SIGNIFICANT RIVER ICE PROBLEMS CAN OCCUR EVEN IN SOUTHERN BRITISH COLUMBIA

by

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INTRODUCTION

Southern British Columbia is not noted for mammoth ice jams and extensive icings which are common in colder regions of North America. However, given the right meteorological conditions during the early part of winter, certain streams can and do occasionally experience either ice jamming or icings similar to those which occur in harsher climates. Ice jams within the Region do result in overbank flooding, sometimes in populated areas. Icings do result in near-bankfull conditions creating the possibility of overbank flooding, sometimes in populated areas. The two objectives of this brief paper are:

(1) to make individuals and agencies aware that river ice problems occur even in this part of Canada so that planning and management of regional water resources consider such occurrences and

(2) to establish documentation of jamming and aufeis problems which hopefully will lead to a greater awareness and understanding of ice problems heretofore considered non-existent in the Region.

To accomplish these objectives I have selected both an ice jam and an icing which have been documented in the field. Also, I briefly mention several other jams in the area which have been reported during the past three winters but have received little or no hydrotechnical investigation.

NORTH THOMPSON RIVER ICE JAM

The North Thompson River at the jam site has a watershed of 4400 km^2 draining rugged mountains and a mean annual flow of 150 m^3/s. The river is steep, has a gravel bed and is dotted with islands and bars. It is actively meandering across a floodplain consisting of terraces of varying levels and numerous flood channels. Normal winter ice thickness at a WSC gauging station 10 km downstream of the jam site is about 0.6 m with half of it clear ice and half of it snow and slush ice. The low velocity portion of the channel at the discharge measuring cross section generally has an accumulation of slush ice extending down to the bed.[2]

The ice jammed upstream of Clearwater during the night of December 16, 1980 following an unusual warm spell and some heavy rain in the area.[3] The location of the jam is marked by a star in Figure 1. On December 17, 1980 I observed the jam from the air and noted the following:

(1) the ice had jammed against the intact ice cover, (apparently running over the intact cover in some locations) and had grounded among the islands and shallows.

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[1] Regional Water Management, B.C. Ministry of Environment, Kamloops, B.C.

