was little action taken on it, and the protest was not pursued.

# Section 5.6) Later Reports

Ever since the present dam was built there have call for upgrading it or replacing it with a better structure. An addendum to the 1953 McLean Report was published at a later date. (This report is on file in the BC Ministry of Environment library at Selkirk in Victoria. There is no indication of who authored this report, or when it was published. Since it provides weather records up to 1966, and mentions the dam built by Mill Bay Waterworks, it must have been published in 1967 or later.) This report recommends adopting McLean's option D, which would still involve blasting and lowering the lake control point by "approaching 4 feet" (= > 1m), removal and reconstruction of the highway bridge to allow a channel excavation of 3.5 feet under the bridge, blasting and removal of the rock island below the damsite, and relocation or raising of the house. The report recommends installing a Calco #101 slide gate or its equivalent in the dam, to allow for fine-tuning of outflows at all flow levels. The costs are itemized in this report – apparently simply by multiplying McLean's costs by an inflation factor or 1.7. The cost of removing and rebuilding the highway bridge does not seem to be included. Perhaps it was expected that the Ministry of Highways would fund this? In this report, the total cost is estimated to be $53,030. It is interesting to notice that this document suggests removal of the Mill Bay Waterworks dam (still the active dam at the outflow), so soon after it was built. The new dam would have occupied the same spot.

In 1984, J.C. Kwong, Water Engineer with the Water Management Branch, published a report which noted that "Leakage has developed under the foundation of the existing concrete structure." (Kwong, 1984) He recommended construction of a new dam, at a site 13m upstream from the present dam. His plan does not involve the blasting and lowering of the actual rock sill control point, and eventual lowering of the late summer lake level by up to 1.2m, as in McLean's Option's A and D. But it still recommends excavation of sediments and glacial tills to widen and deepen the existing outflow channel. Kwong's cost estimate for the new dam (which includes channel excavation, but does not include removing bridges, houses, and islands) is a more sensible $252,000.

Kwong's report was followed by another written by R.J. Talbot, engineer for the Rivers Section, Water management Branch, titled <u>Shawnigan Lake Water Level Study</u>. It contains lake level records from 1970-82, and notes that high lake levels caused by flooding on Dec. 18, 1979 brought complaints of flooded basements. His report recommended removal of the existing dam, channel excavation similar to that proposed by Kwong, and construction of a new dam with a crest level of 116.5m (0.6m higher than the present dam). This dam would be designed with screw-operated gates, which would offer the opportunity for fine-tuned outflow control in summer, as well as control during high flow periods.

If there is one generalization that can be made about all of the technical reports I have read regarding water levels, outflow levels, and dams on Shawnigan Lake, it is this: The issue of fisheries impacts resulting from the installation and operation of the proposed dams has never been discussed, or even raised - once. Nor has there been any mention of fish passage through the damsite.

# Section 5.7) Summer Low Flows

It is hard to say just how much water flows down Shawnigan Creek in summer nowadays. The Water Survey of Canada maintained a streamflow gauge downstream of the lake sporadically during the 20th century, but this service was terminated in 1989. Normal summer low flows are exaggerated by human consumption out of the lake. Licenses already exist to allow for extraction of over 4,000 $m^3$/day from the lake and creek, and licenses for another 2,610 $m^3$/day are under application. (See Appendix 4). Even without the increased withdrawals from additional licenses there is already great disagreement about lake levels. Some waterfront property owners are upset about the effects of holding the lake back in summer at all to feed existing water supply demands. Others wish to hold back more water in the lake for urban withdrawals. Allowing for more water to be withdrawn from the lake without increasing storage would result in an even more drastic summer drawdown in the lake than occurs now.

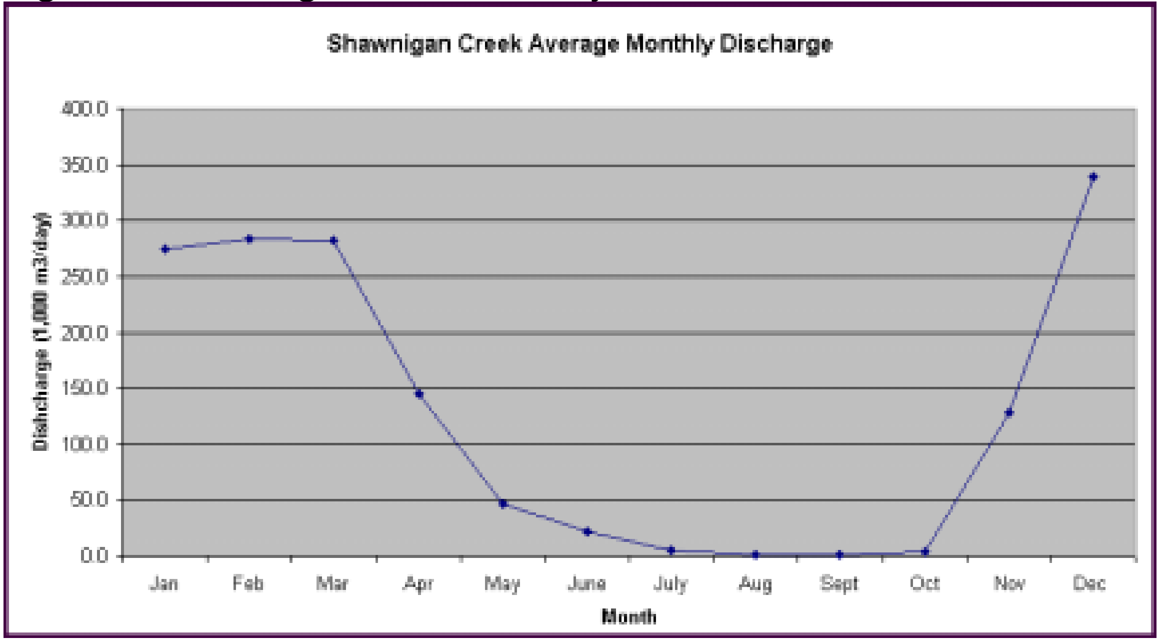
The Ministry of Environment is reviewing the new license applications (which have been on hold for a number of years), and is actively investigating the possibility of replacing the dam with a new structure which would store more water and release it in a more controlled manner. As well as the existing 1,000 acre feet of storage in Shawnigan Lake now granted to the Mill Bay Waterworks, there are an additional 1,043 acre feet of storage applied for, split 50/50 by the Shawnigan Lake Village and Sherwood Waterworks. These applications are being reviewed by Richard Penner, Head of the VictoriaWater Licensing Unit. Mr. Penner is also attempting to determine a "water budget" for Shawnigan Lake, which would express the balance of water gains (in the form of tributaries, groundflow, and direct precipitation into the lake) against water losses (in the form of human use, evaporation, and outflow down the creek). The results of this analysis will be used to make decisions about granting the new licenses and building a new dam. In conversation with Mr. Penner I was told that he hoped to have some report of the results of his analysis available to the public by spring, 2001. Whatever decision is reached about the dam will have a great impact on the quality of future fish habitat in the lower mainstem of Shawnigan Creek.

It is hard to say just how much water flows down Shawnigan Creek in summer nowadays. The Water Survey of Canada maintained a streamflow gauge downstream of the lake sporadically during the 20th century, but this service was terminated in 1989.  I have attempted to summarize the available data, and present it in graphical form here. A more detailed listing of the flow data is contained in Appendix 5.

It is obvious from a quick look at the following graph that this is a creek of extremes. During the summer, when fish are actively feeding and growing, water is extremely scarce in this system. For the years when data is available, the average flow during the peak month (December) was 338,700 $m^3$ per day, while the average flow during the lowest flow month (September) was only 900 $m^3$ per day. Based on the average of this data, there is over 375 times as much water flowing down lower Shawnigan Creek in December as there is in September, or, in other words, the average September flow is less than 0.0027 of the average December flow. The average flow during the four summer months of July-Sept is 3,025 $m^3$ per day, less than 1/100 of the average December flow, and only 2/100 of the mean annual flow of 130,500 $m^3$ per day. Average monthly flows of less than 1,000 $m^3$ per day were recorded at least once for all months from July until

November. Average monthly flows in  November – a critical month for spawning cohos - have ranged from a low of 900 $m^3$ per day to a high of 420,800 $m^3$ per day.

## Figure 49: Shawnigan Creek Monthly Flow Levels




Shawnigan Creek summer flow is miniscule compared to winter. (data obtained from water survey of Canada)

But the graph of average monthly flows only hints at the problem. To get an idea of the disparity between high and low flow levels in this creek, compare the flow visible in Figure 40, taken in summer a short distance below the dam (on a day when I did not measure flow levels), with Figure 26 or 28, taken in spring. A comparison of maximum / minimum daily flows, also obtained by the W.S.C. for most of these years, is even more extreme than the previous graph.  The average annual daily minimum flow is only four $m^3$ per day, while the average annual daily maximum flow is nearly on million $m^3$ per day. The highest flow recorded was on December 17, 1979, at an awesome flood level of nearly 2.5 million $m^3$ per day. One day's flow at this level would sustain the average minimum daily flow for 1,675 years! One day's flow at this level would also sustain the average total flow down the creek during the four driest months of July-September for 7 full seasons.  Maximum daily discharges have occurred between the dates of December 14 and April 11.

