SILTY SOURCES

A CRITIQUE OF THE GVRD'S (GREATER VANCOUVER REGIONAL DISTRICT'S) ECOLOGICAL INVENTORY PROJECT ANNEX AND ANALYSIS REPORTS

WRITTEN AND RESEARCHED

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ON BEHALF OF THE SOCIETY PROMOTING ENVIRONMENTAL CONSERVATION (SPEC)

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SPEC, a local community-based environmental organization in existence for the past thirty years, has been consistently and actively involved in monitoring and participating in the Greater Vancouver Water District's forest management of the watersheds over the past nine years. There is a wealth of correspondence and report material related to SPEC's and other local groups' involvement on this issue. Without a doubt, the logging issue and future policy directive for the Greater Vancouver watersheds has been the longest and most intensely debated issue in GVRD history. The result of keeping tabs with this process is what binds the present report and gives it some depth.

I wish to thank the effort that many people have given from their lives and labours of love in this process. Particularly Elaine Golds of the Burke Mountain Naturalists, Paul Hundal, Ivan Bulic, Inessa Ormond, and Heather Mahony from SPEC; Ross Muirhead from Friends of the Watersheds; Paul George, Joe Foy, and many members at the Western Canada Wilderness Committee. There are many others of course. There have been countless cups of coffee (and herbal tea) consumed in discussion over many matters relating to the ecological inventory process and the watersheds.

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AN OVERVIEW AND OBJECTIVE OF THIS REPORT

The purpose of this lengthy report critique on the Greater Vancouver Regional District's (GVRD's) ecological inventory and Management Plan #5 process for the Greater Vancouver watersheds is to provide two things for the reader: a background on this process (chapters one and two); and arguments which raise doubts on the directives, assumptions, modeling methods, and related recommendations in the GVRD's reports (chapters three to six).

For almost four decades this century, the three Greater Vancouver watersheds, the Capilano, Seymour, and Coquitlam, were protected from logging through legislation and policy (see Appendix B-timeline). Greater Vancouver administrators consistently enforced this policy because it provided residents and businesses with the best water possible. That policy suddenly changed in 1967 which allowed the GVRD to become a bonafide logging company with a Tree Farm Licence agreement, and required the GVRD to submit 5 year logging management plans to the Ministry of Forests, which is why the GVRD now refers to Management Plan #5. In contrast to the original policy, the Water District strangely argued that commercial logging was compatible with its aims to provide the best drinking water, a justification which the Ministry of Forests then conveniently used to extend its own arguments for commercial logging in other community drinking watersheds. During the building of over 300 kilometers of roads into pristine mountain valleys, and clearcut logging nearly 5000 hectares of old cedar, fir, and hemlock forests, the public began to complain about its drinking water. As a result, there was a demand for a logging moratorium in the late 1980s, which was eventually enforced in late 1994. Public concerns led to a review in 1991, which forced the Greater Vancouver Water District to defend its logging program. This review resulted in a recommendation by consultants to conduct an "ecological inventory" of the watersheds, with the objective to rationalize logging through arguments mostly related to forest fires, tree pests, disease, tree species preferences, and silvicultural "thinning".

This ecological inventory project, which was to be backed by 'scientific' analysis, began in late 1992 and ended in April 1999, with an attached price tag of about 6.7 million tax dollars in consultants fees alone (see Appendix A). Related expenditures for staff, materials, and developing Management Plan #5 documents and plans are not yet known. Had the GVRD hired university graduate students, instead of high-priced consultants, to provide data and "inventory" the watersheds, with a more 'independent' approach, the final price tag could have been about four to five times less. Two final reports were presented by the consultants in early 1999: a three volume technical report, called the *Annex Report*; and a summary document with three related management options, called the *Analysis Report*. Though the project was to have included all three watersheds for future considerations, the reports are primarily about future management options for only one watershed, the Capilano. Will this mean that more money will be spent for future recommendations for the other two watersheds?

There were two significant shortcomings of the ecological inventory project process:

- there was virtually no public involvement and scrutiny of this process (see chapter two);
- the consultants were specifically instructed by the GVRD in an August 1992 *Requests for Proposals* document not to review the repercussions of previous logging activities in the watersheds, a situation which the Scientific Review Panel state in their final report as being a "serious deficiency".

For good reasons from documented case histories, local conservationists have become quite skeptical about information presented to and withheld from them by the Greater Vancouver Water District's forestry department over the last ten years on the effects of logging to the Greater Vancouver drinking-supply watersheds, despite opposing suggestions by Water District staff. In a number of ways, the ecological inventory process and reports is another indication of that history.

This present critique of the ecological inventory, which is written from a conservationist's and a long-standing participant's perspective, concerns information presented in the 1999 three volume *Annex Report*. This critique attempts to demonstrate, through an examination of the main issues identified or missing in the report, that the modeling applications in the ecological inventory are unreliable limited constructs as future tools for the Greater Vancouver watersheds. Some of our findings are also supported, to certain degrees, in other recent reports by the Regional Water Advisory Committee (RWAC) in September 1999, and the Scientific Review Panel in October 1999. For instance, page 5 of the RWAC report states that:

> More information needs to be provided regarding how the various analytical models were developed with, of course, the underlying scientific references which are, for the most part, absent. In several sections of the Analysis and Annex Reports, it is difficult to determine where science ends and speculation about water quality effects begins.

However, the Scientific Review Panel state in two instances that:

> In the Panel's opinion, the applied science and modeling systems used in this work are technically sound and reliable.
>
> Certain findings from the preliminary analyses carried out for the Capilano watershed have extremely important implications for management planning. These results have been produced using applied science and modeling techniques that, in our opinion, are sound and reliable. Moreover, they are broadly consistent with the results of other studies. We feel that the GVRD Board can have confidence in these findings as a basis for decision-making. [1]

According to a communication with Everett Peterson of the Scientific Review Panel, [2] the Panel never critically reviewed the ecological inventory modeling, with the exception that they received a summary critique of the fire and sediment modeling by Dr. Michael Feller from the U.B.C. Forest Sciences Department, which went unmentioned in their short reference section. This is disturbing, simply because the Panel have stated that the models are "technically sound and reliable". If the modeling has not been peer reviewed, and with one academic presenting them with challenging information, then their statement about confidence in the modeling is unsubstantiated. After all, the original intention of having the Scientific Review Panel was to "peer review" the ecological inventory reports. The Terms of Reference for the Panel states that: "Is the collection, compilation, analysis, and modeling of the data adequate for long term management planning?"

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[1] *Testing the Water*, page one of the Executive Summary, and page 23, respectively.

[2] Personal communication, October 29, 1999. According to Peterson, the Panel chair, Dr. Peter Pearse, had proposed hiring professionals to examine the models (which are summarized in this Overview chapter), but it was never done. Originally, the Panel had proposed to meet with university academics in either the Fall of 1997, or the early months of 1998, to review the ecological inventory report which was not ready at that time, and the meeting never occurred after the reports were published in early 1999.

A SUMMARY OF THE FINDINGS IN THIS REPORT

1. The consultants' Annual Fine Sediment Yield modeling from the Capilano watershed (chapters 3 and 4). The consultants' infer in the *Annex Report*, from their extensive but questionable modeling, that 86% of the fine sediments transported into the Capilano Reservoir come directly from landslides, and that the majority of these landslides are naturally caused. The *Analysis Report's* Executive Summary takes it one step further by stating that "the largest percentage of overall fine sediment yield originates from naturally occurring landslides that are largely untreatable" (page x). However, there is no comparison made between the estimated volume of sediments released from human-caused and natural landslides, which brings into doubt the conclusion in the *Analysis Report*. Furthermore, the consultants state that 70% of these fine landslide sediments originate from areas that were intensively logged right to the edge of streams in the early part of this century, which raises further doubts to the interpretation that landslides from these areas are "naturally" induced. However, there is no information contextualized in the *Annex Report* to let the reader understand the information about early and later logging practices and its relation to these fine sediments. This may have something to do with the GVRD's instructions to the consultants to avoid discussion of logging practices in the Capilano watershed.

A coring study conducted in the Capilano Reservoir indicates that the consultants' annual average estimates for fine sediment may be 2.3 (two point three) times too high, a problem which alters both the consultants' conclusions about the total percentage of fine sediments from landslides and future management options for the Capilano watershed.

2. A short-term road experiment conducted at two stations in the Seymour watershed, which started quite late in the ecological inventory project, is inadequate in presenting reliable applicable data on the long term effects on the release of fine sediments into the public drinking supply reservoirs, especially the Capilano Reservoir (chapter 3, section 3.4d). Roads, which have been in existence for many years, and decades, have produced many sediments that have gone unrecorded. There was no attempt in the experiment to monitor the erosional effects that concentrated water runoff collected in ditches have in areas directly below culverts. Applied modeling on "average" fine sediment production from these two road experiments should be approached with caution.

3. Environment Canada's modeling on the transport of fine sediments through the Capilano Reservoir (chapters 3 and 4). The primary finding from Environment Canada's report is that only large scale turbidity events from landslides impact water quality at the Capilano intake, and that persistent low turbidity events do not. The inference from this conclusion is that small scale natural or unnatural fine turbidity producing disturbances are not a concern. However, Environment Canada repeatedly admits in its report that this conclusion lacks proper physical data from the Capilano reservoir current dynamics, and is only a hypothetical model, and that testing of its hypothesis is needed. Because the *Analysis Report*, GVRD staff, and the Scientific Review Panel admit that Environment Canada's conclusion is critical to the assumptions made about the future of the Capilano watershed, and obviously of the other two watersheds, it is extremely critical that the assumptions in this model are thoroughly examined before it is blindly accepted as a rule of thumb.

4. During the Capilano Reservoir coring and sediment estimation project the large delta area was overlooked (chapter 4). This oversight neglects to investigate both the amount and type of materials deposited here, the fundamental concerns that managers should have during drawdown periods from the erosion and transport of materials into the reservoir, and the overall effects this has on water quality.

5. The catastrophic fire argument and fire modeling (chapter 5). The catastrophic fire argument, which states in GVRD reports that large scale fires occur every 500 years in our watersheds, has been used by other agencies to validate logging as a means of controlling these hypothetical future fires. Transcript information from a United States court case in Oregon on Portland's Bull Run watershed in 1976 demonstrates this point quite clearly. "Catastrophic" fires, for our coastal rainforest watersheds, are a red herring meant to bring the debate to an emotional level, and that people are responsible for not only burning many forested areas in the three watersheds over the last hundred years or so, but in logging thousands of hectares of forests and disturbing the soils and landscape. Forest science has also shown that the plantation forests in the watersheds are more vulnerable to forest fires than the old forests which were cut down.

6. The Hemlock Looper modeling (chapter 6). I have shown in this chapter that the Water District's own correspondence files and federal reports on problems related to forest defoliating insects contradict the information presented in recent GVRD reports on the watersheds. Concerns from the impact of forest defoliators became the motivating rationale for logging in the 1960s, which is also the same information which the consultants refer to for supporting their concern about forest insects. The Hemlock Looper model, which is a modeling-based scenario for a Looper outbreak in 120 years in the distant future (the year 2120), is refuted by a well-known United States entomologist, who gives this phase of the ecological inventory a failure mark. Never in his entire professional forty year career has this entomologist come across a similar argument for predicting an insect outbreak 120 years into the future, and for suggesting that the forest be thinned to deal with this future supposed outbreak.

THREE RECOMMENDATIONS FOR FUTURE PLANNING IN THE GREATER VANCOUVER WATERSHEDS

1. ROAD DEACTIVATION

Road deactivation is an important consideration for the future management of the watersheds, a subject which is strangely lacking in the ecological inventory reports. The Scientific Review Panel also acknowledge this in their latest October 1999 report, where "roads receive inadequate attention". They go on to state that "analysis might reveal that a significant portion of the road system is no longer needed, making a deactivation schedule, balancing maintenance and deactivation costs, an important element in the management plan" (page 12).

On this particular topic, we suggest that the GVRD consider forming a public Greater Vancouver Watersheds Road Committee to identify the problems with the existing road structures and to come up with an immediate and long term road deactivation program. The City of Seattle, for example, is developing a long term road deactivation plan for its Cedar River watershed, and has already set aside funds for this project.

2. CAUTIONARY APPROACH TO EROSION CONTROL PROJECTS

A similar committee could also be formed, or the two combined, to examine the whole subject of erosion control projects presented in the Annex and Analysis Reports. As the Scientific Review Panel comment:

> there is no indicator to reflect the condition of aquatic environments [i.e., streams]. This, in our opinion, is a serious deficiency, insofar as some of the management regimes considered involve channel training and erosion control measures along streams, which are often destructive of aquatic habitats. We therefore recommend an indicator of performance reflecting the integrity of aquatic habitat. (Page 16)

The Regional Water Advisory Committee, in their recent September 1999 report, also comment:

> Stream bank stabilization work involving the application of riprap disturbs a natural streambed and would detrimentally impact tailed frog habitat. In fact, much of the existing stream bank stabilization work in the watersheds which has transformed natural stream beds to rip-rapped (i.e., rock-lined) linear chutes, has likely destroyed tailed frog and fish habitat. Some discussion of the impacts of this management approach would have been appropriate in the Ecological Inventory Program." (Page 11)

We believe that the GVRD should approach the subject of erosion control projects with extreme caution. In this regard, we remind the GVRD about the problems encountered during the Meech Creek erosion control project in the Coquitlam watershed from 1992-1993.

3. NO MORE MODELING AND EXPENDITURES

On October 15, 1999, the Chair of the Scientific Review Panel, Peter Pearse, recommended contracting the Acres International to provide modeling for missing information in the ecological inventory project regarding the effects of logging practices on the release of sediments into the Capilano Reservoir. Because we have already shown our concerns about the deficiencies from the modeling applications in the ecological inventory Annex Report in this critique, we believe that it is both unwise to spend any more tax dollars to conduct questionable modeling on this issue, and the fact that it is far too late to conduct theories about logging related disturbances that have come and gone.

SELECTED QUOTATIONS FROM THE GVRD'S REGIONAL WATER ADVISORY COMMITTEE'S (RWAC's) REPORT ON THE ECOLOGICAL INVENTORY PROGRAM, ANALYSIS, AND ANNEX REPORTS (SEPTEMBER 15, 1999)

(RWAC is chaired by Dr. Chad Day, SFU professor of Resource and Environmental Management)

Every effort should be made to permit the GVRD to gain complete control over its watersheds as quickly as possible. (Page 15)

In general, interventions that disrupt natural processes should be minimized. Allowing nature an opportunity to restore the damage caused by the logging and roadbuilding activities of the last century was felt to be the best option from an ecological perspective. (Page 7)

Overall, the Ecological Inventory Program deals far more with manipulations of tree cover in the forest rather than having a focus on overall water quality. This may reflect the interests and expertise of GVWD staff when the study was designed who appear to have been mainly foresters rather than hydrologists, limnologists, or ecologists. (Page 6)

Some aspects of the Ecological Inventory Program may appear flawed simply because, during the extended period of time this report was in preparation, some previously-held concepts have become outdated or proven wrong by more contemporary research. (Page 4)

At the June 10th [1999] workshop, most of the attending RWAC members expressed the concern that the language and terminology of the Analysis and Annex Reports appeared to be more appropriate for the type of forestry management applied to timber-supply forests than to drinking watersheds. (Page 4)

More information needs to be provided regarding how the various analytical models were developed with, of course, the underlying scientific references which are, for the most part, absent. In several sections of the Analysis and Annex Reports, it is difficult to determine where science ends and speculation about water quality effects begins. (Page 5)

The study conclusions are often based on uncertain numbers and assumptions about what occurrences produced some of the effects. This relates particularly to fire, forestry practices, and forest health. (Page 11)

Within the Ecological Inventory Program, the guidelines that apparently will be used to protect wildlife habitat and provide streamside buffers are based on the Forest Practices Code - a code that has been developed for application to forests managed for their timber value. Some RWAC members felt this was not appropriate for a drinking watershed in which the forest provides a different ecosystem service…. Again, these recommendations have been interpreted by some RWAC members as more evidence of bias ... towards logging practices and timber extraction than water quality protection. (Pages 10-11)

The terms of reference for the Ecological Inventory Program appear not to have been well thought out with regard to impacts on water quality. While the consultants appear to have done what they were asked to do, the dilemma for readers now is how to verify many of the conclusions drawn from the modeling studies. Given the cost and length of this extensive ecological inventory, this is unfortunate. Clearly, guidance is needed to the scientific basis of recommended policies in Management Plan No. 5. Without this it will be difficult, if not impossible, to have any confidence in the management scenarios and their associated costs and benefits. (Page 6)

Some RWAC members expressed the hope that members of the public would be able to gain some sense of the tremendous biological values of our watersheds from the Analysis and Annex reports but noted that this concept is not adequately described or referenced. It was suggested that the inventory should have documented how much low elevation old growth forest remains in our watersheds, the plant and animal species supported by this ecosystem, and the significance of this habitat in the watersheds to these species. Some indication that undiscovered species are likely to exist within mature forests of the watersheds would also have been appropriate. (Page 10)

SELECTED QUOTATIONS FROM THE SCIENTIFIC REVIEW PANEL'S OCTOBER 1999 REPORT TO THE GVRD, TESTING THE WATER. TOWARD A NEW MANAGEMENT PLAN FOR GREATER VANCOUVER'S WATERSHEDS: FOCUSING ON OBJECTIVES

It is evident to us that the planning project has reached a point at which clearer guidance from the GVRD Board is needed. If the Board has already determined that certain activities are unacceptable, it should inform the planning team to avoid wasting its effort in formulating a management plan that will be rejected. (Page 26)

So far, some eight years and $6 million have been expended on this project - probably more than any other watershed management plan in Canada. (Page 23)

The initial analytical work described in the Analysis Report deals only with the Capilano watershed, and treats it independently of the Seymour and Coquitlam, as if it were the sole source of water for the GVRD water supply. It is inappropriate, or at least risky, to draw conclusions from analysis of the Capilano alone for planning the management of all three watersheds.... (Page 19)

Certain other matters which the Panel considers central to management planning for the watersheds are not analysed. Among these, the absence of explicit investigation of the effects on the water supply of logging and roadbuilding are considered to be serious deficiencies in view of longstanding controversies about these issues. (Executive Summary, page 2)

We questioned whether maintenance of the existing 300 kilometers of roads built years ago for intensive logging and forestry purposes, certain erosion control measures, and other activities can be shown to have measurable benefits in terms of water quality. We therefore recommend that the financial analysis be extended to include existing programs and activities. (Page 16)
The other category of issues that are inadequately explored is the range of actions available to watershed managers. No analysis is made of certain matters that appear to be central to this whole

investigation, such as logging and road requirements. No evaluation is made of road systems or of a "hands-off" management strategy. (Page 24)

The Analysis Report adopts certain secondary indicators of the risks of sedimentation and turbidity, notably the measurable hazards of forest fire and insect infestation. The analysis shows that the relevance of these indicators to the GVRD's water quality problems is tenuous. Analyses undertaken for the Capilano in isolation show that even severe, low probability fires and insect infestations do not greatly affect the quality of the water. And if the entire system of interconnections of water supply from the three watersheds were examined, the impact would certainly be less. We suggest that these indicators of risk be deleted. (Page 15)

There is no indicator to reflect the condition of aquatic environments. This, in our opinion, is a serious deficiency, insofar as some of the management regimes considered involve channel training and erosion control measures along streams, which are often destructive of aquatic habitats. We therefore recommend an indicator of performance reflecting the integrity of aquatic habitat. Protection of endangered species is another important part of environmental stewardship that is ignored in the Analysis Report. It calls for a performance measure, which might be based on one or two species of concern, such as the spotted owl or marbled murrelet. (Page 16)

QUOTE FROM: DR. DAVID SUZUKI, KEYNOTE ADDRESS, AT THE CANADIAN WATER RESOURCES ASSOCIATION ANNUAL CONFERENCE, RICHMOND, B.C., OCTOBER 27, 1999

The very essence of science is that most of our current ideas and the cutting edge of knowledge are wrong. The way that science progresses is that you make observations, you set up a hypothesis, you test it, and chances are nine out of ten you toss out your hypothesis and say I better go back to the drawing board and do something else. So then, why do we have this conceit, that with all these little bits of knowledge that we are acquiring we have gained the ability to manage the world around us.

I have received this analysis here [the GVRD's 1999 ecological inventory Annex and Analysis Reports] *which is some kind of look at the [Greater] Vancouver watersheds. To me, this is totally worthless. It is worthless because it is based on a conceit that we know enough to be able to manage our way into the future. We haven't learned the most fundamental lesson of the twentieth century, which is Nature has had four billion years to learn how to work, and we have no idea of how it is all put together and works. And the notion that we are going into a system that is delivering services for us for nothing, that isn't even included in our economic system, and then be able to build roads and log and do all these things and still maintain the delivery that Nature gives us, is an unbelievable and unwarranted conceit.*

We are approaching the end of this century and our children are going to look back and say that we set in motion all kinds of activities and development that have compromised their world in ways that we can't even begin to imagine. We have an enormous responsibility.

Nature, as you know, the web of living things, filters fresh water and delivers it to us in a way that we can drink. And so the idea that we are going to somehow intrude on that system that works, and then continue to guarantee not only will we have clean water, but we can make money by cutting down the systems that are actually filtering that water for us and cleansing it is an unbelievable assumption for which there is no supporting evidence.

CHAPTER 1

ECOLOGICAL INVENTORY BACKGROUNDER

QUOTATIONS

The disastrous effects which will surely follow logging operations in the Capilano Watershed cannot be overlooked. [3]

That the alienated timber in the watershed should be completely controlled by those responsible for the supply of water to the Cities and Districts concerned is beyond question…. The pre-eminent object to be attained is the maintenance of an adequate supply of pure (i.e. unpolluted) water - all other considerations are subordinate: and to that end the watershed should be preserved inviolate. [4]

The watersheds on the north shore are a heritage for this whole area. This is the golden opportunity for the exercise of that Greater Vancouver spirit which knows no internal bounds and is bound to avail itself of the heritage which nature has supplied for the common good of all. [5]

They will log that watershed over my dead body. [6]

I believe that some day you will employ foresters and bring your lands under their management for the production of a forest crop and the best conservation of the water. [7]

The Panel has found no compelling water quality reason to suspend the present timber harvesting program, however all future watershed activity should reflect the risk management philosophy. There are, however, to the best of the Panel's knowledge, no urgent issues relating to forest stability or health that require immediate silvicultural remedies. [8]

One of the things that we are working with Bob [Cavill's] group on is to make sure that enough of the skills and enough of the tools are in the Watershed Division's hands ... that we won't be sitting here at the age of 65 still on the dole at the GVRD. [9]

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[3] Quote from H.M. Burwell, civil engineer, in a letter to Mayor and Council of Vancouver, September 17, 1917.
[4] Quote from E.A. Cleveland, B.C. Comptroller of Water Rights, in his report to the Minister of Lands and Forests, The Question of Joint Control of Water Supply to the Cities and Municipalities on Burrard Inlet, October 1922, pages 92-93.
[5] Quote from E.A. Cleveland, B.C. Comptroller of Water Rights, in his report to the Minister of Lands and Forests, The Question of Joint Control of Water Supply to the Cities and Municipalities on Burrard Inlet, October 1922, pages 92-93.
[6] Quote from E.A. Cleveland, Water District Commissioner, 1926-1952, from a suppressed October 1953 newspaper article by Vancouver Province reporter Doug Leiterman.
[7] H.R. MacMillan, March 30, 1951. Correspondence to Water District Commissioner E.A. Cleveland.
[8] Final Summary Report, August 1991, page 78.
[9] Audio transcript of Scott Hanna from Acres International, during a presentation to the Regional Water Advisory Committee meeting, November 22, 1995.

1.1 INTRODUCTION

Probably the three most important questions to ask about the Greater Vancouver watersheds' ecological inventory project is:

- What is its purpose and objective?
- Who was involved in the decision-making process?
- What has changed over the past 10 years?

The original purpose of the ecological inventory, which is explained to some degree later in this chapter, was focused on a continued but lesser logging program than previously in specific forest management areas set aside in each watershed (see Appendix D for maps of these management areas). Logging in these management areas was to come under a new rationale related to fire risk hazard, preferred forest species types (such as Western Red and Yellow Cedar), forest insect prevention, and commercial logging and thinning. However, as the years passed on after 1992, politicians and the public began to learn more about the future implications of logging in the watersheds, about the effects that past logging practices were having on water quality, and about the logging agreement with the provincial government, called the 1967 *Amending Indenture*. Awareness of these matters began to temper management perspectives and philosophy for the watersheds, and to restrict the targets for forest management objectives defined by GVRD Watershed Management Division staff foresters both in separate annual proposals and in the ongoing ecological inventory project.

The key issue, which conservationist groups began to raise in 1997 and especially in 1999, was on the logging licence agreement with the provincial government. This issue had never been carefully discussed or debated by the GVRD either in its Water Committee or in its Water Administration Board meetings, because staff often direct the issues to be debated. Directors began to learn about the original policy with the provincial government, called the 1927 Indenture, which gave the GVRD's Water District control over the protective administration of the Crown land forests in the three watersheds, to protect the water supply from commercial logging, while preventing the GVRD's Water District from ever making a profit from logging on Crown lands.

The 1967 *Amending Indenture* changed all that, by allowing the Water District to make a profit under a Tree Farm Licence arrangement with the Ministry of Forests, with the requirement that it submit five year forest management plans to the Ministry of Forests. Four such Management Plans were submitted to the Ministry of Forests between 1968 and 1989, and the GVRD is currently working on submitting Management Plan #5 with regard to the ecological inventory project. By becoming informed on these matters in 1999, GVRD Directors began to understand that, should they enact escape clause #25 in the *Amending Indenture*, which would return the GVRD back to the original *Indenture*, it would allow the GVRD to administer its own water quality management plan without the attending forest management constraints imposed under the Ministry of Forests, upon which the ecological inventory is structured. Directors began to determine that the recommendations for a continuance under the Amending Indenture by GVRD management staff were constrictive and contrary to good water quality management. This means that the GVRD may not in fact have to produce Management Plan #5 for the Ministry of Forests. In other words, despite the direction of the ecological inventory and its objectives over the last eight years, there has been a significant shift in the Greater Vancouver Regional District Board's perspective on the watersheds from continued logging and roadbuilding.

Throughout the ecological inventory process, from 1992 to 1999, there was virtually no involvement or scrutiny by the public on this project, a subject which is summarized in chapter 2.

1.2 THE RECOMMENDATION FOR AN ECOLOGICAL INVENTORY

After 1967, the GVRD began logging on an annual basis anywhere between 100,000 to 200,000 cubic meters of old growth forests in the three watersheds. [10] In late 1988 and early 1989 elected representatives at the Greater Vancouver Regional District were confronted with mounting public concerns about logging and water quality (see Appendix E). As a result, administrative staff at the GVRD's Water District defended their tree farming forestry operations and repeatedly denied allegations that logging was impacting water quality. [11] To manage public concerns, staff contracted Gregory Kirmeyer with Economic Engineering Services Inc. in March 1989 to both chair and recruit a panel of consultants (called the "review panel") to review the logging practices and to provide recommendations for a revised long-term logging plan. [12] More recently, Water District staff have attempted to claim that this review was simply a result of a "response to new science and changing public values", [13] rather than concerns about the long term effect of logging to water quality and quantity, public concerns which originally shut down the watersheds from logging in the 1920s. The origin of the ecological inventory project for the Greater Vancouver watersheds was born out of this 1989-1990 internal audit of the Greater Vancouver Regional District's forestry practices. [14]

In the January *Draft* and August *Final Summary Reports* of 1991, the review panel identified that the logging program in the public's source of drinking water had no clearly defined criteria, other than logging for profit:

> GVWD has broadly defined long term goals for its watersheds, but a clear "road-map" of how to accomplish those goals does not exist. Clearly defined, long term forest stand and vegetation strategies need to be developed.... GVRD's Watershed Management Program is based on the premise that forest health can be improved with an ecologically-driven harvesting program, however the criteria for what to harvest and when is not sufficiently developed.... It is not clearly defined how the relatively small harvesting program will accomplish GVWD's stated goals in the overall scheme of forest and water quality protection on one-third of the lands. A clearer set of criteria for the selection of stands to be harvested needs to be developed.

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[10] Close to 5,000 hectares of forest, including road right-of-ways. A truck load of logs usually holds about 30 to 40 cubic meters. 100,000 cubic meters is anywhere between 2,500 to 3,300 truckloads.

[11] For instance, the July 13, 1989 Water Committee Agenda report, *Watershed Management Program*. Staff edited an excerpt from a November 1988 report by forest hydrology associate professor Douglas Golding to the GVRD's Regional Manager, in order to make it sound as if the professor had made a sweeping conclusion: "The GVWD can be fairly confident that their forest management creates no deleterious effects." Under a logging agreement with the provincial government for a Tree Farm Licence, called the Amending Indenture, over 300 kilometers of roads were constructed and over 200 cutblocks logged since the 1960s.

[12] The Washington State based company was first hired by the Greater Vancouver Water District in 1987 to evaluate concerns emanating from the persistence of turbidity in the water distribution system. The company remained to conduct many studies and recommendations for the Water District until 1992.

[13] *Watershed Management Planning at the Greater Vancouver Water District*, October 27-28, 1999, by Derek Bonin and Dan Ohlson, page 1.

[14] There is no public record of Water District staff requesting permission from the GVRD's Water Administration Board for this audit at the time, and was initially mentioned in a brief July 1989 Water Committee Agenda. Just prior to the audit (referred to as the "Comprehensive Watershed Management Plan" in the July 12, 1990 Water Committee Agenda) being released to GVRD politicians at the end of 1990 it became external, or public, after a November 1990 landslide in the Seymour watershed, which initiated in a clearcut, and muddied the Seymour Reservoir for a period of weeks. The landslide became the source of intensive public scrutiny and controversy, with some politicians calling for an immediate public enquiry. In January 1991, foresters at the Water District were requested to make their report available for public review and comment.

> The Panel found that a comprehensive long-range forest management plan is needed.... The requirement to meet an AAC [Allowable Annual Cut] in an area where water quality is paramount seems contradictory. **There should be an ecological rationale for the harvesting of timber to protect or enhance water quality, particularly with regard to disease, insect infestation and fire protection.** The Panel found that a comprehensive analysis of stand health and vigour is needed.... This type of plan can be created only upon the completion of a comprehensive ecological inventory of the entire watershed area that includes an evaluation of stand health and stability. [15]

It is very clear that continued logging was the objective of an ecological inventory, further qualified by the review panel's recommendation to revise the *Amending Indenture* to restructure and reduce the rate of logging.

According to a poll which the review panel members conducted amongst themselves in the *Draft Summary Report*, leaving the forests alone to natural processes (called "hands off" and "reactive" management) in the Greater Vancouver watersheds is as great a risk to water quality as intensive logging activities. Out of the 6 management options they formulated to consider, the review panel chose the middle-ground option, called "**pro-active, low level**", a management strategy which:

> ... would seek to anticipate the consequences of natural processes and disasters." "Vegetation would be manipulated through silvicultural practices, including harvesting where possible and beneficial, in order to increase forest stability and resistance to insects, disease and fire." "This strategy attempts to anticipate conditions and intervene where feasible .... a portion of the forest cover would be converted to younger forest stands." "The road building and harvesting in this strategy would incrementally increase erosion potential but the risk to water quality could be kept to a minimum.... (Page 68)

The panel's defense for choosing the proactive low-level option was predicated upon an unfounded assumption of there being "no compelling water quality reason" from previous watershed logging activities "to suspend the present timber harvesting program" (page 78). The review panel went on to reason that:

- coastal temperate old growth rain forests (once identified as "decadent" and "over- mature") are "more susceptible to decay than a younger, more diverse forest", and are vulnerable to "catastrophic events such as major fires" and to "disease and insect infestations";
- such events "would adversely affect water quality by adding to erosion potential" and the rapid release of "nutrients to the water reservoirs", and that "natural erosion and mass wasting events occur annually and will continue to occur", because of these conditions. [16]

The proactive low-level philosophy is quite apparent in reviewing the Option A proposal in the 1999 ecological inventory *Analysis Report*, to "thin" out about 50% of the forest on 4000 hectares in the Capilano Watershed over the next 20 years.

Since the late 1970s, under the GVRD's industrial tree farming policy, the lands and forests in the three watersheds were divided into two management categories, reserve and operational areas, boundaries of which kept changing over the years as staff applied different sets of criteria for these

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[15] Pages 19-21, *Draft Summary Report*, January 1991.

[16] P.52, *Draft Summary Report*, January 1991. In contrast, however, the review panel found that the human disturbances to the watersheds did not produce water quality problems.

areas. The reserve areas were those considered as too steep for logging and a risk to water quality, and were theoretically off-limits. The remainder of the lands were open for perpetual commercial logging. The 1991 review panel reclassified these areas as Protection Forest Areas, and Planned Management Areas (see Appendix D for maps on these designated zones).

According to the review panel, most of the forests in the Planned Management Areas would in the future be logged over a 200 year rotation plan instead of an eighty year plan, in order to "ensure a stable forest and landscape to meet the primary water supply objective": [17] "harvesting should be driven by a long term stand goal". [18] In other words, the allowable annual cut would be reduced by 2.5 times to accommodate a longer rotation of forest crops. Accordingly, data from a "comprehensive" ecological inventory would be gathered to "develop the long-term vegetation, land and road plans":

> The Panel recommends that GVWD conduct a detailed ecological inventory of the entire watershed area, including an evaluation of water resources, vegetation and timber resources, soils and stability, insect and disease status, fire susceptibility, climate and micro-climate, wild life and fishery resources. To enable GVWD to move forward with the road and vegetation plans, the key areas include development of a hazard rating for fire fuel management, development of a hazard rating for insect and forest disease management, development of a hazard rating for erosion control, and establishment of an in-house Geographic Information System (GIS) capability. [19]

In summary, it was very clear that the intention of the ecological inventory was to continue road building and logging, despite the growing public demands to end all logging. [20]

After the *Final Summary Report* was released in August 1991, Water District administrators recommended to the Water Committee that the GVRD's politicians adopt the ecological inventory project proposal, which was eventually passed by the GVRD Board on November 27, 1991. The basis of staff's assurances to the Water Committee on the recommendations for future "proactive" management was presented by assurances from Gregory Kirmeyer, the chair of the review panel, at a special Water Committee meeting held on October 29, 1991, that **"the Consultants do not believe that the cause of turbidity is a result of logging practices in the watersheds"**. This conclusion, which is both unscientific and fraudulent, is at the heart of the November 1991 resolutions which are so often quoted by staff to politicians and the public for the present ecological inventory process, and the reason for continuing with the *Amending Indenture*. This, however, did not go unnoticed during that time, as partly expressed in a press release by the Burke Mountain Naturalists on September 27, 1991:

> The Burke Mountain Naturalists say that the GVWD Committee failed to notice data which clearly link harvesting activities to landslides in the GVRD watersheds. Because of this serious

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[17] P. 61, *Draft Summary Report*, January 1991. The identified Management Areas compose large areas in each watershed, and are presented in the appendix A-21 to A-23. Greater Victoria's consultant Terrasol in 1992 also recommended the same 200 year rotation plan for their watersheds in the report "Greater Victoria Water District Land Use Technical Review". Terrasol's Bill Carr was on the Greater Vancouver's watershed review panel.

