


Multi-Use Hydrometric Data
for British Columbia

W.L. Kreuder

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MULTI-USE HYDROMETRIC DATA FOR BRITISH COLUMBIA

W.L. KREUDER

I. Introduction

Stream gauging in British Columbia was started in 1911 by the Railway Belt Hydrographic Survey of the Department of Interior. The purpose was primarily for the allotment of irrigation water. As the population of the province increased, the purposes for which streamflow data were required expanded to include hydro-electric power development, fisheries studies, flood studies, and navigation.

Presently, April 1, 1987, there are 583 hydrometric stations in British Columbia which are operated and maintained by the Water Survey of Canada for the common purpose of gathering streamflow data.

It is the purpose of this report to discuss and identify the many uses for hydrometric data presently gathered in British Columbia. Uses are identified under three categories:

1. information required for current or immediate use
2. information required for planning and design purposes and
3. information for providing inventories of water resources.

Current use data are gathered at stations which are called project stations, data for planning and design are collected at regional and major stream stations, and inventory stations provide data for national or provincial inventories of water resources.

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II. Current Use Data

Streamflow data required on a day-to-day basis are obtained by operating gauging stations at specific locations according to identifiable project requirements. Project stations providing data for current use have the following characteristics:

- a) justification can be related to specific needs
- b) data may have no transfer capability
- c) location of station and period of operation are specified by the user of the data
- d) locations are fixed and are not subject to network design
- e) data are required now
- f) user pays for the station
- g) stations must be continued in operation as long as the need exists

The identification of current use stations is accomplished by coding each station according to the specific uses being made of the data. Current uses of the data can be summarized under seven functions or categories:

- 1 -International waters: current records are collected in response to IJC orders; under the Boundary Waters Treaty; and to provide for control of waters crossing or forming part of the international boundary and for which Canada has determined that monitoring is required for water management purposes.
- 2 -Interprovincial waters: data are required for monitoring of waters flowing across or forming part of provincial or territorial boundaries where justified by an inter-jurisdictional concern.
- 3 -Operation of large storage reservoirs: data are required for the day-to-day operation of reservoirs for purposes such as hydroelectric power generation, or supply of minimum flows across boundaries.

- 4 -Forecasting of flows: data are required on a daily basis for estimating spring runoff volumes, for forecasting flood peaks, and for estimating low flows and seasonal flows.
- 5 -Assessment of current water conditions: data are required for assessment of the water resources of a basin, for basin study implementation; also included are stations with federal DCPs.
- 6 -Water quality assessment: quality of water data for which streamflow records are needed, also included are data for determination of sediment concentration and load, and data required for control of pollution.
- 7 -All other current specific monitoring requirements: data are required for municipal water supply, for bridge and culvert design, fisheries habitat studies, wildlife enhancement, flood protection, small hydro electric projects, water licensing for irrigation, navigation of main channels, and research studies in small basins.

It must be recognized that many stations provide data that are useful for more than one specific purpose; indeed at numerous stations the purpose for which the station was originally installed has been replaced with other purposes reflecting the changing environmental issues that have evolved over the years.

Table 1 lists the number of project stations for each indicated current use function. The table shows that three quarters (75%) of the stations being operated in British Columbia by the Water Survey of Canada are required to provide current data for existing projects.

III Stations for Planning and Design

The main objective of these stations is to provide data suitable for the planning and design of water resources projects. The data that are required are the statistical parameters of flow characteristics. Depending on the nature of the project, these data could be annual runoff volumes, instantaneous or daily maximum and minimum flows, duration curves, etc. The period of record should generally be longer than for current use stations. Data for planning and design purposes can be obtained from a regional or a major stream network.

T A B L E 1

IDENTIFICATION OF GAUGING STATIONS USES IN BRITISH COLUMBIA
(1987)

Number of stations operated by WSC..... 583

Number of Project Stations required for current use data..... 438

Number of stations for indicated current uses:

1	International gauging stations and for International Boards of Control	31
2	Interprovincial streams	7
3	For operation of storage reservoirs.....	59
4	For flow forecasting, spring freshet.....	64
5	For assessment of current water conditions, basin study implementation, sites of federal DCPs	74
6	For water quality assessment including sediment discharge monitoring	27
7	For fisheries studies	134
	For irrigation requirements	57
	For other project requirements such as municipal water supply, bridge and culvert design, small hydro projects, research basins..	169
	Total current uses	622

1. Regional Network

Since there are far too many streams in British Columbia for gauging each one, techniques of generalizing the information gained from a few gauged streams are used. Generalization is accomplished by some process of regionalization. The most commonly used process is one that employs multiple regression techniques that estimate statistical parameters of hydrologic quantities from independent variables such as physiographic basin parameters. To attain the goal of defining flow characteristics at any point on any stream in the Province one must identify those streams/basins which are representative of hydrologic conditions in a region and which should be gauged; the gauged information should then be transferable to ungauged basins in the same region by the use of regional equations.

