FEDERAL PROVINCIAL FLOODPLAIN MAPPING AGREEMENT

PROVINCE OF BRITISH COLUMBIA
Ministry of Environment
Water Management Branch

A DESIGN BRIEF ON THE FLOODPLAIN MAPPING STUDY WILLIAMS LAKE

An Overview of the Study Undertaken
to Produce Floodplain Mapping for
Williams Lake

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FEDERAL PROVINCIAL FLOODPLAIN MAPPING AGREEMENT

FLOODPLAIN MAPPING STUDY

WILLIAMS LAKE

Preface

The purpose of this design brief is to present a description of the methodologies used and results of the study undertaken to delineate the floodplain of Williams Lake, Drawings 88-46, Sheets 1 and 2, Appendix 3.

1. Study Area

The City of Williams Lake (Figure 1) is located in the Cariboo region of the Province at the junction of Highway 20 and Highway 97 approximately 200 km south of Prince George. Figure 2 is a key map showing the two floodplain map sheets for the study area and the boundary of the City of Williams Lake.

Williams Lake has a drainage area of 2240 km^2. Major runoff collected by the Lac La Hache drainage basin is transported in a northwesterly direction via the San Jose River and is the major source of inflow to Williams Lake. Outflow from Williams Lake is carried by Williams Lake River within a fairly well incised channel, a distance of approximately 13 km to the Fraser River.

2. Background

2.1 General

A report by Mr. W.S. Klopp (Appendix 1.1) entitled "Water Levels of Williams Lake", dated September 1983 provides background information with respect to recent Ministry involvement concerning extremely high water levels in Williams Lake.

The maximum recorded lake level of 568.45 m GSC occurred on April 30, 1965. An investigation of this flooding event was carried out by Mr. P.G. Odynsky, District Engineer, Kamloops, B.C. It was determined that all the tributaries to Williams Lake experienced extremely high flows during this period resulting in culvert and road washouts and flooding of low lying properties. The investigation by Odynsky indicated that the 1965 level at Williams Lake exceeded the previous high (June, 1962) by approximately 0.7 m and was approximately 1.2 m above the 1948 level.

The Ministry of Environment established a 1:200 year flood level (freeboard included) for Williams Lake of 569.5 metres in May of 1979 based on information available at that time. This

elevation has since been used for administration purposes with respect to the Flood Damage Reduction Program.

The outlet of Williams Lake has been changed from its original location. J. Martin Dayton, a consultant for the Town of Williams Lake, designed a control structure and associated outlet works in an effort to control water levels for the town's domestic water supply. A dyke (causeway) was constructed (circa 1972) across the original outlet from the north shore to Scout Island and a new channel was dredged on the west side of the Island. An adjustable stoplog control structure and fishway was then constructed at this new outlet location and is known as the "Scout Island" control works. (See Photo 2 Appendix 2). This was eventually abandoned and deactivated in 1982 in favour of deep wells located on Scout Island.

High runoff in May of 1982, resulted in lake levels of 567.4 metres which caused flooding of properties at Williams Lake, was instrumental in prompting an investigation by the Ministry of possible remedial actions to reduce lake levels (Appendix 1.1).

Data collected for the investigation including river cross sections of Williams Lake River supplied by Mr. W.S. Klopp. This information was utilized in backwater computations of Williams Lake River flows carried out by the Special Projects Section. A memo dated January 9, 1986 (Appendix 1.2) summarizes the studies undertaken at that time.

2.2 Present Studies

In connection with the Provincial Large Scale Mapping Program, topographic base mapping of the study area at a scale of 1:5000 with 2 metre contour intervals was produced by the Mapping Section, Ministry of Crown Lands, in 1981 based on 1980 air photography (Appendix 1.4).

The 1989 studies undertaken to identify the floodplain of Williams Lake are based on the following additional information:

- Survey data obtained by the regional office staff in October, 1982 include 10 cross sections on Williams Lake River beginning approximately 400 m downstream of the B.C. Railway bridge crossing in the vicinity of Gauge 08MC005 and extending upstream to the Highway bridge. Three additional cross sections located between this bridge and the outlet of Williams Lake were manufactured by use of thalweg profiles, bathymetric and topographic mapping. (Appendix 1.1).

- Lake bathymetry was obtained in 1982 by the Surveys Section, Water Management Branch, Project No. 82-SIP-17, Dwg. No 5967-5-1 to 3 (Appendix 1.3).

- Hydrology studies to determine the 1:200 year return period flood were carried out by the Hydrology Section, Water Management Branch (Appendix 1.5).

3. Flood Magnitudes

Gauge 08MC005 on Williams Lake River has been in operation continually since 1969 with some data available for the years 1928 through 1930 and 1968. The maximum recorded daily discharge of 16.6 cms occurred on April 23, 1976.

