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SOME ASPECTS OF THE WATER QUALITY OF THE  
UPPER FRASER RIVER BASIN, BRITISH COLUMBIA

Paul H. Whitfield  
Project Scientist

Water Quality Branch  
Inland Waters Directorate  
Vancouver, B. C.

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"Apart from slight seasonal and geographical variations, the composition of the water in the (Fraser) river system is very uniform. Water turbidity however, varies greatly with stream flow and shows a large increase during spring."

British Columbia Research Council 1952

### Abstract

Water quality data collected over a 21 month period from thirty-one sites within the Fraser River basin upstream from Hope are analysed. These data were found to be skewed, making central tendency statistics inadequate. Natural logarithmic transformation of the data proved to be a partial solution.

Using cluster analysis techniques these 31 sites were found to form clusters of sites which had similar properties. These groupings were found to be related to geographical location.

Three types of parameters were found to exist; some being directly related to discharge; some being inversely related to discharge, and some being independent of discharge. The relationships with discharge are non-linear and are believed to exhibit a seasonal differential rate of transport thought to be hysteresis.

## CHAPTER 1 - INTRODUCTION

The water quality of the Fraser River system from Hope to the headwaters in the Rocky Mountains was examined by the Water Quality Branch, Pacific and Yukon Region, between April 1975 and December 1976. The program was initiated to examine variations in water quality at different locations within the river system and to provide a basis for establishing water quality objectives for the basin as a whole. The primary aims of the study were to:

1. determine the degree of uniformity in water quality within the system;
2. examine techniques to subdivide the basins into sections with similar chemical conditions;
3. examine interdependence amongst water quality parameter; and
4. identify relationships between water quality parameters and discharge.

Based on data from a large number of mainstream and tributary stations an attempt was made to divide the Fraser River system into segments with common chemical properties. Differences between mean concentrations; inter-dependence amongst chemical parameters, and relationships between chemical properties and discharge were investigated in the hope of gaining a better understanding of the mechanisms affecting water quality within the system.

A project which attempts to evaluate a large number of rivers on a synoptic basis is faced with a number of limitations. In this study, time limitations affect two aspects of the study. Since the period of data collection was limited to twenty-one months, one could question the manner in which the data represents a broader time period. This is a limitation which affects all such studies, and one must be content with the data as the best available. The second limitation with respect to

time is the potential for temporal variation to exist both at a particular station, and between the various stations. Sampling of the 31 stations normally took five days in summer and six in winter. We have had to assume that temporal variation at each station and over each sampling period was negligible in respect to spatial and seasonal variation.

Analytical limitations also exist, particularly with respect to the number of samples which may be analysed. In this respect, compromises must be reached and these are reflected in the distribution of samplings.

One is also forced to make compromises when one wishes to take representative samples from a large number of locations over short periods of time. The logistical problems are particularly evident during winter when general travel conditions are poor and the effort required for sampling is increased. We were forced, at times, to omit some stations due to physical limitations, however, these were kept to a minimum.

The present report is organized in the following manner. Chapter 2 describes the study area, sampling methods, analytical techniques, and statistical methodology. Chapter 3 describes the variations in mean condition of water quality of the mainstream of the Fraser River and its tributaries. Chapter 4 describes the interdependence of water quality parameters and examines the relationships of various parameters to discharge. Chapter 5 attempts to relate the variations described in the previous three chapters to water quality objectives.

## CHAPTER 2 - STUDY AREA AND METHODS

### I. STUDY AREA

The Fraser River flows northwestward from its source in the Rocky Mountains, through the Rocky Mountain Trench and Caribou Plateau. At Prince George it changes direction southwards and eventually crosses the coastal mountains through the Fraser Canyon and into the Pacific Ocean. The downstream boundary for the present study was chosen at Hope where the river leaves the Fraser Canyon and enters the lower Fraser Valley.

The total distance the river covers from its headwaters to its mouth is 1400 km. It drains a total of  $233,100 \text{ km}^2$ , being the largest river in British Columbia. The long term mean annual discharge recorded at Hope is  $2700 \text{ m}^3/\text{sec}$ . (96,000 cfs).

The largest portion of the drainage basin is a plateau comprised primarily of recent sediments. The eastern edge of the basin, where the headwaters rise, lies in the highly fold paleozoic sedimentary formations of the Rocky Mountains. The western boundary of the basin is the coast mountains which are a great mass of igneous rocks termed the coast batholith.

In this study we have considered that portion of the basin upstream from Hope. This examination has been restricted to a series of locations along the mainstem of the Fraser River and a number of its tributaries. The tributaries are considered only as contributors to the Fraser River, and not examined as separate systems.

### II. STATION SELECTION

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### II.I. Fraser River Mainstem

The initial survey taken during April 1975 sampled the Fraser River where access to the river was readily obtained. A review of that data suggested that additional stations were required in the uppermost portion of the basin, where large differences in water quality were noted. One of the original stations was eliminated because of its unsuitable location. In the remainder of the sampling trips we attempted to collect samples from fourteen locations on the mainstem of the Fraser River. The locations of these are shown in Figure 1.

## II.2. Tributaries

In the initial survey, samples were collected from only four tributaries; the Thompson River, Nechako River, Quesnel River, and Bowron River. These had been chosen because of a preconceived importance based on the magnitude of recorded discharge and because of their large drainage areas.

Additional tributaries were sampled on all subsequent sampling trips. These were selected on the basis of a number of criteria:

- (a) where discharge records were available, the size of the river relative to the Fraser at the nearest gauged site was considered. This suggested that the sampling of smaller tributaries would be useful at the upper end of the basin;
- (b) obvious physiographic differences suggested that smaller tributaries in different regions should be considered; and
- (c) ease of access to collect samples. Some tributaries were not sampled because of conditions which made sampling difficult, particularly in winter. Some important tributaries such as the McGregor, West Road and Chilcotin were omitted for this reason.

In the end, we had collected data sets which we considered to be adequate for analysis from seventeen tributaries. The locations of these are shown in Figure 1.

Figure 1 - The Fraser River Basin showing the locations of mainstem stations (●) and tributary stations (○). The number beside the symbols correspond to:

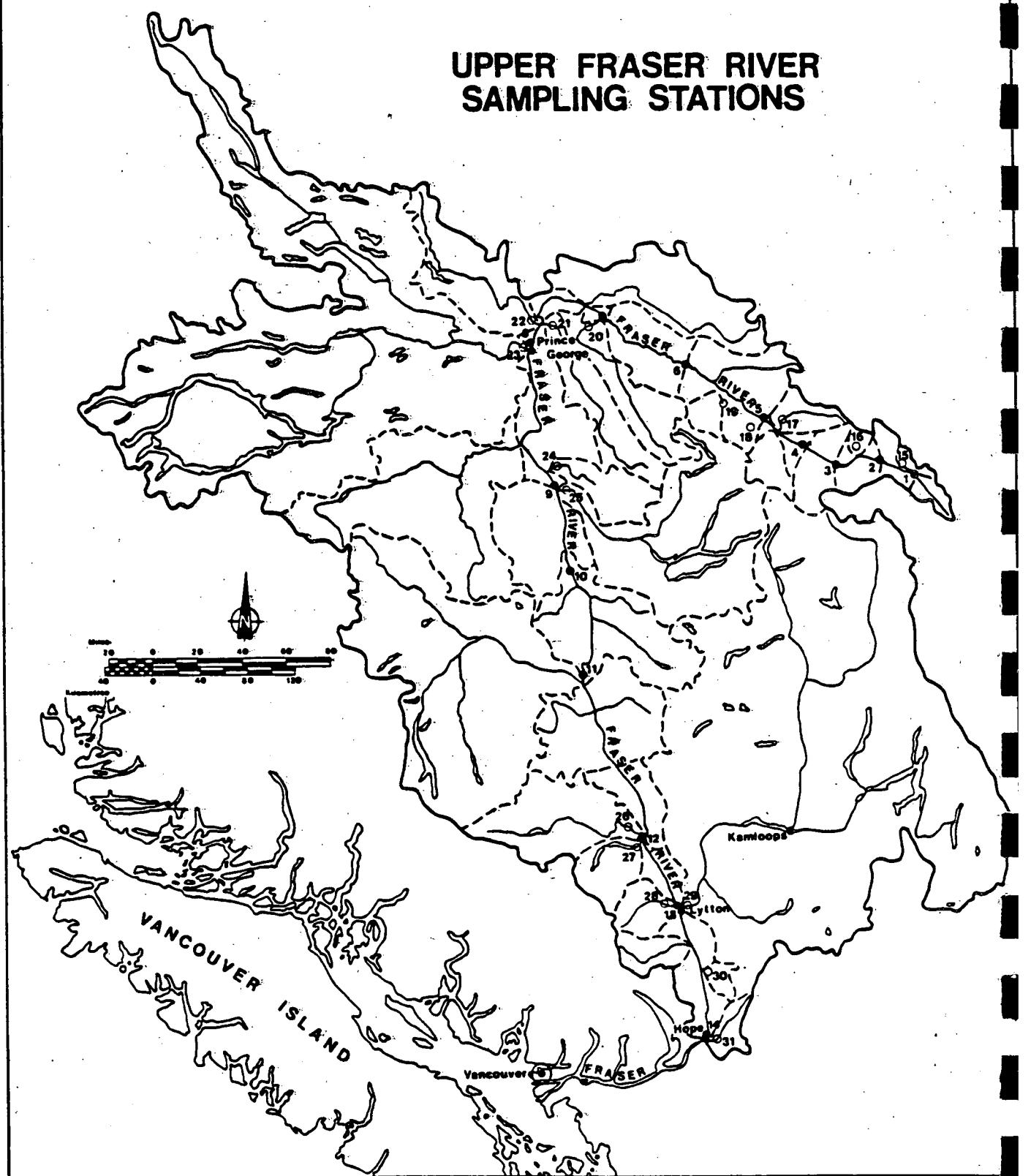
Mainstem

1. Fraser River near Jasper
2. Fraser River at Red Pass
3. Fraser River at Tete Jaune Cache
4. Fraser River at Dunster
5. Fraser River at McBride
6. Fraser River at Dome Creek
7. Fraser River at Hansard
8. Fraser River at Intercontinental Pulp
9. Fraser River at Quesnel
10. Fraser River at Marguerite
11. Fraser River at Chilcotin Highway
12. Fraser River at Lillooet
13. Fraser River at Lytton
14. Fraser River at Hope

Tributaries

- |                  |                      |                      |
|------------------|----------------------|----------------------|
| 15. Moose River  | 21. Willow River     | 27. Seton River      |
| 16. Robson River | 22. Salmon River     | 28. Stein River      |
| 17. Beaver River | 23. Nechako River    | 29. Thompson River   |
| 18. Dore River   | 24. Cottonwood River | 30. Anderson River   |
| 19. Goat River   | 25. Quesnel River    | 31. Coquihilla River |
| 20. Bowron River | 26. Bridge River     |                      |

## UPPER FRASER RIVER SAMPLING STATIONS



### III. Sample Collection

At each station samples were collected using a 2 liter bottle frame and the IWD replicate sampler from as close to midstream as was practical. At all stations a two liter sample was collected for the determination of turbidity, colour, pH, conductivity, alkalinity, hardness, calcium, sulphate, sodium, potassium and chloride. A set of six replicate samples were collected directly into glass bottles for determination of total phosphorus. Six replicate samples were collected in ~~in~~ polyethylene bottles for determination of nitrate plus nitrite and ammonia. Determination of silicate concentration was done on two of these six samples. Two samples were collected into 250 ml polyethylene bottles to which 0.5 mls of <sup>NH4C ACID</sup>  $\text{HNO}_3$  was added. These samples were analysed for the following trace metals; copper, zinc, lead, iron and manganese.

At stations on the mainstem of the Fraser River, and on the major tributaries, four replicate 500 ml samples were collected for determination of total and fixed non-filterable residues. This additional sampling was done only periodically at some of the minor tributaries.

### IV. Chemical Determinations

The methods used in performing the chemical determinations are listed in Table 1. All analytical work was performed by Analytical Services Division, Water Quality Branch, Pacific and Yukon Region.

### V. Discharge Measurements & Sediment Data

Discharge measurements used in the accompanying analysis were obtained from the Water Survey of Canada publication "Surface Water Data - British Columbia" (1976, 1977).

TABLE 1. ANALYTICAL METHODS

<u>Parameter</u>	<u>Method</u>	<u>Reference</u>
Turbidity	Photometrically	Inland Water Directorate 1974
Colour	Spectrophotometrically	Inland Water Directorate 1974
pH	pH meter	Inland Water Directorate 1974
Conductivity	Conductivity meter	Inland Water Directorate 1974
Alkalinity	$\text{H}_2\text{SO}_4$ titration	Inland Water Directorate 1974
Hardness	EDTA titration	Inland Water Directorate 1974
Calcium	EDTA titration	Inland Water Directorate 1974
Sulphate	Colourimetry (AAII)	Inland Water Directorate 1974
Silicate	Colourimetry (AAII)	Inland Water Directorate 1974
Chloride	Colourimetry (AAII)	Inland Water Directorate 1974
Sodium	Flame photometry	Inland Water Directorate 1974
Potassium	Flame photometry	Inland Water Directorate 1974
Nitrate+Nitrite	Colourimetry	Technicon Instrument Corp. 1972
Ammonia	Colourimetry	Inland Water Directorate 1974
Total Phosphorus	Colourimetry	Technicon Instrument Corp. 1971
Copper	Atomic absorption spectrophotometry	Inland Water Directorate 1974
Zinc	Atomic absorption spectrophotometry	Inland Water Directorate 1974
Lead	Atomic absorption spectrophotometry	Inland Water Directorate 1974
Iron	Atomic absorption spectrophotometry	Inland Water Directorate 1974
Manganese	Atomic absorption spectrophotometry	Inland Water Directorate 1974
Total nonfilterable Residue	Gravimetrically	Inland Water Directorate 1974
Fixed nonfilterable residue	Gravimetrically	Inland Water Directorate 1974

*' Analytical II methodology*

*Class*

VI. Sediment Data

Suspended sediment measurements considered in this report were initially obtained as prepublication data from Water Survey of Canada. These have since been published. (Water Survey of Canada, 1976, 1977, 1978, 1979).

VII. Data Analysis

All data reduction and analysis were performed at The University of British Columbia Computing Center. This is an IBM 370/168 operating under Michigan Terminal System.

VII.1. Data Transformations

All statistical calculations were performed on the natural logarithmic ( $\ln$ ) transformations of the data. The transformation accomplishes several desirable items; it makes the variance independent of the mean; precludes zero from the confidence interval; and makes the confidence interval assymetric about the geometric mean. Values reported are the antilogs of the mean and standard deviation of the  $\ln$ -values. These are the geometric mean ( $\bar{x}$ ) and  $\lambda$  respectively. The confidence interval about  $\bar{x}$  are  $\bar{x} \pm \lambda$  and  $\bar{x}/\lambda$ .

VII.2. Statistical Analysis of Mean Condition

One aspect of interest (a priori) was the differences in mean condition between stations. Amongst the mainstem stations the interest was in pairs of stations in the order that the stations occur along the river. In other words, we were interested in the occurrence of significant transitions in mean concentration. The tributary stations can be considered to be logically independent of each other, based on the lack of interaction between them. Thus, we must consider the differences between all pairs.

In both instances the statistic used was

$$t_b = \frac{\bar{t} \ln \bar{x}_1 - \bar{t} \ln \bar{x}_2}{\sqrt{\frac{(n_1-1) * s^2_1 + (n_2-1) * s^2_2}{n_1 + n_2 - 2}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where  $\bar{t} \ln \bar{x}_i$ ,  $s^2_i$ , and  $n_i$  are the mean of the  $\ln$  transform of the concentration measurements, its variance, and the number of samples respectively. This is in fact equivalent to

$$t_b = \frac{\bar{R}_1 / \bar{G}_2}{\sqrt{\frac{(n_1-1) * \lambda_1^2 + (n_2-1) * \lambda_2^2}{n_1 + n_2 - 2}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

The value of  $t_b$  is evaluated with  $(n_1 + n_2 - 2)$  degrees of freedom.

### VII.3. Cluster Analysis

One technique which seeks to separate data into constituent groups is cluster analysis. The result of a cluster analysis is a number of clusters or groups. Cases are clustered using average distance as a measure of similarity. Two cases having the shortest distance between them (Euclidean) are amalgamated (clustered) and become treated as one case having properties which are the average of the members of the cluster. The clustering process is complete when all cases have been amalgamated into one cluster.

In the present application of this method we chose nine parameters <sup>which</sup> exhibited apparent variation among all the stations and which could be ~~deemed to be~~ independent of each other. Those used were turbidity, chloride, calcium, sulphate, total phosphorus, nitrate plus nitrite, iron, silicate and sodium.

These parameters have different magnitudes, ranges, and units of measurement. <sup>Using the original data,</sup> ~~In the raw form~~, certain of these would carry more weight due entirely to the magnitude of its value. This difficulty is overcome by standardizing each variable to zero mean and unit variance by

$$(\bar{x}_i - \bar{x}_{all}) / SD_{\bar{x}_{all}}$$

The distances between cases  $C_1$   $C_2$  are computed by

$$D^2_{C_1 C_2} = \sum_j (x_{C_1j} - x_{C_2j})^2$$

Where  $x_{ij}$  is the standardized value for the  $C^{th}$  case,  $j^{th}$  variable.

The two cases with  $D^2$  minimum (i.e. the shortest distance) are grouped into a cluster. This cluster is treated as a new case with the variable values being the weighted average of the member of the cluster. In the actual analysis performed we used BMDP2M (DIXON, 1975).

#### VII.4. Correlation Analysis

Correlation analysis was performed to determine whether pairs of variable were interdependent (covarying) or statistically independent. In this analysis, no distinction is made between independent and dependent variables. The basis of the analysis is the assumption that the two variables are both effects of a common cause.

This analysis was performed on the ln transform of the concentration data. Pearson's product-moment correlation coefficient is commonly used as a measure of covariance (Sokal and Rohlf, 1969). This coefficient requires that the relationship between the variables is linear, and that the pair of variables have a binormal distribution.

The product-moment correlation coefficient ( $r$ ) ranges in value from +1.0 for a perfect association, to -1.0 for perfect negative correlation. The calculation of  $r$  for a pair of variables  $X_j$  and  $X_k$  requires the following computations:

$$\Sigma x_j^2 = \sum_i x_{ji}^2 - \frac{(\Sigma x_j)^2}{n}$$

$$\Sigma x_k^2 = \sum_i x_{ki}^2 - \frac{(\Sigma x_k)^2}{n}$$

$$\Sigma x_j x_k = \sum_i x_{ji} x_{ki} - \frac{(\Sigma x_j)(\Sigma x_k)}{n}$$

$$\text{and } r = \frac{\Sigma x_j x_k}{\sqrt{\Sigma x_j^2} \sqrt{\Sigma x_k^2}}$$

The significance of  $r$  is determined by the F-test of independence where

$$F = \frac{r^2 (n-2)}{1 - r^2}$$

where  $n$  is the number of observations of the parameter pair  $(X_j \text{ and } X_k)$ . The value of  $F$  is evaluated with 1 and  $n-2$  degrees of freedom.

#### VII.5. Regression Analysis

In initial considerations of the dependence of parameter concentration on discharge it was decided that some benefit was to be obtained from examining whether or not a functional relationship existed. To test for a functional relationship a linear regression between ln-concentration and ln discharge was used.

In using the regression the following have been assumed;

- (a) the independent variable (discharge) is measured without error.
- (b) the expected value for the dependent variable ("y") for any value of the independent variable could be described by the linear function
$$Y = \alpha + \beta X$$
with slope  $\beta$  and intercept  $\alpha$ .
- (c) for any given value of the independent variable, the dependent variables are independently and normally distributed. This can be represented by
$$Y = \alpha + \beta X + \epsilon$$
Where  $\epsilon$  is a normally distributed error term with a mean of zero.

- (d) The samples along the regression line are assumed to be homoscedastic. In simpler terms, the samples have a common variance which is the variance of the  $\epsilon$ 's and that variance is constant and independent of the magnitude of either the dependent or independent variable.

With X representing the independent variable and Y the dependent variable, the following computations are required

$$\Sigma X; \Sigma X^2; \Sigma Y; \Sigma Y^2; \text{ and } \Sigma XY$$

The means, sums of squares and sums of products are:

$$\bar{X} = \Sigma X/n$$

$$\bar{Y} = \Sigma Y/n$$

$$\Sigma X^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{n}$$

$$\Sigma Y^2 = \Sigma Y^2 - \frac{(\Sigma Y)^2}{n}$$

$$\text{and } \Sigma XY = \Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{n}$$

The regression coefficient b, an estimate of  $\beta$  is

$$b = \frac{\Sigma XY}{\Sigma X^2}$$

The explained sum of squares is

$$\hat{\Sigma y}^2 = \frac{(\Sigma XY)^2}{\Sigma X^2}$$

and the unexplained sum of squares is

$$\Sigma d_{y,x}^2 = \Sigma Y^2 - \hat{\Sigma y}^2$$

Our primary interest in this analysis is in testing the assumption that the relationship is linear. This was done by testing for a significant proportion of the variation in y being explained by variation in x. The analysis of variance of the portioned sums is:

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES
EXPLAINED BY REGRESSION	1	$\sum \hat{y}^2$	$S^2 \hat{y}$
UNEXPLAINED ERROR	n-2	$\sum d^2_{y,x}$	$S^2_{y,x}$
TOTAL	n-1	$\sum y^2$	$S^2_y$

The significance test used is  $F_s = S^2 \hat{y} / S^2_{y,x}$  for the null hypothesis

$H_0: \beta = 0$ . If  $F_s$  is greater than  $F_{\alpha} [1, n-2]$  a significant portion of the variation of the dependent variable is explained by regression on the independent variable discharge.

## CHAPTER 3 - VARIATIONS IN MEAN CONDITIONS

### I. DEALING WITH SKEWED DATA.

Most of the water quality parameters for which data was collected were found to be skewed. This results in central tendency statistics such as means, variances and t-test being inadequate in data evaluation. In order to overcome this problem all data evaluation was performed using the natural logarithmic transformation of the original data. Data is, however, reported in the antilog form.

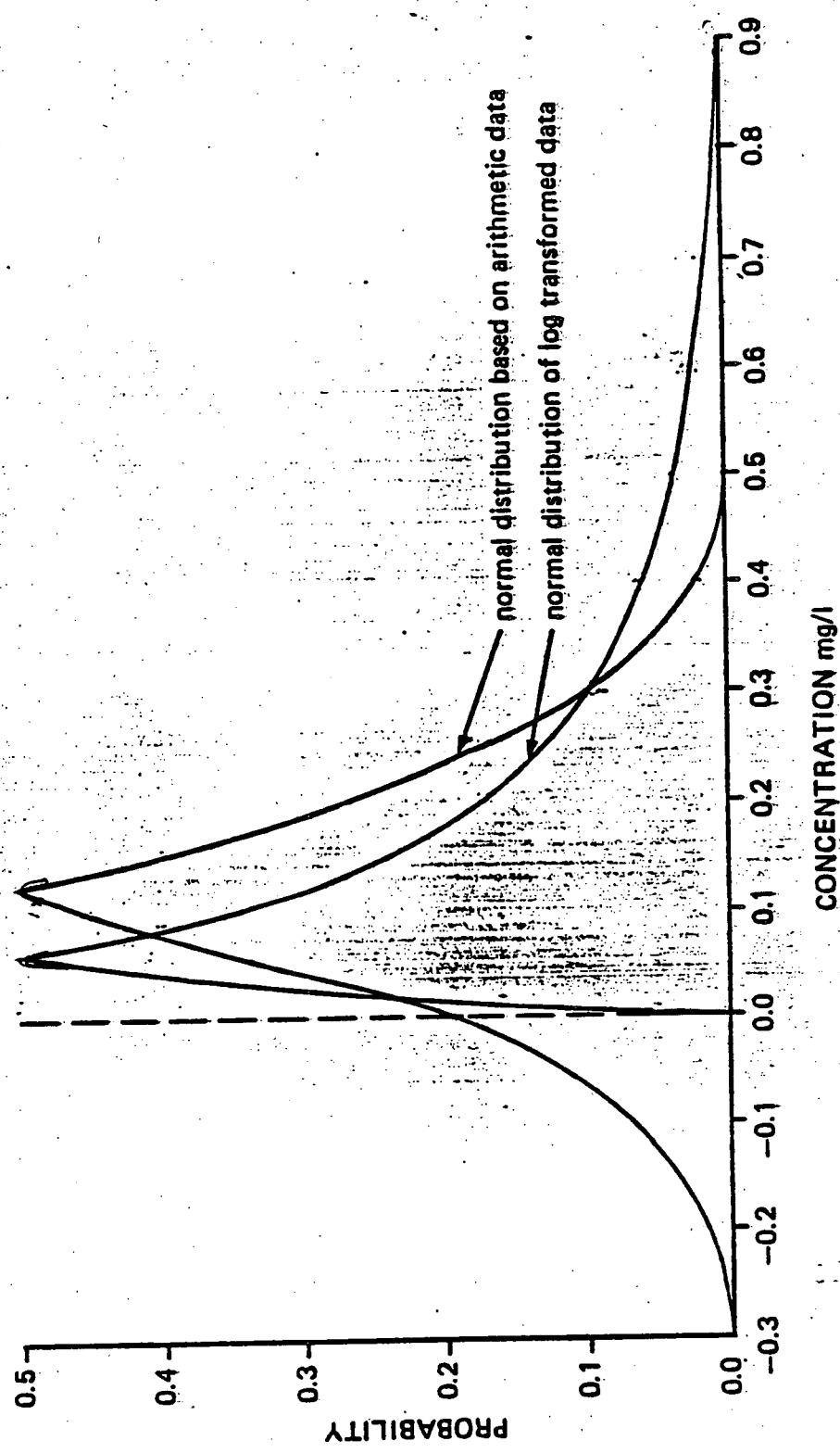
The manner in which data is distributed has a marked effect on the manner in which it can be interpreted. To emphasize these effects, some statistics are compared in Table 3.1. When the data is skewed there are a number of effects that the use central tendency statistics have which are critical in evaluation:

- (a) overestimation of mean concentration;
- (b) symmetrical confidence limits; and hence
- (c) inadequate probabilities of high values.

Table 3.1 and Figure 3.1 show the differences between the arithmetic form and ln-transformed normal distributions for one parameter. In this case we can see that there is a <sup>substantial</sup> large difference between the mean concentrations of the two theoretical distributions, based on the same data set. It is important to note two features of the probability distribution shown in Table 3.1 and graphically in Figure 3.1. There is, for the arithmetic data, a 20% probability of obtaining a concentration value of less than or equal to zero. For ln-transformed distribution this probability is zero. At higher concentration values the probabilities for arithmetic distribution are very much less than for the ln-transformed.

**TABLE 3.1. COMPARISON OF THEORETICAL NORMAL DISTRIBUTIONS**

	<u>UNTRANSFORMED</u>	<u>Tn-TRANSFORMED</u>
mean	0.117	0.064
s	$\pm 0.138$	3.228
95% confidence interval		
upper	0.387	0.405
Lower	-0.153	0.010
probability of obtaining a value		
<0.0	.20	.00
>0.1	.55	.35
>0.2	.27	.17
>0.3	.09	.09
>0.4	.02	.06
>0.5	.004	.04



The choice of a theoretic distribution is a critical decision which affects many aspects of interpretation. As a theoretical example, consider an objective or criteria of 0.2. For the arithmetic normal distribution one would expect that 20% of the data values obtained would be less than 0 and 27% of the values would exceed the criteria/objective. With the ln-transformed normal distribution one would expect that 17% of the values of further collections would exceed 0.2. Obviously there is a difference between the accuracy and prediction potential.

This transformation is felt to be an improved representation of the data being reported herein, and the arithmetic normal distribution is inadequate. The derivation is based on relatively small sample size and the assumption that the data have a normal distribution subsequent to the natural logarithmic transformation.

## II. VARIATION IN FRASER RIVER WATER QUALITY

Most of the water quality parameters considered in this study showed considerable variation along the length of the Fraser River. These variations, however, were not random but appear to reflect systematic changes.

Rather than consider each of the parameters individually for each of the stations, we shall consider only a few parameters which reflect the various manners in which parameters vary along the river. Mean concentrations and confidence limits for each of the 22 parameters taken at the fourteen sites are given as Appendix I.

We found that the parameters varied in one of three ways: those increasing in concentrations with downstream distance; those decreasing in concentrations with downstream distance; and reaching maximum concentration above the midpoint of the river.

Most of the parameters were found to have substantial concentration increases with downstream distance. Some examples are given in Figure 3.2 - 3.6. Figure 3.2 shows the distribution of chloride concentrations along the river. Evidenced in this figure is the general increase in both the mean concentration and its variance. The increase in concentration with distance is not a linear function but appears to reflect step changes, one near the headwaters and one between Hansard and Intercontinental Pulp. Turbidity (Figure 3.3) also shows substantial concentration increases along the river, being lowest in the headwaters and highest in the downstream portion. Total phosphorus (Figure 3.4) also shows these increases with rapid increases between Tete Jaune Cache and McBride and between Intercontinental Pulp and Marguerite. Iron (Figure 3.5) shows marked increases in the uppermost portion of the basin with additional increases and increased variation with downstream distance. It is of interest to note that while all of the preceding parameters have increases in both mean concentration and variation with downstream distance, nitrate, nitrite (Figure 3.6) while reflecting downstream increases in mean concentration, there is little change in variance about the mean. Other parameters which behave in a similar manner include sodium, potassium, colour, silicate, ammonia, copper, zinc, lead, manganese and both total and fixed nonfilterable residues.

It is important to note the coincidence of stepchanges and/or rapid changes in concentration. These seem to lie in two areas; one between Tete Jaune Cache and Dunster, and another either upstream or downstream of Intercontinental Pulp mill. Some parameters had low concentration in the upper few stations along the river but showed rapid increases in concentration and reached maximum concentration upstream from Prince George and decreased in level downstream. Parameters which behaved in this manner include calcium, which is shown in Figure 3.7, alkalinity, hardness, pH and conductivity.

# FRASER RIVER

direction of flow

3.2

2.8

2.4

2.0

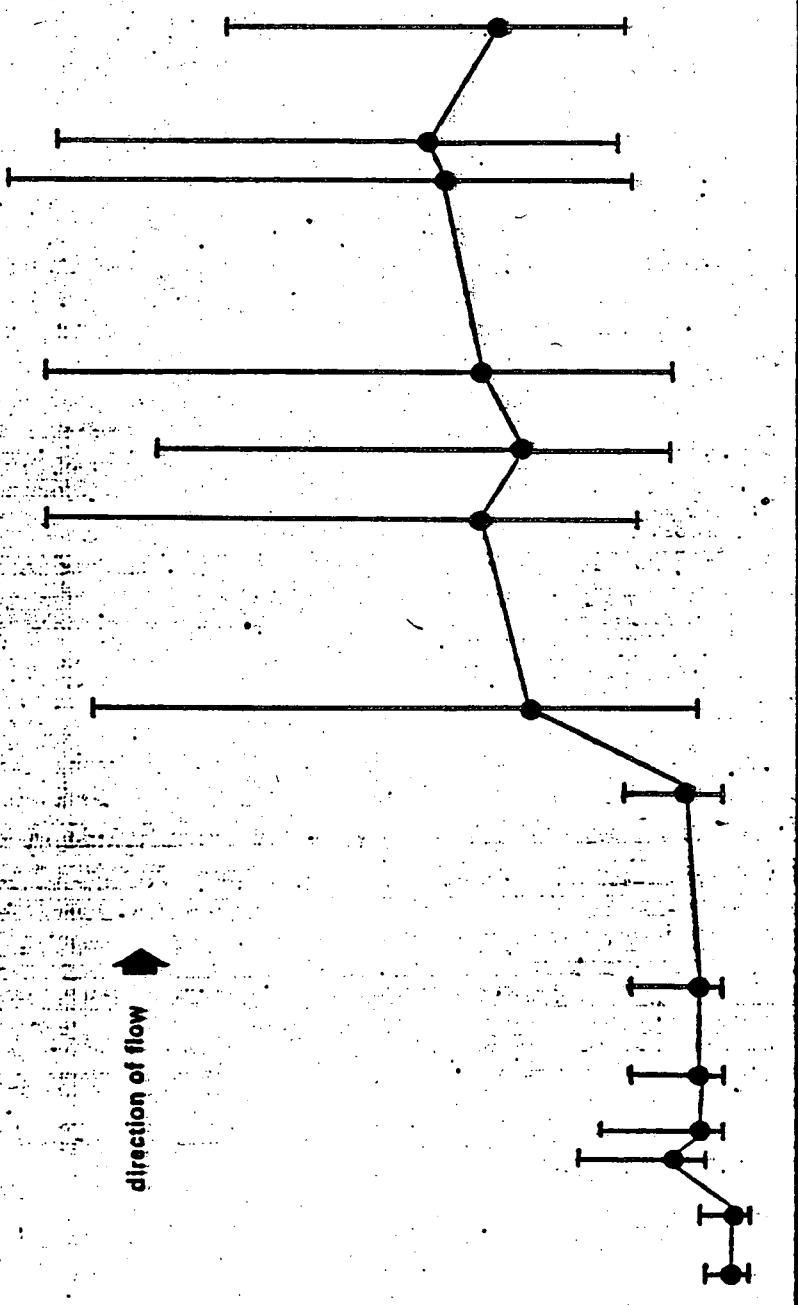
1.6

1.2

8

4

CHLORIDE(mg/L)



