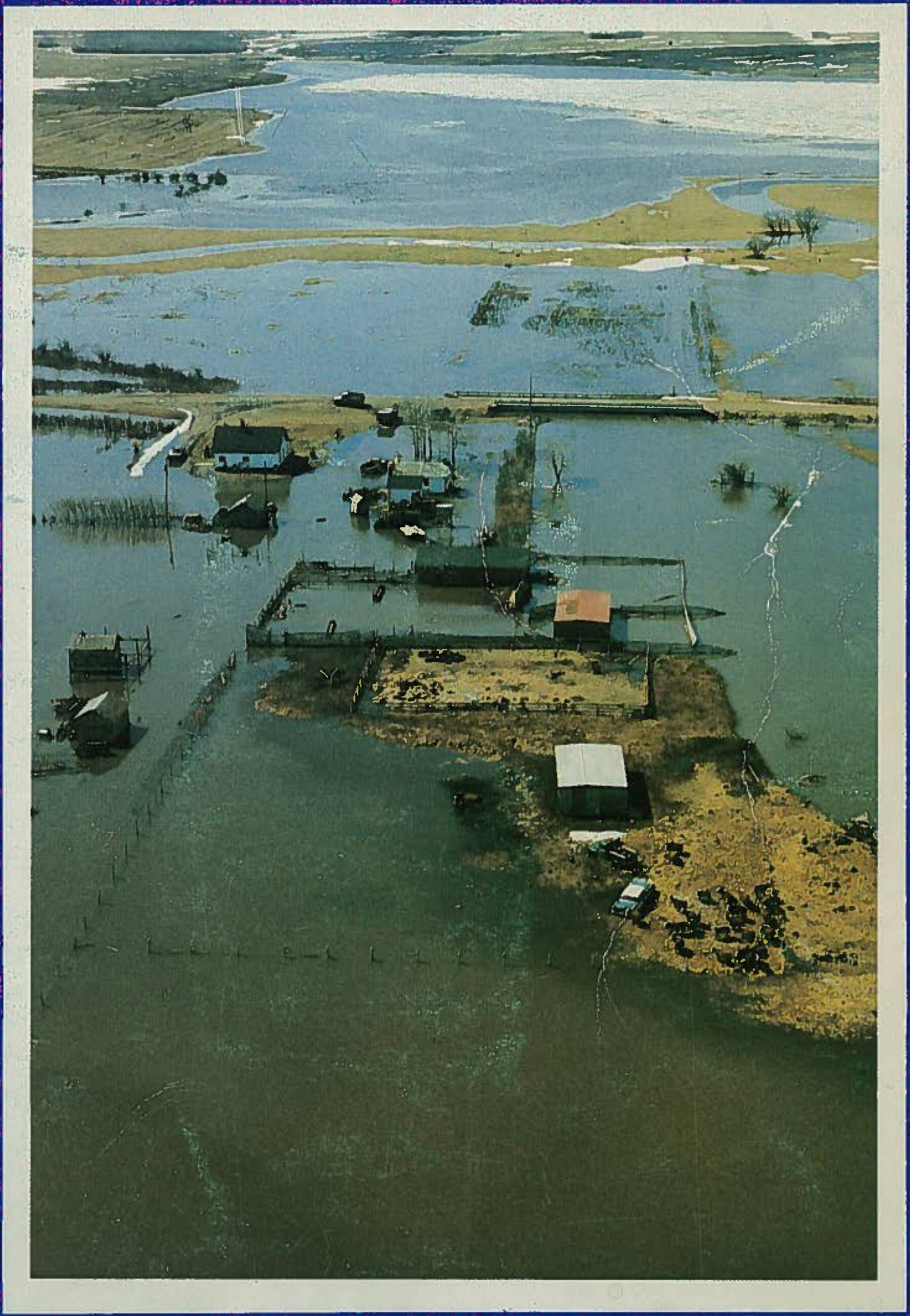
HISTORY OF FLOODS IN THE NORTH SASKATCHEWAN RIVER BASIN



Alberta
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History Of Floods In The North Saskatchewan River Basin

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January,

FOREWORD

The objective of this report is to present historical information and data concerning the floods in the North Saskatchewan River Basin. It is the intent to provide in one report, the most salient flood data and information which may be available in any of the several existing publications.

There are currently about sixty hydrometric stations active in the North Saskatchewan River Basin. This report presents data for eighteen selected hydrometric stations. Streamflow data have been collected for the North Saskatchewan River for approximately seventy years and there are several publications which give the recorded flood data in various forms.

The report preparation, the compilation of data and the analyses were done by the staff of the Technical Services Division, Environmental Engineering Support Service, Alberta Environment.

The Technical Services Division makes no warranties, expressed or implied, concerning the accuracy, completeness, reliability, usability or suitability for any particular purpose of the information and data contained in this report, and the Technical Services Division shall be under no liability whatsoever to any person by any reason of any use made of this report.

ACKNOWLEDGEMENTS

Thanks are expressed to the following agencies for providing information:

Water Survey of Canada, Environment Canada.
Water and Sanitation, Drainage Engineering, City of Edmonton.

Photographs supplied courtesy of the following:

Alberta Government, Public Affairs Bureau - Front Cover, Fig. 62, 63, 64, 65 and 66.

Edmonton Sun - Fig. 52, 53 and 54.

Town of Rocky Mountain House - Fig. 55 and 56.

Provincial Archives of Alberta, (E. Brown Collection) - Fig. 57.

Glenbow Museum, (McDermid Studios) - Fig. 58, 59, 60 and 61.

Diagrams were prepared by Virgilio T. Da Silva and the manuscript was typed by Gayle Hollander of the Technical Services Division.

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ABSTRACT

This report presents some of the most salient historical flood information and data for eighteen selected hydrometric stations in the North Saskatchewan River Basin. The principal sections of the report cover maximum annual flood discharge data, causes of floods, the effect of ice on recorded stages, historical flood levels, flood damages and flood frequency analyses.

Tables and histograms of the maximum annual floods, discharge hydrographs, selected river stage data and flood frequency curves are presented for the eighteen stations.

The report also lists other flood related information and data which are currently available from the Technical Services Division, Environmental Engineering Support Service, Alberta Environment.

INTRODUCTION

Objective

The objective of this report is to present information and data concerning the recorded floods in the North Saskatchewan River Basin (Figure 1). It is the intent to provide a compilation of historical flood data and information which may already be published in several other reports or data books. This report also includes flood frequency analyses and inferences as to the causes of the floods.

In this report, the word "flood" does not necessarily mean that there was inundation related to the event. It might simply refer to the peak river stage or peak flow in a particular year.

Selection of hydrometric stations for the report

Although there were approximately 60 hydrometric stations in operation in the North Saskatchewan River Basin in 1978, the data presented in this report are for 18 selected stations. Figure 2 is a listing of the selected stations along with other pertinent data concerning each station.

The stations were selected to give a good representation of floods in the mountain, foothills and plains regions, as well as along the main-stem of the North Saskatchewan River. The number of years of hydrometric record was also an important criterion in station selection. Although the station on the Clearwater River near Rocky Mountain House (Station No. 5DB001) has been discontinued since 1975, it has been included in this report because it has over 45 years of streamflow records.

This report presents data recorded up to the end of 1978. Figure 2 gives complete details on the period of record and the type of operation for each of the selected stations.

Terminology and units

Terms used frequently in the report are defined below.

Flood - peak river stage, gauge height or the peak flow in a particular year.

Hydrometric station or gauging station - is a location where records of river stage and discharge are obtained.

Maximum annual flood discharge - the highest daily discharge occurring in any given year.

Maximum instantaneous discharge - the highest momentary discharge in a specified period. In the case of manual stations where only one or a few observations were made during a single day, it usually signifies the highest discharge that could be inferred from the observations reported or from high water marks, which may then be qualified as "estimated", therefore, maximum instantaneous discharges for manual stations are subject to some degree of uncertainty.

Maximum daily discharge - the highest daily discharge in a specified period. Where the period is a single water year, it is referred to as maximum annual daily discharge.

Mean daily discharge - the average discharge over a single calendar day.

River stage or gauge height - the height of the water surface at a station above an arbitrary elevation known as "gauge zero".

Gauge zero - is an arbitrary datum above which the elevation or height of the river stage or gauge height is measured. Gauge zero does not necessarily correspond to minimum water level, zero discharge, or any other consistent flow condition. (At some stations the elevation of gauge zero has been changed from time to time.)

Gauge datum - has the same meaning as gauge zero as stated above.

Systematic records - annual peak discharge information collected in a systematic manner by means of an observer, a stage recorder or a crest-stage gauge.

Regulated discharge - the actual (recorded) discharge measured at a station affected by river regulation works, diversions, etc.

Natural discharge - the discharge that would have occurred without regulation at a station affected by regulation.

Historical flood - a flood event at a station since records have been kept.

Historic flood - a flood which occurred either before or after the period of data collection and whose peak discharge has been either recorded or estimated.

Cubic metre per second (m^3/s) - is a unit expressing the rate of discharge. One cubic metre per second is equal to one cubic metre of water flowing past a particular point in one second.

The following units are used in this report:

Discharge - cubic metres per second (m^3/s) or cubic feet per second (cfs).

Gauge height - metres (m) or feet (ft).

UNIT CONVERSION FACTORS

1 inch	= 25.4	mm.	1 mm.	=	0.03937	in.
1 ft.	= 0.3048	m.	1 m.	=	3.2808	ft.
1 mile	= 1.6093	km.	1 km.	=	0.62137	mi.
1 $ft.^2$	= 0.0929	$m.^2$	1 $m.^2$	=	10.764	$ft.^2$
1 $mi.^2$	= 2.59	$km.^2$	1 $km.^2$	=	0.3861	$mi.^2$
1 $ft.^3$	= 0.02832	$m.^3$	1 $m.^3$	=	35.314	$ft.^3$
1 $ft.^3$/sec	= 0.02832	$m.^3$/sec	1 $m.^3$/sec	=	35.314	$ft.^3$/sec
1 ac.ft.	= 43,560	$ft.^3$	= 1,233.2 $m.^3$			
1 ac.ft./mi^2	= 0.01875	in.	= 0.47625 mm.			

BASIN DESCRIPTION

The North Saskatchewan River traverses three major physiographic regions as it extends from the Continental Divide of the Rocky Mountains to its junction with the South Saskatchewan River. These regions are the mountains, the foothills, and the Great Plains. The total drainage area of the North Saskatchewan River is about 47,700 square kilometres at the hydrometric station North Saskatchewan River near Deer Creek, which is just downstream of the Alberta Saskatchewan border (see Figure 1).

The following quotation from The Saskatchewan-Nelson Basin Study[1] gives a detailed physiographic description of the basin.

> *"The mountains occupy a narrow belt bounded on the west by The Continental Divide and on the east by the most easterly range of the Rocky Mountains. Local relief is extreme, with elevations varying between 1219 metres (4,000 feet) in the large river valleys to over 3048 metres (10,000 feet) at the mountain peaks. The mountain ranges are overthrusts of sedimentary rock. The lower slopes are covered by alpine forests up to about elevation 2133 metres (7,000 feet). In places, the mountains are capped by permanent snowfields and glaciers. The valleys contain glacial gravel deposits, sometimes in depths of hundreds of feet. Annual precipitation varies from about 50 centimetres in the valleys to 180 centimetres and higher in the mountains.*
>
> *The foothills occupy a belt paralleling the mountains and extending eastward for about 160 kilometres from the eastermost limit of the Rockies. It is a transition zone*

between the mountains and the Canadian Plains, incorporating the eastern slopes of the Rocky Mountains, and characterized by ridges of hills paralleling the mountain ranges. The mountain-fed streams enter this belt at about 1280 metres (4,200 feet) elevation and emerge on to the plains at about 914 metres (3,000 feet). The transition zone characteristics are reflected in the vegetative cover. Rock outcrop about the timber-line merges into alpine forest, as the elevation decreases, then into areas of deciduous trees and finally to rolling grassland. The average annual precipitation is similar to that in the mountain region. However, moist air from the southeast invades the foothills belt upon occasion, without penetrating beyond the first ridge of mountains. These storms release their moisture on the eastern slope of the Rockies, producing rainfall of intensities not experienced in the mountain region and causing the significant floods of the North Saskatchewan River Basin.

Most of the North Saskatchewan River Basin lies in the Great Plains region. This region extends from the foothills in Alberta to the eastern limits of the drainage basin. It is an area of low relief, sloping gently eastward at about two or three feet to the mile (0.4 to 0.6 metre per kilometre). Drainage patterns are poorly developed and there are many small undrained lakes, sloughs and marshes contained within the overall boundaries of the basin. The average annual precipitation is between 30 and 50 centimetres. Water yield from the plains *is relatively low, making up only a small percentage of the North Saskatchewan River discharge, despite the fact that the plains comprise about 60 percent of the drainage area."*

The major tributaries in the mountain and foothill regions are the Clearwater, Ram, Brazeau, Nordegg and Baptiste Rivers. Some major tributaries in the plains area are the Sturgeon, Vermilion and Battle Rivers.

ANNUAL FLOOD DISCHARGE DATA

Maximum annual flood discharge data

Tables 1-18 give the maximum annual flood discharge data available up to 1978 for the selected hydrometric stations. These tables were prepared from data published by the Inland Waters Directorate in Historical Streamflow Summary, Alberta, to 1976[2], and Historical Streamflow Summary, Saskatchewan, to 1976[3].

Where available, the maximum instantaneous flood discharges were given along with the time and date of occurrence. The maximum instantaneous discharge is the highest momentary discharge occurring in a given year.

Figures 3-9 show histograms of the annual maximum mean daily discharge for the selected stations. The histograms illustrate that the maximum annual flood peaks vary at all hydrometric stations from one year to the next over the period of recorded data. For example, it can be seen that flood peaks for the North Saskatchewan River at Saunders (Station No. 5DC002), Figure 3, and the Mistaya River near Saskatchewan Crossing (Station No. 5AA007), Figure 4, do not show a great degree of variability from year to year. This is because they reflect the mountain region runoff which comes primarily from high elevation snowmelt. Such runoff can produce highly variable total runoff volumes from year to year, but the magnitude of the annual flood peaks does not vary significantly from year to year.

From the histograms, Figures 3-9, it can also be seen that the streams in the foothills region exhibit a higher degree of peak flow variability from year to year than mountain streams. The greatest variability from year to year for the flood peaks occurs on the plains area streams. Figure 7 illustrates a high variability of flood peaks on the mainstem of the North Saskatchewan River also since the two hydrometric stations at Edmonton and near Deer Creek reflect the integrated runoff from the mountain: foothills and plains areas.

For the stations which had streamflow records since 1915, a significa fact is that the flood peaks of 1915 on the mainstem and foothills streams w the largest on record, whereas on the plains area streams the flood peaks of April 1974 stand out as the largest for the period of record.

Variability of flows

Figures 10-18 are hydrographs which illustrate the variability of flows for some typical years for the selected stations. These hydrographs are plots of the mean daily discharges. These figures are discussed in greater detail under the section "Causes of Floods".

Figure 10 shows the daily discharge hydrographs for the North Saskatchewan River at Edmonton for several years for the period May 1 to August 31. These hydrographs were selected to portray the variability in flows on a mainstem station during the most active runoff period and were all plotted to the same scale for comparison purposes. It can be seen that in some years the streamflow is relatively low as in 1945 and 1955. In 1925 the flows were extremely low until mid-August when heavy rainfall resulted in a large increase in discharge. In 1915 and in 1965 there was more than one significant flood peak. It is significant that most of the major flood peaks shown in Figure 10 resulted primarily from rainfall run-off.

CAUSES OF FLOODS

General

Figures 11-15 are discharge hydrographs for selected stations on the North Saskatchewan River for the period of May 1 to August 31, for 1915, 1944, 1952, 1954 and 1972 respectively. These are years of some of the highest recorded flood peaks on the North Saskatchewan River. From a careful study of these hydrographs it can be determined which portions of the watershed provided significant runoff contributions to the flood flows.

The highest flood on record was in June 1915. From Figure 11 it can be seen that the greater portion of the flood runoff in June 1915 came from the area upstream of Rocky Mountain House. The selected hydrographs indicate that three of the peak flood events had major runoff contributions originating upstream of Rocky Mountain House. These occurred at the end of June in 1915, 1952 and 1972. For these events a considerable portion of the runoff was generated by extremely heavy rainfall in the foothills portion of the basin upstream of Rocky Mountain House. There are not enough streamflow records to plot hydrographs for the station at Saunders to illustrate the contributions from the mountain region of the basin in either the June 1915 or the June 1972 flood events. However, it was found that for the years when the area upstream of Saunders did contribute significantly to the flood peak, the ratio of the instantaneous flood peak at Saunders to the corresponding peak at Rocky Mountain House was 0.30, 0.39 and 0.41 for the 1915, 1952 and 1972 floods respectively. This means that there was a significant runoff contribution from the portion of the watershed within the mountain region. In all likelihood, this was primarily from snowmelt runoff. All the other major flood peaks on the selected hydrographs shown on Figures 11, 12 and

13 seem to have been generated primarily by rainfall on the drainage area downstream of Rocky Mountain House.

Mountain region

In the mountain region most of the annual runoff volume and the annual flood peaks are due to snowmelt in the spring and summer.

The drainage area of the North Saskatchewan River at Saunders (Hydrometric Station No. 05DC002) has been selected to typify the runoff conditions for the mountain area. This area is 5150 square kilometres and most of it is above the 1500 metre (5,000 foot) contour.

Table 7 shows the maximum annual flood peaks recorded for the statio at Saunders. Figure 3 shows a plot of these flood peaks. For the period of record up to 1972, the average of the maximum annual flood peaks is 488 m^3/s with a minimum value of 328 m^3/s and a maximum value of 776 m^3/s. This clearly shows that the range of the maximum annual flood peaks is not very wide, the ratio of the highest flood peak to the lowest being 2.4.

Since late 1972, about 75 percent of the drainage area above the Saunders gauge has come under regulation by the Bighorn Dam, and for the 1973-78 period the average of the maximum annual flood peaks has been reduced to 160 m^3/s. This is relatively low in comparison with the average of 488 m^3/s prior to regulation.

Figure 16 shows selected hydrographs for the Saunders hydrometric station. The hydrographs show daily flows for the period of May 1 to August 31 for 1953, 1970 and 1976. It can be seen that in 1953 and 1970 the flow equalled or exceeded 200 m^3/s for almost the entire period from June 1 to th end of August; this is in contrast to the regulated flows of 1976 when the flow was close to 100 m^3/s most of the time.

It is evident that the regulatory effect of the Bighorn Dam reduces the snowmelt flood peak from the mountainous areas upstream of the dam, thus resulting in an overall reduction of flood peaks at downstream points on the North Saskatchewan River. It should be noted that the maximum flow which can be released past the Bighorn Dam is about 160 m^3/s. The overall effect of the dam is the reduction of the spring and summer flows and an increase in the fall and winter flows.

Foothills region

While snowmelt is a contributing factor to runoff in the foothills, the major flood peaks are generated by heavy rainfall in this region. When the runoff from mountain snowmelt combines with the runoff from major storms in the foothills region, the largest flood peaks on the North Saskatchewan River are generally produced.

The storms which produce the major floods in the foothills are called "cold lows". The term "cold lows" refers to a certain type of low pressure air mass which originates off the west coast of North America. The low pressure system has counterclockwise circulation and travels generally from west to east across the continent. As the system crosses the continental divide, it often intensifies. The classic flood-producing situation occurs when the system draws warm, moist maritime air and mixes it with colder air from the polar regions at the ground surface. The circulation of the air mass is such that the moisture-laden air is directed towards the foothills and mountains. The air is forced to rise, as it rises it cools, as it cools it becomes saturated, and heavy rainfall in the foothills and along the most easterly range of mountains may result. The effect of the topography on intensification of the rainfall is referred to as the "orographic effect" or "upslope conditions".

There are several major tributaries which drain the foothills portion of the North Saskatchewan River Basin, such as the Brazeau, Nordegg, Baptiste and Clearwater Rivers. Prairie Creek has been selected to typify the runoff conditions of the foothills area because of the relatively long period of record (32 years). The hydrometric station is Prairie Creek near Rocky Mounta House (Hydrometric Station No. 05DB002).

Table No. 5 shows the maximum annual flood peaks for this station, and Figure 4 is a plot of these flood peaks. For the period of record from 1952-1978 the average of the maximum annual flood peaks is 38 m^3/s, with a maximum 102 m^3/s and a minimum value of 8.4 m^3/s. The ratio of the highest to the lowest maximum annual flood peak is 12.1. This wide range between the highest and lowest flood peaks illustrates the high variability of the flood peaks for foothills streams.

Figure 17 shows selected hydrographs for the hydrometric station on Prairie Creek. These hydrographs show daily flows for the period May 1 to August 31 for 1965, 1971 and 1972. Generally the runoff from snowmelt in April and May is relatively low for this basin, but storm rainfall in the May to September period can cause sudden large increases in streamflow. In 1965 there were four storms on this river basin which produced moderate flood peaks. In June 1972 there was a large storm which caused the flow to increase from about 10 m^3/s to an instantaneous peak of about 116 m^3/s, and in 1971 there was only one relatively small storm in the basin. These hydrographs il-lustrate the high variability or flashy nature in the flows of the streams in the foothills region.

The Brazeau Dam was completed in 1961. This dam regulates the runoff from almost the entire drainage area of the Brazeau River. This regulated area represents about twenty percent of the total drainage area of the North Saskatchewan River above Edmonton. Therefore, the Brazeau dam is strategically important in the flood reduction on the North Saskatchewan River.

The major floods on the Brazeau are generated predominantly by intense rainfall in the foothills portion of the river basin. The degree to which a flood is reduced by the Brazeau Dam depends largely on the amount of water already in storage in the reservoir immediately prior to the event. If the reservoir is nearly full, as it would be in the late summer, the flood control capability is less than if the reservoir is at a low level as it normally would be in the early summer. In the flood of June 1972 the flood storage at the Brazeau Dam resulted in approximately a three feet reduction of the flood stage at Edmonton.

In spite of the existing reservoir regulation from the Brazeau and Bighorn Dams, it is still possible to have flood peaks which may exceed the record flood of June 1915 on the North Saskatchewan River.

<u>Plains region</u>

Although most of the North Saskatchewan River drainage basin lies in the Great Plains region, the water yield from this area is relatively low in most years. In this region most of the annual runoff (over 85 percent) is generated from early spring snowmelt. Some of the larger tributaries of this region are the Sturgeon, Vermilion and Battle Rivers.

In some years there is exceptionally high runoff from snowmelt and there may be extensive flooding in the plains area, as was the case in 1974. In these years the plains area snowmelt can be the major contributing factor to the maximum annual flood peaks at downstream points on the mainstem of the North Saskatchewan River. Such flood peaks are recorded in April or early May. On April 20, 1974 the maximum annual flood peak on the North Saskatchewan River at Edmonton was 1062 m^3/s while the corresponding flood peak on the North Saskatchewan River near Deer Creek was 1659 m^3/s on April 25, 1974. The difference between these flows is a good indicator of the potential magnitude of extremely high runoff from snowmelt in the plains region.

On occasion, the early spring runoff from this region is due to a combination of rain and snowmelt. High runoff from late spring and summer rains is not very common in the plains area, however, in some years the maximum annual flood peaks on plains area tributaries result primarily from rainfall runoff. For example, Table 17 shows the maximum annual flood peak for the Vermilion River near Vegreville in 1973 was on July 7. The maximum mean daily flood peak was 18.5 m^3/s. This runoff event was due entirely to heavy summer rain. Table 18 shows that the Sturgeon River near Fort Saskatchewan recorded summer flood peaks in 1914, 1915, 1944, 1953, 1954 and 1965.

The drainage area of the Sturgeon River near Fort Saskatchewan (Hydrometric Station No. 05EA001) has been selected to typify the runoff conditions for the plains area. Its area is 3340 square kilometres. Most of the area lies in the elevation range between 600 metres (2,000 feet) and 800 metres (2,600 feet).

Table 18 gives the maximum annual flood peaks for this station and Figure 8 is a plot of these flood peaks. For the period of record the average of the maximum annual flood peaks is 25.7 m^3/s, with a minimum value of 3.2 m^3/s and a maximum value of 115 m^3/s. The ratio of the highest to the lowest flood peak is 35.9, illustrating the extremely wide range between the highest and lowest flood peaks for the plains area streams.

There is considerable natural regulation due to the presence of several large lakes in the Sturgeon drainage basin. Consequently, the recession limb of the hydrographs tend to be long and drawn out over several weeks for snowmelt, as well as rainfall events.

Figure 18 shows selected hydrographs for the hydrometric station on the Sturgeon River. These hydrographs show daily flows for the period April 10 to August 15 for 1965, 1971 and 1974. In these three years the snowmelt started in early April and peaked towards the end of April, and gradually receded until June, then rainfall late in the summer resulted in an increase in streamflow. In 1965 the volume of runoff from rainfall was almost as much as the volume of runoff from the early spring snowmelt, and the maximum annual flood peak was caused by the rainfall. In 1971 the runoff from rainfall was not very significant. The snowmelt flood peak of 115 m^3/s on April 27, 1974 was the highest flood peak ever recorded at this station, and this was followed at the end of the summer by substantial runoff from rainfall.

Urban storms

Urban flooding is generally caused by highly localized rainstorms whose intensity and subsequent runoff exceeds the design capacity of the urban storm sewer system.

It is extremely difficult to predict accurately the severity and location of these storms because they are highly variable in movement and intensity. Similarly, because of the relatively rapid response of the urban basins to these storm events, it is, at present, virtually impossible to provide any advance flood warnings.

One such storm occurred in the Edmonton area of July 10-11, 1978 (see Figure 34). During this event the Millwoods area in south-east Edmonton recorded about 135 millimetres of rain in a 20-hour interval. The most intense part of the storm occurred between 8 a.m. and 12 noon on July 11, 1978, when 90 millimetres of rain were recorded. Figure 35 shows the rainfall accumulation for the Millwoods area. This storm caused extensive flood damage to property in the south-east part of Edmonton. Figures 52, 53 and 54 are scenes in Edmonton during this flood event.

It is estimated that the Government of Alberta paid out in excess of 1.3 million dollars in compensation for flood damages caused by this storm.

THE EFFECT OF ICE ON RECORDED STAGES

General

The objective of this section is to present a summary of the effect of ice conditions on recorded gauge heights for fifteen of the selected stations. Table 20 gives the maximum recorded gauge heights during the break-up, freeze-up, and ice cover periods. The mean stage used to determine an increase due to ice was obtained by taking a mean for a five-day period prior to the maximum recorded gauge height. In the summary table, Table 20, the maximum recorded gauge heights do not mean that there was flooding related to the event, but simply provides an indication of the changes in water levels that are due to one of the three ice generated conditions.

A summary of the dates of the first and last ice is given in Table 21.

Break-up period

Break-up, or last ice, is the period when the channel ice cover progresses from a solid mass to open water. This process is affected mainly by hydrologic conditions and the characteristics of the ice. Ice jams are common during this period, but at the present time, the magnitude and duration of ice jams are unpredictable.

A combination of analyzing the recorded chart traces and noting the observer's comments of ice conditions was used to determine any significant or excessive increase in stage.

Freeze-up period

Freeze-up, or first ice, is the period when the channel progresses from an open water condition to an ice cover. This process is less complicated than break-up and ice jam magnitudes and durations are less pronounced.

A combination of analyzing the recorded chart traces and noting the observer's comments of the ice conditions was used to determine any significant or excessive increase in stage. Figures 55 and 56 are scenes during the freeze-up period on December, 1975 on the North Saskatchewan River near Rocky Mountain House.

Fluctuations during winter ice cover

For most channels in this report, a stable situation exists during ice cover. Increases in stage during the winter do not affect the entire length of the river uniformly, but vary from point to point. A noticeable change that can disturb a stable condition throughout the winter ice cover period are fluctuations on regulated channels due to varying releases from upstream reservoirs.

HISTORICAL FLOOD LEVELS AND FLOOD DAMAGES

Recorded river stages

Figures 19-33 give selected maximum river stage data for 15 of the selected stations in the North Saskatchewan River Basin in Alberta. The highest flood stage recorded at the station is given along with a few other selected maximum annual flood stages, which are not necessarily the highest values recorded for the particular station. Whenever available, the Geodetic elevation for gauge datum or gauge zero is given to allow conversion of the plotted gauge heights.

It should be noted that the elevations and gauge heights shown on Figures 19-33 refer only to the exact hydrometric station location. These locations are given in Figure 2.

Pre 1915 floods

In order to present some important background information on the earliest floods at Edmonton, a direct quotation from the Report of Hydrometric Surveys[4] for 1915 will be given. On page 565 of that report - G.H. Whyte wrote the following:

"Previous to 1915 the worst flood in the past fifty years, and in fact as far as records or memory goes, took place in August 1899.

At that time the river reached a height equal to 41.37 feet (12.61 metres) on our gauges at Edmonton, or an elevation of 2034.75 feet (620.19 metres), Public Works of Canada datum. This height gave a discharge of approximately 180,000 sec.-ft. (5100 cubic metres per second) from an estimate of Kutter's formula. At Prince Albert the gauge height reached was equal to 25.9 feet (7.80 metres) on the gauge or an elevation of 1481.997 feet (451.7 metres), Public Works of Canada datum. This height gives a discharge of 160,000 sec.-ft. (4530 cubic metres per second) by Kutter's formula.

Stories at Prince Albert and Edmonton give records of higher floods, but both seem to have been caused by ice jams in the spring. The jam at Prince Albert is alleged to have taken place some 35 or 40 years ago, while that at Edmonton took place over 80 years ago.

In 1900 the river reached a gauge height equal to 37.9 feet (11.55 metres) on the gauge at Edmonton and did considerable damage. Since August, 1907, we have fairly continuous records, and the highest gauge height reached was 26 feet (7.92 metres) on July 10, 1912, the discharge on this date being about 75,000 sec.-ft. (2120 cubic metres per second).

During the floods of 1899 and 1900, considerable damage was done all along the river, but no actual figures are available. In 1899 the low-level bridge at Edmonton was in the process of construction at the time of the flood, and it was found necessary to raise the piers eight feet (2.44 metres) higher than at first proposed so as to provide for floods of such magnitude. The water reached to within one and one half feet (0.46 metres) at the tops of the present piers at that time."

Figure 57 is a scene of the 1899 flood at Edmonton.

In the above quotation from G.H. Whyte[4], mention was made about a large ice jam flood at Edmonton. The following quotation from the Edmonton Bulletin[9], August 21, 1899 also makes reference to that event:

> *"There is a legend that at one time about 70 years ago a jam of ice caused the water to flow over Ross' flat. At that time the H. B. Co. Fort was on the flat, and it is said that this is the reason of the present site on higher ground having been selected. Mrs. Fraser, mother of John and Henry Fraser of this settlement, is said to remember the occasion. It will be noticed that the flood arose from a different cause, and was not a freshet in the proper sense of the word, as this was. Therefore as a matter of fact there has been no such flood so far as memory or even legend extends."*

Since the Edmonton House journals for a three year period around 1829 to 1832 are missing, there is not enough information to determine if the major flood, which caused the relocation of Edmonton House from the flats to higher ground, near today's Legislative Building, was caused by an ice jam or a high runoff event. Furthermore, evidence could not be obtained at this time to determine whether that flood is indeed the legendary ice jam flood, referred to in the above quotation from the 1899 Edmonton Bulletin[9].

June 1915 flood

Of the historical floods for which streamflow records are available, the flood of June 1915 had the highest flood stage at Edmonton along with the most severe flood damages ever reported at Edmonton from the North Saskatchewan

River (see Figure 26). A most graphic description of the flood damages was made by Whyte[4], page 567. This description is as follows:

"The total damages caused by the flood are hard to accurately arrive at owing to the impossibility of making an accurate and exhaustive survey of such damages.

Above the mouth of the Clearwater River the only damages were to trails and to the grade of the Canadian Northern railway (Brazeau branch). These losses would total at least $30,000.00, principally to the railway whose grade was destroyed in a number of places. On the Clearwater River a new traffic bridge, about two miles from the mouth, was completely destroyed with a loss of $2,500.00. At Rocky Mountain House the ferry was destroyed, as well as the cable station of this branch. The cost of replacing the ferry was some $1,000.00 and the cable station some $150.00. The cable station at Rocky Rapids, owned by Sir John Jackson Company (Canada), was taken out, and it is estimated that it will cost at least $1,000.00 to replace it. The greatest amount of damage done was at Edmonton where the direct losses are estimated at from $500,000.00 to $750,000.00 caused by damages to sidewalks, roads and other property; the balance of losses being due to the inundating of the lower parts of the town known as Fraser, Ross and Mill Creek and Gallagher flats, the washing away of the Edmonton Lumber Company's mill and the destruction of booms belonging to the Edmonton Lumber Company and the Walters' mills. Many homes were destroyed and the damage to hundreds of others and their contents was very great. It is estimated that eight hundred families were rendered homeless by the flood. The loss of life was fortunately very light, the only casualty being an infant which was dropped by its mother from a floating sidewalk into the flooded street. The river began to flood over its banks at gauge height 35.0 feet (10.67 metres) at Edmonton and thus there was a depth of 10 feet (3.05 metres) of water at some points on the flats. The city electric light and pumping plants at Edmonton were out of commission for some hours owing to flooding of their boiler fires and this caused considerable inconvenience to numbers of businesses and residents in the higher parts of the city.

The damage to property along the river below Edmonton was not very great, a few farms along the flats were inundated and at Battleford several houses were flooded. At Prince Albert the principal damage was due to losses of logs which was well under $10,000.00.

At Edmonton the low-level bridge was in danger owing to debris such as buildings, sidewalks, logs and roots collecting on the piers and bridge stringers, but this structure was saved by clearing this debris away and by placing a loaded train on the bridge. The same procedure was carried out at Prince Albert where much debris collected on the piers. At Ceepee, the Canadian Northern Railway bridge approaches were damaged to some slight extent.

It is probable that the total actual damage on the whole stream amounted to between $750,000.00 and $1,000,000.00. In addition to the damage to property the stream channel at many points was completely changed. Banks and low flats were washed away and deposited at different points along the river and there is probably little of the river bed which was not changed to some extent. In general the river channel has been enlarged which will provide more room for such floods if they occur in the near future."

Figures 58-60 show scenes in Edmonton during the June 1915 flood.

June 1972 flood

In June 1972 intense rainfall in the foothills region produced relatively high floods in the foothills tributaries and on the North Saskatchewan River at Rocky Mountain House and at Edmonton. Several stations in the foothills reported between 100 to 150 millimetres of rainfall in less than 48 hours.

There was some minor flooding in farms and roads in the Caroline area, and some minor problems with the water supply intakes for Rocky Mountain House and Drayton Valley. The agricultural flood damage was estimated by Knapp[5] at approximately $56,000.00, but no estimates are available for the other flood damage that was caused by this flood.

At Edmonton the flood peak was at a stage of 9.75 metres (32.0 feet) and an estimated discharge of 3200 cubic metres per second (113,000 cfs). There was negligible damage reported to private property at Edmonton, although some gardens and lawns "got wet" in Rossdale, Riverdale and Cloverdale areas. Apparently the river level came within about 0.15 metre of forcing the shut-down of the Rossdale Power Plant - Edmonton's main source of electricity.

It should be pointed out that the regulating effect of the Brazeau Dam reduced the peak flood stage by about 1.0 metre at Edmonton, thereby preventing some minor flooding to a few homes in the river valley at Edmonton and damage to the Rossdale Power Plant.

April 1974 flood (plains region)

A relatively wet fall in 1973, together with a heavy snowpack accumulation during the winter of 1973/74 resulted in extremely high runoff for most rivers and streams in the plains region of the North Saskatchewan River Basin in April 1974. In particular the Sturgeon, Vermilion and Battle Rivers and their tributaries along with many other small streams caused extensive flood damages.

From the flood stages presented in Figures 19-33 it can be seen that five of the plains area stations recorded their maximum flood stage in April 1974.

It is difficult to get a good estimate of the total losses due to this flood. Most of the losses, however, were in the plains area of the North Saskatchewan River Basin. The total amount paid out by Alberta Disaster Services as compensation for damage during this flood event was about nine million dollars, and more than 50 percent of this was in the North Saskatchewan Basin. Photographs 59-66 show some scenes from the April 1974 flood in the Vermilion River Basin.

It should be noted that in the above mentioned floods, the cost of the flood damages is expressed in terms of the value at the time of the occurence, however, because of both increased development and present value, the present cost of similar flood events could conceivably be much higher.

ADDITIONAL FLOOD-RELATED DATA

General

In addition to streamflow data, compiled by Water Survey of Canada, there are other flood-related data which have been compiled by the River Engineering Branch, Technical Services Division, Alberta Environment. This section provides an index of additional flood information for the North Saskatchewan River Basin. The information was previously published in 1977 in a "Flood Information Index"[8].

The information is classified under four main categories -- Historica[l] Flood Information, Aerial Flood Photography, High Water Mark Surveys, and Floodplain Studies.

The following sections summarize the data and information which are currently available within the Technical Services Division of Alberta Enviro[nment].

Historical flood information

Historical flood information is in the form of clippings from numerou[s] Alberta newspapers of which several date back to as early as 1895.

A list of the years for which newspaper clippings are available for the North Saskatchewan River Basin are:

North Saskatchewan River in the vicinity of Edmonton and Rocky Mountain House	1915, 1923, 1936, 1942, 1944, 1952, 1954, 1956, 1965, 1972
Sturgeon River in the vicinity of St. Albert and Fort Saskatchewan	1936, 1940, 1943, 1948, 1956, 1965, 1971, 1974

The following page gives an example of several headlines which appea[r] in *The Edmonton Journal* in April, 1974.

14 EDMONTON JOURNAL, Thursday, April 25 1974

Aid plans begin as flood eases

By The Canadian Press

Flood fighters across the ...iries are finding it easier ...ut the work is just be... officials of all ... government ... the dam...

...day. By Wednes... EMO officials wer... optimistic they w... battle.

Federal Just... Otto Lang tour... in Saskatchev... Wednesda... civic offici... Moose Jaw ... returnin... ang

Camrose man first victim of flooding

A 47-year-old Camrose man who tried to cross a creek near here was swept off his feet and carried into Dried-meat Lake by the flood waters Wednesday.

RCMP said Lester Gordon Kanten's body was recovered from the lake after his futile ... to cross the flooding ... point nine miles ... wo miles east of ... is the first ...

...by 36 wash-outs and is closed indefinitely. The Wetaskiwin-Camrose - Hardisty - Provost line will be out for several days, along with the La-come - Stettler - Coronation line.

The Wetaskiwin to Provost line carries a lot of grai... is also one of th... riers of ...

...traffic on the Vegreville-Lloydmi... halted over the w... Traffic now mov... over the "soft trac... Alex Rennie, of ... public information ... as of W... of grain ... in V... wo wee... won't ... prob... CP's ... Deer i...

Cabinet okays move for flood vict...

...tal damage to property, ...ings, highways and crops ...by flooding so far this ...is nearing the $80 mil... ...rk, Agriculture Minis... ...Horner said Wednes...

...the legislature the cabinet has ...ulations ...

Various fl... Horner sug... riculture r... —with an in... could be us... ers a st...

Planting held up

The director of the Alberta Disaster Services agency ... "dozens" of Albert... face losses ... cause...

Providing th... heavy rains, Alb... probably be spared ... ther floods in June ... harvest melting o... search, says a feder... But unlike the ... Prairie ... ing of ... circled a ... there may ... floods ...

Rains ...ld spell ...

...ngineer for the water ...of Canada, a branch of ...leral environment de... ...ment, which operates ...of the stream flow mea... ...stations in Alberta. ...ough mountain snow... ...are 15 per cent greater ...normal, snow melting ...will not cause flooding ...n rivers such as ...tchewan, Red ...or Old...

...heavy rainfall in the moun... ...tains during the spring snow ...melt. With the ground ... ...rated by melting snow, ...would run ... rivers, p... floods. That wa... 1972 when ... track of ... source ... Grande Prairie ...

...progress and won't ...pleted until ...

Edmonton Journal

...perty, ...nd agricul... ...isure items ...l because ...n of the ...s to en... ...stablish ...od and ...mmit...

...a late re... ...e difficulties in ...tler area," he said ...day.

Ottawa will be prese... bill for its share of the ...pensation in a package ...could run close to $20 milli...

Under a rule of thumb ... has been used in the pas... the province pays ... dollar per capita ... cial populatio...

...be... ...weather con... and again this ...

...s assessors ...dent Adjus... of Canada ...claims for ...property ...Vegreville ...d of the ...

Vermilion river still on rampage

River drops, easing city fears

By DAN POWERS
Of The Journal

As long as the ice in the North Saskatchewan River doesn't jam, there's no flood hazard, a city ...

...east of 97th Street and north of 137th Avenue, and in the southeast corner of the city near 47th Street and ... Avenue ...

...to place around homes experiencing flooding.

"They have the ... and ...

...no available manpower. He said ADS also has li... equipment suppli... are alread... city. ...

floods take big bite roads, buildings

...made by bridge ...adway experts

Several agriculturalists said it will be two to three weeks ... before enough water is ...