Gauge 08MC023 located on Williams Lake has been in continuous operation since 1976, with limited data available from 1960. The maximum daily recorded level of 568.45 m G.S.C. occurred on April 30, 1965.

Table 1 summarizes the annual extremes for the above noted gauges to 1987. This data, plus discharges for 1965, 1967 and 1968 of 32.2, 4.0 and 3.6 cms, respectively, was used in a frequency analysis carried out by the Hydrology Section of the Water Management Branch (Appendix 1.5). The 1965 and 1967 flows were computed from the backwater calculations previously carried out by the Special Projects Section (Appendix 1.2).

Based on the above-noted flow data, the 1:200 year return period mean daily flow at Williams Lake River was estimated to be 44.8 cms., (equivalent lake level 568.7 m) using the mean of the Log Normal, Pearson Type III and Log Pearson III distributions (Appendix 1.5).

Exclusion of the estimated flow for the 1965 flood event results in a 1:200 year mean daily flow estimate of approximately 27.7 cms. (equivalent lake level 568.2 m), (Appendix 1.6).

Based on the investigation by Odynsky, referred to in Section 2.1, it was considered that omission of the observed 1965 flood event, (lake level 568.45 m) would result in an unrealistically low estimate.

The 1:200 year lake level, based on a statistical analysis of the published lake level data listed in Table 1 was estimated to be 568.7 metres or 0.3 metres above the 1965 flood level. This level is equivalent to the flow of 44.8 cms noted above, based on backwater calculations discussed in Section 4.

4. Hydraulic Analysis

4.1 General

The information sources listed in Appendix 1 were utilized in the HEC 2 water surface profile program developed by the Hydrologic Engineering Centre, U.S. Army Corps of Engineers in Davis, California. The flood profile studies assumed open channel flow conditions.

4.2 Cross Section Plot Run

A computer plot of the thirteen river cross sections was obtained to assess the river cross section data input and the extensions of the sections obtained from the existing topographic mapping in the study area. Output from the plot run was also used to review the flow regime, loss coefficients, bridge information, reach lengths, overbank information and Manning's "n" values.

4.3 Model Calibration

Highwater data for the flow of April 23, 1976 [Q = 16.6 cms, lake level = 567.5 metres], was utilized to calibrate the model. Mannings "n" values were determined to be 0.032 for the river channel in the study area. (See Photos 1 to 3, Appendix 2).

4.4 Calculated Flood Levels

Flood levels were calculated for a variety of flows based on the calibration data noted above. Figure 3 is a profile of the Williams Lake River showing the calculated levels for the calibrated flow (16.6 cms) and the 1:200 year flow (44.8 cms, freeboard included) for the 1.7 km distance between XS-1 and 13.

The flood level profile has a slope of 0.34% in the 0.53 km between XS-1 and XS-7 (just upstream of the BCR bridge). The slope decreases to 0.038% from XS-7 to XS-13, a distance of 1.08 km.

4.5 Sensitivity Studies

4.5.1 Effect of Flow on Flood Levels

Figure 4 is a stage discharge curve for XS-13 (near Scouts Island). As indicated, a flow increase of 65% above the estimated 1:200 year flow (i.e. from 44.8 cms to 74.1 cms) results in a level increase of 0.8 m (i.e. from

568.7 m to 569.5 m). As stated in Section 2, the flood level (freeboard included) previously established by the Ministry for Williams Lake was 569.5 m.

4.5.2 Effect of Manning's "n" On Flood Levels

Studies indicate that increasing channel "n" values by 40% (i.e. from 0.032 to 0.044) results in a lake level increase of 0.28 m for a 1:200 year flow of 44.8 cms.

5. Williams Lake Flood Level

The 1:200 year flood level for Williams Lake, based on an analysis of the available information including the 1965 flood event, has been estimated to be 568.7 m. During April of 1965, the lake level reached an elevation of 568.45 m.

As noted in Section 2, the 1:200 year flood level (including freeboard) established by the Ministry in May, 1979 for administrative purposes, pursuant to the Flood Damage Prevention Program, is 569.5 metres. A designated flood level of 569.5 metres provides a freeboard of 0.8 metres above the estimated 1:200 year flood level of 568.7 metres.

The freeboard allowance provides for meteorological effects, wave runup impacts and hydrological uncertainties. Wave and wind setup effects and wave runup are site specific and vary with the fetch distance, depth of water and wind direction (Appendix 1.7).

Based on the above-noted information, it is recommended that the designated flood level of 569.5 metres be retained for administrative purposes.

6. Floodplain Mapping

The flood levels determined in the study were used to delineate the floodplain limits onto the existing 1:5000 scale, 2 metre contour mapping of the study area. The studies were based on the information noted in Section 2.2.

