



# MEMORANDUM

To: W. Nichols  
Senior Hydraulic Engineer  
Planning

Date: January 10, 1984

File: 0323545  
Your File: 0305030-Hec2

Re: Frequency Analysis, Nanaimo River and Haslam Creek

Reference is to your memo of December 9th on the above subject.

## DATA

Records on the Nanaimo River are available for a total of 49 years: 1914-27 and 1949-63 at gauge #08HB005 and 1965 to the present at gauge #08HB034. As the gauges have similar drainage areas (645 and 684 sq. km respectively) and there is no significant tributary between the two gauges, the records were assumed to be compatible for this study.

For both gauges, Water Survey of Canada publications state "regulated since 1963". Discussion with our Power and Major Licences Section and with Water Survey both in Nanaimo and Vancouver failed to produce a reason for this statement. There seems to have been some regulation as early as 1915, but the major storage reservoir called Fourth Nanaimo Lake was completed in 1953 and another dam on Jump Creek was constructed in the 1970's. Plots of moving averages and cumulative averages show that there seems to be a downward trend in peak annual flows as would be expected with increased storage and human operation. The twelve highest flows were recorded in 1961, 1921, 1918, 1974, 1949, 1914, 1980, 1983, 1924, 1973, 1955 and 1923 respectively. This could be interpreted as showing that, while average or lower peaks are attenuated by the storages there is relatively little affect on the major events. The full data set was therefore used in the analysis.

Instantaneous peak flows on the Nanaimo River are available only since 1953. However, there is a good correlation between peak instantaneous and peak daily flows ( $r^2 = 0.95$ ), so the instantaneous flows were estimated for these years in which only daily peak flows were available, thus extending the data to 49 years.

On Haslam Creek there are only 13 years of peak flow data at gauge #8HB003 which has a drainage area of 96 sq. km. There are only 5 years in which peak instantaneous flow data are available, so it was not possible to run the frequency analysis program on the instantaneous flow data. It should be noted that WSC describe the flow records as "poor" for flows greater than  $30 \text{ m}^3/\text{s}$ .

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7.

To estimate instantaneous peak flows a regression relating the 4 years on which peak instantaneous and peak daily flows occurred as a result of the same event gave an equation  $Q_I = 14.8 + 1.04 Q_D$  with an  $r^2$  of 0.78. This seems reasonable, but it must be stressed that based on only 4 years of data from a station with "poor" records, the resulting figures must be treated with extreme caution.

The data used are shown on the attached sheets of the first page of the computer output.

### RESULTS

Flow and Return Period	DISTRIBUTION			
	3 param log normal	Gumbel	Pearson III	Logarithmic Pearson III
<u>1. Nanaimo River above confluence with Haslam Creek</u>				
200 year Daily	1410	1270	1350	1390
Instantaneous	1760	1640	1680	1720
20 year Daily	926	881	928	927
Instantaneous	1170	1130	1170	1180
<u>2. Haslam Creek</u>				
200 year Daily	115	93	86	101
20 year Daily	73	66	66	70

### RECOMMENDATIONS

On the Nanaimo River none of the distributions appeared to fit the data significantly better than any other, therefore the recommended flows are the averages of the four distributions for both daily and instantaneous peak flows. The relationship between the daily and instantaneous is exactly that of the equation used to extend the data from 28 to 49 years.

On Haslam Creek, the frequency analyses using log-transformed data appear to have the best fit and it is therefore recommended that the log normal and log Pearson estimates be averaged. This implies a considerably lower unit runoff on the Haslam Creek watershed than on the Nanaimo River - presumably because of the relatively lowland nature of the Haslam Creek watershed. If the two watersheds were hydrologically similar we would anticipate a  $Q_{200}$  of 306  $m^3/sec$  for Haslam Creek based on the Nanaimo River analysis compared with the recommended 108  $m^3/sec$ .