Two bridges have been washed out on the Vermilion and several others are un... ...the ap...

Floods threatening Vegreville hospital

By DON THOMAS
... Journal

...REVILLE — Staff of ...oseph's Hospital here ...be possibility of having ...work by boat if ...er rises as ...

...said water behind the d... had risen a foot overnight ... by early morning was n... the lip of the dike.

Residents of at least th... homes near the river eva... ated their homes overnigh... including Cassie Berezans... whose house is only a ston... throw from the river. Wa... this morning near her hom... ...the river ...

Aerial flood photography

This section gives a summary of aerial photography flown during or immediately following, a flood. Aerial photographs are distributed by the Alberta Department of Energy and Natural Resources and all flood photography is catalogued under a special flights file. The following is a summary of the aerial photography flown in the North Saskatchewan River Basin:

1965 Aerial Flood Photography

Name and Date	Location	Scale	Contract No.
Waskatenau (27/04.65)	Waskatenau	1:2000	C-65-6197
Sturgeon River (25/04.65)	Villeneuve	1:1320	C-65-6917 (E65-15)
Vermilion River (07/09/65)	Vegreville	1:2000	C-65-6197
North Saskatchewan River (17/09/65)	Blue Rapids to Berrymoor Ferry	1:6000	C-65-26

1971 Aerial Flood Photography

Name and Date	Location	Scale	Contract No.
Riviere Qui Barre (20/04/71)	Big Lake to George Lake	1:21120	71-186

1972 Aerial Flood Photography

Name and Date	Location	Scale	Contract No.
North Saskatchewan River (27/06/72) (28/06/72)	Keephills to above Calmar	1"=800'	72-131
	Devon to Fort Saskatchewan	Oblique photography	72-132

1974 Aerial Flood Photography

Name and Date	Location	Scale	Contract No.
Sturgeon River (25/04/74)	Gainford to Scotford	1:12000	74-51
Vermilion River (23/04/74)	Vegreville	1:12000	74-54B 74-54C

1979 Aerial Flood Photography

Name and Date	Location	Scale	Contract No.
Vermilion River (21/04/79) (24/04/79)	Vegreville	1:3000	79-65

Additional information or enquiries about the above aerial photography can be made to:

Alberta Department of Energy and Natural Resources
Technical Division
Resource Evaluation Branch

Flood high water mark surveys

This section gives a list of the high water mark survey reports completed by the Technical Services Division, Alberta Department of the Environment. Actual markings left during the peak flow for any flood were located and surveyed. The results of these surveys were then compiled into report form. For the majority of the locations, the surveys were tied into geodetic datum and permanent benchmarks were established to enable a rapid re-survey during future floods.

The reports completed to date are:

North Saskatchewan River, Clearwater River

Report title: "Photographic Coverage and High Water Mark Benchmarks of Four Alberta Rivers for the June, 1972 Flood"
By: H. Rickert, June, 1973

Sturgeon River

Report title: "High Water Mark Benchmarks for Riviere Qui Barre and Sturgeon Rivers Spring Flood, 1974"
By: H. Rickert, November, 1974

In addition to the above, twenty-one high water marks located during the 1972 flood on the North Saskatchewan River are included on the longitudinal profile (Figure 67). This is a profile of the North Saskatchewan River in Alberta. This profile was originally prepared by the Research Council of Alberta in 1965 and was revised by Alberta Environment in 1980. This profile includes the elevations of the approximate river bed, apparent bedrock, water levels on selected dates, high water marks from some of the larger floods and the decks of some of the bridges.

Additional information or enquiries for specific flood events or elevations should be made to:

River Engineering Branch
Technical Services Division
Alberta Department of the Environment

Floodplain studies

Floodplain studies in the North Saskatchewan River Basin completed by the River Engineering Branch, Alberta Environment, are listed below. A floodplain study for any specific location is a documentation of the historical flooding, hydrology, and a floodplain analysis for that area. Floodplains are delineated on airphoto mosaics showing the extent of flooding and in most studies, flood profiles are also plotted.

Floodplain Studies

River	Location	Year	Author
North Saskatchewan River (SE. 32-51-25.4 to NE. 29-53-23.4)	Edmonton	1974	S. Lowe, P. Eng.
Sturgeon River (SW. 32-53-25.4 to NW. 10-54-25.4)	St. Albert	1975	B. Szabon, P. Eng.
Battle River (SE. 36-42-26.4 to NE. 10-43-25.4)	Ponoka	1979	H. Rickert, Technologist

Additional information about these studies can be obtained from:

River Engineering Branch
Technical Services Division
Alberta Department of the Environment

Copies of the completed reports are available for public perusal in the Alberta Department of Environment Library.

FLOOD FREQUENCY ANALYSES

The previous sections have demonstrated that there is a high degree of variability in the magnitude of floods which may be experienced from one site to the next, as well as from one year to the next. Because of this variability it is seldom economical to design engineering works to protect against the maximum flow which may be expected to occur. Rather, a compromise has to be reached between the average annual damages resulting from ocassional floods and the cost of providing a greater level of protection. Decisions as to the optimum level of compromise are made on the basis of knowledge of the probability of future occurences. Probabilities of future occurrences are defined by fitting flood data to a selected frequency distribution.

There are numerous frequency distributions for the fitting of flood data. However, comparisons of probability estimates, from previous in-house studies, of the natural and log-transform maximum likelihood Gumbel, Normal, Three Parameter Gamma, and method of moments Three Parameter Pearson distributions indicated that the method of moments Pearson III distribution most accurately approximated the Hazen Plots of the observed annual flow series. Therefore, the method of moments Pearson III frequency distribution was selected as the basic distribution to define the annual flood series and was utilized in all subsequent frequency analyses. It should be noted that the underlying assumption in any frequency analyses is that the available data is a reliable and representative time sample of random homogeneous events.

For the purpose of this study, the following three categories of flood data were recognized and utilized in the evaluation of flood probabilities: systematic records, historic data, and comparisons with similar watersheds.

Due to the limited number of data samples, a degree of uncertainty is inherent in any flood frequency analysis. Therefore, the frequency curve provides only an estimate of the population curve and not an exact representation. The level of uncertainty in the estimated exceedance probability of a selected discharge or in the discharge of a specified exceedance probability, is reflected by the establishment of confidence limits. In this study, all confidence limits were established by the procedure recommended by the U.S. Water Resources Council[6]. Records from stations with a relatively short period of record were extended by means of regression with a nearby station with a longer period of record. In such cases, the sample size used to compute the confidence bands was assumed to be equal to the equivalent years of record of the regression, rather than the length of either the short or long-term record, (Hardison[7]).

The procedure outlined above was utilized in the derivation of frequency curves and confidence bands of the annual mean daily flood series for streams in the North Saskatchewan River Basin whose flood flows were not significantly altered by reservoir regulation.

Frequency curves for station 5DC1 and 5DC2 (North Saskatchewan River at Rocky Mountain House and at Saunders), which have been regulated since 1972, were established solely on the basis of their pre-regulation records. For station 5DF1 (North Saskatchewan River at Edmonton), the natural mean daily flows were re-constructed for the years of regulation using the U.S. Corps of Engineers Streamflow Synthesis and Reservoir Regulation (SSARR) model, and then a frequency curve for the natural flow conditions was established. The resultant frequency curves for the North Saskatchewan River at Rocky Mountain House, Saunders, and at Edmonton and for the non-regulated streams are shown graphically on Figures 36 to 51. Frequency analyses were not done for two stations, Brazeau River below Big Bend Plant and North Saskatchewan River near Deer Creek.

If refinements were made to the basic frequency curves, they are noted on the appropriate figures.

The instantaneous flow series is relatively incomplete when compared to the main daily flow series. No attempt has been made to determine the frequency curves for instantaneous flows. The ratio of the average peak flow to mean daily flow has been determined for each of the stations analyzed and is presented in Table 19 for all 18 stations selected for this report.

REFERENCES

1. SNBB (1972): "Water Supply for the Saskatchewan-Nelson Basin, Appendix 1, Study Background"; Saskatchewan Nelson Basin Board, Prairie Provinces Water Board.

2. Inland Waters Directorate (1977): "Historical Streamflows Summary, Alberta, to 1976"; Inland Waters Directorate, Water Resources Branch, Water Survey of Canada.

3. Inland Waters Directorate (1977): "Historical Streamflows Summary, Saskatchewan, to 1976"; Inland Waters Directorate, Water Resources Branch, Water Survey of Canada.

4. Whyte, G.H. (1916): "Report of Hydrometric Surveys for the Calendar Year 1915, Appendix No. 4"; Department of the Interior, presently known as the Inland Waters Directorate.

5. Knapp, J.L. (1972): "Flood Damage Estimation, June 1972, Athabasca, North Saskatchewan and Peace River Basins"; Alberta Department of Agriculture.

6. United States Water Resources Council (1977)" "Guidelines for Determining Flood Flow Frequency", Bulletin #17A of the Hydrology Committee, United States Water Resources Council.

7. Hardison, C.H. (1969): "Accuracy of Streamflow Characteristics", Geological Survey Research 1969, pages D210-D214, U.S. Geological Survey Professional Paper 650-D.

8. Quazi, M.E., Rickert, H. and Foy, G. (1977): "Flood Information Index", Technical Services Division, Alberta Environment.

9. Edmonton Bulletin, August 21, 1899.

TABLE 1

NORTH SASKATCHEWAN RIVER AT EDMONTON - STATION NO. 05DF001

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1911			1460	JUL 3
1912			2100	JUL 10
1913			923	AUG 15
1914			1750	JUN 9
1915	5800	JUN 28*	4640	JUN 29**
1916	1740	JUN 22	1670	JUN 22
1917			1860	MAY 18
1918			1000	JUN 16
1919			564	JUN 24
1920			1620	MAY 10
1921	776	MAY 23	705	MAY 23
1922	810	1900 MST, AUG 18	731	AUG 18
1923	2820	0900 MST, JUN 25	2380	JUN 25
1924	782	JUL 5	779	JUL 5
1925	2180	1150 MST, AUG 18	2150	AUG 18
1926			1660	SEP 4
1927	1280	1800 MST, JUN 28	1140	JUN 29
1928			1730	JUL 7
1929			1080	JUN 5
1930	677	0600 MST, JUN 13	671	JUL 17
1931			1110	JUL 2
1932			1870	JUN 4
1933			974	JUN 19
1934			796	JUN 1
1935			1310	JUL 11
1936			1140	APR 19
1937			892	JUL 17
1938			1130	JUL 4
1939			855	JUN 28
1940			1010	APR 18
1941			756	JUN 28
1942			1200	JUL 14
1943			1250	APR 12

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

(table 1 cont'd)

YEAR	MAXIMUM INSTANTANEOUS m³/s	TIME AND DATE	MAXIMUM DAILY m³/s	DATE
1944	3570	1600 MST, JUN 16	3460	JUN 16
1945			688	JUN 1
1946			1270	JUN 24
1947			810	JUN 13
1948			1850	MAY 25
1949			926	JUN 22
1950	1520	0500 MST, JUN 17	1420	JUN 17
1951	1160	1300 MST, MAY 3	1100	MAY 3
1952	3740	1100 MST, JUN 25	3540	JUN 25
1953	1300	1000 MST, JUN 5	1270	JUN 5
1954	3340	2145 MST, JUN 8	3030	JUN 8
1955	906	0100 MST, JUN 15	861	JUN 15
1956	753	1600 MST, JUN 7	722	JUN 7
1957	663	0700 MST, MAY 22	617	JUN 11
1958	1480	1800 MST, JUN 30	1410	JUL 1
1959	1460	2200 MST, JUN 28	1310	JUN 29
1960	1100	1300 MST, JUL 3	1040	JUL 3
1961	852	2100 MST, JUL 31	770	JUL 31
1962	807	0800 MST, JUL 14	765	AUG 6
1963	1130	2359 MST, JUL 17	1050	JUL 18
1964	1410	0100 MST, JUN 21	1350	JUN 21
1965	2700	2000 MST, JUN 29	2590	JUN 29
1966	1750	1200 MST, JUL 6	1630	JUL 6
1967	1050	0900 MST, JUN 19	1000	JUN 19
1968	660	0800 MST, JUN 13	597	AUG 9
1969	1850	2149 MST, JUL 7	1740	JUL 7
1970	1610	1424 MST, JUN 18	1520	JUN 18
1971			1180	JUN 11
1972	3200	2000 MST, JUN 27	2970	JUN 27
1973	719	0100 MST, JUL 3	589	JUN 26
1974	1120	0140 MST, APR 24	1060	APR 20
1975	708	1900 MST, MAY 2	419	MAY 7
1976	487	2230 MST, AUG 19	430	AUG 19
1977	980	1750 MST, MAY 30	920	MAY 31
1978	1040	1915 MST, JUL 12	949	JUL 13

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 2

NORTH SASKATCHEWAN RIVER NEAR ROCKY MOUNTAIN HOUSE - STATION NO. 05DC001

MAXIMUM ANNUAL DISCHARGES

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1913			646	AUG 13
1914			510	JUN 7
1915	4110	JUN 27*	3680	JUN 27**
1916			1060	JUN 20
1917			561	JUN 3
1918			753	JUN 15
1919			447	JUN 23
1920			614	JUL 3
1921			479	JUN 26
1922			564	AUG 17
1923	1270	JUN 14	1260	JUN 14
1924			674	JUL 4
1925			1030	AUG 17
1926			878	SEP 2
1927			784	JUN 27
1928			900	JUN 23
1929			850	JUN 3
1930			575	JUL 16
1931			682	JUN 19
1944	971	JUN 15	937	JUN 15
1945			447	MAY 31
1946			719	MAY 29
1947			660	JUN 11
1948			1170	MAY 24
1949			408	JUL 17
1950			1030	JUN 15
1951			600	JUN 16
1952	1990	2200 MST, JUN 23	1600	JUN 24
1953	742	2300 MST, JUL 15	711	JUN 14
1954	1260	2000 MST, AUG 25	1060	AUG 26
1955	586	2000 MST, JUL 19	583	JUL 19
1956	464	0500 MST, JUN 6	439	JUN 6

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

(table 2 cont'd)

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1957	422	1200 MST, JUN 9	419	JUN 9
1958			714	JUN 29
1959	779	1200 MST, JUN 27	719	JUN 27
1960	609	0100 MST, JUL 2	558	JUL 2
1961	566	0830 MST, JUN 8	541	JUN 8
1962	504	0300 MST, AUG 6	473	AUG 6
1963	680	0400 MST, JUL 16	648	JUL 16
1964	790	0600 MST, JUN 19	776	JUN 19
1965	1460	1930 MST, JUN 18	1050	JUN 19
1966	835	0800 MST, JUL 4	733	JUL 4
1967	626	1200 MST, JUN 18	617	JUN 18
1968	558	0550 MST, JUN 28	547	JUL 11
1969	963	1008 MST, JUL 6	906	JUL 6
1970	1290	1150 MST, JUN 17	1120	JUN 17
1971			736	JUN 6
1972	1880	2200 MST, JUN 25	1470	JUN 26
1973	348	1300 MST, MAY 28	311	MAY 18
1974	351	1830 MST, JUN 26	340	JUN 26
1975	191	1100 MST, JUL 18	170	JUL 14
1976	212	0630 MST, AUG 11	199	AUG 10
1977	243	0830 MST, MAY 30	229	MAY 30
1978	323	0430 MST, JUL 12	292	JUN 17

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 3

CLEARWATER RIVER NEAR ROCKY MOUNTAIN HOUSE - STATION NO. 05DB001

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1914			64.6	JUN 8
1915			1110	JUN 27**
1916			221	JUN 20
1917			174	MAY 17
1918			119	JUN 15
1919			42.2	AUG 9
1920			178	MAY 9
1921			56.9	JUN 7
1922	75.3	1900 MST, AUG 17	72.5	AUG 17
1923			320	JUN 2
1924	153	2000 MST, MAY 1	115	MAY 1
1925	328	1800 MST, AUG 17	274	AUG 17
1926			233	SEP 2
1927	117	1000 MST, JUL 28	113	JUL 28
1928	267	1000 MST, JUN 19	259	JUN 19
1929	253	1800 MST, JUN 3	230	JUN 3
1930			66.3	JUN 11
1944			231	JUN 15
1945			103	JUN 1
1946			144	JUN 23
1947			119	JUN 28
1948			289	MAY 24
1949			46.2	JUL 21
1950			137	JUN 15
1951			90.6	MAY 5
1952	425	1500 MST, JUN 24	411	JUN 24
1953	171	1400 MST, JUN 4	167	JUN 4
1954	385	1200 MST, AUG 26	357	AUG 26
1955	96.3	2345 MST, JUN 13	89.5	JUN 14
1956			53.8	JUN 21
1957	78.4	1800 MST, APR 30	68.5	MAY 1
1958	104	2300 MST, JUL 2	98.3	JUL 2

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

(table 3 cont'd)

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1959	146	0600 MST, JUN 28	135	JUN 28
1960	63.7	0200 MST, JUL 3	62.0	JUL 2
1961	62.9	0600 MST, JUL 3	59.2	MAY 28
1962	62.0	0100 MST, MAY 21	55.5	MAY 21
1963	147	0300 MST, JUL 17	138	JUL 17
1964	189	2200 MST, MAY 7	168	MAY 7
1965	524	1800 MST, JUN 19*	385	JUN 19
1966	180	1900 MST, JUL 4	162	JUL 5
1967	152	0300 MST, JUN 1	138	JUN 1
1968	74.2	1900 MST, JUL 21	69.4	JUL 22
1969	286	1020 MST, JUL 7	274	JUL 6
1970	399	1500 MST, JUN 17	340	JUN 17
1971	146	0700 MST, JUN 7	138	JUN 7
1972	467	0800 MST, JUN 26	442	JUN 26
1973	98.8	1800 MST, MAY 28	95.4	MAY 28
1974	121	0430 MST, JUN 18	115	JUN 18
1975	45.3	1630 MST, JUN 26	42.8	JUN 27

Station Discontinued in 1976

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* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 4

MISTAYA RIVER NEAR SASKATCHEWAN CROSSING - STATION NO. 05DA007

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1951	36.2	0500 MST, JUL 19	34.8	JUL 19
1952	27.8	AUG 15	26.2	JUN 30
1953	65.4	5000 MST, JUL 15*	58.6	JUL 15**
1954	38.5	0900 MST, JUL 8	37.4	JUL 8
1955	49.8	0700 MST, JUL 18	49.0	JUL 18
1956	33.7	0500 MST, JUL 23	32.0	JUL 23
1957	25.9	1200 MST, JUN 8	25.0	JUN 8
1958	36.2	1600 MST, JUN 28	34.0	JUN 28
1959	35.7	0900 MST, JUL 25	34.8	JUL 25
1960	34.0	0600 MST, JUL 20	33.1	JUL 19
1961	35.1	1600 MST, JUN 7	34.3	JUN 7
1962	27.9	2100 MST, JUN 26	26.1	JUN 26
1963	33.4	0600 MST, JUL 9	32.6	JUL 9
1964	35.7	0400 MST, JUL 10	34.5	JUL 14
1965			34.5	JUL 9
1966			29.2	JUL 9
1967	32.3	1200 MST, JUL 5	31.4	JUN 22
1968	36.2	0110 MST, JUL 13	34.2	JUL 10
1969	26.5	0852 MST, JUN 21	25.9	JUN 21
1970	26.1	0930 MST, JUL 9	25.6	JUL 9
1971	29.4	0800 MST, JUL 24	29.2	AUG 9
1972	41.1	1830 MST, JUN 11	39.9	JUN 11
1973	35.1	2140 MST, JUN 24	31.7	JUN 24
1974	44.5	1020 MST, JUN 24	43.3	JUN 24
1975	37.9	0700 MST, JUL 16	36.2	JUL 16
1976	31.4	1130 MST, SEP 6	30.3	SEP 6
1977	26.8	0600 MST, JUN 9	24.8	JUN 9
1978	30.9	0200 MST, JUL 10	29.4	JUL 9

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 5

PRAIRIE CREEK NEAR ROCKY MOUNTAIN HOUSE - STATION NO. 05DB002

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1922			15.4	AUG 17
1923	58.9	2000 MST, JUN 24	57.5	JUN 24
1924			11.8	MAY 3
1925	43.9	1745 MST, AUG 17	42.5	AUG 17
1952	94.3	1700 MST, JUN 24	86.1	JUN 24
1953			28.3	JUN 4
1954	94.6	0900 MST, AUG 27	94.0	AUG 26
1955			36.8	JUN 1
1956			8.4	APR 16
1957			18.4	APR 30
1958			17.9	JUL 2
1959			43.6	JUN 29
1960			22.5	MAY 19
1961			9.6	MAY 5
1962	17.4	0100 MST, MAY 16	17.1	MAY 16
1963	42.2	0300 MST, JUL 17	36.8	JUL 17
1964	109	0400 MST, MAY 8	90.0	MAY 8
1965	68.8	0500 MST, JUN 30	65.4	JUN 30
1966	32.3	1300 MST, JUL 4	29.7	JUL 4
1967	22.0	0800 MST, JUN 1	21.2	JUN 1
1968	22.5	1932 MST, JUL 21	20.3	JUL 22
1969	69.4	1913 MST, JUL 6	67.4	JUL 6
1970	70.5	1829 MST, JUN 17	64.8	JUN 17
1971	24.9	1000 MST, JUN 10	24.0	JUN 10
1972	116	2100 MST, JUN 26*	102	JUN 26**
1973	20.4	2330 MST, MAY 28	19.4	MAY 28
1974	23.5	2220 MST, MAY 21	23.0	MAY 20
1975	11.6	1100 MST, MAY 8	11.2	MAY 8
1976	11.6	1900 MST, AUG 9	9.8	AUG 17
1977	38.2	1900 MST, MAY 30	34.0	MAY 30
1978	22.4	0100 MST, JUN 1	19.0	JUN 1

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 6

CLEARWATER RIVER ABOVE LIMESTONE CREEK - STATION NO. 05DB003

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1959	81.6	0700 MST, JUN 13	70.8	JUN 27
1960	49.6	0900 MST, JUL 2	47.3	JUL 2
1961	56.4	0600 MST, MAY 28	52.3	MAY 27
1962	40.8	0600 MST, JUN 27	37.4	JUN 27
1963	92.6	1700 MST, JUL 25	77.6	JUL 17
1964	211	0200 MST, JUL 4	136	JUL 4
1965	510	1800 MST, JUN 18*	283	JUN 18**
1966	108	0100 MST, JUL 4	93.2	JUL 4
1967	114	0245 MST, MAY 31	86.9	MAY 31
1968	57.8	1204 MST, JUN 27	53.5	JUN 27
1969	154	1040 MST, JUL 5	147	JUL 5
1970	209	1340 MST, JUN 16	169	JUN 16
1971	120	1200 MST, JUN 6	99.1	JUN 6
1972	199	0930 MST, JUN 25	180	JUN 25
1973	75.3	1600 MST, JUN 24	69.1	JUN 24
1974	120	0500 MST, JUN 17	104	JUN 17
1975	40.2	1700 MST, JUL 14	39.1	JUL 14
1976	46.7	1730 MST, AUG 10	43.0	AUG 10
1977	63.1	0730 MST, JUN 9	57.5	JUN 9
1978	92.6	1145 MST, JUN 6	84.4	JUN 6

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 7

NORTH SASKATCHEWAN RIVER AT SAUNDERS - STATION NO. 05DC002

MAXIMUM ANNUAL DISCHARGE

YEAR	MAXIMUM INSTANTANEOUS m^3/s	TIME AND DATE	MAXIMUM DAILY m^3/s	DATE
1915	1240	JUN 27*		
1916			694	JUN 20
1917			464	JUL 17
1918			776	JUN 15**
1919			442	JUN 23
1920			521	JUL 3
1921			408	JUN 26
1922			439	JUL 7
1923				
1924				
1952	770	0800 MST, JUN 23	663	JUN 23
1953	609	1200 MST, JUL 15	580	JUL 15
1954	476	1400 MST, AUG 25	430	JUL 9
1955	518	1100 MST, JUL 19	507	JUL 19
1956	419	2100 MST, JUN 5	393	JUN 5
1957	345	1800 MST, JUN 8	328	JUN 8
1958	541	2100 MST, JUN 28	481	JUN 29
1959	493	JUN 27	476	JUN 27
1960	464	2100 MST, JUL 1	416	JUL 2
1961	487	0300 MST, JUN 8	459	JUN 7
1962	419	0300 MST, JUN 27	385	JUN 27
1963	416	1900 MST, JUL 8	408	JUL 9
1964	507	0800 MST, JUL 10	490	JUL 10
1965			600	JUL 8
1966	595	0500 MST, JUL 4	549	JUL 4
1967	453	1000 MST, JUN 18	447	JUN 18
1968	524	0744 MST, JUL 12	507	JUL 12
1969	396	0904 MST, JUN 6	382	JUN 6
1970	493	1545 MST, JUN 16	428	JUN 16
1971	442	1700 MST, JUN 6	430	JUN 6
1972	779	2200 MST, JUN 25	580	JUN 26
1973	188	0300 MST, JUL 5	164	MAY 18

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

(table 7 cont'd)

YEAR	MAXIMUM INSTANTANEOUS m^3/s	TIME AND DATE	MAXIMUM DAILY m^3/s	DATE
1974	207	0940 MST, JUN 26	194	JUN 22
1975	152	0230 MST, JUL 18	111	JUL 14
1976	160	0400 MST, SEP 8	142	JUL 22
1977	169	0000 MST, JUN 23	166	JUN 23
1978	226	1940 MST, JUL 11	185	JUL 6

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* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 8

BRAZEAU RIVER BELOW BIG BEND PLANT - STATION NO. 05DD005

MAXIMUM ANNUAL DISCHARGE

YEAR	MAXIMUM INSTANTANEOUS m^3/s	MAXIMUM INSTANTANEOUS TIME AND DATE	MAXIMUM DAILY m^3/s	MAXIMUM DAILY DATE
1957	289	1945 MST, MAY 20	216	MAY 3
1958	544	0500 MST, JUN 29	504	JUN 29
1959	492	1500 MST, JUN 27	416	JUN 27
1960	371	0530 MST, JUL 2	337	JUL 2
1961	365	1350 MST, JUL 30	328	JUL 30
1962	433	1200 MST, JUN 7	314	JUL 12
1963	365	1600 MST, APR 29	254	APR 30
1964	535	1900 MST, JUN 19	411	JUN 20
1965	549	1600 MST, JUN 29	496	JUN 29
1966	679	0730 MST, JUL 5*	575	JUL 5**
1967	308	1200 MST, JUN 22	198	JUN 26
1968	282	1700 MST, AUG 19	198	SEP 10
1969	345	2300 MST, JUL 5	270	JUL 6
1970	311	1400 MST, DEC 4	234	DEC 4
1971			257	JUN 10
1972			513	JUN 27
1973			209	MAY 8
1974	317	1615 MST, JUN 26	194	JUL 22
1975			130	DEC 12
1976			147	JAN 8
1977			226	JUN 3
1978	334	0500 MST, JUL 12	309	JUL 12

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 9

BATTLE RIVER NEAR UNWIN - STATION NO. 05FE001

MAXIMUM ANNUAL DISCHARGE

YEAR	MAXIMUM INSTANTANEOUS m^3/s	TIME AND DATE	MAXIMUM DAILY m^3/s	DATE
1944			39.4	AUG 7
1945			14.6	APR 3
1946			25.3	APR 3
1947			55.2	APR 10
1948			282	MAY 7
1949			22.8	AUG 1
1950			30.0	APR 22
1951			140	APR 13
1952			239	APR 12
1953			51.5	MAY 7
1954			51.5	SEP 2
1955			131	MAY 3
1956			185	APR 20
1957			46.1	APR 8
1958			98.2	APR 11
1959			8.4	APR 8
1960			29.2	APR 9
1961			10.6	APR 18
1962	68.2	0630 CST, JUL 20	64.6	JUL 20
1963			70.2	APR 1
1964			11.7	MAY 12
1965			185	APR 14
1966			44.7	APR 8
1967			56.4	MAY 6
1968			27.2	MAR 9
1969			210	APR 14
1970			121	APR 13
1971	189	1153 CST, APR 17	148	APR 17
1972			50.7	APR 15
1973	67.4	0813 CST, JUN 25	58.6	JUN 21
1974	402	1307 CST, MAY 3*	402	MAY 3**
1975	92.9	1946 CST, APR 28	92.3	APR 30
1976			58.0	APR 13
1977	16.6	1556 CST, MAY 21	16.1	MAY 21
1978	29.7	2357 CST, APR 9	27.8	APR 11

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 10

IRON CREEK NEAR HARDISTY - STATION NO. 05FB002

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1964				
1965			16.7	APR 18
1966			3.1	APR 6
1967			1.2	APR 25
1968			3.5	MAR 1
1969			19.2	APR 14
1970	8.2	1419 MST, APR 14	7.9	APR 16
1971	15.8	0500 MST, APR 21	15.7	APR 21
1972			4.0	APR 14
1973	6.9	1510 MST, AUG 15	6.9	AUG 15
1974	68.0	0230 MST, APR 23*	67.7	APR 23**
1975			8.4	APR 26
1976	7.4	0530 MST, APR 11	7.2	APR 11
1977	2.3	0800 MST, APR 11	1.4	MAY 18
1978	1.6	0100 MST, SEP 26	1.4	SEP 26

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 11

BATTLE RIVER NEAR PONOKA - STATION NO. 05FA001

MAXIMUM ANNUAL DISCHARGE

YEAR	MAXIMUM INSTANTANEOUS m^3/s	TIME AND DATE	MAXIMUM DAILY m^3/s	DATE
1913			17.0	JUL 16
1914			55.5	JUN 10
1915			55.8	JUN 6
1916			58.9	SEP 8
1917			59.5	APR 14
1918			7.1	APR 14
1919			28.3	APR 14
1920			90.9	MAY 9
1921			32.3	APR 16
1922			2.4	JUN 6
1923			6.3	JUL 11
1924			4.0	APR 28
1925			55.2	APR 10
1926	46.4	0735 MST, JUN 23	46.1	JUN 23
1927	78.4	JUL 10	75.6	JUL 11
1928			52.9	MAR 26
1929			8.7	APR 18
1930			1.5	APR 2
1931				
1932				
1966				
1967			17.4	APR 26
1968				
1969			66.0	APR 10
1970			31.7	APR 12
1971	55.5	1800 MST, APR 16	53.5	APR 16
1972			17.8	APR 9
1973	29.1	2400 MST, JUL 4	27.8	JUL 5
1974	108	1100 MST, APR 19*	105	APR 20**
1975			20.0	APR 22
1976			11.1	APR 10
1977	11.0	1300 MST, MAY 31	9.9	MAY 31
1978	13.8	0430 MST, APR 1	12.7	APR 1

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 12

RAM RIVER NEAR THE MOUTH - STATION NO.05DC006

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1915	951	JUN 27*		
1967	119	0430 MST, MAY 31	101	MAY 31
1968	65.1	1101 MST, JUL 22	57.2	JUL 22
1969	241	0642 MST, JUL 6	227	JUL 6
1970	303	1200 MST, JUN 16	239	JUN 16
1971	246	1000 MST, JUN 6	203	JUN 6
1972	470	0900 MST, JUN 25	413	JUN 25**
1973			114	MAY 31
1974	153	0350 MST, JUN 17	115	JUN 17
1975	39.1	0930 MST, JUN 3	31.4	JUN 3
1976			40.2	AUG 10
1977	103	0600 MST, JUN 2	88.9	JUN 2
1978	142	1030 MST, JUN 6	122	JUN 6

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 13

NORTH SASKATCHEWAN RIVER NEAR DEER CREEK - STATION NO. 05EF001

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1917				
1918			920	JUN 18
1919			549	JUN 27
1920			1480	MAY 11
1921				
1922				
1944	3480	2120 MST, JUN 17*	3110	JUN 17**
1945			677	JUN 4
1946			1290	JUN 26
1947			784	JUN 15
1948			1830	MAY 25
1949			804	JUL 24
1950			1120	JUN 19
1951			1020	MAY 5
1952	3310	1400 MST, JUN 26	3090	JUN 26
1953	1280	0400 MST, JUN 7	1240	JUN 7
1954	3230	0300 MST, JUN 10	3000	JUN 10
1955			912	JUN 17
1956			1250	APR 17
1957	660	1445 MST, JUN 13	651	JUN 13
1958	1390	0930 MST, JUL 2	1330	JUL 2
1969	1570	1600 CST, JUL 9	1550	JUL 9
1970			1360	JUN 20
1971	1100	0826 CST, JUN 10	1080	JUN 10
1972	3170	1159 CST, JUN 29	3030	JUN 29
1973	623	0449 CST, JUN 29	580	JUL 5
1974			1660	APR 25
1975	481	0144 CST, MAY 10	456	MAY 10
1976	442	2011 CST, AUG 22	439	AUG 22
1977	954	0205 CST, JUN 2	920	JUN 2
1978	951	0948 CST, JUN 15	943	JUN 15

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 14

STRAWBERRY CREEK NEAR THE MOUTH - STATION NO. 05DF004

MAXIMUM ANNUAL DISCHARGE

YEAR	MAXIMUM INSTANTANEOUS m^3/s	MAXIMUM INSTANTANEOUS TIME AND DATE	MAXIMUM DAILY m^3/s	MAXIMUM DAILY DATE
1966				
1967				
1968			13.6	APR 15
1969			8.1	MAR 6
			60.9	APR 9
1970			30.6	APR 6
1971	67.4	2300 MST, APR 15	52.4	APR 15
1972	59.7	2230 MST, APR 6	36.5	APR 7
1973			59.5	JUL 2
1974	122	2210 MST, APR 19*	102	APR 19**
1975			17.2	APR 19
1976			18.3	APR 7
1977	74.8	1250 MST, MAY 29	77.9	MAY 29
1978	37.7	0300 MST, JUL 12	25.4	JUL 12

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 15

STURGEON RIVER NEAR VILLENEUVE - STATION NO. 05EA005

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1914			40.8	JUN 12
1915			50.7	JUN 13
1928			10.5	MAY 13
1929				
1930			2.0	APR 6
1968				
1969			33.1	APR 12
1970	54.9	0049 MST, APR 11	46.4	APR 11
1971	100	2230 MST, APR 21	96.0	APR 21
1972	59.7	2130 MST, APR 15	58.9	APR 16
1973	12.7	0400 MST, APR 2	9.3	APR 2
1974	138	1540 MST, APR 21*	136	APR 22**
1975			26.5	APR 22
1976			15.9	APR 8
1977	16.8	0900 MST, APR 9	15.1	APR 9
1978	13.3	0940 MST, APR 4	10.8	APR 4

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s- cubic metres per second

TABLE 16

WASKATENAU CREEK NEAR WASKATENAU - STATION NO. 05EC002

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1966				
1967			5.4	MAY 4
1968			1.8	MAR 6
1969	6.7	0500 MST, APR 15	6.7	APR 15
1970	4.8	0009 MST, APR 15	4.6	APR 18
1971	45.3	1430 MST, APR 22*	44.2	APR 22**
1972	25.8	1630 MST, APR 17	17.4	APR 18
1973	3.1	1400 MST, JUN 26	0.9	JUN 26
1974	34.0	0500 MST, APR 21	32.8	APR 20
1975	3.1	1930 MST, APR 22	2.7	APR 23
1976	3.5	1630 MST, APR 10	3.5	APR 10
1977	5.8	1330 MST, APR 10	5.7	APR 10
1978	8.0	1350 MST, APR 8	7.5	APR 8

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s- cubic metres per second

TABLE 17

VERMILION RIVER NEAR VEGREVILLE - STATION NO. 05EE003

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1967				
1968			6.3	MAR 7
1969			13.3	APR 12
1970			6.5	APR 13
1971	21.6	0300 MST, APR 18	20.7	APR 18
1972	12.5	1340 MST, APR 15	12.2	APR 15
1973	18.8	0600 MST, JUL 7	18.5	JUL 7
1974	77.3	0610 MST, APR 20*	74.5	APR 20**
1975	10.4	1500 MST, APR 25	9.6	APR 25
1976			2.1	APR 12
1977				
1978	5.1	0900 MST, SEP 21	5.0	SEP 21

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 18

STURGEON RIVER NEAR FORT SASKATCHEWAN - STATION NO. 05EA001

MAXIMUM ANNUAL DISCHARGE

	MAXIMUM INSTANTANEOUS		MAXIMUM DAILY	
YEAR	m^3/s	TIME AND DATE	m^3/s	DATE
1914			51.8	JUN 22
1915			30.6	JUN 23
1916			17.0	APR 18
1917			31.4	APR 24
1918			16.4	APR 14
1919			10.8	APR 15
1920			28.9	MAY 14
1921			17.0	APR 13
1922			3.8	APR 29
1923			3.2	MAY 4
1927				
1928				
1929			8.7	APR 27
1930			4.4	APR 15
1931				
1935			32.8	MAY 4
1936			58.0	APR 25
1937			9.2	APR 17
1938			20.3	APR 16
1939			5.2	APR 22
1940			47.3	APR 21
1941			12.8	APR 11
1942			4.0	APR 22
1943			54.4	APR 15
1944			38.5	JUN 28
1945			5.5	APR 9
1946			13.7	APR 12
1947			10.5	APR 16
1948			89.8	MAY 7
1949			13.6	APR 13

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

(table 18 cont'd)

YEAR	MAXIMUM INSTANTANEOUS m^3/s	MAXIMUM INSTANTANEOUS TIME AND DATE	MAXIMUM DAILY m^3/s	MAXIMUM DAILY DATE
1950			6.7	APR 24
1951			11.4	MAY 3
1952			29.4	APR 15
1953			33.4	AUG 14
1954	31.1	0400 MST, JUN 19	28.9	JUN 19
1955			18.3	APR 12
1956			51.3	APR 30
1957			14.0	APR 19
1958	63.7	1700 MST, APR 7*	42.2	APR 7
1959	15.0	1030 MST, APR 4	13.5	APR 4
1960			14.1	APR 10
1961	20.8	1115 MST, MAR 30	18.9	MAR 30
1962			25.2	APR 23
1963			17.6	APR 24
1964			10.6	APR 21
1965			37.1	JUL 11
1966			36.8	APR 6
1967			22.4	MAY 1
1968			8.5	MAR 14
1969			18.4	APR 11
1970			27.3	APR 19
1971			51.0	APR 28
1972			44.5	APR 22
1973			12.3	APR 11
1974			115	APR 27**
1975			21.1	APR 25
1976			13.5	APR 8
1977			21.7	APR 10
1978			21.0	APR 11

* - Maximum Instantaneous Discharge
** - Maximum Daily Discharge
m^3/s - cubic metres per second

TABLE 19

NORTH SASKATCHEWAN RIVER BASIN

AVERAGE RATIOS OF ANNUAL MAXIMUM INSTANTANEOUS PEAK

TO ANNUAL MAXIMUM MEAN DAILY FLOWS

Station Number	Station Name	Peak to Mean Ratio
05DF001	North Saskatchewan River at Edmonton	1.07
05DC001	North Saskatchewan River at Rocky Mountain House	1.04
05DB001	Clearwater River near Rocky Mountain House	1.09
05DA007	Mistaya River near Saskatchewan Crossing	1.04
05DB002	Prairie Creek near Rocky Mountain House	1.08
05DB003	Clearwater River above Limestone Creek	1.18
05DC002	North Saskatchewan River at Saunders	1.07
05DD005	Brazeau River below Big Bend Plant	1.20
05FE001	Battle River near Unwin	1.09
05FB002	Iron Creek near Hardisty	1.12
05FA001	Battle River near Ponoka	1.05
05DC006	Ram River near the Mouth	1.17
05EF001	North Saskatchewan River near Deer Creek	1.06
05DF004	Strawberry Creek near the Mouth	1.36
05EA005	Sturgeon River near Villeneuve	1.14
05EC002	Waskateneau Creek near Waskateneau	1.33
05EE003	Vermilion River near Vegreville	1.04
05EA001	Sturgeon River near Fort Saskatchewan	1.20

TABLE 20

RECORDED MAXIMUM GAUGE HEIGHTS AND RISE IN WATER LEVELS

DUE TO ICE FOR SELECTED STATIONS IN THE

NORTH SASKATCHEWAN RIVER BASIN

Station *	BREAK-UP			FREEZE-UP			ICE COVER PERIOD		
	Maximum Gauge Height Recorded (m)	Date	Rise in Gauge Height Above Pre-break-up (m)	Maximum Gauge Height Recorded (m)	Date	Rise in Gauge Height Above Pre-freeze-up (m)	Maximum Gauge Height Recorded (m)	Date	Maximum Gauge Height During Ice Conditions (m)
05DF001	5.36	May 7/20	1.27	4.67	Nov. 24/74	1.38			
05DC001	4.43	Apr. 14/75	0.52	3.96	Nov. 14/73	0.25	4.94	Dec. 17/75	2.15
05DB001	2.39	Apr. 12/56	--	2.05	Nov. 6/66	1.25	2.44	Mar. 29/56	0.12
05DA007	1.46	May 20/72	0.07	1.17	Oct. 17/61	0.20	1.42	Apr. 20/68	--
05DB002	1.44	Apr. 6/52	0.41	0.89	Oct. 28/56	0.42	1.73	May 3/22	0.35
05DB003	1.00	May 6/70	0.20	0.84	Oct. 22/63	0.02		No Record	
05DD005		No Record		0.93	Nov. 1/59	0.02		No Record	
05FB002	4.23	Apr. 24/74	1.41	1.45	Oct. 29/64	0.02	2.27	Mar. 12/68	No Record
05FA001	4.07	Apr. 18/27	1.36	1.26	Nov. 2/22	--	3.34	Mar. 26/28	0.99
05DC006	1.58	Apr. 16/74	0.10	1.22	Nov. 29/77	0.16	1.97	Apr. 1/78	0.14
05DF004	3.65	Apr. 17/74	2.40	0.86	Oct. 20/75	0.02	2.20	Apr. 18/75	1.63
05EA005	4.18	Apr. 21/74	No Record	1.08	Oct. 22/15	--	1.76	Mar. 30/15	--
05EC002	3.04	Apr. 22/71	0.96	0.87	Oct. 16/76	--	1.88	Apr. 5/78	0.20
05EE003	3.60	Apr. 20/74	1.77	1.39	Oct. 31/73	0.03	1.72	Mar. 7/68	0.07
05EA001	3.01	Apr. 7/58	1.05	1.31	Oct. 28/76	0.03	2.33	Apr. 14/56	0.63

* See Figures 1 and 2 for station details.