The floodplain mapping of Williams Lake, Drawing 88-46, Sheets 1 and 2 (Appendix 3) were produced and provide the following information:

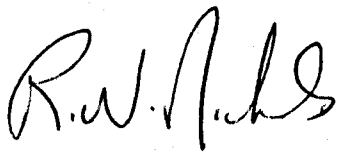
- the location of river cross sections, designated floodplain limits, flood levels determined in the study, survey monuments and WSC gauge locations.

7. Recommendations

1. Pursuant to the terms of the Federal Provincial Floodplain Mapping Agreement it is recommended that the floodplain delineated on Drawings 88-46, Sheets 1 and 2 be Interim Designated.

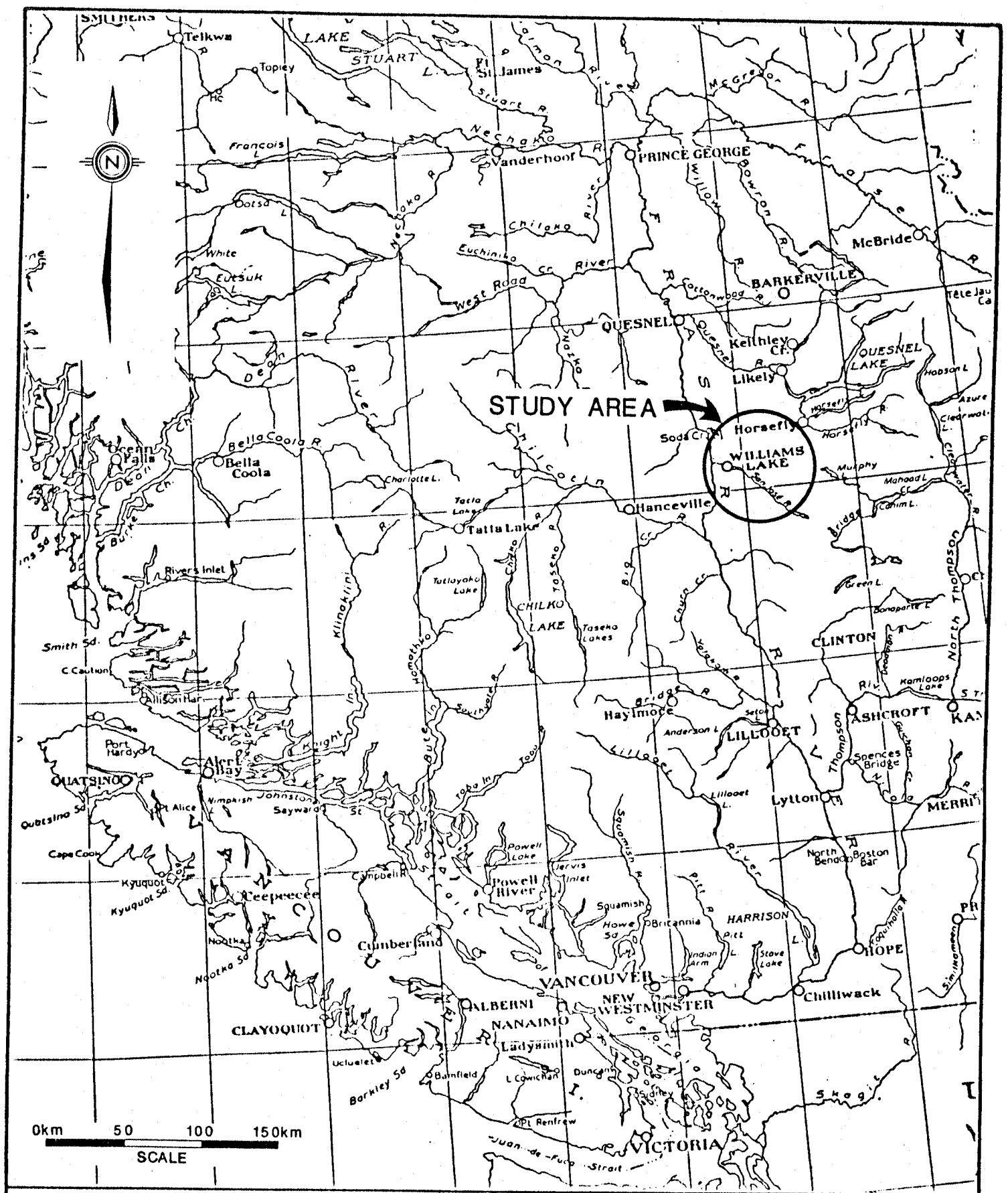
2. The drawings may be used for administrative purpose related to the preparation of hazard map schedule for official plans; floodproofing requirements in zoning and building bylaws; the interim designation of floodplains in floodplain management plans; the identification of floodable land by subdivision approving officers.