Meanwhile, minimum daily flows were all recorded as zero for the first six years in the data, and in the range of 7-10 $m^3$ per day for the years after 1984. This makes sense in light of my conversation with Bruno Blecic, who told me that the dam operators paid little attention to fish habitat before 1980, after which an attempt has been made to maintain some minimum flow downstream. Daily minimums were recorded between the dates of July 31 and October 17.

## Figure 50: Shawnigan Creek Maximum and Minimum Daily Discharge

| Year | Max Flow, $m^3$ / day | | Min Flow, $m^3$ / day | |
|---|---|---|---|---|
| 1914 | | | 0 | 19-Aug |
| 1915 | 993,600 | 22-Dec | 0 | 4-Sep |
| 1916 | 1,270,080 | 10-Mar | 0 | 26-Sep |
| | | | | |
| 1977 | 976,320 | 14-Dec | 0 | 16-Aug |
| 1978 | 570,240 | 12-Jan | 0 | 31-Jul |
| 1979 | 2,445,120 | 17-Dec | 0 | 3-Aug |
| 1984 | 812,160 | 15-Dec | 6.9 | 17-Oct |
| 1985 | 293,760 | 11-Apr | 7.8 | 8-Oct |
| 1986 | 1,226,880 | 17-Jan | 7.8 | 7-Oct |
| 1987 | 432,000 | 5-Jan | 9.5 | 27-Sep |
| 1988 | 457,920 | 17-Jan | 7.8 | 16-Aug |
| 1989 | | | 8.4 | 30-Sep |
| **Average** | **947,808** | | **4.0** | |

Bruno Blecic also told me that the ministry has currently been aiming at a target low flow of 1,250 $m^3$ per day in recent years. However, since there has been no flow monitoring since 1989, and since the flow control mechanism on the dam is so crude, and monitoring and adjustment so infrequent, this target seems largely hypothetical. My guess is that typical late summer low flows during 1999 and 2000, when I visited the creek, were well under 100 $m^3$ per day. These extreme low flows cannot be beneficial for fisheries habitat. For a fish, a day without water can be as stressful as a day without air would be for a human. Flow levels appear to have been maintained at a higher and steadier level during spring and summer,2001, due to the improved operation of the control gate.

In June 2000, after the lake had receded below the level of the top of the flashboards (but long before the outflow diminished to minimum levels), I calculated the flow below the dam at approximately 0.17 $m^3$/min. If you do the math, this amounts to 10.2 $m^3$/hour = 244.9 $m^3$/day. On October 3, 1999, when instream flows were at or near minimum levels for the year, we calculated Shawnigan Creek minimum low flows at 0.32$m^3$/min = 19.2$m^3$/hr = 460.8$m^3$/day at Shawnigan/Mill Bay Road bridge. (This site is far downstream of the lake outlet, and includes additional inputs of groundwater flows and several small tributaries.) Let us round these figures to 250 $m^3$/day below the dam and 500$m^3$/day at Shawnigan/Mill Bay Road bridge, for convenience. (250 $m^3$/day below the dam also reflects a compromise between the ministry's theoretical 1,250 $m^3$/day and the 7-10 $m^3$/day flow levels suggested by the WSC records and my own experience.)

The surface area of Shawnigan Lake has been variously calculated at 525-530 ha. Let us round this figure to 500 ha for convenience. 500 ha x 10,000 $m^2$/ha = 5,000,000 $m^2$. Therefore, if an increased one meter of lake level could be held back behind a dam for later release, this would amount to over five million cubic meters of water. Simple arithmetic will show that this is enough water to double a flow level of 250$m^3$/day for:

$$5 \text{ million } m^3/(250m^3/\text{day}) = 20{,}000 \text{ days} = 54.8 \text{ years!}$$

From another angle, if one wished to double this flow for a period of 100 days (a typical length for the Shawnigan watershed dry season) it would require:

$$100\text{days} \times 250\text{m}^3/\text{day} = 25{,}000\text{m}^3.$$

If a one meter depth of lake storage = 5,000,000$m^3$ of water, this doubling would require:

$$25{,}000\ \text{m}^3/5{,}000{,}000\ \text{m}^3 = 0.005\text{m}$$ elevation in the lake level.

If my arithmetic is correct, 5mm (less than ¼ inch) of water held back in the lake for fisheries habitat could theoretically double an average low flow of 250$m^3$/day for all of July, August, and September. If one wished to increase this flow by tenfold, to a more robust 2,500$m^3$/day, this would require a theoretical increase in storage level of only 5cm, or about 2 inches.

# Section 5.8) Water Withdrawals

As of February 2,000, the BC Ministry of Environment Water License Query website returned 199 active water licenses on the Shawnigan system, with a total volume of 883,518 gallons per day (= 4,011 $m^3$ per day). Most of the licenses were issued to private users for amounts of 1,000 gallons per day or less. There were 158 licenses for withdrawals of 500gpd, and one for 150gpd. Another 23 licenses have been issued for withdrawals ranging from 1,000-5,000gpd, three more to organizations for amounts of 7,000-60,000gpd. The total licensed withdrawals allotted to these small-scale users added up to slightly less than 200,000gpd, or 883 $m^3$ per day. The great bulk of the total withdrawals were licensed to three organizations: Mill Bay Waterworks - 250,000gpd, Lidstech Holdings (Shawnigan Lake Village) - 175,500gpd, and Cowichan Valley Regional District (which now manages what used to be Sherwood Waterworks) - 263,535gpd. The sum of all licenses issued to these three organizations amounted to 689,068 gallons per day, or slightly more than ¾ of all licensed volume. In addition to licensed withdrawals, there is significant unlicensed extraction from the lake. It is legal for any household to withdraw up to 500 gallons per day (2.7 $m^3$ per day) from a lake without a license (providing that all the water available in the lake is not already under license, which it is not). Shawingan Lake is ringed with kilometers of summer cabins, many of which have private water systems pumping directly from the lake.

**Figure 51:** **Shawnigan Creek/Lake Water Licenses (active and under application)**

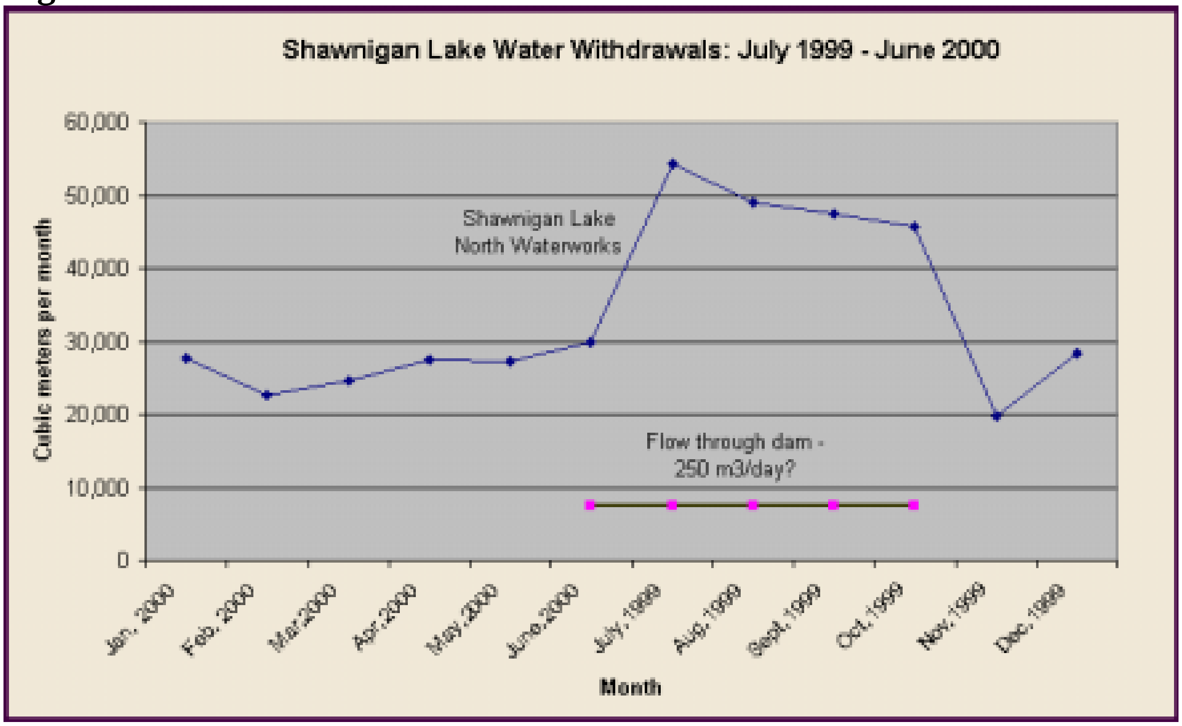
| Total licenses | Gal/Day | $m^3$/Day |
|---|---|---|
| Small users | 194,450 | 883 |
| Mill Bay WW | 250,000 | 1,135 |
| Lidstech Holdings | 175,533 | 797 |
| Cow. V. R. D. | 263,535 | 1,196 |
| **Total, all licenses** | **883,518** | **4,011** |

| Total applications | Gal/Day | $m^3$/Day |
|---|---|---|
| Small users | 2,500 | 11 |
| Lidstech Holdings | 372,448 | 1,691 |
| Cow. V. R. D. | 449,911 | 2,043 |
| **Total, all licenses** | **824,859** | **3,745** |

