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# Flood of June 1972 in the Southern Peace (Smoky River) Basin, Alberta

L. A. Warner and W. C. Thompson



**TECHNICAL BULLETIN NO. 87**  
(Résumé en français)

*INLAND WATERS DIRECTORATE,  
WATER RESOURCES BRANCH,  
CALGARY, ALBERTA, 1974.*

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## Abstract

In June 1972, more than six inches of rain fell over parts of the Peace River basin southwest of Grande Prairie, resulting in record flows in nearly all streams in that area. The rain occurred with the passage of a cold low over Central Alberta, which permitted a northeasterly upslope of warm, moist air to prevail over the southern Peace River basin for about 36 hours.

Flood damage was reported in Grande Prairie, Grande Cache, Watino, and the town of Peace River. Calculations indicate that the influence of the W.A.C. Bennett Dam and a diking operation in the town probably reduced the severity of flooding at Peace River townsite. The effect of the diking operation on water levels associated with an ice jam in April 1973 is discussed in Appendix A. Details on agricultural flood damage incurred by farmers along the Peace River system have been excerpted from "Flood Damage Estimation, June, 1972, Athabasca, North Saskatchewan and Peace River Basins" by J.L. Knapp of Alberta Department of Agriculture.

The present report contains a brief account of the flood damage, a description of the Southern Peace (Smoky River) basin, and a location map which shows the area affected by the flood, the various stream gauging and meteorological observation stations, as well as an isohyet analysis of the rainfall event.

The description of the flood covers the following: meteorological analysis, flood hydrographs, maximum discharges, and maximum unit discharges.

The analysis of the flood includes flood frequency analyses for two of the gauging sites and an explanation of streamflow data tables. Hourly discharge determinations are provided for seven gauging sites, and peak flows for two miscellaneous sites.

## Résumé

En juin 1972, plus de six pouces de pluie sont tombés dans le bassin de la rivière de la Paix, au sud-ouest de Grande-Prairie; il en a résulté un débit record dans presque tous les cours d'eau de la région. Un courant de basse température dans le centre de l'Alberta a amené la pluie et a provoqué, en direction nord-est, une pente d'air chaud et humide qui s'est maintenu au-dessus de la partie sud du bassin durant près de 36 heures.

Grande-Prairie, Grande-Cache, Watino et le village de Peace River ont signalé des dégâts attribuables à la crue. Les calculs montrent que le barrage W.A.C. Bennett et la construction de digues ont réduit la gravité de la crue dans le dernier endroit. L'Annexe A décrit l'effet de la construction de digues sur les niveaux de l'eau par rapport à l'embâcle d'avril 1973. Les extraits sur les dégâts causés aux terres agricoles le long du réseau de la rivière de la Paix proviennent d'un ouvrage intitulé "Flood Damage Estimation, June, 1972, Athabasca, North Saskatchewan and Peace River Basins," par J.L. Knapp du ministère de l'Agriculture de l'Alberta.

Ce rapport comprend un résumé des dégâts causés par la crue, une description du bassin sud de la rivière de la Paix (rivière Smoky), une carte montrant l'emplacement de la région touchée par la crue et des différentes stations d'observation météorologique et limnimétriques et une analyse isohyète des pluies.

La description de la crue renferme une analyse météorologique, des hydrogrammes de la crue, des débits maximaux et des débits unitaires maximaux.

L'analyse de la crue comprend des analyses de fréquence des crues pour deux stations limnimétriques et une explication des tables de données sur le débit des cours d'eau. Des renseignements sont donnés sur les débits, à toutes les heures, à sept stations limnimétriques et sur les débits maximaux, à deux stations diverses.

## Acknowledgments

The authors would like to thank the public and private agencies that contributed to the content of this report. Among them are the field staff of the Peace River Sub-office of the Water Survey of Canada, and personnel of the Atmospheric Environment Service responsible for storm analysis. Contributions from the Alberta Department of Lands and Forests, through its field staff members, Messrs. Short, Hrabar and Sorenson, concerning precipitation data collected at the Cutbank River site, are greatly appreciated. British Columbia Hydro provided the inflow-outflow data for Williston Reservoir during the flood period. Information and photographs of flood damage are included in this report through the courtesy of the Edmonton Journal and the Peace River Record-Gazette.

## Introduction

In June 1972, heavy rains in the Peace River basin southwest of Grande Prairie resulted in record flows in nearly all streams in that area.

In the 36-hour period between 0600 MDT, June 11, and 1800 MDT, June 12, 1972, more than six inches of rain fell over parts of the Peace River basin southwest of Grande Prairie. The maximum reported amount was about eight inches at Nose Mountain Lookout Tower, and intensities exceeded one-half inch per hour on two occasions at an observation site on the Cutbank River.

The rain occurred with the passage of a cold low over Central Alberta which permitted a northeasterly upslope flow of fairly warm, moist air to prevail over the southern Peace River basin for about 36 hours.

On June 13, flood waters from the Wapiti River inundated the water treatment plant in the town of Grande Prairie. Bridges and bridge approaches were damaged or destroyed. Damage has been estimated at over \$1 million in the Grande Prairie area alone.

Flood waters of the Smoky River washed out the main power supply for Grande Cache. The Alberta Resource Railway was a major victim of the flood and estimates of damage exceed \$8 million. The Northern Alberta Railway bridge at Watino was destroyed and damages were approximately \$100,000.

Flood waters of the Smoky and Peace Rivers combined, in what may be described as an extremely rare event, at Peace River townsite to produce a discharge of 550,000 cubic feet per second. Calculations mentioned elsewhere in this report indicate that without the influence of the W.A.C. Bennett Dam on the Peace River, nearly simultaneous maximum flows in the Smoky and Peace Rivers would have combined at the Peace River townsite to produce a discharge of over 800,000 cubic feet per second, corresponding to a stage about six feet higher than what actually occurred.

The depth of water in communities along the West Peace River reached five feet or more in the developed areas. The town of Peace River itself was not so severely affected, however, a diking operation probably averted

much greater damage. It is of interest here to note that this same diking operation, during and subsequent to the June 1972 flood, accounted for flood protection during the high water conditions caused by ice jamming on April 10–14, 1973. A series of ice jams on the Peace River below the townsite caused a water level approximately one and one-half feet higher than that experienced during the flood of June 1972. A brief account of the water levels associated with this ice jam is given in Appendix A.

The present report contains a brief account of the flood damage, a description of the Southern Peace (Smoky River) basin, and a location map (in pocket) which shows the area affected by the flood, the various stream gauging and meteorological observation stations, and an isohyet analysis of the rainfall event.

The description of the flood is covered under the following topics: Meteorological Analysis; Flood Hydrographs; Maximum Discharges; and Maximum Unit Discharges. In addition to the basic streamflow data, some flood analysis is provided in the following sections: Williston Lake Regulation; and Frequency Analysis.

Hydrometric coverage during the peak runoff period was sufficient to permit hourly discharge determinations at seven gauging sites. In addition, peak flows were indirectly measured and are presented for two miscellaneous sites on Pinto Creek and Nose Creek. Much of the discharge data included in this report has been published in the annual series, Surface Water Data in Canada. Daily discharges for 1972 were published in a report of the Water Survey of Canada (1972). The data pertinent to this report has been segregated and presented in greater detail; hourly discharges covering a period before and after the peak have been computed (Appendix C).

## FLOOD DAMAGE

On June 13 a state of emergency was declared in the town of Grande Prairie as flood water from the Wapiti River inundated the water treatment plant. Strict water rationing was brought into effect and all non-essential water use was curtailed. Some local industries were shut down and elementary schools closed.



In the Grande Prairie area alone, damage has been estimated in excess of \$1 million. Bridges and bridge approaches were damaged or destroyed. In the forest region to the south, forestry crews were stranded, some 40 to 60 homes were damaged, and several families were forced to evacuate.

Earlier in the week, floodwaters of the Smoky River washed out the main power supply for Grande Cache. The Alberta Resource Railway was a major victim of the flood and estimates of damage exceed \$8 million.

The Highway No. 34 bridge crossing at Bezanson, 20 miles east of Grande Prairie, was closed on June 13. The RCMP reported that the bridge was under five feet of water. Rail traffic over the Northern Alberta Railway bridge at Watino was halted on the afternoon of June 13 (Photograph 3). Soon after, that bridge was destroyed; damage was approximately \$100,000.

Floodwaters of the Peace River turned the communities of West Peace River into a lake as the depth of water reached five feet or more in the developed areas (Photograph 6). On June 14, 105 persons were evacuated.

The town of Peace River itself was not so severely affected, however, a diking operation probably averted much greater damage. The townspeople erected a dike extending from the mouth of the Heart River to the north end of 98th Street. The Heart River, which flows through the downtown area of Peace River, was backed up by the high flow in the Peace River. During the flood crisis, the residents of Peace River were warned that the town filtration system was being heavily taxed because of the heavy silt load in the main supply.

The following material has been excerpted from the July 1972 report by J. L. Knapp, "Flood Damage Estimation, June, 1972, Athabasca, North Saskatchewan and Peace River Basins," Resource Economics Branch, Marketing Division, Alberta Department of Agriculture. The report assesses the crop, livestock, and property losses incurred by farmers as a result of the June floods. Losses suffered by farmers (Alberta only) in the Peace River, Wapiti River, and Smoky River Basins are summarized below.

Each farmer was interviewed personally for a damage assessment. A questionnaire was used for this purpose and is included as Appendix B.

#### **Peace River**

Agricultural damage resulting from flooding of the Peace River occurred south of the town of Peace River. One farmer reported damage to 140 acres of rapeseed. His total losses were estimated at \$5,692.



**Photograph 1.** Flood almost submerges Grande Prairie water treatment plant; reservoir at right. *Edmonton Journal*, June 14, 1972.



**Photograph 2.** Southern approaches to Wapiti Bridge under water. *Edmonton Journal*, June 14, 1972.



**Photograph 3.** Northern Alberta Railway bridge at Watino yields to the onslaught of the waters from the Smoky River six hours before the town of Peace River noticed the danger of the rising rivers. This photo was taken by Peace River Record-Gazette staffer Dave Nelson in a plane owned by Estabrook Construction of Grimshaw.



**Photograph 4.** June 14, 1972. Smoky River at Watino, taken from south end of bridge on Highway 49 and looking downstream. Gauge height at time of photograph = 32.0 ft. Maximum gauge height attained during flood = 33.24 ft. Water Survey of Canada.



**Photograph 5.** June 14, 1972. Smoky River at Watino taken from left bank, downstream of bridge on Highway 49. Gauge height at time of photograph = 32.0 ft. Water Survey of Canada.



Photograph 6. Raging floodwaters of the Peace River transformed the West Peace into a lake during the worst flooding ever seen there. Here, sign posts for 91st Street and 107th Avenue barely emerge above the rising flood waters. Peace River Record-Gazette.

### Wapiti River

In the area south of Beaverlodge, the flooding of the Wapiti River caused slight agricultural damage. One farmer reported damages estimated at \$600 to 3 acres of potatoes and silt damage estimated at \$323 to 10 acres of land.

### Smoky River

Thirty-three farmers experienced agricultural losses caused by flooding of the Smoky River in June of 1972. These farmers are located between Watino and Bezanson. The table below summarizes the estimated agricultural flood losses in this region.

SMOKY RIVER AGRICULTURAL FLOOD DAMAGES

Damaged Factor	Acres	Estimated Loss (\$)
Wheat	380	14,096
Oats	124	3,949
Barley	233	8,330
Rapeseed	404	17,172
Hay	203	4,978
Mixed grain	140	5,160
Flax	122	6,040
Silt damage	639	20,630
Permanent land loss	165	15,750
Grass reseeding	161	1,015
Stored crop damage	-	4,463
Fence damage	-	2,502
Driftwood cleanup	-	845
Equipment damage	-	6,100
Domestic garden	-	200
Market garden	-	1,412
Cattle losses	-	20,700
<b>TOTAL</b>		<b>133,342</b>

In addition, the Alberta Emergency Measures Organization has compiled loss figures (see table on page 5).



Photograph 7. Town of Peace River. Backwater from the Heart River. Peace River Record-Gazette.



Photograph 8. Safest place on 98th Street was atop the Powell building during the severe floods in that part of town. Peace River Record-Gazette.

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**PRINCIPAL DWELLING PROPERTY DAMAGE**

Smoky River/ Watino	Wapiti River	West Peace	East Peace
\$ 56,586.00	Nil	\$102,761.00	\$ 9,028.00
			<b>TOTAL</b>
			168,375.00

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**PERSONAL EFFECTS LOSSES – PRINCIPAL DWELLING**

Smoky River/ Watino	Wapiti River	West Peace	East Peace	South Peace
\$ 19,292.40	Nil	\$111,355.84	\$ 8,254.31	\$ 980.00
				<b>TOTAL</b>
				\$139,882.55

---

**NOT PRINCIPAL DWELLING**

Smoky River/ Watino		Wapiti River		Peace River	
Property Damage	Personal Effects	Property Damage	Personal Effects	Property Damage	Personal Effects
\$ 8,660.00	\$ 8,170.00	\$25,985.00	\$34,748.25	\$25,238.00	\$ 2,745.00
					<b>TOTAL</b>
					105,546.25

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**SMALL BUSINESS – LOSS OF STOCK**

Watino	\$ 30,000 (1 business only)
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**LOCATION MAP**

The general location map (Figure 1, in pocket) delineates the area affected by the flood of June 1972. Information on the map includes the various stream gauging and meteorological observation stations and, as well, an isohyet analysis of the rainfall event.

**DESCRIPTION OF THE SOUTHERN PEACE  
(SMOKY RIVER) BASIN**

The description of the Smoky River basin will be limited to the headwaters of the Smoky River and the following tributaries: the Cutbank, Wapiti, and Simonette Rivers. Refer to Figure 1 for the area of interest.

The Smoky, Cutbank, and Wapiti Rivers all rise in the Rocky Mountains of Western Alberta and Eastern British Columbia. The Simonette River rises in the Rocky Mountain Foothills area of mid-western Alberta. These streams then pass through the Western Alberta Plains to the Wapiti Plain and on to the Peace River lowland.

Surficial deposits in the higher areas are primarily till (ground moraine and hummocky moraine); the lower areas (Wapiti Plain) are predominantly silt and clay (lake deposits). The vegetation in the area of interest consists of alpine meadow in the Rocky Mountains and forest cover in the lower region. Progressing downstream, the forest cover is altitudinally zoned as follows: lodgepole pine – white spruce – Engelmann spruce; lodgepole pine – white spruce ecotone to spruce (white and black); aspen poplar; aspen poplar with grass, park-like in the Peace River lowland.

Grey wooded soils comprise the major soil group in the Western Alberta and Wapiti Plains area of the Smoky River basin. These soils occur primarily in a subhumid climate and where there is usually continuous tree cover. Rainfall varies from 12 to 14 inches annually. Dark grey and dark grey wooded soils are predominant in the Grande Prairie area and extend northward to the Peace River lowland. These soils occur in a dry-subhumid to subhumid climate and where there is fairly continuous tree cover. The average annual rainfall varies from 16 to 19 inches.

# Description of the Flood

## METEOROLOGICAL ANALYSIS

This chapter discusses the meteorological aspects of the storm event that caused the flooding. The synoptic conditions during the storm are presented through a series of weather maps and satellite photographs, the intensity and areal coverage of the rainfall are discussed, and the factors that contributed to the heavy rainfall are investigated. A few comments relating the intensity of the rainfall from this storm to previous storms are also included.