[2] Personal Communication - K. Barker, Water Survey of Canada

[3] Personal Communication - T. Pye Family, local residents

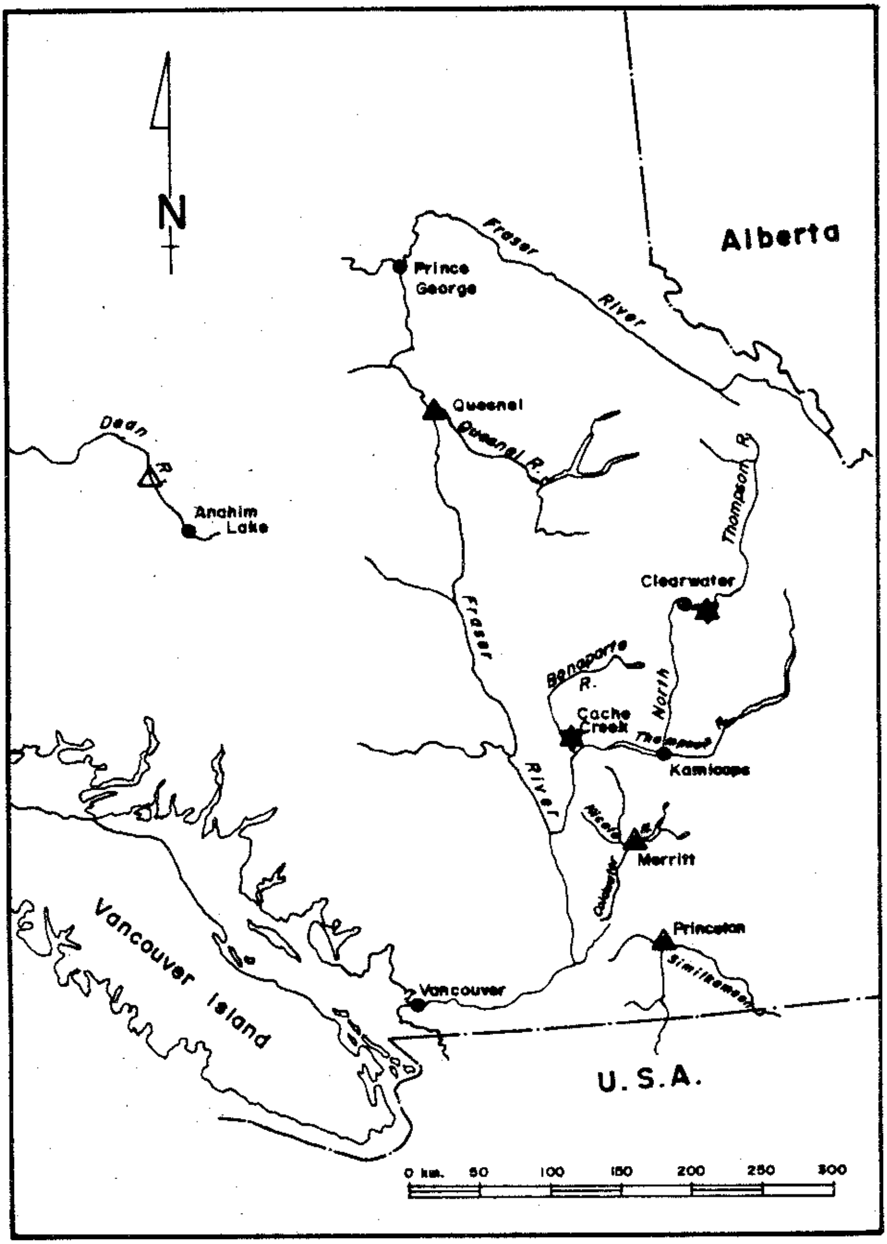

Figure 1. Location of ice jams and icings during past three winters in southern B.C.

(2) the jam was about 4 km long. Figure 2 is a schematic diagram showing the position of the jam.

(3) the intact ice extended about 3 km downstream of the jam. Downstream of the intact ice cover, the river was open for many kms and upstream of the jam the river was open for at least 10 km. The intact ice appeared competent although open leads along the thalweg were common.

(4) the greatest dimension of the largest floes at the toe did not exceed 10 m. Most of the ice even at the toe was badly fragmented and ground up. Upstream of the immediate toe area all of the ice was mush.

(5) water had overflowed the right bank from the toe upstream for some distance and overflowed a low area on the left bank near the head.

(6) the right bank overflow emptied back into the channel downstream of the jam via several old flood channels.

Observers[1] reported that on December 18, the water level at the toe peaked at a stage about 0.6 m higher than it had been during the aerial reconnaisance the previous day and that there had been a consolidation of the jam in the meantime which stacked the jammed ice in piles up to 8 m high at the toe. The following day they reported that water levels on the left bank near the head had risen about 0.6 m as well and that levels were steady at the toe. On December 22 another report indicated a gradual decrease in water levels as well as failure of the downstream end of the intact ice cover and some additional movement at the toe. Eventually water levels returned to normal.

A long overdue ground investigation aided by local observers[1] revealed the peak water level at the toe was approximately 1 m over banktop or about 3 m above the open water stage. The thickest floes at the toe were reported to be 1.5 m thick with clear ice comprising only about 0.3 m of this thickness. Some flows had large cobbles imbedded in the ice.

Published discharge data at the manual WSC gauge 10 km downstream indicate that flow increased from 31 m^3/s on December 7 to 56 m^3/s on December 16 to 74 m^3/s on December 22. Naturally, flow during ice conditions is estimated from other surrounding station record and meteorological data. Of interest is the gauge reader's staff readings during jam formation: December 16 - 1.587 m (the eve of the jam); December 17 - 1.323 m - (just after the jam); December 18 - 1.707 m. The drop in stage on December 17 may reflect the temporary storage of water in the jam.

Perhaps the most important practical piece of data gathered was that the peak water level during the jam exceeded the estimated 200 year flood level by about 1 m. No doubt the height of backwater due to the jam was unusual. Local residents can recall no ice jams approaching the severity of this one.

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[1] Personal Communication - T. Pye Family, local residents