[18] P.76, *Final Summary Report*.

[19] Ibid., P. 77.

[20] "Mr. Marr [Water District Commissioner] stated that the inventory was a tool to meet the Board's proactive directive to manage the watershed to enhance water quality." "Director Tiedeman stated that he too recognized that there were two different philosophies regarding management of the watersheds and that there will be major difficulty reconciling those viewpoints." (Water Committee minutes for April 15, 1993)

oversight, the GVRD Board of Directors should not accept the recommendations of the Water Committee at their October 2 meeting.

1.3 THE ECOLOGICAL INVENTORY PILOT STUDY

According to the initial proposed outline in the August Final Summary Report, the ecological inventory would be completed by mid-1993 and a Management Plan in place by Spring 1994. Projected costs for the two summer season study, as outlined in the report's Appendix, were estimated at about $2 million. [21] News of the ecological inventory proposal was greeted with great disdain by the province's Chief Forester and the Regional Forester, who became concerned that the study might stall logging activities, and the transfer of stumpage revenues to the provincial government:

> I am concerned about the Board's suggestion of terminating existing logging contracts and restricting future harvesting operations to those stands that are categorized as "diseased or insect infested, fire hazard or erosion control". This would appear to be a technically unwarranted action, in view of the independent Panel's conclusion that road building and timber harvesting do not appear to have created a water quality problem. I'm concerned that this would set a precedent for other community watersheds, and restrict future development in the Vancouver watersheds. [22]

> We are concerned that recent statements by the board lead one to believe they wish to modify the recommended action to only allow harvesting in stands that have demonstrated a fire, insect, or stability problem. We feel that this approach will not be in the best interest of achieving your long term water quality and quantity objectives. [23]

Before the commencement of full inventory field work, a pilot project was proposed for the Eastcap Creek area in the Capilano watershed as a testing ground for the complete project. Only a month after the *Final Summary Report* was released, at the end of September 1991, Don McLennan, from Oikos Ecological Services Ltd., submitted a working proposal for the ecological inventory and stated that his costs would run between $3 to $3.6 million for the entire project, including the pilot study. [24] Though concepts in his proposal may have been taken into consideration, Oikos later became part of consortium of consultants coordinated through the firm of Acres International. Don McLennan was also given small contracts on assessing candidate areas for logging in the watersheds from 1992 to 1994 under the new proactive low-level strategy. [25]

After considering a total of 47 resumes, 'ecological' consultant Tom Griffing was hired in August 1992 by Water Commissioner Ben Marr and chief engineer John Morse as Project Manager for the

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[21] Of course we now know that total costs for the project are well over $10 million and we still don't have a management plan.

[22] John Cuthbert to Water District Commissioner Ben Marr, December 19, 1991. The Chief Forester argued that the entire study could be done for $250,000 and another management plan could easily be in place by 1995.

[23] Ministry of Forests Regional Manager Ken Ingram to Commissioner Marr, January 23, 1992.

[24] The first proposal, *Ecological Inventory of the Greater Vancouver Watershed District Proposed Working Plan*, was submitted to Water District foresters on September 27, 1991, and a second revised proposal on October 9, 1991.

[25] *'Common Sense' Criteria for the Selection of Forest Stands for Regeneration Cuttings in the Greater Vancouver Watershed District*, January 1992; *Assessment of Proposed 1992 Cutting Areas for Greater Vancouver Water District, Second Summary Report*, July 1992; *Assessments of 1994 Candidate Areas in the Coquitlam, Seymour, and Capilano Watersheds*, April 6, 1994.

ecological inventory. [26] Part of Delta resident Griffing's recent 'environmental' consulting experience (IEC - International Environmental Consultants Inc., and Griffing Consultants Inc.), included his contract with a local multi-housing developer, Michael Geller & Associates Ltd., in a highly controversial issue for Delta residents - the Spetifore farm lands. [27] Griffing's new responsibility with the GVRD was to coordinate assignments, projects, financial considerations, and editing of reports with Acres International on behalf of the GVRD's Water District. As a consultant, Griffing didn't work out his own office but was provided office space in the Watershed Management Division's department, and had access to all of the District's files. Mr. Griffing remained Project Manager for six and a half years until January 1999, when his contract was finally terminated near the completion of the ecological inventory. According to incomplete contract information from a GRVD Freedom of Information request (see Appendix A), Griffing Consultants Inc. earned $628,284.13 from 1992 to January 1999.

By early October 1992, Acres International and its consortium (henceforth 'Acres') got the green light for the ecological inventory contract out of 14 other consortia submissions. From October to November 1992 the Acres team conducted field work for the pilot study project in an alternate site to Eastcap Creek area: the Orchid drainage in the upper Seymour watershed. The reason for the change in locations was the distinct and convenient advantage it had as being part of a long- term monitoring experiment and with much acquired data, [28] and probably because the Eastcap area was being actively logged at the time and could have the potential of some embarrassment in terms of logging practices in that valley since 1968. In October 1992, Water District staff announced that the pilot project would be ready by early Spring 1993 and the entire project would be completed by the summer of 1995.

The Orchid Creek drainage includes two sub-drainages: Elbow and Jamieson Creek. These two drainages were part of a forest hydrology monitoring experiment which began in 1969 as a jointly funded program between the UBC forestry department and the Water District. The purpose of the

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[26] Ben Marr is considered by some ex-provincial government employees as the bureaucrat's bureaucrat. Formerly the Chief Engineer with the B.C. Water Investigations Branch in the late 1960s, he became the Deputy Minister of the Environment from 1975-1987. He was the provincial Deputy Minister of Forests from 1987-1990. From the end of 1990 to the end of 1996, he was the GVRD's chief executive officer and the Water District Commissioner. As the GVRD's chief engineer with the Water District since 1987, John Morse was also in charge of watershed policy and was a tireless advocate of the logging program in presentations to the Water Committee and the GVRD Board. John Morse's portfolio changed in September 1998 during the restructuring of the Water Department, and he is no longer overseeing the watersheds.

[27] During this acrimonious and well-publicized land-use debate, apparently the longest running public hearing in Canadian history, arguments presented before Delta Council by 2 residents with Ph.Ds in Zoology and Biology put into question Griffing's findings on bird and animal habitat for the Spetifore farm areas. Dr. Mary Tait's 9 page critique to Mayor and Council, May 10, 1989; Dr. John P. Kelsall's 5 page report, May 1, 1989. Both criticize Griffing's two reports, *Ecological Report and Conceptual Plan for Wildlife Enhancement at Dawn Development's Delta Property* (1982), and *A Commentary on Ecological Considerations Relating to the TDL Lands* (1989). Both the B.C. Ministry of Environment in 1983 and a GVRD committee report in January 1983 were also highly critical of the 1982 report. Kelsall writes: "neither of the reports are scientific in nature. They are subjective and unbalanced. They contain little or no documentation. They are expressions of opinion, not the results of investigation and deliberation. They are not what one expects in professionally prepared documents for public scrutiny." Mary Tait writes: "Well how long did Mr. Griffing spend in the field?" "Two field visits"! Did he spend all day? Where did he walk? Was the tide high or low? What was the weather like? Did he visit all the ecological communities? What equipment did he use? The only real ecological data in all three submissions [one was oral] comes in the second, when Dr. Griffing took the species list drawn up by the Tswassessen Nature Park Society for the forest only and attached them to his 1989 report as an appendix." It is not known if Water District staff were cognizant of these matters during his candidacy in 1992, seeing that Mr. Griffing would be involved in another highly controversial issue.

[28] Pages 2-8, 9, 15 of the *Annex Report*.

experiment was to examine the differences between the Jamieson drainage, which was to be roaded and logged, with the Elbow ("control") drainage which was left unmanaged, in order to scientifically determine the relationship on the effects of logging on water quality, timing, and flow. Weirs at the bottom of both creeks were constructed to monitor water flows, sediment, and turbidity, along with numerous monitoring stations throughout the drainages which recorded climatic conditions. Along with this data, the consultants had access to numerous reports and studies by university students and professors. Though the Acres team had access to much climatic data, the experiment had a number of serious flaws on the relationships between logging and water quality and timing:

(a) The total area logged in the Jamieson, the site of the disastrous landslide which muddied the water supply for many weeks, was not 19.2% of the watershed as calculated in numerous reports, but closer to 15%. Two of the four cutblocks extended into two other drainages, yet their total areas were included within the Jamieson drainage. This reckless oversight affects mathematical constructs on the experimental relationships between the two drainages. A fifth cutblock was logged in 1992, well after the 19.2% figure in numerous reports. The Pilot Study report, which had digitized and calculated the areas in the drainage failed to make note of this particularly evident discrepancy.

(b) Personnel monitoring the two weirs were unable to access the sites for many winter months because of snowpack, when storm events were normally at their worst. According to an overview of this experiment by Terrance Lewis in 1985, access was prevented for almost one third of 200 months. This prevented proper tabulation of turbidity events. [29]

(c) Calculations for total water runoff in the Elbow Creek were unreliable, [30] especially during storm events and high water runoff during snow melt. At the "elbow" in the Creek, water was diverted into another drainage, and water near the weir itself went subsurface through boulders on a fan. Proper monitoring of flows is important in establishing mathematical water flow relationships between Elbow and Jamieson. Professor Douglas Golding later attempted to recalculate the flows in 1993 with modeling formulas by one of his undergraduate students, however such an attempt is meaningless.

Data on turbidity generated as a result of logging, and data on the relationships for water flows are unreliable for the 20 year experiment. This accounts for the generalized comments about turbidity and peak flow relationships in the Pilot Study report for the Jamieson/Elbow drainages, and comments about the results from other experiments outside of the Greater Vancouver watersheds, which the Pilot Study recognizes "may have limited applicability to the GVWD watersheds" (page 2-17).

[29] Though this is mentioned in the Pilot Study report on page 2-10, there was no evaluation or comment on the significance this had to the Jamieson experiment.

[30] "Confidence in these results [peak flow relationships] is limited because the Elbow Creek gauge does not measure all the flow from the watershed." Page 2.14, Pilot Study report.

1.4 NO TERMS OF REFERENCE FOR THE ECOLOGICAL INVENTORY PROJECT?

One of the concerns with the ecological inventory mentioned by the Scientific Review Panel in their second report in 1998 is the absence of a Terms of Reference for the project. During their enquiry of the project, the Scientific Review Panel were told by project manager Tom Griffing that there were no Terms of Reference, only the Requests for Proposals document which was acting as the Terms of Reference. [31]

> In beginning this review we found it difficult to obtain a clear view of the scope of the work expected of the consultants in carrying out the ecological inventory. The GVRD issued a request for proposals for the pilot study in the Seymour watershed. The terms of this request provide the clearest indication of what was expected of the consultants over the whole ecological inventory program, because there were no specific terms of reference for either the pilot project or subsequent phases of the work, which were contracted individually. The consultants and the GVRD adapted their mandate as the inventory progressed, leaving some uncertainty about the intended scope, methodology and plan for the ecological inventory program as a whole. [32]

Terms of Reference are a regular mandatory contractual arrangement between the buyer and the seller, the client and the consultant, for a schedule and deliverables on a given project. When Ken Cameron, the manager of the GVRD's Strategic Planning department, was confronted by a question from the audience at a public meeting on May 15, 1999 about the apparent missing Terms of Reference for the Acres consultants mentioned in the Scientific Review Panel's report, he responded by saying that they were established after the completion of the March 1993 Pilot study. Towards the end of September 1999, after continual requests to receive this information, the writer was finally told that the Terms of Reference are those included in the June 17, 1993 Water Committee Agenda, as Appendix A, *Proposed Seymour Watershed Inventory Program*. Subsequent to Mr. Cameron's response, this new information was never provided to the Scientific Review Panel by Water District staff. It is confusing at best when looking at this Water Committee Agenda attachment. Nowhere does it state on the 12 pages of the attachment that they are the Terms of Reference, and nowhere in the staff report in Agenda Item No.2F is there mention that the attachment is the Terms of Reference.

To make matters even more confusing is mention of the ecological inventory Terms of Reference in attachment B of the June 17, 1993 Water Committee Agenda. This document summarizes both the responses by the Regional Water Advisory Committee of their April 5, 1993 review of the ecological inventory Pilot Study, and the Water District's responses to their input. **The Advisory Committee was concerned that the Pilot Study overlooked the "impact of harvesting and road construction on drinking water quality"**, and:

> recognizes that this may not be part of the terms of reference; however **the Pilot Study must consider man-made disturbances.** This is not mentioned in the Report.

Water District staff responded that "the assessment of impacts of man-made disturbances was not part of the terms of reference". What are staff referring to here? They are referring to the

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[31] Personal Communication with Everett Peterson.

[32] *Management Planning for Greater Vancouver's Watersheds: The Data Base. Second Progress Report of the Scientific Review Panel.* Vancouver, June 1998, page 14.

Request for Proposals document which was sent to the Acres International Ltd. on August 27, 1992. [33] It states in that document that:

> **the ecological inventory is not designed specifically to assess the impact of past forest harvesting on water quality within the watersheds.**

This is obviously what staff are referring to as the Terms of Reference, which, as the Scientific Review Panel have appropriately commented, are not. Aside from the fact that there are no Terms of Reference, and merely guidelines, it should be of great concern to the public that the Acres Team were told not to investigate the relationship between logging activities and water quality. The question is, in reports that are supposedly structured on the relationship and origin of fine sediment delivery to the public's water supply, why not?

1.5 POST PILOT PROJECT

After the Pilot Study report was presented to the Water Committee in April 1993, Acres were provided with a budget and given the nod to proceed with the ecological inventory for the Seymour watershed alone, and that that phase of the study would be completed by 1994. During the April 1993 Water Committee meeting, the Chair, New Westminster Mayor Betty Toporowski, was disappointed because of the project's inadequacy on addressing biodiversity issues. Water District staff promised the Committee that biodiversity would be examined in the next phases of the inventory. Of course we now know, for instance, that a wildlife inventory was never done, despite the fact that it was so outlined in the November 27, 1991 GVRD Board resolution. Most of the inventory for the Seymour watershed was finally completed in 1995, and work begun on the Capilano and Coquitlam in 1995, with total net consulting expenses from 1992 to 1995 of $3,393,919 for Acres and Tom Griffing.

1.6 INITIAL PRESENTATIONS OF THE ECOLOGICAL INVENTORY TO THE PUBLIC

After two years of field work, the first occasion when applied data from the ecological inventory was presented was at an expensive GIS (Geographic Information System) conference in downtown Vancouver at 1:30 pm on March 29, 1995. Knowledge of the event was never publicized by the Watershed Management administrators to the public or to the Water Committee in advance of the meeting. This was extremely odd especially because of the fact that the study was funded through public tax dollars, and was a politically sensitive issue. Moments before the meeting, Project Manager Tom Griffing became alarmed and red-faced when he discovered that his Greater Vancouver taxpayer-based presentation was going to be video recorded by the author of this report, and unsuccessfully ordered that it not be taped. It was an opportunity for Mr. Griffing and the Acres Team consultants to show off their computer modeling applications to the business community at a function which cost hundreds of dollars for participants to attend.

The first occasion upon which introductory information on the progress of the ecological inventory was presented to a GVRD committee was 6 months later on September 18, 1995. Tom Griffing, Don McLennan, Jerry Carlson, Bruce Blackwell, and Ken Rood provided brief introductions on their

[33] A copy of the request for proposals can be found in the April 15, 1993 Water Committee Agenda, under Item 2B.

project to members of the Regional Water Advisory Committee (RWAC) at the Seymour Dam Field House. Different maps of the Seymour watershed showing biogeoclimatic classifications, forest types, terrain stability, etc., were shown. After the discussions, RWAC members were treated to a helicopter ride over the Seymour watershed, and then a tour up a switchback logging road in the southwestern area of the Seymour towards Burwell Lake, with a few stops along the way to show the members sections of the forest and road system.

On November 22, 1995, after a landslide into the Capilano Reservoir, an issue which was quite prominent on the minds of Greater Vancouver residents, the same members of the Acres team made another presentation about the ecological inventory to the RWAC. RWAC members received a copy of a draft 15 page summary called *GVRD Seymour Watershed Ecological Inventory Summary Report: Fall 1992 to Fall 1995 and Beyond*, in advance of the meeting. [34] The apparent intention of the meeting was for RWAC members to read the report beforehand in order to provide feedback and recommendations for the Acres Team and the Project Manager to make changes to it. However, none of the RWAC members received the Agenda where instructions requested them to do so, and many of them only received the report the day before and so came unprepared for the meeting. Nevertheless, RWAC members came up with some hard-nosed questions about shortcomings with the draft report and were generally critical about its content and map information. Oddly, the draft report remained unchanged after the RWAC meeting, and was later circulated to the public and the GVRD Board with no indication that it was a draft report.

At the RWAC meeting, Tom Griffing introduced a number of computer generated maps to the RWAC members on different aspects of the Seymour watershed ecological inventory process. Of particular attention was a 3-D map of the Seymour watershed showing "natural" landslide zones, giving the unqualified impression that sediment from the hundreds of red lines outnumbered the concerns that logging activities might generate.

In the latter half of the RWAC meeting, Don McLennan from Oikos Consulting presented a brief slide show on the effects of the Hemlock Looper in the Rocky Mountain Trench area near McBride. [35] It was the first occasion by the consultants to test the public on their case for using the Hemlock Looper as a wedge for future logging intervention. Based on his evaluation that the climatic conditions of the McBride area were similar to the Greater Vancouver watersheds, McLennan began to impress upon the RWAC members that this could easily happen here. He then asked other members of the Acres team to provide comments on the effects the McBride area could have on forest fires and erosion.

For instance, Bruce Blackwell began to make a case that branches falling off the dead trees would build up on the forest floor, together with dead tree tops, vulnerable conditions for creating crown fires. Upon questioning from RWAC members, Blackwell then admitted that forest fires occur more frequently in that particular area of the northern Interior wet belt than on the coast. Jerry Carlson from Pherotech added that part of his efforts were to develop and refine a Western Looper hazard model, as the Greater Vancouver watersheds are "susceptible to a Looper outbreak". Along with Carlson's concerns, he also emphasized that fecal matter from the many Loopers could pose a water quality risk, information which he also alluded to in the 1999 ecological inventory reports, a conclusion which was

[34] According to Scott Hanna of Acres International, the original draft report was four times longer in length, but Water District staff edited it out. With regard to future logging in the watersheds, the introduction in the draft report stated that the watershed Crown lands are "administered by the Ministry of Forests", and "fall under the terms and conditions of the 1995 *Forest Practices Code Act*."

[35] The presentation was videotaped by the author.

never demonstrated through scientific evaluation. [36]

[36] The following quotes are from a GVRD transcript of the June 10, 1999 Regional Water Advisory Committee meeting, pp. 56-58. Chad Day: "You refer in there [the ecological inventory annex report] to the relationship of insect waste, nitrogen, water quality, yet the literature is never cited on that. Are there any references on that or is that just speculation on your part?" Mr. Carlson: "We did a separate report which was not part of the Annex report, for other reasons, on a speculation as to the impact of an insect outbreak on the delivery of nitrogenous compounds and those kind of things, because they make a big mess." "So we do have an exhaustive literature source on those things as consultants, and we're hoping as scientists that we'll be able to get an investigation happening in the future." Chad Day: "Given the quality of water in the reservoirs, would an increase in nitrogen be of significance anyway to the GVRD water supply? I think if you're not going to use it, I'd drop it." "And I'm looking for the scientific basis of what you're saying, but it's not there so I find it very frustrating."

CHAPTER 2

POLITICS AND PUBLIC PROCESS

> *Information from the public has an important role in the development of the Watershed Management Plan. Despite the fact that the results* [of the ecological inventory] *were open and available to support the development of alternative management options, a degree of mistrust, stemming from long-standing opposition to past management approaches, appears to lead some stakeholders to either ignore or misinterpret specific findings.* [37]

BACKGROUND

Though the approach to public involvement on watershed management issues by the GVRD has taken somewhat of a constructive shift within this very year, 1999, it is important to note that there was an absence of public participation in the ecological inventory process, a systemic problem which the Water District cultivated for many decades. Since logging began in the 1960s, there was a marked unwillingness on the part of the Greater Vancouver Water District administrators to allow any public discussion and participation in the management of the Greater Vancouver watersheds. Staff were well aware that commercial logging of the old growth forests in B.C.'s largest population center drinking-water supply was a significantly sensitive topic. In fact, when opposition to the logging program periodically cropped up either at municipal Council meetings, or at Water Committee meetings, the concerns were consistently brushed off by staff with contrary assurances. [38]

Perhaps the most striking example of this former rigid internal management policy is found in correspondence files between the Ministry of Forests and the Water District. In 1979, the province's Chief Forester Bill Young reminded the Water District's Commissioner Doug MacKay in a letter dated June 18 about his responsibility to provide public involvement in reviewing the five year Working Management Plan, a process which all Tree Farm Licence holders are mandated to comply with under provincial regulations. In response, forestry manager Ed Hamaguchi [39] wrote back on July 13 stating that "we take exception to the requirements for public involvement" because "we wish to maintain a low key in our watershed management program":

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[37] *Watershed Management Planning at the Greater Vancouver Water District*, by Derek Bonin (GVRD Watershed Management manager) and Dan Ohlson (GVRD consultant and editor of the Analysis Report), for the Canadian Water Resources Association's annual conference proceedings, *Confronting Uncertainty*, October 27-28, 1999. This disclaimer is discussed below.

[38] Rebuttals by the public to staff's remarks during Water Committee and GVRD Board meetings are not allowed, because the public only has 'observer' status. This is perhaps the greatest advantage that Water District staff have had at Water Committee meetings, as informed members of the public cannot voice their concerns. There is, for instance, no question period allowed to address these concerns while issues are actively debated. Instead, the public must subsequently submit letters of concern to Water Committee directors or appear the following month as a delegation to present their concerns, well after the matter has been discussed and voted upon. If politicians are unaware of the issues, or lack the time to become familiar with lengthy reports, they may be vulnerable to proposals and information from staff, especially on issues related to logging in the watersheds. Concerns related to policy and decision-making processes at the GVRD level suggest an alternative and more accountable approach, whereby all decisions are discussed and directed at municipal council meetings first, and then representatively discussed at Water Committee meetings.

[39] Hamaguchi, a graduate from the U.B.C. forestry department, was employed with the Water District from 1968 to 1993, and eventually became manager of the forestry department.

> It is our concern that a provision for public involvement will lead to a vociferous minority bringing out issues not related to the Working Plan and not consistent with our obligation to provide potable water to the inhabitants of the Greater Vancouver area.

Bill Young responded on July 31 by diplomatically stating that:

> the Ministry of Forests policy relative to the public viewing of TFL management working plans will not apply to the GVWD area. Since the licensee is, in effect, a "public-civic" body directly responsible to a specific electorate, I am assuming that your Board will ensure that a satisfactory public information process will exist.

Bill Young's assumption was misplaced. There was no public scrutiny or accountability of the watershed logging program in the 1970s and 1980s, mostly because Water District managers kept the information under tight control, coupled with the fact that the public were prohibited from entering the watersheds and directly inspecting the roadbuilding and logging activities. The first time that the Water District allowed the public to view its management plans was in 1989, that is only after considerable attention was brought before the regional politicians by public activists. The critical interface for public concern eventually took place at some of the monthly Water Committee meetings from 1989 onwards, where members of the public began to investigate staff reports and criticize forestry management recommendations on the administrate policy and mismanagement of the Greater Vancouver watersheds.

From the end of 1991 to the present day, members of the public began to take an active consistent role in monitoring Water District staff and making presentations to regional politicians who participated in the decision-making process. Despite these efforts, it took many years before local politicians began to understand the issues and to challenge watershed management staff themselves. [40] The recent end to the Seymour Advisory Committee and the dismantling of the Seymour Demonstration Forest designation to the Lower Seymour Conservation Reserve, as well as increased public awareness of the escape clause and requirements in the 1967 Amending Indenture, are two examples of this transition process. [41]

With the exception of one meeting with the Regional Water Advisory Committee in April, 1993, the public was never involved, nor asked to be involved, in the planning and implementation of the GVRD's ecological inventory from 1992 to the final reports in April 1999. As shown in the quotation at the beginning of this chapter, the Water District's forester, Derek Bonin, has recently suggested otherwise, stating that data relating to the ecological inventory was available throughout the process, which it was not, and further implying that conservation "stakeholders" are uninformed and misdirected, a clear and blatant attempt to discredit the 'opposition':

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[40] Municipal mayors and some councillors, who make the decisions at the GVRD, are elected every three years, and each year many of them are rotated on different committees. GVRD staff are particularly aware of the in-the-door-out-the-door world of decision making at the GVRD. As a result, when some members finally come to understand a complicated issue, such as the logging issue in the Greater Vancouver watersheds, they may suddenly leave, and the learning process begins anew. It is very difficult to find a politician that has a good grasp of the issues and the 10 year process behind the ecological inventory, given their hectic schedules. Of course there are the seldom few who are regularly reappointed to a committee, whose leanings usually end up winning the tie- breaking decisions.

[41] The control of the decision-making process and policy by Water District staff and forest industry representatives in the off-catchment Lower Seymour lands is discussed in Will Koop's report, *Seymourgate*.

> Despite the fact that the results [of the ecological inventory] were open and available to support the development of alternative management options, a degree of mistrust, stemming from long-standing opposition to past management approaches, appears to lead some stakeholders to either ignore or misinterpret specific findings.

The absence of a formal public monitoring committee on the extravagantly expensive and lengthy ecological inventory process, [42] and the absence of annual reports or updates on the project to the Water Committee, is a clear indication of a sensitive project that has been carefully guided through internal administration and control at the GVRD's Water Department. A further hindrance in this process was that the Water District gave written instructions to the Acres Team not to discuss the project with members of the public outside of their appearance at formal public meetings, and that all questions to the consultants should first be directed to Water District staff who would act as go-betweens on such questions. This of course made it extremely difficult for members of the public to feel confident in getting an accurate and unrestrained response, especially on sensitive issues.

IMPORTANT CHECKPOINTS

2.1 THE 1989-1991 REVIEW OF WATERSHED LOGGING

As a direct result of public criticism in late 1988 by professional forester Mark Wareing [43] with the Western Canada Wilderness Committee, the Water District contracted consultants to conduct an internal audit of the watershed logging program. The audit, which began in March of 1989, was not presented to the GVRD's Water Committee for information until four months later in July 1989. During this process of investigation by consultants who were hired without public consultation, the public were never asked to provide input for this process, nor were politicians given meaningful status reports during the enquiry. The final report was intended to be submitted to the GVRD Board at the end of 1990, without public scrutiny and review, had it not been for a large landslide in a Seymour watershed cutblock in late November 1990 which shut down the Seymour supply for a number of weeks. This event triggered enormous public concern and media attention which caused the internal report to take a sudden turn.

In January 1991, after some politicians called for an investigation of the logging program, the consultants' Draft Summary Report went through some very sudden editing, but failed to mention the November 1990 Jamieson landslide, a very significant landslide which was initiated in a clearcut. Public meetings on the watershed logging issue ran for 2 consecutive days at the Robson Square Media Center on May 2 and 3, 1991, where many members of the public voiced their concerns for a logging moratorium. [44] Many representatives from different sectors of the forest industry provided about half of the written and oral presentations during the hearing process, scoffing at the moratorium proposal, with concerns about logging ending in other drinking-water supply districts. The Water District consultants, who reviewed the public's presentations, recommended the continuation of logging under a "proactive" management philosophy, for reasons already stated in chapter one.

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[42] See Appendix A.

[43] Wareing was a former employee with the Lower Mainland District office for the Ministry of Forests, where part of his responsibility was to monitor logging proposals and activities in the Greater Vancouver watersheds. His "green card", which authorized him to access the watersheds was taken away from him by Water District staff when he tried to access and inspect the Coquitlam watershed in 1988 after he left the Ministry.

[44] Refer to Economic and Engineering's 1991 Public Input document.

2.2 PUBLIC MONITORING GROUPS KEPT OUT OF THE WATERSHEDS

Undoubtedly the most important factor in knowing anything about the watersheds is to get first hand knowledge by visiting them. For want of a better analogy, the watersheds are the living library, and unless you get into the library you will never know what is on the bookshelves.

In recent decades, the Water District closed the library door to concerned members of the public, by maintaining its long-held policy against public access to restrict public critics from assessing and documenting the impacts of forestry management activities to soils and stream environments. Observations by the public on radio spots and in newspapers sarcastically comment that loggers, however, are not restricted from the watersheds. Members of the public have frequently approached the GVRD's Water District staff and Water Committee since 1992 for permission to inspect the watersheds. Almost all of their requests have been denied because staff always recommend to GVRD politicians to refuse access. The main arguments by staff have been that escorting public citizens into the watersheds is a health risk and a waste of taxpayer dollars, adding on that the GVRD may be liable for any accidents. Eventually, after years of continual requests, the Water Committee and GVRD Board first voted to allow a member of public (the author of this report) a two month program access to monitor forest management activities in March of 1999. This was a significant step on the part of the GVRD Board, and showed that they were changing their policy on the matter, that is after the completion of the ecological inventory project for the Capilano watershed.

Access to the watersheds is very critical to not only understanding the ecological inventory technical reports, but also in observing what the reports may not be reporting on. For instance, on May 11, 1999, the author inspected extensive damage to a road in the Daniels Creek drainage in the Capilano watershed. Approximately 14 culverts were plugged and damaged on a very steep road grade, large volumes of material were eroded and scoured by water energy from the road prism, and several small landslides consisting of fine clay soils below the road slumped into Daniels Creek which were transported into the Capilano River and Reservoir. This of course happened to be one isolated event on a network of 118 kilometers of road in the Capilano watershed. Had this event not been documented and publicized the road would have simply been repaired, and this information may never have been presented to the public by the Water District. Have the Water District staff presented annual reports to the public on the problems related to the transport of sediments from roads and clearcuts into stream environments, which staff witness first hand? No. The question remains: how confident can the public be in the information presented to them by the Water District on the effects of logging in the watersheds?

Consider the following as an example. Most recently in the Georgia Straight newspaper (September 16-23, 1999), the manager of the GVRD's forestry department, Bob Cavill, was quoted as saying that from findings in the ecological inventory, "logging roads are only responsible for two-and-a-half percent of the overall sediment flowing into [the Capilano] reservoir", and that "the remainder was caused by naturally occurring mudslides." It is apparent that Mr. Cavill may not be at all familiar with or critical of his department's reports, and it is most disturbing that this sort of misleading summary is being presented to the public. [45]

Another instance of having "inside" information is documented in my December 1995 report Not Coming Clean, on the October 1995 landslide into the Capilano Reservoir. During the early and later parts of 1995, Water District staff and some politicians were preventing some members of the public from accessing the watersheds to inspect land and road failures above the western part of the Capilano

[45] A critique of the findings on this issue is found in chapters three and four of this report.

Reservoir. The areas were however inspected and documented, which led to the understanding of what triggered the landslide. Had these things not been monitored, the public would have been left in the dark about the cause of this landslide which shut down the reservoir for many months.

Related to this subject of restricted access was a proposal by SPEC (Society Promoting Environmental Conservation) at an April 21, 1995 Water Committee meeting to initiate a core sampling project in Greater Vancouver's three reservoirs. SPEC's Paul Hundal proposed to hire, at SPEC's cost, a professional limnologist to direct a coring project to investigate the rate of sedimentation. The proposal was rejected by the Water Committee on the grounds that the public were not allowed access to the watersheds. In August of 1996, the Water District privately approved its own core sampling of the reservoirs without making this known either to the politicians at the Water Committee or to SPEC. SPEC subsequently found out about the core sampling only after the November 1997 ecological inventory Methodology report was released to the public. As a consequence, there was no public input on the core sampling program, a program which SPEC had wanted to make public.

2.3 THE ECOLOGICAL INVENTORY PILOT STUDY AND THE FORMATION OF THE REGIONAL WATER ADVISORY COMMITTEE

As a result of recommendations to the GVRD Board about public accountability on issues related to the watersheds and water quality in general, the GVRD's Communication Department established the Regional Water Advisory Committee (RWAC) in November 1992. Over the following years, this Committee dealt with many issues to do with watershed management, the chlorine/chloramine debate, water metering, pipe cleaning, water filtration proposals, etc. Though there was a perception that this Committee would represent the public on the watershed logging issue, they were never given a position of influence on the topic, and their recommendations for watershed management were often inadequately passed on to the politicians until 1998, after a change in management of the Communications Department.

When the ecological inventory pilot study was released in March 1993, the RWAC met on April 5 to provide input on the report. The results of their input was presented to the Water Committee in June, 1993. The most critical question the RWAC had was on the avoidance of discussing the implications of logging roads and logging on water quality. The Water District responded to the RWAC's concern by stating that their concern would not form part of the ecological inventory project. Did the Water District have a good reason for defending this response? None was provided. This puts forward the question on the limitations and purpose of the RWAC. Other than this meeting, there was no provision for the RWAC on public input, direction, and ongoing involvement in developing the ecological inventory. In terms of watershed management issues, the role of the RWAC had more to do with simply keeping appearances. Only within the 1999 year has the RWAC's involvement in the ecological inventory process been taken seriously.

2.4 THE 1994 PROPOSAL TO LEAVE OUT THE PUBLIC OVERTURNED

In the March 11, 1994 Water Committee Agenda, item 2(D), was a report by Water District's chief engineer John Morse called Watershed Management Planning - Status Update. In it there were two sentences which the Water Committee overlooked during their busy meeting:

> The public consultation process of the Watershed Management Plan development has been reduced as a result of the budget reduction. Public input by the Regional Water Advisory Committee only is possible with the current available funding.

This was a dramatic shift from the GVRD Board's November 1991 resolution which called for a "public review process" as a follow up on the ecological inventory. In a letter of concern to the Water Committee dated November 8, 1994, the writer of this report pointed out that:

> Public statements from Water Management staff indicate that roadbuilding, logging, and erosion control projects which involve the logging of old growth forests will continue after the inventories for each of the three watersheds are completed. Any type of development which is planned is of crucial concern to the public. A great sum of public monies have already been, and will be, expended on this inventory process, so it is not only incumbent that proper funds be allocated for a full public review process, but that this matter be openly discussed.

The overall expenditures for the ecological inventory to date, both in terms of consultants and staff time and related expenditures, are probably over $10 million to date, and it would have been difficult, in retrospect, for the Water District to argue that there were no funds available for public involvement. Fortunately, the Water District's attempt to limit public input to members of the RWAC only was subsequently overturned when the public process was reviewed at a later date.