TABLE 21

DATES OF FIRST AND LAST ICE
FOR SELECTED STATIONS IN THE NORTH SASKATCHEWAN RIVER BASIN

Station	Dates of Last Ice			Dates of First Ice		
	Earliest	Mean	Latest	Earliest	Mean	Latest
05DF001	Mar. 15/61	Apr. 15	May 7/20	Oct. 10/69	Nov. 6	Dec. 7/33
05DC001	Apr. 6/15	Apr. 23	May20/67	Oct. 22/19 & 57	Nov. 10	Dec. 24/54
05DB001	Apr. 4/15	Apr. 19	May 5/20 & 54	Oct. 15/30	Nov. 6	Nov. 28/54
05DA007	Apr. 25/74	May 6	May 19/72	Oct. 26/69 & 70	Nov. 1	Nov. 11/76
05DB002	Apr. 6/60	Apr. 20	May 18/22	Oct. 4/57	Oct. 30	Nov. 12/65
05DB003	No Record			Oct. 24/67	Nov. 1	Nov. 16/60
05DD005	Apr. 6/57	Apr. 19	Apr. 26/59	Nov. 4/59	Nov. 5	Nov. 17/57
05FB002	Apr. 6/66	Apr. 15	Apr. 29/67	Oct. 25/78	Oct. 29	Oct. 31/73
05FA001	Mar. 31/68	Apr. 15	Apr. 28/24 & 30	Oct. 11-13 /19	Oct. 29	Nov. 12/31
05DC006	Apr. 5/73 & 77	Apr. 22	May 1/67	Oct. 16/71	Oct. 27	Nov. 23/77
05DF004	Apr. 4/73	Apr. 12	Apr. 26/75	Oct. 23/76	Oct. 26	Nov. 2/71
05EA005	Apr. 4/73	Apr. 10	Apr. 22/75	Oct. 15/30	Oct. 27	Nov. 9/78
05EC002	Mar. 30/76	Apr. 12	Apr. 22/67 71, & 75	Oct. 7/70	Oct. 20	Oct. 30/73
05EE003	Apr. 2/78	Apr. 12	Apr. 25/75	Oct. 26/70	Oct. 26	Oct. 31/73
05EA001	Mar. 31/61	Apr. 18	May 5/67	Oct. 15/30	Oct. 27	Nov. 6/21 & 22

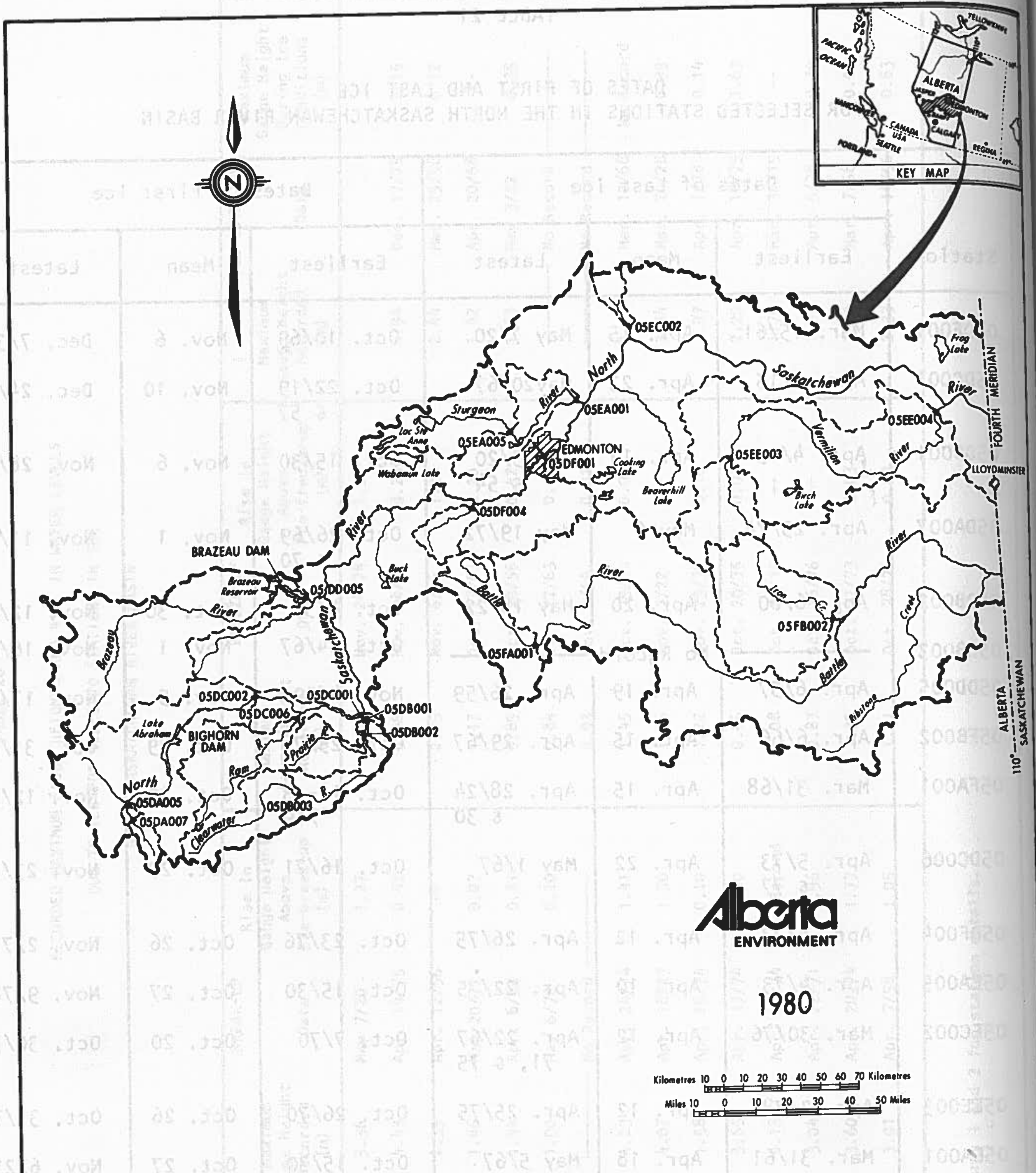


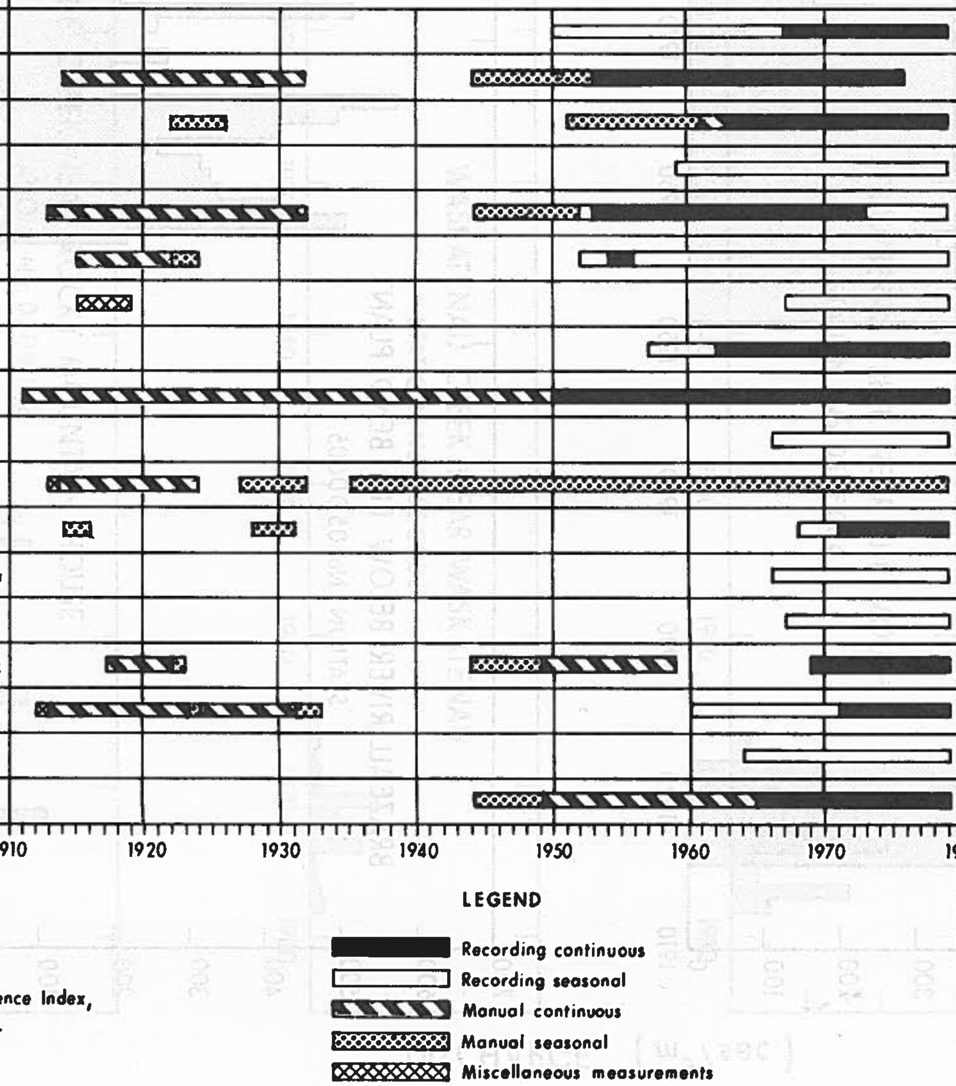
FIG. 1 - NORTH SASKATCHEWAN RIVER BASIN IN ALBERTA

NORTH SASKATCHEWAN RIVER BASIN

SELECTED HYDROMETRIC GAUGING STATIONS * *

STATION No.	RIVER	STATION NAME	No. OF FULL YEARS	No. OF PART YEARS	DRAINAGE AREA (Km²)	LOCATION LATITUDE LONGITUDE	REGULATED OR NATURAL FLOW
05DA007	Mistaya River	Sask. Crossing	12	17	249	51° 53' 00" 116 41 20	Natural
05DB001	Clearwater River	Rocky Mtn. House	41	9	3210	52 20 40 114 56 10	Natural
05DB002	Prairie Creek	Rock. Mtn. House	18	14	860	52 16 20 114 55 50	Natural
05DB003	Clearwater River	Limestone Creek		20	1330	51 59 30 115 26 00	Natural
05DC001	N. Sask. River	Rocky Mtn. House	39	15	11000	52 22 51 114 56 21	Regulated 1972
05DC002	N. Sask. River	At Saunders	9	27	5150	52 27 10 115 45 20	Regulated 1972
05DC006	Ram River	Near the Mouth		16	1860	52 21 55 115 25 33	Natural
05DD005	Brazeau River	Big Bend Plant	17	5	5650	52 54 45 115 21 50	Regulated 1960
05DF001	N. Sask. River	At Edmonton	68		28000	53 32 20 113 29 10	Regulated 1960
05DF004	Strawberry Cr.	Near the Mouth		13	583	53 18 41 114 03 02	Natural
05EA001	Sturgeon River	Near Fort Sask.	10	50	3340	53 47 14 113 13 23	Natural
05EA005	Sturgeon River	Near Villeneuve	8	8	1910	53 39 20 113 45 40	Natural
05EC002	Waskatenau Cr.	Near Waskatenau		13	311	54 07 23 112 46 58	Natural
05EE003	Vermilion River	Near Vegreville		12	1590	53 27 54 112 03 52	Natural
05EF001	N. Sask. River	Near Deer Creek	25	6	57000	53 31 00 109 36 40	Regulated 1962
05FA001	Battle River	Near Ponoka	25	8	1840	52 39 44 113 34 56	Natural
05FB002	Iron Creek	Near Hardisty		15	3500	52 42 28 111 18 36	Natural
05FE001	Battle River	Near Unwin	30	5	25900	52 56 25 109 52 25	Natural

YEARS OF RECORD (to December 1978)



* * From Surface Water Data Reference Index, 1978 Water Survey of Canada.

FIG. 2

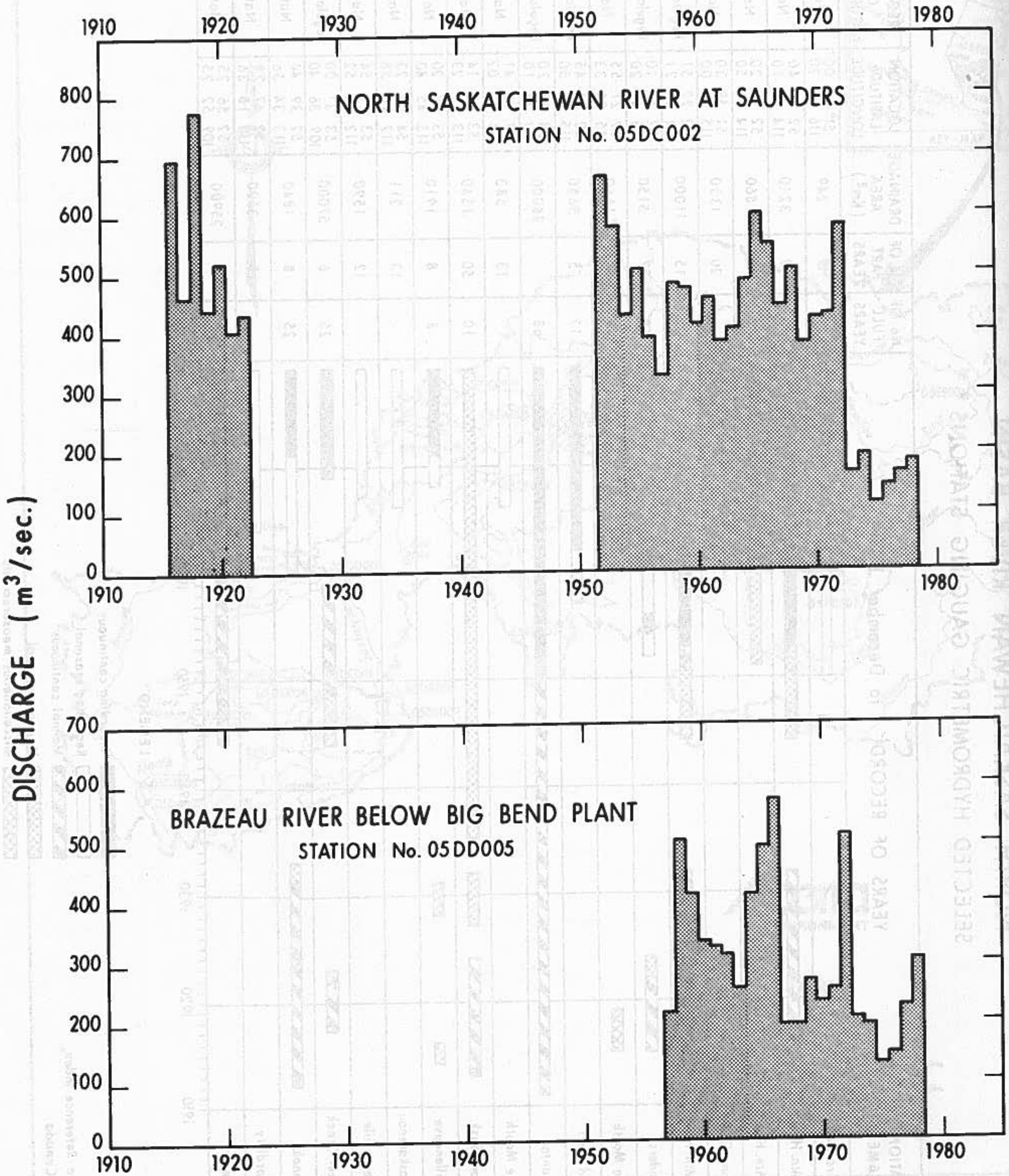


FIG. 3 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

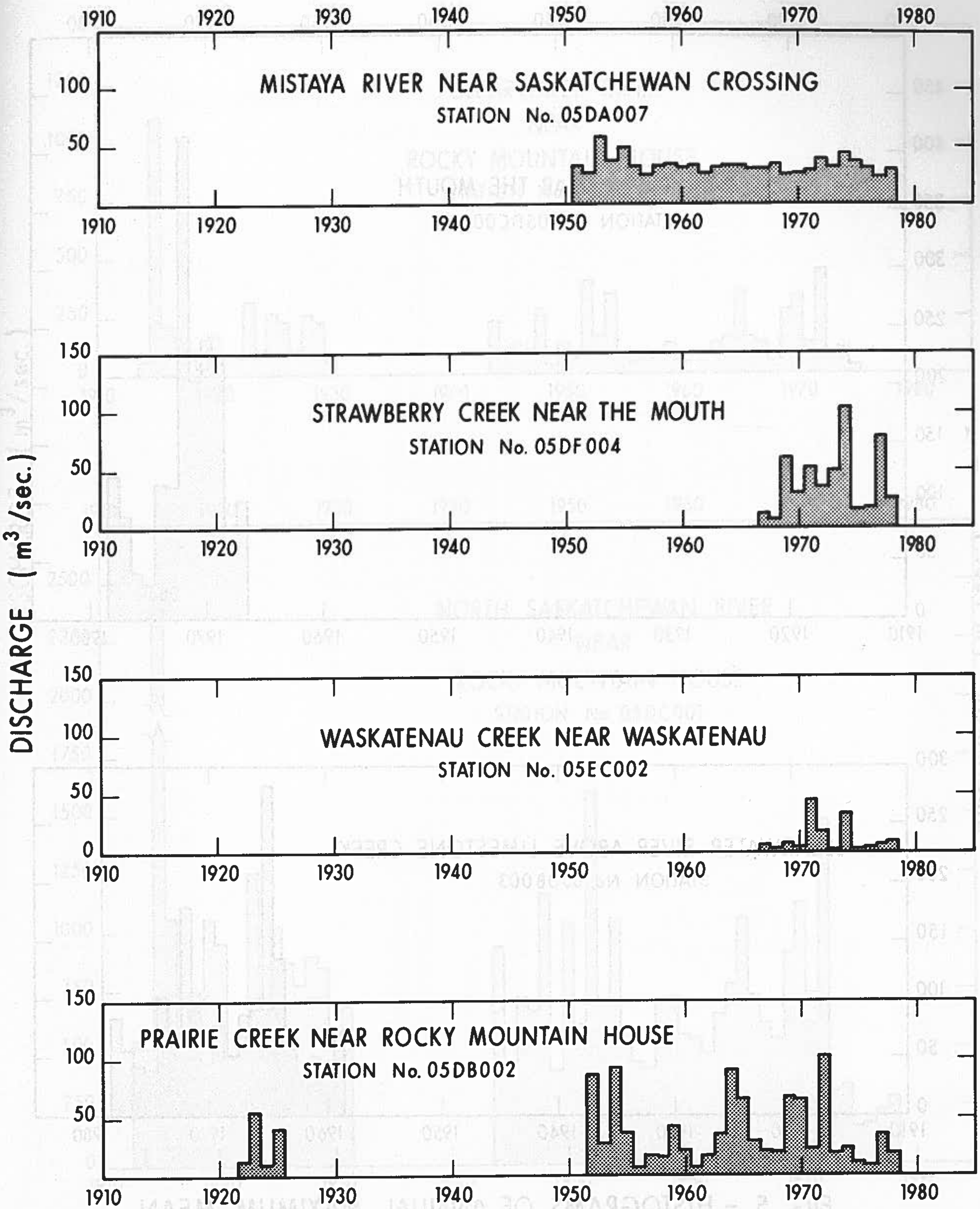


FIG. 4 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

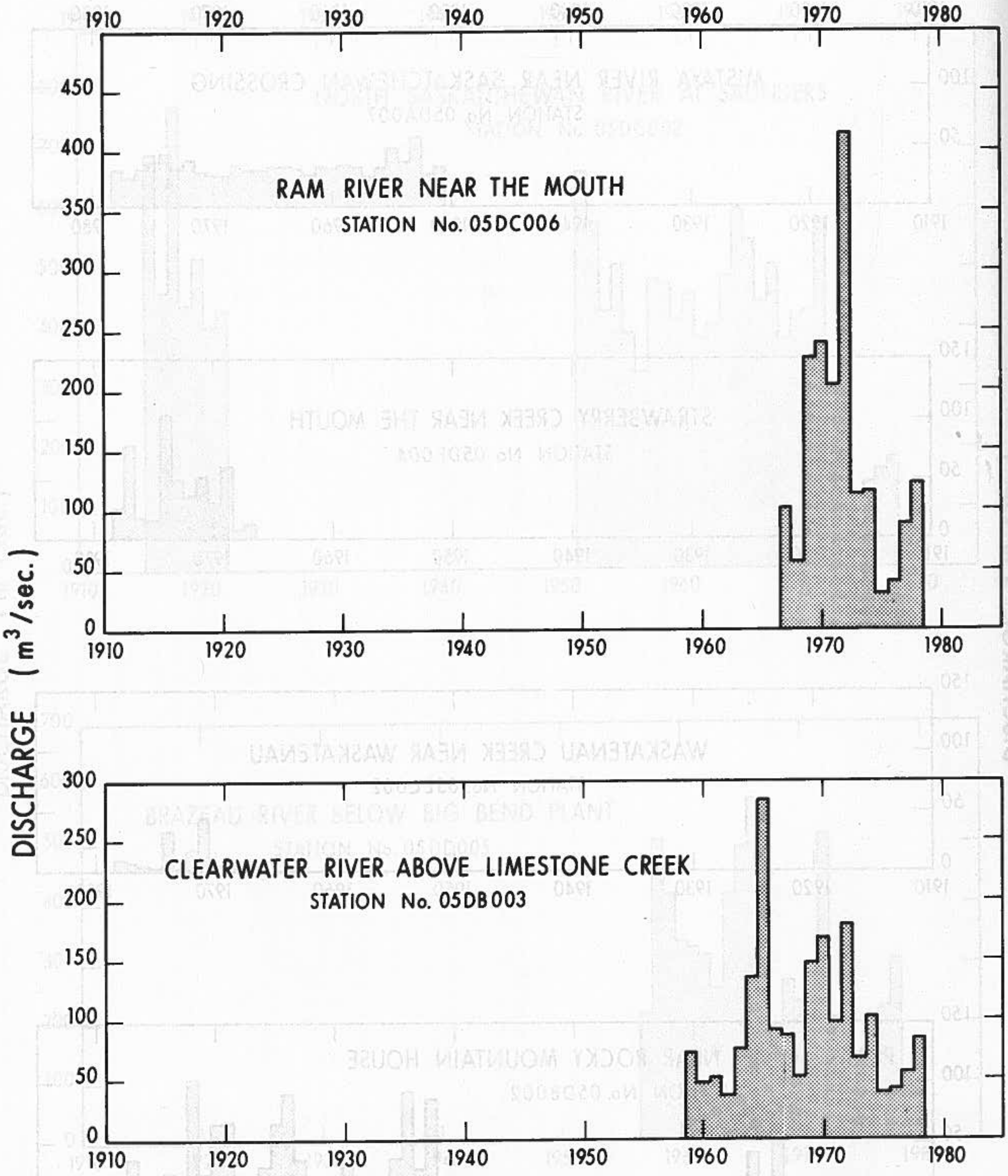


FIG. 5 – HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

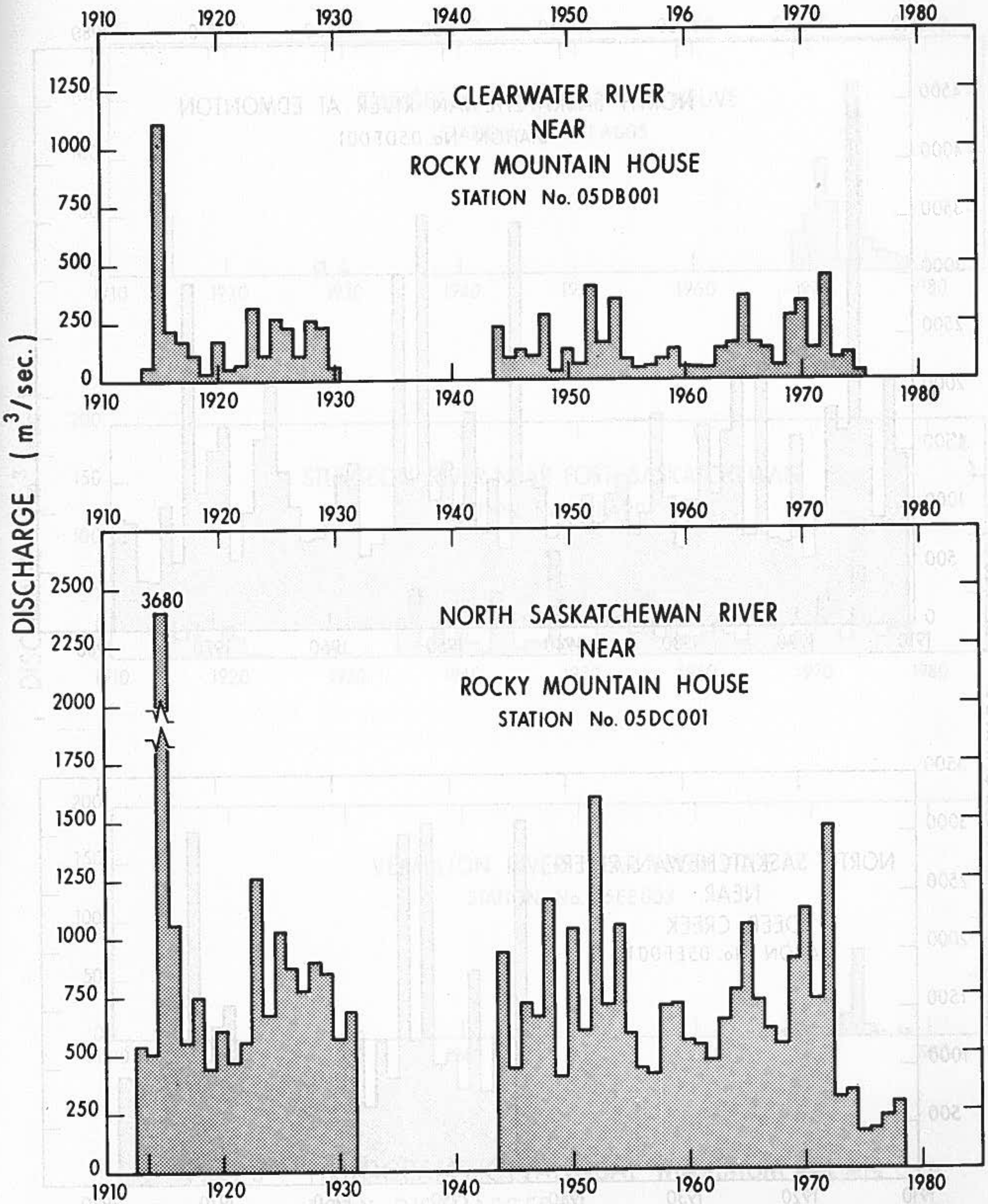


FIG. 6 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

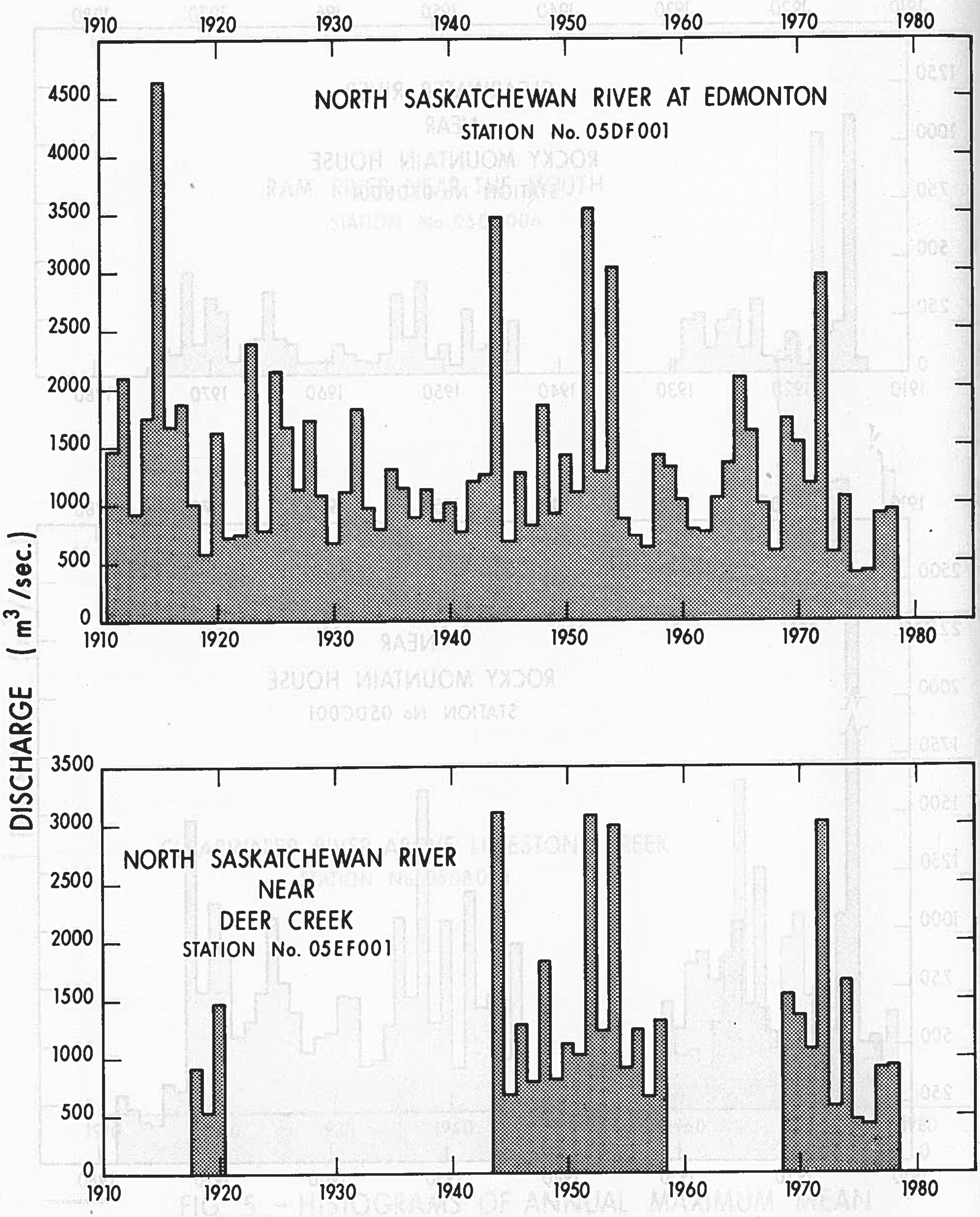


FIG. 7 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

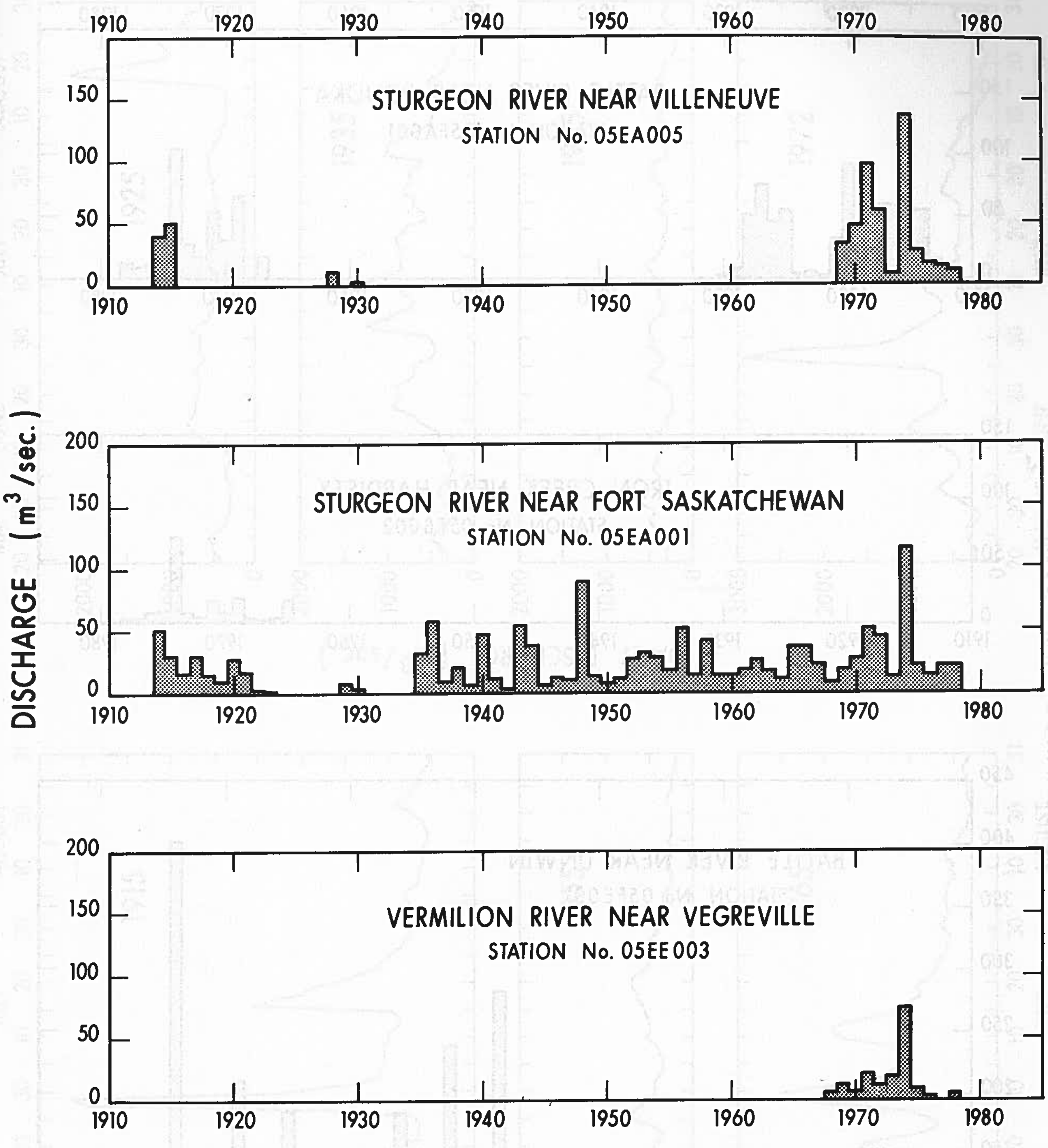


FIG. 8 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

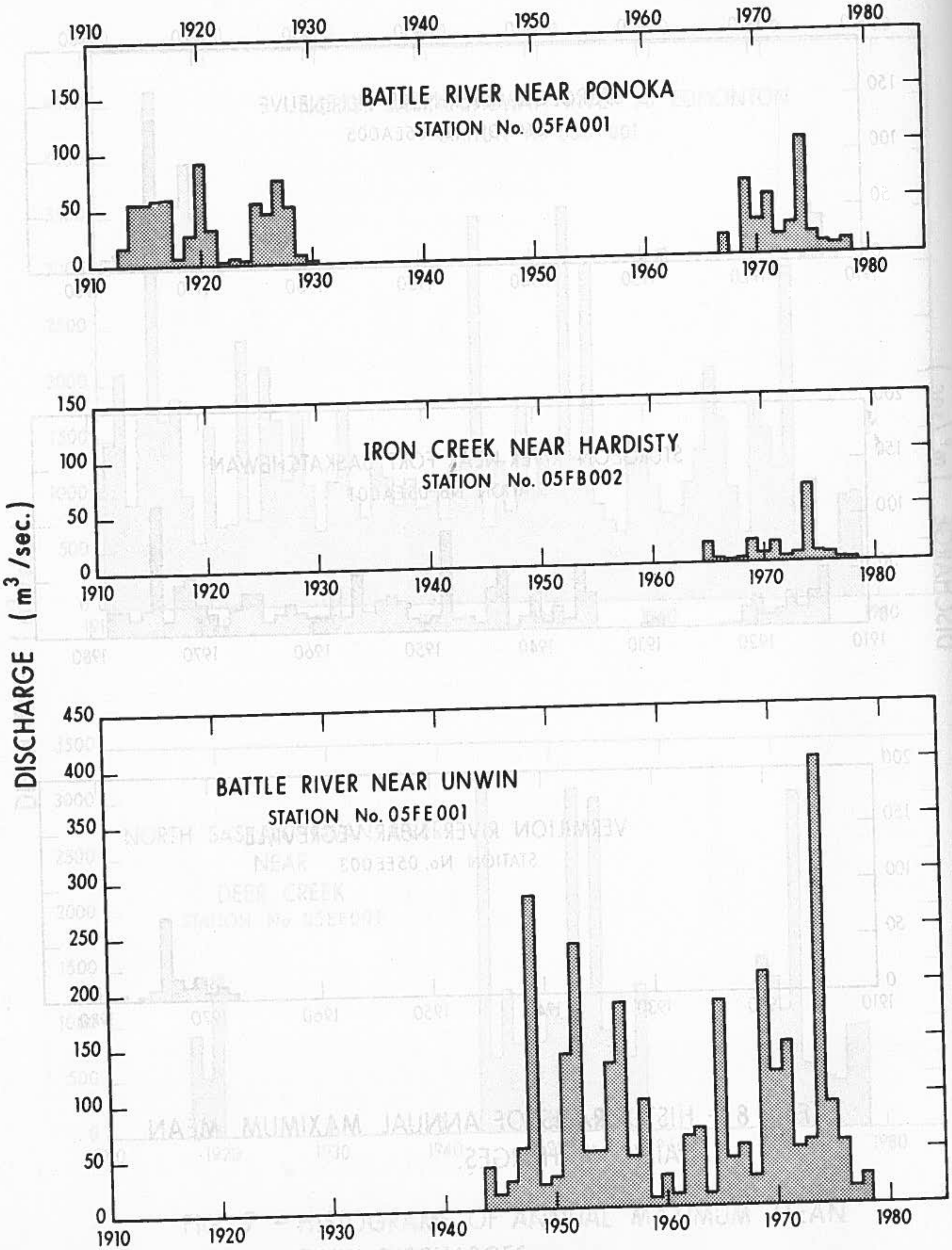


FIG. 9 - HISTOGRAMS OF ANNUAL MAXIMUM MEAN DAILY DISCHARGES.

