PROVINCE OF BRITISH COLUMBIA
MINISTRY OF ENVIRONMENT
WATER MANAGEMENT BRANCH

REPORT ON THE FLOODPLAIN MAPPING STUDY

VEDDER RIVER

An Overview of the Study Undertaken to Produce Preliminary Floodplain Mapping for the Vedder River (Vedder Canal to Vedder Crossing)

by

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REPORT ON FLOODPLAIN MAPPING STUDY

VEDDER RIVER (Vedder Canal to Vedder Crossing

PREFACE

The purpose of this report is to present a description of the methodologies used and to summarize the results of the study undertaken to produce the attached floodplain mapping, Drawings 85-53, Sheets 1 and 2. Detailed information used in the study is available from the references listed in Appendix 1.

1. LOCATION

The Vedder River traces its course over the alluvial fan of the Chilliwack-Vedder River system and extends from Vedder Crossing to join the Sumas River via the Vedder Canal. The Sumas River enters the Fraser River just upstream of Sumas Mountain.

As shown in Appendix 2, the study area is located in the Fraser Valley in southwest British Columbia and covers 8.0 kilometres of the Vedder River from Vedder Crossing to the Vedder Canal. Upstream of Vedder Crossing, the river is known as the Chilliwack River and has a drainage area of 1230 square kilometres.

A hydrometric gauge has been maintained at Vedder Crossing from 1911 to 1931 and from 1952 to date. Mean annual precipitation in the study area averages between 100 to 250 cm. which is high in comparison to interior drainages in the Province where values are as low as 30 cm. (Reference 1).

2. BACKGROUND

The Ministry previously issued floodplain mapping (Dwg. A5283) in February 1981, upstream of the study area from Vedder Crossing upstream to Slesse Creek on the Chilliwack River.

The necessity for long term flood control of the Vedder River was emphasized after the December, 1975 flood when the river overtopped its banks and flooded Yarrow, incurring substantial damage to property and causing considerable stress to local inhabitants. This flood event was documented in an article in "The Chilliwack Progress" dated December 3, 1975.

Phases I and II of the Vedder River project were initiated in 1975/76 by the Ministry of Environment under the Fraser River Flood Control Program. This involved the reconstruction of 7,500 metres of bank line dykes and the excavation of 550 thousand cubic metres of sedimentation from the channel below Vedder Crossing Bridge. The total cost of the works was $1.2 million.

A report entitled "Flood Control Works for the Vedder River Phase III", dated February, 1978 (Reference 2) outlined the proposed Vedder River setback dykes

and various structural works to provide protection from a 1:200 year flood for the Yarrow, Sumas and Chilliwack areas. This project was completed by December of 1984 at a cost of approximately $2.9 million. Maintenance of the project is now the responsibility of the District of Chilliwack. Background information related to the formulation of a Vedder River Floodway Management Plan is provided in a report dated July, 1979, by the Ministry of Environment (Reference 3).

The problem of sediment deposition is an ongoing concern in the study area creating the potential for increased flood levels which pose a threat to the existing dyking system. As a result of this concern, the Special Projects Section (formerly the Planning and Surveys Section) of the Ministry became involved in the study area at the request of Mr. E.W.D. Bonham of the Rivers Section, Water Management Branch in December of 1984 (Reference 4). The request involved:

(a) a review of the flood profile for the Vedder River to confirm existing dyke elevations;

(b) the development of a river model to evaluate annual deposition quantities in the main channel of the Vedder River.

The results of the studies undertaken in response to the above request were summarized in a memo dated March 11, 1985, (Reference 5). These results have been used to produce floodplain mapping for the study area.

3. DESIGNATED FLOOD

The flood levels and floodplain limits shown on the floodplain mapping sheets for the study area are based on a designated flood (1330 m^3/s Instantaneous, 1:200 year frequency) plus an allowance for freeboard, assuming open water flow conditions, in accordance with the policy of the Ministry of Environment.

4. SURVEY AND MAPPING DATA

River cross section survey information used in the study area was based on Project No. 84 RPP 7. Field surveys of the 49 cross sections shown on the floodplain mapping were obtained on February of 1984 (Reference 6) by the Surveys Section, Ministry of Environment.

