Fraser River Model Study :
Generation of the 1968 hydrometric data...

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FRASER RIVER MODEL STUDY

Generation of the 1968 Hydrometric Data of the Lower Fraser River, Using the 1-D Hydrodynamic Model

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SUMMARY

This report corresponds to the first section of a two-part document whose general objective is to compute the daily suspended sediment loadings in the Lower Fraser River at Port Mann, using the observed and estimated concentrations and the discharges determined by Environment Canada's One-Dimensional (1-D) Hydrodynamic model. The particular year of 1968 has been selected for this analysis because of the availability of hydrometric and sediment data.

In the following report, all the information concerning the simulation of the 1968 discharges necessary for the computation of the daily suspended sediment loadings at Port Mann is given. In order to run the 1-D model for the particular 1968 conditions, it was necessary to prepare the appropriate boundary conditions and lateral inflow, and to determine the proper physical properties of the river. The annual records of the 15 minutes water levels at Port Mann, Port Coquitlam and Mission were obtained from continuous- strip charts, and were then digitized and stored on computer files in order to produce water level boundary conditions. The annual record of the hourly hydroelectrical power produced by the Ruskin Power House were obtained from punched cards and were stored on a computer file in order to be later transformed into hourly discharge boundary conditions. Most of the lateral inflows were obtained using a correlation method which relates the ungauged runoff between Port Mann and Mission to the gauged runoff of representative sub-basins. However, a modified rational method relating the lateral inflows to the precipitation, surface area and runoff coefficient was used for situations when both heavy rainfall, arbitrarily defined as more than or equal to 1 inch per day, and low flow in the Fraser River occurred simultaneously. The Manning's roughness coefficients obtained from the initial calibration of the model (1980-1981 river conditions) for low to moderate flows (discharges at Mission lower than or equal to 199,000 cfs) have been increased by 10% in order to adjust the model to the 1968 physical conditions of the river. This adjustment of the Manning's n was needed in order to take into account the natural and man-induced variations of the river properties (roughness, shape of cross-section) that took place between the studied period (1968) and the initial period of calibration (1980-1981). The verification of the updated calibration of the Manning's n has shown that both simulated and measured hourly discharges at Mission are in very good agreement. The water levels simulated at Port Hammond and Whonock also agree very well with the measured values. The results obtained from the generation of the 1968 hydro-metric data indicate that the simulated daily flows at Mission correspond to the values obtained from the stage-discharge relationship (published values) when the flow at Mission is larger than or equal to 199,000 cfs (range where the stage-discharge relationship is valid). However, the simulated daily flows at Mission are slightly larger (January to April) or smaller (August to December) than the values obtained from the summation method (published values) when the daily flow is smaller than 199,000 cfs (range where the flow at Mission is approximated by adding the flow at Hope lagged by 24 hours plus 146% of the flow at Harrison River plus the tidal flow into and out of storage in the river channel upstream of Mission). It is also found that for most of the year, the simulated discharges at Port Mann are larger than the values obtained from the cubature method by an annual mean value of 12%, and approximately 9% during the peak flow period (May to July). The annual suspended sediment loading at Port Mann computed using the daily discharges obtained from the 1-D model should then be expected to be larger than the original loadings (published values) by approximately 9%, since most of the loading is expected to occur during the peak flow period.

1. Introduction

For many years, several federal government departments have been concerned with the problem of evaluating the total amount of sediment transported by the Fraser River and, in particular, through the reach near Port Mann (B.C.). The major difficulty in the determination of the suspended sediment loading has been that no suitable method was available to determine the river flow at this location with reliable and consistent accuracy. The discharge at Port Mann is a major factor in the sediment transport calculation, but its determination requires special treatment because of the tidal effects and flow reversals. Techniques such as the Cubature and the Power Series methods (Inland Waters Branch, 1970) and the Marine Sciences Fraser River model (Ages A. and Woollard, A., 1976) have been developed and applied, but their degree of accuracy still remain to be improved. However, a one-dimensional hydrodynamic mathematical model (1-D model) was recently applied by Environment Canada to the Lower Fraser system (Water Planning and Management Branch et al., 1983). The model was run for different days in 1980-1981, and the results were found to be in very good agreement with observed values (see discussion in Chapter 4). It can then be considered as a reliable and useful tool for the computation of the suspended sediment loadings at Port Mann, by providing a good estimate of the discharges.

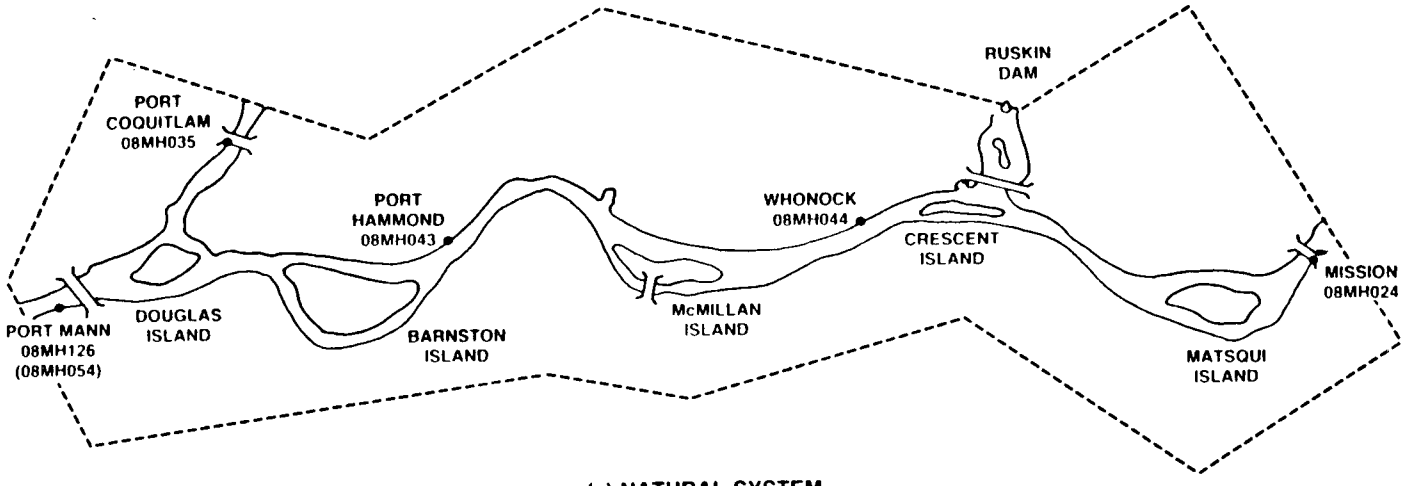
The 1-D model solves the complete one-dimensional gradually varied unsteady flow equations (Saint Venant equations) using an implicit finite difference technique. A presentation of the model is given in Water Planning and Management Branch, 1982. For the study of the Lower Fraser River, the model can be used to compute the discharges at Port Mann (08MH054/08MH126), Port Coquitlam (08MH035) and Mission (08MH024), as well as the water levels

and discharges for intermediate locations such as Port Hammond (08MH043) and Whonock (08MH044) at every 15 minutes. The Lower Fraser River natural system and computer model schematization are indicated in Figure 1.1. The river discharge is assumed to enter or leave the system at 5 different locations:

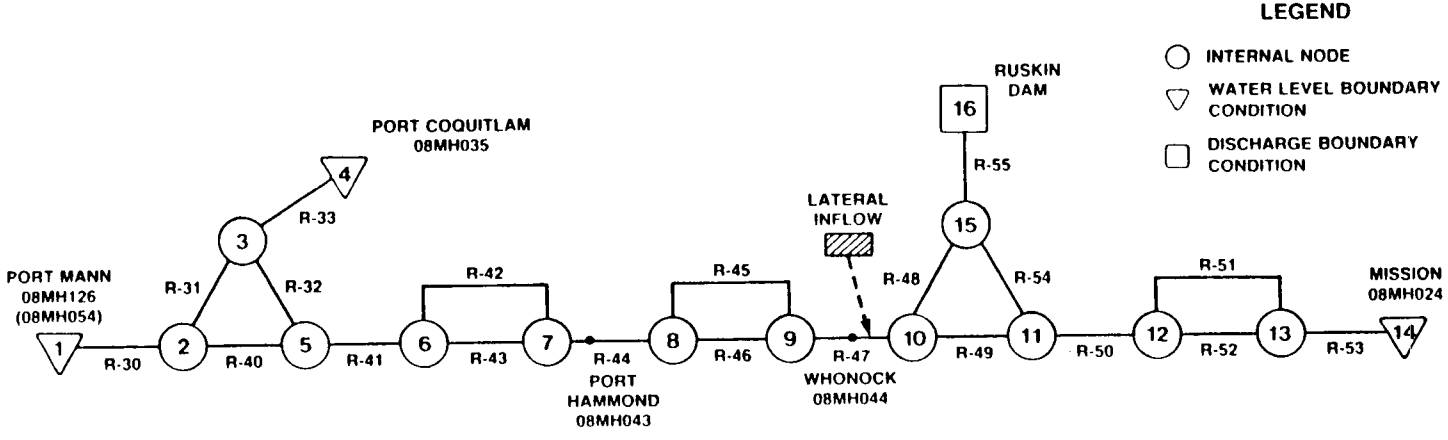
- Lower Fraser River at Mission City;
- Lower Fraser River at Port Mann;
- Pitt River at Port Coquitlam;
- Regulated flow from the Stave Lake, at the Ruskin Power House;
- Lateral inflow.

The first four locations are known as boundaries. In order to run the model for a period of time specified by the user, it is necessary to define the boundary conditions, the lateral inflows, and the physical characteristics of the river in the 1-D input file. The data preparation for every boundary and the identification of associated computer programs and files are presented in Chapter 2. The third chapter describes and discusses the methods developed for the computation of the lateral inflow and identifies the corresponding computer program and files. Chapter 4 is concerned with the calibration of physical properties of the model in order to adapt the model to the 1968 actual existing conditions. Finally, the results obtained from the simulation of the 1-D model are presented and compared to the values published by the Water Survey of Canada (Inland Waters Branch, 1968). A complete list of the computer tapes where the results of the simulations are stored, and a copy of all the computer programs required for the preparation of the 1-D model input data are given in the appendices.

Figure 1.1



(a) NATURAL SYSTEM



(b) SCHEMATIZATION

LOWER FRASER RIVER NATURAL SYSTEM AND SCHEMATIZATION

2. Boundary Conditions

In practical words, the boundary conditions are equivalent to the stimulus, or driving forces, to the model. They represent the hydraulic conditions in the outside world at the border of the model. The boundary conditions used by the model are the water levels at every 15 minute time increment at Mission, Port Mann and Port Coquitlam, and the hourly discharges released from the Ruskin Power House. These values must be defined in the input file of the 1-D model. The data preparation is described in the following sections.

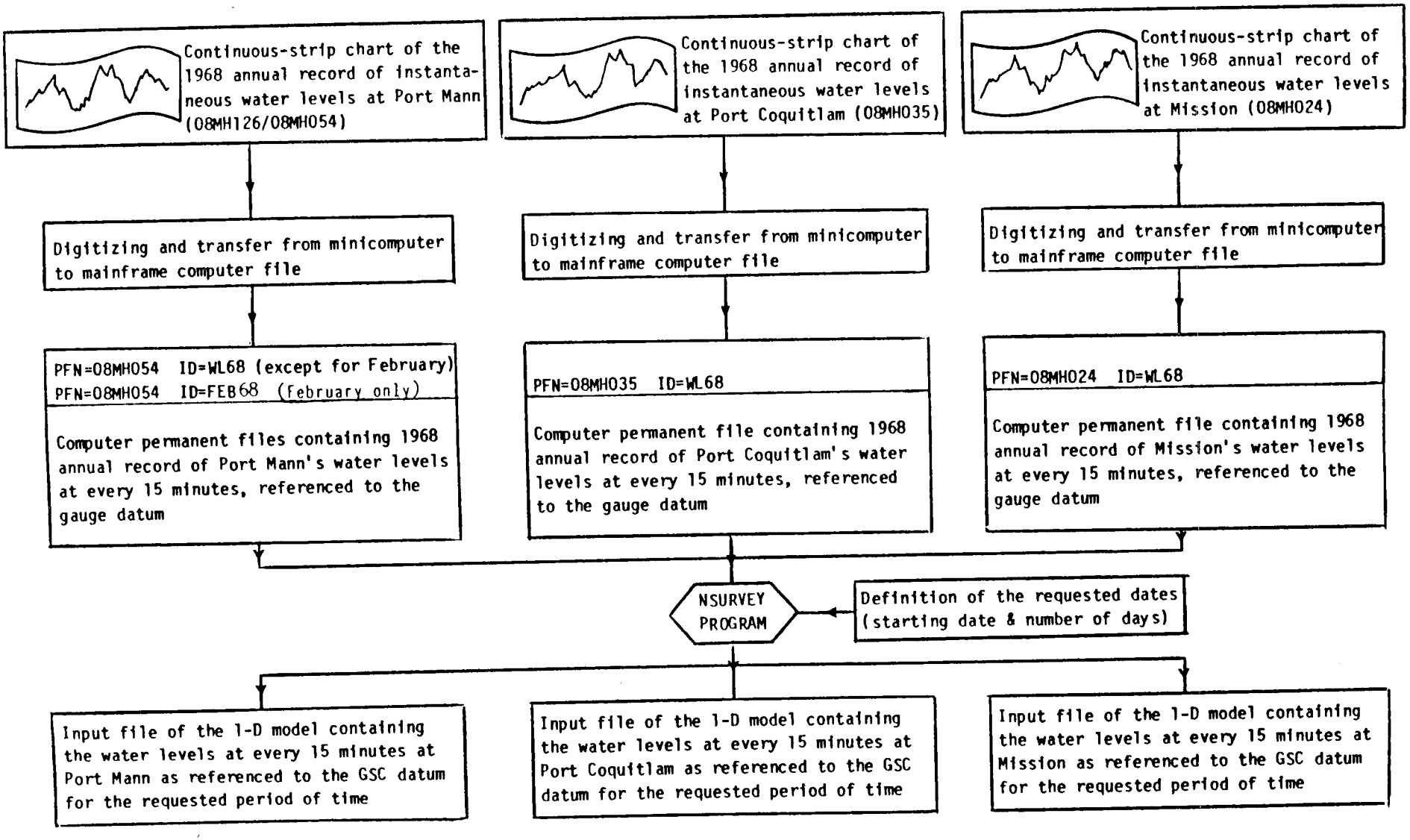
2.1 Water Levels at Port Mann, Port Coquitlam and Mission

Analog records of the 1968 water levels at Port Mann, Port Coquitlam and Mission are available from continuous-strip charts. These charts were obtained from Water Resources Branch, Pacific and Yukon Region. In ord to make these values compatible with the 1-D model, a standard digitizing procedure was used to determine the water levels at every 15 minutes from the analog records. This procedure was established by Water Resources Branch, Ottawa. The 3 resulting 1968 annual records of the 15 minute water levels are stored on 3 computer files using the standard Water Survey of Canada formats. The computer program NSURVEY is then run to extract from the annual records the 15 minute water levels corresponding to the period of time requested by the user for the simulation of the model. The proceeding steps, as well as the computer files identification, are summarized in Figure 2.1.

For each hydrometric station, the water levels recorded on the continuous-strip charts are referenced to a gauge datum. These values are normall transformed into water levels referenced to a common datum (GSC datum)

Figure 2.1

Preparation of Boundary Conditions Input Data:
Water Levels at Port Mann, Port Coquitlam and Mission



during the digitizing operation. However, for the preparation of 1968 input data, this normal procedure was inadvertently omitted such that the annual records of the 15 minute water levels stored on the computer files are expressed in terms of the gauge datum. The computer program NSURVEY was slightly modified in order to perform the conversion between gauge and GSC datum, such that the water levels stored on the input file of the 1-D model are all expressed in terms of the GSC datum.

Previous to the operation of the model, the computer files containing the annual records of the 15 minute water levels have to be checked and possibly corrected for different reasons. One reason is that most of the time, some data are missing on the continuous-strip chart. The missing water levels are represented in the annual records computer files by a dummy value (-999). In order to run the model, the missing values have to be replaced by approximations of the existing water levels. For this study, this step was carried out manually. Another important reason for the checking of the annual records computer files is that many errors can be introduced during the digitizing operation. These errors are critical because they are often very difficult to detect. A computer program, called CHECK.WL, has recently been written by Water Resources Branch, Pacific and Yukon Region, in order to locate the abnormally large changes between every 15 minute water levels. However, this program was not used in the present study because it did not meet the deadline and needed some refinement. The digitizing errors were identified by analyzing the results obtained from the simulation of the 1-D model. It was determined that two significant mistakes were made in the initial ditigizing of the water levels. The first mistake was introduced by the selection of a wrong origin for the digitizing of February's water levels at Port Mann. It affected the water

detected by comparing the simulated hourly discharges at Mission with the few available measurements. The differences of the measured values relative to the simulated discharges were found to be unacceptable (-30.2% at 13h15 on February 5; -4.7% at 8h15 on February 6; -25.5% at 8h30 and -30.5% at 15h00 on February 12). The relative differences were significantly reduced when the corrected water levels were used (-2.1%, 3.9%, -1.0% and -2.8%). The second mistake consisted of keypunching a bad reference point for July 15, resulting in errors in Port Coquitlam's water levels from July 15 to July 28. The errors were located by comparing the simulated and published daily discharges at Mission. The differences between both values were found to be much larger than 10%. These large differences could only be explained by the inaccuracy of the simulated discharges, because the precision of the published discharges is expected to be within $\pm$ 5% of the real discharges for high flows such as those occurring in July. The differences between simulated and published daily discharges felt below $\pm$ 2% when the proper water levels were used.

2.2 Regulated Discharges at the Ruskin Power House

The water flowing from the Stave Lake into the Fraser River is regulated by the Ruskin Power House. The hourly discharges at the dam are required in order to run the 1-D model. These values are not directly available, but can be determined from the standard equation:

$$P = \frac{\eta \gamma_w Q H}{737{,}550.}$$

where P = power produced by the turbines (megawatts)
η = turbine efficiency
γ_w = specific weight of the water (lb/ft^3)
Q = discharge (cfs)
H = water head (ft)

Using the specific weight value of 62.4 lb/ft^3 and replacing (H) by the average value of 94.5 ft, the equation is reduced to:

$$P \text{ (megawatts)} = \frac{Q \text{ (cfs)}}{125}$$

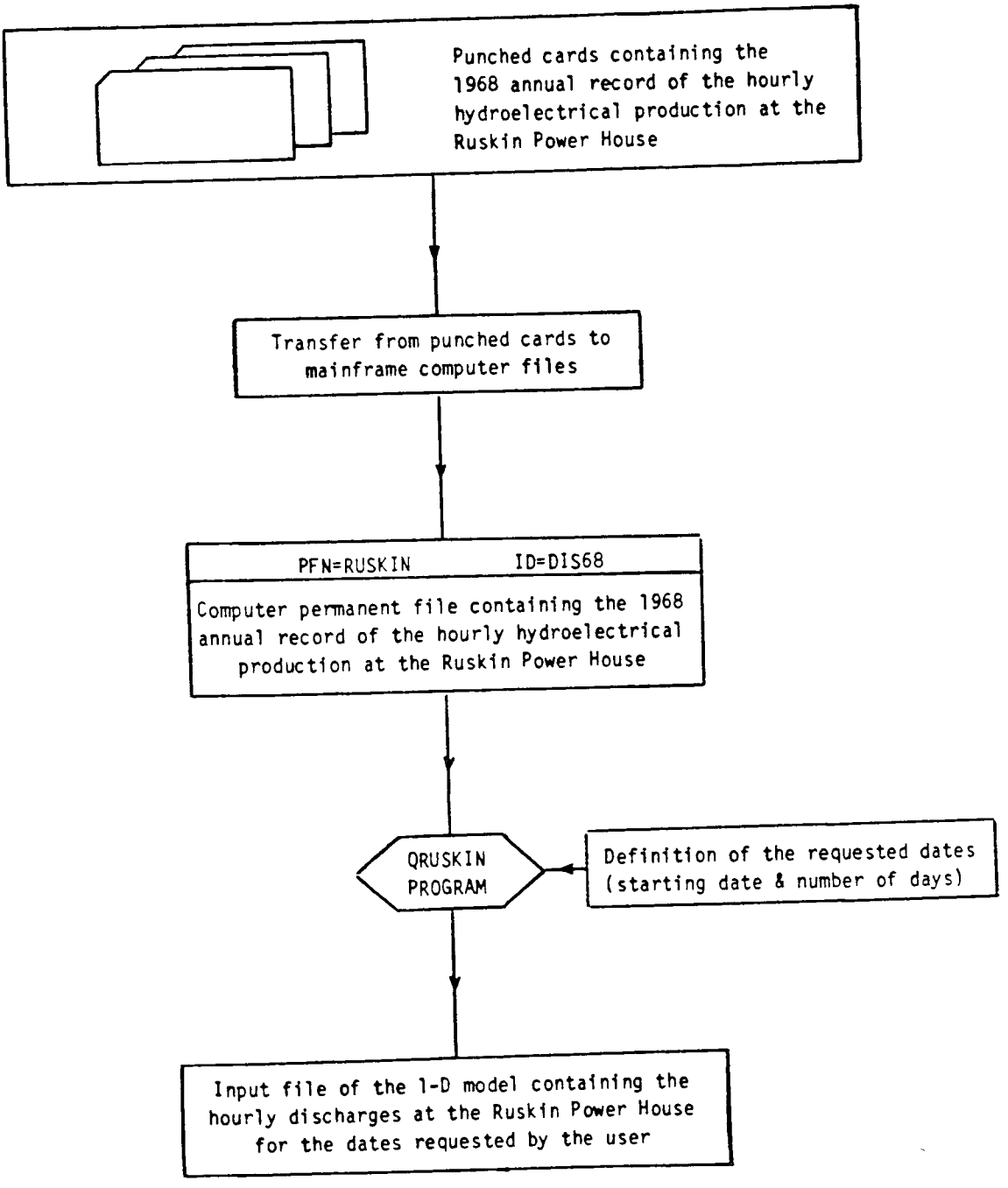
It may be noticed that the average value for the water head may change fro year to year. For instance, a value of 102.8 ft. (in other words, a denominator of 115) was used for the generation of the 1984 hydrometric data.

The electrical power produced at the dam for the year 1968 can be obtaine from B.C. Hydro. The original B.C. annual records of hourly power are placed on printed forms, and can be obtained either on a computer file or on punched cards. For the 1968 study, the values were obtained on punche cards. In order to be compatible with the 1-D model, they had to be transferred to a computer file. The computer program QRUSKIN was then us in order to convert the hourly power into discharges and prepare the inpu file of the 1-D model. The data preparation for the hourly discharges at the Ruskin Power House is summarized in Figure 2.2.

During the simulation of the model, the computations are performed at eve 15 minutes (time step). Since the boundary conditions must be defined at every time step, the model uses the hourly discharges defined in the inpu file and interpolates the intermediate 15 minute values. Because of this procedure, the simulation of the complete year requires that the annual record of data also includes the conditions of the day preceding the firs simulation day. For the study of 1968, the conditions of December 31, 19 must be defined in order to allow the model to interpolate the 15 minute discharges at the Ruskin Power House, for the time 0h00, 0h15, 0h30 and 0h45 on January 1, 1968.

Figure 2.2

Preparation of boundary conditions input data:
Ruskin Power House discharges



In order to avoid difficulties during the simulation, it is necessary to verify the annual record containing the hourly power produced at the R .n Power House. This check is necessary because different errors can be introduced during the preparation of the punched cards, such as coding errors in the station number and dates, missing cards and typing errors. A computer program would be a useful tool for this task. It would be simple to develop and inexpensive to operate. It was not developed for this particular project because of the tight schedule. The annual record computer file was checked manually. The only error detected in the original file was a missing card on June 14, 1968. The missing card was replaced by approximate values of existing conditions.

3. Lateral Inflow

The lateral inflow is a hydrological input needed for the total water balance of the system, to account for the ungauged part of the runoff from the drainage basin between Port Mann and Mission City. In the present model, it is considered as a point inflow, located approximately 18 miles upstream of Port Mann.

3.1 Data Preparation

The lateral inflow must be defined in the input file of the 1-D model. Two simplified methods are available in order to determine these values: the correlation method and a modified rational method. These methods are fully described and discussed in the following sections. For the generation of the 1968 hydrometric data, the correlation method was applied when both the climatic conditions consisted of low to moderate precipitation (less than or equal to 1 inch/day) and the estimated lateral inflow was small compared to the flow at Mission (less than 25%). A modified rational method was applied for the other cases, mainly because the accuracy of the correlation method decreases as the lateral inflow increases. Once the daily lateral inflows are estimated, the annual record is placed on a computer file. The computer program FUSION can then be used to merge this file with another computer file containing a list of the dates for the year studied. The computer file produced by this program contains the complete annual record of the daily lateral inflows and dates. It may be noticed at this point that the preceeding steps can be performed in any other way, as long as the resulting computer file contains the annual record of the daily lateral inflows and dates. When this file is completed, the computer program RUNOFF can be run in order to determine the lateral inflow at every 12 hours for the dates requested by the user, and to put these values in the

input file of the 1-D model. The procedure and files identification are summarized in Figure 3.1.

The daily lateral inflows included in the annual record computer file are assumed to represent the values at noon. Since the lateral inflows in the 1-D input file are required at every 12 hours, the program RUNOFF interpolates the values for the times 0h00 and 24h00. Because of this interpolation procedure, the simulation for the complete year requires that the user also include in the annual record computer file the lateral inflow for the day preceeding the first day to be simulated (December 31, 1967) and for the day following the last day to be run (January 1, 1969).

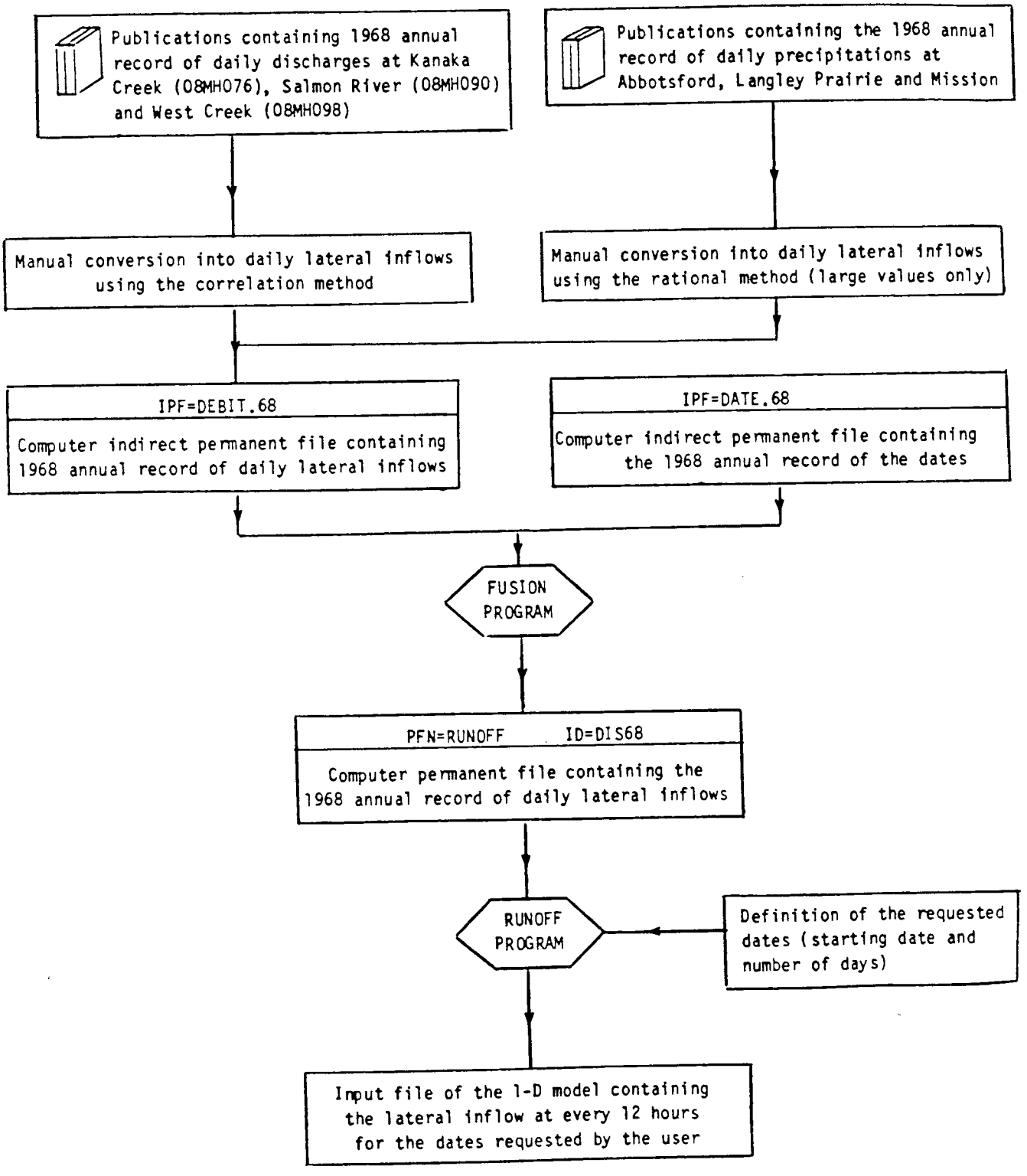
3.2 Determination of the Surface Area of the Ungauged Sub-Basin

In normal conditions, it can be assumed that the runoff over any basin is proportional to its surface area. In order to determine the lateral flow of the Lower Fraser River system, it is necessary to evaluate the surface area that contributes to the ungauged runoff between Port Mann and Mission City. It can be assumed that the drainage basin area of the Lower Fraser River at Port Mann, A_{TOT}, is divided into three main sub-basin areas, namely the Pitt River sub-basin at Port Coquitlam A_1, the Lower Fraser River sub-basin at Mission City A_2, and the Lower Fraser River sub-basin between Port Mann and Mission City A_3. The Lower Fraser River sub-basin between Port Mann and Mission City can be further subdivided into two parts, namely the Stave Lake sub-basin regulated by the Ruskin Power House A_{31}, and the remaining part of the sub-basin called the ungauged sub-basin between Port Mann and Mission City A_{32}. The sub-basins relationship can then be expressed by the following equation:

$$A_{TOT} = A_1 + A_2 + A_3 = A_1 + A_2 + (A_{31} + A_{32})$$

Figure 3.1

Preparation of the lateral inflow



From the Reference Index of the Surface Water Data published by Water Survey of Canada (Water Resources Branch, 1983), it is found that:

- Port Mann (08MH126): A_{TOT} = 89,575 mi^2 (232,000 km^2)
- Port Coquitlam (08MH035): A_1 = 633 mi^2 (1,640 km^2)
- Mission City (08MH024): A_2 = 88,031 mi^2 (228,000 km^2)
- Stave Lake (08MH011): A_{31} = 440 mi^2 (1,140 km^2)

Applying the sub-basin relationship, the so-called ungauged sub-basin area between Port Mann and Mission City is equal to:

A_{32} = 471 mi^2 (1,220 km^2)

Using the ungauged sub-basin area, two different methods are developed in order to evaluate the lateral inflow.

3.3 Correlation Method

3.3.1 Definition

In hydrologic projects, it is common practice to determine the runoff of an ungauged basin (or sub-basin) by correlating this basin with surrounding representative gauged basins. A simple correlation relationship for the estimation of the runoff of an ungauged basin is:

$$q_L = \frac{A}{m} \sum_{i=1}^{m} \frac{q_i}{a_i}$$

where: q_L = estimated runoff of the ungauged basin

A = surface area of the ungauged basin

m = number of gauged basins that are representative of the ungauged basin

q_i = runoff of the ith gauged basin

a_i = surface area of the ith gauged basin

The term $\frac{1}{m}\sum_{i=1}^{m}(q_i/a_i)$ can be understood as a mean runoff per unit surface area. It implies an equal representativeness for each gauged basin (non-weighed method).

Three gauged basins were selected as representative of the ungauged sub-basin of the Lower Fraser River between Port Mann and Mission City:

- Kanaka Creek near Webster Corners (08MH076): a_1=18.42 mi^2 (47.7 km^2);
- Salmon River at 72 Avenue, Langley (08MH090): a_2=18.92 mi^2(49 km^2);
- West Creek near Fort Langley (08MH098): a_3=4.40 mi^2(11.4 km^2).

When the operational aspect is considered, it may be found that data from one or even two stations is sporadically missing. Thus, a number of equations must be determined and used according to the available data (operating stations). Applying the general correlation relationship to different situations, the following equations can be obtained:

- When Kanaka Creek, Salmon River and West Creek data are available:

$$q_L = \frac{1,220}{3}\left(\frac{q_1}{47.7} + \frac{q_2}{49.0} + \frac{q_3}{11.4}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

- When only Kanaka Creek and Salmon River data are available:

$$q_L = \frac{1,220}{2}\left(\frac{q_1}{47.7} + \frac{q_2}{49.0}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

- When only Kanaka Creek data are available:

$$q_L = 1,220\left(\frac{q_1}{47.7}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

where: q_L = runoff of the ungauged sub-basin (lateral inflow)

q_1 = runoff of the Kanaka Creek

q_2 = runoff of the Salmon River

q_3 = runoff of the West Creek

(note that the units of q_L are identical to the units of q_1, q_2 and q_3).

As an example, the following discharges were observed on December 10, 1968:

Kanaka Creek: 215 cfs (6.09 m^3/s)

Salmon River: 232 cfs (6.57 m^3/s)

West Creek : no data

Then the lateral inflow can be computed from equation 3.2: q_L=5,638 cfs (159.7 m^3/s). A second estimation can be made using equation 3.3: q_L=5,499 cfs (155.8 m^3/s). Both values are very close. However, the first one should be considered slightly more accurate because data from two representative stations have been used in the calculation of the runoff.

3.3.2 Verification

It is possible to evaluate the accuracy of the correlation method by studying its ability to reproduce a volume of water equivalent to the volu resulting from the total precipitations over the ungauged sub-basin. Table 3.1 presents typical values. These results correspond to the month of October 1968. Kanaka Creek Station data and equation 3.3 were used to estimate the lateral inflow. The daily rainfall was determined by averag daily measurements (Meteorological Branch, 1968) taken at 3 representati meteorological stations located in the vicinity of the ungauged sub-basi (Abbotsford A., Langley Prairie, Mission). The monthly volume resulting from the total precipitation ($10.8 \cdot 10^9$ ft^3) is in good agreement with the volume determined from the lateral inflow ($9.0 \cdot 10^9$ ft^3). The small difference between both values can be regarded to be in the o of a base flow (equivalent daily discharge of 672 cfs). The weekly vo

Table 3.1

Comparison of Equivalent Volumes of Water for October, 1968

Day	q_1 (cfs)	q_L (cfs)	Equivalent Water Volume ($10^6 ft^3$)	Weekly Cumulative Volume ($10^6 ft^3$)	Monthly Cumulative Volume ($10^6 ft^3$)	I_A (in/day)	I_L (in/day)	I_M (in/day)	I (in/day)	Equivalent Water Volume ($10^6 ft^3$)	Weekly Cumulative Volume ($10^6 ft^3$)	Monthly Cumulative Volume ($10^6 ft^3$)
1	24.	614.	53.	53.	53.	0.00	0.00	0.00	0.00	0.	0.	0.
2	22.	562.	49.	102.	102.	0.00	0.00	0.00	0.00	0.	0.	0.
3	21.	541.	47.	149.	149.	0.00	0.23	0.17	0.13	146.	146.	146.
4	42.	1066.	92.	241.	241.	0.17	0.03	0.02	0.07	80.	226.	226.
5	49.	1246.	108.	348.	348.	0.61	0.48	0.74	0.61	668.	894.	894.
6	195.	4986.	431.	779.	779.	0.26	0.04	0.25	0.18	201.	1094.	1094.
7	172.	4399.	380.	1159.	1159.	0.99	0.00	0.15	0.38	416.	1510.	1510.
8	105.	2683.	232.	232.	1391.	0.00	0.00	0.00	0.00	0.	0.	1510.
9	89.	2267.	196.	428.	1587.	0.54	0.60	0.57	0.57	624.	624.	2134.
10	163.	4173.	361.	788.	1947.	0.62	0.32	0.46	0.47	511.	1134.	2645.
11	228.	5835.	504.	1292.	2451.	0.47	0.37	0.49	0.44	485.	1620.	3130.
12	215.	5500.	475.	1768.	2927.	0.24	0.33	0.28	0.28	310.	1930.	3440.
13	293.	7497.	648.	2415.	3574.	0.12	0.06	0.06	0.08	88.	2017.	3527.
14	172.	4399.	380.	2795.	3954.	0.01	0.20	0.27	0.16	175.	2192.	3702.
15	156.	3993.	345.	345.	4299.	0.25	0.00	0.01	0.09	95.	95.	3797.
16	107.	2737.	236.	581.	4536.	0.00	0.01	0.01	0.01	7.	102.	3805.
17	139.	3559.	307.	889.	4843.	0.66	0.69	0.79	0.71	781.	883.	4585.
18	152.	3884.	336.	1224.	5179.	0.00	0.31	0.25	0.19	204.	1087.	4789.
19	198.	5067.	438.	1662.	5617.	1.12	0.89	0.84	0.95	1040.	2127.	5829.
20	238.	6088.	526.	2188.	6143.	0.17	0.00	0.13	0.10	109.	2236.	5938.
21	191.	4886.	422.	2610.	6565.	0.39	0.57	0.54	0.50	547.	2783.	6486.
22	230.	5880.	508.	508.	7073.	0.01	0.17	0.07	0.08	91.	91.	6577.
23	200.	5112.	442.	950.	7515.	0.47	1.45	0.55	0.82	901.	992.	7478.
24	410.	10477.	905.	1855.	8420.	0.12	0.30	0.21	0.21	230.	1222.	7708.
25	200.	5112.	442.	2297.	8862.	0.19	0.00	0.01	0.07	73.	1295.	7781.
26	136.	3477.	300.	2597.	9162.	0.00	0.00	0.00	0.00	0.	1295.	7781.
27	92.	2357.	204.	2801.	9366.	0.00	0.07	0.00	0.02	26.	1320.	7806.
28	99.	2538.	219.	3020.	9585.	0.32	0.60	0.53	0.48	529.	1849.	8335.
29	154.	3938.	340.	340.	9925.	0.19	0.19	0.10	0.16	175.	175.	8510.
30	198.	5067.	438.	778.	10363.	0.55	0.40	0.47	0.47	518.	693.	9028.
31	210.	5374.	464.	1242.	10827.	0.00	0.00	0.00	0.00	0.	693.	9028.

where: q_1 = published daily discharge at Kanaka Creek (08MH076)

q_L = daily lateral inflow estimated from equation 3.3

I_A = daily rainfall recorded at Abbotsford A. station

I_L = daily rainfall recorded at Langley Prairie station

I_M = daily rainfall recorded at Mission station

I = mean daily rainfall = $(I_A+I_L+I_M)/3$

Equivalent Water Volume = (86,400 · q_L(cfs)) and (896,971 · 1220 (km^2) · I(in/day))

also compare reasonably well, although larger differences are to be expected when such small time periods are considered.

3.3.3 Limitation

It can be assumed that the degree of accuracy for the estimation of the ungauged runoff (lateral inflow) increases with the number of representative stations used. In other words, equation 3.1 should be used when the complete data records are available for all 3 stations. For the 1968 data generation project, it was found that most of the time, the only runoff data available was for Kanaka Creek Station (except for November and December, where Salmon River data were also available), and equation 3.3 had to be used.

Generally, an error on the estimation of the lateral inflow is not very significant on the overall results produced by the 1-D model, because q_L is often very small compared to the total Lower Fraser River discharge. However, the analysis of some results obtained for 1968 showed that the lateral inflow computed from the correlation equation 3.3 can be found to be of the same order than the river discharge, for periods where low flow in the river and heavy rainfall occur simultaneously. For instance, on January 19, 1968, the recorded rainfall was 2.24 inches; the estimated lateral inflow is 62,142 cfs (using the published value of q_1=2,430 cfs in equation 3.3) and the published discharge at Mission is 76,300 cfs. In this case, the accuracy of the estimated lateral inflow has to be very good because both values are of the same order. A water volume comparison was done for the period of January 15-21, 1968 (see Table 3.2). It revealed that the volume of water obtained from the correlation method ($14.1 \cdot 10^9$ ft^3) was much larger than the volume resulting from the

Table 3.2

Comparison of Equivalent Volumes of Water, January 15-21, 1968

Day	q_I (cfs)	q_L (cfs)	Equivalent Water Volume ($10^6 ft^3$)	Weekly Cumulative Volume ($10^6 ft^3$)	I_A (in/day)	I_L (in/day)	I_M (in/day)	I (in/day)	Equivalent Water Volume ($10^6 ft^3$)	Weekly Cumulative Volume ($10^6 ft^3$)
15	281.	7190.	621.	621.	0.33	0.23	0.21	0.26	281.	281.
16	188.	4805.	415.	1036.	0.38	0.23	0.44	0.35	383.	664.
17	121.	3098.	268.	1304.	0.01	0.20	0.15	0.12	131.	795.
18	344.	8797.	760.	2064.	1.89	4.65	3.84	3.46	3786.	4581.
19	2430.	62142.	5369.	7433.	3.08	2.01	1.63	2.24	2451.	7033.
20	2250.	57536.	4971.	12404.	0.88	0.50	0.36	0.58	635.	7667.
21	770.	19690.	1701.	14105.	0.00	0.00	0.00	0.00	0.	7667.

All the variables are defined in Table 3.1

total rainfall ($7.7 \cdot 10^9$ ft^3). The snow melt could not explain the large difference between the two water volumes, because this would require the melting in 5 days of approximately 5.5 ft of snow in a region of province where the snow cover is practically non-existent. It seems more reasonable to believe that the difference between the water volumes simply indicates some limitations of the correlation method. In other words, the correlation method could fail to estimate reasonably well the large values of runoff. The last interpretation would be consistent with the fact that the accuracy of the gauged (published) discharges used as the known variables in the correlation equations (q_1, q_2, q_3) decreases as the discharges increase. To better understand this statement, the methodolog used to determine the published discharges must be shortly discussed. Th published daily discharges are determined from averaging a number of "instantaneous" discharges (instantaneous is to be understood as "over a short period of time", as opposed to daily mean). The instantaneous discharges are obtained from a stage-discharge (Q-h) curve, using t measured instantaneous stages as the input values. The Q-h curve is originally built using a series of measured instantaneous stage-discharg values. When it comes to very high stages such as those occuring during heavy rainfalls, few measurements are available on the Q-h curve, and extrapolation is used in order to determine the corresponding instantane discharges. Errors on the extrapolation of the large instantaneous discharges will then reflect on the evaluation of the sub-basin daily discharge, which in turn will lead to an error in the estimation of the lateral inflow of the ungauged sub-basin. As an illustration, the published daily discharge for Kanaka Creek station for December 14, 197 is equal to 3,044 cfs. The lateral inflow estimated from equation (3.3 would be 77,855 cfs. The maximum instantaneous measured stage-discharg

value that appears on the Q-h curve corresponds to 2,649 cfs. Since the basin is relatively small, it seems likely to affirm that instantaneous discharges have significantly exceeded the daily discharge during that day (in fact, the maximum instantaneous discharge for that day was estimated from the Q-h curve to be equal to 5,156 cfs). Because of the error on the extrapolated large instantaneous discharges, the accuracy of the daily discharge is questionable, and the estimation for the lateral inflow doubtful.

The preceeding discussion clearly indicates that the correlation method is not adequate for the estimation of the lateral inflow in the situation where both heavy rainfall and low flow in the Lower Fraser River occur simultaneously. A method for the computation of the large lateral inflows is presented in the next section.