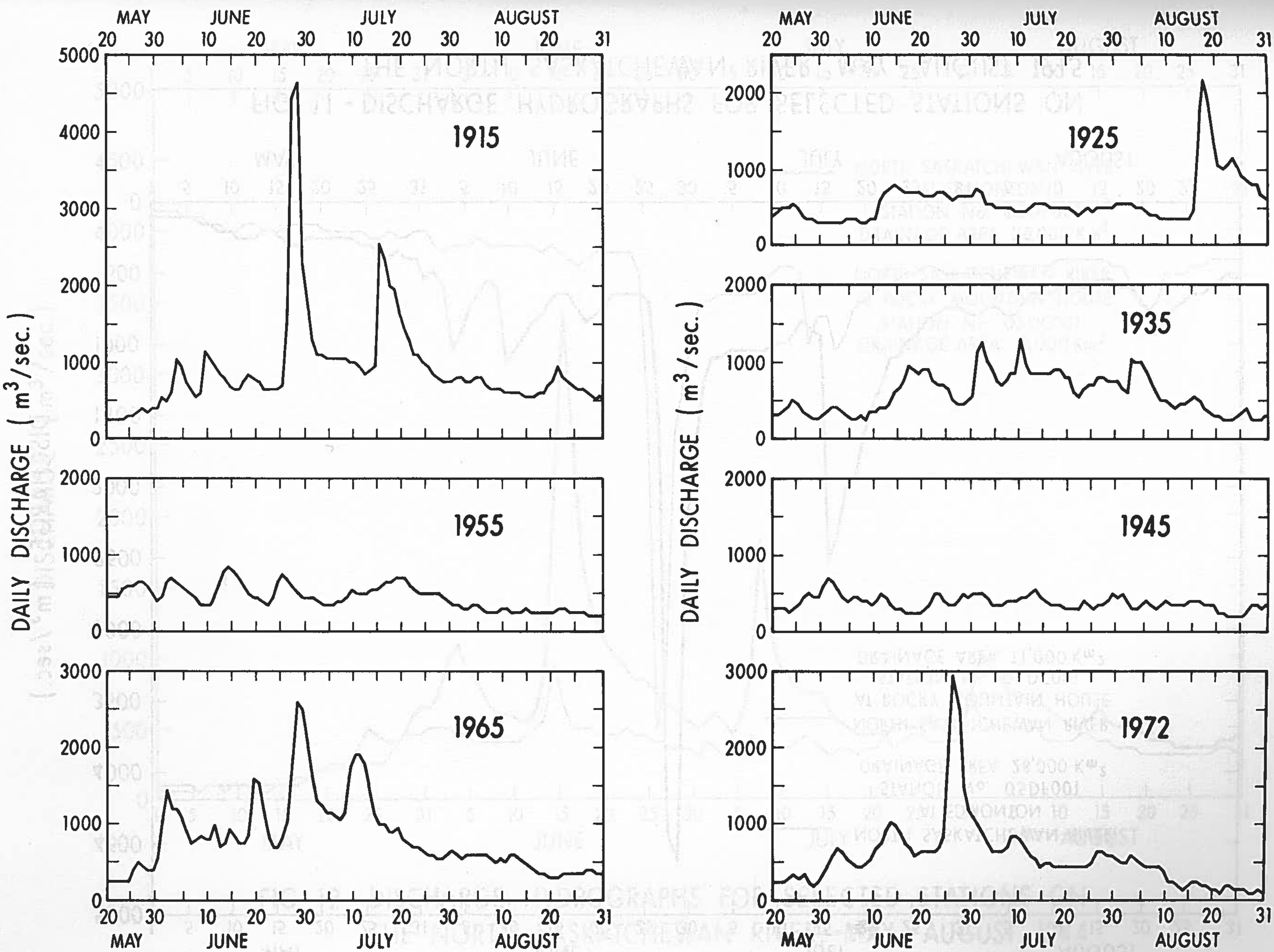


FIG. 10 – SELECTED DAILY DISCHARGE HYDROGRAPHS, NORTH SASK. RIVER AT EDMONTON (May – August)

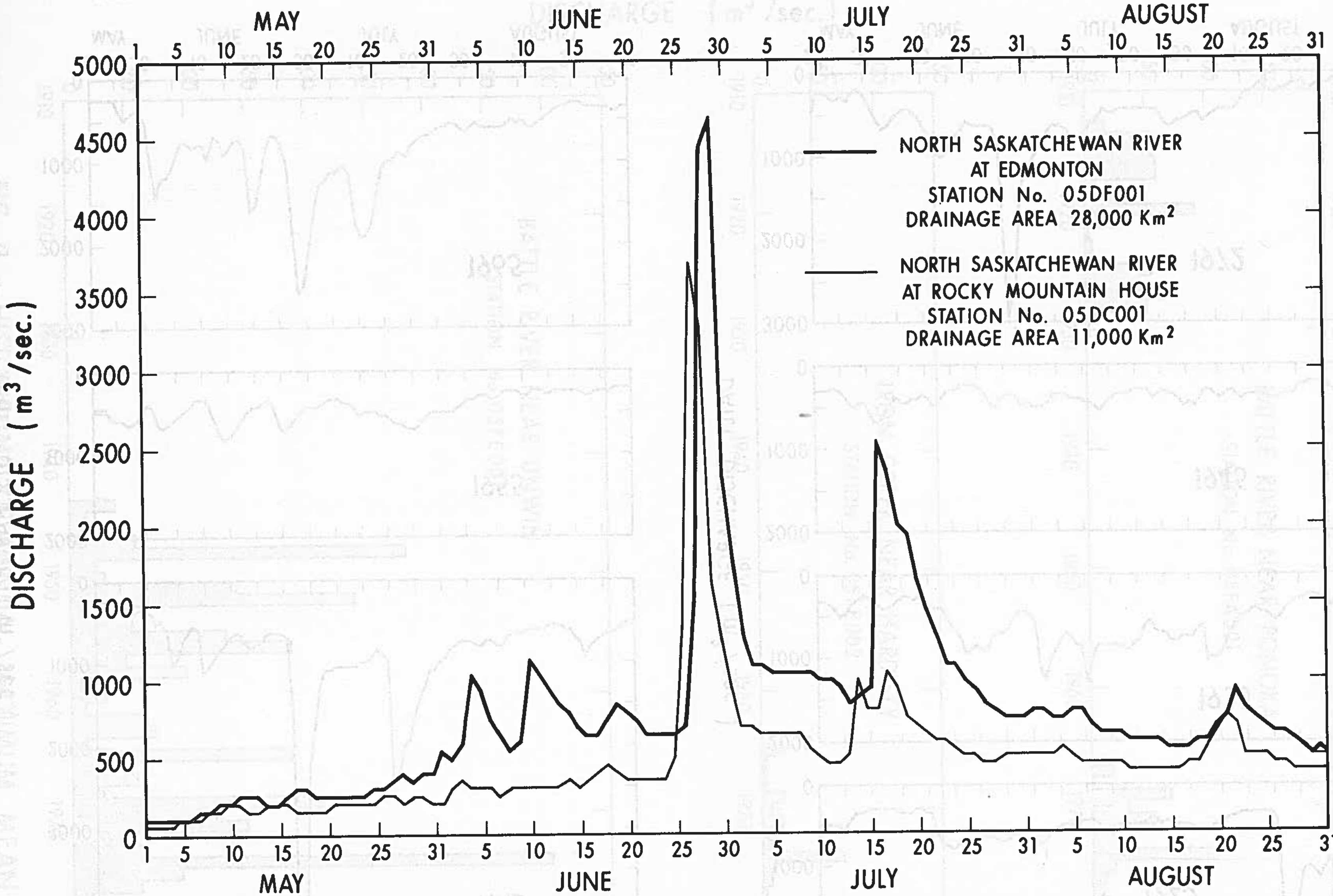


FIG. 11 - DISCHARGE HYDROGRAPHS FOR SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER, MAY - AUGUST 1915

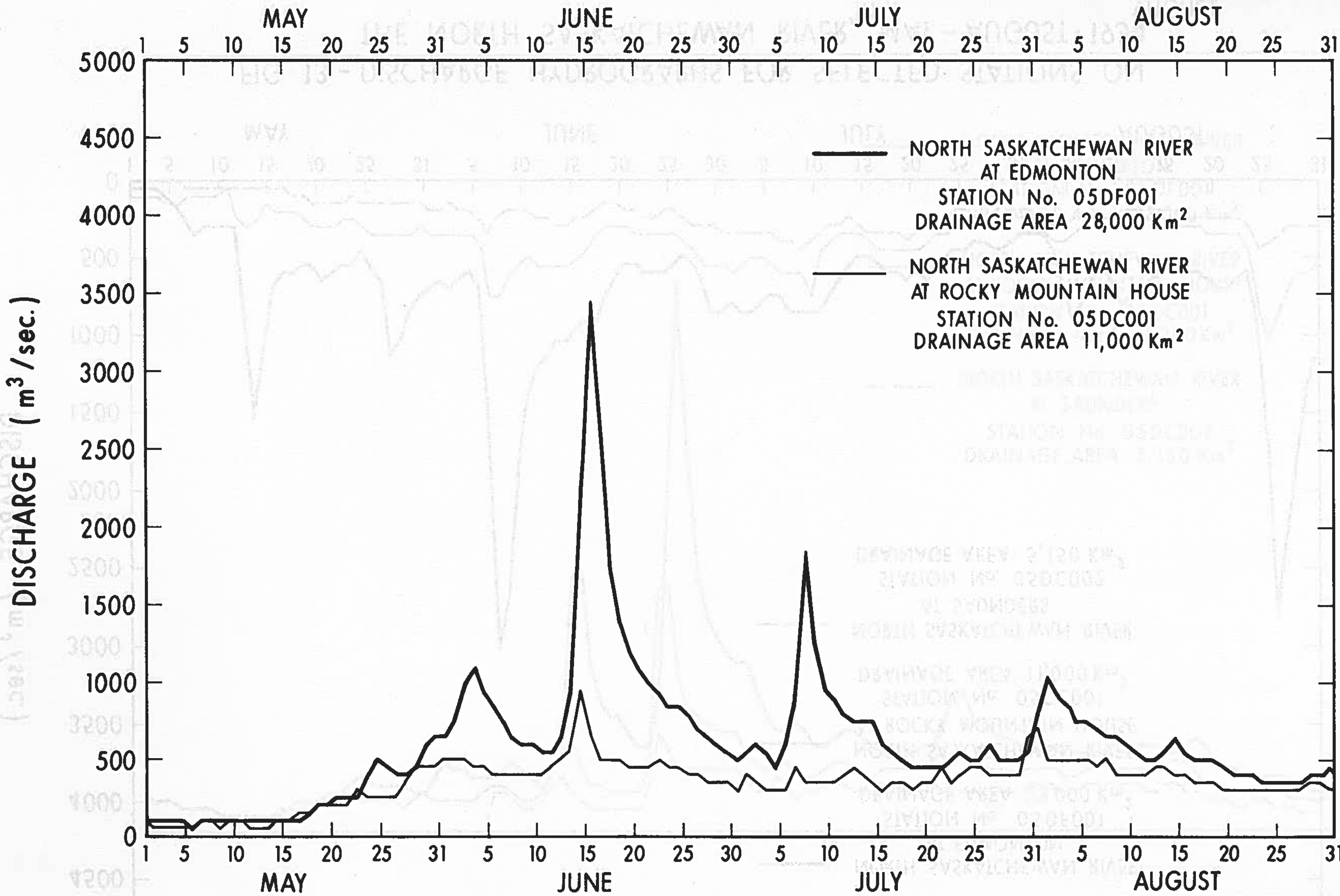


FIG. 12 - DISCHARGE HYDROGRAPHS FOR SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER, MAY - AUGUST 1944

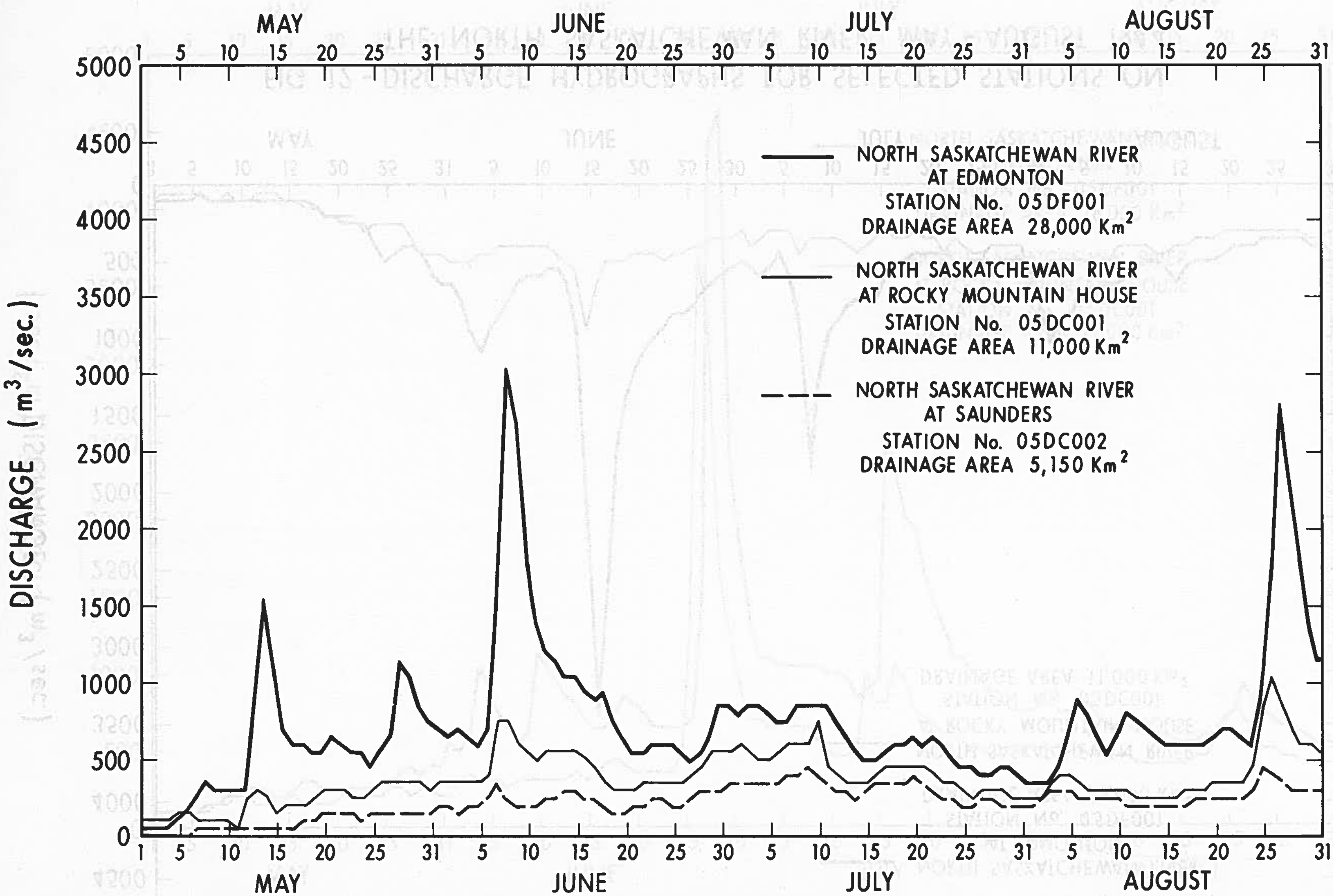


FIG. 13 - DISCHARGE HYDROGRAPHS FOR SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER, MAY - AUGUST 1954

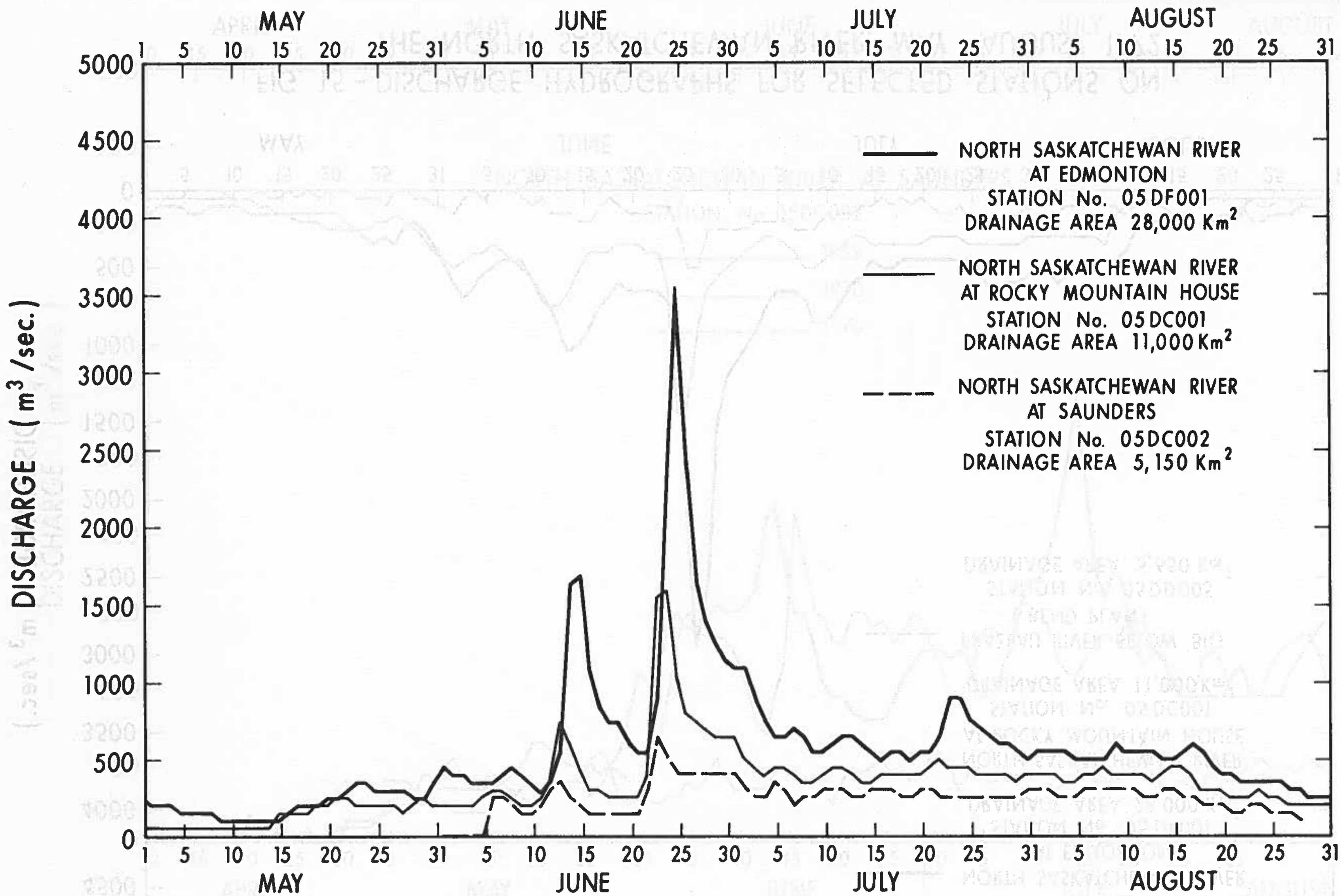


FIG. 14 - DISCHARGE HYDROGRAPHS FOR SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER, MAY - AUGUST 1952

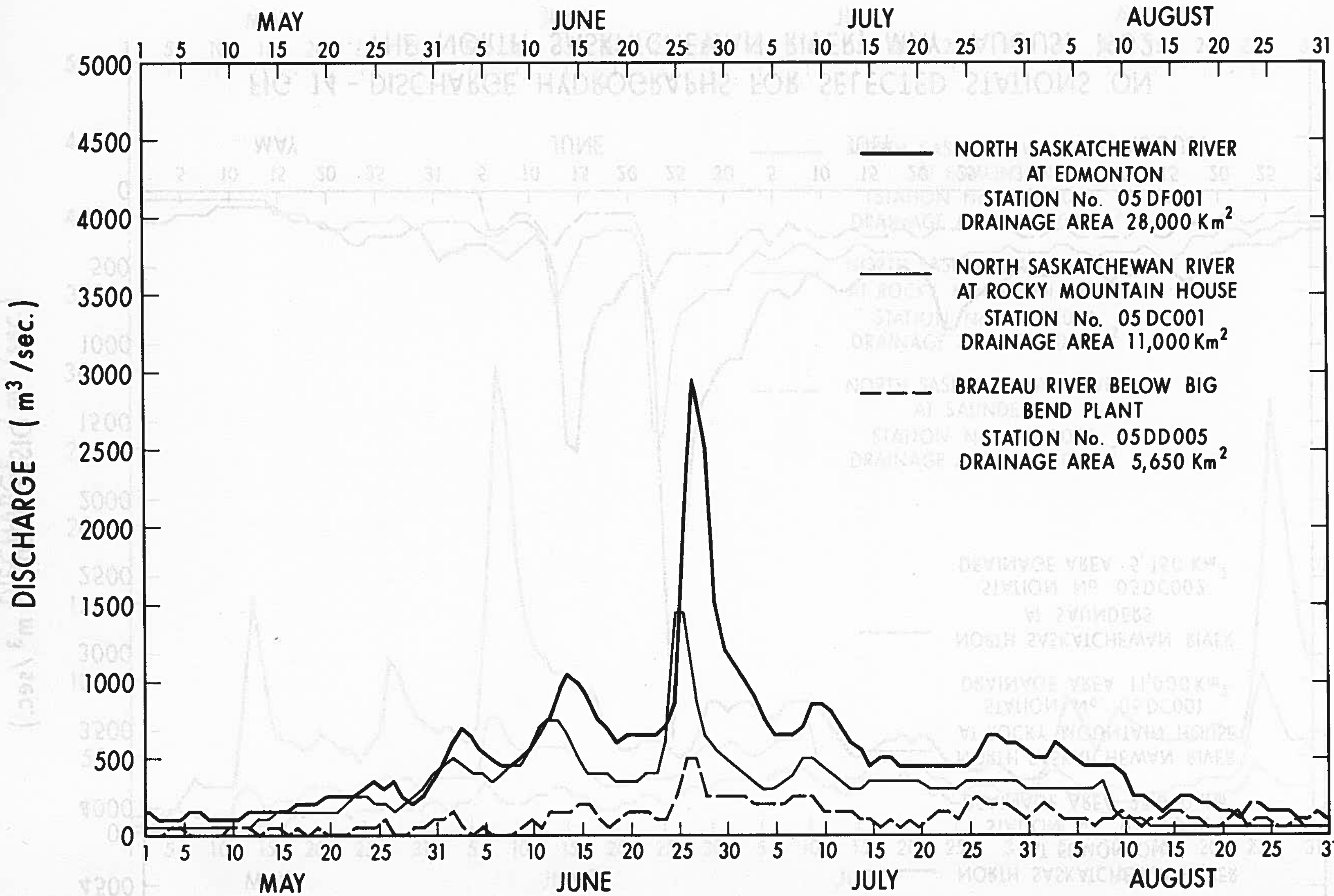


FIG. 15 - DISCHARGE HYDROGRAPHS FOR SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER, MAY - AUGUST 1972

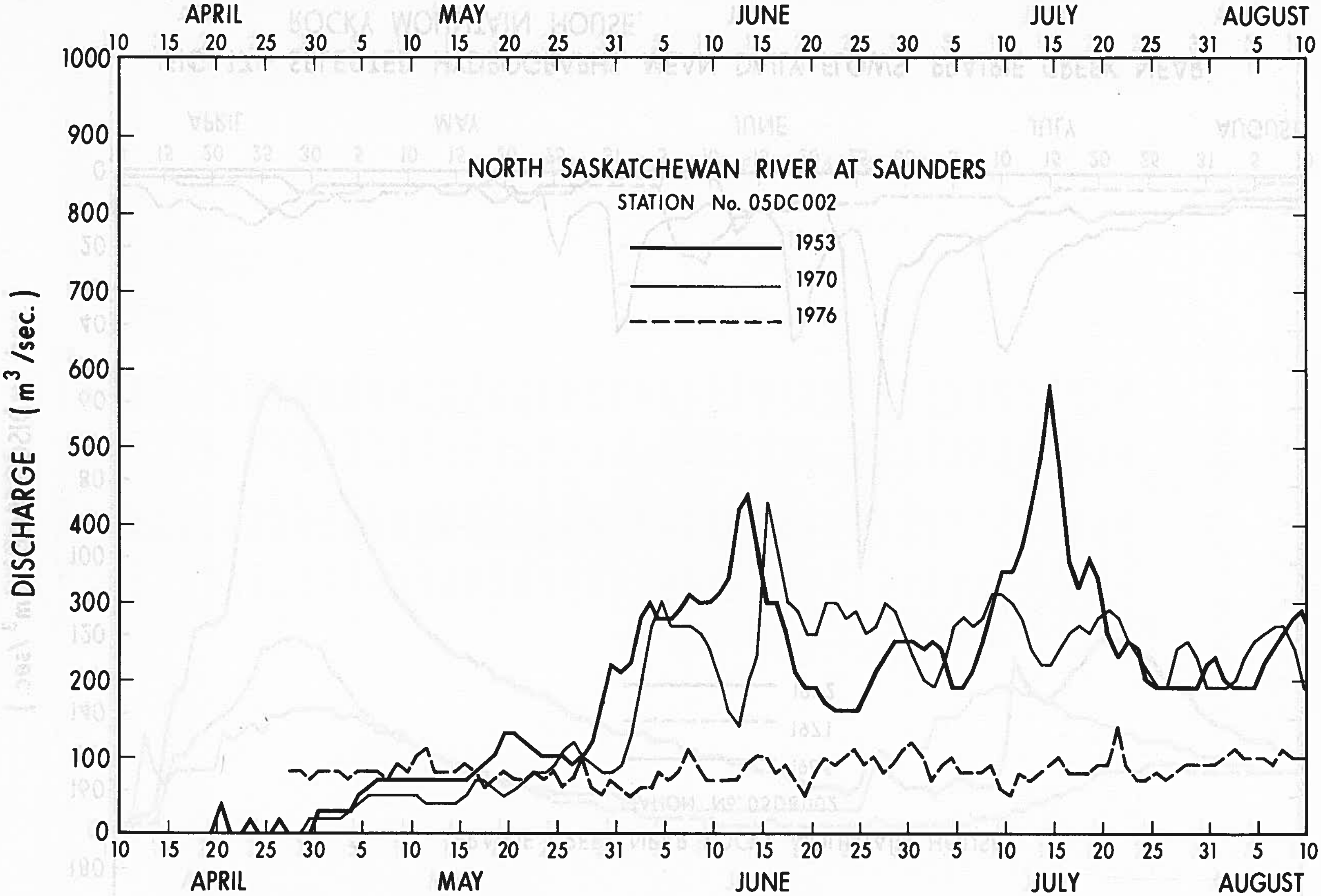


FIG. 16 - SELECTED HYDROGRAPHS, MEAN DAILY FLOWS, NORTH SASKATCHEWAN RIVER AT SAUNDERS.

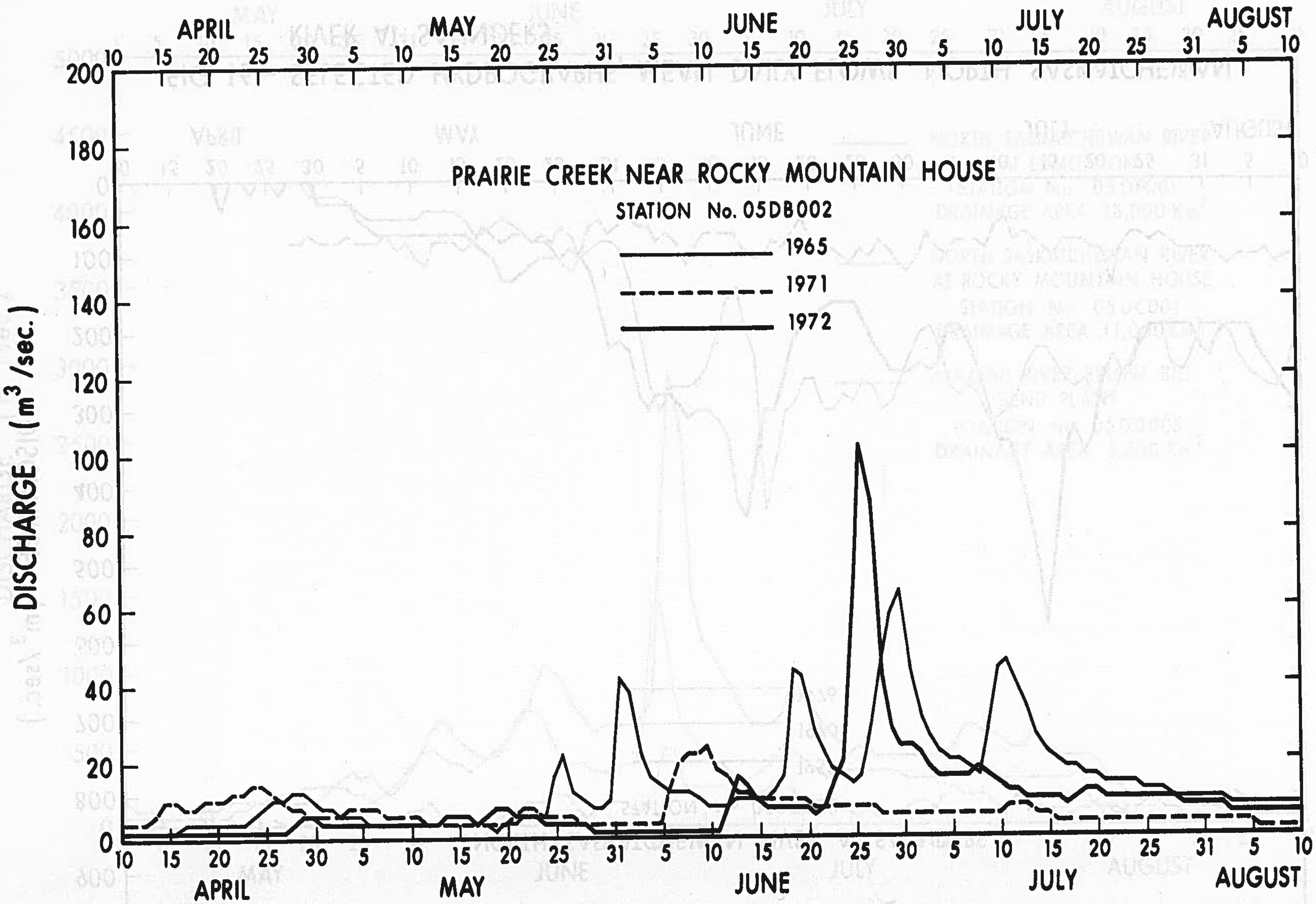


FIG. 17 - SELECTED HYDROGRAPHS, MEAN DAILY FLOWS, PRAIRIE CREEK NEAR ROCKY MOUNTAIN HOUSE.

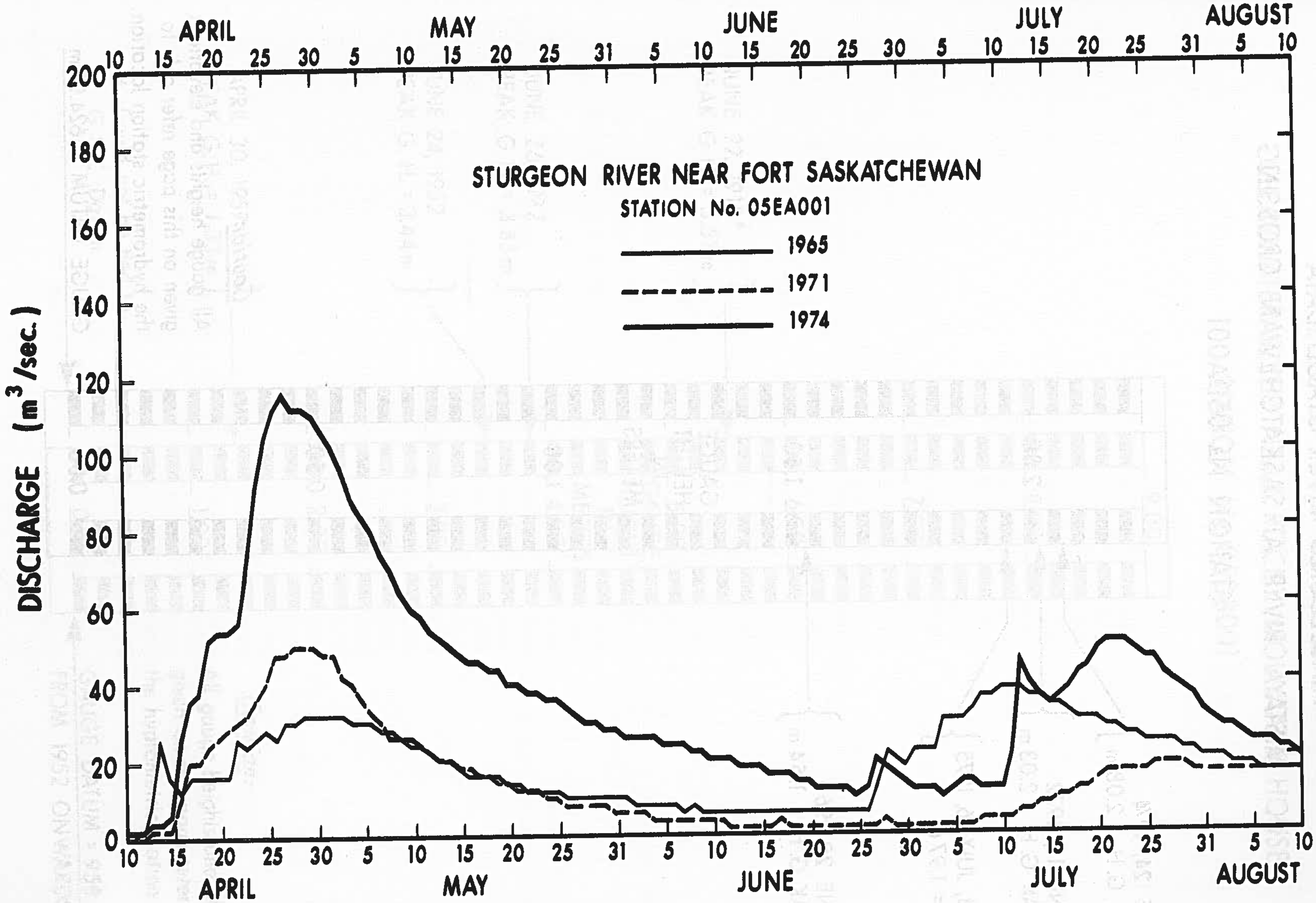
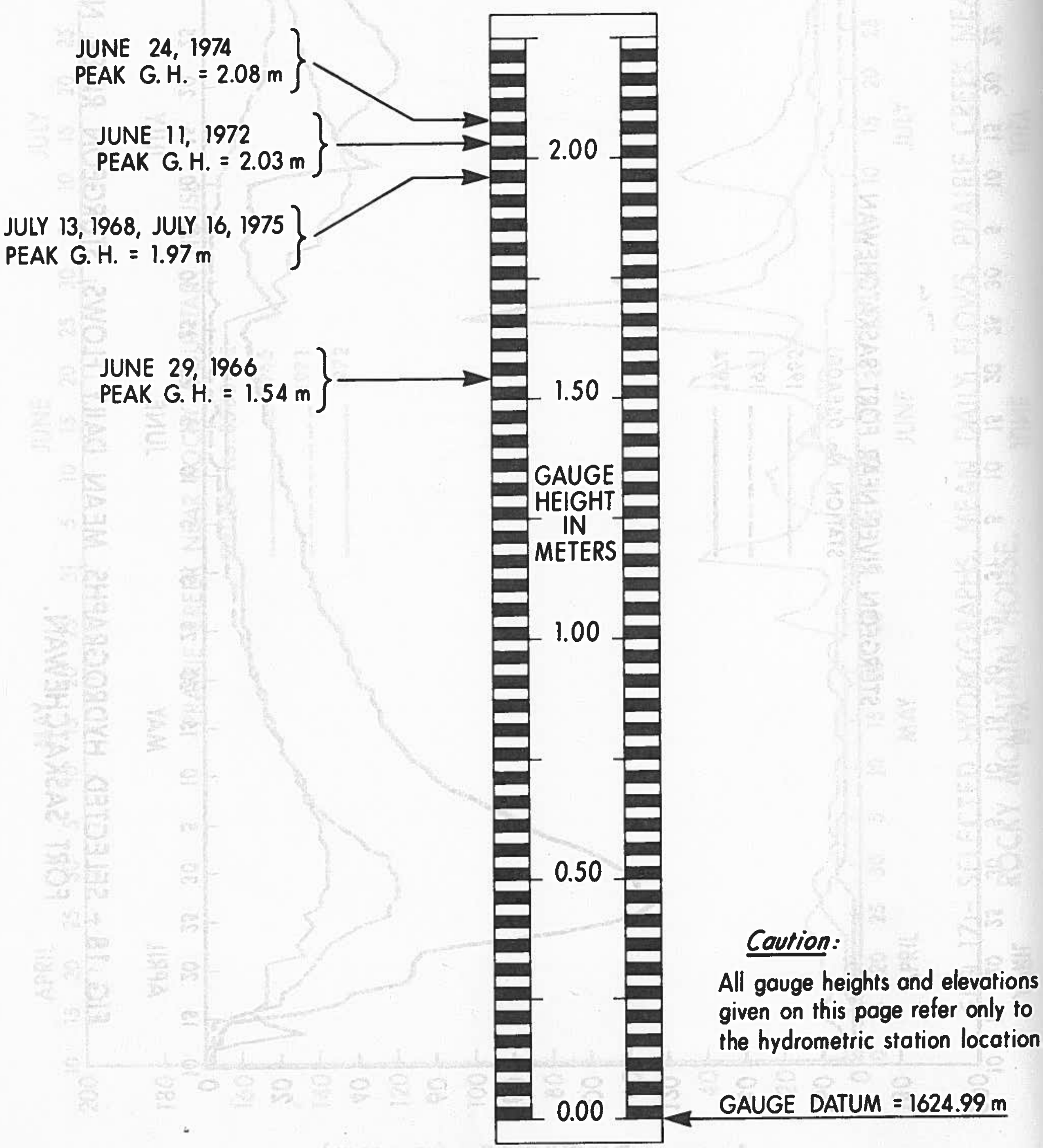


FIG. 18 – SELECTED HYDROGRAPHS, MEAN DAILY FLOWS, STURGEON RIVER NEAR FORT SASKATCHEWAN.