In addition to the current total of over 4,000 $m^3$/day of active water licenses (numbers come from my interpretation of the query returns for Shawnigan Creek in the BC government water license query website), Lidstech Holddings and Cow VRD have applied for an additional 3,745 $m^3$/day worth of licenses. Granting of these licenses, along with the additional 2,500gpd applied for by private users, would bring the total licensed withdrawals from Shwanigan Lake and Creek up to a total of 7,756 $m^3$ per day.

In summer, water extraction from the lake for human use is far greater than outflow. According to withdrawal records supplied by CowVRD, water withdrawals into the Shawingan Lake North Waterworks facility (what used to be Sherwood WW) alone ranged from a low of about 660$m^3$/day during November, 1999, to a high of about 1,750 $m^3$/day during July, 2000. (see graph in Figure 52) During the entire period of July-October, 1999, withdrawals into this Shawnigan North Water System averaged over 1,600$m^3$/day.

## Figure 52: Water withdrawals




It is important to note that almost all the water withdrawn from the lake for human usage is likely to end up going back into the lake as groundflow - after it has percolated through lawns, gardens, water treatment plants, and septic fields. But there will be a time lapse involved in this process. At least some, and probably most, of the water pumped out of the lake during the peak withdrawal periods in summer will not percolate back into the lake until later in the fall or winter, when flow levels down the creek are no longer critical. The Water Management Branch generally assumes about a 30% return of recycled water during summer (B. Blesic, pers. comm.).

Also, in spite of the two obvious water budget “debits” of outflow and human extraction, it is important to realize that the by far the biggest source of water loss from Shawnigan Lake during summer is neither to the outflow down the creek or to human consumption. In summer, the biggest water “user” on this lake is the sun. If we assume an average summer low flow of 1,000$m^3$/day for 100 days, this amounts to 100,000$m^3$ of water.

$$\frac{100{,}000m^3 \text{ of water}}{5{,}000{,}000m^2 \text{ of lake surface}}$$ equals .02m worth of lake level (about ¾”)

Total human withdrawals from the lake during summer are estimated to be responsible for a 4” decline (0.1m) in the lake level. If we combine both of these figures it amounts to less than a 5” (0.12m) drop in lake level. But evaporation during the summer is enormous. Even after subtracting the 18-20cm of rain that falls directly into the lake during the summer months, evaporation is estimated to account for a drop in over 12" (0.3m) of lake level. No dam will ever be able to eliminate the effects of evaporation.

In conversation with Harvey Elbe of CowVRD Engineering, I learned that it is now district policy to not allow development of new subdivisions around the north end of the lake unless the developer can prove access to a groundwater supply that will be added to the Shawnigan Lake North Waterworks. Therefore, the waterworks would not have to increase pumping levels from the lake in order to supply new housing developments. In particular, a large new subdivision was approved in spring 2000 on the hill directly north of the lake, near the outflow. This developer has located a proven 100 gallon per minute well (= $654m^3$/day) which will be directed into the Sherwood treatment plant and added to the water extracted from the lake. While it is true that this agreement will lessen the immediate impact of withdrawing more water from the lake, the location of the wellsite would tend to indicate that the groundwater being tapped here would likely have flowed directly downhill into the creek, if it had not been pumped up to the subdivision above. Requiring this subdivision to contribute well water to the Sherwood system may avoid drawing the lake down any further in summer, but there still may be a reduction in summer flows down the creek?

# Section 5.9) Options

Replacement of the existing dam with a more fish-friendly structure faces two major obstacles: cost, and impacts on lakefront property owners.

The first issue is fairly straightforward. If either federal, provincial, or local government - or some combination of these - wished to spend the money, there is no doubt that a new dam could be constructed that would allow for much more precise manipulation of outflows as well as a fishway that would allow passage of adults and juveniles throughout the year. The second issue is much more complicated.

As Talbot and many others have noted in the past, "residents become concerned" about <u>any</u> effort to modify lake levels. The individuals currently most involved in this process, Bruno Blecic of MELP and the engineers from CowVRD, operate under a continuous barrage of complaints - sometimes even to the point of personal insults, and vandalism to the dam itself - that the lake level is too high or too low. There is no right answer to this question, since a level that is too high for the owners of a petunia bed along the shore may be too low for waterskiers exposed to gravel bars. One suspects that managers involved in regulating lake levels and outflows may be forced to focus just as much on the issue of flak managment as on balancing environmental impacts. It is clear from public meetings held over the past few years that any attempt to raise summer lake levels, even by a centimeter, in order to store water that could be released later to improve fish habitat downstream, will meet with stiff opposition from some quarters.

An environmental impact assessment into the effects of manipulating lake levels might help clarify some of the issues involved in these arguments, and replace some of the emotionalism with facts. A public relations or public awareness campaign that would both emphasize the importance of the fish habitat available in Lower Shawnigan Creek, and define some of the costs and benefits involved in various management regimes, might also lead to greater consensus on these issues. The Cowichan watershed to the north - which is much larger and more fish-productive than the Shawnigan system - faces many of the same problems I have attempted to outline here. A proposal is underway to upgrade the existing Cowichan Lake dam with an improved structure that will allow for more storage in the lake, which can be released for fish to augment summer low flows. As with the Shawnigan watershed, much public consultation will be required, and probably more than a little anger vented by pro and anti factions, before a decision is reached.

On the other hand, it simply may not be worth the effort, expense, and hassle that would be involved in regulating Shawnigan Lake flows for the benefit of fish. There may be an easier and cheaper way to accomplish the same objective here. Just as the CowVRD now requires new subdivisions to develop wells that will provide a supply of water sufficient to meet the additional demands they create, it is possible that wells could be located downstream of the dam that could pumped directly into the creek during summer low flows. In addition to augmenting the volume of water flowing down the creek, well water might benefit fish habitat in three other important ways:

1) The temperature of well water would be much cooler, and more salmonid-friendly, than the very warm outflows of surface water from Shawnign Lake that now feed the lower mainstem during summer and early fall.

2) The water from wells might contain more nutrients, and might be much more productive than the oligotrophic and nutrient depleted outflows from the lake.

3) If a well could also be tapped near the outflow of the Cameron/Taggert swamp, the cooler water added there might counteract the effects of high temperature outflows from the swamp during summer.

This type of low-flow enhancement has already been funded by USHP in a number of other places - notably in Portuguese Creek, a tributary to the Courtenay River watershed. The Portuguese Creek project might also serve as an inspiration and model flow enhancement in the Shawnigan system.

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# Appendix 1: Shawnigan Aerial Photo