3.4 Modified Rational Method

As mentioned earlier, the accuracy of the correlation method is expected to decrease for the situation where both heavy rainfall and low flow in the Lower Fraser River occur simultaneously (large runoff). It is beyond the scope of this project to develop a new sophisticated method. An approximate method based on the rational formula is developed according to basic hydrologic principles in order to determine the lateral inflow for this particular situation.

The method is based on two major assumptions. It is first assumed that the shape of the time distribution of the lateral inflows obtained from the correlation method (percentage per day), represents reasonably well the real distribution. It is also assumed that the volume of water equivalent

to the lateral inflow over a period of time is equal to the volume resulting from the precipitation over the sub-basin during the same time period ($Q\ \Delta t=[CIA]\Delta t$). In order to have the last assumption to be true, it is necessary to consider large flows (such that the base-flow is small compared to the runoff) and reasonably long time period relative to the size of the basin (longer than the concentration time of the basin).

The large lateral inflows can be determined according to the following procedure. In the first step, the time distribution of the lateral inflow must be determined. An approximation of the daily lateral inflows $(q_L)_i$ is done using one of the equations developed by the correlation method. The number of days "j" over which the large flow conditions prevail is also determined by the user. The lateral inflows are then added for the complete time period, "$\sum_{i=1}^{j} (q_L)_i$". The distribution of the flow (in percentage) is then determined as the ratio of the daily over the total lateral inflow, "$d_i=(q_L)_i \,/\, \sum_{i=1}^{j} (q_L)_i$". Once the lateral inflow distribution is determined, the second step consists of evaluating the real volume of water resulting from the rainfall over the ungauged sub-basin. The daily rainfall "I_i" is estimated from averaging the measurements taken at three representative meteorological stations (Abbotsford A, Langley Prairie and Mission). The daily precipitations are added in order to determine the precipitation for the total time period considered, "$\sum_{i=1}^{j} I_i$". The equivalent volume of water over the ungauged sub-basin area is estimated from the rational method "$V_{TOT}=C(\sum_{i=1}^{j} I_i)A$", where C corresponds to a mean runoff coefficient (here, $C \sim 0.8$) and A is the surface area of the ungau sub-basin ($1.3132 \cdot 10^{10}$ ft^2 or 1,220 km^2). In the third step, the new estimation of the daily lateral inflow is determined from the daily distribution of the total volume of water "$(q_L)_i = V_{TOT}d_i/86,400$". The procedure is illustrated by an example in Table 3.3.

Table 3.3

Determination of Lateral Inflow by the Rational Method

	Jan 18/68	Jan 19/68	Jan 20/68	Jan 21/68	Jan 22/68
Kanaka C. runoff (cfs): $(q_1)_i$	344	2430	2250	770	317
Correlated runoff (cfs): $(q_L)_i = 1220(q_1)_i/47.7$	8797	62142	57536	19690	8111
Runoff distribution (%): $d_i = \frac{(q_L)_i \times 100}{\sum_{i=1}^{j} (q_L)_i}$	5	40	37	13	5
Rainfall (in/Day): I_i	3.46	2.24	0.58	0.00	0.01
Adjusted runoff (cfs) $(q_L)_i = \frac{d_i V_{TOT}}{86400}$	3187	25493	23581	8285	3187

$j=5$

$\sum_{i=1}^{j} (q_L)_i = 156276$ cfs

$\sum_{i=1}^{j} d_i = 100\%$

$\sum_{i=1}^{j} I_i = 6.29$ in

$V_{TOT} = 5.5.10^9$ ft^3

$\sum_{i=1}^{j} (q_L)_i = 63733$ cfs

The rational method should be regarded only as an approximate method, the results being at the best of the order of the real solution. It was developed only to slightly improve the estimation of the daily lateral inflow in situations where the correlation method lead to unrealistic values. One of its weaknesses is that it may fail to reproduce the right peak (instantaneous runoff). The method also gives no indication about the base flow in the ungauged system.

The difficulty caused by the relatively large lateral inflows (large relative to the Lower Fraser River discharge) did not only occur for this project, but also during the generation of the 1984 hydrometric data. The accuracy of the results obtained from the application of the 1-D model could certainly be improved if the large lateral inflows were better estimated. This points out the need for the development of a new method to handle the situation of large lateral inflow, or of a general method that could be used to compute all small, moderate and large lateral inflows.

4. Calibration of the 1-D model to 1968 Conditions

As mentioned earler, it is necessary to describe the physical properties of the river in the input file of the 1-D model in order to simulate the system. This description consists basically of two things:

- the shape of every cross-section and their position one relative to the other;
- the flow-resistance properties of every cross-section (in this case, the Manning's roughness coefficient).

The available data describing the physical properties of the Lower Fraser River correspond to those obtained from the original calibration of the model, and represent the 1980-1981 conditions (see Water Planning and Management Branch, 1983). However, because a river such as the Lower Fraser River is experiencing natural and man-induced changes in time (such as erosion, deposition, bank slumping and dredging), variations of the cross-sections data and Manning's n over the years are to be expected. As it will be demonstrated in Section 4.3, it appears that all the changes that took place between 1968 and 1980-1981 can be taken into account by increasing by 10% the Manning's n obtained for low to moderate flow conditions in the original calibration ($n_{i,L}$). In order to understand the development that led to this calibration method, the results of the original calibration of the model will be shortly presented. The adjustment methods used for the 1983 and 1984 hydrometric data generation will then be discussed. Finally, the calibration of the Manning's roughness coefficients to the 1968 conditions will be demonstrated and verified.

4.1 Original Calibration of the Model (1980-1981 Conditions)

4.1.1 Definition

The original calibration of the model was performed using 1980-1981 water data. The complete method and results are presented in Water Planning and Management Branch, 1983. The cross-section data were obtained from surveys taken over different years, and were adjusted to the actual 1980-1981 conditions by either raising or lowering the cross-sections such that they matched with updated surveys.

The second step consisted of the determination of the Manning's roughness coefficients for the whole system. It is well known that the flow-resistance properties of an open channel (in this case the Manning's n) are likely to vary with water depth, location along the channel and flow characteristics. The major physical factors generally recognized to influence the flow-resistance properties include: vegetation, cross-section shape and irregularities, channel meandering, size and shape of the material forming the bed, flood plain conditions, and the presence of obstructions such as bridge piers, ice and log cover or jams. For a river bed composed of erodible granular material such as the Lower Fraser River, the Manning roughness coefficients can also be affected by the flow induced conditions because they control the bed load, suspended material and the geometric configuration of the bed surface (flat bed, ripple patterns, dunes and antidunes). Physical observations have confirmed that for different flow regimes, dunes were formed, progressed downstream or were washed out of the Fraser system. Quantitative methods or equations have not yet been established to accurately compute the Manning's roughness coefficients in the Lower Fraser River in relation to all three variables (depth, location and flow conditions). One alternative solution was to determine the

Manning's n using a calibration technique. With this method, approximative coefficients of roughness are first estimated by the user and are defined in the data input. The model is then successively run and the Manning's n are adjusted by trial-and- error according to the comparison between observed and simulated discharges and water levels along the river system. This technique was used during the original calibration of the model.

4.1.2 Results

The general results of the original calibration indicate that for daily flow conditions at Mission, less than 199 500 cfs, the Manning's n does not seem to vary with depth or flow conditions, the only significant variable being the location along the channel. Those values, expressed as $n_{i,L}$ (Manning's n in reach i, for Low to moderate flow conditions), are given in Table 4.1. However, for high flow conditions such as a daily flow of 303,700 cfs at Mission, it seems that the bottom changes are more significant and increase the Manning's n by approximately 10%. These values, expressed as $n_{i,H}$ (Manning's n in reach i, for High flow conditions), are given as well in Table 4.1.

The calibration of 1980-1981 demonstrated that the model can reproduce very well the natural hydrometric conditions. The standard errors of the water levels at Port Hammond and Whonock were below 0.32 ft. During the high and low tides, the simulated discharges at Port Mann, Port Coquitlam and Mission were found to be within $\pm$6% of the values measured by the moving-boat technique, and were very close to the Water Survey of Canada's standard of $\pm$5%. The accuracy of the simulated discharges slightly decreased during the flow transition (from high to low tide and vice-versa), but still compared reasonably well with the measurements.

Table 4.1

Original Calibration of Manning's Roughness Coefficients

Reach i	Manning's roughness coefficients		
	$n_{i,L}$	$n_{i,H}$	$K_i = n_{i,H}/n_{i,L}$
30	0.0245	0.0270	1.1020
31	0.0315	0.0347	1.1016
32	0.0315	0.0347	1.1016
33	0.0365	0.0365	1.0000
40	0.0245	0.0270	1.1020
41	0.0245	0.0270	1.1020
42	0.0245	0.0270	1.1020
43	0.0245	0.0270	1.1020
44	0.0285	0.0314	1.1018
45	0.0275	0.0303	1.1018
46	0.0275	0.0303	1.1018
47	0.0255	0.0281	1.1020
48	0.0255	0.0281	1.1020
49	0.0255	0.0281	1.1020
50	0.0255	0.0281	1.1020
51	0.0245	0.0270	1.1020
52	0.0245	0.0270	1.1020
53	0.0245	0.0270	1.1020
54	0.0255	0.0281	1.1020
55	0.0245	0.0303	1.2367

where: $n_{i,L}$ = calibrated Manning's n for reach i for low to moderate flow conditions (when the observed daily discharge at Mission is lower than or equal to 199,500 cfs).

$n_{i,H}$ = calibrated Manning's n for reach i for high flow conditions (when the observed daily discharge at Mission is equal to 303,700 cfs).

The results obtained from this calibration can lead to a slight over-estimation of the simulated daily discharge at Mission as compared to the measurements obtained from the moving-boat technique (by approximately 5%). On the other hand, the simulated daily discharge at Port Mann can be slightly under-estimated as compared to the observed value (also by approximately 5%). The tendency of the model to diverge from the observed values by +5% at Mission and -5% at Port Mann could probably be corrected by having more precise methods in order to determine the variable Manning's roughness coefficients.

4.2 Operation of the Model for the Generation of 1983 and 1984 Hydrometric Data

When the application of the 1-D model to the generation of annual records of hydrometric data is considered, many questions are raised. The original calibration has shown that over a critical daily discharge at Mission ($Q_{53,L}$), the Manning's roughness coefficients seem to vary according to the flow conditions. Since the model has to be run for different flow conditions during the simulation of annual records, it is essential to know how these coefficients vary. Also, when the simulation of years other than 1980-1981 is considered, temporal changes that took place in the cross-sections shape and in the Manning's roughness coefficients have to be evaluated. A standard procedure developed to operate the model for any period of time is to use the cross-sections data corresponding to the 1980-1981 river characteristics and to adjust or calibrate the Manning's coefficients in order to take into account both the particular flow conditions and the changes that occurred to the cross-sections. In the following sections, three different approximative methods developed for the Manning's n adjustment are presented. Although these methods could not be applied to the particular study of 1968, they are briefly presented for the

sake of completeness because they lead to the final solution.

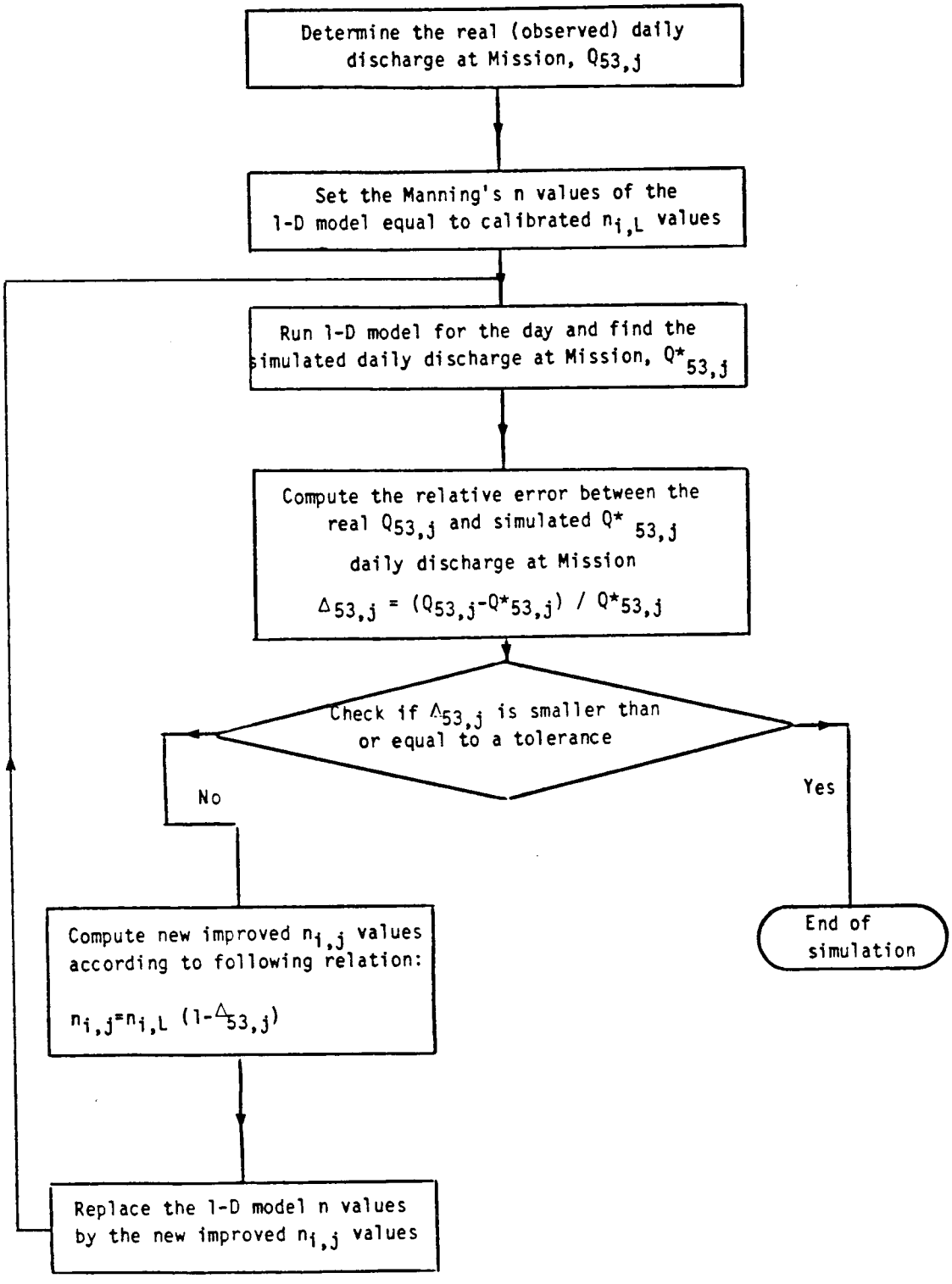
The first method takes advantage of the fact that in the Lower Fraser River system, the water levels at the extremeties are considered as the boundary conditions. This means that for fixed elevations at these points, the discharge in the river varies approximately as the inverse of the Manning's coefficients. By comparing the results of the simulation to the observed daily discharge at Mission, one can directly adjust the n values and make an improved simulation. The method is summarized in Figure 4.1. One difficulty with this method is that the observed daily discharge at Mission is required in order to compute the adjusted Manning's n. As is the case for 1968, this value is usually not known to the user, unless the tides have no effect and the stage-discharge relationship can be used. The method is also time consuming because it requires a direct operation by the user. It was successfully applied in the 1983 Data Generation Project, for the days when the daily discharge at Mission was known.

In order to solve the difficulty caused by the unknown daily discharge at Mission, a second method for the adjustment of the Manning's coefficients was developed. This method is based on three assumptions:

- Manning's roughness coefficients obtained in the initial calibration ($n_{i,L}$ and $n_{i,H}$) are reproduced in the river if the same discharges ($Q_{53,L}$ and $Q_{53,H}$) occur;
- for Mission's discharges lower than $Q_{53,L}$ (199 500 cfs), the Manning's n do not vary with discharge and are equal to $n_{i,L}$;
- Manning's n for intermediate discharges (between $Q_{53,L}$ and $Q_{53,H}$) can be interpolated (between $n_{i,L}$ and $n_{n,H}$), and values for larger discharges (greater than $Q_{53,H}$) can be extrapolated.

Figure 4.1

First Method for the Adjustment of the Mannings' Coefficients
(the observed daily discharge at Mission has to be known)



The method is summarized in Figure 4.2. This method can also be used if the observed daily discharge at Mission is known. The method was successfully applied to the 1983 Data Generation Project, and it gav results equivalent to the first method. However, the accuracy of this method is expected to decrease if it is applied for years such as 1968, where the cross-sections of the river may have significantly changed from those used in the original calibration. The method also has the disadvantage of being time consuming because it requires an additional intervention of the user.

A third method was developed in order to allow the model to compute the adjusted Manning's coefficients with no direct intervention of the user. The method is presented in Figure 4.3. It was successfully applied duri the 1984 Data Generation Project. The assumptions used are identical to those set for the second method. Therefore, this method may also not be relevant for the 1968 Data Generation Project.

In order to determine whether or not the second and third adjustment methods are appropriate for 1968, it is necessary to determine the approximate variation in the cross-sections between 1968 and 1980-1981. do that, the 1-D model can be run for a series of days of low to moderat flow in 1968 using the cross-sections defined in the original calibratic and the Manning's n obtained for low to moderate flow conditions ($n_{i,L}$). Although the observed daily discharge at Mission may not be known, the simulated hourly discharges at this location can be compared to the available discharges measured in the field.

Figure 4.2

Second Method for the Adjustment of Manning's Coefficients
(the observed daily discharges at Mission may not be known)

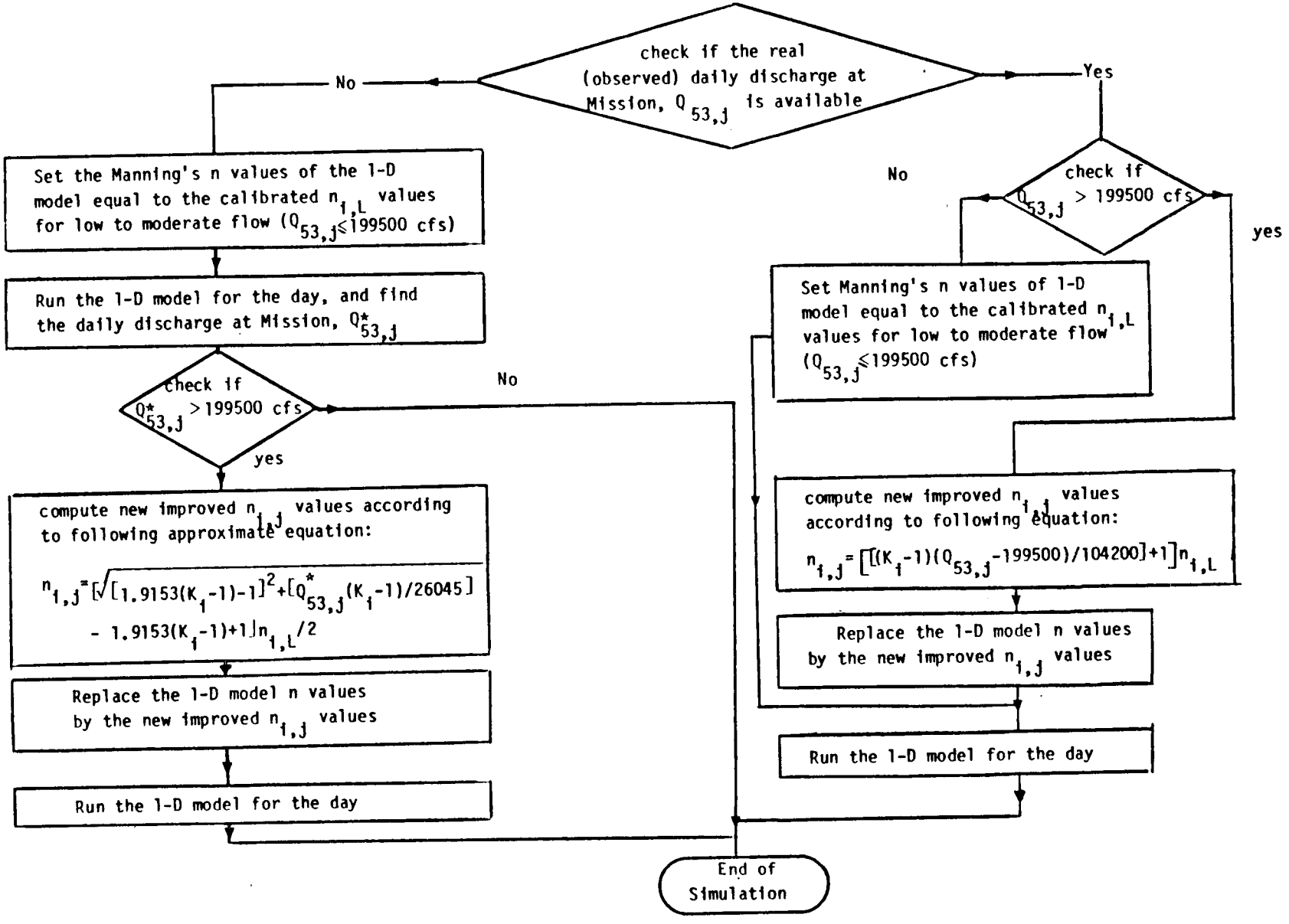
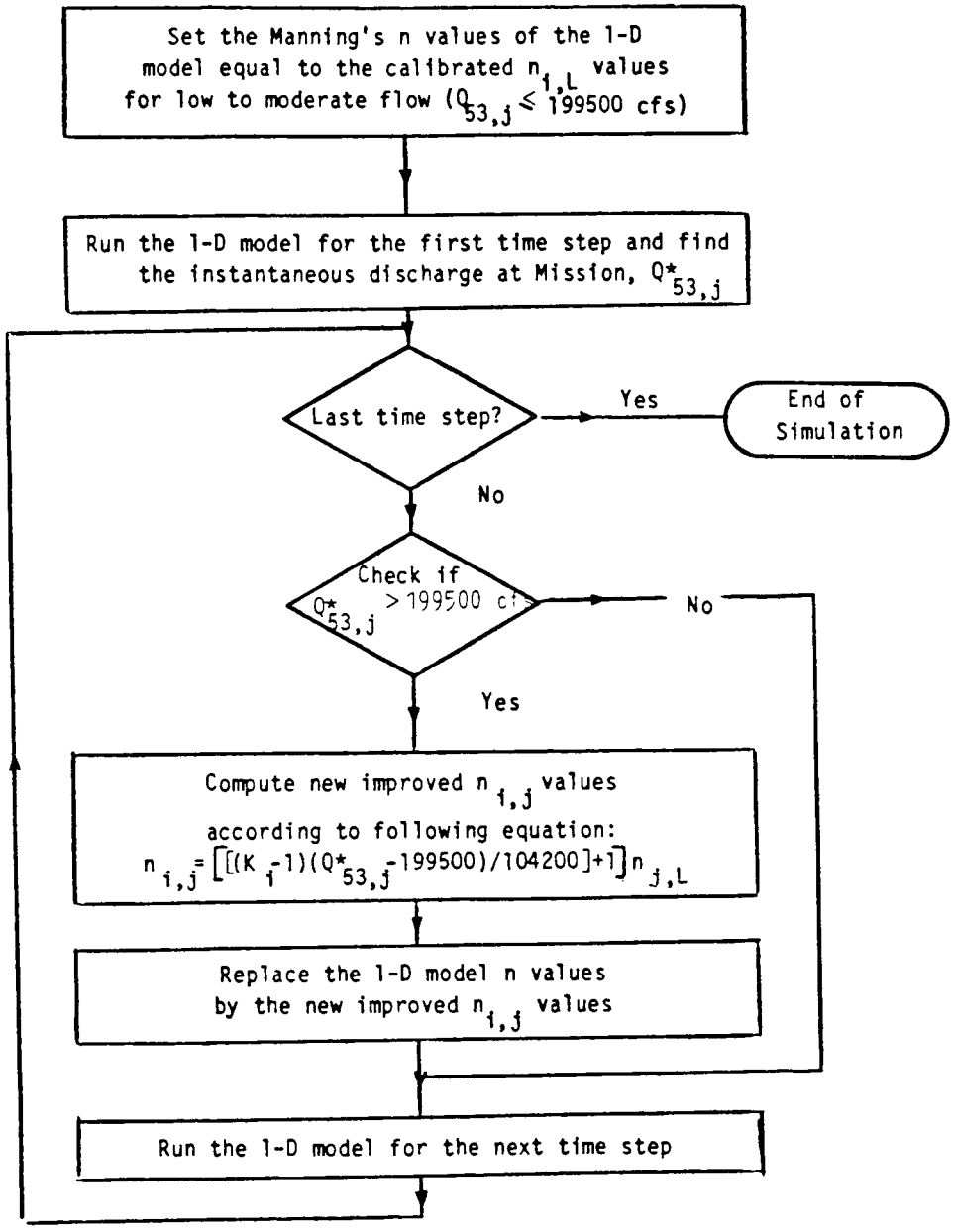


Figure 4.3

Third Method for the Adjustment of the Manning's Coefficients



This comparison is shown in Table 4.2, for three different days. Two sets of observations are available for each day. The table presents the time when the mesurement took place, the observed (measured) hourly discharge (hourly because a measurement takes approximately 60 minutes), and the water level variation during the measurement. It gives the simulated instantaneous discharges at the beginning and at the end of the measurement period, and the mean simulated value. The table also presents the relative difference between the measured and the corresponding mean simulated discharge. The results indicate that if the cross-sections defined in the original calibration and the Manning's $n_{i,L}$ are used for the 1968 simulation, the model over-estimates the hourly discharge at Mission by more than 10% (the larger difference of 27.8% occurring on January 4 can be explained by the imprecision of the measurement method when the tide effects are important, as indicated by a water level variation of 0.42 ft within the period the flow measurement was performed). A reasonable interpretation for the over-estimation of the discharges by the model can be that since the bed material particle size distribution has approximately remained the same between 1968 and 1980-1981, the cross-sectional area of the river must have slightly increased during the time under the influence of natural erosion and over-dredging. Using the Manning's equation, it is found that a 10% decrease of the Manning's n between 1968 and 1980-1981 is approximately equivalent to a 5% increase in the cross-sections areas.

It can be concluded from the preceeding paragraph that the second and third methods for the adjustment of the Manning's n are not appropriate for the 1968 simulation. The utilisation of the cross-sectional data corresponding to the 1980-1981 river characteristics combined with the n values obtained from the original calibration would lead to an over-estimation of the

Table 4.2

Comparison Between Observed and Simulated Hourly Discharge at Mission Using Unadjusted and Adjusted Manning's Coefficients

			January 4	January 22	3
First measurement		$t_o - t_f$	7h45-8h50	8h27-9h31	8h00-8h5
		$Q_{53}[t_o - t_f]$ (cfs)	51 100	121 400	113 000
		$\Delta h[t_o - t_f]$ (ft)	0.10	0.07	0.05
	Unadjusted n $n_{i,L}$	$Q^*_{53}[t_o]$ (cfs)	73 152	133 732	128 505
		$Q^*_{53}[t_f]$ (cfs)	49 673	121 418	125 467
		$\bar{Q}^*_{53}$ (cfs)	61 413	127 575	126 986
		$100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53})/\bar{Q}^*_{53}$ (%)	-16.8	-4.8	-11.0
	Adjusted n 1.1 $n_{i,L}$	$Q^*_{53}[t_o]$ (cfs)	66 004	124 104	116 643
		$Q^*_{53}[t_f]$ (cfs)	44 836	112 936	113 647
		$\bar{Q}^*_{53}$ (cfs)	55 420	118 520	115 145
		$100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53})/\bar{Q}^*_{53}$ (%)	-7.8	2.4	-1.9
Second measurement		$t_o - t_f$	11h50-12h50	12h57-14h10	10h55-11h4
		$Q_{53}[t_o - t_f]$ (cfs)	35 000	110 900	116 700
		$\Delta h[t_o - t_f]$ (ft)	0.42	-0.01	0.04
	Unadjusted n $n_{i,L}$	$Q^*_{53}[t_o]$ (cfs)	38 229	122 845	127 198
		$Q^*_{53}[t_f]$ (cfs)	58 674	132 701	129 224
		$\bar{Q}^*_{53}$ (cfs)	48 452	127 773	128 211
		$100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53}(/\bar{Q}^*_{53}$ (%)	-27.8	-13.2	-9.0
	Adjusted n 1.1 $n_{i,L}$	$Q^*_{53}[t_o]$ (cfs)	38 469	114 091	114 742
		$Q^*_{53}[t_f]$ (cfs)	55 698	122 006	116 459
		$\bar{Q}^*_{53}$ (cfs)	47 084	118 047	115 600
		$100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53})/\bar{Q}^*_{53}$ (%)	-25.7	-6.1	-1.0

where:

t_o = starting time of the measurement

t_f = ending time of the measurement

$\Delta h[t_o - t_f]$ = observed variation of the water level during the measurement

$Q_{53}[t_o - t_f]$ = observed hourly discharge

$Q^*_{53}[t_o]$ = simulated instantaneous discharge, at the beginning of the measurement

$Q^*_{53}[t_f]$ = simulated instantenaous discharge, at the end of the measurement

$\bar{Q}^*_{53}$ = simulated hourly discharge, $(Q^*_{53}[t_o] + Q^*_{53}[t_f])/2$

discharge at Mission. In order to solve this problem, a new adjustment method was developed for the particular application of 1968.

4.3 Determination and Verification of the 1968 Calibration

A simple calibration of the 1-D model for the application to the 1968 conditions consists of using the cross-sections data corresponding to the 1980-1981 river characteristics and to increase by 10% the calibrated Manning's n obtained in the original calibration for low to moderate flows ($n_{i,L}$). The results for the simulation of 3 days using these adjusted Manning's coefficients are also presented in Table 4.2. The simulated and observed hourly discharge at Mission are in reasonably good agreement (difference smaller than $\pm$8% except for one case which was already discussed). The simulation using the adjusted Manning's n ($1.1\ n_{i,L}$) represents a significant improvement when compared to the results obtained from the simulation using the original calibrated n values ($n_{i,L}$).

In order to determine if the 10% increase of the Manning's n ($n_{i,L}$) is an adjustment that can be generalized for any flow conditions in 1968 (even for high flow conditions), it is necessary to analyse a broad range of flow situations. This verification can be done by comparing all the hourly discharges measured at Mission for 1968 with the values obtained from the 1-D model using the adjusted Manning's n. A total of 61 measurements are available for the verification. The comparison is presented in Table 4.3. It can be seen from these results that 43 out of 61 measurements fall within $\pm$5% of the simulated values, and that 57 out of 61 are within $\pm$10%. The largest errors of -25.7% and 14.4% occur on January 4 and October 25, at times when the flow was very much unsteady during the measurements (indicated by the large variation of the water level of 0.42 ft and 0.36 ft

Table 4.3

Verification of the 1968 Manning's n adjustment method

	$t_o - t_f$	$Q_{53}[t_o - t_f]$	$\Delta h[t_o - t_f]$	$Q^*_{53}[t_o]$	$Q^*_{53}[t_f]$	$\bar{Q}^*_{53}$	$\frac{100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53})}{\bar{Q}^*_{53}}$
		(cfs)	(ft)	(cfs)	(cfs)	(cfs)	(%)
Jan. 4	07h45-08h50	51 000	0.10	66 004	44 836	55 420	- 7.8
Jan. 4	11h50-12h50	35 000	0.42	38 469	55 698	47 084	-25.7
Jan. 12	13h05-13h55	50 300	0.06	50 820	45 542	48 181	4.4
Jan. 22	08h27-09h31	121 400	0.07	124 104	112 936	118 520	2.4
Jan. 22	12h57-14h10	110 900	0.01	114 091	122 006	118 047	- 6.1
Feb. 5	12h44-13h48	79 600	0.06	76 795	85 887	81 341	- 2.1
Feb. 6	07h40-08h45	81 000	0.12	79 693	76 269	77 986	3.9
Feb. 12	08h55-09h50	71 500	0.01	68 095	76 405	72 250	- 1.0
Feb. 12	14h28-15h20	72 000	0.01	75 823	72 246	74 036	- 2.8
Feb. 22	12h50-13h55	71 400	0.06	66 841	71 359	69 100	3.3
Mar. 6	07h10-08h00	96 600	0.00	103 155	100 207	101 681	- 5.0
Mar. 6	12h10-13h05	100 600	0.08	105 276	104 236	104 756	- 4.0
Mar. 11	07h45-08h40	95 300	0.02	104 700	107 892	106 296	-10.3
Mar. 11	13h30-14h20	103 000	0.00	105 207	102 969	104 088	- 1.0
Mar. 15	09h00-09h55	81 200	0.00	83 002	91 286	87 144	- 6.8
Mar. 20	07h40-08h40	77 500	0.19	78 623	72 373	75 498	2.7
Mar. 20	11h40-12h40	74 200	0.12	77 961	82 740	80 350	- 7.7
Mar. 26	07h45-08h40	78 400	0.03	75 587	87 014	81 300	- 3.6
Apr. 5	09h00-09h50	73 400	0.05	75 694	74 646	75 170	- 2.4
Apr. 5	11h25-12h15	78 800	0.06	77 389	79 934	78 661	0.2
Apr. 11	07h30-08h25	84 400	0.12	79 843	86 764	83 304	1.3
Apr. 19	09h00-09h50	78 500	0.02	82 964	80 261	81 612	- 3.8
Apr. 19	12h00-12h50	77 900	0.09	79 641	79 626	79 634	- 2.2
Apr. 25	07h15-08h05	62 100	0.05	68 730	74 513	71 622	-13.3

Table 4.3 (cont'd)

	$t_o - t_f$	$Q_{53}[t_o - t_f]$	$\Delta h[t_o - t_f]$	$Q^*_{53}[t_o]$	$Q^*_{53}[t_f]$	$\bar{Q}^*_{53}$	$\frac{100(Q_{53}[t_o - t_f] - \bar{Q}^*_{53})}{\bar{Q}^*_{53}}$
		(cfs)	(ft)	(cfs)	(cfs)	(cfs)	(%)
May 3	08h00-08h50	113 000	0.05	116 643	113 647	115 145	- 1.9
May 3	10h55-11h45	116 700	0.04	114 742	116 459	115 600	1.0
May 8	13h40-14h30	124 500	0.00	121 847	120 057	120 952	2.9
May 14	08h20-09h25	160 800	0.00	155 254	159 211	157 233	2.3
May 17	08h50-11h05	186 300	0.02	179 683	179 832	179 757	3.6
May 23	08h30-09h30	289 100	0.02	284 507	286 073	285 290	1.3
May 28	08h40-09h55	321 500	0.01	323 063	322 344	322 704	- 0.4
June 5	08h40-09h40	313 000	0.01	321 880	321 807	321 844	- 2.7
June 14	09h40-10h40	321 000	0.02	334 881	336 071	335 476	- 4.3
June 19	09h20-10h30	295 000	0.01	312 187	312 116	312 152	- 5.5
June 24	08h45-09h40	295 000	0.00	308 607	309 390	308 999	- 4.5
June 28	08h45-09h45	331 000	0.04	336 521	335 985	336 253	- 1.6
July 8	10h20-11h41	327 000	0.01	353 729	353 192	353 461	- 7.5
July 12	08h32-09h30	336 000	0.08	351 324	350 927	351 126	- 4.3
July 17	09h25-10h32	324 000	0.04	343 387	343 248	343 218	- 5.6
Aug. 6	08h30-09h20	193 000	0.03	192 581	192 617	192 599	0.2
Aug. 13	08h25-09h15	155 000	0.01	149 957	147 139	148 548	4.3
Aug. 23	06h55-07h40	126 000	0.00	121 107	124 379	122 743	2.7
Aug. 28	07h45-08h35	133 000	0.01	130 234	124 620	127 427	4.4
Aug. 28	11h40-12h30	129 000	0.01	118 028	120 875	119 451	8.0
Sept 3	05h55-06h45	109 000	0.00	119 784	122 257	121 020	- 9.9
Sept 5	16h20-17h10	109 000	0.07	108 643	98 256	103 450	5.4
Sept 11	12h20-13h10	118 000	0.00	112 290	115 117	113 704	3.8
Sept 12	08h05-08h50	126 000	0.02	126 124	122 223	124 173	1.5
Sept 18	14h00-14h50	152 000	0.01	150 708	146 510	148 609	2.3
Sept 26	11h55-12h40	117 200	0.00	110 409	113 213	111 811	4.8
Sept 27	08h20-09h15	125 000	0.03	127 437	123 117	125 277	- 0.2

Table 4.3 (cont'd)

	t_o-t_f	$Q_{53}[t_o-t_f]$	$\Delta h[t_o-t_f]$	$Q^*_{53}[t_o]$	$Q^*_{53}[t_f]$	$\bar{Q}^*_{53}$	$\frac{100(Q_{53}[t_o-t_f]-\bar{Q}^*_{53})}{\bar{Q}^*_{53}}$
		(cfs)	(ft)	(cfs)	(cfs)	(cfs)	(%)
Oct. 3	14h05-14h55	114 000	0.00	108 021	102 898	105 460	8.1
Oct. 10	06h58-07h50	99 000	0.12	97 203	88 697	92 950	6.5
Oct. 10	11h40-12h40	92 000	0.04	86 870	95 237	91 053	1.3
Oct. 25	07h50-08h40	101 000	0.36	99 114	77 432	88 273	14.4
Nov. 13	09h15-10h10	99 700	0.00	101 203	96 572	98 887	0.8
Nov. 13	15h10-16h00	86 500	0.06	84 129	92 738	88 433	- 2.2
Nov. 25	08h22-09h10	98 800	0.01	103 154	94 113	98 634	0.2
Nov. 25	13h15-14h05	81 700	0.13	82 491	94 817	88 654	- 7.8
Dec. 10	07h40-08h30	77 400	0.32	75 736	71 799	73 767	4.9
Dec. 10	12h55-13h55	61 200	0.00	61 690	71 287	66 488	- 8.0

Mean of absolute values = 4.5

Standard deviation of absolute values = 4.1

where:

t_o = starting time of the measurement

t_f = ending time of the measurement

$\Delta h[t_o - t_f]$ = observed variation of the water level during the measurement

$Q_{53}[t_o-t_f]$ = observed hourly discharge

$Q^*_{53}[t_o]$ = simulated instantaneous discharge, at the beginning of the measurement

$Q^*_{53}[t_f]$ = simulated instantenaous discharge, at the end of the measurement

$\bar{Q}^*_{53}$ = simulated hourly discharge, $(Q^*_{53}[t_o] + Q^*_{53}[t_f])/2$

respectively). As it was already mentioned, the precision on the measured discharges is expected to be much smaller for these particular conditions, explaining the larger relative differences.

It is also possible to check the accuracy of the calibration by comparing the instantaneous simulated and observed water levels at Whonock (08MH044) and at Port Hammond (08MH043). The major advantage of this method is that the observed water levels at the two stations are not only available for the hours where discharge measurements took place, but for every 15 minutes in the day. The check is then more complete. The comparison between the simulated and observed water levels could be carried out using automated graphical and/or statistical methods, or simply by manual checks. The graphical package is presently available, but is too expensive to run for this type of work. No statistical program has been developed for the particular problem of comparing the water levels. However, this option should be considered seriously in other projects; it is the most interesting method because of the low costs associated with its development and operation. This computer program could also be used in the detection of significant errors in the water level boundary conditions. For the present project, only manual checks were done. The results indicate that the times where the simulated maximum and minimum water levels occur during the day are in very good agreement with the observed values both at Whonock and at Port Hammond. The comparison of the water levels also shows that the simulated levels are generally within $\pm$0.15 ft of the observed values. Larger differences are also found, but can be partly attributed to the fact that the lateral inflow is assumed to enter the system as a point inflow.

It is interesting to observe that as opposed to the original calibration, both verification methods indicated that the Manning's roughness coefficients do not seem to change very much with the flow conditions (low, moderate, high). To explore this in more detail, accurate measurements such as those obtained from the moving-boat techniques, would be necessary but are not available. From the available information, it can be concluded that the 10% increase of the Manning's coefficients of roughness obtained in the original calibration for low to moderate flow ($n_{i,L}$), combined with the use of the cross-sections data also used in the original calibration will provide satisfactory physical data input for the generation of 1968 hydrometric data.

5. Generation of Hydrometric Data

In the following chapter, the general procedure adopted in order to simulate efficiently the complete year of 1968 will be presented. The results will then be listed and discussed. The final section is concerned with an estimate of the costs strictly associated with the computer use during this project.

5.1 Data Processing

In order to use reasonable computer time and memory, it was determined that the model could be run on a weekly basis (7 days per run). A version of the model was dimensioned in order to allow the simulation of up to 7 days in one run. The corresponding compiled verson is identified as:

PFN (Permanent File Name) = ONEDEEFRASER

ID (IDentification) = BERNARD

CY (CYcle) = 111

Another version of the model was also prepared in order to simulate the Lower Fraser River on a daily basis (1 day per run). This version was very useful for the calibration and verification of the model for the 1968 conditions, for the preparation of initial conditions (for the first day of the year) and finally for the analysis of the periods when the weekly version of the model failed during the execution of a run. The corresponding compiled version of the model is identified as:

PFN = LGOSHORT

ID = BMMAR85

CY = 1

Appendix 1 presents a summary of the various versions of the 1-D model used during this project.

A series of 52 short JCL (Job Control Language) programs were prepared for the purpose of minimizing the number of direct intervention by the user, and for reducing the time required for the simulation of the total y[illegible]. Every one of the corresponding JCL programs accomplishes the following tas

- The topology (program's schematization of the natural system) and the description of the physical characteristics of the river are read from computer file and are placed in the input file of the 1-D model.
- The type of boundary, the location of the lateral inflow and the outpu requirements (hydrographs and profiles) are then read from another computer file and are also placed in the input file of the model.
- The JCL then reads the boundary conditions and lateral inflow from annual records, for a period of time defined by the user (starting dat and number of days to be read), and merges these values at the appropriate locations in the input file of the model.
- The initial conditions of the model (approximate water level and discharge at every mesh point at the beginning of the run) are obtaine from a computer file (binary coded) created during a previous run of t model, and are also placed in the input file of the model.
- The next task of the JCL is to get and run the appropriate version of the 1-D model. The model generates three different output files: the hydrographs and profiles of the network, the water level and discharg computed at every mesh point at the end of the simulation, and the wa level and discharge at every mesh point and every time step. The JCL program allows the user to store these output files in a temporary or permanent mode.
- Finally, the JCL program has the capacity to attach automatically the next JCL (ie., to submit the job for the simulation of the next week)

or simply to terminate the job.

The procedure described above is summarized in Figure 5.1. A copy of the master JCL program used to produce the 52 JCL programs is presented in Appendix 4.