3. Highwater mark and flow data should be obtained when significant floods occur in the study area to verify the floodplain mapping.



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RWN/csv



Province of British Columbia
Ministry of Environment
WATER MANAGEMENT BRANCH

TO ACCOMPANY A DESIGN BRIEF ON THE FLOODPLAIN MAPPING STUDY

WILLIAMS LAKE

STUDY AREA LOCATION

SCALE: VERT. .....
HOR AS SHOWN

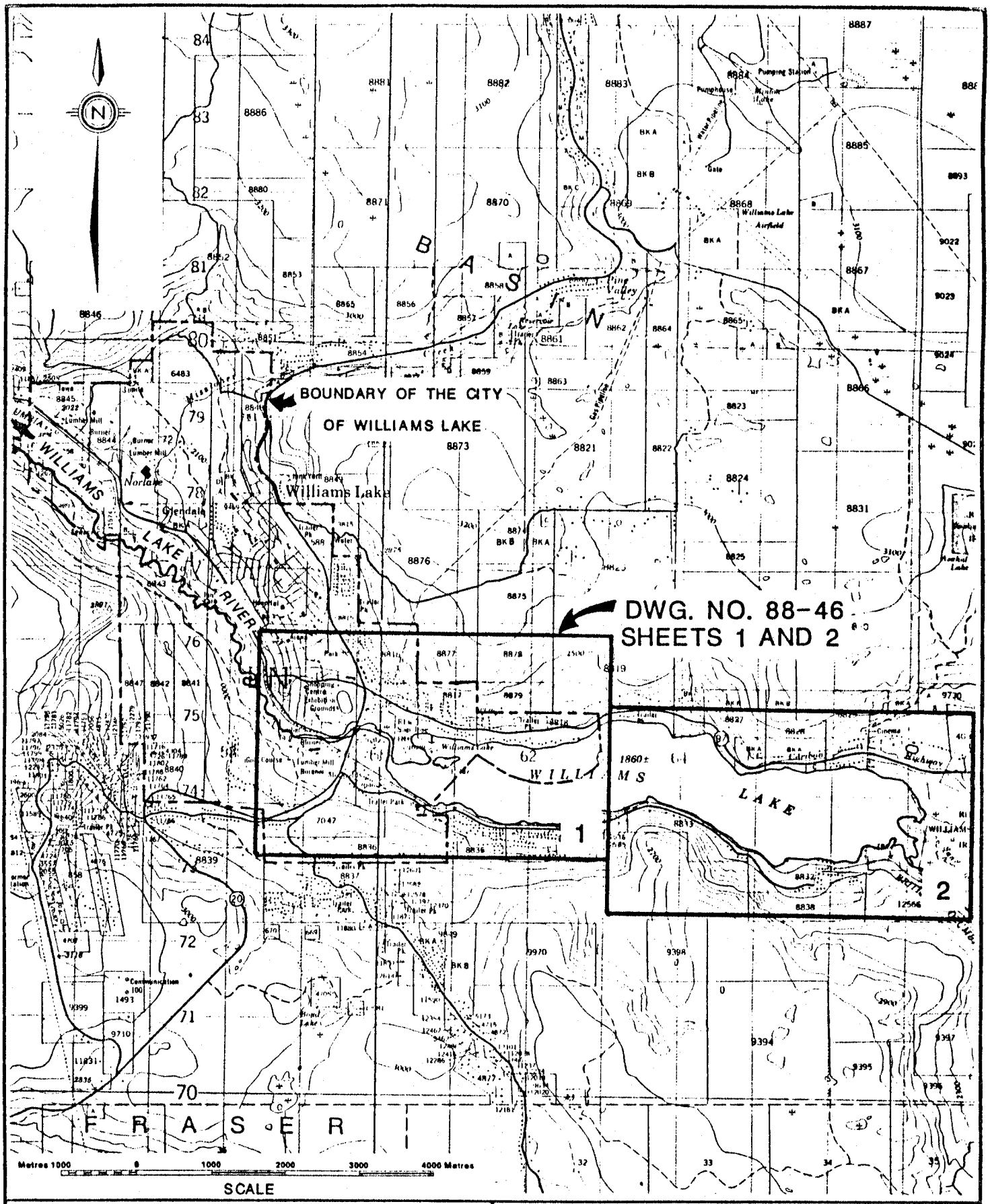
DATE .....

R.W. NICHOLS ENGINEER

FILE No .....