Additional field surveys of structural works in the study area, including the B.C.H.P.A railway bridge and the concrete culvert overflow structure which passes under the railway, were obtained by the Surveys Section in January of 1985 (Reference 7). The culvert consists of ten openings, approximately 6 metres in length, each 2.43 metres square.

Highwater mark elevations based on the flood of January 4, 1984, were obtained by the Surveys Section and the results utilized in model calibration (Reference 8).

Base mapping of the study area at 1:5000 scale was obtained from the Surveys

and Resource Mapping Branch Project No. 74-28T-0. Contours (1 metre) and spot heights for the project were obtained from May 1974 air photography (Reference 9).

5. FLOOD MAGNITUDES

The Modelling Section, Water Management Branch carried out a study (Reference 10) in December 1984, to estimate the required peak flows for the study area. The analysis was based on Gauge 8MH001R, Chilliwack River at Vedder Crossing, utilizing 50 years of recorded winter (rain event) flood data.

The January 4, 1984, flood for which highwater marks were obtained, was estimated to be 544 m^3/s(daily) and 925 m^3/s(instantaneous). This flood is similar in magnitude to that which occurred in December 1980 (533m^3/s daily) and December 1975 (530 m^3/s daily). The 1984 flood was exceeded in December 1917 (765 m^3/s daily) and January 1914 (566 m^3/s daily).

The 1:200 year return period winter (rain event) flood was estimated to be 810 m^3/s (daily) and 1330 m^3/sec (instantaneous). This exceeds the 1984 flood by a factor of 1.44.

Freshet flood flows due to snowmelt occur in May and June in the study area but are considerably less than flood produced by winter rain events. The maximum recorded daily snowmelt flood (50 years of record) of 436 m^3/s occurred in

June, 1968. The maximum daily 1:200 year flood is approximately 463 m^3/s (500 m^3/s instantaneous) for a snowmelt condition (Reference 11).

6. HYDRAULIC ANALYSIS

6.1 General

The references listed in Appendix 1 were utilized in the HEC-2 water surface profile computer program developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers. The profile calculations assume open water flow conditions.

During the study, the question arose as to whether levels in the setback dyke reach resulting from a 1:200 year winter rain induced flood event in the Vedder River (1330 m^3/s) would exceed levels reached by a 1:200 year spring freshet flood on the Vedder River (500 m^3/s). Fraser River levels are higher for a 1:200 year freshet flood (Fraser levels 9.8 metres) than for a 1:200 year winter flood (Fraser levels 5.5 metres).

In order to determine the flood levels from these events, existing cross section information for the Vedder Canal from the study area downstream to the Fraser River confluence was utilized (Reference 12). Results of the studies determined that the winter flow conditions resulted in higher flood levels in the setback dyke area.

6.2 Model Calibration

The model was calibrated from the confluence of the Fraser and Sumas Rivers to the upstream end of the Vedder Canal (Canal Reach) and upstream to Vedder Crossing (Setback Dyke Reach). The calibration was based on highwater mark data obtained from the January 4, 1984, flood which included 70 elevations in the setback dyke reach. Manning's "n" values determined from the calibration analysis were used to compute the additional flood profiles required for the study.

6.3 Flood Profiles

A total of 21 computer runs were obtained during the study; 6 in the canal reach, 11 in the setback dyke reach and 4 involving the capacity of the concrete overflow structure under the BCHPA railway.

6.3.1 Canal Reach

Table 1 summarizes the results of the analysis in this reach which extends from the Fraser River confluence to cross section number 1. (see Dwg. 85-53, Sheet 1). The studies determined the starting elevations for the setback dyke reach for the winter flow (rain event) and the spring freshet (snowmelt event) conditions.

The Manning "n" value determined in the calibration was 0.023. Winter flow

conditions resulted in low velocities in the canal reach (less than 2.0 m/s). Velocities are even lower for the spring freshet conditions (less than 0.5 m/s) due to the lower flow and higher backwater effect of the Fraser River. The winter flood levels on the Fraser River can vary substantially without impacting on the flood levels in the upstream portion of the Vedder canal.