The development of the regional network in British Columbia began in 1971 with the active participation of the provincial Water Management Service and has been described by Kreuder (1979).

Presently there are 102 active stations in the Province whose primary purpose is for regional estimates of hydrologic design parameters. In addition there are 28 project stations which can be utilized within the regional network.

2. Major Streams

When planning and designing water resources projects, accuracy requirements of the streamflow information required for design increase with the size and cost of the project. The accuracy requirements also determine which technique should be used to transfer information to the desired project location. Because of higher accuracy requirements for projects on large streams, techniques of regionalization cannot be used. Instead, transfer methods such as interpolation between stations on the same stream or system studies should be employed. These techniques have been proposed by the U.S. Geological Survey in its study of the national streamflow data collection program, summarized by Benson and Carter (1973). The U.S.G.S. method was employed to design a major stream network for British Columbia and the Yukon Territory, Kreuder (1979).

There are 57 stations presently operated at major stream locations, most of these stations are located in Northern British Columbia above the 54th Parallel; included in the table are 29 project stations.

IV Inventory Stations

The purpose of inventory stations is to gauge the flow of very large rivers in order to provide an assessment of the total water resources of a province or part of a country and to indicate the distribution and variation of these resources across the country. This information can be transferred onto maps and shown in an hydrologic atlas as average annual discharge in cubic meters per second (m^3/sec) or, by employing a suitable conversion factor, the annual volume of runoff can be computed and shown. The identification of inventory stations within a province would be based on the contribution of each of the stations to an inventory of water resources of the province.

An example of an inventory of provincial water resources using recorded and estimated runoff values is provided by Coulson (1986) from which Table 2 has been extracted.

The table shows that gauges would be required in about 30 basins to account for 100% of the area and annual runoff volume of the Province. It requires only about 20 gauges to account for 91% of the area and 83% of the annual runoff volume of the Province.

Presently, there are 28 active gauging stations in British Columbia which provide an inventory of the water resources of 82% of the total area of the Province.

T A B L E 2

British Columbia Annual Runoff

Basin	Area $\times 10^3 \text{ km}^2$	Mean Annual Runoff $\times 10^6 \text{ dam}^3$
Fraser	234.2	120.8
Liard	144.0	37.3
Peace-Wapiti	125.8	50.2
Columbia	105.2	66.9
Skeena	56.5	61.2
Stikine	49.8	46.2
North Coast	36.5	74.5
Vanc. Is. & Gulf I.	34.8	95.2
Mid-Coast (S)	27.0	58.4
Nass-Bear	26.9	47.1
Yukon	24.7	13.0
Taku-Whiting	18.8	19.5
Mid-Coast (N)	16.2	36.0
Lower Coast	15.6	37.7
Alsek-Skagway	11.1	10.2
Queen Charlotte Is.	10.1	27.5
Hay-Chinchaga	8.6	0.6
Unuk	1.8	4.1
Skagit	<u>1.0</u>	<u>1.0</u>
Province	<u>948.6</u>	<u>807.4</u>

V Summary for British Columbia

Stations operated by WSC	583
Project stations	438
Project stations as a percentage of total stations operated	75%
Current use requirements	622
Other data uses	71
Total data uses at Project stations	693
Average Number of Uses per Project Station	1.58
Other Stations: Regional Network	102
Major Stream	28
National Inventory	15

REFERENCES

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W.L. Kreuder (1979), Development of Hydrometric Networks in British Columbia, Water Resources Research, Vol. 13, No. 5, American Geophysical Union, Washington, D.C.

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A P P E N D I X

Results of similar surveys of data uses in the United States were summarized in Benson and Carter (1973). Shown below are the data uses for adjacent states with total number of stations shown in parentheses.

Alaska	(123)	: 38% are project stations with 1.42 uses per stn
Washington	(311)	: 60% are project stations with 1.29 uses per stn
Idaho	(254)	: 83% are project stations with 1.83 uses per stn
Montana	(174)	: 92% are project stations with 1.70 uses per stn
North Dakota	(107)	: 75% are project stations with 2.11 uses per stn
Minnesota	(127)	: 83% are project stations with 1.62 uses per stn
Wisconsin	(105)	: 57% are project stations with 1.43 uses per stn
Michigan	(194)	: 49% are project stations with 1.24 uses per stn
Ohio	(174)	: 81% are project stations with 1.61 uses per stn
Pennsylvania	(249)	: 60% are project stations with 1.21 uses per stn
New York	(192)	: 61% are project stations with 1.20 uses per stn
Maine	(62)	: 74% are project stations with 1.56 uses per stn
Massachusetts	(213)	: 56% are project stations with 1.48 uses per stn
(incl. Vermont & New Hampshire		
United States	(8136)	: 66% are project stations with 1.55 uses per stn