RIVER SAMPLING LOCATIONS

# FRASER RIVER

direction of flow

100

90

80

70

60

50

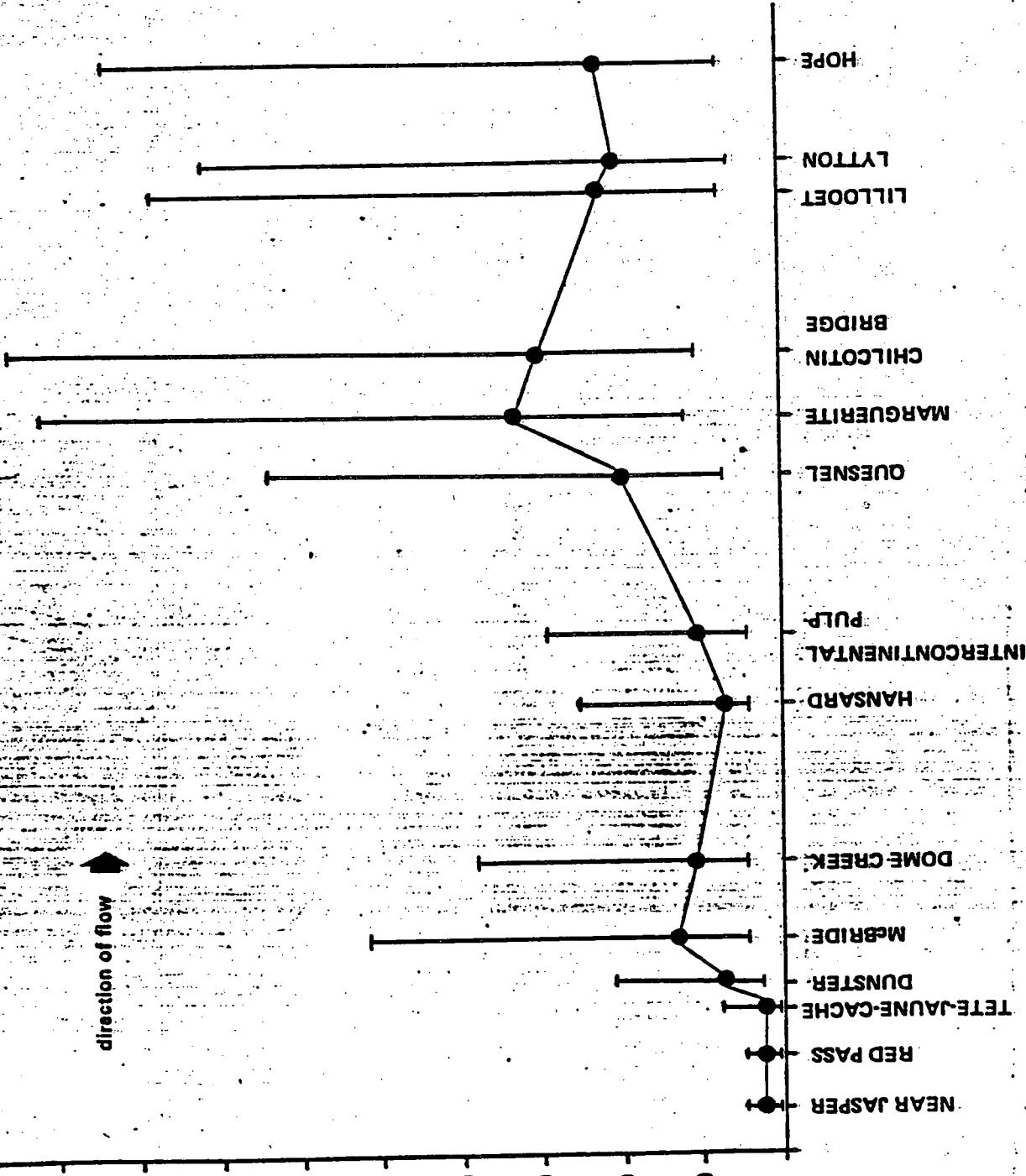
40

30

20

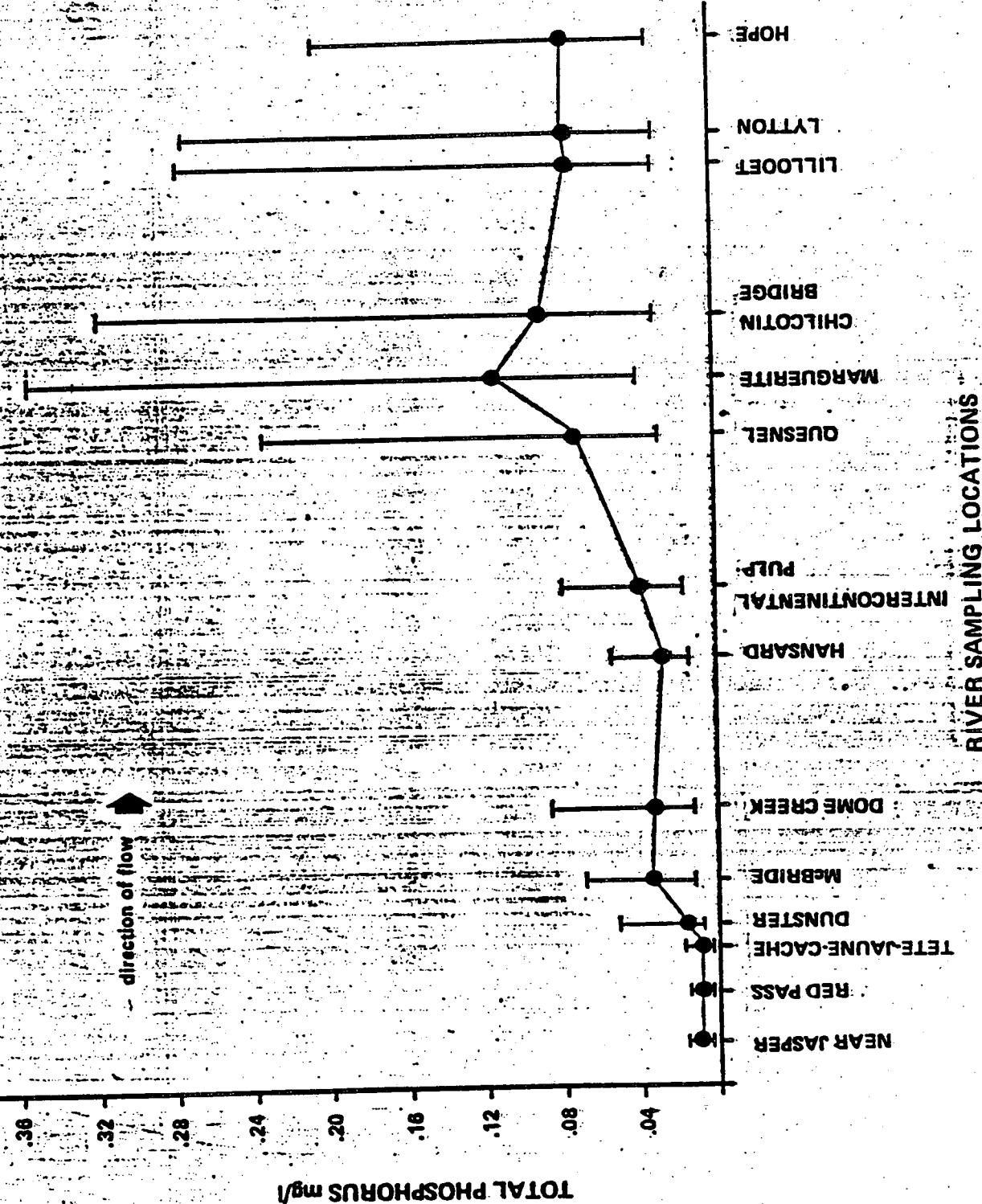
10

TURBIDITY J.T.U.'s

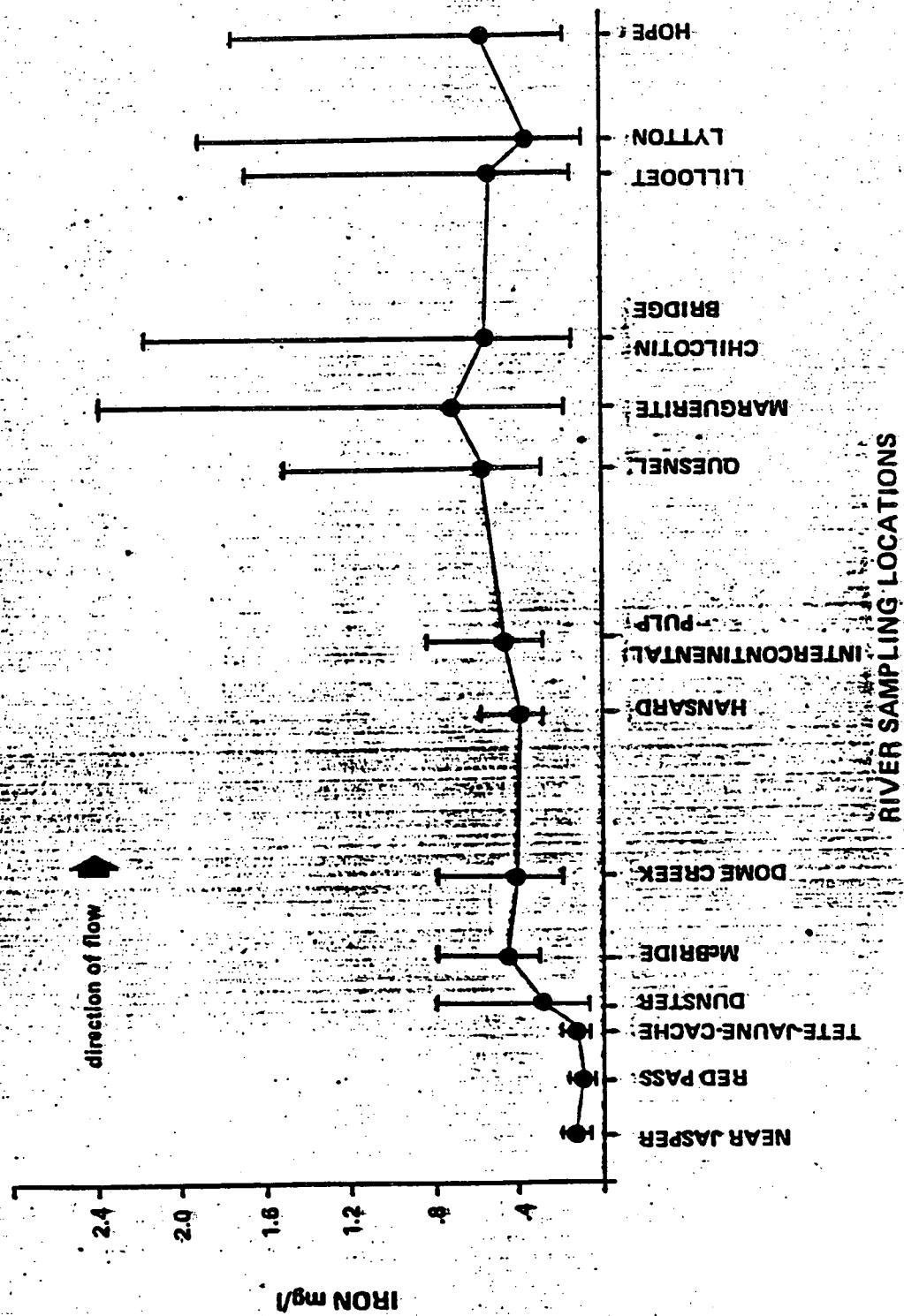


RIVER SAMPLING LOCATIONS

# FRASER RIVER

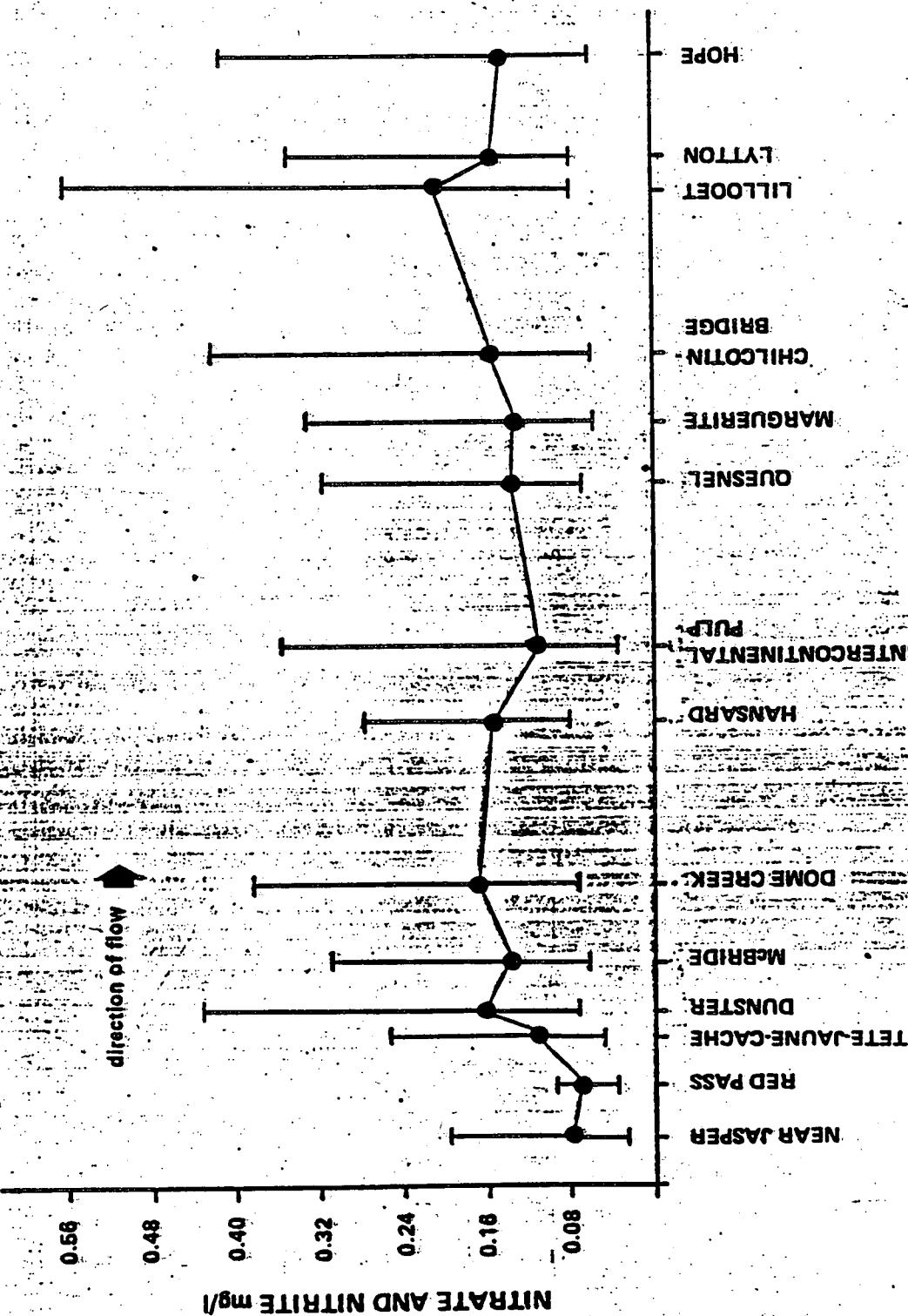


# FRASER RIVER



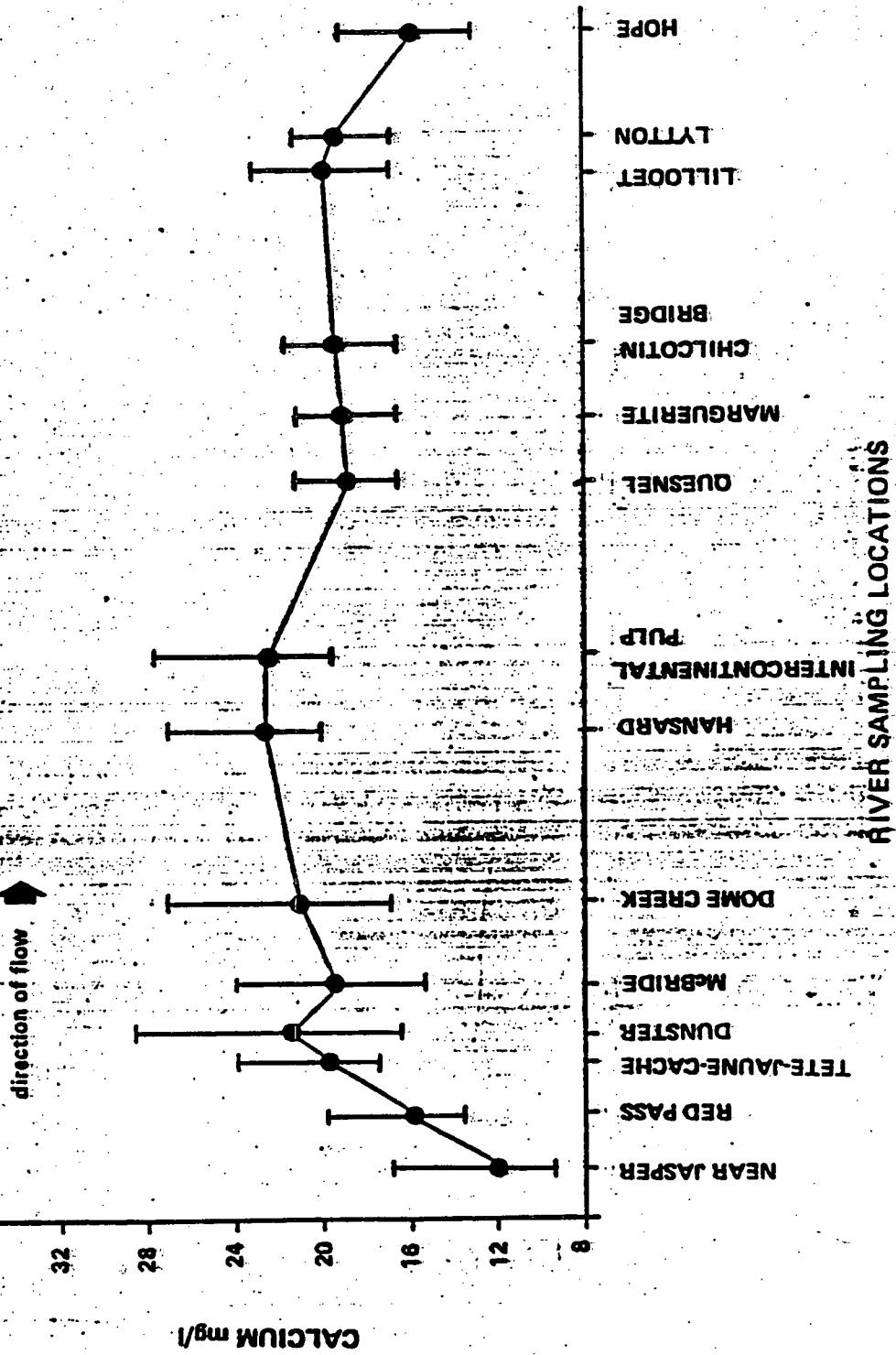
# FRAZER RIVER

## RIVER SAMPLING LOCATIONS



# FRAZER RIVER

27



21

One parameter, sulphate, was found to have its highest concentrations in the headwaters and to generally decrease with distance downstream (Figure 3.8). The most dramatic decreases in sulphate concentration occurred between McBride and Quesnel.

Initially we used a t-test on the mean concentrations of each parameter between pairs of stations as they occur along the river. The values of these are included in Appendix I, and were calculated as described in the methods sections. Subsequent to this, it became clear to us that such testing provided us with two conflicting facts: rapid increases in concentrations in the headwaters was reflected in a large number of statistical differences; and step changes either upstream or downstream of Intercontinental Pulp produced some significant differences, for some parameters.

Based on these statistical differences, and on the manner in which parameters appear to vary along the river, we decided that it would be useful to divide the mainstem into three portions. These portions are:

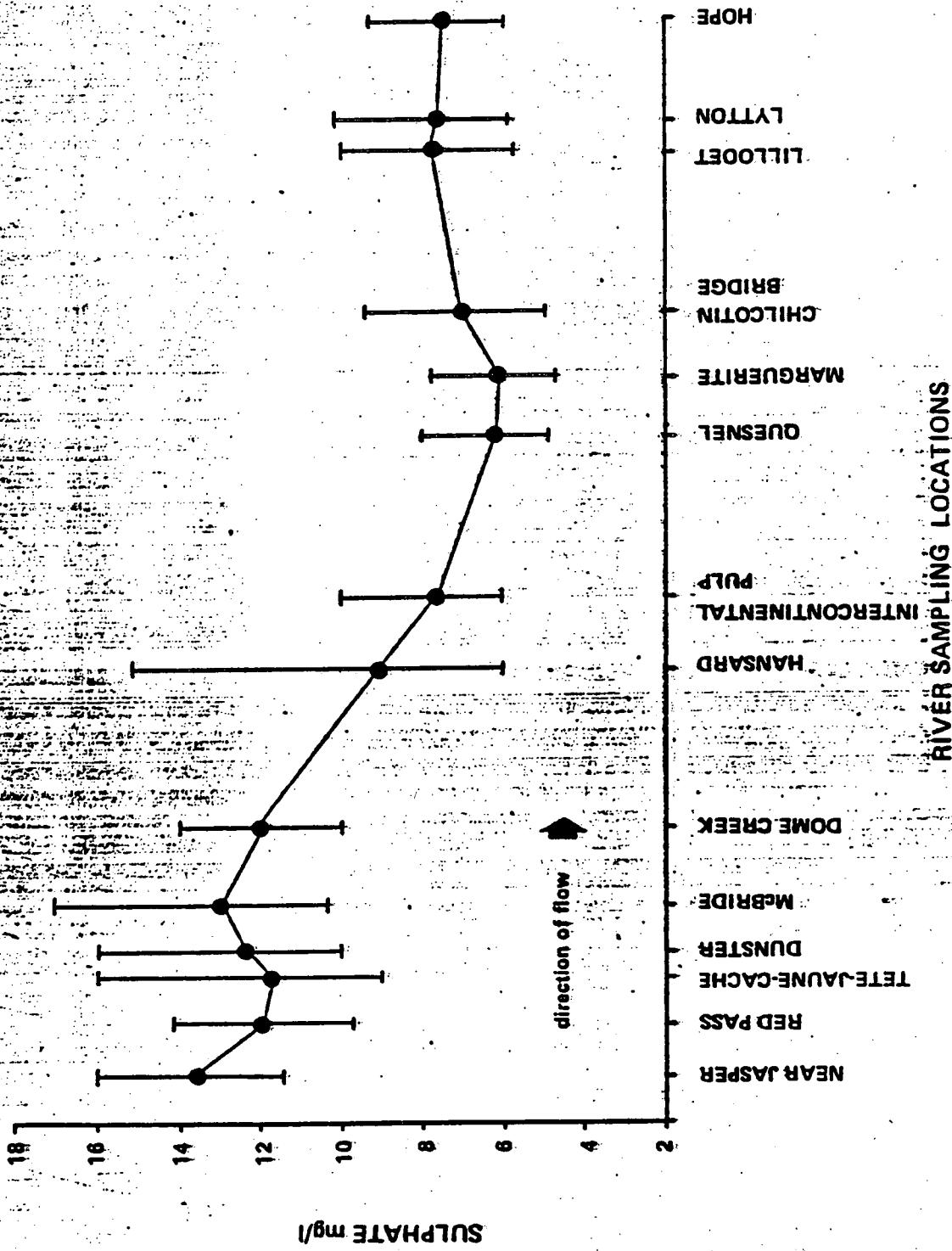
(a) Headwaters

The three sites at the upper end of the river consistently show rapid changes in the concentrations of most parameters. The decision to consider these three as a group was based on parameter behavior rather than consistency of mean concentration.

(b) Hansard Plateau

The sites from Dunster to the Intercontinental Pulp form the second portion. Parameter concentrations are relatively consistent in this reach with significant differences occurring for many parameters at either end of this reach.

# FRASER RIVER



2 X

(c) Cariboo Plateau and Fraser Canyon

This portion of the river has relatively consistent mean concentration for most parameters. Variation about the mean concentration tends to be greatest amongst these stations. Some significant differences exist between the downstream boundary and stations further upstream.

The range of mean concentration of each parameter within the three reaches of the river are given in Table 3.2. The concentration differences which occur along the river are very evident, substantiating the thesis that the river has three distinct portions, and that the behavior of the parameters occurs in the three manners suggested.

We then examined the relationship between pairs of parameters, using a linear model. Commonly in linear regression, one would be interested in the slope and intercept of a regression equation. This is, however, ~~not~~ the statistic of interest here. The use of such a test in this instance is to look for parameters which behave in a similar manner along the river and hence would be expected to result from similar mechanisms. The resulting  $F_s$  for pairs of parameters are shown in Table 3.3.

This Table contains only those values of  $F_s$  which have a probability of  $<.05$ . This shows a distinction between two major groups of parameters with nitrate-nitrite representing some form of transition. Remembering that only sulphate showed decreases with downstream distance, hence its relationship is inverse to the others and represents a third behavior.

Following this, we decided that we should attempt to use cluster analysis to attempt to obtain an unbiased estimate of the similarity of stations, and consider that against our notion that the river had three distinct portions.

**TABLE 3.2. RANGES OF MEAN CONCENTRATION WITHIN REACHES  
OF THE MAINSTEM OF THE FRASER RIVER.**

PARAMETER	HEADWATERS	HANSARD PLATEAU	CARIBOO PLATEAU & FRASER CANYON
Turbidity (JTU)	1-6	6-10	19-25
Colour	5	7-10	15-25
pH	7.6-8.0	7.9	7.8 - 7.9
Chloride (mg/l)	.25 - .55	.39 - 1.0	1.1 - 1.5
Conductivity ( $\mu$ siemens)	100 - 145	133 - 146	114 - 139
Alkalinity	35 - 60	51 - 65	47 - 61
Hardness	50 - 73	65 - 74	53 - 67
Calcium (mg/l)	12 - 20	19 - 23	16 - 20
Sulphate (mg/l)	11.5 - 13.5	7.8 - 12.4	6.3 - 7.8
Silicate (mg/l)	2.6 - 3.8	3.0 - 4.0	3.9 - 5.6
Sodium (mg/l)	.6 - .9	.8 - 1.5	2.1 - 2.7
Potassium (mg/l)	.2 - .3	.4 - .7	.6 - .8
Total Phosphorous (mg/l)	.005 - .008	.02 - .04	.07 - .11
Nitrate-Nitrite (mg/l)	.06 - .11	.13 - .17	.13 - .21
Ammonia (mg/l)	.02 - .04	.02 - .06	.05 - .06
Copper (ug/l)	1-2	2	3-5
Zinc (ug/l)	2-3	2	2-5
Lead (ug/l)	1	1-2	1-2
Iron (mg/l)	.03 - .10	.25 - .45	.35 - .68
Manganese (mg/l)	.01	.01 - .02	.03 - .05
Total nonfilterable (mg/l)	1.6 - 3.8	13.5 - 26.6	38 - 66
Fixed nonfilterable (mg/l)	0.7 - 2.0	10 - 22	32 - 62

TABLE 3.3.

F Values for linear relationship between mean concentrations of parameters within the Fraser River mainstem. Only those values whose probability is less than .05 are included.

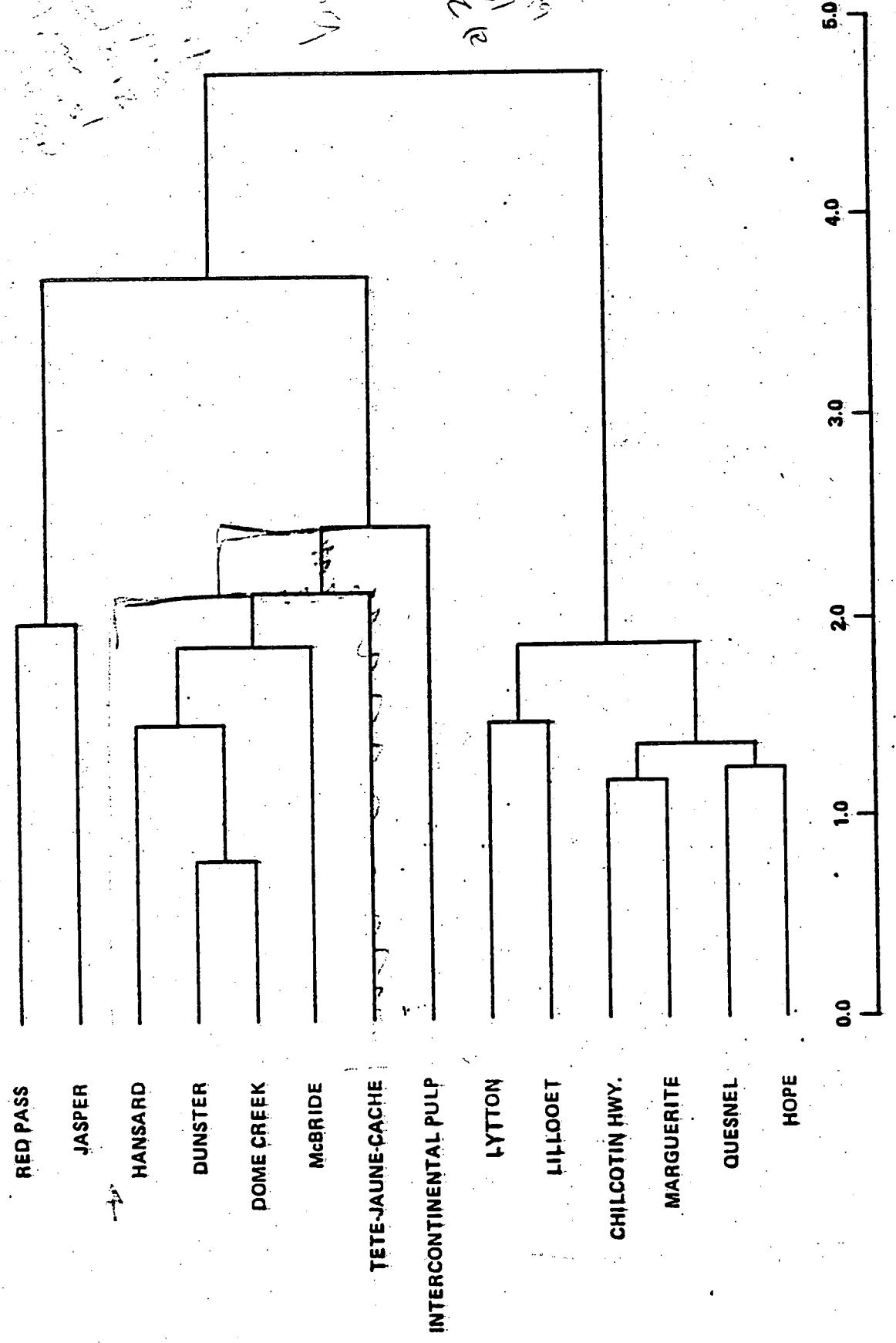
The manner in which the data was considered warrants some explanation. Each parameter mean concentration has a variance comprised of both seasonal and temporal variation. These variations were ignored in order to determine similarity of mean conditions, not overall similarity. Since we know that the parameters are related to each other, as has been shown previously, we reduced the number of parameters considered. We decided to use nine parameters, (turbidity, chloride, calcium, sulphate, total phosphorous, nitrate-nitrite, iron, silicate and sodium). The use of these was based on two items. First, the parameters to be used must show considerable variation amongst the stations and secondly, it was desired to use parameters which could be ~~considered to be~~ independent.

The resulting cluster pattern is shown in Figure 3.9. There appears to be three distinct clusters of similar stations. Each of these clusters contains groups of stations which are closest to each other along the river, and is in approximate agreement with the divisions previously suggested.

It is interesting to look at the manner in which stations are clustered in Figure 3.9. In general, stations from the central portion of the ~~reach~~ reach are clustered first as evidenced by Lytton-Lillooet, Chicotin-Marguerite and Dunster-Dome Creek, and stations at the ends of the reach, i.e. Tete Jaune Cache and Intercontinental Pulp; and Quesnel and Hope, are the last to be joined to the clusters. These suggest that these reflect the transitional areas previously suggested.

The manner in which Tete Jaune Cache became clustered does not agree with our previous suggestion. This result occurs because we considered the rate of change in concentration evidenced in the headwaters to be as important as the actual concentrations. The cluster analysis does not account for this type of consideration, hence finds Tete Jaune Cache most similar to downstream sites.

# FRASER RIVER MAINSTEM



It appears likely that the Fraser River should be considered to be comprised of three distinct portions when considering water quality. These appear to reflect three physiographic areas; the Rocky Mountain headwaters, the Hansard Plateau, and the Cariboo Plateau - Fraser Canyon. It has been shown that similarities in water quality either in mean concentration and/or behavior of parameters do exist.

### III. TRIBUTARIES TO THE FRASER RIVER

There is considerable variation in the concentration of materials between the seventeen tributaries to the Fraser River that were examined. In order to provide a summary of the variation which exists, the range of concentrations (in between the maximum and minimum) for each parameter was divided into five intervals. Each parameter for each station was then tabulated as to the interval in which its geometric mean concentration occurred. This summary is presented as Table 3.4. Appendix II contains the mean concentrations with confidence intervals of each of the parameters for each of the stations.

On an overall basis, most of the tributaries have mean concentrations which fall in the lowest one-fifth of the range (43%) with progressively less in each succeeding interval (19%, 17%, 11%, 11%). Each parameter exhibits different distribution among the five intervals.

The tributaries to the Fraser River can be considered to be logically independent of each other, since there is not any direct interaction between them. On this basis, we tested the hypothesis that for pairs of stations the samples come from the same population ( $H_0: \mu_1 = \mu_2$ ).

Here  $\mu_1$  and  $\mu_2$  are the means for a parameter from the two stations using a t-test. Results from these are summarized in Table 3.5.

Values of  $t_b$  and their probabilities for mean concentration for each of the parameters between pairs of stations is given in Appendix III.

TABLE 3.4.

## OCCURRENCE OF MEAN VALUES BETWEEN LIMITS LYING BETWEEN MAXIMUM AND MINIMUM

	<u>Min.</u>	<u>#</u>	<u>Max/ Min.</u>	<u>#</u>																			
Turbidity	.07	12	3.9	3	7.7	1	11.5	0	15.4	1	19.2												
Colour	5.0	11	12.0	3	19.0	0	26.0	2	33.0	1	39.9												
pH	7.40	3	7.54	2	7.67	3	7.81	5	7.95	4	8.13												
Chloride	0.2	8	0.44	6	0.68	1	0.92	1	1.16	1	1.40												
Conductivity	62	6	96	5	129.	4	163	1	196	1	230												
Alkalinity	22	5	37	5	52.	3	67	3	83	1	98												
Hardness	29	7	46	4	63	3	81	2	98	1	115												
Calcium	9	4	12.5	4	16.0	1	19	4	22.5	4	26												
Sulphate	2.9	10	6.9	2	10.2	4	13.6	0	17.0	1	22.5												
Silicate	1.9	3	3.3	3	4.6	5	6.0	3	7.3	3	8.7												
Sodium	0.5	10	1.2	3	1.9	2	2.6	1	3.3	1	4.0												
Potassium	0.19	6	0.33	2	0.47	4	0.62	3	0.77	2	.91												
Total Phosphorous	0.005	9	0.017	5	0.029	2	0.041	0	0.053	1	.065												
Nitrate-Nitrite	0.028	3	0.070	2	0.112	4	0.153	6	0.195	2	.237												
Ammonia	0.020	3	0.027	2	0.034	5	0.042	4	0.049	3	0.056												
Copper	0.001	5	0.0014	-	.0018	10	0.0022	-	0.026	2	0.003												
Zinc	0.002	12	0.0026	4	.0032	-	0.0030	-	0.0044	1	0.005												
Lead	0.001	15	0.002	2	--	--	--	--	--	--	--												
Iron	0.043	10	0.143	2	0.244	1	0.344	1	0.444	3	0.545												
Manganese	0.01	9	0.015	3	0.021	3	0.027	0	0.032	2	0.038												
Tnf	3.5	4	9.8	2	16.1	0	22.4	0	28.7	1	35												
Fnf	1.5	4	7.2	2	12.9	0	18.6	0	24.3	1	30												

# only 7

# only 7

**TABLE 3.5 - NUMBER OF SIGNIFICANT  $t_b$  BETWEEN STATIONS  
FOR EACH OF THE PARAMETERS**

	<u>Number Significant at .05</u>	<u>Number Significant at .10</u>	<u>Non- Significant</u>
Turbidity	51	10	75
Colour	89	4	43
pH	71	11	54
Cl	65	5	66
Conductivity	99	4	33
Alkalinity	97	11	28
Hardness	100	9	27
Calcium	96	9	31
Sulphate	99	5	32
Silicate	102	6	28
Sodium	99	5	31
Potassium	94	6	36
Total Phosphorous	57	12	67
Nitrate-Nitrite	34	4	98
$\text{NH}_3$	11	11	114
Cu	20	9	107
Zn	12	11	113
Pb	3	2	131
Fe	65	8	63
Mn	26	3	107
TNF	7	0	14
FNF	6	1	14

Table 3.5 provides an indication of the degree of dissimilarity between the stations. For many parameters, most of the differences were found to be significant at  $p < 0.05$ . Those differences having probabilities between 0.05 and 0.10 were fewer in number. It is obvious from Table 3.5 that some parameters would, based on the frequency of occurrence of significant differences, be most useful in distinguishing between tributaries.

In order to better express the relationship between tributaries we performed cluster analysis in the manner previously described. It is interesting to note that although the parameters chosen to include in the analysis were based on the selection process used for clustering the mainstem stations, these nine also show marked dissimilarities between the tributaries. Ranking the nine parameters on the basis of percent occurrence of significant differences ( $p < .05$ ) leads to: Silicate (75%); sulphate and sodium (73%); calcium (70%); iron and chloride (48%); total phosphorus (42%); turbidity (38%) and nitrate/nitrite (25%). This suggests that these parameters will be useful in the clustering procedure.