### Data Source

Nearly all the weather observations used were taken by three agencies. These agencies with their observation schedules are:

1. Atmospheric Environment Service, Federal Department of Environment—Hourly to 3-hourly observations with precipitation measurements at 0000, 0600, 1200, and 1800 MDT.
2. Alberta Forest Service
  - (a) Lookout Towers—Twice-daily observations, including precipitation measurements at 0800 and 1400 MDT.
  - (b) Ranger Stations—Daily observations, including precipitation measurements at 1400 MDT.
3. B.C. Forest Service—Daily observations, including precipitation measurements at 1400 MDT.

The locations of the observation sites are shown in Figure 1 (in pocket).

### Synoptic Analyses

#### *Weather Charts*

A series of weather charts is shown in Figures 2, 3, and 4 for June 11, 0600 MDT, June 11, 1800 MDT, and June 12, 0600 MDT, respectively, depicting the synoptic conditions during the period in which the rate of rainfall over the subject area was greatest. Part (a) of each figure is a 500-millibar (mb) analysis and Part (b) is a surface analysis.

The analyses typify the development and passage of a cold low, a type of storm that is often the cause of heavy precipitation over the Alberta Foothills. Figure 2a shows that at 0600 MDT, June 11, about the time heavy rain began falling on the South Peace basin, a 500-mb low had moved from off the coast to a position over western Washington. East of the low, a ridge with associated warm air extended northward over Saskatchewan and northern Alberta. At the same time, an elongated trough existed at the surface, east of the Rockies, with a low beginning to form near Calgary (Fig. 2b). Fairly warm, nearly saturated air with typical dewpoints in the 55-60°F range covered northeastern B.C. and much of Alberta. The cyclonic circulation forming around the developing low had just begun to transport the warm, moist air westward across north-central Alberta, forcing it to rise over the Foothills of the South Peace basin. Southeast of the low centre, a cold front marked the leading edge of a surge of cooler, drier air advancing eastward over Southern Alberta.

Twelve hours later, at 1800 MDT, June 11, the 500-mb low centre had moved northeastward to southeastern B.C. without deepening (Fig. 3a). The ridge over the Prairies remained stationary, and the warm air associated with it appeared as a tongue on the periphery of the northeastern quadrant of the low. At the surface, Figure 3b shows that the low had moved northward to just south of Edmonton and deepened 5 mb to 996 mb. At that time the easterly upslope flow of warm, moist air over the foothills was well established, and heavy rain was falling over the South Peace basin (Fig. 6). The cold front had advanced northeastward to a nearly east-west line through east-central Alberta.

By 0600 MDT, June 12, the 500-mb low had moved eastward to Southern Alberta and deepened to 5,460 metres (Fig. 4a). The tongue of warm air had shifted slightly eastward over the southern Prairies but had spiraled around the northwest side of the low, so that it still remained over the South Peace basin. The surface low had moved only slightly northward, and had nearly been overtaken by the upper low (Fig. 4b). The easterly upslope flow still persisted over the northern sections of the Foothills, though the extent of the area of the warm, moist air had noticeably diminished as the advancing cooler, drier air behind the cold front pushed northward.



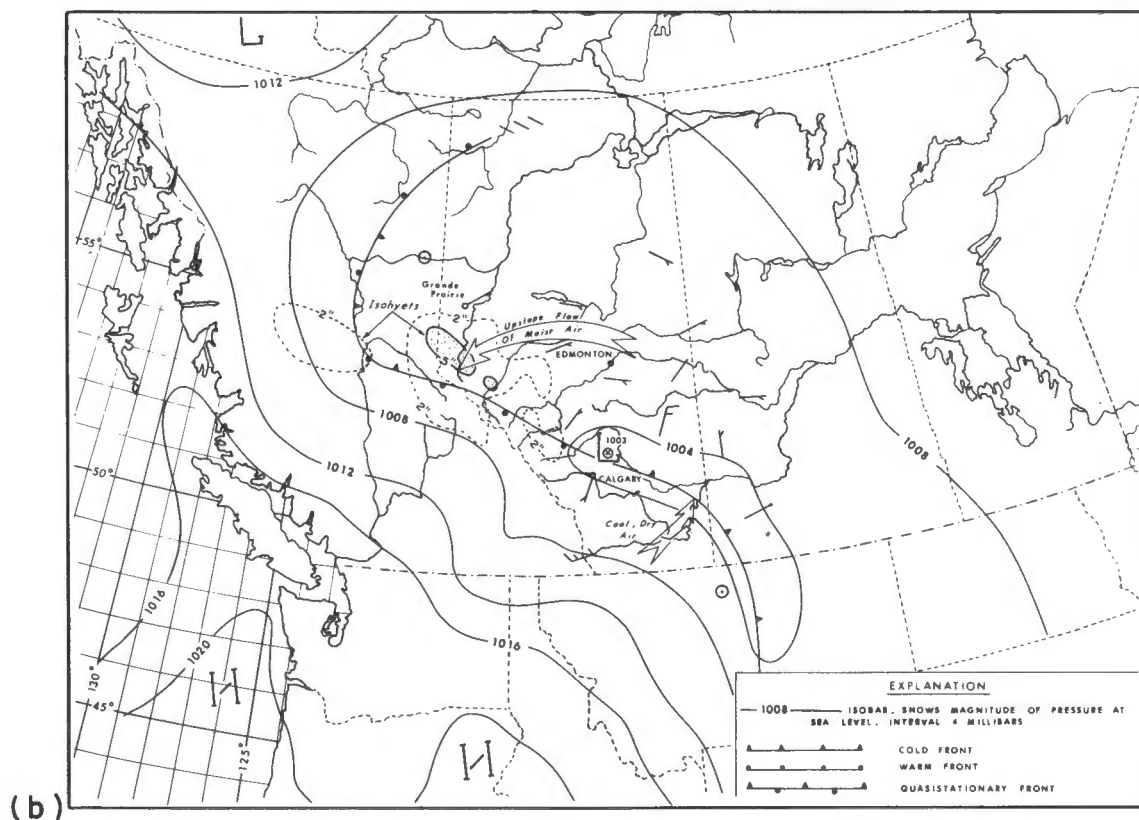
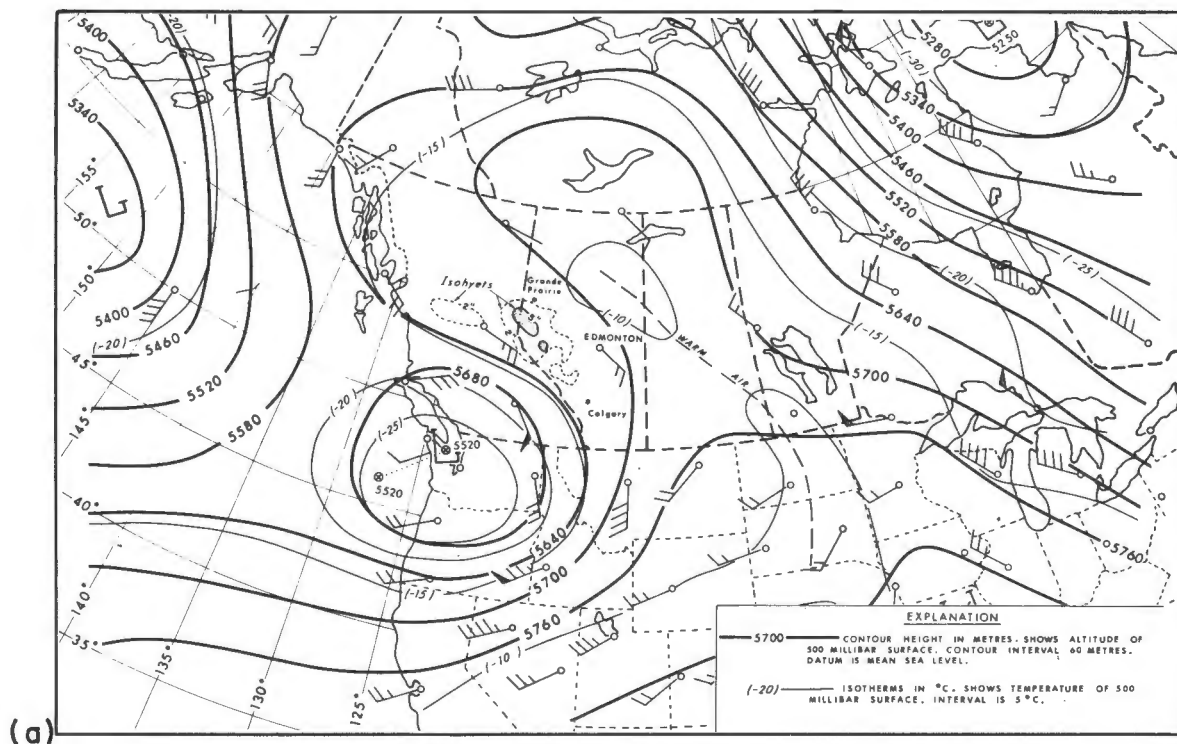


Figure 2. The 500-millibar height (a) and sea-level pressure (b) maps at 0600 MDT, June 11, 1972, about the time heavy rain began over the Peace basin. A 500-mb low was located over northwest Washington, with a surface low forming near Calgary causing an easterly upslope flow of fairly warm, saturated air over the south Peace basin. Wind velocity shafts are oriented with the wind direction; each flag represents 50 knots, each full barb represents 10 knots, and each half barb represents 5 knots. The 2- and 5-inch isohyets for the storm are shown.

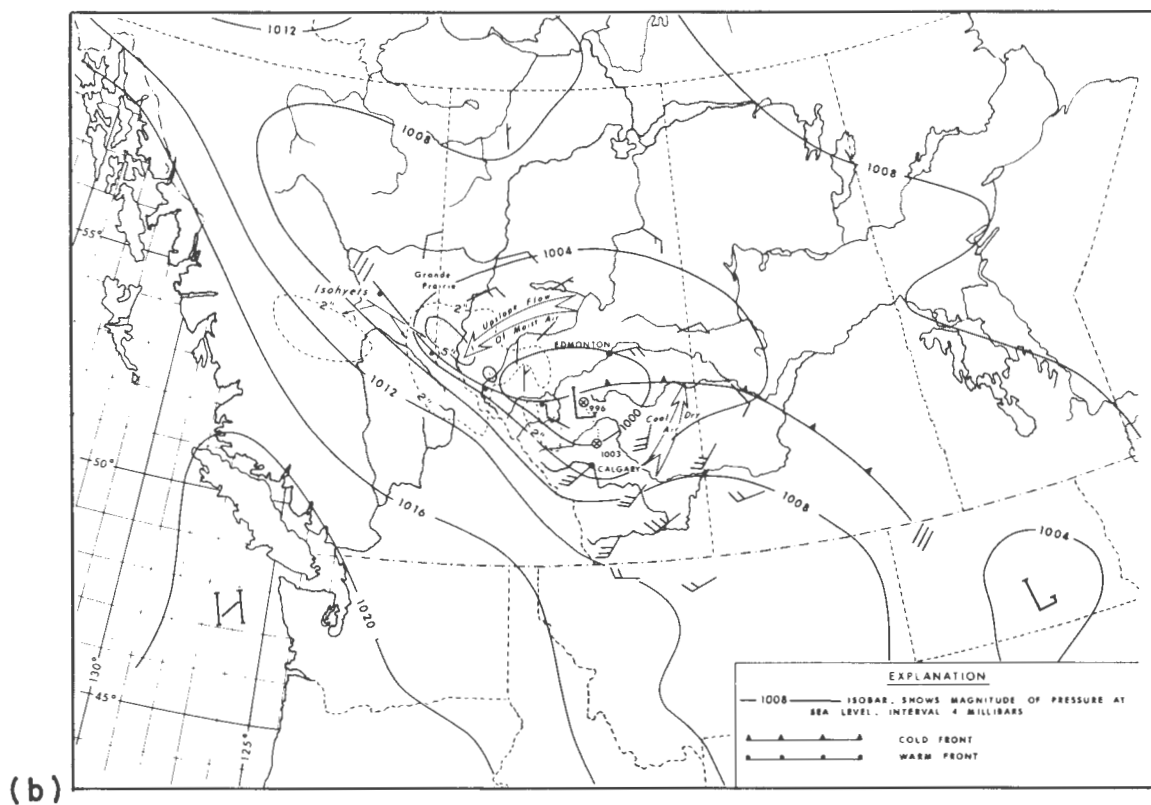
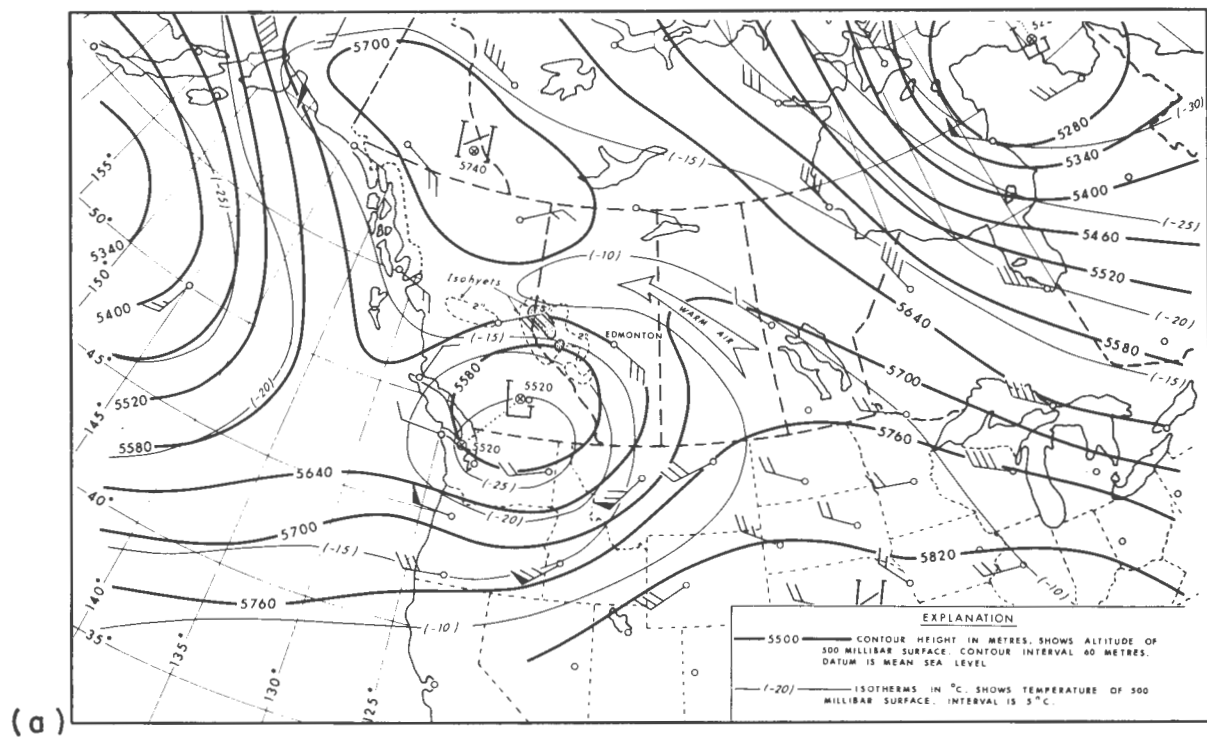


Figure 3. The 500-millibar height (a) and sea-level pressure (b) maps at 1800 MDT, June 11, 1972 about 12 hours after heavy rain began over the Peace basin. The 500-mb low had moved to southeastern B.C., with a tongue of warm air extending northwestward over Saskatchewan into North Central Alberta. The surface low had drifted slightly northward and deepened, maintaining the upslope flow of moist saturated air over the Peace basin. See Figure 2 for explanation of wind symbols and isohyets.