DWG No 1

BCIL 7673-M E



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Ministry of Environment
WATER MANAGEMENT BRANCH

TO ACCOMPANY A DESIGN BRIEF ON THE
FLOODPLAIN MAPPING STUDY
WILLIAMS LAKE
KEY MAP

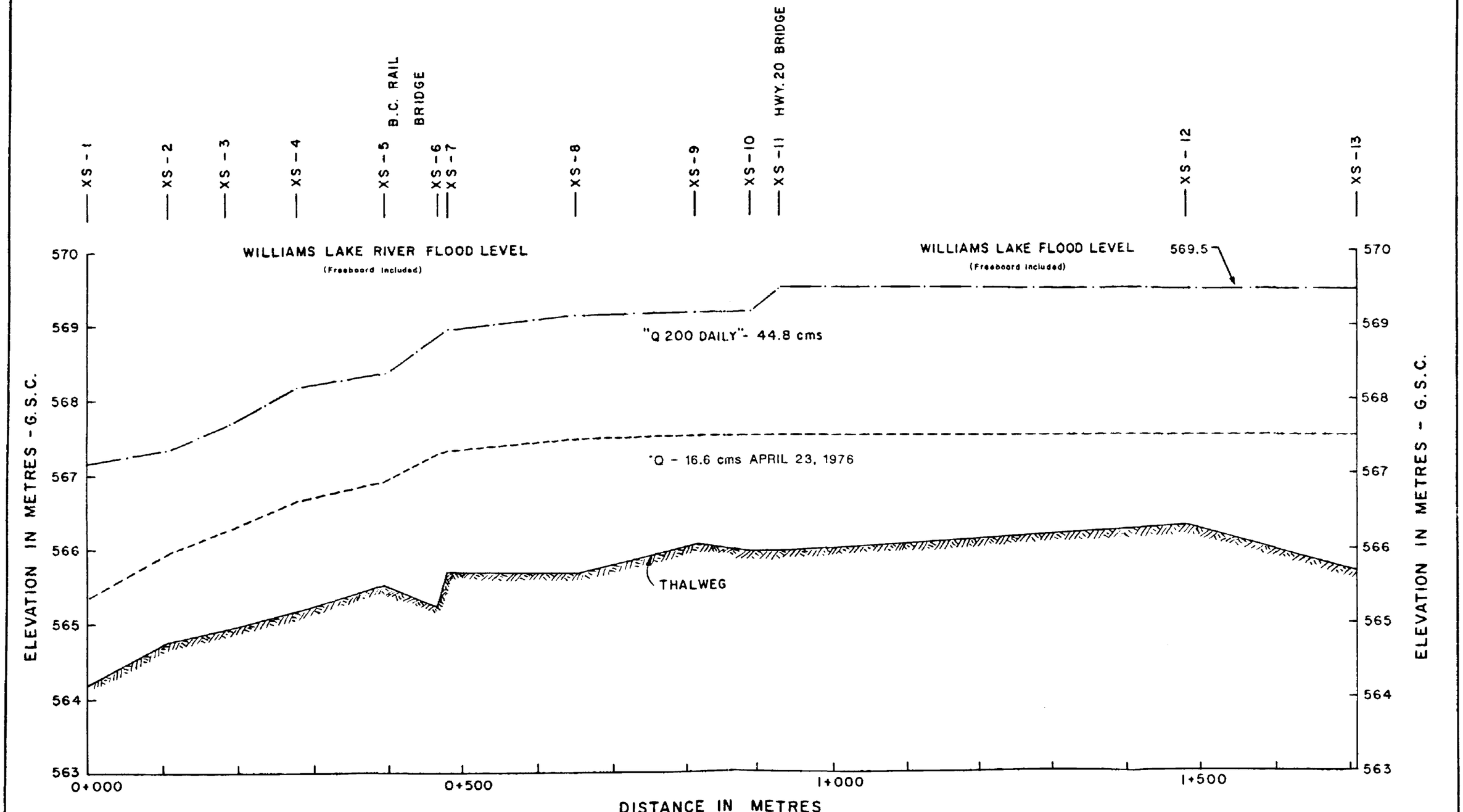
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DATE .....