The cluster diagram which resulted from the analysis is given as Figure 3.10. As was observed for the mainstem stations, distinct clusters are evident. This representation of the relationship between tributaries is more useful than a detailed consideration of parameter concentrations and differences between stations. The large number of comparisons which have to be made, that is for 22 parameters between seventeen stations, the problem becomes incomprehensible. The abstraction provided by clustering becomes most useful under these circumstances.

Most evident in Figure 3.10 is the grouping of those tributaries from similar areas of the basin. In one cluster are all five of the tributaries draining from the Rocky Mountains in the headwaters of the

# FRASER RIVER TRIBUTARIES

MOOSE RIVER

ROBSON RIVER

GOAT RIVER

BEAVER RIVER

DORE RIVER

SETON RIVER

COOUIHALA RIVER

STEIN RIVER

SALMON RIVER

WILLOW RIVER

COTTONWOOD RIVER

ANDERSON RIVER

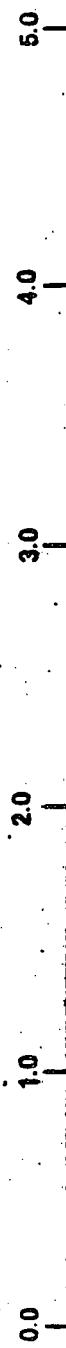
BOWRON RIVER

THOMPSON RIVER

NECHAKO RIVER

QUESNEL RIVER

BRIDGE RIVER



RELATIVE LENGTH

basin. Three of the tributaries in the Fraser Canyon form a second cluster. A third cluster contains those tributaries draining the central portion of the basin. There is one exception to the regional aspect of the clusters, where the Anderson River is clustered with those from the central portion of the basin. During the study period there was fairly intensive logging activity within the Anderson Basin. The effects of logging practices on the parameters considered may in part be responsible for the manner in which this tribuary relates to the others. Four of the tributaries did not form part of a cluster. These were the Thompson, Quesnel, Nechako and Bridge Rivers. The first three of these are the largest of the tribuaries considered in this study. This pattern would suggest that these four tributaries are separate and distinct from all others in terms of the parameters used in the analysis.

Based on the cluster analysis a table, summarizing concentration variation was developed (Table 3.6). Examination of this Table shows that the four non-clustered tributaries are distinctively and significantly different for a number of parameters. Those parameters not used in the clustering procedure have been included in Table 3.6. Most of these additional parameters show additional differences between the groups of tributaries and the four dissimilar tributaries.

$(\bar{K}_g)$

TABLE 3.6.

SUMMARY OF MEAN CONCENTRATIONS AMONG TRIBUTARIES

ED

PARAMETER	C L U S T E R S			N O N - C L U S T E R S		
	HEADWATER TRIBUTARIES	CANYON TRIBUTARIES	CENTRAL PLATEAU	THOMPSON	QUESNEL	NECHAKO BRIDGE
Turbidity	.95-2.2	.7-2.9	3.3-9.0	1.5	19.2	3.3
Chloride	.23-.42	.39-.73	.40-.66	1.38	.37	.47
Calcium	19.25-25.7	9.0-14.5	9.8-22.4	13.4	20.0	12.4
Sulphate	10.0 - 13.6	5.3-9.9	3.9-5.4	6.8	6.8	3.3
Total Phosph.	0.005-0.014	0.007-0.013	0.024-0.031	.021	0.065	0.029
Nitrate-Nitrite	.11 - .19	.17-.20	0.03 - .11	.24	.16	.08
Iron	.04 - .08	.07-.12	.24 - .24	.12	.45	.16
Silicate	1.9 - 3.3	5.3 - 6.2	5.1 - 7.9	5.1	3.9	5.1
Sodium	0.5 - 1.0	1.1 - 1.6	0.8 - 2.3	2.3	1.1	2.0

THE FOLLOWING PARAMETERS WERE NOT USED IN THE CLUSTER ANALYSIS

Colour	5.0-5.5	5.9-7.8	13.6-39	7.2	11.4	13.9	5.3
pH	7.8-8.0	7.4-7.7	7.4-7.9	7.7	7.9	7.7	8.1
Conductivity	122 - 177	63 - 101	65-142	97.	125	88	230
Alkalinity	47.9-76.5	22.4-38.4	27.8-69.6	36.7	55	39.7	97.7
Hardness	60.5-91.6	29.1- 47	32.8-73.8	42.7	62.2	41.6	114.9
Potassium	0.19-0.28	0.59-0.86	0.28-0.65	0.91	0.51	0.66	0.60
Ammonia	.02--.04	.04--.05	0.03-0.04	0.05	.05	0.05	0.05
Copper	.001-.002	.001-.002	.002-.003	.002	.003	.002	.002
Zinc	.002-.003	.002-.005	.002-.003	.002	.003	.002	.002
Lead	.001	.001	.001-.002	.001	.002	.001	.001
Manganese	0.010-.015	.010-.018	.017-.038	.011	.027	.017	.011

## CHAPTER 4 - COVARIANCE OF WATER QUALITY PARAMETER

### 4.1 CORRELATION ANALYSIS

Any attempt to examine a system as complex as that portion of the Fraser River Basin requires that some understanding of how things vary, both in time and space as well as in relation to each other. Our data set was collected with the sole intention of examination of spatial differences within the basin. As a time series this data set is inadequate. However, it is felt that sufficient data is available to enable us to examine the relationship between the parameters.

We chose initially to look for significant correlation between pairs of parameters for each station. Again, this quickly becomes incomprehensive due to the sheer volume of information available. In fact, it was decided on the basis of the preceding chapter, to look at correlations with the nine parameters within each group of stations determined through cluster analysis.

The groupings of stations for this analysis was:

#### 1. Fraser River Headwaters

- Fraser River near Jasper
- Fraser River at Red Pass

#### 2. Fraser River Cariboo Plateau

- Fraser River at Hansard
- Fraser River at Dome Creek
- Fraser River at McBride
- Fraser River at Tete Jaune Cache
- Fraser River at Intercontinental Pulp

3. Fraser River - Canyon

- Fraser River at Lytton
- Fraser River at Lillooet
- Fraser River at Chilcotin Highway
- Fraser River at Marguerite
- Fraser River at Quesnel
- Fraser River at Hope

4. Tributaries - Headwaters

- Moose River
- Robson River
- Beaver River
- Goat River
- Dore River

5. Tributaries - Cariboo Plateau

- Salmon River
- Willow River
- Cottonwood River
- Anderson River
- Bowron River

6. Tributaries - Fraser Canyon

- Coquihalla River
- Seton River
- Stein River

7.(a) Nechako River

- (b) Quesnel River
- (c) Thompson River
- (d) Bridge River

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Significant correlation coefficients ( $p < .10$ ) for all parameters with the nine parameters used in the cluster analysis for each of the above groups of stations are given in Appendix IV.

In general, the correlation coefficients suggest that there are three groups of parameters. The first group made up of turbidity colour, total phosphorus, iron, zinc, copper, lead, manganese, and non-filterable residues, have positive correlations amongst themselves. The second group of parameters: chloride, conductivity, alkalinity, hardness, calcium, sodium, potassium, sulphate and silicate, have positive correlations amongst themselves and negative correlations with the members of the first group. The remaining three parameters pH, nitrate-nitrite and ammonia, appear to be independent from all other parameters.

This general pattern does not hold in all cases. There are a number of cases where there are reversals of the general rule, particularly amongst the four individual tributaries. This then suggests that the situation is more complex than is initially evident.

Thus, one is faced with the task of developing an understanding of what the general case is and to try and relate this to the exceptions to the general case. The correlation analysis has provided us with a clue as to the nature of the processes. In correlation we are concerned largely whether two variables are independent or covarying (Sokal and Rohlf, 1969). The most typical assumption then is that the two variables are both effects of a common cause. Cause

It seemed obvious that the most likely common cause could be related to discharge, because of its variation over the study period at all sites.

## 4.2 REGRESSION ANALYSIS

As an initial consideration of the dependence of concentration on discharge it was thought that some benefit was to be obtained from examining whether or not a significant portion of the variation in concentration was attributable to variation in discharge. In testing for this we used a Model I regression (Sokal and Rohlf, 1969). This required the following assumptions:

1. The independent variable (discharge) is measured without error.
2. The expected value for the dependant variable (concentration) could be expressed by the linear function

$$y = \alpha + \beta x + \epsilon$$

Where  $\epsilon$  is a normally distributed error term independant of both  $x$  and  $y$  and with a mean of zero.

Regression analysis was performed on five stations along the Fraser River and for ten tributaries to the Fraser River where discharge data were available. (~~These data were published by~~ Water Survey of Canada, 1976, 1977).

Table 4.1 shows estimates of  $\beta$  for the five mainstem locations and Table 4.2 for the ten tributaries. Only those estimates where  $F_s$  is greater than  $F_{.05}$  [ $f, n-2$ ] are shown.

None of the parameters tested showed a significant regression in all fourteen cases. Even among those parameters which showed a large number of significant regression, there is considerable variation in the estimates of  $\beta$ . This suggested

TABLE 4.1

	<u>HOPE</u>	<u>MARGUERITE</u>	<u>HANSARD</u>	<u>MCBRIDE</u>	<u>RED PASS</u>
TURBIDITY				.8820 *	
CL	-.4865 *			-.3267 *	
CONDUCTIVITY	-.1351 *	-.1322 **	-.0935 *	-.1718 **	
CA		-.0923 *		-.1786 **	
SO4	-.2198 **	-.2115 **		-.2301 **	
SiO <sub>2</sub>				-.2447 *	
NA	-.3316 **				
P-TOT.				.5116 **	.3299 *
NITRATE-NITRITE					
CU				.3725 *	.3783 *
ZN					
FE					
MANGANESE					



that one of two conditions existed, either

- (a) concentration was independent of discharge, or
- (b) one of our assumptions was violated.

Reconsidering the correlation information, it seemed unlikely that concentration was independent of discharge. It seemed likely that our assumption regarding the measurements of discharge being without error would not have a major effect since the error is believed to be small 5% and the variation over the study period very large. This then led us to reconsider our assumptions regarding a linear function and the error term  $\epsilon$ .

Thus, two questions must be addressed; is the relationship truly linear or is it some higher order relationship; and are the  $\epsilon$  truly independent of both concentration and discharge and normally distributed. Since the analysis was performed using  $\ln$  transformed values of both the concentration and discharge measurements, it appears that simple higher order relations did not exist. We are then left with resolving whether or not our assumptions about  $\epsilon$  are valid.

#### 4.3 EXAMINATION OF $\epsilon$

In order to evaluate whether or not the assumptions regarding  $\epsilon$  are valid, we need to examine whether or not

- (a)  $\epsilon$  is normally distributed
- (b)  $\epsilon$  is independent of concentration and discharge.

A number of data sets were evaluated in terms of these two factors. It appears that although the sample sizes are small,  $\epsilon$  is at least approximately normally distributed and independent of both concentration and discharge. However, a major flaw

in the analysis during this evaluation became apparent. It was observed that there is a serial correlation among  $\epsilon$ . That is to say that the residuals, while appearing to be normally distributed and independent of both concentration and discharge are not independent of each other.

This serial correlation appears to be time dependent. The residuals are on the most part of a consistent sign between January and August, changing sign during August and maintaining this sign through December. In some cases, the spring sign was positive with negative signs in the fall, while in others the reverse was true. This suggested that an additional mechanism was operating that we had not anticipated.

As the next step, we proceeded to produce plots of ln-concentration vs ln-discharge for all sites where discharge and concentration data was available. In producing these plots we chose to connect the data points in the time sequence they represent, hoping that this would produce some useful information.

This results in an interesting series of plots. In preparing the figures presented here, we chose to use only a few selected parameters and locations presenting only the 1976 data. The 1975 data does not span the entire year, hence only confuses the figures.

Figures 4.1 - 4.4 are plots of log concentration vs log discharge for turbidity, chloride, calcium and iron at three of the Fraser River stations. Iron (Figure 4.4) and turbidity (Figure 4.1) show a positive relationship between concentration and discharge, that is the high concentrations are associated

FIGURE 4.1

PLOT OF LOG TURBIDITY VS LOG DISCHARGE FOR THE  
FRASER RIVER AT HOPE, AT HANSARD AND AT RED PASS.  
THE NUMBERS BESIDE THE POINTS CORRESPOND TO THE  
PERIOD OF THE SAMPLING:

1. February 2 - 6, 1976
2. April 13 - 16, 1976
3. May 31 - June 4, 1976
4. July 4 - 7, 1976
5. August 16 - 19, 1976
6. September 21 - 24, 1976
7. October 25, 1976 (Hope, only)
8. December 13 - 17, 1976

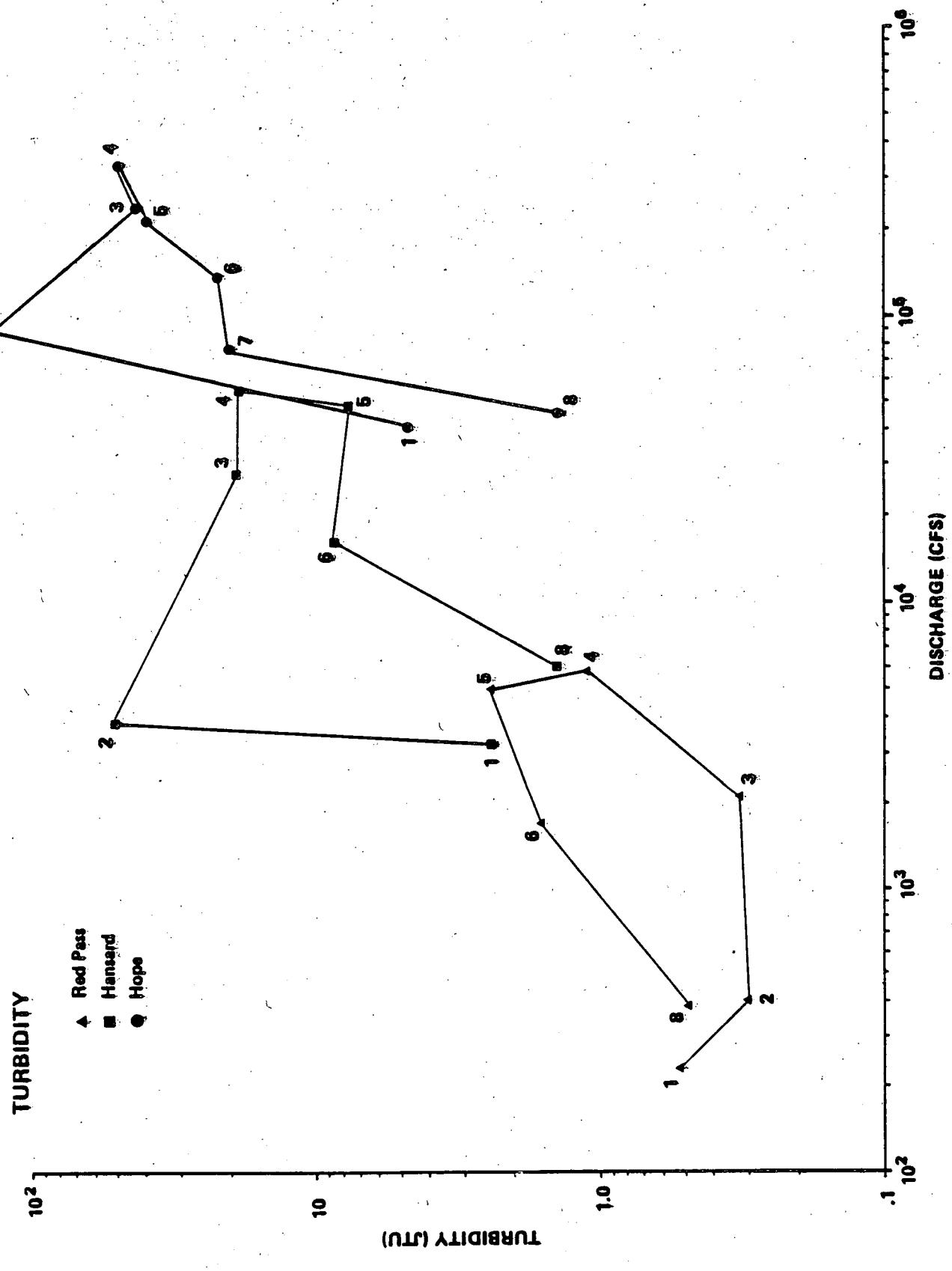


FIGURE 4.2

PLOT OF  $\log$  CHLORIDE CONCENTRATION (mg/l) VS  $\log$  DISCHARGE (CFS) FOR THE FRASER RIVER AT HOPE, AT HANSARD, AND AT RED PASS. THE NUMBERS BESIDE THE POINTS CORRESPOND TO THE PERIOD OF SAMPLING (ACCOMPANYING FIG.4.1).

CHLORIDE

- ▲ Red Pass
- Hantard
- Hope

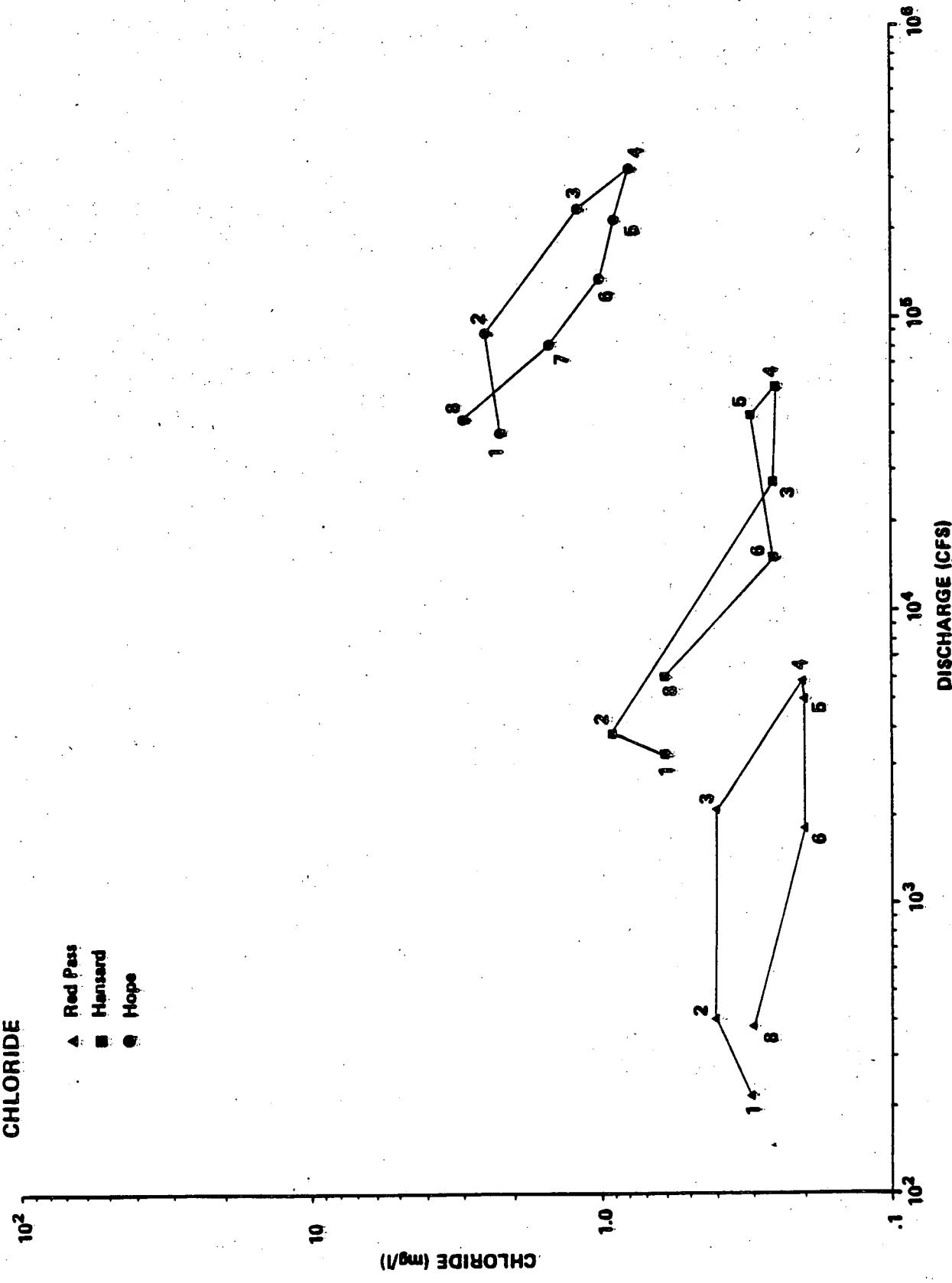


FIGURE 4.3

PLOT OF  $\log$  CALCIUM CONCENTRATION (mg/l)  
VS  $\log$  DISCHARGE (CFS) FOR THE FRASER RIVER  
AT HOPE, HANSARD AND RED PASS. THE NUMBERS  
BESIDE THE POINTS CORRESPOND TO THE PERIOD  
OF SAMPLING (ACCOMPANYING FIGURE 4.1).

## CALCIUM

▲ Red Pass  
■ Hensard  
● Hope

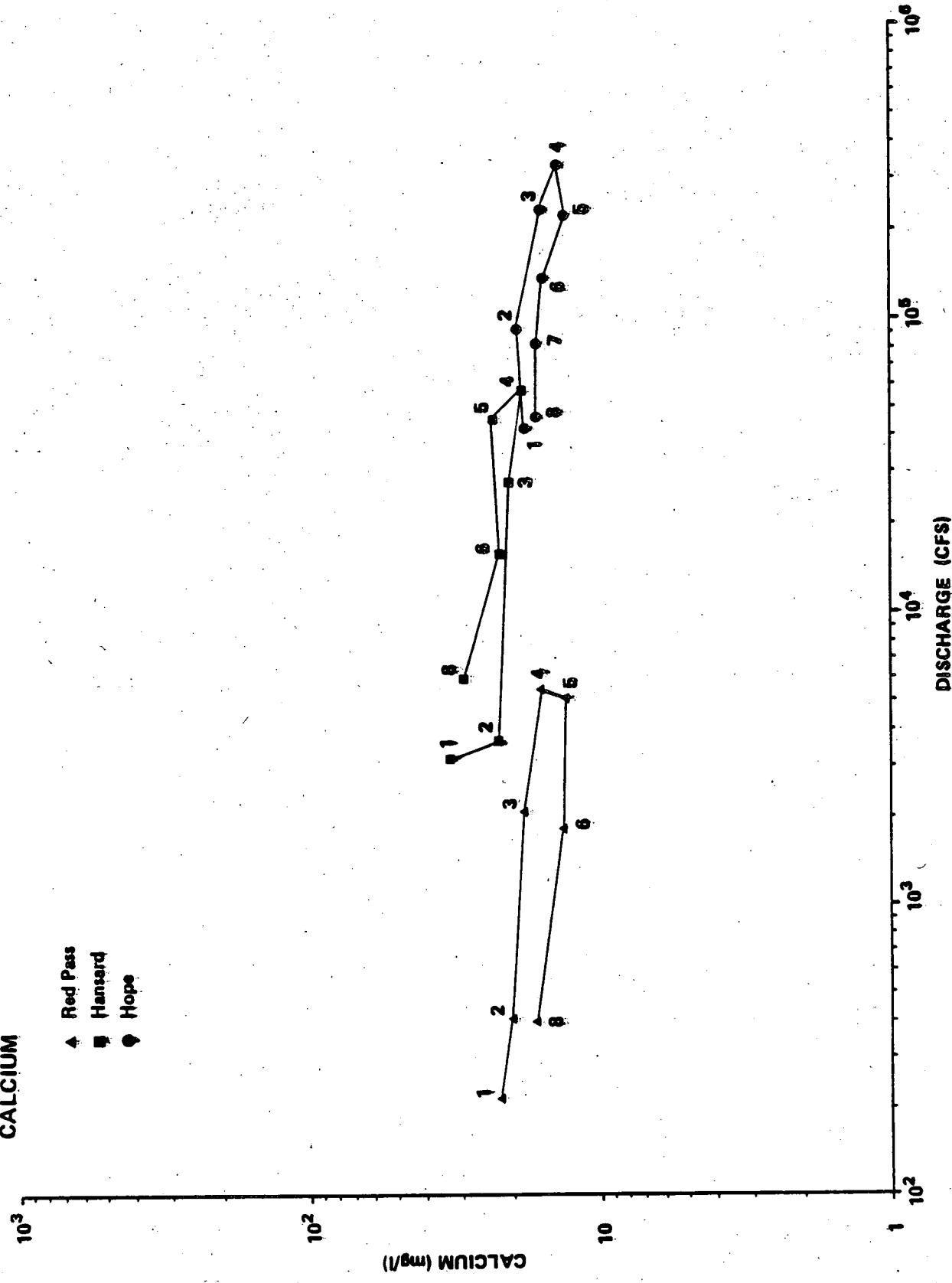
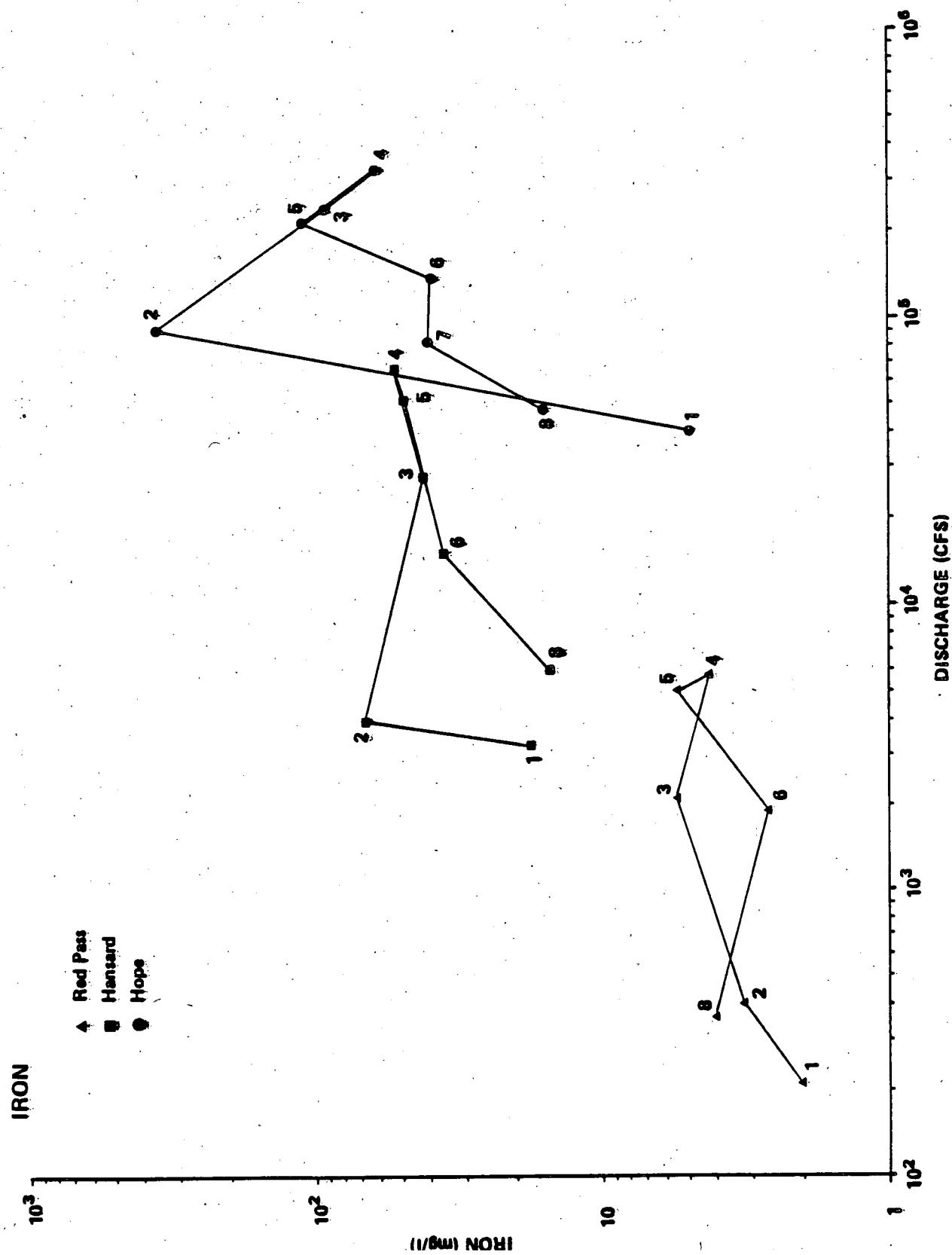


FIGURE 4.4

PLOT OF LOG IRON CONCENTRATION (mg/l)  
VS LOG DISCHARGE (CTS) FOR THE FRASER RIVER  
AT HOPE, HANSARD AND RED PASS. THE NUMBERS  
BESIDE THE POINTS CORRESPOND TO THE PERIOD  
OF SAMPLING (ACTUAL DATES ACCOMPANY FIG.4.1).



with high discharge both between and within the stations. On the other hand, chloride (Figure 4.2) shows a positive relationship with discharge between stations and a negative relationship within stations. Calcium (Figure 4.3) shows a similar pattern.

What is most important to note is the order of the points as they occur on the loops. Samples 1 - 4 represent the period of time during the period of the year prior to peak freshet and samples 5 - 8 represent the post freshet period. It is here that one can see where the serial correlation of  $\epsilon$  arises. For all these parameters, those samples collected during the prefreshet period have higher concentrations than at the same discharges during the post freshet period. Although this judgement is only qualitative, it would seem highly improbable that this pattern would occur with such regularity.

It is believed that these represent indication that hysteresis plays a major role in this system. However, since these are based on relatively few samples, some ancillary evidence was desired.

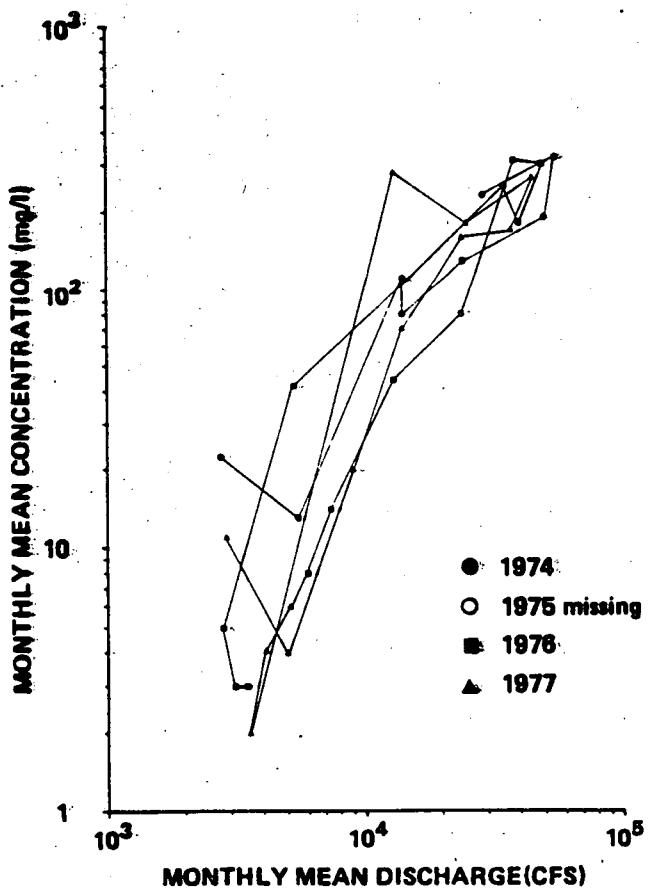
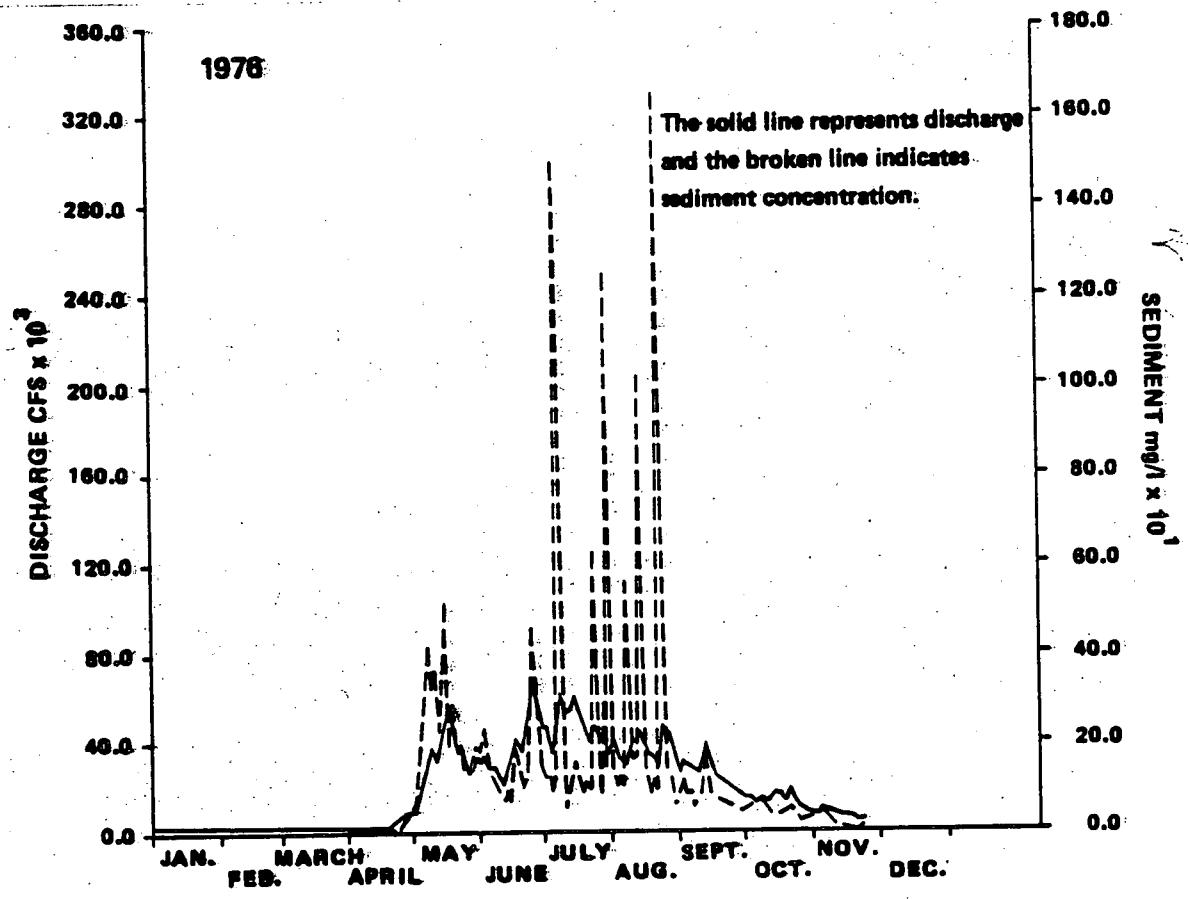
Water Survey of Canada collects suspended sediment samples at three sites in the study area. These are: Fraser River at Hansard, Fraser River at Marguerite, and the Fraser River at Hope. Since these data were collected much more frequently than were water quality samples, and also over a number of years, it was thought that examination of the published data (Water Survey of Canada 1975, 1976, 1977, 1978) would support our hysteresis hypothesis.

Figures 4.5 - 4.7 show discharge and suspended sediment concentrations over 1976, and plots of log mean monthly suspended sediment concentration vs log mean monthly discharge for the period 1975 - 1977. These figures show the typical features of hysteresis, in particular at Marguerite and at Hope. Hysteresis occurs to a lesser degree at Hansard and highest sediment concentrations are associated with peak discharge.