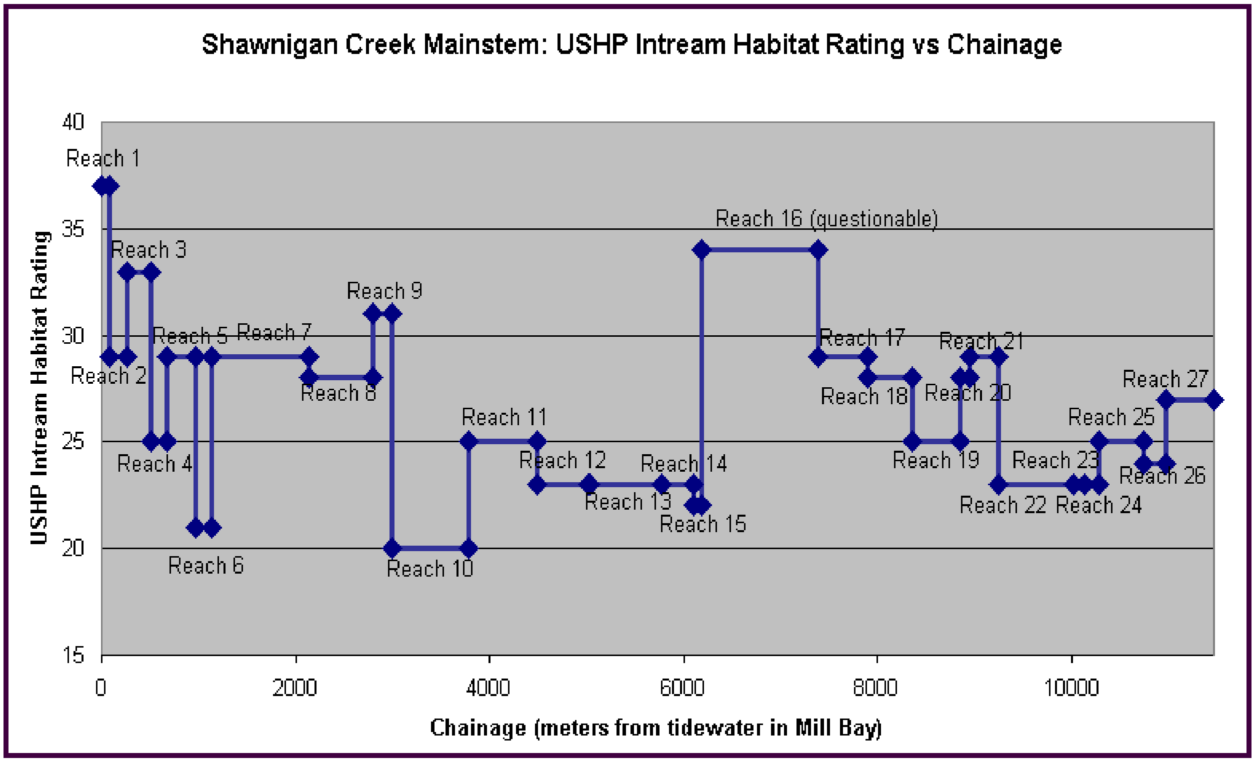
**Composite aerial photo of Shawnigan Lake and lower Shawnigan Creek**

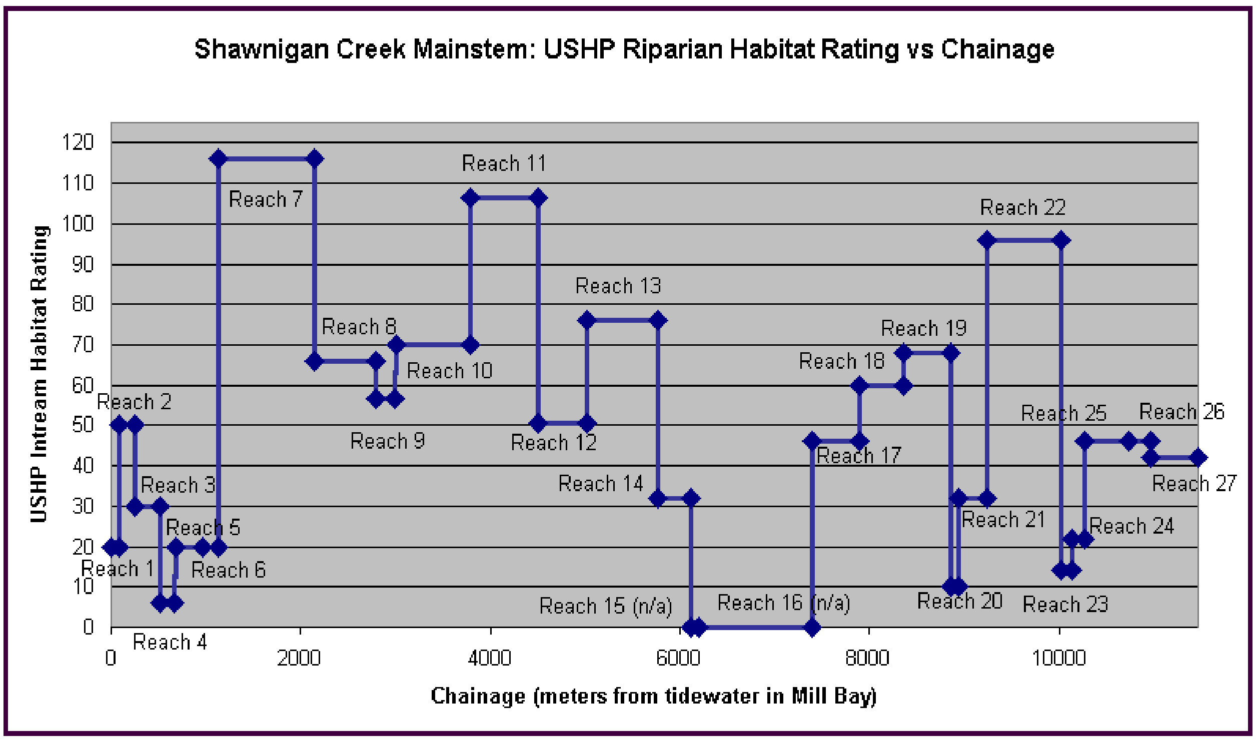
# Appendix 2: USHP Results

## USHP Habitat Ratings, Riparian Ratings, Projected Fry Capacity

| | | Habitat | Riparian | Fry Capacity | |
|---|---|---|---|---|---|
| Reach # | Length (m) | Rating | Rating | Total | per meter |
| 1 | 75 | 37 | 20 | 1,069 | 14.3 |
| 2 | 215 | 29 | 50 | 3,225 | 15.0 |
| 3 | 220 | 33 | 30 | 2,962 | 13.5 |
| 4 | 163 | 25 | 6 | 1,724 | 10.6 |
| 5 | 298 | 29 | 20 | 4,226 | 14.3 |
| 6 | 160 | 21 | 20 | 1,712 | 10.7 |
| 7 | 1010 | 29 | 116 | 13,217 | 13.1 |
| 8 | 659 | 28 | 66 | 9,556 | 14.5 |
| 9 | 200 | 31 | 57 | 2,250 | 11.3 |
| 10 | 788 | 20 | 70 | 9,908 | 12.6 |
| 11 | 712 | 25 | 107 | 7,903 | 11.1 |
| 12 | 527 | 23 | 51 | 7,115 | 13.5 |
| 13 | 773 | 23 | 76 | 12,092 | 15.6 |
| 14 | 336 | 23 | 32 | 4,536 | 13.5 |
| 15 | 83 | 22 | N/A | 840 | 10.1 |
| 16 | 1197 | 34 | N/A | 14,364 | 12.0 |
| 17 | 509 | 29 | 46 | 6,604 | 13.0 |
| 18 | 466 | 28 | 60 | 4,448 | 9.5 |
| 19 | 493 | 25 | 68 | 4,642 | 9.4 |
| 20 | 87 | 28 | 10 | 587 | 6.8 |
| 21 | 295 | 29 | 32 | 2,345 | 8.0 |
| 22 | 788 | 23 | 96 | 7,787 | 9.9 |
| 23 | 112 | 23 | 14 | 806 | 7.2 |
| 24 | 139 | 23 | 22 | 1,199 | 8.6 |
| 25 | 461 | 25 | 46 | 5,359 | 11.6 |
| 26 | 238 | 24 | 46 | 2,142 | 9.0 |
| 27 | 492 | 27 | 42 | 6,519 | 13.3 |
| Total: | 11421 | Av: 26.5 | Av: 48 | 139,177 | Av: 11.5 |

# Shawnigan Creek USHP Ratings per Meter of Chainage



# Shawnigan Creek USHP Riparian Ratings

| Reach | 1 | Ave. | 2 | Ave. | 3 | Ave. | 4 | Ave. | 5 | Ave. | 6 | Ave. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | 6 | 3.00 | 14 | 2.33 | 6 | 1.00 | 2 | 1.00 | 6 | 1.00 | 12 | 3.00 | 46 |
| Livestock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Slope | 8 | 4.00 | 22 | 3.67 | 10 | 1.67 | 2 | 1.00 | 6 | 1.00 | 4 | 1.00 | 52 |
| Stability | 6 | 3.00 | 14 | 2.33 | 14 | 2.33 | 2 | 1.00 | 8 | 1.33 | 4 | 1.00 | 48 |
| Totals | 20 | | 50 | | 30 | | 6 | | 20 | | 20 | | 146 |

| Reach | 7 | Ave. | 8 | Ave. | 9 | Ave. | 10 | Ave. | 11 | Ave. | 12 | Ave. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | 26 | 1.18 | 24 | 2 | 16 | 4 | 16 | 1 | 32 | 2.29 | 8 | 1 | 122 |
| Livestock | 0 | 0.00 | 0 | 0 | 22.5 | 5 | 0 | 0 | 10.53 | 5.00 | 4.74 | 3 | 37.78 |
| Slope | 54 | 2.45 | 20 | 1.67 | 4 | 1 | 20 | 1.25 | 18.00 | 1.29 | 12.00 | 1.5 | 128.00 |
| Stability | 36 | 1.64 | 22 | 1.83 | 14 | 3.5 | 34 | 2.13 | 46.00 | 3.29 | 26.00 | 3.25 | 178.00 |
| Totals | 116 | | 66 | | 56.5 | | 70 | | 106.5 | | 50.74 | | 465.78 |

