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PEACE RIVER DATA

REVIEW

1959 to 1984

**Inland Waters and Lands
Western and Northern Region**

**Eaux intérieures et terres
Région de l'ouest et du nord**

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PEACE RIVER DATA
REVIEW

1959 to 1984

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Water Survey of Canada
Calgary, Alberta
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ABSTRACT

Modelling studies detected the possibility of data anomalies at a number of the gauging stations operated along the Peace River. The Hydrology subcommittee of the Alberta-NWT Transboundary Waters Agreement requested that Water Survey of Canada (WSC) review the Peace River data. WSC agreed and the data for the period 1959 to 1984, inclusive, for the four gauging station sites, Peace River at Dunvegan, Peace River at Peace River, Peace River at Fort Vermilion and Peace River at Peace Point were reviewed with the results of this review being contained in this report.

Significant revisions to the daily discharge data were found to be warranted during ice-affected periods with considerably lesser revisions being applied to data during open water conditions. In particular, when slush (frazil) ice was present in the measurement cross-section, the original calculated discharges exhibited large discrepancies along the river's reach. Subsequently, the largest revisions were made to the data for these periods.

ACKNOWLEDGEMENTS

The review of hydrometric data is often a long drawn out tedious affair with little in the way of rewards. In particular, this Peace River review took considerable time and a great deal of effort on the part of two individuals: Mr. V. S. Elder, Officer-in-Charge of the Peace River suboffice, who reviewed and revised the data for the gauging stations on the Peace River at Dunvegan, at Peace River and at Fort Vermilion, and Mr. A. Wilson, Area Head, WRB, Yellowknife, who did the review and revisions for the data for the Peace River at Peace Point gauging station.

A third vital member of the review team was Ilene Batty, who took the scribblings and near indecipherable hieroglyphics of the author, transcribing them into this typed version of the report.

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1.0

SUMMARY AND RECOMMENDATIONS

1.1 SUMMARY

Significant revisions were required and made to the data of Peace River at Peace River, and Peace River a Peace Point. Most of these revisions were made to data during the ice-affected periods. Similarly, the originally computed winter discharge data at Peace River at Fort Vermilion were found, for the most part, to be grossly in error. It was determined that supporting information, such as winter flow measurements, were either highly suspect or unavailable and as such, it was decided to eliminate flow data for all the ice-affected periods at this site. Revisions to data at Peace River at Dunvegan were minor.

The number of gauged sites along the Peace River's reach were useful in the review process from a comparison point of view. Once the W.A.C. Bennett Dam went into operation the stage-discharge relations at Hudson Hope and, for the most part, Taylor were no longer affected by ice conditions, thus presenting reliable data during the winter period, for comparison purposes in the downstream reach. Prior to the operation of the dam the computed flows at Peace Point appeared fairly reliable and hence were useful in the comparisons.

The review points out that Public Enemy No. 1 to the acquisition of reliable record during the winter period is the presence of slush in the streamflow measurement cross-section. Slush was always present along the reach of the Peace River, particularly at Peace River, but became much more of a problem, especially in the early winter, at Peace Point once the W.A.C. Bennett Dam went into operation. This condition was reflected in the magnitude of revisions at Peace Point, which were as high as 61.7 percent to the monthly average streamflow in December 1970.

1.2 RECOMMENDATIONS

It is apparent that much research and development work is required to accurately determine streamflow in the presence of slush ice. The Water Resources Branch (WRB) efforts in research and development should be directed to this problem and the assistance of research institutes should be sought.

The review of the Peace River data has pointed out the need to review the data at Slave River at Fitzgerald, especially winter records, and in particular for 1978 and for 1980 onward.

When more than one station exists along the reach of a river it is essential that the data not be calculated without close and continuous reference to the other sites.

Rough estimates can be made to determine water "losses" due to storage in the form of ice formation and prismodic storage, but a rigid procedure for these calculations is not readily apparent. It is recommended that a contract be let to develop these procedures and to apply some of these calculations to particular periods in the Peace River Basin.

Additional research and development is also recommended regarding the rating of meters in low velocities, the use of alternate meters for particular circumstances, and the effect on meter ratings when various suspension apparatus are used.