For the Nanaimo River downstream of the confluence with Haslam Creek on a unit runoff basis a daily  $Q_{200}$  of 1500  $m^3/s$  would be expected. However, this is greater than the sum of the  $Q_{200}$  for each of the two streams. An examination of the records of the two gauges shows that the same event causes the peaks on both streams in most years, although the peaks are generally separated by a few hours. A conservative estimate of the daily  $Q_{200}$  downstream of the confluence would therefore be 1470  $m^3/sec$ .

In summary, the following are the recommended flows:

Location	Return period	Daily/Inst	Flow $m^3/s$
Nanaimo R at gauge #8HB034	200	D	1360
		I	1700
	20	D	916
		I	1160
Haslam Cr. at gauge #8HB003	200	D	108
		I	127
	20	D	72
		I	90
Nanaimo R. below Haslam Creek	200	D	1470
		I	1830
	20	D	988
		I	1250

*R.Y. McNeil*

R.Y. McNeil, Head  
Modelling Section  
Water Management Branch

NANAIMO RIVER NEAR CASSIDY - GAUGE 08HB034+NANAIMO R NR EXTENSION  
 MAX ANNUAL DAILY FLOWS M3/S 1965-82/ 1913-27 AND 1949-64

JAN 6, 1984

FREQUENCY ANALY

INPUT DATA

323.000	716.000	274.000	371.000	464.000	946.000	450.000	265.000
1160.00	436.000	612.000	643.000	436.000	600.000	430.000	736.000
374.000	481.000	269.000	464.000	479.000	623.000	217.000	289.000
564.000	254.000	572.000	1250.00	493.000	532.000	286.000	430.000
317.000	600.000	223.000	262.000	314.000	453.000	626.000	784.000
402.000	149.000	294.000	156.000	507.000	714.000	414.000	321.000
673.000							

NO. OF INPUT DATA VALUES 49

MAXIMUM	1250.00
MINIMUM	149.000
RANGE	1101.00
MEDIAN	450.000
MEAN	482.612
VARIANCE	53131.9
STANDARD DEVIATION	230.504
COEFFICIENT OF VARIATION	0.477617
COEFFICIENT OF SKEW	1.33224



Maximum instantaneous flow Nanaimo River near Cassidy and near Extension  
Gauges SH8005 & SH834 1913-27 & 49-83, missing data by correlation

DEC 23, 1983

FREQUENCY

INPUT DATA

*calculated by correlation*

415.000	904.000	354.000	475.000	591.000	1190.00	573.000	343.000
1456.00	556.000	775.000	813.000	556.000	760.000	548.000	929.000
479.000	612.000	348.000	591.000	654.000	788.000	283.000	334.000
674.000	326.000	731.000	1550.00	627.000	886.000	352.000	490.000
402.000	660.000	337.000	297.000	368.000	688.000	668.000	903.000
510.000	185.000	320.000	179.000	765.000	958.000	585.000	391.000
869.000							

NO. OF INPUT DATA VALUES 49

MAXIMUM 1550.00

MINIMUM 179.000

RANGE 1371.00

MEDIAN 585.000

MEAN 613.429

VARIANCE 84725.3

STANDARD DEVIATION 291.076

COEFFICIENT OF VARIATION 0.474507

COEFFICIENT OF SKEW 1.19083

*5/10/83  
Nov 1/83  
Nov 1/83  
-9/14*

Haslam Creek near Cassidy, station #8HB003  
Max annual daily flow m3/s, 1915 and 1949-61

DEC 23, 1983

FREQUENCY ANAL

INPUT DATA

18.7000	37.7000	22.7000	29.7000	24.6000	33.4000	62.6000	65.1000
26.1000	35.7000	44.5000	45.0000	56.4000			

NO. OF INPUT DATA VALUES 13

MAXIMUM 65.1000

MINIMUM 18.7000

RANGE 46.4000

MEDIAN 35.7000

MEAN 38.6308

VARIANCE 232.282

STANDARD DEVIATION 15.2408

COEFFICIENT OF VARIATION 0.394525

COEFFICIENT OF SKEW 0.579071