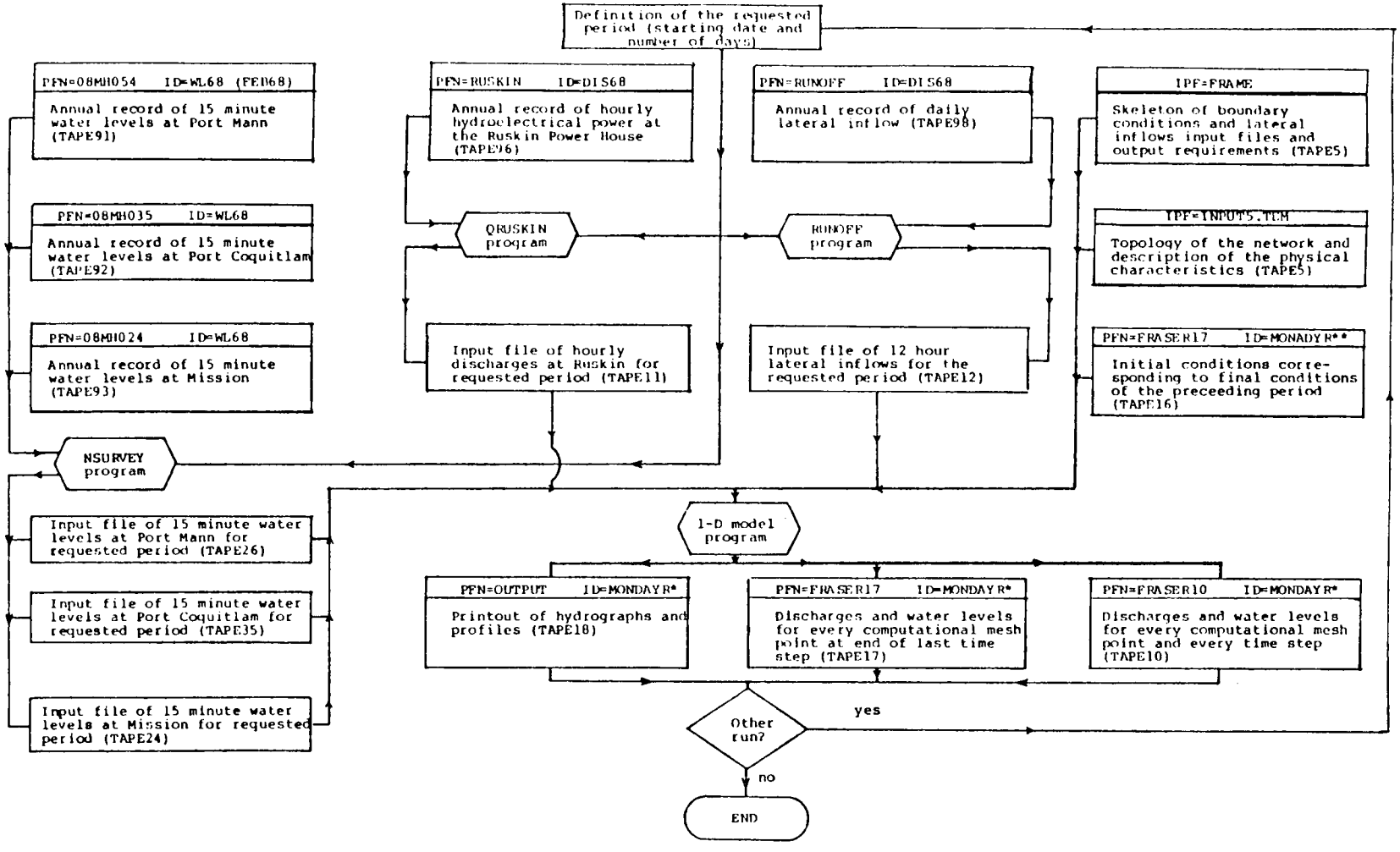
Once the 15-minute values of the water level and discharge have been produced by the 1-D model for the total year, the data can be processed through the program MEANS.JCL in order to obtain the daily discharge for every day. The standard procedure adopted consists of analyzing the data on a monthly basis. The MEANS.JCL program reads all the output files of the 1-D model containing the water level and discharge at every time step for a specific month, and produces two output files, namely the monthly record of the daily water level and discharge at every computational mesh point, and the maximum and minimum 15-minute discharge for every day of the month. This procedure is summarized in Figure 5.2. A copy of the program MEANS.JCL is included in Appendix 4.

5.2 Presentation and Discussion of Results

The discharges and water levels at every computational mesh point of the Lower Fraser River were simulated for every 15 minutes of the year 1968. These results are stored on computer files on a weekly basis (1 file per week). Each file is binary coded and is identified by a permanent file name (PFN=FRASER10), an owner's identification (ID=MONDAYR, where MON=three first letters of the month, DA=two digits of the first day of the week or period, YR=two digits identifying the year; (ie., January 8, 1968, then MONDAYR = JAN0868) and by a cycle). The files are available on tapes number E24206 and E24207. A list of the files is given in Appendix 3.

Figure 5.1

Data Processing for the Simulation of the 1-D Model

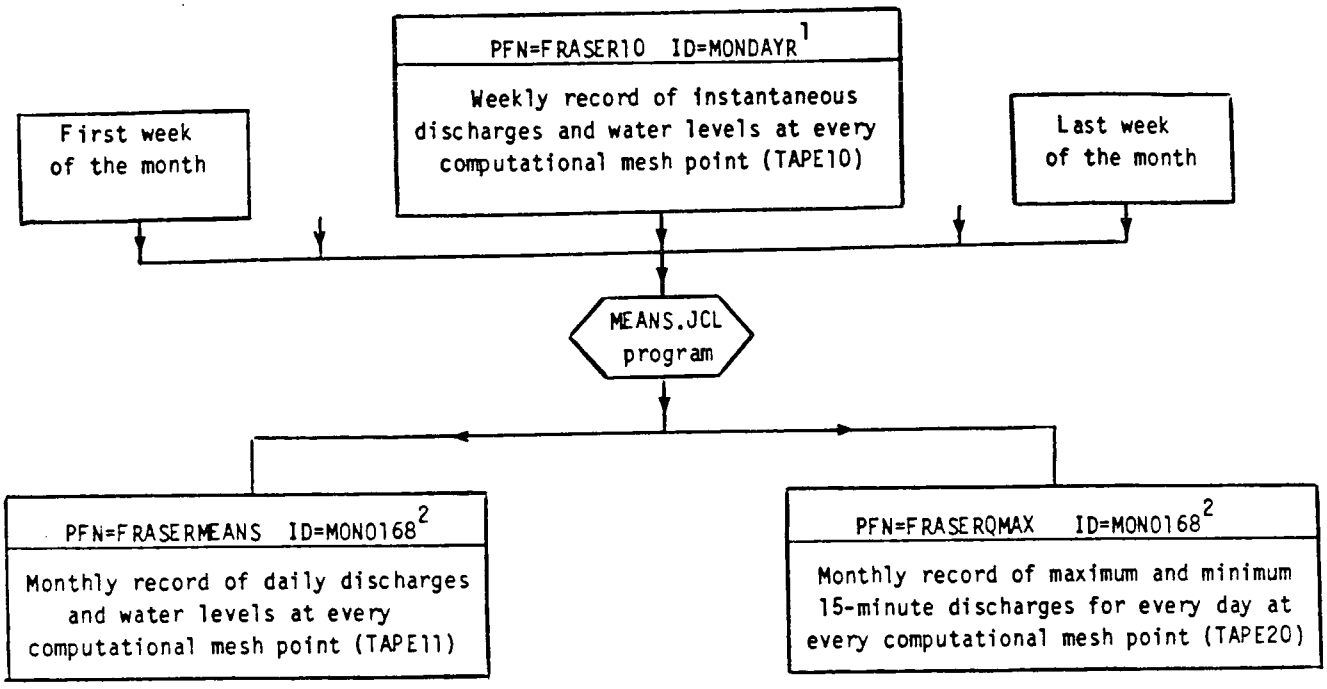


* MONDAYR corresponds to owner's identification of the file where:
MON = 3 first letters of the month;
DA = 2 digits of the first day of the week or period;
YR = 2 digits identifying the year
(i.e. for January 8, 1968, MONDAYR = JAN0868)

** MONADYR corresponds to owner's identification of the file containing the water level and discharge at every computational mesh point, computed at the last time step of the run preceeding the requested period.

Figure 5.2

Computation of the Daily and Extreme Values



1 MONDAYR corresponds to the owner's identification of the file, where:
MON = three first letters of the month
DA = two digits of the first day of the week or period
YR = two digits identifying the year
(example: for January 8, 1968, MONDAYR=JAN0868)

2 MON0168 corresponds to the owner's identification of the file, where MON represents the three first letters of the month
(example: for January, MON0168=JAN0168)

Using the instantaneous or 15-minute values, the daily discharges at Por Mann, Port Coquitlam and Mission can be computed. These values are illustrated in Figure 5.3 and are listed in Tables 5.1 to 5.12. In the tables, the simulated daily discharges at Port Mann and Mission are also compared to the values published in Water Survey of Canada (Inland Water Branch, 1968). The published discharges at Port Mann were obtained usin the cubature method, because the river at this station is affected by ti to varying degrees at all stages. The published discharges at Mission w obtained from stage-discharge relationships when the daily mean discharg is greater than 190,000 cfs, or by summing the flow of the Fraser River Hope (with a 24-hour time lag), 146% of the flow of Harrison River near Harrison Hot Spring and the tidal flow into and out of storage in the ri channel upstream of Mission when the flow is less than or equal to 190,0 cfs.

It can be noticed from Tables 5.1 to 5.12 that the published daily discharges at Mission compare reasonably well with the values simulated the model. As indicated in Table 5.13, the monthly means of the relativ differences between the published and simulated daily discharges at Miss vary between -11.5% and 9.5%. The relative differences are particularly small for the period between May 8 and August 5 (-3.8% to 2.7%). This period corresponds to the high flow conditions (daily discharge at Missi larger than or equal to 190,000 cfs) during which the stage-discharge relationship can be used with an accuracy of $\pm$ 5% because of the negligi effects of the tides at these levels. For the cases when the daily discharge at Mission is below 190,000 cfs, the method used to compute th published values is not as accurate, explaining to a great extent the larger values of the relative error for these cases.

Figure 5.3

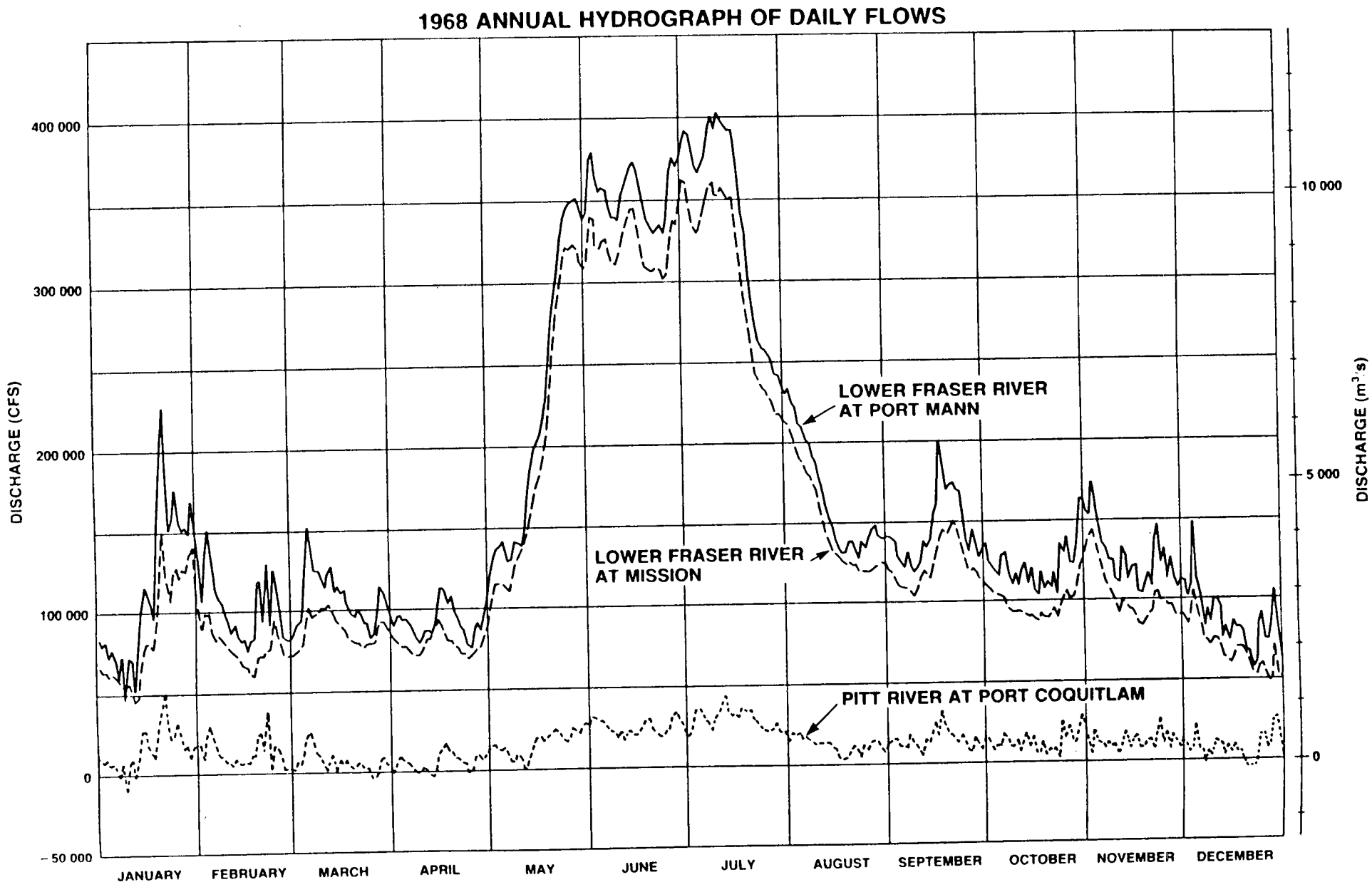

1968 ANNUAL HYDROGRAPH OF DAILY FLOWS
DISCHARGE (CFS)
400 000
300 000
200 000
100 000
0
– 50 000
DISCHARGE (m³/s)
10 000
5 000
0
LOWER FRASER RIVER AT PORT MANN
LOWER FRASER RIVER AT MISSION
PITT RIVER AT PORT COQUITLAM
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

Table 5.1

Results of 1-D Simulation for January 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)
1	84 291	63 900	-24.2	67 327	58 300	-13.4	10 105
2	79 945	63 200	-20.9	64 054	56 700	-11.5	7 785
3	81 880	66 600	-18.7	64 083	54 600	-14.8	9 730
4	73 255	57 700	-21.2	60 696	52 200	-14.0	5 636
5	76 167	62 300	-18.2	62 057	51 600	-16.9	7 201
6	70 820	58 700	-17.1	60 229	51 500	-14.5	4 315
7	59 171	47 300	-20.1	57 557	50 900	-11.6	-1 129
8	72 965	58 400	-20.0	57 008	50 300	-11.8	6 060
9	46 321	39 100	-15.6	52 299	48 400	- 7.5	-8 943
10	73 011	60 600	-17.0	56 274	48 200	-14.3	6 285
11	70 682	61 900	-12.4	51 261	46 100	-10.1	8 961
12	50 087	39 600	-20.9	45 753	42 700	- 6.7	-1 640
13	75 917	33 600	-55.7	46 966	40 600	-13.6	12 255
14	101 614	34 800	-65.8	61 646	46 700	-24.2	26 266
15	116 497	65 200	-44.0	77 327	61 500	-20.5	26 506
16	111 167	82 300	-26.0	81 392	72 200	-11.3	17 322
17	106 108	86 600	-18.4	79 866	74 900	- 6.2	13 539
18	96 124	70 700	-26.4	77 278	71 800	- 7.1	9 572
19	153 004	77 100	-49.6	96 229	76 300	-20.7	28 455
20	198 656	106 000	-46.6	128 810	90 100	-30.1	42 7[illegible]
21	227 000	157 000	-30.8	148 700	113 000	-24.0	48 6
22	173 787	141 000	-18.9	122 393	114 000	- 6.9	32 411
23	149 137	122 000	-18.2	107 781	107 000	- .7	22 355
24	157 835	111 000	-29.7	123 499	111 000	-10.1	23 107
25	177 469	144 000	-18.9	127 071	126 000	- .8	30 916
26	156 068	136 000	-12.9	121 102	127 000	4.9	24 134
27	151 665	129 000	-14.9	127 505	129 000	1.2	15 820
28	153 337	130 000	-15.2	126 703	125 000	- 1.3	17 840
29	148 240	117 000	-21.1	135 899	119 000	-12.4	8 917
30	169 031	124 000	-26.6	140 932	115 000	-18.4	17 980
31	145 190	118 000	-18.7	117 383	110 000	- 6.3	17 531
			$\bar{x}$ = -25.3			$\bar{x}$ = -11.5	
			σ = 13.2			σ = 7.9	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.2

Results of 1-D Simulation for February 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)
1	133 967	120 000	-10.4	101 316	103 000	1.7	18 589
2	106 731	89 100	-16.5	89 387	93 800	4.9	9 512
3	134 127	104 000	-22.5	98 940	95 000	- 4.0	20 286
4	151 317	116 000	-23.3	99 338	95 500	- 3.9	29 996
5	130 897	112 000	-14.4	87 917	89 200	1.5	21 457
6	113 178	94 000	-16.9	82 486	82 000	- .6	14 901
7	107 736	90 300	-16.2	84 723	82 600	- 2.5	10 461
8	106 192	90 800	-14.5	82 818	81 800	- 1.2	11 188
9	98 523	85 200	-13.5	80 262	78 900	- 1.7	7 742
10	95 160	80 100	-15.8	78 166	75 400	- 3.5	7 882
11	88 448	75 800	-14.3	75 640	71 900	- 4.9	5 139
12	92 142	75 400	-18.2	74 074	69 600	- 6.0	9 648
13	85 589	68 800	-19.6	72 093	66 700	- 7.5	6 891
14	82 232	68 500	-16.7	68 461	64 500	- 5.8	6 055
15	82 975	69 400	-16.4	67 591	62 200	- 8.0	7 260
16	77 714	63 400	-18.4	65 020	59 500	- 8.5	6 073
17	82 610	59 500	-28.0	62 242	57 300	- 7.9	11 673
18	83 121	52 000	-37.4	60 530	54 800	- 9.5	10 778
19	118 747	65 000	-45.3	71 328	56 900	-20.2	23 874
20	119 288	76 600	-35.8	73 140	60 700	-17.0	25 523
21	94 158	69 500	-26.2	73 177	62 100	-15.1	4 022
22	130 292	82 000	-37.1	76 390	64 300	-15.8	37 263
23	92 298	61 500	-33.4	77 204	65 700	-14.9	2 195
24	126 619	83 600	-34.0	95 157	74 000	-22.2	17 408
25	117 037	88 000	-24.8	86 912	75 300	-13.4	16 336
26	100 480	80 200	-20.2	79 191	70 100	-11.5	11 007
27	85 057	70 700	-16.9	73 865	67 400	- 8.8	2 398
28	83 129	71 600	-13.9	72 223	66 600	- 7.8	2 954
29	82 323	67 100	-18.5	72 658	66 800	- 8.1	2 958
		$\bar{x}$ = -22.0			$\bar{x}$ = - 7.7		
		σ = 9.0			σ = 6.6		

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.3

Results of 1-D Simulation for March 1968

Day	Port Mann			Mission			Port Coqui
	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)
1	84 407	74 400	-11.9	73 257	68 500	- 6.5	2 230
2	91 673	77 700	-15.2	74 214	70 400	- 5.1	6 431
3	94 054	81 500	-13.3	76 006	73 300	- 3.6	5 141
4	103 256	76 300	-26.1	79 611	75 500	- 5.2	10 948
5	132 468	87 100	-34.2	91 557	85 200	- 6.9	23 492
6	152 206	120 000	-21.2	102 188	96 500	- 5.6	25 976
7	133 522	114 000	-14.6	97 334	98 000	.7	16 567
8	125 415	112 000	-10.7	98 052	99 300	1.3	12 476
9	124 338	113 000	- 9.1	99 509	102 000	2.5	10 203
10	120 785	112 000	- 7.3	101 875	105 000	3.1	7 649
11	114 559	106 000	- 7.5	102 057	107 000	4.8	2 065
12	123 049	103 000	-16.3	104 154	107 000	2.7	6 051
13	127 820	108 000	-15.5	101 690	104 000	2.3	10 715
14	111 320	102 000	- 8.4	95 952	99 200	3.4	1 114
15	114 839	98 200	-14.5	92 395	94 600	2.4	8 632
16	110 186	95 000	-13.8	90 078	91 200	1.2	6 109
17	111 975	99 100	-11.5	87 723	88 600	1.0	8 787
18	104 167	98 600	- 5.3	84 433	85 600	1.4	6 226
19	97 700	94 200	- 3.6	81 933	82 300	.4	2 99
20	96 679	92 500	- 4.3	80 364	79 200	- 1.4	3 49
21	100 678	93 700	- 6.9	79 553	78 000	- 2.0	6 552
22	97 277	89 500	- 8.0	77 336	75 300	- 2.6	5 262
23	92 478	81 500	-11.9	77 547	74 000	- 4.6	2 961
24	92 532	81 200	-12.2	79 790	74 800	- 6.3	3 654
25	83 688	75 100	-10.3	79 432	77 100	- 2.9	-3 137
26	85 965	79 900	- 7.1	79 623	79 300	- .4	-2 685
27	100 176	79 500	-20.6	87 655	81 900	- 6.6	2 339
28	114 982	96 100	-16.4	93 030	87 400	- 6.1	8 314
29	111 719	88 000	-21.2	93 250	87 000	- 6.7	8 788
30	105 271	96 000	- 8.8	89 425	86 100	- 3.7	4 499
31	98 560	85 000	-13.8	86 239	83 100	- 3.6	4 391
			$\bar{x}$ = -13.0			$\bar{x}$ = - 1.7	
			σ = 6.6			σ = 3.7	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.4

Results of 1-D Simulation for April 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$\frac{100(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)	Q (cfs)	$\frac{100(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)
1	90 201	85 000	- 5.8	82 734	80 400	- 2.8	808
2	96 575	90 600	- 6.2	81 614	78 400	- 3.9	6 977
3	97 536	85 700	-12.1	79 360	76 000	- 4.2	9 922
4	94 128	80 200	-14.8	77 796	73 100	- 6.0	6 791
5	94 570	83 900	-11.3	77 918	72 300	- 7.2	6 376
6	90 967	84 600	- 7.0	75 458	71 500	- 5.2	4 602
7	87 546	82 900	- 5.3	73 436	69 600	- 5.2	2 463
8	83 160	77 700	- 6.6	72 197	69 100	- 4.3	318
9	80 083	72 000	-10.1	72 488	69 000	- 4.8	- 367
10	82 969	61 600	-25.8	75 112	69 300	- 7.7	3 681
11	87 432	73 300	-16.2	80 815	74 000	- 8.4	1 649
12	87 466	83 700	- 4.3	82 710	80 200	- 3.0	-1 449
13	86 220	77 700	- 9.9	86 213	84 400	- 2.1	-3 251
14	93 052	76 300	-18.0	91 759	87 100	- 5.1	- 722
15	114 005	93 100	-18.3	94 382	89 000	- 5.7	11 273
16	113 510	98 000	-13.7	90 552	85 800	- 5.2	14 067
17	111 007	95 100	-14.3	84 835	80 800	- 4.8	16 884
18	105 183	84 300	-19.9	81 453	76 000	- 6.7	13 049
19	107 840	92 300	-14.4	80 483	74 000	- 8.1	12 586
20	99 905	90 000	- 9.9	77 120	71 000	- 7.9	8 613
21	95 667	80 600	-15.7	76 032	68 900	- 9.4	8 213
22	89 328	72 200	-19.2	73 586	67 100	- 8.8	5 652
23	86 917	64 600	-25.7	73 364	65 900	-10.2	5 032
24	78 583	64 600	-17.8	70 267	65 400	- 6.9	- 447
25	76 116	58 300	-23.4	71 831	64 700	- 9.9	- 184
26	89 378	70 500	-21.1	73 939	66 500	-10.1	8 212
27	91 178	69 200	-24.1	75 779	67 800	-10.5	10 165
28	87 532	67 300	-23.1	77 280	69 700	- 9.8	6 706
29	95 669	74 000	-22.6	82 677	74 800	- 9.5	9 187
30	108 356	85 400	-21.2	90 231	83 300	- 7.7	11 982
			$\bar{x}$ = -15.3			$\bar{x}$ = - 6.7	
			σ = 6.6			σ = 2.5	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.5

Results of 1-D Simulation for May 1968

Day	Port Mann			Mission			Port Coquitlam
	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)
1	121 653	102 000	-16.2	99 747	93 800	- 6.0	15 005
2	133 265	115 000	-13.7	111 379	106 000	- 4.8	15 539
3	137 427	123 000	-10.5	116 017	114 000	- 1.7	13 175
4	139 201	121 000	-13.1	115 994	117 000	.9	12 553
5	141 526	134 000	- 5.3	115 044	116 000	.8	13 678
6	134 798	124 000	- 8.0	113 049	114 000	.8	9 692
7	129 743	127 000	- 2.1	112 223	115 000	2.5	6 040
8	131 062	120 000	- 8.4	118 181	119 000	.7	5 810
9	142 267	125 000	-12.1	127 088	128 000	.7	9 735
10	141 062	128 000	- 9.3	132 431	134 000	1.2	6 277
11	138 894	129 000	- 7.1	137 254	139 000	1.3	1 321
12	147 719	140 000	- 5.2	145 502	148 000	1.7	3 691
13	166 443	158 000	- 5.1	154 651	159 000	2.8	9 164
14	184 719	174 000	- 5.8	163 550	169 000	3.3	17 448
15	197 677	186 000	- 5.9	172 896	179 000	3.5	20 476
16	203 230	192 000	- 5.5	177 834	186 000	4.6	21 030
17	208 423	194 000	- 6.9	183 796	187 000	1.7	18 296
18	217 240	195 000	-10.2	193 307	194 000	.4	20 259
19	230 162	204 000	-11.4	206 192	205 000	- .6	21 692
20	251 550	217 000	-13.7	225 925	222 000	- 1.7	24 422
21	277 521	239 000	-13.9	251 303	246 000	- 2.1	25 217
22	295 173	260 000	-11.9	270 934	263 000	- 2.9	22 665
23	310 256	275 000	-11.4	289 118	279 000	- 3.5	18 793
24	326 903	290 000	-11.3	306 403	295 000	- 3.7	18 403
25	339 697	303 000	-10.8	318 225	306 000	- 3.8	20 221
26	346 027	312 000	- 9.8	321 659	312 000	- 3.0	22 503
27	349 939	316 000	- 9.7	321 369	314 000	- 2.3	23 831
28	350 376	320 000	- 8.7	322 597	316 000	- 2.0	23 275
29	352 061	321 000	- 8.8	320 790	315 000	- 1.8	26 679
30	346 455	316 000	- 8.8	313 591	307 000	- 2.1	28 443
31	339 009	306 000	- 9.7	307 785	300 000	- 2.5	27 679
			$\bar{x}$ = - 9.4			$\bar{x}$ = - 0.6	
			σ = 3.2			σ = 2.7	

where: Q* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.6

Results of 1-D Simulation for June 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)
1	343 793	297 000	-13.6	310 682	304 000	- 2.2	32 100
2	374 857	324 000	-13.6	340 273	332 000	- 2.4	31 832
3	379 822	344 000	- 9.4	338 511	336 000	- .7	30 620
4	364 471	334 000	- 8.4	322 477	320 000	- .8	30 854
5	355 913	323 000	- 9.2	321 011	316 000	- 1.6	26 905
6	357 847	323 000	- 9.7	325 199	319 000	- 1.9	25 000
7	356 578	325 000	- 8.9	326 711	321 000	- 1.7	22 893
8	349 327	321 000	- 8.1	318 765	313 000	- 1.8	22 732
9	340 191	315 000	- 7.4	313 454	310 000	- 1.1	19 186
10	340 246	315 000	- 7.4	312 206	308 000	- 1.3	21 893
11	338 491	313 000	- 7.5	316 566	311 000	- 1.8	18 390
12	352 750	325 000	- 7.9	324 913	320 000	- 1.5	23 234
13	358 293	328 000	- 8.5	331 404	325 000	- 1.9	23 077
14	364 385	335 000	- 8.1	338 832	332 000	- 2.0	21 456
15	370 916	338 000	- 8.9	344 886	336 000	- 2.6	21 612
16	374 079	340 000	- 9.1	345 303	336 000	- 2.7	23 821
17	369 809	337 000	- 8.9	333 297	327 000	- 1.9	28 557
18	355 121	322 000	- 9.3	317 731	311 000	- 2.1	30 259
19	346 144	308 000	-11.0	310 359	302 000	- 2.7	30 444
20	338 060	306 000	- 9.5	309 324	300 000	- 3.0	23 472
21	333 142	301 000	- 9.6	307 807	297 000	- 3.5	21 091
22	330 855	299 000	- 9.6	308 061	298 000	- 3.3	19 798
23	333 229	302 000	- 9.4	309 851	300 000	- 3.2	20 272
24	334 851	302 000	- 9.8	308 140	300 000	- 2.6	23 454
25	330 841	294 000	-11.1	303 487	295 000	- 2.8	24 288
26	340 255	293 000	-13.9	305 158	300 000	- 1.7	31 560
27	367 989	326 000	-11.4	327 687	323 000	- 1.4	34 165
28	376 172	341 000	- 9.3	337 475	333 000	- 1.3	30 644
29	371 852	340 000	- 8.6	336 405	331 000	- 1.6	27 288
30	375 381	343 000	- 8.6	350 372	341 000	- 2.7	20 141
			$\bar{x}$ = - 9.5			$\bar{x}$ = - 2.1	
			σ = 1.7			σ = 0.7	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.7

Results of 1-D Simulation for July 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)
1	387 981	355 000	- 8.5	363 092	354 000	- 2.5	20 188
2	393 223	363 000	- 7.7	360 888	356 000	- 1.4	24 566
3	390 248	356 000	- 8.8	347 402	344 000	- 1.0	34 541
4	380 591	342 000	-10.1	335 841	332 000	- 1.1	35 581
5	371 356	335 000	- 9.8	330 503	326 000	- 1.4	33 458
6	367 681	330 000	-10.2	332 650	327 000	- 1.7	28 799
7	372 398	336 000	- 9.8	340 770	334 000	- 2.0	26 807
8	376 293	344 000	- 8.6	349 415	345 000	- 1.3	22 490
9	394 576	357 000	- 9.5	357 943	355 000	- .8	30 695
10	399 325	367 000	- 8.1	360 218	359 000	- .3	32 365
11	394 276	356 000	- 9.7	353 897	352 000	- .5	35 523
12	404 207	360 000	-10.9	353 219	353 000	- .1	44 893
13	398 758	365 000	- 8.5	357 631	355 000	- .7	34 303
14	394 581	361 000	- 8.5	353 688	352 000	- .5	32 114
15	393 109	359 000	- 8.7	352 550	349 000	- 1.0	33 243
16	393 060	357 000	- 9.2	352 194	348 000	- 1.2	31 505
17	385 137	349 000	- 9.4	339 572	334 000	- 1.6	36 136
18	364 886	330 000	- 9.6	319 389	314 000	- 1.7	35 346
19	344 105	309 000	-10.2	301 085	296 000	- 1.7	34 674
20	329 815	292 000	-11.5	285 540	282 000	- 1.2	35 095
21	307 071	274 000	-10.8	268 667	266 000	- 1.0	30 471
22	289 235	262 000	- 9.4	254 162	252 000	- .9	28 227
23	274 201	248 000	- 9.6	244 029	242 000	- .8	25 157
24	264 553	239 000	- 9.7	237 983	236 000	- .8	22 788
25	259 708	236 000	- 9.1	234 801	233 000	- .8	21 984
26	258 101	234 000	- 9.3	232 973	231 000	- .8	22 544
27	255 050	231 000	- 9.4	228 883	228 000	- .4	23 487
28	251 688	226 000	-10.2	223 492	222 000	- .7	26 104
29	243 291	221 000	- 9.2	218 477	217 000	- .7	21 406
30	241 948	220 000	- 9.1	218 102	216 000	- 1.0	21 176
31	234 946	214 000	- 8.9	214 779	212 000	- 1.3	17 732
			$\bar{x}$ = - 9.4			$\bar{x}$ = - 1.1	
			σ = 0.8			σ = 0.5	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.8

Results of 1-D Simulation for August 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)
1	231 160	212 000	- 8.3	213 133	211 000	- 1.0	15 935
2	234 050	211 000	- 9.8	211 605	211 000	- .3	19 753
3	226 614	207 000	- 8.7	205 990	206 000	.0	18 718
4	222 538	203 000	- 8.8	198 375	201 000	1.3	20 673
5	212 404	199 000	- 6.3	191 063	196 000	2.6	17 354
6	209 918	198 000	- 5.7	188 017	193 000	2.7	17 467
7	203 170	193 000	- 5.0	183 422	189 000	3.0	15 887
8	198 741	207 000	4.2	180 600	201 000	11.3	14 442
9	192 070	198 000	3.1	176 154	197 000	11.8	12 974
10	188 261	195 000	3.6	171 914	191 000	11.1	13 915
11	179 817	187 000	4.0	164 289	182 000	10.8	13 988
12	171 833	180 000	4.8	154 227	174 000	12.8	13 693
13	162 797	169 000	3.8	145 486	164 000	12.7	14 405
14	152 595	159 000	4.2	137 902	156 000	13.1	11 799
15	147 034	156 000	6.1	133 560	152 000	13.8	10 165
16	138 772	149 000	7.4	130 244	148 000	13.6	5 371
17	133 965	147 000	9.7	129 610	147 000	13.4	2 919
18	132 071	144 000	9.0	127 308	144 000	13.1	4 043
19	131 863	142 000	7.7	125 089	142 000	13.5	4 924
20	139 084	144 000	3.5	125 732	141 000	12.1	10 280
21	138 749	144 000	3.8	124 415	140 000	12.5	10 998
22	134 563	138 000	2.6	124 279	138 000	11.0	8 450
23	128 231	134 000	4.5	120 847	137 000	13.4	5 100
24	138 386	141 000	1.9	119 924	135 000	12.6	11 971
25	135 384	136 000	.5	119 297	133 000	11.5	10 104
26	142 443	137 000	- 3.8	120 607	133 000	10.3	14 304
27	146 123	137 000	- 6.2	121 274	133 000	9.7	14 967
28	147 641	146 000	- 1.1	122 974	135 000	9.8	15 011
29	142 196	145 000	2.0	124 254	137 000	10.3	9 957
30	139 966	144 000	2.9	125 214	138 000	10.2	7 567
31	140 041	140 000	- .0	124 470	137 000	10.1	11 268
		$\bar{x}$ = 0.8			$\bar{x}$ = 9.5		
		σ = 5.6			σ = 4.7		

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.9

Results of 1-D Simulation for September 1968

Day	Port Mann			Mission			Port Coquit
	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)
1	140 750	138 000	- 2.0	120 843	134 000	10.9	13 954
2	139 516	137 000	- 1.8	118 003	130 000	10.2	15 270
3	136 648	133 000	- 2.7	114 726	126 000	9.8	14 757
4	128 642	130 000	1.1	111 205	124 000	11.5	10 840
5	125 658	124 000	- 1.3	108 885	120 000	10.2	11 337
6	121 779	119 000	- 2.3	108 129	118 000	9.1	10 052
7	130 933	123 000	- 6.1	108 682	118 000	8.6	18 334
8	122 288	118 000	- 3.5	106 416	116 000	9.0	13 595
9	119 426	118 000	- 1.2	104 467	116 000	11.0	10 757
10	121 700	124 000	1.9	108 354	119 000	9.8	9 662
11	126 424	129 000	2.0	115 471	126 000	9.1	6 111
12	139 448	133 000	- 4.6	120 389	129 000	7.2	14 973
13	134 489	128 000	- 4.8	117 770	128 000	8.7	13 240
14	139 830	125 000	-10.6	116 170	126 000	8.5	20 805
15	155 595	134 000	-13.9	124 536	129 000	3.6	25 303
16	161 265	136 000	-15.7	131 076	136 000	3.8	18 431
17	198 890	142 000	-28.6	140 175	143 000	2.0	32 109
18	186 716	163 000	-12.7	144 982	149 000	2.8	23 242
19	171 650	158 000	- 8.0	141 706	147 000	3.7	18 553
20	172 610	160 000	- 7.3	145 198	151 000	4.0	18 106
21	174 675	163 000	- 6.7	150 448	157 000	4.4	16 446
22	169 630	158 000	- 6.9	147 230	156 000	6.0	13 077
23	169 026	157 000	- 7.1	137 974	147 000	6.5	17 181
24	153 995	144 000	- 6.5	129 307	138 000	6.7	12 961
25	138 475	137 000	- 1.1	121 995	131 000	7.4	7 796
26	131 654	126 000	- 4.3	119 471	128 000	7.1	6 874
27	144 787	143 000	- 1.2	120 022	128 000	6.6	16 178
28	135 526	130 000	- 4.1	118 630	126 000	6.2	12 142
29	128 330	128 000	- .3	114 655	122 000	6.4	8 774
30	133 685	127 000	- 5.0	111 948	119 000	6.3	15 523

$\bar{x}$ = - 5.5 $\bar{x}$ = 7.2

σ = 6.2 σ = 2.6

where: Q* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.10

Results of 1-D Simulation for October 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)	Q (cfs)	$100(\frac{Q-Q^*}{Q^*})$ (%)	Q^* (cfs)
1	136 300	127 000	- 6.8	110 200	117 000	6.2	15 373
2	125 232	123 000	- 1.8	108 395	116 000	7.0	11 937
3	120 316	116 000	- 3.6	105 817	112 000	5.8	8 366
4	119 369	115 000	- 3.7	104 692	111 000	6.0	10 640
5	116 115	105 000	- 9.6	103 828	109 000	5.0	10 485
6	129 478	110 000	-15.0	103 418	107 000	3.5	17 490
7	130 517	119 000	- 8.8	101 287	106 000	4.7	14 983
8	117 210	108 000	- 7.9	96 601	101 000	4.6	10 109
9	110 771	102 000	- 7.9	93 899	99 000	5.4	8 900
10	117 163	103 000	-12.1	94 000	98 600	4.9	13 669
11	110 896	96 900	-12.6	94 406	97 900	3.7	7 013
12	119 596	105 000	-12.2	93 555	96 800	3.5	12 506
13	122 613	103 000	-16.0	91 550	94 900	3.7	17 116
14	111 389	99 700	-10.5	90 437	93 200	3.1	9 624
15	120 696	106 000	-12.2	91 161	92 100	1.0	15 983
16	106 946	104 000	- 2.8	89 301	91 400	2.4	6 032
17	104 358	91 300	-12.5	88 268	90 300	2.3	5 875
18	118 704	107 000	- 9.9	92 656	93 300	.7	12 521
19	107 782	97 700	- 9.4	90 695	93 500	3.1	5 369
20	112 458	100 000	-11.1	90 116	92 600	2.8	8 375
21	107 630	94 300	-12.4	92 159	93 600	1.6	6 791
22	117 632	102 000	-13.3	96 139	96 800	.7	9 289
23	104 949	89 300	-14.9	91 396	96 000	5.0	2 847
24	135 666	104 000	-23.3	96 677	97 800	1.2	24 941
25	129 618	109 000	-15.9	101 693	102 000	.3	15 706
26	139 944	118 000	-15.7	106 293	106 000	- .3	21 993
27	124 508	114 000	- 8.4	102 316	105 000	2.6	11 931
28	124 129	106 000	-14.6	103 560	106 000	2.4	12 379
29	137 163	107 000	-22.0	108 732	112 000	3.0	19 638
30	164 174	142 000	-13.5	121 664	126 000	3.6	28 544
31	163 289	153 000	- 6.3	127 748	136 000	6.5	19 569
			$\bar{x}$ = -11.2			$\bar{x}$ = 3.4	
			σ = 5.0			σ = 2.0	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.11

Results of 1-D Simulation for November 1968

Day	Port Mann			Mission			Port Coquitlam
	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q* (cfs)
1	156 641	150 000	- 4.2	132 686	142 000	7.0	13 465
2	152 975	148 000	- 3.3	139 095	150 000	7.8	5 636
3	172 923	165 000	- 4.6	143 532	154 000	7.3	17 887
4	159 205	157 000	- 1.4	135 100	148 000	9.5	12 206
5	148 974	149 000	.0	125 864	137 000	8.8	11 581
6	136 042	135 000	- .8	117 921	128 000	8.5	9 180
7	133 043	128 000	- 3.8	112 603	121 000	7.5	11 364
8	125 419	118 000	- 5.9	107 457	115 000	7.0	9 874
9	124 890	121 000	- 3.1	103 810	110 000	6.0	9 926
10	113 555	110 000	- 3.1	98 803	105 000	6.3	4 903
11	109 986	97 700	-11.2	92 918	99 700	7.3	7 970
12	133 221	115 000	-13.7	100 172	102 000	1.8	18 131
13	125 977	117 000	- 7.1	98 639	102 000	3.4	14 528
14	112 911	103 000	- 8.8	94 988	98 200	3.4	8 970
15	119 967	103 000	-14.1	93 649	96 100	2.6	14 259
16	121 480	111 000	- 8.6	91 181	94 500	3.6	15 851
17	105 183	93 800	-10.8	86 421	90 200	4.4	8 689
18	104 355	84 600	-18.9	84 390	86 000	1.9	8 809
19	109 683	85 200	-22.3	87 272	85 700	- 1.8	11 814
20	116 027	86 300	-25.6	90 743	87 100	- 4.0	14 230
21	108 018	79 700	-26.2	93 277	89 300	- 4.3	7 633
22	136 998	109 000	-20.4	104 577	97 000	- 7.2	19 535
23	147 053	122 000	-17.0	105 316	103 000	- 2.2	24 824
24	123 875	115 000	- 7.2	99 793	102 000	2.2	10 672
25	131 175	120 000	- 8.5	100 091	102 000	1.9	17 744
26	113 034	106 000	- 6.2	97 275	101 000	3.8	7 581
27	125 820	114 000	- 9.4	97 204	98 900	1.7	15 995
28	113 707	107 000	- 5.9	90 598	94 400	4.2	11 061
29	107 260	87 000	-18.9	90 231	89 600	- .7	8 244
30	113 665	97 100	-14.6	90 126	90 500	.4	11 919
			$\bar{x}$ = -10.2			$\bar{x}$ = 3.3	
			σ = 7.4			σ = 4.3	

where: Q* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.12

Results of 1-D Simulation for December 1968

Day	Port Mann			Mission			Port Coquitlam
	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)	Q (cfs)	$100\frac{(Q-Q^*)}{Q^*}$ (%)	Q^* (cfs)
1	111 326	101 000	- 9.3	87 853	88 800	1.1	9 608
2	102 285	94 500	- 7.6	83 916	85 600	2.0	5 351
3	109 324	71 300	-34.8	89 215	85 300	- 4.4	6 897
4	148 218	117 000	-21.1	104 977	95 400	- 9.1	22 217
5	112 615	97 000	-13.9	92 101	88 300	- 4.1	6 666
6	102 430	94 900	- 7.4	83 748	81 900	- 2.2	6 296
7	82 951	73 800	-12.2	76 435	74 800	- 2.1	- 958
8	93 828	82 300	-12.3	74 905	72 000	- 3.9	5 488
9	85 996	66 900	-22.2	72 307	69 300	- 4.2	3 198
10	98 762	77 200	-21.8	74 903	70 500	- 5.9	11 533
11	99 994	86 100	-13.9	74 128	71 400	- 3.7	11 719
12	94 742	87 600	- 7.5	71 889	71 300	- .8	9 614
13	76 632	68 900	-10.1	66 558	67 800	1.9	2 375
14	83 164	73 300	-11.9	62 646	64 100	2.3	8 511
15	76 380	65 600	-14.1	61 574	61 500	- .1	4 673
16	86 229	73 200	-15.1	64 308	61 900	- 3.7	9 929
17	82 010	66 300	-19.2	69 005	63 900	- 7.4	4 853
18	82 748	69 000	-16.6	69 759	66 100	- 5.2	4 993
19	78 983	73 000	- 7.6	69 837	65 700	- 5.9	- 163
20	68 938	68 000	- 1.4	65 886	63 100	- 4.2	-4 584
21	66 631	65 900	- 1.1	60 359	60 200	- .3	-2 148
22	57 646	59 600	3.4	54 925	56 700	3.2	-3 837
23	59 731	52 000	-12.9	53 887	54 300	.8	- 163
24	84 659	60 900	-28.1	57 183	54 500	- 4.7	14 454
25	91 148	72 500	-20.5	59 116	55 500	- 6.1	15 436
26	73 847	65 300	-11.6	52 750	53 000	.5	7 510
27	73 848	70 200	- 4.9	48 483	51 200	5.6	10 817
28	86 310	61 500	-28.7	50 790	48 600	- 4.3	25 927
29	105 867	56 100	-47.0	70 159	48 500	-30.9	26 203
30	72 823	52 700	-27.6	52 663	45 500	-13.6	13 520
31	56 188	33 500	-40.4	51 976	41 600	-20.0	1 566
			$\bar{x}$ = -16.1			$\bar{x}$ = - 4.2	
			σ = 11.4			σ = 7.1	

where: Q^* = simulated daily discharge

Q = daily discharge published by WSC

Table 5.13

Summary of Monthly Mean and Standard Deviation of the Relative Difference Between Published and Simulated Daily Discharges

Month	Port Mann		Mission	
	$\bar{x}$	σ	$\bar{x}$	σ
January	-25.31	13.19	-11.47	7.86
February	-22.04	8.95	- 7.67	6.61
March	-12.95	6.60	- 1.70	3.69
April	-15.26	6.59	- 6.70	2.45
May	- 9.36	3.21	- 0.56	2.65
June	- 9.52	1.72	- 2.06	0.73
July	- 9.42	0.83	- 1.06	0.52
August	0.83	5.64	9.45	4.74
September	- 5.51	6.19	7.23	2.63
October	-11.18	4.98	3.42	1.95
November	-10.19	7.42	3.27	4.25
December	-16.11	11.36	- 4.17	7.05
Annual	-12.14	9.81	-0.98	7.31

The accuracy of the simulated discharge may be expected to slightly decrease for some days during the winter period, because of the fact that some of the water gauges may be temporarily operating under partial ice conditions.