Where winter metering results are giving suspicious results, and no immediate cause is suspected, it is recommended that a velocity profile program be conducted to determine the proper velocity coefficients.

2.0

INTRODUCTION

2.1 DESCRIPTION OF BASIN

The main stem of the Peace River arises in northeastern British Columbia, flows primarily eastward into Alberta to the Town of Peace River. At Peace River the river flows predominantly northward to Fort Vermillion, then again eastward until it joins with the Riviere des Rochers to form the Slave River. The Peace River Basin, as well as pertinent gauging stations within this basin, are depicted in Figure 1.

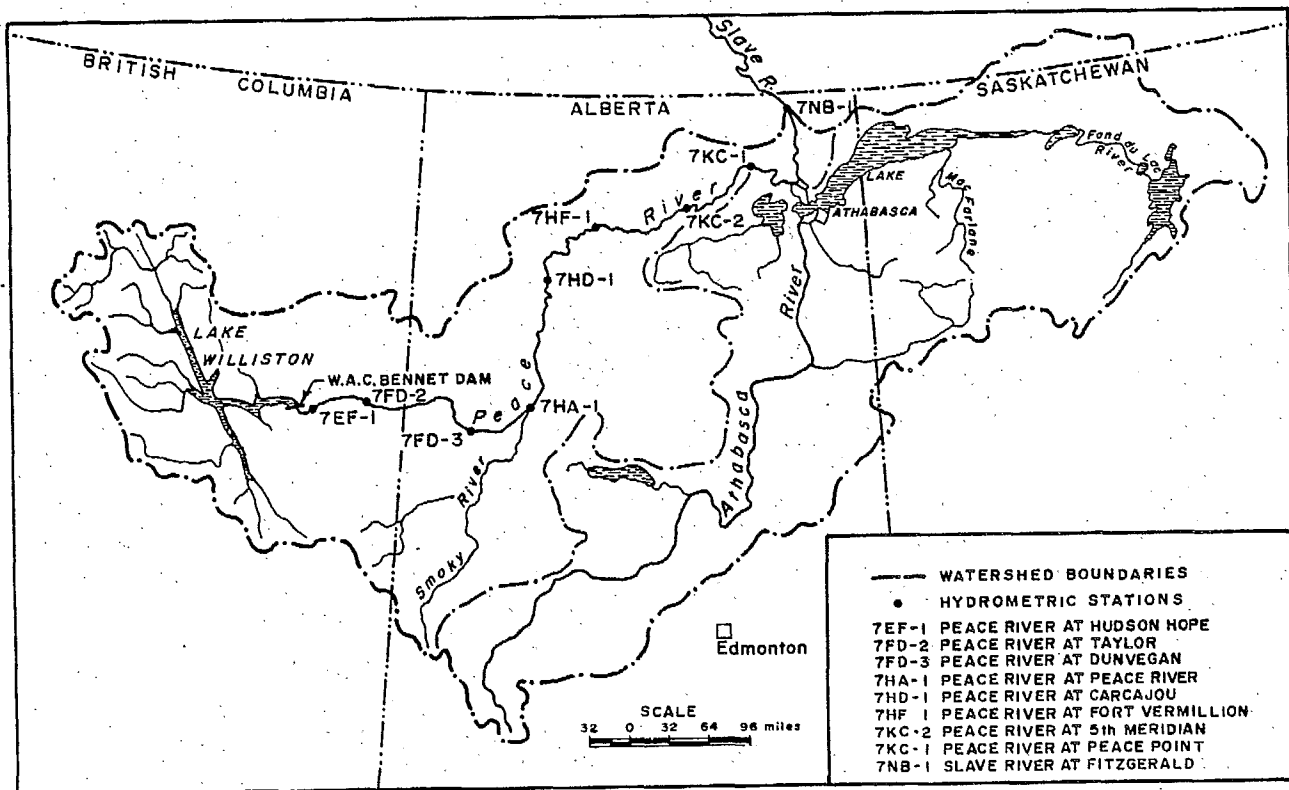


Figure 1: Peace River Basin

The W.A.C. Bennett Dam was completed in 1968. At that time storage behind the dam began and Lake Williston was formed. Further in this report the significance of this dam's operation to the Peace River flow data determinations will become apparent.