2.5 NO PUBLIC INPUT ON THE SPOTTED OWL DISCUSSIONS

During the commencement of the ecological inventory, there was no announcement to the Regional Water Advisory Committee, the Water Committee or to the public that the Water District's forester, Derek Bonin, was representing Greater Vancouver residents on discussions for the future of the spotted owl in the watersheds. As a result, after a series of forest management options were presented to the Water Committee on February 10, 1995, ranging from full protection of forest habitat to 67% retention of "suitable owl habitat in each 3200 ha [owl] activity center", the majority of Water Committee directors voted in favour of Water District staff's recommendation for option H, 67% retention. The Water Committee report stated:

> Option H permits some timber harvesting utilizing modified or alternative timber harvesting practices. This alternative timber harvesting criteria is applied to all the SOCAs [Spotted Owl Conservation Reserves]. The alternative practices may include operations such as selective harvesting, green tree retention, and extended rotations. These types of operations are likely more compatible with the GVWD objectives to reduce forest fire hazard through vegetation management. Over the years the District has been engaged in a lengthy and detailed public and scientific process to determine appropriate watershed management approaches. At risk is this effort as well as GVWD's ability to develop policy which reflects water priorities. To reduce this risk a strong message from the District is required to advise Cabinet of its preference of a management option as outlined in this report.

The federal and provincial governments formed the Spotted Owl Recovery Team (SORT) in 1990 to address the habitat ranges of the Spotted Owl in southwestern B.C. As a result, the team produced SOCA, which included all of the forest lands in the Greater Vancouver watersheds. These watersheds have the greatest component of remaining old growth forests in the Lower Fraser River Basin. [46] In the Spring of 1993, the Water District was notified of the SOCA designation in the watersheds. In John Morse's initial report on the Spotted Owl to the Water Committee on October 14, 1993, he stated:

> The draft interim guidelines for Spotted Owl protection, if ultimately adopted, could substantially restrict watershed management activities and water supply planning programs. Some of the more limiting options ... would significantly constrain the District's ability to manage its watersheds for the primary purposes of water supply and water quality.

John Morse's reference to "constraint" reflected his concern that the designation would impede future logging. The report went on to emphasize that "land use decisions relating to Spotted Owl habitat could conflict with Regional District decisions, many of which are based on lengthy local public involvement processes." There of course were no short or "lengthy local public involvement processes". On August 12, 1993, John Morse wrote a letter of protest to Ministry of Environment employee Dave Dunbar, chair of the SORT, stating that:

> An acute sensitivity exists about the unilateral imposition of a designation and related management guidelines on the District's watersheds which could either compromise or conflict with our primary water objective. GVWD believes that solutions will be found through cooperative assessment and action rather than through designation and stipulation. There we urge you to remove the SOCA designation from our watersheds.

On August 13, 1993, Water District Commissioner Ben Marr wrote to the Deputy Minister of the Environment, Gerry Armstrong, to request that he immediately remove the "GVWD Watersheds from the Spotted Owl Conservation Area interim management guidelines."

As the issue continued to be presented to the Water Committee, and as discussions with the SORT unfolded, the present writer wrote the following to the Minister of Environment, Lands, and Parks, Moe Sihota, on January 6, 1995:

> I have recently learned that one of the GVRD staff has sat on the Spotted Owl Advisory Committee to represent only the views for a continued program of logging in the watersheds. In speaking with public members who have been actively and closely following the watersheds issue, no one read nor knew of his appointment to this Committee. I have also learned that the same GVRD representative made false allegations regarding the status of the watersheds during the day of the special public meeting in Victoria, when the spotted owl report was officially released. So how can proper decisions be made when the process is being secretly and undemocratically administered?

The politics behind the Spotted Owl issue from Water District staff is a strong indication of why funding for an inventory of wildlife in the ecological inventory project may have been subsequently eliminated, or that the Spotted Owl was not mentioned in the ecological inventory reports.

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[46] Capilano - 10,343 ha of old forests out of a total of 19,818 ha; Seymour - 8,942 ha of old forests out of a total of 12,587 ha; Coquitlam - 11,031 ha of old forests out of a total of 21,186 ha. Source: Greater Vancouver Water District data base, 1999.

2.6 THE MARCH 1997 TERMS OF REFERENCE FOR MANAGEMENT PLAN NO.5

The ecological inventory project is directed towards future forest 'management' of the Greater Vancouver watersheds. Since 1967, when the Water District signed the *Amending Indenture* Tree Farm logging licence agreement with the Province, they were required to produce a Working Management Plan. From 1968 to the early 1990s, there were four management plans submitted to the Ministry of Forests. These plans, which documented all forest management activities in annual increments, are to be completed every five years, a condition which was rarely met by the Water District. [47] The present logging moratorium, which began in late 1994, interrupted the sequence and administrative philosophy of these management plans. That is why there is now a reference to Management Plan No.5 in the ecological inventory documents.

In 1996, staff at the Water District's forestry department began drafting a Terms of Reference document for Management Plan No.5. This document detailed policy management of the watersheds under chapter 1.2, "Regulatory Framework", which included the adoption of the *Amending Indenture*, the Forest Practices Code Act, and the Forest Act. [48] All of these policies require future management plans and commercial logging. The drafting process and final submission of this document to the Ministry of Forests in early March 1997 was done behind closed doors, and was never presented to the Regional Water Advisory Committee nor the GVRD's Water Committee for review and comment. This contradicted a comment in the Terms of Reference document which states that the Water Committee and GVWD Administration Board are "responsible for developing and recommending water-related policy for approval".

The most likely reason that the *Terms of Reference* was crafted behind closed doors was to bypass public criticism and growing political disdain for future logging in the watersheds. Since the November 1991 Board resolution, which called for continued logging, there were two municipal elections in November 1993 and November 1996, and politicians were dramatically changing their position on the GVRD's November 1991 resolutions for future logging, mostly as a result of becoming educated on the issue over the years by citizens monitoring the issue. Credit must be given to many politicians of late who have recently stated that they are unwilling to authorize future commercial logging in the watersheds. The dilemma on this issue clearly rests with GVRD Watershed Management staff for promoting continued logging options, and avoiding public debate and discussion of this issue.

Even after public groups confirmed that the Terms of Reference for Management Plan No. 5 were secretly approved, and protested these things publicly, [49] the manager of the forestry department, Bob Cavill, misled the Water Committee by stating that the Terms of Reference did have public approval. To his credit, that is after complaints about his statement were raised in a letter on March 2, 1999 to his boss, Ken Cameron, Manager of Strategic Planning, Cavill did retract and refine his statement at a subsequent Water Committee meeting, the Terms of Reference for Management Plan No.5 did not go

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[47] "I have been told that the Management Working Plan for the Greater Vancouver Water District is now more than two years overdue. Surely this is not true. It seems to me that we should ask ourselves, do we or do we not require a M.W.P from the GVWD? If we don't, let's forget it and advise the GVWD accordingly; but if we do, then we should make every effort to get the M.W.P in on time." Memo from Chief Forester Bill Young, September 26, 1983.

[48] On January 7, 1994 the Water District sent a submission to the Ministry of Forests on the proposed Forest Practices Code, with a cover letter by chief engineer John Morse. The *Amending Indenture* requires the Water District to conform to Ministry of Forest regulations, and was therefore concerned about future regulations.

[49] Detailed in the B.C. Tap Water Alliance website: *www.alternatives.com/bctwa*.

through public process.

2.7 THE JUNE 28, 1997 PUBLIC WORKSHOP

As the field studies for the ecological inventory were nearing completion, and just after the three members of the scientific review panel were chosen by the GVRD Board to begin their process of reviewing the ecological inventory (see Appendix F), it was suddenly announced at the May 16, 1997 Water Committee meeting that the first public meeting on the ecological inventory would be held some time during the following month. On May 29th, the day before the GVRD Board were to consider and discuss the meeting date, the Water District sent out a letter of invitation to previous watershed tour participants only, forgetting to invite even the RWAC members who had not met for some time. [50] The letter had set out the meeting date for June 28th, the Saturday of the long weekend (see Appendix H). Who in their right mind, you might ask, would want to organize a meeting for a summer long weekend? When interested members of the public who were not on the guest list called the Communications Department to sign up for the meeting the following week, they were told that they could not attend because they had not been on a watershed tour. When this embarrassing news hit the local press, the Communications Department backed off and opened the meeting to all members of the public. [51]

One of the problems with the date of the meeting, was that the introductory report by the Scientific Review Panel was not going to be ready until one week before the meeting. Another problem was that there was no comprehensive report available on the ecological inventory for the public to consider, which made it quite frustrating for the public to understand the project.

So what was the original intention of the meeting? It was most likely meant to direct the participants towards a sympathetic approval of the *Terms of Reference* document for Management Plan No. 5. Instead, the overwhelming majority of the 130 or so participants who sacrificed their long weekend stated in no uncertain terms that they wanted an end to logging in the Greater Vancouver watersheds and to cancel the 1967 *Amending Indenture*. But despite their consensus statement, it was suppressed by managers of the Water District and not encapsulated in their report to the GVRD Board in September 1997, and kept from meaningful discussion in their November 1997 Issues and Options report. The Water District was committed to have a public review process, but to what extent was this a genuine process or simply window-dressing?

2.8 THE ISSUES AND OPTIONS REPORT

Water District staff planned to present a series of three interrelated 'building-block' reports to provincial agencies as part of their "revision process" for the eventual approval of Management Plan No.5. The Terms of Reference document was the first, the Issues and Options the second, and upon upcoming approval, the Analysis Report is the third. The Issues and Options report, much like its

[50] The summer watershed tour program began in 1994 with the attending aim to poll participants on grading the Water District's logging activities. The Water District submitted the results of their self-interested poll to the Ministry of Forests in their Issues and Options Report, in order to maintain their logging policy outlined in the Terms of Reference document. See section 8 in this chapter for more details.

[51] It was shortly after this occasion that the Communications Department began to take a more independent and responsible role on watershed management activities than it had in the past.

predecessor, was never meant to go through public process, but public watchdogs rerouted that process at the last moment before it was presented to the GVRD Board at the end of November 1997.

On June 10, 1997, at a private meeting with the Scientific Review Panel, public watchdogs were provided with two reports they had never seen in public circulation before that time, the Terms of Reference and the draft Issues and Options reports. Water District staff were subsequently requested that these reports be made available for the June 28, 1997 public workshop. Despite the fact that the Issues and Options report was presented to public participants as a handout at that meeting, they were not asked to provide written comments. The only other time the report was presented to a 'public' body before it was intended to be presented to the Ministry of Forests at the end of August 1997, was to the Seymour Advisory Committee on June 10, a now defunct committee whose decision-making processes were largely unaccountable to the Greater Vancouver public. The Issues and Options report was prevented from being submitted to the provincial government and was finally rerouted to a meeting of the Regional Water Advisory Committee in November 1997. However, there was insufficient time allotted for a full review of the report.

In a recent conversation with the GVRD's Manager of Communications, Bob Paddon, he remarked that there was no public process involved in the Issues and Options report, the implications of which put the reasoning for management options A and B in the Analysis Report on very shaky ground. [52] Options A and B, call for intensive "thinning" of old and second growth forests over a twenty year period. The consultants in the Annex Report admit that some roadbuilding and logging will affect water quality down the road, so to speak, and that it is a necessary trade-off or "risk" with regard to the pending threat of a natural fire or a bug kill. The effects of logging practices to water quality are unknown and cannot be predicted. The importance of this admission by the consultants is that it contradicts Gregory Kirmeyer's October 1991 assurance to GVRD politicians in adopting a "proactive low-level" management philosophy that the Water District's logging practices have not impacted water quality.

2.9 THE NOVEMBER 1997 METHODOLOGY REPORT

As a result of the June 28th public workshop, there was a consensus by the participants that the public finally be provided with a technical report on the findings of the ecological inventory. After all, people were concerned that had been no information forthcoming on the ecological inventory, a process which to that time had already expended $5 million for consultants' fees alone. The contract for a technical report was let out in early July 1997, and a Methodology Report was produced and published in November 1997. Disappointingly, the report was not on the consultants' findings, but strictly on how the consultants went about collecting their data. The Methodology Report also lacked a critical review of the existing relevant scientific literature, which would have allowed the consultants to justify the modeling applications they chose.

Even after the release of the Methodology Report, the Regional Water Advisory Committee was not asked to provide comments or input on the document. In fact, it took 8 months for the Scientific Review Panel to release their critique of the Methodology Report for the July 17, 1998 Water Committee meeting, about a month and a half from the first (postponed) deadline for the final ecological inventory reports for August 31, 1998.

[52] Communication, September 30, 1999.

CHAPTER 3 - EROSION, SEDIMENTS, TURBIDITY

QUOTATIONS

Water from undisturbed forests is generally of the highest quality available. [53]

Attention: Mr. T.V. Berry, Commissioner. We find as follows: 7. Most of the soils in the Watershed are of glacial origin and are generally resistant to erosion. 10. Hydrologic research indicates that an undisturbed virgin forest maintained over the entire Watershed is not the most satisfactory cover from the aspect of water yield. 11. The forest cover can be managed to improve the stream flow of the watershed. 13. An analysis of forestry techniques for watersheds in this region indicates that controlled harvesting of forest products in the Watershed can be carried out without detriment to water quality or quantity. [54]

Replying to your letter of December 5th instructing us to have sufficient culverts installed on the Balfour road. A phone call to this office would have ... made the threatening tone of your letter unnecessary. I believe you must be aware of the conditions that resulted in the plugging of culverts and the loss of some road surface. There was firstly the snowfall referred to above [12 or more inches], followed by three or four days of rain and then an intense storm that dropped about 6 inches of rain in twelve hours that washed away about half of the snowfall with its accumulated rain. Combine this runoff with a newly constructed road in a very mountainous area, where many watercourses are ill-defined and only carry runoff during intense storms a situation develops that is almost uncontrollable. Fortunately, once construction disturbances stabilize, normal maintenance prevents the situation from reoccurring. [55]

This study demonstrated that road construction combined with patch clearcutting ranging from 10-25% of basin area produced significant, long-term increases in peak discharges in small and large basins in the western Cascades. The addition of roads to clearcutting in small basins produced a quite different hydrologic response than clearcutting alone, leading to significant increases in all sizes of peak discharges in all seasons, and especially prolonged increases in peak discharges of winter events. These results support the hypothesis that roads interact positively with clearcutting to modify water flowpaths and speed the delivery of water to channels during storm events, producing much greater changes in peak discharges than either clearcuting or roads alone. Road surfaces, cutbanks, ditches and culverts all can convert subsurface flowpaths to surface flowpaths. [56]

Although the general effect (i.e. increased sediment yield) of clearcut logging on steep slopes is well known, few quantitative studies have been conducted in environments that are physiographically and ecologically similar to the Vancouver watersheds. [57]

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[53] Jack Rothacher, USFS forest hydrologist. *Managing Forest Land for Water Quality, Proceedings of the Joint FAO/USSR International Symposium on Forest Influences and Watershed Management*, Moscow, 1970.

[54] *Appreciation of Factors Affecting Watershed Management on the Watershed of the Greater Vancouver Water District*. C.D. Schultz & Co., December 1956, p.3.

[55] GVWD correspondence, December 13, 1974. Assistant engineer A.K. Blakeney, to Ministry of Forests Forest Ranger G. Stahl.

[56] *Peak Flow Responses to Clearcutting and Roads in Small and Large Basins, Western Cascades, Oregon*, by J.A. Jones and G.E. Grant. Draft, June 1, 1995, p.17-20. Final version in Water Resources Research journal, 1995.

[57] Ecological Inventory *Annex Report*, page 6-41.

The Consultants do not believe that the cause of turbidity is a result of logging practices in the watersheds. [58]

In both these reaches [4 and 5] the Capilano River has widened its channel, and shifted its course by lateral erosion and avulsion, as a result of riparian harvesting, road and powerline construction along the valley bottom. [59]

The largest percentage of overall fine sediment yield originates from naturally occurring landslides that are largely untreatable. [60]

The data and fine sediment yield model for Capilano watershed indicate that most (86%) of the fine sediment comes from landslides and that logging has had no influence on the number of landslides. The inference here is that logging has had no influence on the major source of sediment for Capilano reservoir. A simple observation renders this inference incorrect. The observation is that a major landslide into Capilano reservoir in 1995 caused such high suspended sediment levels that the reservoir had to be closed for a number of months. The fine sediment yield from this one landslide amounted to fully 20% of the total fine sediment yield passing through the Capilano Dam in the 10 year period from 1987 through 1996. This landslide was caused by inadequate road drainage in a logged area. If landslides in undisturbed forest produced as much fine sediment in the reservoir as have logging-induced landslides, then Capilano reservoir would have been closed for substantial periods in the last 20 years or so as a result of these landslides in natural forests. This has not been the case. [61]

3.1 BACKGROUND

The ecological inventory targets the origin of turbidity (the colloidal suspension of fine sediments) as one of the principle concerns about the Greater Vancouver watersheds as a source of domestic water supply. Turbidity may either be the result, or combined results, of human- caused activities or natural circumstances. It is specifically the issue of logging roads and logging (called "forest management", "integrated resource management", "multiple use management") and its effects on water quality which is at the forefront of the SPEC's concern with the ecological inventory and the Capilano watershed, and the positive impression the ecological inventory reports are meant to indirectly have to both vindicate previous and future logging activities. Because the topic of fine sediments dominates the ecological inventory technical reports, and because all of the recommendations for future "silvicultural treatments" are predicated on and structured around this issue, is why this chapter is the longest in this report.

The damage to municipal water supplies by logging activities are well-understood by some, but this information is rarely provided by agencies which depend upon or promote resource use within water supplies:

> The two most significant potential hazards for consumers of water from a watershed that is subjected to logging are the siltation of rivers, and the discharge of colloidal clay and of

[58] Comments from the Chair of the 1989-1991 review panel on forest management activities, special October 29, 1991 GVRD Water Committee meeting minutes.

[59] *Annex Report*, page 9-16.

[60] *Ecological Inventory Analysis Report*, page x.

[61] *Review of the GVRD Watershed Ecological Inventory Program Watershed Analysis Report*. Submission to the Scientific Review Panel, by Michael Feller, September 1999, pp.5-6.

> organic colloids (i.e.: humus) into drinking water. Generally, public attention focuses on the aesthetic aspects of siltation; the deposit of silt, and in particular, colloids in pipes of the water distribution network and the problem this causes through formation of organic deposits that act as breeding foci for microorganisms, is less known. The discrepancies between the low concentrations of coliform bacteria at the water intake in Chapman Creek, and the often above-federally recommended maximum concentrations in water samples taken from within the water distribution system of the Sechelt area, are likely due to silt and colloid deposits within pipes. [62]

On the subject of logging related to the release of fine sediments, the connection between declarations in the August 1991 *Final Summary Report* and summary inferences in the ecological inventory documents is obvious and intentional: logging activities since the 1960s, both for the short and long term, are almost irrelevant in comparison to sediments associated with natural causes. The theme is consistent but the question remains: is it tenable? In other words, where is the data that supports this conclusion, given the present road network of 118 kms and 76 cutblocks in the Capilano watershed, overlapped with earlier extensive logging and long term repercussions to soil disturbance and stream environments by the Capilano Timber Co? There simply isn't the data to support this, and is the convenient result of manipulating assumptions, questionable methodology, and avoidance of investigating management practices and admitting them publicly, in stark contrast to many other studies outside of the Greater Vancouver watersheds on the long term repercussions from logging on soils and stream environments. There is also no statistical information provided in the *Annex Report* which would compare the combined amount of logging and roadbuilding in hectares to the total area in each of the Capilano sub-drainages. Instead, there is only information on the length and slope of roads per sub-drainage unit spread throughout the report.

There are only a few photographs depicting fine sediment producing areas for the Capilano watershed in the *Annex Report*, and there is no associated description of where these photographs were taken. For instance, there should have been a map provided for the reader to identify the location of each of the photos. I can think of numerous locations for photographic examples of fine sediment production related to roadbuilding and clearcutting practices in the Capilano watershed, and it is odd that there is not a wide representation of these in the report.

The Annex document and the 1993 *Pilot Study* acknowledge there are only two studies which have attempted to monitor the amount of sediment delivered from logging practices, the 1969- 1990 Jamieson/Elbow forest hydrology experiment, and the 1997-1998 Seymour road sediment monitoring stations experiment (see section 3.4d below for a discussion of this experiment). The inability for field researchers to access the Jamieson study area during the critical late Fall and Winter months from the 1970s onwards, indicates that data on fine sediment movement and totals is absent, making conclusions from the experiment on the issue of turbidity unreliable. [63] Concerns from the two road monitoring stations in the Seymour, particularly the single upper Balfour drainage site, that the equipment failed to quantify the total amount of sediments and turbidity, indicates that this short-term experiment is also inconclusive. It would have been appropriate to have conducted the Balfour road experiment since the beginning of the ecological inventory in 1993, or more appropriately, since the

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[62] Dr. Edward Diener, *Tetrahedron Local Resource Use Plan - Final Report*, 1994, Water section, page 13.

[63] Despite the fact that the GVRD provided a good portion of the 20 year plus financial commitment of somewhere between one to 2 million dollars, there is no final report published to the GVRD on the 20 year Jamieson/Elbow forest hydrology study, or a single scientific report published in a peer review journal. According to the last principal advisor of the project, forest hydrology professor Doug Golding, he threw all of the project files in the garbage around 1995. What a sham!

upper section of the Balfour road was constructed in 1988. [64] As a result, there is only a tiny chronological window to catalogue the general production of sediments from this 40 meter section of road in the upper Balfour, with soils and dynamics unrepresentative of conditions in other areas of the watersheds, particularly the Capilano watershed. Outside of these two studies, there are no other study sites on the relationship and effects of logging to sediment production in the Greater Vancouver watersheds, making it impossible to render generalized conclusions about the origins and delivery of sediments into the Capilano River system.

Nevertheless, the *Annex* document states that one of the abilities of the GIS modeling applications is to be able to predict fine sediment production (**particles less than 0.063 mm in diameter**) over time. [65] How is this possible, you might ask, if no one has consistently and systematically measured the fine material for the Capilano River and its tributaries in the past? Well, the Acres team client, the GVRD, gave the green light to expend enormous effort to attempt to calculate the amount of these fine sediments through highly interpretative methodology. Through this process they have not only attempted to estimate the total annual average, but also determined the fine sediment sources, and then made predictions about future management activities and natural disturbances. Therefore, a case is presented in the *Annex Report* to show how their computer modeling scenario for the Capilano watershed is able to predict the impacts that a future fire, the hemlock looper, and future management activities may have on fine sediment delivery into the Capilano Reservoir, even though there is almost no scientific data available or statistically significant confidence levels to reliably predict this.
The consultants, however, were unable to release the *Annex Report* with the results of their high-end hypothetical estimate on total fine sediments (explained below) prior to findings in another related project. U.B.C. Geography professor Michael Church, who conducted a coring and sonar project in the three reservoirs in August 1996 and August 1997 (see chapter 4), didn't arrive at his results on the amount of trapped fine sediments in the reservoir until the summer of 1998, results which were initially mentioned in the Acres first draft of the ecological inventory in September 1998. Church later had one of his students publish the findings in a Bachelor of Science research paper. [66] Church's results were far below the consultants' inflated estimates for fine sediments, which the consultants admit, but at the same time the authors of the *Annex Report* refuse to readjust its high-end estimates to Church's findings, because to do so would necessitate a significant alteration in the *Annex Report's* conclusions and comparisons, along with changes to its figures and tables. This problem is investigated in chapter 4.

The basis for understanding the modeling estimations on fine sediments and turbidity is from details in eight of the 15 sections in the *Annex Report*, chapters 3 to 10, which comprise about half of the entire technical report. It is obvious that a major focus of and budgeting for the ecological inventory went into the various aspects of producing a fine sediment yield model for the Capilano watershed, and for hopes in later establishing a similar approach for the other two watersheds. The entire process for developing this model was done without public scrutiny.

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[64] There is a recorded instance of a large cutslope failure before the experiment began, which once again brings into question the conclusions of this experiment. Immediately after the failure, the area was hydroseeded. "A cutbank failure occurred immediately upstream of Station C in the early spring of 1997, prior to data collection." "Several small cutbank failures occurred on the same section of bank in the early spring of 1998; these failures were significantly smaller than the 1997 failure." (Page 8-14, *Annex report*)

[65] Sediment particles which are deposited in the Capilano reservoir in and beyond the river delta area are those less than 180 microns (0.180 mm) in size, which is mentioned in chapter 3 of the *Annex Report*. Most of the fine clay and silt sediments which reach the dam spillway and water intake in a state of suspension are those less than 5 microns (0.005 mm) in size.

[66] *Determination of Sedimentation Rates for Capilano and Seymour Lakes, North Vancouver, BC*, by Lesley Kalmakoff. March 1999.

Of course, it is not just the subject of these very fine sediments which concerns us, but on the displacement and transport of all materials in general into the reservoirs as a result of forest management activities in the Capilano, Seymour, and Coquitlam watersheds, and on options for future logging.

3.2 Comparison with selective sediment survey stations from other watersheds

In section 2.5 in the *Annex Report*, on suspended sediment transport, there is an attempt made to compare annual suspended sediment loads of other coastal watersheds of various sizes with the Capilano watershed, in order to establish a mathematical relationship on what these rates are in terms of watershed area alone. Comparative information drawn from Table 2.5 is highly questionable, because the majority of the 8 comparisons are taken from glaciated sources, where delivery of suspended sediments are endemic and naturally much higher, and where stream channel characteristics and material erosion may be much different. It is inexcusable that there is no distinction made nor discussion of this comparative discrepancy in the *Annex Report*. The other two watersheds, which include Chilliwack River and Carnation Creek, have had an overdose of logging activities, especially over the last thirty years, and it is probably unfair to compare what the annual sedimentation loads are because of this. The important question to ask is why are there no comparisons of annual fine sediment production with similar sized coastal watersheds to the Capilano that have had no previous management activities, and are not influenced by the regular production of glacial flour?

To establish relationships on annual suspended sediment loading, both from naturally chronic fine sediment producing areas, and from areas which have been heavily managed through logging, is an illegitimate means to establish a hypothesis about "natural" annual background levels of sediments in terms of "mean annual suspended sediment concentration" (page 2-21) in the Capilano watershed, which is an un-glaciated and previously managed source. Accordingly, the assumption is made that, given the total area of the Capilano watershed, and given the average index from the 8 comparisons, that the corresponding fine sediment load is somewhere between 15 and 30 mg/L (page 2-21). This assumption is used prima facia to support the lower end findings from the comparisons with the Acres AFSY (Annual Fine Sediment Yield) model for the Capilano.

We have no scientific data for suspended sediments in the Capilano prior to logging activities, and this is the most critical data for the concerns in the *Annex Report*. Much like the working hypothesis behind the Jamieson/Elbow experiment to monitor the areas before logging that without previous long term monitoring before management activities there is little confidence in what natural backgrounds may be. Since the GVRD set up its 2 turbidity stations in the Capilano in late 1995, [67] with daily suspended sediment readings far below the mathematical formula established in section 2.5, we still have no confidence in what a "natural" anticipated rate is, because historical logging has significantly upset the landscape. Therefore, there is no apparent local standard with which to compare a managed and an unmanaged source. This is definitely not science, and these shortcomings are not explained in the report.

To properly measure the amount of fine sediment delivery in the Capilano watershed necessitates a long term study over several decades, before, during, and after logging. Such a study would carefully measure turbidity at the mouth of the Capilano River, on all other streams entering the reservoir, and measure sediments carried over the dam and into the distribution system. In order to track the source of these sediments above the Capilano reservoir delta, and the other smaller streams flowing into the

[67] As well, the monitoring excludes tributaries flowing directly into the Capilano Reservoir, a total area of which is estimated at about 13% of the Capilano watershed (page 3-3)

reservoir, a more rigorous approach is needed by installing instruments and monitoring the confluence of all tributaries, sampling up the reaches of those tributaries, and then up the tributaries to the tributaries. To do so would require either a host of automatic stations, or a host of personnel on constant alert. But these things can no longer be known, because of the previous logging in the Capilano watershed. The August 1991 *Final Summary Report* recommended extensive hydrological monitoring in the watersheds, a recommendation which has not been followed until recently, and only partially, as limited but identified funds were always cut from the Water District budget.

3.3 Recalculating fine sediment delivery to the Capilano Reservoir

In order to tackle the issue on the origin and amount of suspended fine sediment transport to the Capilano Reservoir, as it relates to the contentious issue of recent and historical logging in the population's water supply, and the GVRD's previous ongoing opinionated defense that logging activities were not affecting water quality, the Acres Team were instructed to come up with a plan to determine the annual average. The only available avenue to approach such an enormous and speculative undertaking was to devise an estimate through a comparative study of aerial photographs over a thirty year time period (1962-1992). [68]

Aerial photography mappers identified two predominant types of landscape disturbances: landslides and stream channels or stream reaches. Out of the 864 classified "landslides", 100 were identified as unnatural, or logging related. Each of the 864 landslides were then identified and measured as a unit of the whole through map interpretation or by conducting field observations to ground truth a small percentage of the landslide dimensions. [69] There is no information in the *Annex Report* which presents the total volume of material from these logging related landslides, in comparison with the natural landslides, making it impossible to understand the sediment producing relationships between the two in different parts of the watershed. As Dr. Michael Feller points out in his submission to the Scientific Review Panel, this clever oversight purposely clouds the public's perception of the real data:

> The data and fine sediment yield model for Capilano watershed indicate that most (86%) of the fine sediment comes from landslides and that logging has had no influence on the number of landslides. The inference here is that logging has had no influence on the major source of sediment for Capilano reservoir. A simple observation renders this inference incorrect. The observation is that a major landslide into Capilano reservoir in 1995 caused such high suspended sediment levels that the reservoir had to be closed for a number of months. The fine sediment yield from this one landslide amounted to fully 20% of the total fine sediment yield passing through the Capilano Dam in the 10 year period from 1987 through 1996. This landslide was caused by inadequate road drainage in a logged area. If landslides in undisturbed forest produced as much fine sediment in the reservoir as have logging-induced landslides, then Capilano reservoir would have been closed for substantial periods in the last 20 years or so as a result of these landslides in natural forests. This has not been the case. [70]

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[68] The consultants should have extended their comparison to 1996, as the Water District had another batch of aerial photos taken by McElhaney for their GIS system. Had this comparison been extended, it would have included the enormous October 1995 landslide into the reservoir, which shut it down for the next 6 months because of extremely high turbidity readings.

[69] 86 landslides were measured in the Capilano (p. 6-12).

[70] Feller, pp.5-6.

Soil samples were also collected to help the modelers estimate the percentage of fine sediments which may have been released into stream channels from these sites.

After each of these areas were identified, an equation was created for calculating volumes of landslide material (page 6-29) and each polygon related landslide was given a number for percentage of fine sediment production. **It was assumed by the consultants that all of the fine sediment was transported into the reservoir.** [71] After the total volume figure for fine sediments was obtained from the 1962-1992 time period, it was divided by 30 to produce a final tally of 12,825 Mg per year (p.6-36) for Annual Fine Sediment Yield (AFSY) for landslides only. According to the table of summary fine sediment yield totals in Appendix 7A of the *Annex Report*, this calculation constitutes 86% of the annual average total of fine sediments of 14,875 Mg/yr in the Capilano watershed.

Information on the other categories of **stream channel erosion** (at 1,525 Mg/yr, or 10.3%), **road erosion** (374 Mg/yr, or 2.5%), **scar erosion** (70 Mg/yr, or .5%), **gully erosion** (80 Mg/yr, or .5%), and **surface erosion** (2 Mg/yr) are also summarized in the table in appendix 7A from other observations, measurements, and formulas. The *Analysis Report* summarizes these in Figure 5.3.

Question: how confident can we be with most of these estimations? The *Annex Report* suggests that the total figure of 14,875 Mg/yr is 65% too high, as compared with the Capilano Reservoir coring study which estimated the annual average of fine sediments. [72] The *Annex Report* further identifies that the largest error category comes from the landslide estimations. As a result, there was some energy spent in assessing this error in Table 6.13, and the suggestion that the original estimate nevertheless remain unchanged.

Let's look at the assumptions in the landslide analysis, changes to which could drastically reduce the theory that 86% of average annual fine sediments could come from these unnatural and natural sources:

> (a) Regarding soil depth for a landslide or a gulley, 1.5 meters was applied to each as an "average" depth. If this figure is too high as an average, as most of the sites were not measured, particularly at higher elevations far from the road networks, then it miscalculates the percentage volume of fine sediments per landslide;
>
> (b) Regarding the soil characteristics on the percentage of fine sediments in a given location. If there is less fine sediments than assumed, then the final estimation is off;
> (c) Some of the slide scars identified on the aerial photos may be older than 30 years, making it a problem for the criteria of landscape erosion for the thirty year window. These errors "would result in over-estimation of landslide sediment yield" (page 6-18).

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[71] According to both Everett Peterson with the Scientific Review Panel, and Dan Ohlson of Compass Consultants who compiled and edited the Analysis Report, there was a debate between June Ryder of J.M. Ryder and Associates Terrain Analysis Inc., and Ken Rood of Northwest Hydraulics Consultants Ltd. at a regular meeting with their client around June 1998 on this very topic. They debated whether the "assumed delivery ratio of one" for all fine sediments entering the reservoir from the 864 landslides was appropriate, or whether it was much lower, and decided in the end to uphold the highest rate assumption. Is this assumption a matter of time tested experience, or is it a result of what could be more favorable to the client's leanings? There are considerable amount of questions to bring a lot of serious concern to this assumption.