Except for the month of August, Tables 5.1 to 5.12 indicate that the daily discharge simulated by the model at Port Mann is always larger than the published value. During the original calibration of the model (1980-1981 data), it was observed that the model had a general trend to slightly over-estimate the discharge at Mission and under-estimate the discharge at Port Mann by 5% at the most. This tendency was explained mainly by the difficulty of determining the exact values of the Manning's roughness coefficients. Based on this trend, one could argue that the 1968 calibration of the Manning's n can lead to a greater under-estimation of the daily discharges at Port Mann, because the adjustment is done such that the difference between the observed and simulated discharge at Mission is minimized. It is very difficult to verify this point of view, because no discharge measurement is available at Port Mann for 1968. Nevertheless, Tables 5.1 to 5.12 show that most of the simulated daily discharges at Port Mann are greater than the values published by Water Survey of Canada, indicating that if the simulated values are under-estimated, they are at least less under-estimated than the published values.

One other aspect of the results presented in Tables 5.1 to 5.12 can be better understood from the analysis of the rainfall over the Lower Fraser River basin. Comparing these tables with the 1968 record of moderate to heavy rainfall presented in Table 5.14 (moderate to heavy rainfall meaning precipitation greater than or equal to 0.5 inch per day), it is found that

Table 5.14

Summary of Moderate to Heavy Precipitation (inch/day) over the Lower Fraser River Basin

(from Meteorological Branch, 1968)

Day	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1						1.69						
2		0.73										1.05
3		1.08										0.81
4			1.51									
5			0.57									
6										0.61		
7												1.00
8											0.52	
9										0.57		
10												0.70
11			1.06								1.00	
12	1.38		0.77									
13	0.68			0.65								
14				0.62					0.54			
15												
16									1.64			
17		0.63								0.71		
18	3.46	1.96										
19	2.24							0.53		0.95		
20	0.58				0.52							
21										0.50		
22		0.64										0.53
23		0.87						0.55		0.82		1.02
24												0.54
25								1.04				
26			0.87			0.50		0.58				
27			0.66									
28												
29											0.50	
30				0.62								0.53
31												0.74

the larger relative errors between the simulated and published daily discharge at Port Mann occur specifically during the periods when the intensity of the rainfall is very important, and these relative errors become more and more significant as the daily river discharge descreases. This fact indicates that either the rainfall runoff was totally neglected or under-estimated during the calculation of the published discharge at Port Mann, or that the methods (correlation and rational) used to estimate the lateral inflow have a general trend of over-estimating the lateral inflow. This remark re-emphasizes the need to establish a reliable method for the determination of the lateral inflow resulting from the runoff over the Lower Fraser River basin.

5.3 Cost Estimate of the Project

The purpose of this section is to provide some information concerning the schedule adopted for the completion of this project and the expenses associated with the utilization of the CYBER 74 computer system located at the Computer Science Centre. In order to allow a comparison with other systems, the processing charges are also given in terms of central processing (CP) time, input-output (IO) transfer time and central memory (CM) used.

The work done for the application of the 1-D model to the generation of the 1968 hydrometric data of the Lower Fraser River extended between March and September 1985, and can be summarized according to the following schedule:

March:

- Preparation of 1-D input data (lateral inflow, discharge at Ruskin);
- Calibration of the 1-D model to the 1968 conditions;
- running of the model for the complete year.

April:

- Analysis of results and comparison between simulated and observed water levels at Port Hammond and Whonock;
- Localization and correction of errors in the water level data (February and July);
- Development of a new method (rational method) for the calculation of the lateral inflow during periods of heavy rainfall and low flow in the Fraser River;
- Re-running of the model for the periods affected by errors in the water levels and lateral inflow data.

May:

- Computation of the daily mean values of discharge and water level;
- Development of a program to compute the daily suspended sediment loadings (SEDIM.PGM);
- Computation of the daily suspended sediment loadings.

June-September:

- Writing of first draft report.

The total cost associated with the utilization of the computer represents $3,093.36. This amount includes all the discounts related to the low batch priority used and all the rebates granted by CSC. The details of the costs are given in Table 5.15. Since the project was realized over two different fiscal years (1984-85 and 1985-86) the Table presents separate values (March 1985 and April-June 1985). The Table indicates that the most expensive items correspond to the processing charges (including CP time, IO time and CM occupancy ($2,218.03)), and the storage of results on permanent

Table 5.15

Costs Associated with the Computer Utilization

Description	March 1985	April-June, 1985	Sum
Processing charges	$1,645.87	$ 572.16	$2,218.03
Unit record charges	296.34	67.12	363.46
Operator activity charges	-	24.75	24.75
Permanent disk file charges	522.54	4,196.07	4,718.61*
Library services	-	34.53	34.53
Rental/Sale	-	15.50	15.50
Sub-total	2,464.75	4,910.13	7,374.88
CSC Adjustment (rebate)	-$2,464.75	-$1,816.77	-$4,281.52
			$3,093.36

* The cost associated with the permanent disk file storage is controlled mainly by the storage of the TAPE10 files (output file of the 1-D model containing the simulated discharges and water levels at every computational mesh point and every time step). These files were stored on the disk for approximately two months before being dumped to a tape. The cost may be estimated as: permanent disk file charges = ($45.90 per week of simulation, per month of storage) x (52 weeks per year) x (2 months of storage) = $4,773.60.

disk files ($4,718.61). Most of the storage on the disk files consist o TAPE10 files (simulated discharges and water levels at every computation mesh point and at every time step). The amount of money spent for [illegible]ora is rather high, because the files were kept on disk for a period of approximately two months before being dumped on a tape. This element should be taken into consideration for the next project, and the TAPE10 file should be dumped on tape as soon as possible.

An estimate of the way the money was spent as processing charges is presented in Table 5.16. This Table represents only an approximation an the details could be obtained from the Statement of Charges produced by Computer Science Centre. It may be interesting to note in this table th the 90% discount weekend-rate was taken into consideration during this study, and this has allowed to keep the processing costs rather small ($2,218.03 instead or $13,795.63). This advantage should also be taken into consideration during the realization of any other projects.

Table 5.16

Estimation of Processing Costs

Description	CP per run (sec)	IO per run (sec)	CM per run (words·10^6)	$ per run	No of runs	Total $ before priority rate discount	Priority rate discount (%)	Total after priority rate discount
Calibration of model	135/day	147/day	37/day	$ 23/day	3 days, 3 runs/day	207.00	0	207.00
Verification of calibration	135/day	147/day	37/day	$ 23/day	44 days, 2 runs/day	2,024.00	90	202.40
1968 simulation	732/week	495/week	246/week	$135/week	52 weeks, 1 run/week	7,020.00	90	702.00
Correction runs*	732/week	495/week	246/week	$135/week	5 weeks, 1 run/week	675.00	90	67.50
Redundant runs**	732/week	495/week	246/week	$135/week	27 weeks, 1 run/week	3,645.00	90	364.50
Mean values	53/month	238/month	14/month	$ 11/month	12 months, 1 run/month	132.00	0	132.00
Suspended sediment loading calculation	64/month	218/month	14/month	$ 11/month	12 months, 1 run/month	132.00	0	132.00
Other	-	-	-	-	-	410.63	-	410.63
Total						13,795.63		2,218.03

* Jobs that had to be rerun for the periods where water level errors were detected (4 weeks in February and 1 week in July).

** Jobs that were run because of an error in the JCL for the week of December 9-15. JCL was chaining to the JCL of November 25-December 1, resulting in a nested loop. The loop ran 9 times before abortion was requested, so that 9 x 3 = 27 runs were redundant.

Recommendations

The recommendations presented herein arise from the experience gained during this particular project, and also from the application of the 1-D model to Lower Fraser River for the generation of the 1983 and 1984 hydrometric data. The purpose of these recommendations consists of improving the simulations by reducing the time required to prepare and verify the input and output data, and by increasing the accuracy of the simulated discharges and water levels:

- A computer program should be prepared for the purpose of comparing the simulated and observed 15-minute water levels at Port Hammond and Whonock. The output of this program should include statistical variables such as daily means and standard deviations.

- A method should be developed for the calculation of the lateral inflow during periods when both heavy rainfall and low flow in the Fraser River occur simultaneously.

- The variation of the Manning's roughness coefficients according to location, depth and flow conditions (empirical, semi-empirical or theoretical formulation) should be better understood.

- A computer program should be prepared for the purpose of replacing the missing values (-999) in the annual records of the 15-minute water levels at Mission, Port Coquitlam, Port Hammond, Port Mann and Whonock. The missing values would have to be replaced by water levels corresponding to approximate actual values. This program would also have to check for missing cards (12 cards per day, 365 or 366 days per year), errors in stations, dates or codes identification, and abnormal changes (too ra- - c

too slow) between consecutive 15-minute values resulting from gauges malfunction or from errors that may have occurred during the digitizing process.

- A computer program should be prepared in order to check the annual record of the hourly hydroelectrical power produced at the Ruskin Power House. The program should be able to locate the missing cards, errors in dates and codes identification, and finally typing errors in hourly values (illogical values) that may have occurred during the card punching process.

- The TAPE10 files produced by the 1-D model should be dumped from the disk to a tape as soon as possible, in order to keep the storing cost low (the results for a period of one week cost approximately $45.90 per month of storage on the disk).

List of References

1. Ages, A. and Woollard, A., 1976. The Tides in the Fraser Estuary, Institute of Ocean Sciences. Pacific Marine Science Report 76-5, Patricia Bay, Victoria, Canada.

2. Inland Waters Branch, 1968. Sediment Data for Canadian Rivers. Water Survey of Canada, Department of Energy, Mines and Resources, Ottawa, Canada.

3. Inland Waters Branch, 1970. Hydrometric and Sediment Survey, Lower Fraser River Progress Report 1965-68. Sediment Survey Section, Department of Energy, Mines and Resources, Ottawa, Canada.

4. Meteorological Branch, January-December 1968. Monthly Record/Meteorological Observations in Canada. Department of Transport, Toronto, Canada.

5. Water Planning and Management Branch, July 1982. Enviroment Canada One-Dimensional Hydrodynamic Model Computer Manual. Inland Waters Directorate, Environment Canada, Ottawa, Canada.

6. Water Planning and Management Branch et al., June 1983. The Application of a 1-Dimensional Hydrodynamic Model to the Lower Fraser River - Fraser River Model Study, Inland Waters Directorate, Environment Canada, Ottawa, Canada.

7. Water Resources Branch, 1983. Surface Water Data - Reference Index Canada 1983. Water Survey of Canada, Inland Waters Directorate, Environment Canada, Ottawa.

APPENDIX 1

Different Versions of the 1-D Model

Different Versions of the 1-D Model

Permanent File Name (PFN)	Identification (ID)	Cycle (CY)	Type	Maximum Number of Days	Automati Interpolation of n values Q 199,500 cfs
ONEDEEFRASER	BERNARD	1	Source	7	No
ONEDSMAL	MSJLY81	X	Source	2	No
ONEDSMAL	BMMAR85	X	Source	2	Yes
ONEDEEFRASER	BERNARD	111	Compiled	7	No
LGOSHORT	BMMAR85	X	Compiled	2	No
LGOSMAL	BMMAR85	X	Compiled	2	Yes

APPENDIX 2

Description of Computer Files

2.1 Indirect Permanent Files (IPF)

List of Major Indirect Permanent Files (IPF)
Available on the FRASER83 Library

IPF Name	Description
CHECK.WL	Source program written in order to verify the gradient between every 15 minutes water level values corresponding to the boundary conditions. This program has not been used for this project, because additional testing is required.
DATE.68	Data file containing a list of the dates for every day of the year 1968, including the preceeding (December 31, 1967) and the following (January 1, 1969) days.
DEBIT.68	Data file containing the annual record of the estimated daily lateral inflow corresponding to the rainfall runoff over the ungauged sub-basin between Mission and Port Mann. It includes the values for December 31, 1967 and January 1, 1969.
FRAME	Input file of the 1-D model containing the description of the boundaries, the location of the lateral inflow and the output requirements (hydraulic profiles and hydrographs). The numerical values (actual data) of the boundary conditions and lateral inflows will be merged into this file in a later step during the data processing.
FUSION	Source program that reads the annual record of the lateral inflow (IPF=DEBIT.68) and the file containing the list of the dates for the year (IPF=DATE.68), and generates a permanent file (PFN=RUNOFF, ID=DIS68) containing the annual record of daily date and lateral inflow.
FUSION.JCL	JCL program used to run FUSION program.
INPUT5.TEM	Input file of the 1-D model containing the information concerning the topology of the network and the description of the physical properties of the river.
JCL.DAY	JCL program used to run the 1-D model for a period of 1 day. The date must be specified by the user.
JCL.WEK	JCL program used to run the 1-D model for a period of 7 days. The date and period must be defined by the user. At the end of the run, the program has the ability to submit automatically the JCL for the run of the next week.
MEANS.JCL	Source program that produces the monthly record of the daily discharges and water levels in every reach, at the computational mesh points requested by the user. The program also determines the maximum and minimum 15-minute discharge for every day, and the corresponding water levels and time of occurrence. The first part of the program includes a short JCL program needed in order to run the program.

List of Major Indirect Permanent Files (IPF)
Available on the FRASER83 Library (cont'd)

IPF Name	Description
NSURVEY	Source program that reads the annual records of the 15-minute water levels at Port Mann (PFN=08MH054, ID=WL68), Port Coquitlam (PFN=08MH035, ID=WL68) and Mission (PFN=08MH024, ID=WL68) referenced to the gauges datum, and generates the 1-D model boundary conditions at all three stations relative to the GSC datum for the specific period of time.
NSURVEY.LGO	Compiled version of NSURVEY program.
QRUSKIN	Source program that reads the annual record of the hourly hydro-electrical power produced at the Ruskin Power House (PFN=RUSKIN, ID=DIS68) and generates the 1-D model boundary conditions at Ruskin (hourly discharges) for the specified period of time.
QRUSKIN.LGO	Compiled version of QRUSKIN program.
RUNOFF	Source program that reads the annual record of the lateral inflow (PFN=RUNOFF, ID=DIS68) and generates the 1-D model lateral inflow at every 12 hours for the specified period of time.
RUNOFF.LGO	Compiled version of RUNOFF program.
SEDIM.JCL	JCL program used to run SEDIM.PGM program.
SEDIM.PGM	Source program that computes the daily suspended sediment loadings at Port Mann from both the hourly and the daily river discharge and concentration, and compares these loadings with the values published by WSC. The program also compares the simulated daily discharges at Port Mann and Mission with the values published by WSC.

2.2 Permanent Files (PFN)

Index of Major Permanent File Names (PFN)

PFN Name	ID	Description
FRASER	68HSED	Annual record of hourly concentrations at Port Mann. This file does not include the corrections required for the month of May.
FRASER10	MONDAYR*	Binary coded file containing the simulated discharges and water levels at every computational mesh point and every time step. This file can be used for plots and for the computation of daily mean values.
FRASER17	MONADYR**	Binary coded file containing the simulated discharges and water levels at every computational mesh point, at the end of the simulation period (last time step). This file can be used for the initial conditions of the next period to be simulated.
FRASERNEW	68HSED	Annual record of hourly concentrations at Port Mann. This file includes the corrections required for the month of May.
FRASERMEANS	MON0168***	Monthly record of the simulated daily discharges and water levels in every reach, at the computational mesh point requested by the user. These values are formatted according to WSC standards.
FRASERQMAX	MON0168***	Monthly record of the maximum and minimum simulated 15-minute discharges for every day, and the corresponding water levels and time of occurrence.
LGOSHORT	BMMAR85	Compiled version of the 1-D model. The dimensions allow the model to run for a period of up to 2 days.
LGOSMAL	BMMAR85	Compiled version of the modified 1-D model. It includes the automatic interpolation of the Manninng's roughness coefficients for discharges at Mission larger than 199,500 cfs. The dimensions allow the model to run for a period of up to 2 days.
ONEDEEFRASER	BERNARD	Source (cycle=1) or compiled (cycle=111) version of the 1-D model. The dimensions allow the model to run for a period of up to 7 days.
ONEDSMAL	BMMAR85	Source version of the modified 1-D model. It includes the automatic interpolation of the Manning's roughness coefficients for discharges at Mission larger than 199,500 cfs. The dimensions allow the model to run for a period of up to 2 days.

PFN Name	ID	Description
ONEDSMAL	MSJLY81	Source version of the 1-D model. The dimensions allow the model to run for a period of up to 2 days.
OUTPUT	MONDAYR*	File containing a copy of the print-out of the 1-D model (hydrographs and profiles).
RUNOFF	DIS68	Annual record of daily lateral inflow, including the inflow for December 31, 1967 and January 1, 1969.
RUSKIN	DIS68	Annual record of the hourly hydroelectrical power produced at the Ruskin Power House.
08MH024	DAILYQ	Annual record of daily discharges at Mission, as published by WSC.
08MH024	WL68	Annual record of the 15-minute water levels measured at Mission.
08MH035	WL68	Annual record of the 15-minute water levels measured at Port Coquitlam.
08MH043	HR1968	Annual record of the 15-minute water levels measured at Port Hammond.
08MH044	HR1968	Annual record of the 15-minute water levels measured at Whonock.
08MH054	DAILYQ	Annual record of daily discharges at Port Mann, as published by WSC.
08MH054	DAILYG	Annual record of daily suspended sediment loadings at Port Mann, as published by WSC.
08MH054	FEB68	Record of the 15-minute water levels measured at Port Mann, for the time segment between January 29, 1968 and March 31, 1968.
08MH054	WL68	Annual record of the 15-minute water levels measured at Port Mann. The values for the time segment between January 29, 1968 and February 25, 1968 contains errors and should be obtained from PFN=08MH054, ID=FEB68.

* MONDAYR corresponds to the identification of the period simulated, where: MON = three first letters of the month; DA = date of the firs day of the simulated period; YR = year (68)

** MONADYR corresponds to the identification of the period preceeding the simulated period in order to obtain approximate initial conditions, where: MON = three first letters of the month; AD = date of the first day of the simulated period; YR = year (68)

*** MON0168 corresponds to the identification of the first day of the month, where MON = three first letters of the month.

APPENDIX 3

List of Files Available on Tapes E24206 and E24207

PERMANENT FILE NAME	CYCLE	OWNER	VSN
OUTPUT	1	FEB1968	E24206
FRASER10	2	FEB1968	E24206
FRASER17	1	FEB1968	E24206
FRASERMEANS	2	DEC0168	E24206
RUSKIN	1	DIS68	E24206
08MH054	5	WL68	E24206
FRASER10	1	AUG1268	E24206
08MH024	4	WL68	E24206
RUNOFF	2	DIS68	E24206
08MH054	1	FE868	E24206
08MH024	666	WL83	E24206
OUTPUT	1	JUL2268	E24206
FRASER10	2	JUL2268	E24206
FRASER17	1	JUL2268	E24206
FRASERMEANS	2	JUL0168	E24206
FRASERMEANS	2	FEB0168	E24206
FRASERQMAX	2	FEB0168	E24206
FRASERMEANS	2	JAN0168	E24206
FRASERQMAX	2	JAN0168	E24206
08MH035	666	WL83	E24206
08MH054	1	WL68	E24206
FRASERMEANS	1	JAN0168	E24206
08MH035	4	WL68	E24206
FRASERQMAX	1	JAN0168	E24206
08MH126	666	WL83	E24206
08MH043	1	HR1968	E24206
08MH044	1	HR1968	E24206
FRASER17	1	FEB0568	E24206
FRASER17	1	FEB1268	E24206
OUTPUT	1	FEB1268	E24206
FRASER10	1	AUG1968	E24206
FRASER10	1	AUG2668	E24206
FRASER10	1	OCT2168	E24206
FRASERMEANS	1	MONDAYR	E24206
FRASER10	1	SEP0268	E24206
FRASERQMAX	1	MONDAYR	E24206
FRASER10	1	SEP0968	E24206
FRASER10	1	OCT2868	E24206
FRASER10	1	NOV0468	E24206
FRASER10	1	SEP1668	E24206
FRASER10	1	NOV1168	E24206
FRASER10	4	JAN2268	E24206
FRASER17	2	JAN2968	E24206
FRASER10	1	FEB2668	E24206
FRASER10	1	NOV1868	E24206
FRASER10	1	MAR0468	E24206
FRASER10	1	SEP2368	E24206
FRASER10	1	MAR1168	E24206
FRASER10	1	SEP3068	E24206
FRASER10	1	DEC3168	E24206
FRASER10	1	MAY1768	E24206
FRASER10	11	DEC0968	E24206
FRASER10	1	MAR1868	E24206

PERMANENT FILE NAME	CYCLE	OWNER	
ONEDEEFRASER	1	BERNARD	E
FRASER10	11	DEC0268	E
FRASER10	1	MAR2568	E
ONEDEEFRASER	111	BERNARD	E
FRASER10	1	OCT0768	E
FRASER10	1	APR0168	E
FRASER10	11	NOV2568	E
FRASER10	1	APR0868	E
FRASER10	1	APR1568	E
FRASER10	1	OCT1468	E
FRASERMEANS	1	APR0168	E
FRASER10	2	FEB1268	E
FRASERQMAX	1	APR0168	E
FRASERMEANS	1	FEB0168	E
FRASERQMAX	1	FEB0168	E
FRASER10	1	APR2268	E
FRASER10	1	DEC1668	E
FRASER10	1	DEC2368	E
FRASER10	1	DEC3068	E
FRASER10	1	APR2968	E
OUTPUT	1	FEB0568	E
FRASER10	1	MAY0668	E
FRASERMEANS	3	MONDAYR	E
FRASER10	1	MAY1368	E
FRASERQMAX	3	MONDAYR	E
FRASERMEANS	1	DEC0168	E
FRASERQMAX	1	DEC0168	E
FRASERMEANS	1	NOV0468	E
FRASER10	1	MAY2068	E
FRASER10	1	MAY2768	E
FRASER10	1	JUL0168	E
FRASER10	1	JUN0368	E
FRASER10	1	JAN0868	E
FRASER10	2	JAN0768	E
FRASERQMAX	1	NOV0468	E
FRASER10	1	JAN1568	E
FRASER10	1	JUN1068	E
FRASERMEANS	2	MONDAYR	E
FRASER10	4	JAN0168	E
FRASERQMAX	2	MONDAYR	E
FRASER10	2	MAY2868	E
FRASER10	4	JAN0468	E
FRASER10	1	JUN1768	E
FRASER10	1	JUN2468	E
FRASER10	1	JUL0868	E
FRASER17	1	JUL1568	E
FRASERQMAX	2	JUL0168	E
FRASER10	1	JUL2968	E
FRASER10	1	AUG0568	E
FRASERMEANS	1	JUN0168	E
FRASERQMAX	1	JUN0168	E
LGOSHORT	1	RMMAR95	E

PERMANENT FILE NAME	CYCLE	OWNER	VSN
FRASERMEANS	1	OCTO168	E24207
FRASERQMAX	1	OCTO168	E24207
FRASERMEANS	1	MARO168	E24207
FRASERMEANS	1	SEPO168	E24207
FRASERQMAX	1	MARO168	E24207
FRASERQMAX	1	SEPO168	E24207
FRASERMEANS	1	AUGO168	E24207
FRASERQMAX	1	AUGO168	E24207
FRASERMEANS	1	JULO168	E24207
FRASERQMAX	1	JULO168	E24207
FRASER10	2	FEB0568	E24207
RUSKIN	1	DIS83	E24207
LGOSMAL	1	BMMAR85	E24207
ONEDSMAL	4	MSJLY81	E24207
OUTPUT	1	JAN2968	E24207
FRASER10	2	JAN2968	E24207
RUSKIN	3	DIS68	E24207
FRASERMEANS	3	JANO168	E24207
FRASERQMAX	3	JANO168	E24207
FRASER17	1	JULO868	E24207
OUTPUT	1	JUL1568	E24207
FRASER10	2	JUL1568	E24207

APPENDIX 4

Listing of Computer Programs

FUSION.JCL Program

```
ICPJO,CM100000,T150,P2.  FUSION-JCL                                    000100
ACCOUNT,22956.                                                         000110
COMMENT.*************************************************************  000120
COMMENT.*  THIS JCL RUNS PROGRAM FUSION.  IT MERGES THE DATE         *  000130
COMMENT.*  FILE WITH THE DAILY RUNOFF FILE, TO CREATE ONLY           *  000140
COMMENT.*  FILE.                                                     *  000150
COMMENT.*************************************************************  000160
                                                                       000170
IUSE,FRASER83,FRASER83,FRASER83.                                       000180
IGET,TAPE5=DATE.68.                                                    000190
IGET,TAPE55=DEBIT.68.                                                  000200
IGET,PGM=FUSION.                                                       000210
REQUEST,TAPE98,*PF.                                                    000220
FTN(L=0,I=PGM).                                                        000230
LGO.                                                                   000240
CATALOG,TAPE98,RUNOFF,ID=DIS68,RP=999.                                 000250
REWIND TAPE98.                                                         000260
COPYSBF,TAPE98,OUTPUT.
```

FUSION Program

```
      PROGRAM FUSION(INPUT,OUTPUT,TAPE98,TAPE5,TAPE55)
      KO=98
      KIN1=5
      KIN2=55
      JDAY=365
      IYEAR=IYR/4
      IYEAR=IYEAR*4
      IF(IYEAR.EQ.IYR) JDAY=366
      KDAY=JDAY+2
      DO 10 I=1,KDAY
      READ(KIN1,5) IYR,MONDA
      READ(KIN2,6) Q
      WRITE(KO,7) IYR,MONDA,Q
   10 CONTINUE
    5 FORMAT(I2,I4)
    6 FORMAT(F10.0)
    7 FORMAT(4X,I2,I4,F10.0)
      STOP
      END
```

JCL.DAY Program

```
10PJO,CM200000,T290,P2.   JCL-DAY                                          000100
ACCOUNT,22956.                                                             000110
COMMENT.*****************************************************************  000120
COMMENT.*                                                               *  000130
COMMENT.*                F R A S E R   M O D E L                        *  000140
COMMENT.*  THIS JCL IS PREPARED TO RUN 1 DAY WITH THE 1-D MODEL,        *  000150
COMMENT.*  USING DATA FROM ANNUAL RECORDS.  THE USER MUST MODIFY        *  000160
COMMENT.*  THE FOLLOWING STATEMENTS:                                    *  000170
COMMENT.*      /YRMODA/ BY THE BEGINNING OF THE REQUESTED PERIOD       *  000180
COMMENT.*      /MONDAYR/ BY THE BEGINNING OF THE REQUESTED PERIOD      *  000190
COMMENT.*      /MONADYR/ BY THE STARTING DAY OF THE PRECEEDING PE-*        000200
COMMENT.*                RIOD.                                          *  000210
COMMENT.*                                                               *  000220
COMMENT.*****************************************************************  000230
IUSE,FRASER83,FRASER83,FRASER83.                                           000240
IGET,LG01=NSURVEY.LGO.                                                     000250
ATTACH,TAPE91,08MH054,ID=WL68.                                             000260
ATTACH,TAPE92,08MH035,ID=WL68.                                             000270
ATTACH,TAPE93,08MH024,ID=WL68.                                             000280
COPYBR,INPUT,LINPUT.                                                       000290
REWIND LINPUT.                                                             000300
LG01(LINPUT).                                                              000310
REWIND LINPUT.                                                             000320
UNLOAD LGO.                                                                000330
IGET,LG02=GRUSKIN.LGO.                                                     000340
ATTACH,TAPE96,RUSKIN,ID=DIS68.                                             000350
LG02(LINPUT).                                                              000360
REWIND LINPUT.                                                             000370
UNLOAD LGO.                                                                000380
IGET,LG03=RUNOFF.LGO.                                                      000390
ATTACH,TAPE98,RUNOFF,ID=DIS68.                                             000400
LG03(LINPUT).                                                              000410
REWIND(TAPE26,TAPE35,TAPE24,TAPE11,TAPE12).                                000420
UNLOAD LGO.                                                                000430
IGET,FRAME.                                                                000440
IGET,HALF=INPUT5.TEM.                                                      000450
MSUEDIT.                                                                   000460
ATTACH,LGO,LGOSHORT,ID=BMMAR85,MR=1.                                       000470
COPYBR,HALF,TAPE5.                                                         000480
COPYBF,FRAME,TAPE5.                                                        000490
REWIND,TAPE5.                                                              000500
ATTACH,TAPE16,FRASER17,ID=MONADYR.                                         000510
UNLOAD(TAPE12).                                                            000520
REQUEST,TAPE17,*PF.                                                        000530
REQUEST,TAPE10,*PF.                                                        000540
LGO.                                                                       000550
REWIND,TAPE10.                                                             000560
REWIND,TAPE17.                                                             000570
CATCYC,TAPE17,FRASER17,ID=MONDAYR,RP=10,KP=1.                              000580
CATCYC,TAPE10,FRASER10,ID=MONDAYR,RP=10,KP=1.                              000590

YRMODA                                                                     000610
001                                                                        000620

LENGTH 80.                                                                 000640
EDIT,FRAME,FR,100,BY,100.                                                  000650
INSERT,TAPE12,AT,310,BY,1.                                                 000660
INSERT,TAPE26,AT,510,BY,1.                                                 000670
INSERT,TAPE35,AT,810,BY,1.                                                 000680
INSERT,TAPE24,AT,1810,BY,1.                                                000690
INSERT,TAPE11,AT,2010,BY,1.                                                000700
/RUN/*/MONDAYR/ 400.                                                       000710
/ITE/*/096/ *A.                                                            000720
/ITO/*/030/ 2000.                                                          000730
```

```
SAVE,FRAME,NS.                                                  000760
EDIT,HALF,FR,100,BY,100.                                        000770
/ITE/=/096/ 300.                                                000780
/TOTIME/=/ 86400/ 300.                                          000790
SAVE,HALF,NS.                                                   000800
```

JCL.WEK Program

```
ICPJD,CM230000,T1500,STWDJ.   JCL-WEK                                    000100
ACCOUNT,22556.                                                           000110
COMMENT.*****************************************************************000120
COMMENT.*                                                               *000130
COMMENT.*                  F R A S E R   M O D E L                      *000140
COMMENT.*  THIS JCL IS PREPARED TO RUN 7 DAYS WITH THE 1-D MODEL,       *000150
COMMENT.*  USING DATA FROM ANNUAL RECORDS.  THE USER MUST MODIFY        *000160
COMMENT.*  THE FOLLOWING STATEMENTS:                                    *000170
COMMENT.*       /YRMODA/ BY THE BEGINNING OF THE REQUESTED PERIOD      *000180
COMMENT.*       /MONDAYR/ BY THE BEGINNING OF THE REQUESTED PERIOD     *000190
COMMENT.*       /MONADYR/ BY THE STARTING DAY OF THE PRECEEDING PE-    *000200
COMMENT.*                 RIOD.                                         *000210
COMMENT.*       /MONNDYR/ BY THE DATE OF THE FIRST DAY OF THE          *000220
COMMENT.*                 NEXT PERIOD.                                  *000230
COMMENT.*                                                               *000240
COMMENT.*****************************************************************000250
IUSE,FRASER83,FRASER83,FRASER83.                                         000260
IGET,LGO1=NSURVEY.LGO.                                                   000270
ATTACH,TAPE91,08MH054,ID=WL68.                                           000280
ATTACH,TAPE92,08MH035,ID=WL69.                                           000290
ATTACH,TAPE93,08MH024,ID=WL68.                                           000300
COPYBR,INPUT,LINPUT.                                                     000310
REWIND LINPUT.                                                           000320
LGO1(LINPUT).                                                            000330
REWIND LINPUT.                                                           000340
UNLOAD LGO.                                                              000350
IGET,LGO2=GRUSKIN.LGO.                                                   000360
ATTACH,TAPE96,RUSKIN,ID=DIS68.                                           000370
LGO2(LINPUT).                                                            000380
REWIND LINPUT.                                                           000390
UNLOAD LGO.                                                              000400
IGET,LGO3=RUNOFF.LGO.                                                    000410
ATTACH,TAPE98,RUNOFF,ID=DIS68.                                           000420
LGO3(LINPUT).                                                            000430
REWIND(TAPE26,TAPE35,TAPE24,TAPE11,TAPE12).                              000440
UNLOAD LGO.                                                              000450
IGET,FRAME.                                                              000460
IGET,HALF=INPUT5.TEM.                                                    000470
MSUEDIT.                                                                 000480
*REQUEST,TAPE10,*PF.                                                     000490
REQUEST,TAPE17,*PF.                                                      000500
REQUEST,TAPE18,*PF.                                                      000510
ATTACH,LGO,ONEDEEFRASER,ID=BERNARD,CY=111,MR=1.                          000520
COPYBR,HALF,TAPE5.                                                       000530
COPYBF,FRAME,TAPE5.                                                      000540
REWIND,TAPE5.                                                            000550
ATTACH,TAPE16,FRASER17,ID=MONADYR.                                       000560
UNLOAD(TAPE12).                                                          000570
LGO(TAPE5).                                                              000580
REWIND,OUTPUT.                                                           000590
COPYBF,OUTPUT,TAPE18,9999.                                               000600
CATCYC,TAPE18,OUTPUT,ID=MONDAYR,KP=1,RP=10,OR=INFINITE.                  000610
REWIND,OUTPUT.                                                           000620
DISPOSE,OUTPUT.                                                          000630
CATCYC,TAPE10,FRASER10,ID=MONDAYR,RP=10,KP=1.                            000640
CATCYC,TAPE17,FRASER17,ID=MONDAYR,KP=1,RP=10.                            000650
IGET,NEXT=MONNDYR.JCL.                                                   000660
SUBMIT,NEXT.                                                             000670
EXIT(S).                                                                 000680
DMP.                                                                     000690

YRMODA                                                                   000710
007                                                                      000720
```

```
LENGTH 80.                                                      000740
EDIT,FRAME,FR,100,BY,100.                                       000750
INSERT,TAPE12,AT,310,BY,1.                                      000760
INSERT,TAPE26,AT,510,BY,1.                                      000770
INSERT,TAPE35,AT,810,BY,1.                                      000780
INSERT,TAPE24,AT,1810,BY,1.                                     000790
INSERT,TAPE11,AT,2010,BY,1.                                     000800
/RUN/*/MONDAYR/ 400.                                            000810
/ITE/*/672/ *A.                                                 000820
/ITQ/*/174/ 2000.                                               000830
/ IL/*/013/ 300.                                                000840
L *A.                                                           000850
SAVE,FRAME,NS.                                                  000860
EDIT,HALF,FR,100,BY,100.                                        000870
/ITE/*/672/ 300.                                                000880
/TOTIME/*/604800/ 300.                                          000890
SAVE,HALF,NS.                                                   000900
```

NSURVEY Program

```
C **********
C     THIS PROGRAM READS 15 MINUTES WATER LEVELS (REFERENCED TO
C     GAUGE DATUM) FROM THE ANNUAL RECORDS AT PORT MANN (TAPE91),
C     PORT COQUITLAM (TAPE92) AND MISSION (TAPE93), AND WRITES
C     THE 15 MINUTES WATER LEVELS (REFERENCED TO G.S.C. DATUM)
C     FOR THE REQUESTED DATES ON TAPE26 (PORT MANN),
C     TAPE35 (PORT COQUITLAM) AND TAPE24 (MISSION).
C
C     THE CONVERSION FROM GAUGE DATUM TO G.S.C. DATUM IS DONE BY
C     THE USE OF THE COEFFICIENT "ADJUST" WHICH IS ADDED TO
C     THE DATA READ FROM THE ANNUAL RECORDS.  THE USER MUST CHANGE
C     THESE VALUES IF NECESSARY.
C
C                     ANNUAL RECORD      ADJUST      REQUESTED PERIOD DATA
C    08MH126(08MH054)  TAPE91           -8.54            TAPE26
C    08MH035           TAPE92           -8.54            TAPE35
C    08MH024           TAPE93            0.24            TAPE24
C
C     THE FOLLOWING VALUES ARE ASSUMED:
C          -NUMBER OF DATA PER CARD=8
C          -NUMBER OF CARDS PER DAY PER STATION=12
C
C     THE FOLLOWING VALUES MUST BE DEFINED BY THE USER:
C          -THE STARTING DATE:  YEAR/MONTH/DAY
C          -THE NUMBER OF DAYS TO BE READ
C
C **********
      PROGRAM MSURVEY(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     *TAPE26,TAPE35,TAPE24,TAPE43,TAPE44,TAPE91,TAPE92,TAPE93,
     *TAPE94,TAPE95)
      DIMENSION DATAX(8)
C
C ***** READ THE REQUESTED PERIOD(INITIAL DATE, NB. OF DAYS)
C
      READ(5,1)IYR,MONDA
    1 FORMAT(I2,I4)
      READ(5,2) NDAYS
    2 FORMAT(I3)
      LYR=IYR
      LMONDA=MONDA
      IF(NDAYS.EQ.1) GOTO 75
      MDAYS=NDAYS-1
      IFEBDY=0228
      IYEAR=IYR/4
      IYEAR=IYEAR*4
      IF(IYR.EQ.IYEAR) IFEBDY=0229
C
C ***** DETERMINE THE LAST DAY'S DATE OF THE REQUESTED
C       PERIOD.  SPECIAL CARES MUST BE TAKEN FOR THE
C       TRANSITION BETWEEN TWO MONTHS.
C
      DO 70 I=1,MDAYS
      IF(LMONDA.NE.0131) GOTO 10
      LMONDA=0201
      GOTO 70
   10 IF(LMONDA.NE.IFEBDY) GOTO 15
      LMONDA=0301
```

```
      GOTO 70
   15 IF(LMONDA.NE.0331) GOTO 20
      LMONDA=0401
      GOTO 70
   20 IF(LMONDA.NE.0430) GOTO 25
      LMONDA=0501
      GOTO 70
   25 IF(LMONDA.NE.0531) GOTO 30
      LMONDA=0601
      GOTO 70
   30 IF(LMONDA.NE.0630) GOTO 35
      LMONDA=0701
      GOTO 70
   35 IF(LMONDA.NE.0731) GOTO 40
      LMONDA=0801
      GOTO 70
   40 IF(LMONDA.NE.0831) GOTO 45
      LMONDA=0901
      GOTO 70
   45 IF(LMONDA.NE.0930) GOTO 50
      LMONDA=1001
      GOTO 70
   50 IF(LMONDA.NE.1031) GOTO 55
      LMONDA=1101
      GOTO 70
   55 IF(LMONDA.NE.1130) GOTO 60
      LMONDA=1201
      GOTO 70
   60 IF(LMONDA.NE.1231) GOTO 65
      LMONDA=0101
      LYR=LYR+1
      GOTO 70
   65 LMONDA=LMONDA+1
   70 CONTINUE
   75 NCARDS=NDAYS*12
C
C  ***** SET FILES FOR THE FIRST STATION
C
      KIN=91
      KO=26
C
C  ***** ADJUSTMENT FACTOR TO CONVERT WATER LEVELS TO G.S.C.
C
      ADJUST=-8.54
C
C  ***** LOCATE THE STARTING POSITION IN THE ANNUAL
C        RECORD FILE.
C
  100 READ(KIN,3) KYR,KMONDA
    3 FORMAT(8X,I2,I4)
      IF(EOF(KIN).NE.0) GO TO 355
      IF(KYR.EQ.IYR.AND.KMONDA.EQ.MONDA) GOTO 110
      GOTO 100
  110 BACKSPACE KIN
C
C  ***** WHEN THE STARTING POSITION IS DETERMINED, READ
C        DATA AND CREATE THE OUTPUT FILE.
```

```
C
      DO 300 I=1,NCARDS
      READ(KIN,4) ITYPE,STA,NO,JYR,JMONDA,KCARD,DATAX
      DO 200 J=1,8
      DATAX(J)=DATAX(J)+ADJUST
200   CONTINUE
      WRITE(KO,4) ITYPE,STA,NO,JYR,JMONDA,KCARD,DATAX
    4 FORMAT(I1,A5,I2,I2,I4,I2,8F8.2)
  300 CONTINUE
C
C ***** CHECK IF THE "LAST DATE READ" CORRESPONDS TO
C       THE DATE OF THE "LAST DAY REQUESTED".
C
      IF(LMONDA.EQ.JMONDA.AND.LYR.EQ.JYR.AND.KCARD.EQ.12) GOTO 310
      WRITE(6,5) STA,NO
    5 FORMAT(/,5X,"MISSING DATA AT STATION ",A5,I2,/)
C
C ***** SET FILES FOR THE NEXT STATION
C
  310 IF(KIN.NE.91) GOTO 330
      KIN=92
      KO=35
      ADJUST=-8.54
      GOTO 100
  330 IF(KIN.NE.92) GOTO 355
      KIN=93
      KO=24
      ADJUST=0.24
      GOTO 100
  355 STOP
      END
```