SELECTED RIVER STAGE DATA
MISTAYA RIVER AT SASKATCHEWAN CROSSING
STATION № 05DA001

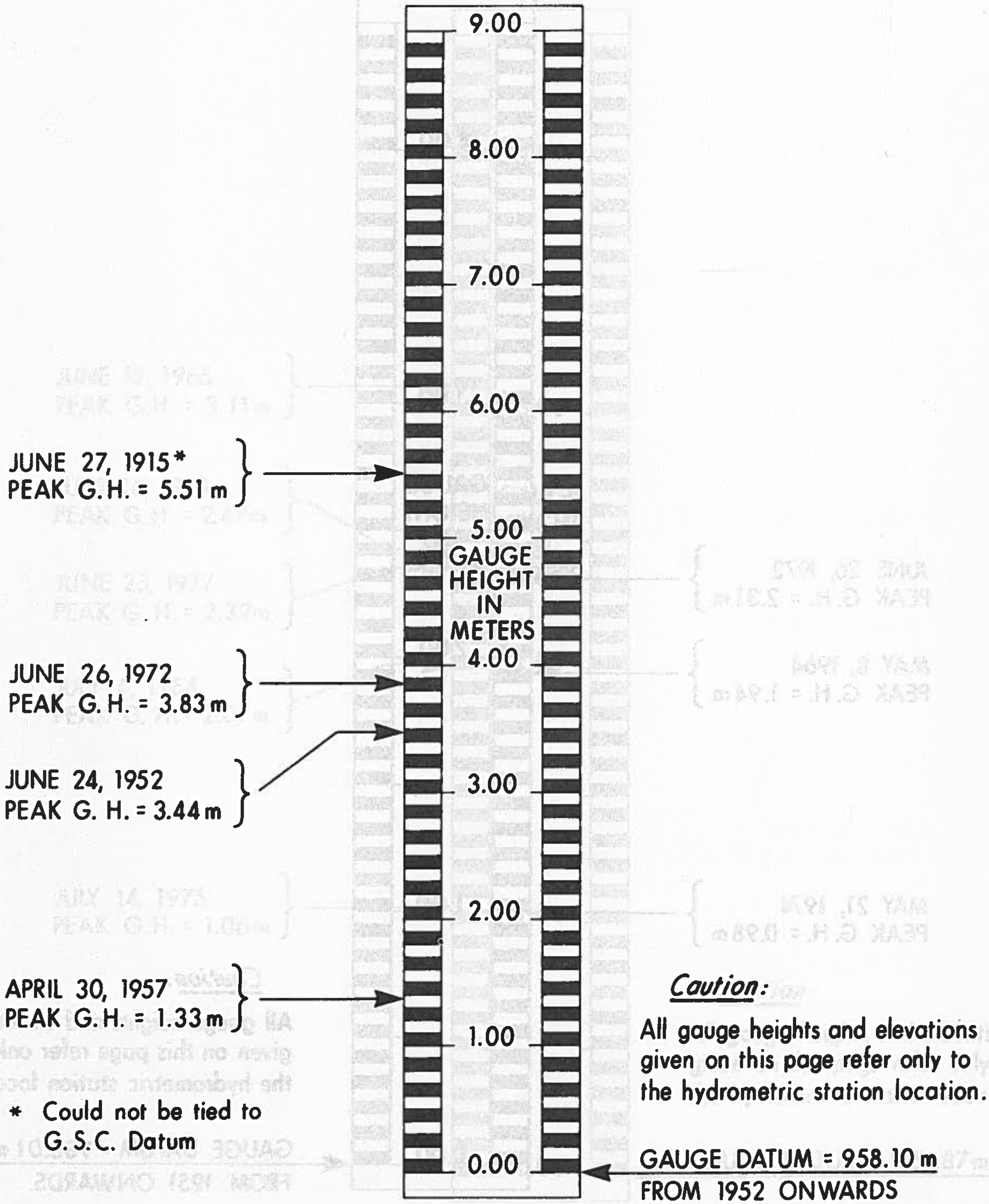


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 19

SELECTED RIVER STAGE DATA
CLEARWATER RIVER NEAR ROCKY MOUNTAIN HOUSE
STATION № 05DB001



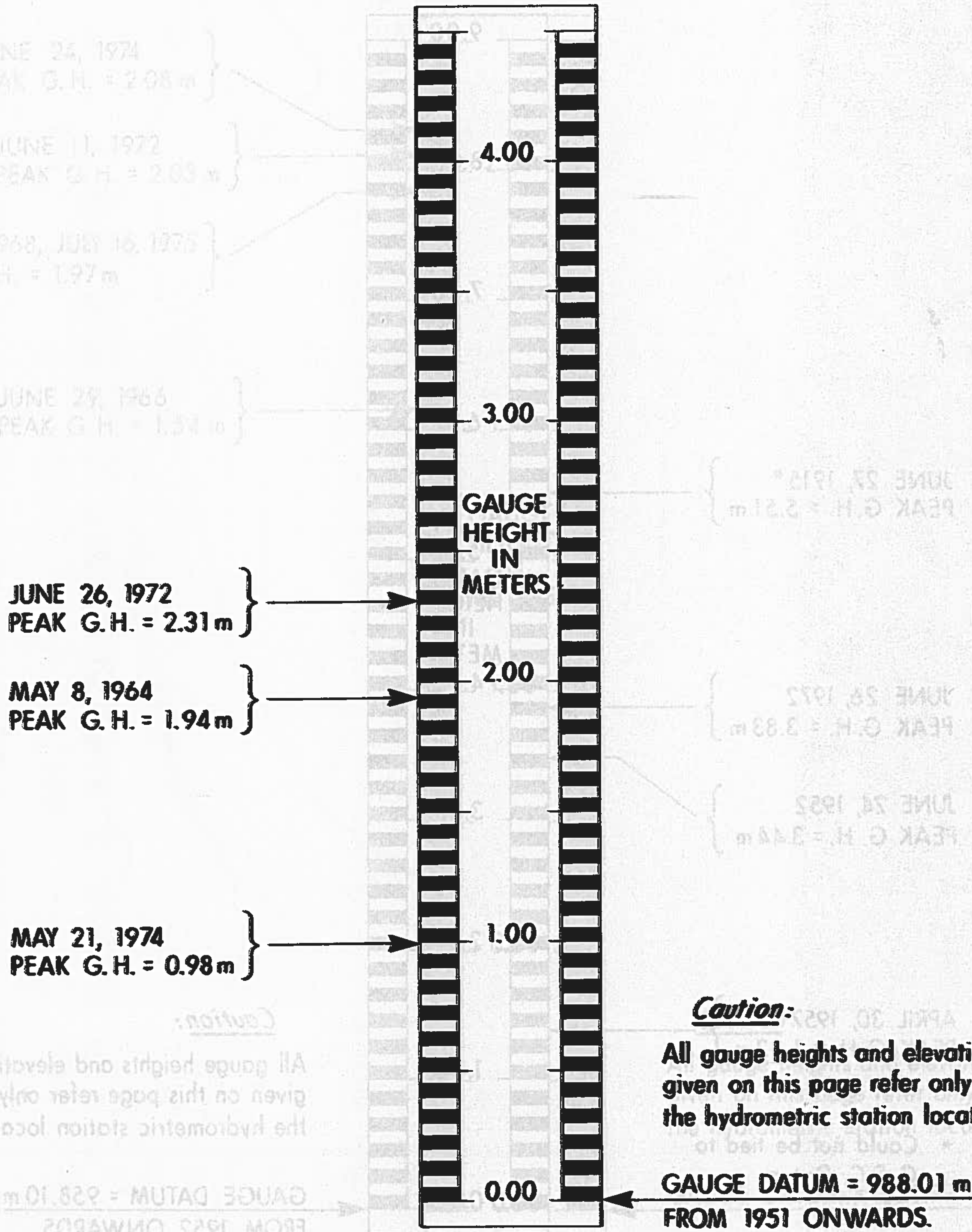
* Could not be tied to G.S.C. Datum

Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 20

SELECTED RIVER STAGE DATA
PRAIRIE CREEK NEAR ROCKY MOUNTAIN HOUSE
STATION № 05DB002

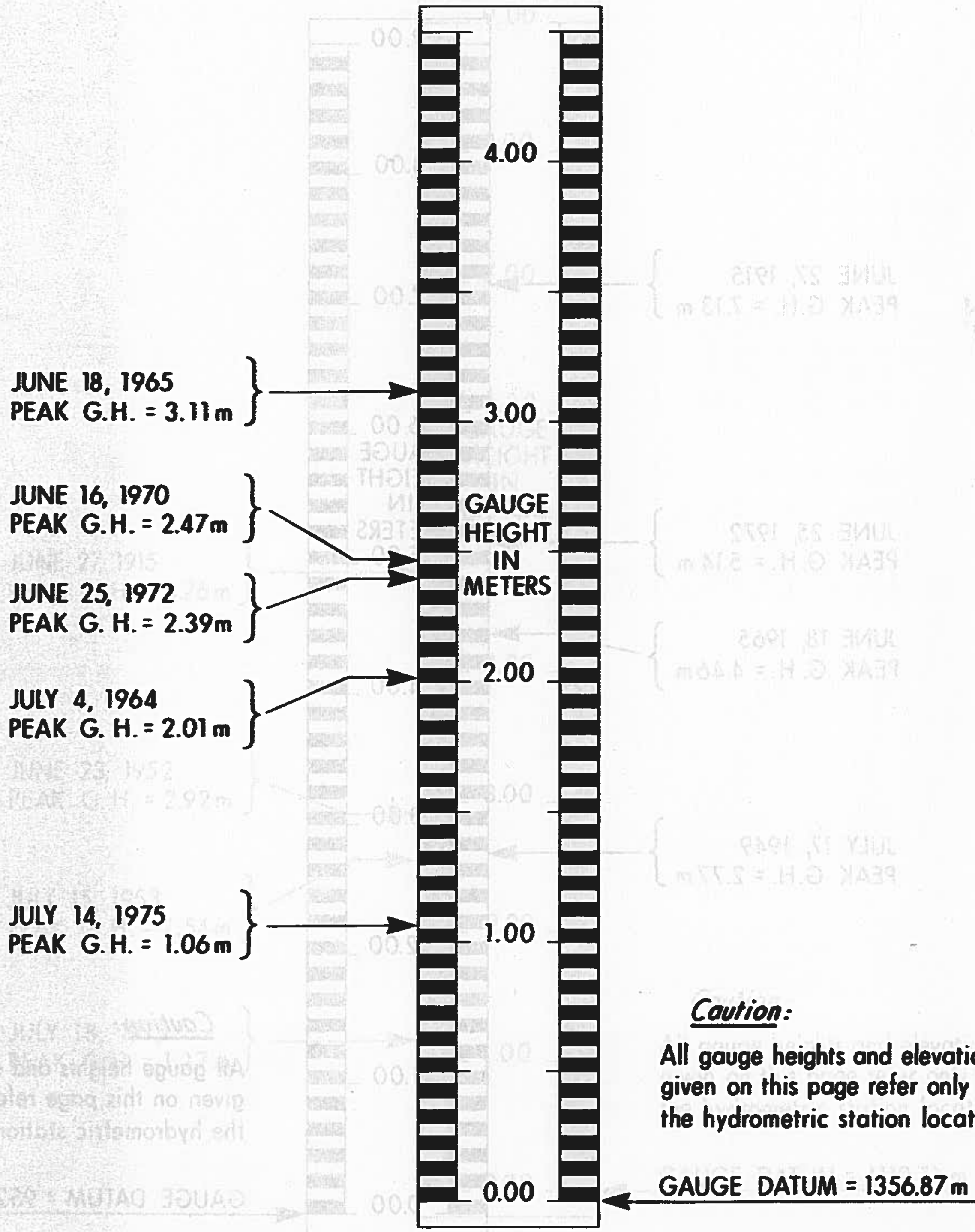


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 21

SELECTED RIVER STAGE DATA
CLEARWATER RIVER ABOVE LIMESTONE CREEK
STATION № 05DB003

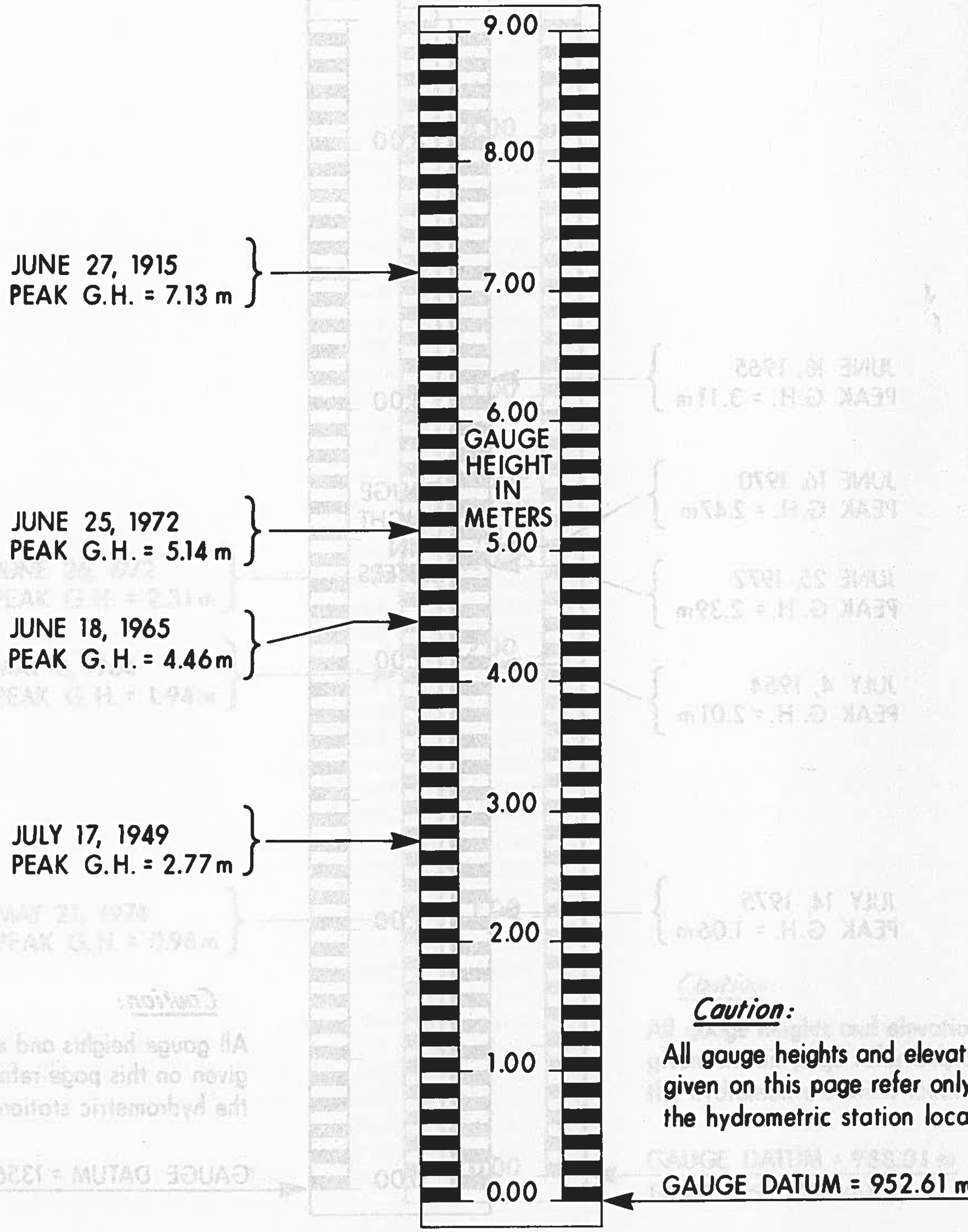


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 22

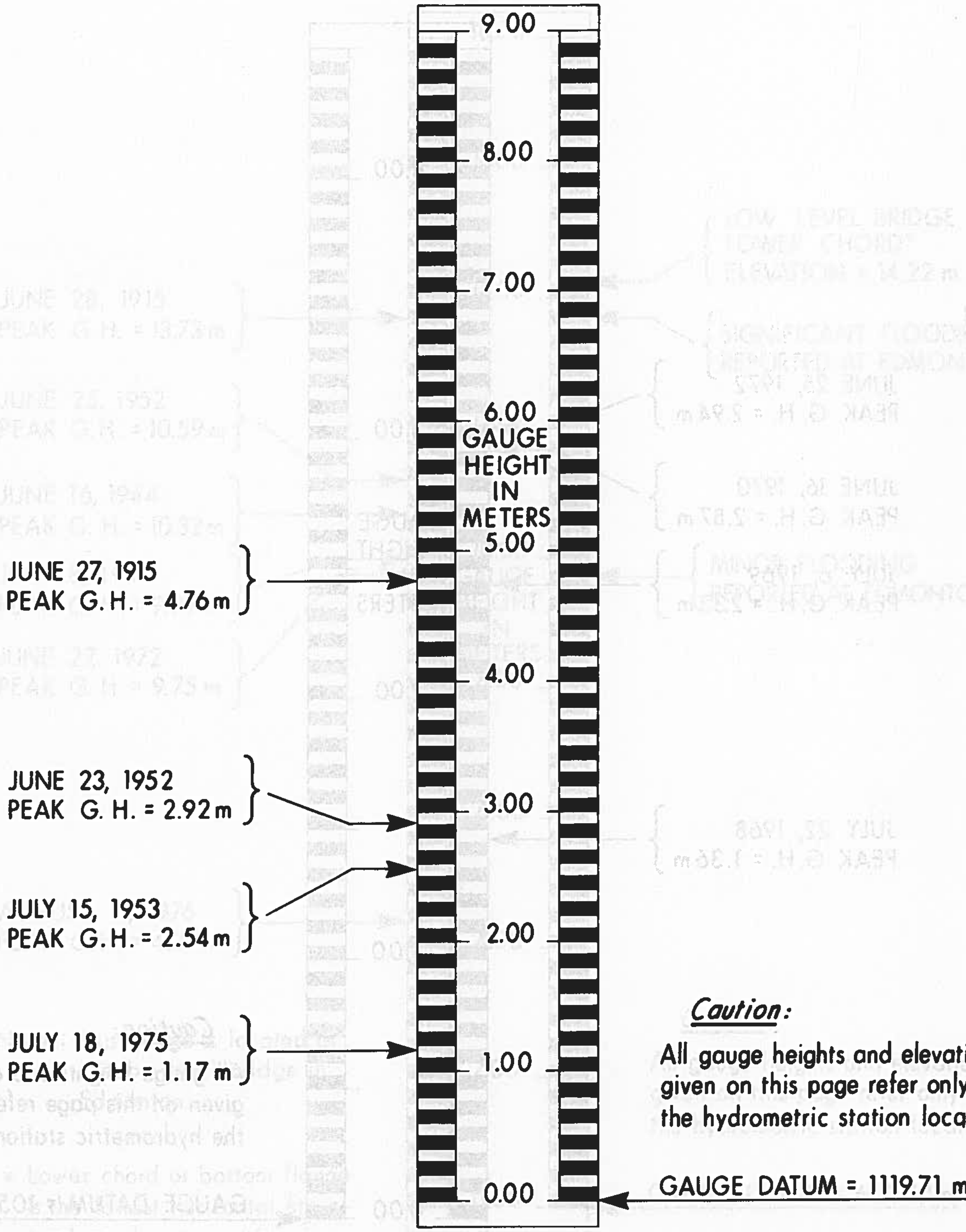
SELECTED RIVER STAGE DATA
NORTH SASKATCHEWAN RIVER NEAR ROCKY MOUNTAIN HOUSE
STATION N_ 05DC001



Caution:
All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 23

SELECTED RIVER STAGE DATA
NORTH SASKATCHEWAN RIVER AT SAUNDERS
STATION № 05DC002

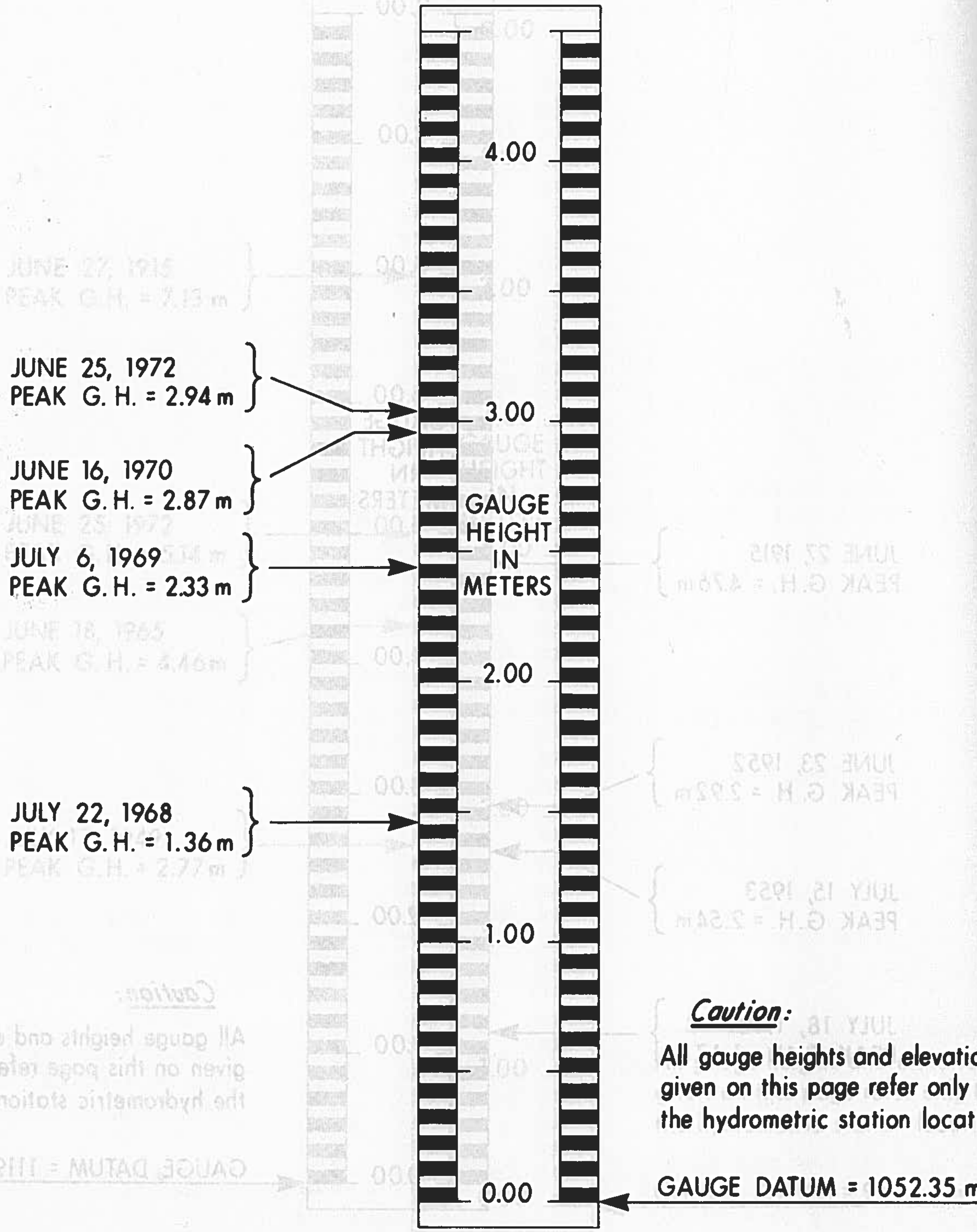


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 24

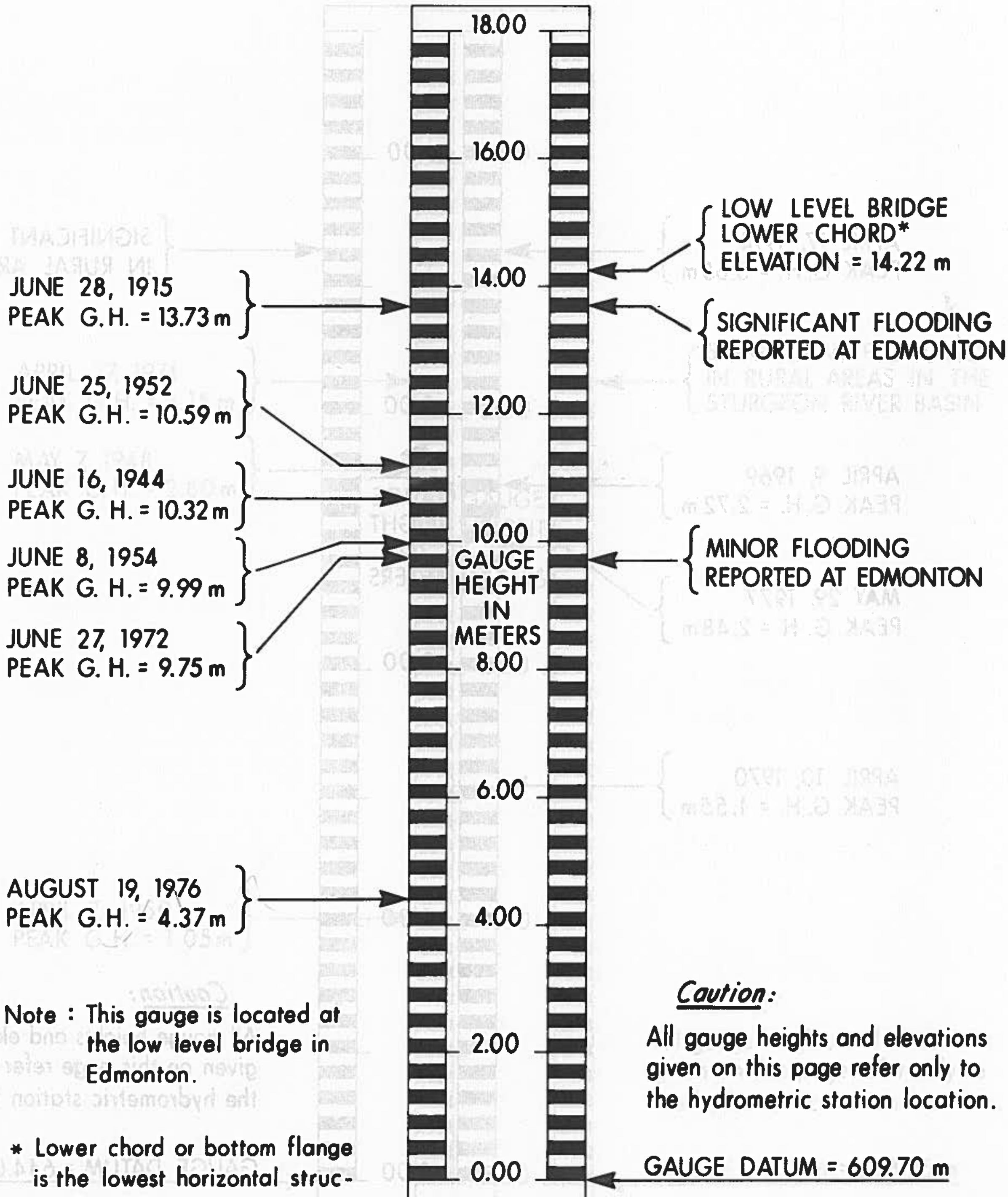
SELECTED RIVER STAGE DATA
RAM RIVER NEAR THE MOUTH
STATION № 05DC001



Caution:
All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 25

SELECTED RIVER STAGE DATA
NORTH SASKATCHEWAN RIVER AT EDMONTON
STATION No. 05DF001



Note : This gauge is located at the low level bridge in Edmonton.

* Lower chord or bottom flange is the lowest horizontal structural member supporting a bridge deck.

Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 26

SELECTED RIVER STAGE DATA
STRAWBERRY CREEK NEAR THE MOUTH
STATION № 05DF004

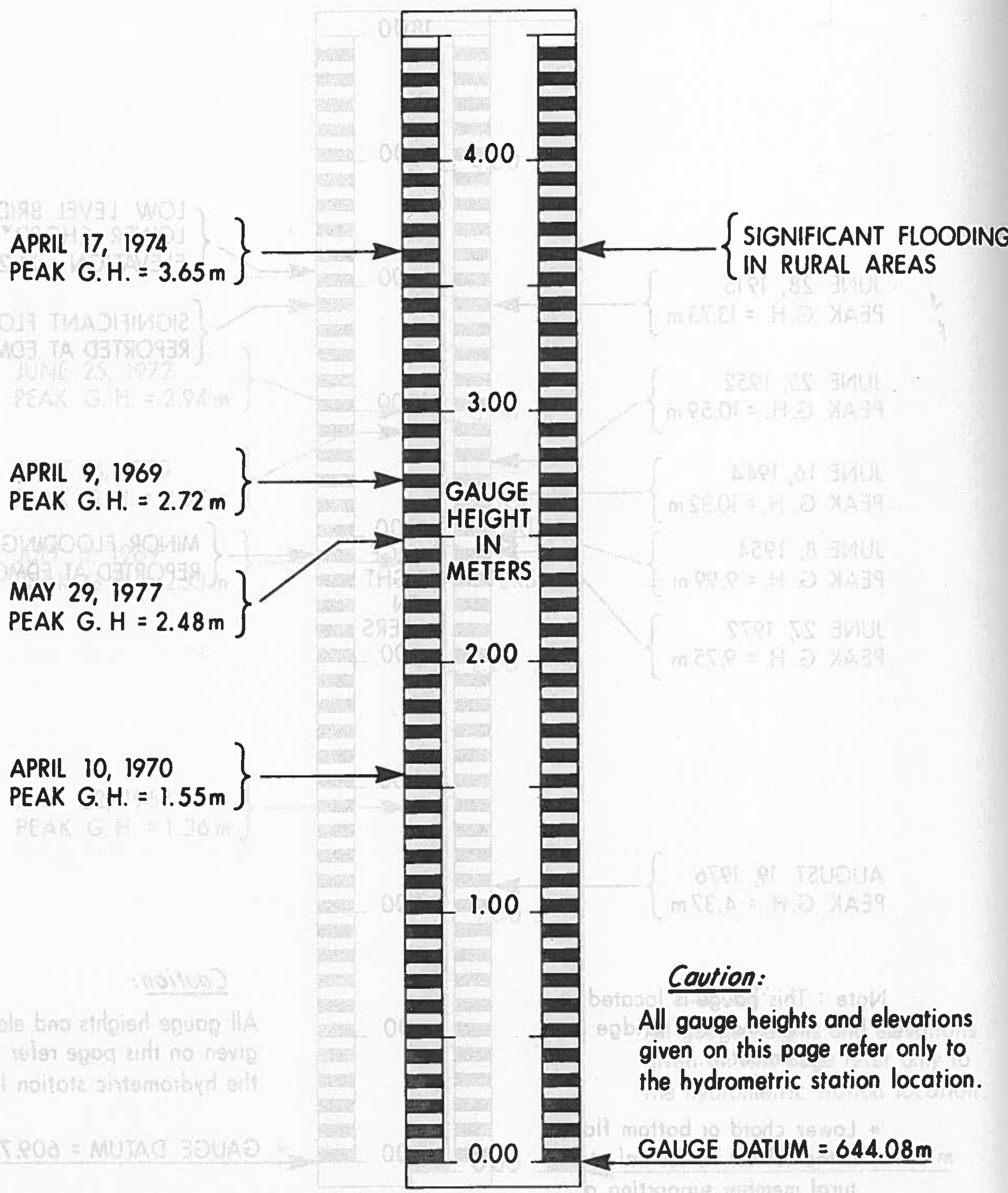
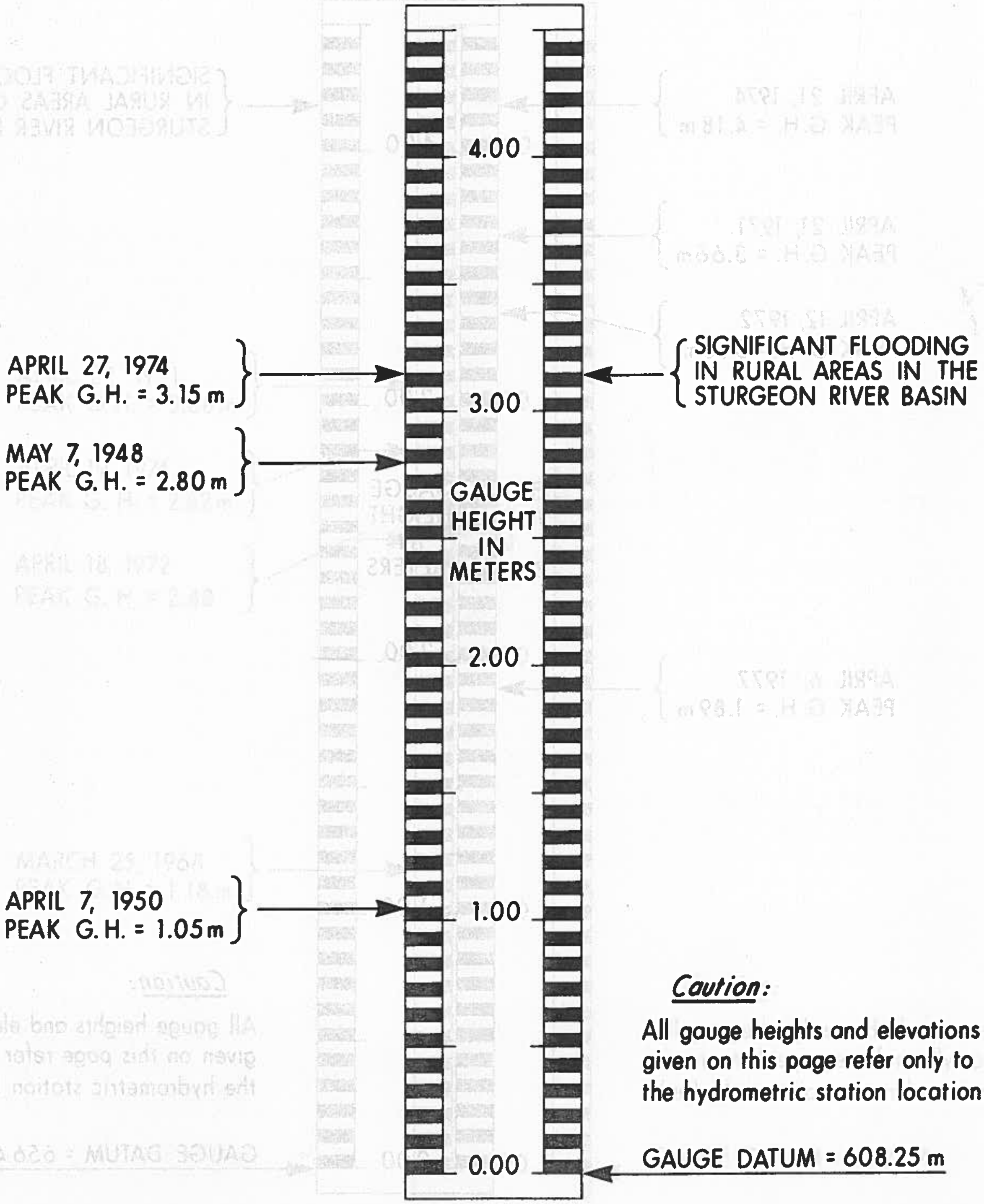