2.2 PEACE RIVER GAUGING STATIONS

A total of eight gauging stations have been operated at various times on the Peace River from Hudson Hope to Peace Point. Two of these stations, Peace River at Carcajou (07H0001) and Peace River at Fifth Meridian (07KC002) were only operated for short periods. The data for these sites were not reviewed, nor were they utilized in the review of data at the other sites.

Two of the gauging stations, Peace River at Hudson Hope (07EF001) and Peace River at Taylor (07FD002) are operated by the Water Survey of Canada (WSC), British Columbia District. The gauging stations, Peace River at Peace Point (07KC001) and Slave River at Fitzgerald (07NB001) are operated by the personnel of the Ft. Smith suboffice of the Water Resources Branch (WRB), NWT Region. The station at Fifth Meridian was also operated by these personnel. The remaining stations, Peace River at Dunvegan (07FD003), Peace River at Peace River (07HA001), Peace River at Carcajou (07HD001), Peace River at Fort Vermilion (07HF001) as well as the gauging station Smoky River at Watino (07GJ001) were operated by personnel from the Peace River suboffice of the Alberta, WRB, District.

Table I, which follows, presents a listing of the gauging stations, their inventory numbers, the operating office, and the period of record, along with the operating season.

TABLE I: GAUGING STATION DATA (FROM 1959 TO 1984)

STATION NUMBER	NAME	OPERATING DISTRICT	PERIOD OF RECORD AND SEASON OF OPERATION
07EF001	Peace River at Hudson Hope	B.C.	1959-68 Manual; Continuous 1969-84 Recording; Continuous
07FD002	Peace River at Taylor	B.C.	1959 Manual; Continuous 1960-84 Recording; Continuous
07FD003	Peace River at Dunvegan	Alta.	1960-69 Manual; Seasonal 1974-84 Recording; Seasonal
07HA001	Peace River at Peace River	Alta.	1959-62 Manual; Continuous 1963-84 Recording; Continuous
07HD001	Peace River at Carcajou	Alta.	1960-65 Manual; Seasonal 1966-67 Recording; Seasonal
07HF001	Peace River at Ft. Vermilion	Alta.	1962 Manual; Continuous 1963-66 Recording; Continuous 1967-78 Recording; Seasonal 1979-84 Stage only; Seasonal
07KC002	Peace River at Fifth Meridian	NWT	1960-64 Manual; Seasonal 1966-67 Recording; Seasonal
07KC001	Peace River at Peace Point	NWT	1959-60 Manual; Continuous 1961-62 Recording; Continuous 1963 Recording; Seasonal 1964-84 Recording; Continuous
07NB001	Slave River at Fitzgerald	NWT	1959-84 Recording; Continuous
07GJ001	Smoky River at Watino	Alta.	1959-84 Recording; Continuous

In addition to the main stem gauging stations, numerous tributaries to the Peace River were, and are, also gauged.

Throughout this report gauging station sites will be referred to by their locations (i.e., Peace River at Peace Point will be referred to as Peace Point, whereas Peace River at Peace River will be referred to as Peace River).

The river reach between the stations at Taylor to Peace River is approximately 300 kilometres, while the reach between Peace River and Peace Point is approximately 750 kilometres. These figures are presented to give some indication of the distances involved.

Streamflow data from 1959 to 1984, inclusive, were reviewed.

2.3 DATA ANOMALIES

Because of the large number of gauging stations on the main stem of the Peace River and operations by three separate districts of WRB, it was almost inevitable that anomalies in data would occur. Anomalies were detected as early as the mid-sixties and several piece-meal reviews of the data at various sites have been undertaken at various times, with varying degrees of success.

This latest review was primarily fueled by the importance of the Peace-Athabasca Delta (PAD) area and the subsequent studies conducted to review the remedial measures taken to stabilize the water levels of the PAD area.