QRUSKIN Program

```
C **********
C     THIS PROGRAM READS THE ANNUAL RECORD OF THE HOURLY HYDROELECTRICAL
C     PRODUCTION AT THE RUSKIN POWER HOUSE (TAPE96) AND WRITES THE
C     CORRESPONDING HOURLY DISCHARGES FOR THE DATES REQUESTED BY THE
C     USER ON TAPE11.
C
C     IN ORDER TO RUN PROPERLY, THE PROGRAM REQUIRES THAT THE ANNUAL
C     RECORD ALSO INCLUDESTHE LAST CARD OF THE DAY PRECEEDING THE
C     FIRST OF JANUARY.
C
C     THE FOLLOWING VALUES ARE ASSUMED:
C          -NUMBER OF DATA PER CARD=6
C          -NUMBER OF CARDS PER DAY PER STATION=4
C
C     THE FOLLOWING VALUES MUST BE DEFINED BY THE USER:
C          -THE STARTING DATE:  YEAR/MONTH/DAY
C          -THE NUMBER OF DAYS TO BE READ
C
C **********
      PROGRAM QRUSKIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     *TAPE11,TAPE96)
      DIMENSION DATAX(6)
C
C ***** READ THE REQUESTED PERIOD(INITIAL DATE, NB. OF DAYS)
C
      READ(5,1)IYR,MONDA
    1 FORMAT(I2,I4)
      READ(5,2) NDAYS
    2 FORMAT(I3)
      LYR=IYR
      LMONDA=MONDA
      IF(NDAYS.EQ.1) GOTO 75
      MDAYS=NDAYS-1
      IFEBDY=0228
      IYEAR=IYR/4
      IYEAR=IYEAR*4
      IF(IYR.EQ.IYEAR) IFEBDY=0229
C
C ***** DETERMINE THE LAST DAY'S DATE OF THE REQUESTED
C       PERIOD.  SPECIAL CARES MUST BE TAKEN FOR THE
C       TRANSITION BETWEEN TWO MONTHS.
C
      DO 70 I=1,MDAYS
      IF(LMONDA.NE.0131) GOTO 10
      LMONDA=0201
      GOTO 70
   10 IF(LMONDA.NE.IFEBDY) GOTO 15
      LMONDA=0301
      GOTO 70
   15 IF(LMONDA.NE.0331) GOTO 20
      LMONDA=0401
      GOTO 70
   20 IF(LMONDA.NE.0430) GOTO 25
      LMONDA=0501
      GOTO 70
   25 IF(LMONDA.NE.0531) GOTO 30
      LMONDA=0601
```

```
            GOTO 70
         30 IF(LMONDA.NE.0630) GOTO 35
60          LMONDA=0701
            GOTO 70
         35 IF(LMONDA.NE.0731) GOTO 40
            LMONDA=0801
            GOTO 70
65       40 IF(LMONDA.NE.0831) GOTO 45
            LMONDA=0901
            GOTO 70
         45 IF(LMONDA.NE.0930) GOTO 50
            LMONDA=1001
70          GOTO 70
         50 IF(LMONDA.NE.1031) GOTO 55
            LMONDA=1101
            GOTO 70
         55 IF(LMONDA.NE.1130) GOTO 60
75          LMONDA=1201
            GOTO 70
         60 IF(LMONDA.NE.1231) GOTO 65
            LMONDA=0101
            LYR=LYR+1
80          GOTO 70
         65 LMONDA=LMONDA+1
         70 CONTINUE
         75 NCARDS=NDAYS*4 + 1
            KIN=96
85          KO=11
            DELTA=-0.1
      C
      C  ***** LOCATE THE STARTING POSITION IN THE ANNUAL
      C        RECORD FILE.
90    C
        100 READ(KIN,3) KYR,KMONDA
          3 FORMAT(8X,I2,I4)
            IF(EOF(KIN).NE.0) GO TO 355
            IF(KYR.EQ.IYR.AND.KMONDA.EQ.MONDA) GOTO 110
95          GOTO 100
        110 BACKSPACE KIN
            BACKSPACE KIN
      C
      C  ***** WHEN THE STARTING POSITION IS DETERMINED, READ
100   C        DATA AND CREATE THE OUTPUT FILE.
      C
            DO 300 I=1,NCARDS
            READ(KIN,4) ITYPE,STA,NO,JYR,JMONDA,KCARD,DATAX
            DO 200 J=1,6
105         DATAX(J)=-1000.*DATAX(J)/8.
            IF(DATAX(J).GE.DELTA) DATAX(J)=-50.
        200 CONTINUE
            WRITE(KO,4) ITYPE,STA,NO,JYR,JMONDA,KCARD,DATAX
          4 FORMAT(I1,A5,I2,I2,I4,I2,6F10.0)
110     300 CONTINUE
      C
      C  ***** CHECK IF THE "LAST DATE READ" CORRESPONDS TO
      C        THE DATE OF THE "LAST DAY REQUESTED".
      C
```

```
115
      IF(LMONDA.EQ.JMONDA.AND.LYR.EQ.JYR.AND.KCARD.EQ.4) GOTO 355
      WRITE(6,5) STA,NO
    5 FORMAT(//,5X,"MISSING DATA AT STATION ",A5,I2,/)
  355 STOP
      END
```

RUNOFF Program

```
C **********
C     THIS PROGRAM READS MEAN LATERAL INFLOWS FROM ANNUAL
C     RECORDS (TAPE98) AND WRITE THE REQUESTED PERIOD ON TAPE12.
C     THE DAILY MEAN LATERAL INFLOW READ FROM THE ANNUAL RECORD
C     IS ASSUMED TO CORRESPOND TO THE DISCHARGE AT NOON TIME.
C     THIS PROGRAM COMPUTES VALUES FOR EACH 12 HR OF THE TOTAL
C     PERIOD.
C
C     THE FORMAT OF THE ANNUAL RECORD IS A NON-STANDARD FORMAT SINCE
C     THE FILE WAS CREATED BY THE USER.  THE FORMAT ADOPTED IS:
C           -YEAR, MONTH AND DAY, DISCHARGE (4X,I2,I4,F10.0)
C           -ONLY ONE DAY PER CARD.
C
C     TO WORK PROPERLY, THE PROGRAM REQUIRES THAT THE ANNUAL RECORD
C     ALSO INCLUDES THE DAILY MEAN LATERAL INFLOW OF THE DAY PRECEEDING
C     THE FIRST OF JANUARY, AND THE DAY FOLLOWING THE 31ST OF DECEMBER
C
C     THE REQUESTED PERIOD IS SPECIFIED IN THE JCL:
C          -THE STARTING DATE (YEAR/MONTH/DAY)
C          -THE NUMBER OF DAYS REQUESTED (I3 FORMAT)
C
C **********
      PROGRAM RUNOFF(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     *TAPE12,TAPE98)
C
C ***** READ THE REQUESTED PERIOD(INITIAL DATE, NB. OF DAYS)
C
      READ(5,1)IYR,MONDA
    1 FORMAT(I2,I4)
      READ(5,2) NDAYS
    2 FORMAT(I3)
      LYR=IYR
      LMONDA=MONDA
      IFEBDY=0228
      IYEAR=IYR/4
      IYEAR=IYEAR*4
      IF(IYR.EQ.IYEAR) IFEBDY=0229
C
C ***** DETERMINE THE LAST DAY'S DATE OF THE REQUESTED
C       PERIOD.  SPECIAL CARES MUST BE TAKEN FOR THE
C       TRANSITION BETWEEN TWO MONTHS.
C
      DO 70 I=1,NDAYS
      IF(LMONDA.NE.0131) GOTO 10
      LMONDA=0201
      GOTO 70
   10 IF(LMONDA.NE.IFEBDY) GOTO 15
      LMONDA=0301
      GOTO 70
   15 IF(LMONDA.NE.0331) GOTO 20
      LMONDA=0401
      GOTO 70
   20 IF(LMONDA.NE.0430) GOTO 25
      LMONDA=0501
      GOTO 70
   25 IF(LMONDA.NE.0531) GOTO 30
      LMONDA=0601
```

```
            GOTO 70
         30 IF(LMONDA.NE.0630) GOTO 35
60          LMONDA=0701
            GOTO 70
         35 IF(LMONDA.NE.0731) GOTO 40
            LMONDA=0801
            GOTO 70
65       40 IF(LMONDA.NE.0831) GOTO 45
            LMONDA=0901
            GOTO 70
         45 IF(LMONDA.NE.0930) GOTO 50
            LMONDA=1001
70          GOTO 70
         50 IF(LMONDA.NE.1031) GOTO 55
            LMONDA=1101
            GOTO 70
         55 IF(LMONDA.NE.1130) GOTO 60
75          LMONDA=1201
            GOTO 70
         60 IF(LMONDA.NE.1231) GOTO 65
            LMONDA=0101
            LYR=LYR+1
80          GOTO 70
         65 LMONDA=LMONDA+1
         70 CONTINUE
         75 KIN=98
            KO=12
85       C
         C ***** LOCATE THE STARTING POSITION IN THE ANNUAL
         C       RECORD FILE.
         C
        100 READ(KIN,3) JYR,JMONDA,Q
90        3 FORMAT(4X,I2,I4,F10.0)
            IF(EOF(KIN).NE.0) GO TO 355
            IF(JYR.EQ.IYR.AND.JMONDA.EQ.MONDA) GOTO 110
            QO=Q
            GOTO 100
95      110 QSTART=Q
        C
        C ***** WHEN THE STARTING POSITION IS DETERMINED, READ
        C       DATA AND CREATE THE OUTPUT FILE.
        C
100         TSUM=0.
            QMORN=0.5*(QO+QSTART)
            WRITE(KO,5) TSUM,QMORN
            Q1=QSTART
          5 FORMAT(2F10.0)
105         DO 300 I=1,NDAYS
            READ(KIN,3) JYR,JMONDA,Q3
            Q2=0.5*(Q1+Q3)
            TSUM=TSUM+43200.
            WRITE(KO,5) TSUM,Q1
110         TSUM=TSUM+43200.
            WRITE(KO,5) TSUM,Q2
            Q1=Q3
        300 CONTINUE
        C
```

```
C ***** CHECK IF THE "LAST DATE READ" CORRESPONDS TO
C       THE DATE OF THE "LAST DAY REQUESTED".
C
      IF(LMONDA.EQ.JMONDA.AND.LYR.EQ.JYR) GOTO 355
      WRITE(6,6)
    6 FORMAT(/,5X,"MISSING DATA",/)
  355 STOP
      END
```

INPUT5.TEM

```
FRASER RIVER MODEL C - MATSQUI ISLAND TO DOUGLAS ISLAND                                                  000
         1         2         1         1         3                                                     000
         1       IYE   TOTIME.                                                                         000120
        20        16         0                                                                         000130
         1        30         1         2                                                               000140
         2        31         2         3                                                               000150
         3        32         5         3                                                               000160
         4        33         3         4                                                               000170
         5        40         2         5                                                               000180
         6        41         5         6                                                               000190
         7        42         6         7                                                               000200
         8        43         6         7                                                               000210
         9        44         7         8                                                               000220
        10        45         8         9                                                               000230
        11        46         8         9                                                               000240
        12        47         9        10                                                               000250
        13        48        10        15                                                               000260
        14        49        10        11                                                               000270
        15        50        11        12                                                               000280
        16        51        12        13                                                               000290
        17        52        12        13                                                               000300
        18        53        13        14                                                               000310
        19        54        15        11                                                               000320
        20        55        15        16                                                               000330
REACH   30      FRASER RIVER  -  SAPPERTON V-DYKE TO DOUGLAS ISLAND                                     000340
        30         1         2         2                   0        -1                                  000350
                          .0270                 8208.     1000.                                        000360
         8         7     -3.00      6.00        -.5       -.5       1.5                               1.5000370
        0.                -65.357                -2.61   -60000.     .0000                            000380
         2                                                                                             000390
    -3.000     1372.     1372.    58491.     1386.    58491.                                         000400
    -1.500     1443.     1443.    60598.     1458.    60598.                                         000410
     0.000     1456.     1456.    62777.     1471.    62777.                                         000420
     1.500     1462.     1462.    64966.     1478.    64966.                                         000430
     3.000     1468.     1468.    67164.     1485.    67164.                                         000440
     4.500     1474.     1474.    69371.     1491.    69371.                                         000450
     6.000     1480.     1480.    71587.     1498.    71587.                                         000460
     1326.               -66.306                -2.61   -60000.     .0000                            000470
         2                                                                                             000
    -3.000     1670.     1670.    59744.     1678.    59744.                                         000
    -1.500     1703.     1703.    62274.     1712.    62274.                                         000
     0.000     1713.     1713.    64838.     1722.    64838.                                         000510
     1.500     1719.     1719.    67411.     1728.    67411.                                         000520
     3.000     1725.     1725.    69994.     1735.    69994.                                         000530
     4.500     1731.     1731.    72585.     1742.    72585.                                         000540
     6.000     1737.     1737.    75185.     1749.    75185.                                         000550
     2401.               -58.264                -2.61   -60000.     .0000                            000560
         2                                                                                             000570
    -3.000     2053.     2053.    55513.     2061.    55513.                                         000580
    -1.500     2083.     2083.    58615.     2090.    58615.                                         000590
     0.000     2092.     2092.    61749.     2101.    61749.                                         000600
     1.500     2098.     2098.    64892.     2107.    64892.                                         000610
     3.000     2104.     2104.    68044.     2114.    68044.                                         000620
     4.500     2110.     2110.    71205.     2121.    71205.                                         000630
     6.000     2116.     2116.    74375.     2128.    74375.                                         000640
     3429.               -55.224                -2.61   -60000.     .0000                            000650
         2                                                                                             000660
    -3.000     2639.     2639.    56440.     2646.    56440.                                         000670
    -1.500     2680.     2680.    60430.     2688.    60430.                                         000680
     0.000     2693.     2693.    64463.     2701.    64463.                                         000690
     1.500     2699.     2699.    68507.     2708.    68507.                                         000700
     3.000     2705.     2705.    72560.     2715.    72560.                                         000710
     4.500     2711.     2711.    76622.     2722.    76622.                                         000720
     6.000     2717.     2717.    80693.     2728.    80693.                                         000730
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                                                                                                                    000730
4522.                  -49.182                          -2.61     -60000.      .0000                               000740
    2                                                                                                               000750
-3.000      2388.       2388.      50304.      2394.      50304.                                                   000760
-1.500      2869.       2869.      54247.      2875.      54247.                                                   000770
 0.000      3195.       3195.      58949.      3202.      58949.                                                   000780
 1.500      3201.       3201.      63747.      3209.      63747.                                                   000790
 3.000      3207.       3207.      68553.      3216.      68553.                                                   000800
 4.500      3213.       3213.      73368.      3222.      73368.                                                   000810
 6.000      3219.       3219.      78193.      3229.      78193.                                                   000820
5623.                  -44.140                          -2.61     -60000.      .0000                               000830
    2                                                                                                           000840
-3.000      3432.       3432.      55521.      3436.      55521.                                                   000850
-1.500      3604.       3604.      60738.      3609.      60738.                                                   000860
 0.000      3695.       3695.      66261.      3700.      66261.                                                   000870
 1.500      3701.       3701.      71807.      3707.      71807.                                                   000880
 3.000      3707.       3707.      77363.      3713.      77363.                                                   000890
 4.500      3713.       3713.      82928.      3720.      82928.                                                   000900
 6.000      3719.       3719.      88501.      3727.      88501.                                                   000910
6675.                  -45.099                          -2.61     -60000.      .0000                               000920
    2                                                                                                           000930
-3.000      3936.       3936.      62344.      3942.      62344.                                                   000940
-1.500      3957.       3957.      68264.      3963.      68264.                                                   000950
 0.000      3967.       3967.      74209.      3974.      74209.                                                   000960
 1.500      3973.       3973.      80165.      3980.      80165.                                                   000970
 3.000      3979.       3979.      86129.      3987.      86129.                                                   000980
 4.500      3985.       3985.      92102.      3994.      92102.                                                   000990
 6.000      3991.       3991.      98085.      4001.      98085.                                                   001000
8208.                  -41.040                          -2.61     -60000.      .0000                               001010
    2                                                                                                           001020
-3.000      4281.       4281.      61756.      4286.      61756.                                                   001030
-1.500      4375.       4375.      68248.      4381.      68248.                                                   001040
 0.000      4499.       4499.      74944.      4505.      74944.                                                   001050
 1.500      4505.       4505.      81698.      4512.      81698.                                                   001060
 3.000      4511.       4511.      88460.      4518.      88460.                                                   001070
 4.500      4517.       4517.      95231.      4525.      95231.                                                   001080
 6.000      4523.       4523.     102011.      4532.     102011.                                                   001090
          PITT RIVER - NORTH SIDE OF DOUGLAS ISLAND                                                             001100
   31          1           2          2                                 0          -1                            001110
                       .0347                            6361.      1000.                                        001120
    8          7      -2.00       7.00                 -1.75      -1.75        -2.      -2.001130
   0.                  -18.040                          -1.80     -25200.      .0000                               001140
    2                                                                                                           001150
-2.000      2803.       2803.      23224.      2804.      23224.                                                   001160
 -.500      2855.       2855.      27480.      2856.      27480.                                                   001170
 1.000      2861.       2861.      31767.      2863.      31767.                                                   001180
 2.500      2867.       2867.      36063.      2870.      36063.                                                   001190
 4.000      2873.       2873.      40368.      2877.      40368.                                                   001200
 5.500      2879.       2879.      44683.      2883.      44683.                                                   001210
 7.000      2885.       2885.      49006.      2890.      49006.                                                   001220
 916.                   -18.040                          -1.80     -25200.      .0000                               001230
    2                                                                                                           001240
-2.000      2331.       2331.      23454.      2333.      23454.                                                   001250
 -.500      2376.       2376.      26995.      2378.      26995.                                                   001260
 1.000      2382.       2382.      30564.      2385.      30564.                                                   001270
 2.500      2388.       2388.      34142.      2391.      34142.                                                   001280
 4.000      2394.       2394.      37729.      2398.      37729.                                                   001290
 5.500      2400.       2400.      41324.      2405.      41324.                                                   001300
 7.000      2406.       2406.      44929.      2412.      44929.                                                   001310
1870.                  -21.040                          -1.80     -25200.      .0000                               001320
    2                                                                                                           001330
-2.000      1782.       1782.      22245.      1783.      22245.                                                   001340
 -.500      1829.       1829.      24964.      1831.      24964.                                                   001350
 1.000      1835.       1835.      27713.      1838.      27713.                                                   001360
 2.500      1841.       1841.      30471.      1845.      30471.                                                   001370
 4.000      1847.       1847.      33237.      1851.      33237.                                                   001380
 4.500      1853.       1853.      34013.      1858.      34013.                                                   001390
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                                                                                                                    001400
7.000     1859.     1859.     38797.    1865.     38797.                                                         001410
2943.               -31.040               -1.80     -25200.     .0000                                              001420
   2                                                                                                                00
-2.000    1259.     1259.     22830.    1261.     22830.                                                         00
-.500     1288.     1288.     24746.    1290.     24746.                                                         001440
1.000     1294.     1294.     26683.    1297.     26683.                                                         001450
2.500     1300.     1300.     28628.    1304.     28628.                                                         001460
4.000     1306.     1306.     30582.    1311.     30582.                                                         001470
5.500     1312.     1312.     32546.    1317.     32546.                                                         001480
7.000     1318.     1318.     34518.    1324.     34518.                                                         001490
3907.               -48.040               -1.80     -25200.     .0000                                          001500
   2                                                                                                            001510
-2.000     904.      904.     27053.     912.     27053.                                                         001520
-.500      919.      919.     28423.     928.     28423.                                                         001530
1.000      925.      925.     29806.     935.     29806.                                                         001540
2.500      931.      931.     31199.     942.     31199.                                                         001550
4.000      937.      937.     32601.     948.     32601.                                                         001560
5.500      943.      943.     34012.     955.     34012.                                                         001570
7.000      950.      950.     35431.     962.     35431.                                                         001580
4924.               -58.440               -1.80     -25200.     .0000                                          001590
   2                                                                                                            001600
-2.000    1012.     1012.     34546.    1023.     34546.                                                         001610
-.500     1166.     1166.     36219.    1177.     36219.                                                         001620
1.000     1172.     1172.     37972.    1184.     37972.                                                         001630
2.500     1178.     1178.     38734.    1191.     38734.                                                         001640
4.000     1184.     1184.     41505.    1197.     41505.                                                         001650
5.500     1190.     1190.     43285.    1204.     43285.                                                         001660
7.000     1196.     1196.     45074.    1211.     45074.                                                         001670
5813.               -34.840               -1.80     -25200.     .0000                                          001680
   2                                                                                                            001690
-2.000    1618.     1618.     31599.    1649.     31599.                                                         001700
-.500     1689.     1689.     34098.    1721.     34098.                                                         001710
1.000     1692.     1692.     36634.    1726.     36634.                                                         001720
2.500     1695.     1695.     39174.    1731.     39174.                                                         001730
4.000     1698.     1698.     41719.    1736.     41719.                                                         001740
5.500     1701.     1701.     43268.    1741.     43268.                                                         001750
7.000     1704.     1704.     46822.    1745.     46822.                                                         001760
6361.               -36.840               -1.80     -25200.     .0000                                          001770
   2                                                                                                            001780
-2.000    1634.     1634.     42242.    1642.     42242.                                                         001790
-.500     1675.     1675.     44735.    1685.     44735.                                                         001800
1.000     1678.     1678.     47250.    1690.     47250.                                                         00
2.500     1681.     1681.     49769.    1695.     49769.                                                         00
4.000     1684.     1684.     52294.    1700.     52294.                                                         00
5.500     1687.     1687.     54822.    1705.     54822.                                                         001840
7.000     1690.     1690.     57355.    1709.     57355.                                                         001850
REACH 32     EAST SIDE OF DOUGLAS ISLAND                                                                        001860
     32          1         2         2                        0         -1                                       001870
                          .0347                 4193.     1000.                                                 001880
      5          7       -2.00      7.00        -2.       -2.       -2.                                        -2.001890
     57.                 -22.040               -1.45     -24600.     .0000                                      001900
   2                                                                                                            001910
-2.000    1521.     1521.     17725.    1523.     17725.                                                         001920
-.500     1599.     1599.     20085.    1601.     20085.                                                         001930
1.000     1605.     1605.     22488.    1608.     22488.                                                         001940
2.500     1611.     1611.     24900.    1615.     24900.                                                         001950
4.000     1617.     1617.     27322.    1622.     27322.                                                         001960
5.500     1623.     1623.     29752.    1628.     29752.                                                         001970
7.000     1629.     1629.     32191.    1635.     32191.                                                         001980
 732.               -23.040               -1.45     -24600.     .0000                                          001990
   2                                                                                                            002000
-2.000    1493.     1493.     16551.    1495.     16551.                                                         002010
-.500     1530.     1530.     18827.    1532.     18827.                                                         002020
1.000     1536.     1536.     21127.    1539.     21127.                                                         002030
2.500     1542.     1542.     23437.    1546.     23437.                                                         002040
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 5.500     1554.     1554.    28082.     1559.    28082.                    002060
 7.000     1560.     1560.    30418.     1566.    30418.                    002070
2019.               -22.040               -1.45   -24600.      .0000        002080
     2                                                                       002090
-2.000     1455.     1455.    16837.     1456.    16837.                    002100
 -.500     1484.     1484.    19047.     1486.    19047.                    002110
 1.000     1490.     1490.    21278.     1493.    21278.                    002120
 2.500     1496.     1496.    23517.     1499.    23517.                    002130
 4.000     1502.     1502.    25765.     1506.    25765.                    002140
 5.500     1508.     1508.    28022.     1513.    28022.                    002150
 7.000     1514.     1514.    30289.     1519.    30289.                    002160
2838.               -18.040               -1.45   -24600.      .0000        002170
     2                                                                       002180
-2.000     1443.     1443.    15759.     1444.    15759.                    002190
 -.500     1471.     1471.    17950.     1472.    17950.                    002200
 1.000     1477.     1477.    20160.     1479.    20160.                    002210
 2.500     1483.     1483.    22380.     1486.    22380.                    002220
 4.000     1489.     1489.    24608.     1492.    24608.                    002230
 5.500     1495.     1495.    26846.     1499.    26846.                    002240
 7.000     1501.     1501.    29093.     1506.    29093.                    002250
4193.               -16.040               -1.45   -24600.      .0000        002260
     2                                                                       002270
-2.000     1747.     1747.    15714.     1751.    15714.                    002280
 -.500     1773.     1773.    18361.     1779.    18361.                    002290
 1.000     1776.     1776.    21022.     1784.    21022.                    002300
 2.500     1779.     1779.    23689.     1789.    23689.                    002310
 4.000     1782.     1782.    26359.     1794.    26359.                    002320
 5.500     1785.     1785.    29035.     1798.    29035.                    002330
 7.000     1788.     1788.    31714.     1803.    31714.                    002340
REACH 33    PITT RIVER  -  FISH BOUNDARY TO ALOUETTE RIVER                  002350
    33           1         2          2          2000          -1          002360
                        .0402                  9278.         660.         002370
    15           7      -2.00       7.00        .8            .8          002380
  11.                 -37.040                 -0.85         -600.      .0000 002390
     2                                                                       002400
-2.000     2564.     2564.    32389.     2568.    32389.                    002410
 -.500     2598.     2598.    36269.     2603.    36269.                    002420
 1.000     2604.     2604.    40171.     2610.    40171.                    002430
 2.500     2610.     2610.    44082.     2617.    44082.                    002440
 4.000     2616.     2616.    48002.     2623.    48002.                    002450
 5.500     2622.     2622.    51932.     2630.    51932.                    002460
 7.000     2628.     2628.    55870.     2637.    55870.                    002470
 770.                -39.040                 -0.85         -600.      .0000 002480
     2                                                                       002490
-2.000     2084.     2084.    26115.     2088.    26115.                    002500
 -.500     2210.     2210.    29334.     2214.    29334.                    002510
 1.000     2216.     2216.    32654.     2221.    32654.                    002520
 2.500     2222.     2222.    35983.     2228.    35983.                    002530
 4.000     2228.     2228.    39322.     2234.    39322.                    002540
 5.500     2234.     2234.    42669.     2241.    42669.                    002550
 7.000     2240.     2240.    46025.     2248.    46025.                    002560
1498.               -37.040                 -0.85         -600.      .0000 002570
     2                                                                       002580
-2.000     1878.     1878.    22949.     1882.    22949.                    002590
 -.500     2101.     2101.    25992.     2106.    25992.                    002600
 1.000     2107.     2107.    29148.     2112.    29148.                    002610
 2.500     2113.     2113.    32313.     2119.    32313.                    002620
 4.000     2119.     2119.    35487.     2126.    35487.                    002630
 5.500     2125.     2125.    38670.     2133.    38670.                    002640
 7.000     2131.     2131.    41862.     2139.    41862.                    002650
2281.               -42.040                 -0.85         -600.      .0000 002660
     2                                                                       002670
-2.000     1751.     1751.    27163.     1755.    27163.                    002680
 -.500     1834.     1834.    29872.     1838.    29872.                    002690
 1.000     1840.     1840.    32627.     1845.    32627.                    002700
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4.000     1852.     1852.    38165.    1858.    38165.                    002720
5.500     1858.     1858.    40947.    1865.    40947.                    002730
7.000     1864.     1864.    43738.    1872.    43738.                    002740
2692.               -41.040             -0.85     -600.     .0000         002750
   2                                                                       002760
-2.000    1597.     1597.    30969.    1604.    30969.                    002770
 -.500    1649.     1649.    33390.    1656.    33390.                    002780
1.000     1750.     1750.    35940.    1758.    35940.                    002790
2.500     1851.     1851.    38641.    1860.    38641.                    002800
4.000     1887.     1887.    41459.    1896.    41459.                    002810
5.500     1893.     1893.    44294.    1903.    44294.                    002820
7.000     1899.     1899.    47137.    1909.    47137.                    002830
2881.               -31.040             -0.85     -600.     .0000         002840
   2                                                                       002850
-2.000    1573.     1573.    26856.    1582.    26856.                    002860
 -.500    1694.     1694.    29303.    1704.    29303.                    002870
1.000     1829.     1829.    31945.    1839.    31945.                    002880
2.500     1917.     1917.    34776.    1927.    34776.                    002890
4.000     1923.     1923.    37656.    1934.    37656.                    002900
5.500     1929.     1929.    40545.    1941.    40545.                    002910
7.000     1935.     1935.    43442.    1948.    43442.                    002920
3674.               -33.040             -0.85     -600.     .0000         002930
   2                                                                       002940
-2.000    1603.     1603.    26291.    1611.    26291.                    002950
 -.500    1965.     1965.    29037.    1974.    29037.                    002960
1.000     2070.     2070.    32065.    2079.    32065.                    002970
2.500     2109.     2109.    35199.    2119.    35199.                    002980
4.000     2147.     2147.    38391.    2158.    38391.                    002990
5.500     2174.     2174.    41637.    2186.    41637.                    003000
7.000     2180.     2180.    44902.    2192.    44902.                    003010
4329.               -40.040             -0.85     -600.     .0000         003020
   2                                                                       003030
-2.000    2177.     2177.    32296.    2184.    32296.                    003040
 -.500    2215.     2215.    35598.    2222.    35598.                    003050
1.000     2221.     2221.    38925.    2229.    38925.                    003060
2.500     2227.     2227.    42260.    2236.    42260.                    003070
4.000     2233.     2233.    45604.    2242.    45604.                    003080
5.500     2239.     2239.    48958.    2249.    48958.                    003090
7.000     2245.     2245.    52320.    2256.    52320.                    003100
5186.               -30.040             -0.85     -600.     .0000         003110
   2                                                                       003120
-2.000    2231.     2231.    30563.    2235.    30563.                    003130
 -.500    2266.     2266.    33944.    2270.    33944.                    003140
1.000     2272.     2272.    37347.    2277.    37347.                    003150
2.500     2278.     2278.    40759.    2283.    40759.                    003160
4.000     2284.     2284.    44180.    2290.    44180.                    003170
5.500     2290.     2290.    47611.    2297.    47611.                    003180
7.000     2296.     2296.    51050.    2303.    51050.                    003190
6001.               -28.040             -0.85     -600.     .0000         003200
   2                                                                       003210
-2.000    2279.     2279.    30212.    2281.    30212.                    003220
 -.500    2346.     2346.    33697.    2349.    33697.                    003230
1.000     2352.     2352.    37221.    2356.    37221.                    003240
2.500     2358.     2358.    40754.    2363.    40754.                    003250
4.000     2364.     2364.    44296.    2370.    44296.                    003260
5.500     2370.     2370.    47847.    2376.    47847.                    003270
7.000     2376.     2376.    51407.    2383.    51407.                    003280
6769.               -31.040             -0.85     -600.     .0000         003290
   2                                                                       003300
-2.000    2398.     2398.    30566.    2401.    30566.                    003310
 -.500    2483.     2483.    34248.    2485.    34248.                    003320
1.000     2489.     2489.    37976.    2492.    37976.                    003330
2.500     2495.     2495.    41713.    2499.    41713.                    003340
4.000     2501.     2501.    45460.    2505.    45460.                    003350
5.500     2507.     2507.    49215.    2512.    49215.                    003360
```

```
      7560.                -28.040                      -0.85      -600.      .0000
         2
     -2.000      2269.      2269.      27487.      2272.      27487.
      -.500      2565.      2565.      31093.      2568.      31093.
     1.000      2571.      2571.      34945.      2575.      34945.
     2.500      2577.      2577.      38807.      2582.      38807.
     4.000      2583.      2583.      42677.      2588.      42677.
     5.500      2589.      2589.      46556.      2595.      46556.
     7.000      2595.      2595.      50445.      2602.      50445.
      8463.                -33.040                      -0.85      -600.      .0000
         2
     -2.000      1851.      1851.      28778.      1854.      28778.
      -.500      1926.      1926.      31594.      1929.      31594.
     1.000      2062.      2062.      34585.      2066.      34585.
     2.500      2229.      2229.      37810.      2234.      37810.
     4.000      2235.      2235.      41159.      2241.      41159.
     5.500      2241.      2241.      44516.      2247.      44516.
     7.000      2247.      2247.      47883.      2254.      47883.
      9086.                -40.040                      -0.85      -600.      .0000
         2
     -2.000      1582.      1582.      27107.      1592.      27107.
      -.500      1642.      1642.      29521.      1652.      29521.
     1.000      1714.      1714.      32038.      1725.      32038.
     2.500      1786.      1786.      34663.      1798.      34663.
     4.000      1904.      1904.      37422.      1916.      37422.
     5.500      1910.      1910.      40282.      1923.      40282.
     7.000      1916.      1916.      43151.      1930.      43151.
      9884.                -53.040                      -0.85      -600.      .0000
         2
     -2.000      1354.      1354.      33919.      1361.      33919.
      -.500      1418.      1418.      35982.      1426.      35982.
     1.000      1687.      1687.      38211.      1695.      38211.
     2.500      1693.      1693.      40746.      1702.      40746.
     4.000      1699.      1699.      43290.      1708.      43290.
     5.500      1705.      1705.      45843.      1715.      45843.
     7.000      1711.      1711.      48405.      1722.      48405.
REACH    40     FRASER RIVER  -  SOUTH SIDE OF DOUGLAS ISLAND
        40         1          2          2                     0        -1
                              .0270                      9291.      1150.
        10         7        -2.00       7.00             -3.        -3.        -9.    -8.
        0.                   -33.300                     -1.85     -34800.      .0000
         2
     -2.000      1937.      1937.      33634.      1953.      33634.
      -.500      1945.      1945.      36547.      1963.      36547.
     1.000      1948.      1948.      39467.      1967.      39467.
     2.500      1951.      1951.      42391.      1972.      42391.
     4.000      1954.      1954.      45320.      1977.      45320.
     5.500      1957.      1957.      48253.      1982.      48253.
     7.000      1960.      1960.      51191.      1987.      51191.
      1131.                -33.288                     -1.85     -34800.      .0000
         2
     -2.000      1652.      1652.      29653.      1655.      29653.
      -.500      1673.      1673.      32148.      1676.      32148.
     1.000      1679.      1679.      34662.      1682.      34662.
     2.500      1685.      1685.      37184.      1689.      37184.
     4.000      1691.      1691.      39715.      1696.      39715.
     5.500      1697.      1697.      42255.      1703.      42255.
     7.000      1703.      1703.      44805.      1709.      44805.
      2126.                -39.777                     -1.85     -34800.      .0000
         2
     -2.000      1536.      1536.      30819.      1541.      30819.
      -.500      1558.      1558.      33142.      1564.      33142.
     1.000      1564.      1564.      35484.      1571.      35484.
     2.500      1570.      1570.      37836.      1577.      37836.
     4.000      1576.      1576.      40196.      1584.      40196.
     5.500      1582.      1582.      42568.      1591.      42568.
```

7.000	1588.	1588.	44943.	1597.	44943.		004040
2914.		-40.269		-1.85	-34800.	.0000	0040
2							0040
-2.000	1508.	1508.	32581.	1517.	32581.		0040
-.500	1535.	1535.	34867.	1545.	34867.		004080
1.000	1541.	1541.	37174.	1552.	37174.		004090
2.500	1547.	1547.	39491.	1558.	39491.		004100
4.000	1553.	1553.	41817.	1565.	41817.		004110
5.500	1559.	1559.	44151.	1572.	44151.		004120
7.000	1565.	1565.	46495.	1578.	46495.		004130
3936.		-38.758		-1.85	-34800.	.0000	004140
2							004150
-2.000	1173.	1173.	30259.	1179.	30259.		004160
-.500	1184.	1184.	32028.	1191.	32028.		004170
1.000	1190.	1190.	33808.	1198.	33808.		004180
2.500	1196.	1196.	35598.	1204.	35598.		004190
4.000	1202.	1202.	37397.	1211.	37397.		004200
5.500	1208.	1208.	39204.	1218.	39204.		004210
7.000	1214.	1214.	41021.	1224.	41021.		004220
4843.		-32.248		-1.85	-34800.	.0000	004230
2							004240
-2.000	1166.	1166.	28436.	1173.	28436.		004250
-.500	1178.	1178.	30195.	1186.	30195.		004260
1.000	1184.	1184.	31967.	1192.	31967.		004270
2.500	1190.	1190.	33748.	1199.	33748.		004280
4.000	1196.	1196.	35537.	1206.	35537.		004290
5.500	1202.	1202.	37336.	1212.	37336.		004300
7.000	1208.	1208.	39144.	1219.	39144.		004310
6251.		-41.733		-1.85	-34800.	.0000	004320
2							004330
-2.000	1576.	1576.	33704.	1583.	33704.		004340
-.500	1603.	1603.	36090.	1610.	36090.		004350
1.000	1609.	1609.	38499.	1617.	38499.		004360
2.500	1615.	1615.	40916.	1624.	40916.		004370
4.000	1621.	1621.	43343.	1630.	43343.		004380
5.500	1627.	1627.	45778.	1637.	45778.		004390
7.000	1633.	1633.	48223.	1644.	48223.		004400
7271.		-31.722		-1.85	-34800.	.0000	004410
2							004420
-2.000	1707.	1707.	31787.	1713.	31787.		004430
-.500	1748.	1748.	34381.	1754.	34381.		004440
1.000	1754.	1754.	37007.	1761.	37007.		0044
2.500	1760.	1760.	39642.	1767.	39642.		0044
4.000	1766.	1766.	42286.	1774.	42286.		004470
5.500	1772.	1772.	44939.	1781.	44939.		004480
7.000	1778.	1778.	47601.	1787.	47601.		004490
8166.		-31.712		-1.85	-34800.	.0000	004500
2							004510
-2.000	1767.	1767.	33226.	1772.	33226.		004520
-.500	1811.	1811.	35913.	1816.	35913.		004530
1.000	1817.	1817.	38634.	1822.	38634.		004540
2.500	1823.	1823.	41363.	1829.	41363.		004550
4.000	1829.	1829.	44101.	1836.	44101.		004560
5.500	1835.	1835.	46849.	1842.	46849.		004570
7.000	1841.	1841.	49605.	1849.	49605.		004580
9291.		-26.200		-1.85	-34800.	.0000	004590
2							004600
-2.000	1989.	1989.	36852.	2007.	36852.		004610
-.500	2021.	2021.	39863.	2040.	39863.		004620
1.000	2024.	2024.	42896.	2045.	42896.		004630
2.500	2027.	2027.	45934.	2050.	45934.		004640
4.000	2030.	2030.	48976.	2055.	48976.		004650
5.500	2033.	2033.	52023.	2060.	52023.		004660
7.000	2036.	2036.	55074.	2064.	55074.		004670