| Reach | 13 | Ave. | 14 | Ave. | 15 | Ave. | 16 | Ave. | 17 | Ave. | 18 | Ave. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | 14 | 1 | 8 | 1 | | | 2 | 1 | 26 | 2.6 | 18 | 1.8 | 68 |
| Livestock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Slope | 20 | 1.43 | 10 | 1.25 | | | 2 | 1 | 10 | 1 | 12 | 1.2 | 54 |
| Stability | 42 | 3 | 14 | 1.75 | | | 6 | 3 | 10 | 1 | 30 | 3 | 102 |
| Totals | 76 | | 32 | | 0 | | 10 | | 46 | | 60 | | 224 |

| Reach | 19 | Ave. | 20 | Ave. | 21 | Ave. | 22 | Ave. | 23 | Ave. | 24 | Ave. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | 24 | 2.4 | 4 | 2 | 12 | 2 | 16 | 1 | 2 | 1 | 4 | 1 | 62 |
| Livestock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Slope | 18 | 1.8 | 4 | 2 | 8 | 1.33 | 38 | 2.38 | 10 | 5 | 8 | 2 | 86 |
| Stability | 26 | 2.6 | 2 | 1 | 12 | 2 | 42 | 2.63 | 2 | 1 | 10 | 2.5 | 94 |
| Totals | 68 | | 10 | | 32 | | 96 | | 14 | | 22 | | 242 |

| Reach | 25 | Ave. | 26 | Ave. | 27 | Ave. | Total |
|---|---|---|---|---|---|---|---|
| Land Use | 12 | 1.5 | 16 | 2.67 | 22 | 2.2 | 50 |
| Livestock | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 |
| Slope | 10 | 1.25 | 16 | 2.67 | 10 | 1 | 36 |
| Stability | 24 | 3 | 14 | 2.33 | 10 | 1 | 48 |
| Totals | 46 | | 46 | | 42 | | 134 |

| AVERAGE - ALL REACHES | |
|---|---|
| Land Use | 11.4 |
| Livestock | 1.5 |
| Slope | 10.8 |
| Stability | 15.0 |
| Totals | 38.8 |

# Appendix 3: Fry Trapping Results

I obtained fry trapping permits from BC Ministry of Environment in both 199 and 2000 which allowed me to set G-traps in the watershed. Results from this limited sampling are presented in **Figure XX.** As per USHP policy, G-trap sampling is not intended to be used to generate population estimates, only to establish fish presence. I can vouch for this policy. Some of the places where I observed the most fish were the places I caught the least. This is partly due to the fact that I have a lot to learn about G-trapping. However, trout fry are very skittish, and remarkably clever. Often, they are just not dumb enough to swim into a G-trap and stay there. Therefore, an empty G-trap is no indication of a lack of fish, and numbers of fish caught per trap are no indication of population density. I am presenting the results here simply to begin documenting what lives where within the watershed.

Note that no coho fry were caught in any of the traps. This is not surprising. The traps I set in 1999 were set late in the season, when the fry were already moving into to their winter hideouts. Few fry of any kind were observed in the creeks in October, even in places where they had been plentiful a month earlier. This was also my first attempt at setting a G-trap, and I was very clumsy at it. I only caught 2 cutthroat fry in total. Since no adult coho were released into the creek in fall 1999, no juveniles would be expected in the traps in summer 2000. Now that a reasonably successful capture and transplant of adult coho has occurred in fall 2000, it would be interesting to electrofish selected spots thoughout the watershed in summer 2001. This is the only fast and economical way to establish what habitat the coho juveniles are using, what other species they are sharing it with, and roughly how many of them there are.

Also note that cutthroat fry were either caught or observed at every site sampled, with the exception of the two sites near the Cameron/Taggert swamp. From my experience, every stream in the watershed that is accessible to fish from the Shawnigan Creek mainstem and maintains a flow – no matter how tiny – throughout the summer still contains populations of juvenile salmonids. Some streams that do not maintain all-summer flow (such as the lower reaches of McGee Creek) also support salmonids in isolated pools, and/or further upstream from the area where the creek is intermittent.

Since the invasion of the shallower areas of Shawnigan Lake by smallmouth bass, these tributary streams may be the last rearing refuge for many juvenile trout. There are other small tribs in the watershed that were not G-trapped, and are likely provide habitat for salmonids as well. Further reconnaissance is needed to determine the rest.

## Figure XX: Fry Trapping

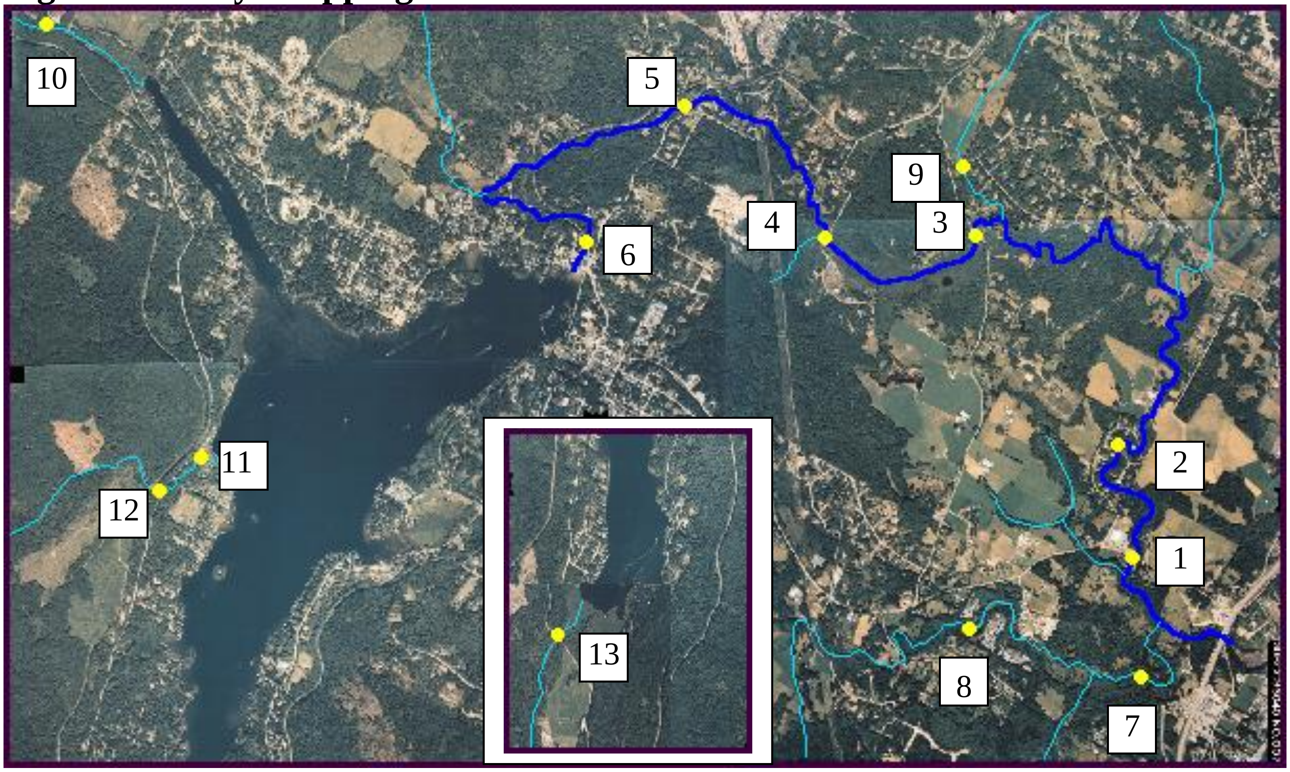
| Site # | Date | Creek name | WS Code | Site | Duration | Result |
|---|---|---|---|---|---|---|
| **1999** | | | | | | |
| 13 | 3-Oct | **Upper Shawnigan** | **920-235800** | **W. Shgn Lake Road** | **5 hrs** | **(2 CT, 3cm), 2 crayfish** |
| | | | Water temp: 10.5C. Fry still plentiful, but much less abundant than last month. | | | |
| 13 | 24-Oct | **Upper Shawnigan** | **920-235800** | W. Shgn Lake Road | 4 hrs | (4 sculpins, 7-10cm). 1 crayfish |
| | | | Temp: 7C. Creek is much higher after rain. No trout fry observed. | | | |
| 7 | 24-Oct | **Cedar** | **920-235800-01800** | Below recycling station | 3 hrs | **(CT, 10cm)**, 4 crayfish |
| | | | Temp: 7C. Some fry observed | | | |