6.3.2 Setback Dyke Reach

The computer runs undertaken to determine the flood profiles for this reach, (which extends from cross section 1 to cross section 49 at Vedder Crossing) are outlined in Table 2. An analysis of the sensitivity of water levels to various conditions assumed in the study provided the following results:

- water levels for the 1330 m^3/s flow average 0.54 metres higher than for the 925 m^3/s flow (Jan. 4, 1984 flood) over the entire reach. Level increases vary from 1.0 metres in areas where the floodway is confined (upstream end of canal, bridge area, Vedder Crossing area) to 0.10 metres in areas where the floodway is wide.

- an increase in the starting elevation of 0.6 metres for the 1330 m^3/s flow does not effect levels upstream of cross section 16 (ie. downstream of the railroad bridge).

- water levels in the railway fill area upstream of the bridge increase by 0.6 metres, if no flow through the culverts is assumed, and by 0.2 metres

if 150 m^3/s. is passed through the culverts. The calculated culvert capacity as used in the study is 250 m^3/s with velocities in the culvert reaching 4.2 m/s.

- a ten percent increase in flow (1463 m^3/s) results in an average level increase of approximately 0.2 metres over the entire reach.

- a twenty percent increase in "n" values results in an average water level increase of 0.2 metres over the entire reach for a flow of 1330 m^3/s.

7. FLOODPLAIN MAPPING

The flood levels determined in the study were used to draw the designated floodplain limits onto the existing topographic mapping of the study area. The attached floodplain mapping sheets were produced and indicate the following information:

- the orthophoto, 1 metre contour mapping indicates the location of the river cross sections, the designated floodplain limits and the flood levels determined in the study.

- the study area covers 8.0 kilometres of the Vedder River from the Vedder Canal upstream through the setback dyke reach to Vedder Crossing.

- the Vedder River flood profile an average slope of 4.0 metres per kilometre (0.4%) in the study area.

- the Vedder River is confined by dykes throughout the study area except for a distance of 1.3 kilometres located downstream of Vedder Crossing.

- the flood levels shown on the drawings have been extended to the existing dyking or to the floodplain limits in the area that is not protected by dykes. The portion of the Vedder River floodplain that is protected by dykes and is subject to flooding from dyke failure or overtopping, and/or from internal drainage, has been cross hatched on the drawings.

- the Fraser River floodplain limits (flood level 10.5 metres, freeboard included) have been shown the drawings.

8. CONCLUSIONS AND RECOMMENDATIONS

1. This report serves to present a description of the methodologies used and the results of the study undertaken in response to a request from the Rivers Section, Water Management Branch, to provide information on flood profiles and to establish an annual depostion monitoring computer model. The results of these studies, which have been used to produce floodplain mapping for the study area, are based on river cross-sections obtained in February, 1984.

2. In the section of the Vedder River where the B.C.H.P.A. railway crosses the area between the setback dykes, the railway fill exceeds the

calculated flood level with a freeboard of between 0.5 and 1.4 metres. Consequently, the floodway is relatively confined in this area and the entire river flow is directed under the railway bridge and through the concrete overflow structure. Ice and debris buildup during high flows could reduce the bridge and culvert capacities and thus increase flood levels flood levels and pose a threat to the dyking system in this portion of the study area.

3. It is recommended that the program of annual sediment deposition monitoring in the study area be continued to determine the effects on future flood levels.

4. The existing floodplain mapping upstream of Vedder Crossing (Dwg. No. A5283-Sheet 1, February 1981) should be revised to take cognizance of the results of this study.