R.W. NICHOLS ENGINEER

FILE No ..... DWG No. 2

VAN CAL 15712



Province of British Columbia
Ministry of Environment
Water Management Branch

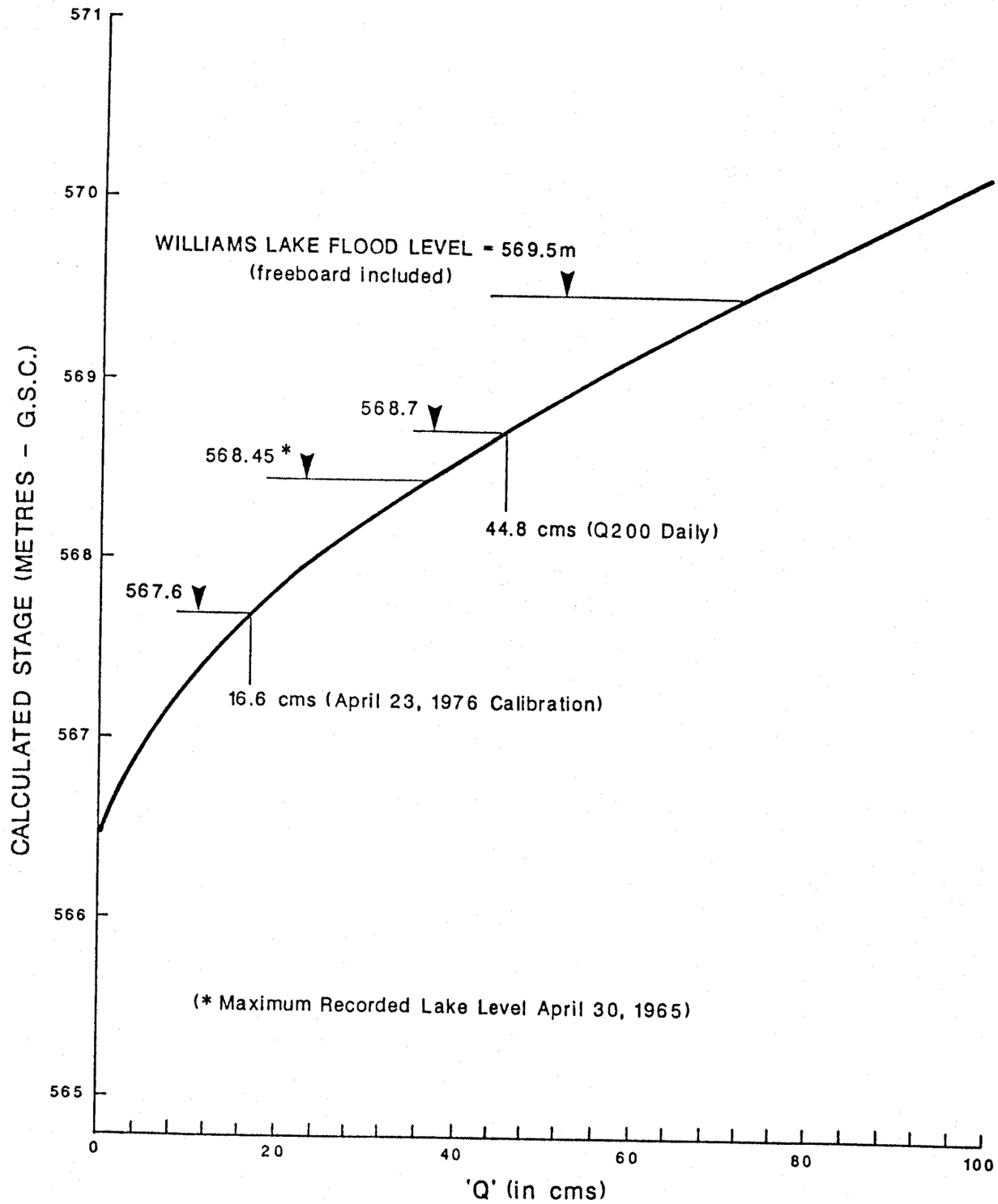
TO ACCOMPANY A DESIGN BRIEF ON THE
FLOODPLAIN MAPPING STUDY
WILLIAMS LAKE
FLOOD LEVEL PROFILES

SCALE: VERT. 1:50
HOR. 1:5000

DATE
JUNE 1989

R.W. NICHOLS ENGINEER

FILE No. _____ DWG No. FIGURE 3



Province of British Columbia
Ministry of Environment
WATER MANAGEMENT BRANCH

TO ACCOMPANY A DESIGN BRIEF ON THE FLOODPLAIN MAPPING STUDY

WILLIAMS LAKE
STAGE - DISCHARGE CURVE AT XS-13 - SCOUT ISLAND

SCALE: VERT. .....
HOR .....

DATE
JUNE, 1989

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FILE No. ..... DWG No. FIGURE 4

VAN CAL 15712

TABLE NO. 1

Annual Extremes

Year	Max. Daily Water Level		Max. Daily Discharge	
	Williams Lake 08MC023 (m)		Williams Lake River 08MC005 (cms)	
1929	-	-	0.490	(May 4)
1930		-	0.345	(May 2)
1965	*568.447	(April 30)	-	
1966	-	-	-	
1967	566.954	(May 13)	-	
1968	566.844	(June 4)	-	
1969	-	-	15.2	(May 11)
1970	-	-	3.31	(April 29)
1971	-	-	13.3	(May 4)
1972	567.121	(March 21)	8.75	(May 12)
1973	566.826	(May 8)	4.42	(May 7)
1974	-	-	8.52	(May 24)
1975	-	-	3.94	(June 14)
1976	567.536	(May 5)	*16.6	(April 23)
1977	567.173	(May 17)	10.5	(May 15)
1978	566.887	(April 29)	5.58	(April 30)
1979	566.862	(May 22)	4.76	(May 22)
1980	566.901	(December 31)	1.58	(July 15)
1981	566.963	(January 25)	3.16	(June 5)
1982	567.401	(May 22)	11.8	(May 21)
1983	566.721	(March 21)	2.76	(May 22)
1984	566.788	(April 9)	3.00	(April 22)
1985	567.326	(April 20)	12.40	(April 28)
1986	-	-	2.80	(April 3)
1987	566.489	(March 18)	0.808	(March 18)

Note: 565.582 m added to convert lake stage to Geodetic Survey of Canada Datum.