| Site # | Date | Creek name | WS Code | Site | Duration | Result |
|---|---|---|---|---|---|---|
| **2000** | | | | | | |
| 6 | 5-Aug | **Shawnigan** | **920-235800** | W.R. Rivers Park | 6 hrs | |
| | | Comments: | Water temp: 22C near lake outlet. | | | |
| 1 | 5-Aug | **Shawnigan** | **920-235800** | Sh/MB Road | 6 hrs | 1 crayfish |
| | | Comments: | Water temp: 17C. CSome fry observed. | | | |
| 2 | 5-Aug | **Shawnigan** | **920-235800** | Wilkinson Road | 6 hrs | 2 crayfish |
| | | Comments: | Fry observed | | | |
| 8 | 5-Aug | **Cedar** | **920-235800-01800** | Cedar Creek Mobil Park | 6 hrs | Trap stolen |
| | | Comments: | Temp: 14C. Many fry observed, up to 10 cm. Lots of kids. The trap is stolen when we return. | | | |
| 5 | 5-Aug | **Shawnigan** | **920-235800** | Sh/CH Road | 6 hrs | **(1 CT, 7 cm)** |
| | | Comments: | Temp: 17C. Fry observed, up to 6 cm. | | | |
| 9 | 5-Aug | **Unnamed** | **920-235800-19900** | Lovers Lane | 6 hrs | **(2 CT, 6 and 9 cm); (2 stklbk)** |
| | | Comments: | Temp: 17C. The creek here is a ditch, dug recently (2 years?) to drain swamp | | | |
| 3 | 5-Aug | **Shawnigan** | **920-235800** | Cameron/Taggert Road | 6 hrs | **(11 stickleback)** |
| | | Comments: | Temp: 22C. Large school of stickleback fry, 1cm | | | |
| 4 | 5-Aug | **Shawnigan** | **920-235800** | Filgate Road | 6 hrs | **(>30 stickleback)** |
| | | Comments: | Temp: 18C. Many small fry, 2-3 cm. Sticklebacks? | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 6-Aug | **Shawnigan** | **920-235800** | Sh/MB Road | 12 hrs | **(1 CT, 5 cm)**, 4 crayfish |
| 2 | 6-Aug | **Shawnigan** | **920-235800** | Wilkinson Road | 12 hrs | 5 crayfish |
| 5 | 6-Aug | **Shawnigan** | **920-235800** | Sh/CH Road | 12 hrs | 1 crayfish |
| 3 | 6-Aug | **Shawnigan** | **920-235800** | Cameron/Taggert Road | 12 hrs | 2 crayfish |
| 4 | 6-Aug | **Shawnigan** | **920-235800** | Shinrock Road | 6 hrs | **(4 stklbk)**, 3 crayfish |
| 1 | 6-Aug | **Shawnigan** | **920-235800** | Sh/MB Road | 8 hrs | **(1 CT, 5 cm), 1 (stklbk)**, 5 crayfish |
| 2 | 6-Aug | **Shawnigan** | **920-235800** | Wilkinson Road | 8 hrs | 2 crayfish |
| 5 | 6-Aug | **Shawnigan** | **920-235800** | Sh/CH Road | 8 hrs | Trap stolen |
| 4 | 6-Aug | **Shawnigan** | **920-235800** | Filgate Road | 8 hrs | **(15 stklbk), (1 pumpkinseed, 6cm)** |
| | | Comments: | Large school of sticklebacks (> 100) under bridge | | | 3 crayfish |
| 3 | 6-Aug | **Shawnigan** | **920-235800** | Cameron/Taggert Road | 8 hrs | 4 crayfish |
| | | Comments: | Schools of adult and juvenile stickleback | | | |
| 9 | 6-Aug | **Unnamed** | **920-235800-19900** | Lovers Lane | 20 hrs | **(3 CT, 3, 3, 5 cm), (3 stklbk)** |
| | | | | | | |
| 13 | 27-Aug | **Upper Shawnigan** | **920-235800** | West Shgn Lake Road | 3 hrs | **(2 CT, 5 cm)**, 1 crayfish |
| | | Comments: | Temp 14C. Many fry observed. Mostly small (3-5 cm). School of at least 25 10-15cm fish in deeper water. | | | |
| 11 | 27-Aug | **McGee Creek** | **920-235800-49700** | Hempworth Road | | No trap set |
| | | Comments: | No flow, most of creek is dry. There are still trout fry in what pools remain. Too shallow to trap. | | | |
| 12 | 27-Aug | **McGee Creek** | **920-235800-49700** | West Shgn Lake Road | 3 hrs | **(1 CT, 6 cm)** |
| | | Comments: | Temp 13C. Creek is still running here, but dry upstream + downstream. Large school (> 50) of 10cm trout | | | |
| | | | fry observed, as well as smaller ones. All pools above and below this are observed to be full of fry. | | | |
| | | | Bedrock slide above this bridge, then intermittent gravelly pools up to old rail trestle. | | | |
| 10 | 27-Aug | **Unnamed** | **none** | West Shgn Lake Road | 3 hrs | **(6 CT, 5,5,5,7,9, +10cm)** |
| | | Comments: | Temp 12C. Steady flow - much more than McGee Creek. 4m diameter steel culvert under road. | | | |
| | | | Mud/gravel bottom, 100% canopy. Fry to 8 cm observed in pools. | | | |

Limited fry trapping was conducted throughout the watershed to establish fish presence. Cutthroat trout juveniles were plentiful everywhere there was water that flowed all throughout the summer, with the exception of the area near the Cameron/Taggert swamp. Only stickleback and a single pumpkinseed sunfish were captured there. No coho were caught.

## Figure XX: Fry Trapping Sites




Fry trapping sites in 1999/2000: The numbers correspond to the **Site #** column in **Figure XX** above. The inset shows the site on upper Shawnigan Creek. Cutthroat fry were caught or observed at all locations except 3 and 4.

## Figure XX: Cutthroat fry in G-trap

## Figure XX: "West Arm Creek"

## Figure XX: McGee Creek

The trap set in the creek that enters the west arm of the lake (above, exiting the West Shawnigan Road culvert) caught the most fish (above left). Fry were observed to be much more plentiful elsewhere, but the traps didn't catch as much as the one here.

McGee Creek (left) runs dry in its lower reaches in summer. The upper reaches are being harvested by Timberwest. The fry in the pool under the bushes will die or get eaten by predators if no rain falls soon.

# Appendix 4: Shawnigan Creek Water Licenses

| ACTIVE LICENSES | Gal/Day | $m^3$/Day |
|---|---|---|
| Small users | 194,450 | 883 |
| Mill Bay WW | 250,000 | 1,135 |
| Lidstech Holdings | 175,533 | 797 |
| Cow. V. R. D. | 263,535 | 1,196 |
| **Total, all licenses** | **883,518** | **4,011** |

| APPLICATIONS | Gal/Day | $m^3$/Day |
|---|---|---|
| Small users | 2,500 | 11 |
| Lidstech Holdings | 372,450 | 1,691 |
| Cow. V. R. D. | 574,900 | 2,610 |
| **Total applications** | | |
| **all licenses** | **949,850** | **4,312** |

### Active Licenses – Small Users

| | | |
|---|---|---|
| 150 GPD | 1 license | 150 |
| 500 GPD | 159 licenses | 79,500 |
| 1,000 GPD | C027381 | 1,000 |
| | C027735 | 1,000 |
| | C027948 | 1,000 |
| | C039337 | 1,000 |
| | C042815 | 1,000 |
| | C046480 | 1,000 |
| | C063944 | 1,000 |
| | C065832 | 1,000 |
| | F014946 | 1,000 |
| | F017856 | 1,000 |
| | F040263 | 1,000 |
| Total | | 90,650 |
| | | |
| **TOTAL, All Small Users:** | | **194,450** |

| | | |
|---|---|---|
| > 1,000 GPD | C043128 | 1,250 |
| | C040847 | 1,250 |
| | F043005 | 1,400 |
| | C050001 | 1,500 |
| | C048372 | 1,500 |
| | F043004 | 2,000 |
| | F016843 | 2,000 |
| | F014954 | 2,000 |
| | C108349 | 2,500 |
| | C053849 | 3,200 |
| | C070355 | 3,700 |
| | C040162 | 4,500 |
| | C114930 | 7,000 |
| | C042816 | 10,000 |
| | C042919 | 60,000 |
| TOTAL | | 103,800 |