[72] "The reservoir outflow and accumulation measurements indicate that the yield estimate from the sediment model is likely too high." (page 10-7)

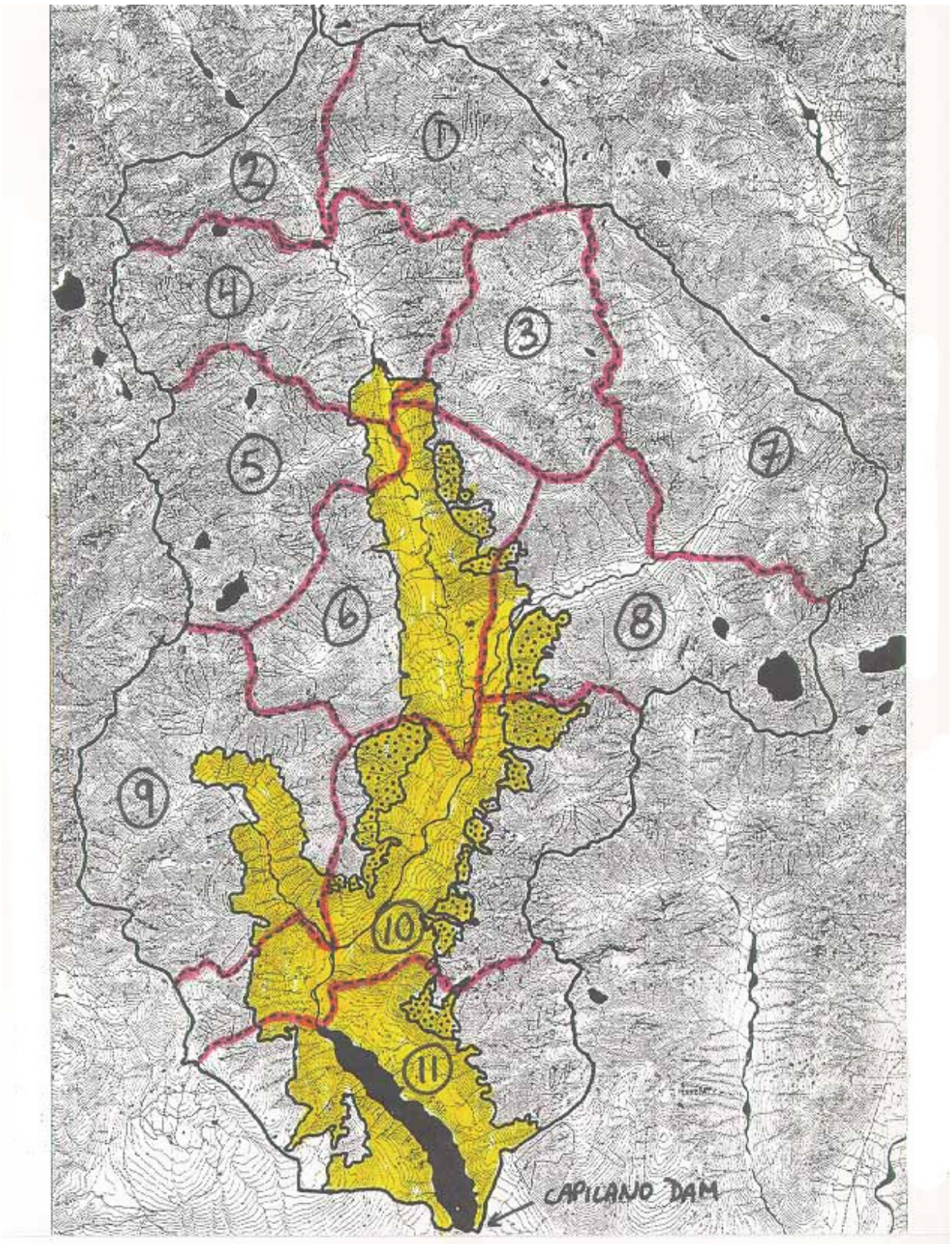
(d) It was assumed that all of the fine sediments at the base of each disturbance area were washed into a stream and then sent directly into the Capilano Reservoir: all of the "fine sediment contained within a landslide is washed from the debris and transported by streams to the reservoir, i.e. that the sediment delivery ratio is 1" (p.6-18). It is this assumption that Acres have recognized may be too high: "although the absolute values obtained should be treated with great caution because they may be unreliable, much more confidence can be placed in the relative values of the sediment yield estimates" (p.6-36). Despite this admission, the Annex report states in Table 6.13 that the sediment delivery ratio should not be changed and lie within .8 to 1 of all sediments delivered to the reservoir. [73] The shortcomings and fallibility of these estimations are only contextualized later on in the report: "It was chosen not to adjust the sediment yield model, as interest lies in the absolute magnitude of the sediment yield rather than in predicting the change in sediment yield under different erosion control options and under natural or anthropogenic disturbances [logging]" (page 10-7).

For argument sake, let us reduce the total estimates of fine suspended sediments from the landslides category by 50% to comfortably accommodate many of these unknown errors. This would reduce the acknowledged high figure of 12,824 Mg/yr down to **6,412 Mg/yr**, and bring us closer to the estimates provided by Church in his coring study. This figure as a percentage of the new total of **8,465 Mg/yr** for the Capilano watershed would then move from a total of 86% down to 76%, and would in turn increase the other percentages: stream channels, 18%; roads, 4.5%; scar and gully erosion, 1.8%.

TABLE 3.1 - COMPANION INFORMATION TO MAP 3.1 FOR CAPILANO MESO-WATERSHED IDENTIFICATION UNITS (See page 45)

Meso-Watershed or Sub-Basin Unit Numbers identified on Map 3.1	Meso-Watershed Name	Meso-Watershed area (ha) Capilano total = 19,520 ha
1	ANDREWS	1260
2	WEST CAP #1	800
3	DANIELS	1300
4	WEST CAP #2	1760
5	ENCHANTMENT	1460
6	WEST CAP #3	1950
7	EAST CAP #1	2020
8	EAST CAP #2	2070
9	SISTERS	2270
10	CAPILANO LOWER	2610
11	CAPILANO RESERVOIR	2020

[73] When the author visited the floodplain of the Daniels Creek area adjacent to the Capilano River on May 11, 1999, to inspect the effects of the road washout and slides from the previous winter, a thick deposit of fine silts and sands were distributed over a very wide area. Such an example indicates that these fine sediments from storm events are not all transported into the reservoir.



MAP 3.1 CAPILANO WATERSHED CONTOUR MAP WITH EARLY LOGGING

CAPILANO TIMBER CO. LOGGING (1918 - 1931)
ESCAPED FIRES - CAPILANO TIMBER CO.
MESO - WATERSHED BOUNDARIES

Keeping this in mind, let us move on to examine two other overlapping considerations that were improperly explained and contextualized in the *Annex Report*, the results of which may significantly shift attention towards previous forest management activities as a liability for long term sediment production:

> (1) where the *Annex Report* identifies that 70% of the average annual Capilano fine sediments delivered to the reservoir are located in the lowest three meso-watershed units: Capilano Reservoir, Sisters, and Capilano Lower units, which together form 35% of the total Capilano lands (page 10-5). [74] This of course means that 30% of the annual fine sediments come from the remaining 65% of upper Capilano watershed lands on the other 8 meso-watersheds; [75]
>
> (2) that there has been virtually no consideration and discussion in the *Annex Report* on the effects that previous logging activities have had on forest hydrology and fine sediment disturbance in these three lower meso-watersheds. [76]

If the boundaries of these three high sediment producing meso-watersheds are examined on the accompanying map (Map 3.1, page 45), information which was combined from the ecological inventory maps on landslide tracks and disturbance regimes, it is apparent that earlier logging and escaped fires by the Capilano Timber Co, and recent roadbuilding and clearcutting by the GVRD, dominate a great proportion of the landscape. [77]

It is evident from both oblique and conventional aerial photographs, and general knowledge about logging, that earlier extensive clearcut logging to the edge and through all stream environments by the Capilano Timber Co. dramatically changed the forest hydrology, destabilizing all stream and river channels, initiating many landslides, processes which have continued to unfold into the present. [78] As a result, many of these areas have destabilized, processes which are still working themselves out while the naturally regenerated forest is slowly getting older. Examine the:

- deep incising of clays along small drainages above the Capilano Reservoir
- the amount of sediments produced near Hurricane Creek beside the logging road
- the extensive riprap project on Sisters Creek
- the October 1995 landslide into the Capilano Reservoir
- debris flows and landslides through second growth forests
- the numerous troublesome and high cutslopes along the Capilano mainline road beside the Capilano River
- and many destabilized stream channel tributaries on both sides of the River.

Logging activities will affect the landscape over the long term, especially in an area that has so many glacial lacustrine and silty clay deposits.

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[74] "Sisters Creek, Capilano Lower and Capilano Reservoir have the greatest contribution from erosion of landslide scars" (page 7-13). The Capilano Reservoir meso-watershed "provides about 36% of the total fine sediment yield to the reservoir" (page 10-5).

[75] See figure 2.4 in the *Annex Report* for a map of the meso-watersheds, table 2F.1 and the appendix table on page 2G-1 for statistics.

[76] See Map 3.1 in this chapter, page 45.

[77] Note. Roads and recent clearcutting are not shown on Map 3.1.

[78] See Will Koop's summary of the Capilano Timber Co.'s practices in his December 1995 report *Not Coming Clean*.

As a result of this logging history, the appropriate question to ask is what proportion of the previously managed landscape in the three meso-watersheds is contributing to fine sediment delivery to the reservoir? Is it more or less than half the total 70% figure? What if it is, for convenience sake, half of that figure, an estimate which is not unrealistic. That means that 35% of the total fine sediments into the Capilano Reservoir from these areas are related to previous logging activities, and there is no clue about these concerns or about the possibilities of these estimations in the report, outside of one or two general tables. [79] In fact, there is no distinction made in the annex report for a breakdown on the specific location and volume of landslides in these and other meso-watersheds, especially as they relate to previous logging areas.

Given this theory, and the corresponding figures, then out of the reduced 6,412 Mg/yr figure for landslides, **4,488 Mg/yr** comes from the 3 meso-watersheds, of which **2,244 Mg/yr**, or 35% of the 6,412 total, is related to previous logging activities. This may suddenly cast a new light on the subject.

But what about the other 8 meso-watersheds, and the 30% total figure for annual suspended sediments? What is the relationship on landslides and previous logging activities for the 1962- 1992 time period in these areas? If we once again assume, for convenience sake, the figure of 50%, then one half of 1,924 Mg/yr is **962 Mg/yr**. If you combine this and the previous theory on logging related activities, then 3,206 Mg/yr, or exactly half of the total annual sediment yield, is related to previous logging activities. If one then combines these figures with the other figures for a total calculation (out of 8,465 Mg/yr), then the fine sediment delivery from "natural" landslides is at 38%, down from 76%. This re-adjustment in the percentage outcomes significantly alters the pie charts and bar graphs in the Analysis Report (Figures 5.1, 5.2).

3.4 The absence of consideration of logging impacts on forest hydrology and the delivery of fine sediments into the Capilano Reservoir, and an underestimation of sediments from roads

One would have thought, given the extensive literature and studies on the subject of forest hydrology, that the repercussions and the associated disturbances to the landscape from logging activities in the Capilano watershed, on a sub-drainage by sub-drainage basis, would have been covered in at least one small sub-section of the *Annex Report*, especially as it relates to increases in peak flow responses and the effects to stream channels. Instead, there are only a few sentences scattered randomly throughout seven chapters in the *Annex Report* on this subject. This should raise alarm bells.

For instance, in section 9 of the *Annex Report*, on discussions about changes over the years to stream channel reaches 4 and 5 on the upper Capilano River, as observed and measured from aerial photographs, it briefly states that the stream channels were altered and eroded as a result of riparian harvesting and road construction (pages 9-16, 9-22). In the *Annex Report* it is understood that this is the result of logging, since old forests tend to maintain stream stability (9- 25). There are only these three brief references on this subject, and no accompanying estimation of volume of material lost in and transported down the Capilano River. According to the Acres model, this is a particularly important subject since stream erosion accounts for about 10% of the total sediment delivery to the reservoir according to their high estimates (or about 18% according to new estimates as explained above).

[79] For instance, in Table 6.5.

Where else has such erosion occurred to stream channels as a result of logging practices, you may want to ask, and why was it not accurately covered in the report, with estimations on erosion rates as a result of logging activities over the same 30 year time frame? If the Acres team was mandated to systematically and rigorously review certain landscape changes over a 30 year period, but overlooked investigating the effects that logging may have had during the same time period, and then contextualizing that in the report, the study appears to be one-sided. This is evidenced in instructions to the Acres Team by the GVRD in its August 1992 request for proposals document:

> **The ecological inventory is not designed specifically to assess the impact of past forest harvesting on water quality within the watersheds.** [80]

To what extent this instruction was enforced is not known, as the public has been kept out of the loop, but it may obviously account for the overwhelming neglect of this subject and proper accounting that previous logging activities have had in the report. Once again, this oversight fits into the ongoing defense over the last 10 years the GVRD has maintained through its watershed administrators, that logging has not impacted water quality.

One of the many assumptions in the *Annex Report* is that the landscape becomes hydrologicly stable after 20 years of forest regeneration following logging. This assumption is worked into the *Annex Report's* model of erosional forces on the landscape, and if it is wrong then it alters the conclusion on the way in which logging affects the landscape over the long term. The basis for this assumption is from the *Forest Practices Code* guidelines which are meant to accommodate the provincial politics of forest industry tree farming, which provide management strategies for "first pass" requirements and frequent rotation of plantation forests.

However, this assumption was recently challenged in findings from a long term study in Oregon, where United States Forest Service and university researchers discovered that forest hydrology rates fully recover to normal rates about 80 years after logging. [81] This study is well recognized among forest hydrologists and has caused a revolution in thinking, as well as great concern from the forest industry because of its implications, yet it is not referenced in the *Annex* bibliography. The exclusion of this report from the *Annex Report* reference section is an indication of serious misconsideration of fundamental research on the long term impacts to stream flow and stream channel characteristics, and once again indicates a biased approach in the ecological inventory project. The findings related to full hydrological recovery rates are based on the growing season, climate, elevation, and latitude in

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[80] Refer to chapter 1.4 for background discussion.

[81] *Peak Flow Responses to Clearcutting and Roads in Small and Large Basins, Western Cascades*, Oregon, by J.A. Jones and G.E. Grant. The study was based on 40 years of data from the Willamette National Forest, and showed that logging and roadbuilding cause long term changes to water flows. When this report was released and subsequently covered in newspapers (Corvallis Gazette-Times, March 9/96; the Oregonian, March 8/96, and April 8/96) it provoked controversy for the forest industry. The study was reviewed in the papers because of the extensive damage to managed forests in the northwest US after a storm in early 1996. "I felt that the conclusions in this study far overreach the data that is presented", said Kate Sullivan, a hydrologist with the timber giant Weyerhaeuser." Weyerhaeuser was especially concerned because of its extremely intensive forest practices and clearcutting all of its lands every 30 to 50 years, causing perpetual stream flow modifications in many locations. The recommendation from the report stated that "Extrapolations of these rates into the future should be tempered by the fact that future management of public land may involve lower rates of cutting and road construction than occurred over the past 50 years". Pressure and challenges from the timber industry and the U.S. Forest Service to modify the conclusions and recommendations in the report have been persistent. A copy of one of the newspaper articles was presented during a delegation to the GVRD Board in 1995 by the present writer.

Oregon. Applications of hydrological recovery rates to British Columbia farther to the north must take into consideration changes to the above mentioned parameters for the growing season and may be adjusted mathematically.

Another dimension of the Oregon report are the long term impacts to the landscape and stream environments from the presence and placement of logging roads. This subject is inadequately discussed in the *Annex Report* and the public is therefore left out of the loop when it comes to understanding what the issues really are in terms of the Water District's proposals to deactivate a number of logging roads, and related concerns about why some logging roads should be maintained.

3.4a. Removal of riparian forest due to recent logging

On the subject of clearcutting to the edge of larger stream channels during the GVRD logging years (1964-1994) in the Capilano, there are a number of other examples of this, all of which were available for inspection by the Acres Team on the same aerial photographs: the lower Eastcap Creek; the upper Hesketh Creek drainage; the Healmond drainage; the Enchantment drainage; the Andrews drainage; and the Lembke drainage. Concerns about these controversial practices were also raised in the August 1991 *Final Summary Report*, and much like the *Annex Report* there was no documentation provided on specific locations or on estimates for total areas. Roots bind and reinforce stream channels, and logging disrupts this protection. When small exposed leave strip buffers beside stream channels blow down from windstorms they can sometimes greatly impact stream channel disruption. What have the consequences of these actions been to the transport of fine sediments to the reservoir? There is no estimation or distinction made for this in the report.

3.4b. Logging to the edge of tributary and ephemeral streams within cutblocks

Within many of the 76 Capilano cutblocks, logging by the Water District has inexplicably occurred right to the edge of both ephemeral and small stream channels both above and below roads that transect the same cutblock. These conditions are transparent in aerial photos where drainage systems are exposed immediately after logging. Because of their exposure within the cutblock, coupled with the loss of root structures to fortify the small banks, these areas become subject to increased water rates and energy, or peak flows, during storm and snow melt events, actions which cause erosion and transport of duff, sediments, and materials. The eroded materials are either transported over the cutslope and into a ditch, or directly into a culvert or cross ditch, or under a bridge, then either through another exposed and logged area directly below, and then down into a major stream channel. There is no accounting or estimation of fine sediment delivery for this in the *Annex Report*.

3.4c. The effects of roads, cutslopes, fillslopes, and ditches on sediment transport and erosion of downslope soils

According to the *Annex Report*, about 2.5% (two point five) of the average annual fine sediments are directly related to road erosion in the Capilano watershed from 1964 to the 1990s. This includes all areas of the road prism, cutslopes, the ditch, road surfaces, and fillslopes. Can we have confidence in the Acres estimation, which seems to be on the low side, given the problems that many roads in mountainous areas usually experience? Absolutely not.

There are no measured records of erosion to the road prism over time on the 118 km of roads in the Capilano, processes which are still active in many areas. There are annual road maintenance log books kept by Watershed Management staff, but there is no reference in the *Annex Report* that these were reviewed for information, or that they may be helpful. There are a number of troublesome locations and historical incidents along road prisms from storms, oversaturation, and gravitational forces on cutslopes which have become particularly problematic due to their uncontrollable and increasing erosional size. There is also continued seasonal pocketing of cutslopes from runoff, especially where cutblocks are situated directly above the road. In some locations, these areas have been rip-rapped (lined with large rocks) to control the erosion, but most are not. Though it is reported that cutslope areas were measured, there are no examples provided on the total volume of material lost on some of these problematic areas. The areas measured and observed were in late summer, when most cutslopes were covered in vegetation from hydroseeding, providing the illusion that erosion is under control. However, during and just after the winter season many of these cutslopes erode or slump, where vegetation is no longer present, and erosional forces at work. [82] It is difficult for a road inspector to understand the total loss of material from a cutslope if he/she have no intimate knowledge of the area over time.

Roads can cause long term problems. They may appear to be relatively stable at one point, and at another cause great damage. One of these problem areas was documented by the present writer to the north of Hurricane Creek at the upper switchback road above the reservoir. The area is well known to watershed management staff and the Acres Team, yet there is no estimation of materials eroded and transported into the Reservoir from this location in the report. The cutslope is about 60 meters in length above the road, and about 30 meters in width at the top. Below the road there is also much erosion extending about 40 meters in length, and about 50 meters in width. In the 1980s this road failed, slumping into the turbulent waters of Hurricane Creek. In all, we can speculate that well over 500 cubic meters of mostly fine sediment have eroded from this area alone over time.

Along the Capilano mainline which runs just above the Capilano River, near the 12 kilometer signpost, there is a long section of myriad cutslopes extending for about one kilometer along the length of the road that has been problematic over the years, despite repeated attempts to fortify them with hydroseeding and a few areas with rebar. This fine and highly erodible material is directly transported into the Capilano River. There is no estimation of lost and transported material from this area in the report. It was noted by the author in recent repeated visits to this area, that a large amount of fine material failed over the winter on one of these cutslopes that was more than 60 meters in length and about 10 meters in width, filling and blocking a culvert, with water redirected over the road surface and into the River.

On May 11, 1999, the writer also visited a road failure site in the Daniels Creek area. Approximately 14 culverts were either blocked or dysfunctional on two long sections of the same road immediately below the intersection of Daniels 100 and 200 branches, extending over an area of 1.3 kilometers of road. Damage to the road prism was extensive. It was evident that water flows wandered over the road width at different points eroding the road surface, sometimes leaving the road abruptly and eroding the fill slope and steep slopes into Daniels Creek. The mouth of Daniels Creek was also inspected. It was noted that the Creek spilled its banks in many areas, and that an extensive volume of fine silt and sand were dispersed throughout the forest surface area, with no estimated measurements. It can be safely assumed that hundreds of cubic meters of material were eroded from the road prism and from areas below the road.

[82] These were noted during field trips to the Capilano in April and May 1999.

How many and what type of failures associated with roads have there been in the Capilano over the last 30 odd years, and what have been the consequences on the release of fine and coarse materials into stream channels? We have no records of this, and had it not been for the allowance by elected GVRD officials for a member of the public to enter the watersheds, the public may not have known about the damage in the Daniels Creek area. This example, though perhaps unordinary, and the others presented above, puts into question the average annual figures on the discharge of fine sediments from roads into the Capilano River.

3.4d. The 1997-1998 Seymour watershed road monitoring experiment

It was only at the last moment of the ecological inventory project at the end of 1996 that GVRD staff directed the consultants to conduct a road sedimentation experiment to estimate the amount of fine sediment produced from logging roads in the watersheds. Out of the three watersheds, the Seymour watershed was selected for two experiment locations. The mid-valley location was on a gentle slope on the mainline road, while the second location was farther to the north on a steeper secondary branch logging road along the upper western section of the Balfour drainage. The greater producer of sediment of the two sites is the Balfour site, as there is a much larger silty/clay cutslope beside the ditch, and there is more erosion of the road surface because of the steeper incline. Once again, this component of the ecological inventory project was initiated without public knowledge until the release of the November 1997 *Methodology Report*.

The results of the study, which was conducted over a period of 18 months, showed for the Balfour site that there was 7.8 times more sediment produced from rain-fall caused surface erosion per kilometer than from combined ditch and cutslope erosion, and 55.6 times more per kilometer at the mid-valley station. [83] The implications from these short term and selective experiments are that surface road sediments are more problematic in the watersheds than sediments from cutslopes and ditches, an implication that some familiar with steep mountainous roads in silty sources would find a little hard to swallow. Because the two Seymour stations seem to be the only experimental road sites in British Columbian history, an indication of the wide gap in our knowledge about B.C. coastal logging roads, the consultants infer that "they represent a major step in constructing an accurate sediment yield model". [84] Can we be confident with their conclusion? Most likely not, for at least six reasons.

> (i) The western Balfour logging road branch was completed in 1988. This means that there are about 10 years of missing data on the production of fine sediments from this site. The mid-valley site logging road was built in the 1960s. There is a lot of missing data from this site as well.
>
> (ii) When the plywood weir and sediment monitoring station was placed in the Balfour ditch, a cutslope failure brought buckets of mud into the box before monitoring began. This material was not recorded. Immediately after this incident the cutslope was hydroseeded, which prevented fine materials from eroding into the ditch throughout the experiment. There are many locations in the watersheds, particularly in the Capilano, where there is either no hydroseeding, or that hydroseeding is ineffective in controlling fine sediment erosion. Therefore, there should have been two ditch experiments, one with hydroseeding, another without.

[83] Page 8-10 of the *Annex Report*. Balfour: 4.809 and 0.617 Mg; mid-valley station: 0.612 and 0.011 Mg.
[84] Page 8-2, *Annex Report*.

(iii) During the Balfour road surface experiment, a road maintenance contractor removed fine sediments near a culvert and spread the highly erodable material over the road surface. According to GVRD watershed maintenance standards, this practice is not allowed. Site managers of the experiment were alarmed that the contractor did this, because it compromised their experiment. Nevertheless, the material erosion from this incident was incorporated into the data, the total material of which amounts to about half of the fine sediment results. [85] This would reduce the figure of 7.9 times more sediment from roads to the ditch down to about 3.8 times.

(iv) The mid-valley road surface station did not collect all of the road surface sediments, due to the curvature of the road surface. Instrumentation on the collection of this escaped sediment data was not constructed.

(v) The reliability of data. Most of the time no one is actually babysitting these sites, where managers rely on electronics to collect the information. This becomes problematic when solar panels are covered in snow, when batteries die, and when the instruments themselves are ineffective due to algae growth, when they are covered in debris, or fail from freezing conditions. When the snow pack is high and thick during winter conditions, there is no access to the site. The snow pack state changes during the early winter months, when melting conditions are erratic. These problems compromise the data collection project because researchers may be missing critical data.

(vi) The experiment overlooks the effects of erosion to areas immediately below culverts, where artificially diverted rushing waters collected in the ditch can erode downslope landscapes.

Finally, the GVRD could easily have instructed the consultants to monitor known problematic turbidity-generating road cutslope locations in the Capilano watershed over a short periods of time, in order to estimate some other conclusions. Why this was not done is inexcusable, and does not help the public to understand some of the real concerns in some locations in the Capilano watershed.

3.4e. The increase in peak flows and stream channel instability as a result of clearcut logging and roadbuilding

The most important consideration about the combined extent and area of roads and cutblocks in the various sub-drainages, or meso-watershed divisions, are the effects that these have had on the forest hydrology, the increase in peak flows to each affected stream. These changes are responsible for initiating domino effects, dislodging large boulders which may be fortifying a stream channel, in moving debris and materials that were stored in some location near or in the stream channel.

Matters can sometimes become extremely complicated with debris flows resulting from roads and cutblocks. When masses of debris cascade down a steep slope, or down an existing drainage system, they scour out materials along the way. When these materials converge with a larger stream channel, they can cause a momentary disruption to the flow, either building up water volumes behind it like a dam, or sending it around the deposited mass, causing the bank to erode. Sometimes these materials are sent downstream at great speeds, causing damage to stream banks, which dislodge even more materials.

[85] Communication with Northwest Hydraulic Consultants staff.

The November 1990 cutblock failure in the Seymour watershed Jamieson drainage is a classic example of this. Depending on the rate of logging and roadbuilding, changes can be quite subtle for long periods of time. If there is enough disruption in tributary branches to the Capilano River, and if a sudden and large storm event occurs, where materials and increased runoff from each main tributary valley converge with the main river channel, the results can be quite destructive and complicated. Fine sediments disturbed in cutblocks, from roads, from new streams as a result of culverting, from channel erosion due to sudden peak flows, are all sent down the River, most of which arrive in the reservoir. The amount of these sediments have never been measured, nor can they be properly understood through air photo interpretation.

A great concern about logging in a given watershed is the long term damage to stream channels, which is casually mentioned in the *Annex Report* in chapter nine:

> Disturbance refers to losses of forest cover that increase peak flows (or coarse sediment yield), and cause channel widening or rapid bank erosion. (P.9-13)
>
> Shifting rates may respond more to disturbance in the upper watershed, such as increased peak flows, due to removal of forest, increased coarse sediment supply, or the effects of a very large flood. (P.9-22)

When the soil from a stream channel is removed, which may have been there for thousands of years, it may never be replaced. As stream channels become wider, depending upon the terrain, water depth decreases, current flows are dispersed and become erratic, especially with the new addition of boulders which have worked their way down the stream channel. As this happens, logs may become jammed on these boulder beds more often, displacing water flows in other directions. As banks collapse, trees fall down, sometimes sending water flows towards the bank, causing more erosion. When the system is upset, things are set in motion, as it were, for many decades. There are hundreds examples of this in B.C., and the upper Lynn Creek area, north of the Lynn Creek Headwaters Park entrance, is another example of this.

There is no estimate made in Chapter 9 of the *Annex Report* on what percentage of the total 1,525 Mg/yr for stream channels may be related to logging activities. Let's provide our own estimate of 75%, a figure which is quite reasonable. That means that an annual average of **1144 Mg/yr** over the thirty year time period is related to logging activities. The other concern is that the 1,525 Mg/yr figure could be on the low side, given the extreme variables and difficulty for that assessment. If the 1,525 figure is actually greater, then the annual fine sediment yield percentage figure for landslides becomes lower.

3.5 The deposition of organic and coarser materials in the Capilano Reservoir, and the effects of reservoir drawdown

The ecological inventory process avoided estimating and calculating the annual deposition and rate of organic and coarser materials in the Capilano and Seymour Reservoir headwaters, or river deltas. At some point a decision was undoubtedly made to withhold an investigation of these findings as it could have the potential to uncover important information related to forest management activities and their impact upon reservoir dynamics, including the calculated loss of reservoir storage area. For instance, watershed management staff are aware of many episodes related to logging activities in the lower Capilano River area which have eroded and transported many coarse materials into the Capilano River delta.

In April of 1995, SPEC had requested the GVRD's Water Committee to allow a professional reservoir limnologist of their own choosing to conduct a coring experiment in the watershed reservoirs, in order to analyze the sedimentation rates over the years. SPEC was denied this request. In fact, the 1994 *Limnotek* report, which was not referenced in the *Annex Report*, had also recommended the GVRD to obtain core samples of both its delta and reservoir bottom zones, as well as setting up reservoir sediment traps. [86] Though SPEC showed great concern about retrieving these results, the Water District did not inform SPEC nor the public about its watershed coring project in 1996. Much to SPEC's surprise, this project was eventually discovered after the release of the November 1997 *Methodology Report*. Had the GVRD notified the public of its intention, much like everything else related to the ecological inventory, then members of the public may have provided some input on the scope and terms of reference for the project, particularly in measuring the Capilano and Seymour River deltas.

It is well known that logging is related to increases in deposition rates, especially during storm events in late Fall and Winter. Deltas can be likened to smoking guns, as deposition rates are, to use another analogy, like fingerprints, responding to environmental disturbances. A summary of these concerns were related to the Scientific Review Panel in July 1997. [87]

This was, for example, the case in Portland's Bull Run impoundment. When the reservoir was drawn down on one occasion in the 1980s, a limnologist took a careful look at the exposed and enormous delta. The amount of vertical and lateral erosion of the river down-cutting the unconsolidated and non-compacted materials which had previously been unexposed and intact was observed. During high water, materials conveyed down the river are immediately deposited in the quiescent waters, because the river loses its energy and drops its load, with finer materials sent farther down the reservoir. With the draw down, the river energy conveyed the downcut material farther into the reservoir, and fine sediments were suspended causing turbidity. In the vertical exposures of the downcut delta, annual deposition rates were analyzed and an association made with a storm event in 1964 which caused the release of a very thick deposit of materials related to logging activities. In fact, there was a dramatic increase in deposition rates from 1964 to 1970. Because of concerns about logging in the Bull Run watershed, and its impact on the public's water supply, a reservoir study was initiated in 1994 and it was found that about 90% of the reservoir material loading was situated in the delta area. Because of problems associated with the volume of material and the release of fine suspended sediments which have accumulated on top of and in the delta, the City of Portland's Bull Run Water Bureau has placed a limit on the draw down level for its impoundment. Forest management activities impact and increase the rate of deposition in a watershed. Studies of reservoir delta dynamics is a fundamental geomorphological procedure in any concern about water quality in a municipal impoundment or any other impoundment.

The physical principles and related effects of reservoir drawdown are well known in the field of reservoir management. For instance, in a recent article in the *Journal of Lake and Reservoir Management*, there is a report on the *Effects of Reservoir Drawdown on Resuspension of Deltaic Sediments in Lake Powell.* [88] It was found that over a period of 20 years, during fill up time, that 3.2% of the reservoir storage volume was lost to sediment accumulation. During a prolonged period of drought in this extensive reservoir system in southern Utah, the reservoir drew down about 29 meters below high pool line:

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[86] *Limnotek* report, section 9.0, Recommendations, page 64.

[87] *Comments on the Scientific Review Panel's Draft Report, "Protecting Vancouver's Water", and Related Matters*, by Will Koop, July 7, 1997, pages 11-13.

[88] 13(1): 67-78, 1997.

> Lake Powell's low level of February 1993 exposed over 100 combined channel kilometers in its three major tributaries, the Colorado, San Juan, and Escalante Rivers, which had previously been inundated. In the Colorado River, over 50 channel kilometers of deltaic deposits were exposed....Throughout the drawdown period, the Colorado River progressively cut through its sediment delta. In this process, the deltaic sediment was eroded, reworked, and deposited further downstream in the reservoir. This resuspension process exposed sediments which had been buried up to twenty years.... The objective of this study was to determine the amount of sediment and associated substances being released into the water column as a result of reservoir drawdown and the persistence of these substances as suspended and dissolved components further into the reservoir.
>
> During the drought years from 1987 to 1993, lake levels steadily decreased, and extensive banks of alluvial sediment were exposed along canyon margins. The pattern of this exposure consists first of downward incision of the river channel through these sediments, then lateral erosion and calving as the channel meanders back and forth within the confines of the canyon walls. Observation during recent years has revealed continual lateral cutting of these deposits.... In some cases the height of these cutbanks approaches 20 meters.... In downstream portions of the canyon, sand banks have been completely removed and channel margin deposits of fine sediments occur as mud flats." [89]

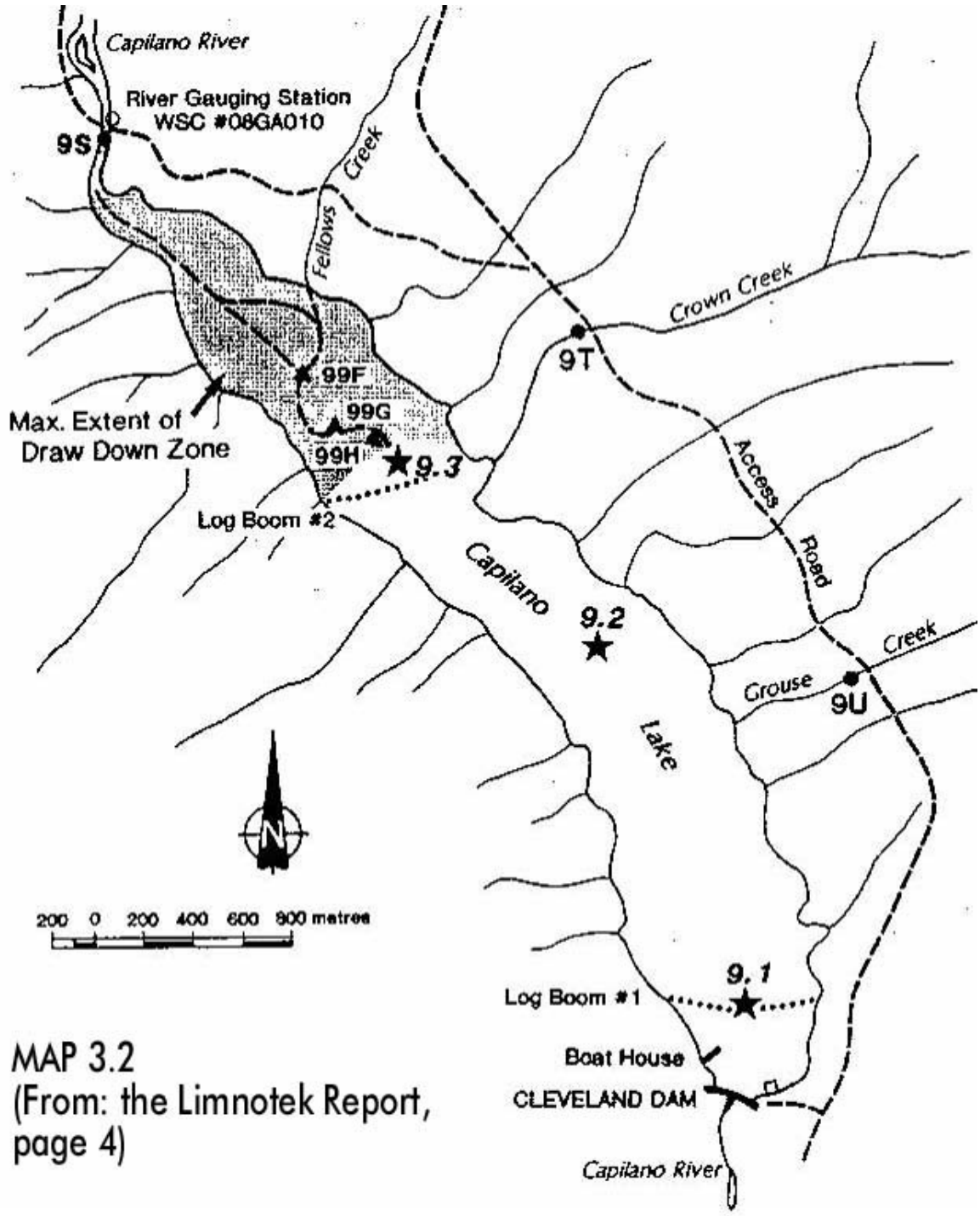
Concerns about these effects are well understood among professional engineers and hydrologists. The concern of course about the Greater Vancouver watersheds, and other reservoirs in B.C. that produce hydro power over the long term, are how logging activities actually increase deposition rates, and how deltas impact fine sediment delivery and life expectancy of the reservoir itself.