* Extremes recorded.
WSC indicates flows regulated since 1973. Stoplogging was reportedly discontinued in 1981.

Reference: Water Survey of Canada.

APPENDIX 1

Detailed Information Sources

Williams Lake Floodplain Mapping Study

NO.	SOURCE	CONTENTS
1.	"Water Levels of Williams Lake", Ministry of Environment, Williams Lake, B.C., prepared by W.S. Klopp, September, 1983.	A review of high water level data including estimates of channel improvements.
2.	Memo to J.D.C. Fuller from P.J. Woods dated July 9, 1986, re: Williams Lake River - Benefits of Channel Improvement. File: 00-3900-S.2.	Summary of the results of an appraisal of proposed river improvements.
3.	Surveys Section, Water Management Branch, Ministry of Environment, Project No. 82-SIP-17.	Bathymetric survey of Williams Lake.
4.	Mapping Section, Ministry of Crown Lands, Project No. 81-17T.	1:5000 scale 2 metre contour mapping.
5.	Memo from R.R. Wyman, Hydrology Section to P.J. Woods, Special Projects Section, re: Williams Lake and River hydrology, October 7, 1988.	Estimated lake levels and river discharges.
6.	Memo to P.J. Woods, P. Eng. from H. Coulson, Hydrology Section on Williams Lake Hydrology, October 18, 1983.	Revised lake levels and discharges.
7.	Memo dated April 17, 1989. File: 00-3900-S, by B.J. Holden, P. Eng., Special Projects Section.	Williams Lake, Wind and Wave Effects on Water Levels.

APPENDIX 2

Photos of Williams Lake Area

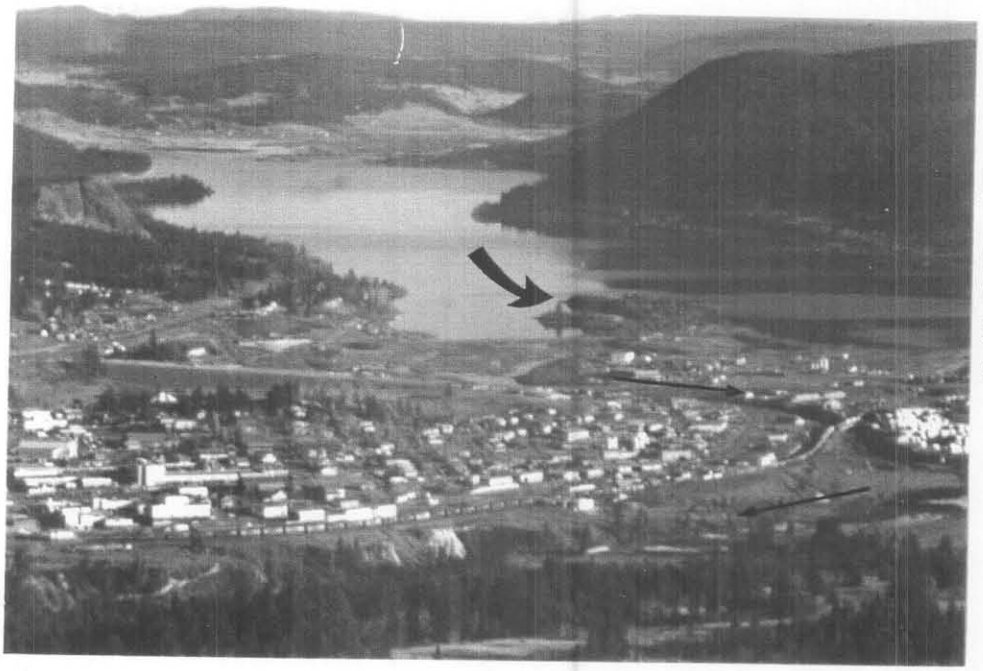


Photo 1

Aerial view of Williams Lake near Scout Island in centre foreground.