REACH 41 FRASER RIVER - DOUGLAS ISLAND TO BARNSTON ISLAND 004680

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                    .0270                    6344.     1050.                    004700
      7       7    -2.00        7.00          -1.       -1.        5.5        -.5004710
   499.            -29.700                   -1.45    -60000.      .0000       004720
      2                                                                         004730
-2.000     2708.     2708.     50958.       2710.     50958.                   004740
 -.500     2769.     2769.     55071.       2771.     55071.                   004750
1.000      2775.     2775.     59229.       2777.     59229.                   004760
2.500      2781.     2781.     63395.       2784.     63395.                   004770
4.000      2787.     2787.     67571.       2791.     67571.                   004780
5.500      2793.     2793.     71755.       2798.     71755.                   004790
7.000      2799.     2799.     75949.       2804.     75949.                   004800
1603.           -40.200                   -1.45    -60000.      .0000       004810
      2                                                                         004820
-2.000     1967.     1967.     49898.       1971.     49898.                   004830
 -.500     2010.     2010.     52885.       2014.     52885.                   004840
1.000      2016.     2016.     55905.       2021.     55905.                   004850
2.500      2022.     2022.     58934.       2028.     58934.                   004860
4.000      2028.     2028.     61972.       2034.     61972.                   004870
5.500      2034.     2034.     65018.       2041.     65018.                   004880
7.000      2040.     2040.     68074.       2048.     68074.                   004890
2557.           -41.200                   -1.45    -60000.      .0000       004900
      2                                                                         004910
-2.000     1672.     1672.     47332.       1678.     47332.                   004920
 -.500     1695.     1695.     49859.       1701.     49859.                   004930
1.000      1701.     1701.     52406.       1708.     52406.                   004940
2.500      1707.     1707.     54961.       1714.     54961.                   004950
4.000      1713.     1713.     57526.       1721.     57526.                   004960
5.500      1719.     1719.     60099.       1728.     60099.                   004970
7.000      1725.     1725.     62682.       1735.     62682.                   004980
3552.           -40.700                   -1.45    -60000.      .0000       004990
      2                                                                         005000
-2.000     1445.     1445.     41493.       1452.     41493.                   005010
 -.500     1864.     1864.     43781.       1871.     43781.                   005020
1.000      1870.     1870.     46582.       1878.     46582.                   005030
2.500      1876.     1876.     49391.       1885.     49391.                   005040
4.000      1882.     1882.     52209.       1891.     52209.                   005050
5.500      1888.     1888.     55036.       1898.     55036.                   005060
7.000      1894.     1894.     57873.       1905.     57873.                   005070
4710.           -44.700                   -1.45    -60000.      .0000       005080
      2                                                                         005090
-2.000     1835.     1835.     44737.       1841.     44737.                   005100
 -.500     1955.     1955.     47591.       1961.     47591.                   005110
1.000      1961.     1961.     50529.       1968.     50529.                   005120
2.500      1967.     1967.     53475.       1975.     53475.                   005130
4.000      1973.     1973.     56431.       1982.     56431.                   005140
5.500      1979.     1979.     59396.       1988.     59396.                   005150
7.000      1985.     1985.     62370.       1995.     62370.                   005160
5795.           -53.700                   -1.45    -60000.      .0000       005170
      2                                                                         005180
-2.000     2106.     2106.     49911.       2112.     49911.                   005190
 -.500     2244.     2244.     53186.       2250.     53186.                   005200
1.000      2250.     2250.     56556.       2257.     56556.                   005210
2.500      2256.     2256.     59935.       2263.     59935.                   005220
4.000      2262.     2262.     63323.       2270.     63323.                   005230
5.500      2268.     2268.     66720.       2277.     66720.                   005240
7.000      2274.     2274.     70126.       2283.     70126.                   005250
6344.           -53.700                   -1.45    -60000.      .0000       005260
      2                                                                         005270
-2.000     2534.     2534.     57019.       2542.     57019.                   005280
 -.500     2617.     2617.     60890.       2625.     60890.                   005290
1.000      2623.     2623.     64820.       2631.     64820.                   005300
2.500      2629.     2629.     68758.       2638.     68758.                   005310
4.000      2635.     2635.     72706.       2645.     72706.                   005320
5.500      2641.     2641.     76662.       2651.     76662.                   005330
7.000      2647.     2647.     80628.       2658.     80628.                   005340
REACH   42      ERASER RIVER - NORTH SIDE OF BARNSTON ISLAND                   005350
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      42          1          2          2                     0          -1
                            .0270                 15221.     1080.
      15          7          -1.00       6.00        .5        -2.        1.25      -5.00
     748.                   -38.690                -1.35     -40800.      .0000
       2
   -1.000     1269.      1265.      31478.     1285.      31478.
    .167      1267.      1267.      32955.     1288.      32955.
   1.333      1269.      1269.      34434.     1292.      34434.
   2.500      1272.      1272.      35917.     1296.      35917.
   3.667      1274.      1274.      37402.     1300.      37402.
   4.833      1276.      1276.      38889.     1304.      38889.
   6.000      1279.      1279.      40380.     1307.      40380.
    1623.                 -47.179                -1.35     -40800.      .0000
       2
   -1.000     1323.      1323.      32735.     1336.      32735.
    .167      1332.      1332.      34286.     1346.      34286.
   1.333      1337.      1337.      35843.     1351.      35843.
   2.500      1342.      1342.      37406.     1356.      37406.
   3.667      1346.      1346.      38974.     1361.      38974.
   4.833      1351.      1351.      40547.     1367.      40547.
   6.000      1356.      1356.      42126.     1372.      42126.
    2481.                 -50.167                -1.35     -40800.      .0000
       2
   -1.000     1317.      1317.      33726.     1327.      33726.
    .167      1325.      1325.      35269.     1336.      35269.
   1.333      1330.      1330.      36817.     1341.      36817.
   2.500      1335.      1335.      38372.     1346.      38372.
   3.667      1339.      1339.      39932.     1352.      39932.
   4.833      1344.      1344.      41497.     1357.      41497.
   6.000      1349.      1349.      43067.     1362.      43067.
    3531.                 -48.654                -1.35     -40800.      .0000
       2
   -1.000     1294.      1294.      34127.     1306.      34127.
    .167      1302.      1302.      35643.     1315.      35643.
   1.333      1307.      1307.      37165.     1320.      37165.
   2.500      1312.      1312.      38693.     1325.      38693.
   3.667      1316.      1316.      40226.     1330.      40226.
   4.833      1321.      1321.      41764.     1336.      41764.
   6.000      1326.      1326.      43308.     1341.      43308.
    5005.                 -37.634                -1.35     -40800.      .0000
       2
   -1.000     1134.      1134.      32689.     1142.      32689.
    .167      1140.      1140.      34017.     1149.      34017.
   1.333      1145.      1145.      35350.     1154.      35350.
   2.500      1150.      1150.      36689.     1159.      36689.
   3.667      1154.      1154.      38033.     1164.      38033.
   4.833      1159.      1159.      39382.     1170.      39382.
   6.000      1164.      1164.      40737.     1175.      40737.
    5919.                 -41.622                -1.35     -40800.      .0000
       2
   -1.000     1323.      1323.      32772.     1334.      32772.
    .167      1349.      1349.      34339.     1360.      34339.
   1.333      1353.      1353.      35915.     1365.      35915.
   2.500      1358.      1358.      37497.     1370.      37497.
   3.667      1363.      1363.      39084.     1376.      39084.
   4.833      1367.      1367.      40677.     1381.      40677.
   6.000      1372.      1372.      42275.     1386.      42275.
    6947.                 -33.109                -1.35     -40800.      .0000
       2
   -1.000     1426.      1426.      29824.     1430.      29824.
    .167      1437.      1437.      31497.     1442.      31497.
   1.333      1442.      1442.      33176.     1447.      33176.
   2.500      1447.      1447.      34861.     1452.      34861.
   3.667      1451.      1451.      36551.     1457.      36551.
   4.833      1456.      1456.      38247.     1463.      38247.
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                                                                                006020
7957.          -39.095                          -1.35   -40800.     .0000       006030
     2                                                                          006040
-1.000   1459.    1459.   28671.    1465.   28671.                              006050
  .167   1473.    1473.   30385.    1480.   30385.                              006060
1.333    1477.    1477.   32106.    1485.   32106.                              006070
2.500    1482.    1482.   33832.    1490.   33832.                              006080
3.667    1487.    1487.   35564.    1495.   35564.                              006090
4.833    1491.    1491.   37301.    1501.   37301.                              006100
6.000    1496.    1496.   39044.    1506.   39044.                              006110
9217.          -37.079                          -1.35   -40800.     .0000       006120
     2                                                                          006130
-1.000   1647.    1647.   25577.    1651.   25577.                              006140
  .167   1665.    1665.   27514.    1670.   27514.                              006150
1.333    1670.    1670.   29460.    1675.   29460.                              006160
2.500    1675.    1675.   31411.    1680.   31411.                              006170
3.667    1679.    1679.   33367.    1686.   33367.                              006180
4.833    1684.    1684.   35329.    1691.   35329.                              006190
6.000    1689.    1689.   37297.    1696.   37297.                              006200
10077.         -34.068                          -1.35   -40800.     .0000       006210
     2                                                                          006220
-1.000   1744.    1744.   27542.    1748.   27542.                              006230
  .167   1765.    1765.   29595.    1770.   29595.                              006240
1.333    1770.    1770.   31658.    1775.   31658.                              006250
2.500    1775.    1775.   33725.    1781.   33725.                              006260
3.667    1779.    1779.   35799.    1786.   35799.                              006270
4.833    1784.    1784.   37877.    1791.   37877.                              006280
6.000    1789.    1789.   39961.    1796.   39961.                              006290
11067.         -35.555                          -1.35   -40800.     .0000       006300
     2                                                                          006310
-1.000   1710.    1710.   29559.    1714.   29559.                              006320
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1.333    1727.    1727.   33575.    1732.   33575.                              006340
2.500    1731.    1731.   35592.    1737.   35592.                              006350
3.667    1736.    1736.   37615.    1742.   37615.                              006360
4.833    1741.    1741.   39643.    1747.   39643.                              006370
6.000    1745.    1745.   41676.    1753.   41676.                              006380
12353.         -34.538                          -1.35   -40800.     .0000       006390
     2                                                                          006400
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  .167   1544.    1544.   29826.    1551.   29826.                              006420
1.333    1549.    1549.   31630.    1556.   31630.                              006430
2.500    1553.    1553.   33440.    1561.   33440.                              006440
3.667    1558.    1558.   35255.    1566.   35255.                              006450
4.833    1563.    1563.   37075.    1572.   37075.                              006460
6.000    1567.    1567.   38901.    1577.   38901.                              006470
13155.         -35.027                          -1.35   -40800.     .0000       006480
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  .167   1590.    1590.   30492.    1596.   30492.                              006510
1.333    1594.    1594.   32350.    1601.   32350.                              006520
2.500    1599.    1599.   34213.    1607.   34213.                              006530
3.667    1604.    1604.   36081.    1612.   36081.                              006540
4.833    1608.    1608.   37955.    1617.   37955.                              006550
6.000    1613.    1613.   39834.    1622.   39834.                              006560
14125.         -23.014                          -1.35   -40800.     .0000       006570
     2                                                                          006580
-1.000   1862.    1862.   26392.    1864.   26392.                              006590
  .167   1883.    1883.   28583.    1885.   28583.                              006600
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2.500    1892.    1892.   32987.    1896.   32987.                              006620
3.667    1897.    1897.   35197.    1901.   35197.                              006630
4.833    1902.    1902.   37413.    1906.   37413.                              006640
6.000    1906.    1906.   39635.    1912.   39635.                              006650
15221.         -23.500                          -1.35   -40800.     .0000       006660
     2                                                                          006670
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3.667	2262.	2262.	37004.	2269.	37004.			006690
4.833	2264.	2264.	39644.	2273.	39644.			006700
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REACH 43	FRASER RIVER - SOUTH SIDE OF BARNSTON ISLAND							006720
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		.0270		21624.	1080.			006740
21	7	-1.00	6.00	-1.25	-2.	-5.5	-1.75	006750
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2								006770
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.167	1427.	1427.	21455.	1433.	21455.			006790
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3.667	1434.	1434.	26462.	1444.	26462.			006820
4.833	1436.	1436.	28136.	1448.	28136.			006830
6.000	1439.	1439.	29813.	1452.	29813.			006840
1112.		-31.190		-1.35	-19200.	.0000		006850
2								006860
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1.333	1114.	1114.	20236.	1119.	20236.			006890
2.500	1119.	1119.	21538.	1125.	21538.			006900
3.667	1123.	1123.	22846.	1130.	22846.			006910
4.833	1128.	1128.	24159.	1135.	24159.			006920
6.000	1133.	1133.	25478.	1140.	25478.			006930
2051.		-29.681		-1.35	-19200.	.0000		006940
2								006950
-1.000	932.	932.	16878.	936.	16878.			006960
.167	938.	938.	17969.	942.	17969.			006970
1.333	943.	943.	19066.	948.	19066.			006980
2.500	947.	947.	20168.	953.	20168.			006990
3.667	952.	952.	21276.	958.	21276.			007000
4.833	957.	957.	22389.	963.	22389.			007010
6.000	961.	961.	23508.	969.	23508.			007020
3445.		-27.168		-1.35	-19200.	.0000		007030
2								007040
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.167	857.	857.	17612.	862.	17612.			007060
1.333	862.	862.	18615.	868.	18615.			007070
2.500	867.	867.	19623.	873.	19623.			007080
3.667	871.	871.	20637.	878.	20637.			007090
4.833	876.	876.	21656.	883.	21656.			007100
6.000	881.	881.	22681.	888.	22681.			007110
4404.		-28.159		-1.35	-19200.	.0000		007120
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1.333	879.	879.	18165.	883.	18165.			007160
2.500	883.	883.	19193.	888.	19193.			007170
3.667	888.	888.	20226.	894.	20226.			007180
4.833	893.	893.	21265.	899.	21265.			007190
6.000	897.	897.	22309.	904.	22309.			007200
5442.		-34.150		-1.35	-19200.	.0000		007210
2								007220
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1.333	784.	784.	17268.	792.	17268.			007250
2.500	789.	789.	18185.	798.	18185.			007260
3.667	793.	793.	19108.	803.	19108.			007270
4.833	798.	798.	20036.	808.	20036.			007280
6.000	803.	803.	20970.	813.	20970.			007290
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                                                                            007520
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 2                                                                          007620
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 2                                                                          007710
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 3.667     1039.     1039.    20777.     1044.    20777.                    007760
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 2.500     1050.     1050.    19014.     1055.    19014.                    007840
 3.667     1055.     1055.    20242.     1060.    20242.                    007850
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12751.                -19.082             -1.35   -19200.      .0000        007880
 2                                                                          007890
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 1.333     1118.     1118.    17350.     1121.    17350.                    007920
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 2                                                                          007980
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4.833	1042.	1042.	22364.	1051.	22364.	
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.167	1163.	1163.	16627.	1166.	16627.	
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.167	1178.	1178.	15159.	1180.	15159.	
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3.667	1192.	1192.	19306.	1196.	19306.	
4.833	1197.	1197.	20700.	1201.	20700.	
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4.833	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

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REACH   44   FRASER RIVER  -  BARNSTON ISLAND TO PORT HAMMOND                 008670
       44          1        2         2          0          -1               008680
                          .0314              25364.     970.                 008690
       26          7     -1.00       5.00      -2.       -2.       -6.  -6.008700
       0.                -24.500              -.900   -60000.      .0000     008710
        2                                                                    008720
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    3.000    3602.    3602.    58057.    3607.    58057.                    008770
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    1159.                -27.900              -.900   -60000.      .0000     008800
        2                                                                    008810
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    2192.                -27.000              -.900   -60000.      .0000     008890
        2                                                                    008900
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    3.000    2520.    2520.    55548.    2526.    55548.                    008950
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    2.000    2292.    2292.    52790.    2298.    52790.                    009030
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    3982.                -31.000              -.900   -60000.      .0000     009070
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    2.000    2098.    2098.    51897.    2105.    51897.                    009120
    3.000    2102.    2102.    53998.    2110.    53998.                    009130
    4.000    2106.    2106.    56102.    2114.    56102.                    009140
    5.000    2110.    2110.    58210.    2118.    58210.                    009150
    5188.                -38.000              -.900   -60000.      .0000     009160
        2                                                                    009170
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    1.000    1849.    1849.    53709.    1861.    53709.                    009200
    2.000    1853.    1853.    55560.    1865.    55560.                    009210
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    4.000    1861.    1861.    59275.    1874.    59275.                    009230
    5.000    1865.    1865.    61138.    1878.    61138.                    009240
    6265.                -41.500              -.900   -60000.      .0000     009250
        2                                                                    009260
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    0.000    1766.    1766.    49367.    1773.    49367.                    009280
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 7191.             -46.500            -.900  -60000.      .0000        009340
    2                                                                  009350
-1.000    1634.    1634.   47449.    1646.   47449.                    009360
 0.000    1640.    1640.   49087.    1652.   49087.                    009370
 1.000    1644.    1644.   50728.    1657.   50728.                    009380
 2.000    1648.    1648.   52374.    1661.   52374.                    009390
 3.000    1652.    1652.   54024.    1666.   54024.                    009400
 4.000    1656.    1656.   55678.    1670.   55678.                    009410
 5.000    1660.    1660.   57336.    1675.   57336.                    009420
 8190.             -46.500            -.900  -60000.      .0000        009430
    2                                                                  009440
-1.000    1658.    1658.   47108.    1663.   47108.                    009450
 0.000    1673.    1673.   48776.    1678.   48776.                    009460
 1.000    1677.    1677.   50452.    1683.   50452.                    009470
 2.000    1681.    1681.   52131.    1687.   52131.                    009480
 3.000    1685.    1685.   53814.    1692.   53814.                    009490
 4.000    1689.    1689.   55501.    1696.   55501.                    009500
 5.000    1693.    1693.   57192.    1701.   57192.                    009510
 9139.             -50.000            -.900  -60000.      .0000        009520
    2                                                                  009530
-1.000    1593.    1593.   45288.    1599.   45288.                    009540
 0.000    1608.    1608.   46891.    1614.   46891.                    009550
 1.000    1612.    1612.   48500.    1619.   48500.                    009560
 2.000    1616.    1616.   50114.    1623.   50114.                    009570
 3.000    1620.    1620.   51732.    1628.   51732.                    009580
 4.000    1624.    1624.   53354.    1632.   53354.                    009590
 5.000    1628.    1628.   54979.    1637.   54979.                    009600
 10070.            -60.000            -.900  -60000.      .0000        009610
    2                                                                  009620
-1.000    1441.    1441.   45097.    1456.   45097.                    009630
 0.000    1473.    1473.   46561.    1488.   46561.                    009640
 1.000    1477.    1477.   48035.    1493.   48035.                    009650
 2.000    1481.    1481.   49514.    1497.   49514.                    009660
 3.000    1485.    1485.   50996.    1502.   50996.                    009670
 4.000    1489.    1489.   52483.    1506.   52483.                    009680
 5.000    1493.    1493.   53973.    1511.   53973.                    009690
 11439.            -60.500            -.900  -60000.      .0000        009700
    2                                                                  009710
-1.000    1345.    1345.   41449.    1363.   41449.                    009720
 0.000    1359.    1359.   42804.    1377.   42804.                    009730
 1.000    1363.    1363.   44165.    1382.   44165.                    009740
 2.000    1367.    1367.   45530.    1386.   45530.                    009750
 3.000    1371.    1371.   46899.    1391.   46899.                    009760
 4.000    1375.    1375.   48272.    1395.   48272.                    009770
 5.000    1379.    1379.   49649.    1400.   49649.                    009780
 12342.            -70.000            -.900  -60000.      .0000        009790
    2                                                                  009800
-1.000    1405.    1405.   44775.    1420.   44775.                    009810
 0.000    1422.    1422.   46192.    1438.   46192.                    009820
 1.000    1426.    1426.   47616.    1442.   47616.                    009830
 2.000    1430.    1430.   49044.    1446.   49044.                    009840
 3.000    1434.    1434.   50476.    1451.   50476.                    009850
 4.000    1438.    1438.   51912.    1455.   51912.                    009860
 5.000    1442.    1442.   53352.    1460.   53352.                    009870
 13427.            -69.500            -.900  -60000.      .0000        009880
    2                                                                  009890
-1.000    1519.    1519.   46126.    1535.   46126.                    009900
 0.000    1542.    1542.   47661.    1558.   47661.                    009910
 1.000    1546.    1546.   49206.    1562.   49206.                    009920
 2.000    1550.    1550.   50754.    1567.   50754.                    009930
 3.000    1554.    1554.   52307.    1571.   52307.                    009940
 4.000    1558.    1558.   53863.    1576.   53863.                    009950
 5.000    1562.    1562.   55423.    1580.   55423.                    009960
 14824.            -68.000            -.900  -60000.      .0000        009970
```

```
                                                                                009980
     2                                                                          009990
-1.000     1406.     1406.    48270.    1418.    48270.                        010000
 0.000     1431.     1431.    49693.    1444.    49693.                        010010
 1.000     1435.     1435.    51127.    1448.    51127.                        010020
 2.000     1439.     1439.    52564.    1453.    52564.                        010030
 3.000     1443.     1443.    54005.    1457.    54005.                        010040
 4.000     1447.     1447.    55450.    1462.    55450.                        010050
 5.000     1451.     1451.    56899.    1466.    56899.                        010060
15363.               -72.000              -.900   -60000.     .0000          010070
     2                                                                          010080
-1.000     1412.     1412.    49284.    1423.    49284.                        010090
 0.000     1429.     1429.    50708.    1441.    50708.                        010100
 1.000     1433.     1433.    52139.    1445.    52139.                        010110
 2.000     1437.     1437.    53575.    1450.    53575.                        010120
 3.000     1441.     1441.    55014.    1454.    55014.                        010130
 4.000     1445.     1445.    56457.    1459.    56457.                        010140
 5.000     1449.     1449.    57905.    1463.    57905.                        010150
16218.               -71.500              -.900   -60000.     .0000          010160
     2                                                                          010170
-1.000     1421.     1421.    46911.    1437.    46911.                        010180
 0.000     1431.     1431.    48339.    1448.    48339.                        010190
 1.000     1435.     1435.    49772.    1452.    49772.                        010200
 2.000     1439.     1439.    51210.    1457.    51210.                        010210
 3.000     1443.     1443.    52651.    1461.    52651.                        010220
 4.000     1447.     1447.    54096.    1465.    54096.                        010230
 5.000     1451.     1451.    55546.    1470.    55546.                        010240
16894.               -71.000              -.900   -60000.     .0000          010250
     2                                                                          010260
-1.000     1342.     1342.    49602.    1369.    49602.                        010270
 0.000     1350.     1350.    50949.    1379.    50949.                        010280
 1.000     1354.     1354.    52302.    1383.    52302.                        010290
 2.000     1358.     1358.    53658.    1388.    53658.                        010300
 3.000     1362.     1362.    55018.    1392.    55018.                        010310
 4.000     1366.     1366.    56383.    1397.    56383.                        010320
 5.000     1370.     1370.    57751.    1401.    57751.                        010330
17730.               -77.000              -.900   -60000.     .0000          010340
     2                                                                          010350
-1.000     1480.     1480.    54218.    1496.    54218.                        010360
 0.000     1487.     1487.    55703.    1504.    55703.                        010370
 1.000     1491.     1491.    57192.    1508.    57192.                        010380
 2.000     1495.     1495.    58685.    1513.    58685.                        010390
 3.000     1499.     1499.    60182.    1517.    60182.                        010400
 4.000     1503.     1503.    61683.    1521.    61683.                        010410
 5.000     1507.     1507.    63188.    1526.    63188.                        010420
18773.               -66.500              -.900   -60000.     .0000          010430
     2                                                                          010440
-1.000     1488.     1488.    53315.    1499.    53315.                        010450
 0.000     1496.     1496.    54808.    1508.    54808.                        010460
 1.000     1500.     1500.    56306.    1512.    56306.                        010470
 2.000     1504.     1504.    57808.    1517.    57808.                        010480
 3.000     1508.     1508.    59313.    1521.    59313.                        010490
 4.000     1512.     1512.    60823.    1525.    60823.                        010500
 5.000     1516.     1516.    62337.    1530.    62337.                        010510
20042.               -59.500              -.900   -60000.     .0000          010520
     2                                                                          010530
-1.000     1454.     1454.    45941.    1464.    45941.                        010540
 0.000     1481.     1481.    47414.    1492.    47414.                        010550
 1.000     1485.     1485.    48896.    1496.    48896.                        010560
 2.000     1489.     1489.    50383.    1500.    50383.                        010570
 3.000     1493.     1493.    51874.    1505.    51874.                        010580
 4.000     1497.     1497.    53369.    1509.    53369.                        010590
 5.000     1501.     1501.    54867.    1514.    54867.                        010600
20924.               -56.500              -.900   -60000.     .0000          010610
     2                                                                          010620
-1.000     1641.     1641.    45155.    1652.    45155.                        010630
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
1.000	1666.	1666.	48475.	1677.	48475.	
2.000	1670.	1670.	50144.	1682.	50144.	
3.000	1674.	1674.	51816.	1686.	51816.	
4.000	1678.	1678.	53492.	1691.	53492.	
5.000	1682.	1682.	55172.	1695.	55172.	
21985.		-62.500		-.900	-60000.	.0000
2						
-1.000	1804.	1804.	42035.	1816.	42035.	
0.000	1814.	1814.	43845.	1826.	43845.	
1.000	1818.	1818.	45660.	1831.	45660.	
2.000	1822.	1822.	47480.	1835.	47480.	
3.000	1826.	1826.	49303.	1840.	49303.	
4.000	1830.	1830.	51131.	1844.	51131.	
5.000	1834.	1834.	52962.	1849.	52962.	
22962.		-65.500		-.900	-60000.	.0000
2						
-1.000	2072.	2072.	41274.	2083.	41274.	
0.000	2082.	2082.	43353.	2094.	43353.	
1.000	2086.	2086.	45438.	2098.	45438.	
2.000	2090.	2090.	47526.	2103.	47526.	
3.000	2094.	2094.	49619.	2107.	49619.	
4.000	2098.	2098.	51715.	2111.	51715.	
5.000	2102.	2102.	53815.	2116.	53815.	
24294.		-67.500		-.900	-60000.	.0000
2						
-1.000	2488.	2488.	43051.	2502.	43051.	
0.000	2509.	2509.	45554.	2523.	45554.	
1.000	2513.	2513.	48065.	2528.	48065.	
2.000	2517.	2517.	50580.	2532.	50580.	
3.000	2521.	2521.	53098.	2537.	53098.	
4.000	2525.	2525.	55621.	2541.	55621.	
5.000	2529.	2529.	58148.	2546.	58148.	
25364.		-44.500		-.900	-60000.	.0000
2						
-1.000	2919.	2919.	49142.	2923.	49142.	
0.000	2941.	2941.	52077.	2945.	52077.	
1.000	2945.	2945.	55020.	2949.	55020.	
2.000	2949.	2949.	57967.	2954.	57967.	
3.000	2953.	2953.	60918.	2958.	60918.	
4.000	2957.	2957.	63873.	2963.	63873.	
5.000	2961.	2961.	66832.	2967.	66832.	
REACH 45	FRASER RIVER - NORTH SIDE OF MCMILLAN ISLAND					
45	1	2	2		0	-1
		.0303		12175.	1000.	
13	7	-1.00	5.00	-0.	-0.	-0.
563.		-36.995		-.600	-57600.	.000
2						
-1.000	2514.	2514.	46377.	2520.	46377.	
0.000	2529.	2529.	48901.	2536.	48901.	
1.000	2533.	2533.	51431.	2540.	51431.	
2.000	2537.	2537.	53966.	2544.	53966.	
3.000	2541.	2541.	56505.	2549.	56505.	
4.000	2545.	2545.	59047.	2553.	59047.	
5.000	2549.	2549.	61594.	2558.	61594.	
1604.		-28.987		-.600	-57600.	.000
2						
-1.000	2224.	2224.	44138.	2226.	44138.	
0.000	2238.	2238.	46371.	2240.	46371.	
1.000	2242.	2242.	48610.	2245.	48610.	
2.000	2246.	2246.	50854.	2249.	50854.	
3.000	2250.	2250.	53101.	2253.	53101.	
4.000	2254.	2254.	55353.	2258.	55353.	
5.000	2258.	2258.	57609.	2262.	57609.	
2637.		-37.978		-.600	-57600.	.000
2						
-1.000	2031.	2031.	42743.	2033.	42743.	

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0.000     2052.     2052.     44808.     2055.     44808.                    011300
1.000     2056.     2056.     46863.     2060.     46863.                    011310
2.000     2060.     2060.     48921.     2064.     48921.                    011320
3.000     2064.     2064.     50984.     2069.     50984.                    011330
4.000     2068.     2068.     53050.     2073.     53050.                    011340
5.000     2072.     2072.     55121.     2078.     55121.                    011350
3622.               -48.470               -.600    -57600.      .000        011360
    2                                                                        011370
-1.000    1710.     1710.     41712.     1721.     41712.                    011380
0.000     1772.     1772.     43467.     1784.     43467.                    011390
1.000     1776.     1776.     45241.     1788.     45241.                    011400
2.000     1780.     1780.     47019.     1793.     47019.                    011410
3.000     1784.     1784.     48801.     1797.     48801.                    011420
4.000     1788.     1788.     50588.     1802.     50588.                    011430
5.000     1792.     1792.     52378.     1806.     52378.                    011440
4491.               -44.463               -.600    -57600.      .000        011450
    2                                                                        011460
-1.000    1910.     1910.     43087.     1919.     43087.                    011470
0.000     1955.     1955.     45029.     1964.     45029.                    011480
1.000     1959.     1959.     46985.     1969.     46985.                    011490
2.000     1963.     1963.     48946.     1973.     48946.                    011500
3.000     1967.     1967.     50910.     1978.     50910.                    011510
4.000     1971.     1971.     52879.     1982.     52879.                    011520
5.000     1975.     1975.     54852.     1987.     54852.                    011530
5660.               -52.454               -.600    -57600.      .000        011540
    2                                                                        011550
-1.000    1496.     1496.     38789.     1508.     38789.                    011560
0.000     1500.     1500.     40287.     1513.     40287.                    011570
1.000     1504.     1504.     41789.     1517.     41789.                    011580
2.000     1508.     1508.     43295.     1522.     43295.                    011590
3.000     1512.     1512.     44805.     1526.     44805.                    011600
4.000     1516.     1516.     46319.     1531.     46319.                    011610
5.000     1520.     1520.     47837.     1535.     47837.                    011620
6757.               -48.945               -.600    -57600.      .000        011630
    2                                                                        011640
-1.000    1745.     1745.     42191.     1760.     42191.                    011650
0.000     1791.     1791.     43969.     1807.     43969.                    011660
1.000     1795.     1795.     45762.     1811.     45762.                    011670
2.000     1799.     1799.     47558.     1816.     47558.                    011680
3.000     1803.     1803.     49359.     1820.     49359.                    011690
4.000     1807.     1807.     51164.     1825.     51164.                    011700
5.000     1811.     1811.     52973.     1829.     52973.                    011710
7734.               -49.936               -.600    -57600.      .000        011720
    2                                                                        011730
-1.000    1576.     1576.     42200.     1667.     42200.                    011740
0.000     1595.     1595.     43789.     1689.     43789.                    011750
1.000     1597.     1597.     45385.     1692.     45385.                    011760
2.000     1599.     1599.     46983.     1695.     46983.                    011770
3.000     1601.     1601.     48584.     1698.     48584.                    011780
4.000     1603.     1603.     50186.     1702.     50186.                    011790
5.000     1605.     1605.     51790.     1705.     51790.                    011800
8513.               -43.430               -.600    -57600.      .000        011810
    2                                                                        011820
-1.000    1556.     1556.     44089.     1566.     44089.                    011830
0.000     1593.     1593.     45671.     1604.     45671.                    011840
1.000     1597.     1597.     47266.     1608.     47266.                    011850
2.000     1601.     1601.     48865.     1613.     48865.                    011860
3.000     1605.     1605.     50469.     1617.     50469.                    011870
4.000     1609.     1609.     52076.     1621.     52076.                    011880
5.000     1613.     1613.     53688.     1626.     53688.                    011890
9484.               -49.422               -.600    -57600.      .000        011900
    2                                                                        011910
-1.000    1486.     1486.     40607.     1491.     40607.                    011920
0.000     1497.     1497.     42100.     1503.     42100.                    011930
1.000     1501.     1501.     43600.     1507.     43600.                    011940
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      3.000     1509.     1509.    46610.     1516.    46610.
      4.000     1513.     1513.    48122.     1521.    48122.
      5.000     1517.     1517.    49637.     1525.    49637.
    10341.                -37.915              -.600   -57600.      .000
          2
     -1.000     1635.     1635.    38914.     1641.    38914.
      0.000     1641.     1641.    40552.     1647.    40552.
      1.000     1645.     1645.    42195.     1651.    42195.
      2.000     1649.     1649.    43842.     1656.    43842.
      3.000     1653.     1653.    45493.     1660.    45493.
      4.000     1657.     1657.    47148.     1665.    47148.
      5.000     1661.     1661.    48807.     1669.    48807.
    11509.                -22.905              -.600   -57600.      .000
          2
     -1.000     2752.     2752.    37599.     2757.    37599.
      0.000     2760.     2760.    40356.     2765.    40356.
      1.000     2764.     2764.    43118.     2769.    43118.
      2.000     2768.     2768.    45884.     2774.    45884.
      3.000     2772.     2772.    48654.     2778.    48654.
      4.000     2776.     2776.    51428.     2783.    51428.
      5.000     2780.     2780.    54206.     2787.    54206.
    12175.                -17.900              -.600   -57600.      .000
          2
     -1.000     2854.     2854.    30689.     2866.    30689.
      0.000     2857.     2857.    33545.     2870.    33545.
      1.000     2859.     2859.    36402.     2873.    36402.
      2.000     2861.     2861.    39262.     2876.    39262.
      3.000     2863.     2863.    42123.     2879.    42123.
      4.000     2865.     2865.    44987.     2883.    44987.
      5.000     2867.     2867.    47853.     2886.    47853.
REACH    46      FRASER RIVER  -  SOUTH SIDE OF MCMILLAN ISLAND
        46         1         2          2                   0        -1
                              .0303              15198.    1080.
        16         7        -1.00       5.00       -0.       -0.      -0.
       562.                -11.496              -.600   -2400.       .000
          2
     -1.000      472.      472.     2771.      473.     2771.
      0.000      485.      485.     3252.      486.     3252.
      1.000      489.      489.     3739.      491.     3739.
      2.000      493.      493.     4230.      495.     4230.
      3.000      497.      497.     4725.      500.     4725.
      4.000      501.      501.     5224.      504.     5224.
      5.000      505.      505.     5727.      509.     5727.
    1431.                -13.691              -.600   -2400.       .000
          2
     -1.000      267.      267.     2160.      268.     2160.
      0.000      343.      343.     2449.      345.     2449.
      1.000      409.      409.     2836.      412.     2836.
      2.000      443.      443.     3262.      446.     3262.
      3.000      459.      459.     3717.      463.     3717.
      4.000      463.      463.     4179.      468.     4179.
      5.000      467.      467.     4644.      472.     4644.
    2405.                -17.184              -.600   -2400.       .000
          2
     -1.000      271.      271.     2777.      273.     2777.
      0.000      291.      291.     3056.      295.     3056.
      1.000      323.      323.     3363.      327.     3363.
      2.000      355.      355.     3701.      360.     3701.
      3.000      386.      386.     4072.      392.     4072.
      4.000      418.      418.     4474.      425.     4474.
      5.000      450.      450.     4908.      457.     4908.
    3393.                -12.278              -.600   -2400.       .000
          2
     -1.000      282.      282.     1826.      283.     1826.
      0.000      313.      313.     2119.      315.     2119.
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 2.000    410.     410.    2842.    413.    2842.                012620
 3.000    456.     456.    3276.    459.    3276.                012630
 4.000    476.     476.    3742.    480.    3742.                012640
 5.000    491.     491.    4227.    496.    4227.                012650
 4362.            -12.771           -.600   -2400.     .000      012660
     2                                                           012670
-1.000    318.     318.    1944.    319.    1944.                012680
 0.000    348.     348.    2275.    350.    2275.                012690
 1.000    385.     385.    2642.    387.    2642.                012700
 2.000    422.     422.    3046.    425.    3046.                012710
 3.000    459.     459.    3487.    463.    3487.                012720
 4.000    496.     496.    3964.    501.    3964.                012730
 5.000    533.     533.    4479.    538.    4479.                012740
 5259.            -8.965            -.600   -2400.     .000      012750
     2                                                           012760
-1.000    323.     323.    1873.    324.    1873.                012770
 0.000    356.     356.    2208.    357.    2208.                012780
 1.000    408.     408.    2590.    410.    2590.                012790
 2.000    461.     461.    3025.    463.    3025.                012800
 3.000    512.     512.    3512.    515.    3512.                012810
 4.000    544.     544.    4040.    547.    4040.                012820
 5.000    575.     575.    4599.    580.    4599.                012830
 6677.            -5.856            -.600   -2400.     .000      012840
     2                                                           012850
-1.000    313.     313.    1039.    313.    1039.                012860
 0.000    351.     351.    1367.    352.    1367.                012870
 1.000    409.     409.    1747.    410.    1747.                012880
 2.000    466.     466.    2184.    468.    2184.                012890
 3.000    523.     523.    2679.    526.    2679.                012900
 4.000    581.     581.    3231.    584.    3231.                012910
 5.000    638.     638.    3840.    642.    3840.                012920
 7717.            -7.849            -.600   -2400.     .000      012930
     2                                                           012940
-1.000    144.     144.     487.    144.     487.                012950
 0.000    209.     209.     659.    210.     659.                012960
 1.000    296.     296.     911.    297.     911.                012970
 2.000    459.     459.    1278.    461.    1278.                012980
 3.000    534.     534.    1774.    537.    1774.                012990
 4.000    609.     609.    2346.    613.    2346.                013000
 5.000    685.     685.    2993.    689.    2993.                013010
 8909.            -3.041            -.600   -2400.     .000      013020
     2                                                           013030
-1.000    196.     196.     163.    196.     163.                013040
 0.000    341.     341.     430.    341.     430.                013050
 1.000    413.     413.     810.    414.     810.                013060
 2.000    480.     480.    1256.    482.    1256.                013070
 3.000    547.     547.    1770.    549.    1770.                013080
 4.000    614.     614.    2350.    617.    2350.                013090
 5.000    680.     680.    2998.    683.    2998.                013100
 10044.           -2.634            -.600   -2400.     .000      013110
     2                                                           013120
-1.000    173.     173.     122.    174.     122.                013130
 0.000    331.     331.     386.    331.     386.                013140
 1.000    396.     396.     751.    397.     751.                013150
 2.000    456.     456.    1177.    457.    1177.                013160
 3.000    516.     516.    1663.    518.    1663.                013170
 4.000    551.     551.    2200.    554.    2200.                013180
 5.000    576.     576.    2763.    580.    2763.                013190
 10885.           -1.628            -.600   -2400.     .000      013200
     2                                                           013210
-1.000     67.      67.      21.     67.      21.                013220
 0.000    198.     198.     169.    198.     169.                013230
 1.000    282.     282.     409.    283.     409.                013240
 2.000    378.     378.     737.    379.     737.                013250
 3.000    477.     477.    1165.    479.    1165.                013260
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                                                                                013270
 5.000      679.      679.     2302.      682.     2302.                       013280
11794.                -4.322                -.600    -2400.      .000         013290
     2                                                                          013300
-1.000      141.      141.      293.      141.      293.                       013
 0.000      182.      182.      451.      183.      451.                       013
 1.000      249.      249.      665.      250.      665.                       013330
 2.000      324.      324.      951.      325.      951.                       013340
 3.000      398.      398.     1312.      401.     1312.                       013350
 4.000      549.      549.     1771.      552.     1771.                       013360
 5.000      717.      717.     2437.      721.     2437.                       013370
12755.                -1.816                -.600    -2400.      .000         013380
     2                                                                          013390
-1.000      103.      103.       51.      103.       51.                       013400
 0.000      213.      213.      199.      214.      199.                       013410
 1.000      311.      311.      467.      313.      467.                       013420
 2.000      485.      485.      843.      487.      843.                       013430
 3.000      511.      511.     1341.      514.     1341.                       013440
 4.000      537.      537.     1865.      541.     1865.                       013450
 5.000      563.      563.     2415.      568.     2415.                       013460
13753.                -3.410                -.600    -2400.      .000         013470
     2                                                                          013480
-1.000      249.      249.      276.      249.      276.                       013490
 0.000      305.      305.      552.      306.      552.                       013500
 1.000      370.      370.      890.      371.      890.                       013510
 2.000      418.      418.     1287.      420.     1287.                       013520
 3.000      457.      457.     1724.      460.     1724.                       013530
 4.000      495.      495.     2200.      499.     2200.                       013540
 5.000      534.      534.     2715.      538.     2715.                       013550
14755.               -10.503                -.600    -2400.      .000         013560
     2                                                                          013570
-1.000      432.      432.     1643.      436.     1643.                       013580
 0.000      460.      460.     2085.      465.     2085.                       013590
 1.000      507.      507.     2568.      514.     2568.                       013600
 2.000      555.      555.     3099.      562.     3099.                       013610
 3.000      602.      602.     3678.      611.     3678.                       013620
 4.000      650.      650.     4304.      660.     4304.                       013630
 5.000      661.      661.     4963.      672.     4963.                       013640
15198.               -12.300                -.600    -2400.      .000         013650
     2                                                                          013660
-1.000      647.      647.     6158.      657.     6158.                       013670
 0.000      765.      765.     6853.      776.     6853.                       013680
 1.000      767.      767.     7619.      779.     7619.                       013
 2.000      769.      769.     8387.      782.     8387.                       013
 3.000      771.      771.     9156.      785.     9156.                       013
 4.000      773.      773.     9928.      789.     9928.                       013
 5.000      775.      775.    10702.      792.    10702.                       013730
REACH  47      FRASER RIVER -  MCMILLAN ISLAND TO CRESCENT ISLAND              013740
    47      1        2         2                  0          -1               013750
                  .0281                19600.      980.                       013760
    21      7     -1.00      5.00                                             013770
     0.              -17.900                -.300    -60000.      .000         013780
     2                                                                          013790
-1.000     3498.     3498.    35422.     3501.    35422.                       013800
 0.000     3509.     3509.    38926.     3512.    38926.                       013810
 1.000     3624.     3624.    42548.     3628.    42548.                       013820
 2.000     3628.     3628.    46174.     3632.    46174.                       013830
 3.000     3632.     3632.    49804.     3637.    49804.                       013840
 4.000     3636.     3636.    53438.     3641.    53438.                       013850
 5.000     3640.     3640.    57076.     3646.    57076.                       013860
 1124.               -16.894                -.300    -60000.      .000         013870
     2                                                                          013880
-1.000     3522.     3522.    32902.     3528.    32902.                       013890
 0.000     3527.     3527.    36427.     3533.    36427.                       013900
 1.000     3531.     3531.    39955.     3537.    39955.                       013910
 2.000     3535.     3535.    43488.     3542.    43488.                       013920
 3.000     3539.     3539.    47025.     3546.    47024.                       013930
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4.000    3543.    3543.    50565.    3551.    50565.                    013940
5.000    3547.    3547.    54110.    3555.    54110.                    013950
2036.             -25.390             -.300   -60000.      .000         013960
   2                                                                     013970
-1.000   3462.    3462.    32635.    3468.    32635.                    013980
 0.000   3476.    3476.    36106.    3482.    36106.                    013990
 1.000   3480.    3480.    39585.    3487.    39585.                    014000
 2.000   3484.    3484.    43067.    3491.    43067.                    014010
 3.000   3488.    3488.    46554.    3496.    46554.                    014020
 4.000   3492.    3492.    50044.    3500.    50044.                    014030
 5.000   3496.    3496.    53539.    3505.    53539.                    014040
2858.             -33.385             -.300   -60000.      .000         014050
   2                                                                     014060
-1.000   3538.    3538.    32425.    3546.    32425.                    014070
 0.000   3543.    3543.    35965.    3551.    35965.                    014080
 1.000   3547.    3547.    39510.    3555.    39510.                    014090
 2.000   3551.    3551.    43059.    3560.    43059.                    014100
 3.000   3555.    3555.    46611.    3564.    46611.                    014110
 4.000   3559.    3559.    50168.    3569.    50168.                    014120
 5.000   3563.    3563.    53729.    3573.    53729.                    014130
3803.             -20.881             -.300   -60000.      .000         014140
   2                                                                     014150
-1.000   3770.    3770.    33940.    3773.    33940.                    014160
 0.000   3779.    3779.    37715.    3782.    37715.                    014170
 1.000   3783.    3783.    41496.    3786.    41496.                    014180
 2.000   3787.    3787.    45281.    3791.    45281.                    014190
 3.000   3791.    3791.    49069.    3795.    49069.                    014200
 4.000   3795.    3795.    52862.    3800.    52862.                    014210
 5.000   3799.    3799.    56659.    3804.    56659.                    014220
4990.             -18.875             -.300   -60000.      .000         014230
   2                                                                     014240
-1.000   3341.    3341.    38223.    3344.    38223.                    014250
 0.000   3352.    3352.    41571.    3355.    41571.                    014260
 1.000   3356.    3356.    44925.    3359.    44925.                    014270
 2.000   3360.    3360.    48283.    3363.    48283.                    014280
 3.000   3364.    3364.    51645.    3368.    51645.                    014290
 4.000   3368.    3368.    55011.    3372.    55011.                    014300
 5.000   3372.    3372.    58381.    3377.    58381.                    014310
6076.             -21.869             -.300   -60000.      .000         014320
   2                                                                     014330
-1.000   2779.    2779.    39774.    2782.    39774.                    014340
 0.000   2786.    2786.    42557.    2790.    42557.                    014350
 1.000   2790.    2790.    45344.    2794.    45344.                    014360
 2.000   2794.    2794.    48136.    2799.    48136.                    014370
 3.000   2798.    2798.    50932.    2803.    50932.                    014380
 4.000   2802.    2802.    53732.    2807.    53732.                    014390
 5.000   2806.    2806.    56536.    2812.    56536.                    014400
7019.             -24.864             -.300   -60000.      .000         014410
   2                                                                     014420
-1.000   2393.    2393.    40414.    2397.    40414.                    014430
 0.000   2400.    2400.    42812.    2405.    42812.                    014440
 1.000   2404.    2404.    45214.    2409.    45214.                    014450
 2.000   2408.    2408.    47620.    2413.    47620.                    014460
 3.000   2412.    2412.    50031.    2418.    50031.                    014470
 4.000   2416.    2416.    52445.    2422.    52445.                    014480
 5.000   2420.    2420.    54863.    2427.    54863.                    014490
7968.             -32.859             -.300   -60000.      .000         014500
   2                                                                     014510
-1.000   2308.    2308.    41457.    2312.    41457.                    014520
 0.000   2332.    2332.    43781.    2336.    43781.                    014530
 1.000   2336.    2336.    46115.    2341.    46115.                    014540
 2.000   2340.    2340.    48453.    2345.    48453.                    014550
 3.000   2344.    2344.    50795.    2350.    50795.                    014560
 4.000   2348.    2348.    53142.    2354.    53142.                    014570
 5.000   2352.    2352.    55492.    2359.    55492.                    014580
8933.             -28.354             -.300   -60000.      .000         014590
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                                                                                    014600
          2                                                                         014610
-1.000    2173.     2173.     40439.    2179.     40439.                           014620
 0.000    2181.     2181.     42616.    2187.     42616.                           0146
 1.000    2185.     2185.     44799.    2192.     44799.                           0146
 2.000    2189.     2189.     46985.    2196.     46985.                           0146
 3.000    2193.     2193.     49176.    2201.     49176.                           014660
 4.000    2197.     2197.     51371.    2205.     51371.                           014670
 5.000    2201.     2201.     53569.    2210.     53569.                           014680
 9789.              -26.850              -.300     -60000.      .000                014690
          2                                                                         014700
-1.000    2143.     2143.     41101.    2151.     41101.                           014710
 0.000    2152.     2152.     43249.    2160.     43249.                           014720
 1.000    2156.     2156.     45403.    2165.     45403.                           014730
 2.000    2160.     2160.     47561.    2169.     47561.                           014740
 3.000    2164.     2164.     49723.    2174.     49723.                           014750
 4.000    2168.     2168.     51889.    2178.     51889.                           014760
 5.000    2172.     2172.     54059.    2183.     54059.                           014770
11024.              -31.844              -.300     -60000.      .000                014780
          2                                                                         014790
-1.000    1914.     1914.     43050.    1923.     43050.                           014800
 0.000    1921.     1921.     44968.    1931.     44968.                           014810
 1.000    1925.     1925.     46891.    1935.     46891.                           014820
 2.000    1929.     1929.     48819.    1940.     48819.                           014830
 3.000    1933.     1933.     50750.    1944.     50750.                           014840
 4.000    1937.     1937.     52685.    1949.     52685.                           014850
 5.000    1941.     1941.     54624.    1953.     54624.                           014860
11843.              -28.340              -.300     -60000.      .000                014870
          2                                                                         014880
-1.000    1921.     1921.     43185.    1926.     43185.                           014890
 0.000    1932.     1932.     45112.    1936.     45112.                           014900
 1.000    1936.     1936.     47046.    1941.     47046.                           014910
 2.000    1940.     1940.     48984.    1945.     48984.                           014920
 3.000    1944.     1944.     50926.    1950.     50926.                           014930
 4.000    1948.     1948.     52871.    1954.     52871.                           014940
 5.000    1952.     1952.     54821.    1959.     54821.                           014950
12892.              -32.834              -.300     -60000.      .000                014960
          2                                                                         014970
-1.000    1823.     1823.     44328.    1830.     44328.                           014980
 0.000    1829.     1829.     46154.    1836.     46154.                           014990
 1.000    1833.     1833.     47985.    1840.     47985.                           015000
 2.000    1837.     1837.     49820.    1845.     49820.                           015010
 3.000    1841.     1841.     51659.    1849.     51659.                           0150
 4.000    1845.     1845.     53501.    1854.     53501.                           0150
 5.000    1849.     1849.     55348.    1858.     55348.                           0150
13811.              -33.330              -.300     -60000.      .000                0150
          2                                                                         015050
-1.000    1829.     1829.     43395.    1838.     43395.                           015060
 0.000    1843.     1843.     45233.    1852.     45233.                           015070
 1.000    1847.     1847.     47077.    1856.     47077.                           015080
 2.000    1851.     1851.     48926.    1861.     48926.                           015090
 3.000    1855.     1855.     50779.    1865.     50779.                           015100
 4.000    1859.     1859.     52636.    1870.     52636.                           015110
 5.000    1863.     1863.     54497.    1874.     54497.                           015120
14728.              -33.325              -.300     -60000.      .000                015130
          2                                                                         015140
-1.000    1722.     1722.     44097.    1733.     44097.                           015150
 0.000    1726.     1726.     45821.    1737.     45821.                           015160
 1.000    1730.     1730.     47548.    1742.     47548.                           015170
 2.000    1734.     1734.     49280.    1746.     49280.                           015180
 3.000    1738.     1738.     51016.    1751.     51016.                           015190
 4.000    1742.     1742.     52756.    1755.     52756.                           015200
 5.000    1746.     1746.     54500.    1760.     54500.                           015210
15632.              -38.820              -.300     -60000.      .000                015220
          2                                                                         015230
-1.000    1625.     1625.     40505.    1633.     40505.                           015240
 0.000    1634.     1634.     42137.    1642.     42137.                           015250
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1.000     1640.     1640.     43774.     1648.     43774.                                                         015270
2.000     1644.     1644.     45416.     1652.     45416.                                                         015280
3.000     1648.     1648.     47062.     1657.     47062.                                                         015290
4.000     1652.     1652.     48711.     1661.     48711.                                                         015300
5.000     1656.     1656.     50365.     1666.     50365.                                                         015310
16521.              -34.816                -.300   -60000.      .000                                              015320
    2                                                                                                               015330
-1.000    1627.     1627.     46013.     1638.     46013.                                                         015340
 0.000    1636.     1636.     47646.     1648.     47646.                                                         015350
 1.000    1640.     1640.     49284.     1652.     49284.                                                         015360
 2.000    1644.     1644.     50925.     1657.     50925.                                                         015370
 3.000    1648.     1648.     52571.     1661.     52571.                                                         015380
 4.000    1652.     1652.     54221.     1666.     54221.                                                         015390
 5.000    1656.     1656.     55875.     1670.     55875.                                                         015400
17635.              -42.310                -.300   -60000.      .000                                              015410
    2                                                                                                               015420
-1.000    1557.     1557.     42670.     1562.     42670.                                                         015430
 0.000    1805.     1805.     44312.     1810.     44312.                                                         015440
 1.000    1809.     1809.     46119.     1815.     46119.                                                         015450
 2.000    1813.     1813.     47929.     1819.     47929.                                                         015460
 3.000    1817.     1817.     49744.     1824.     49744.                                                         015470
 4.000    1821.     1821.     51563.     1828.     51563.                                                         015480
 5.000    1825.     1825.     53386.     1833.     53386.                                                         015490
18828.              -39.304                -.300   -60000.      .000                                              015500
    2                                                                                                               015510
-1.000    1483.     1483.     33624.     1487.     33624.                                                         015520
 0.000    1900.     1900.     35269.     1905.     35269.                                                         015530
 1.000    1904.     1904.     37171.     1909.     37171.                                                         015540
 2.000    1908.     1908.     39077.     1914.     39077.                                                         015550
 3.000    1912.     1912.     40987.     1918.     40987.                                                         015560
 4.000    1916.     1916.     42902.     1923.     42902.                                                         015570
 5.000    1920.     1920.     44820.     1927.     44820.                                                         015580
19600.              -45.800                -.300   -60000.      .000                                              015590
    2                                                                                                               015600
-1.000    1740.     1740.     34553.     1745.     34553.                                                         015610
 0.000    2002.     2002.     36413.     2007.     36413.                                                         015620
 1.000    2006.     2006.     38417.     2012.     38417.                                                         015630
 2.000    2010.     2010.     40426.     2016.     40426.                                                         015640
 3.000    2014.     2014.     42438.     2021.     42438.                                                         015650
 4.000    2018.     2018.     44454.     2025.     44454.                                                         015660
 5.000    2022.     2022.     46474.     2030.     46474.                                                         015670
REACH   48      FRASER RIVER  -  NORTH SIDE OF CRESCENT ISLAND                                                    015680
     48     1         2         2                    0        -1                                                  015690
                .0281                  9100.      910.                                                          015700
     10     7      -.50       5.50                                                                               015710
   459.              -52.293                0.000   -54600.      .000                                              015720
    2                                                                                                               015730
 -.500    1291.     1291.     35338.     1298.     35338.                                                         015740
  .500    1302.     1302.     36638.     1309.     36638.                                                         015750
 1.500    1306.     1306.     37942.     1314.     37942.                                                         015760
 2.500    1310.     1310.     39251.     1318.     39251.                                                         015770
 3.500    1314.     1314.     40563.     1323.     40563.                                                         015780
 4.500    1318.     1318.     41879.     1327.     41879.                                                         015790
 5.500    1322.     1322.     43200.     1332.     43200.                                                         015800
1380.               -50.279                0.000   -54600.      .000                                              015810
    2                                                                                                               015820
 -.500    1231.     1231.     38909.     1238.     38909.                                                         015830
  .500    1236.     1236.     40143.     1243.     40143.                                                         015840
 1.500    1240.     1240.     41381.     1247.     41381.                                                         015850
 2.500    1244.     1244.     42623.     1252.     42623.                                                         015860
 3.500    1248.     1248.     43869.     1256.     43869.                                                         015870
 4.500    1252.     1252.     45120.     1261.     45120.                                                         015880
 5.500    1256.     1256.     46374.     1265.     46374.                                                         015890
2250.               -46.266                0.000   -54600.      .000                                              015900
    2                                                                                                               015910
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2.500	1192.	1192.	37340.	1200.	37340.		01594
3.500	1196.	1196.	38534.	1204.	38534.		01595
4.500	1200.	1200.	39732.	1209.	39732.		015960
5.500	1204.	1204.	40934.	1213.	40934.		015970
3082.		-47.753		0.000	-54600.	.000	015980
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1.500	1228.	1228.	37765.	1235.	37765.		016020
2.500	1232.	1232.	38995.	1239.	38995.		016030
3.500	1236.	1236.	40228.	1243.	40228.		016040
4.500	1240.	1240.	41466.	1248.	41466.		016050
5.500	1244.	1244.	42708.	1252.	42708.		016060
3970.		-47.739		0.000	-54600.	.000	016070
2							016080
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1.500	1337.	1337.	38405.	1349.	38405.		016110
2.500	1341.	1341.	39744.	1353.	39744.		016120
3.500	1345.	1345.	41088.	1358.	41088.		016130
4.500	1349.	1349.	42435.	1362.	42435.		016140
5.500	1353.	1353.	43786.	1367.	43786.		016150
4777.		-46.727		0.000	-54600.	.000	016160
2							016170
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1.500	1350.	1350.	37471.	1358.	37471.		016200
2.500	1354.	1354.	38823.	1363.	38823.		016210
3.500	1358.	1358.	40179.	1367.	40179.		016220
4.500	1362.	1362.	41539.	1372.	41539.		016230
5.500	1366.	1366.	42903.	1376.	42903.		016240
5871.		-45.710		0.000	-54600.	.000	016250
2							016260
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.500	1528.	1528.	42195.	1543.	42195.		016280
1.500	1532.	1532.	43725.	1547.	43725.		016290
2.500	1536.	1536.	45260.	1552.	45260.		016300
3.500	1540.	1540.	46798.	1556.	46798.		016310
4.500	1544.	1544.	48341.	1561.	48341.		016320
5.500	1548.	1548.	49887.	1565.	49887.		01633
6985.		-38.193		0.000	-54600.	.000	01634
2							01635
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3.500	1847.	1847.	43689.	1852.	43689.		016400
4.500	1851.	1851.	45538.	1856.	45538.		016410
5.500	1855.	1855.	47392.	1861.	47392.		016420
7998.		-28.177		0.000	-54600.	.000	016430
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2.500	2050.	2050.	40909.	2054.	40909.		016480
3.500	2054.	2054.	42961.	2058.	42961.		016490
4.500	2058.	2058.	45018.	2062.	45018.		016500
5.500	2062.	2062.	47078.	2067.	47078.		016510
8845.		-29.665		0.000	-54600.	.000	016520
2							016530
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1.500	2443.	2443.	42665.	2448.	42665.		016560