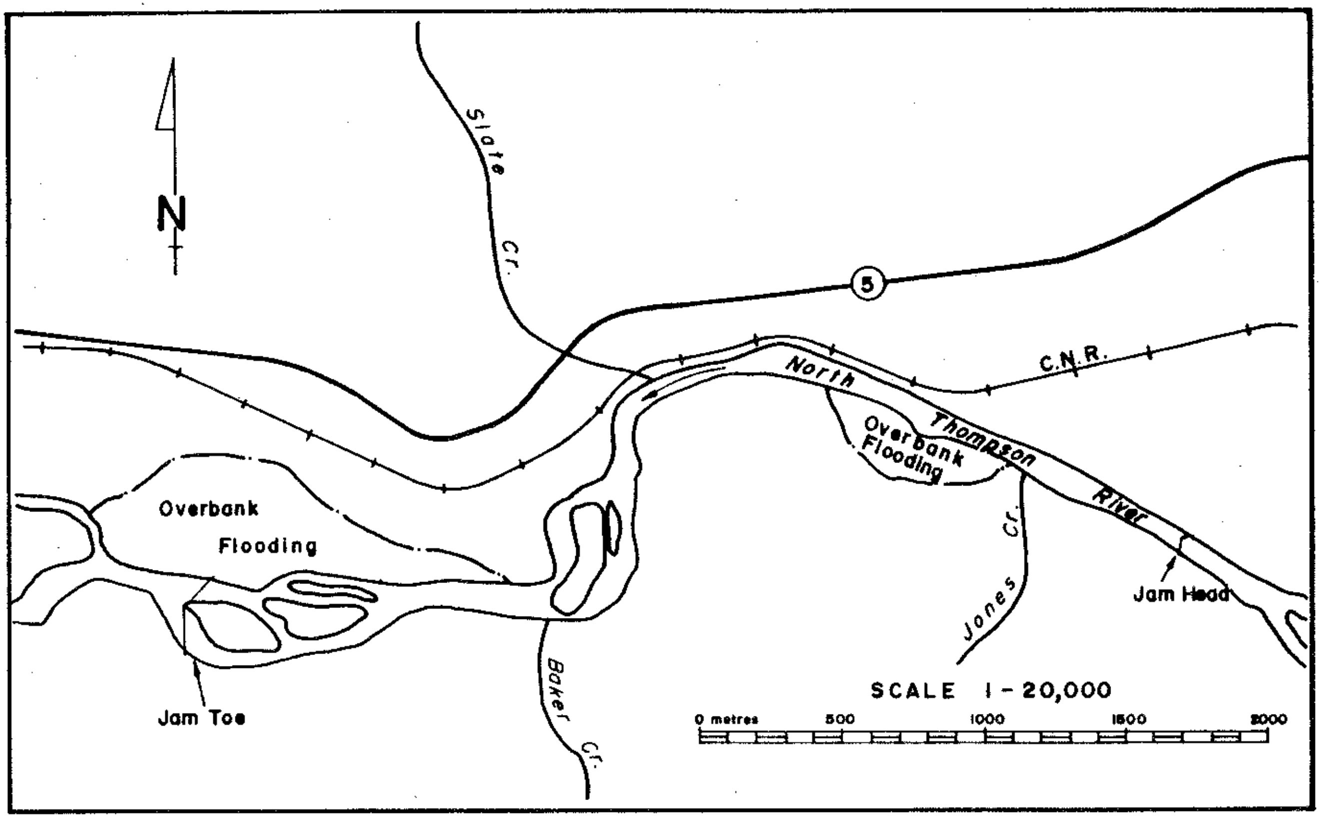

Figure 2. Location of December 1980 ice jam on the North Thompson River upstream of Clearwater.

BONAPARTE RIVER ICINGS

The Bonaparte River at the icing sites has a watershed of 5000 km^2 draining upland plateau and a mean annual flow of 5.7 m^3/s. (See Figure 1 for the location of the icings at Cache Creek). It is a small sand, gravel and cobble bed river with slowly progressing downstream meanders. In the area of Cache Creek steeper reaches alternate with flatter ones. Stream width varies from 10 - 15 m with a low bank about 1 m in height and a high bank about 2 m in height. Figure 3 shows the two icing locations within the Village of Cache Creek.

Measured flow at the WSC gauging station located between the two icing locations was 1.15 m^3/s on January 5, 1982 and 1.88 m^3/s on February 24, 1982[1]. The lowest preliminary estimate of daily discharge in late December 1981 was 1.05 m^3/s (Preliminary daily discharge estimates for 1982 at the WSC gauge are not yet available). The Bonaparte River at the WSC gauge often has anchor ice through the cross section but seldom has complete ice cover[1]. The January 5, 1982 measurement was made under a complete ice cover of about 0.2 m indicating that ice conditions were more severe than usual.

A local observer[2] at the downstream icing site states that the icing at this location has developed in the same manner in each of the past three winters. Each year the icing gradually extended upstream from a complete ice cover in a certain spot. Inspection of both aufeis reaches during open water revealed that each reach was a steep cobble reach between flatter, deeper reaches - the downstream icing reach exhibited the more pronounced difference. At the downstream icing location, the initial complete ice cover formed in the flatter, deeper reach downstream.

At its maximum, the downstream icing was about 200 m long and over 1 m thick. The upstream icing was similar but smaller. The peak water level in the downstream icing was over the low bank but still 0.5 m below the high left bank and the top of a small dyke on the right bank protecting a mobile home park. The peak water level in the upstream icing crept to within about 0.3 m of overtopping the low right bank also occupied by a mobile home park.

The return of warmer weather in each case alleviated the icing problem. Prolonged cold might well have aggravated the situation. A longtime Cache Creek resident[3] recalled that a bulldozer was required to clear the channel at the downstream icing location about a dozen years ago when a severe aufeis problem developed.

OTHER SIGNIFICANT JAMS IN SOUTHERN B.C.
IN PAST THREE YEARS

Ice jams on the Coldwater River in December 1979 and again in December 1980 resulted in minor overbank flooding in the town of Merritt. A jam on the Similkameen River at Princeton resulted in bankfull conditions in December 1980. A series of 3 jams on the Dean River in December 1980 reportedly caused some erosion of farmland when flow was forced out of the channel. A jam on the Quesnel River at Quesnel in February 1982 created near bankfull conditions. The locations of these jams are denoted by triangles in Figure 1.