### Active Licenses – Large Users

| Organization | License # | Million GPY | Gallons/Day | m3 / Day |
|---|---|---|---|---|
| Mill Bay WW | C027947 | 91.25 | 250,000 | 1,135 |
| Lidstech Hldg | C028078 | 18.26 | 50,027 | 227 |
| Lidstech Hldg | C045744 | 25.56 | 70,027 | 318 |
| Lidstech Hldg | C053345 | 16.60 | 45,479 | 206 |
| Lidstech Hldg | F015036 | 3.65 | 10,000 | 45 |
| CowVRD | C040373 | 13.51 | 37,014 | 168 |
| CowVRD | C041661 | 11.86 | 32,493 | 148 |
| CowVRD | C042494 | 4.02 | 11,014 | 50 |
| CowVRD | C046042 | 9.49 | 26,000 | 118 |
| CowVRD | C051620 | 4.20 | 11,507 | 52 |
| CowVRD | C057106 | 1.64 | 4,493 | 20 |
| CowVRD | C057107 | 45.99 | 126,000 | 572 |
| CowVRD | C064057 | 5.48 | 15,014 | 68 |
| **TOTAL** | | **251.51** | **689,068** | **3,128** |

# Shawnigan Creek Water License Applications Pending

| | License # | Gallons / Day | Gallons / Year | $m^3$ / Day | Acre Feet |
|---|---|---|---|---|---|
| **Private** | C045292 | **500** | .2 million | 2.3 | |
| **Private** | C054298 | **500** | .2 million | 2.3 | |
| **Private** | C059652 | **1,500** | .5 million | 6.8 | |
| **Lidstech Hldg** | Z101105 | 371,900 | 135.7 million | 1,688.4 | **500 AF** |
| **Lidstech Hldg** | Z101106 | 275 | **.1 million** | 1.4 | |
| **Lidstech Hldg** | Z101106 | 275 | **.1 million** | 1.4 | |
| **CowVRD** | Z100968 | 20,000 | **7.3 million** | 90.8 | |
| **CowVRD** | Z100968 | 18,600 | 6.8 million | 84.4 | **25 AF** |
| **CowVRD** | Z101107 | 260,300 | 95.0 million | 1,181.8 | **350 AF** |
| **CowVRD** | Z101108 | 3,000 | **1.1 million** | 13.6 | |
| **CowVRD** | Z101109 | 23,000 | **8.4 million** | 104.4 | |
| **CowVRD** | Z106568 | 125,000 | **45.6 million** | 567.5 | |
| **CowVRD** | Z106569 | 125,000 | 45.6 million | 567.5 | **168 AF** |
| | TOTAL | **949,850** | **346.7 Million** | **2,610** | |

Bolded numbers indicate the actual quota indicated in the license application. Non-bolded numbers are converted by formula. License information was obtained from BC Ministry of Environment Water License Query website, February, 2001.

# Appendix 5:

## Shawnigan Lake Pool and Outflow Levels

### Water Survey of Canada historical Shawnigan Lake outflow levels – $m^3$ per day

| Year | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1914** | | | | | | 18.1 | 0.9 | 0.0 | 0.0 | 15.6 | 433.7 | 270.4 | **0.0** |
| **1915** | 258.3 | 178.0 | 113.2 | 112.3 | 46.7 | 22.5 | 7.8 | 2.6 | 0.0 | 0.9 | 184.0 | 284.3 | **137.4** |
| **1916** | 261.8 | 520.1 | 739.6 | 261.8 | 89.0 | 25.1 | 10.4 | 5.2 | 1.7 | 0.9 | 16.4 | 238.5 | **180.6** |
| **1917** | 344.7 | 265.2 | 217.7 | | | | | | | | | | **0.0** |
| **1976** | | | | | | | | | | | 2.6 | 31.1 | **0.0** |
| **1977** | 134.8 | 202.2 | 423.4 | 104.5 | 32.0 | 12.1 | 0.9 | 0.0 | 0.0 | 0.9 | 230.7 | 609.1 | **146.0** |
| **1978** | 370.7 | 280.8 | 146.0 | 111.5 | 36.3 | 11.2 | 0.9 | 0.0 | 0.0 | 0.0 | 1.7 | 105.4 | **88.1** |
| **1979** | 92.4 | 441.5 | 428.5 | 95.0 | 35.4 | 4.3 | 0.9 | 0.0 | 0.0 | 0.9 | 4.3 | 889.9 | **165.9** |
| **1984** | 353.4 | 197.9 | 238.5 | 141.7 | 121.8 | 87.3 | 13.0 | 1.7 | 0.9 | 9.5 | 420.8 | 508.0 | **175.4** |
| **1985** | 167.6 | 180.6 | 91.6 | 109.7 | 44.1 | 22.5 | 5.2 | 1.7 | 1.7 | 6.0 | 80.4 | 89.9 | **65.7** |
| **1986** | 419.0 | 394.8 | 303.3 | 94.2 | 54.4 | 32.8 | 7.8 | 0.9 | 0.9 | 0.9 | 93.3 | 240.2 | **135.6** |
| **1987** | 333.5 | 292.0 | 241.1 | 51.0 | 16.4 | 6.9 | 1.7 | 1.7 | 0.9 | 0.9 | 0.9 | 262.7 | **100.2** |
| **1988** | 276.5 | 162.4 | 159.0 | 268.7 | 19.0 | 15.6 | 5.2 | 1.7 | 0.9 | 0.9 | 168.5 | 241.9 | **110.6** |
| **1989** | | | | 248.0 | 13.8 | 5.2 | 4.3 | 5.2 | 0.9 | 32.0 | 197.0 | | |
| **Average** | **273.9** | **283.4** | **281.7** | **145.2** | **46.7** | **21.6** | **5.2** | **1.7** | **0.9** | **4.3** | **128.7** | **338.7** | **130.5** |

This table is converted from the original WSC data, which is recorded in $m^3$ per second. The government operated a water flow monitoring station on the Shawnigan Lake outflow only intermittently in the past century. Data for other years is not available.

### Water Survey of Canada historical Shawnigan Lake pool elevation levels – meters

| Year | Minimum | Maximum | Year | Minimum | Maximum | | |
|---|---|---|---|---|---|---|---|
| **1970** | 115.7 | 116.8 | **1977** | **115.6** | 117.2 | Average Max: | 117.2 |
| **1971** | 115.8 | 116.8 | **1978** | 115.7 | 116.7 | Average Min: | 115.7 |
| **1972** | 115.8 | **118.2** | **1979** | 115.7 | 118.1 | Average Flux: | 1.5m |
| **1973** | 115.6 | 117.1 | **1980** | 115.8 | 117.3 | Absolute Max: | 118.2 |
| **1974** | 115.7 | 116.9 | **1981** | 115.8 | 117.2 | Absolute Min: | 115.6 |
| **1975** | 115.8 | 117.0 | **1982** | 115.5 | 117.4 | Absolute Flux: | 2.6m |
| **1976** | 115.8 | 116.9 | | | | | |

# Provisional Rule Curve

# Appendix 6: The Shawnigan Coho Run

As mentioned previously, coho are not native to the Shawnigan system due to impassible falls located near the mouth. Local volunteers have created an artificial run by planting the creek with juvenile coho obtained from the Goldstream hatchery. The volunteers later attempt to capture the adult coho at the base of the falls, after the fish return from a feeding tour of the north Pacific Ocean. Escapement totals (representing the number of fish transported over the falls, except in the two years of exceptionally large returns) are provided in **Figure XX** for the years since the first planted run returned.

Notice that esacpement totals are zero for a number of years, and very low in some others. This is not proof of a lack of fish, for in spite of a great deal of volunteer effort, capture and transport of the returning adults is difficult at the best of times (moderate flow levels), and has been virtually impossible during high water. In years when an insufficient escapement occurs the creek is augmented with more coho fry from the Goldstream hatchery. This works both ways. In yeas when the Goldsteam coho were in trouble, brood stock for that system has been obtained from Shawnigan.

| Year | # of Coho |
|---|---|
| 1979 | 19 |
| 1980 | 33 |
| 1981 | 20 |
| 1982 | 34 |
| 1983 | 0 |
| 1984 | 20 |
| 1985 | 120 |
| 1986 | 22 |
| 1987 | 12 |
| 1988 | 482 |
| 1989 | 99 |
| 1990 | 52 |
| 1991 | 1500 |
| 1992 | 293 |
| 1993 | 72 |
| 1994 | 2000 |
| 1995 | 0 |
| 1996 | ? |
| 1997 | 370 |
| 1998 | 175 |
| 1999 | 0 |
| 2000 | 104 |
| **Total** | **5427** |

In 1999, for instance, the escapement figure is zero even though a good number of fish returned to the falls. The volunteer capture effort was scheduled for a Saturday, so I stopped by the base of the falls on Wednesday morning to have a look. I cast a single barbless spinner and caught (and released) either jack or adult coho on the first 10 casts I made off the shore below the capture shack. By the time Saturday morning came around the first big fall rainstorm had turned the creek into a torrent. Although many coho could be seen jumping at the falls and in the bay, none chose to swim into the capture shack on their own. Using dipnets or seine nets in Mill Bay itself was also impossible due to the high flow from the creek. The high water persisted for weeks, and thwarted all efforts to catch the coho until all they finally all disappeared – either gone off to other creeks or eaten by the chubby seals that had cornered the school of coho in the top end of Mill Bay. Also, in good years there may have been more fish than are counted here. The volunteers may simply estimated the remaining run size after they felt they had transported enough fish over the falls. Actual escapement **upstream was ??? in 1991 and ??? in 1992.**