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6.000    1387.    1387.    31888.    1394.    31888.                    019240
1537.             -31.358             .600    -42000.      .000         019250
   2                                                                     019260
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1.000    1246.    1246.    25703.    1251.    25703.                    019280
2.000    1250.    1250.    26951.    1255.    26951.                    019290
3.000    1254.    1254.    28204.    1260.    28204.                    019300
4.000    1258.    1258.    29460.    1264.    29460.                    019310
5.000    1262.    1262.    30720.    1269.    30720.                    019320
6.000    1266.    1266.    31984.    1273.    31984.                    019330
2320.             -34.337             .600    -42000.      .000         019340
   2                                                                     019350
0.000    1239.    1239.    22838.    1245.    22838.                    019360
1.000    1247.    1247.    24084.    1254.    24084.                    019370
2.000    1251.    1251.    25333.    1258.    25333.                    019380
3.000    1255.    1255.    26586.    1263.    26586.                    019390
4.000    1259.    1259.    27844.    1267.    27844.                    019400
5.000    1263.    1263.    29105.    1272.    29105.                    019410
6.000    1267.    1267.    30371.    1276.    30371.                    019420
3250.             -30.311             .600    -42000.      .000         019430
   2                                                                     019440
0.000    1319.    1319.    25099.    1322.    25099.                    019450
1.000    1324.    1324.    26421.    1328.    26421.                    019460
2.000    1328.    1328.    27748.    1333.    27748.                    019470
3.000    1332.    1332.    29078.    1337.    29078.                    019480
4.000    1336.    1336.    30413.    1342.    30413.                    019490
5.000    1340.    1340.    31751.    1346.    31751.                    019500
6.000    1344.    1344.    33094.    1351.    33094.                    019510
4315.             -32.282             .600    -42000.      .000         019520
   2                                                                     019530
0.000    1199.    1199.    23215.    1201.    23215.                    019540
1.000    1248.    1248.    24436.    1251.    24436.                    019550
2.000    1301.    1301.    25711.    1305.    25711.                    019560
3.000    1316.    1316.    27024.    1320.    27024.                    019570
4.000    1320.    1320.    28342.    1325.    28342.                    019580
5.000    1324.    1324.    29664.    1329.    29664.                    019590
6.000    1328.    1328.    30990.    1334.    30990.                    019600
5126.             -35.760             .600    -42000.      .000         019610
   2                                                                     019620
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2.000    1290.    1290.    23838.    1296.    23838.                    019650
3.000    1294.    1294.    25130.    1300.    25130.                    019660
4.000    1298.    1298.    26426.    1305.    26426.                    019670
5.000    1302.    1302.    27725.    1309.    27725.                    019680
6.000    1306.    1306.    29029.    1314.    29029.                    019690
6030.             -36.235             .600    -42000.      .000         019700
   2                                                                     019710
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1.000    1480.    1480.    24471.    1485.    24471.                    019730
2.000    1484.    1484.    25954.    1490.    25954.                    019740
3.000    1488.    1488.    27440.    1494.    27440.                    019750
4.000    1492.    1492.    28930.    1499.    28930.                    019760
5.000    1496.    1496.    30424.    1503.    30424.                    019770
6.000    1500.    1500.    31922.    1508.    31922.                    019780
6847.             -34.213             .600    -42000.      .000         019790
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1.000    1228.    1228.    23540.    1236.    23540.                    019820
2.000    1326.    1326.    24833.    1334.    24833.                    019830
3.000    1344.    1344.    26173.    1352.    26173.                    019840
4.000    1348.    1348.    27518.    1357.    27518.                    019850
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4.000    1364.    1364.    30221.    1368.    30221.                    019870
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2.500      859.      859.     2932.      860.     2932.                    017240
3.500      863.      863.     3793.      865.     3793.                    017250
4.500      867.      867.     4658.      869.     4658.                    017
5.500      871.      871.     5526.      874.     5526.                    017
7746.                -2.168              0.000      -54.      .000        017...
   2                                                                       017290
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1.500      796.      796.     1863.      797.     1863.                    017320
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3.500      804.      804.     3463.      806.     3463.                    017340
4.500      808.      808.     4269.      810.     4269.                    017350
5.500      812.      812.     5079.      815.     5079.                    017360
8732.                -2.651              0.000      -54.      .000        017370
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2.500      741.      741.     3171.      743.     3171.                    017420
3.500      745.      745.     3914.      747.     3914.                    017430
4.500      749.      749.     4662.      752.     4662.                    017440
5.500      753.      753.     5413.      756.     5413.                    017450
9690.                -4.635              0.000      -54.      .000        017460
   2                                                                       017470
-.500      435.      435.     1286.      435.     1286.                    017480
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2.500      560.      560.     2783.      562.     2783.                    017510
3.500      600.      600.     3363.      603.     3363.                    017520
4.500      641.      641.     3983.      644.     3983.                    017530
5.500      690.      690.     4645.      693.     4645.                    017540
10740.               -3.617              0.000      -54.      .000        017550
   2                                                                       017560
-.500      398.      398.      824.      398.      824.                    017570
 .500      482.      482.     1263.      482.     1263.                    017580
1.500      571.      571.     1788.      572.     1788.                    017590
2.500      676.      676.     2412.      677.     2412.                    017600
3.500      781.      781.     3140.      782.     3140.                    017610
4.500      888.      888.     3974.      890.     3974.                    017620
5.500      984.      984.     4915.      987.     4915.                    017630
11720.               -5.100              0.000      -54.      .000        017640
   2                                                                       017
2                                                                          017
-.500      394.      394.      712.      394.      712.                    017
 .500      596.      596.     1188.      596.     1188.                    017
1.500      835.      835.     1916.      836.     1916.                    017680
2.500      839.      839.     2753.      841.     2753.                    017690
3.500      843.      843.     3595.      845.     3595.                    017700
4.500      847.      847.     4440.      850.     4440.                    017710
5.500      851.      851.     5290.      854.     5290.                    017720
REACH   50      FRASER RIVER  -  CRESCENT ISLAND TO MATSQUI ISLAND        017730
     50      1         2         2                  0        -1           017740
                    .0281              12081.      860.                   017750
     14      7       -.50      9.50                                        017760
      0.               -33.100                    .300   -60000.      .000 017770
   2                                                                       017780
-.500     2232.     2232.    36990.     2237.    36990.                    017790
 .500     2246.     2246.    39232.     2251.    39232.                    017800
1.500     2250.     2250.    41481.     2255.    41481.                    017810
2.500     2254.     2254.    43733.     2260.    43733.                    017820
3.500     2258.     2258.    45989.     2264.    45989.                    017830
4.500     2262.     2262.    48249.     2269.    48249.                    017840
5.500     2266.     2266.    50514.     2273.    50514.                    017850
 893.                -40.085              .300   -60000.      .000        017860
   2                                                                       017870
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 .500     1820.     1820.    42847.     1824.    42847.                    017890
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2.000           1481.      1481.     26662.     1487.     26662.                    020560
3.000           1542.      1542.     28174.     1548.     28174.                    020570
4.000           1600.      1600.     29746.     1606.     29746.                    020580
5.000           1604.      1604.     31348.     1611.     31348.                    020590
6.000          14199.               -31.012                .600    -42000.   .000  020600
                   2                                                               020610
0.000           1369.      1369.     20517.     1372.     20517.                    020620
1.000           1439.      1439.     21918.     1443.     21918.                    020630
2.000           1520.      1520.     23398.     1524.     23398.                    020640
3.000           1562.      1562.     24948.     1566.     24948.                    020650
4.000           1566.      1566.     26512.     1571.     26512.                    020660
5.000           1570.      1570.     28080.     1575.     28080.                    020670
6.000           1574.      1574.     29651.     1580.     29651.                    020680
               15002.               -26.490                .600    -42000.   .000  020690
                   2                                                               020700
0.000           1404.      1404.     23364.     1407.     23364.                    020710
1.000           1705.      1705.     24920.     1708.     24920.                    020720
2.000           1792.      1792.     26669.     1795.     26669.                    020730
3.000           1878.      1878.     28504.     1881.     28504.                    020740
4.000           1963.      1963.     30424.     1968.     30424.                    020750
5.000           2049.      2049.     32430.     2054.     32430.                    020760
6.000           2160.      2160.     34534.     2165.     34534.                    020770
               15678.               -22.472                .600    -42000.   .000  020780
                   2                                                               020790
0.000           1334.      1334.     20487.     1347.     20487.                    020800
1.000           1342.      1342.     21826.     1356.     21826.                    020810
2.000           1346.      1346.     23169.     1361.     23169.                    020820
3.000           1350.      1350.     24517.     1365.     24517.                    020830
4.000           1354.      1354.     25869.     1370.     25869.                    020840
5.000           1358.      1358.     27225.     1374.     27225.                    020850
6.000           1362.      1362.     28584.     1379.     28584.                    020860
REACH   52      FRASER RIVER  -  SOUTH SIDE OF MATSQUI ISLAND                      020870
     52            1          2          2                    0          -1       020880
                              .0270                 20640.     850.               020890
                                                                                  020900
                  23          7        0.00         6.00                          020910
                 482.                 -16.391                .600    -18000.   .000  020920
                   2                                                               020930
0.000           1105.      1105.     12548.     1106.     12548.                    020940
1.000           1114.      1114.     13658.     1115.     13658.                    020950
2.000           1122.      1122.     14776.     1124.     14776.                    020960
3.000           1130.      1130.     15902.     1132.     15902.                    020970
4.000           1137.      1137.     17036.     1139.     17036.                    020980
5.000           1141.      1141.     18175.     1144.     18175.                    020990
6.000           1145.      1145.     19317.     1148.     19317.                    021000
               1259.               -15.876                .600    -18000.   .000  021010
                   2                                                               021020
0.000           1078.      1078.     12403.     1079.     12403.                    021030
1.000           1084.      1084.     13484.     1085.     13484.                    021040
2.000           1088.      1088.     14570.     1090.     14570.                    021050
3.000           1092.      1092.     15660.     1094.     15660.                    021060
4.000           1096.      1096.     16753.     1099.     16753.                    021070
5.000           1100.      1100.     17851.     1103.     17851.                    021080
6.000           1104.      1104.     18953.     1108.     18953.                    021090
               2079.               -19.860                .600    -18000.   .000  021100
                   2                                                               021110
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1.000           1063.      1063.     15382.     1066.     15382.                    021130
2.000           1067.      1067.     16447.     1070.     16447.                    021140
3.000           1071.      1071.     17516.     1075.     17516.                    021150
4.000           1075.      1075.     18588.     1079.     18588.                    021160
5.000           1079.      1079.     19665.     1084.     19665.                    021170
6.000           1083.      1083.     20746.     1088.     20746.                    021180
               2919.               -21.343                .600    -18000.   .000  021190
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   2                                                                     0
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1.500    1990.    1990.    40802.    2002.    40802.                    018620
2.500    1994.    1994.    42794.    2006.    42794.                    018630
3.500    1998.    1998.    44790.    2010.    44790.                    018640
4.500    2002.    2002.    46790.    2015.    46790.                    018650
5.500    2006.    2006.    48795.    2019.    48795.                    018660
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3.500    2092.    2092.    42118.    2102.    42118.                    018730
4.500    2096.    2096.    44212.    2107.    44212.                    018740
5.500    2100.    2100.    46310.    2111.    46310.                    018750
9992.             -37.935             .300    -60000.      .000         018760
   2                                                                     018770
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 .500    2179.    2179.    38233.    2188.    38233.                    018790
1.500    2183.    2183.    40414.    2192.    40414.                    018800
2.500    2187.    2187.    42599.    2197.    42599.                    018810
3.500    2191.    2191.    44788.    2201.    44788.                    018820
4.500    2195.    2195.    46981.    2206.    46981.                    018830
5.500    2199.    2199.    49178.    2210.    49178.                    018840
10934.            -31.419             .300    -60000.      .000         018850
   2                                                                     018860
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1.500    2387.    2387.    40645.    2390.    40645.                    018890
2.500    2391.    2391.    43033.    2394.    43033.                    018900
3.500    2395.    2395.    45426.    2399.    45426.                    018910
4.500    2399.    2399.    47823.    2403.    47823.                    018920
5.500    2403.    2403.    50224.    2407.    50224.                    018930
12081.            -27.400             .300    -60000.      .000         018940
   2                                                                     018950
-.500    2492.    2492.    36209.    2494.    36209.                    0
 .500    2519.    2519.    38711.    2521.    38711.                    0
1.500    2563.    2563.    41252.    2565.    41252.                    0
2.500    2606.    2606.    43837.    2609.    43837.                    018990
3.500    2634.    2634.    46462.    2637.    46462.                    019000
4.500    2638.    2638.    49098.    2642.    49098.                    019010
5.500    2642.    2642.    51737.    2646.    51737.                    019020
REACH   51      FRASER RIVER  -  NORTH SIDE OF MATSQUI ISLAND           019030
   51      1        2        2                 0          -1           019040
                .0270                14642.      800.                  019050
   20      7      0.00      6.00                                        019060
    0.             -26.900             .600    -42000.      .000         019070
   2                                                                     019080
 0.000    1379.    1379.    24671.    1385.    24671.                    019090
 1.000    1402.    1402.    26061.    1409.    26061.                    019100
 2.000    1427.    1427.    27476.    1434.    27476.                    019110
 3.000    1452.    1452.    28915.    1459.    28915.                    019120
 4.000    1476.    1476.    30379.    1484.    30379.                    019130
 5.000    1501.    1501.    31867.    1509.    31867.                    019140
 6.000    1517.    1517.    33379.    1526.    33379.                    019150
  711.             -25.881             .600    -42000.      .000         019160
   2                                                                     019170
 0.000    1245.    1245.    23940.    1248.    23940.                    019180
 1.000    1272.    1272.    25198.    1275.    25198.                    019190
 2.000    1299.    1299.    26484.    1303.    26484.                    019200
 3.000    1324.    1324.    27704.    1331.    27704.                    019210
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3.000	697.	697.	17305.	712.	17305.		021860
4.000	701.	701.	18004.	717.	18004.		021870
5.000	705.	705.	18707.	721.	18707.		021880
6.000	709.	709.	19414.	726.	19414.		021890
11351.		-44.680		.600	-18000.	.000	021900
2							021910
0.000	721.	721.	13080.	732.	13080.		021920
1.000	731.	731.	13808.	742.	13808.		021930
2.000	735.	735.	14541.	746.	14541.		021940
3.000	739.	739.	15279.	751.	15279.		021950
4.000	743.	743.	16020.	755.	16020.		021960
5.000	747.	747.	16765.	760.	16765.		021970
6.000	751.	751.	17515.	764.	17515.		021980
12170.		-32.664		.600	-18000.	.000	021990
2							022000
0.000	533.	533.	9879.	539.	9879.		022010
1.000	651.	651.	10479.	658.	10479.		022020
2.000	709.	709.	11159.	716.	11159.		022030
3.000	767.	767.	11898.	775.	11898.		022040
4.000	790.	790.	12682.	797.	12682.		022050
5.000	794.	794.	13474.	802.	13474.		022060
6.000	798.	798.	14269.	806.	14269.		022070
12866.		-33.150		.600	-18000.	.000	022080
2							022090
0.000	620.	620.	9603.	625.	9603.		022100
1.000	661.	661.	10240.	666.	10240.		022110
2.000	710.	710.	10926.	716.	10926.		022120
3.000	756.	756.	11659.	762.	11659.		022130
4.000	801.	801.	12438.	808.	12438.		022140
5.000	819.	819.	13252.	826.	13252.		022150
6.000	823.	823.	14073.	831.	14073.		022160
14048.		-33.127		.600	-18000.	.000	022170
2							022180
0.000	697.	697.	11624.	703.	11624.		022190
1.000	837.	837.	12368.	843.	12368.		022200
2.000	917.	917.	13269.	925.	13269.		022210
3.000	921.	921.	14189.	929.	14189.		022220
4.000	925.	925.	15112.	934.	15112.		022230
5.000	929.	929.	16040.	938.	16040.		022240
6.000	933.	933.	16971.	942.	16971.		022250
14793.		-39.613		.600	-18000.	.000	022260
2							022270
0.000	639.	639.	11236.	648.	11236.		022280
1.000	790.	790.	11937.	800.	11937.		022290
2.000	968.	968.	12816.	978.	12816.		022300
3.000	1144.	1144.	13872.	1155.	13872.		022310
4.000	1305.	1305.	15096.	1316.	15096.		022320
5.000	1466.	1466.	16482.	1478.	16482.		022330
6.000	1627.	1627.	18028.	1640.	18028.		022340
15754.		-37.594		.600	-18000.	.000	022350
2							022360
0.000	558.	558.	8711.	569.	8711.		022370
1.000	680.	680.	9311.	691.	9311.		022380
2.000	878.	878.	10088.	890.	10088.		022390
3.000	1085.	1085.	11069.	1097.	11069.		022400
4.000	1297.	1297.	12259.	1309.	12259.		022410
5.000	1512.	1512.	13664.	1525.	13664.		022420
6.000	1707.	1707.	15282.	1720.	15282.		022430
16690.		-23.076		.600	-18000.	.000	022440
2							022450
0.000	770.	770.	7798.	773.	7798.		022460
1.000	952.	952.	8633.	955.	8633.		022470
2.000	1223.	1223.	9720.	1227.	9720.		022480
3.000	1496.	1496.	11079.	1501.	11079.		022490
4.000	1772.	1772.	12714.	1777.	12714.		022500
5.000	2048.	2048.	14629.	2053.	14629.		022510

7626.		-40.192		.600	-42000.	.000	01
2							01
0.000	994.	994.	23433.	1003.	23433.		01
1.000	1038.	1038.	24452.	1047.	24452.		019910
2.000	1070.	1070.	25506.	1081.	25506.		019920
3.000	1097.	1097.	26593.	1108.	26593.		019930
4.000	1101.	1101.	27692.	1113.	27692.		019940
5.000	1105.	1105.	28795.	1117.	28795.		019950
6.000	1109.	1109.	29903.	1122.	29903.		019960
8516.		-53.167		.600	-42000.	.000	019970
2							019980
0.000	946.	946.	26430.	961.	26430.		019990
1.000	985.	985.	27408.	1001.	27408.		020000
2.000	989.	989.	28395.	1005.	28395.		020010
3.000	993.	993.	29387.	1010.	29387.		020020
4.000	997.	997.	30382.	1014.	30382.		020030
5.000	1001.	1001.	31381.	1018.	31381.		020040
6.000	1005.	1005.	32385.	1023.	32385.		020050
9329.		-31.645		.600	-42000.	.000	020060
2							020070
0.000	1126.	1126.	26476.	1131.	26476.		020080
1.000	1147.	1147.	27618.	1153.	27618.		020090
2.000	1151.	1151.	28767.	1158.	28767.		020100
3.000	1155.	1155.	29920.	1162.	29920.		020110
4.000	1159.	1159.	31077.	1167.	31077.		020120
5.000	1163.	1163.	32238.	1171.	32238.		020130
6.000	1167.	1167.	33403.	1176.	33403.		020140
10103.		-33.624		.600	-42000.	.000	020150
2							020160
0.000	1531.	1531.	23934.	1536.	23934.		020170
1.000	1539.	1539.	25470.	1544.	25470.		020180
2.000	1543.	1543.	27011.	1549.	27011.		020190
3.000	1547.	1547.	28555.	1553.	28555.		020200
4.000	1551.	1551.	30104.	1558.	30104.		020210
5.000	1555.	1555.	31657.	1562.	31657.		020220
6.000	1559.	1559.	33214.	1567.	33214.		020230
10915.		-40.602		.600	-42000.	.000	020240
2							020250
0.000	1230.	1230.	21496.	1236.	21496.		020260
1.000	1472.	1472.	22857.	1479.	22857.		020270
2.000	1588.	1588.	24387.	1595.	24387.		020
3.000	1696.	1696.	26030.	1704.	26030.		020
4.000	1799.	1799.	27778.	1807.	27778.		020
5.000	1892.	1892.	29628.	1900.	29628.		020310
6.000	1896.	1896.	31521.	1905.	31521.		020320
11747.		-38.579		.600	-42000.	.000	020330
2							020340
0.000	1250.	1250.	18338.	1256.	18338.		020350
1.000	1321.	1321.	19619.	1328.	19619.		020360
2.000	1443.	1443.	20993.	1450.	20993.		020370
3.000	1586.	1586.	22510.	1594.	22510.		020380
4.000	1679.	1679.	24142.	1687.	24142.		020390
5.000	1771.	1771.	25867.	1780.	25867.		020400
6.000	1864.	1864.	27684.	1873.	27684.		020410
12575.		-35.556		.600	-42000.	.000	020420
2							020430
0.000	1354.	1354.	20893.	1359.	20893.		020440
1.000	1435.	1435.	22283.	1441.	22283.		020450
2.000	1505.	1505.	23754.	1511.	23754.		020460
3.000	1574.	1574.	25293.	1580.	25293.		020470
4.000	1644.	1644.	26902.	1650.	26902.		020480
5.000	1713.	1713.	28580.	1720.	28580.		020490
6.000	1782.	1782.	30328.	1790.	30328.		020500
13378.		-32.535		.600	-42000.	.000	020510
2							020520
0.000	1314.	1314.	22484.	1319.	22484.		020530

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[illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]                  [illegible]
9.000      2399.      2399.     47370.     2404.     47370.                  023180
6.000      2403.      2403.     49772.     2408.     49772.                  023190
2919.                -26.000                0.000    -60000.      .000       023200
     2                                                                       023210
0.000      1743.      1743.     37531.     1747.     37531.                  023220
1.000      1833.      1833.     39300.     1837.     39300.                  023230
2.000      1920.      1920.     41197.     1925.     41197.                  023240
3.000      1924.      1924.     43120.     1929.     43120.                  023250
4.000      1928.      1928.     45046.     1934.     45046.                  023260
5.000      1932.      1932.     46976.     1938.     46976.                  023270
6.000      1936.      1936.     48911.     1943.     48911.                  023280
3649.                -36.500                0.000    -60000.      .000       023290
     2                                                                       023300
0.000      1715.      1715.     44848.     1720.     44848.                  023310
1.000      1724.      1724.     46569.     1730.     46569.                  023320
2.000      1728.      1728.     48295.     1734.     48295.                  023330
3.000      1732.      1732.     50025.     1739.     50025.                  023340
4.000      1736.      1736.     51759.     1743.     51759.                  023350
5.000      1740.      1740.     53497.     1748.     53497.                  023360
6.000      1744.      1744.     55239.     1752.     55239.                  023370
4044.                -37.000                0.000    -60000.      .000       023380
     2                                                                       023390
0.000      1720.      1720.     43949.     1731.     43949.                  023400
1.000      1729.      1729.     45675.     1740.     45675.                  023410
2.000      1733.      1733.     47406.     1745.     47406.                  023420
3.000      1737.      1737.     49140.     1749.     49140.                  023430
4.000      1741.      1741.     50879.     1753.     50879.                  023440
5.000      1745.      1745.     52622.     1758.     52622.                  023450
6.000      1749.      1749.     54369.     1762.     54369.                  023460
REACH   54      FRASER RIVER  -  NORTH SIDE OF CRESCENT ISLAND               023470
    54          1          2          2                    0        -1       023480
                         .0281                4957.      800.               023490
                                                                            023500
     6          7        -.50       5.50                                    023510
 253.                -30.157                0.000    -54600.      .000       023520
     2                                                                       023530
-.500      2381.      2381.     38788.     2384.     38788.                  023540
 .500      2391.      2391.     41176.     2394.     41176.                  023550
1.500      2395.      2395.     43569.     2399.     43569.                  023560
2.500      2399.      2399.     45966.     2403.     45966.                  023570
3.500      2403.      2403.     48366.     2408.     48366.                  023580
4.500      2407.      2407.     50771.     2412.     50771.                  023590
5.500      2411.      2411.     53180.     2417.     53180.                  023600
1017.                -28.645                0.000    -54600.      .000       023610
     2                                                                       023620
-.500      2126.      2126.     37146.     2130.     37146.                  023630
 .500      2133.      2133.     39277.     2137.     39277.                  023640
1.500      2137.      2137.     41412.     2142.     41412.                  023650
2.500      2141.      2141.     43551.     2146.     43551.                  023660
3.500      2145.      2145.     45694.     2151.     45694.                  023670
4.500      2149.      2149.     47841.     2155.     47841.                  023680
5.500      2153.      2153.     49992.     2160.     49992.                  023690
1799.                -30.133                0.000    -54600.      .000       023700
     2                                                                       023710
-.500      1860.      1860.     37834.     1864.     37834.                  023720
 .500      1865.      1865.     39697.     1870.     39697.                  023730
1.500      1869.      1869.     41564.     1874.     41564.                  023740
2.500      1873.      1873.     43435.     1879.     43435.                  023750
3.500      1877.      1877.     45311.     1883.     45311.                  023760
4.500      1881.      1881.     47190.     1888.     47190.                  023770
5.500      1885.      1885.     49073.     1892.     49073.                  023780
2741.                -36.119                0.000    -54600.      .000       023790
     2                                                                       023800
-.500      1752.      1752.     36060.     1757.     36060.                  023810
 .500      1764.      1764.     37820.     1769.     37820.                  023820
1.500      1768.      1768.     39585.     1773.     39585.                  023830
[illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]                  [illegible]
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0.000	1065.	1065.	12983.	1066.	12983.		021200
1.000	1072.	1072.	14052.	1073.	14052.		021210
2.000	1076.	1076.	15126.	1078.	15126.		021
3.000	1080.	1080.	16203.	1082.	16203.		021
4.000	1084.	1084.	17285.	1087.	17285.		021
5.000	1088.	1088.	18370.	1091.	18370.		021250
6.000	1092.	1092.	19460.	1096.	19460.		021260
3710.		-22.828		.600	-18000.	.000	021270
2							021280
0.000	1045.	1045.	14092.	1048.	14092.		021290
1.000	1050.	1050.	15140.	1053.	15140.		021300
2.000	1054.	1054.	16192.	1058.	16192.		021310
3.000	1058.	1058.	17248.	1062.	17248.		021320
4.000	1062.	1062.	18308.	1067.	18308.		021330
5.000	1066.	1066.	19372.	1071.	19372.		021340
6.000	1070.	1070.	20440.	1076.	20440.		021350
4501.		-16.313		.600	-18000.	.000	021360
2							021370
0.000	986.	986.	11441.	988.	11441.		021380
1.000	992.	992.	12430.	994.	12430.		021390
2.000	996.	996.	13424.	998.	13424.		021400
3.000	1000.	1000.	14422.	1003.	14422.		021410
4.000	1004.	1004.	15423.	1007.	15423.		021420
5.000	1008.	1008.	16429.	1012.	16429.		021430
6.000	1012.	1012.	17438.	1016.	17438.		021440
5471.		-17.294		.600	-18000.	.000	021450
2							021460
0.000	974.	974.	11954.	976.	11954.		021470
1.000	979.	979.	12931.	982.	12931.		021480
2.000	983.	983.	13912.	986.	13912.		021490
3.000	987.	987.	14897.	991.	14897.		021500
4.000	991.	991.	15886.	995.	15886.		021510
5.000	995.	995.	16879.	1000.	16879.		021520
6.000	999.	999.	17877.	1004.	17877.		021530
6405.		-17.776		.600	-18000.	.000	021540
2							021550
0.000	1059.	1059.	12350.	1060.	12350.		021560
1.000	1065.	1065.	13413.	1067.	13413.		021570
2.000	1069.	1069.	14480.	1072.	14480.		021580
3.000	1073.	1073.	15551.	1076.	15551.		021590
4.000	1077.	1077.	16626.	1081.	16626.		021600
5.000	1081.	1081.	17705.	1085.	17705.		0216
6.000	1085.	1085.	18789.	1089.	18789.		0216
7155.		-20.761		.600	-18000.	.000	0216
2							021640
0.000	1005.	1005.	13498.	1006.	13498.		021650
1.000	1013.	1013.	14508.	1015.	14508.		021660
2.000	1017.	1017.	15523.	1019.	15523.		021670
3.000	1021.	1021.	16541.	1023.	16541.		021680
4.000	1025.	1025.	17564.	1028.	17564.		021690
5.000	1029.	1029.	18591.	1032.	18591.		021700
6.000	1033.	1033.	19621.	1037.	19621.		021710
9758.		-29.711		.600	-18000.	.000	021720
2							021730
0.000	702.	702.	14363.	708.	14363.		021740
1.000	707.	707.	15068.	714.	15068.		021750
2.000	711.	711.	15777.	719.	15777.		021760
3.000	715.	715.	16490.	723.	16490.		021770
4.000	719.	719.	17208.	728.	17208.		021780
5.000	723.	723.	17929.	732.	17929.		021790
6.000	727.	727.	18654.	737.	18654.		021800
10546.		-41.195		.600	-18000.	.000	021810
2							021820
0.000	679.	679.	15234.	693.	15234.		021830
1.000	689.	689.	15920.	703.	15920.		021840
2.000	693.	693.	16611.	708.	16611.		021850

1.500	886.	886.	2687.	891.	2687.		024490
2.500	962.	962.	2972.	965.	2972.		024500
3.500	1124.	1124.	4015.	1129.	4015.		024510
4.500	1247.	1247.	5212.	1252.	5212.		024520
5.500	1285.	1285.	6478.	1291.	6478.		024530
4556.		-5.380		0.000	0.	.000	024540
2							024550
-.500	171.	171.	555.	172.	555.		024560
.500	180.	180.	730.	181.	730.		024570
1.500	348.	348.	965.	351.	965.		024580
2.500	578.	578.	1441.	582.	1441.		024590
3.500	696.	696.	2084.	700.	2084.		024600
4.500	759.	759.	2817.	764.	2817.		024610
5.500	807.	807.	3600.	813.	3600.		024620
6004.		-2.000		0.000	0.	.000	024630
2							024640
-.500	74.	74.	56.	74.	56.		024650
.500	117.	117.	153.	117.	153.		024660
1.500	165.	165.	288.	165.	288.		024670
2.500	359.	359.	543.	359.	543.		024680
3.500	685.	685.	1085.	686.	1085.		024690
4.500	811.	811.	1833.	813.	1833.		024700
5.500	886.	886.	2692.	889.	2692.		024710
7408.		-2.490		0.000	0.	.000	024720
2							024730
-.500	58.	58.	57.	58.	57.		024740
.500	109.	109.	133.	109.	133.		024750
1.500	188.	188.	278.	189.	278.		024760
2.500	243.	243.	503.	244.	503.		024770
3.500	282.	282.	762.	283.	762.		024780
4.500	344.	344.	1075.	345.	1075.		024790
5.500	400.	400.	1478.	402.	1478.		024800

```
                                                                                                  [illegible]
     6.000     2356.     2356.    16852.     2362.    16852.                                    022520
   17523.               -19.060                .600   -18000.      .000                         022530
        2                                                                                        02254
    0.000      869.      869.     6952.      873.     6952.                                     02255
    1.000      985.      985.     7868.      989.     7868.                                     022560
    2.000     1139.     1139.     8930.     1143.     8930.                                     022570
    3.000     1315.     1315.    10152.     1320.    10152.                                     022580
    4.000     1520.     1520.    11565.     1526.    11565.                                     022590
    5.000     1782.     1782.    13239.     1788.    13239.                                     022600
    6.000     1959.     1959.    15110.     1965.    15110.                                     022610
   18403.               -14.043                .600   -18000.      .000                         022620
        2                                                                                        022630
    0.000     1014.     1014.     4807.     1014.     4807.                                     022640
    1.000     1242.     1242.     5951.     1243.     5951.                                     022650
    2.000     1411.     1411.     7277.     1413.     7277.                                     022660
    3.000     1581.     1581.     8773.     1583.     8773.                                     022670
    4.000     1764.     1764.    10440.     1766.    10440.                                     022680
    5.000     2046.     2046.    12386.     2049.    12386.                                     022690
    6.000     2175.     2175.    14496.     2179.    14496.                                     022700
   19135.               -6.529                 .600   -18000.      .000                         022710
        2                                                                                        022720
    0.000     1201.     1201.     3758.     1201.     3758.                                     022730
    1.000     1366.     1366.     5048.     1366.     5048.                                     022740
    2.000     1458.     1458.     6460.     1459.     6460.                                     022750
    3.000     1572.     1572.     7975.     1573.     7975.                                     022760
    4.000     1696.     1696.     9606.     1697.     9606.                                     022770
    5.000     1827.     1827.    11368.     1828.    11368.                                     022780
    6.000     1908.     1908.    13236.     1910.    13236.                                     022790
   20130.               -7.509                 .600   -18000.      .000                         022800
        2                                                                                        022810
    0.000     1271.     1271.     3906.     1274.     3906.                                     022820
    1.000     1358.     1358.     5242.     1362.     5242.                                     022830
    2.000     1360.     1360.     6601.     1365.     6601.                                     022840
    3.000     1362.     1362.     7961.     1369.     7961.                                     022850
    4.000     1364.     1364.     9324.     1372.     9324.                                     022860
    5.000     1366.     1366.    10689.     1375.    10689.                                     022870
    6.000     1368.     1368.    12056.     1378.    12056.                                     022880
   20604.               -10.500                .600   -18000.      .000                         022890
        2                                                                                        022900
    0.000     1332.     1332.     6411.     1343.     6411.                                     022910
    1.000     1561.     1561.     7914.     1573.     7914.                                     022920
    2.000     1563.     1563.     9477.     1577.     9477.                                     02293
    3.000     1565.     1565.    11041.     1580.    11041.                                     02294
    4.000     1567.     1567.    12608.     1583.    12608.                                     02295
    5.000     1569.     1569.    14176.     1586.    14176.                                     022960
    6.000     1571.     1571.    15747.     1590.    15747.                                     022970
REACH   53      FRASER RIVER  -  MATSQUI ISLAND TO MISSION                                      022980
       53        1         2         2                    0        -1                          022990
                          .0270                  3945.      980.                               023000
        5        7         0.00      6.00                                                      023010
      566.               -24.500                0.000   -60000.      .000                         023020
        2                                                                                        023030
    0.000     2678.     2678.    29928.     2681.    29928.                                     023040
    1.000     2766.     2766.    32654.     2768.    32654.                                     023050
    2.000     2770.     2770.    35422.     2773.    35422.                                     023060
    3.000     2774.     2774.    38193.     2777.    38193.                                     023070
    4.000     2778.     2778.    40969.     2782.    40969.                                     023080
    5.000     2782.     2782.    43748.     2786.    43748.                                     023090
    6.000     2786.     2786.    46532.     2791.    46532.                                     023100
   1897.               -25.500                0.000   -60000.      .000                         023110
        2                                                                                        023120
    0.000     2215.     2215.    35732.     2218.    35732.                                     023130
    1.000     2256.     2256.    37964.     2259.    37964.                                     023140
    2.000     2311.     2311.    40248.     2314.    40248.                                     023150
    3.000     2366.     2366.    42586.     2370.    42586.                                     023160
    4.000     2305      2305     44973      2309     44973                                      023170
```

```
LATERAL INFLOWS                                                                 000100
                                                                                000110
     1                                                                          000120
     1        47    17150.        0.0         2        IL                      000130
HYDRAULIC DESCRIPTION OF NODES - RUN                                            000140
     1         1         2        ITE         3       900       900            000150
     2         0                                                                000160
     3         0                                                                000170
     4         1         2        ITE         3       900       900            000180
     5         0                                                                000190
     6         0                                                                000200
     7         0                                                                000210
     8         0                                                                000220
     9         0                                                                000230
    10         0                                                                000240
    11         0                                                                000250
    12         0                                                                000260
    13         0                                                                000270
    14         1         2        ITE         3       900       900            000280
    15         0                                                                000290
    16         2         2        ITO         1    -18000      3600            000300
HYDROGRAPHS AND PROFILE REQUIREMENTS                                            000310
    20                                                                          000320
    30        0.         1                                                     000330
    31        0.         1                                                     000340
    32        0.         1                                                     000350
    33     9278.         1                                                     000360
    40        0.         1                                                     000370
    41        0.         1                                                     000380
    42        0.         1                                                     000390
    43        0.         1                                                     000400
    44     4379.         1                                                     000410
    45        0.         1                                                     000420
    46        0.         1                                                     000430
    47    17261.         1                                                     000440
    48        0.         1                                                     000450
    49        0.         1                                                     000460
    50        0.         1                                                     000470
    51        0.         1                                                     000480
    52        0.         1                                                     000490
    53     3945.         1                                                     000500
    54        0.         1                                                     000510
    55     7408.         1                                                     000520
    20                                                                          000530
    30       ITE         1                                                     000540
    31       ITE         1                                                     000550
    32       ITE         1                                                     000560
    33       ITE         1                                                     000570
    40       ITE         1                                                     000580
    41       ITE         1                                                     000590
    42       ITE         1                                                     000600
    43       ITE         1                                                     000610
    44       ITE         1                                                     000620
    45       ITE         1                                                     000630
    46       ITE         1                                                     000640
    47       ITE         1                                                     000650
    48       ITE         1                                                     000660
    49       ITE         1                                                     000670
    50       ITE         1                                                     000680
    51       ITE         1                                                     000690
    52       ITE         1                                                     000700
    53       ITE         1                                                     000710
    54       ITE         1                                                     000720
```

```
      3.500      1776.      1776.     43128.      1782.     43128.                                  023860
      4.500      1780.      1780.     44906.      1787.     44906.                                  023870
      5.500      1784.      1784.     46688.      1791.     46688.                                  023880
     3545.                -40.106                 0.000    -54600.      .000                       023890
        2                                                                                          023900
     -.500      1678.      1678.     38601.      1686.     38601.                                  023910
      .500      1692.      1692.     40290.      1701.     40290.                                  023920
     1.500      1696.      1696.     41984.      1705.     41984.                                  023930
     2.500      1700.      1700.     43682.      1710.     43682.                                  023940
     3.500      1704.      1704.     45384.      1714.     45384.                                  023950
     4.500      1708.      1708.     47091.      1719.     47091.                                  023960
     5.500      1712.      1712.     48801.      1723.     48801.                                  023970
     3957.                -36.100                 0.000    -54600.      .000                       023980
        2                                                                                          023990
     -.500      1597.      1597.     36734.      1603.     36734.                                  024000
      .500      1620.      1620.     38348.      1626.     38348.                                  024010
     1.500      1624.      1624.     39970.      1630.     39970.                                  024020
     2.500      1628.      1628.     41596.      1635.     41596.                                  024030
     3.500      1632.      1632.     43225.      1639.     43225.                                  024040
     4.500      1636.      1636.     44859.      1644.     44859.                                  024050
     5.500      1640.      1640.     46497.      1648.     46497.                                  024060
REACH   55          STAVE RIVER - RUSKIN DAM TO FRASER RIVER                                      024070
       55        1         2         2                     0        -1                            024080
                          .0270                 7408.     1200.                                   024090
         8       7         -.50      5.50         0.        0.       0.       0.                  024100
        0.                -37.990                 0.000       0.     .000                       024110
        2                                                                                          024120
     -.500       329.       329.     7986.       346.      7986.                                  024130
      .500       332.       332.     8316.       349.      8316.                                  024140
     1.500       335.       335.     8649.       353.      8649.                                  024150
     2.500       338.       338.     8985.       356.      8985.                                  024160
     3.500       341.       341.     9324.       360.      9324.                                  024170
     4.500       345.       345.     9667.       364.      9667.                                  024180
     5.500       349.       349.    10014.       369.     10014.                                  024190
      615.                -8.890                 0.000       0.     .000                       024200
        2                                                                                          024210
     -.500       764.       764.     4252.       765.      4292.                                  024220
      .500       799.       799.     5032.       800.      5032.                                  024230
     1.500       814.       814.     5838.       815.      5838.                                  024240
     2.500       830.       830.     6659.       832.      6659.                                  024250
     3.500       862.       862.     7506.       864.      7506.                                  024260
     4.500       872.       872.     8375.       876.      8375.                                  024270
     5.500       877.       877.     9250.       883.      9250.                                  024280
     1506.                -11.710                 0.000       0.     .000                       024290
        2                                                                                          024300
     -.500       604.       604.     3219.       608.      3219.                                  024310
      .500       786.       786.     3882.       790.      3882.                                  024320
     1.500       914.       914.     4705.       919.      4705.                                  024330
     2.500       966.       966.     5668.       972.      5668.                                  024340
     3.500       970.       970.     6636.       976.      6636.                                  024350
     4.500       972.       972.     7608.       980.      7608.                                  024360
     5.500       975.       975.     8581.       983.      8581.                                  024370
     2220.                -7.020                 0.000       0.     .000                       024380
        2                                                                                          024390
     -.500       522.       522.     1678.       524.      1678.                                  024400
      .500       700.       700.     2281.       703.      2281.                                  024410
     1.500       827.       827.     3083.       830.      3083.                                  024420
     2.500       833.       833.     3913.       836.      3913.                                  024430
     3.500       836.       836.     4748.       840.      4748.                                  024440
     4.500       840.       840.     5585.       844.      5585.                                  024450
     5.500       843.       843.     6427.       848.      6427.                                  024460
     3125.                -7.150                 0.000       0.     .000                       024470
        2                                                                                          024480
     -.500       543.       543.      723.       545.       723.                                  024490
      .500       689.       689.     1344.       692.      1344.                                  024500
```

```
ICPJO,STWOJ,C=230000.  STOP SEVEN   B. MORASSE
ACCOUNT,22556.
FTN(L=0).
MAP(PART)
ATTACH,EMRLIB.
LIBRARY(EMRLIB)
COPYBR(INPUT,TAPE9)
REWIND(TAPE9)
REQUEST,TAPE11,*PF.
REQUEST,TAPE20,*PF.
REWIND(TAPE11).
REWIND(TAPE20).
LGO.
REWIND,TAPE11.
REWIND,TAPE20.
COPYSBF,TAPE11,OUTPUT.
COPYBF,TAPE20,OUTPUT.
REWIND,TAPE11.
REWIND,TAPE20.
CATALOG,TAPE11,FRASERMEANS,ID=MONDAYR,KP=1,RP=10.
CATALOG,TAPE20,FRASERMAX,ID=MONDAYR,KP=1,RP=10.
```