FIG. 27

SELECTED RIVER STAGE DATA
STURGEON RIVER NEAR FORT SASKATCHEWAN
STATION № 05EA001

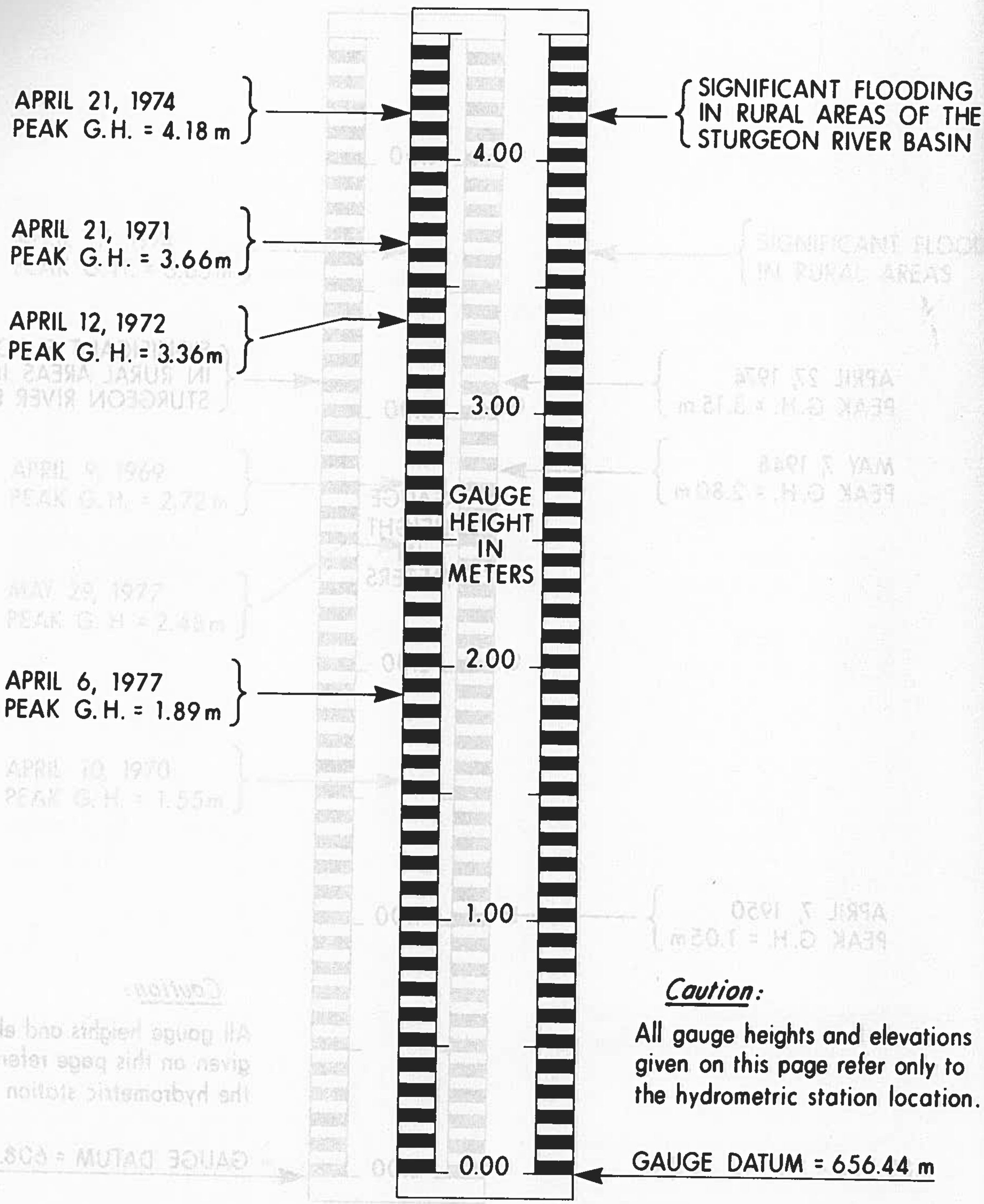


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 28

SELECTED RIVER STAGE DATA
STURGEON RIVER NEAR VILLENEUVE
STATION № 05EA005

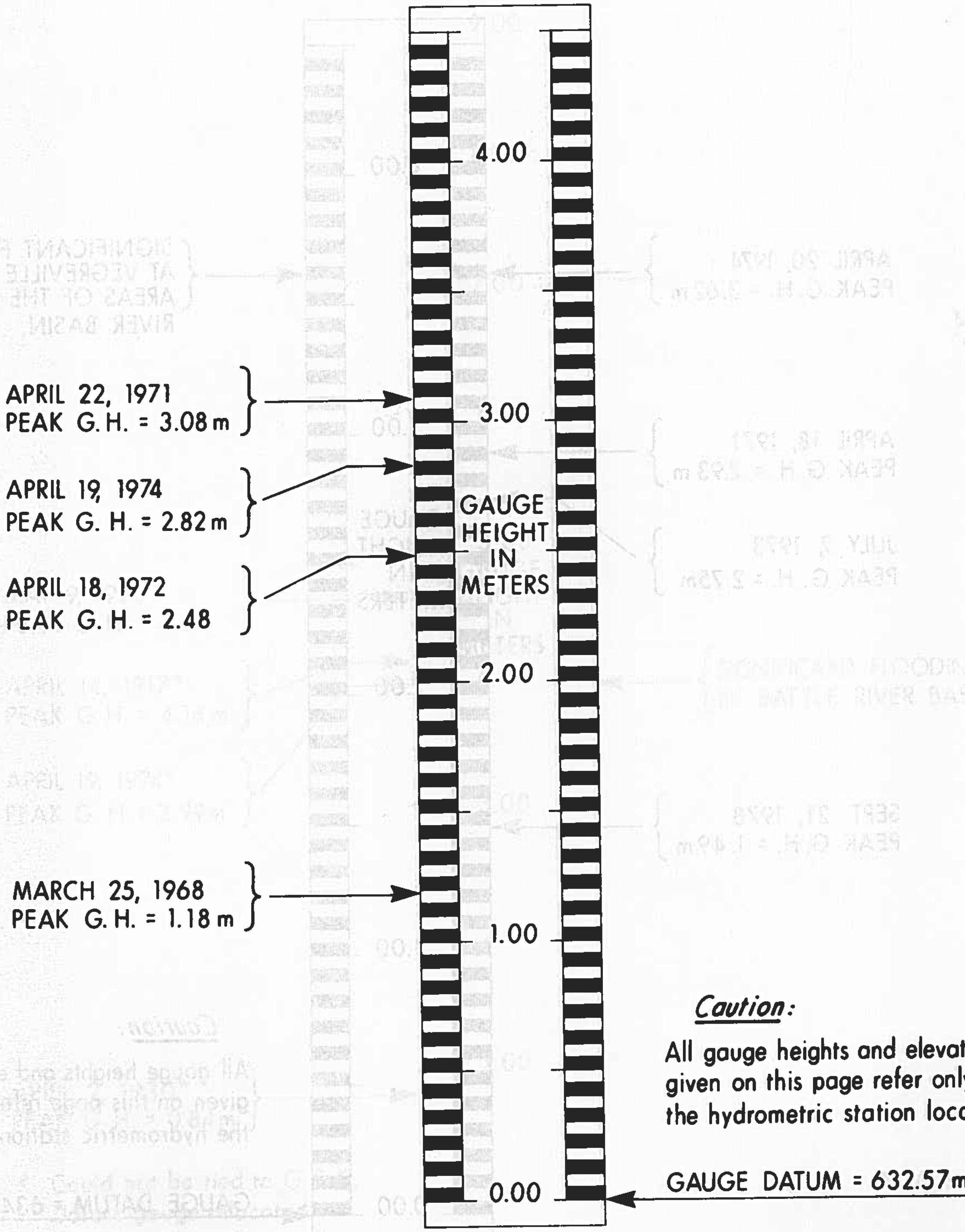


Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 29

SELECTED RIVER STAGE DATA
WASKATENAU CREEK NEAR WASKATENAU
STATION № 05EC002



Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 30

SELECTED RIVER STAGE DATA
VERMILION RIVER NEAR VEGREVILLE
STATION № 05EC003

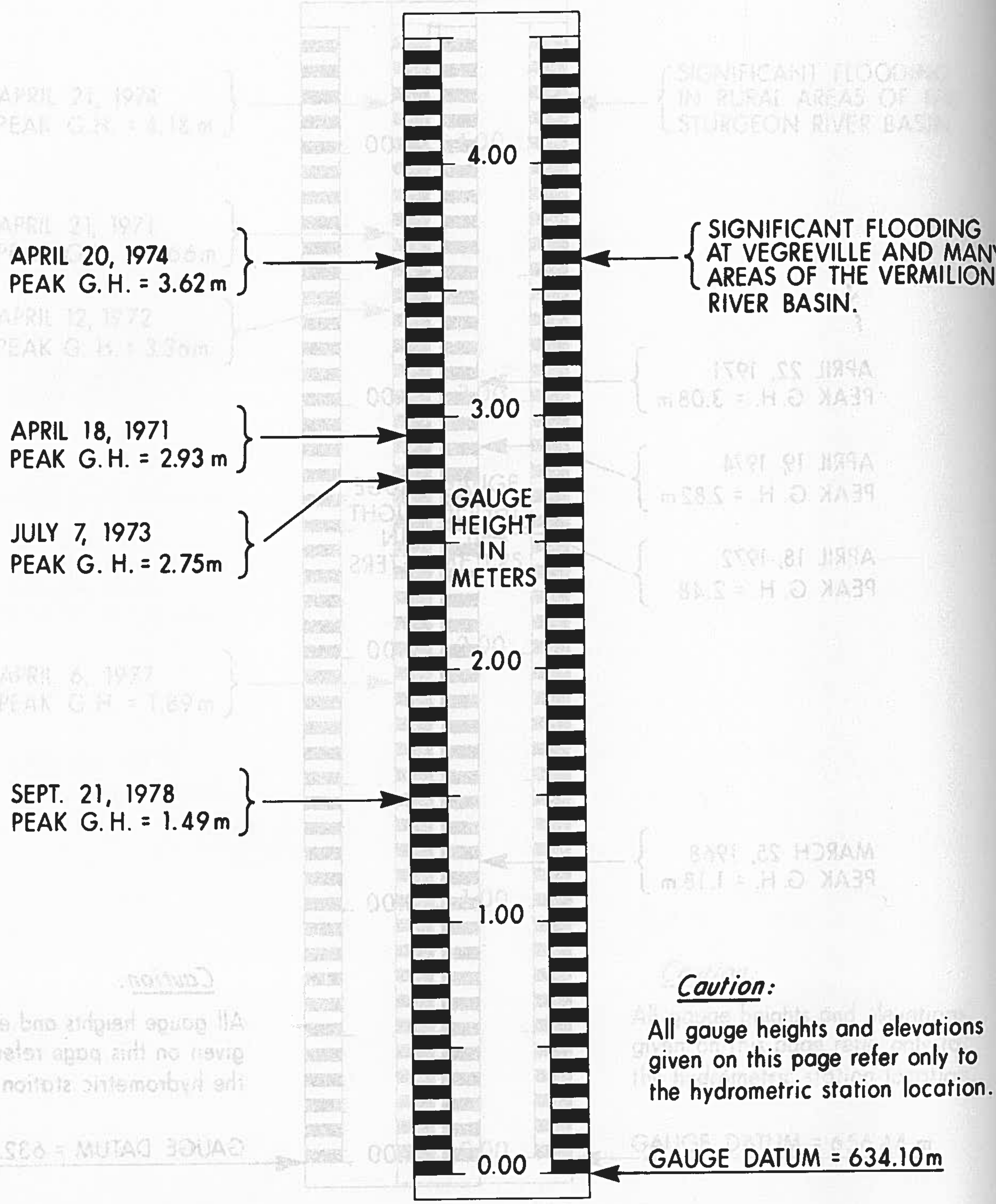


FIG. 31

SELECTED RIVER STAGE DATA
BATTLE RIVER NEAR PONOKA
STATION № 05FA001

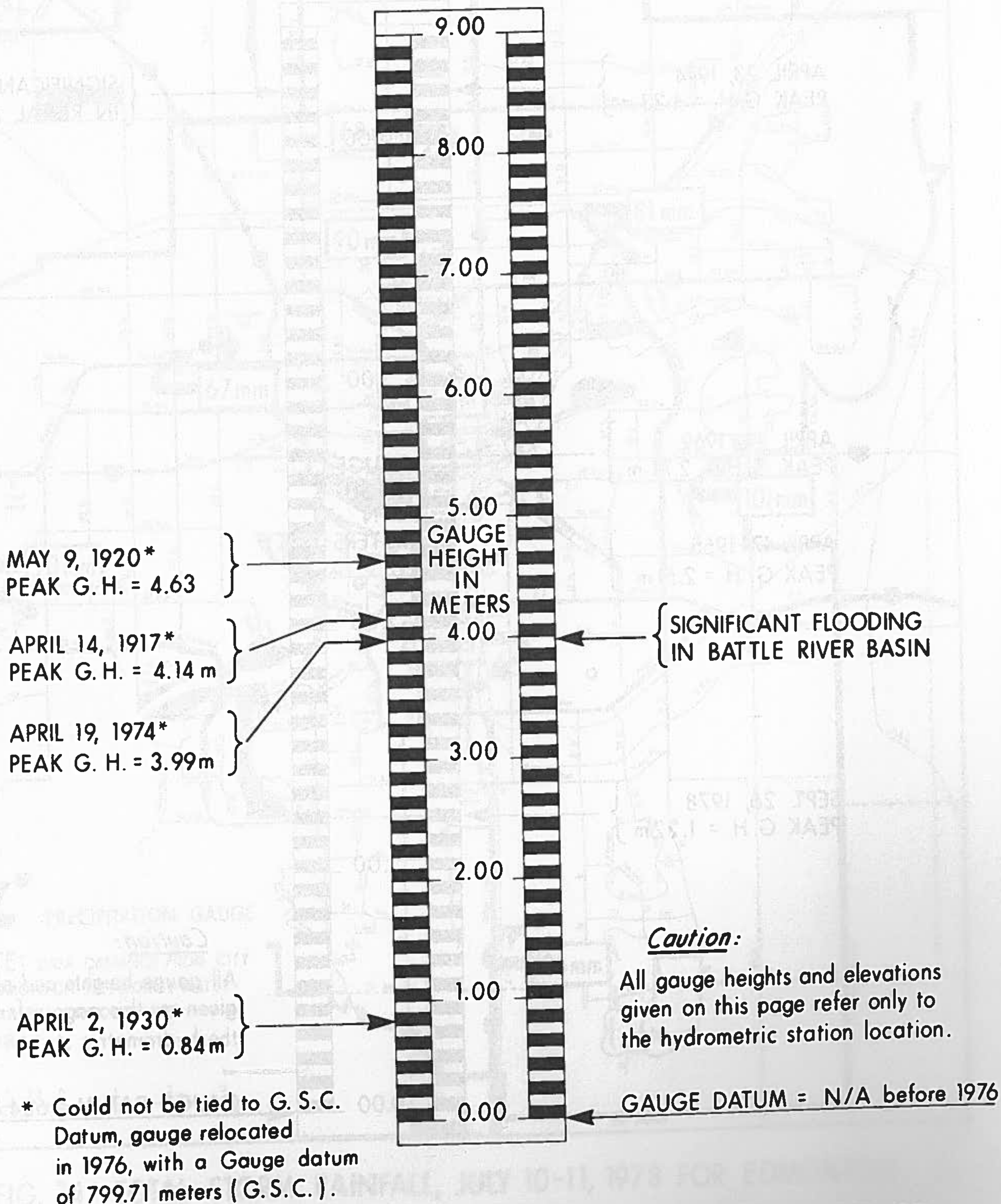
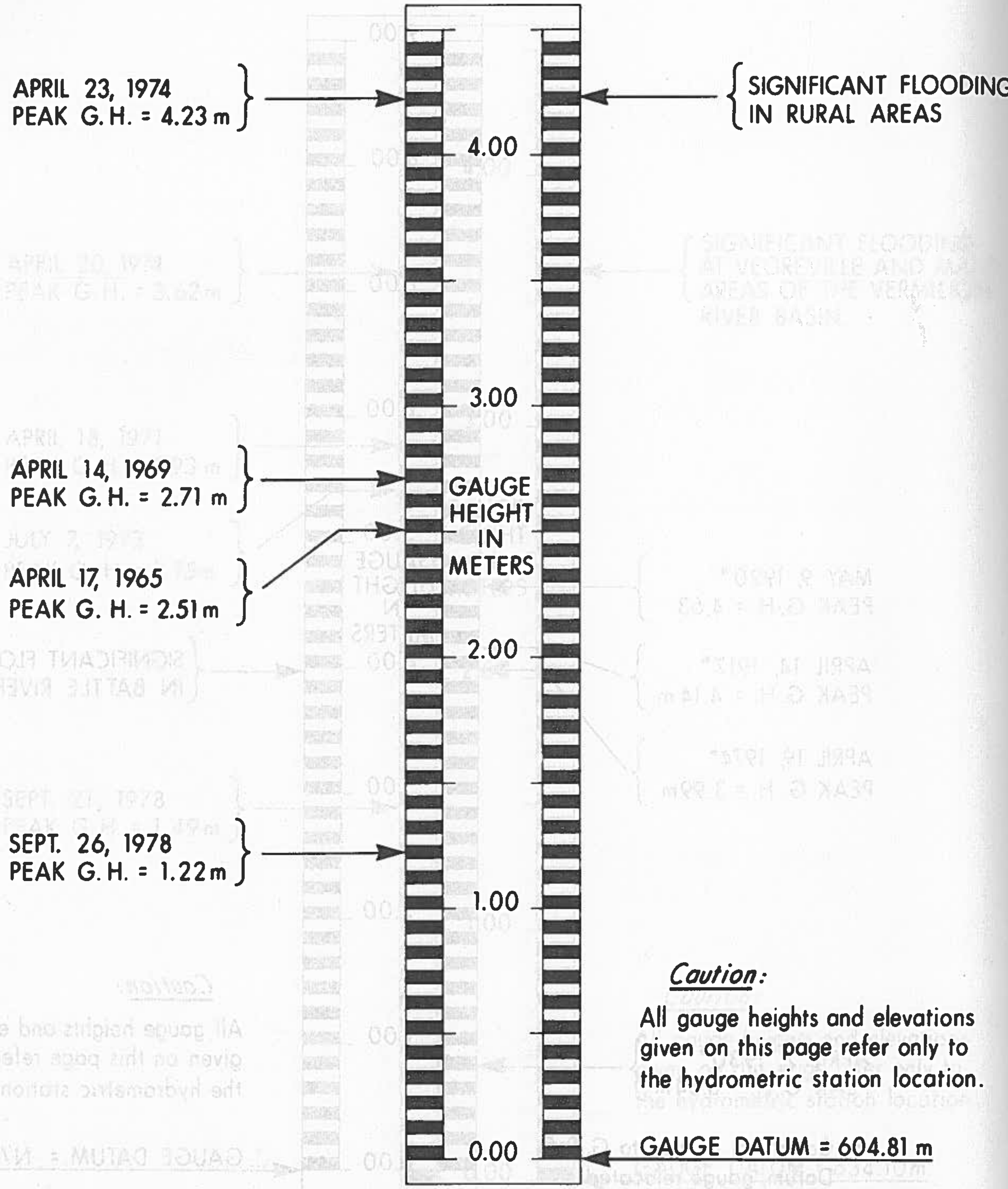


FIG. 32

SELECTED RIVER STAGE DATA
IRON CREEK NEAR HARDISTY
STATION № 05FB002



Caution:

All gauge heights and elevations given on this page refer only to the hydrometric station location.

FIG. 33

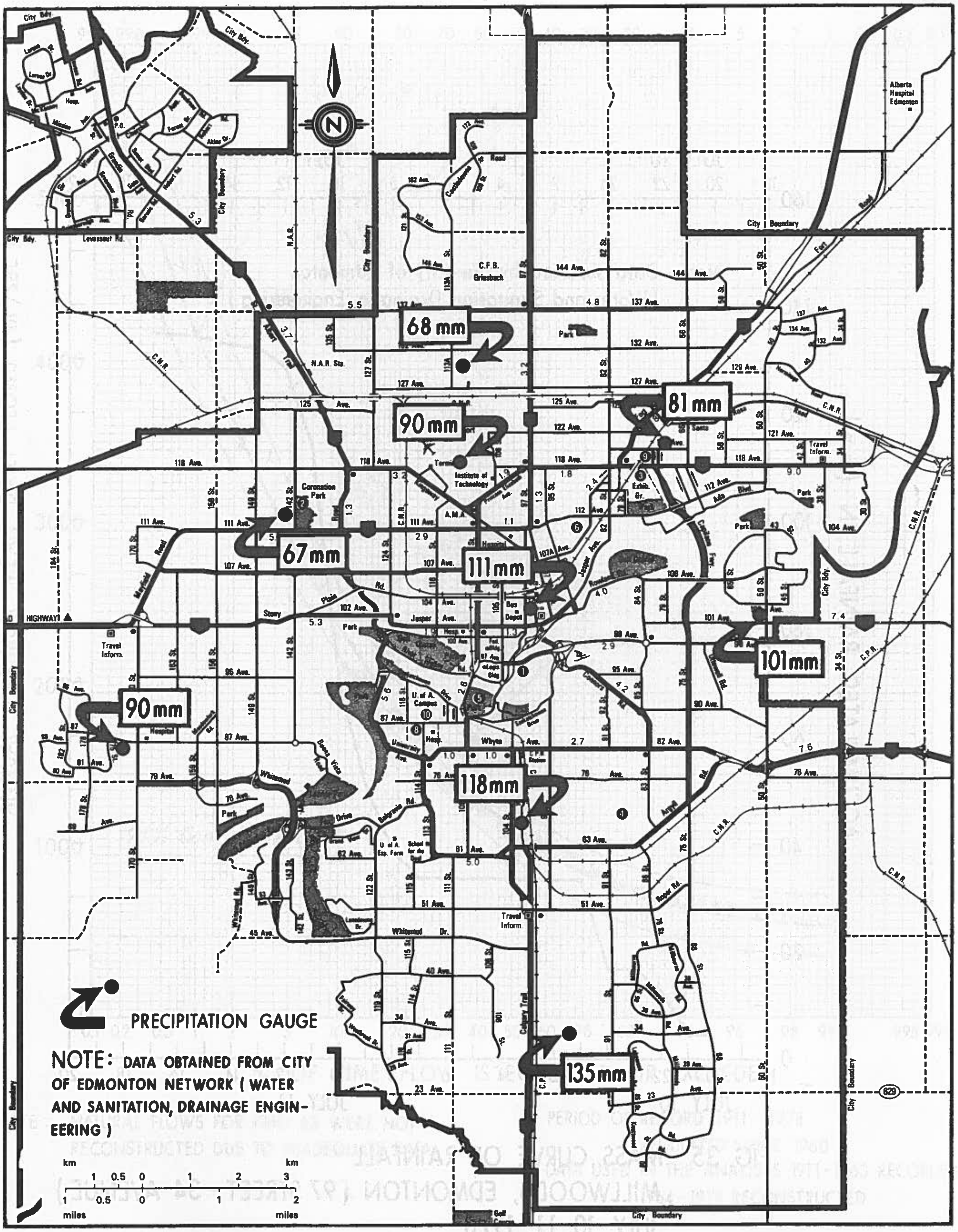


FIG. 34 - TOTAL STORM RAINFALL, JULY 10-11, 1978 FOR EDMONTON

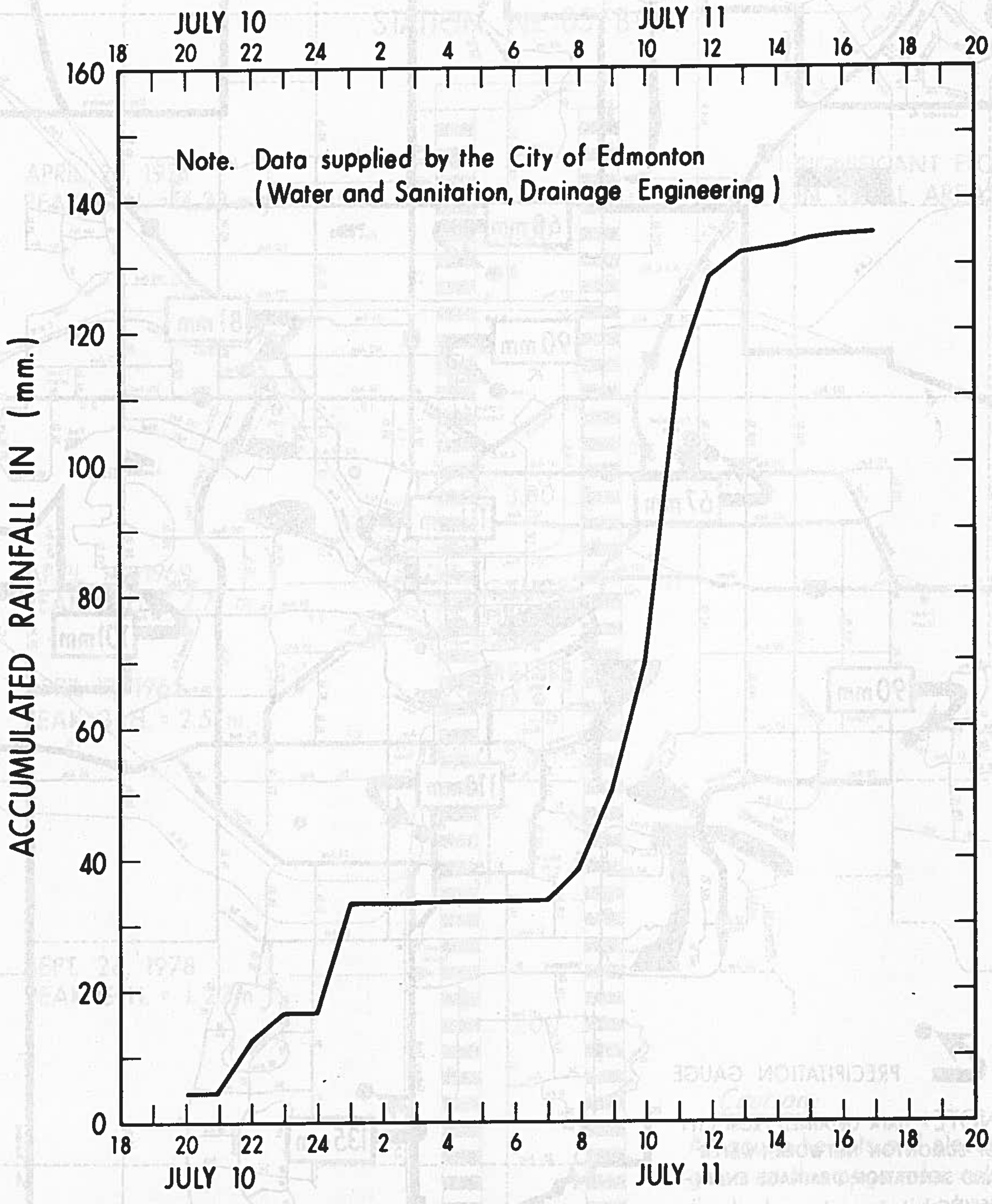
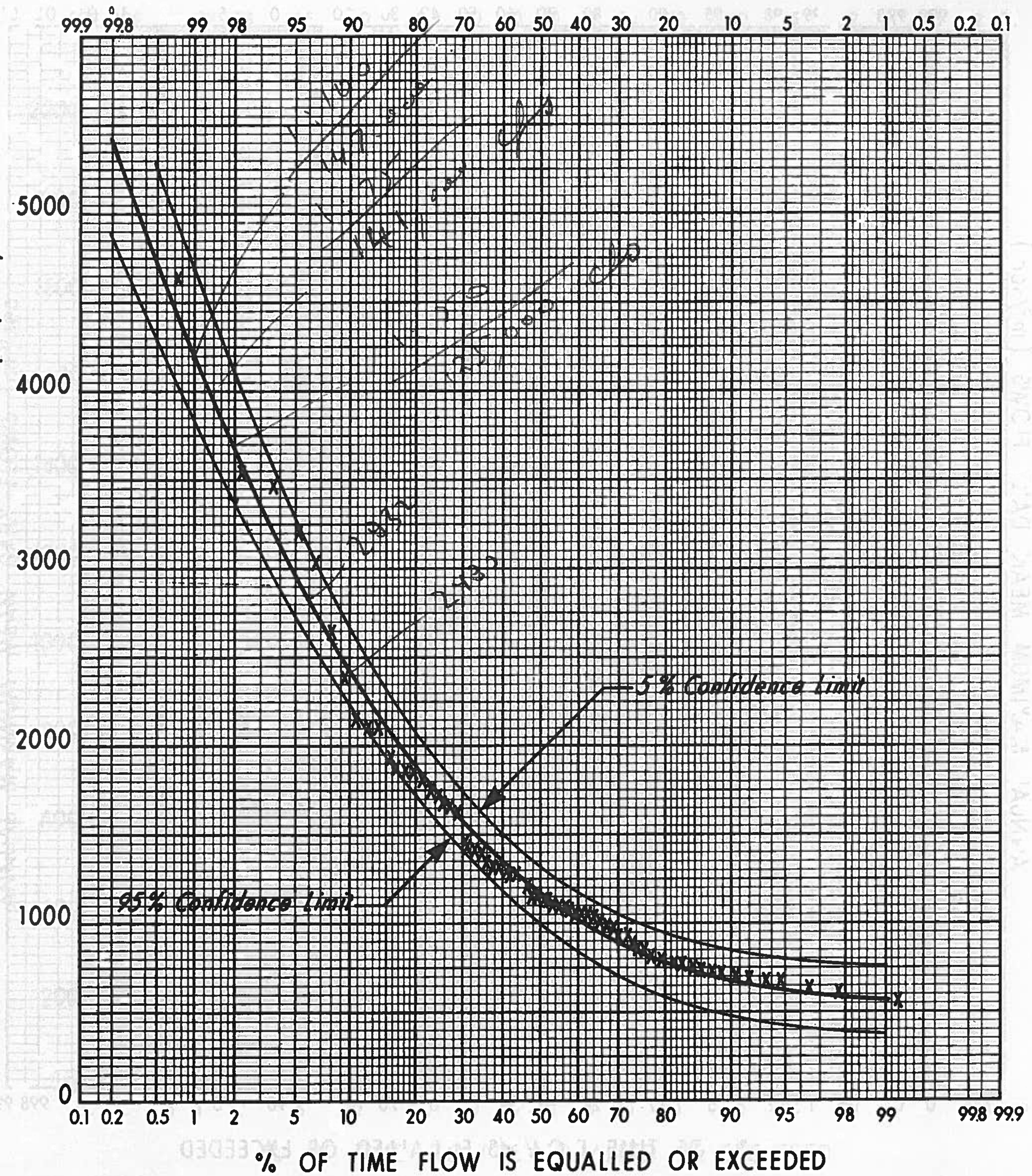


FIG. 35 - MASS CURVE OF RAINFALL
MILLWOODS, EDMONTON (97 STREET - 34 AVENUE)
JULY 10, 11, 1978



NOTE : NATURAL FLOWS FOR 1961-63 WERE NOT RECONSTRUCTED DUE TO INADEQUATE DATA.

PERIOD OF RECORD 1911 - 1978
REGULATED SINCE 1960
DATA USED IN THE ANALYSES 1911-1963 RECORDED
1964-1978 RECONSTRUCTED

Alberta ENVIRONMENT

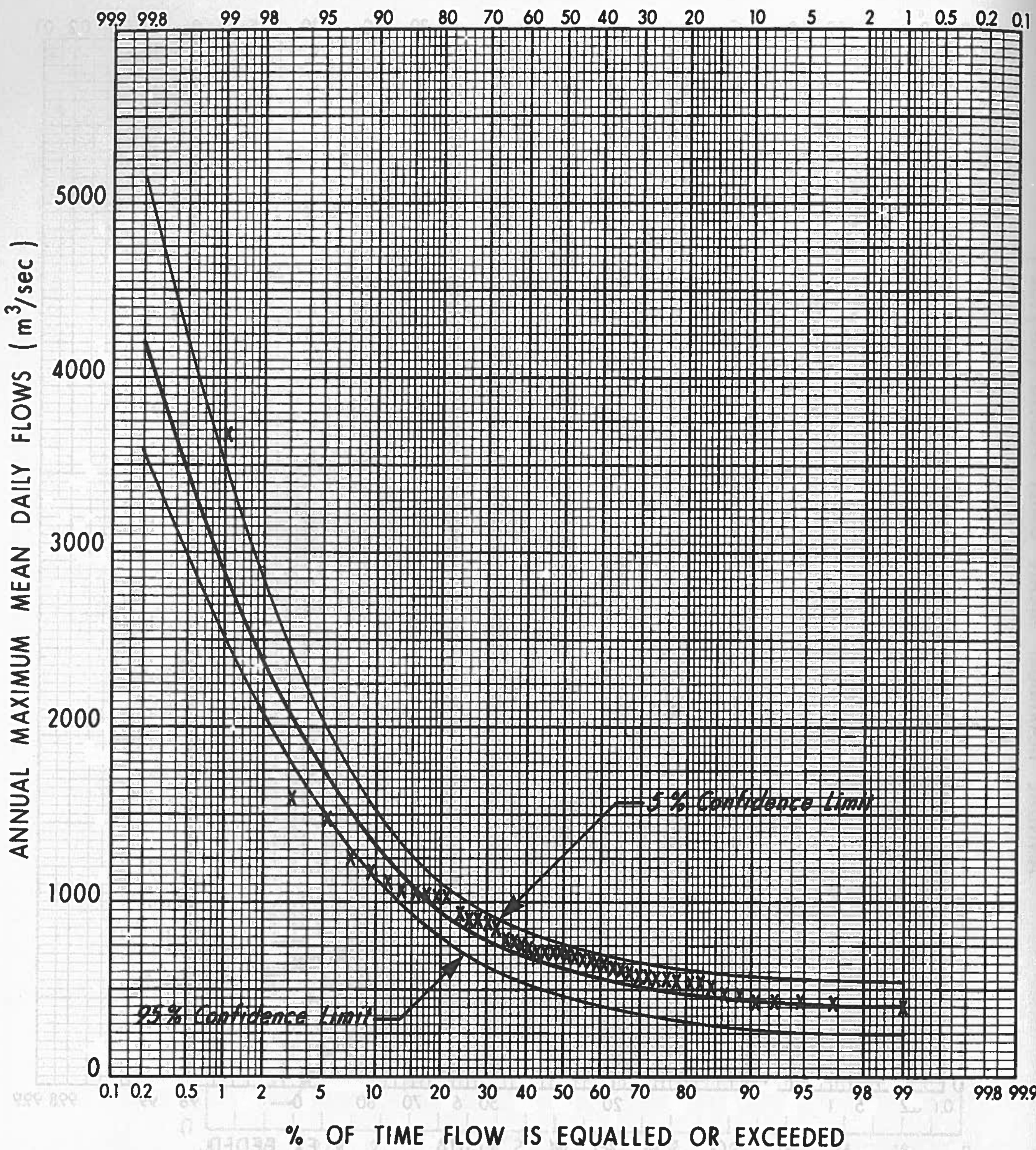
SUBMITTED S. J. F.
DATE MAY 1980
APPROVED J. CARD
DATE MAY 1980

TECHNICAL SERVICES DIVISION
HYDROLOGY BRANCH

DESIGNED S. J. F.
CHECKED
DRAWN V. DA SILVA
CHECKED S. J. F.

NORTH SASKATCHEWAN RIVER AT EDMONTON
PEARSON III FREQUENCY DISTRIBUTION OF
ANNUAL MAXIMUM MEAN DAILY FLOWS

FIGURE 36



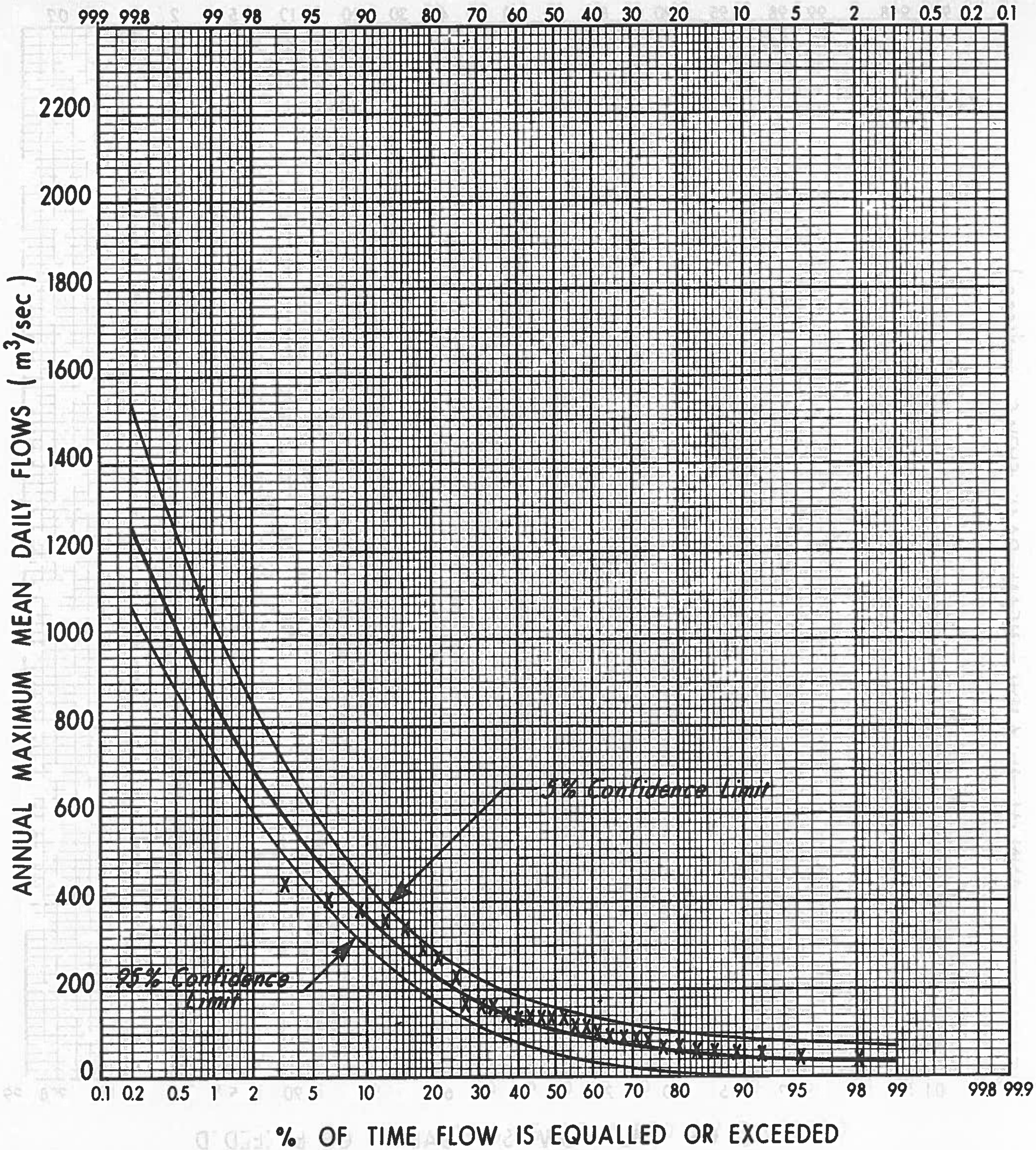
NOTE : LONGEST CONTINUOUS PERIOD OF DATA WAS USED IN THE ANALYSES SINCE THE LACK OF DATA FOR THE 1931 - 34 LOW FLOW PERIOD REPRESENTS A SAMPLE BIAS.

PERIOD OF RECORD 1913 - 1931
1944 - 1972 NATURAL
1973 - 1978 REGULATED

DATA USED IN THE ANALYSES 1915, 1944 - 1972

Alberta ENVIRONMENT SUBMITTED S. J. F. DATE MAY 1980	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH DESIGNED S. J. F. CHECKED	NORTH SASK. RIVER AT ROCKY MTN. HOUSE PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 37

MICROFILM DATE
DRAWING No.
FILE No.

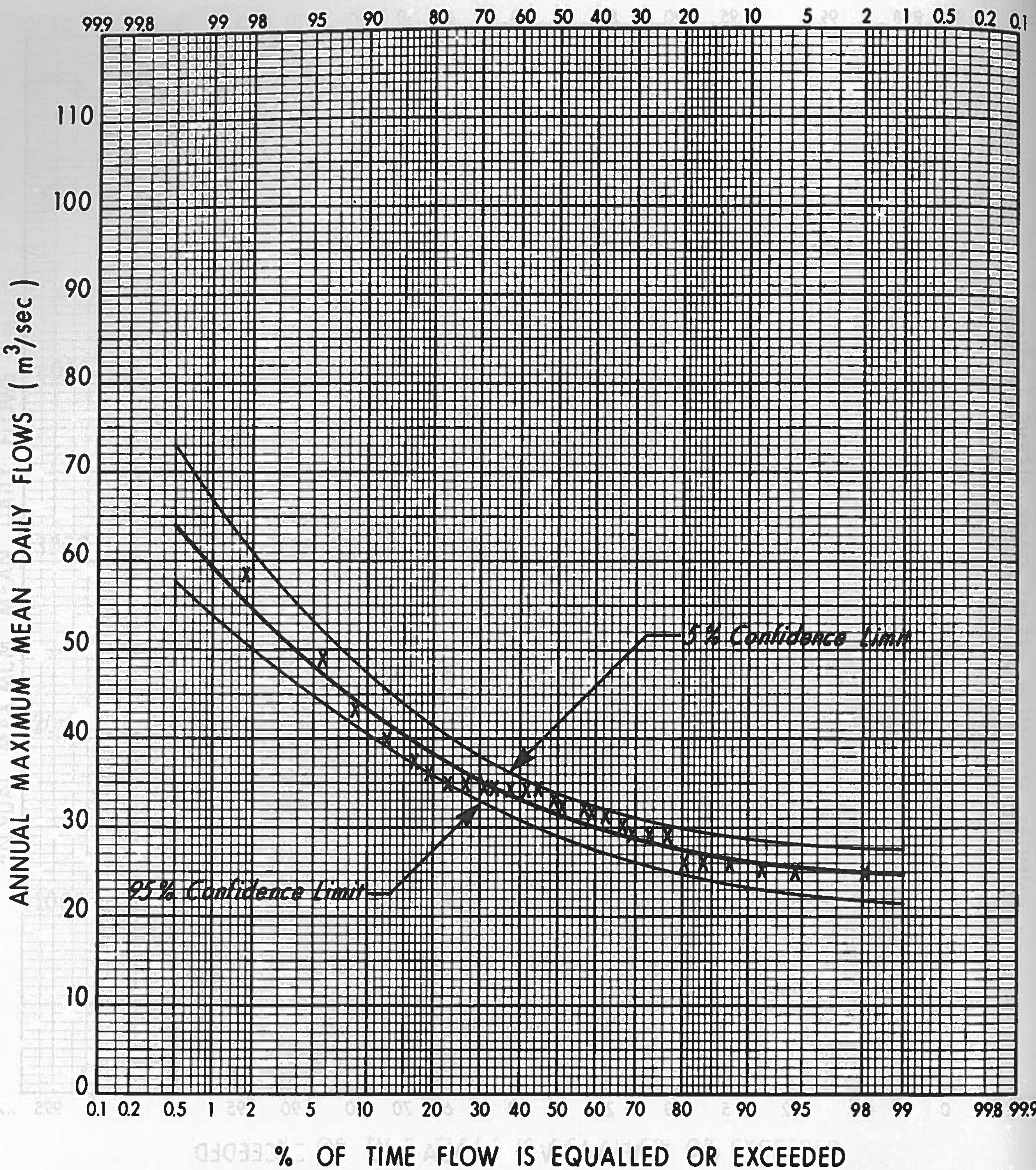


NOTE : LONGEST CONTINUOUS PERIOD OF DATA WAS USED IN THE ANALYSES SINCE THE LACK OF DATA FOR THE 1931-44 LOW FLOW PERIOD REPRESENTS A SAMPLE BIAS.

PERIOD OF RECORD 1914-1930, 1944-1975

DATA USED IN THE ANALYSES 1915, 1944 - 1975

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	CLEARWATER RIVER NEAR ROCKY MTN. HOUSE PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 38



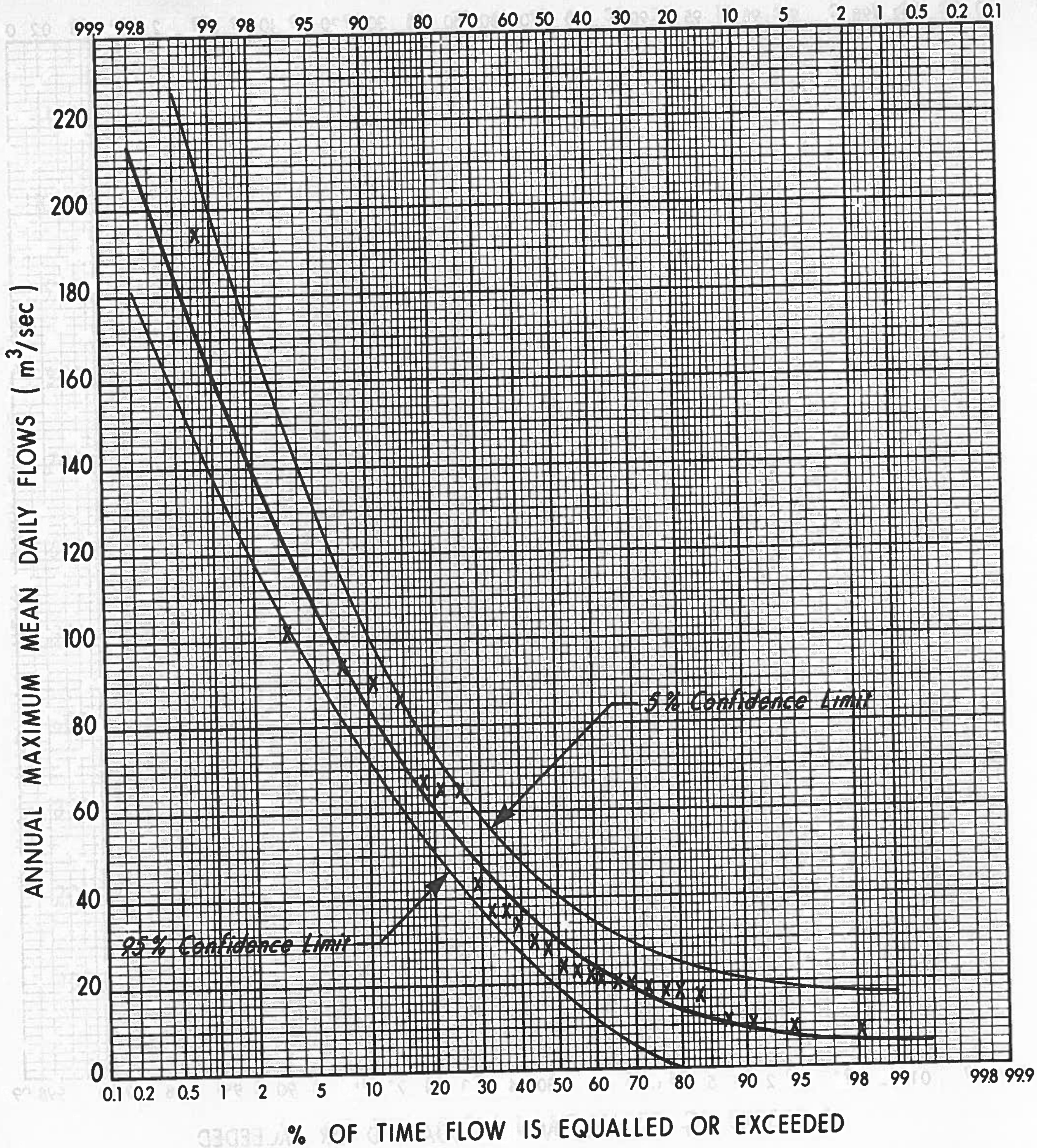
PERIOD OF RECORD 1951 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	MISTAYA RIVER NEAR SASKATCHEWAN CROSSING PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 39

MICROFILM DATE

DRAWING No

FILE No.