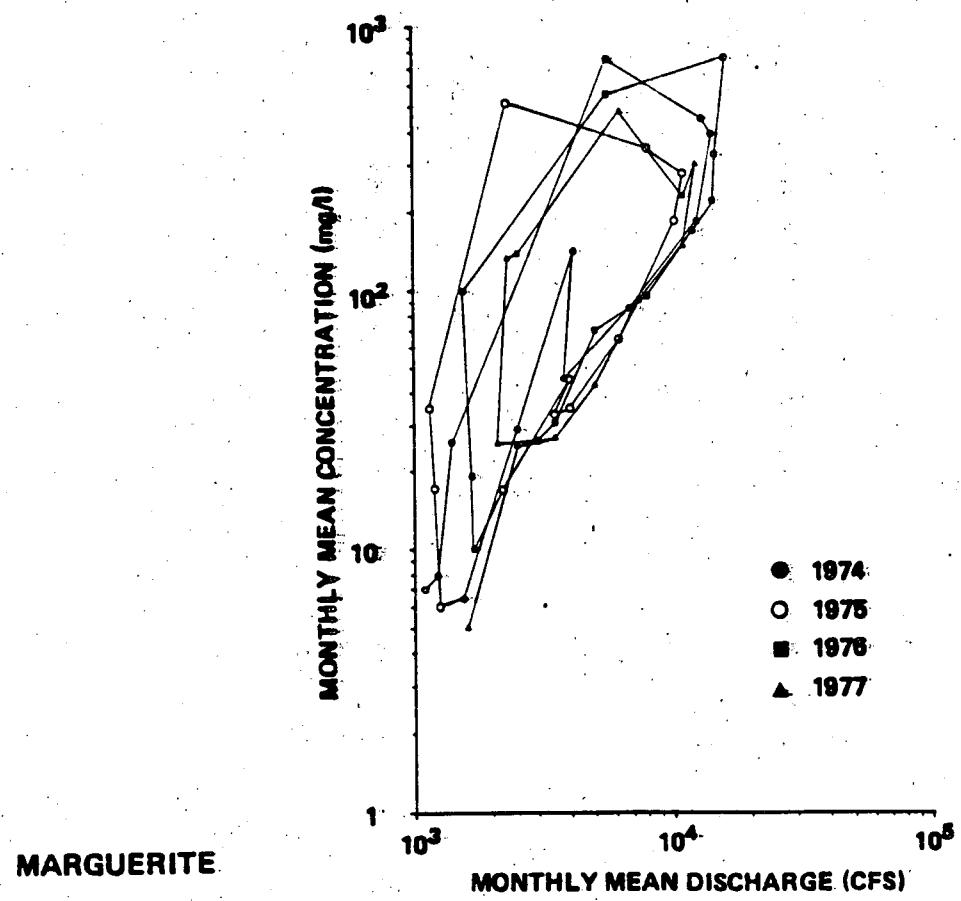
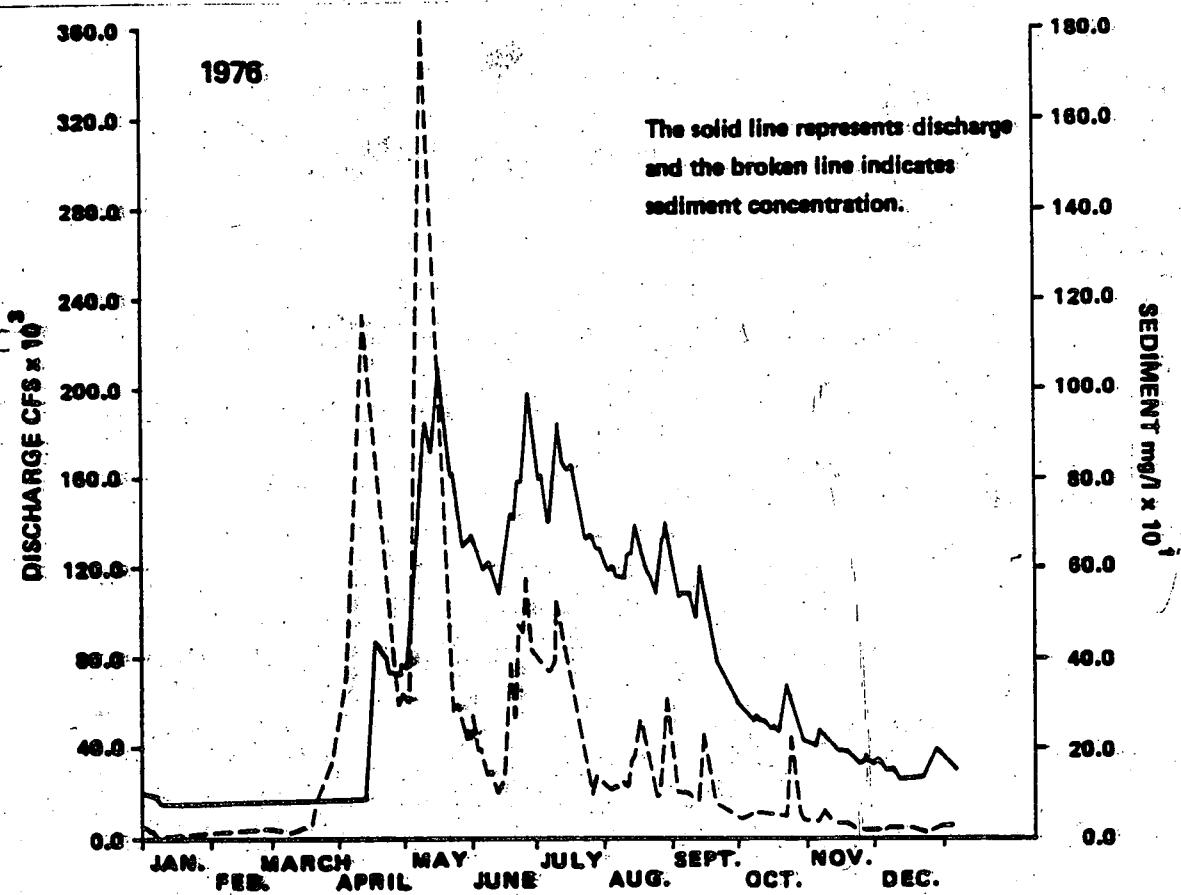
It is interesting to note that the pattern of mean monthly sediment concentrations and discharges (Figure 4.5 - 4.7(b)) is very repeatable. One would expect that a similar case would hold for mean monthly concentrations of water quality parameters.

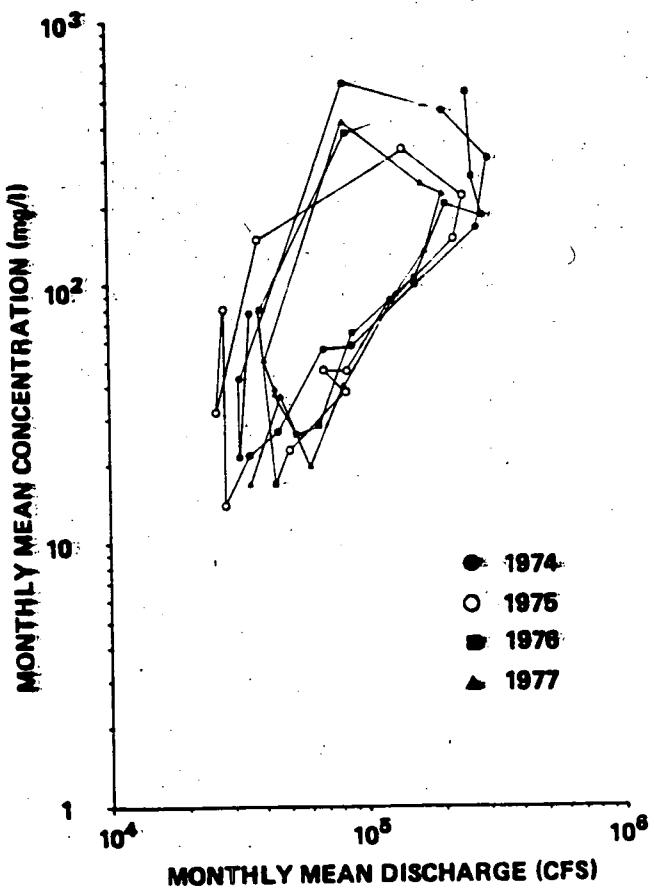
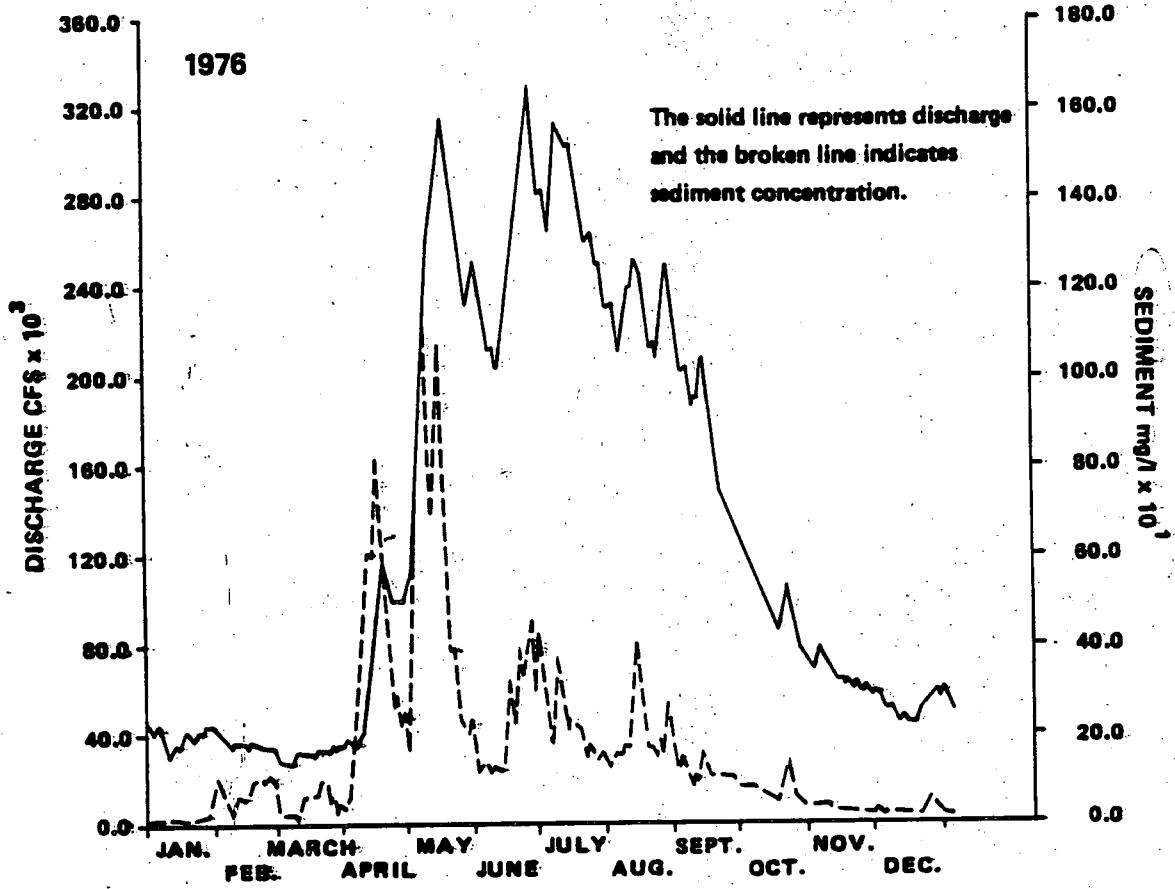
The differential rate of transport of suspended material between the prefreshet and post freshet periods is believed to result from a difference in the rate of supply to the river of erodible materials. The scenario believed to be taking place is that during the winter months and on into the early stages in freshet there is a build-up of sediments in tributary deltas and within the mainstem channel, as the discharge rises towards the peak of freshet this material quickly becomes eroded and is supplemented by surface flow associated with snow melt. Supply of such materials during the post-freshet material is thought to be substantially less.

It would seem reasonable then to speculate that some of the water quality parameter behave in the same manner as does suspended sediments. Turbidity, total phosphorous, the trace metals and non-filterable residues are positively correlated with each other and show a positive relationship to discharge.



HANSARD





Turbidity and iron have been shown to exhibit a pattern of hysteresis similar to that evidenced for suspended sediments. One would anticipate then that these parameters are to a high degree dependent on those mechanisms which cause suspended sediment to be transported.

Calcium (Figure 4.3) and Chloride (Figure 4.2) show a hysteresis effect where higher concentrations are associated with low discharges and higher concentrations during the prefreshet period than during the post-freshet period. This phenomenon warrants further investigation. The mechanisms which result in this phenomenon are believed to be complex and dependent on the form and amount of precipitation and the amount of time the water is stored in the form of snow. A general observation that those rivers under coastal influence where a large proportion of the basin remains snow-free during most of the year, do not exhibit the degree of hysteresis for these parameters which is evidenced in the mainstem. This area, however, requires specific investigations.

Although both types of hysteresis were observed throughout the basin, it was most pronounced at the lower end of the mainstem. One would desire a method by which a statistical evaluation of data demonstrating hysteresis could be evaluated. The serial correlation of  $\epsilon$  of a linear regression makes that analysis invalid.

In summary, we have found that the parameters considered could be placed into three groups; one positively associated with discharge, one negatively associated with discharge and one independent of discharge. The manner of association of parameters with discharge was observed to be complex, with differential transport of materials between the pre-freshet and post-freshet periods.

## CHAPTER 5 - WATER QUALITY OBJECTIVES

A number of aspects regarding the development of water quality objectives for this basin are worth considering. A water quality objective has been defined as a desirable level of water quality to be attained by either short or long term water resource management, (Water Quality Branch, 1972). In that document, the scope of objectives is qualified by:

"A uniform or standard water quality in a country as large as Canada with its wide differences in geology, climate, water quality, existing uses and water pollution is impossible. Thus it is necessary that each area must be managed or planned on its own merits, insofar as water use is concerned.

Any attempt to write a national standard for every surface water in Canada would either permit the pollution or the deterioration of certain waters or would place impossible demands for quality control on waters which do not meet high quality standards even in their natural state."

In the past, water quality objectives have been short-term criteria for reversing deteriorating trends. In this context, an objective is generally recognized as being adequate for protecting a water from the individual effect of a pollutant. On the other hand, the setting of water quality objectives for the upper Fraser River basin for long term effectiveness, will require objectives which reflect the complexities of this basin.

Objectives for the Fraser River basin should reflect the regional differences in water quality evidenced in Chapters 3 & 4. Hynes (1972) suggests that the chemical content of water varies from region to region reflecting local geography and climate. This is indeed the case within the Fraser River basin. It is generally recognized that a natural standard or objective would permit the pollution of some rivers, while placing impossible requirements on some natural systems. This situation also exists on the sub-basin

scale within the Fraser River basin.

This suggests that water quality objectives must be precisely defined for each sub-basin or possibly a group of sub-basins with similar characteristics. The preceding chapters suggest that a minimum of ten regions exist within the basin on the basis of similar water quality conditions. It would seem likely that different objectives would be necessary for each of these.

It has also been observed that the manner in which those parameters considered varied through time, and in relation to discharge was complex. The question which should be addressed in this respect is how important to the ecology of the system are these relationships. If certain relationships are ecologically important, then objectives should reflect the importance of such relationships. The differential transport rate which exists between the rising and falling periods of freshet suggests that a minimum of two objectives will be required, each reflecting this differential transport rate.

This then leads to a consideration of the statistical distribution of water quality measurements and of water quality objectives. At the outset of this study, we decided that central tendency statistics were inadequate for dealing with the data as it was found to be distributed. It was decided that since the data was skewed to the right that transformation to natural logarithms produced a distribution which was approximately normal.

The transformation has two major effects; it results in a lower mean concentration and in assymmetric confidence intervals. It additionally produces some statistical properties which are conceptually important. These are the elimination of the probability of having negative concentration values; and increased probability of extreme values.

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In setting objectives, the establishment of the statistical distribution of the desired objective is critical. To illustrate this, one can consider the data presented in Table 3.1. Differential probabilities for obtaining extreme values exist between the two theoretical distributions. Thus if the objective was written "shall not exceed 0.2", one is faced with a quandry. Since values greater than 0.2 are expected to occur with probabilities of 27% for control tendency distribution and 17% for ln-transformed normal distribution, the natural system itself would not conform to such an objective.

On the other hand, if the natural distribution of data is recognized and accounted for, an objective such as "based on ln-transformed data the probability of obtaining a value greater than 0.2 shall not exceed 0.19" would reflect a more realistic approach to this problem. A perhaps more distinct example is where an objective was established to be the mean concentration. In such cases the probability of obtaining a value greater than that mean would be 50%, hence, the natural system would be in non-compliance one-half of the time. How a potential user of the water could proceed with development under such a situation needs resolution.

The process of establishing water quality objectives for the very complex Fraser River basin must account for:

1. differences in mean water quality that exist between various sub-basins.
2. the statistical distribution of water quality data.
3. interrelationships between parameters, particularly those of ecological significance.
4. dependence of parameters on discharge; and
5. the differential rate of transport between the prefreshet and post-freshet periods.

It is then recognized that the establishment of water quality objective will of necessity be as complex as the system under consideration.

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## CHAPTER 6 - SUMMARY

1. That portion of the Fraser River system considered in this study is diverse in respect to water quality. The diversity evident is related to geographical areas, similarities being greatest among tributaries and mainstem stations which are closest together, while differences are maximized with geographical distance.
2. It is possible to divide the basin into 10 units, each has dissimilar properties. Techniques useful on making distinctions between these units were cluster analysis supported by t-tests between means.
3. The interdependence and relationships amongst the 22 parameters considered were assessed using correlation and regression techniques. In terms of covariance and behavior, the parameters can be classified into three groups.
  - (a) those parameters which were found to exhibit a positive covariance with one another and formed positive relationships with discharge: turbidity, colour, total phosphorus, trace metals and non-filterable residues.
  - (b) those parameters which were found to exhibit positive covariance with one another and negative relationships with discharge: chloride, sulphate, calcium, conductivity, alkalinity hardness, sodium, potassium and silicate.
  - (c) those parameters which are independent of all other parameters and of discharge: nitrate-nitrite, ammonia and pH.

4. For most of the water quality parameters, the data collected over a 21 month period was found to be skewed. This means that the use of central tendency statistics such as means, variances and t-tests is inadequate. The use of natural logarithmic transformations is suggested as a partial solution. This improves the accuracy and prediction potential for water quality parameters, both of which are essential in establishing water quality objectives.
5. The relationship between discharge and some of the water quality parameters was found to be non-linear and complex. The distribution of the residuals from regressions appeared to be serially correlated. Log-log plots of concentration against discharge showed a distinct ellipsoidal relationship thought to be hysteresis. Suspended sediment data exhibits similar relationships.
6. The complexities of this basin should be reflected upon when water quality objectives are to be established. Objectives should account for the skewness evident in the data, relationships between parameters, dependence of concentration on discharge and the observed differential rate of transport believed to be hysteresis.

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APPENDIX I

GEOMETRIC MEAN CONCENTRATIONS OF WATER QUALITY  
PARAMETERS WITH CONFIDENCE INTERVALS FOR MAIN-  
STEM FRASER RIVER STATIONS.  $t_b$  VALUES AND THEIR  
PROBABILITIES BETWEEN STATIONS ALONG THE RIVER  
ARE ALSO GIVEN.

## PARAMETER TURBIDITY

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	23,979	3,477	6,894	83,375	14.	0,417	25.	0.680
FRASER RIVER @ LYTTON	19,539	3,676	5,315	71,831	13.	-0,302	23.	0.766
FRASER RIVER @ LILLOOET	22,742	3,366	6,757	76,538	12.	-0,539	20.	0.596
FRASER RIVER @ CHILCOTIN	29,958	3,246	9,229	97,240	10.	-0,486	17.	0.855
FRASER RIVER @ MARGUERITE	32,907	2,784	11,019	91,619	9.	1,041	18.	0.312
FRASER RIVER @ QUESNEL	19,835	3,154	6,288	62,567	14.	1,561	22.	0.133
FRASER RIVER @ ICP	9,704	2,950	3,289	28,615	13.	0,345	25.	0.733
FRASER RIVER @ HANSARD	8,392	3,010	2,788	25,262	14.	-0,279	25.	0.783
FRASER RIVER @ DOME CREEK	9,575	3,802	2,519	36,405	13.	-0,695	24.	0.494
FRASER RIVER @ MCBRIDE	13,764	3,774	3,647	51,940	13.	1,458	20.	0.160
FRASER RIVER @ DUNSTER	6,313	3,199	1,973	20,195	9.	2,162	21.	0.042
FRASER RIVER @ TETE JAUNE	2,199	3,026	0,727	6,655	14.	2,279	22.	0.033
FRASER RIVER @ RED PASS	0,900	2,256	0,399	2,030	10.	-0,920	17.	0.371
FRASER RIVER @ JASPER	1,300	2,511	0,518	3,266	9.			

## PARAMETER CCCLCUR

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T <sub>0</sub>	DF	PROB
FRASER RIVER @ HOPE	16.349	2.081	7.853	33.998	14.	-0.298	25.	0.768
FRASER RIVER @ LYTTON	17.830	2.189	8.145	39.030	13.	-0.577	23.	0.570
FRASER RIVER @ LILLOOET	21.313	2.145	9.938	45.709	12.	0.222	20.	0.827
FRASER RIVER @ CHILCOTIN	19.856	2.077	9.561	41.235	10.	-0.249	17.	0.806
FRASER RIVER @ MARGUERITE	21.798	2.422	8.999	52.802	9.	-0.101	18.	0.921
FRASER RIVER @ QUESNEL	22.633	2.115	10.700	47.873	11.	0.931	22.	0.362
FRASER RIVER @ ICP	16.729	2.317	7.220	38.760	13.	1.437	25.	0.163
FRASER RIVER @ HANSARD	10.417	2.393	4.353	24.926	14.	0.458	25.	0.651
FRASER RIVER @ DOME CREEK	8.978	2.262	3.969	20.305	13.	0.445	24.	0.660
FRASER RIVER @ MCBRIDE	7.932	1.792	4.427	14.214	13.	0.227	20.	0.823
FRASER RIVER @ DUNSTER	7.540	1.588	4.749	11.971	9.	2.659	21.	0.015
FRASER RIVER @ TETE JAUNE	4.985	1.083	4.603	5.400	14.	-0.300	22.	0.767
FRASER RIVER @ RED PASS	5.057	1.143	4.423	5.782	10.	-0.530	17.	0.603
FRASER RIVER @ JASPER	5.256	1.195	4.399	6.281	9.			

## PARAMETER PH

LOCATION	MEAN	GEOMETRIC LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	7.798	1.024	7.611	7.989	14.	-0.773	25.	0.447
FRASER RIVER @ LYTTON	7.859	1.028	7.644	8.080	13.	-0.547	23.	0.589
FRASER RIVER @ LILLOOET	7.906	1.027	7.697	8.120	12.	-0.207	20.	0.838
FRASER RIVER @ CHILCOTIN	7.926	1.032	7.679	8.182	10.	0.444	17.	0.663
FRASER RIVER @ MARGUERITE	7.874	1.034	7.614	8.142	9.	0.041	18.	0.968
FRASER RIVER @ QUESNEL	7.869	1.033	7.620	8.126	11.	-0.670	22.	0.510
FRASER RIVER @ ICP	7.942	1.036	7.668	8.225	13.	-0.215	25.	0.830
FRASER RIVER @ HANSARD	7.962	1.026	7.762	8.167	14.	0.027	25.	0.979
FRASER RIVER @ DOME CREEK	7.960	1.021	7.800	8.123	13.	0.235	24.	0.816
FRASER RIVER @ MCBRIDE	7.944	1.023	7.766	8.127	13.	-1.196	20.	0.246
FRASER RIVER @ DUNSTER	8.024	1.015	7.901	8.144	9.	0.143	21.	0.888
FRASER RIVER @ TETE JAUNE	8.012	1.024	7.827	8.202	14.	2.357	22.	0.028
FRASER RIVER @ RED PASS	7.838	1.022	7.669	8.012	10.	2.105	17.	0.050
FRASER RIVER @ JASPER	7.676	1.022	7.514	7.842	9.			

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## PARAMETER CL

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	1.270	1.832	0.693	2.325	14.	-0.680	25.	0.502
FRASER RIVER @ LYTTON	1.506	2.000	0.753	3.013	13.	0.081	23.	0.936
FRASER RIVER @ TILLOOET	1.470	2.233	0.658	3.283	12.	0.309	20.	0.761
FRASER RIVER @ CHILCOTIN	1.318	2.330	0.566	3.071	10.	0.384	17.	0.706
FRASER RIVER @ MARGUERITE	1.138	2.276	0.500	2.589	9.	-0.409	18.	0.687
FRASER RIVER @ QUESNEL	1.325	2.315	0.572	3.068	11.	0.521	22.	0.608
FRASER RIVER @ ICP	1.091	2.689	0.406	2.934	13.	3.005.	25.	0.006
FRASER RIVER @ HANSARD	0.447	1.535	0.291	0.686	14.	0.782	25.	0.442
FRASER RIVER @ DOME CREEK	0.395	1.470	0.269	0.581	13.	-0.020	24.	0.985
FRASER RIVER @ MCBRIDE	0.396	1.597	0.248	0.633	13.	-0.645	20.	0.526
FRASER RIVER @ DUNSTER	0.457	1.703	0.268	0.778	9.	-0.862	21.	0.399
FRASER RIVER @ TETE JAUNE	0.553	1.646	0.336	0.910	14.	4.342	22.	0.000
FRASER RIVER @ RED PASS	0.267	1.380	0.193	0.369	10.	0.236	17.	0.816
FRASER RIVER @ JASPER	0.259	1.297	0.199	0.336	9.			

## PARAMETER CONDUCTIVITY

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	114,430	1.198	95,543	137,050	14.	-2,634	25.	0.014
FRASER RIVER @ LYTTON	135,218	1.160	116,583	156,832	13.	-0.454	23.	0.654
FRASER RIVER @ LILLOOET	139,472	1.208	115,468	168,465	12.	0.580	20.	0.569
FRASER RIVER @ CHILCOTIN	133,304	1.193	111,739	159,031	10.	0.498	17.	0.625
FRASER RIVER @ MARGUERITE	128,208	1.179	108,774	151,114	9.	-0.329	18.	0.746
FRASER RIVER @ QUESNEL	131,430	1.188	110,626	156,146	11.	-1,387	22.	0.179
FRASER RIVER @ ICP	146,335	1.230	118,960	180,009	13.	0,051	25.	0.960
FRASER RIVER @ HANSARD	145,790	1.187	122,786	173,104	14.	0.535	25.	0.597
FRASER RIVER @ DOME CREEK	140,555	1.200	117,117	168,683	13.	0.715	24.	0.481
FRASER RIVER @ MCBRIDE	133,289	1.216	109,603	162,093	13.	-1,163	20.	0.258
FRASER RIVER @ DUNSTER	148,337	1.249	118,723	185,337	9.	0.303	21.	0.765
FRASER RIVER @ TETE JAUNE	144,575	1.165	124,044	168,504	14.	3,191	22.	0.004
FRASER RIVER @ RED PASS	119,820	1.143	104,817	136,970	10.	1,846	17.	0.082
FRASER RIVER @ JASPER	101,326	1.273	79,613	128,961	9.			

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## PARAMETER ALKALINITY

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	47.495	1.213	39.156	57.609	14.	-3.400	25.	0.002
FRASER RIVER @ LYTTON	58.825	1.139	51.664	66.977	13.	-0.641	23.	0.528
FRASER RIVER @ LILLOOET	61.163	1.185	51.605	72.492	12.	0.810	20.	0.427
FRASER RIVER @ CHILCOTIN	57.950	1.153	50.257	66.822	10.	0.508	17.	0.618
FRASER RIVER @ MARGUERITE	55.994	1.163	48.148	65.118	9.	-0.342	18.	0.737
FRASER RIVER @ QUESNEL	57.347	1.175	48.818	67.366	11.	-1.511	22.	0.145
FRASER RIVER @ ICP	64.123	1.222	52.454	78.388	13.	0.059	25.	0.953
FRASER RIVER @ HANSARD	63.850	1.188	53.767	75.824	14.	1.203	25.	0.240
FRASER RIVER @ DOME CREEK	58.591	1.218	48.101	71.369	13.	1.556	24.	0.133
FRASER RIVER @ MCBRIDE	51.815	1.228	42.193	63.631	13.	-1.767	20.	0.093
FRASER RIVER @ DUNSTER	61.615	1.271	48.495	78.285	9.	0.314	21.	0.757
FRASER RIVER @ TETE JAUNE	59.925	1.155	51.878	69.220	14.	4.049	22.	0.001
FRASER RIVER @ RED PASS	47.873	1.134	42.203	54.305	10.	2.822	17.	0.012
FRASER RIVER @ JASPER	35.388	1.347	26.265	47.681	9.			

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## PARAMETER HARDNESS

RATIO/N	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	T	DF	PROB	
FRASER RIVER @ HOPE	53.395	1.192	44.809	63.626	14.	-3.232	25.	0.003
FRASER RIVER @ LYTTON	64.316	1.128	57.003	72.565	13.	-0.697	23.	0.493
FRASER RIVER @ LILLCETT	66.879	1.169	57.231	78.153	12.	0.597	20.	0.557
FRASER RIVER @ CHILCOTIN	64.443	1.145	56.282	73.788	10.	0.714	17.	0.485
FRASER RIVER @ MARGUERITE	61.712	1.137	54.256	70.192	9.	-0.329	18.	0.746
FRASER RIVER @ QUESNEL	62.957	1.153	54.610	72.579	11.	-1.899	22.	0.071
FRASER RIVER @ LCP	72.011	1.225	58.779	88.222	13.	-0.319	25.	0.752
FRASER RIVER @ HANSARD	73.687	1.184	62.242	87.236	14.	0.712	25.	0.483
FRASER RIVER @ DCNE CREEK	70.097	1.214	57.744	85.093	13.	0.955	24.	0.349
FRASER RIVER @ MCBRIDE	65.141	1.219	53.452	79.385	13.	-1.345	20.	0.203
FRASER RIVER @ DUNSTER	73.981	1.270	58.240	93.976	9.	0.210	21.	0.835
FRASER RIVER @ TETE JAUNE	72.594	1.169	62.108	84.851	14.	3.182	22.	0.004
FRASER RIVER @ RED PASS	60.040	1.145	52.453	68.724	10.	2.140	17.	0.047
FRASER RIVER @ JASPER	49.537	1.268	39.080	62.792	9.			

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## PARAMETER CA

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
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FRASER RIVER @ HCPE	15.972	1.172	13.631	18.715	14.	-3.668	25,	0.001
FRASER RIVER @ LYTTON	19.200	1.102	17.423	21.158	13.	-0.603	23,	0.552
FRASER RIVER @ LILCOET	19.779	1.154	17.145	22.818	12.	0.380	20,	0.708
FRASER RIVER @ CHILCOTIN	19.339	1.143	16.916	22.110	10.	0.370	17,	0.716
FRASER RIVER @ MARGUERITE	18.921	1.132	16.717	21.415	9,	0.034	18,	0.973
FRASER RIVER @ QUESNEL	18.885	1.126	16.771	21.266	14,	-3.072	22,	0.006
FRASER RIVER @ ICP	22.758	1.193	19.070	27.161	13,	-0.137,	25,	0.892
FRASER RIVER @ HANSARD	22.957	1.164	19.719	26.727	14,	0.984	25,	0.335
FRASER RIVER @ DOME CREEK	21.407	1.234	17.346	26.418	13,	1.233	24,	0.230
FRASER RIVER @ MCBRIDE	19.322	1.238	15.608	23.920	13,	-1.211	20,	0.240
FRASER RIVER @ DUNSTER	21.944	1.297	16.916	28.467	9,	0.883	21,	0.387
FRASER RIVER @ TETE JAUNE	20.134	1.181	17.043	23.785	14,	3.071	22,	0.006
FRASER RIVER @ RED PASS	16.240	1.186	13.693	19.262	10,	2.222	17,	0.040
FRASER RIVER @ JASPER	12.444	1.378	9.027	17.155	9,			

## PARAMETER S04

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	7,427	1,242	5.980	9.225	14.	-0.502	25.	0.620
FRASER RIVER @ LYTTON	7,784	1,302	5.979	10.133	13.	0.227	23.	0.822
FRASER RIVER @ LILCOET	7,591	1,331	5.705	10.102	12.	0.722	20.	0.478
FRASER RIVER @ CHILCOTIN	6,957	1,322	5.260	9.290	10.	0.744	17.	0.467
FRASER RIVER @ MARGUERITE	6,359	1,280	4.966	8.142	9.	0.033	18.	0.974
FRASER RIVER @ QUESNEL	6,336	1,279	4.952	8.195	11.	-1.999	22.	0.058
FRASER RIVER @ ICP	7,773	1,289	6.031	10.018	13.	-0.906	25.	0.374
FRASER RIVER @ HANSARD	8,936	1,669	5.355	14.910	14.	-1.701	25.	0.101
FRASER RIVER @ DONE CREEK	11.526	1,244	9.266	14.337	13.	-1.445	24.	0.161
FRASER RIVER @ MCBRIDE	13.156	1,281	10.270	16.855	13.	0.535	20.	0.598
FRASER RIVER @ DUNSTER	12.394	1,302	9.519	16.136	9.	0.409	21.	0.687
FRASER RIVER @ TETE JAUNE	11.810	1,342	8.803	15.845	14.	0.228	22.	0.822
FRASER RIVER @ RED PASS	11.541	1,224	9.431	14.124	10.	-1.759	17.	0.097
FRASER RIVER @ JASPER	13.472	1,199	11.236	16.154	9.			

## PARAMETER S102

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	5.466	1.215	4.499	6.640	14*	-0.205	25.	0.839
FRASER RIVER @ LYTTEN	5.556	1.243	4.472	6.903	13*	0.970	23.	0.944
FRASER RIVER @ LILLOOET	5.519	1.285	4.296	7.091	12*	0.856	20.	0.402
FRASER RIVER @ CHILCOTIN	5.045	1.273	3.963	6.421	10*	0.267	17.	0.793
FRASER RIVER @ MARGUERITE	4.899	1.268	3.864	6.212	9*	-0.465	18.	0.648
FRASER RIVER @ QUESNEL	5.146	1.263	4.075	6.498	11*	2.536	22.	0.019
FRASER RIVER @ ICP	3.951	1.319	2.995	5.212	13*	-0.128.	25.	0.899
FRASER RIVER @ HANSARD	4.004	1.298	3.084	5.199	14*	1.820	25.	0.081
FRASER RIVER @ DCHE CREEK	3.353	1.278	2.623	4.286	13*	1.097	24.	0.283
FRASER RIVER @ MCERIDE	2.980	1.350	2.208	4.022	13*	-0.811	20.	0.427
FRASER RIVER @ DUNSTER	3.299	1.325	2.490	4.373	9*	2.288	21.	0.033
FRASER RIVER @ TETE JAUNE	2.558	1.250	2.047	3.198	14*	-0.328	22.	0.746
FRASER RIVER @ RED PASS	2.625	1.173	2.237	3.080	10*	-4.741	17.	0.000
FRASER RIVER @ JASPER	3.840	1.206	3.185	4.630	9.			

## PARAMETER NAME

ACTION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
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FRASER RIVER @ HOPE	2.297	1.440	1.595	3.397	14.	-0.776	25.	0.445
FRASER RIVER @ LYTTON	2.599	1.577	1.648	4.100	13.	-0.110	23.	0.913
FRASER RIVER @ LILLOOET	2.655	1.646	1.612	4.371	12.	0.738	20.	0.469
FRASER RIVER @ CHILCOTIN	2.253	1.709	1.318	3.851	10.	0.334	17.	0.742
FRASER RIVER @ MARGUERITE	2.084	1.616	1.290	3.368	9.	-0.176	18.	0.862
FRASER RIVER @ QUESNEL	2.166	1.632	1.327	3.535	11.	1.581	22.	0.128
FRASER RIVER @ ICP	1.508	1.879	0.803	2.833	13.	2.137.	25.	0.043
FRASER RIVER @ HANSARD	0.999	1.349	0.741	1.349	14.	0.587	25.	0.563
FRASER RIVER @ DCME CREEK	0.922	1.493	0.618	1.377	13.	0.652	24.	0.521
FRASER RIVER @ MCBRIDE	0.824	1.618	0.509	1.332	13.	0.644	20.	0.527
FRASER RIVER @ DUNSTER	0.942	1.623	0.581	1.529	9.	0.338	21.	0.739
FRASER RIVER @ TETE JAUNE	0.881	1.556	0.566	1.370	14.	2.344	22.	0.028
FRASER RIVER @ RED PASS	0.634	1.272	0.498	0.806	10.	-1.486	17.	0.156
FRASER RIVER @ JASPER	0.781	1.425	0.548	1.112	9.			