When Gilbert and Church were requested to conduct acoustic soundings in the Capilano and Seymour Reservoirs, they were not asked by the GVRD's ecological inventory Project Manager to provide readings of the delta areas, readings which could have been quickly and easily accomplished, and would have provided the GVRD with a proper estimation of total volume and area with comparisons to other municipal impoundments. A proper estimation of the Capilano delta can still be conducted through the same procedure for a cost under $10,000 in a relatively short period of time. [90] This information is not only relevant to the ecological inventory, but to our fundamental understanding of the reservoir itself, and should still be conducted.

During an extreme drawdown of the reservoir for a seismic upgrade of the Capilano dam in February 1992, Thurber Engineering were able to visually inspect the delta area and produced a rough estimate of the total volume of material. [91] However, the results of this estimate were not incorporated in the 1993 *Thurber Report* to the GVRD, but in an unpublicized 1994 GVRD report by Limnotek Research and Development Inc.:

> Within the two weeks required for total drawdown, a large zone of organic and inorganic deltaic material at the north end of Capilano Lake became exposed. The amount of this material has been roughly estimated to be 500,000 cubic meters (R. Gerath, Thurber Engineering Ltd. Pers. Comm.) which if correct, suggests that the annual average particulate deposition rate from the Capilano River into the north end of Capilano Lake is just over 13,000 cu.meters/yr. With this material exposed, the Capilano River eroded a path that roughly

[89] Ibid., pages 68-71.
[90] Michael Church, personal communication.
[91] It is not known how the volume was estimated, implying that the figure may be unreliable.



"Capilano Reservoir showing road access routes, drainage streams, location of the Cleveland Dam and the three lake sampling sites. During drawdown in February, 1992 the Capilan River within the draw-down zone was monitored at sites beginning with "99". "

MAP 3.2 - CAPILANO RESERVOIR 1992 DRAWDOWN SHOWING EXPOSED DELTA ZONE – LIMNOTEK REPORT

TABLE 3.2 - CAPILANO RESERVOIR SIGNIFICANT AND MINOR DRAW-DOWNS PRIOR TO 1992 (information from the Greater Vancouver Water District)

Year	Extreme draw-downs (feet)	Minor draw-downs (feet)
Late 1956	50	
1961/1962 (Winter)	65	
1962/1963 (Winter)	90	
1963/1964		30
Early 1965	90	
Early 1966	90	
Early 1967	90	
Early 1968		25
September 1978		25
1979 (Fall)		30

> conformed to the original river channel before impoundment (Gerath and Smith, 1993). Sediment and other debris that had accumulated in this path since any previous exposure was resuspended, a process that continued for about four weeks; the time required for water flow to cut a path to cobble and boulder substrata that formed the original river channel. Field visits confirmed that the river cut a channel up to 2.5m deep through the deposited material. [92]

The *Limnotek* report is a particularly significant study, because:

> This project was the first in the GVWD to collect data directly from the lakes [reservoirs] (rather than the dam wall) to introduce a preliminary understanding of sediment water interactions. It also integrated some processes in the rivers with those in the lakes. This approach was essential to begin a process of differentiating processes upstream of the lakes from those within the lakes, which is required to understand the cause and effect relationships and manage water quality over the long term. To continue this process, we strongly recommend that a lake and stream monitoring program be maintained by the GVWD. Monitoring data will prove valuable for interpreting unexpected events, providing a baseline to be used for trend analysis, separating sources of turbidity, and interpreting chemical interactions that are essential in recommending procedures that are necessary to maintain high water quality. [93]

The extent of the exposed area during the reservoir drawdown is shown on Map 3.2. [94] Along with the description of the delta erosion, the *Limnotek* report summarized other related problems to chemical alterations and concentrations in water quality:

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[92] *Limnology and Remedial Measures for Taste and Odour Problems in Capilano and Seymour Reservoirs*, Limnotek Research and Development Inc., submitted to the GVWD April 22, 1994, p.34. Limnotek was retained by the GVWD in October 1991 to conduct the study. It is odd that this report was not referenced in the *Annex Report*, especially since the ecological inventory project manager Tom Griffing reviewed the final draft report.

[93] Limnotek report, pages 65-66.

[94] Ibid., map from page four of the *Limnotek* report.

> Effects of erosion of the deltaic zone on iron and ammonia concentrations in the river were striking. Ammonia and dissolved and particulate iron were up to two orders of magnitude higher at the downstream end of the drawdown zone than concentrations upstream. The effect continued from February 26, when the sampling started, through the third week of April, a month past the time when the original substrata was exposed in the river channel. Without physical disturbance of sediments, most of the ammonia would have been trapped in interstitial spaces of the particulate material and mostly immobilized.
>
> Accompanying the ammonia and iron mobilization, turbidity increased several fold over background levels. At a depth of 50m, turbidity levels reached more than 50 NTU. Like the isopleths for iron and ammonia, a turbidity density current was also apparent close to the lake bottom. [95]

The deposition and increase of organic materials related to logging activities should also be a concern to managers at the GVRD, as they can mask bacteria and pathogens. When organics enter the distribution system more chlorine must be added to combat these problems.

The Capilano Reservoir has been drawn down to similar extremes on previous occasions in the late 1950s and 1960s, when erosion of the delta also occurred. These are instances not mentioned in the *Annex* or the *Limnotek* reports. [96] According to the Water District, there were 6 extreme draw-downs of the reservoir between 1956 and 1967, and four minor draw-downs between 1963 and 1979, as shown in Table 3.2 above.

The materials which were down cut at the delta by the Capilano River in 1992 were those that had been deposited since 1967, after the last extreme drawdown event. The erosional effects to the deltas since 1955 have changed the sedimentation dynamics and displacement of fine sediments and organic materials farther into the Capilano reservoir, a subject which is improperly discussed in the coring chapter of the *Annex Report*. The continual erosion of the delta area complicates the findings about the origin and annual fine material deposition rate.

In September to October 1995, I asked engineers at the Water District if I could view the photographs of the Capilano delta area taken by their Limnotek consultants during the 1992 drawdown. The Water District replied that I was not permitted to look at them because they were not part of the report, and that the attached photographs in the 1993 *Thurber* report were all that I needed to see. My concerns were that public monies were spent on obtaining information that the Water District was refusing a member of the public to review, and that I wondered why staff may have been protective of this information.

Because of the above-mentioned concerns, of which GVRD have been cognizant of for decades, we find it particularly disconcerting that no study of the delta areas were conducted during the ecological inventory. Perhaps someone didn't want to open up that can of worms.

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[95] Ibid., pages 35, 38.

[96] Related no doubt to not asking Water District engineers enough questions.

3.6 Automatic turbidity monitoring stations in the Capilano watershed

As the result of recommendations from the 1991 review of watershed management to immediately install turbidity monitoring stations in the watersheds, and the ongoing public concern to counteract administrative reluctance to enforce those recommendations, two stations were eventually established by the GVRD beside Capilano River in the late summer of 1995. [97] The stations are located on the east side of the Capilano mainline bridge just north of the reservoir (Capilano Lake Head station), and another just north of the confluence of Eastcap Creek on the east side of the River (Capilano Mid-Valley station), with a separation of some 7 kilometers of free flowing river between stations. The stations which sample turbidity every 15 minutes, 24 hours a day, also record data on stream flows, stream levels, and water temperature. The stations are monitored through a contract with Environment Canada related to their expertise in maintaining equipment, measuring water levels, flow, and fine sediment. It is extremely unfortunate that the units were not installed at the end of 1991, as recommended. As a result, the GVRD will not have understood the relationships of turbidity and streamflow dynamics over time in the 1990s on the Capilano River, information which could have demonstrated a number of things, amongst which that annual average turbidity readings may be diminishing after the cessation of logging in the early 1990s.

However, aside from the problems of obtaining reliable information from the automatic monitoring units, there are a number of shortcomings for monitoring turbidity sources and water flows above the Capilano Reservoir with only two stations.

- (1.) There should have been a station placed just north of the confluence of Sisters Creek on the Capilano River for two reasons: Sisters Creek is a relatively large sub-drainage, and has a reputation as a major source of turbidity over the years, especially since the early 1980s.
- (2.) There should also have been a station established either at the bottom of the Eastcap Creek, or just below the confluence of it with the Capilano River. The Eastcap represents 20% of the entire Capilano watershed, and has been the focus of much roadbuilding and logging since the late 1960s.
- (3.) There should have been another station on the Capilano River above the confluence of Hesketh Creek.

Had all of these stations been established, the GVRD would have been able to make better short term conclusions and analyses of fine sediment transport origin than the highly questionable theories about fine sediment production in the Annex report.

For instance, turbidity and flow readings from August 3 to 12, 1998. The mid-valley station records an ntu (nephelometric turbidity unit) value of about 2.0 on a consistent basis until it jumps to 7.0 and even up to 16.0 at one brief point in the morning of August 6, and back to 2.0 ntu's at 7 pm that same evening. However, at the lower station, there are quite high erratic readings ranging from levels above 5.0 ntu's to over 90 ntu's. On August 3, at 1:15 am, levels are at 11.3 ntu's, and by August 5 they level out at 7.5 ntu's. By August 8 levels are at 8.0 ntu's, and on August 11, at 11:30 pm, levels jump

[97] This despite an earlier suggestion, for instance, by the Ministry of Forests to immediately set up 12 automatic monitoring stations. "There are several approaches that can be taken to monitor water quality in the Greater Vancouver Water District watersheds; each represents a different level of funding. The recommendations included in Appendix A "Water Quality Monitoring in the GVWD Watersheds" will cost $1,000,000 to initiate and $300,000 annually to operate. Almost all of these costs are related to equipment purchase and the installation and operation of twelve continuous fixed monitoring stations (four stations per watershed)." Ministry of Forests Regional Manager Ken Ingram to Water District Commissioner Ben Marr, January 23, 1992.

to 30 ntu's. On August 12, at 12:15 am, levels suddenly jump to 115.5 ntu's, and by 3:30 am levels drop back below 5 ntu's. By 8:45 am levels are below 1.0 ntu. What happened here? Where is the source of turbidity between the two stations? What is the turbidity in the reservoir? Did anyone go out into the field to monitor the problem, and was it recorded?

Another example. On October 2, 1998, the mid-valley station went up to 5.1 ntu's at 4 pm. By 5:15 am on October 3, readings went up to 6.0 ntu's; by 7:30 am to 7.2 ntu's; by 9:30 am to 8.4 ntus's; by 10:15 to 9.1 ntu's; by 11:30 am to 10.1 ntu's; by 1 pm to 12.1 ntu's; by 1:45 pm to 13.0 ntu's; and by 6:45 to 34.6 ntu's. By 4:15 am on October 4, readings began to decline below 20 ntu's, and by 3:30 pm on October 5, levels were below 2.0 ntu's. During this entire time, levels at the lower station remained around 2.0 ntu's. The turbidity monitored at the upper station didn't seem to affect the lower station at all. Why not? Where did the sediments go? Where did they come from? Can we be confident in the measurements and the sampling unit?

Another example. There were a series of storms in late 1998, one or many resulting in serious erosion of the road network in the Daniels Creek drainage. During one of these storms, from December 12 to 13, at 6:45 am on December 12, the lower station started to measure over 5 ntu's, while mid-valley was at 2.4 ntu's. By 7:45 am the lower station was over 10 ntu's and mid- valley at 3.1 ntu's. By 1:30 pm the lower station was at 44.9 ntu's, and mid-valley at 7.3 ntu's. At 5:30 pm, the lower station was at 33.1 ntu's, and the mid-valley jumped to 77.3 ntu's. On December 13 at 2 am, the lower station was at 90.2 ntu's and the mid-valley at 103 ntu's. By 2:30 pm the lower station was below 10 ntu's as well as mid-valley. By 8:15 pm, both stations were running below 5 ntu's. For a period of time the lower station was reading a lot of turbidity before the mid-valley station got lively. Where was the source of that turbidity coming from? Were the roads drivable, and was anyone taking samples of the tributaries?

Despite these drawbacks, these two stations are still relatively important and can determine relationships on a limited basis, so long as we remain conscious of all the influential parameters, one of which includes reliability of the monitoring units themselves.

More importantly, we can determine what the effects of river energy, turbidity from the Capilano River, and reservoir levels have on dynamics of fine sediments in the reservoir itself. Despite the fact that the Acres Team had access to over two years of this information from Water District staff, and aside from modeling of turbidity events in the reservoir by Environment Canada, there is no description of these relationships and dynamics in the *Annex Report*. It is important that the results of these relationships, given their limitations, are presented in an easily understood and meaningful way to the public. The GVRD could have instructed members of the Acres Team to simply look at a two or three month window of comparative data for turbidity from all five stations, [98] along with stream flow characteristics, and reservoir levels. They could have come up with a simple descriptive narrative on the relationships of the combined readings, and provided some kind of analysis. The ecological inventory project manager could also have requested staff to be on alert out in the field to take these measurements for the inventory process over the years.

[98] There are two automatic turbidity monitoring stations in the Capilano Reservoir, each with two monitors at different depths. According to staff, these stations are somewhat unreliable, and staff take physical samples at these sites to test the readings. There is another station at the Capilano intake, which takes continuous readings which are automatically sent to the central monitoring station in northeastern Burnaby.

3.7 Options A and B: what are the repercussions from future logging proposals?

There are three primary assumptions from the ecological inventory *Annex Report* which make it appear as if the logging proposals under option A and B would have relatively small impacts on fine sediment production. The first assumption is that the consequences from logging activities on the release of very fine sediments are insignificant when compared with the overall annual fine sediment budget. The second is that, based on the *Forest Practices Code*, it takes about 20 years for full recovery of the forest hydrology following logging. The third, from the Environment Canada study, the assumption that small turbidity events are not registered at the Capilano intake.

Regarding the first assumption. Both in this chapter and in chapter 4, we have explored how the consultants' estimates for the annual average total fine sediments are both too high and mostly likely not constant. When the consultants' estimate is reduced by 2.3 times from explanations provided in chapter 4, then the assumed comparative repercussions from logging activities takes a more dramatic rise. This is particularly the case for the proposed intensive selection logging under options A and B in an area that is specifically identified by the consultants as the most sensitive to the availability and release of fine sediments, that is within the three lowest Capilano meso-watersheds.

Regarding the second assumption, the greatest concern the Water District should have is that, according to the 1995 Oregon study, the natural forest hydrological recovery rate is not at 20 years but at 80 years, and has just returned to full recovery in areas previously logged by the Capilano Timber Company (1918-1931), except some of those areas which have been influenced by surface and sub-surface water diversions from more recent road construction. Under option A, over the next 20 years, the proposal is to log on 4000 hectares. There is no assessment of the type of logging that is scheduled, and we can assume that the Water District would most likely conduct a 50% or more "thinning" of old and second growth forests. This means that the equivalent of about 2000 hectares of forest would be removed under option A, which is twice as much logging that the Water District conducted in the Capilano since the 1960s. The impact of more logging in an area that has just become hydrologically stabilized could have significant repercussions on the release of fine sediments, as they relate to the soils, topography, existing road structures from future storm and rain-on-snow events. The thinning of existing second growth forests in the lower three meso-watersheds, in terms of visual quality impacts, are presented in *Visual Quality Analysis of Silviculture Treatment Options in the Capilano Watershed* by Resource Design Inc. Many of the thinning limits in identified visual quality areas are around 40%, and forests outside of these identified areas have more intense thinning proposals.

The third assumption from the Environment Canada report on fine sediment transport through the Capilano reservoir is that low turbidity events arriving at the reservoir delta area are inconsequential, as they do not reach the intake some 5 kilometers distant. What is not explained, and not understood, is how currents in the reservoir transport fine sediment concentrations in colloidal suspension from the delta to the intake. For instance, Environment Canada presents us with elapsed time visuals for turbidity events on CDROM from a bird's eye view, but does not present us with time lapse conditions on a cross-profile of the reservoir bathymetry as it relates to different current flows from the delta area and the transport of sediments to the spillway area. This is because Environment Canada acknowledges that they have no data on current flow, flow rates which can vary up to 133 times from the junction of the Capilano River into the delta area: [99]

[99] Environment Canada report, page 48: "The magnitude of inflow from the Capilano River is highly dependent on precipitation; the inflow can range from 3 m3/s during a dry period to 400 m3/s during a large storm."

> Water velocity data for locations within the Capilano Reservoir were not available. Water velocities are not required for the hydrodynamic calculations, but are useful for evaluating model results. (P.56)
> Due to the absence of velocity measurements, sediment travel times were obtained from the sediment model and compared against the timing of measured turbidity peaks at Cleveland Dam. (P.58)
> The hydrodynamic model could be improved with the availability of more field data. Data that could be useful would include: velocity measurements taken through the depth and at key locations in the reservoir under a variety of conditions; the travel location and timing of velocity drogues placed in the reservoir. (p.75)

Oddly enough, the Environment Canada report, in which the Canadian Hydraulics Center participated in specifically providing modeling for the transport of sediments through the reservoir to the intake, acknowledges the importance of current flow in arriving at those conclusions:

> Knowledge of how flow through the reservoir affects the distribution of turbidity in time and space is required to provide estimates of how changes in sediment delivery at the upstream end of the reservoir impact water quality as measured at the water supply intake. (P.45)

The implications of relying completely on modeling assumptions, and in not directly understanding the real dynamics of flow regimes within the Capilano reservoir profile, are inappropriate when it comes to conclusions about the public's drinking supply and long term management considerations. The same can be said about making assumptions from modeling on the release of fine sediments as opposed to understanding the reality behind the events which triggered the 1995 landslide into the Capilano Reservoir and its association with the inappropriate management of old logging roads (Feller).

CHAPTER 4

THE CAPILANO RESERVOIR STUDY – UNEARTHING THE FINE SEDIMENT THEORY

4.1 - THE NEGLECT OF CITING RELEVANT LITERATURE

There is no literature review in chapter 3 of the Annex report with regard to coring analyses conducted in other reservoirs. This is most peculiar because of the important instructional literature on this subject. For instance, a relevant study was conducted in Portland's Bull Run drinking-water reservoir by Portland University's Geology Department, an intensive study which predated the initiation of the Greater Vancouver coring project by one year. [100] There are a number of interesting findings and recommendations from that study which could have helped the Water District direct its study on the three reservoirs. In contrast to information presented in the GVRD's report, there is information presented on: the delta for Bull Run reservoir #1; on the limitations that wave action has on producing fine sediments; the annual deposition rate; reservoir current characteristics; and recommendations for future studies to fine tune reservoir knowledge and characteristics. The following are some of these findings:

> These data show a nearly four-fold increase in sedimentation rate (by mass) in Reservoir No.1 between 1964 and 1972. Two possible causes for this increase are:
> (a) the 1964 flood could have destabilized portions of the watershed for some period of time, causing a higher sediment yield to persist for a number of years.
> (b) the 1964-1972 period coincides with the peak of road construction activity in Bull Run, and with an increase in logging activity. These activities were minimal or absent during the pre-1964 period. (p.4)
>
> The 1964 flood and the 1972 North Fork slide each produced about 17 times the normal annual sediment supply to Reservoir No.1. Together the two events contributed about 28% (by mass) of the total sediment accumulation. (p.5)
>
> The thickest sediment deposits are located at the upper (east) end of the reservoir, where they are deposited in deltas downstream of the mouths of Bull Run River Mainstem, Fir Creek, and North Fork tributaries. Deposit thickness can vary greatly in this area, exhibiting as much as a 10-fold change within a few hundred meters. (p.2)
>
> Observations by divers indicate that the main channel of the reservoir (axial valley) is subject to sediment movement and sorting by bottom currents. This conclusion is drawn from the presence of ripples in the sandy silt deposits at the bottom of the central valley about 1 km east of the dam, and from the presence of a bottom current estimated to be about 25 cm/sec (0.8 ft/sec) at this location during low discharge conditions. (p.3)
>
> The sustained high-turbidity levels during late fall and early winter months in Reservoir #1 argue against reservoir turbidity increases from wind-wave erosion or rain sheet-wash erosion of reservoir side banks. Most of the side bank area is exposed to subaerial erosion processes

[100] *Sediment Deposition in Reservoir No.1, Bull Run Watershed*, *Oregon*. By Curt D. Pederson, Doann M. Hamilton, Scott F. Burns, 1995. Submitted to the City of Portland, Bureau of Water Works.

only during summer and early fall .... The anomalous high turbidity in Reservoir #1 during late-fall and early-winter months must be controlled by tributary discharge and/or remobilization of tributary delta deposits, not by side bank erosion or wind-wave resuspension of shoreline deposits. (P.18)

We recommend that long-term continuous monitoring of source tributaries and reservoir columns be performed to capture the reservoir response to discrete events of high- turbidity loading from tributary discharge. The discrete event data taken together with calibrated hydrodynamic models of internal reservoir flow should help to predict conditions of maximum reservoir turbidity in the Bull Run system. (P.19)

Had the Greater Vancouver Water District allowed the public to provide input to the coring project, SPEC would have brought the Bull Run reservoir project to their attention.

4.2 THE CAPILANO RESERVOIR CORING STUDY

4.2.1 Calculating the amount of sediment in the Reservoir

According to U.B.C. Geography professor Michael Church, he privately wrote to the Water District in 1993 proposing a coring project for the three reservoirs as part of his own research on determining sedimentation rates from watersheds in the Fraser Valley Region. He remarked that he never received a reply to his letter. [101] The April 1994 *Limnotek* report on the Capilano and Seymour Reservoirs recommended that core samples be taken both in the delta and reservoir bottom areas. [102] Church reinitiated his proposal in 1996, after which the Greater Vancouver Water District provided staff assistance for his meagerly university-funded measurement of the reservoirs in August 1996. In his initial assessment, Church used "an acoustic sounder to image bottom sediments" of the three reservoirs. [103] Professor R. Gilbert, from the University of Ontario, who a7ssisted Church in his soundings, helped write a preliminary report on their project. [104] Based on the sonar findings, Church determined where to physically take the cores. Water D7istrict staff assisted Church in recovering 33 core samples from the Capilano and Seymour reservoirs in August 1997 with a "3.5 cm (diameter) Phleger gravity corer, deployed from GVRD workboats". [105]

The Capilano reservoir was divided into 16 polygon units (see Map 4.1, page 65) and one core sample was taken from each, with one exception. [106] Segments of the cores were later examined and weighed at the university. From findings on the dimension of each core, the consultants were then able to estimate the total volume of the reservoir sediments from each of the 16 polygon reservoir bottom

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[101] At a private interview with Church at his university office in early May 1998, he was given specific instructions by Project Manager Tom Griffing on the same day of the meeting to not comment or provide details to me on the coring project. As a result, general questions and discussion continued 'around' the coring process. At a later meeting with Griffing in his GVRD office on May 15, he stated that he had a right to request Church not to answer my questions as Church had been under Water District contract for "three or four months". Church told me that he was not under a contractual relationship. Coincidentally, Church is married to June Ryder, of June Ryder and Associates, who is one of the Acres Team for the ecological inventory project.

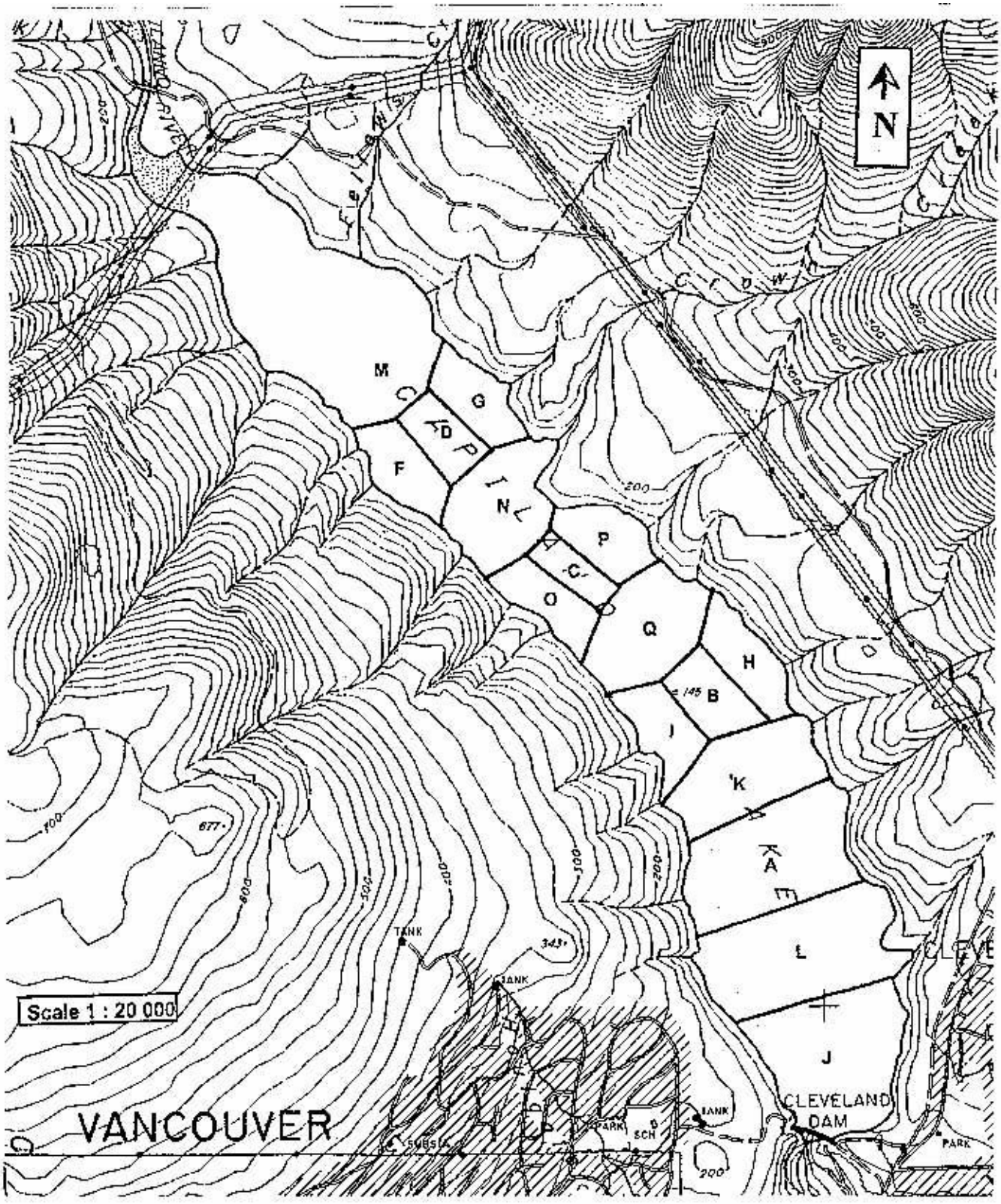
[102] *Limnotek Report*, page 64.

[103] *Annex Report*, p.3-5.

[104] M. Church and R. Gilbert. *Report of an Acoustic Survey of Bottom Sediments in the Greater Vancouver Water Supply Reservoirs.* 1996.

[105] *Annex Report*, p.3-6.

[106] Two of the cores were taken in the same polygon.



Capilano Reservoir with Lettered Core Locations and Thiessen Polygons

MAP 4.1 (From Lesley Kalmakoff's essay, page 12)

surface areas. As a result, it was estimated that there was **196,000 cubic meters** of fine material deposited in these 16 polygons from 1954 to 1997. [107] In order to convert the total estimated volume to units of weight, it was assumed from calculations in a handbook on reservoir sedimentation that a cubic meter of these fine sediments weighs 1.2 megagrams, [108] to arrive a total estimated weight of **235,200 megagrams**. An adjustment was made on this weight estimate to compensate only for the presumed amount of fine clay and silt sediments from the 17 Capilano cores. Based on average estimates from the 17 cores, where 92.5% of the total volume of material was thought to comprise these fine sediments, this brought about their final estimate of **217,375 megagrams** of fine clay and silt sediments. Finally, that figure was then divided by the 43 year time period of sediment production since the dam was completed for a yearly average of **5055 megagrams**, which was rounded off to **5100 Mg**. The units of measurement for weight are described as Megagrams per year (Mg/yr).

In a more recent interview, Church believes the figure of 5055 Mg is probably too high. Church's concerns relate to the steep side walls along the outer profile of the Capilano reservoir, where sediments aren't deposited in a uniform way, simply because gravity and lowered reservoir levels send the sediments downwards to where the surface area becomes less steep. This concern affects the calculations for specific polygon outcomes, because when they were originally calculated an average consistent depth was assumed for the entire polygon. Though Church was of course reluctant to speculate an estimated adjustment for this, I am going to assume a reduction of 10% to the 5055 Mg/yr estimate, which reduces the total down to 4,550 Mg/yr. [109]

4.2.2 Estimating the amount of fine sediments over the spillway

We now need to compare this new estimate of 4,550 Mg/yr with the consultant's calculations of 14,875 Mg/yr, which is over three times higher. The only other variable left to bring the 4,550 estimation closer to the consultants' estimate was to evaluate the amount of sediments transported over the dam's spillway - the final fudge factor (no pun intended). All of the very fine sediments from turbidity events do not get trapped in the reservoir (called "trap efficiency"), and the remainder is carried over the dam spillway and into the water intake. This was the next stage of the battle, so to speak, to determine what this estimate was and to try to elevate it as high as possible to get closer to the consultants' modeling predictions.

From a literature review, the consultants found conflicting estimates in this fudge factor, and found that the numbers could lie anywhere between 9% to 25% of the total annual fine sediment budget. In the end, after discussing these factors, the consultants accepted the limit of 20% to 30% of the total annual sediments to be spillway sediments (p.3-5). What gets particularly confusing is that the

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[107] In contrast, the estimated amount of fine, coarse, and woody materials deposited in the Capilano delta area is over 500,000 cubic meters, which is not part of the ecological inventory analysis. This means that since 1954, over 700,000 cubic meters of materials have been deposited in the Reservoir. According to Water District information, the 1954 reservoir holding capacity was 70 million cubic meters, which means that about 1.5% of the reservoir has been filled by materials. This 500,000 figure is only a "rough" eye-balled estimate from Thurber Engineering in 1993, and the area should be sonar scanned for an accurate estimate. There are additional delta volumes in different parts of the Reservoir, for instance from Crown and Hurricane Creeks, which have not been estimated.

[108] *Reservoir sedimentation Handbook: Design and management of dams, reservoirs and watersheds for sustainable use*. By G.L. Morris and J. Fan, 1998.

[109] This new calculation will change the findings of total reservoir sediment weight in terms of megagrams.

consultants suddenly jump beyond their own stated limits and argue that this figure is actually as high as 44% of the total trapped sediments. [110]

However, in another recent GVRD report, which assesses the dynamics of reservoir fine sediments and a calculation of reservoir bottom and spillway estimates, the consultant states that:

> although the fine material is the sole contributor to the turbidity at the intake, it represents only a small fraction of the overall sediment budget. [111]

According to Hay and Co., who based their reservoir sedimentation estimates on Michael's Church's coring results, the total sediment input is **4,660 Mg/y**r, of which **182 Mg/y**r, or **3.9%**, goes over the spillway and into the intake. This report assessment of spillway sediments, which was not referenced in the Annex Report, is in direct contrast to the Acres conclusion on the ratio of fine spillway sediments to the overall sediment budget into the Capilano Reservoir, a point which needs to be reconciled by the GVRD's Water Department engineers.

How did the consultants arrive at this figure of 44%? The only indirect data available on spillway sediments that the consultants could find was from turbidity readings at the Capilano water supply intake, readings which were only measured consistently from 1987 onwards. Turbidity, which is measured in NTU's (nephelometric turbidity units), is a relationship between light and the density of fine sediments. The higher the ntu, the greater the concentration of fine sediments. The problem the consultants faced was to convert those readings into comparable units of weight. After taking "twenty-six pairs of turbidity and sediment concentration samples" and then weighing them, based on estimated averages of representative-sized fine sediment particles, the consultants plotted their relationships on a graph (figure 3.2) and then established a formula to quantify the sediments from a given ntu reading. These figures were calculated for each year and then plotted on a bar graph (figure 3.3). For the ten year period between 1987 and 1996, the annual average was estimated at **3,900 Mg/yr**. According to Ken Rood from Northwest Hydraulics Consulting, there is an error of plus or minus 25% in calculating these findings, with rates between 4,875 Mg/yr and 2,925 Mg/yr. This makes the efforts of obtaining reliable results on the spillway sediments even more difficult and confusing, particularly when their totals fluctuate between 49% to 37% of the estimated total annual fine sediments.

In relation to calculating the annual average fine sediments, it is puzzling why bar graphs for the 1997 and 1998 years are not included or updated in figure 3.3, as the *Annex Report* was released in February 1999. What are the values for these two years? If, for instance, their values are close to 2000 Mg each, as suggested by other yearly averages in figure 3.3, then the average for the years 1987 to 1998 would then be reduced by 400 Mg from the 10 year average of 3,900 Mg to **3,500 Mg**. This is instrumental in providing evidence that longer averages are more accurate in predicting annual averages. After all, if the total spillway sediments for annual rates from 1954 to 1997 are actually

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[110] Annex Report, page 3-15. 3,900 Mg/yr and 5055 Mg/yr together add up to 8955 Mg/yr, of which 3900 is 44%. If we replace the 5055 Mg/yr figure with our new estimate of 4,550 Mg/yr, which changes the total to 8,450, it rises to **46%**. There is no explanation in the Annex report about why we should be confident in the fact that their estimates conflict with lower findings from other studies mentioned in chapter 3 of the Annex report.