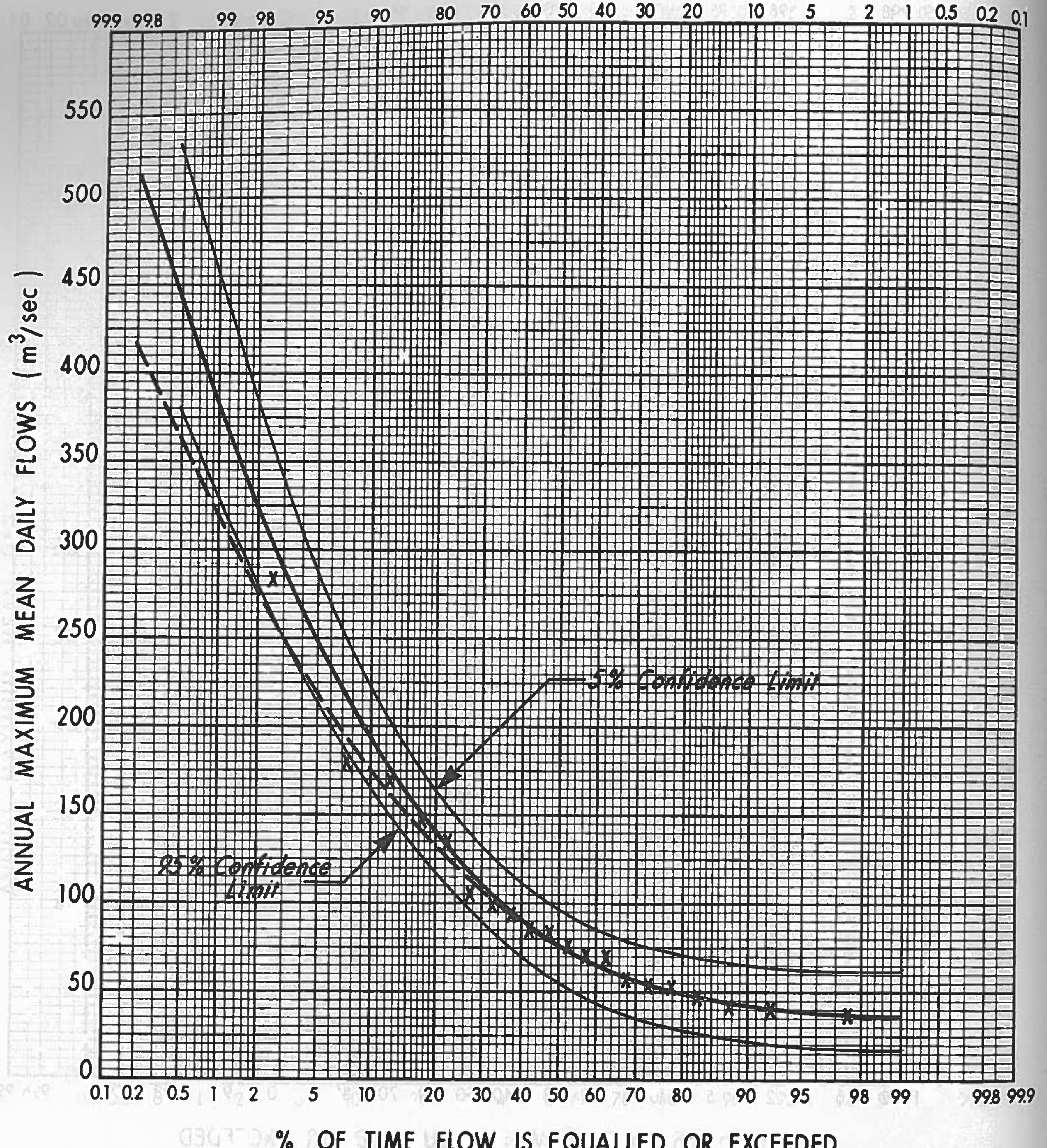


PERIOD OF RECORD 1922-1925, 1952-1958

DATA USED IN THE ANALYSES 1915 ESTIMATED
1952-1958

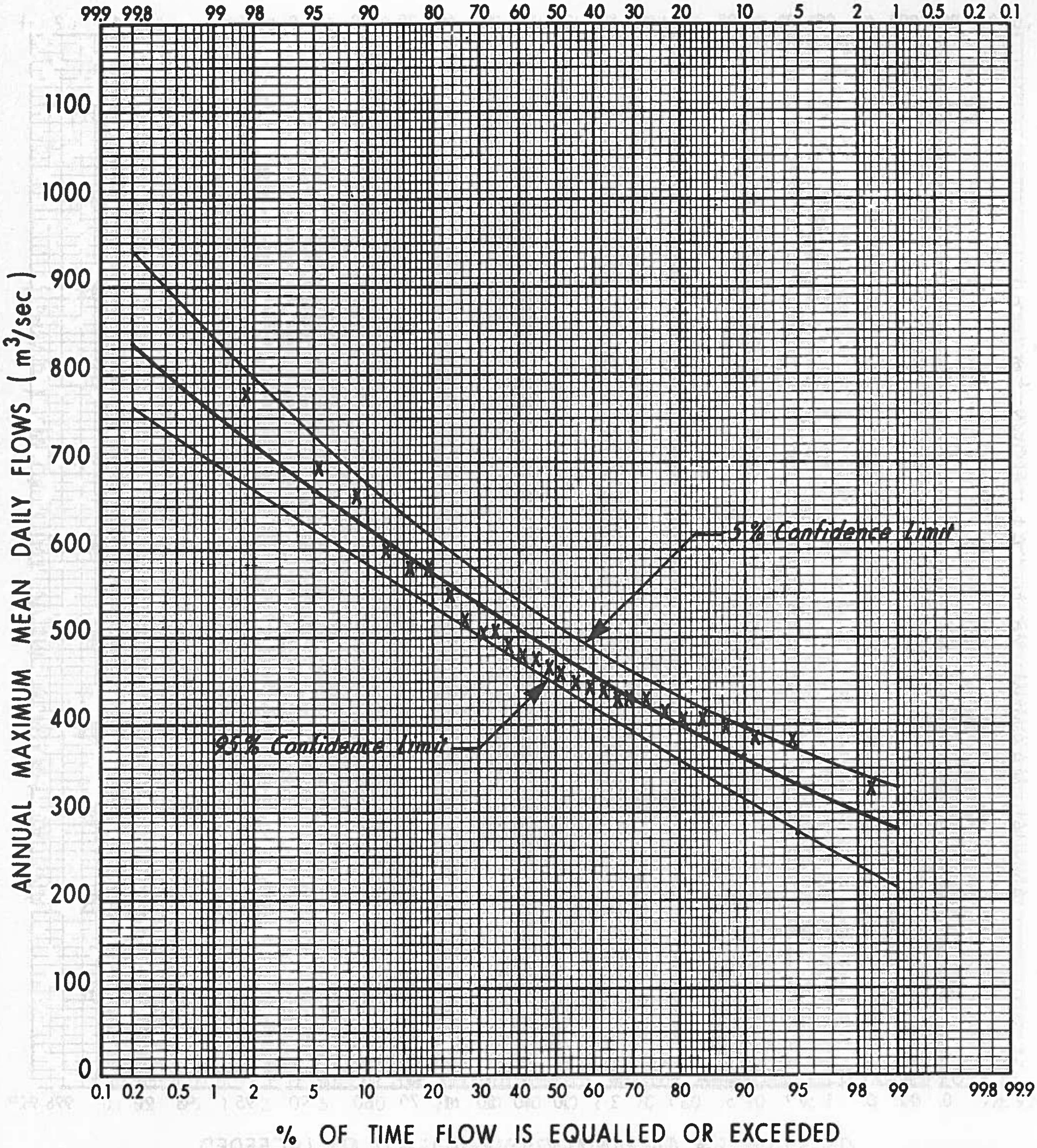
Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	PRAIRIE CREEK NEAR ROCKY MTN. HOUSE PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 40

FILE No.



Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	CLEARWATER RIVER ABOVE LIMESTONE CREEK PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 41

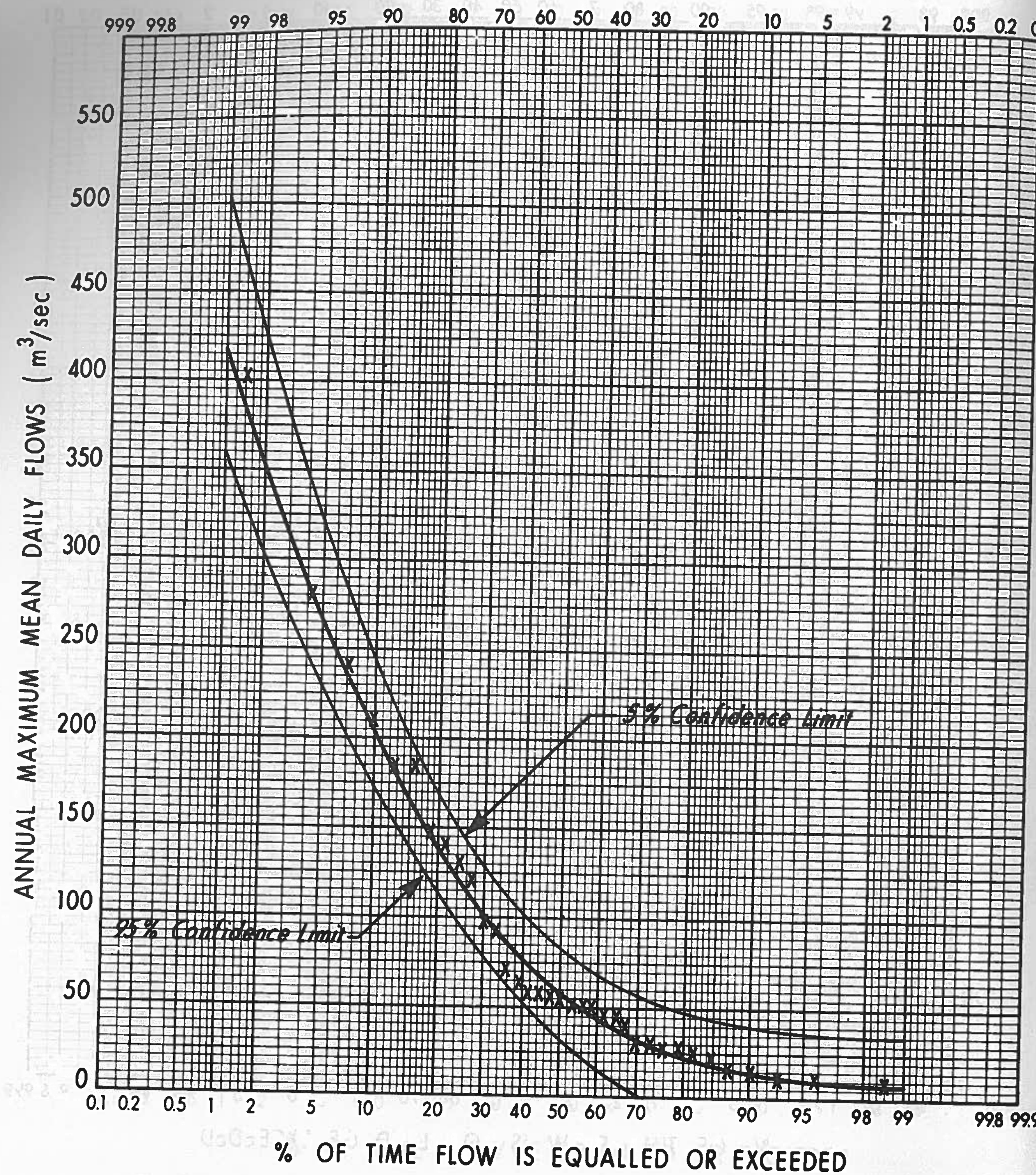
MICROFILM DATE
DRAWING No.
FILE No.



PERIOD OF RECORD 1915 - 1923
1952 - 1972 NATURAL
1972 - 1978 REGULATED

DATA USED IN THE ANALYSES 1916 - 1923
1952 - 1972

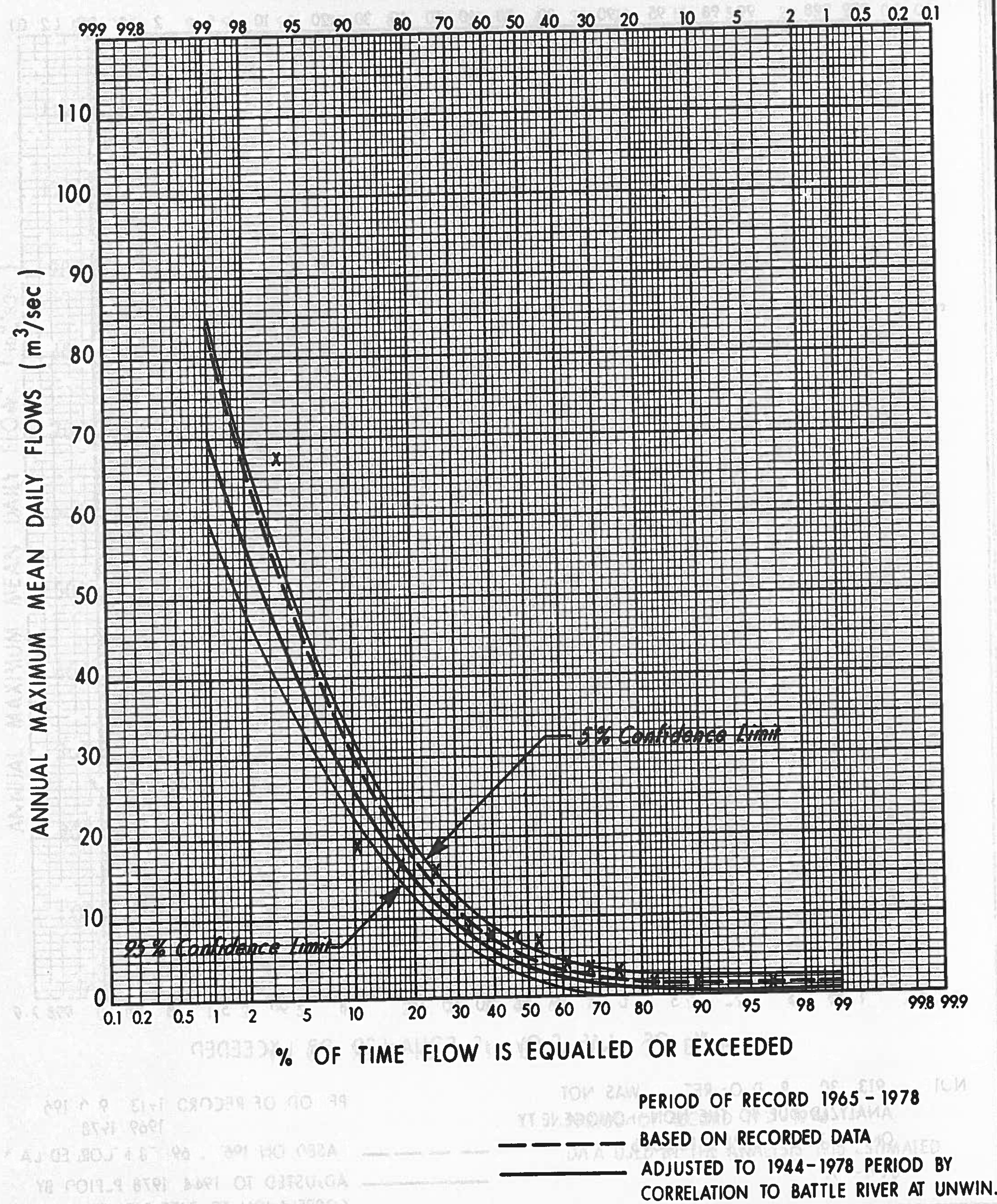
Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	NORTH SASKATCHEWAN RIVER AT SAUNDERS PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 42



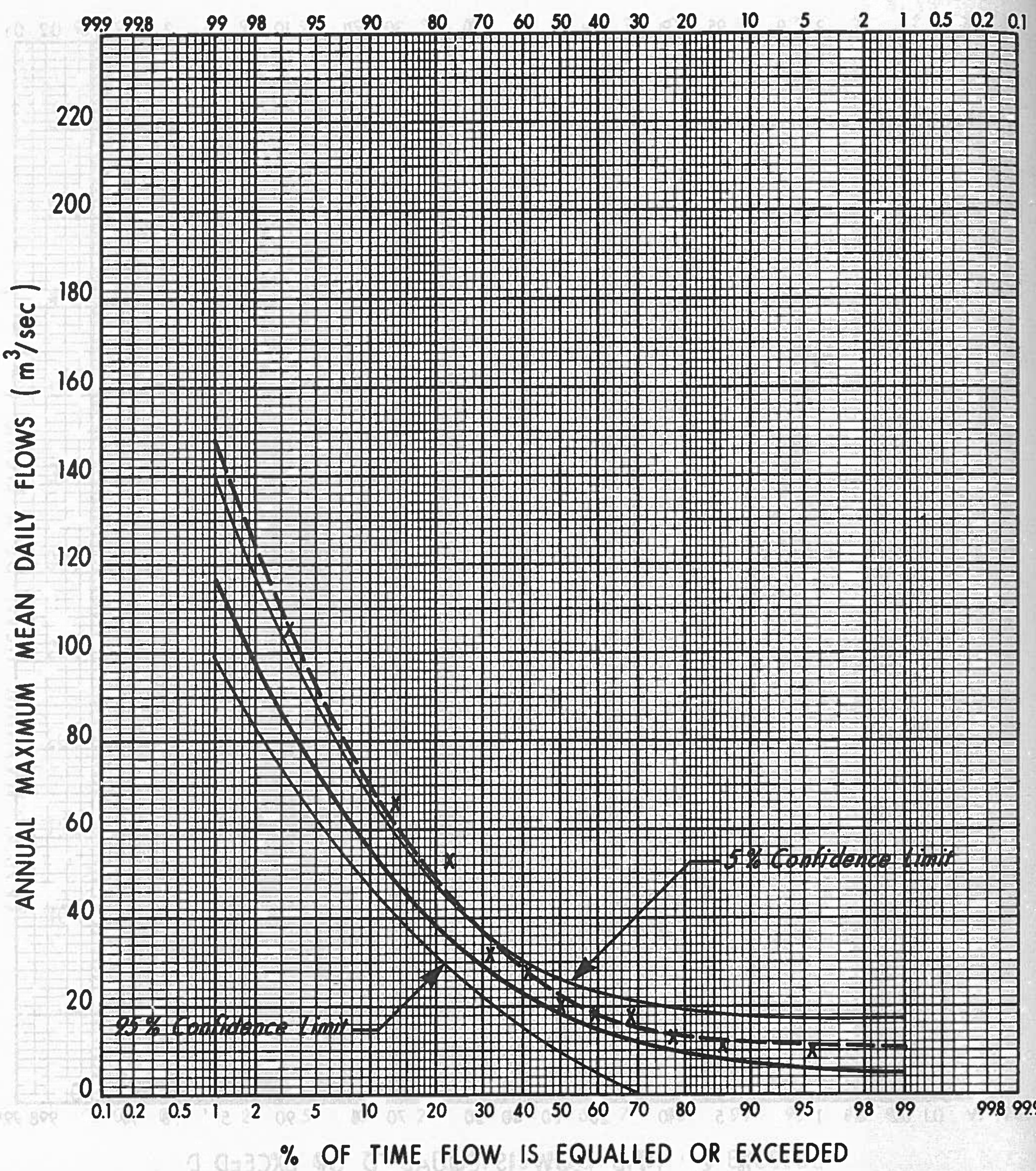
PERIOD OF RECORD 1944 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	BATTLE RIVER AT UNWIN PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 43

MICROFILM DATE
DRAWING No.
FILE No.



Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	IRON CREEK NEAR HARDISTY PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 44



NOTE : 1913 - 30 PERIOD OF RECORD WAS NOT ANALYZED DUE TO THE NON-HOMOGENEITY OF THE TWO SAMPLES PERIODS.

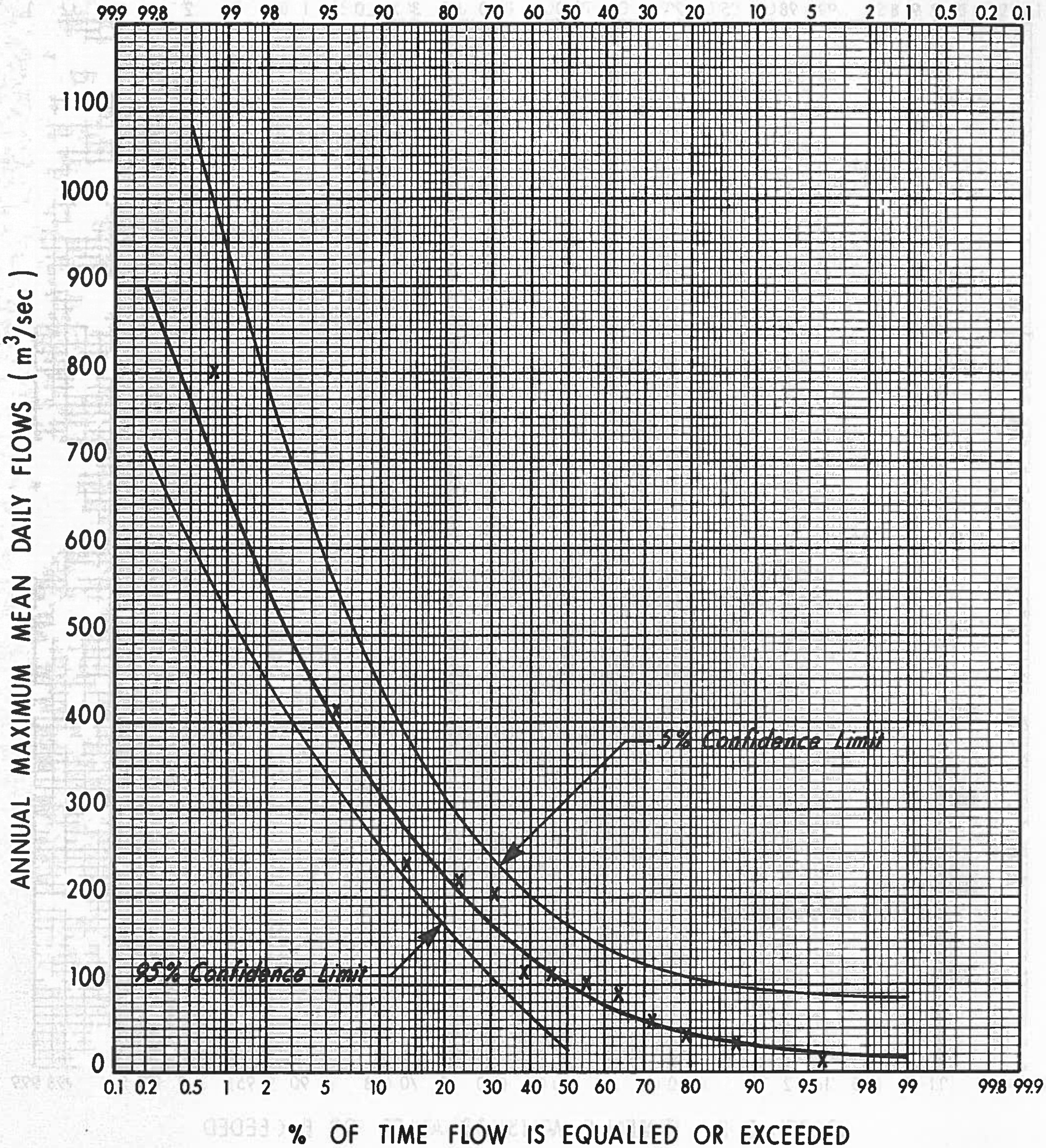
PERIOD OF RECORD 1913 - 1930, 1967, 1969 - 1978

– – – – – BASED ON 1967, 1969 - 78 RECORDED DATA

———— ADJUSTED TO 1944 - 1978 PERIOD BY CORRELATION TO BATTLE RIVER AT UNWIN.

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	BATTLE RIVER NEAR PONOKA PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 45

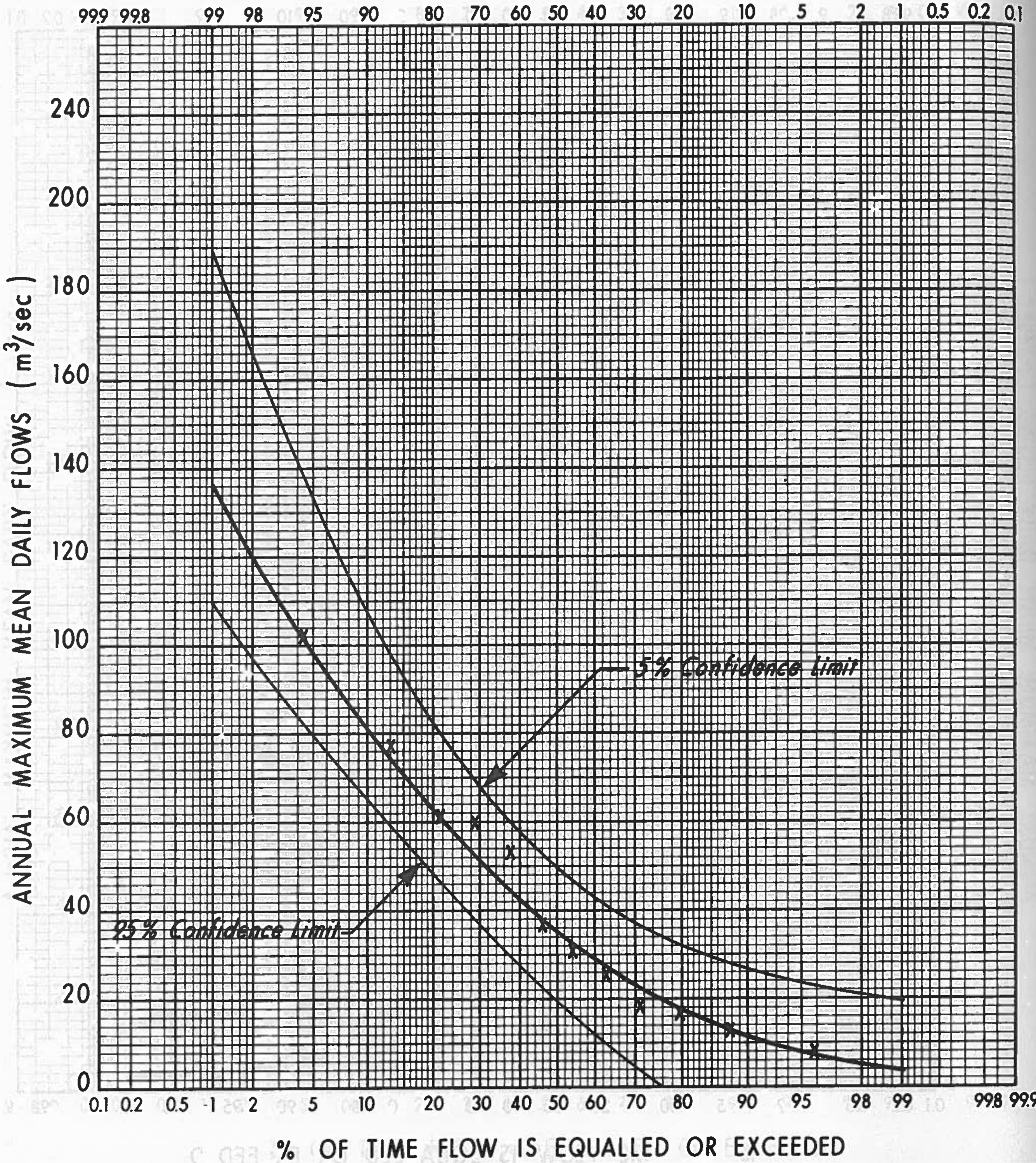
MICROFILM DATE ______ DRAWING No. ______ FILE No. ______



PERIOD OF RECORD 1967 - 1978

DATA USED IN THE ANALYSIS 1915 ESTIMATED
1967 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	RAM RIVER NEAR THE MOUTH PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 46



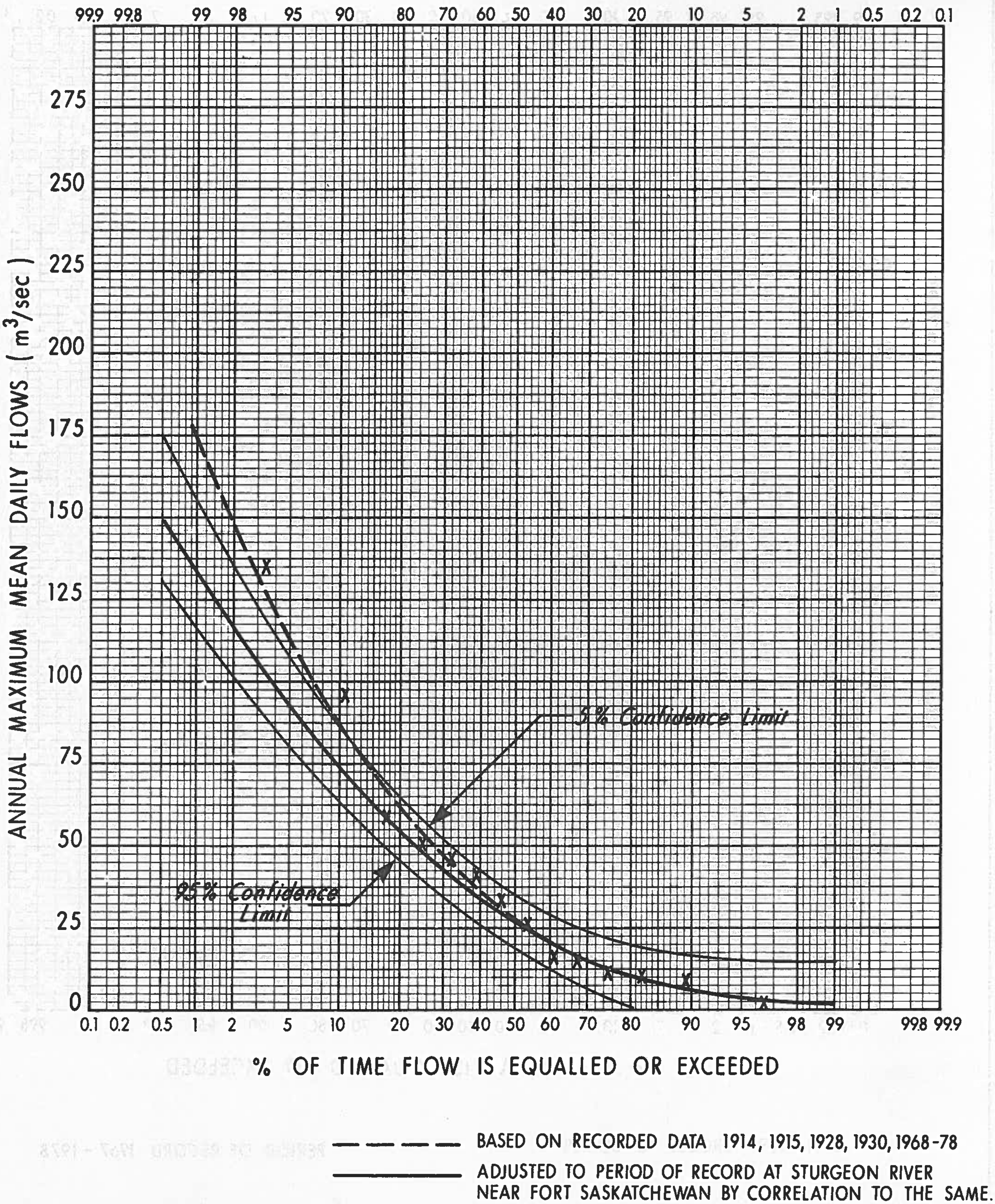
PERIOD OF RECORD 1967 – 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	STRAWBERRY CREEK NEAR THE MOUTH PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 47

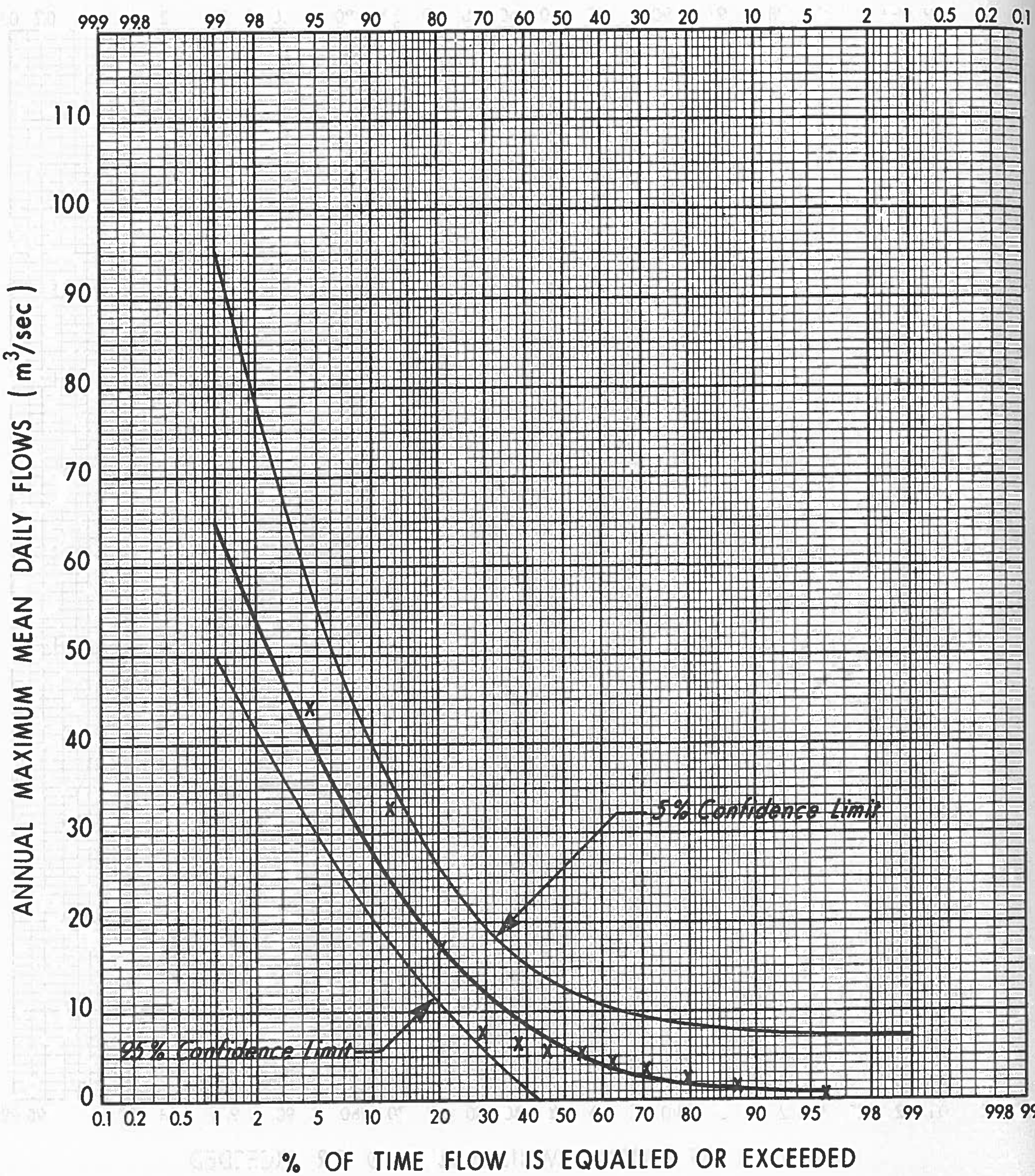
MICROFILM DATE

DRAWING No.

FILE No.



Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	STURGEON RIVER NEAR VILLENEUVE PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 48



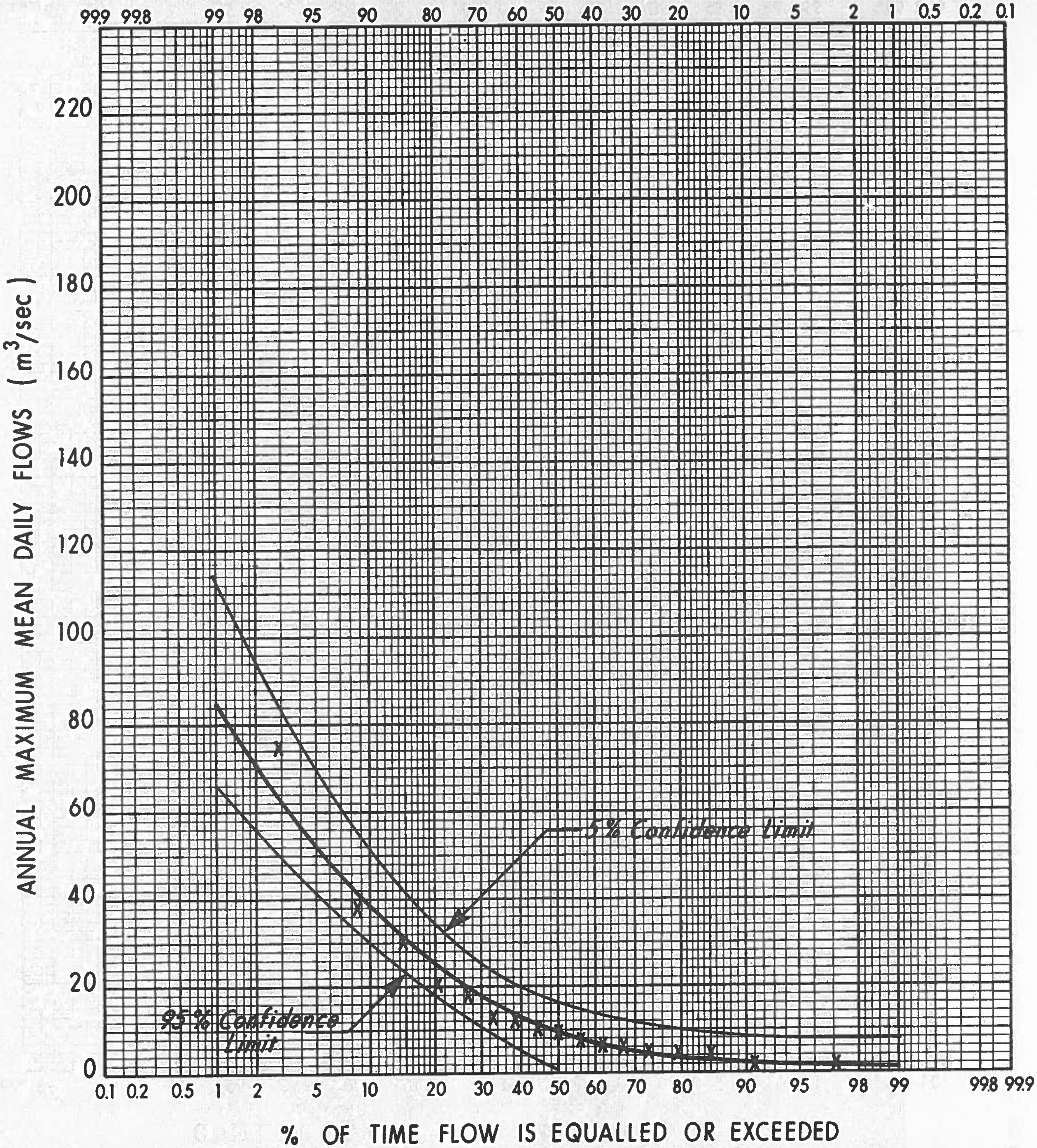
PERIOD OF RECORD 1967 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	WASKATENAU CREEK NEAR WASKATENAU PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 49

MICROFILM DATE

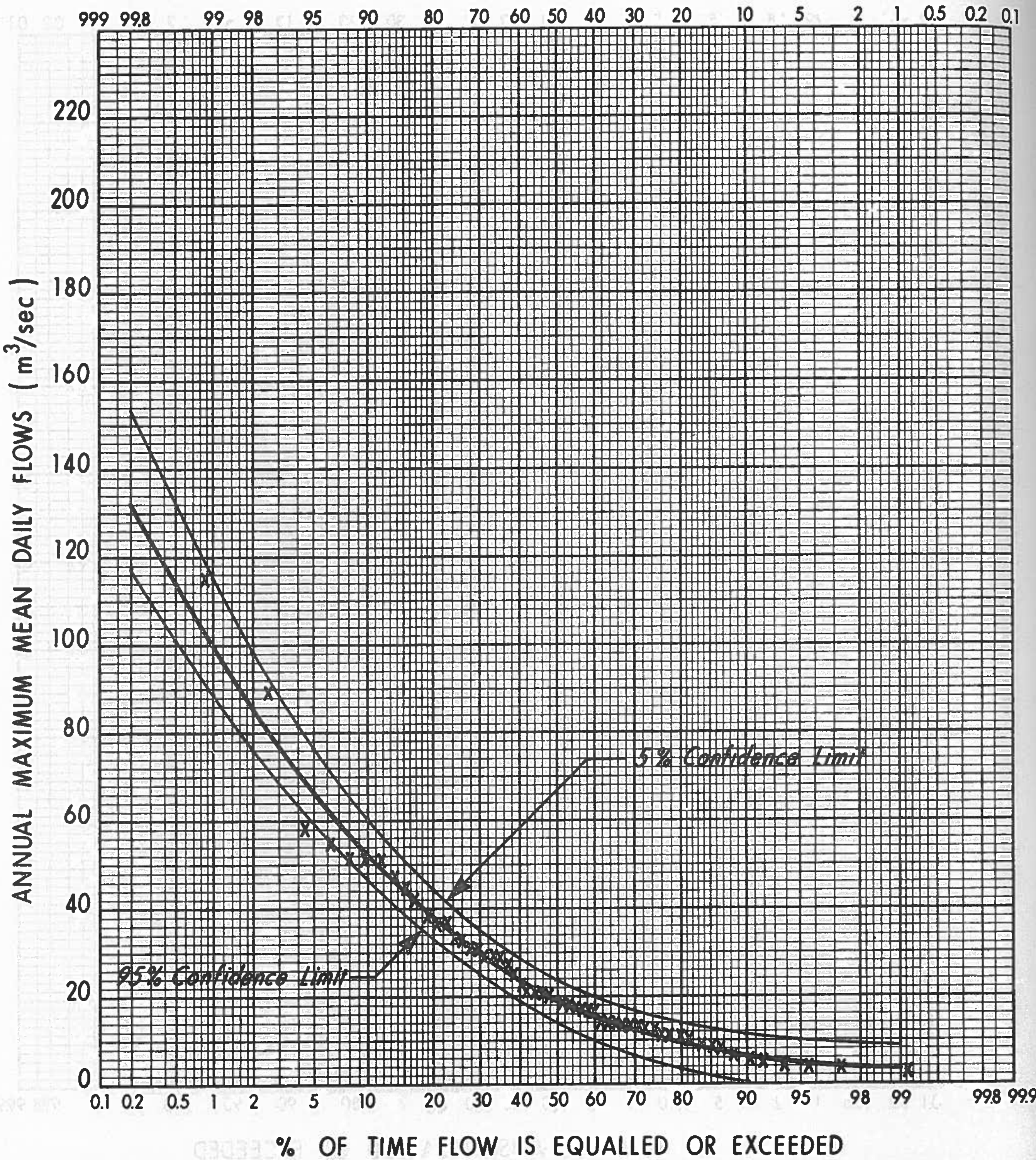
DRAWING No.

FILE No.



PERIOD OF RECORD 1962 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	VERMILION RIVER NEAR VEGREVILLE PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 50



PERIOD OF RECORD 1914 - 1923, 1929 - 1930, 1935 - 1978

Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	STURGEON RIVER NEAR FORT SASKATCHEWAN PEARSON III FREQUENCY DISTRIBUTION OF ANNUAL MAXIMUM MEAN DAILY FLOWS
SUBMITTED S. J. F. DATE MAY 1980	DESIGNED S. J. F. CHECKED	
APPROVED J. CARD DATE MAY 1980	DRAWN V. DA SILVA CHECKED S. J. F.	FIGURE 51

MICROFILM DATE
DRAWING No.
FILE No.