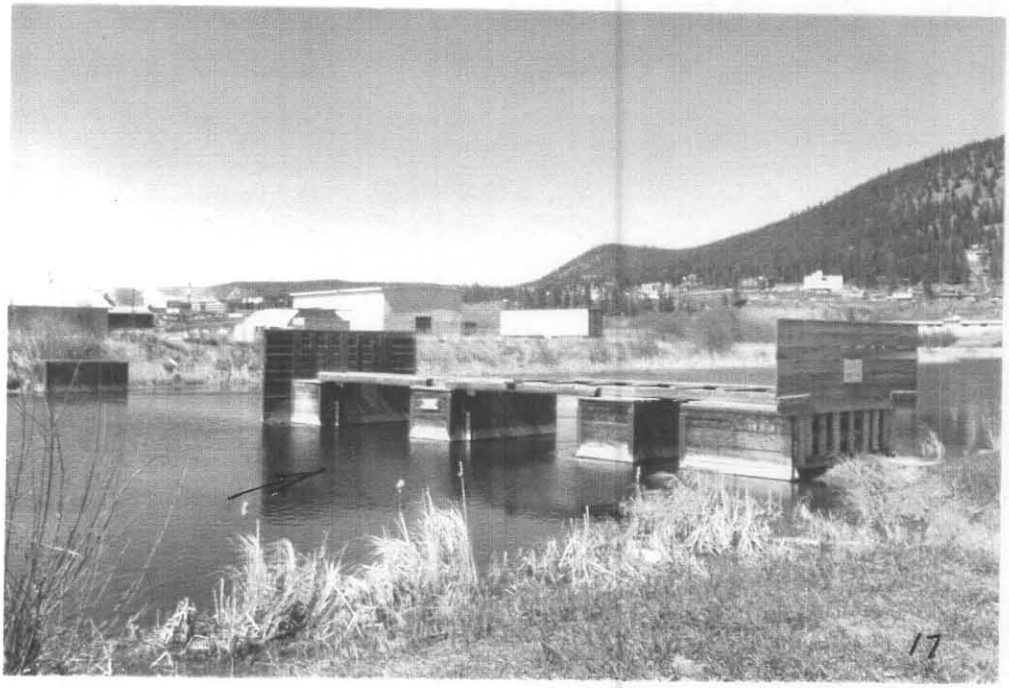


Photo 2

Scout Island Control Works

APPENDIX 2

Photos of Williams Lake Area (Continued)

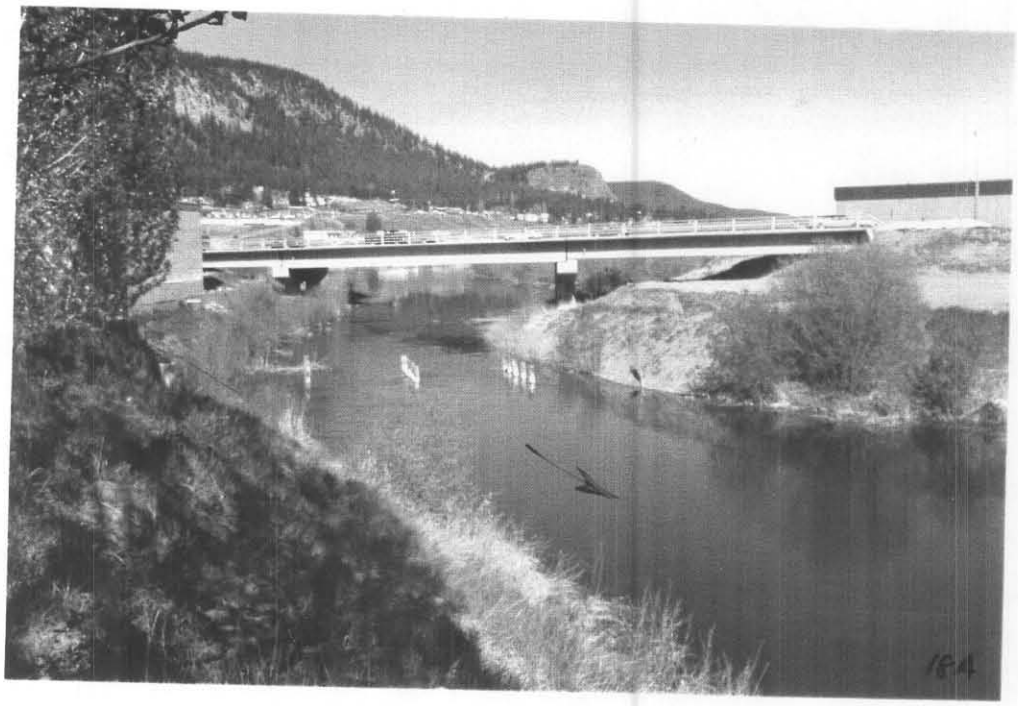


Photo 3

Looking upstream a Highway 20 Bridge



Photo 4

Looking downstream to BCR Bridge (XS-5 to 6)

APPENDIX 3