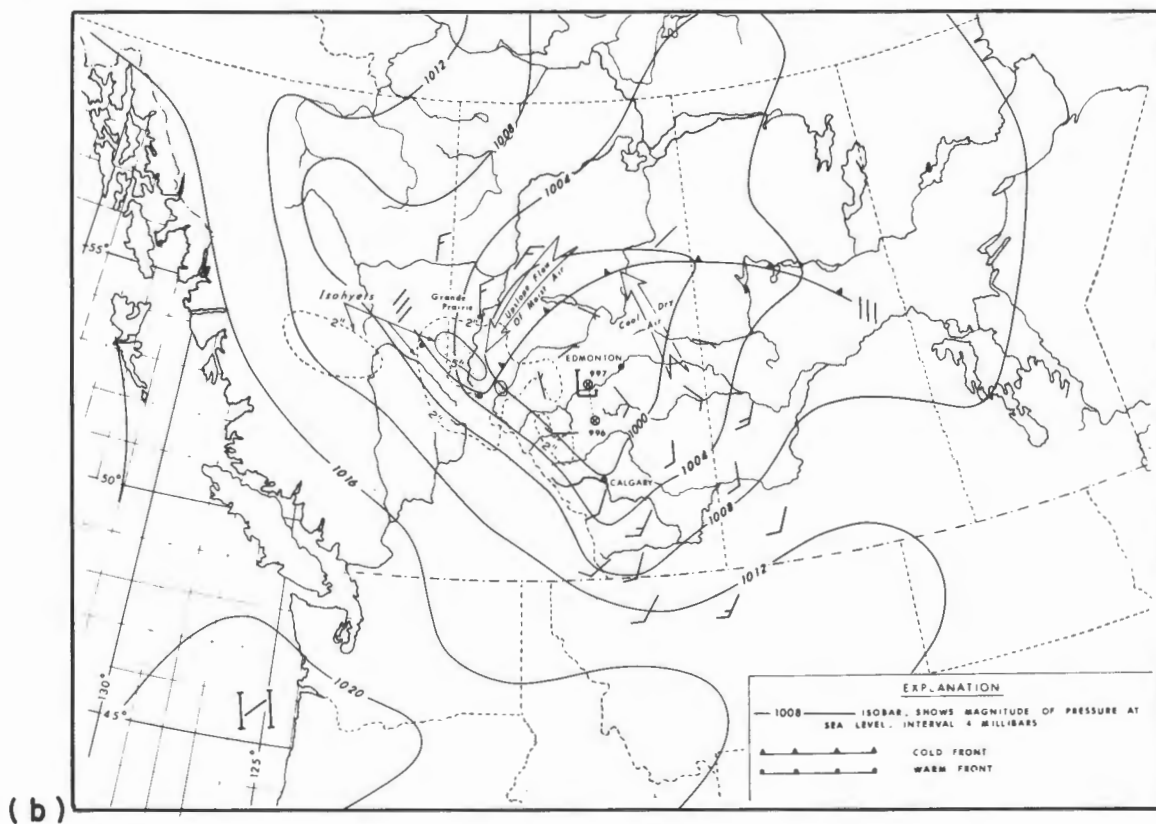
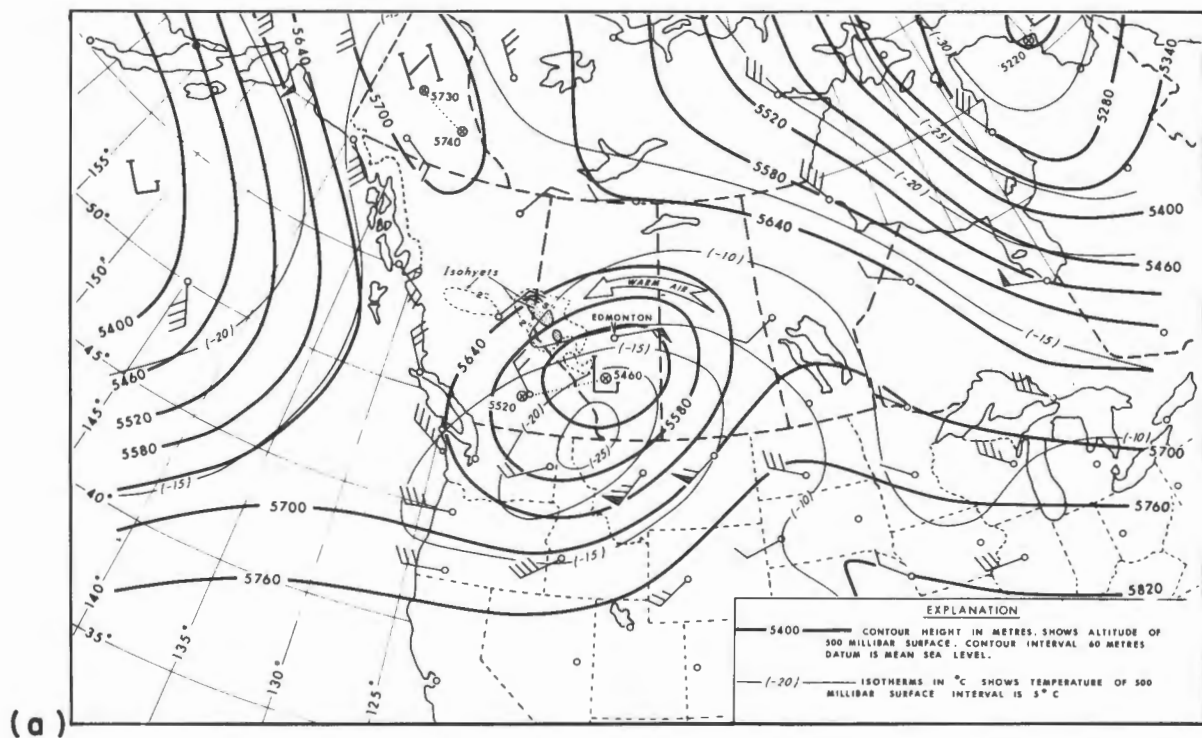
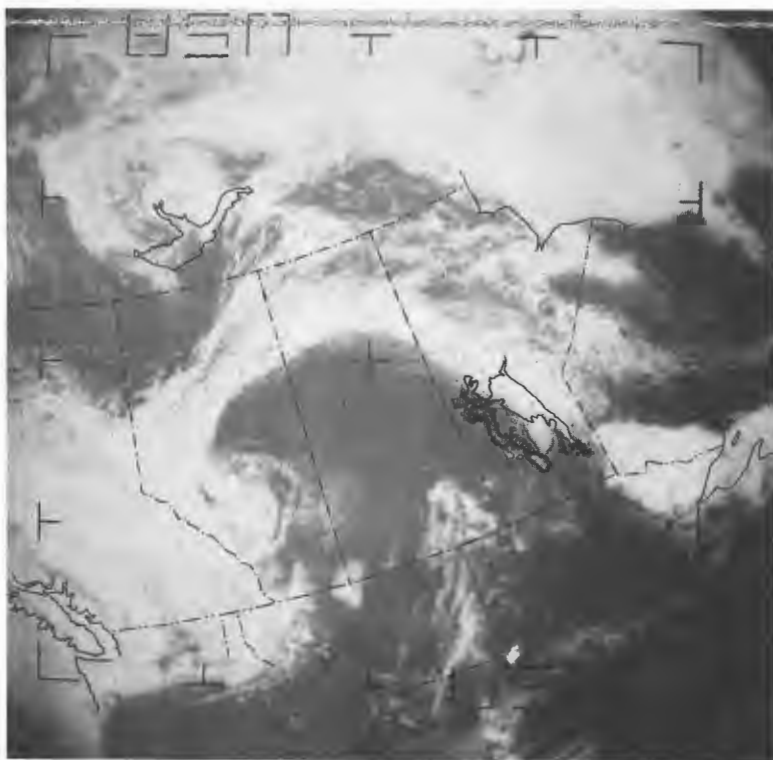


Figure 4. The 500-millibar height (a) and sea-level pressure (b) maps at 0600 MDT, June 12, 1972 about 24 hours after the rain began and approximately 12 hours before it ended over the Peace basin. The 500-mb low had moved to near Calgary catching up with the surface low. The upslope flow of warm, moist air still continued over the Peace basin, although the areal extent of the warm air was being rapidly diminished as cooler, drier air moved northward behind the cold front. See Figure 2 for explanation of wind symbols and isohyets.





Figure 5. ESSA-8 satellite photographs taken at 1300 MDT, June 11, about six hours after heavy rain began over the South Peace basin (a), and at 1200 MDT, June 12, about six hours before it ended (b). Extensive cloud covered Western Alberta early in the period and gradually diminished to a narrow band as the advancing cooler, drier air from the south cut off the warm, moist air.



During the following 12 hours (not shown) the storm entered its final stage of development. The surface low was overtaken by the 500-mb low and both moved eastward over Saskatchewan. The cold front continued to push northwestward and eventually pinched off the supply of warm moist air to the South Peace basin, so that by 1800 MDT, June 12, most of the precipitation had ended (Fig. 6).

#### Satellite Photographs

Two stages in the development of the storm are illustrated by the ESSA-8 weather satellite photographs of Figures 5a and 5b.

The photograph shown in Figure 5a was taken at 1300 MDT, June 11, about six hours after heavy rain began falling over the South Peace basin (Fig. 6). A massive shield of heavy cloud covered southern B.C. and the Alberta Foothills, but about the only identifiable synoptic feature (Figs. 2 and 3) is the surface cold front. It is shown by the narrow band of cloud extending southeastward from near Calgary to southeastern Alberta.

The photograph shown in Figure 5b was taken at 1200 MDT, June 12, about six hours before the heavy rain ended and shows that considerable development had taken place during the intervening 23 hours. The vortex over Central Alberta marks the position of the upper low (Fig. 4a). The band of cloud curling over Central Manitoba, Northern Saskatchewan and southwestward across north central Alberta shows that considerable cloud still existed in the tongue of warm air. The cold front (Fig. 4b) lies near the southern edge of this band.

#### Rainfall Intensity and Areal Extent

##### Mass Curves

The accumulated precipitation at three Alberta Forest Service lookout towers from 1400 MDT, June 9 to 1400 MDT, June 13 is shown in Figure 6. The locations of the stations are given in Figure 1. No recording rain gauges are known to have been located in the area of heavy precipitation, though an Alberta Forest Service field crew recorded precipitation in a standard MSC rain gauge at one- to two-hour intervals during the storm near the Cutbank River (site shown in Figure 1). This mass curve (Fig. 6) shows two intervals where rainfall rates exceeded one-half inch per hour.

All locations except Moberly show that most of the rain fell in the 36-hour period between 0600 MDT, June 11 and 1800 MDT, June 12. Although over six inches of rain was recorded at Moberly, about two inches was recorded prior to 0800 MDT, June 10 and was probably due to localized convective activity not associated with the main storm.

#### Isohyetal Analysis

An isohyetal analysis of the storm for the period 1400 MDT, June 9 to 1400 MDT, June 13 is shown in Figure 1. The major rain centre was located southwest of Grande Prairie, with a maximum reported amount of 8.06 inches at Nose Mountain. The major precipitation area is elongated in a northwest-southeast direction parallel to but just east of the front ranges of the Rockies.

#### Maximum Depth-Area Curves

The maximum depth-area curves prepared by the Atmospheric Environment Service (1973) are shown in Figure 7. Rainfall rates over large areas near the storm centre were high; for example, the average depth over a

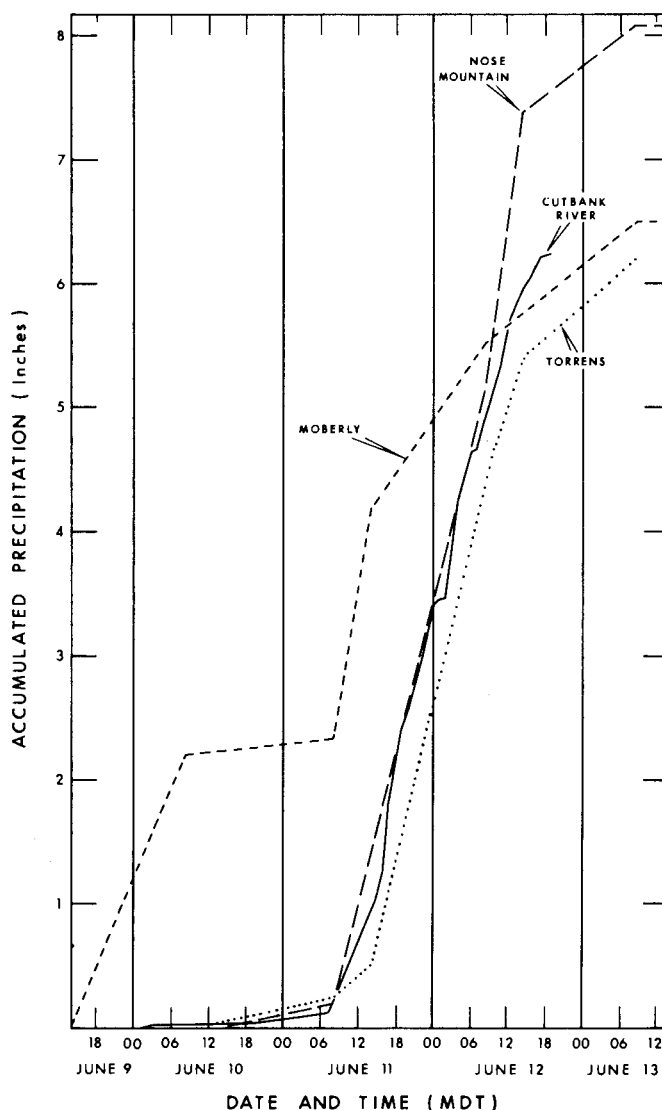


Figure 6. Mass curves for four observation sites, the locations of which are shown in Figure 1. Nearly all the rain on the South Peace basin fell in the 36-hour period between 0600 MDT, June 11 and 1800 MDT, June 12.

1,000 square-mile area in 24 hours was 5.3 inches and in 36 hours was 6.6 inches.