## PARAMETER K

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	0.792	1.0281	0.618	1.014	14.	0.662	25.	0.514
FRASER RIVER @ LYTTON	0.739	1.0331	0.555	0.984	13.	0.159	23.	0.875
FRASER RIVER @ LILLCCET	0.725	1.0385	0.524	1.004	12.	0.219	20.	0.829
FRASER RIVER @ CHILCOTIN	0.701	1.0464	0.479	1.026	10.	0.688	17.	0.501
FRASER RIVER @ MARGUERITE	0.623	1.0451	0.429	0.904	9.	0.199	18.	0.845
FRASER RIVER @ QUESNEL	0.604	1.0349	0.448	0.844	11.	3.067	22.	0.006
FRASER RIVER @ ICP	0.424	1.0294	0.328	0.549	13.	-0.169.	25.	0.867
FRASER RIVER @ HANSARD	0.431	1.0287	0.335	0.555	14.	-1.092	25.	0.285
FRASER RIVER @ DOME CREEK	0.478	1.0271	0.376	0.608	13.	-2.444	24.	0.022
FRASER RIVER @ MCBRIDE	0.604	1.0281	0.472	0.775	13.	-4.260	20.	0.222
FRASER RIVER @ DUNSTER	0.704	1.0347	0.522	0.948	9.	6.311	21.	0.000
FRASER RIVER @ TETE JAUNE	0.296	1.0425	0.208	0.422	14.	2.392	22.	0.026
FRASER RIVER @ RED PASS	0.226	1.0216	0.186	0.275	10.	-0.836	17.	0.415
FRASER RIVER @ JASPER	0.247	1.0306	0.189	0.323	9.			

## PARAMETER TOTAL PHOSPHORUS

TATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER à HCPE	0.079	2.621	0.030	0.208	14.	-0.154	25.	0.879
FRASER RIVER à LYTTON	0.085	3.181	0.027	0.269	13.	-0.071	23.	0.944
FRASER RIVER à LILLOOET	0.087	3.122	0.028	0.273	12.	-0.165	20.	0.871
FRASER RIVER à CHILCOTIN	0.095	3.370	0.028	0.320	10.	-0.349	17.	0.732
FRASER RIVER à MARGUERITE	0.115	3.093	0.037	0.355	9.	0.808	18.	0.430
FRASER RIVER à QUESNEL	0.076	3.010	0.025	0.230	11.	1.643	22.	0.115
FRASER RIVER à ICP	0.041	1.970	0.021	0.080	13.	1.429	25.	0.165
FRASER RIVER à HANSARD	0.027	2.331	0.012	0.063	14.	-0.320	25.	0.752
FRASER RIVER à DOME CREEK	0.030	2.920	0.010	0.088	13.	-0.161	24.	0.873
FRASER RIVER à MCBRIDE	0.032	2.064	0.016	0.066	13.	1.082	20.	0.292
FRASER RIVER à DUNSTER	0.022	2.332	0.009	0.051	9.	2.623	21.	0.016
FRASER RIVER à TETE JAUNE	0.008	2.891	0.003	0.022	14.	1.142	22.	0.266
FRASER RIVER à RED PASS	0.005	1.674	0.003	0.009	10.	-0.142	17.	0.889
FRASER RIVER à JASPER	0.005	1.845	0.003	0.010	9.			

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## PARAMETER NITRATE + NITRITE

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	0.147	2.777	0.053	0.410	14.	-0.302	25.	0.765
FRASER RIVER @ LYTTON	0.164	2.221	0.074	0.364	13.	-0.659	23.	0.516
FRASER RIVER @ LILLOOET	0.208	2.663	0.078	0.553	12.	0.656	20.	0.519
FRASER RIVER @ CHILCOOTIN	0.158	2.686	0.059	0.423	10.	0.443	17.	0.664
FRASER RIVER @ MARGUERITE	0.129	2.572	0.050	0.333	9.	-0.155	18.	0.879
FRASER RIVER @ QUESNEL	0.138	2.285	0.060	0.315	11.	0.224	22.	0.825
FRASER RIVER @ ICP	0.127	2.849	0.044	0.360	13.	-0.612,	25.	0.546
FRASER RIVER @ HANSARD	0.155	1.823	0.085	0.282	14.	-0.289	25.	0.775
FRASER RIVER @ DOME CREEK	0.168	2.317	0.073	0.390	13.	0.810	24.	0.426
FRASER RIVER @ MCBRIDE	0.129	2.337	0.055	0.300	13.	-0.611	20.	0.548
FRASER RIVER @ DUNSTER	0.165	2.706	0.061	0.446	9.	0.933	21.	0.361
FRASER RIVER @ TETE JAUNE	0.114	2.252	0.051	0.257	14.	2.485	22.	0.021
FRASER RIVER @ RED PASS	0.062	1.462	0.042	0.090	10.	-0.584	17.	0.567
FRASER RIVER @ JASPER	0.075	2.634	0.029	0.198	9.			

## PARAMETER NH3

LOCATION	GEOMETRIC LAMBDA MEAN	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB	
FRASER RIVER @ HOPE	0.047	2.448	0.019	0.115	13.	-0.477	23.	0.638
FRASER RIVER @ LYTTON	0.056	2.314	0.024	0.129	12.	0.279	21.	0.783
FRASER RIVER @ LILCOET	0.051	2.329	0.022	0.118	11.	-0.500	18.	0.623
FRASER RIVER @ CHILCOTIN	0.060	1.977	0.030	0.118	9.	0.713	15.	0.487
FRASER RIVER @ MARGUERITE	0.047	1.934	0.025	0.092	8.	-0.560	16.	0.583
FRASER RIVER @ QUESNEL	0.057	2.052	0.028	0.117	10.	1.180	21.	0.251
FRASER RIVER @ ICP	0.037	2.847	0.013	0.105	13.	-1.377	24.	0.181
FRASER RIVER @ HANSARD	0.061	2.160	0.028	0.131	13.	0.335	24.	0.740
FRASER RIVER @ DONE CREEK	0.055	1.844	0.030	0.102	13.	2.060	23.	0.051
FRASER RIVER @ MCBRIDE	0.030	2.344	0.013	0.070	12.	0.609	19.	0.550
FRASER RIVER @ DUNSTER	0.024	2.470	0.010	0.058	9.	-1.227	20.	0.234
FRASER RIVER @ TETE JAUNE	0.037	2.208	0.017	0.082	13.	1.594	21.	0.126
FRASER RIVER @ RED PASS	0.022	2.086	0.011	0.047	10.	-0.368	17.	0.717
FRASER RIVER @ JASPER	0.025	2.026	0.012	0.051	9.			

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PARAMETER	CU	STATION	GEOMETRIC MEAN	LAMARDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	0.003	2,174	0.001	0.007	14.	0.0	25.	1.000		
FRASER RIVER @ LYTTON	0.003	2,555	0.001	0.008	13.	-0.085	23,	0.933		
FRASER RIVER @ LILLOOET	0.003	2,540	0.001	0.008	12.	-0.897	20,	0.380		
FRASER RIVER @ CHILCOTIN	0.005	2,335	0.002	0.010	10.	0.213	17,	0.834		
FRASER RIVER @ MARGUERITE	0.004	2,806	0.002	0.012	9.	0.847	18,	0.408		
FRASER RIVER @ QUESNEL	0.003	2,624	0.001	0.007	11.	1.722	22,	0.099		
FRASER RIVER @ ICP	0.002	1,687	0.001	0.003	13.	-1.165,	25,	0.255		
FRASER RIVER @ HANSARD	0.002	1,598	0.001	0.003	14.	-0.419	25,	0.679		
FRASER RIVER @ DOME CREEK	0.002	1,982	0.001	0.004	13.	0.605	24,	0.551		
FRASER RIVER @ MCBRIDE	0.002	1,723	0.001	0.003	13.	0.832	20,	0.415		
FRASER RIVER @ DUNSTER	0.002	1,527	0.001	0.002	9.	1.159	21,	0.259		
FRASER RIVER @ TETE JAUNE	0.001	1,512	0.001	0.002	14.	-0.657	22,	0.518		
FRASER RIVER @ RED PASS	0.002	1,811	0.001	0.003	10.	-0.497	17,	0.626		
FRASER RIVER @ JASPER	0.002	1,656	0.001	0.003	9.					

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## PARAMETER ZN

RATIO	GEOMETRIC MEAN	LAMADA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER à HCPE	0.004	2.495	0.002	0.010	14.	0.078	25.	0.938
FRASER RIVER à LYTTON	0.004	2.360	0.002	0.009	13.	0.573	23.	0.572
FRASER RIVER à LILCOET	0.003	2.616	0.001	0.008	12.	-1.280	20.	0.215
FRASER RIVER à CHILCOTIN	0.005	2.646	0.002	0.013	10.	1.100	17.	0.287
FRASER RIVER à MARGUERITE	0.003	2.705	0.001	0.008	9.	0.492	18.	0.629
FRASER RIVER à QUÉSNEL	0.002	2.578	0.001	0.006	11.	0.699	22.	0.492
FRASER RIVER à ICP	0.002	1.672	0.001	0.003	13.	-0.801	25.	0.430
FRASER RIVER à HANSARD	0.002	2.447	0.001	0.006	14.	0.392	25.	0.698
FRASER RIVER à DOME CREEK	0.002	2.220	0.001	0.005	13.	-0.155	24.	0.878
FRASER RIVER à MCBRIDÉ	0.002	1.940	0.001	0.005	13.	-0.230	20.	0.820
FRASER RIVER à DUNSTER	0.002	2.548	0.001	0.006	9.	0.980	21.	0.338
FRASER RIVER à TÊTE JAUNE	0.002	1.587	0.001	0.003	14.	-1.514	22.	0.144
FRASER RIVER à RED PASS	0.003	2.700	0.001	0.008	10.	1.323	17.	0.203
FRASER RIVER à JASPER	0.002	1.962	0.001	0.003	9.			

PARAMETER PB	STATION	GEOMETRIC MEAN LAMBDA	LOWER LIMIT.	UPPER LIMIT.	N	T	DF	PROB
	FRASER RIVER @ HOPE	0.002	1.717	0.001	0.002	14.	0.343	25.
	FRASER RIVER @ LYTTON	0.001	1.656	0.001	0.002	13.	-0.725	23.
	FRASER RIVER @ LILLOOET	0.002	2.206	0.001	0.004	12.	0.634	20.
	FRASER RIVER @ CHILCOTIN	0.001	1.908	0.001	0.003	10.	-0.239	17.
	FRASER RIVER @ MARGUERITE	0.002	1.844	0.001	0.003	9.	-0.720	18.
	FRASER RIVER @ QUESNEL	0.002	3.123	0.001	0.006	11.	1.440	22.
	FRASER RIVER @ ICP	0.001	1.382	0.001	0.002	13.	-1.554.	25.
	FRASER RIVER @ HANSARD	0.002	1.521	0.001	0.002	14.	-0.303	25.
	FRASER RIVER @ DOME CREEK	0.002	1.923	0.001	0.003	13.	0.978	24.
	FRASER RIVER @ MCBRIDE	0.001	1.489	0.001	0.002	13.	2.199	20.
	FRASER RIVER @ DUNSTER	0.001	1.145	0.001	0.001	9.	-1.117	21.
	FRASER RIVER @ TETE JAUNE	0.001	1.311	0.001	0.002	14.	0.0	22.
	FRASER RIVER @ RED PASS	0.001	1.273	0.001	0.001	10.	-0.832	17.
	FRASER RIVER @ JASPER	0.001	1.745	0.001	0.002	9.		

## PARAMETER FE

## RATION GEOMETRIC LAHRDA LOWER UPPER N T DF PROB

		MEAN	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB	
FRASER RIVER @ HOPE		0.600	3.043	0.197	1.826	14.	0.935	25.	0.359
FRASER RIVER @ LYTTON		0.361	5.180	0.070	1.869	13.	-0.633	23.	0.533
FRASER RIVER @ LILLOOET		0.517	3.259	0.159	1.686	12.	-0.205	20.	0.840
FRASER RIVER @ CHILCOTIN		0.578	3.785	0.153	2.188	10.	-0.284	17.	0.780
FRASER RIVER @ MARGUERITE		0.683	3.428	0.199	2.342	9.	0.200	18.	0.843
FRASER RIVER @ QUESNEL		0.619	2.490	0.248	1.540	11.	1.041	22.	0.309
FRASER RIVER @ IICP		0.447	1.717	0.260	0.767	13.	0.632	25.	0.533
FRASER RIVER @ HANSARD		0.395	1.603	0.246	0.632	14.	0.265	25.	0.793
FRASER RIVER @ COOME CREEK		0.369	2.212	0.167	0.816	13.	-0.758	24.	0.456
FRASER RIVER @ MCBRIDE		0.453	1.785	0.254	0.809	13.	1.403	20.	0.176
FRASER RIVER @ DUNSTER		0.254	3.133	0.081	0.795	9.	2.661	21.	0.015
FRASER RIVER @ TETE JAUNE		0.082	2.016	0.041	0.165	14.	3.707	22.	0.001
FRASER RIVER @ RED PASS		0.034	1.589	0.021	0.054	10.	-5.281	17.	0.000
FRASER RIVER @ JASPER		0.096	1.479	0.065	0.142	9.			

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## PARAMETER MN

## STATION

	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
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FRASER RIVER à HOPE	0.032	3.372	0.010	0.108	14.	-0.175	25.	0.863
FRASER RIVER à LYTTON	0.035	2.981	0.012	0.104	13.	-0.094	23.	0.926
FRASER RIVER à LILLCOET	0.036	3.133	0.012	0.114	12.	-0.345	20.	0.734
FRASER RIVER à CHILCOTIN	0.043	3.642	0.012	0.158	10.	-0.238	17.	0.815
FRASER RIVER à MARGUERITE	0.050	3.030	0.016	0.150	9.	0.495	18.	0.627
FRASER RIVER à QUESNEL	0.040	2.487	0.016	0.098	11.	1.541	22.	0.137
FRASER RIVER à ICP	0.023	2.126	0.011	0.049	13.	0.751	25.	0.460
FRASER RIVER à HANSARD	0.019	1.772	0.011	0.034	14.	-0.071	25.	0.944
FRASER RIVER à DOME CREEK	0.019	2.465	0.008	0.048	13.	-0.035	24.	0.972
FRASER RIVER à MCBRIDE	0.020	1.672	0.012	0.033	13.	2.197	20.	0.040
FRASER RIVER à DUNSTER	0.013	1.476	0.009	0.019	9.	1.448	21.	0.162
FRASER RIVER à TETE JAUNE	0.011	1.159	0.009	0.012	14.	1.477	22.	0.154
FRASER RIVER à RED PASS	0.010	1.006	0.010	0.010	10.	-1.444	17.	0.167
FRASER RIVER à JASPER	0.011	1.196	0.009	0.013	9.			

## PARAMETER FIXED NONFILTERABLE RESIDUE

LOCATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	33.344	5.386	6.191	179.584	13.	0.042	23.	0.567
FRASER RIVER @ LYTTON	32.433	4.944	6.559	160.359	12.	-0.366	21.	0.718
FRASER RIVER @ LILLOOET	41.024	6.390	9.344	180.110	11.	-0.326	18.	0.748
FRASER RIVER @ CHILCOTIN	50.126	3.551	14.116	178.005	9.	-0.360	15.	0.724
FRASER RIVER @ MARGUERITE	61.688	3.042	20.276	187.679	8.	1.027	16.	0.320
FRASER RIVER @ QUESNEL	32.277	4.759	6.783	153.590	10.	0.890	20.	0.384
FRASER RIVER @ ICP	18.610	3.650	5.099	67.921	12.	0.811	22.	0.426
FRASER RIVER @ HAASARD	11.731	4.417	2.656	51.818	12.	-0.902	22.	0.377
FRASER RIVER @ DOME CREEK	20.916	5.214	4.012	109.058	12.	-0.093	22.	0.927
FRASER RIVER @ MCBRIDE	22.100	3.410	6.481	75.363	12.	1.060	19.	0.223
FRASER RIVER @ DUNSTER	10.254	4.432	2.314	45.443	9.	2.560	20.	0.019
FRASER RIVER @ TETE JAUNE	1.983	4.338	0.457	8.601	13.	1.827	21.	0.082
FRASER RIVER @ RED PASS	0.725	3.234	0.224	2.345	10.	-1.385	15.	0.186
FRASER RIVER @ JASPER	1.894	4.705	0.402	8.910	7.			

## PARAMETER TOTAL NONFILTERABLE RESIDUE

STATION	GEOMETRIC MEAN	LAMBDA	LOWER LIMIT	UPPER LIMIT	N	T	DF	PROB
FRASER RIVER @ HOPE	38.476	4.742	8.114	182.457	13*	0.020	23*	0.984
FRASER RIVER @ LYTTON	38.020	4.356	8.729	165.598	12*	-0.296	21*	0.770
FRASER RIVER @ LILLCET	45.453	4.154	10.943	188.794	11*	-0.299	18*	0.768
FRASER RIVER @ CHILCOTIN	54.321	3.455	15.723	187.674	9*	-0.336	15*	0.742
FRASER RIVER @ MARGUERITE	65.742	3.012	21.823	198.050	8*	0.878	16*	0.393
FRASER RIVER @ QUESNEL	39.771	3.763	10.569	149.650	10*	1.108	20*	0.281
FRASER RIVER @ ICP	21.786	3.307	6.588	72.046	12*	0.634	22*	0.532
FRASER RIVER @ HANSARD	15.974	3.323	4.807	53.077	12*	-0.828	22*	0.417
FRASER RIVER @ DCYNE CREEK	25.245	4.447	5.677	112.257	12*	-0.102	22*	0.920
FRASER RIVER @ MCBRIDE	26.604	2.671	9.962	71.051	12*	1.359	19*	0.190
FRASER RIVER @ DUNSTER	13.551	3.397	3.990	46.031	9*	2.498	20*	0.021
FRASER RIVER @ TETE JAUNE	3.770	3.059	1.233	11.532	13*	1.900	21*	0.071
FRASER RIVER @ RED PASS	1.672	2.540	0.658	4.247	10*	-1.137	15*	0.273
FRASER RIVER @ JASPER	3.141	3.464	0.907	10.881	7*			

APPENDIX II

GEOMETRIC MEAN CONCENTRATIONS OF WATER QUALITY  
PARAMETERS WITH CONFIDENCE INTERVALS FOR  
SEVENTEEN TRIBUTARIES TO THE FRASER RIVER.  
WITHIN EACH OF THE TABLES, THE TRIBUTARIES ARE  
ORDERED ON THE BASIS OF MEAN CONCENTRATION.

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## PARAMETER TURBIDITY

TRIBUTARY	GEOMETRIC LAMDA MEAN	UPPER LIMIT	LOWER LIMIT
STEIN	0.708	1.570	1.111
GOAT	0.951	2.476	2.352
MOOSE	1.377	2.172	2.991
BEAVER	1.454	1.964	2.856
THOMPSON	1.517	1.896	2.976
ROBSON	1.545	3.041	1.697
BRIDGE	2.068	3.192	6.602
DORE	2.169	4.419	9.583
COQUITHALA	2.541	7.174	18.231
SETON	2.860	2.718	7.774
SAFON	3.340	3.842	12.830
NECHAKO	3.340	3.013	10.062
WILLOW	5.172	3.516	18.186
BOWRON	5.541	4.814	26.672
COTTONWOOD	7.123	3.398	24.207
ANDERSON	9.053	4.373	39.592
QUESNEL	19.174	3.685	70.662

## PARAMETER COLOUR

TRIBUTARY	GEOMETRIC LAW90A MEAN	UPPER LIMIT	LOWER LIMIT
ROBSON	5.000	1.030	5.000
MOOSE	5.000	1.000	5.000
BRIDGE	5.303	1.181	6.261
GOAT	5.359	1.245	6.672
DORE	5.400	1.260	6.804
BEAVER	5.453	1.278	6.967
STEIN	5.504	1.338	7.098
SETON	6.083	1.442	8.774
THOMPSON	7.167	1.611	11.544
COQUIMALLA	7.758	2.372	18.404
QUESTNEL	11.398	2.378	27.195
ANDERSON	13.566	2.053	27.852
NECHAKO	14.900	2.011	27.948
BOWRON	15.027	2.135	32.087
WILLOW	30.478	1.618	49.312
COTTONWOOD	38.055	1.414	53.806
SALMON	38.886	1.625	63.181

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PARAMETER: PH	TRIBUTARY	GEOMETRIC LAMADA		LOWER LIMIT	6%
		MEAN	LIMIT		
COTTONWOOD		7.445	1.040	7.745	7.156
COQUIHALLA		7.447	1.031	7.692	7.219
STEIN		7.467	1.040	7.765	7.180
WILLOW		7.557	1.031	7.795	7.326
ANDERSON		7.646	1.033	7.902	7.399
NECHAKO		7.678	1.033	7.930	7.434
THOMPSON		7.688	1.031	7.929	7.455
SETON		7.733	1.035	8.004	7.472
SALMON		7.814	1.041	8.133	7.509
DORE		7.821	1.017	7.956	7.694
BEAVER		7.825	1.012	7.915	7.736
BONRON		7.905	1.036	8.192	7.627
QUESNEL		7.907	1.025	8.102	7.716
GOAT		7.989	1.022	8.163	7.818
MOOSE		8.024	1.015	8.142	7.909
ROSSON		8.029	1.015	8.146	7.914
BRIDGE		8.135	1.029	8.368	7.908

## PARAMETER CL

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT
DORE	0.236	1.302	0.308
GOAT	0.342	1.604	0.549
MOOSE	0.366	1.578	0.578
QUESNEL	0.369	1.573	0.581
BEAVER	0.391	1.556	0.608
SETON	0.396	1.391	0.550
BOWRON	0.403	1.344	0.542
ROBSON	0.420	1.380	0.580
NECHAKO	0.474	1.366	0.647
ANDERSON	0.522	1.490	0.778
COTTONWOOD	0.526	1.488	0.782
STEIN	0.538	1.671	0.898
WILLOW	0.558	1.326	0.740
SALMON	0.667	1.385	0.924
COQUITHLA	0.729	1.589	1.159
BRIDGE	0.946	1.607	1.520
THOMPSON	1.378	2.077	2.863

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## PARAMETER CONDUCTIVITY

TRIBUTARY	GEOMETRIC LAMDA MEAN	UPPER LIMIT	LOWER LIMIT	8.
COQUIHALLA	62.775	82.140	47.975	
COTTONWOOD	65.444	90.882	47.127	6.
STEIN	65.881	94.588	45.897	7.
WILLOW	63.745	106.796	65.669	10.
ANDERSON	85.342	124.098	58.690	8.
NECHAKO	88.191	96.623	80.495	10.
THOMPSON	97.117	121.561	77.588	10.
SETON	101.967	122.848	84.635	9.
DORE	+ 122.217	163.498	91.363	9.
BEAVER	+ 123.334	160.041	95.046	8.
QUESNEL	125.420	146.305	107.913	10.
ROWSON	+ 132.788	156.103	112.955	10.
SALMON	141.893	184.986	108.839	10.
GOAT	+ 154.928	178.252	134.656	10.
ROBSON	+ 157.322	178.977	138.287	10.
MOOSE	+ 177.060	215.793	145.312	8.
BRIDGE	+ 230.016	300.482	176.076	8.

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## PARAMETER ALKALINITY

TRIBUTARY	MEAN	GEOOMETRIC LAMBDA	UPPER LIMIT	LOWER LIMIT	N
COQUIHALLA	22.420	1.295	29.036	17.314	8.
STEIN	24.270	1.463	35.508	16.589	7.
COTTONWOOD	27.819	1.467	40.794	18.969	6.
ANDERSON	36.211	1.479	53.524	24.484	6.
THOMPSON	36.782	1.212	44.590	30.342	10.
WILLOW	38.012	1.330	50.574	28.570	10.
SETON	38.407	1.205	46.276	31.877	8.
NECHAKA	39.710	1.105	43.862	35.951	10.
DORE	47.882	1.372	65.697	34.898	9.
BEAVER	48.997	1.325	64.902	36.990	8.
QUESTNEL	55.861	1.181	65.962	47.304	10.
BOWRON	63.751	1.210	77.139	52.686	10.
GOAT	66.276	1.150	76.232	57.621	10.
SALMON	69.593	1.349	93.919	51.568	10.
ROBSON	70.070	1.124	78.733	62.361	10.
MOOSE	76.496	1.209	92.458	63.290	8.
BRIDGE	97.700	1.277	124.749	76.515	8.

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## PARAMETER HARDNESS

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT	N
COQUIHALLA	29.115	1.286	37.455	22.632
STEIN	29.392	1.393	40.941	21.101
COTTONWOOD	32.913	1.365	44.803	24.031
ANDERSON	40.504	1.478	59.877	27.399
NECHAKO	41.614	1.087	45.233	38.285
WILLOW	42.443	1.261	53.520	33.659
THOMPSON	42.679	1.205	51.443	35.400
SETON	47.096	1.208	56.908	38.977
DORE	60.550	1.358	82.238	44.582
BEAVER	61.153	1.304	80.162	47.119
QUESNEL	62.231	1.161	72.224	53.620
BOWRON	69.020	1.174	81.035	58.704
SALMON	73.816	1.283	94.723	57.523
GOAT	79.683	1.159	91.686	68.214
ROBSON	81.625	1.134	92.592	71.957
MOOSE	91.650	1.229	112.683	74.564
BRIDGE	114.922	1.313	150.943	87.497

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## PARAMETER CA

TRIBUTARY	GEOGRAPHIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT	N
STEIN	9.029	1.389	12.537	6.502
COCOHELLA	9.516	1.292	12.290	7.367
COTTONWOOD	9.846	1.302	12.021	7.561
NECHAKO	12.361	1.107	13.691	11.167
WILLOW	12.811	1.221	15.639	10.495
THOMPSON	13.411	1.185	15.892	11.318
ANDERSON	13.664	1.474	20.141	9.270
SETON	14.585	1.187	17.315	12.286
BEAVER	17.734	1.282	22.730	13.835
DORE	19.257	1.365	26.284	14.109
QUEENEL	20.016	1.143	22.872	17.517
SALMON	20.785	1.155	24.007	17.996
BOMBERN	22.444	1.161	26.052	19.336
ROBISON	22.970	1.160	26.644	19.802
MOOSE	24.982	1.240	30.975	20.149
BRIDGE	25.519	1.295	33.041	19.709
GOAT	25.678	1.144	29.383	22.440

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## PARAMETER S04

TRIBUTARY	GEOMETRIC LENGTH MEAN	UPPER LIMIT	LOWER LIMIT
COTTONWOOD	2.932	1.193	3.469
WILLOW	3.148	1.196	3.732
NECHAKO	3.321	1.162	3.858
SALMON	3.657	1.357	4.961
BONARCH	4.083	1.604	6.549
STEIN	5.329	1.475	7.861
ANDERSON	5.362	1.498	9.073
COQUITHALA	5.836	1.320	7.592
QUESNEL	6.791	1.196	8.123
THOMPSON	6.862	1.711	11.741
SETON	9.906	1.272	12.604
ROBSON	10.059	1.295	13.027
GOAT	11.286	1.263	14.251
SEASIDE	11.464	1.316	15.090
DORE	11.548	1.348	15.567
MOOSE	13.552	1.449	19.636
BRIDGE	22.530	1.613	36.445

## PARAMETER S102

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT
ACBSON	1.896	1.493	2.660
MOOSE	2.057	1.278	2.630
DORE	2.531	1.384	3.502
GOAT	3.346	1.147	3.839
BEAVER	3.355	1.194	4.006
QUESNEL	3.944	1.267	4.995
THOMPSON	5.113	1.214	6.206
NECHAKO	5.125	1.153	5.912
BOWRCN	5.136	1.374	7.059
SETON	5.327	1.079	5.700
COCUHALLA	5.885	1.186	6.979
STEIN	6.178	1.347	8.323
ANDERSON	6.603	1.251	8.263
COTTONWOOD	6.888	1.204	8.291
SALMON	7.594	1.189	9.022
WILLOW	7.956	1.208	9.607
BRIDGE	8.696	1.102	9.580

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## PARAMETER NAME

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT	N
ROBSON	0.569	1.604	0.913	0.355
DORE	0.651	1.416	0.934	0.453
MOOSE	0.750	1.613	1.210	0.469
BONNIE	0.799	1.250	0.998	0.632
GOAT	0.820	1.268	1.039	0.647
BEAVER	1.041	1.491	1.552	0.698
COTTONWOOD	1.052	1.362	1.369	0.808
COQUITHLA	1.067	1.239	1.321	0.862
QUESNEL	1.100	1.331	1.465	0.826
WILLOW	1.186	1.294	1.534	0.916
STEIN	1.318	1.419	1.869	0.930
ANDERSON	1.546	1.396	2.142	1.116
SETON	1.570	1.297	2.037	1.210
NECHAKO	2.006	1.096	2.198	1.830
SALMON	2.272	1.274	2.895	1.783
THOMPSON	2.297	1.538	3.532	1.493
BRIDGE	3.954	1.477	5.841	2.676

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## PARAMETER K

TRIBUTARY	GEOGRAPHIC LAT/DOA MEAN	UPPER LIMIT	LOWER LIMIT
GOAT	0.194	1.305	0.253
DORE	0.226	1.288	0.291
BEAVER	0.241	1.316	0.317
ROBSON	0.249	1.349	0.336
MOOSE	0.245	1.407	0.400
BOWRON	0.286	1.496	0.427
COTTONWOOD	0.424	1.581	0.671
WILLOW	0.426	1.427	0.608
ANDERSON	0.486	1.407	0.684
QUESNEL	0.519	1.344	0.697
COQUITHLA	0.592	1.435	0.850
BRIDGE	0.634	1.320	0.797
SAFON	0.654	1.245	0.815
NECHAKC	0.659	1.392	0.917
STEIN	0.764	1.385	1.059
SETON	✓ 0.867	1.155	1.001
THOMPSON	0.913	1.214	1.108

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## PARAMETER TOTAL PHOSPHORUS

TRIBUTARY	GEOMETRIC MEAN	UPPER LIMIT	LOWER LIMIT
MOOSE	0.005	0.008	0.004
ROBSON	0.006	0.013	0.003
GOAT	0.006	0.016	0.003
STEIN	0.007	0.013	0.003
DORE	0.008	0.023	0.002
BRIDGE	0.011	0.025	0.005
COQUIMALLA	0.013	0.044	0.005
SETON	0.014	0.053	0.005
BEAVER	0.014	0.028	0.008
THOMPSON	0.021	0.747	0.012
BOWRON	0.027	3.210	0.070
SALMON	0.028	2.498	0.068
ANDERSON	0.029	4.179	0.119
NECHAKC	0.030	2.468	0.072
COTTONWOOD	0.030	3.856	0.117
WILLOW	0.031	2.609	0.080
QUEENSL	0.065	3.224	0.209

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## PARAMETER NITRATE + NITRITE

TRIBUTARY	GFC VETRIC LAYACCA MEAN	UPPER LIMIT	LOWER LIMIT
SALMON	0.028	3.024	0.086
COTTONWOOD	0.042	3.139	0.132
WILLOW	0.058	2.095	0.122
NECHAKO	0.078	4.078	0.318
BOWRON	0.109	6.049	0.440
ANDERSON	0.113	3.860	0.437
MOOSE	0.114	2.669	0.303
ROBSON	0.127	1.675	0.212
GOLD	0.152	2.032	0.305
BRIDGE	0.159	3.114	0.494
BEAVER	0.169	1.526	0.307
QUESNEL	0.164	2.045	0.468
STEIN	0.173	2.319	0.400
DORE	0.187	1.916	0.370
COQUILLES	0.188	2.356	0.442
SETON	0.234	2.406	0.490
THOMPSON	0.237	2.628	0.623

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## PARAMETER N14

TRIBUTARY	GEOMETRIC MEAN	UPPER LIMIT	LOWER LIMIT
BEAVER	0.020	2.213	0.043
MOOSE	0.021	2.667	0.056
ROBSON	0.027	2.171	0.048
SALMON	0.032	1.653	0.049
DORE	0.033	1.979	0.065
ANDERSON	0.036	2.728	0.398
WILLOW	0.038	2.194	0.044
STEIN	0.038	2.913	0.112
SETON	0.043	3.473	0.137
BOWRON	0.044	2.447	0.101
COTTONWOOD	0.043	2.392	0.109
GOAT	0.045	1.730	0.079
YECMAK	0.048	3.495	0.169
BRINGE	0.049	2.351	0.115
QUESNEL	0.052	2.587	0.134
THOMPSON	0.055	3.093	0.169
COQUITHLA	0.056	2.219	0.124

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## PARAMETER CU

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT
GOAT	0.001	1.273	0.001
ROBISON	0.001	1.591	0.001
BEAVER	0.001	1.368	0.002
STEIN	0.001	1.396	0.002
MOOSE	0.001	1.497	0.002
SETON	0.002	1.801	0.003
YECMAKO	0.002	1.815	0.003
THOMPSON	0.002	1.678	0.003
BOWRON	0.002	1.858	0.003
DORE	0.002	1.622	0.003
BRIDGE	0.002	1.952	0.004
WILLOW	0.002	1.794	0.003
SALMON	0.002	1.946	0.004
COCUITHALLA	0.002	1.893	0.004
ANDERSON	0.002	2.301	0.005
COTTONWOOD	0.003	2.176	0.006
QUESNEL	0.003	2.533	0.009

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## PARAMETER Z1

TRIBUTARY	GEOMETRIC LENGTH MEAN	UPPER LIMIT	LOWER LIMIT
NECHAKO	0.002	1.676	0.303
GOAT	0.002	1.665	0.003
WONSE	0.002	2.054	0.303
ROBSON	0.002	1.793	0.003
THOMPSON	0.002	2.063	0.304
SEASIDE	0.032	2.164	0.001
COTTONWOOD	0.002	2.238	0.005
STEIN	0.032	1.678	0.005
WILLOW	0.002	1.593	0.005
SALMON	0.002	2.592	0.006
ACHRON	0.002	2.545	0.006
BRIDGE	0.032	1.626	0.005
DORE	0.003	2.155	0.006
COQUILTHA	0.003	1.903	0.005
ANDERSON	0.003	2.654	0.006
QUESNEL	0.003	2.615	0.006
SETON	0.035	2.661	0.002

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## PARAMETER P8

TRIBUTARY		GEOMETRIC LENGTH MEAN	UPPER LIMIT	LOWER LIMIT	N
GCAT		0.001	1.009	0.001	0.001
STEIN		0.001	1.009	0.001	0.001
ANDERSON		0.001	1.009	0.001	0.001
SALMON		0.001	1.245	0.001	0.001
BRIDGE		0.001	1.475	0.902	0.001
COTTONWOOD		0.001	1.327	0.002	0.001
THOMPSON		0.001	1.171	0.001	0.001
SETCH		0.001	1.278	0.391	0.001
DORE		0.001	1.432	0.002	0.001
BEAVER		0.001	1.316	0.002	0.001
BONANCA		0.001	1.456	0.002	0.001
ROBSCN		0.001	1.410	0.902	0.001
COQUIHALLA		0.001	1.663	0.002	0.001
AGOSE		0.001	1.379	0.002	0.001
YECHAKO		0.001	1.487	0.002	0.001
MILLION		0.002	3.218	0.905	0.001
SUESNEL		0.002	1.659	0.003	0.001

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## PARAMETERS FOR

TRIBUTARY	GEOMETRIC MEAN	UPPER LIMIT	LOWER LIMIT
GOAT	0.043	2.256	0.098
ROBSON	0.055	2.619	0.144
STEIN	0.069	1.412	0.092
MOOSE	0.074	1.450	0.107
ARIDGE	0.078	3.508	0.272
DORE	0.034	3.016	0.250
SETON	0.114	2.655	0.302
THCPFSCH	0.117	1.934	0.226
COQUITHLA	0.122	0.601	0.053
BEAVER	0.124	1.542	0.192
NECHAKO	0.156	2.460	0.393
ANDERSON	0.243	3.273	0.796
BOWRON	0.312	2.297	0.716
WILLOW	0.370	1.770	0.655
QUÉSNEL	0.455	2.500	1.142
COTTONWOOD	0.484	1.565	0.758
SALMON	0.545	1.522	0.830

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## PARAMETER 4N

TRIBUTARY	GEOMETRIC LAMBDA MEAN	UPPER LIMIT	LOWER LIMIT
GOAT	0.010	1.006	0.010
STEIN	0.010	1.006	0.010
MOOSE	0.010	1.006	0.010
BRIDGE	0.011	1.078	0.014
THOMPSON	0.010	1.049	0.014
ROBSON	0.012	1.550	0.014
BEAVER	0.012	1.304	0.015
SETON	0.013	1.675	0.022
DORE	0.015	2.189	0.032
YECOARD	0.017	2.493	0.042
ANDERSON	0.017	3.370	0.057
COQUITHLA	0.018	5.269	0.095
COTTONWOOD	0.022	2.148	0.046
DOWNIE	0.026	2.257	0.058
DUANE	0.027	2.606	0.072
MILLOW	0.035	1.686	0.060
SALMON	0.038	1.753	0.067

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## PARAMETER TOTAL NONFILTRABLE RESIDUE

TRIBUTARY	GEOMETRIC MEAN	UPPER LIMIT	LOWER LIMIT
GOAT	0.0	2.003	0.000
COQUIMALLA	0.0	0.000	0.000
WILLOW	0.0	0.000	0.000
STEIN	0.0	0.000	0.000
COTTONWOOD	0.0	0.000	0.000
SETON	0.0	0.000	0.000
BEAVER	0.0	0.000	0.000
ANDERSON	0.0	0.000	0.000
SALMON	0.0	0.000	0.000
BRIDGE	0.0	0.000	0.000
ROBSON	3.556	2.012	7.156
RHIMPSCN	4.388	3.294	14.412
HOOSE	4.819	2.324	11.201
NECHAKO	7.685	3.705	28.471
DORE	13.612	6.719	61.412
OMRCN	15.176	3.916	57.919
QUESNEL	34.941	4.273	149.291

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## PARAMETER FIXED NONFILTRABLE RESIDUE

TRIADICITY

GEOMETRIC LIMITS  
UPPER AND LOWER

APPENDIX III

VALUES OF  $t_b$  AND THEIR ASSOCIATED PROBABILITIES  
BETWEEN TRIBUTARIES TO THE FRASER RIVER FOR  
TWENTY-TWO WATER QUALITY PARAMETERS.