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FLOODPLAIN MAPPING-VEDDER RIVER
TABLE 1
CANAL REACH - COMPUTER RUN SUMMARY

Computer Run Number	Q (m^3/s)	Level (metres, GSC datum)		Comments
		Sumas at Sardis	Upstream End End of Canal	
1	925	-	-	Plot of Sections
2	925	4.5(o.)	7.6(o.)	January 4, 1984 flood calculated "n"=0.023 velocities 1.8m/s.
3	360	7.9(o.)	8.0(c.)	"typical" summer flood flood June 9, 1972 velocities 0.5m/s
4	500	9.8(c.)	9.87(c.)	1894 level on Fraser 1:200 year instantaneous summer flow on Chilliwack (maximum summer conditions)
5	1330	5.5(a.)	8.43(c.)	200 year instantaneous fall flow on Chilliwack (maximum fall condition)
6	925	6.5(a.)	7.87(c.)	effect of starting level, see run 2

(o.) observed
(c.) calculated
(a.) assumed

FLOODPLAIN MAPPING-VEDDER RIVER
TABLE 2
Setback Dyke Reach-Computer Run Summary

Computer Run Number	Q (cms.)	Culvert Flow (cms.)	Starting Elevation (metres)	Comments
1	925	N.A.	N.A.	Obtain Cross Section Plots
2	925	0	7.6	Selection of "n" Values
3	925	0	7.6	Section of "n" Values
4	820	0	7.6	1:200 Year Daily Flow
5	1330	200	9.0	Effect of increased starting elevation relative to Run 8
6	1330	0	8.43	Effect of no culvert flow on levels relative to Run 8
7	500	0	9.87	Comparison of summer flow levels relative to Run 8.
8*	1330	250	8.43	1:200 Year Instantaneous Flow
9	1330	150	8.43	Effect of lower culvert flow on levels relative to Run 8
10	1463	250	8.43	Effects of 10 percent flow increase on levels relative to Run 8
11	1330	250	8.43	Effect of 20 percent increase in "n" values relative to Run 8

* Selected Flood Profile

Appendix 1

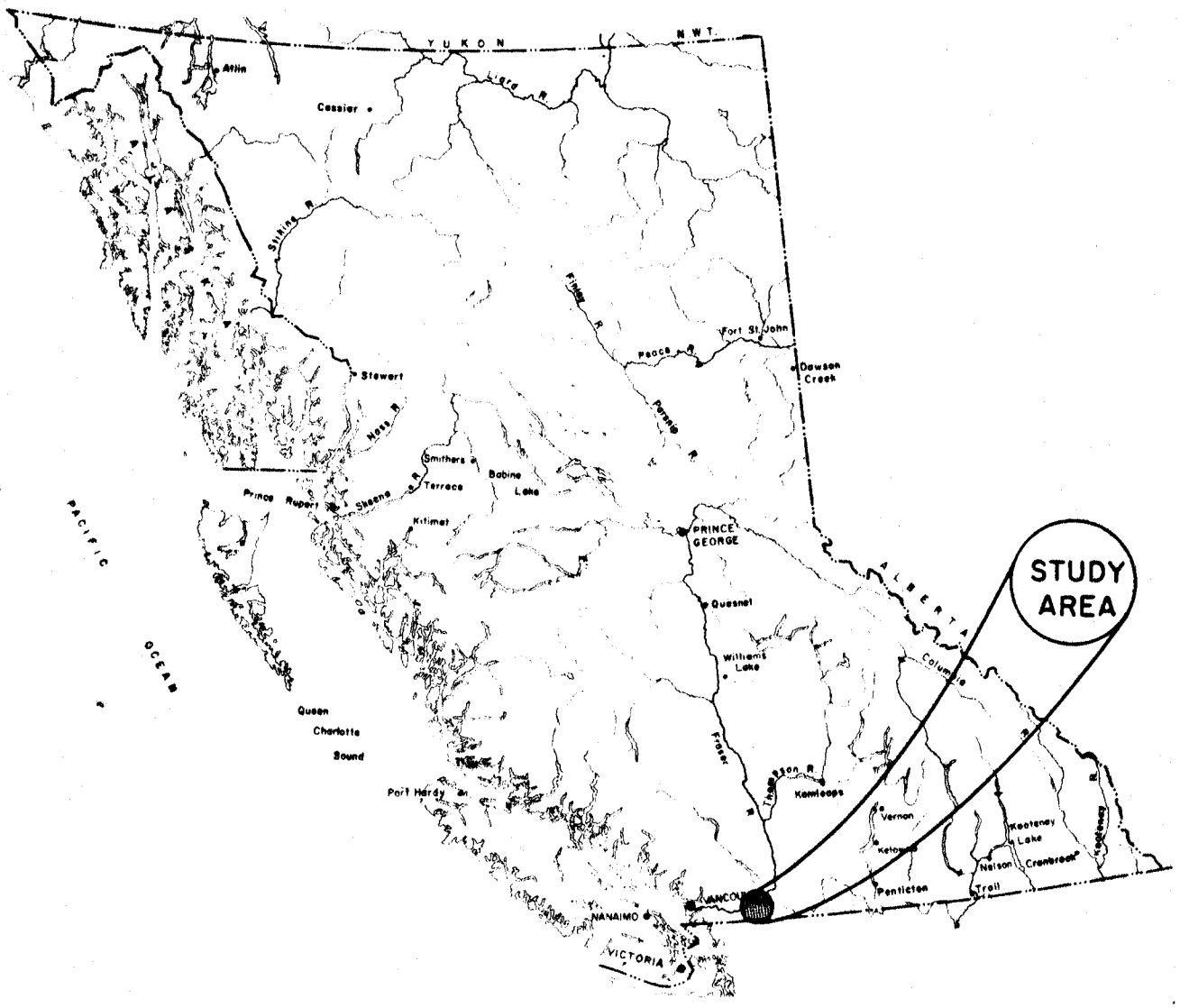
Detailed Information Sources Used in the Floodplain Mapping Study - Vedder River (Vedder Canal to Vedder Crossing)