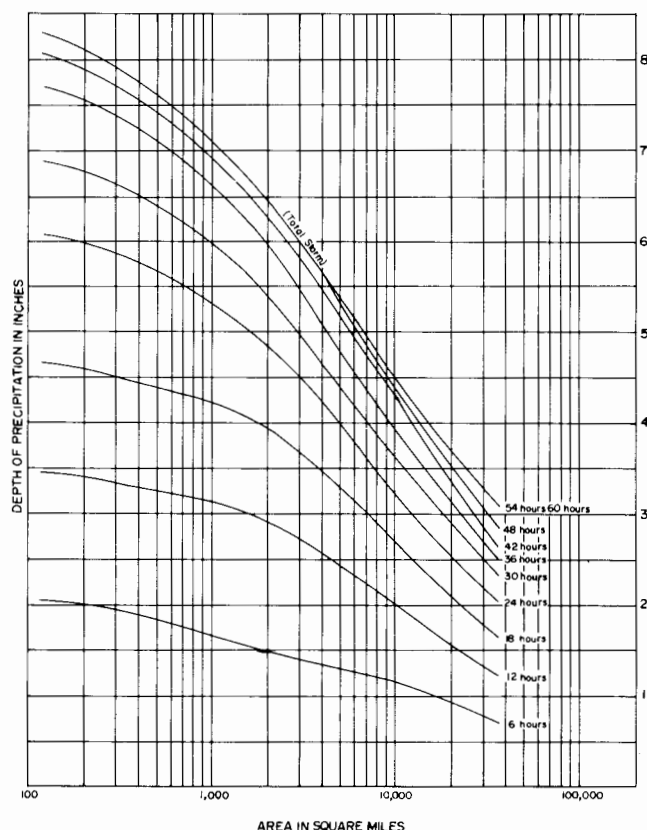


Figure 7. Maximum depth-area curves.

### Factors Contributing to Rainfall Intensity

According to theory, the precipitation rate is determined by the moisture content and the vertical velocity of the precipitating layer.

A good indication of the moisture content of an airmass is provided by the magnitude of the surface dewpoints. Prior to this storm, dewpoints at stations near the 2,500-foot level in the South Peace basin had built up to the upper fifties by noon of June 9 and remained at those levels until the cold frontal passage near noon of June 12, a period of approximately 72 hours. On the basis of calculations made by McKay (1963), the return period for such an event over the South Peace basin is roughly 100 years.

The factors that may contribute to vertical motion in this type of storm are (1) convergence, (2) frontal lift, (3) orographic lift, and (4) convective activity. The observational network does not provide the detail required for accurate measurements of these parameters, therefore, only a qualitative assessment of their respective contributions is possible.

Convergence associated with the low and lift over the frontal surface undoubtedly made sizeable contributions to the over-all vertical motion, but there is evidence to support the presence of the other two factors also. The northeasterly low level flows (Figs. 2b, 3b, and 4b) indicate that an upslope condition was present. Further evidence of the presence of orographic lift is indicated by the heavier rainfall amounts, and the northwest-southeast orientation of the isohyetal pattern over the Foothills (Fig. 1). Although only two cases of thunder activity were reported by Alberta Forest Service Lookout Towers in the heavy rain area, upper air soundings at Edmonton indicated that the warm air would have become convectively unstable if lift such as that provided by the upslope flow had been present in the lower levels.

### Relative Severity

Only a short period of meteorological record is available for the area over which the storm reached its greatest severity, thus preventing a comparison of the intensity of the rainfall from this storm with those of previous storms.

There are other topographically similar areas of the Foothills further southeast with longer records. Storr (1967) has calculated 25-year return period amounts for storms of two days duration at the stations shown in Table 1. By comparison, the amounts for the two-day period June 11, 0800 MDT to June 13, 0800 MDT recorded at Nose Mountain and Kakwa (see Figure 1 for locations) were 7.35 and 6.20 inches, respectively, which far exceed the statistically determined 1-in-25 year values.

Table 1. 25-year return period rainfall amounts for a two-day storm at selected foothills stations (after Storr, 1967)

Station	Two Day - 25 Year Rainfall Amounts (inches)
Edson	3.20
Mayberne	3.70
Entrance	3.20
Lovett	3.40
Nordegg	3.40
Pekisko	4.20
Beaver Mines	4.10

The only record of areal rainfall intensities is contained in the "Storm Rainfall in Canada" series. Since it is felt that this series is not complete for the less populated sections of Alberta such as the South Peace basin, no attempt has been made to compare rainfall amounts on an areal basis.

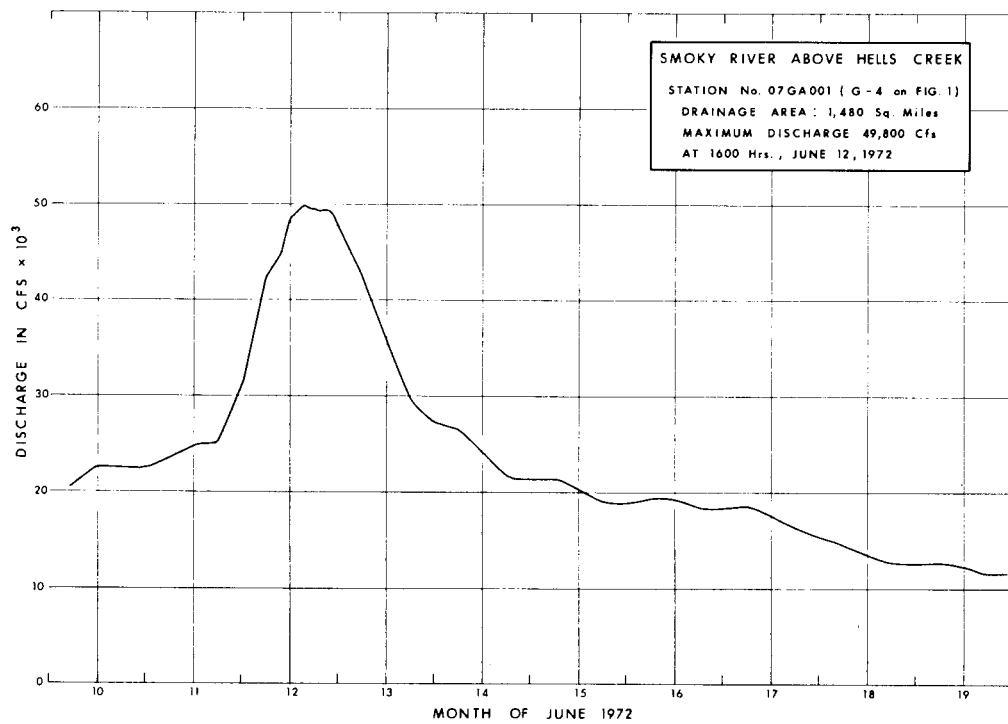


Figure 8. Hydrograph of peak flow period—Smoky River above Hells Creek.

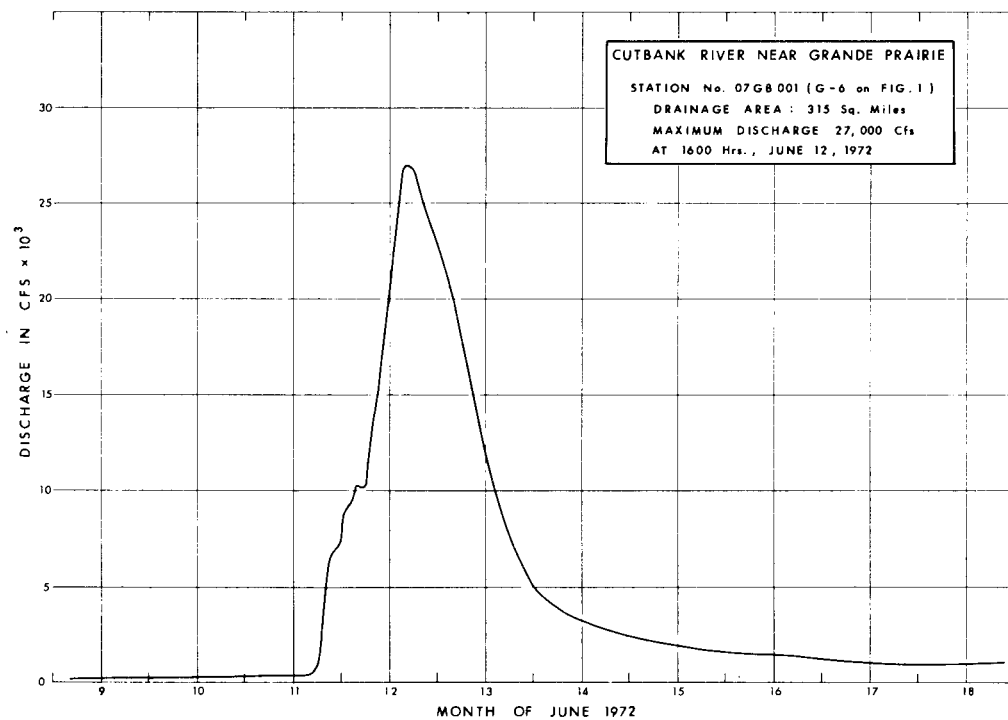


Figure 9. Hydrograph of peak flow period—Cutbank River near Grande Prairie.

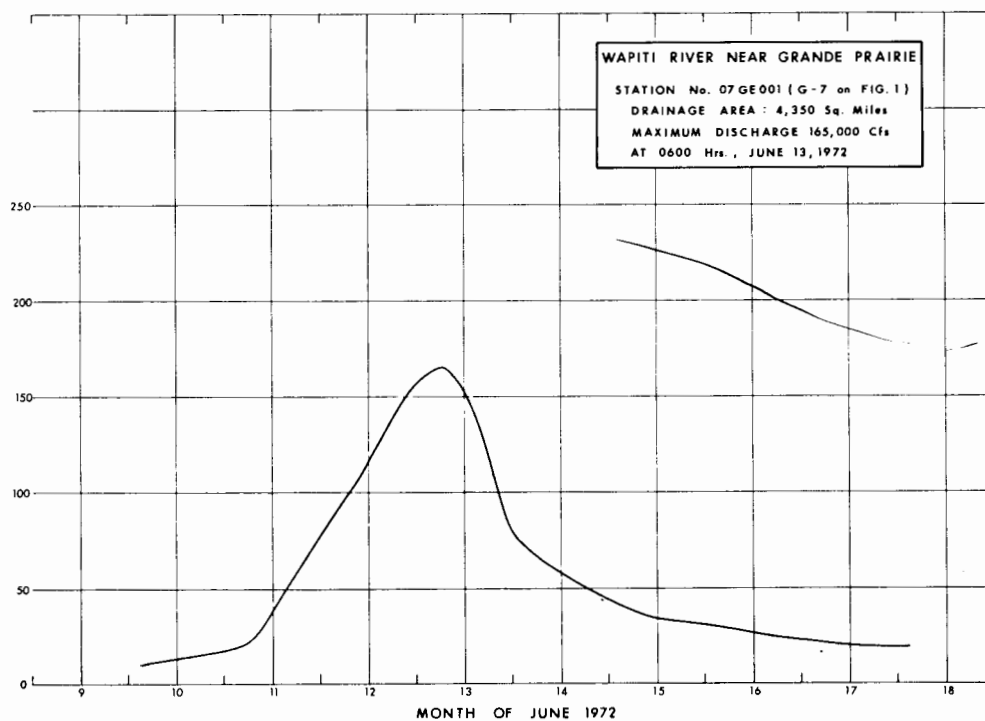


Figure 10. Hydrograph of peak flow period—Wapiti River near Grande Prairie.

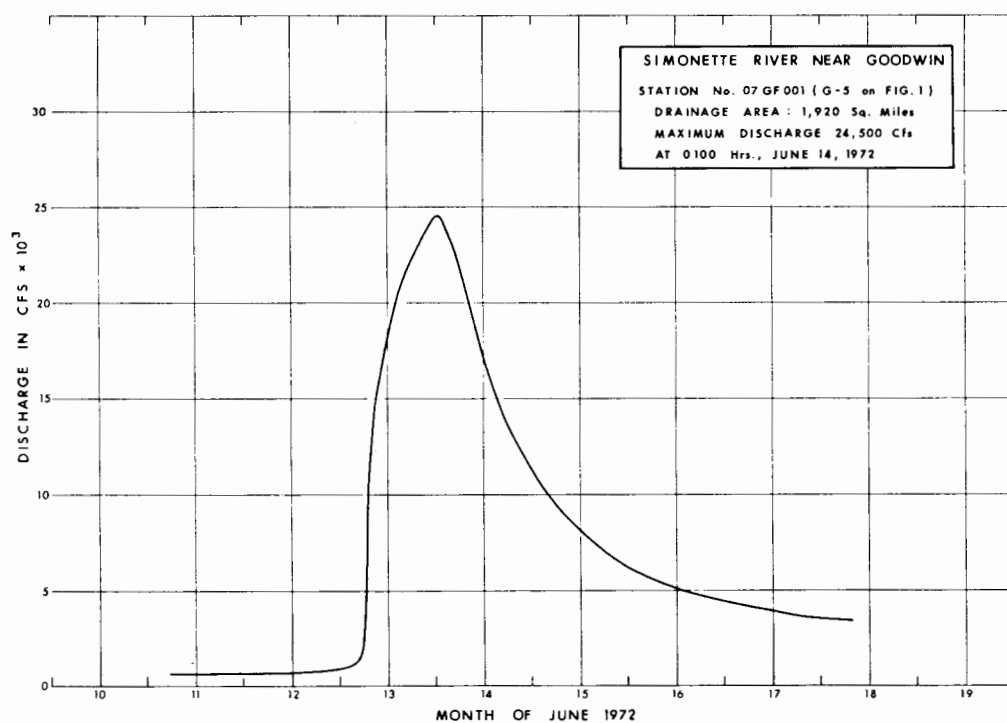


Figure 11. Hydrograph of peak flow period—Simonette River near Goodwin.

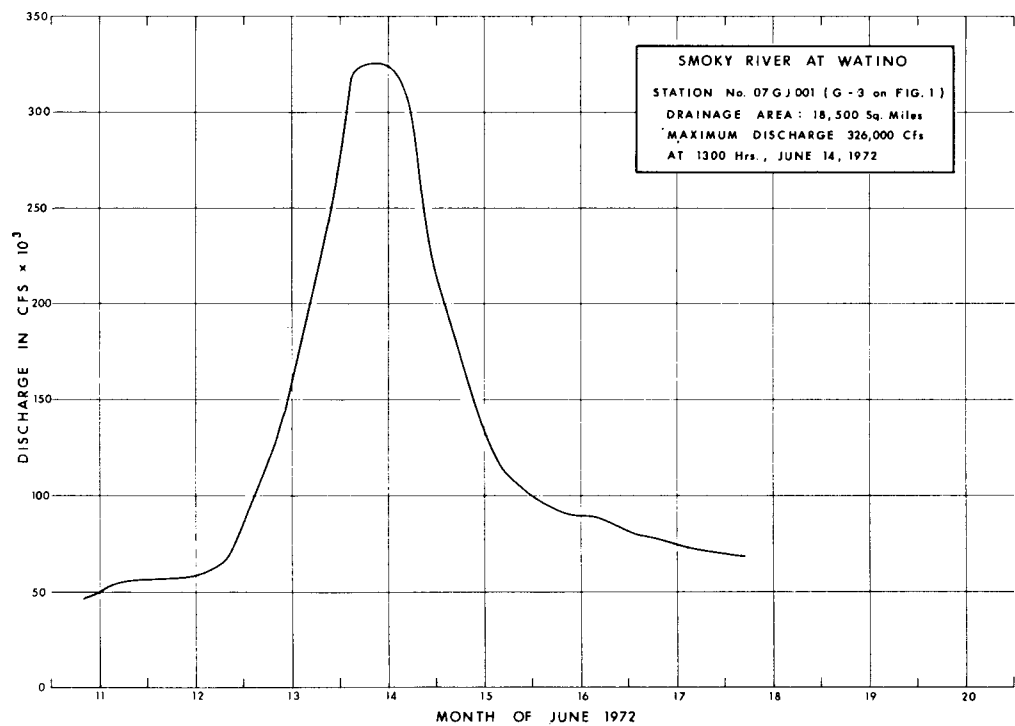


Figure 12. Hydrograph of peak flow period—Smoky River at Watino.