[111] Hay and Company, *Three Dimensional Modeling Approach to Turbidity/Sedimentation Calculations*, page 5. "The total sediment input into the reservoir was calculated as the sum of the material deposited in the reservoir (medium silt and coarser) and suspended sediment passing through the reservoir (fine silt-sized material and finer). The sediment deposition rate for the reservoir was estimated at an average of 4.48 x 10(10) g/yr since the dam was built. The average sediment output was estimated at 1.825 x 10(9) g/yr. The sediment which remains in the reservoir is therefore 4.66 x 10(10) g/yr, which represents all material sizes."

much lower than those from the 10 year period of 1987 to 1996, then the assumed annual average of 3900 Mg gets severely reduced.

Because we don't have consistent Ntu data prior to 1987, we may correctly or incorrectly assume that the longer more recent annual average rate of fine sediments over the spillway from 1954 to 1998 may be in the neighbourhood of 2,000 Mg/yr. This means that on an annual average basis, that is, from 1954 to the present, when we add on the trapped sediments estimate, there may be a total annual average deposition rate of **6,550 Mg** of fine sediments. This is **2.3 times less**, or **44%** of the annual average of 14,875 Mg stated by the consultants in the *Annex Report* (see figure 4.1 of this report).

Aside from the problems of accuracy and reliability of modeling estimates from ntu readings, there are two specific problems with chapter three of the Annex Report in depicting an annual average from spillway sediments over a 10 year period only. A 10 year window between 1987 to 1996 for predicting annual sediment rates is both unreliable and artificially inflated in this case because of disturbances related to previous management activities, ie. logging. That is discussed in a quote by Dr. Michael Feller in chapter three of this report, and indirectly admitted in the Annex Report for the 1995 year:

> The greatest discharge of sediment occurred in 1995 following a landslide in the glaciolacustrine sediments on the west side of the reservoir. The total fine sediment load of 1995 is about three times as great as in most other years. In most years the total load lies between 2,000 and 4,000 Mg. [112]

There is also no assessment made on the origin of turbidity spikes from previous years shown in the bar graph on figure 3.3, and the data in Table 3D.1, and what caused them. To what extent were these spikes attributable to previous logging activities? There is no information presented in chapter 3 of the *Annex Report* on this concern. For instance, in the winter of 1994 to 1995, during heavy turbidity spikes at the Capilano intake, no landslides were reported during these storm events in the Capilano watershed in the February 1995 Water Committee Agenda. So, where did these fine sediments originate from? In 1992, the Water District lowered the reservoir about 30 meters for seismic work on the dam. This procedure, which eroded the reservoir delta area, and caused the river to incise the reservoir in lower contour areas, increased turbidity levels substantially, and is not accounted for in the report. In November to December 1990 the reservoir was again drawn down for remedial work. During this time period were two landslides in previously logged areas. [113] The consultants also suggest that earlier high turbidity events in 1981 and 1983 demonstrate support for their reasons for having a high spillway estimate. [114] The cause of those events in 1981 and 1983 are unexplained. We know from Water District files and interviews from staff that there large landslides in 1983 in the Sister's Creek area in previously logged zones, events which made the Water District riprap close to 2 kilometers of Sisters Creek. What happened in 1981? None of these events are contextualized in the report. In March of 1985, there was another large landslide in the Sisters Creek area which was not mentioned in the report.

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[112] *Annex Report*, page 3-15. The total is actually between three to five times as great as in other years recorded between 1987 to 1996. There are two separate camps on the debate about what set off this large landslide which shut down the Capilano reservoir for almost 6 months. Many agree that this landslide area, which had been clearcut logged in the 1920s, and which had been influenced by diverted waters from a logging road built by the Water District in the late 1960s, was related to logging activities. For a full discussion, see Will Koop's report *Not Coming Clean*.

[113] See Thurber's May 1991 report *Geotechnical Assessment of 1990-1991 Landslide events in Greater Vancouver Water District Watersheds*, p.25. A landslide in the Sister's Creek area and by Hollyburn Creek.

[114] *Annex Report*, page 3-15.

Turbidity readings for the Capilano began to take a distinctively sharp rise since the very early 1980s. The Capilano primarily provides water for the western municipalities of Greater Vancouver, where Vancouver City municipal engineers noticed sediments in their water distribution pipes in the early 1980s, and concerns from Medical Health officers who were responding to this information. [115] A Water Quality Technical Committee was subsequently formed in December 1984 by the GVRD in direct response to this issue, and relatedly why in 1987 a study by the Water District concluded that "the major problem associated with the GVWD water sources is excessive levels of turbidity" and that "turbidity, and its impact on disinfection, will be a high priority research item". [116] Landslide activities from early logging by the Capilano Timber Co. in the Sisters Creek area, along with new roads built in this area, and many roads and logging in many other areas in the Capilano, were creating all sorts of interrelated problems associated with the release of fine sediments.

The important question to ask at this point is, if we were to apply this new information on the annual average of 6,550 Mg/yr in the *Annex* and *Analysis* reports, how would this affect the consultants' applications and recommendations which are presented throughout the Annex and Analysis reports? The answer is that it would dramatically alter them, and the consultants are no doubt aware of this.

4.2.3 Environment Canada's conclusion needs further scrutiny

However, according to the findings from the Environment Canada modeling study on sediment transport (refer to chapter 3.7), there is apparently one thing that wouldn't change, and that is regardless of whatever management practices may be inflicted upon the landscape, only large landslide turbidity events impact water quality at the intake and spillway area:

> The results suggest that any gains that can be made in water quality at the water supply intake are indistinguishable from the baseline case. This is likely due to the fact that of an estimated 15,000 Mg/y of annual sediment yield, almost 13,000 Mg are attributed to landslides. The proposed interventions have only a minimal effect on sediments from these sources (less than 2% improvement in landslide sediment yield at year 40 for option A relative to the baseline case). Turbidity which results from surface erosion (where a 60% improvement can be achieved with option A at year 40 compared to the baseline case) may not be a significant contribution to the problem at the water supply intake. Landslide events are episodic in nature and generally introduce enough sediment in a single pulse to generate a turbidity event at the intake. In contrast, the chronic low-grade introduction of sediments from surface erosion spread the benefit of reduced yield from surface erosion over time. As a result, even though substantial reductions can be made in sediment yield resulting from surface erosion the benefits as measured at the intake will be minimal due to dilution. [117]

[115] See Appendix E for a summary of concerns about turbidity in the 1980s.

[116] *Evaluation of Region's Drinking Water Quality and Treatment Procedures*, a final report, by Economic Engineering Services Inc., 1987, pages 5, 7.

[117] Environment Canada report, page 79.

Those findings, however, are based only on modeling application assumptions, and not from direct sampling and tracking of turbidity values from the Capilano delta area to the intake, a distance of approximately 5 kilometers. [118] The relationship and dynamics on the transport of fine sediments to the Capilano intake have not been analysed for the ecological inventory project, and assumptions about fine sediment transport are still not understood. Yet watershed managers at the GVRD are already treating the reservoir modeling as reliable before it has received peer review, as seen in the following quote recently taken from the annual October 1999 conference proceedings of the Canadian Water Resources Association:

> The most interesting result of the entire analysis are those for resultant water quality at the intake.... This options evaluation exercise found that despite differences in fine sediment yield to the reservoir across the options, there was no discernible change in water quality at the water supply intake. [119]

The nature of the fine sediments, which remain in a chronic state of suspension, are only briefly discussed in the *Annex Report*. There are no references in the *Annex Report* to the two most important studies to the GVRD on this subject, the *Limnotek* and *Hay and Co*. reports, which go into some of the details on these suspended sediments. Most importantly is the fact that fine clay and silt sediments under about 5 microns (0.005 mm) in diameter stay in a state of suspension for extended lengths of duration:

> The small percentage of clay-size material which enters the reservoir is referred to as fine glaciolacustrine material. Almost all of this material would remain in suspension long enough to reach the dam and; hence, pass through the intake. This material rarely settles in the reservoir due to its very low settling velocity. [120]
>
> Bacon Donaldson and Associates (1991) also found that 98% of suspended particles had a diameter < [less than] 0.005 mm, the mid-range of fine silt, and most were smaller than 0.001 mm or less than clay size. These suspended particles are small enough to have colloidal properties and they are commonly lyophobic, meaning that they are hydrophobic and never become dissolved in solution. [121]

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[118] Communication with Stuart Hamilton, project manager, Environment Canada, concerning his report, *Hydrological and Hydraulic Modeling of Fine Sediment Transport in the Capilano Watershed*, April 1999. Hamilton became "inspired" to conduct this project after an October 1997 Canadian Water Resources Association meeting at the Metrotown Holiday Inn meeting, which featured speakers Peter Pearse, chair of the scientific review panel, and Water District Manager Bob Cavill. According to Hamilton, the river entering the delta area is much like a pressurized hose in a swimming pool, where the effects of the hose energy becomes dissipated farther into the pool. The only difficulty with that analogy is that, unlike a swimming pool, the Capilano reservoir has a current, a current which increases or subsides based on water flows into and leaving the reservoir over the spillway. It is known that fine clay and silt sediments do not quickly settle, therefore strong reservoir currents bring these unsettled or suspended sediments to the intake and spillway area. This is the one critical factor which is inadequately addressed in the Environment Canada report, and it is this assumption which drives the conclusion that only large turbidity events from landslides affect the public's drinking water quality.

[119] *Watershed Management Planning at the Greater Vancouver Water District*, pages 226-232, by Derek Bonin and Dan Ohlson. Ohlson is the editor of the GVRD's *Analysis Report*, and Bonin is the GVRD's watershed manager.

[120] *Hay and Co.*, page A1/5.

[121] *Limnotek Report*, page 23.

It is the nature of these suspended sediments which to some degree bring into question Environment Canada's concerns about turbidity at the intake which relate only to large episodic turbidity events. If there are, for instance, smaller persistent turbidity sources, these fine sediments will most likely reach the intake by the currents in the reservoir, depending of course on the dynamics of the current(s), as these fine sediments do not settle out:

> The coarser mobilized material will settle quickly whereas the finer material is transported in suspension toward the dam. The resettling of the mobilized material will depend on factors such as the velocity and direction of the lake currents (including density currents), water temperature and settling velocity of the various sized particles. [122]

4.2.4 What are the origin and rate of the Capilano Reservoir fine sediments attributed to?

If the origin of these fine sediments could somehow be separated from events attributable to logging, then we come closer to the truth about what is most important in the long term management objectives, and not those suggested by the consultants in the *Annex Report*. What do we know about the annual characteristics of fine sediments from the Capilano watershed in this century? We don't. We can only make guesses, that is good guesses. We know that prior to about 1918, the Capilano watershed was a largely untouched, 'unmanaged' watershed, and that the fine sediment production was undoubtedly at its lowest. After 1931, when intensive railway logging ended in the Capilano, we know that the landscape took a long slow recovery process. This is evidenced in both oblique and normal 1939 aerial photographs of the lower Capilano watershed. The generalized instability of the Capilano watershed from logging activities probably accounts for the sidebar quote by Water District Commissioner Cleveland in March 1947 on page one of the October 1999 Scientific Review Panel's report, *Testing the Water*, about turbidity events after a series of winter storms:

> From November 23 to February 13, four extreme storm events occurred, causing the water to carry considerable colour and sediment. A great number of complaints were received.

The Greater Vancouver Water District, in its original vision to remove commercial logging and industrial activities from the watersheds, was hopeful that over time the Lower Capilano watershed would recover from its devastated state, and that together with the other pristine valleys in the Capilano, and the other two watersheds, there would never be a need for filtration and chemical treatment:

> The District's policy is to preserve all the timber both commercially loggable and otherwise in the watersheds for the conservation of the run-off and to preserve the area from human occupation either temporary or permanent. I would not attempt to set a value on the watershed lands in the Coquitlam, Seymour, and Capilano watersheds as they constitute an almost invaluable asset of the District permitting the complete and entire control of the water supply for all time so that neither now nor in the future will filtration or sterilization of the water be required. [123]

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[122] *Hay and Company*, page A1/4.

[123] Correspondence from Water District Commissioner E.A. Cleveland, November 30, 1936.

Logging resumed in the Capilano in 1964, and logging and roadbuilding increased dramatically in the 1970s and 1980s. [124] It makes sense to argue that fine sediments disturbed and transported as a result of unnatural disturbances after 1931 until the 1960s were declining, and that after the 1960s they began to rise again. But more of a concern are the areas logged closer to the Capilano Reservoir by the Capilano Timber Co. and the long term instability of the landscape as a result of those practices, and the future proposals by the Water District to log throughout these areas again.

How can we be confident in what the consultants are telling us about fine sediment production without pondering the most fundamental and obvious question: what is a good estimate of annual fine sediment production from the Capilano watershed had it never been logged and roaded? Let's say, for instance, that the total annual average fine sediment yield of an undisturbed Capilano watershed over a timeline of hundreds of years is about **2000 Mg/yr**, which is roughly one third of this chapter's refined figure of trapped reservoir sediments (4550 Mg/yr) and for a low end average of spillway sediments (2000 Mg/yr) from the consultant's bar graph figure 3.3. Then the long term calculations, assumptions, and attendant suggestions by the consultants that the annual average fine sediment will remain almost constant over the next 200 years is brought into question. The consultants' unexplained theory about a 200 year constant is presented in Table 15.3 of the *Annex Report*, "Predicted Annual Fine Sediment Yield from all Sources for the Capilano Watershed", which at year zero, under option C, shows 14,875 Mg/yr, and at year 200 at 14,371 Mg/yr.

The graph in this report (Figure 4.1, page 73) provides a theoretical contrast by the present writer on gathered findings and analyses in scientific studies on forest hydrology to the consultants' conclusion in the *Annex Report*, and is based on the assumption that a natural or pristine Capilano watershed produces the least amount of fine sediment over time, and that logging activities upset that baseline. Figure 4.1 presents three baselines for comparison sake: the consultants' inflated constant (dotted lines); the annual average from the coring study and spillway estimates based on this report's revised figures (solid line); and the unmeasured hypothetical average from the historic natural or pristine Capilano watershed (dotted line). Figure 4.1 illustrates the argument that the fine sediments in the Capilano were displaced by previous logging activities and that their intensity and persistence diminishes over time toward the historic natural average. This is presented in the logging management disturbance roller coaster curves (dotted line) for both the Capilano Timber Co. damages, and the Greater Vancouver Water District logging damages. The value of the curves themselves are not taken from data and are not known, but are presented only to make a point. For instance, the first spike may be much higher. In contrast, the consultants' imply that their baseline is almost a constant over the next 200 years, a theory which may hold no water.

From what evidence do the consultants base their conclusion that the estimates for annual fine sediments will be at a constant over the next 200 years, and will not significantly reduce, based on the long term recovery of the managed Capilano watershed? It is not discussed in the report. If, for instance, forest management activities actually come to an end in the Capilano, and if road deactivation projects are seriously introduced, will the annual fine sediments in the watershed begin to decline, and if so, when, and are they already beginning to decline? Good sense and forest science suggest that they should decline, and it is only a matter of time until this is understood.

[124] See Appendix G for Capilano roadbuilding and logging summary.

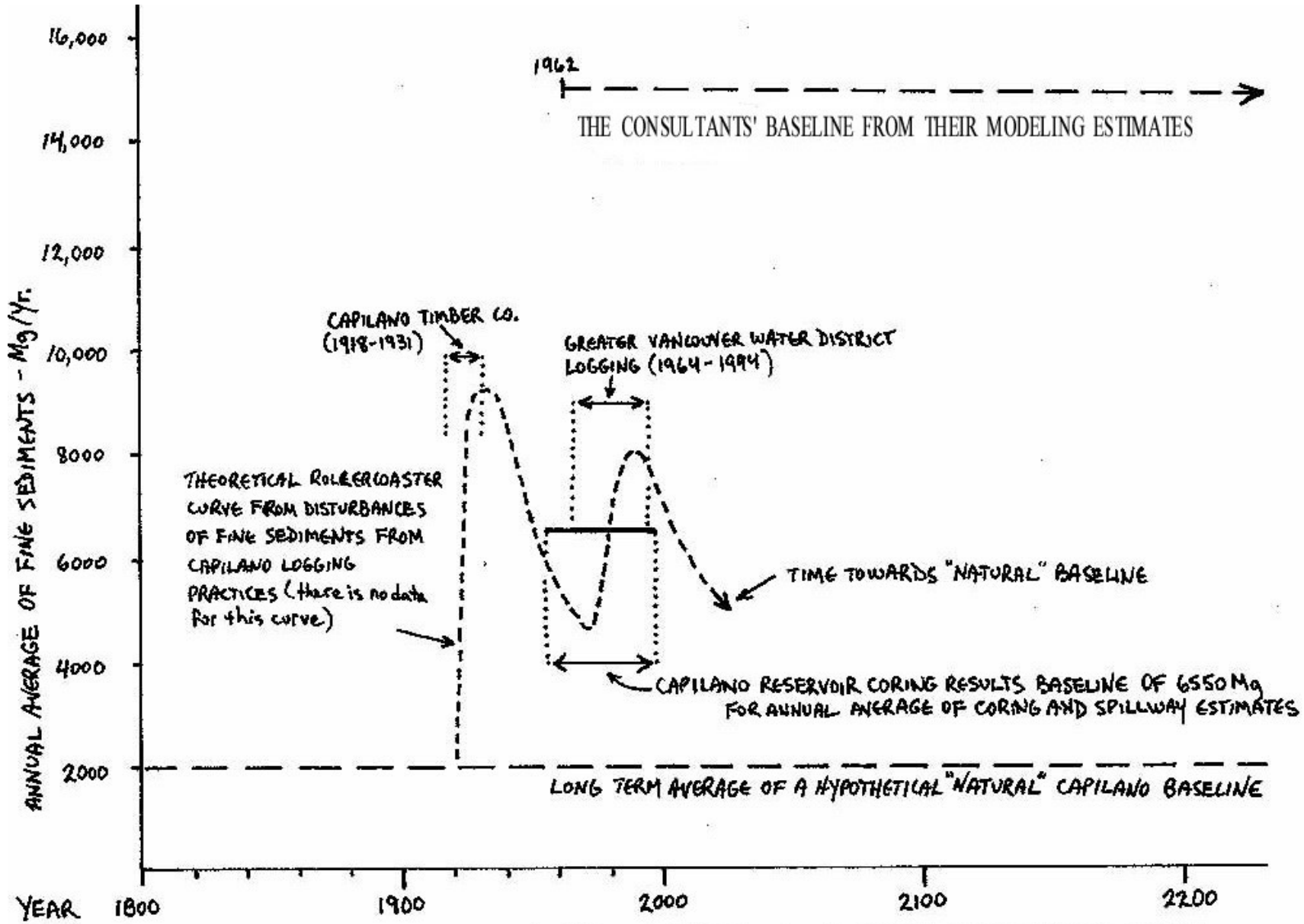

FIGURE 4.1 THEORETICAL CONSTRUCT ON THE EFFECTS OF LOGGING TO THE RELEASE OF FINE SEDIMENTS AND FOR AN ANNUAL AVERAGE OF FINE SEDIMENTS FROM A PRISTINE CAPILANO WATERSHED

For example. There was no comparison of the Capilano Reservoir deposition estimates to the Seymour Reservoir deposition estimates in the *Annex Report*, even though the consultants had the results. This is important, for one specific reason, in that there has been less historical logging in the Seymour on-catchment lands this century. [125] According to Kalmakoff's thesis, the rate for the Seymour deposition is one third that of the Capilano, leaving her to consider that this "difference in sedimentation rates raises interesting questions about the possible reasons behind it". What we don't know about the Seymour on-catchment lands are the previous natural or pristine fine sediment and deposition rates.

4.2.5 Summary

As was briefly discussed in chapter 3, the process behind the coring and sedimentation rate analysis of the Capilano, Seymour, and Coquitlam Reservoirs was done without public knowledge. Had the public been notified the coring project could have benefitted, for instance, by knowledge and applications from the Bull Run reservoir coring project. This truth doesn't negate the coring project, it merely tells us about the consistent, internalized, and bureaucratic nature of the ecological inventory process and its direction. In fact, the coring project was not originally part of the project schedule for the ecological inventory (which it should have been), but seems to have been pulled in to help the consultants 'ball park' their fine sediment yield model.

> The mandate of the consulting team was understandably limited to a study of the watersheds (excluding the reservoirs), and the responsibilities of the GVRD's watershed management staff is similarly constrained in scope. [126]

For instance, had the ecological inventory project advisors wished to know more from the coring results, there would have been funding provided and an analysis done of the cores to determine the annual rate of deposition, to perhaps help us consider if that rate was rising, consistent, or falling. Unfortunately, the assumption that the deposition rate for the Capilano and Seymour watershed is constant is also presented in Church's student thesis paper on the coring project:

These [fine sediment] rates are a general estimate of annual accumulation under the assumption that the rate has been steady since the time of reservoir closure. (Page 28)

This conclusion seems to emanate from Kalmakoff's review of Greater Vancouver Water District public relations literature, where she perhaps innocently overlooks previous management activities and extols the virtues of the Greater Vancouver watersheds regarding their "protected status":

> General research interests may appreciate the information as the protected status of the watersheds has ensured minimum human disturbance during the industrial development of British Columbia. A record of undisturbed sedimentation is particularly important if the current trend of using lake sediments to determine industrial effects on natural systems continues. (p.2)
>
> The results will provide the research community with an indication of fine sediment accumulation rates in two protected coastal watersheds. (p.5)

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[125] Logging began above the dam in 1962. The area, other than the clearing for the reservoir, had never been roaded or logged.

[126] Scientific Review Panel report, *Testing the Water*, page 10.

As was pointed out in chapter three of this report, the limitations of the coring project were that the reservoir delta areas were left unexamined. This is a particularly inexcusable omission, especially as it relates to the deposition of mostly coarser materials which have entered the Capilano reservoir since 1954, and the value it would have had in determining, among other repercussions associated with logging activity, the loss of reservoir storage capacity.

Lastly, we need to ask ourselves the following questions. Given the arguments presented so far, to what extent are the consultants' conclusions about fine sediments being driven by their inflated fine sediment yield model, and to what extent is the maintenance of their fine sediment yield model being driven by their client, the GVRD?

CHAPTER 5

FIRES

QUOTATIONS

Since 1924 there has been a constant endeavor to develop a system of roads within the watershed that will permit fire fighting equipment to reach an area in which a fire might start ... This road building program is still under way and it is hoped that finally there will be no point within the watershed that will be more than half a mile from a road over which equipment will travel. [127]

The statement has been repeated many times and occasionally by men in authority that forest fires are for the most part preventable. If they are, our experience shows they are very frequently not prevented. [128]

The Amending Indenture explicitly requires road construction for fire prevention. [129]

Roads are not themselves particularly useful in fighting the catastrophic or crown fire. Only nature will suppress such a fire. [130]

The Panel supports the concept of forest management, including road construction and timber harvesting, for the purpose of reducing the risk of catastrophic fire events. [131]

The "catastrophic fire", plaintiff's submit, is a red herring, designed to be an emotional bellowing of doom if loggers do not get their way. [132]

Forest fire management is the underlying basis for the GVWD's forest management program. Fire management is the management of fuels and risk to achieve a hazard level which reduces the chances of catastrophic fire. [133]

Logging operations [in the Capilano Valley] *left 8,765 acres of logged and/or burned land.... Restocking has been satisfactory on all logged and/or burned lands except those where fire has burned the layer of organic soil from steep faces of rock. Even in these burned areas some regeneration has started in cracks an ledges of the rock. Fire-killed timber is found about the perimeter of the logging operations.* [134]

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[127] Petitionary letter to members of Seattle City Council from W.C. Morse, Superintendent of Seattle's Water District, to support continued logging in the Cedar River watershed, October 22, 1943, page 7.

[128] E.A. Cleveland, *Proposed Public Highway Through Capilano Watershed*, July 17, 1951, p.7.

[129] GVWD September 1991 *Final Technical Report*, page V-46

[130] Miller vs Mallery, in the United States District Court for the District of Oregon, civil no. 73-609, Opinion by Judge James Burns, March 5, 1976, p.26.

[131] *Greater Vancouver Watershed Management Evaluation and Policy Review Public Input Document*, 1991, p. II-6.

[132] Joseph Miller, et al, Plaintiffs, v. Wright Mallery, et al, Defendants. In the United States District Court for the District of Oregon, Civil No. 73-609, Plaintiff's Brief on Second Claim, p.87, re Bull Run watershed.

[133] GVWD *Final Technical Report*, September 1991, p.V-44.

[134] *Appreciation of Factors Affecting Watershed Management on the Watershed of the Greater Vancouver Water District*, December 1956, C.D. Schultz & Co. Ltd., 1956, p.53.

Within the three watersheds, lightning strikes are considered the most significant fire risk in relation to other probable causes (i.e. human). [135]

Forests can be a liability to watershed management. A mature forest is ideal fuel for a fire which could destroy in a day the favourable soil conditions that were built up over centuries. Dead standing trees are an acute fire hazard and should not be allowed to remain. [136]

Should one half million people depend upon the whims and fancies of Mother Nature for their supply of drinking water? Should the Forest Service as custodians of the area sit back and wait for D-day, the day that a major fire sweeps through the watershed to clean up the old decadent timber so that a new crop of trees can get started?
The solution is simple, but the problem is great. For fifty years city officials and Portland residents have been bally-hooing pure Bull Run water from an unmolested watershed. Many are fully convinced that to keep their water pure the watershed must remain forever untouched. There is a tremendous P.R. job to change this thinking of some 50 years standing.
The initial approach should be made through Ben Morrow, who is the City Engineer that has been the God-father to the Bull Run for years. The fire angle should be played up and revenue returns subdued in this initial discussion. [137]

The silviculture practices that we recommend in the various options were to address the risk of fire, and a secondary benefit of that was that it would address the western hemlock looper potential 120 years down the road. [138]

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[135] *Annex to the Ecological Inventory Analysis Report*, Watershed Management Plan #5, p. 13-2.
[136] *Appreciation of Factors Affecting Watershed Management on the Watershed of the Greater Vancouver Water District*, December 1956, C.D. Schultz & Co., p. 124, 105.
[137] *A Plan of Approach to Better Management of the Bull Run Watershed, Mt. Hood National Forest*, District Ranger internal report, August 1, 1952.
[138] Scott Hanna, Acres Team Coordinator, Regional Water Advisory Committee meeting transcript, June 10, 1999, p.44.

5.1 BACKGROUND

There is little question that the primary argument for the initiation of logging in the Greater Vancouver watersheds in the 1960s, similar to the present argumentative framework in the ecological inventory, was promoted through concerns about forest fires. The pattern between the two time periods is marked by flagrant hype from forestry consultants about doom scenarios to frighten municipal administrators and the public.

> The fact that we have not suffered extensive fire loss in the watersheds during the last 30 years, should not lull us into complacency. [139]

The 'fire angle' was hardly an isolated affair, but part of a standard approach in both the northwestern United States and British Columbia by foresters as a primary excuse to log in watersheds which were under special protection or under sensitive government policy. In 1952, for instance, a U.S. Forest Service regional forest manager in Oregon's Mt. Hood National Forest wrote an internal 'hush hush' report as a guide to his fellow foresters to deceitfully influence Portland's Water District administrators to revise federal legislation which protected Portland's drinking supply watershed, the Bull Run, from logging. The conspiratorial plan was to play up the "fire angle", as presented in the italicized quotation at the beginning of this chapter. Another example can been seen in the following governmental response letter to a concerned citizen in the Sechelt area in late 1973, over logging in the Chapman Creek community water supply watershed, an area which was under considerable public controversy at the time:

> It has often been asked why logging activities are permitted in a community watershed, considering the forest's importance on regulating runoff, erosion and water quality in general. Experience in British Columbia and other areas of North America has indicated that largely over-mature or decadent forest heavily infested with disease and insects, with thousands of snags and dead tops inviting lightning strikes, and with a heavy litter of windfall and deadfall timber rotting on the ground, is not in keeping with sound conservation, good water protection, or with good forestry practice. [140]

However, in the 1950s, the Greater Vancouver Water District was not about to be suckered by such disingenuous comments because its staff had developed an excellent fire prevention and protection program, particularly under the watchful assistance of Watershed Inspector Bill Angus (1932-1958). Staff were acutely aware of the real dangers, namely that logging companies and people were responsible for causing fires in the watersheds. Under the Water District's administration, from the late 1920s to the early 1950s, there were a total of three natural fires ignited through lightning at higher elevations, which burned a total of about 5 acres. [141] In contrast, loggers had started numerous fires in the Capilano, the Lower Seymour, and Lower Coquitlam areas, total estimates of which have never been properly catalogued and identified in recent Greater Vancouver Watershed Management reports. The reason these figures have not been given is that they clearly show that people have been carelessly responsible for the destruction of forests from fire in the Greater Vancouver watersheds in this century.

According to early Water District reports, the Capilano Timber Co. was responsible for setting off a total of 37 fires. The upper limits of these fires are shown in the ecological inventory map on the Capilano "Disturbance Regimes" (refer to Map 3.1, page 45). In fact, the catalyst for the early

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[139] F.G. Johnson, consulting forester, letter to Water District Commissioner, February, 1952.

[140] Ben Marr, chief engineer of the B.C. Water Resources Department, and Acting Associate Deputy Minister, January 3, 1974.

[141] Early Water District correspondence files.

formation of the Water District in February 1926 was directly related to a large escaped fire in the lower Capilano in the summer of 1925, which had been started by employees of the Capilano Timber Co. Greater Vancouver residents and civic administrators were shocked and dismayed about the billowing cloud of smoke directly behind the local mountains. Ministry of Forests Regional files on the Greater Vancouver watersheds also acknowledge the 1925 incident as being pivotal to end commercial logging in the 1920s. According to historic provincial Lands Department files:

> A fire which covered approximately 3200 acres [1300 ha] occurred in this region during the months of June and July. This was most unfortunate but it is not out of order to state here that the Company concerned fought and extinguished this fire to the best of their ability. [142]

The ecological inventory *Annex Report*, however, states that this event burned 172 ha, [143] not the 1300 ha described in the official Lands Report. This once again brings into question the discrepancy in information from GVRD reports on the Greater Vancouver watersheds.

The 1920s were highlighted by large scale fires being started by logging companies throughout British Columbia, especially on the Coast, as hundreds of new companies were established who set up logging camps in previously undisturbed watersheds. [144] From 1922 to 1926 the provincial government heavily advertised fire prevention in newspapers and forest industry journals. In 1922 and 1923, loggers in Seattle's water supply, the Cedar River watershed, started a number of very large fires which also brought about great concerns by Seattle City Council to end logging practices. During the initial logging stages in Victoria's previously unlogged Sooke watershed, a fire started on July 12, 1951 by loggers which spread over 600 acres of mostly slash, felled and bucked timber.

When the C.D. Schultz Co. finally submitted their sustained yield commercial logging proposal to the Water District in late 1956, they recommended that access roads be developed into all the watershed subdrainages for long term fire suppression, and it is not too difficult to interpret the motivation behind such a suggestion. At the time there was only one access road in the three watersheds, and that was B.C. Hydro's "jeep road" in the Capilano which was built in the 1930s and followed the main valley to Furry Creek to the north. [145] All other drainages were unroaded and many accessible only by rough trails maintained by staff.

The Water District, under the early administration, was opposed to road construction in the watersheds for two main reasons: erosion of soils and public access. These arguments were presented at length in two reports by separate Commissioners during the extended and controversial Capilano highway debate from 1951 to 1954:

> The rigid restrictions on access of persons to the watershed accounts in large measure for the success of the Water District during the last two decades with its efficient protective organization in preventing serious outbreaks of fire. [146]

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142 File: *Vancouver Watersheds, Report on North Shore Watersheds - Season 1925*.

143 *Annex Report*, p.12-38.

144 "Our main problem on the Coast is to secure better organization in the logging camps. It seems remarkable that logging operators, employing men familiar with the woods and carrying a comprehensive equipment of tools, should be the worst offenders, but such is the fact." Western Lumberman, May 1923, p.5.

145 "The grades, curvature and surface condition of the road make it passable to jeeps and trucks and a motor car may at its peril negotiate it but it may hardly be described as a road in the ordinary sense of the word." E.A. Cleveland, *Proposed Public Highway Through Capilano Watershed*, July 17, 1951, p.3.

146 Ibid.

> Now dealing with the probability of excess turbidity which may be expected during and following construction of the proposed road. This condition [of high turbidity] is caused by the effect of the wash by heavy rains on clay and gravel banks ... has been particularly bad on several occasions during each winter in recent years and it is the firm opinion of observers that the condition occurs on more numerous occasions and to a worse extent since the transmission line road was constructed." "If the purity of the water deteriorates due to excess turbidity from the existence of the road, the public may find that its investment of $15 million in the Capilano Valley is gone ... [147]

Cleveland stood his ground when advocates for the highway related the advantage for fighting fires through quick access:

> Easy access by logging railway during some of these fires did not serve to prevent them or to curtail their ravages to insignificant areas. Easy access along the bottom of the valley and organized firefighters, as has been demonstrated so many times, are slow and feeble agencies against the merciless flames of a raging fire. [148]

During the highway debate, the Water District's Commissioner sent out letters of enquiry to numerous West Coast municipalities in the United States on this issue. In a reply from the Superintendent of Portland's water supply, the Bull Run watershed, Ben Morrow advised:

> You in Vancouver have such a wonderful source of water supply that it seems a shame to be forced to go to the trouble and expense you will likely find necessary to protect it from contamination and fire in the event the proposed road is constructed. [149]

The Senior Medical Health Officer, Stuart Murray, from the Metropolitan Health Committee at Vancouver City Hall, was adamantly opposed to the road proposal because:

> a watershed should be used only for the purpose for which it has been set up, namely the collection of water. The ideal with reference to watersheds is to keep them free of human habitation, to keep the surface soil undisturbed and to carry on only essential activities in the watershed. [150]

The Water District's policy against road building and the attending concerns was firmly established and was widely supported, including written resolutions by all the Greater Vancouver municipalities on the Administration Board of the Water District. [151] On September 6, 1951, the Board resolved that:

> It has been the considered policy of successive Administration Boards to endeavour to protect the water supply derived from the three catchment areas under the District's control from the dangers of pollution and contamination that might be caused by:
> (1) The encroachment of logging and other industrial activity.
> (2) The presence of human beings either for recreational or other purposes.
> (3) The very serious consequences of forest fire attendant upon any human habitation or activity within the boundaries of the catchment areas.

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147 *Proposed Public Highway Through the Capilano*, by T.V. Berry, February 15, 1954.
148 E.A. Cleveland, *Proposed Public Highway Through Capilano Watershed*.
149 Correspondence, September 12, 1951.
150 Correspondence to Commissioner T.V. Berry, May 13, 1953.
151 Letters of support and resolutions by City Councils were provided during this debate.

After a period of prolonged and clandestine lobbying by forestry consultants, who, much like the 1952 U.S. Forest Service memo, stressed the dangers of widespread fires as a result of defoliating insects (i.e., the Balsam Woolly Adelgid), the Water District took a sudden sharp turn regarding its road policy in the 1960s. As roadbuilding and logging began in the Seymour and Capilano watersheds, the very things the Commissioners warned against during the Capilano Highway debate began to unfold.