With the construction of the W.A.C. Bennett Dam, the flow regime of the Peace River was changed so that summer peaks were significantly reduced. The high peaks formerly had the effect of retarding outflow from Lake Athabasca and the Delta in general. With the reduction of these peaks the outflow was no longer retarded to the same extent and hence remedial measures in the form of a weir on the major channel, Riviere des Rochers, was constructed to stabilize the lake levels. In the 1980's, under the auspices of the Peace-Athabasca Delta Implementation Committee (PADIC), studies were commissioned to ascertain the effectiveness of this weir. These studies involved the use of modelling techniques, primarily the Hydrodynamic Model. It was in the calibration of the model that numerous anomalies in flows between Peace River and Peace Point and between Peace Point and Slave River at Fitzgerald were detected.

These anomalies prompted this latest review of the data of the Peace River main stem stations. The actual review was requested by the Hydrology Subcommittee of the Alberta-NWT Transboundary Waters Agreement.

The PAD area is depicted in Figure 2.

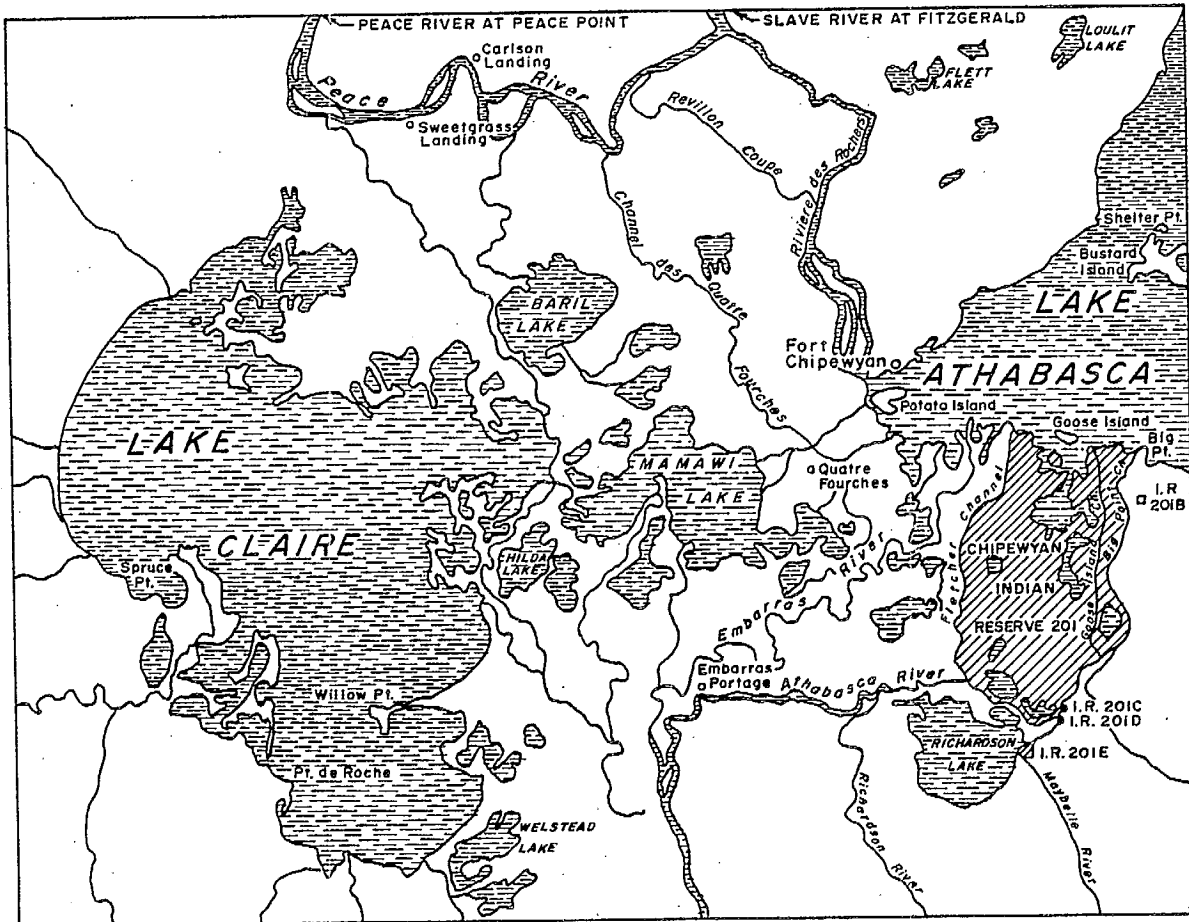


Figure 2: Peace-Athabasca Delta Area

2.4 REPORT CONTENTS AND ORGANIZATION

The next section of this report will detail the procedures used to review the data of the Peace River main stem gauging stations. This includes the initial review utilizing combined hydrographs, special techniques utilized to review the initial data, the meeting of principals involved in the final review and details of the final review.

The findings of the review committee indicated that the major problems with the data were during the winter period. To this end, a section has been included in this report to detail the uncertainties encountered in the performance of winter streamflow measurements and in the computations of winter streamflow data.

The major section of the report contains information on the year-by-year review of the data at each pertinent gauging station. It includes details on the initial detection of the anomalies utilizing hydro-graph comparisons, the initial recommendations for revisions based on hydrograph sketching as well as on the use of other specific tools for suggesting revisions, and outlines the final revisions made with explanations for the final revision decisions.

A summary and recommendation section is also included to summarize the types of anomalies found and to make recommendations as to the future field programs and computation procedures at the Peace River stations. Recommendations are also made with respect to studies which should be undertaken to improve the accuracy of winter data collection and computation in general.

The appendix contains copies of the combined hydrographs after the revisions were made. Further information and data on the review are contained in WSC files at Calgary.

3.0

REVIEW PROCEDURES