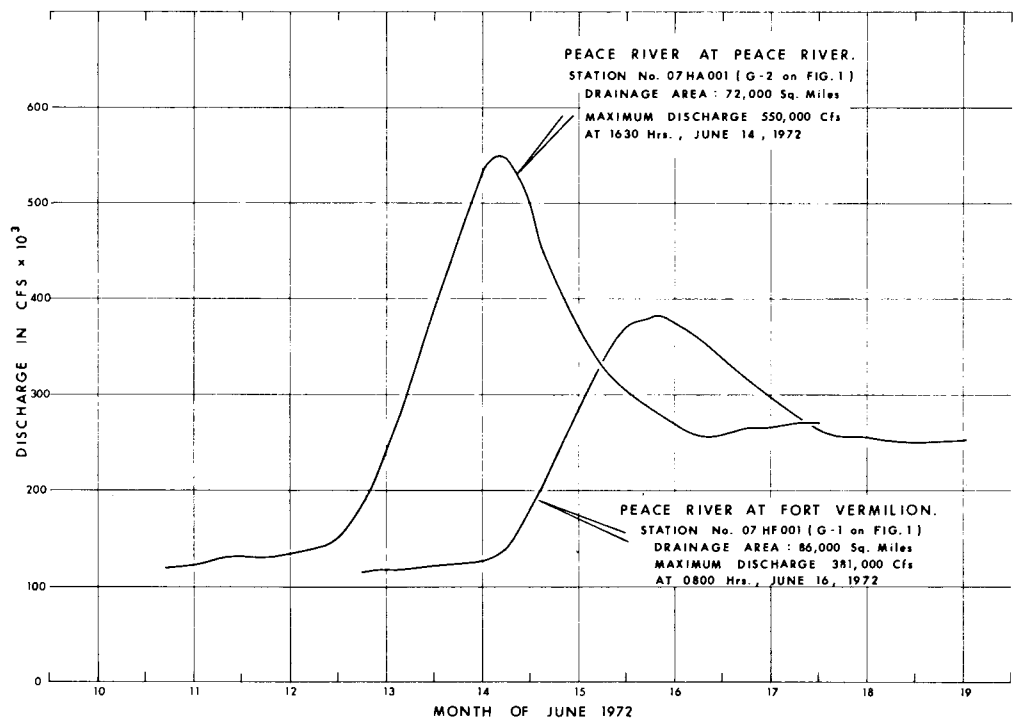


Figure 13. Hydrographs of peak flow period—Peace River at Peace River and at Fort Vermilion.

## FLOOD HYDROGRAPHS

The following section deals with flood flows in the gauged tributaries of the Smoky River, the Smoky River, Peace River at Peace River, and Peace River at Fort Vermilion. Discharge hydrographs are presented, and the reader is referred to Figure 1 for the gauging sites.

### Smoky River above Hells Creek (G4 on Fig. 1)

A maximum discharge of 48,900 cfs was reached at 1600 MST, June 12, yielding 33.0 cfs/m (cubic feet per second per square mile of drainage area) from an area of 1,480 square miles (Fig. 8).

### Cutbank River near Grande Prairie (G6 on Fig. 1)

A maximum discharge of 27,000 cfs was reached at 1500 MST, June 12, yielding 85.7 cfs/m from an area of 315 square miles (Fig. 9).

### Wapiti River near Grande Prairie (G7 on Fig. 1)

A maximum discharge of 165,000 cfs was reached at 0800 MST, June 13, yielding 37.9 cfs/m from an area of 4,350 square miles (Fig. 10). The Wapiti River received a major contribution to its flow from a number of ungauged tributaries in its headwaters, two of which, Pinto Creek and Nose Creek, are reported in Table 2.

### Simonette River near Goodwin (G5 on Fig. 1)

A maximum discharge of 24,500 cfs was reached at 2400 MST, June 13, yielding 12.8 cfs/m from an area of 1,920 square miles (Fig. 11).

### Smoky River at Watino (G3 on Fig. 1)

A maximum discharge of 325,000 cfs was reached at 0300 MST, June 14, yielding 17.6 cfs/m from an area of 18,500 square miles (Fig. 12).

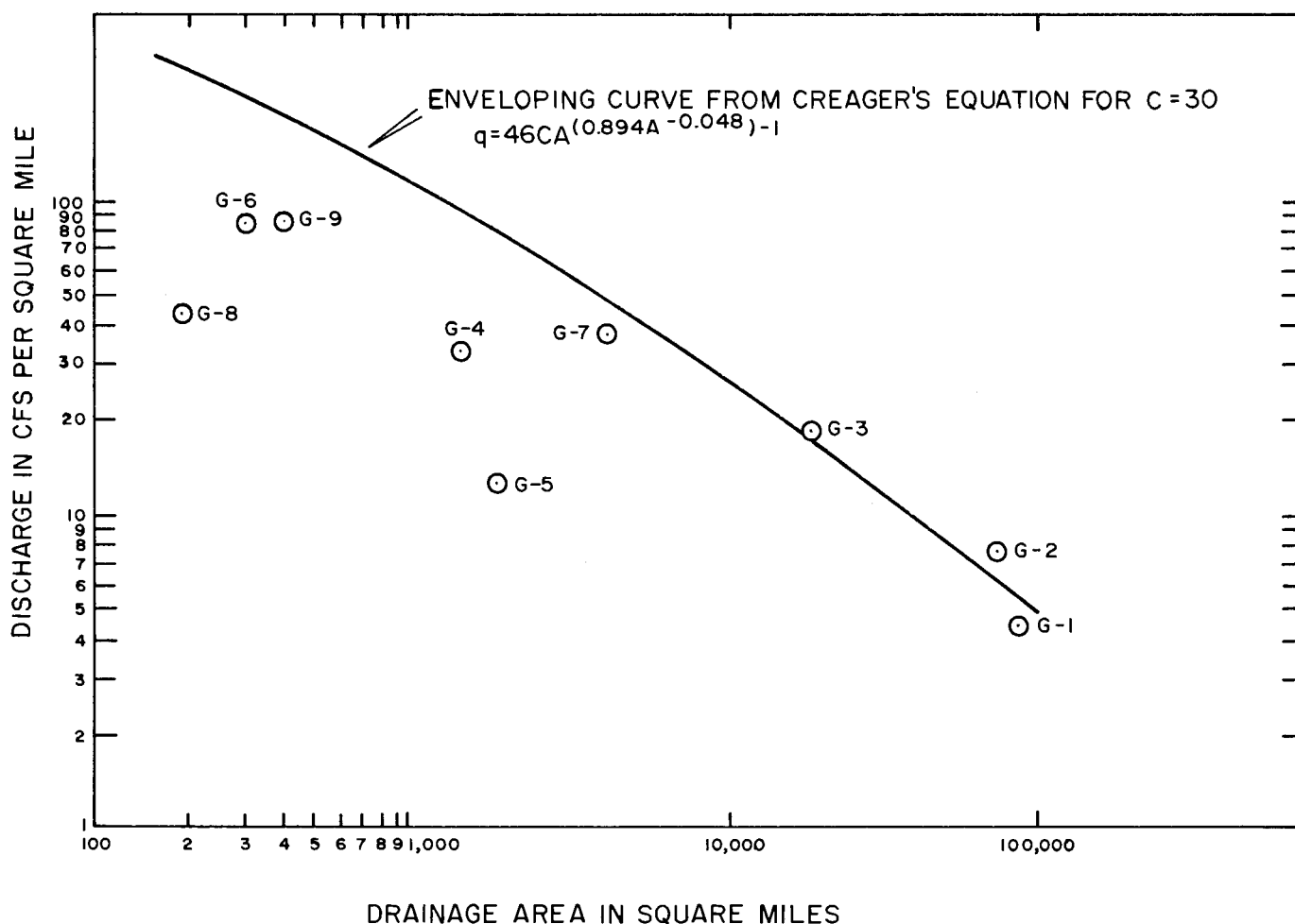


Figure 14. Plot showing maximum unit discharges versus drainage areas.

Table 2. Summary of peak gauge heights and discharges in the Peace River basin, Flood of June 1972

Map Index No.	Station No.	Gauging Station	D.A. mi. <sup>2</sup>	Period of Record	Maximum Recorded Flood Prior to 1972		Recorded Extremes – Flood of June 1972					Remarks
					Date	Discharge	Time MST	Date	G.H. ft.	Discharge		
										cfs	cfsm	
G1	07HF001	Peace River at Fort Vermilion	86,000	1915-22 1960-72	1964	437,000 <sup>d</sup>	0700	June 16	30.42	382,000 <sup>b</sup>	4.44 <sup>b</sup>	Discharges affected by W.A.C. Bennett Dam since 1968
G2	07HA001	Peace River at Peace River	72,000	1915-32 1957-72	1935	600,000 <sup>e</sup>	1500	June 14	42.32	550,000 <sup>bc</sup>	7.64 <sup>bc</sup>	
G3	07GJ001	Smoky River at Watino	18,500	1915-22 1955-72	1935	250,000 <sup>e</sup>	0300	June 14	33.24	325,000 <sup>ac</sup>	17.6	
G4	07GA001	Smoky River above Hells Creek	1,480	1967-72	1970	19,500	1600	June 12	14.69	48,900 <sup>ac</sup>	33.0	
G5	07GF001	Simonette River near Goodwin	1,920	1965-72	1971	29,000 <sup>c</sup>	2400	June 13	11.07	24,500 <sup>c</sup>	12.8	
G6	07GB001	Cutbank River near Grande Prairie	315	1970-72	1971	7,000 <sup>d</sup>	1500	June 12	17.96	27,000 <sup>ac</sup>	85.7	
G7	07GE001	Wapiti River near Grande Prairie	4,350	1917-18 1960-72	1935	135,000 <sup>e</sup>	0800	June 13	27.18	165,000 <sup>ac</sup>	37.9	
G8	—	Pinto Creek on Two Lakes Forestry Road	195	—	—	—	—	June 12	—	8,500 <sup>c</sup>	43.6	Miscellaneous measurement site
G9	—	Nose Creek at Shutler Flats	404	—	—	—	—	June 12	—	34,000 <sup>c</sup>	84.2	Miscellaneous measurement site

<sup>a</sup>New maximum for period of record

<sup>b</sup>Discharge affected by significant upstream storage

<sup>c</sup>Maximum discharge determined by indirect methods

<sup>d</sup>Daily mean

<sup>e</sup>Estimated



#### **Peace River at Peace River (G2 on Fig. 1)**

A maximum discharge of 550,000 cfs was reached at 1500 MST, June 14 (Fig. 13).

#### **Peace River at Fort Vermilion (G1 on Fig. 1)**

A maximum discharge of 382,000 cfs was reached at 0700 MST, June 16. Figure 13 shows that the peak had attenuated considerably from that at the Peace River townsite. No damaging flood resulted at Fort Vermilion.

### **MAXIMUM DISCHARGES**

A summary of peak gauge heights and discharges in the flood area are presented in Table 2. The maximum discharges recorded prior to 1972 for the reported stations are also given, in addition to other information such as drainage areas and periods of record. The maximum discharge per unit of drainage area is shown in the far right column.

### **MAXIMUM UNIT DISCHARGES**

The maximum discharge per square mile (cfs/mi<sup>2</sup>) from drainage areas of varying sizes is a useful factor in the study of extreme floods. On this basis, a flood may be compared

with former floods in the same basin or in other areas; the relative contributions to the flood by various tributary areas in the basin may be assessed or the maximum discharge from ungauged areas estimated with the help of these data. Maximum unit discharges may also provide the basis for assessing the applicability to the basin of general flood potential formulae based on drainage area factors.

The maximum unit discharges shown in Table 2 are plotted against their respective drainage areas in Figure 14. It should be noted that for stations G1, Peace River at Fort Vermilion, and G2, Peace River at Peace River, the actual recorded peak discharge per square mile has been plotted. The natural peak flows, taking into account the storage in Williston Reservoir, would of course have plotted much higher.

For reference purposes, the enveloping curve from Creager's equation with  $C = 30$  is shown in Figure 14. This value of  $C$  is taken from "Design Factors for Maximum Probable Flood, General Engineering Report, South Saskatchewan River Project, Prairie Farm Rehabilitation Administration, 1952." It is recognized that  $C = 30$  may not be applicable to the Peace River drainage, however, the scarcity of historical streamflow data in this area precludes strict analysis.

## Analysis of the Flood

### WILLISTON LAKE REGULATION

An evaluation of the effect of storage behind the W.A.C. Bennett Dam on flood flows in the Peace River (for June 1972) is presented in a Water Survey of Canada report by Broderick and Nemanishen, "1972 Peace River Flood – Williston Lake Regulation" (summer, 1973). Natural flows in the Peace River at Peace River and elsewhere were constituted using the U.S. Army Corps of Engineer's SSARR Model. A complete description of this model is presented in "Program Description and User Manual for SSARR (Streamflow Synthesis and Reservoir Regulation) Model" – Program 724-K5-G0010, U.S. Army Engineer Division, North Pacific, Portland, Oregon – September 1972 (Revised December 1972).

SSARR Model routing calculations indicate that, without the influence of the W.A.C. Bennett Dam on the Peace River, nearly simultaneous maximum flows in the Smoky and Peace Rivers would have combined at the Peace River townsite to produce a discharge of 814,000 cfs, corresponding to a stage approximately 6 feet higher than what actually occurred.

Table 3. Inflow and outflow discharges at Williston Reservoir during the flood period

Date	Total Outflow (cfs)	Total Inflow (cfs)
1 June 1972	16,420	268,390
2 June 1972	17,820	234,550
3 June 1972	21,610	183,030
4 June 1972	20,580	169,100
5 June 1972	24,630	190,110
6 June 1972	25,800	145,970
7 June 1972	25,570	185,980
8 June 1972	25,150	176,390
9 June 1972	25,330	214,640
10 June 1972	24,180	237,430
11 June 1972	22,660	281,690
12 June 1972	25,250	289,920
13 June 1972	32,300	289,360
14 June 1972	51,150	306,010
15 June 1972	78,220	273,930
16 June 1972	110,680	282,060
17 June 1972	124,720	208,320
18 June 1972	136,610	257,830
19 June 1972	68,230	175,320
20 June 1972	123,470	163,370
21 June 1972	143,590	168,790

Table 3, showing inflow and outflow discharges at Williston Reservoir during the flood period, has been provided by the British Columbia Hydro and Power Authority.

### FREQUENCY ANALYSIS

Frequency curves are presented for two of the gauging sites in the flood region. Various procedures have been used in the analysis of streamflow records to determine probable frequency or recurrence intervals of flood stages of a given magnitude. The record at a single gauging station is only a sample of the long-term conditions at the site, therefore, any one of the various methods of flood frequency analysis of such a record, regardless of its relative merit, is subject to the same sampling error. Although the sampling error decreases with the length of the record, it has been established (USGS Water-Supply Paper 1943-A) that periods of record up to 25 years cannot define satisfactorily even short-term floods.