Aside from the erosional and hydrologic problems associated with the systematic roadbuilding program into all accessible drainages, the Ministry of Forests' enforced its policy of slash burning on all cutblocks. This policy ran contrary to decades of concerns by the Water District, practices which also caused a number of escaped fires. [152] Although the slashburning policy was initially countered by the Water Administration Board after the large 1967 escaped slash burn fire on the western mountain slope of the Lower Seymour off-catchment lands, it was strangely reenacted shortly thereafter. It was only until the late 1980s that slashburning was abandoned in the watersheds.

One of the problems associated with slashburning was that the scorched soil became repellant for the short term. A study on this by a U.B.C. Masters student in Forest Hydrology identified that "there was a significantly greater proportion of soils that were water repellant in burned cutblocks than in uncut forest". [153] These repellant soils are of concern when it comes to rainstorm events and runoff from these cutblocks, in terms of accelerated energy of water and consequent erosion of soils. It once again seems highly ironic that forestry practices were responsible for initiating the very things they were supposedly preventing.

5.2 INTRODUCTION OF THE CATASTROPHIC FIRE ANGLE

During the period of active logging from 1961 to 1991, escaped fires from slashburning practices and forestry equipment caused about 100 hectares of forest to be consumed, [154] compared with a total of about 5 hectares of high elevation forest lost to lightning strikes in the Greater Vancouver watersheds. This information was obscured in the two 1991 'public review' reports on logging where a bar graph (Exhibit S-3) gave the impression that lightning was the major cause for total fire damage. In another location in Appendix A-4, the review panel only presented partial information on the history of fires in the watersheds for this century. [155] The likely reason for the way in which the information was presented was to provide an impression that disturbance levels from fires in the watersheds are a result of ongoing natural circumstances, and that logging practices are inconsequential. This points to the conclusion, once again, that someone has something to hide, and that somebody didn't do their homework.

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[152] There were also incidences of escaped fires from equipment causing sparks.

[153] GVWD September *Final Technical Report*, page V-44.

[154] The figure of 86 hectares in the August 1991 *Final Summary Report* is too low, as it overlooked one escaped fire in 1982 in the Healmond drainage, Capilano watershed. Of course, the Water District was extremely fortunate that the escaped fires were contained, and did not do more damage.

[155] There is a discrepancy in information on this topic between the *Final Summary Report* and September 1991 *Final Technical Report*. The *Technical Report* states that loggers caused 565 ha of forest to be burned in the early part of this century (page V-7), while the *Final Summary Report* gives a figure of 612 ha in a category of "other, unknown" (Appendix A-4). To confuse matters even more, the Ecological Inventory *Annex Report* shows that 787 ha were burned in the Capilano alone from 1920-1932 (page 12-38). However, loggers burned burned far more forest than stated in the *Technical Report*, the proper figure of which has never been summarized in Water District reports. This shows that information on this topic is inconsistent and misleading in the *Final Summary Report*.

As Elaine Golds, from the Burke Mountain Naturalists, has often pointed out in her descriptive letters, reports, and presentations over the last 7 years, it is not fires, but logging of close to 5000 hectares of mostly old growth forests between 1961 and 1994 which has been responsible for the destruction of forests. If one were to add up the total amount of forest lost to fires caused by loggers in this century in each of the watersheds (including the off-catchment lands), and include the amount of forest harvested by the Water District, and the amount logged in the early 1900s, the loss would be well over 10,000 hectares. That perspective is the most instructive thing that we can learn in this debate. For some reason, however, the Water District has never entertained this perspective nor presented accurate information on areas lost to fires from loggers. The greatest level of disturbance to the watersheds has clearly been from people, events which, one might say, have been somewhat catastrophic.

Somewhere between the release of the *Draft Summary Report* (*DSR*) in January 1991, and the release of the *Final Summary Report* (*FSR*) in August 1991, members of the related review panel hired by the GVRD introduced a new argument or future focus for the watershed management program, namely the catastrophic fire concept, and edited other sections of the final report to support this approach. For instance:

> Preventing major fires is beneficial to water quality; however interruption of this natural disturbance results in development of an over-mature forest, which is more susceptible to decay (*DSR*, page 6)

changed to:

> While the prevention of major fires is beneficial to water quality, the interruption of this natural disturbance results in the development of old growth forests that contain very high fuel loads. Given the probable high fuel loads in portions of the watersheds, it is only a matter of time until the right combination of weather and fire source meet to create a catastrophic fire. (*FSR*, page 11)

And:

> The current forest management policies and programs were initiated to respond to this natural disaster [Balsam Woolly Adelgid]. (*DSR*, pages 8-9)

changed to:

> The current forest management policies and programs were initiated to respond to this natural disaster, with a philosophy of removing potential fuels and creating a more healthy forest cover containing a mosaic of young stands. (*FSR*, page 13)

This new shift and emphasis in the fire argument was significant, because it not only showed that the Water District seemed to be getting help from outside sources on a controversial debate, but became the new emotional twist and a central planning component for the ecological inventory. By introducing this new argument after the public had provided their written criticisms to the *Draft Summary Report* in May 1991, it conveniently excluded the public from commenting upon the introduction of this new twist.

Where did the suggestion for catastrophic fire come from you may ask? A clue to this answer was revealed through the introduction of other new information in the *Final Summary Report* from

Portland's Bull Run watershed on sedimentation studies from the U.S. Forest Service. [156] In fact, upon closer inspection in another more comprehensive report, the September 1991 *Final Technical Report*, it clearly states the following:

> One example of applying a fuel management program in a municipal watershed was developed by the U.S. Forest Service for Portland's Bull Run watershed.... The system was recently applied on a large, wind damaged area within the Bull Run watershed. [157]

The debate over logging in Portland's drinking-water supply has been one of the most important case studies in North America for northwestern Pacific maritime coastal watersheds. Of particular interest within this history were the arguments presented to the courts and the public in the early 1970s on the U.S. Forest Service's justification for logging in a federally legislated reserve, and in subsequent years by foresters and hydrologists on the question of sedimentation. Those arguments were carefully contested and exposed to the public by public watchdogs. However, that did not prevent the arguments for catastrophic fire and turbidity from being incorporated in official journals and related literature.

During the court case launched by Portland resident Dr. Joseph Miller et al. in 1973 against Portland's Water District, the U.S. Forest Service, and eight local forest companies, the Forest Service introduced evidence that it needed to log the area to prevent a "catastrophic fire". That argument was clearly contradicted by the defendants who showed that logging practices were responsible for starting almost all of the fires in the Bull Run watershed in this century. After the judge reviewed all of the evidence he concluded that the Forest Service's catastrophic fire argument was an unjustified concoction meant to administer a logging program. In fact, all the other arguments, which have been used by foresters in the past for logging in the Greater Vancouver watersheds, had also reared their heads, each of which were also rejected by the judge:

> Indeed the evidence at trial was strong, from the government's own witnesses as well as from the government's answers to plaintiff's interrogatories, that the road system which has been constructed since 1958 has not been the system which would have been built if intended primarily for fire fighting and control purposes. The road system largely represents roads to timber — not roads to fires. [The Forest Service] "piggybacks" fire roads onto the back of logging roads, because it can get the logging roads built by timber purchasers. Under the Forest Service's theory, to protect the water and the forest, it has to build roads to fight fires; it has to sell timber — lots of it — to get the roads built. Ergo, large-scale timber sales protect the forest. Good logic or not, I hold this theory is not good law.
>
> I have concluded, in summary, that the present logging program in the Bull Run Reserve does not protect the forest, whether from landslide, or blowdown, or insects, or disease, or fire.... Plaintiffs have shown, largely from the reports and studies of the federal defendants, that large-scale logging poses serious dangers to the Reserve. [158]

Arguments stemming from the Forest Service on the catastrophic fire concept became entrenched in U.S. forestry journals and reports, which the 1991 *Final Technical Report* makes partial reference to. [159] The ingenuity in the argument is that logging reduces the residue or fallen natural 'debris' from

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[156] *Final Summary Report*, pages 33-36, 44, 54-56.

[157] *Final Technical Report*, page V-48. Most of the "wind damaged area" was the result of damage directly adjacent to large cutblocks, a detail not mentioned in the report.

[158] Miller vs Mallery, in the United States District Court for the District of Oregon, civil no. 73-609, Opinion by Judge James Burns, March 5, 1976, pages 25-27.

[159] See pages V-44 ff. in the GVWD 1991 *Final Technical Report.*

trees on the forest floor, which will prevent a "hot fire" from destroying sensitive soil layers, the effects of which may lead to erosion of the landscape through the acceleration of water runoff and the transport of fine sediments into the water supply.

> The first objective, reducing risk, is primarily accomplished through fuel management. Within the watersheds this is directed at the conversion of the forest cover to a more fire- resistant condition while maintaining the hydrologic conditions necessary for the continuous production of high water quality. Meeting this goal involves the balancing of potential short term risks to water quality association with road construction and timber harvesting against the long term risk of catastrophic fire. [160]

If you have a problem related to logging in community watersheds, then go to another district which has encountered the same problems and get their advice. That's exactly what the consultants and the Water District did - shared their experiences. Astoundingly, through these arguments comes the inevitable and incredible leap of faith by the Water District's consultants:

> The present condition of the watersheds has a reduced potential for forest fires compared to the unmanaged watersheds existing before the GVWD began its active program in the mid-1960s. [161]

Was this objective actually accomplished, or is there more to the picture which the review panel may have conveniently and purposely avoided? U.B.C. forest science professor Dr. Michael Feller, B.C.'s expert on forest fires, presented contradictory evidence in his May 1991 written submission to the review panel. He assessed that the problems associated with fire in our coastal maritime watersheds are actually increased through logging activities. His three reasons were related to people and equipment, to logging slash left on the ground after logging, and to young plantation forests, whose tight crowns are agents for fast spreading fires.

> The net effect of forest management in the watersheds is to increase the fuel hazard, increase the risk of fire caused by people, and increase the area which can sustain faster spreading fires and more severe crown fires, compared to the existing old-growth forest situation." "The greatest potential for crown fires actually occurs during and just after the period when the tree crowns begin to meet - probably when a forest in the watershed is 30-60 years old. Logging in the watersheds can only lead to a decrease in old-growth forests and an increase in the type of forests with a higher crowing potential. [162]

Dr. Feller's observations, particularly the plantation assessment, are critical to the forest fire debate. Relatedly, it is disturbing to note that there was no acknowledgment from the review panel members on this assessment either in their official response column in the 1991 written submission document, [163] nor in their final report, with the result that there was no application of this enlightening argument in the overall perspective of fire risk assessment in the watersheds. And it is safe to guess why it was never acknowledged, because it contradicted their assumptions about fires. Aside from those concerns, Feller's argument essentially means is that there is now over 4000 hectares of plantation forest with a higher fire hazard rating than the forest that had been logged, a glaring contradiction in the forest fire

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[160] *Final Technical Report*, page V-44.

[161] Ibid., page V-45.

[162] Michael Feller, April 27, 1991 (submission #57), *Greater Vancouver Watershed Management Evaluation and Policy Review Public Input Document*, 1991.

[163] Ibid.

argument.

5.3 THE ECOLOGICAL INVENTORY

Compared to the eight chapters devoted to the fine sediment yield model, there are just 2 for the development of a forest fire hazard model. Apart from the relatively rigorous exercise in obtaining field data on fire history, in assessing 'fuel loading', tabulating data, and then applying this information through computer-based constructs, there was also a concerted effort to determine the effects that a future fire might have on sediment delivery in different areas of the Capilano watershed. The upshot of this entire project is to identify which forests are candidates for logging in order to prevent both a local "hot" fire and the "catastrophic" fire with the object of somehow keeping the forest hydrology and water quality at its premium.

According to the Conclusion in chapter 12 on "Fire History", the consultants found through their reconstruction of the fire history in the Capilano watershed, that:

(1) "catastrophic fires have historically burned at infrequent intervals";
(2) "fire has been a significant disturbance agent in these forests for the past 1,000 years".

This fire history is detailed in Table 12.4 according to date and area burned. The information in this table is incomplete for the period after 1964, where areas burned from escaped slash burns are not shown, nor the very small areas burned by lightning. Nevertheless, let's compare the amount of post-settlement fires in the Capilano (1855-1999) mentioned in Table 12.4, to pre-settlement fires (797-1687) which the consultants have measured through field examinations. Within a 144 year period in the post-settlement era, 1007 ha were burned by people. Within this same period, about 4200 ha were clearcut logged and roaded. This adds up to about 5200 ha of forest affected by fire and logging (an average of 36 ha per year). Over a 900 year period in the pre-settlement time period, 3,356 ha were apparently burned (an average of less than 4 ha per year). Unlike clearcutting and roadbuilding operations, fires in coastal forests do not destroy all of the forest, nor remove it from its location on logging trucks, and disrupt the soils and forest hydrology by building roads.

Based on this analysis, we can easily conclude that the most catastrophic history to the forests in the Capilano watershed has been in recent memory and is human related. In contrast, there is little evidence for the natural catastrophic fire argument. That is not to say that it won't happen, but merely that it hasn't occurred. The findings on the history of fires in the Capilano watershed doesn't seem to meet the "catastrophic" criteria, criteria which is nowhere defined either in the relevant chapters, nor in the *Annex Report's* glossary. There is neither a definition for it in recognized national and academic glossaries, such as the *Glossary of Forest Fire Management Terms* [164] and the *Wildland Fire Management Terminology*. [165] Because the definition is not listed or accepted anywhere, it seems as if anyone can define the term in anyway they so wish. Therefore the only reason the word itself is being applied is undoubtedly related to the introduction of this term in the *Final Summary Report* and to the client, the Greater Vancouver Water District, for purely emotional reasons. This is the same conclusion that the judge reached in 1976 for Portland's Bull Run watershed against the U.S. Forest Service.

Furthermore, we should ask ourselves some other questions on the origin of early disturbances in the Capilano watershed. Three come to mind. The possibility of escaped fires from First Nation peoples

[164] Canadian Committee of Forest Fire Management, National Research Council of Canada.
[165] FAO Forestry Paper #70.

in the watershed is already alluded to in the consultants reports, and this is something that we should keep in mind. Surprisingly, the other two, earthquakes and fierce wind storms, are not considered. A severe earthquake, for which there is evidence of periodic occurrence in the Pacific Northwest, can snap forest roots, injure trees, and bring down sections of the forest. The likelihood of a "catastrophic" fire which occurred approximately 300 years ago, could have been a consequence of a severe January, 1700 earthquake (a scenario suggested by Elaine Golds of the Burke Mountain Naturalists), has apparently not even been considered by the consultants. A severe windstorm can also blow down different sections of the forest, depending on wind direction, velocity, and duration. An escaped fire, from human or non-human causes, in such damaged zones can cause larger fires. Of course, unlike the Water District's present plan to manage the forests for a future catastrophic fire, there is no way that they can manage the forests for an earthquake or a wind storm. Logging through "thinning", which the Water District is presently advocating, actually makes the existing forest more vulnerable to damage from wind storms.

CHAPTER 6

FOREST HEALTH:
FOREST INSECTS AND FOREST DISEASE

QUOTATIONS

We find as follows: 3. The estimated net volume of merchantable timber in the Watershed is approximately 244 million cubic feet, or 1,464 million board feet. 4. The timber stands are generally overmature and are susceptible to insect disease and attacks. 5. The estimated sustained yield capacity of the forest lands in the Watershed is 3.3 million cubic feet of merchantable timber per year. [166]

Insect infestations and disease outbreaks have affected significant amounts of vegetation and forest cover in the watersheds.... This in turn increases the potential hazards from forest fires which can directly and indirectly threaten water quality. [167]

Disease and insect infestations occur more often than fires and two major insect problems have already occurred since the 1930s. [168]

They inventoried or focused only on the insect and on the tree. What ecosystem works that way? Where do you know in a natural ecosystem is there a tree and a insect and nothing surrounds them, and nothing interacts with them? This is an archaic view of forest systems. That comes up very clearly in that document. Everything is focused to one purpose, and that purpose is logging. They missed so much in the way of biosystem dynamics, that I could write a textbook on it. [169]

6.1 BACKGROUND

It is well known in the United States and in Canada that where there is an interest to log on public lands, whether it is in a contentious area or not, that foresters and companies inevitably point to forest insects as an excuse to intervene with logging. The roots of this interventionism go back many decades, but became quite prominent as a focus on "forest health" as a buzz word from United States federal foresters in the late 1980s. In British Columbia, for instance, the frenzy in the 1980s for the extensive logging and roadbuilding in the upper Bowron drainages southeast of Prince George, or the drive to combat the beetles in the Kalum Forest District north of Kitwanga in the late 1980s, etc., were used as a rationale for humans rather than insects to kill trees. In the United States, environmental legislation has developed which allows citizens the right to proceed to the courts to investigate fraudulent proposals to log public lands and to put a freeze on the lands during the proceedings. In Canada, these privileges have yet to be given to the public. When all else failed in the mid to late 1950s to break the legislated policy against commercial logging in an urban community water supply,

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166 *Appreciation of Factors Affecting Watershed Management on the Watershed of the Greater Vancouver Water District*. C.D. Schultz & Co., December 1956, p.2.

167 P.9, *Final Summary Report*.

168 P.52, *Draft Summary Report*.

169 Art Partridge, May 16, 1999. As an entomologist, Dr. Arthur Partridge is Professor Emeritus of Forest Disease and Insect Problems, University of Idaho.

the forest industry used forest insects and the threat of fire as an emotional means to persuade publicly accountable administrators to begin logging these watersheds in the 1960s.

This is an important and relevant topic for the Greater Vancouver watersheds. Therefore, there are two components to this section of the report, namely the initial history of two insect species and subsequent commercial logging in the watersheds, and the present modeling analysis of the hemlock looper in the ecological inventory Annex and Analysis reports.

6.2 THE 1930s HEMLOCK LOOPER AND THE 1960s BALSAM WOOLLY APHID

According to information in the 1991 *Draft* and *Final Summary Reports* about the 1929-1930 outbreak of the Hemlock Looper in the Lower Seymour Valley, it "damaged over 1,620 ha of old growth timber, mainly in the Seymour drainage." [170] A similar analysis is given in the 1993 *Pilot Study* report, with the exceptions that it identified a reference to a December 24, 1930 Water Board report which generalized "extensive mortality on the Seymour River", but with no reference to the total area of 1,620 ha mentioned in the 1991 Summary Reports. [171] However, this information conflicts with relevant Water District correspondence on this matter, information which is not referenced in any GVRD reports on the hemlock looper and its history.

When H.A. Richmond, Officer-in-Charge of the Forest Zoology Unit with the federal Department of Agriculture wrote on February 17, 1955 to Water District Watershed Inspector William Angus, who had been with the Water District since the early 1930s as a watershed ranger, Richmond wanted to determine the "losses of timber in the Vancouver Water Shed by the hemlock looper" to be included in his presentation to a provincial forestry commission (the 2nd Sloan Commission). On February 24, 1955 he received a reply from Commissioner T.V. Berry that the hemlock looper had affected an area of "about 120 acres". [172] In a follow-up letter from Water District engineer Ken Patrick, who had received a memo from William Angus with the details, Richmond was provided with more information on the hemlock looper problem:

> ... a heavy infestation of hemlock loopers occurred in the Seymour Valley starting at a point approximately 2.5 miles north of Seymour Falls. Another much smaller infestation took place to the south of the Falls. The affected areas were approximately 120 acres and 12 acres respectively. It was estimated that from 50% - 80% of the hemlock trees so attacked were killed. These trees started to fall in 1945 and in May 1946 during a heavy wind storm the balance of the looper-killed timber was blown down. [173]

William Angus' February 24, 1955 internal note to Ken Patrick also stated that "a complete and extensive survey and check was carried out in 1954, both for looper and bud worm signs - everything was normal." The same results on forest health was also reported on in 1950 by D.W. Taylor who

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[170] P.10, *Final Summary Report.* There is no reference to where the source of the information is based. The most likely source for both the hemlock looper and the balsam woolly aphid calculations is from the 1969 Management and Working Plan No.1, pages 1: 26-27, with conversions from acres to hectares.

[171] P.2-37, Ecological Inventory *Pilot Study*. The 1930 report states that "the maximum damage has been done within the region of the Dam and Regulating Basin."

[172] City Archives of Vancouver.

[173] Ibid.

conducted an investigation on forest insects in the Greater Vancouver watersheds. [174] These facts contradict many statements by Water District staff, the most recent of which from Water District administrator John Morse to the GVRD's Water Committee during a discussion about why logging began in the watersheds, that insects were posing a large problem in the Greater Vancouver watersheds in the 1950s before the advent of the Balsam Woolly Aphid (or Adelgid, as it is sometimes called).

The relationship between 'injurious' forest insects and the advocation of commercial logging in the Greater Vancouver watersheds was first developed in the latter half of 1959, four years after the C.D. Schultz Co. first proposed that the Water District amend its long term lease with the province to allow sustained yield logging of its protected forests. Former C.D. Schultz Co. employee Kel Blakeney, who had been hired in 1958 to supervise the clearing of the Seymour Reservoir, was the Water District's first forester. In late 1959 and in 1960, Blakeney notified Water District engineers about the potential disadvantages of the Balsam Woolly aphid and encouraged the affected lands to be clearcut logged, despite the fact not all tree species were affected by this pest. As a result, the Water District began conventional clearcut logging and road building on its private lands in the Lower Seymour off-catchment lands in 1961. [175] In 1962, logging began on the privately held on-catchment lands along the eastern shore of the newly formed Seymour Reservoir, where a road had recently been constructed, and on the privately held on-catchment lands in the upper Capilano River Valley in 1964. The areas of clearcut lands were relatively large from the 1960s to the early 1980s, with numerous adjoining cutblocks forming large swaths of denuded areas. Contrary to the heightened concerns about the Woolly Aphid, the cutblocks were not designed to remove specific trees or stands of Balsam (Amabilis Fir), ie., the species affected by the adelgid, but included all mixed old growth commercially valuable forest stands of Western Red Cedar, Western Hemlock, and Douglas Fir, from which the log sale profits were reported in subsequent Water Committee Agendas.

> ... since that time about 1,500 acres of infested forests have been removed and replanted with seedlings.... the net income from the sale of logs for the five year period to the end of 1965 exceeds $1,160,000. [176]

In February 1963, the Water District's Commissioner T.V. Berry privately petitioned the Minister of Lands to allow logging on provincial Crown lands identified in the 999 lease Indenture. This initiated a four year long period of negotiations with the Minister of Lands for a Tree Farm Licence, an agreement eventually signed in March 1967, referred to as the Amending Indenture. During these negotiations, the Water District clearcut logged its private lands in the Seymour and Capilano watersheds. The 1967 logging licence permitted the Water District to roll together its private and Crown leased lands and to make a profit from Crown land timber, well after the initial isolated effects of the Balsam Woolly Aphid had diminished.

It can be argued, given the C.D. Schultz Co.'s controversial proposal to log the watersheds from 1955 onward, that the extent of damage to the watershed forests by the Balsam Woolly Aphid may have been conveniently exaggerated by foresters as a tool to begin logging. Evidence from several sources supports this theory.

> (a) On July 13, 1959, the C.D. Schultz Co. sent a draft 14 page report to an unidentified administrator at the Water District which included recommendations for the Water Board to

[174] Page 2: "... it can be concluded that no immediate threat from forest insects exists at this time." *Report of Forest Insect Survey 1950*, Forest Insect Investigations, Victoria Laboratory.

[175] The Water District was prevented from logging for profit on watershed Crown lands mentioned in its 1927 lease Indenture with the provincial government.

[176] Water District Commissioner's report to the Administration Board, September 9, 1966.

rewrite the 1927 lease Indenture and to initiate sustained yield logging in the Greater Vancouver watersheds. [177] Under section 5 of the report there was no indication that insects were a problem at that time, only that "timber stands are generally overmature and are susceptible to insect and disease attacks".

(b) According to the Water District's consultants in the 1993 Ecological Inventory Pilot Study, there were "no mortality figures reported" for the Balsam Woolly Aphid, only "testimony and photographs". [178] This also corroborates statements by Jerry Carlson of Pherotech, [179] who has carefully studied the issue, that mortality and extent information about the Balsam Woolly Aphid is largely anecdotal and unavailable.

(c) In sharp contrast, the Water District's consultants in their 1991 *Draft* and *Final Summary Reports* provide specifics on the areas, that 2300 ha of forest were affected by the Balsam Woolly Aphid, with no specific indication of which watershed lands were affected, or where this information was retrieved:

> Insects and disease have historically played a major role in defoliating and adversely affecting GVWD forests and as a result the continued presence of snags and damaged vegetation has likely increased the fire hazard over time.... Insect problems are the primary reason [for] the existence of the Amending Indenture and an active management program today. From 1930 to 1967 insects destroyed over 3,920 ha of trees. This included damage from the hemlock looper in the 1930s and by the [introduced] balsam wooly aphid in the 1950s and 1960s. [180]
>
> The present management program was initiated in response to a major insect infestation by the balsam woolly aphid. That infestation occurred in the late 1950s and 1960s and affected timber on 2,300 ha of watershed land, or 4% of the land base. Harvest and salvage of the infested timber was considered necessary by the GVWD and the B.C. Ministry of Forests to check the spread of the insect and to reduce the fire hazard posed by large areas of dead trees. [181]

(d) However, there are some figures available in the Canadian Forest Service's Forest Insect and Disease Surveys for 1959-1963 on the Balsam Woolly Aphid. [182] According to the surveys, by 1962 there were 140 Balsam trees above the Seymour Reservoir, and 111 below the Reservoir with red tops, while logging was in progress. By 1963, there were 236 trees identified with red tops above the Seymour Reservoir area, and 141 below. The reports end in 1963, with comments to the effect that the extent of the aphid attack was petering out, as was happening elsewhere along the coast. There are no total mortality figures for the Seymour watershed, only counts of trees with red tops, which do not indicate mortality. Even if 300 hectares had been logged by 1963, and if we even out the number of red top trees to a total of

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[177] *The Practice of Watershed Management on the Watershed of the Greater Vancouver Water District*, July 13, 1959. Document reference W-74, at the GVRD Library. Under sections 3 and 4 it states that "the estimated net volume of merchantable timber on the Watershed is approximately 244,000,000 cubic feet", and "the estimated sustained yield capacity of the forest lands in the Watershed is 3.3,000,000 cubic feet per year."

[178] P. 2-38, 1993 *Pilot Study*.

[179] Private communication.

[180] P.39, *Draft Summary Report.*

[181] P.4, *Final Summary Report*.

[182] There is no reference to these Canadian Forest Service surveys in either the 1991 *Summary Reports* or the 1993 *Pilot Study* report.

> 500, that leaves an average of 4 red tops per hectare for the remaining 2000 hectares. That would hardly justify the statement that "large areas of dead trees" were present.

Despite the generalized language about the Balsam Woolly Aphid and its effects on the forest cover, it is well known in correspondence, in commissions, and in Water District reports that logging continued in the watersheds because it now had a Tree Farm Licence with an allowable annual cut, which ranged anywhere between 140,000 to 200,000 cubic meters since 1968. For instance, correspondence from B.C. Chief Forester Swannell to W.W. Jeffrey about the Greater Vancouver watersheds, and from forestry consultant David Bakewell in his report to the Water District in 1978:

> One point that does not seem too clear in your draft is the status of the Vancouver watershed. From your draft [page 3] I would infer that what logging is contemplated is only a salvage or sanitation nature. This is not quite the case. To all intents and purposes, the Vancouver Water Board now has a tree farm licence and will be subject to a regular schedule of logging in accordance with a working plan. A preliminary plan has already been prepared and approved. [183]

> The advent of the forest management program [the Tree Farm Licence agreement of 1967] resulted in major changes in GVWD policies and operations regarding timber production. No longer was logging restricted to salvaging of dead and dying trees resulting from insect attacks, fires and blow-downs. Instead, logging was permitted in all mature timber stands where the forest management plan could meet the long term objective of protecting and improving the water yield characteristics of the lands. Thus, the GVWD started a comprehensive Watershed Management Program in place of a restrictive watershed protection program.
> The working plan, designed to ensure perpetual production from the watersheds, is updated every five years. Each year, the GVWD applies for approval of cutting plans for the year ahead.... In turn, this process implies that the GVWD is subjected to the experiences and constraints found on all forest operations in the Lower Coast Region...." [184]

As a result, an entire forestry department and bureaucracy was established within the GVRD which relied upon the continuance of logging within our drinking watersheds. This situation was well recognized and promotionally advocated by the forest industry sector to promote logging in community water supply watersheds in B.C.:

> Vancouver and Victoria watersheds are prime examples of viability of logging in our arguments with other cities and districts. [185]

> It has also been suggested that the timber harvesting should be encouraged in this area because of the influential effect for logging controversies in other watersheds. [186]

Overall, there is sufficient justification to be concerned about the credibility and reliability of information presented to the public on the Hemlock Looper and the Balsam Woolly Aphid in Water District reports, especially on an issue that has been central to the rationale for logging in the Greater

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[183] April 10, 1969, Chief Forester Swannell.

[184] *Overview of the Forest Management Practices in the Watersheds of the Greater Vancouver Water District* , by David R. Bakewell, July 1978 report to the Water District's Administration Board, pages 3-4.

[185] A.C. Markus, Ministry of Forests memo, August 31, 1981.

[186] J.A.K. Reid, Ministry of Forests staff consultant, letter to Assistant Deputy Minister of Forests, September 14, 1981.

Vancouver watersheds. It is of course extremely difficult to find information on this subject since the Water District has so very carefully guarded its internal post-1956 files from public scrutiny.

One of the most important considerations that foresters and engineers at the GVRD have had with regard to the balsam woolly adelgid has been the effect that dead and dying trees would have on the potential for forest fires following lightning strikes. What has been the outcome of the affected areas with regard to fire since the 1960s in areas where there was tree mortality but no logging? Have there been natural fires in these areas over last 40 years? Is the argument justified? If you examine the areas that were identified with the largest component of balsam firs from the C.D. Schultz forest cover maps in Ministry of Environment early files, such as the long obvious slope southwest of Mt. Seymour, the upper western slopes near the Capilano Reservoir, a small area at the bottom southern quadrant of Eastcap Creek, and the upper Balfour Creek area, there have been no incidents of fire in this time period, nor the widespread defoliation that was anticipated.

According to the Annex report, the primary transport of the balsam woolly adelgid is from wind, and from "infestations [that] are common in trees along roads". [187] If this is the case, then clearcutting is also a practice which is responsible for the transport and migration of the adelgid. So with the mitigation practices of the Water District to initially combat the adelgid, and the subsequent logging practices throughout the watershed, it follows that the Water District may in fact be responsible for creating an increase of future adelgid populations. The *Annex Report* also indicates that only stem attacks lead to mortality and that balsam fir over 100 years of age rarely experience stem attacks. This information is also important in understanding the amount of mortality which may have spread to the balsam firs in the 1960s. Overall, the future threat from the balsam woolly adelgid is considered by the consultants to be unimportant and has "a negligible effect upon watershed management objectives". [188]

6.3 THE ECOLOGICAL INVENTORY AND COMPUTER MODELING FOR THE HEMLOCK LOOPER

Shortly after the ecological inventory *Annex Report* was released in February 1999, SPEC became concerned about the nature of the study, because it focused on management options for the Capilano watershed only, and relatedly about a modeling hypothesis for a Hemlock Looper infestation 120 years into the future. Why was the Seymour watershed, which had received a relatively thorough investigation from late 1992 to 1995, not a fundamental component of the *Annex Report*? Why was there a sudden interest to focus only on the Capilano lands and the unqualified impact the Hemlock Looper may have in over a century from now? These questions were addressed when it became apparent that one of the main arguments available to the GVRD for logging these coastal rainforests was related to the juvenile hemlock stands in the Capilano watershed. Under options A and B there was no futuristic threat to the two other watershed forests other than from "forest health" concerns. Apart from the concentration of information in the Annex document on forest fuels and future fires, the hemlock Looper model seems to be the only other opportunity to rationalize the present management philosophy.

The *Annex Report* identifies that among all of the resident insects "the western hemlock looper has the greatest potential to threaten water quality objectives within the GVRD watersheds". Accordingly, "a forest mortality model was only developed" for it, and that "implementing the mortality model across successive time periods (0-200 years past present) can assist in developing long term management

[187] Section 14, page 14-6.
[188] Page 14-27, *Annex Report*.

strategies to mitigate potential looper outbreaks and their impact upon sediment yield and water quality." [189]

But where is the science which supports the model that a major hemlock looper outbreak will occur in the year 2120, and what are the associated vectors for the complexities that support the modeling parameters behind the Hemlock Looper forecast?

There is absolutely no mention or discussion in the *Annex* document about predator-prey relationships associated with the Hemlock Looper, and one cannot make any accurate predictions about an event 120 years into the future without describing the fundamental and complex role that predators would play in that event, and the role that root decay has. There is, for instance, no mention of important group of predators, spiders, and there is no mention of bird species and their role in forest ecology. It is extremely odd that this information is not provided in the *Annex Report*.

On September 18, 1995, when members of the Acres team introduced themselves and their specialities to members of the Regional Water Advisory Committee in a workshop session at the Seymour Dam field house, Jerry Carlson was asked by one of the members about the complexities behind the way in which insects are regulated by predators in the watersheds. He replied that:

> One of the things that I would have liked to do, would be to do a complete arachnid [spider] survey. Spiders are probably the single most important predator out there in the forest environment. The numbers of species is unbelievably daunting. I invited 2 arachnologists, spider specialists, to come out with me. They spent one day with me and three of my more well educated field crew people, and just within an hour were overwhelmed. The amount of taxonomic literature you need to have, and the interpretation of the different spiders and their life stages, and how does their life stage and their egg laying overlap those of the insect species you are interested in. And that is just looking at the spiders. Then if you want to look at the competition factors among the arthropod herbivores, the insect species that feed on plant foliage. We are looking at some incredibly complicated associations. (Audio transcript)

Why are these important factors not even mentioned in the *Annex Report* since, according to the GVRD's consultant, they seem to be a fundamental component to what might shape the future and any modeling vectors with regard to the Hemlock Looper? Is this oversight simply the client's constraint forced upon the consultant? Why is the information not there?

Concerns about a fundamental lack of information in the *Annex* and *Analysis* documents regarding the Hemlock Looper were addressed by Dr. Art Partridge, who was requested by SPEC requested to review the documents and attend the May 15, 1999 forum. [190] As a previous professor at the University of Idaho for 37 years, Dr. Partridge is highly qualified and has peer reviewed many studies in entomology. He has also been called to numerous court cases in the United States as an expert

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[189] Pages 14-8, 14-9.