#### PARAMETER TURBIDITY

## PARAMETER COLOUR

	ROBSON	MOOSE	BRIGGE	GOAT	DORE	BEAVER	STEIN	SETON	THOMPS	COQUILH	QUEENL	ANDERS	NECHAK	WILLOW	COTTON	SALMON	
ROBSON	6.0 1.00	0.0 1.00	-1.00 0.33	-1.05 0.31	-1.00 0.33	-1.00 0.33	-1.00 0.33	-1.51 0.15	-1.51 0.15	-2.50 0.02	-1.44 0.17	-3.15 0.00	-3.92 0.00	-4.81 0.00	-12.46 0.00	-14.35 0.00	-14.02 0.00
MOOSE	0.0 1.00	0.0 1.00	-1.00 0.33	-1.05 0.31	-1.00 0.33	-1.00 0.33	-1.00 0.33	-1.51 0.15	-1.51 0.15	-2.50 0.02	-1.44 0.17	-3.15 0.01	-3.92 0.00	-4.85 0.00	-12.46 0.00	-14.35 0.00	-14.02 0.00
BRIGGE	1.00 0.33	1.00 0.33	0.0 1.00	-0.12 0.91	-0.19 0.85	-0.27 0.79	-0.86 0.40	-0.97 0.35	-1.94 0.07	-1.22 0.24	-2.86 0.01	-3.60 0.00	-4.41 0.00	-11.17 0.00	-12.87 0.00	-12.63 0.00	
GOAT	1.05 0.31	1.05 0.31	0.12 0.31	0.0 0.91	-0.08 0.89	-0.16 0.89	-0.75 0.46	-0.87 0.39	-1.84 0.08	-1.18 0.25	-2.80 0.01	-3.53 0.00	-4.33 0.00	-10.90 0.00	-12.56 0.00	-12.34 0.00	
DORE	1.00 0.33	1.00 0.33	0.19 0.85	0.08 0.94	0.0 1.00	-0.08 0.93	-0.66 0.52	-0.79 0.44	-1.74 0.10	-1.15 0.27	-2.74 0.01	-3.47 0.00	-4.24 0.00	-10.54 0.00	-12.13 0.00	-11.94 0.00	
BEAVER	1.00 0.33	1.00 0.33	0.27 0.79	0.16 0.88	0.16 0.93	0.08 1.00	0.0 0.58	-0.57 0.49	-0.70 0.12	-1.63 0.28	-2.68 0.01	-3.39 0.00	-4.11 0.00	-10.18 0.00	-11.72 0.00	-11.55 0.00	
STEIN	1.51 0.15	1.51 0.15	0.86 0.40	0.75 0.46	0.66 0.52	0.57 0.50	0.0 0.86	-0.18 0.30	-1.07 0.41	-0.84 0.03	-2.32 0.01	-3.00 0.00	-3.68 0.00	-9.02 0.00	-10.40 0.00	-10.30 0.00	
SETON	1.51 0.15	1.51 0.15	0.57 0.35	0.87 0.39	0.79 0.44	0.70 0.49	0.18 0.46	0.0 1.00	-0.85 0.41	-0.73 0.47	-2.15 0.04	-2.81 0.01	-3.34 0.00	-7.64 0.00	-8.29 0.00	-9.56 0.00	-9.49 0.00
THOMPS	2.50 0.02	2.50 0.02	1.94 0.07	1.86 0.08	1.76 0.10	1.63 0.12	1.07 0.30	0.85 0.41	0.0 0.30	-0.23 0.00	-1.56 0.13	-2.18 0.04	-2.60 0.02	-2.74 0.01	-7.09 0.00	-8.28 0.00	-8.24 0.00
COQUILH	1.44 0.17	1.44 0.17	1.22 0.24	1.18 0.25	1.15 0.27	1.11 0.28	0.84 0.41	0.73 0.82	0.23 1.00	0.0 0.35	-0.96 0.18	-1.41 0.14	-1.57 0.13	-1.73 0.10	-4.05 0.00	-4.72 0.00	-4.76 0.00
QUEENL	3.15 0.03	3.15 0.01	2.86 0.01	2.80 0.01	2.74 0.01	2.68 0.03	2.32 0.04	2.15 0.13	1.56 0.35	0.96 1.00	0.0 0.64	-0.48 0.64	-0.59 0.56	-0.80 0.43	-3.29 0.00	-4.06 0.00	-4.10 0.00
ANDERS	3.92 0.00	3.92 0.00	3.60 0.00	3.53 0.00	3.47 0.00	3.39 0.01	3.00 0.01	2.81 0.04	2.18 0.18	1.41 0.18	0.48 0.64	0.0 1.80	-0.07 0.94	-0.30 0.77	-2.76 0.01	-3.54 0.00	-3.59 0.00
NECHAK	4.85 0.00	4.85 0.00	4.41 0.00	4.32 0.00	4.11 0.00	4.00 0.00	3.60 0.00	3.34 0.02	2.60 0.13	1.57 0.56	0.59 0.94	0.0 1.80	-0.0 0.80	-0.25 0.01	-3.07 0.01	-3.97 0.00	-4.01 0.00
BOWRON	4.81 0.00	4.81 0.00	4.41 0.00	4.33 0.00	4.24 0.00	4.14 0.00	3.68 0.00	3.44 0.01	2.74 0.10	1.73 0.43	0.80 0.77	0.25 0.01	0.0 0.01	-2.61 0.02	-3.46 0.00	-3.50 0.00	
WILLOW	12.46 0.00	12.46 0.00	11.17 0.00	10.90 0.00	10.54 0.00	10.18 0.00	9.02 0.00	8.29 0.00	7.09 0.00	6.05 0.00	3.29 0.00	2.76 0.01	2.61 0.01	0.0 0.02	-1.10 1.00	-1.10 0.29	0.25 0.25
COTTON	14.35 0.00	14.35 0.00	12.87 0.00	12.56 0.00	12.13 0.00	11.72 0.00	10.40 0.00	9.56 0.00	8.28 0.00	4.72 0.00	4.06 0.00	3.54 0.00	3.97 0.00	3.46 0.00	1.10 0.29	1.10 0.92	0.11 0.92
SALMON	14.02 0.00	14.02 0.00	12.63 0.03	12.34 0.03	11.94 0.00	11.55 0.00	10.30 0.00	9.49 0.00	8.24 0.00	4.76 0.00	4.10 0.00	3.59 0.00	4.01 0.00	3.50 0.00	1.18 0.25	0.11 0.92	0.0 1.00

## PARAMETER PH

	COTTON	COQUINH	STEIN	WILLOW	ANDERS	NECHAK	THOMPS	SETON	SALMON	DORE	BEAVER	BOWRON	QUESNL	GOAT	MOOSE	ROBSON	BRIDGE
COTTON	0.0 -0.01 1.80 C.99	-0.13 0.90	-0.80 0.44	-1.34 0.20	-1.64 0.12	-1.73 0.10	-1.88 0.08	-2.41 0.03	-2.99 0.01	-3.09 0.01	-3.39 0.00	-4.42 0.00	-4.52 0.00	-4.67 0.00	-4.67 0.00	-4.67 0.00	
COQUINH	0.01 0.0 0.99 1.00	-0.14 0.89	-1.02 0.32	-1.66 0.12	-2.05 0.05	-2.22 0.04	-2.31 0.03	-2.96 0.01	-4.01 0.00	-4.23 0.00	-3.88 0.00	-4.54 0.00	-5.51 0.00	-6.16 0.00	-6.38 0.00	-5.95 0.00	
STEIN	0.13 0.14 0.90 0.89	0.0 0.50	-0.69 0.50	-1.26 0.24	-1.58 0.13	-1.68 0.11	-1.83 0.09	-2.39 0.03	-2.91 0.01	-3.05 0.01	-3.11 0.01	-3.47 0.00	-4.18 0.00	-4.60 0.00	-4.71 0.00	-4.80 0.00	
WILLOW	0.80 1.02 0.44 0.32	0.65 0.50	0.0 0.44	-0.79 0.25	-1.19 0.20	-1.31 0.15	-1.51 0.04	-2.20 0.00	-3.18 0.00	-3.42 0.00	-3.15 0.00	-4.88 0.00	-5.62 0.00	-5.88 0.00	-5.38 0.00	-5.38 0.00	
ANDERS	1.34 1.66 0.20 0.12	1.26 0.23	0.79 0.44	0.0 1.80	-0.27 0.79	-0.37 0.72	-0.67 0.51	-1.30 0.21	-1.76 0.19	-1.87 0.09	-2.10 0.05	-2.44 0.02	-3.29 0.00	-3.80 0.00	-3.94 0.00	-4.04 0.00	
NECHAK	1.64 2.09 0.12 0.05	1.58 0.13	1.18 0.25	0.27 0.79	0.0 1.00	-0.10 0.92	-0.46 0.69	-1.14 0.27	-1.66 0.11	-1.79 0.09	-2.00 0.06	-2.41 0.02	-3.38 0.00	-4.00 0.00	-4.19 0.00	-4.14 0.00	
THOMPS	1.73 2.22 0.13 0.34	1.68 0.11	1.31 0.20	0.37 0.72	0.10 0.92	0.0 1.00	-0.38 0.71	-1.07 0.30	-1.59 0.13	-1.73 0.10	-1.95 0.06	-2.37 0.03	-3.36 0.00	-4.02 0.00	-4.22 0.00	-4.13 0.00	
SETON	1.88 2.31 0.08 0.08	1.83 0.63	1.51 0.09	0.67 0.15	0.46 0.51	0.38 0.45	0.0 0.71	-0.61 1.00	-0.85 0.55	-0.91 0.41	-1.35 0.37	-1.56 0.19	-2.35 0.03	-2.79 0.01	-3.21 0.01	-3.21 0.01	
SALMON	2.41 2.96 0.03 0.01	2.39 0.61	2.20 0.04	1.30 0.21	1.14 0.27	1.07 0.30	0.61 0.59	0.0 1.00	-0.07 0.95	-0.10 0.92	-0.71 0.49	-0.83 0.41	-1.61 0.12	-2.02 0.06	-2.12 0.05	-2.57 0.02	
DORE	2.90 4.31 0.01 0.00	2.94 0.01	3.18 0.00	1.76 0.10	1.66 0.11	1.59 0.13	0.85 0.41	0.07 0.95	0.0 1.00	-0.06 0.95	-0.88 0.39	-1.19 0.25	-2.49 0.02	-3.41 0.00	-3.75 0.00	-3.45 0.00	
BEAVER	2.99 4.23 0.01 0.00	3.05 0.01	3.42 0.00	1.87 0.08	1.79 0.09	1.73 0.10	0.91 0.37	0.10 0.92	0.06 0.95	0.0 1.00	-0.88 0.39	-1.25 0.23	-2.71 0.01	-3.84 0.00	-4.34 0.00	-3.60 0.00	
BOWRON	3.09 3.88 0.01 0.00	3.11 0.01	3.15 0.00	2.10 0.05	2.00 0.06	1.95 0.19	1.35 0.49	0.71 0.39	0.88 0.39	0.0 0.39	-0.02 0.98	-0.84 1.00	-0.84 0.31	-1.26 0.12	-1.35 0.09	-1.95 0.03	
QUESNL	3.39 3.54 0.00 0.00	3.47 0.00	3.81 0.00	2.44 0.02	2.41 0.03	2.37 0.14	1.56 0.41	0.83 0.25	1.19 0.23	1.25 0.23	0.02 0.98	0.0 1.00	-1.04 0.31	-1.64 0.12	-1.79 0.09	-2.29 0.03	
GOAT	4.05 5.51 0.03 0.00	4.18 0.00	4.88 0.00	3.29 0.03	3.38 0.00	2.35 0.03	1.61 0.12	2.49 0.02	2.71 0.01	0.84 0.41	1.04 0.31	0.0 1.00	-0.54 0.60	-0.65 0.52	-1.52 0.14	-1.52 0.14	
MOOSE	4.42 6.16 0.00 0.00	4.60 0.00	5.62 0.00	3.80 0.00	4.00 0.00	4.02 0.01	2.79 0.06	2.02 0.00	3.41 0.00	1.26 0.12	1.64 0.12	0.54 0.60	0.0 0.60	-0.09 1.00	-1.21 0.93	-1.21 0.24	
ROBSON	4.52 6.38 0.00 0.00	4.71 0.00	5.88 0.00	3.94 0.00	4.19 0.00	4.22 0.01	2.90 0.00	2.12 0.01	3.75 0.00	1.35 0.00	1.79 0.09	0.65 0.52	0.09 0.93	0.0 1.00	-1.19 0.25	-1.19 0.25	
BRIDGE	4.67 5.95 0.03 0.00	4.80 0.00	5.38 0.03	4.04 0.00	4.14 0.00	4.13 0.01	3.21 0.02	2.57 0.00	3.45 0.00	3.60 0.00	1.95 0.07	2.29 0.03	1.52 0.14	1.21 0.14	1.19 0.24	1.19 0.25	

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PARAMETER CL

	DORE	QCAT	MOOSE	QUESNL	BEAVER	SETON	BOWRON	ROBSON	NECHAK	ANDERS	COTTON	STEIN	WILLOW	SALMON	COQUIH	BRIDGE	THOMPS
DORE	0.0 1.30	-2.21 0.04	-2.38 0.03	-2.75 0.01	-2.80 0.01	-3.52 0.00	-4.26 0.00	-5.40 0.00	-6.77 0.00	-4.33 0.00	-3.85 0.00	-7.02 0.00	-7.87 0.00	-6.06 0.00	-7.32 0.00	-7.43 0.00	
GOAT	2.21 0.04	0.0 1.00	-0.31 0.76	-0.38 0.70	-0.63 0.54	-0.78 0.44	-0.98 0.34	-1.18 0.25	-1.90 0.07	-2.11 0.05	-1.99 0.06	-1.87 0.04	-2.95 0.01	-3.85 0.00	-4.62 0.00	-5.31 0.00	
MOOSE	2.38 0.03	0.0 0.76	-0.04 1.00	-0.29 0.97	-0.39 0.78	-0.53 0.60	-0.53 0.48	-1.38 0.18	-1.66 0.12	-1.58 0.14	-1.52 0.15	-2.31 0.03	-3.18 0.00	-3.00 0.01	-4.08 0.01	-4.85 0.00	
QUESNL	2.75 0.01	0.38 0.70	0.04 0.57	0.0 1.00	-0.27 0.79	-0.38 0.71	-0.54 0.59	-0.76 0.45	-1.50 0.15	-1.50 0.09	-1.77 0.11	-1.67 0.13	-2.57 0.02	-3.51 0.00	-4.35 0.00	-5.08 0.00	
BEAVER	2.80 0.01	0.63 0.54	0.29 0.78	0.27 0.79	0.0 1.00	-0.06 0.95	-0.18 0.86	-0.39 0.70	-1.06 0.39	-1.38 0.19	-1.32 0.21	-1.28 0.22	-2.00 0.06	-2.90 0.01	-2.76 0.01	-3.85 0.00	
SETON	3.52 0.00	0.78 0.44	0.39 0.70	0.38 0.71	0.0 0.95	0.06 1.00	0.0 0.90	-0.13 0.70	-0.39 0.24	-1.20 0.15	-1.52 0.19	-1.42 0.20	-2.39 0.03	-3.43 0.00	-3.04 0.01	-4.27 0.00	
BOWRON	4.26 0.00	0.98 0.34	0.53 0.60	0.54 0.59	0.18 0.86	0.13 0.90	0.18 0.90	0.30 0.77	-1.24 0.21	-1.55 0.14	-1.43 0.17	-1.34 0.20	-2.63 0.02	-3.79 0.00	-3.17 0.01	-4.49 0.00	
ROBSON	4.38 0.03	1.18 0.25	0.73 0.48	0.76 0.45	0.39 0.70	0.39 0.70	0.30 0.70	0.30 0.77	0.90 1.00	-1.28 0.38	-1.19 0.22	-1.14 0.25	-2.21 0.04	-3.35 0.00	-2.90 0.01	-4.19 0.00	
NECHAK	5.40 0.03	1.90 0.07	1.38 0.19	1.50 0.15	1.06 0.30	1.24 0.24	0.90 0.23	1.20 0.48	1.20 0.00	-0.58 0.57	-0.56 0.59	-0.58 0.57	-1.29 0.21	-2.52 0.02	-2.28 0.03	-3.59 0.00	
ANDERS	4.77 0.00	2.11 0.35	1.66 0.12	1.77 0.09	1.38 0.19	1.52 0.15	1.55 0.14	1.28 0.22	0.58 0.03	0.0 -0.12	-0.40 0.40	-1.42 0.69	-1.54 0.17	-2.71 0.14	-3.71 0.02	-4.66 0.00	
COTTON	4.33 0.03	1.99 0.06	1.58 0.14	1.67 0.11	1.32 0.21	1.42 0.18	1.43 0.17	1.19 0.25	0.56 0.27	0.03 0.12	0.03 0.91	0.03 0.93	-0.33 1.00	-1.25 0.93	-1.42 0.75	-2.52 0.23	
STEIN	3.85 0.00	1.87 0.08	1.52 0.15	1.58 0.13	1.28 0.22	1.35 0.20	1.34 0.20	1.14 0.20	0.56 0.27	0.12 0.57	0.09 0.91	0.09 0.93	-0.33 1.00	-1.20 0.86	-1.25 0.93	-2.20 0.25	
WILLOW	7.02 0.00	2.95 0.01	2.31 0.03	2.57 0.02	2.00 0.06	2.39 0.03	2.63 0.02	2.24 0.04	1.29 0.21	0.40 0.69	0.33 0.75	0.18 0.86	0.18 1.00	-1.37 0.00	-1.45 0.18	-2.80 0.16	
SALMON	7.87 0.00	3.85 0.00	3.19 0.00	3.51 0.01	2.90 0.00	3.43 0.00	3.79 0.00	3.35 0.00	2.52 0.02	1.42 0.17	1.25 0.23	0.99 0.33	1.37 0.18	0.0 0.18	-0.47 0.00	-1.80 0.65	
COQUIH	6.06 0.00	3.48 0.00	3.00 0.01	3.19 0.00	2.76 0.01	3.04 0.01	3.17 0.01	2.90 0.01	2.28 0.03	1.54 0.14	1.42 0.18	1.20 0.25	1.45 0.16	0.47 0.16	-1.11 0.65	-2.3 1.00	
BRIDGE	7.32 0.00	4.62 0.00	4.08 0.00	4.35 0.00	3.85 0.00	4.27 0.00	4.48 0.00	4.19 0.00	3.59 0.00	2.71 0.00	2.52 0.02	2.20 0.04	2.80 0.01	1.80 0.09	1.11 0.28	-1.3 1.00	
THOMPS	7.43 0.00	5.31 0.00	4.85 0.00	5.08 0.00	4.67 0.00	5.01 0.00	5.17 0.00	4.94 0.00	3.71 0.00	3.52 0.00	3.21 0.00	3.01 0.00	3.82 0.00	1.36 0.03	1.36 0.19	0.0 1.00	

## PARAMETER CONDUCTIVITY

	GOAT	COTTON	STEIN	WILLOW	ANDERS	NECHAK	THOMPS	SETON	DORE	BEAVER	QUESNL	BOWRON	SALMON	GOAT	ROBSON	MOOSE	BRIDGE
GOAT	0.3 1.00	-0.25 0.80	-0.29 0.76	-2.40 0.03	-1.88 0.08	-3.43 0.00	-3.74 0.00	-4.19 0.00	-4.91 0.00	-5.10 0.00	-6.54 0.00	-7.01 0.00	-6.57 0.00	-8.66 0.00	-8.95 0.00	-8.79 0.00	-9.69 0.00
COTTON	0.25 0.80	0.3 1.00	-0.03 0.97	-1.61 0.12	-1.41 0.16	-2.18 0.04	-2.63 0.02	-2.97 0.01	-3.77 0.00	-3.93 0.00	-4.58 0.00	-4.96 0.00	-4.96 0.00	-6.13 0.00	-6.26 0.00	-6.56 0.00	-7.66 0.00
STEIN	0.29 0.78	0.03 0.97	0.0 1.00	-1.55 0.14	-1.36 0.19	-2.09 0.05	-2.54 0.02	-2.88 0.01	-3.69 0.00	-3.63 0.00	-4.46 0.00	-4.83 0.00	-4.84 0.00	-5.98 0.00	-6.13 0.00	-6.44 0.00	-7.52 0.00
WILLOW	2.40 0.03	1.61 0.12	1.55 0.14	0.0 1.00	-0.12 0.90	-0.66 0.52	-1.48 0.15	-2.00 0.04	-3.11 0.00	-3.29 0.00	-4.65 0.00	-5.23 0.00	-4.86 0.00	-7.27 0.00	-7.63 0.00	-7.39 0.00	-8.45 0.00
ANDERS	1.68 0.03	1.41 0.19	1.36 0.19	0.0 1.00	-0.24 0.81	-0.87 0.40	-1.20 0.25	-2.00 0.04	-2.19 0.04	-2.28 0.04	-2.74 0.04	-3.13 0.01	-3.29 0.00	-4.29 0.00	-4.63 0.00	-4.88 0.00	-6.10 0.00
NECHAK	3.43 0.03	2.18 0.04	2.69 0.05	0.66 0.52	0.21 0.81	0.0 1.00	-1.32 0.20	-2.03 0.06	-3.26 0.00	-3.69 0.00	-6.52 0.00	-7.31 0.00	-5.62 0.00	-11.17 0.00	-12.15 0.00	-9.28 0.00	-9.74 0.00
THOMPS	3.74 0.00	2.63 0.02	2.54 0.02	1.48 0.15	0.87 0.40	1.32 0.20	0.0 1.00	-0.52 0.04	-1.94 0.07	-2.09 0.05	-3.12 0.01	-3.75 0.00	-3.62 0.00	-5.85 0.00	-6.19 0.00	-6.17 0.00	-7.42 0.00
SETON	4.19 0.00	2.97 0.01	2.88 0.01	2.00 0.06	1.20 0.25	2.03 0.06	0.52 0.61	0.0 1.00	-1.55 0.14	-1.68 0.11	-2.57 0.02	-3.22 0.00	-3.19 0.00	-5.34 0.00	-5.67 0.00	-5.75 0.00	-7.06 0.00
DORE	4.91 0.00	3.77 0.00	3.69 0.00	3.11 0.01	2.19 0.04	3.24 0.01	1.94 0.07	1.55 0.14	0.0 0.03	-0.07 0.95	-0.24 0.81	-0.76 0.45	-1.19 0.25	-2.24 0.25	-2.42 0.04	-3.10 0.03	-4.67 0.00
BEAVER	5.10 0.00	3.90 0.00	3.80 0.00	3.29 0.00	2.28 0.04	3.49 0.00	2.09 0.05	1.68 0.07	0.0 0.07	-0.16 0.07	-0.71 0.67	-1.15 0.49	-2.25 0.26	-2.43 0.04	-3.13 0.02	-4.72 0.01	-6.00 0.00
QUESNL	6.54 0.00	4.58 0.00	4.46 0.00	4.65 0.00	2.74 0.01	6.52 0.00	3.12 0.01	2.57 0.02	0.24 0.81	0.16 0.87	0.0 1.00	-0.85 0.41	-1.33 0.20	-3.74 0.00	-4.11 0.00	-5.76 0.00	-7.06 0.00
BOWRON	7.01 0.00	4.96 0.00	4.83 0.00	5.23 0.00	3.13 0.01	7.31 0.00	3.75 0.00	3.22 0.00	0.76 0.45	0.71 0.49	0.85 0.41	0.0 1.00	-0.71 0.45	-2.39 0.03	-2.72 0.01	-3.38 0.00	-5.17 0.00
SALMON	6.57 0.00	4.96 0.00	4.84 0.00	4.86 0.00	3.29 0.00	5.62 0.00	3.62 0.00	3.19 0.00	1.19 0.25	1.15 0.26	1.33 0.20	0.71 0.49	0.0 1.00	-0.97 0.05	-1.16 0.26	-2.09 0.05	-3.90 0.00
GOAT	8.68 0.00	6.13 0.00	5.98 0.00	7.27 0.00	4.29 0.00	11.17 0.00	5.85 0.00	5.34 0.00	2.24 0.04	2.25 0.04	3.36 0.00	2.39 0.03	0.97 0.34	-0.27 1.00	-1.64 0.79	-3.82 0.12	-0.00 0.00
ROBSON	8.55 0.03	6.28 0.30	6.13 0.00	7.60 0.00	4.43 0.00	12.15 0.00	6.18 0.00	5.67 0.00	2.42 0.03	2.43 0.02	3.74 0.00	2.72 0.01	1.16 0.26	0.27 0.79	0.0 1.00	-1.48 0.16	-3.72 0.00
MOOSE	8.79 0.00	6.58 0.30	6.44 0.00	7.39 0.00	4.88 0.00	9.26 0.00	6.17 0.00	5.75 0.03	3.10 0.01	3.13 0.01	4.11 0.00	3.38 0.00	2.09 0.05	1.64 0.12	1.64 0.16	0.0 1.00	-2.23 0.04
BRIDGE	9.69 0.03	7.66 0.00	7.52 0.00	8.45 0.00	6.10 0.00	9.74 0.00	7.42 0.00	7.06 0.00	4.67 0.00	4.72 0.00	5.76 0.00	5.17 0.00	3.90 0.00	3.82 0.00	3.72 0.00	2.23 0.04	0.0 1.00

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## PARAMETER ALKALINITY

	COQUIH	STEIN	COTTON	ANDERS	THOMPS	WILLOW	SETON	NECHAK	DORE	BEAVER	QUEENL	BOWRON	GOAT	SALMON	ROBSON	MOOSE	BRIDGE
COQUIH	0.0 1.20	-0.47 0.65	-1.16 0.25	-2.89 0.01	-4.57 0.03	-4.20 0.00	-4.78 0.00	-5.94 0.00	-5.44 0.00	-5.79 0.00	-8.76 0.00	-9.68 0.00	-10.76 0.00	-11.63 0.00	-10.83 0.00	-11.70 0.00	
STEIN	0.47 0.65	0.0 1.00	-0.64 0.53	-2.00 0.06	-2.68 0.02	-2.68 0.01	-2.90 0.01	-3.35 0.00	-3.81 0.00	-4.02 0.00	-5.67 0.00	-6.23 0.00	-6.70 0.00	-7.20 0.00	-7.16 0.00	-7.23 0.00	-8.30 0.00
COTTON	1.19 0.25	0.64 0.53	0.0 1.00	-1.26 0.23	-1.68 0.11	-1.75 0.10	-1.90 0.09	-2.24 0.04	-2.68 0.01	-3.06 0.01	-4.25 0.00	-4.98 0.00	-5.36 0.00	-5.08 0.00	-5.77 0.00	-5.95 0.00	-7.03 0.00
ANDERS	2.89 0.01	2.00 0.06	1.26 0.23	0.0 1.00	-0.10 0.92	-0.30 0.77	-0.38 0.71	-0.65 0.52	-1.61 0.13	-1.78 0.09	-2.95 0.01	-3.78 0.00	-4.18 0.00	-3.95 0.00	-4.62 0.00	-4.86 0.00	-6.08 0.00
THOMPS	4.57 0.00	2.68 0.02	1.68 0.11	0.10 0.92	0.0 1.00	-0.32 0.75	-0.49 0.63	-1.17 0.25	-2.19 0.04	-2.49 0.02	-5.45 0.00	-6.73 0.00	-8.21 0.00	-5.94 0.00	-9.50 0.00	-8.26 0.00	-9.38 0.00
WILLOW	4.20 0.00	2.68 0.02	1.75 0.10	0.30 0.77	0.32 0.75	0.0 1.00	-0.10 0.90	-0.48 0.64	-1.70 0.11	-1.93 0.07	-3.86 0.00	-4.99 0.00	-5.80 0.00	-4.85 0.00	-6.58 0.00	-7.61 0.00	-7.74 0.00
SETON	5.78 0.00	2.93 0.01	1.90 0.08	0.38 0.71	0.49 0.92	0.10 0.92	0.0 1.00	-0.46 0.65	-1.77 0.09	-2.04 0.06	-4.52 0.00	-5.79 0.00	-6.97 0.00	-5.31 0.00	-8.05 0.00	-7.33 0.00	-8.59 0.00
NECHAK	5.94 0.00	3.24 0.04	2.24 0.52	0.65 0.25	1.17 0.64	0.48 0.65	0.46 0.64	0.46 0.65	1.71 1.00	-1.71 0.10	-2.02 0.06	-5.84 0.00	-7.30 0.00	-9.89 0.00	-12.29 0.00	-8.93 0.00	-9.84 0.00
DORE	5.44 0.00	3.84 0.01	2.88 0.13	1.61 0.04	2.19 0.11	1.70 0.09	1.77 0.09	1.71 0.10	0.0 0.00	-0.16 0.00	-1.32 0.20	-2.38 0.03	-2.86 0.03	-2.69 0.01	-3.43 0.01	-3.75 0.01	-5.23 0.00
BEAVER	5.79 0.00	4.02 0.00	3.06 0.01	1.78 0.09	2.49 0.02	1.93 0.07	2.04 0.06	2.02 0.06	0.16 0.06	0.0 0.00	-1.18 0.25	-2.29 0.23	-2.80 0.23	-2.61 0.01	-3.39 0.02	-3.72 0.02	-5.24 0.00
QUEENL	8.76 0.00	5.47 0.00	4.25 0.01	2.95 0.00	5.45 0.00	3.86 0.00	4.52 0.00	5.84 0.00	1.32 0.20	1.18 0.25	0.0 0.00	-1.73 0.00	-2.61 0.02	-2.61 0.01	-3.70 0.01	-3.76 0.01	-5.60 0.00
BOWRON	9.68 0.00	6.23 0.00	5.98 0.00	3.78 0.00	4.99 0.00	5.79 0.00	7.30 0.00	2.38 0.03	2.29 0.03	1.73 0.10	0.0 0.00	-0.54 0.59	-0.82 1.00	-1.40 0.63	-2.06 0.63	-4.11 0.55	-5.60 0.00
GOAT	10.76 0.00	6.70 0.00	5.36 0.00	4.18 0.00	5.80 0.00	6.97 0.00	9.89 0.00	2.86 0.01	2.80 0.01	2.61 0.02	0.54 0.59	0.0 0.00	-0.49 0.17	-1.01 0.32	-1.81 0.32	-4.04 0.09	-4.04 0.00
SALMON	8.81 0.00	6.20 0.30	5.08 0.00	3.95 0.00	5.94 0.00	4.85 0.00	5.31 0.00	5.89 0.00	2.69 0.01	2.13 0.00	0.82 0.00	0.49 0.42	0.0 0.63	0.0 1.80	-0.84 0.94	-0.84 0.41	-2.71 0.01
ROBSON	11.63 0.00	7.16 0.23	6.77 0.00	4.62 0.00	9.50 0.00	6.58 0.00	8.05 0.00	12.29 0.00	3.43 0.01	3.70 0.00	1.40 0.17	1.01 0.32	0.0 0.94	0.0 1.80	0.0 0.26	0.0 0.26	-2.24 0.04
MOOSE	10.83 0.00	8.30 0.00	7.23 0.00	5.95 0.00	8.26 0.00	6.41 0.00	7.34 0.00	8.93 0.00	3.75 0.00	3.76 0.00	2.06 0.05	1.81 0.09	0.84 0.41	1.16 0.26	0.0 1.00	0.0 0.04	-2.24 0.04
BRIDGE	11.70 0.00	8.30 0.00	7.03 0.00	6.08 0.00	9.38 0.00	7.74 0.00	8.59 0.00	9.84 0.00	5.23 0.00	5.60 0.00	4.11 0.00	4.04 0.00	2.71 0.00	3.56 0.00	2.24 0.04	0.0 0.04	0.0 1.00