Both frequency curves presented here have been derived from single station analysis. In both cases, maximum annual instantaneous discharges were ranked and plotted on the curve sheets. As explained in the following paragraphs, the missing instantaneous maxima were derived from a simple correlation with the available annual daily mean peaks. A reference to the paper "Use of Historical Data in Flood-Frequency Analysis," by M.A. Benson (Trans., Am. Geoph. Union, Vol. 31, No. 3, June 1950), will reveal the method of extending the available, or actual, gauged period of record to take into account historical floods that are known to have occurred.

#### Smoky River at Watino (Fig. 15)

Annual daily peaks are available from 1915 to 1922. Maximum instantaneous peaks are available for most years from 1955 to 1972. By simple correlation, the missing instantaneous maxima were derived in order to rank the actual recorded maxima for plotting purposes.

An instantaneous peak of 250,000 cfs for 1935 was estimated from high-water marks recalled by local in-

habitants. In the same manner, a peak of 225,000 cfs was estimated for 1954. From these estimates and from further consideration of local flood history, it was assumed that any peak over 150,000 cfs would apply to the entire period, 1915 to 1972. All other peaks were referred to the 28 years of gauged record.

#### **Peace River at Peace River (Fig. 16)**

Annual daily peaks are available from 1915 to 1931. Maximum instantaneous peaks are available for most years from 1958 to 1972. By simple correlation, the missing instantaneous maxima were derived in order to rank the actual recorded maxima for plotting purposes.

The recorded maxima for the years 1968 to 1972 were excluded from the frequency analysis, since these flows have been affected by storage in Williston Reservoir. Assuming natural flow conditions (i.e., with the influence of the W.A.C. Bennett Dam removed), an instantaneous peak of 814,000 cfs for 1972 was derived, using the United States Army Corps of Engineer's SSARR Computer Model (see section "Williston Lake Regulation"). This derived flow has been plotted on the frequency curve. In addition, a peak flow of 600,000 cfs was estimated for 1935 on the basis of evidence obtained from local inhabitants. From the above estimates and from further consideration of local flood history, it was assumed that any instantaneous peak over 450,000 cfs would apply to the entire period, 1915 to 1972. All other peaks were referred to the 29 years of gauged record (i.e., to 1967 inclusive).

### **DETERMINATION OF PEAK FLOWS**

Under normal circumstances, a hydrometric survey requires that enough current meter measurements be made at each gauging location to completely define the relationship between gauge height or stage and discharge. During a flood period, however, some peaks at various stations are missed because it is often impossible for available field personnel to reach all stations at the critical times. Heavy debris, generally associated with a rapidly rising stage, often precludes the use of standard metering equipment. In addition, measuring facilities such as cableways or bridges may have been destroyed.

Within days after the flood period, engineers and technical personnel of the Water Survey of Canada estimated the peak discharges at two gauging locations and two miscellaneous measurement sites indirectly by the slope-area and contracted-section methods. At other gauging sites the extension of the stage-discharge relationship beyond the highest current meter measurement was carried out by logarithmic plotting. This procedure is one

that has been extensively employed in the analysis of hydrometric data and is based on the known tendency for the stage-discharge relationship in natural channels to follow a logarithmic curve over wide ranges in stage.

### **EXPLANATION OF STREAMFLOW DATA**

Appended to the report (Appendix C) are detailed streamflow data for seven hydrometric gauging stations operated by the Water Survey of Canada. Peak flows were also determined for two miscellaneous measurement sites on Pinto Creek and Nose Creek (Appendix C). All stations reported are situated in northwestern Alberta and are representative of the runoff from the storm event.

#### **Station Descriptions**

The streamflow tabulations are headed by the station name and number under which the data are published in the annual Water Survey of Canada series of surface water data publications. For convenience in using this report, a map index number, prefixed by the letter "G", has also been assigned.

The latitude and longitude of each station is given, followed by its legal land description and usually by references to adjacent towns, bridges, or other significant features.

Under the heading "Drainage Area" is given the gross area of the catchment above the station, as determined from topographic maps. No adjustments have been made to this gross area for non-contributing areas.

The source of the gauge-height record is described under the heading "Gauge Height Record." For stations with automatic stage recorders, the gauge heights were taken directly from the recorder chart. Where the station was equipped with a manual gauge, the observer's readings were usually plotted and a graph drawn through them. The gauge height for any required time was then read from the graph. In some cases where the description indicates that the station was equipped with an automatic stage recorder in 1972, the instrument was installed at some time after the station was originally established and some of the earlier years of record were obtained by manual gauge observations.

The range of the stage-discharge relationship defined by standard current meter measurements is given under the heading "Discharge Record." Where applicable, the method used to extend the relationship to the peak stage is also indicated.

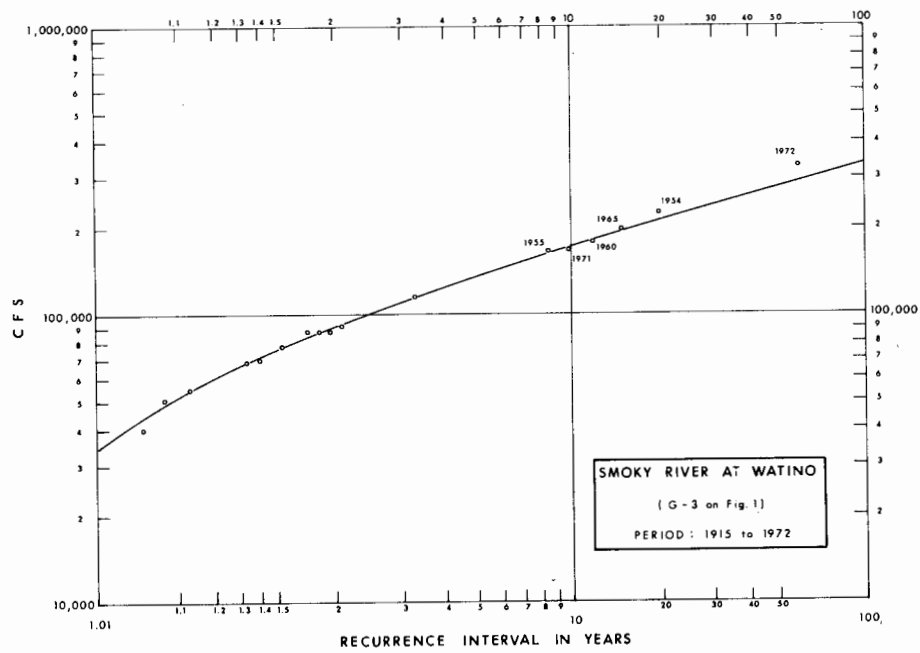


Figure 15. Frequency curve: Smoky River at Watino.

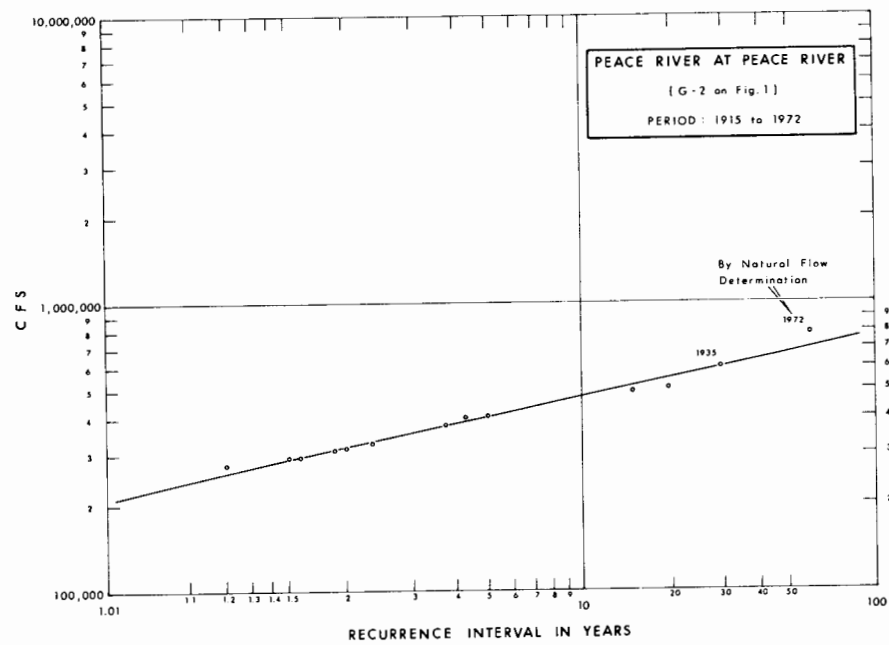


Figure 16. Frequency curve: Peace River at Peace River.

The "Period of Record" specifies that period over which streamflow records have been collected at each station. Where there have been significant gaps in the record since the gauge was first established, appropriate remarks to that effect are included. In some cases the records have been collected on a seasonal basis (i.e., during the open-water seasons only), and this is pointed out where applicable.

The peak gauge heights and corresponding discharges for the period of record are given under the heading "Recorded Extremes."

#### **Daily Mean Discharge Tables**

The figures in these tables are the mean discharges for each calendar day and they may be used to compare the total flow from day to day. Any fluctuations and instantaneous maxima are not revealed in these daily averages.

#### **Instantaneous Discharge Tables**

These tables show the instantaneous discharges at several times during those days of the flood period when the stage was changing rapidly. The data were selected from stage-recorder charts or from plots of frequent manual gauge observations in such a way as to permit the reasonably accurate reproduction of hourly hydrographs.

## References

Atmospheric Environment Service, Department of the Environment. 1973. Storm rainfall in Canada; Code No. Alta. — 6 (2) — 72. Downsview, Ont.

Atmospheric Environment Service, Department of the Environment. Continuing publication; Storm rainfall in Canada. Downsview, Ont.

McKay, G.A. 1963. Persisting dewpoints in the Prairie Provinces. Meteorological Report No. 11, Prairie Farm Rehabilitation Administration, Canada Department of Agriculture.

Storr, D. 1967. A frequency analysis of maximum two-day and three-day rainfalls in Saskatchewan, Alberta and Northeastern B.C. TEC 654, Meteorological Branch, Canada Department of Transport.

**APPENDIX A**

**Ice Jam Affecting Peace River Townsite,  
April 10–14, 1973**

Hourly water levels recorded, Peace River at Peace River (Water Survey of Canada Station No. 07HA001) during the ice jam of April 10-14, 1973

April 10		April 11		April 12		April 13		April 14	
Time	Gauge Height	Time	Gauge Height	Time	Gauge Height	Time	Gauge Height	Time	Gauge Height
Midnight	29.36	03:00	30.47	03:00	32.50	01:00	39.05	01:00	32.85
12:00	29.45	06:00	30.70	05:00	34.06	02:00	39.35	02:00	32.45
18:00	29.50	09:00	31.07	06:00	34.50	03:00	39.00	03:00	32.35
24:00	29.50	12:00	31.42	07:00	37.50	04:00	36.80	04:00	32.05
		15:00	31.84	08:00	41.55	05:00	34.90	05:00	31.60
		18:00	32.04	09:00	41.90	06:00	37.10	06:00	31.20
		21:00	32.15	10:00	41.90	07:00	37.30	07:00	30.75
		24:00	32.19	11:00	43.50	08:00	37.40	08:00	30.35
				12:00	43.70	09:00	37.40	09:00	30.20
				13:00	43.80	10:00	37.35	10:00	29.95
				14:00	42.40	11:00	37.25	11:00	29.80
				15:00	41.90	12:00	37.10	12:00	29.40
				16:00	42.20	13:00	36.95	14:00	29.25
				17:00	42.25	14:00	36.65	16:00	28.80
				18:00	41.95	15:00	36.50	18:00	28.20
				19:00	42.00	16:00	36.30	20:00	27.75
				20:00	37.60	17:00	35.90	22:00	27.35
				21:00	39.10	18:00	35.10	24:00	27.10
				22:00	38.80	19:00	34.80		
				23:00	37.70	20:00	34.65		
				24:00	38.45	21:00	34.45		
						22:00	34.10		
						23:00	33.75		
						24:00	33.40		

N.B. Add 1,000 feet to convert gauge heights to Geodetic Survey of Canada data.



Excerpts from "Flood Damage Estimation, June 1972, Athabasca, North Saskatchewan and Peace River Basins," by J.L. Knapp, Resource Economics Branch, Marketing Division, Alberta Department of Agriculture, Edmonton, Alberta, July, 1972.

## **APPENDIX B**

# **Methods Used in Assessment of Agricultural Flood Damage**

A number of farmers in the Peace River system reported flood damage. Each was personally interviewed for an individual damage assessment. A questionnaire was used for this purpose and is given below:

# FLOOD DAMAGE QUESTIONNAIRE

June 1972

Record No. \_\_\_\_\_

Alberta Department of Agriculture  
Resource Economics Branch  
Edmonton, Alberta

Please Print

Name of Farm Operator: \_\_\_\_\_

Date: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Home Quarter: \_\_\_\_\_

## Land Use

1. List the quarters you own or rent and check off those flooded this summer.

<u>Quarter owned or rented</u>	<u>Damaged</u>
_____	_____
_____	_____

2. Please list your cropping pattern for 1972 on all lands operated by you (owned or rented) before the flood.

<u>Improved</u>	<u>Acres</u>	<u>Average Yield</u>
Wheat	_____	_____
Oats	_____	_____
Barley	_____	_____
Rapeseed	_____	_____
Tame Hay	_____	_____
Other (specify)	_____	_____
_____	_____	_____
_____	_____	_____
Tame Pasture	_____	_____
Summerfallow	_____	_____
Unimproved Native Hay	_____	_____
Native Pasture	_____	_____
Other Unimproved	_____	_____
Total Acres Operated	_____	_____

## Crop and Soil Losses

3. Please complete the following table showing your crop damages and an estimate of the loss in yield. The first block is shown as an example.

	<u>Acres Damaged</u>	<u>Estimated Loss in Yield</u>
Improved land		
Wheat	<u>40</u>	<u>30 bu.</u>
Oats	_____	_____
Barley	<u>100</u>	<u>10 bu.</u>
Rapeseed	_____	_____
Tame Hay	_____	_____
Other (specify)	_____	_____

## EXAMPLE

_____	_____	_____
_____	_____	_____
Tame Pasture	_____	_____
Summerfallow	_____	_____
Unimproved Land		
Native Hay	_____	_____
Native Pasture	_____	_____
Other Unimproved	_____	_____
Total Acres Damaged	<u>140</u>	_____

4. If you have pasture damages, was the pasture damaged to the point where regrassing is necessary?

	<u>Native</u>	<u>Tame</u>
Yes	_____	_____
No	_____	_____
Acres	_____	_____

## Land Losses

5. How many acres were permanently lost from production due to the June flood?

\_\_\_\_\_ Acres  
\_\_\_\_\_ Location  
\_\_\_\_\_

6. What was the average value per acre of the land lost?

\_\_\_\_\_ Dollars per acre

Fences, Buildings and Equipment

7. Did you receive any damage to fences due to the flood?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" estimate repair cost (labor and materials) \_\_\_\_\_ Dollars.

8. Was there any damage to buildings on your farm?

Yes \_\_\_\_\_

No \_\_\_\_\_

Location \_\_\_\_\_  
\_\_\_\_\_

If "yes" what type of building(s), and how much damage to each?

<u>Type of Building</u>	<u>Amount of Damage</u> (Dollars)
-------------------------	--------------------------------------

\_\_\_\_\_

9. Was there any equipment damaged as a result of the June flood?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" what was the extent of damage?