FIG. 52

Flooding in Edmonton, July 11, 1978 (photo: Edmonton Sun)

FIG. 53

Flooding in Edmonton, July 11, 1978 (photo: Edmonton Sun)

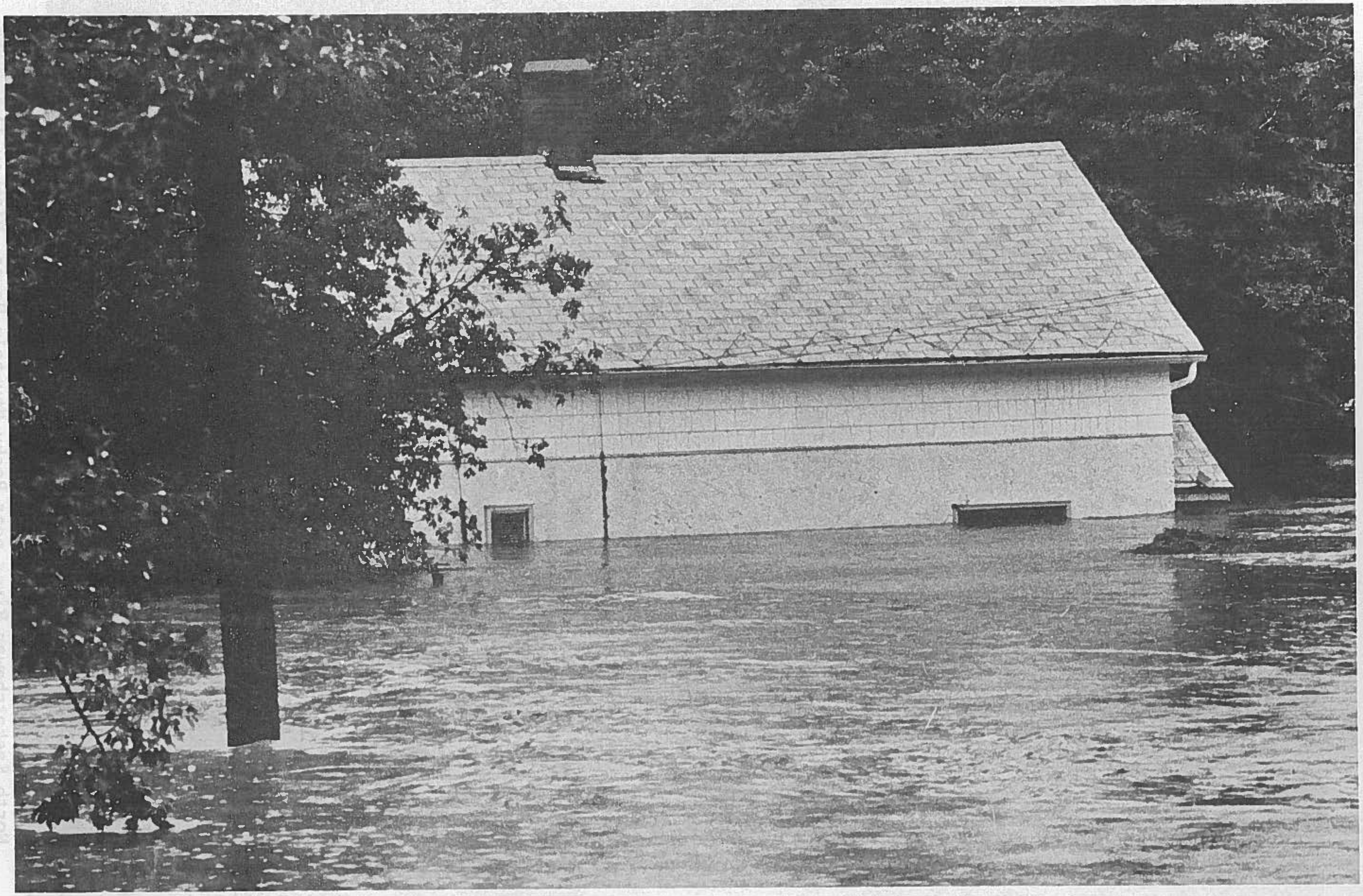


FIG. 54

"Floodwaters swallow house in Mill Creek Ravine where two people were trapped."
(Edmonton Sun, July 12, 1978)

FIG. 55 North Saskatchewan River near Rocky Mountain House, showing the effect of downstream ice jam, Water Level approximately 958 metres, around December 15, 1975.

FIG. 56 North Saskatchewan River near Rocky Mountain House, Highway 11 Bridge, Water Survey of Canada shelter on opposite bank. Water Level approximately 958 metres, around December 15, 1975.

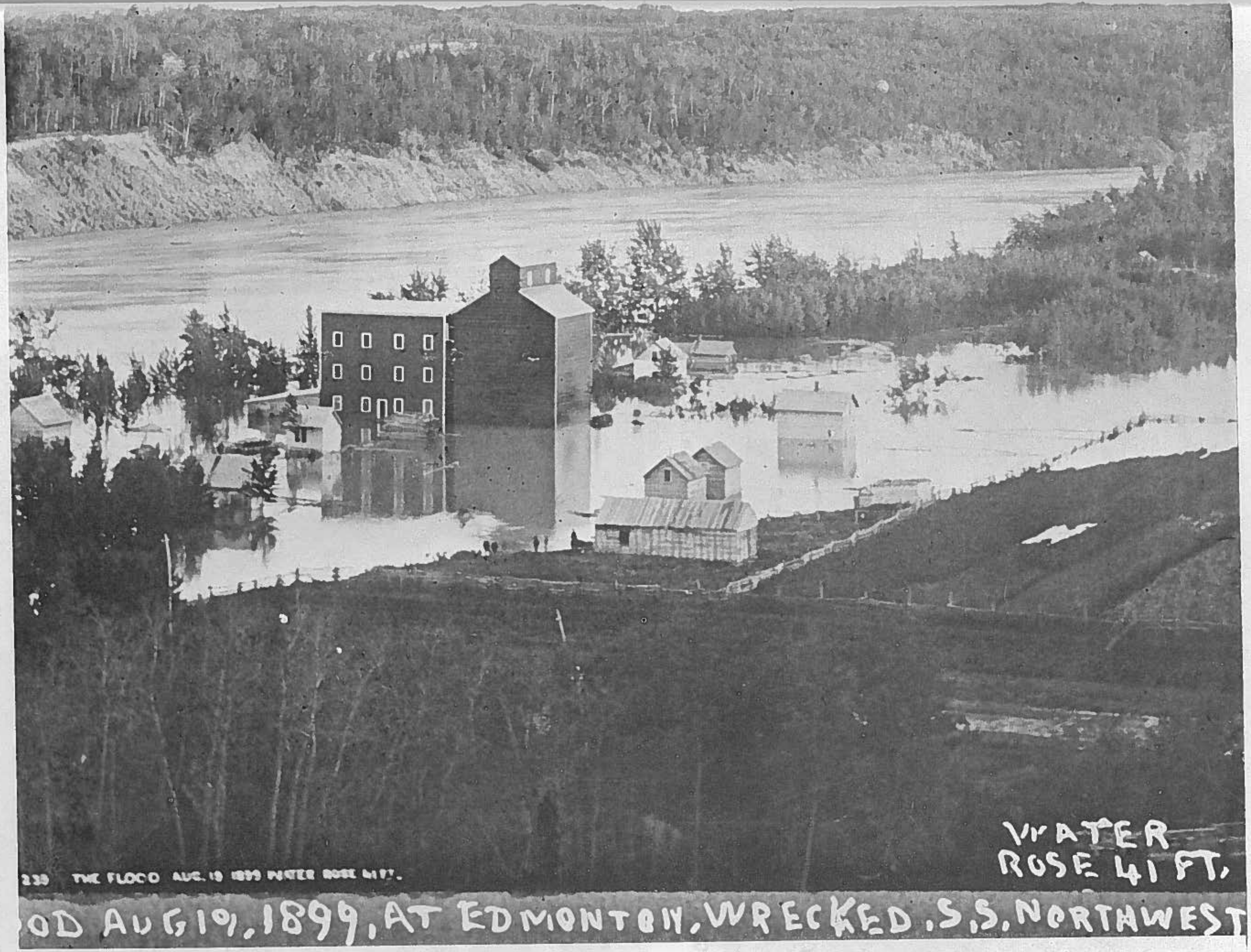


FIG. 57

Flood of August 19, 1899 at Edmonton, the North Saskatchewan River rose 41 feet during this flood.   (photo: E. Brown Collection)

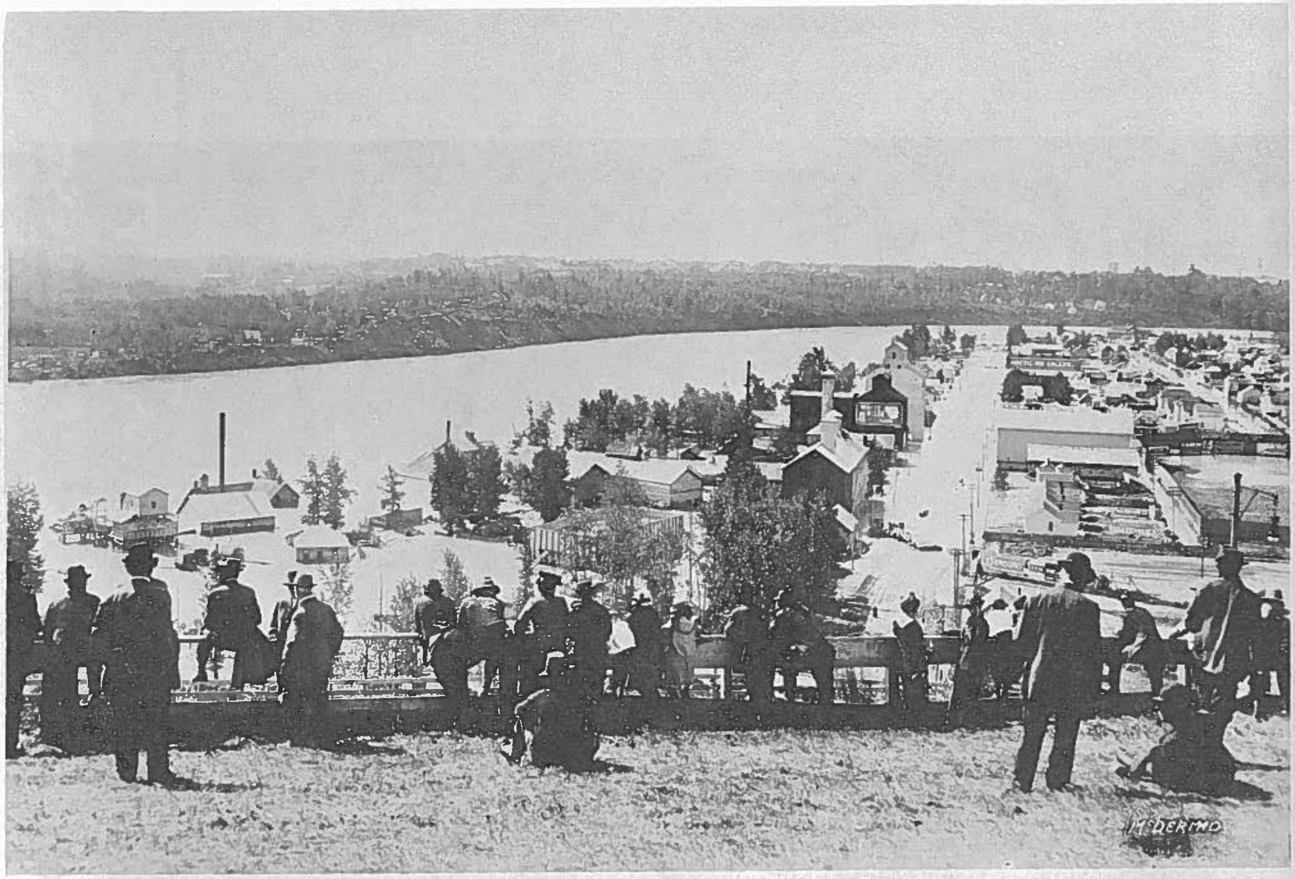


FIG. 58 View of Ross flats from McDougall hill, Edmonton, during 1915 flood. (McDermid Studios)

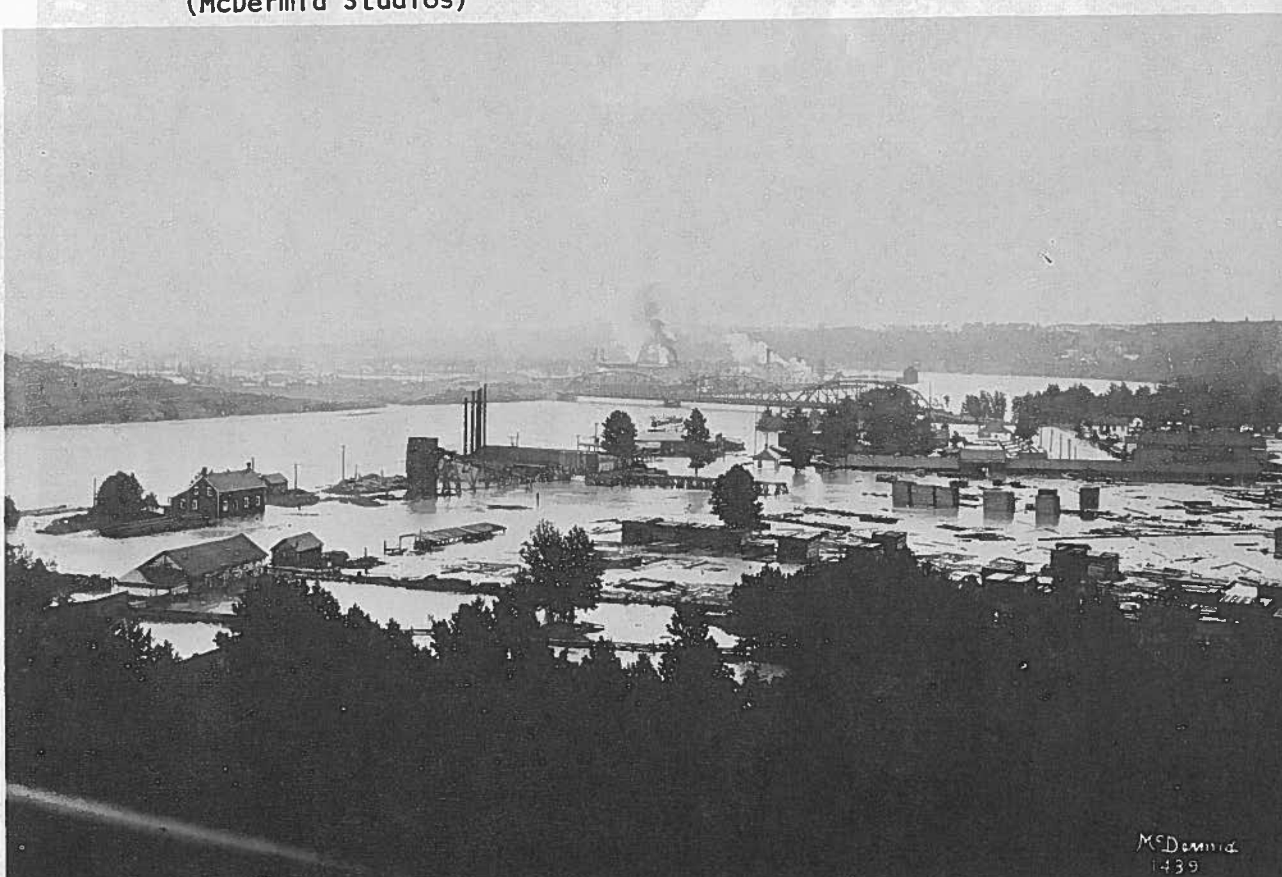


FIG. 59 View of Walter's Mill and flats from High Level Bridge, Edmonton, during 1915 flood. Present site of Kinsmen Field. (McDermid Studios)

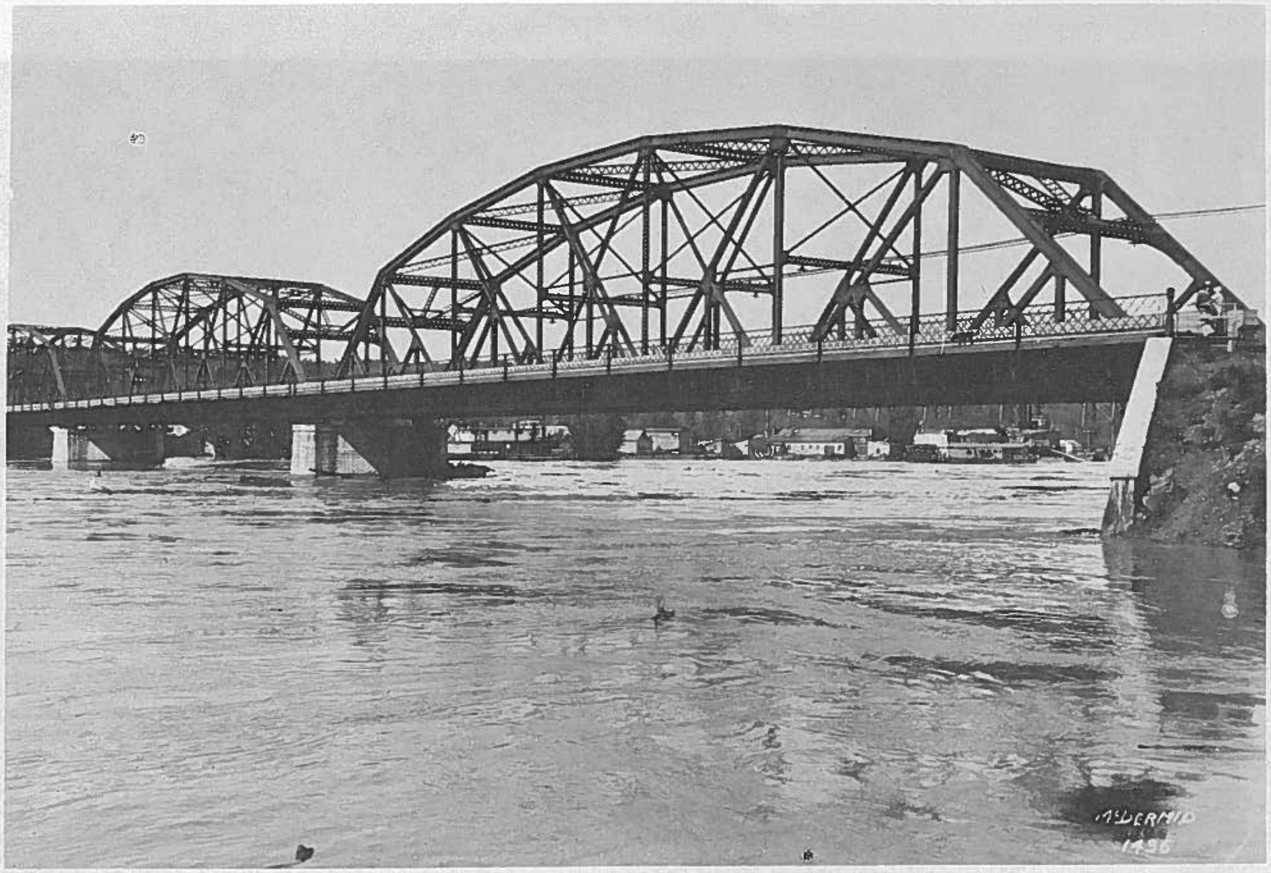


FIG. 60 View of the 105th street bridge, Edmonton, during the 1915 flood. (McDermid Studios)

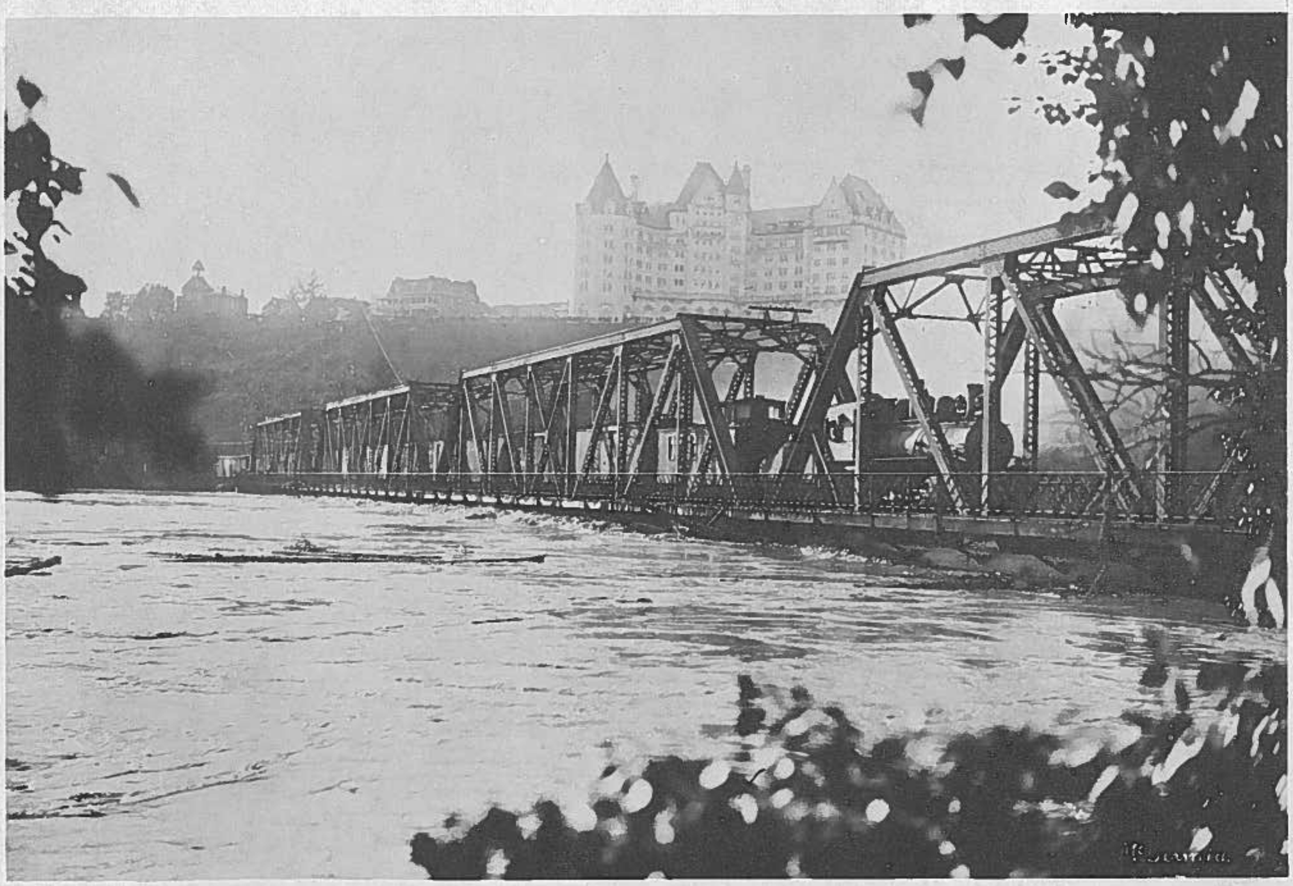


FIG. 61 Low level bridge showing train during the 1915 flood. North Saskatchewan River at Edmonton. (McDermid Studios)

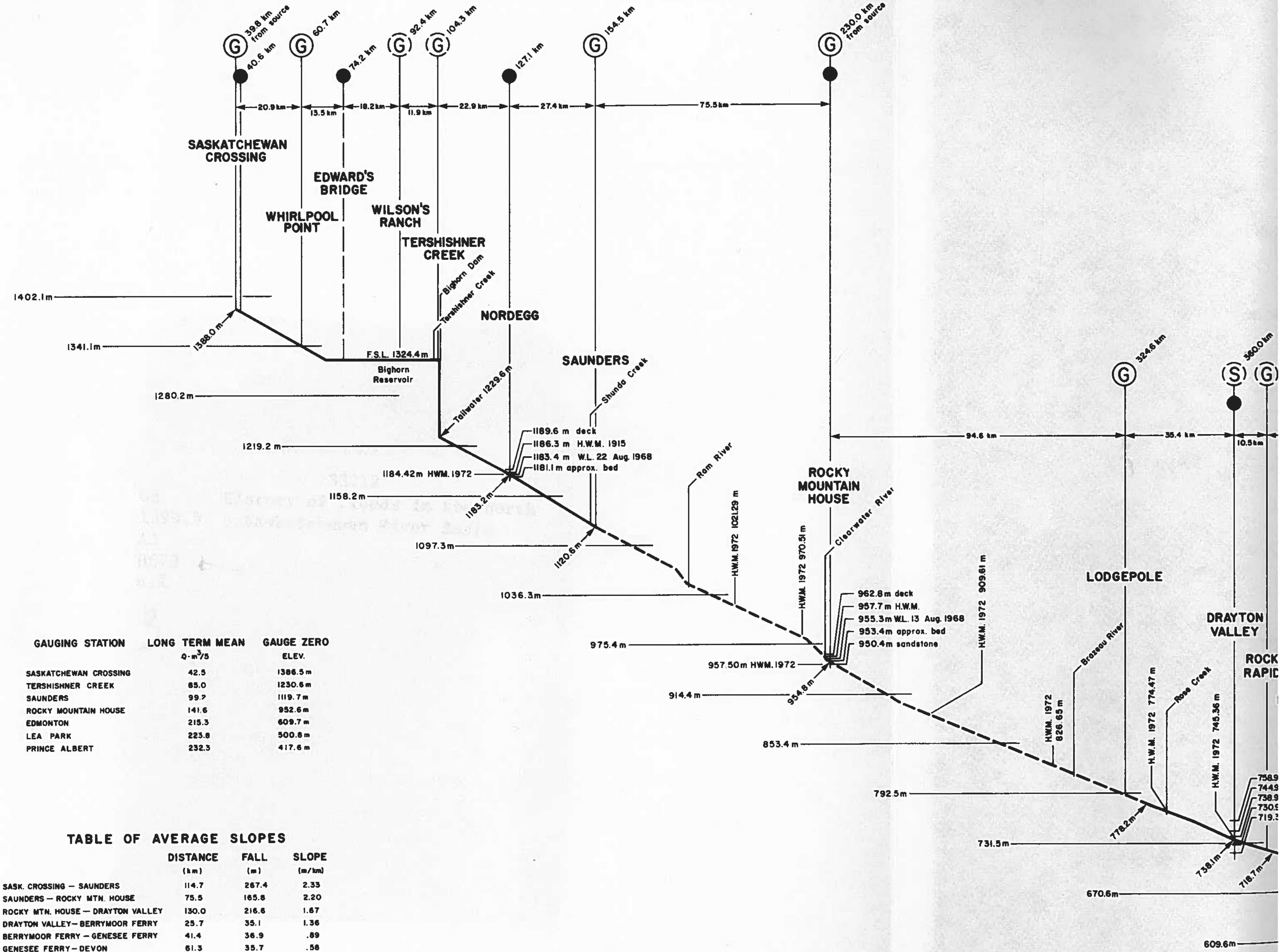
FIG. 62 Two Hills, Alberta during April 1974 flood (photo: Bureau of Public Affairs)

FIG. 63 Two Hills, Alberta during April 1974 flood (photo: Bureau of Public Affairs)

FIG. 64 Find the street! Two Hills, Alberta during April 1974 flood (photo: Bureau of Public Affairs)

FIG. 65 Find the bridge! The bed of this normally quiet river runs across the centre of this picture. Two Hills, Alberta during April 1974 flood (photo: Bureau of Public Affairs)

FIG. 66 St. Joseph's General Hospital, Vegreville, Alberta during April 1974 flood. The hospital became isolated when the dikes holding back water from the access road gave way. (photo: Bureau of Public Affairs)

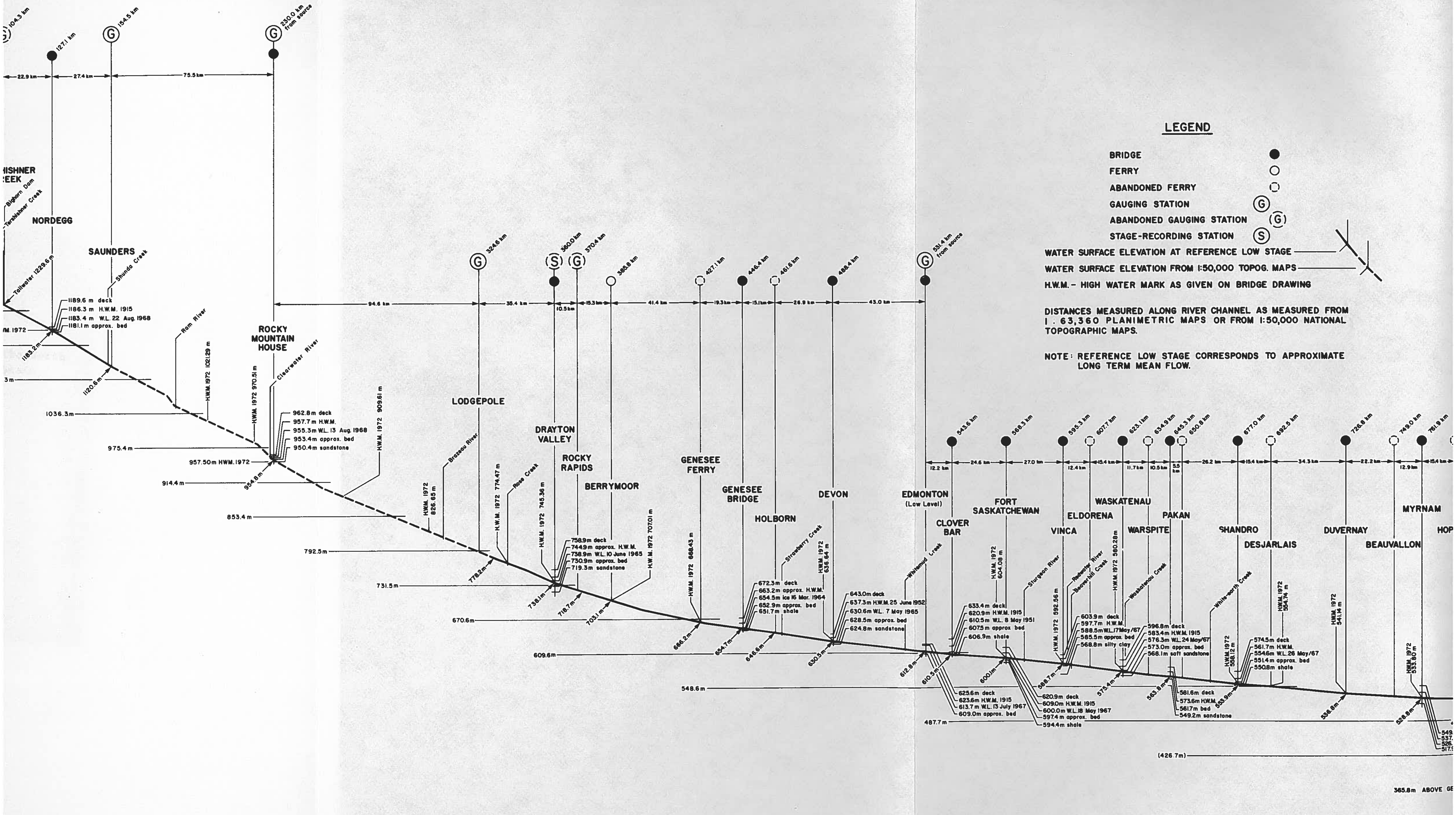


GAUGING STATION	LONG TERM MEAN Q-m³/S	GAUGE ZERO ELEV.
SASKATCHEWAN CROSSING	42.5	1386.5 m
TERSHISHNER CREEK	85.0	1230.6 m
SAUNDERS	99.7	1119.7 m
ROCKY MOUNTAIN HOUSE	141.6	952.6 m
EDMONTON	215.3	609.7 m
LEA PARK	223.8	500.8 m
PRINCE ALBERT	232.3	417.6 m

TABLE OF AVERAGE SLOPES

	DISTANCE (km)	FALL (m)	SLOPE (m/km)
SASK. CROSSING – SAUNDERS	114.7	267.4	2.33
SAUNDERS – ROCKY MTN. HOUSE	75.5	165.8	2.20
ROCKY MTN. HOUSE – DRAYTON VALLEY	130.0	216.6	1.67
DRAYTON VALLEY – BERRYMOOR FERRY	25.7	35.1	1.36
BERRYMOOR FERRY – GENESEE FERRY	41.4	36.9	.89
GENESEE FERRY – DEVON	61.3	35.7	.58
DEVON – EDMONTON	43.0	17.7	.41
EDMONTON – FORT SASKATCHEWAN	36.9	12.7	.34
FORT SASKATCHEWAN – WASKATENAU	54.9	24.7	.45
WASKATENAU – SHANDRO	53.9	21.4	.40
SHANDRO – DUVERNAY	49.7	17.2	.35
DUVERNAY – ELK POINT	60.4	13.3	.22
ELK POINT – HEINSBURG	33.0	15.3	.46
HEINSBURG – LEA PARK	18.5	4.6	.29
LEA PARK – FRENCHMAN BUTTE	61.0	9.1	.15
FRENCHMAN BUTTE – BATTLEFORD	157.7	31.1	.20
BATTLEFORD – PRINCE ALBERT	263.9	43.9	.17

isolated when the dikes holding back water from the access road gave way. (photo: Bureau of



LEGEND
BRIDGE
FERRY
ABANDONED FERRY
GAUGING STATION
ABANDONED GAUGING STATION
STAGE-RECORDING STATION
WATER SURFACE ELEVATION AT REFERENCE LOW STAGE
WATER SURFACE ELEVATION FROM 1:50,000 TOPOG. MAPS
H.W.M.- HIGH WATER MARK AS GIVEN ON BRIDGE DRAWING
DISTANCES MEASURED ALONG RIVER CHANNEL AS MEASURED FROM 1 : 63,360 PLANIMETRIC MAPS OR FROM 1:50,000 NATIONAL TOPOGRAPHIC MAPS.
NOTE: REFERENCE LOW STAGE CORRESPONDS TO APPROXIMATE LONG TERM MEAN FLOW.
NORDEGG
SAUNDERS
ROCKY MOUNTAIN HOUSE
LODGEPOLE
DRAYTON VALLEY
ROCKY RAPIDS
BERRYMOOR
GENESEE FERRY
GENESEE BRIDGE
HOLBORN
DEVON
EDMONTON (Low Level)
CLOVER BAR
FORT SASKATCHEWAN
VINCA
ELDORENA
WASKATENAU
WARSPITE
PAKAN
SHANDRO
DESJARLAIS
DUVERNAY
BEAUVALLON
MYRNAM
230.0 km from source
531.4 km from source
22.9 km
27.4 km
75.5 km
94.6 km
35.4 km
10.5 km
15.3 km
41.4 km
19.3 km
15.1 km
26.9 km
43.0 km
12.2 km
24.6 km
27.0 km
12.4 km
11.7 km
10.5 km
26.2 km
34.3 km
22.2 km
12.9 km
1189.6 m deck
1186.3 m H.W.M. 1915
1183.4 m W.L. 22 Aug. 1968
1181.1 m approx. bed
962.8 m deck
957.7 m H.W.M.
955.3 m W.L. 13 Aug. 1968
953.4 m approx. bed
950.4 m sandstone
758.9 m deck
744.9 m approx. H.W.M.
738.9 m W.L. 10 June 1965
730.9 m approx. bed
719.3 m sandstone
672.3 m deck
663.2 m approx. H.W.M.
654.5 m ice 16 Mar. 1964
652.9 m approx. bed
651.7 m shale
643.0 m deck
637.3 m H.W.M. 25 June 1952
630.6 m W.L. 7 May 1965
628.5 m approx. bed
624.8 m sandstone
633.4 m deck
620.9 m H.W.M. 1915
610.5 m W.L. 8 May 1951
607.5 m approx bed
606.9 m shale
625.6 m deck
623.6 m H.W.M. 1915
613.7 m W.L. 13 July 1967
609.0 m approx. bed
620.9 m deck
609.0 m H.W.M. 1915
600.0 m W.L. 18 May 1967
597.4 m approx. bed
594.4 m shale
603.9 m deck
597.7 m H.W.M.
588.5 m W.L. 17 May/67
585.5 m approx bed
568.8 m silty clay
596.8 m deck
583.4 m H.W.M. 1915
576.3 m W.L. 24 May/67
573.0 m approx. bed
568.1 m soft sandstone
581.6 m deck
573.6 m H.W.M.
561.7 m bed
549.2 m sandstone
574.5 m deck
561.7 m H.W.M.
554.6 m W.L. 26 May/67
551.4 m approx. bed
550.8 m shale
1036.3 m
975.4 m
957.50 m HWM. 1972
914.4 m
853.4 m
792.5 m
731.5 m
670.6 m
609.6 m
548.6 m
487.7 m
(426.7 m)
365.8 m ABOVE GE
Ram River
Clearwater River
Brazeau River
Rose Creek
Strawberry Creek
Whitemud Creek
Sturgeon River
Redwater River
Waskatenau Creek
White-earth Creek
Shunda Creek

Research Council of Alberta
July 1965
Revised Alberta Environment May 1980

LONGITUDINAL PROFILE OF THE NORTH SASKATCHEWAN RIVER IN ALBERTA

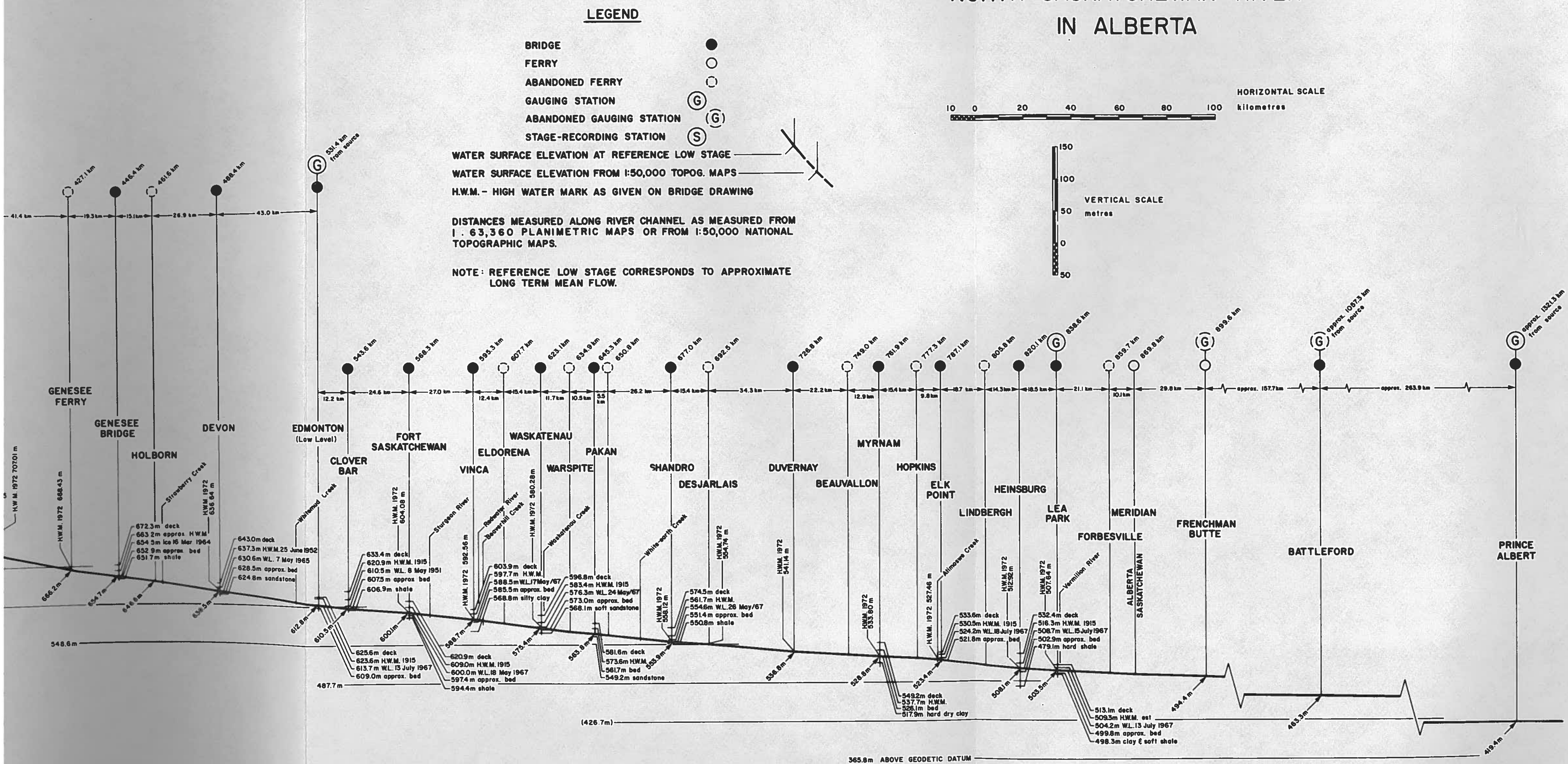


FIGURE 67