As discussed in the introduction, this review was initiated primarily because of anomaly identification by mathematical modellers working on the Peace-Athabasca Delta study project. The model results may have been responsible for highlighting the periods of anomalies, but that was the extent to which they were used for this particular review and subsequent revision of data. This section will detail the procedures utilized in the review of the data.

3.1 COMPOSITE HYDROGRAPHS

The first step used in the preliminary review of the data was the acquisition of composite hydrograph plots so that the data, as originally computed, could be visually compared from site to site.

The Data Control Section, WSC, Ottawa, provided the composite hydrographs in two rolls. The first roll contained daily discharge data plots for Hudson Hope, Taylor, Dunvegan and Peace River for 1959 to 1984, inclusive. The hydrograph for each station was plotted in a different color for easy identification. The second roll contained hydrograph plots for Dunvegan, Smoky River at Watino plus Dunvegan, Peace River, Fort Vermilion and Peace Point. Again, each of the five hydrographs (5) were plotted in a different color for the review period; 1959 to 1984, inclusive.

These hydrographs were visually examined for inconsistencies. When any were detected, the period was circled for further investigation. Anomalies detected using this procedure included inconsistent peaks and troughs from one site to another, less flow at downstream stations than at upstream stations, unusually shaped falling or rising limbs or perhaps unusual flat spots on the plots, inconsistent time of travel of peaks and troughs, and in some instances, simply peculiar looking plots.

It should be noted that the hydrograph comparison technique from Hudson Hope to Peace River during the winter period became particularly pertinent after the W.A.C. Bennett Dam went into operation. That is, once water was released from the reservoir (beginning in 1968) the gauging stations at Hudson Hope, and for the most part at Taylor, no longer experienced ice-affected stage-discharge relations. In extreme cold weather, Taylor experienced some ice formation, and thus backwater, but this was readily discernible as blips on the hydrograph plot and, at most, lasted only several days. Many years showed no evidence of ice formation at Taylor. These blips will be referred to the B.C. office for potential revision.

Using these hydrographs and some additional information, as described in a subsequent subsection, potential revisions were sketched on the hydrograph plots for further consideration by the particular person responsible for the second phase of the review. These hydrograph sketches were considered along with the initial work sheets utilized in the computation of the daily discharge data in the computation of actual revisions.

3.2 MEASUREMENT REVIEW

The preliminary review quickly determined that the periods when the vast majority of anomalies were occurring were during the winter, and in particular, were more pronounced in the early portion of the winter.