[190] As an entomologist, Dr. Arthur Partridge is Professor Emeritus of Forest Disease and Insect Problems, University of Idaho. He has more than 40 years of professional experience working with forest problems from the Yukon to Texas and from New Brunswick to California and 37 years of research, extension, administration and teaching experience at the University level. He has taught graduate courses and undergraduate courses in Forest Disease and Insect Problems, Urban Forestry, Research Methods, Soil Biosystems, Wildland Resource Conservation and related topics. His publications include more than 90 papers and include 5 books. Art Partridge came to Vancouver for a press conference on May 13 and for the May 15 public meeting at Robson Square. Quotations and comments from Art Partridge in the report are taken from taped interviews on May 13, 14, 15, and 16, 1999.

witness in trials related to forest insects and logging proposals. With regard to the ecological inventory reports, Dr. Partridge was asked in an interview on May 16 if, during the last 40 years of his professional experience, he had ever come across anything similar to the 120 year forecast of a insect infestation:

> **Question:** In all of the cases that you have seen or heard of, have you ever seen anything quite like what they are predicting here to look forward in the long term future?
>
> **Answer:** No. This is ridiculous. I mean this is just way out. To predict something 120 years from now in terms of a looper outbreak is just nonsense. Remember, these cycles are not chrono-linear, you cannot describe them with a mathematical formula, because they are eruptive. You never know when they are going to happen, or why the eruption happens. Without the data, as I've indicated before, you are not ever going to be able to do that.

Dr. Partridge made it abundantly clear that the information pertaining to the hemlock looper forecast had no basis as a scientific report, lacked a stated hypothesis, never mentioned the predator-prey relationships in the Greater Vancouver ecosystems, and that its purpose therefore seemed to satisfy the client's wishes for a logging program.

> It is not scientific, it does not begin with a scientific base. If you start with science, you start with good observation. That's your inventory. From that observation you develop an hypothesis. The hypothesis in this case - let's use a negative hypothesis - we won't have an outbreak of hemlock looper in the future. Then you test that hypothesis, and see what its statistical inference is. This would be the modeling procedure if it were done properly. That is not the entire test. You would have to take this into the field and then prove it. You see, they stopped at that point, they modeled, they didn't finish the thing at all. They didn't get to the hypothesis, there was no stated hypothesis anywhere.
>
> I think the main thing that I would ask is a description of the model that tells you precisely how it was formulated and how it works. Whether it is simply narrative, mathematical, whether it is curvilinear, or eruptive, and all those things. That is the first thing that I would want to know. And the second thing that I would want to know is specific data that are going into that model along with specific information about the extent of the data. That is, if you are looking at defoliation as a part of that, maybe one vector, how did you measure defoliation, and exactly what are the limits to those measurements, what's the bottom and what's the upper limit of each measurement. This is the scientific method that I am talking about now. I want exact measurements, and I want exact data, and I want to know exactly how they go into the formula. That is how I would start my critique.
>
> When I see a good report I can see the original data that were taken, first of all. I know exactly what was included in the decision-making process. A good report from the "forest health" viewpoint, would have included everything out there that might impact the situation.
>
> If you are going to model something, you have vectors. Each one of these vectors impinges on what the subject is you are talking about, in this case the hemlock looper. Things like weather, parasites, predators, all this.
>
> This insect is part of a food chain, and that bird is part of a food chain too. In a good report you will see that all of these things will be there"

> Spiders are very important in the woods. They are one of your main predators. They keep everything in balance all of the time. Those spiders up there in the woods, each one of them have a function, and many of them have a specific prey that they will take. And that prey may be the very thing that is going to destroy something if it isn't kept under control.
>
> Why was that hemlock looper put there to begin with, and how does it work, and is it indeed a problem? Hemlock Looper is the feed for a great many bird species. Grosbeaks, nuthatches, chickadees. All sorts of birds that feed on these things. Where are they mentioned in this report? Is there one mention? And are they a part of the ecosystem in the minds of these people? Where in the report is something said about the predators and parasites and other interacting entities that are a part of this ecosystem? ... Parts are all important.
>
> They missed so much in the way of biosystem dynamics, that I could write a textbook on it.

It can also be argued that the greatest threat to water quality objectives in the Greater Vancouver watersheds are human "loopers", as only people build roads which disrupt soils and hydrology up steep valleys and beside rivers and streams, who clearcut large sections of forest, who plant monocultures in place of mixed forests, who start fires and are responsible for the spread of insects, forest disease, and forest blow down, and who bring flammable and toxic fuels into the watersheds, and who allow highly explosive natural gas pipelines to be built through its forests. This is not to dispute the possibility of the hemlock looper, but just to bring things into perspective. Perhaps we need to develop a model for the human looper in future equations.

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APPENDIX A

CONTRACT AWARDS AND NET EXPENSE ANNUAL TOTALS FOR THE GREATER VANCOUVER REGIONAL DISTRICT'S ECOLOGICAL INVENTORY PROJECT, 1992 - AUG. 1999

Data compiled from two GVRD freedom-of-information requests. Regarding the information in the table below, $165,457 has been subtracted from the total amount, as this figure relates to contract awards to the three members of the Scientific Review Panel. The total figure of **$6,707,465** differs from the other total of **$6,303,842.23** under contract awards because the freedom-of-information response neglected to provide the actual expenditures for each purchase order, all of which added up to about **$403,623** extra. As a result of a small news feature in the Georgia Straight, October 14-21, 1999, on how GVRD Watershed Management manager Bob Cavill provided a different total for the consultants of $4.8 million for a North Vancouver District Councillor, the GVRD, according to their freedom-of-information officer, are revising the total figure for the consultants for "gray area" expenditures.

NET EXPENSE ACTUALS		**CONTRACTOR**	**PURCHASE ORDER #**	**CONTRACT AWARD - $**
YEAR	**TOTAL - $**	ACRES TEAM	57013	7,490.00
1992	430,589	"	52746	654,138.08
1993	1,421,844	"	A40166	1,784,784.83,
1994	513,090	"	54573	7,407.12
1995	1,028,396	"	53591	8,560.00
1996	1,187,815	"	52191	63,728.13
1997	1,000,717	"	40166	2,630,404.87
1998	1,013,701	"	46880	41,521.35
1999	276,770	"	37155	187,343.09
		"	36280	42,577.60
TOTAL	**$6,707,465**	"	37155	173,640.67
		"	61506	73,962.36
		TOM GRIFFING	52060	182,311.95
		"	40720	445,972.18
			TOTAL	**$6,303,842.23**

APPENDIX B

GREATER VANCOUVER WATERSHED TIME LINE: IMPORTANT DATES

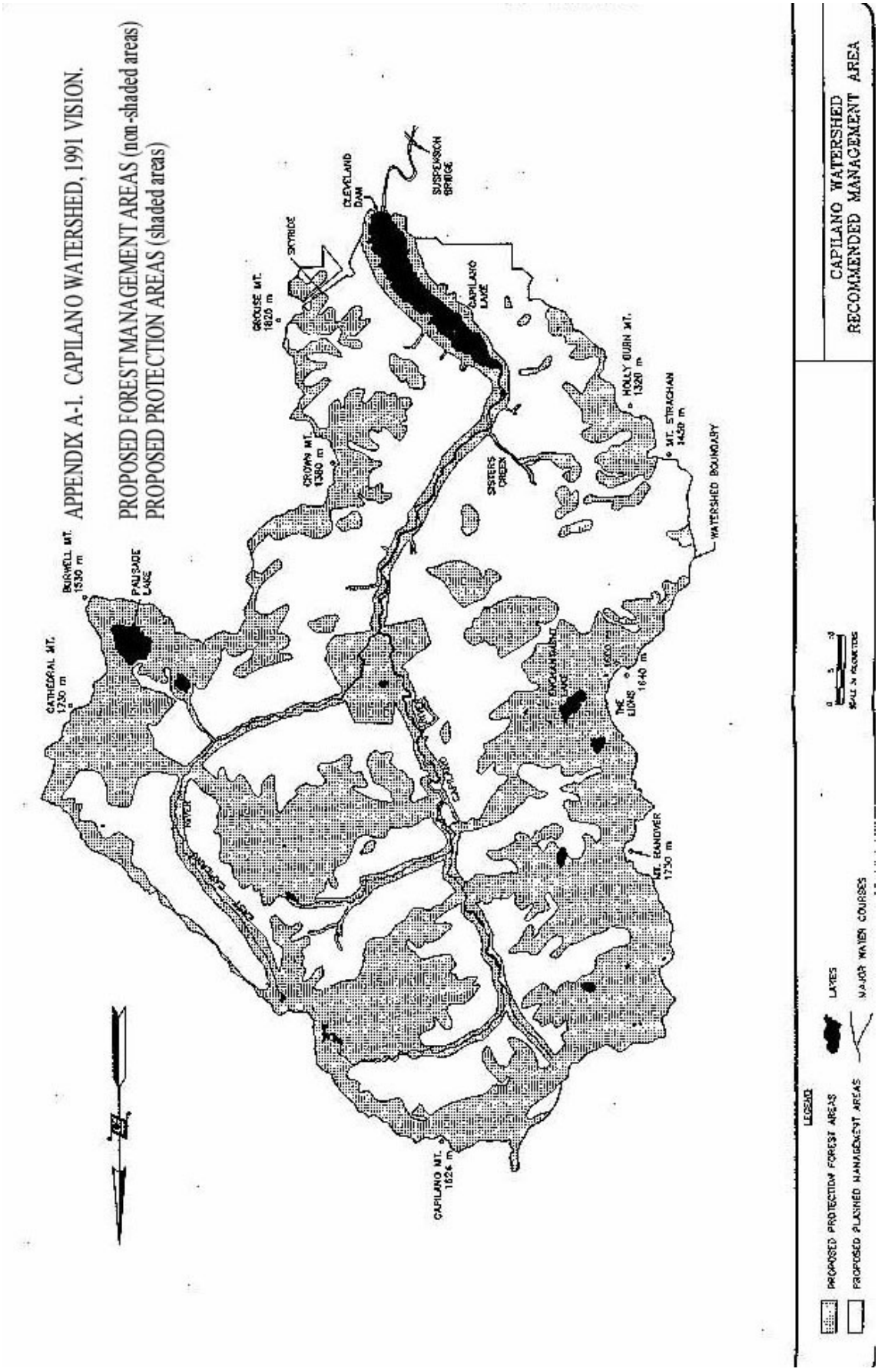
1910	The Coquitlam watershed is protected from logging by a Federal Order-In-Council
1918	The Capilano Timber Company begins railway logging, and is forced out by the Water District in 1931. Extensive clearcutting damages the the main lower valley and Sisters Creek area.
1922	E.A. Cleveland, the provincial Water Rights Comptroller completes a report for the Minister of Forests and recommends an end to logging in the Capilano and future protection of the Seymour.
1924	Rise in public protest against watershed logging. Forest Minister issues another logging permit, raising public ire and attention.
1925	The Capilano Timber starts a 3200 acre fire, startling the Greater Vancouver public. The fire is responsible for forming the Greater Vancouver Water District in 1926.
1927	Creation o f the Indenture: the Water District obtains a 999 year lease from the provincial government under the Land Act, granting control over timber rights, and a no logging policy is established.
1930	The watersheds are protected from mineral exploration and mining.
1931	The Water District negotiates with New Westminster City to incorporate the Coquitlam watershed under its authority.
1942	The Coquitlam watershed Crown lands are transferred to the Water District under the 999 year lease provisions.
1954	Capilano Dam and Reservoir is completed.
1950-1954	The Capilano Highway Debate. Pressures to place a highway through the Capilano by lobbyists are unsuccessful. All municipalities support the Water District's protection of the Capilano.
1953-1956	The C.D. Schultz Co. is hired to conduct an inventory of the watersheds. The Co. attempts to influence the Water District to change its policy from conservation to sustained yield logging, and produces a 2 volume final report in 1956.
1960	Seymour dam and Reservoir are completed.
1961	Foresters convince the Water District to log the Lower Seymour private lands to combat threats of an insect infestation to the watersheds. This threat becomes the rationale for a proposal in 1963 to the Minister of Forests to change the conservation policy to one of logging.
1967	After 4 years of private negotiations, the B.C. government signs the Amending Indenture with the Water District for sustained yield logging and an allowable annual cut, and designates the watersheds as Tree Farm Licence # 42.
1985	Formation of the Seymour Advisory Committee to oppose the park proposal for the Lower Seymour. The Committee designates the area as the Seymour Demonstration Forest in 1987, for a forest industry public relations agenda.
1989	The natural gas pipeline enquiry recommends the approval of a pipeline through the Coquitlam watershed, despite opposition by a majority of GVRD mayors.
1999	The name for the Lower Seymour off-catchment lands designated in 1987 as the Seymour Demonstration Forest changes to the Lower Seymour Conservation Reserve.

APPENDIX C

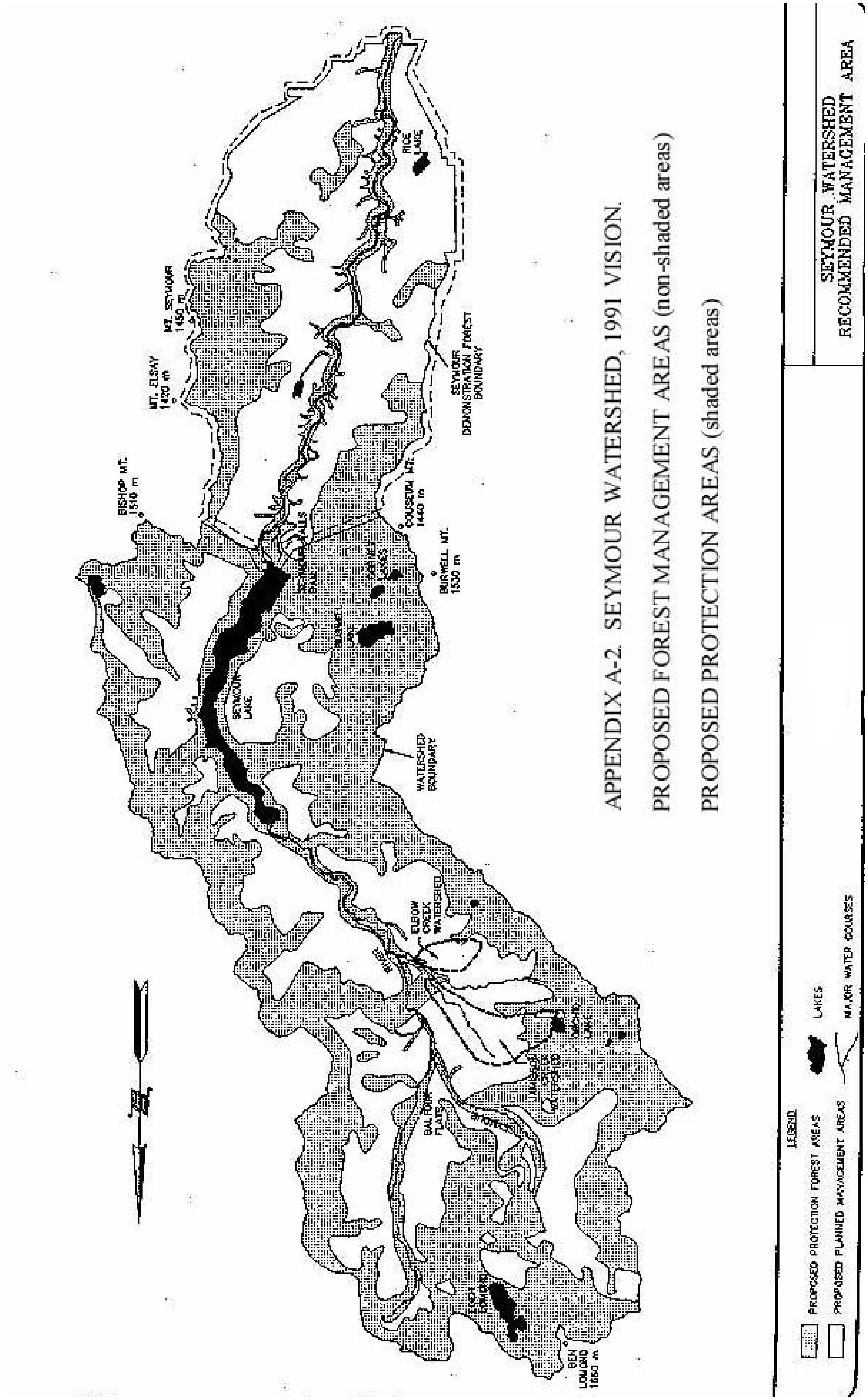
GREATER VANCOUVER WATERSHED TIME LINE: IMPORTANT DATES AND RECENT PUBLIC PROCESSES

1987-1989	The Western Canada Wilderness Committee begins a public campaign on logging in the Greater Vancouver watersheds and creates significant public attention.
1989-1991	Because of mounting public concern the Water District appoints a panel to conduct an internal audit of its watershed management since the 1960's. After a major landslide in the Seymour in November 1990, the panel review becomes public and they release the Draft Summary Report January 1991.
1991	**May** - Two days of public hearings at Robson Square with the public review panel.
	August - The review panel releases its final report with a number of recommendations, including a lower rate of logging, an ecological inventory, and a revision of Amending Indenture.
	November - The GVRD Board pass a number of resolutions based on recommendations from the review panel.
1992	**August** - The ecological inventory process begins with no Terms of Reference.
	November - The Regional Water Advisory Committee is formed. The Committee is to represent public concerns on water quality issues and report to the GVRD's Water Committee.
1993	**March** - The pilot ecological inventory report is completed.
1994	The Water District proposes chloramine as the principal disinfectant. Public opposition to the proposal is widespread, forcing the Water District to consider ozone technology.
	April - Water District staff suggest that the Regional Water Advisory Committee be the only body to review the ecological inventory, in the hopes of bypassing public involvement. The recommendation fails.
	Summer - The Water District begins its watershed tours as a public relations strategy to influence the public on continued logging.
1995	**September** - The GVRD Board pass a resolution to permit public interest groups access to the watersheds, but the provisions make it too restrictive to enter.
	November - The ecological inventory team make their first public appearance before the Regional Water Advisory Committee. The Committee recommends the team produce a comprehensive report, a recommendation not implemented until 1998.
1996	**November** - Water District Commissioner Ben Marr appoints Peter Pearse as chair of the Scientific Review Panel.
1997	**March** - Two final candidates for the Scientific Review Panel are finally chosen: Everett Peterson and Rolf Kellerhals.
	June 28 - The first public workshop with the recently appointed Scientific Review Panel is held. After an attempt by the Water District to rig the meeting, and the process is open to members of the public, an overwhelming majority of participants voice their opposition to future logging, a message not presented to the 1998 GVRD Board by the Water District.
	November - Release of the Methodology Report by the Ecological Inventory team. Still no real information on the collected data.
1998	August 31 deadline for ecological inventory report. The Annex (technical) is Report ready by mid-February 1999.

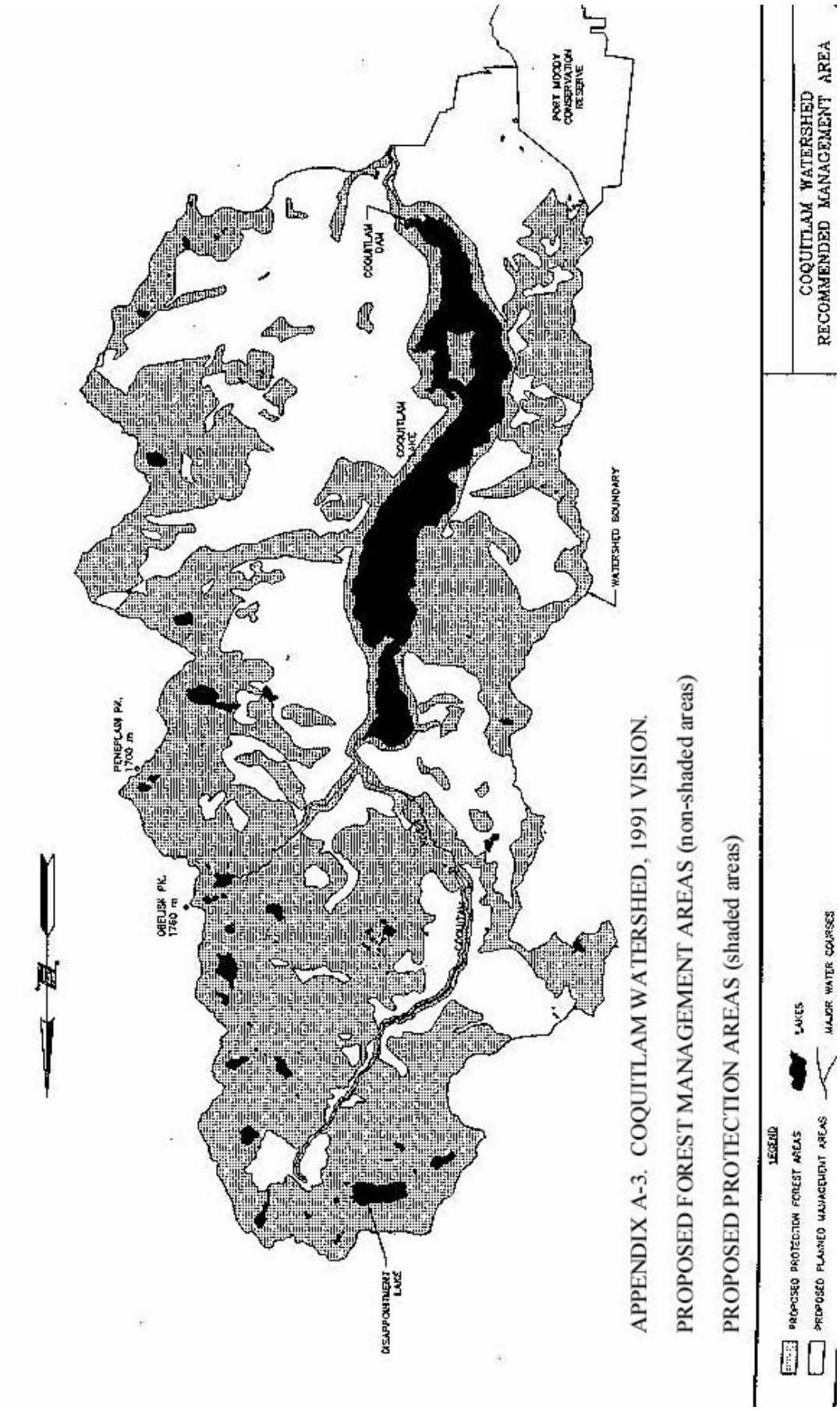
APPENDIX D-1


APPENDIX A-1. CAPILANO WATERSHED, 1991 VISION.
PROPOSED FOREST MANAGEMENT AREAS (non-shaded areas)
PROPOSED PROTECTION AREAS (shaded areas)
CAPILANO WATERSHED
RECOMMENDED MANAGEMENT AREA
LEGEND
PROPOSED PROTECTION FOREST AREAS
PROPOSED PLANNED MANAGEMENT AREAS
LAKES
MAJOR WATER COURSES
SCALE IN KILOMETRES
BURWELL MT. 1539 m
CATHEDRAL MT. 1230 m
PALISADE LAKE
GROUSE MT. 1128 m
SKYRIDE
CLEVELAND DAM
SUSPENSION BRIDGE
CAPILANO LAKE
CROWN MT. 1380 m
SISTERS CREEK
HOLLY BURN MT. 1320 m
MT. STRACHAN 1450 m
WATERSHED BOUNDARY
ENCHANTED LAKE
THE LIONS 1640 m
MT. RANDVER 1230 m
CAPILANO MT. 1626 m

APPENDIX D-2


APPENDIX A-2. SEYMOUR WATERSHED, 1991 VISION.
PROPOSED FOREST MANAGEMENT AREAS (non-shaded areas)
PROPOSED PROTECTION AREAS (shaded areas)
SEYMOUR WATERSHED
RECOMMENDED MANAGEMENT AREA
LEGEND
PROPOSED PROTECTION FOREST AREAS
PROPOSED PLANNED MANAGEMENT AREAS
LAKES
MAJOR WATER COURSES
SEYMOUR LAKE
RICE LAKE
MT. SEYMOUR
1450 m
MT. ELSAY
1420 m
BISHOP MT.
1510 m
COQUITLAM MT.
1440 m
BURWELL MT.
1530 m
WATERSHED BOUNDARY
SEYMOUR DEMONSTRATION FOREST BOUNDARY
ELBOW CREEK WATERSHED
BALFOUR FLATS
BEN LOMOND
1660 m

APPENDIX D-3



APPENDIX A-3. COQUITLAM WATERSHED, 1991 VISION.

PROPOSED FOREST MANAGEMENT AREAS (non-shaded areas)

PROPOSED PROTECTION AREAS (shaded areas)

APPENDIX E

HEALTH CONCERNS FROM TURBIDITY PROMPT FORMATION OF A WATER QUALITY COMMITTEE IN THE 1980's

1983 - First formal reports to the GVRD's Water Committee regarding turbidity from landslides in the Capilano watershed from the Sister's Creek drainage, the area in which the Capilano Timber Company clearcut logged. Complaints of muddy water.

1984 - Vancouver City environmental health and engineering staff complain of "harmful organisms" in water mains, concerns which prompt Medical Health Officer John Blatherwick to report to the GVRD.

1984 - June. First report to the Water Committee on Watershed Management practices since the 1970's.

1984 - December 4. First meeting of newly appointed Water Quality Technical Committee, which consists of member municipality representatives, City of Vancouver Health Department, the Provincial Government, and Water District Staff. Water District engineer John Morse is appointed chair of the Committee. The following subcommittees are formed: Water Testing Programs and Results; Flushing and Cleaning Programs; Disinfection of New and Repaired Facilities; Potential Cross-Connections; Need for Rechlorination and Higher Chlorine Residuals; Corrosion; Water Treatment; Watershed Management.

1985 - **January**. GVRD Board approves "a study of the water quality throughout the supply and distribution systems," and approves a $100,000 budget for the study.

- **March**. Another landslide in the Sisters Creek area with high turbidity.
- **October**. Report to the GVRD states that "the Water District must soon address the problem of high turbidity of the water from Capilano and Seymour Lakes which follows major winter storms."

1986 - **May**. The Water Quality Technical Committee releases its report, *A Preliminary Report on the Status of Water Quality in the Metropolitan Vancouver Area*. Report mentions biofilm regrowth in distribution system: "chlorination alone may not eliminate the regrowth".

1987 - Concerns continue. The Water District hires Economic Engineering Services Inc. to conduct a study on water quality. Terms of Reference for the study: "To address the areas of primary disinfection, secondary disinfection, corrosion control and strategies for dealing with turbidity and bacterial regrowth." The final report, *Evaluation of Region's Drinking Water Quality and Treatment Procedures*, states that:

> "**the major problem associated with the GVWD water sources is excessive levels of turbidity**" [(page 5), and that] "**turbidity, and its impact on disinfection, will be a high priority research item**" (page 7).

APPENDIX F

LIST OF THE ECOLOGICAL INVENTORY PRINCIPAL CONSULTANTS, AND MEMBERS OF THE SCIENTIFIC REVIEW PANEL

Tom Griffing, GVRD ecological inventory project manager, Griffing Consultants Inc.

Scott Hanna, coordinator of the ecological inventory consultants, Acres International Limited.

Bruce Blackwell (fires), B.A. Blackwell and Associates Ltd.

Jerry Carlson (bugs), Phero Tech Inc.

Don McLennan (forest classification), Oikos Ecological Services Ltd.

Ken Rood (sediments), Northwest Hydraulic Consultants Limited.

June Ryder (terrain instability), J.M Ryder and Associates Terrain Analysis Inc.

Timberline Forest Inventory Consultants.

SCIENTIFIC (PEER) REVIEW PANEL

Dr. Peter Pearse. Former U.B.C. professor of Forestry. His consulting business is Pearse Ventures Ltd. Ph.D. in Economics, Edinburgh University, 1962.

Dr. Rolf Kellerhals. Consulting professional engineer in hydrology, geomorphology, sediment production and transport. Kellerhals Engineering Services Ltd. Ph.D, U.B.C. Interdepartmental Program in Hydrology, 1969.

Dr. Everett B. Peterson. Consulting professional forest ecologist. Western Ecological Services Ltd. Ph.D. in Plant Ecology, 1964, U.B.C., Killam post-doctoral fellowship, Faculty of Law, U.B.C., 1970-71.

APPENDIX G

GREATER VANCOUVER WATERSHEDS FACT SHEET

CAPILANO WATERSHED

- Became a water supply in 1886.
- Capilano Reservoir and dam completed in 1954.
- High elevation Palisade Reservoir built in 1928 for summer water supply.
- Total area: 19,535 hectares (ha.) (48,250 acres).
- Area logged 1918-1931: about 3200 ha. (7,900 acres).
- Area logged 1964-1994: about 1250 ha. (includes road right-of-way), on 76 cutblocks.
- Roads built 1964-1992: about 100 km.

SEYMOUR WATERSHED

- Became a water supply in 1907.
- First Reservoir and dam completed in 1928.
- Two summer Reservoirs built: Burwell (1928), and Loch Lomond (1928).
- Present dam and Reservoir completed in 1961.
- Upper Seymour (on-catchment) area: 12,375 ha. (30,566 acres).
- Area logged in Upper Seymour prior to 1962: none.
- Area logged in Upper Seymour after 1962: about 1,300 ha. (3,200 acres).
- Total roads built in Upper Seymour, 1963-1992: about 100 km.
- Lower Seymour, or Lower Sey. Conservation Reserve (off-catchment) area: 5,600 ha. (13,832 ac.)
- Lower Seymour area logged prior to 1935: about 1600 ha. (3,952 acres).
- Area logged in Lower Seymour 1961- 1992: about 800 ha. (1,976 acres).
- Total roads built in Lower Seymour, 1961-1992: about 20 km.

COQUITLAM WATERSHED

- Became a water supply in 1886.
- First small dam completed in 1905, and diversion to Buntzen Reservoir for B.C. Hydro power.
- Present dam and Reservoir completed in 1913, and more water diverted to Buntzen Reservoir.
-Total on-catchment area: 18,370 ha. (45,374 acres).
-Total off-catchment area (Or Creek): 2,091 ha. (5,165 acres)
-on-catchment area logged prior to 1972: almost none.
-Area logged 1972-1993: about 1400 ha. (3,458 acres) on 82 cutblocks.
-Total roads built 1972-1992: about 100 km.

LAND STATUS HISTORY

- 1905 - Provincial government reserves Crown lands in Capilano from alienation.
- 1906 - Provincial government reserves Crown lands in Seymour from alienation.
- 1910 - Federal Order-In-Council protects Coquitlam watershed from all logging.
- 1927 - The Water District acquires 999 year *Land Act* lease agreement (called the *Indenture*) for Crown lands in Capilano and Seymour from the provincial government, to protect the forest lands from future logging.
- 1930 - Water District obtains legislation to protect the watersheds from future mining.
- 1942 - The Coquitlam watershed is protected under the 999 year *Land Act* lease agreement.
- 1967 - The Water District amends the 1927 lease agreement (called the *Amending Indenture*) which requires the District to log the watersheds forests under the authority of the Ministry of Forests. The Water District can cancel the *Amending Indenture* at any time.

APPENDIX H

JUNE 11, 1997.

AN OPEN LETTER TO NORTH VANCOUVER DISTRICT MAYOR DON BELL, GVRD WATER COMMITTEE CHAIR, FROM WILL KOOP.

Re: First Public Workshop for June 28th, on the future management of the Greater Vancouver watersheds.

Last week, on Tuesday June 3rd, I received a letter on GVRD letterhead, dated May 29th, to register for the public consultation workshop scheduled for June 28th, the Saturday of the Dominion Day long weekend. This letter of invitation was sent to previous participants on watershed tours, excluding other members of the public from registering. On the following two days I received telephone calls from individuals who were quite upset after calling in to the Water District to be told that they were not allowed to register for the meeting, because they were not on the Water District's invitation list. I was also told that the Water District would not be advertising the public meeting in the newspapers until about the weekend of June 20th. I tried contacting yourself and other municipal representatives late last week about this matter, but many were away on a conference in Ottawa.

The letter sent out by the Water District to watershed tour participants to register for the workshop on the long weekend was sent the day before the GVRD Board meeting. This was a calculated decision by the Water District, who did not seek approval from the Board about these matters. I would ask you to enquire who was responsible for setting this date and for selecting only watershed tour participants to register in advance, recognizing that there is limited seating space available. This is a very serious matter. Would members of the Board have approved a critical public workshop on a selective basis and on the Dominion Day long weekend? I think not. This is when public schools have just completed their year and when many families go on holidays. The GVRD's own poll indicates that watershed logging and water quality are significant public concerns, and this tactic by the Water District is an affront to the public, particularly since the issue to be decided at this meeting is significant with regard to the future course of logging in the watersheds. The decision will be made whether to continue with the reactive logging over the last four years, or whether to reestablish the proactive logging, which has been strongly opposed by all the environmental groups. As Chair of the Water Committee, you ought to inform all municipal mayors and councillors to attend this important public meeting.

Since last week, because of legitimate public complaints, the Water District has suddenly changed its plans and has allowed all members of the public to register. On Monday, June 9th, the Water District placed an advertisement in the Vancouver Sun and Province for the June 28th workshop. The Communications Department stated that advertisements were not published in local municipal newspapers because of budgetary constraints. In contrast, the Communications Department advertised the summer Watershed Tours in some of the local community newspapers in mid-May. Clearly, the Water District seems to be placing more importance and funding on Watershed Tours than this critical public workshop.

I understand that the draft background report for this public workshop won't be ready until about a week before the meeting. This draft document should not go out to the public before the Regional Water Advisory Committee, the GVRD Water Committee, and the GVRD Board have had an

opportunity to obtain and consider it. This procedure is clearly unacceptable. I also understand that a separate Draft Issues and Options Report, on the future management of the Greater Vancouver watersheds, was recently sent by the Water District to the Ministry of Forests for their review. Will you be able to receive a copy of this report and make it available for the Water Committee and the public for their review before the first public meeting?

To summarize, the following are the important concerns I have about the process for this first public workshop:

1. The initial intention of the Water District to exclude the public at large, without the consent of the Water Committee and the Board;
2. That the workshop is to be held on a long weekend, without the consent of the Water Committee and the Board;
3. That the workshop has not been advertised in local community newspapers;
4. That the Regional Water Advisory Committee has not met to discuss the planning and format of the public workshops;
5. That the public will not receive the background report for the workshop until one week before the meeting, meaning that the Regional Water Advisory Committee, the Water Committee, and the Board have not had an opportunity to review the report.

It is in the public's interest that the Chair of the Water Committee seriously consider canceling this first public workshop and to schedule it for a more appropriate time. Perhaps the meeting could be extended to two meetings, giving the public an option on which day it would be more convenient to attend. I think that it would be appropriate for the Chair to call upon the Regional Water Advisory Committee to meet and discuss this issue and receive their recommendations before going to the public. These concerns were already mentioned in my May 21, 1997 letter to you, from which I have yet to receive a reply, a copy of which I also sent to all GVRD Water Committee and Board members.