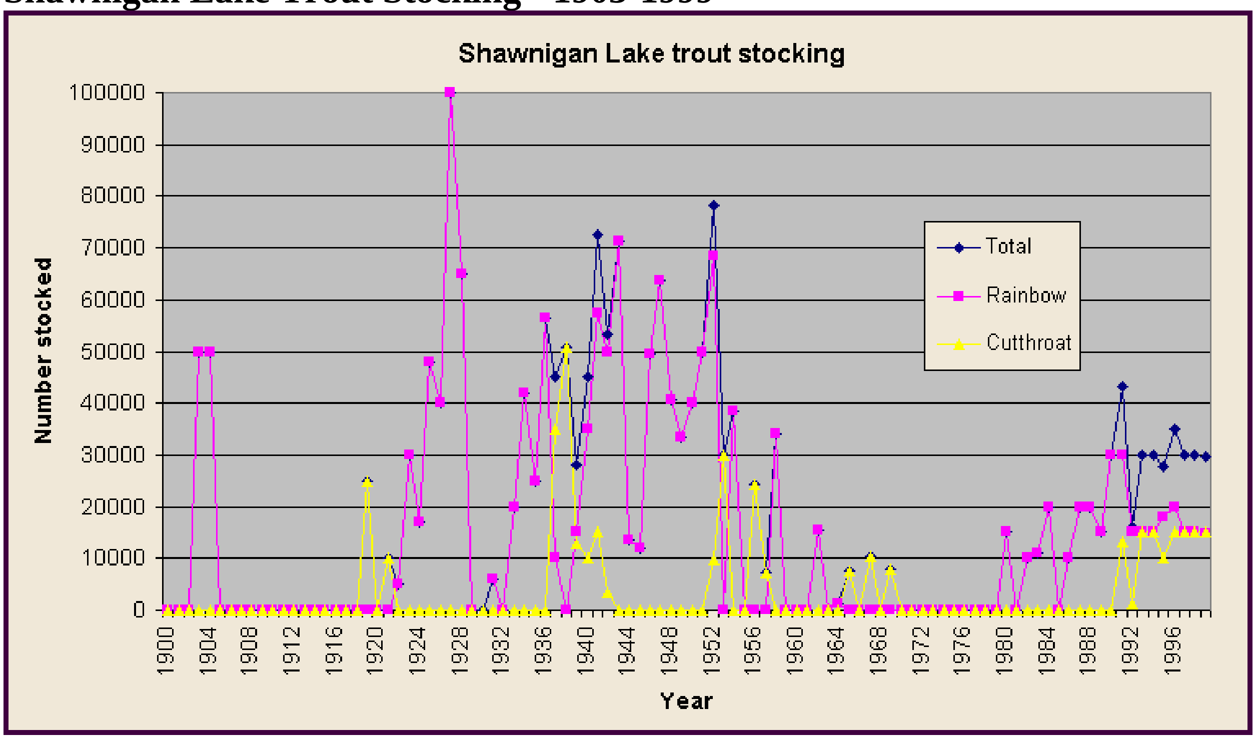
The escapement numbers (when there were any) all range between 10 and 500 except for the two extraordinary returns of 1991 (1,500 fish) and 1994 (2,000 fish). These years give an indication of what this creek can produce under good conditions – even with no enhancement or fishways, and with minimal summer flows. If we eliminate the two high years as anomalies, and the years with zero escapement, there are still 11 years of coho totaling 1,801 fish – an average of over 160 fish per year.  These are not insignificant numbers for a species which is on the verge of extinction in many nearby streams. There are probably many streams on eastern Vancouver Island where significant enhancement work has already occurred that do not produce numbers of coho anything like these. If fishways around the falls were constructed, and a good steady flow of cool water were maintained in the creek all summer, and a bit of instream restoration work were to be carried out here and there, thie potential of this watershed to produce coho, chum, steelhead, searun cutthroat, and even chinook is anyone’s guess.

# Appendix 7: Trout Stocking Records

## Shawnigan Lake Trout Stocking Records, 1903-1999

| Year | Total | Rb | Ct | Year | Total | Rb | Ct | Year | Total | Rb | Ct |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-1903 | 0 | 0 | 0 | 1940 | 45,009 | 35,009 | 10,000 | 1967 | 10,350 | 0 | 10,350 |
| 1903 | 50,000 | 50,000 | 0 | 1941 | 72550 | 57,550 | 15,000 | 1968 | 0 | 0 | 0 |
| 1904 | 50,000 | 50,000 | 0 | 1942 | 53,403 | 49,858 | 3,545 | 1969 | 8,025 | 0 | 8,025 |
| 1905 | 0 | 0 | 0 | 1943 | 71,260 | 71,260 | 0 | 1970 | 0 | 0 | 0 |
| Gap | 0 | 0 | 0 | 1944 | 13500 | 13,500 | 0 | Gap | 0 | 0 | 0 |
| 1918 | 0 | 0 | 0 | 1945 | 11,950 | 11,950 | 0 | 1979 | 0 | 0 | 0 |
| 1919 | 25,000 | 0 | 25,000 | 1946 | 49,572 | 49,572 | 0 | 1980 | 15000 | 15,000 | 0 |
| 1920 | 0 | 0 | 0 | 1947 | 63648 | 63,648 | 0 | 1981 | 0 | 0 | 0 |
| 1921 | 10,000 | 0 | 10,000 | 1948 | 40,800 | 40,800 | 0 | 1982 | 10,000 | 10,000 | 0 |
| 1922 | 5,000 | 5,000 | 0 | 1949 | 33,500 | 33,500 | 0 | 1983 | 11000 | 11,000 | 0 |
| 1923 | 30000 | 30,000 | 0 | 1950 | 40000 | 40,000 | 0 | 1984 | 20,000 | 20,000 | 0 |
| 1924 | 17,000 | 17,000 | 0 | 1951 | 50,000 | 50,000 | 0 | 1985 | 0 | 0 | 0 |
| 1925 | 48,000 | 48,000 | 0 | 1952 | 78,300 | 68,500 | 9,800 | 1986 | 10000 | 10,000 | 0 |
| 1926 | 40000 | 40,000 | 0 | 1953 | 30000 | 0 | 30,000 | 1987 | 20,000 | 20,000 | 0 |
| 1927 | 100,000 | 100,000 | 0 | 1954 | 38,539 | 38,539 | 0 | 1988 | 20,000 | 20,000 | 0 |
| 1928 | 65,000 | 65,000 | 0 | 1955 | 0 | 0 | 0 | 1989 | 15000 | 15,000 | 0 |
| 1929 | 0 | 0 | 0 | 1956 | 24145 | 0 | 24,145 | 1990 | 30,000 | 30,000 | 0 |
| 1930 | 0 | 0 | 0 | 1957 | 7,200 | 0 | 7,200 | 1991 | 43,187 | 30,000 | 13,187 |
| 1931 | 6,000 | 6,000 | 0 | 1958 | 33,950 | 33,950 | 0 | 1992 | 16183 | 15,000 | 1,183 |
| 1932 | 0 | 0 | 0 | 1959 | 0 | 0 | 0 | 1993 | 30,000 | 15,000 | 15,000 |
| 1933 | 20,000 | 20,000 | 0 | 1960 | 0 | 0 | 0 | 1994 | 30,000 | 15,000 | 15,000 |
| 1934 | 42,000 | 42,000 | 0 | 1961 | 0 | 0 | 0 | 1995 | 27900 | 17,900 | 10,000 |
| 1935 | 25000 | 25,000 | 0 | 1962 | 15370 | 15,370 | 0 | 1996 | 35,000 | 20,000 | 15,000 |
| 1936 | 56,341 | 56,341 | 0 | 1963 | 0 | 0 | 0 | 1997 | 30,000 | 15,000 | 15,000 |
| 1937 | 45,000 | 10,000 | 35,000 | 1964 | 1,380 | 1,380 | 0 | 1998 | 30000 | 15,000 | 15,000 |
| 1938 | 50643 | 0 | 50,643 | 1965 | 7605 | 0 | 7,605 | 1999 | 29,753 | 14,753 | 15,000 |
| 1939 | 28,000 | 15,000 | 13,000 | 1966 | 0 | 0 | 0 | Total | 1,562,380 | 373,683 | 1,936,063 |

## Shawnigan Lake Trout Stocking - 1903-1999



# Appendix 8:

## Ian Ross Report on the Feasibility of Installing Fishways in Shawnigan Creek