Number	Source	Comments
1	Atlas of British Columbia, U.B.C. Press W.R. 912.711 F 231 C.4	General information on the people, environment and resource use.
2	Report on "Flood Control Works for the Vedder River, Phase III", February 1978, Ministry of Environment, File: 0281550-B17A	Works proposed for Phase III of the Vedder River project are outlined.
3	Background Report on the Vedder River Floodway Management Plan, July 1979, Ministry of Environment, File 0281550-B17A	Background information related to the Vedder River Floodway Management Plan.
4	Memo dated Dec. 20,1984, "Request for Vedder River Backwater Study", File: 0281550-C17A, E.W.D. Bonham to R.W. Nichols	Request to determine flood profiles and deposition quantities in study area.
5	Memo dated March 11, 1985," Vedder River-Backwater Study", File 0305030-F.P.M., R.W. Nichols to E.W.D. Bonham	Summary of the backwater study for the Vedder River.
6	Vedder River Project No. 84 RPP7, March 1984	49 river cross sections obtained in the study area.

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Appendix 1...cont'd

Number	Reference	Comments
7	Vedder River Project No. 85 RPP3, January, 1985	Survey of structures in study area.
8	Vedder River Project No. 84 RPP3 January, 1984	Highwater mark elevations, flood of January 4, 1984, including photos at cross sections.
9	Survey and Resource Mapping Branch, Ministry of Environment, Project No. 74-28T-0	1:5000 scale, 1 metre orthophoto mapping based on contours and spot heights compiled from May, 1974 air photography, orthophotos produced from June 1976 air photography.
10	Memo on "Estimated Peak Flows Chilliwack River at Vedder Crossing", Dec. 7, 1984, by R.Y. McNeil, Modelling Section, Water Management Branch	Summary of frequency analysis of available flow data to determine 1:200 year flood peaks in the study area.
11	Environment Canada, "Magnitude of Floods in British Columbia Yukon Territory", September,1982	Estimates of flood magnitudes.
12	Vedder Canal, Project No.78FRFC-3 Ministry of Environment	Cross sections, Sumas at Sardis to upstream and of Vedder canal, obtained in 1979.



STUDY AREA LOCATION

100 0 100 200 300 KILOMETERS

Province of British Columbia
Ministry of Environment
WATER MANAGEMENT BRANCH

TO ACCOMPANY REPORT ON
FLOODPLAIN MAPPING STUDY
VEDDER RIVER
(Vedder Canal to Vedder Crossing)

SCALE VERT .....
HOR AS SHOWN

DATE
DECEMBER 1985

R.W. NICHOLS ENGINEER

FILE No 00-0600-S.1 APPENDIX NO. 2

BCIL 7673-M E