<u>Type of Equipment</u>	<u>Amount of Damage</u> (Dollars)
--------------------------	--------------------------------------

\_\_\_\_\_

Stored Crops

10. Was there any damage to stored crops?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" indicate details of damage to stored crops due to the 1972 flood.

<u>Kind of Grain and Feed</u>	<u>Estimated Total Value of Damage</u>
-------------------------------	--

Wheat \$ \_\_\_\_\_

Oats \$ \_\_\_\_\_

Barley \$ \_\_\_\_\_

Hay \$ \_\_\_\_\_

Other: \_\_\_\_\_

1. \_\_\_\_\_ \$ \_\_\_\_\_

2. \_\_\_\_\_ \$ \_\_\_\_\_

Feed Requirements

11. How many cattle do you own?

\_\_\_\_\_ Cows

\_\_\_\_\_ Total Herd

12. Will you require additional feed as a result of feed loss due to flooding?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" what is the estimated amount of feed required?

Grain \_\_\_\_\_ bu.

Hay \_\_\_\_\_ tons

13. Have you had to rent any additional land since the flood?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" how many acres, and for how much?

\_\_\_\_\_ acres

\_\_\_\_\_ \$/acre

14. Will you have to sell any livestock this year as a result of feed loss due to flooding?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" how many?

\_\_\_\_\_ cows

\_\_\_\_\_ steers

\_\_\_\_\_ heifers

General

15. Was this flood beneficial to you in any way?

Yes \_\_\_\_\_

No \_\_\_\_\_

16. Are spring floods beneficial to you in any way?

Yes \_\_\_\_\_

No \_\_\_\_\_

If "yes" in what way? \_\_\_\_\_

17. Please describe any further inconvenience caused by the June flood.

18. Please state any general comments.

.....

The methods used to derive damage figures are explained below:

1. Cereal Crop Damage: The farmer was asked to estimate the number of acres of each crop destroyed as well as the expected yield. The multiplication of these two figures gave an estimate of the number of bushels of grain lost. The market value of these grains was used to evaluate the loss.

Prices of grain are as follows:

Grain	Price Per Bushel (\$) <sup>1</sup>
Wheat	1.25
Oats	.55
Barley	.80
Flax	2.65
Rapeseed	2.10
Mixed Grain	.65

Estimated variable costs that would be incurred harvesting these damaged crops were subtracted from the gross value of the grain since these costs are "saved". A cost of \$0.94 per acre for swathing and combining and \$0.02 per bushel for hauling the grain were the variable costs used.<sup>2</sup>

2. Hay Crop Damage: As with cereal crop damage, the farmer was asked to estimate the number of acres of hay destroyed as well as the expected yield. It was assumed that value of hay per acre would be \$40 at \$16 per ton and 2.5 tons per acre. The estimated variable costs of haying used were \$3.95 for cutting and baling and an additional \$2.00 per acre for hauling, giving a total variable cost of \$5.95 per acre.<sup>3</sup> The net profit per acre forgone, and thus damage, is therefore \$34.05 (\$40.00—\$5.95) or \$13.62 per ton.

<sup>1</sup>Market Analysis Branch of the Alberta Department of Agriculture.

<sup>2</sup>Production Economics Branch, Department of Agriculture.

"Machinery Cost Schedules, 1972."

<sup>3</sup>Production Economics Branch, Department of Agriculture.

"Machinery Cost Schedules, 1972."

<sup>4</sup>Production Economics Branch, Department of Agriculture.

"Alberta Crop Enterprise Analysis, 1970."

<sup>5</sup>Production Economics Branch, Department of Agriculture.

"Machinery Cost Schedule, 1972."

<sup>6</sup>This cost is an estimate based on "The Namepi-Kennedy Creek Project: An Economic Feasibility Study, 1970" and "Machinery Cost Schedules, 1972," both produced by the Alberta Department of Agriculture.

<sup>7</sup>Canada Department of Agriculture, "Livestock and Meat Trade Report, June 13, 1972".

3. Silt Damage: Losses to crops due to silt deposition occurred in some areas. The owner estimated the number of acres affected. It was assumed there would be no returns from silt-covered land for 2 years. The cost to the farmer would be the loss of returns for two years plus the cost of summerfallowing silt-damaged acres. A farm management study points out that the returns over variable costs for a sample of Alberta farms in 1970 were approximately \$14.77 per cultivated acre.<sup>4</sup> The cost of fuel and lubricants used in operating a tractor and cultivator is estimated at \$0.34 per acre.<sup>5</sup> Assuming that the land was cultivated 4 times per year this would cost about \$1.36 per acre. The loss to the farmer, from silt-covered land would be \$14.77 per acre per year loss in profit plus \$1.36 per acre for 4 cultivations per year, or \$16.13 per acre per year. Assuming the loss to be in effect for two years, silt deposition would cost \$32.26 per acre.
4. Permanent Land Losses: In some cases, land was eroded away by the river. The farmer was asked to estimate the number of acres of such land as well as its per acre value. In cases where the farmer was unfamiliar with local land values, estimates provided by other farmers in the region were used as a proxy.
5. Cost of Reseeding Grass: The estimated number of acres requiring reseeding was multiplied by \$6.36 per acre. This latter figure is an estimate of the variable cost of reseeding the grass and consists of the costs of cultivating, and seeding the damaged areas back to grass.<sup>6</sup>
6. Damage to Hay and Grain in Storage: The extent of this damage was an estimate of each individual farmer. The per bushel values of the grain lost are the same as those used to determine the value of the crop in the field (see #1, "Cereal Crop Damage").
7. Damage to Fences: The damage to fences is an estimate of the repair costs as given by each individual farmer.
8. Damage from Driftwood: In certain areas large amounts of driftwood accumulated on farm land. Each farmer estimated the amount of time required for driftwood removal. The total cost of operating a tractor and front-end loader, including the cost of labor, is estimated at \$52.80 per 8-hour day. This figure was used for the assessment.
9. Damage to Equipment: If flood waters were responsible for damage to farming equipment, the farmer was asked to estimate such losses.
10. Cattle Losses: Values used were \$250 for cows and \$150 for calves.<sup>7</sup>

## **APPENDIX C**

# **Streamflow Data**

PEACE RIVER AT FORT VERMILION - STATION NO. 07HF001

(G1 on Fig. 1)

Location: Lat. 58° 23' 15" N., Long. 116° 02' 05" W., Alberta, in S.W. 1/4 sec. 24, tp. 108, rge. 13, W. 5th Mer., in the town of Fort Vermilion about one hundred yards upstream from Alberta Forest Service headquarters. Drainage Area: 86,000 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements. Period of Record: Open water seasons 1915-22, 1960-62, continuous 1963-66, and open water seasons 1967-72. Recorded Extremes: Maximum daily mean discharge, 437,000 cfs on June 16, 1964 (mean g.h. 32.08). For 1972, maximum instantaneous discharge 382,000 cfs at 0700 MST, June 16 (g.h. 30.42).

Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
13 June	117,000	17 June	300,000
14 June	134,000	18 June	252,000
15 June	279,000	19 June	249,000
16 June	368,000	20 June	250,000

Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
13 June	0600	115,000		1000	275,000
	1200	117,000		1100	284,000
	1800	119,000		1400	315,000
	2400	121,000		1500	322,000
14 June				1600	333,000
	0600	124,000		1700	342,000
	1200	128,000		1800	347,000
	1800	144,000		1900	357,000
	2100	163,000		2000	363,000
	2400	188,000		2100	367,000
15 June				2200	371,000
	0100	196,000		2300	374,000
	0200	204,000		2400	377,000
	0300	213,000	16 June	0100	378,000
	0400	221,000		0200	377,000
	0500	228,000		0300	380,000
	0600	233,000		0400	380,000
	0700	244,000		0500	381,000
	0800	254,000		0600	379,000
	0900	265,000			

Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
17 June	0700	382,000	18 June	0500	253,000
	0800	382,000		0800	249,000
	0900	381,000		0900	249,000
	1000	379,000		1000	248,000
	1100	377,000		1100	254,000
	1700	361,000		1200	251,000
	1800	356,000		1300	250,000
	2200	344,000		1400	250,000
	2300	339,000		1800	249,000
				1900	248,000
	0000	336,000		2300	248,000
	0100	331,000		2400	248,000
	0500	318,000	19 June	0500	248,000
	1100	298,000		0900	249,000
	1600	281,000		1100	250,000
	1700	281,000		1800	251,000
	2300	263,000		1900	250,000
	2400	261,000		2300	249,000
				2400	248,000

PEACE RIVER AT PEACE RIVER - STATION NO. 07HA001

(G2 on Fig. 1)

Location: Lat. 56° 14' 41" N., Long. 117° 18' 46" W., Alberta, in N.W. 1/4 sec. 31, tp. 83, rge. 21, W. 5th Mer., on left bank of river one-half mile downstream from the Northern Alberta Railway bridge. Drainage Area: 72,000 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements and logarithmic extension to peak stage. Period of Record: Continuous 1915-32, and 1957-72. Recorded Extremes: 550,000 cfs at 1500 MST on June 14, 1972 (g.h. 42.32).

Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
9 June	115,000	16 June	274,000
10 June	116,000	17 June	266,000
11 June	124,000	18 June	261,000
12 June	135,000	19 June	264,000
13 June	252,000	20 June	228,000
14 June	497,000	21 June	171,000
15 June	379,000	22 June	227,000

Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
11 June	0600	120,000	14 June	0100	416,000
	1200	124,000		0200	427,000
	1800	130,000		0300	440,000
	2400	130,000		0400	452,000
12 June				0500	466,000
	0600	130,000		0600	479,000
	1200	135,000		0700	493,000
	1800	140,000		0800	504,000
	2400	155,000		0900	515,000
13 June				1000	525,000
	0600	193,000		1100	535,000
	1200	253,000		1200	542,000
	1800	321,000		1300	546,000
	2100	359,000		1400	549,000
	2400	403,000			



Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
14 June	1500	550,000	16 June	0300	292,000
	1600	548,000		0600	283,000
	1700	546,000		0900	274,000
	1800	540,000		1200	265,000
	1900	534,000		1500	259,000
	2000	527,000		1800	256,000
	2100	516,000		2100	256,000
	2200	504,000		2300	258,000
	2300	492,000		2400	259,000
	2400	480,000	17 June	0100	259,000
15 June	0300	441,000		0300	262,000
	0600	408,000		0600	264,000
	0900	387,000		0900	265,000
	1200	363,000		1200	265,000
	1500	339,000		1500	268,000
	1800	326,000		1800	268,000
	2100	311,000		2100	269,000
	2400	303,000		2400	269,000

SMOKY RIVER AT WATINO - STATION NO. 07GJ001

(G3 on Fig. 1)

Location: Lat. 55° 42' 56" N., Long. 117° 37' 19" W., Alberta, in E. 1/2 sec. 34, tp. 77, rge. 24, W. 5th Mer., at highway bridge about eight miles below confluence with Little Smoky River and thirty-five miles above confluence with Peace River. Drainage Area: 18,500 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements to approximately 150,000 cfs and thereafter to peak stage by logarithmic extension. Period of Record: Continuous 1915-21, open water season in 1922, and continuous 1955-72. Recorded Extremes: 325,000 cfs at 0300 MST June 14, 1972 (g.h. 33.24).

Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
9 June	43,300	15 June	131,000
10 June	46,200	16 June	87,700
11 June	52,300	17 June	72,100
12 June	65,100	18 June	65,300
13 June	188,000	19 June	53,800
14 June	289,000	20 June	44,300

Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
9 June	0600	41,500	12 June	0100	56,200
	1200	44,300		0400	56,100
	1800	45,200		0500	55,800
	2400	44,300		0600	55,500
10 June				0800	56,000
	0600	44,700		1200	61,100
	1200	47,700		1400	61,800
	1800	48,000		1500	62,800
11 June	2400	46,700		1600	64,600
				1800	73,600
	0600	48,100		2400	105,000
	1200	54,500	13 June		
	1800	56,100		0600	137,000
	2400	56,100		1200	192,000

Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
13 June	1800	247,000	15 June	1200	116,000
	1900	255,000		1400	111,000
	2000	269,000		1600	106,000
	2100	282,000		1800	103,000
	2200	296,000		2000	99,800
	2300	310,000		2200	97,000
	2400	318,000		2400	94,800
14 June	0100	323,000	16 June	0300	91,500
	0200	324,000		0600	89,300
	0300	325,000		0900	88,800
	0400	325,000		1200	89,200
	0500	325,000		1500	86,200
	0600	325,000		1800	83,700
	0700	325,000		2100	81,200
	0800	325,000		2400	79,200
	0900	324,000	17 June	0300	77,200
	1000	322,000		0600	75,200
	1100	319,000		0900	73,700
	1200	315,000		1100	72,700
	1300	301,000		1400	71,200
	1400	285,000		1700	69,900
	1500	269,000		2000	68,900
	1600	253,000		2300	68,200
	1700	243,000	18 June	0500	66,900
	1800	236,000		1100	64,800
	1900	227,000		1700	61,500
	2000	220,000		2300	58,000
	2100	213,000	19 June	0500	54,600
	2200	206,000		1100	52,000
	2300	199,000		1700	49,500
	2400	194,000		2300	46,800
15 June	0100	187,000	20 June	0500	44,700
	0200	180,000		1100	43,400
	0300	171,000		1700	42,900
	0400	162,000		2300	42,700
	0500	154,000			
	0600	145,000			
	0800	131,000			
	1000	123,000			

SMOKY RIVER ABOVE HELLS CREEK - STATION NO. 07GA001

(G4 on Fig. 1)

Location: Lat. 53° 57' 00" N., Long. 119° 09' 00" W., Alberta, approximately one hundred and five miles northwest of Hinton and about 2,400 feet above confluence with Hells Creek. Drainage Area: 1,480 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements to approximately 24,000 cfs and thereafter to peak stage by logarithmic extension. Period of Record: Miscellaneous measurements only in 1966, and continuous 1967 to 1972. Recorded Extremes: 48,900 cfs at 1600 MST, June 12, 1972 (g.h. 14.69).

Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
8 June	14,900	14 June	23,700
9 June	15,700	15 June	19,900
10 June	18,800	16 June	18,600
11 June	20,900	17 June	17,000
12 June	43,300	18 June	13,200
13 June	35,200	19 June	11,600

Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
8 June	0600	15,100	10 June	0600	18,000
	1200	15,300		1200	19,400
	1800	14,800		1800	19,700
	2400	14,900		2400	19,700
9 June	0600	15,700	11 June	0600	20,000
	1200	15,900		1200	20,800
	1800	15,500		1800	21,200
	2400	16,300		2100	22,100

Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
11 June	2200	22,600	14 June	0300	26,500
	2300	24,300		0600	26,000
	2400	26,200		0900	25,100
12 June				1200	23,700
	0100	28,800		1500	22,500
	0200	31,400	15 June	1800	21,500
	0300	33,500		2100	20,900
	0400	35,600		2400	21,000
	0500	37,800			
	0600	39,700		0600	21,200
	0700	40,300	16 June	1200	20,000
	0800	41,200		1800	18,600
	0900	42,500		2400	18,500
	1000	44,000			
	1100	45,900		0600	19,100
	1200	47,900	17 June	1200	18,800
	1300	48,200		1800	18,100
	1400	48,500		2400	17,900
	1500	48,700			
	1600	48,900		0600	18,100
	1700	48,900	18 June	1200	17,300
	1800	48,800		1800	16,000
	1900	48,800		2400	14,900
	2000	48,500			
	2100	48,700		0600	14,100
	2200	48,100	19 June	1200	13,200
	2300	47,300		1800	12,100
	2400	46,600		2400	11,800
13 June					
	0100	45,600		0600	12,000
	0200	44,500	19 June	1200	11,700
	0300	43,500		1800	11,100
	0400	42,700		2400	11,100
	0500	42,000			
	0600	41,400			
	0900	37,600			
	1200	34,600			
	1500	31,600			
	1800	29,000			
	2100	27,400			
	2400	26,700			

## SIMONETTE RIVER NEAR GOODWIN - STATION NO. 07GF001

(G5 on Fig. 1)

Location: Lat. 55° 08' 30" N., Long. 118° 10' 30" W., Alberta, in N.W. 1/4 sec. 12, tp. 71, rge. 2, W. 6th Mer., on right bank of river six miles south of Goodwin on Forestry road. Drainage Area: 1,920 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationships in 1972 defined by current meter measurements and logarithmic extension to peak stage. Period of Record: Miscellaneous discharge measurements 1965-67, open water season 1969, and continuous 1970-72. Recorded Extremes: 29,000 cfs at 0400 MST on July 13, 1971 (g.h. 11.91). For 1972, 24,500 cfs at 2400 MST on June 13 (g.h. 11.07).

## Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
11 June	606	15 June	7,940
12 June	660	16 June	4,920
13 June	14,400	17 June	3,660
14 June	17,500		

## Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
11 June	0600	606		0800	14,400
	2400	606		0900	16,000
12 June				1000	17,200
	0900	606		1100	18,200
	1200	644		1200	19,100
	1500	692		1300	19,700
	1800	740		1400	20,400
	1900	740		1500	21,100
	2000	756		1600	21,800
	2100	764		1700	22,200
	2200	780		1800	22,700
	2300	789		1900	23,100
	2400	789		2000	23,600
13 June				2100	24,100
	0200	798		2200	24,400
	0300	825		2300	24,400
	0400	915		2400	24,500
	0500	1,600	14 June		
	0600	8,400		0100	24,100
	0700	12,500		0200	23,600

Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
14 June	0300	23,100	16 June	0100	5,600
	0400	22,400		0200	5,560
	0500	21,800		0300	5,500
	0600	20,900		0400	5,420
	0700	20,000		0500	5,340
	0800	19,100		0600	5,120
	0900	18,200		0700	5,060
	1000	17,600		0800	4,920
	1100	16,800		0900	4,880
	1200	16,200		1200	4,680
	1300	15,400		1300	4,620
	1400	15,000		1400	4,560
	1500	14,400		1500	4,480
	1600	13,900		1600	4,660
	1700	13,500		1700	4,520
	1800	13,000		1800	4,500
	1900	12,700		1900	4,440
	2000	12,300		2000	4,340
	2400	10,400		2100	4,280
15 June	0100	10,100	17 June	2200	4,220
	0300	9,630		2300	4,160
	0600	8,850		2400	4,120
	0700	8,580		0100	4,100
	0800	8,340		0300	4,020
	0900	8,050		0600	3,840
	1000	7,930		0900	3,740
	1100	7,730		1200	3,580
	1200	7,580		1500	3,440
	1300	7,280		1800	3,370
	1400	7,130		2100	3,340
	1500	6,830		2400	3,330
	1600	6,730			
	1800	6,380			
	2000	6,100			
	2200	5,830			
	2300	5,850			
	2400	5,800			

## CUTBANK RIVER NEAR GRANDE PRAIRIE - STATION NO. 07GB001

(G6 on Fig. 1)

Location: Lat. 54° 31' 00" N., Long. 118° 59' 50" W., Alberta, in S.E. 1/4 sec. 9, tp. 64, rge. 7, W. 6th Mer., approximately fifty miles southwest of Grande Prairie. Drainage Area: 315 square miles. Gauge Height Record: Automatic stage recorder graph. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements and logarithmic extension to peak stage (aided by a slope-area measurement). Period of Record: Open water seasons, 1970 to 1972. Recorded Extremes: 27,000 cfs at 1500 MST June 12, 1972 (g.h. 17.96).

## Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
8 June	149	14 June	2,000
9 June	155	15 June	1,290
10 June	155	16 June	970
11 June	824	17 June	777
12 June	16,400	18 June	732
13 June	9,980		

## Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
9 June	0600	155	12 June	0100	5,980
	1200	155		0200	6,380
	1800	155		0300	6,860
	2400	155		0400	6,780
10 June				0500	6,860
	0600	155		0600	8,360
	1200	155		0700	10,000
	1800	153		0800	11,800
	2400	160		0900	13,300
11 June				1000	15,900
	0600	168		1100	18,200
	1200	208		1200	20,700
	1800	1,300		1300	23,100
	1900	2,060		1400	25,700
	2000	2,720		1500	27,000
	2100	3,220		1600	26,900
	2200	3,880		1700	26,200
	2300	4,390		1800	25,100
	2400	5,660		1900	24,100



Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
12 June	2000	23,400	15 June	0300	1,420
	2100	22,600		0600	1,350
	2200	21,900		0900	1,300
	2300	21,100		1200	1,240
	2400	20,100		1500	1,220
13 June				1800	1,170
	0100	19,300		2100	1,130
	0200	18,200		2400	1,090
	0300	17,300	16 June	0600	1,030
	0600	14,200		1200	965
	0900	10,800		1800	905
	1200	7,580		2400	850
	1500	5,740	17 June	0600	813
	1800	4,180		1200	768
14 June	2100	3,170		1800	719
	2400	2,570		2400	687
	0100	2,490	18 June	0600	692
	0300	2,340		1200	732
	0600	2,160		1800	786
	0900	2,040		2400	737
	1200	1,920			
	1800	1,690			
	2100	1,600			
	2400	1,510			

## WAPITI RIVER NEAR GRANDE PRAIRIE - STATION NO. 07GE001

(G7 on Fig. 1)

Location: Lat. 55° 04' 20" N., Long. 118° 48' 10" W., Alberta, in S.W. 1/4 sec. 23, tp. 70, rge. 6, W. 6th Mer., on bridge ten miles south of Grande Prairie. Drainage Area: 4,350 square miles. Gauge Height Record: Wire weight gauge readings once daily or, more often as required. Discharge Record: Stage-discharge relationship in 1972 defined by current meter measurements and logarithmic extension (with the aid of an indirect, contracted area measurement) to peak stage. Period of Record: December 1917 to March 1918 and continuous 1960-72. Recorded Extremes: 165,000 cfs at 0800 MST June 13, 1972 (g.h. 27.18).

## Daily Mean Discharge in CFS, 1972

Date	Discharge	Date	Discharge
10 June	10,900	14 June	60,600
11 June	13,300	15 June	35,500
12 June	43,000	16 June	26,400
13 June	130,000	17 June	20,800

## Discharge in CFS at Indicated Time, 1972

Date	Hour	Discharge	Date	Hour	Discharge
10 June	0600	10,700	13 June	0700	164,000
	1200	10,800		0800	165,000
	1800	11,200		0900	164,000
	2400	11,500		1000	163,000
11 June	0600	12,000		1100	158,000
	1200	13,100	1200	152,000	
	1800	15,000	1300	145,000	
	2400	17,700	1400	138,000	
12 June	0600	22,900	1500	132,000	
	1200	38,000	1600	125,000	
	1800	64,000	1700	119,000	
	2400	101,000	1800	113,000	
13 June	0100	110,000	1900	107,000	
	0200	120,000	2000	102,000	
	0300	130,000	2100	96,100	
	0400	142,000	2200	91,100	
	0500	153,000	2300	86,600	
	0600	161,000	2400	83,000	
			14 June	0100	78,800
		0600		65,500	

Discharge in CFS at Indicated Time, 1972 (cont'd.)

Date	Hour	Discharge	Date	Hour	Discharge
14 June	0700	64,300	15 June	0700	36,800
	0800	62,900		0800	36,200
	0900	61,800		0900	35,400
	1000	60,600		1000	35,000
	1100	59,100		1100	34,400
	1200	58,000		1200	33,900
	1300	56,500		1600	32,800
	1400	55,100		1700	32,600
	1500	53,700		1800	32,300
	1600	52,700		2200	31,400
	1700	51,300		2400	30,700
	1800	49,900	16 June	0100	30,300
	1900	48,500		0600	28,300
	2000	47,100		1200	26,100
	2100	46,100		1800	24,200
	2200	44,800		2400	22,300
	2300	43,500	17 June	0600	21,300
	2400	42,500		1200	20,700
15 June	0100	41,600		1800	20,100
	0500	38,100		2400	19,400
	0600	37,400			

PINTO CREEK ON TWO LAKES FORESTRY ROAD

(G8 on Fig. 1)

Location: Lat.  $54^{\circ} 50' 00''$  N., Long.  $119^{\circ} 23' 00''$  W., Alberta, approximately 33 miles southwest of Grande Prairie. Drainage Area: 195 square miles. Recorded Extremes: 8,500 cfs on June 12, 1972, as determined by slope-area measurement. Remarks: This is a miscellaneous measurement site and not part of the regular gauging network.

NOSE CREEK AT SHUTLER FLATS

(G9 on Fig. 1)

Location: Lat.  $54^{\circ} 46' 00''$  N., Long.  $119^{\circ} 33' 00''$  W., Alberta, approximately 42 miles southwest of Grande Prairie. Drainage Area: 404 square miles. Recorded Extremes: 34,000 cfs on June 12, 1972, as determined by slope-area measurement. Remarks: This is a miscellaneous measurement site and not part of the regular gauging network.



DEPARTMENT OF THE ENVIRONMENT  
ENVIRONMENTAL MANAGEMENT SERVICE  
INLAND WATERS DIRECTORATE  
WATER SURVEY OF CANADA

FIGURE 1  
LOCATION MAP  
FLOOD OF JUNE 1972  
SOUTHERN PEACE (SMOKY RIVER) BASIN, ALBERTA



LEGEND

STREAM GAUGING STATIONS.

- G-1- PEACE RIVER AT FORT VERMILION
- G-2- PEACE RIVER AT PEACE RIVER
- G-3- SMOKY RIVER AT WATINO
- G-4- SMOKY RIVER ABOVE HELLS CREEK
- G-5- SIMONETTE RIVER NEAR GOODWIN
- G-6- CUTBANK RIVER NEAR GRANDE PRAIRIE
- G-7- WAPITI RIVER NEAR GRANDE PRAIRIE

MISCELLANEOUS MEASUREMENT SITES

- G-8- PINTO CREEK ON TWO LAKES FORESTRY ROAD
- G-9- NOSE CREEK AT SHUTLER FLATS

--- DRAINAGE BOUNDARIES

METEOROLOGICAL INFORMATION

CONTRIBUTING AGENCY

ALBERTA FOREST SERVICE

- LOOKOUT TOWER
- RANGER STATION

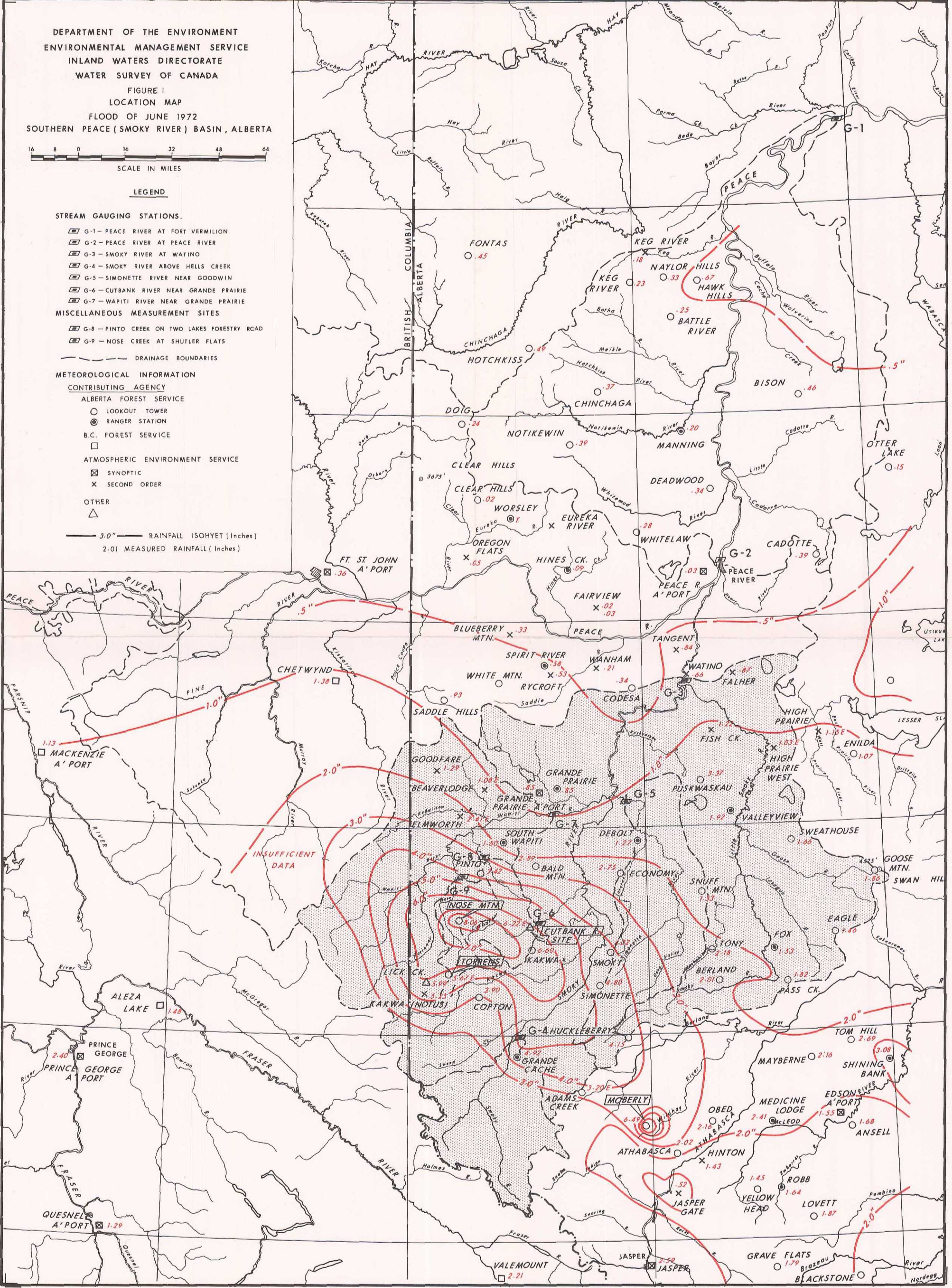
B.C. FOREST SERVICE

- ATMOSPHERIC ENVIRONMENT SERVICE
- ⊗ SYNOPTIC
- × SECOND ORDER

OTHER

- △

- 3.0" — RAINFALL ISOHYET (Inches)
- 2.01 MEASURED RAINFALL (Inches)





GB L.A. Warner  
707 Flood of June 1972 in the Southern  
.C338 Peace (Smoky River) Basin, Alberta.  
No.87  
c.1

DATE

ISSUED TO

GB L.A. Warner  
707 Flood of June 1972 in the Southern  
.C338 Peace (Smoky River) Basin, Alberta.  
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