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[1] Personal Communication - K. Barker, Water Survey of Canada

[2] Personal Communication - R. Hillyard, local resident

[3] Personal Communication - A. Gordon, Village of Cache Creek

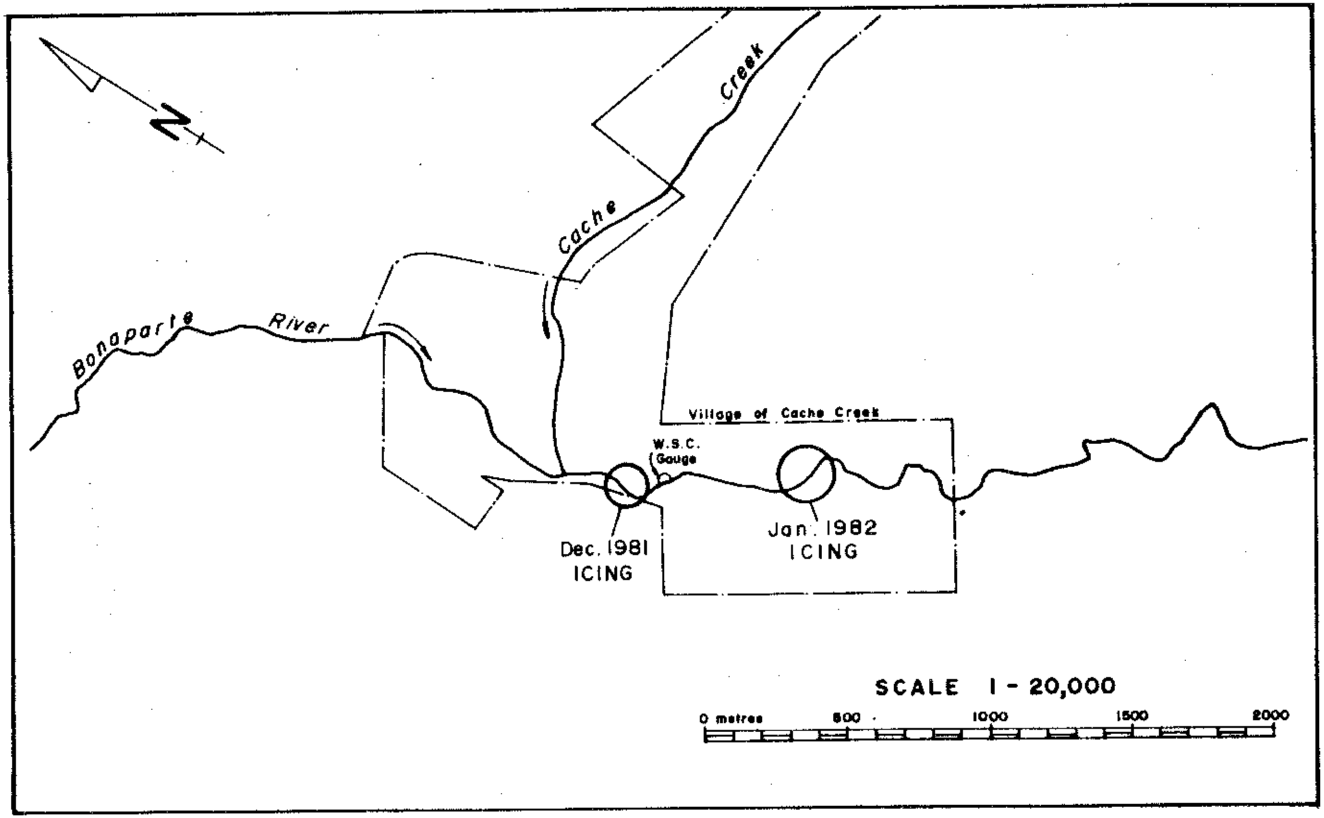

Figure 3. Location of two icings on the Bonaparte River in the Village of Cache Creek during winter of 1981-82.

SUMMARY

A significant ice jam and a significant icing which have recently occurred in Southern B.C. have been partially documented to show that these phenomena do happen here. Most of the problems with river ice happen in early and mid-winter due to a sudden change in weather conditions. Although much less frequent and much less dramatic than ice jams and icings in colder parts of North America, river ice problems in southern B.C. should not be dismissed out-of-hand. This paper has touched upon recent river ice problems in the Region where, heretofore, such problems have been either ignored or thought to be non-existent. More and better documentation of regional ice problems and hydraulic analyses of jams and icings would undoubtedly lead to more comprehensive regional water resource planning and management.