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## PARAMETER HARDNESS

		COAQUIN	STEIN	COTTON	ANDERS	NECHAK	WILLOW	THOMP'S	SETON	DORE	BEAVER	QUEENL	BOWRON	SAFON	GOAT	ROBSON	MOOSE	BRIDGE
0.0	-0.06	-0.77	-2.01	-3.06	-3.33	-3.63	-4.32	-5.41	-5.77	-7.62	-8.52	-7.98	-10.03	-10.64	-9.95	-10.46		
1.00	0.95	0.45	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
STEIN	0.06	0.0	-0.62	-1.72	-2.72	-2.56	-2.72	-3.32	-4.47	-4.71	-5.64	-6.36	-6.30	-7.44	-7.80	-7.84	-8.63	
COTTON	0.77	0.62	0.0	-1.12	-1.83	-1.77	-1.89	-2.52	-3.76	-3.97	-4.75	-5.47	-5.49	-6.53	-6.87	-7.00	-7.86	
ANDERS	2.01	1.72	1.12	0.0	-0.19	-0.30	-0.35	-0.98	-2.34	-2.49	-2.96	-3.64	-3.91	-4.61	-4.89	-5.22	-6.19	
NECHAK	3.86	2.72	1.83	0.19	0.0	-0.27	-0.41	-1.73	-3.57	-4.01	-7.82	-9.29	-7.23	-12.54	-14.78	-10.22	-10.20	
WILLOW	3.33	2.56	1.77	0.30	0.27	0.0	-0.06	-1.08	-2.87	-3.16	-4.61	-5.72	-5.39	-7.50	-8.22	-7.61	-8.37	
THOMP'S	3.63	2.72	1.86	0.35	0.41	0.06	0.0	-1.13	-3.00	-3.00	-4.67	-5.83	-6.59	-9.54	-8.29	-8.87		
SETON	4.32	3.32	2.52	0.98	1.73	1.08	1.13	0.0	-2.31	-3.33	-5.24	-6.47	-6.45	-7.15	-6.72	-7.60		
DORE	5.41	4.47	3.76	2.36	3.57	2.87	3.00	2.06	0.0	-0.11	-0.25	-1.16	-1.56	-2.40	-2.74	-3.30	-4.56	
BEAVER	5.77	4.71	3.97	2.49	4.01	3.16	3.33	2.31	0.11	0.0	-0.12	-1.10	-1.52	-2.13	-2.80	-3.36	-4.65	
QUEENL	7.62	5.64	4.75	2.96	7.82	4.61	5.24	3.46	0.25	0.12	0.0	-1.57	-1.95	-3.79	-4.61	-4.91	-5.77	
BOWRON	8.52	6.36	5.47	3.64	9.28	5.72	6.47	4.63	1.16	1.10	1.57	0.0	-0.75	-2.07	-2.71	-3.24	-4.73	
SAFON	7.98	6.30	5.49	3.81	7.23	5.39	5.83	4.47	1.56	1.52	1.95	0.75	0.0	-0.79	-1.19	-2.06	-3.62	
GOAT	10.03	7.44	6.53	4.61	12.54	7.50	8.59	6.45	2.40	2.43	3.79	2.07	0.79	0.0	-0.54	-1.72	-3.52	
ROBSON	10.64	7.80	6.87	4.89	14.78	8.22	9.54	7.15	2.74	2.80	4.61	2.73	1.19	0.54	0.0	-1.41	-3.30	
MOOSE	9.95	7.84	7.00	5.22	10.22	7.61	8.29	6.72	3.30	3.36	4.51	3.24	2.06	1.72	1.41	0.0	-1.87	
BRIDGE	10.46	8.63	7.86	6.19	13.20	8.37	9.87	7.60	4.56	4.65	5.77	4.73	3.62	3.30	1.87	0.0	1.00	

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CHARACTERISTICS

	STEIN	COOUIH	COTCH	NECHAK	WILLOW	THOMPSON	ANDERS	SETON	BEAVER	DORE	QUEENSLAND	SALMON	BOWRON	ROBSON	MOOSE	BRIDGE	GOAT
STEIN	0.0	-0.34	-0.53	-2.46	-2.54	-2.95	-2.24	-3.47	-4.44	-4.68	-6.13	-6.34	-6.90	-7.08	-6.99	-6.74	-8.01
COOUIH	0.0	0.74	0.61	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTCH	0.34	0.0	-0.24	-2.74	-3.30	-2.20	-3.92	-4.94	-5.12	-7.51	-7.79	-8.50	-8.73	-8.17	-7.67	-10.01	0.00
NECHAK	0.74	1.06	0.81	0.01	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WILLOW	0.53	0.24	0.0	-2.03	-2.13	-2.59	-1.89	-3.18	-4.23	-4.49	-6.17	-6.43	-7.06	-7.26	-7.06	-6.74	-8.32
THOMPSON	0.61	0.81	1.00	0.06	0.05	0.92	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ANDERS	0.02	0.74	2.03	0.0	-0.53	-1.37	-0.71	-2.44	-3.88	-4.10	-9.54	-9.78	-10.97	-11.43	-8.59	-7.53	-14.37
SETON	0.01	0.06	1.00	0.06	1.38	0.60	0.19	0.48	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEAVER	2.46	2.74	2.13	0.53	0.0	-0.58	-0.43	-1.52	-3.06	-3.40	-6.17	-6.52	-7.47	-7.79	-6.89	-6.30	-9.58
DORE	2.95	3.30	2.59	1.37	0.58	0.0	-0.13	-1.06	-2.75	-3.13	-6.15	-6.53	-7.56	-7.91	-6.79	-6.14	-9.94
DORE	2.24	2.20	1.88	0.71	0.43	0.13	0.0	-0.43	-1.60	-2.00	-2.67	-2.92	-3.44	-3.60	-3.85	-3.79	-4.41
QUEENSLAND	0.04	0.54	0.08	0.08	0.48	0.67	0.90	1.00	0.67	0.13	0.06	0.02	0.01	0.00	0.00	0.00	0.00
QUEENSLAND	3.47	3.92	3.18	2.44	1.52	1.06	0.43	0.0	-1.83	-2.31	-4.35	-4.75	-5.71	-6.02	-5.53	-5.10	-7.75
QUEENSLAND	0.00	0.00	0.01	0.02	0.15	0.30	0.67	1.00	0.09	0.03	0.30	0.00	0.00	0.00	0.00	0.00	0.00
BEAVER	4.44	4.94	4.23	3.88	3.06	2.75	1.60	1.83	0.0	-0.61	-1.25	-1.62	-2.39	-2.63	-2.95	-2.87	-3.83
BEAVER	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.13	0.09	1.80	0.55	0.23	0.12	0.03	0.02	0.01	0.00
BEAVER	4.68	5.12	4.49	4.10	3.40	3.13	2.00	2.31	0.61	0.0	-0.35	-0.68	-1.36	-1.56	-2.02	-2.04	-2.58
BEAVER	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.03	0.55	1.80	0.73	0.50	0.19	0.13	0.06	0.06	0.02
QUEENSLAND	6.10	7.51	6.17	9.54	6.17	6.15	2.67	4.35	1.25	0.35	0.0	-0.64	-1.90	-2.29	-2.58	-2.43	-4.36
QUEENSLAND	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.23	0.73	1.80	0.53	0.07	0.03	0.02	0.02	0.00
SALMON	6.34	7.79	6.43	9.78	6.52	6.53	2.92	4.75	1.62	0.68	0.64	0.80	0.23	0.12	0.05	0.06	0.00
SALMON	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.12	0.50	0.53	1.00	0.23	0.10	0.05	0.06	0.00
BOWRON	6.90	8.50	7.06	10.97	7.47	7.56	3.44	5.71	2.39	1.36	1.90	1.23	0.0	-0.36	-1.21	-1.26	-2.22
BOWRON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.19	0.07	0.23	1.00	0.72	0.24	0.22	0.04
ROBSON	7.68	8.73	7.26	11.43	7.91	3.60	6.02	2.63	1.56	2.29	1.60	0.36	0.0	-0.95	-1.03	-1.04	0.00
ROBSON	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.03	0.12	0.72	1.00	0.35	0.31	0.08	0.00
MOOSE	6.99	8.17	7.06	8.59	6.89	3.85	5.53	2.95	2.02	2.58	2.10	1.21	0.95	0.0	-0.18	-0.32	-0.75
MOOSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.06	0.02	0.05	0.24	0.35	1.00	0.86	0.75
BRIDGE	6.74	7.67	6.74	7.53	6.30	6.14	3.79	5.10	2.87	2.04	2.43	2.03	1.26	1.03	0.18	0.0	-3.06
BRIDGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.06	0.02	0.22	0.31	0.86	1.00	0.95
GOAT	8.01	10.01	8.32	14.37	9.58	9.94	6.41	7.75	3.83	2.58	4.36	3.55	2.22	1.84	0.32	0.06	0.00
GOAT	0.30	0.30	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.04	0.75	0.95	1.00

## PARAMETER SD4

	COTTON	WILLOW	NECHAK	SALMON	BOWRON	STEIN	ANDERS	CAQUINH	QUEENSL	THOMPSON	SETON	ROBSON	GOAT	BEAVER	MOOSE	BRIDGE
COTTON	0.0	-0.83	-1.52	-1.93	-2.09	-3.68	-3.81	-5.83	-9.61	-4.84	-11.13	-11.96	-13.71	-11.33	-10.34	-11.12
WILLOW	1.00	0.42	0.15	0.07	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NECHAK	1.52	0.78	0.0	-0.94	-1.38	-3.07	-3.20	-5.32	-10.16	-4.32	-11.34	-12.36	-14.64	-11.56	-11.40	-10.88
SALMON	1.93	1.42	0.94	0.0	-0.65	-2.17	-2.25	-3.50	-5.80	-3.38	-7.95	-8.39	-9.73	-8.54	-8.48	-9.41
BOWRON	2.09	1.72	1.38	0.65	0.0	-1.30	-1.35	-2.06	-3.34	-2.41	-5.34	-5.55	-6.40	-5.98	-6.20	-7.70
STEIN	3.38	3.07	2.17	1.30	0.0	-0.03	-0.49	-1.55	-1.16	-3.65	-3.82	-4.61	-4.35	-4.36	-4.74	-6.61
ANDERS	3.81	3.51	3.20	2.25	1.33	0.03	0.0	-0.44	-1.55	-1.14	-3.69	-3.86	-4.67	-4.40	-4.40	-6.46
CAQUINH	5.83	5.68	5.32	3.50	2.06	0.49	0.46	0.0	-1.44	-0.89	-4.19	-4.68	-5.63	-5.01	-5.00	-6.96
QUEENSL	9.61	10.32	10.16	5.80	3.34	1.55	1.52	1.46	0.0	-0.06	-3.74	-4.14	-5.73	-4.71	-4.69	-6.72
THOMPSON	9.30	9.00	9.00	0.00	0.00	0.14	0.14	0.17	1.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00
SETON	11.13	11.53	11.34	7.95	5.34	3.65	3.69	4.19	3.74	2.01	0.0	-0.13	-1.13	-1.17	-2.00	-4.32
ROBSON	11.86	12.45	12.30	8.39	5.55	3.82	3.86	4.48	4.14	2.13	0.13	0.0	-1.10	-1.05	-1.09	-4.31
GOAT	13.71	14.67	14.64	9.73	6.40	4.61	4.67	5.63	5.73	2.82	1.18	1.10	0.0	-0.13	-0.19	-3.76
BEAVER	11.46	11.76	11.56	8.54	5.99	4.35	4.40	5.01	4.71	2.72	1.13	1.05	0.13	0.0	-0.05	-1.03
DORE	11.33	11.61	11.40	8.48	5.98	4.36	4.40	5.00	4.69	2.74	1.17	1.09	0.05	0.0	-0.97	-3.39
MCOSE	10.34	10.37	10.14	8.18	6.20	4.74	4.78	5.24	4.87	3.27	2.00	1.95	1.23	1.03	0.97	-2.37
BRIDGE	11.12	11.08	10.88	9.41	7.70	6.41	6.46	6.96	6.72	5.06	4.32	4.38	3.76	3.45	3.39	2.37
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80

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## PARAMETER S102

	ROBSON MOOSE	DORE	GOAT	BEAVER	QUESNL	THOMP'S	NECHAK	BOMRON	SETON	COQUIH	STEIN	ANDERS	COTTON	SALMON	WILLOW	BRIDGE
ROBSON	0.0 0.61 1.00	-0.61 0.55 0.00	-1.94 0.00 0.00	-5.16 -4.76 0.00	-5.99 0.00 0.00	-8.44 0.00 0.00	-8.98 0.00 0.00	-7.12 -7.07 0.00	-9.86 -9.56 0.00	-7.77 -9.92 0.00	-9.66 -10.15 0.00	-12.12 -12.28 0.00	-14.15 -13.03 0.00	-14.15 -15.44 0.00		
MOOSE	0.61 C.55	0.0 1.00	-1.49 0.15	-5.06 0.00	-4.56 0.00	-5.79 0.00	-8.70 0.00	-9.42 -9.00	-7.67 -10.56	-9.94 -9.92	-7.73 -10.49	-12.90 -13.03	-13.03 -15.44 0.00	-14.15 -15.44 0.00		
DORE	1.94 0.07	1.49 0.15	0.0 0.03	-2.41 0.04	-2.25 0.00	-3.42 0.00	-5.72 0.00	-6.06 -4.89	-6.71 -10.56	-6.81 -9.94	-5.71 -7.73	-7.15 -10.49	-9.15 -9.37	-10.87 -10.87 0.00		
GOAT	5.16 0.00	5.06 0.03	2.41 0.00	0.0 -0.03	0.0 -1.99	0.0 -5.92	0.0 -7.14	0.0 -6.10	0.0 -9.72	0.0 -7.72	0.0 -5.11	0.0 -7.60	0.0 -9.36	0.0 -12.33	-17.77 -17.77 0.00	
BEAVER	4.76 0.00	4.56 0.04	2.25 0.97	0.0 1.00	0.0 0.19	0.0 0.00	0.0 0.00	0.0 0.00	0.0 -3.72	0.0 -6.89	0.0 -6.46	0.0 -6.74	0.0 -6.70	0.0 -7.32	-10.20 -13.33 0.00	
QUESNL	5.89 0.00	5.79 0.00	3.42 0.00	1.99 0.06	1.79 0.10	0.0 1.80	-2.82 0.01	-3.15 0.00	-2.21 0.04	-4.00 0.00	-4.29 0.00	-3.37 -4.84	-5.36 -7.43	-7.70 -7.70	-10.00 -10.00 0.00	
THOMP'S	8.44 0.00	8.70 0.00	5.72 0.03	5.92 0.03	6.92 0.03	2.82 0.01	0.0 1.80	-0.03 0.97	-0.04 0.97	-0.65 0.52	-1.68 0.11	-1.49 0.15	-2.60 -3.12	-5.06 -5.42	-7.84 -7.84 0.00	
NECHAK	8.68 0.00	9.42 0.00	6.06 0.00	7.14 0.00	5.57 0.03	3.15 0.03	0.0 0.97	0.0 1.80	-0.02 0.98	-0.78 0.44	-1.87 0.08	-1.55 0.14	-2.81 0.01	-3.39 0.00	-5.83 -6.17 0.00	
BOMRON	7.12 0.00	7.67 0.03	4.89 0.00	4.10 0.00	3.72 0.00	2.21 0.04	0.0 0.97	0.02 0.99	0.0 1.80	-0.37 0.72	-1.20 0.24	-1.25 0.23	-2.02 -2.40	-3.59 -3.93	-5.17 -5.17 0.00	
SETON	9.86 0.00	10.56 0.00	6.71 0.00	9.72 0.00	6.89 0.00	4.00 0.00	0.65 0.52	0.79 0.64	0.37 0.72	0.0 0.14	-1.54 0.14	-1.29 0.22	-2.59 -2.02	-6.20 -7.40	-11.73 -11.73 0.00	
COQUIH	9.56 0.00	9.94 0.00	6.81 0.00	7.72 0.00	6.46 0.00	4.29 0.00	1.68 0.11	1.87 0.08	1.20 0.24	1.54 0.14	0.0 0.30	-0.38 0.14	-1.16 0.22	-3.20 -3.24	-3.64 -3.64 0.00	
STEIN	7.77 0.00	7.73 0.00	5.71 0.00	5.11 0.00	4.74 0.00	3.37 0.00	1.99 0.15	1.55 0.14	1.25 0.23	1.29 0.22	0.39 0.71	0.0 0.64	-0.48 -0.44	-1.66 -0.44	-2.00 -2.00 0.06	
ANDERS	9.66 0.00	9.92 0.00	7.15 0.00	6.60 0.00	4.84 0.00	2.60 0.02	2.81 0.01	2.02 0.00	2.59 0.02	1.16 0.26	0.48 0.64	0.0 0.44	-0.38 -0.44	-1.47 -0.44	-1.91 -1.91 0.07	
COTTON	10.15 C.00	10.49 0.00	7.59 0.00	8.36 0.00	7.32 0.00	5.36 0.01	3.12 0.01	2.84 0.03	2.40 0.01	1.63 0.13	0.80 0.54	0.38 0.71	0.0 0.30	-1.06 -1.06	-1.52 -1.52 0.07	
SALMON	12.12 0.00	12.90 0.00	9.15 0.00	12.33 0.00	10.03 0.00	7.43 0.00	5.06 0.00	5.83 0.00	3.59 0.00	6.20 0.00	1.66 0.11	1.47 0.16	1.06 1.06	0.0 0.55	-2.18 -2.18 0.04	
WILLOW	12.28 C.00	13.03 0.00	9.37 0.00	12.31 0.00	10.20 0.00	7.70 0.00	5.42 0.00	6.17 0.00	3.93 0.00	6.50 0.00	2.00 0.06	1.91 0.07	1.52 1.52	0.61 0.55	-1.34 -1.34 0.20	
BRIDGE	14.15 0.00	15.44 3.00	10.67 0.00	17.77 3.00	13.33 3.00	10.00 0.00	7.84 0.00	9.61 0.00	5.17 0.00	11.73 0.00	2.90 0.01	2.19 0.01	2.80 2.80	0.0 0.04	1.34 1.34 0.20	

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PARAMETER K

	CORE	BEAVER	ROBSON	MOOSE	BOWRON	COTTON	WILLOW	ANDERS	QUEENL	COOUIH	BRIDGE	SALMON	NECHAK	STEIN	SETON	THOMPS	
GOAT	0.0	-1.30	-1.73	-2.06	-2.65	-3.84	-5.87	-6.33	-8.18	-7.39	-8.95	-11.65	-9.54	-9.31	-15.75	-15.60	
	1.00	0.21	0.11C	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
DORE	1.30	0.0	-0.51	-0.79	-1.57	-1.59	-3.07	-4.65	-5.20	-6.30	-7.60	-9.93	-8.19	-8.16	-13.66	-13.62	
	0.21	1.00	0.61	0.44	0.14	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BEAVER	1.73	0.51	0.0	-0.24	-1.07	-1.08	-2.68	-3.93	-4.52	-5.80	-5.60	-6.65	-8.50	-7.22	-7.35	-11.68	-11.75
	0.10	0.61	1.66C	0.82	0.30	0.29	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
DOBSON	2.06	0.79	0.26	0.0	-0.89	-0.91	-2.56	-3.83	-4.43	-5.77	-5.54	-6.64	-8.63	-7.23	-7.34	-12.03	-12.08
	0.05	0.44	0.82	1.00	0.39	0.37	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
WICOSSE	2.64	1.57	1.07	0.89	0.0	-0.02	-1.79	-2.50	-3.13	-3.99	-4.17	-4.83	-6.05	-5.36	-5.73	-8.50	-8.69
	0.02	0.14	0.30	0.39	1.00	0.98	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BROWND	2.65	1.59	1.08	0.91	0.02	0.0	-1.77	-2.47	-3.10	-3.95	-4.14	-4.79	-6.00	-5.32	-5.69	-8.44	-8.63
	0.01	0.13	0.29	0.37	0.98	1.00	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COTTON	3.04	3.07	2.68	2.56	1.79	1.77	0.0	-0.02	-0.61	-0.97	-1.47	-1.67	-2.18	-2.08	-2.63	-3.69	-3.91
	0.00	0.01	0.02	0.02	0.09	0.09	1.00	0.99	0.99	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
WILLOW	5.87	4.65	3.93	3.83	2.50	2.47	0.02	0.0	-0.82	-1.41	-1.41	-1.41	-2.40	-3.41	-2.98	-5.98	-6.25
	0.30	0.00	0.00	0.00	0.00	0.02	0.99	1.00	0.42	0.17	0.06	0.03	0.00	0.01	0.00	0.00	
ANDERS	6.33	5.22C	4.52	4.43	3.13	3.10	0.61	0.62	0.0	-0.43	-1.12	-1.39	-2.16	-1.94	-2.62	-6.42	-6.70
	0.03	0.00	0.00	0.00	0.01	0.01	0.55	0.42	1.00	0.67	0.28	0.19	0.04	0.07	0.02	0.00	
QUEENL	6.18	6.76	5.80	5.77	3.99	3.95	0.97	1.41	0.43	0.0	-0.86	-1.15	-2.10	-1.79	-2.55	-5.01	-5.31
	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.35	0.17	0.67	1.00	0.40	0.26	0.05	0.09	0.02	
COOUIH	7.39	6.36	5.60	5.54	4.17	4.14	0.00	0.16	0.06	0.28	0.40	1.00	0.91	0.50	0.52	0.17	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
BRIDGE	8.95	7.60	6.65	6.64	4.83	4.79	1.67	2.40	1.39	1.15	0.12	0.0	-0.68	-0.63	-1.50	-3.28	-3.67
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.03	0.18	0.26	0.91	1.00	0.50	0.54	0.16	
SALMON	11.69	9.93	8.50	8.63	6.05	6.00	2.18	3.41	2.16	2.10	0.69	0.68	0.0	-0.06	-1.11	-3.38	-3.71
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NECHAK	9.54	8.19	7.22	7.23	5.36	5.32	2.08	2.98	1.94	1.79	0.66	0.63	0.54	0.95	0.95	0.0	-0.6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.07	0.39	0.52	0.50	1.00	0.95	0.0	-0.5
STEIN	9.31	8.16	7.35	7.34	5.73	5.69	2.63	3.58	2.62	2.55	1.44	1.50	1.11	0.93	0.0	-0.93	-2.45
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.17	0.16	0.28	0.36	0.02	
SETON	15.75	13.66	11.68	12.03	8.50	8.44	3.69	5.99	4.42	5.01	2.77	3.28	3.38	2.45	0.95	0.0	-0.6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.36	1.00	
THOMPS	15.63	13.62	11.75	12.08	8.69	8.63	3.91	6.25	4.73	5.31	3.08	3.62	3.78	2.82	1.30	0.66	0.0
	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.51	0.21	

## PARAMETER TOTAL PHOSPHORUS

	MONSE	ROBSON	GOAT	STEIN	DORE	BRIDGE	COQUIH	SETON	BEAVER	THOMPS	BOWRON	SAFON	ANDERS	NECHAK	COTTON	WILLOW	QUESTL
MONSE	0.0	-0.52	-0.51	-0.64	-0.86	-2.41	-2.38	-2.43	-4.01	-6.59	-3.89	-5.30	-3.16	-5.61	-3.03	-5.49	-6.60
ROBSON	0.61	0.61	0.62	0.53	0.40	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
GOAT	0.52	0.04	-0.04	-0.13	-0.46	-1.58	-1.77	-1.80	-2.59	-4.31	-3.13	-4.06	-2.71	-4.30	-2.64	-4.29	-5.52
STEIN	0.64	0.13	0.08	0.00	-0.34	-1.36	-1.59	-1.61	-2.26	-3.76	-2.91	-3.71	-2.59	-3.92	-2.53	-3.93	-5.16
DORE	0.86	0.46	0.46	0.34	0.6	-0.75	-1.05	-1.06	-1.38	-2.52	-2.19	-2.72	-2.08	-2.89	-2.07	-2.94	-4.15
BRIDGE	2.41	1.58	1.40	1.36	0.75	0.0	-0.45	-0.46	-0.75	-2.27	-1.80	-2.46	-1.71	-2.69	-1.71	-2.72	-4.12
COQUIH	2.38	1.77	1.63	1.59	1.05	0.45	0.0	0.0	-0.11	-1.29	-1.20	-1.65	-1.27	-1.83	-1.30	-1.90	-3.24
SETON	2.43	1.80	1.65	1.61	1.06	0.46	0.0	0.0	-0.12	-1.32	-1.22	-1.67	-1.27	-1.85	-1.30	-1.92	-3.27
BEAVER	4.01	2.59	2.26	2.26	1.38	0.75	0.11	0.12	0.0	-1.76	-1.36	-2.02	-1.35	-2.27	-1.36	-2.32	-3.85
THOMPS	6.59	4.31	3.76	3.82	2.52	2.27	1.29	1.32	1.76	0.0	-0.26	-0.72	-0.52	-0.96	-0.60	-1.06	-2.81
BOWRON	3.89	3.13	2.91	2.90	2.19	1.80	1.20	1.22	1.36	0.26	0.0	-0.29	-0.25	-0.46	-0.37	-0.55	-1.99
SAFON	5.30	4.06	3.71	3.73	2.72	2.46	1.65	1.67	2.02	0.72	0.29	0.0	-0.08	-0.19	-0.19	-0.31	-1.94
ANDERS	3.16	2.71	2.59	2.57	2.06	1.71	1.27	1.35	0.52	0.29	0.08	0.33	-0.05	-0.09	-0.13	-1.33	-1.33
NECHAK	5.61	4.30	3.92	3.95	2.89	2.68	1.83	1.85	2.27	0.96	0.46	0.19	0.05	0.07	-0.07	-0.13	-1.78
COTTON	3.03	2.64	2.53	2.51	2.07	1.71	1.30	1.30	1.36	0.60	0.37	0.19	0.09	0.07	0.0	-0.02	-1.15
WILLOW	5.49	4.29	3.53	3.96	2.94	2.72	1.90	1.92	2.32	1.06	0.55	0.31	0.13	0.02	0.0	-1.63	-1.63
QUESTL	6.60	5.52	5.16	5.20	4.15	4.12	3.24	3.27	3.85	2.81	1.99	1.33	1.78	1.15	1.63	0.0	0.0

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## PARAMETER : NITRATE + NITRITE

	SALMON	COTTON	WILLOW	NECHAK	BOWRON	ANDERS	MOOSE	ROBSON	GOAT	BRIDGE	BEAVER	QUESTL	STEIN	DORE	COQUITH	SETON	THOMPS
SALMON	0.0 1.03	-0.68 0.51	-1.78 0.09	-1.87 0.07	-2.37 0.02	-2.88 0.03	-4.07 0.01	-4.21 0.00	-3.29 0.00	-4.24 0.00	-3.83 0.00	-3.92 0.00	-4.68 0.00	-4.19 0.00	-4.32 0.00	-4.79 0.00	
COTTON	0.68 0.51	0.0 1.60	-0.63 0.54	-0.98 0.34	-1.51 0.15	-1.49 0.16	-1.71 0.11	-2.25 0.04	-2.49 0.02	-2.16 0.05	-2.56 0.02	-2.43 0.03	-2.51 0.03	-2.69 0.01	-2.82 0.02	-3.15 0.01	
WILLOW	1.78 0.09	0.63 0.54	-0.61 1.60	-1.31 0.55	-1.27 0.20	-1.63 0.22	-2.07 0.12	-3.08 0.01	-2.19 0.04	-2.13 0.04	-2.70 0.01	-2.80 0.01	-3.68 0.00	-3.11 0.00	-3.28 0.01	-3.83 0.00	
NECHAK	1.87 0.07	0.61 0.34	0.0 0.55	-0.56 1.00	-0.59 0.58	-0.69 0.57	-1.08 0.50	-1.38 0.29	-1.22 0.18	-1.48 0.24	-1.42 0.16	-1.50 0.17	-1.83 0.15	-1.69 0.08	-1.83 0.11	-2.16 0.08	
BOWRON	2.49 0.02	1.51 0.15	1.31 0.20	0.56 0.58	1.80 1.80	0.95 0.95	0.94 0.73	0.35 0.50	-0.69 0.52	-0.65 0.44	-0.80 0.44	-0.79 0.39	-1.05 0.27	-1.20 0.31	-1.52 0.24		
ANDERS	2.37 0.03	1.49 0.16	1.27 0.22	0.59 0.57	0.95 1.00	0.07 0.01	0.01 0.82	-0.23 0.59	-0.54 0.60	-0.64 0.53	-0.65 0.52	-0.74 0.47	-0.95 0.35	-0.89 0.35	-1.03 0.39	-1.32 0.32	
MOOSE	2.88 0.01	1.71 0.11	1.63 0.12	0.69 0.50	0.98 0.94	0.01 1.00	0.00 1.00	-0.29 0.77	-0.65 0.50	-0.63 0.54	-0.81 0.43	-0.79 0.44	-1.21 0.39	-1.09 0.24	-1.25 0.25	-1.62 0.23	
ROBSON	4.07 0.00	2.25 0.04	2.87 0.01	1.08 0.29	0.35 0.73	0.23 0.82	0.29 0.77	0.0 0.53	-0.64 0.61	-0.52 0.43	-0.81 0.43	-0.74 0.47	-0.87 0.40	-1.15 0.17	-1.36 0.27	-1.69 0.19	
GOAT	4.21 0.00	2.49 0.02	3.06 0.01	1.38 0.18	0.69 0.50	0.54 0.59	0.69 0.50	0.64 0.53	0.0 1.80	-0.12 0.91	-0.18 0.86	-0.24 0.81	-0.36 0.72	-0.71 0.49	-0.60 0.56	-0.81 0.43	
BRIDGE	3.29 0.00	2.16 0.05	2.19 0.04	1.22 0.24	0.65 0.52	0.54 0.60	0.63 0.54	0.52 0.61	0.12 0.91	0.0 1.80	-0.01 0.99	-0.07 0.94	-0.17 0.87	-0.36 0.72	-0.33 0.74	-0.49 0.63	
BEAVER	4.24 0.00	2.56 0.02	3.13 0.01	1.48 0.16	0.80 0.44	0.64 0.53	0.81 0.43	0.81 0.86	0.18 0.99	0.01 0.93	0.08 0.84	-0.08 0.84	-0.21 0.62	-0.50 0.67	-0.43 0.67	-1.07 0.30	
QUESTL	3.83 0.03	2.43 0.03	2.76 0.01	1.42 0.17	0.79 0.44	0.65 0.52	0.79 0.44	0.74 0.47	0.24 0.81	0.07 0.94	0.08 0.93	0.3 0.90	-0.11 0.92	-0.34 0.76	-0.36 0.77	-0.85 0.63	
STEIN	3.92 0.00	2.51 0.03	2.80 0.01	1.50 0.15	0.88 0.39	0.74 0.47	0.89 0.40	0.87 0.40	0.36 0.72	0.17 0.87	0.21 0.84	0.11 0.92	0.0 1.00	-0.21 0.84	-0.37 0.85	-0.74 0.71	
DORE	4.68 0.00	2.89 0.01	3.68 0.00	1.83 0.08	1.14 0.27	0.95 0.24	1.21 0.17	1.42 0.49	0.71 0.72	0.36 0.62	0.34 0.74	0.21 0.84	0.0 1.00	-0.00 0.84	-0.22 1.00	-0.64 0.83	
COQUITH	4.19 0.00	2.69 0.02	3.11 0.01	1.69 0.11	1.05 0.31	0.89 0.39	1.09 0.29	1.15 0.27	0.60 0.56	0.33 0.74	0.43 0.67	0.19 0.85	0.0 1.00	0.0 1.00	-0.19 0.85	-0.56 0.58	
SETON	4.32 0.00	2.82 0.01	3.28 0.00	1.83 0.08	1.20 0.24	1.03 0.32	1.25 0.19	1.36 0.43	0.81 0.63	0.64 0.63	0.48 0.71	0.37 0.83	0.22 0.83	0.19 0.85	-0.36 0.73		
THOMPS	4.79 0.00	3.83 0.01	3.16 0.04	1.52 0.14	1.62 0.12	1.26 0.07	1.89 0.22	1.26 0.43	0.81 0.30	0.85 0.40	0.74 0.47	0.64 0.53	0.56 0.53	0.56 0.73	0.0 0.73	0.0 1.80	

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## PARAMETER NH3

	BEAVER	MOOSE	ROBSON	SALMON	DORE	ANDERS	WILLOW	STEIN	SETON	BOWRON	COTTON	GOAT	NECHAK	BRIDGE	QUESNL	THOMPS	COQUIL
BEAVER	0.0 0.1C 1.0C	-0.13 0.1C 0.20	-0.32 0.76 0.20	-1.31 0.18 0.19	-1.41 0.20 0.20	-1.34 0.08 0.08	-1.82 0.19 0.19	-1.37 0.20 0.20	-1.34 0.14 0.27	-1.92 0.16 0.27	-2.56 0.02 0.07	-1.92 0.09 0.07	-2.22 0.04 0.07	-2.43 0.03 0.03	-2.33 0.03 0.02	-2.63 -2.21 0.02	
MOOSE	0.13 0.08 0.90	0.0 -0.13 1.08	-0.95 0.35 0.69	-1.08 0.29 0.29	-1.11 0.16 0.29	-1.15 0.16 0.27	-1.16 0.13 0.27	-1.14 0.13 0.27	-1.57 0.17 0.25	-1.65 0.77 0.25	-1.65 0.64 0.02	-1.91 -1.78 0.09	-1.86 0.12 0.08	-2.03 0.08 0.06	-1.99 0.06 0.04	-2.21 -2.55 0.02	
ROBSON	0.32 0.76	0.13 0.89	0.0 -1.09 0.29	-1.21 0.24 0.24	-1.16 0.26 0.11	-1.67 0.11 0.25	-1.20 0.25 0.25	-1.17 0.09 0.25	-1.77 0.77 0.25	-1.64 0.64 0.02	-2.51 -1.78 0.09	-2.09 0.09 0.05	-2.32 0.03 0.04	-2.21 -2.55 0.02	-2.55 -2.55 0.02		
SALMON	1.31 0.20	0.95 0.35	1.39 0.29	3.0 1.08	-0.33 0.75	-0.49 0.63	-0.89 0.38	-0.59 0.56	-0.61 0.55	-1.06 0.30	-1.00 0.33	-1.85 0.08	-1.20 0.24	-1.47 0.16	-1.71 0.10	-1.63 0.12	-1.97 0.06
DORE	1.61 0.18	1.08 0.29	1.21 0.24	0.33 0.75	0.0 1.08	-0.24 0.82	-0.49 0.63	-0.36 0.72	-0.39 0.70	-0.68 0.51	-0.69 0.50	-1.15 0.26	-0.90 0.38	-1.07 0.30	-1.27 0.22	-1.27 0.15	-1.49 -0.97
ANDERS	1.34 0.20	1.11 0.29	1.16 0.26	0.49 0.63	0.24 0.82	0.0 1.08	-0.15 0.89	-0.12 0.90	-0.16 0.87	-0.31 0.76	-0.38 0.71	-0.58 0.57	-0.57 0.57	-0.66 0.52	-0.85 0.43	-0.40 0.40	-0.85 -0.97
WILLOW	1.45 0.08	1.67 0.16	1.67 0.11	0.89 0.38	0.49 0.63	0.15 0.66	0.0 0.99	0.01 0.95	-0.06 0.83	-0.22 0.77	-0.30 0.58	-0.57 0.60	-0.53 0.53	-0.64 0.42	-0.81 0.40	-0.86 -1.03	-0.86 -0.32
STEIN	1.37 0.19	1.16 3.27	1.20 0.25	0.59 0.56	0.36 0.72	0.12 0.90	0.01 0.99	0.0 1.00	-0.04 0.97	-0.15 0.88	-0.22 0.83	-0.36 0.72	-0.41 0.68	-0.47 0.64	-0.60 0.56	-0.67 0.51	-0.76 -0.35
SETON	1.34 0.20	1.14 0.27	1.17 0.25	0.61 0.55	0.39 0.70	0.16 0.95	0.06 0.95	0.04 0.97	0.0 1.03	-0.09 0.93	-0.17 0.87	-0.28 0.78	-0.35 0.73	-0.40 0.69	-0.52 0.61	-0.59 0.56	-0.66 -0.52
BOWRON	1.92 0.07	1.57 0.13	1.77 0.09	1.06 0.30	0.68 0.51	0.31 0.76	0.22 0.83	0.15 0.88	0.09 0.93	0.0 1.00	-0.10 0.92	-0.27 0.79	-0.34 0.74	-0.41 0.69	-0.57 0.57	-0.65 0.53	-0.77 -0.45
COTTON	1.80 0.09	1.51 0.15	1.64 0.12	1.00 0.33	0.69 0.50	0.38 0.71	0.22 0.77	0.17 0.83	0.22 0.87	0.17 0.92	0.10 1.00	-0.11 0.92	-0.22 0.83	-0.27 0.79	-0.40 0.69	-0.49 0.63	-0.58 -0.57
GOAT	2.56 0.02	2.01 0.06	2.51 0.08	1.85 0.26	1.15 0.57	0.58 0.59	0.57 0.72	0.36 0.78	0.28 0.79	0.27 0.74	0.11 0.74	0.41 0.83	0.23 0.87	0.27 0.82	0.42 0.68	0.51 0.61	-0.66 -0.52
NECHAK	1.92 0.07	1.65 0.12	1.78 0.09	1.20 0.38	0.90 0.57	0.57 0.60	0.41 0.68	0.33 0.73	0.22 0.74	0.34 0.74	0.22 0.68	0.17 0.63	0.17 0.63	0.22 0.63	0.14 0.61	-0.14 -0.89	-0.24 -0.81
BRIDGE	2.22 0.04	1.86 0.05	2.09 0.16	1.47 0.30	1.07 0.52	0.66 0.53	0.47 0.64	0.47 0.69	0.41 0.79	0.27 0.79	0.23 0.69	0.02 0.69	0.02 0.68	0.0 0.68	-0.14 0.61	-0.25 -0.89	-0.32 -0.75
QUESNL	2.43 0.03	2.03 0.06	2.32 0.15	1.71 0.35	1.27 0.42	0.80 0.42	0.61 0.56	0.57 0.61	0.49 0.61	0.42 0.63	0.42 0.63	0.49 0.63	0.51 0.61	0.24 0.81	0.14 0.81	0.0 0.81	-0.13 -0.76
THOMPS	2.33 0.03	1.99 0.04	2.21 0.12	1.63 0.38	1.27 0.57	0.85 0.60	0.67 0.68	0.67 0.73	0.59 0.74	0.57 0.74	0.49 0.63	0.51 0.63	0.24 0.61	0.25 0.81	0.13 0.81	0.0 0.81	-0.13 -0.76
COQUIL	2.63 0.02	2.21 0.04	2.55 0.06	1.97 0.15	1.49 0.35	0.97 0.32	0.76 0.46	0.77 0.52	0.66 0.52	0.66 0.52	0.58 0.57	0.32 0.57	0.19 0.57	0.32 0.75	0.19 0.95	0.04 0.96	0.0 0.96