The first step in examining this phenomena was the plotting of the streamflow discharge measurements made during the winter period on the composite hydrographs. It immediately became apparent that each of these measurements was used (as it should be) to compute the daily discharges (i.e., In all cases the plotted hydrograph showed nearly identical flows to the metered flows on the days that the measurements were made.).

Every measurement which was made during an anomalous period was then examined. On the front sheets of many of these measurements it was noted that slush ice conditions were present and indeed when these measurements were examined on a panel-by-panel basis, depths of slush ice were noted and in a number of the panels velocities were erratic as compared to neighboring panels. Even when the front sheets did not note the presence of slush, an examination of the measurements made during anomalous periods indicated velocity inconsistencies from panel to panel. This inferred that there was current meter operation interference.

In some instances velocities from panel to panel would vary from more than 0.6 metres per second (2 feet/second) to less than 0.15 metres per second (0.5 feet/sec.) in the next panel.

A rough attempt was made to estimate the potential undermeasurement by using more consistent velocities. These re-estimated measurements were replotted on the hydrographs to assist in the interpretation of potential revisions.

Some further analyses were performed on the winter flow measurements in that the various hydraulic parameters such as backwater, area, mean velocity, and mean depth were plotted versus metered discharge and versus gauge height. Many of these plots had a wide scattering of points, but some anomalous situations could be detected for a number of measurements which plotted particularly disparatively from the main grouping.

3.3 OPEN WATER ANOMALIES

While not as numerous as during the ice-affected periods, some anomalies were detected during open water periods. Many of these occurred during estimated flow periods and were primarily due to the procedure of bracketing the estimated periods. That is, the estimated mean flow for a five-day, ten-day, or other interval was used for each of the days within the period and was indicated by a bracket around the interval. These bracketed periods were re-estimated for each individual day on the basis of hydrograph comparisons.

Some anomalies also occurred as a result of ill-defined stage - discharge relations, particularly in the early years of the life of the station. Composite stage-discharge relations were plotted and were utilized to recalculate discharges for the stage ranges which were poorly defined in the initial calculations.

In some instances it was determined that the application of shifts were improperly applied and that by distributing shifts in another manner the inconsistencies could be eliminated (i.e., for the most part the revisions were made by changing the shift distribution pattern from a time distributed basis to a stage distributed basis).

In one instance, the review detected that a wrong stage-discharge relation was used to compute a period of record.

3.4 ADDITIONAL PROCEDURES

From 1972 onward, the Technical Services Division of Alberta Environment made discharge measurements on the Riviere des Rochers, the major outflow channel from the Peace-Athabasca Delta area. These measurements were used in conjunction with Slave River at Fitzgerald data in order to provide an additional procedure for estimating flows at Peace Point. This procedure provided very useful corroborating evidence for revisions to Peace Point data, although in later years (the 1980's) the Slave River data were computed utilizing Peace Point data and thus they were not independent checks. In essence, this procedure pointed out some anomalies in the computed daily discharges for Slave River at Fitzgerald, which likely means that the winter records at this site should also be reviewed. Plots utilizing this procedure can be found in figures 3 to 5.

In many instances, initially computed flows at Peace Point were considerably less than at Peace River, particularly in the early part of many winters. To determine whether this was reasonable, some rough calculations were made to calculate water losses due to storage of water in the form of ice cover and prismodic storage due to the backwater effect. These calculations indicated that the losses, as indicated by the initial flow data, were excessive and

that for the most part, the losses would be made up by inflow from major tributaries through the reach. Many assumptions were utilized in the water storage calculation and it readily became apparent that a procedure should be developed to accurately assess these storage "losses".

3.5 REVIEW PERSONNEL

The initial review of the data through the examination of combined hydrographs, the review of streamflow discharge measurements and the production of composite stage-discharge relation plots was performed by the author. The detected anomalies were then brought to the attention of the staff member responsible for the particular gauging station in question. The identified data anomalies for gauging stations at Dunvegan, at Peace River, and at Fort Vermilion were examined in more detail and where revisions were necessary were revised by Mr. Vance Elder, Officer-in-Charge of the Peace River suboffice. The data for Peace River at Peace Point were examined, and appropriate revisions made by Mr. Al Wilson, Area Head of the Yellowknife District office.