FRAME

```
     +           //,10X,35HNUMBER OF TAPE10 FILES ATTACHED   =,I5)
      WRITE(MAGOUT,115)
115   FORMAT(///,10X,12HSEQUENCE NO.,9X,12HSTATION NO. ,9X,12HMESH PT. NO
     +.)
      DO 130 I=1,NREACH
      READ(MAGIN,120) RNO(I),RNAM(I),RMESH(I)
      IF(RMESH(I).LT.1) RMESH(I)=1
120   FORMAT(I10,3X,A7,I5)
C
C         RNO    ..... REACH NUMBER IDENTIFICATION
C         RNAM   ..... REACH NAME IDENTIFICATION
C         RMESH  .....REACH MESH POINT
C
      WRITE(MAGOUT,116) RNO(I),RNAM(I),RMESH(I)
116   FORMAT(12X,I5,10X,A7,10X,I5)
130   CONTINUE
      WRITE(6,131)
131   FORMAT(///,15X,*I N P U T   F I L E S*,///,5X,
     +*STARTING DATE  NO. OF DAYS     PFN        ID    CY*)
C
C      M A I N   L O O P   F O R   E A C H   I N P U T   F I L E
C     ************************************************************
C
      DO 590 I=1,NFILE
      DO 135 K1=1,20
      FDB(K1)=0
135   CONTINUE
      READ(MAGNAM,140) ISDATE,NDAY,NPFN,ID,CY,IOPT
140   FORMAT(4X,3I2,I5,2A10,A2,I2)
C
C     ISDATE(1)  ----- STARTING DAY
C     ISDATE(2)  ----- STARTING MONTH
C     ISDATE(3)  ----- STARTING YEAR
C     NDAY       ----- NO OF DAYS ON TAPE
C     NPFN        ----- PERMANENT FILE NAME
C     ID          ----- ID
C     CY ------ CYCLE NUMBER --- USE IF FILE OTHER THAN HIGHEST
C                                CYCLE. NOTE!!! IF USED SECOND
C                                STATEMENT OF 'CALL SETFDB' MUST
C                                INCLUDE -2HCY,CY-
C
C                                   NPFN,ID,CY ARE LEFT JUSTIFIED
C
C
C     IOPT        ----- FLAG TO INDICATE THAT THE FIRST FILE WAS NOT
C                       CREATED IN I-D MODEL FROM A TAPE17
C                          IOPT=-1 IN COL'S 38-39
C                       BLANK IF FIRST FILE WAS CREATED FROM TAPE17
C                       BLANK FOR OTHER FILES
C
C
      WRITE(MAGOUT,141)ISDATE,NDAY,NPFN,ID,CY
141   FORMAT(8X,3I2,7X,I5,7X,2A10,A2)
C     CHECK FOR LEAP YEAR AND CHANGE THE NUMBER OF DAYS IN
C     FEBRUARY IF NECESSARY.
      NEWDAY=ISDATE(3)/4*4
      IF(NEWDAY.EQ.ISDATE(3)) MONTH(2)=29
      IF(I.EQ.1)GO TO 146
```

MEANS.JCL Program

```
      WRITE(6,1220) IOPT
1220  FORMAT(" --- IOPT =", I3, "   THEREFORE NO TAPE 17 AND A DUMMY SE
     $T WAS BYPASSED.")
175   300   JJ=0
C
C
C                 L O O P   F O R   E A C H   D A Y
C                *************************************
180   C
C
      DO 500 J=1,NDAY
      JDAY=ISDATE(1)+JJ
C
185   C SET "DATAZ" AND "DATAQ" ARRAY TO 0.0 FROM "JDAY" TO END OF MONTH
C
      IF(JJ.EQ.0) CALL BLANK(NREACH,DATAZ,DATAQ,JDAY)
      JJ = JJ +1
      CALL READTEN(NREACH,MAGTEN,RMESH,DATAZ,DATAQ,JDAY,NINC,ISDATE,
190  +RNAM)
      M=MONTH(ISDATE(2))
C
C IF END OF MONTH, WRITES DATA ON UNIT 11 IN WSC FORMAT 10-10-11
C
195   IF(JDAY.EQ.MONTH(ISDATE(2))) CALL WSCFOR(MAGWSC,NREACH,RNAM,MONTH,
     +DATAZ,DATAQ,ISDATE,JJ)
500   CONTINUE
C
C THE CALL TO "RETURN" IS A PERMANENT FILE FUNCTION
200   C DESCRIBED IN EMRLIB ROUTINE PBS004
C
520   CALL RETURN(6HTAPE10)
      IF(I.EQ.NFILE) GO TO 550
      IF(JJ.EQ.0) GO TO 530
205   IFDATE(1)=JDAY+1
      IFDATE(2)=ISDATE(2)
      IFDATE(3)=ISDATE(3)
      GO TO 550
530   DO 540 N=1,3
210   540   IFDATE(N)=ISDATE(N)
550   CONTINUE
      IF(JDAY.EQ.M) GO TO 1000
600   JS = JDAY +1
C
215   C PLACES -99999 IN REMAINING DAYS OF LAST MONTH FOR EACH REACH
C
      DO 620 L=JS,M
      DO 610 K=1,NREACH
      DATAZ(K,L) = -999.99
220   DATAQ(K,L) = -99999.
610   CONTINUE
620   CONTINUE
      JJ=100
C
225   C WRITES LAST MONTH ON UNIT 11
C
      CALL WSCFOR(MAGWSC,NREACH,RNAM,MONTH,DATAZ,DATAQ,ISDATE,JJ)
      GO TO 1000
```

```
      PROGRAM  MEANS(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE10,TAPE
     +11,TAPE9,TAPE20)
C
C       PURPOSE
C       ----------
C
C       THIS PROGRAM TAKES AN OUTPUT FILE (TAPE10) PRODUCED BY THE D
C       DIMENSION MODEL AND CALCULATES DAILY DISCHARGE AND ELEVATION
C       MEANS FOR EACH NODE OR STATION ON THE RIVER SYSTEM. IT
C       PRODUCES IT'S OWN OUTPUT FILE OF DAILY VALUES IN STANDARD
C       WATER SURVEY OF CANADA FORMAT, I.E., 10-10-11.
C
C       WRITTEN BY
C       ----------
C       JOHN HARVEY
C       SYSTEMS EVALUATION SECTION
C       WATER MANAGEMENT SYSTEMS DIV.
C       WATER PLANNING AND MANAGEMENT BR.
C       INLAND WATERS DIRECTORATE
C       ENVIRONMENT CANADA
C                          JULY 1982
C
      INTEGER RNO(30),RMESH(30)
      DIMENSION MONTH(12),RNAM(30),ISDATE(3),DATAZ(30,31),
     +DATAO(30,31),FOB(20),IFDATE(3)
      DIMENSION QMAX(30),NTMAX(30),ELMAX(30)
      DIMENSION QMIN(30),NTMIN(30),ELMIN(30)
      DATA MONTH/31,28,31,30,31,30,31,31,30,31,30,31/
C
C       I N P U T    F I L E S
C       ***************************
C       MAGIN   ..... SYSTEM'S INPUT FILE
C       MAGNAM  ..... FILE OF PFN'S AND ID'S FOR EACH DATA FILE
C       MAGTEN  ..... ONE DIMENSION MODEL OUTPUT DATA FILE
C
      MAGIN =5
      MAGNAM= 9
      MAGTEN=10
C
C       O U T P U T   F I L E S
C       ***************************
C       MAGWSC  ..... FILE OF DAILY VALUES IN W.S.C. FORMAT
C       MAGOUT  ..... SYSTEM'S OUTPUT FILE
C
      MAGOUT=6
      MAGWSC=11
      READ(MAGIN,100) NINC,NREACH,NFILE
  100 FORMAT(3I5)
C
C       NINC    ..... NUMBER OF TIME INCREMENTS PER DAY
C       NREACH  ..... NUMBER OF REACHES OR STATIONS
C       NFILE   ..... NUMBER OF INPUT DATA FILES TO BE ATTACHED
C
      IF(NREACH.GT.30) GO TO 950
      WRITE(MAGOUT,110) NINC,NREACH,NFILE
  110 FORMAT(1H1,///,10X,35HNUMBER OF TIME INCREMENTS PER DAY =,I5,
     +       //,10X,35HNUMBER OF REACHES                   =,I5,
```

```
      SUBROUTINE BLANK(NR,DZ,DQ,J)
C         PURPOSE:
C            TO SET MEAN ELEVATION AND DISCHARGE VARIABLES TO ZERO
C
C            NR   ..... NO. OF REACHES
C            DZ   ..... MEAN ELEVATIONS
C            DQ   ..... MEAN DISCHARGES
C            J    ..... STARTING DAY OF MONTH
C
      DIMENSION DZ(30,31),DQ(30,31)
      DO 100 II=J,31
      DO 50 I=1,NR
      DZ(I,II)=0.0
      DQ(I,II)=0.0
   50 CONTINUE
  100 CONTINUE
      RETURN
      END
```

```
115           C
              C     CHECK DATE OF NEW FILE AGAINST STARTING DATE CALCULATED AT THE
              C     END OF OLD FILE - VALUES MUST MATCH
              C
                    DO 145 J=1,3
120                 IF (IFDATE(J).NE.ISDATE(J)) GO TO 143
                    GO TO 145
              143   WRITE(MAGOUT,144) IFDATE
              144   FORMAT(///,10X,*++++++ ERROR MESSAGE +++++ DATES MISMATCHED,STARTING
                   + DATE SHOULD BE   *,3I2)
125                 STOP
              145   CONTINUE
              C
              C     THE CALL TO "SETFDB" AND "ATTACH" ARE PERMANENT FILE FUNCTIONS
              C     FROM FORTRAN THAT ARE DESCRIBED IN EMRLIB ROUTINE PBS001.
130           C
              146   CALL SETFDB(FDB,IERR,2HLF,6HTAPE10)
                    IF(IERR.NE.0) GO TO 900
                    CALL SETFDB(FDB,IERR,2HPF,NPFN,2HID,ID)
                    IF(IERR.NE.0) GO TO 900
135                 CALL ATTACH(FDB,IERR)
                    IF(IERR.NE.0) GO TO 920
                    REWIND MAGTEN
              C
              C DUMMY READ
140           C
                    READ(MAGTEN) I1,I2,I3,I4
              C     WRITE(MAGOUT,149) I1,I2,I3,I4
              149   FORMAT(10X,4I10,/)
                    IF(EOF(MAGTEN)) 150,155
145           150   WRITE(6,151)
              151   FORMAT(///,10X,*++++++ ERROR MESSAGE +++++ AN EOF WAS ENCOUNTERED IM
                   +MEDIATED ON THE LAST*
                   ** TAPE10 FILE ATTACHED*)
                    STOP
150           155   CONTINUE
                    IF (I.EQ.1.AND.ISDATE(1).GT.1) GO TO 160
                    GO TO 220
              160   IFIN=ISDATE(1)-1
              C PLACES -99999 IN DAYS PREVIOUS TO STARTING DAY
155           C OF FIRST MONTH FOR EACH STATION
                    DO 200 L=1,IFIN
                    DO 180 K=1,NREACH
                    DATAZ(K,L) = -999.99
                    DATAQ(K,L) = -99999.
160           180   CONTINUE
              200   CONTINUE
              220   CONTINUE
              C
              C IF FIRST FILE IS BEING PROCESSED, START UP DATA MUST BE BYPASSED
165           C
                    IF(I.EQ.1.AND.IOPT.LE.-1)250,300
              250   DO 280 K=1,NREACH
                    IR=K
                    READ(MAGTEN) Z,Q
170                 IF (EOF(MAGTEN)) 940,280
              280   CONTINUE
```

```
      WRITE(20,300) JDAY,ISDATE(2),ISDATE(3)
  300 FORMAT(1H1,//,1X,14HDAY/MONTH/YEAR,5X,11HSTATION NO.,8X,
     *10HQMAX(M3/S),5X,8HTQMAX(M),5X,8HTQMAX(S),5X,
     *10HQMIN(M3/S),5X,8HTQMIN(M),5X,8HTQMIN(S),//,2X,I2,2(3X,I2))
      DO 170 I=1,NR
      QMAXI=QMAX(I)/35.32
      TIME1=NTMAX(I)*900.
      WATLE1=ELMAX(I)/3.28
      QMINI=QMIN(I)/35.32
      TIME2=NTMIN(I)*900.
      WATLE2=ELMIN(I)/3.28
      WRITE(20,310) RNAM(I),QMAXI,WATLE1,TIME1,QMINI,WATLE2,TIME2
  310 FORMAT(1H+,20X,A7,11X,F8.0,5X,F8.3,5X,F8.0,7X,F8.0,5X,F8.3,
     *5X,F8.0,/)
  170 CONTINUE
      RETURN
      END
```

```
      900   WRITE(6,910) IERR
230   910   FORMAT(1H1,///,10X,*ERROR IN CALL SETFDB,NO. =*,I5)
            GO TO 1000
      920   WRITE(6,930) IERR
      930   FORMAT(1H1,///,10X,*ERROR IN CALL ATTACH,NO. =*,I5)
            GO TO 1000
235   940   WRITE(MAGOUT,941)IR
      941   FORMAT(///,10X,*AN EOF WAS ENCOUNTERED ON TAPE10 AT*,
           +*TIME PERIOD O AND REACH*,I5)
            GO TO 1000
      950   WRITE(6,951) NREACH
240   951   FORMAT(///,10X,*****  ERROR MESSAGE  ***** PROGRAM STOPPED BECAUSE T
           +HE NUMBER OF*
           +,*REACHES EXCEEDED 30*,///,8X,*SOLUTION IS: REDIMENSION AFF*
           +,*ECTED VARIABLES TO*,I5)
     1000   CONTINUE
245         STOP
            END
```

```
      15    FORMAT(A1,1X,A7,I3,A3,A2,3X,8(I6,1H+))
      20    CONTINUE
60          IF=0
            DO 30 I2=1,4
            IS=IF+1
            IF=IS+7
            IF(I2.EQ.4) IF=IMON
65          WRITE(MAGWSC,15) IQ,RNAM(I),IYR,IMO,IDAY(I2),(IDATAQ(I,J),J=IS,IF)
      30    CONTINUE
      300   CONTINUE
            C
            C      CHANGE DATE TO NEW VALUES
70          C
            IF(JJ.EQ.100) RETURN
            IF(IM.EQ.12) GO TO 400
            JJ=0
            ISDATE(1) = 1
75          ISDATE(2) = ISDATE(2) +1
            GO TO 500
      400   ISDATE(1) = 1
            ISDATE(2) = 1
            ISDATE(3) = ISDATE(3) +1
80          JJ=0
            MON(2)=28
      500   CONTINUE
            RETURN
            END
```

```
      SUBROUTINE READTEN(NR,MAGTEN,RMESH,DATAZ,DATAQ,JDAY,NINC,ISDA
     +RNAM)
C          PURPOSE:
C             TO CALCULATE MEAN ELEVATIONS AND DISCHARGES FOR EACH DAY
C
C          NR      ..... NO. OF REACHES OR STATIONS
C          MAGTEN  ..... INPUT DATA FILE - UNIT 10 (BINARY FILE)
C          RMESH   ..... MESH POINT FOR DATA EXTRACTION
C          DATAZ   ..... MEAN ELEVATION
C          DATAQ   ..... MEAN DISCHARGE
C          JDAY    ..... DAY OF MONTH
C          NINC    ..... NO. OF INCREMENTS PER DAY
C
      INTEGER RMESH(30)
      DIMENSION DATAZ(30,31),DATAQ(30,31),Z(99),Q(99),ISDATE(3)
      DIMENSION QMAX(30),NTMAX(30),ELMAX(30),RNAM(30)
      DIMENSION QMIN(30),NTMIN(30),ELMIN(30)
      ZINC=NINC
      INC=NINC
      DO 100 II=1,INC
      DO 100 I=1,NR
      IR=I
      MT=RMESH(I)
      READ(MAGTEN) (Z(M),Q(M),M=1,MT)
      IF(EOF(MAGTEN)) 110,55
C
C      CALCULATES A RUNNING MEAN
C
55    CONTINUE
      IF(II.NE.1) GO TO 20
      QMAX(I)=Q(MT)
      ELMAX(I)=Z(MT)
      NTMAX(I)=II
      QMIN(I)=Q(MT)
      ELMIN(I)=Z(MT)
      NTMIN(I)=II
      GO TO 60
20    IF(Q(MT).GT.QMAX(I)) GO TO 40
      QMAX(I)=Q(MT)
      ELMAX(I)=Z(MT)
      NTMAX(I)=II
      GO TO 60
40    IF(Q(MT).LT.QMIN(I)) GO TO 60
      QMIN(I)=Q(MT)
      ELMIN(I)=Z(MT)
      NTMIN(I)=II
60    CONTINUE
      DATAZ(I,JDAY) = DATAZ(I,JDAY) + Z(MT)/ZINC
      DATAQ(I,JDAY) = DATAQ(I,JDAY) + Q(MT)/ZINC
100   CONTINUE
      GO TO 130
110   WRITE(6,115) JDAY,IR
115   FORMAT(//,10X,*++++++ ERROR MESSAGE +++++ AN EOF WAS ENCOUNTERED ON
     + TAPE10 AT DAY*,I5,
     +*REACH*,I5)
      STOP
130   CONTINUE
```

```
ICPJD,STWDJ,CM200000.   BERNARD MORASSE                                  000100
ACCOUNT,22556.                                                           000110
COMMENT.*****************************************************************000120
COMMENT.*  THIS JCL RUNS PROGRAM SEDIM.PGM IN ORDER TO COMPUTE           *000130
COMMENT.*  THE DAILY SUSPENDED SEDIMENT LOADINGS AT PORT MANN            *000140
COMMENT.*  USING BOTH HOURLY AND DAILY DISCHARGES AND CONCEN-            *000150
COMMENT.*  TRATIONS.                                                     *000160
COMMENT.*  IN ORDER TO RUN THE JCL, THE USER MUST DEFINE:               *000170
COMMENT.*          -/DAMO/ WHERE DA=FIRST DAY OF THE PERIOD,            *000180
COMMENT.*                  AND MO=MONTH.                                *000190
COMMENT.*          -/MONDA/ WHERE MON=MONTH, AND DA=FIRST DAY           *000200
COMMENT.*                   OF THE PERIOD.                              *000210
COMMENT.*****************************************************************000220
IUSE,FRASER83,FRASER83,FRASER83.                                         000230
IGET,PGM=SEDIM.PGM.                                                      000240
FTN(I=PGM,L=0)                                                           000250
ATTACH,TAPE30,FRASER,ID=68MSED.                                          000260
ATTACH,TAPE24,08MH024,ID=DAILYQ.                                         000270
ATTACH,TAPE54,08MH054,ID=DAILYQ.                                         000280
ATTACH,TAPE55,08MH054,ID=DAILYG.                                         000290
REWIND,TAPE24.                                                           000300
REWIND,TAPE54.                                                           000310
REWIND,TAPE55.                                                           000320
ATTACH,EMRLIB.                                                           000330
LIBRARY(EMRLIB)                                                          000340
COPYBR,INPUT,TAPE9.                                                      000350
REWIND,TAPE9.                                                            000360
LGO.                                                                     000370

     DAMO68     7FRASER10  MONDA68                                       000390
     DAMO68     7FRASER10  MONDA68                                       000400
     DAMO68     7FRASER10  MONDA68                                       000410
     DAMO68     7FRASER10  MONDA68                                       000420
     DAMO68     7FRASER10  MONDA68                                       000430

                                                                         000450
00005
```

```
      SUBROUTINE WSCFOR(MAGWSC,NR,RNAM,MON,DATAZ,DATAQ,ISDATE,JJ)
C     PURPOSE:
C        WRITE MEAN DAILY ELEVATIONS AND DISCHARGES ON OUTPUT FILE
C        (UNIT11) IN STANDARD W.S.C. CARD FORMAT 71-102
C
C
C         MAGWSC ..... OUTPUT DATA FILE (UNIT11)
C         NR     ..... NO. OF REACHES
C         RNAM   ..... REACH IDENTIFICATION
C         MON    ..... NO. OF DAYS IN MONTH
C         DATAZ  ..... MEAN DAILY ELEVATIONS
C         DATAQ  ..... MEAN DAILY DISCHARGES
C         ISDATE ..... DAY - MONTH - YEAR  I.E. 311267
C         JJ     ..... COUNTER
      DIMENSION RNAM(30),MON(12),DATAZ(30,31),DATAQ(30,31),IDATAZ(30,31)
     +,IDATAQ(30,31),ISDATE(3)
      DIMENSION MONTH(12),IDAY(4)
      DATA MONTH/3HJAN,3HFEB,3HMAR,3HAPR,3HMAY,3HJUN,3HJUL,3HAUG,3HSEP,3
     +HOCT,3HNOV,3HDEC/
      DATA IDAY/2H01,2H09,2H17,2H25/
C
C     CHANGE YEAR FROM I.E. 67 TO 967 FOR YEAR 1967
C
      IYR=ISDATE(3)+900
C
C     CHECK FOR LEAP YEAR AND CHANGE FEB. IF NECESSARY
C
      IYEAR=IYR/4
      IYEAR=IYEAR*4
      IF(IYR.EQ.IYEAR) MON(2) = 29
      IMO = MONTH(ISDATE(2))
      IM=ISDATE(2)
C
C       N O T E ! ! ! ! !
C
C       DATA IS WRITTEN AS INTEGER VALUES WHERE ELEVATIONS AND
C       DISCHARGES ARE IN METRIC UNITS AND RECORD FORMAT IS THAT
C       OF STANDARD WATER SURVEY CARD FORMAT 71-102
C       ELEVATIONS ARE IN THOUSANDS OF METRES
C
      IMON=MON(IM)
      IZ=1H9
      IQ=1HQ
      DO 300 I=1,NR
      DO 10 K=1,IMON
      IF(DATAZ(I,K).EQ.-999.99) GO TO 9
      IDATAZ(I,K) = DATAZ(I,K)*1000/3.28084
      IDATAQ(I,K) = DATAQ(I,K)/35.32
      GO TO 10
    9 IDATAZ(I,K)=-99999
      IDATAQ(I,K)=-99999
   10 CONTINUE
      IF=0
      DO 20 I1=1,4
      IS=IF+1
      IF=IS+7
      IF(I1.EQ.4) IF=IMON
      WRITE(MAGWSC,15) IZ,RNAM(I),IYR,IMO,IDAY(I1),(IDATAZ(I,J),J=IS,IF)
```

```
      PROGRAM  SEDIM(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE9,
C
C      THIS PROGRAM  COMPUTES THE DAILY SUSPENDED SEDIMENT LOADINGS AT
C      PORT MANN FROM BOTH HOURLY AND DAILY DISCHARGES & CONCENTRATIONS.
C      IT ALSO COMPARES THE SIMULATED AND PUBLISHED DAILY DISCHARGES AT
C      MISSION AND PORT MANN.
C
     *TAPE10,TAPE30,TAPE24,TAPE54,TAPE55)
      INTEGER RMESH(20),SUMDAY,TOTDAY
      DIMENSION MONTH(12),ISDATE(3),FDB(20),IFDATE(3),DATAX(12)
      DIMENSION CONCHR(7,24),QINST(7,96),CMEAN(7,20),CMEAN(7),SUMLD1(7)
      DIMENSION SUMLD2(7),I(99),Q(99),QHR(7,24)
      DIMENSION ERROR(7),ICDA(8),ICMO(8),ICYR(8),GHP(7),GDP(7)
      DIMENSION ERGPGD(7),ERGPGH(7),ERGDGH(7),EMOPQS(7),EPOPQS(7)
      DIMENSION PUBQ54(370),PUBQ24(370),PUBG54(370),QPP(7),QPM(7),GPP(7)
      DATA MONTH/31,28,31,30,31,30,31,31,30,31,30,31/
      DATA RMESH/1,1,1,15,1,1,1,1,5,1,1,19,1,1,1,1,1,5,1,7/
C
C         I N P U T   A N D   O U T P U T   F I L E S
C         ******************************************
C         MAGIN    ..... SYSTEM'S INPUT FILE
C         MAGNAM   ..... FILE OF PFN'S AND ID'S FOR EACH DATA FILE
C         MAGTEN   ..... ONE DIMENSION MODEL OUTPUT DATA FILE
C         MAGSED   ..... ANNUAL RECORD OF HOURLY CONCENTRATIONS
C         MAGOUT   ..... SYSTEM'S OUTPUT FILE
C
      MAGIN =5
      MAGNAM= 9
      MAGTEN=10
      MAGSED=30
      MAGOUT=6
      MAGQ54=54
      MAGQ24=24
      MAGG54=55
      READ(MAGIN,1000) NFILE
 1000 FORMAT(I5)
C
C         NFILE  ..... NUMBER OF INPUT DATA FILES TO BE ATTACHED
C
      DO 90 K=1,366
      READ(MAGQ54,1005) PUBQ54(K)
      READ(MAGQ24,1005) PUBQ24(K)
      READ(MAGG54,1005) PUBG54(K)
   90 CONTINUE
 1005 FORMAT(F10.0)
C
C      M A I N   L O O P   F O R   E A C H   I N P U T   F I L E
C     ***********************************************************
C
      DO 800 IFILE=1,NFILE
      DO 100 K1=1,20
      FDB(K1)=0
  100 CONTINUE
      READ(MAGNAM,1020) ISDATE,NDAY,NPFN,ID,CY,IOPT
 1020 FORMAT(4X,3I2,I5,2A10,A2,I2)
C
C     ISDATE(1)  ----- STARTING DAY
```

SEDIM.JCL Program

```
115               IFDATE(3)=ISDATE(3)
                  ICDA(1)=ISDATE(1)
                  ICMO(1)=ISDATE(2)
                  ICYR(I)=ISDATE(3)
                  NDAY=NDAY-1
120               DO 150 J=1,NDAY
                  JJ=J+1
                  IF(IFDATE(1).NE.MONTH(IFDATE(2))) GO TO 130
                  IFDATE(1)=1
                  IFDATE(2)=IFDATE(2)+1
125               IF(IFDATE(2).LT.13) GO TO 140
                  IFDATE(2)=1
                  IFDATE(3)=IFDATE(3)+1
                  GO TO 140
            130   IFDATE(1)=IFDATE(1)+1
130         140   ICDA(JJ)=IFDATE(1)
                  ICMO(JJ)=IFDATE(2)
                  ICYR(JJ)=IFDATE(3)
            150   CONTINUE
                  C
135               C     READ HOURLY CONCENTRATIONS AT PORT MANN, FOR THE CORRESPONDING
                  C     PERIOD OF TIME AND NUMBER OF DAYS, FROM THE ANNUAL RECORD ON
                  C     TAPE30.
                  C
                  REWIND MAGSED
140         160   READ(MAGSED,1050) ITYPE,STA,NO,JYEAR,JMONTH,JDAY,KCARD,DATAX
            1050  FORMAT(I1,A5,5I2,12F5.3)
                  IF(EOF(MAGSED).NE.0) GO TO 170
                  IF(JDAY.EQ.ISDATE(1).AND.JMONTH.EQ.ISDATE(2).AND.JYEAR.EQ.
                 +ISDATE(3).AND.KCARD.EQ.1) GO TO 180
145               GO TO 160
            170   WRITE(MAGOUT,1060) ISDATE
            1060  FORMAT(//,10X,"AN EOF WAS ENCOUNTERED ON TAPE30 WHILE SEARCHING"
                 +" FOR CONCENTRATIONS FOR DAY-MONTH-YEAR ",3I2)
                  STOP
150         180   IFLAG1=1
                  DO 220 J=1,NDAY
                  IF(IFLAG1.EQ.1) GO TO 190
                  READ(MAGSED,1050) ITYPE,STA,NO,JYEAR,JMONTH,JDAY,KCARD,DATAX
            190   DO 200 JHOUR=1,12
155               CONCHR(J,JHOUR)=DATAX(JHOUR)
            200   CONTINUE
                  READ(MAGSED,1050) ITYPE,STA,NO,JYEAR,JMONTH,JDAY,KCARD,DATAX
                  DO 210 JJ=1,12
                  JHOUR=JJ+12
160               CONCHR(J,JHOUR)=DATAX(JJ)
            210   CONTINUE
                  IFLAG1=0
            220   CONTINUE
                  C
165               C     CHECK IF THE LAST CARD READ ON THE ANNUAL RECORD OF HOURLY
                  C     CONCENTRATIONS (TAPE30) CORRESPONDS TO THE COMPUTED DATE.  THIS
                  C     IS DONE TO CHECK IF ANY CARD IS MISSING.
                  C
                  IF(JDAY.EQ.ICDA(NDAY).AND.JMONTH.EQ.ICMO(NDAY).AND.JYEAR.EQ.
170               +ICYR(NDAY).AND.KCARD.EQ.2) GO TO 230
                  WRITE(MAGOUT,1070) JDAY,JMONTH,JYEAR,ICDA(NDAY),ICMO(NDAY),
```

```
     +ICYR(NDAY)
1070  FORMAT(///,10X,"MISSING CARD ON TAPE30.  ",/,10X,3I2,
     +" WAS THE DATE READ ",/,10X,3I2," SHOULD HAVE BEEN READ",/)
175   STOP
230   CONTINUE
C
C     READ INSTANTANEOUS DISCHARGES AT PORT MANN, FOR THE CORRESPONDING
C     PERIOD OF TIME AND NUMBER OF DAYS, FROM THE TAPE10 FILE CREATED
180   C     DURING THE 1-D SIMULATION.  ALSO READ INSTANTANEOUS DISCHARGES
C     AT OTHER STATIONS AND COMPUTE DAILY DISCHARGES.
C
C
C
185   C     THE CALL TO "SETFDB" AND "ATTACH" ARE PERMANENT FILE FUNCTIONS
C     FROM FORTRAN THAT ARE DESCRIBED IN EMRLIB ROUTINE PBS001.
C
      CALL SETFDB(FDB,IERR,2HLF,6HTAPE10)
      IF(IERR.NE.0) GO TO 900
190   CALL SETFDB(FDB,IERR,2HPF,NPFN,2HID,ID)
      IF(IERR.NE.0) GO TO 900
      CALL ATTACH(FDB,IERR)
      IF(IERR.NE.0) GO TO 920
      REWIND MAGTEN
195   C
C DUMMY READ
C
      READ(MAGTEN) I1,I2,I3,I4
C     WRITE(MAGOUT,1080) I1,I2,I3,I4
200   1080  FORMAT(10X,4I10,/)
      IF(EOF(MAGTEN)) 240,250
240   WRITE(MAGOUT,1090)
1090  FORMAT(///,10X,*****+ ERROR MESSAGE +++++ AN EOF WAS ENCOUNTERED IM
     +MEDIATED ON THE LAST*
205   +* TAPE10 FILE ATTACHED*)
      STOP
250   CONTINUE
C IF FIRST FILE IS BEING PROCESSED, START UP DATA MUST BE BYPASSED
C
210   IF(IFILE.EQ.1.AND.IOPT.LE.-1)260,280
260   DO 270 K=1,20
      IR=K
      READ(MAGTEN) Z,Q
      IF (EOF(MAGTEN)) 940,270
215   270   CONTINUE
      WRITE(MAGOUT,1100) IOPT
1100  FORMAT(" --- IOPT =", I3, "   THEREFORE NO TAPE 17 AND A DUMMY SE
     $T WAS BYPASSED.")
280   CONTINUE
220   C
C
C                L O O P   F O R   E A C H   D A Y
C               ************************************
C
225   C
      DO 330 J=1,NDAY
      DO 285 JREACH=1,20
      QMEAN(J,JREACH)=0.
```

```
      285   CONTINUE
230         CMEAN(J)=0.
            GMP(J)=0.
            DO 310 JTIME=1,96
            DO 310 JREACH=1,20
            IR=JREACH
235         MT=RMESH(JREACH)
            READ(MAGTEN) (Z(M),Q(M),M=1,MT)
            IF(EOF(MAGTEN)) 290,300
      290   WRITE(MAGOUT,1110) ICDA(J),ICMO(J),ICYR(J),IR
      1110  FORMAT(///,10X,"+++++ ERROR MESSAGE +++++ AN EOF WAS ENCOUNTERED",
240        +" ON TAPE10 AT DAY ",3I2," IN REACH ",I5)
            STOP
      300   IF(JREACH.EQ.1) QINST(J,JTIME)=-Q(MT)
            QMEAN(J,JREACH)=QMEAN(J,JREACH)+(-Q(MT)/96.)
      310   CONTINUE
245         NSUM=1
            DO 320 JHOUR=1,24
            NSUM1=NSUM+1
            NSUM2=NSUM+2
            NSUM3=NSUM+3
250         QHR(J,JHOUR)=(QINST(J,NSUM)+QINST(J,NSUM1)+QINST(J,NSUM2)+
           $QINST(J,NSUM3))/4.
            GMP(J)=GMP(J)+(QHR(J,JHOUR)*CONCHR(J,JHOUR)*3600./32037.)
            CMEAN(J)=CMEAN(J)+(CONCHR(J,JHOUR)/24.)
            NSUM=(4*JHOUR)+1
255   320   CONTINUE
            GDP(J)=QMEAN(J,1)*CMEAN(J)*86400./32037.
            ERGPGM(J)=100.*(GPP(J)-GMP(J))/GMP(J)
            ERGPGD(J)=100.*(GPP(J)-GDP(J))/GDP(J)
            ERGDGM(J)=100.*(GDP(J)-GMP(J))/GMP(J)
260         EMQPQS(J)=100.*(QPM(J)-QMEAN(J,18))/QMEAN(J,18)
            EPQPQS(J)=100.*(QPP(J)-QMEAN(J,1))/QMEAN(J,1)
            IF(IFILE.EQ.1.AND.J.EQ.1) GO TO 325
            IF(ICDA(J).NE.1) GO TO 327
            WRITE(MAGOUT,1990)
265   1990  FORMAT(1X,119(1H*))
      325   WRITE(MAGOUT,2000)
      2000  FORMAT(1H1,119(1H*),/,2H *,6X,1H*,46X,1H*,63X,1H*,/,
           +" * DATE * SIMULATED DAILY DISCHARGES AND COMPARISONS   *",
           +" PORT MANN DAILY SUSPENDED SEDIMENT LOADINGS AND COMPARISONS  ",
270        +2H *,/,2H *,6X,"*   PORT  MANN    *   MISSION CITY  * ",
           +"PT. COQ. * ",
           +"CONC * HR. VAL. * DAY VAL. * PUB. VAL.* ERROR * ERROR * ERROR *",
           +/," *DAMOYR*    QSP  *QPP-QSP*   QSM   *QPM-QSM*    QSC   *  C",
           +"   *    GMP   *    GDP   *    GPP   *GPP-GMP*GPP-GDP*GDP-GMP*",/,
275        +2H *,6X,1H*,9X,"*  QSP  *",9X,"*  QSM  *",10X,1H*,
           +6X,1H*,10X,1H*,10X,
           +1H*,10X,"*  GMP  *  GDP  *  GMP  *",/,2H *,6X,1H*,
           +3X,"(CFS) *   (%) *   (CFS) *   (%) *"
           +"   (CFS)  *(GR/L)*   (T/D)  *   (T/D)  *   (T/D)",
280        +"  *  (%)  *  (%)  *  (%)  *",/,1H ,119(1H*),/,
           +2H *,6X,1H*,2(9X,1H*,7X,1H*),10X,1H*,6X,1H*,3(10X,1H*),
           +3(7X,1H*),/,
           +2H *,6X,1H*,2(9X,1H*,7X,1H*),10X,1H*,6X,1H*,3(10X,1H*),
           +3(7X,1H*))
285   327   WRITE(MAGOUT,2010) ICDA(J),ICMO(J),ICYR(J),QMEAN(J,1),EPQPQS(J),
```

```
     +QMEAN(J,18),EMOPOS(J),QMEAN(J,4),CMEAN(J),GHP(J),GDP(J),
     +GPP(J),ERGPGH(J),ERGPGD(J),ERGDGH(J)
2010 FORMAT(2H *,3I2,1H*,2(F9.0,2H* ,F6.1,1H*),F10.0,1H*,F6.3,1H*,
     +3(F10.0,1H*),3(F7.1,1H*))
330  CONTINUE
C
C THE CALL TO "RETURN" IS A PERMANENT FILE FUNCTION
C DESCRIBED IN EMRLIB ROUTINE PBS004
C
     CALL RETURN(6HTAPE10)
800  CONTINUE
     WRITE(MAGOUT,1990)
     GO TO 990
900  WRITE(MAGOUT,1120) IERR
1120 FORMAT(1H1,///,10X,*ERROR IN CALL SETFDB,NO. =*,I5)
     GO TO 990
920  WRITE(MAGOUT,1130) IERR
1130 FORMAT(1H1,///,10X,*ERROR IN CALL ATTACH,NO. =*,I5)
     GO TO 990
940  WRITE(MAGOUT,1140)IR
1140 FORMAT(///,10X,*AN EOF WAS ENCOUNTERED ON TAPE10 AT*,
    +*TIME PERIOD 0 AND REACH*,I5)
     GO TO 990
950  WRITE(MAGOUT,1150)
1150 FORMAT(///,10X,"***** ERROR MESSAGE ***** PROGRAM STOPPED ",
    +"BECAUSE THE NUMBER OF REACHES EXCEEDED 30",///)
990  CONTINUE
     STOP
     END
```