## PARAMETER CU

	GOAT	ROBSON	BEAVER	STEIN	MOOSE	SETON	NECHAK	THOMPS	BOWRON	DORE	BRIDGE	WILLOW	SALMON	COQUIH	ANDERS	COTTON	QUESNL		
GOAT	0.0 1.08	-0.55 0.55	-1.26 0.22	-1.15 0.27	-1.04 0.31	-1.41 0.18	-1.60 0.12	-1.80 0.09	-1.67 0.07	-2.46 0.02	-1.99 0.06	-2.58 0.02	-2.31 0.03	-2.28 0.03	-2.76 0.01	-3.02 0.00			
ROBSON	0.55 0.59	0.0 1.08	-0.45 0.66	-0.42 0.68	-0.40 0.69	-0.89 0.39	-0.98 0.34	-1.06 0.30	-1.23 0.23	-1.63 0.12	-1.48 0.16	-1.80 0.09	-1.66 0.11	-1.73 0.10	-1.86 0.08	-2.34 0.03	-3.27 0.00		
BEAVER	1.26 0.22	0.45 0.66	0.0 1.08	0.0 1.00	0.0 0.0	-0.61 0.55	-0.68 0.51	-0.75 0.46	-0.96 0.35	-1.37 0.19	-1.25 0.23	-1.56 0.14	-1.42 0.17	-1.51 0.15	-1.67 0.11	-2.17 0.05	-3.13 0.01		
STEIN	1.15 0.27	0.42 0.68	0.0 1.00	0.0 1.00	0.0 1.00	-0.59 0.57	-0.65 0.52	-0.71 0.48	-0.92 0.37	-1.31 0.21	-1.21 0.24	-1.50 0.15	-1.37 0.16	-1.47 0.16	-1.64 0.12	-2.14 0.05	-3.07 0.01		
MOOSE	1.04 0.31	0.40 0.69	0.0 1.00	0.0 1.00	0.0 1.08	-0.57 0.58	-0.62 0.54	-0.63 0.51	-0.88 0.39	-1.25 0.23	-1.18 0.23	-1.44 0.17	-1.32 0.17	-1.42 0.17	-1.61 0.13	-2.10 0.05	-3.01 0.01		
SETON	1.41 0.18	0.85 0.39	0.61 0.55	0.59 0.57	0.57 0.58	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.82	-0.23 0.64	-0.18 0.64	-0.58 0.57	-0.67 0.57	-0.63 0.54	-0.77 0.45	-1.06 0.30	-1.55 0.14	-2.31 0.03	
NECHAK	1.60 0.12	0.98 0.34	0.68 0.51	0.65 0.52	0.62 0.54	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.81	-0.25 0.61	-0.22 0.55	-0.61 0.48	-0.69 0.51	-0.82 0.42	-1.11 0.28	-1.61 0.13	-2.42 0.02		
THOMPS	1.80 0.09	1.06 0.30	0.75 0.46	0.71 0.48	0.68 0.51	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.81	-0.27 0.79	-0.21 0.79	-0.56 0.58	-0.64 0.53	-0.77 0.45	-0.86 0.40	-1.15 0.26	-1.66 0.11	-2.51 0.02	
BOWRON	1.87 0.07	1.24 0.23	0.96 0.35	0.92 0.37	0.88 0.39	0.23 0.39	0.88 0.82	0.82 0.81	0.25 0.79	0.27 1.00	0.0 0.81	-0.25 0.70	-0.39 0.65	-0.46 0.67	-0.59 0.56	-0.91 0.37	-1.42 0.17	-2.21 0.04	
DORE	2.46 0.02	1.63 0.12	1.37 0.19	1.31 0.21	1.25 0.23	0.48 0.64	0.52 0.61	0.56 0.59	0.25 0.81	0.0 1.00	-0.20 0.84	-0.24 0.81	-0.22 0.83	-0.43 0.65	-0.40 0.65	-0.77 0.45	-1.30 0.21	-2.11 0.05	
BRIDGE	1.99 0.06	1.48 0.16	1.25 0.23	1.21 0.24	1.18 0.26	0.58 0.57	0.61 0.55	0.64 0.53	0.39 0.73	0.20 0.84	0.0 1.00	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.85	-0.17 0.57	-0.53 0.57	-1.02 0.07	-1.71 0.10
WILLOW	2.58 0.02	1.80 0.09	1.56 0.13	1.50 0.15	1.44 0.17	0.67 0.51	0.72 0.48	0.77 0.45	0.46 0.65	0.24 0.81	0.0 1.00	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.86	-0.19 0.56	-0.58 0.56	-1.12 0.30	-1.89 0.08
SALMON	2.31 0.03	1.66 0.11	1.42 0.17	1.37 0.19	1.32 0.20	0.63 0.54	0.68 0.51	0.72 0.48	0.43 0.67	0.22 0.83	0.0 1.00	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.86	-0.18 0.56	-0.56 0.56	-1.08 0.30	-1.82 0.08
COQUIH	2.31 0.03	1.51 0.15	1.47 0.16	1.42 0.17	1.37 0.17	0.77 0.51	0.82 0.48	0.86 0.48	0.59 0.65	0.40 0.69	0.40 0.87	0.17 0.85	0.17 0.85	0.18 0.86	0.0 0.86	-0.40 0.70	-0.40 0.58	-0.47 0.58	-1.06 0.30
ANDERS	2.28 0.03	1.86 0.08	1.67 0.11	1.64 0.12	1.61 0.13	1.06 0.30	1.11 0.28	1.15 0.26	0.91 0.37	0.77 0.45	0.60 0.60	0.58 0.57	0.58 0.58	0.40 0.57	0.0 0.58	-0.47 0.70	0.0 0.64	-0.47 0.64	-1.06 0.30
COTTON	2.76 0.01	2.34 0.03	2.17 0.05	2.14 0.05	2.10 0.05	1.55 0.14	1.61 0.13	1.66 0.11	1.42 0.17	1.30 0.21	1.02 0.28	1.12 0.32	1.08 0.32	1.08 0.32	0.90 0.38	0.47 0.38	0.47 0.64	0.0 1.00	-0.54 0.60
QUESNL	3.82 -0.03	3.13 0.01	3.07 0.01	3.01 0.01	2.91 0.02	2.42 0.02	2.31 0.02	2.21 0.02	2.11 0.05	1.71 0.07	1.89 0.10	1.60 0.08	1.60 0.07	1.60 0.07	1.06 0.13	0.54 0.30	1.06 0.30	0.54 0.60	0.0 1.00

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## PARAMETER IN

	NECHAK	G-CAT	MOOSE	ROBSON	THOMPS	BEAVER	COTTON	STEIN	WILLOW	SALMON	BOWRON	BRIDGE	DORE	COQUIH	ANDERS	QUESNL	SEJON
NECHAK	-0.30 0.00	-0.42 0.77	-0.54 0.60	-0.88 0.39	-0.92 0.37	-1.42 0.17	-1.61 0.08	-1.44 0.16	-1.46 0.16	-1.85 0.08	-1.96 0.06	-2.39 0.03	-1.83 0.03	-2.89 0.01	-3.69 0.00		
G-CAT	0.30 0.77	0.20 1.00	0.26 0.84	0.64 1.00	0.64 0.74	0.71 0.67	0.75 0.62	1.21 0.42	1.24 0.34	1.26 0.39	1.62 0.90	1.75 1.13	2.17 0.23	2.65 0.05	2.65 0.04	-3.68 0.00	
MOOSE	0.42 0.68	0.26 0.84	0.0 1.00	0.0 1.00	0.33 0.74	0.44 0.67	0.51 0.62	0.83 0.42	0.83 0.34	1.05 0.22	1.13 0.38	1.28 0.28	1.28 0.22	1.32 0.14	1.91 0.23	-2.88 0.07	0.01
ROBSON	0.54 0.63	0.26 0.80	0.0 1.00	0.0 1.00	0.40 0.69	0.50 0.62	0.57 0.58	0.57 0.34	0.97 0.22	1.27 0.32	1.03 0.31	1.36 0.20	1.49 0.15	1.86 0.08	2.31 0.16	-3.35 0.03	0.00
THOMPS	0.88 0.35	0.64 C.53	0.33 0.74	0.40 0.69	0.0 1.00	0.15 0.88	0.25 0.80	0.57 0.58	0.77 0.45	0.77 0.52	0.65 0.52	0.87 0.40	1.04 0.31	1.34 0.20	1.72 0.10	-2.76 0.01	
BEAVER	C.92 C.37	0.71 C.48	0.44 0.61	0.50 0.62	0.15 0.88	0.0 1.00	0.0 0.91	0.11 0.71	0.37 0.60	0.53 0.65	0.46 0.65	0.63 0.54	0.80 0.43	0.92 0.31	1.36 0.37	-2.34 0.19	0.03
COTTON	0.92 0.37	0.75 C.46	0.51 0.62	0.57 0.58	0.25 0.80	0.11 0.91	0.0 1.00	0.22 0.83	0.34 0.74	0.31 0.76	0.44 0.67	0.60 0.56	0.81 0.43	0.75 0.47	1.08 0.30	-1.98 0.07	
STEIN	1.42 0.17	1.21 C.24	0.83 0.42	0.97 0.34	0.57 0.58	0.37 0.71	0.22 0.83	0.0 1.00	0.13 0.90	0.13 0.60	0.46 0.65	0.63 0.54	0.67 0.43	0.62 0.31	0.99 0.31	-2.03 0.06	
WILLOW	1.81 C.68	1.57 0.13	1.05 0.31	1.27 0.22	0.77 0.45	0.53 0.60	0.74 0.74	0.90 0.90	1.00 1.00	-1.80 0.09							
SALMON	1.44 0.16	1.24 0.23	0.90 0.38	1.03 0.32	0.65 0.52	0.46 0.62	0.31 0.76	0.11 0.91	0.11 1.00	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.91	0.31 0.74	0.52 0.61	-0.81 0.43	0.05
BOWRON	1.46 0.16	1.26 0.22	0.91 0.38	1.04 0.31	0.66 0.52	0.46 0.65	0.31 0.76	0.11 0.91	0.11 1.00	0.0 1.00	0.0 1.00	0.0 1.00	0.0 0.91	0.31 0.76	0.52 0.61	-0.81 0.43	0.09
BRIDGE	1.85 C.68	1.62 0.12	1.13 0.28	1.34 0.20	0.87 0.46	0.63 0.54	0.44 0.67	0.26 0.61	0.13 0.90	0.11 0.91	0.11 0.91	0.11 0.91	0.22 0.76	0.46 0.83	0.46 0.67	-1.90 0.08	
DORE	1.96 0.06	1.75 0.09	1.28 0.22	1.49 0.15	1.04 0.31	0.80 0.43	0.60 0.56	0.44 0.66	0.36 0.72	0.36 0.76	0.31 0.76	0.22 0.76	0.22 0.83	0.21 1.00	0.21 0.84	-0.25 0.61	-1.59 0.13
COQUIH	2.39 0.03	2.17 0.04	1.56 0.14	1.86 0.08	1.34 0.20	1.05 0.31	0.81 0.51	0.51 0.55	0.61 0.61	0.61 0.61	0.52 0.62	0.46 0.62	0.21 0.67	0.21 0.67	0.08 0.61	-0.32 0.61	-1.47 0.08
ANDERS	1.83 0.08	1.66 0.11	1.32 0.20	1.47 0.16	1.12 0.28	0.92 0.37	0.75 0.55	0.62 0.55	0.55 0.59	0.50 0.62	0.44 0.62	0.46 0.62	0.25 0.67	0.79 0.61	0.32 0.75	0.16 0.75	-1.22 0.16
QUESNL	2.89 0.01	2.65 0.01	1.91 C.C7	2.31 0.03	1.72 0.10	1.36 0.15	1.08 0.30	0.99 0.33	0.97 0.34	0.81 0.43	0.82 0.43	0.81 0.43	1.00 0.42	0.79 0.42	0.08 0.42	0.08 0.61	-1.09 0.29
SEJON	3.89 0.00	3.68 0.00	2.89 0.00	3.35 0.00	2.76 0.01	2.34 0.03	1.98 0.07	2.03 0.06	2.10 0.05	1.80 0.09	1.82 0.09	1.90 0.08	1.47 0.08	1.09 0.08	1.22 0.13	0.00 0.24	1.00 0.24

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PARAMETER  $p_4$ 

		GOAT	STEIN	ANDERS	SAFON	BRIDGE	COTTON	THOMPS	SETON	DORE	BEAVER	BROWRON	ROBSON	COQUIH	MOOSE	NECHAK	WILLOW	QUEENL
GOAT	0.0	0.0	-0.07	-0.07	-0.07	-0.07	-0.07	-0.13	-0.13	-0.19	-0.18	-0.19	-0.19	-0.32	-0.33	-0.74	-0.74	
GOAT	1.00	1.00	0.00	0.95	0.95	0.95	0.95	0.90	0.90	0.85	0.85	0.85	0.85	0.75	0.75	0.80	0.80	0.80
STEIN	0.0	0.0	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.10	-0.10	-0.15	-0.15	-0.15	-0.26	-0.26	-0.26	-0.26	-0.26
STEIN	1.00	1.00	1.00	0.96	0.96	0.96	0.96	0.96	0.92	0.92	0.96	0.96	0.96	0.88	0.88	0.88	0.88	0.88
ANDERS	0.0	0.0	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.11	-0.11	-0.16	-0.16	-0.16	-0.28	-0.28	-0.28	-0.28	-0.28
ANDERS	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.91	0.91	0.88	0.88	0.88	0.88	0.78	0.78	0.78	0.78
SAFON	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.22	-1.05	-2.25	-2.25	
SAFON	0.95	0.96	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.31	0.31	0.03	0.03	
BRIDGE	0.07	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	-1.01	-1.01	-1.01	
BRIDGE	0.95	0.96	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.61	0.61	0.34	0.34	0.08	0.08	
COTTON	0.07	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.92	-0.92	-1.02	-1.02	
COTTON	0.95	0.96	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.61	0.61	0.34	0.34	0.08	0.08	
THOMPS	0.07	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	-1.01	-1.01	-1.01	
THOMPS	0.95	0.96	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.51	0.51	0.51	0.24	0.24	0.03	0.03	
SETON	0.07	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.35	-1.30	-2.34	-2.34	
SETON	0.95	0.96	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.51	0.51	0.51	0.24	0.24	0.03	0.03	
DORE	0.13	0.10	0.11	0.64	0.49	0.52	0.68	0.59	0.59	0.00	0.00	0.00	0.00	-0.47	-0.77	-2.13	-2.13	
DORE	0.90	0.92	0.91	0.53	0.64	0.61	0.51	0.56	0.56	0.56	0.56	0.56	0.56	0.45	0.45	0.15	0.15	
BEAVER	0.13	0.10	0.11	0.74	0.52	0.58	0.81	0.67	0.67	0.00	0.00	0.00	0.00	-0.54	-0.52	-1.59	-1.59	
BEAVER	0.90	0.92	0.91	0.47	0.61	0.57	0.43	0.51	0.51	1.00	1.00	1.00	1.00	0.61	0.61	0.13	0.13	
BROWRON	0.13	0.10	0.11	0.66	0.51	0.61	0.51	0.56	0.56	1.00	1.00	1.00	1.00	0.62	0.62	0.14	0.14	
ROBSON	0.19	0.15	0.10	0.92	0.91	0.63	0.66	0.49	0.55	1.00	1.00	1.00	1.00	0.61	0.61	0.39	0.39	
COQUIH	0.18	0.15	0.16	0.87	0.74	0.78	0.45	0.45	0.45	1.00	1.00	1.00	1.00	0.58	0.58	-1.07	-1.07	
MOOSE	0.06	0.05	0.08	0.39	0.47	0.45	0.38	0.26	0.26	0.23	0.62	0.56	0.56	0.56	0.56	0.30	0.30	
NECHAK	0.19	0.15	0.16	1.27	0.94	1.03	1.35	1.17	1.17	0.48	0.54	0.54	0.54	0.52	0.52	0.00	0.00	
NECHAK	0.85	0.86	0.88	0.68	0.19	0.34	0.30	0.16	0.16	0.23	0.27	0.64	0.64	0.64	0.64	0.64	0.64	
WILLOW	0.32	0.26	0.28	1.05	0.99	1.01	1.05	1.03	1.03	0.31	0.45	0.45	0.45	0.58	0.58	1.00	1.00	
QUEENL	0.33	0.26	0.28	0.78	0.03	0.08	0.07	0.03	0.03	2.34	1.02	1.02	1.02	0.58	0.58	0.00	0.00	
QUEENL	0.74	0.42	0.78	0.03	0.08	0.07	0.03	0.03	0.03	0.03	0.15	0.14	0.14	0.27	0.27	0.30	0.30	

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## PARAMETER FE

	GOAT	ROBSON	STEIN	MCCSE	BRIDGE	CORE	SETON	THUMPS	COQUILH	BEAVER	NECHAK	ANDERS	BOWRON	WILLOW	QUEENL	COTTON	SALMON
GOAT	0.0	-0.63	-1.69	-1.93	-1.15	-1.47	-2.29	-3.14	-1.30	-3.65	-3.55	-5.63	-7.16	-6.36	-7.89	-9.17	
ROBSON	0.63	0.0	-0.72	-0.93	-0.65	-0.88	-1.61	-2.14	-0.98	-2.49	-2.62	-4.52	-5.65	-5.26	-6.34	-7.24	
STEIN	1.68	0.72	0.0	-0.37	-0.25	-0.47	-1.35	-2.21	-0.76	-2.92	-2.70	-5.33	-7.77	-6.15	-8.67	-11.35	
MOOSE	1.93	0.93	0.37	0.0	-0.11	-0.29	-1.16	-1.91	-0.65	-2.57	-2.47	-7.08	-7.43	-5.92	-8.34	-10.94	
BRIDGE	1.15	0.65	0.25	0.11	0.0	-0.11	-0.68	-0.84	-0.52	-1.00	-1.34	-4.87	-2.72	-3.28	-3.81	-4.22	
DORE	1.47	0.88	0.47	0.29	0.11	0.0	-0.62	-0.82	-0.46	-1.02	-1.38	-1.93	-2.97	-3.68	-4.30	-4.84	
SETON	2.28	1.61	1.35	1.16	0.68	0.62	0.0	-0.07	-0.09	-0.24	-0.72	-1.40	-2.36	-3.06	-3.71	-4.26	
THUMPS	3.14	2.14	2.21	1.91	0.84	0.82	0.07	0.0	-0.06	-0.25	-0.85	-1.58	-3.07	-4.38	-5.99	-6.53	
COQUILH	1.30	0.98	0.74	0.65	0.52	0.46	0.09	0.06	0.0	-0.02	-0.30	-0.79	-1.17	-1.62	-1.76	-1.94	
BEAVER	2.65	2.49	2.92	2.57	1.00	1.02	0.21	0.25	0.02	0.0	-0.72	-1.50	-3.13	-4.10	-5.70	-7.44	
NECHAK	3.50	2.62	2.70	2.47	1.34	1.38	0.72	0.85	0.30	0.72	0.0	-0.89	-1.88	-2.69	-3.47	-4.18	
ANDERS	3.55	2.92	2.87	2.71	1.87	1.93	1.40	1.58	0.79	1.50	0.89	0.0	-0.51	-0.93	-1.25	-1.84	
BOWRON	6.63	4.52	5.33	5.08	2.72	2.97	2.36	3.07	1.17	3.13	1.88	0.51	0.0	-0.57	-1.01	-1.62	
WILLOW	7.16	5.65	7.77	7.63	3.28	3.68	3.06	4.38	1.42	4.74	2.69	0.93	0.57	0.0	-0.63	-1.07	
QUEENL	6.36	5.26	6.15	5.92	3.38	3.70	3.13	3.99	1.62	4.10	2.77	1.25	1.01	0.63	0.0	-0.59	
COTTON	7.89	6.34	8.67	8.34	3.81	4.30	3.71	5.26	1.76	5.70	3.47	1.51	1.42	1.07	0.19	-0.53	
SALMON	9.17	7.24	11.35	10.94	4.22	4.84	4.26	6.53	1.94	7.44	4.19	1.99	1.01	0.59	0.0	-0.60	

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## PARAMETER MN

	GOAT	STEIN	MOOSE	BRIDGE	THOMPS	ROBSON	BEAVER	SETON	DORE	NECHAK	ANDERS	COQUIH	COTTON	WILLCW	SALMON
GOAT	0.0 1.00	0.0 1.00	0.0 0.95	-0.06 0.95	-0.06 0.93	-0.09 0.93	-0.09 0.93	-0.17 0.87	-0.25 0.81	-0.34 0.74	-0.33 0.75	-0.50 0.72	-0.65 0.63	-0.82 0.55	-0.87 0.52
STEIN	0.0 1.00	0.0 1.00	-0.04 0.97	-0.05 0.96	-0.07 0.94	-0.07 0.94	-0.13 0.89	-0.20 0.95	-0.26 0.79	-0.29 0.80	-0.35 0.78	-0.48 0.76	-0.65 0.70	-0.65 0.64	-0.69 0.61
MOOSE	0.0 1.00	0.0 1.00	-0.05 0.96	-0.05 0.96	-0.08 0.94	-0.08 0.94	-0.15 0.89	-0.21 0.83	-0.29 0.78	-0.28 0.79	-0.34 0.76	-0.42 0.74	-0.52 0.68	-0.56 0.61	-0.69 0.59
BRIDGE	0.04 C.96	0.05 C.96	0.00 0.93	0.00 0.93	-0.08 0.74	-0.14 0.74	-0.42 0.68	-0.87 0.40	-1.09 0.29	-1.50 0.15	-0.99 0.34	-0.84 0.41	-2.11 0.05	-3.28 0.00	-3.07 0.01
THOMPS	0.05 C.95	0.05 C.96	0.06 0.93	0.00 1.00	-0.10 0.77	-0.19 0.79	-0.86 0.40	-1.08 0.30	-1.49 0.15	-0.97 0.34	-0.83 0.42	-2.11 0.05	-3.32 0.02	-3.09 0.01	-6.82 0.00
ROBSON	0.07 C.93	0.08 C.94	0.34 0.74	0.33 0.77	0.00 1.00	0.00 1.00	-0.54 0.59	-0.84 0.41	-1.24 0.23	-0.84 0.41	-0.74 0.47	-1.86 0.08	-2.87 0.01	-2.75 0.01	-5.58 0.00
BEAVER	0.07 C.93	0.08 C.94	0.42 0.66	0.39 0.70	0.00 1.00	0.00 1.00	-0.60 0.56	-0.88 0.39	-1.30 0.21	-0.86 0.40	-0.75 0.46	-1.93 0.07	-3.05 0.01	-2.87 0.01	-6.19 0.00
SETON	0.13 0.87	0.15 0.89	0.87 0.89	0.86 0.40	0.86 0.40	0.54 0.56	0.60 1.00	0.60 0.70	-0.39 0.45	-0.78 0.59	-0.53 0.60	-1.40 0.18	-2.22 0.04	-2.19 0.04	-4.32 0.00
DORE	0.20 C.81	0.21 0.83	0.21 0.29	1.09 0.30	1.08 0.41	0.88 0.39	0.39 0.70	0.00 1.00	-0.35 0.73	-0.27 0.79	-0.31 0.76	-0.95 0.36	-1.55 0.14	-1.61 0.12	-2.87 0.01
NECHAK	0.26 0.74	0.25 0.79	1.50 0.78	1.50 0.15	1.49 0.15	1.24 0.23	1.30 0.21	0.78 0.45	0.35 0.73	0.00 1.00	-0.11 0.92	-0.60 0.55	-1.14 0.27	-1.23 0.23	-2.34 0.02
ANDERS	0.26 0.75	0.28 0.80	0.99 0.78	0.99 0.34	0.97 0.41	0.86 0.49	0.86 0.59	0.55 0.79	0.27 1.00	0.00 0.93	-0.09 0.93	-0.47 0.64	-0.85 0.41	-0.95 0.35	-1.62 0.12
COQUIH	0.29 0.72	0.31 0.78	0.84 0.41	0.83 0.42	0.74 0.47	0.75 0.46	0.53 0.60	0.31 0.76	0.11 0.92	0.09 0.93	0.00 1.00	-0.27 0.79	-0.55 0.59	-0.65 0.53	-1.11 0.28
COTTON	0.42 0.63	0.42 0.70	2.11 0.68	2.11 0.05	1.86 0.08	1.93 0.07	1.40 0.18	0.95 0.36	0.60 0.59	0.60 0.64	0.47 0.79	0.27 1.00	-0.43 0.67	-0.57 0.67	-1.40 0.18
BCHRON	0.48 0.55	0.52 0.61	3.28 0.00	3.32 0.01	2.87 0.04	3.05 0.14	1.55 0.27	1.14 0.41	0.85 0.59	0.55 0.67	0.43 1.00	0.0 0.85	-0.19 1.00	-1.10 0.26	-1.33 0.20
QUESNL	0.52 0.52	0.56 0.61	0.58 0.01	0.01 0.01	0.09 0.01	2.75 0.04	2.87 0.12	1.19 0.23	0.95 0.35	0.65 0.53	0.57 0.59	0.19 0.85	0.0 1.00	-0.76 0.46	-0.97 0.34
WILLCW	0.82 0.42	0.70 C.53	4.54 0.00	6.11 0.00	4.15 0.00	2.87 0.00	1.62 0.12	1.34 0.03	1.62 0.12	1.11 0.28	1.11 0.18	1.40 0.18	0.76 0.46	-0.33 1.00	-0.33 0.74
SALMON	0.69 C.39	0.74 0.47	6.58 0.00	6.92 0.00	5.58 0.00	4.32 0.00	3.06 0.01	2.53 0.02	1.77 0.02	1.60 0.24	1.23 0.13	1.33 0.20	0.97 0.34	0.33 0.74	0.0 1.00

## PARAMETER TOTAL NUNFILTRABLE RESIDUES

	GOAT	COQUILH	WILLOW	STEIN	COTTON	SETON	BEAVER	ANDERS	SALMON	BRIDGE	ROBSON	THOMPS	MOOSE	NECHAK	DORE	BOWRON	QUESNL
GOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COQUILH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WILLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STEIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SETON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEAVER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANDERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALMON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIDGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROBSON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THOMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOOSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NECHAK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DORE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BOWRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
QUESNL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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## PARAMETER FIXED NONFILTRABLE RESIDUE

	COQUILHE	WILLOW	BEAVER	ANDERS	COTTON	SETON	SALMON	STEIN	BRIDGE	RCBSON	MOOSE	THOMPS	NECHAK	DORE	BOWRON	QUESNL
GOAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COWH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WILLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEAVER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANDERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SETON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SALMON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STEIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIDGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RCBSON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOOSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THOMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NECHAK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DORE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BOWRON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
QUESNL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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APPENDIX IV

SIGNS AND CORRELATION COEFFICIENTS FOR THE GROUPS  
OF STATIONS DESCRIBED IN CHAPTER 4. ONLY THOSE  
COEFFICIENTS WHOSE PROBABILITY IS LESS THAN 0.05  
ARE GIVEN.

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	MINTSTEM HEADWATER	MINTSTEM PLATEAU	CANYON TRIB.	PLATE. TRIB.	HEADWATER TRIB.	MINTSTEM CANYON	TRIB. CANYON	QUEENEL	THOMPSON	BRIDGE RIVER
TURBIDITY										
COLOUR	.47	.61	.44	.47	.75	.77	.68	.54		
pH	.22			-.35				.51		
Cl	-.62	-.23		+.29		.95				
CONDUCTIVITY	-.74	-.65		-.60	-.45					
ALKALINITY	-.69	-.60		-.56	-.49					
HARDNESS	-.73	-.66		-.60	-.44					
Ca	-.63	-.48		-.61	-.34		.67			
SO4	-.42			-.52						
SiO2		-.29		-.60			.79	.60		
Na	-.59	-.48		-.57	-.29		.79			
K	-.46	.36	.32		.31		.89		-.76	-.86
TOTAL PHOS.	.50	.82	.89	.72	.87	.85	.67	.95	.69	.82
NITRATE-NITRITE		-.24	-.26							
NH3										
CU	.53	.88		.73		.69	.56	.94		.62
ZN			.65	.26	.46	.44	.58	.83		
Pb				.54			.52			
Fe	.40	.74	.72	.63	.48	.90	.89	.94		.89
MANGANESE	.51	.75	.88	.34	.54	.82	.92	.88		.69
TOTAL STNS.	.58	.87	.94	.67	.95		.88	.98		
FIXED STNS.	.66	.87	.94	.65	.91		.84	.97		





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	MAINSHEET HEADWATER	MAINSHEET PLATEAU	CANYON MAINSHEET	TRIB. HEADWATER	TRIB. PLATE.	CANYON TRIB. CANYON	NECHAKO RIVER	QUEENEL	THOMPSON	BRIDGE RIVER
TURBIDITY	-.29	-.60					.79	.60		
COLOUR	.39	.62					.76	.71		
pH										
C1	.56	.89	.27	.48	.60	.67	.93	.66		
CONDUCTIVITY	.67	.55	.30							
ALKALINITY	.72	.46								
HARDNESS	.66	.45	.26							
CA	.78	.48	.42							
SO4	.65	.50	.49							
S102										
Na	.76	.78	.85	.82	.63	.59	.72	.90	.66	.66
K	.42	.22	.75		.37	.49	.63	.63		
TOTAL PHOS.				.39	-.26				.65	
NITRATE-NITRITE										
NH3										.71
CU										
ZN										
Pb										
Fe	.48	.38	-.33							
MANGANESE										
TOTAL STNS.										
FIXED STNS.										

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	MARSHALL HEADWATER	MARSHALL CANYON	TRIB. PLATEAU	TRIB. CANYON	NECHAKO RIVER	QUEENEL	THOMPSON	BRIDGE RIVER
TURBIDITY	-.59	-.48	-.57	-.29	.79			
COLOUR		.41				.52	.72	
pH		-.41	-.30					
C1	.62	.82	.96	.58	.50	.39	.76	.93
CONDUCTIVITY	.53	.82	.83	.56	.43	.89	.59	.93
ALKALINITY	.81	.72	.45	.41	.90			.95
HARDNESS	.48	.79	.71	.52	.40	.87	.55	.96
CA	.44	.80	.68	.55	.28	.83	.52	.91
S04	.62	.26	.76	.76		.82		.67
S102	.76	.78	.85	.82	.62	.60	.72	.90
Na								
K	.43		.59		.67	.83	.72	.78
TOTAL PHOS.	-.46	-.30		-.33				
NITRATE-NITRITE	.43	.21			-.25	.58		.84
NH3								.61
CU		-.34			-.27	-.38		-.73
ZN								-.58
Pb								
Fe		-.22		-.26			.56	-.50
MANGANESE	-.40						.77	.71
TOTAL STNS.	-.49	-.43	-.33		-.62		.65	
FIXED STNS.	-.57	-.43	-.36		-.64		.59	-.58

	MAINSHEET HEADWATER	MAINSHEET PLATEAU	CANYON TRIB. HEADWATER	PLATE. TRIB.	CANYON TRIB. CANYON	NECHAKO RIVER	QUEENEL	THOMPSON	BRIDGE RIVER	
TURBIDITY	.51	.82	.89	.72	.87	.85	.67	.95	.69	.82
COLOUR		.62	.71	.54	.61	.72	.66	.72	.91	
pH				-.25	-.38				.83	
C1						.47		.68		
CONDUCTIVITY	-.64	-.51		-.66	-.40					
ALKALINITY	-.56	-.43		-.63	-.43					
HARDNESS	-.61	-.55		-.66	-.38					
CA	-.57	-.34		-.64	-.32					
SO4	-.53	-.52		-.54						
S102				.39	-.26			.65		
Na	-.46	-.30		-.33						
K		.30	.50		.49			.77		
TOTAL PHOS.										
NITRATE-NITRITE										
NH3	.43				.28					
CU	.71	.59	.90		.76	.71	.66		.95	
ZN		.19	.70	.31	.54					
Pb		.24	.56					.77	.53	
Fe		.79	.76	.77	.64	.83	.72	.98		
MANGANESE	.43	.75	.93	.31	.70	.71	.68	.89	.72	
TOTAL STNS.	.51	.90	.94	.76	.92			.88	.99	.58
FIXED STNS.	.47	.91	.92	.68	.87			.94	.98	.55

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	MAINSHEET HEADWATER	MAINSHEET PLATEAU	CANYON TRIB.	NECHAKO RIVER	QUEENEL	THOMPSON	BRIDGE RIVER
TURBIDITY	.40	.73	.72	.63	.49	.90	.89
COLOUR	.54	.68	.39	.71	.87	.85	.64
pH		.26	-.30				
Cl		.21		.52		.84	
CONDUCTIVITY	-.51	-.42		-.53			-.51
ALKALINITY	-.60	-.36		-.53			
HARDNESS	-.54	-.45		-.54			-.53
CA	-.53	-.24		-.59			
SO4		-.45		-.37			
S102		.48	.38	-.33		.70	.61
Na			-.22	-.26		.56	-.50
K		.44	.44	.50		.83	-.90
TOTAL PHOS.		.79	.77	.77	.64	.83	.72
NITRATE-NITRITE							
NH3							
Cl		.51	.72		.40	.77	.59
ZN		.32			.40	.36	.55
Pb		.25	.49	.28			.55
Fe							
MANGANESE	.50	.65	.73	.16	.73	.93	.83
TOTAL STNS.	.54	.80	.76	.86	.77	.94	.96
FIXED STNS.	.48	.82	.75	.81	.72	.93	.96