The first station which was examined in detail and revised when revisions were necessary, was the Peace River at Peace River site. It was the initial site because it is the first continuously operated site downstream of Hudson Hope and Taylor which, after the W.A.C. Bennett Dam went into operation, exhibited open water conditions year round and thus had a relatively good data base to which indicated anomalies could be compared. Similarly, prior to the operation of the dam, the data base during the winter at Peace Point was relatively good and hence provided a reference point for revisions for Peace River during this period.

Mr. Elder, utilizing these data bases, the comments which arose from the preliminary review and the initial computation work sheets, performed those data revisions which were deemed necessary. Once Mr. Elder had made the first set of revisions to the Peace River data, a meeting of the three principals was held to review the anomalies and the first set of revisions to the Peace River data, to express and resolve concerns where differences of opinion existed regarding revision of data.

Updated Peace River data were then utilized in the production of combined hydrographs containing flow data for Taylor, Peace River, Peace Point and Slave River at Fitzgerald. Alberta Environment measurement data from the Riviere des Rochers were plotted on these hydrographs to provide two comparison possibilities; one from upstream and one from downstream. Mr. Wilson then utilized these updated hydrographs and original computation work sheets to produce the data revisions he deemed necessary.

Compared to Peace River and Peace point the necessary revisions to the Dunvegan data were minor.

All the revised data were provided to the author. This data was inputted to the computer files and subsequently transmitted to the Data Control Section, WSC, Headquarters, for updating of the "Hydat" file.

The last cycle of the review has been the revision of data for Fort Vermilion by Mr. Elder. Basically, this portion of the review found the winter records at this site to be extremely unreliable; so much so, that the decision has been made to eliminate all these data rather than to produce artificial data based only on hydrographs at Peace River and Peace Point.

The data anomalies detected at Hudson Hope, Taylor and Slave River at Fitzgerald have been referred to the appropriate responsibility centre.

4.0

WINTER RECORD UNCERTAINTIES

The findings of the Peace River review indicated that the vast majority of anomalies in the original data existed during the ice-affected periods, and thus it appears worthwhile to detail uncertainties in winter record collection. This section will briefly discuss a number of factors which can produce uncertainties, particularly in the measurement of streamflow during ice conditions.

4.1 SLUSH ICE (FRAZIL)

With the review of the Peace River data it quickly became apparent that the major anomalies occurred when slush ice was present in the streamflow measurement cross-section. Corroborating this statement to some extent, was the fact that the anomalies at Peace Point in the winters of 1959/60 to 1967/68 were relatively minor and infrequent, but after that period winter flow data anomalies became large and frequent. This corresponds with the operation of the W.A.C. Bennett Dam. Once winter releases were made from the dam, the presence of slush ice at Peace Point increased considerably and correspondingly so did the winter records anomalies.

Few studies have been made regarding the effect of slush ice presence on winter streamflow discharge measurement accuracy. One study which did some comparison studies was the Arctic Rivers Work Group program on the Peace River in 1966/67 (Morton, 1983). In this study concurrent measurements were made on 18 separate occasions, at Peace Point, at cross-sections located approximately 1.4 kilometres apart. One of these sections was severely affected by slush ice conditions, while the other section was considered slush-free. In fact, the slush-free section exhibited some erratic velocity changes from panel to panel indicating the presence of some unconsolidated slush ice.

Nonetheless, in all instances, the metered flow in the "slush-free" section was greater than the metered flow in the "slush" section. Differences in flow varied from two to eighteen percent. The question is whether there is undetected flow through the slush or whether there is meter interference, or perhaps a combination of both. Some personnel involved in winter flow measurements feel that rather than an evenly distributed percolation of water through the slush, flow may actually be occurring in an undetected channel(s) (piping) through the slush layer.

A rather peculiar finding of a particular metering program when slush ice was present occurred in Peace River in 1968 (one year after the Arctic Rivers Work Group study). Staff of the Peace River office found that their usual measurement section was severely affected by a slush pack (quite consolidated under the ice, with a

free-flowing stream below the slush pack). Nevertheless, they performed a streamflow measurement which gave a discharge of 340 m³/s with a mean velocity in the cross-section of 0.5 m³/s. Since the Arctic Rivers Work Group study results were fresh in the minds of the Peace River staff, a second measurement was made in a "slush-free" section, 1.2 kilometres below the usual measurement section, with the results being a discharge of 280 m³/s with a mean cross-sectional velocity of 0.2 m³/s. These results were completely opposite to what was expected; however, upon further inspection, it becomes apparent that the "slush-free" section was really not slush-free, but contained a less consolidated form of slush ice throughout most of the cross-section, which likely interfered with the performance of the current meter; or perhaps the slower velocities in the cross-section could not be accurately metered by the Price meter.

It is apparent that much research is required to produce a procedure and/or equipment to accurately meter flow when slush ice is present.

4.2 VELOCITY DISTRIBUTION

The current procedure, whereby the mean velocity in a vertical is determined by averaging the metered velocity at the 0.2 and 0.8 depth points or multiplying the velocity at the 0.5 depth point by 0.88, was prescribed in 1907 (Barrows and Horton, 1907), after they had conducted a number of vertical velocity profile studies. For the most part, these distributions fit fairly well to the 0.20 and 0.80 procedure, but the recommendations of "Barrows and Horton, 1907" were that actual velocity coefficients should be established by producing vertical velocity profiles at each site to be metered.

The practice of WSC has been to utilize the 0.2D and 0.8D or 0.5D procedure without vertical velocity profile checks, primarily because of staff and budgetary limitations. This may be causing inaccuracies at some sites. A recent example was the program conducted on the Mackenzie River by the WRB, NWT Region. A vertical velocity profile measuring program was conducted at the Mackenzie River above Arctic Red River gauging station in the winter of 1986/87. This study indicated that using the 0.2D and 0.8D method produced results that were consistently 10% too low.

It is obvious that additional emphasis on vertical velocity distribution is required, particularly where data problems are suspected.

4.3 SLOW VELOCITIES

Uncertainties in the measurement of velocity with the Price meter (utilized almost exclusively by WSC) increase as the velocities decrease. A study (Lambie, 1966) into velocity measurement uncertainties indicated that when velocities were greater than 0.3 m³/s

the potential error was only plus or minus 1.5 percent; however, when the velocities were less than 0.3 m³/s the errors were found to be as high as plus or minus 16%.

Additional work is required in the rating of current meters or perhaps in finding alternate meters for use when slow velocities are present.

4.4 ASSEMBLIES

The WSC winter current meters (Price AA with modified yoke) are presently rated utilizing a rod suspension only; however, winter current meters are often used with varying types of cable and weight assemblies. One study (Schneider and Fotrell II, 1984) showed that when using a Price meter suspended on a cable and slush-n-all weight assembly, the meter rotated three to nine percent slower than the official rating made on a rod assembly.

This study indicates that current meters should be rated with the assemblies that are to be used or that a number of ratings should be made with a variety of assemblies.

4.5 METER CUPS

The reference has been lost, but a study has been performed whereby the rating of current meters with full cups showed that these meters under-registered velocities by eight percent. This finding, no doubt, can be linked to some of the inaccuracies which exist when slush ice is present. The development of the solid plastic cup current meter may overcome this source of inaccuracy.

4.6 TYPE OF CURRENT METER

While WSC primarily uses the Price AA with modified yoke to meter velocities under ice cover, there are other types and makes of meters which are, or could be, used. Some preliminary studies indicate the metered flows using different meters can produce significantly different results. Much additional work is required before definitive recommendations can be made as to the preferred meter under specific conditions.

4.7 HEATED METERS

Some very preliminary studies have been conducted by the Peace River suboffice staff into the meter response of a heated meter, as compared to an unheated meter. The meter was heated by pouring hot water over it immediately before immersing it in the river. Preliminary results indicate that the heated meter consistently produces velocities higher than those produced by an unheated meter. This was reported even when air temperatures were only moderately below freezing.

4.8 CALCULATIONS OF WINTER RECORDS

There are numerous different procedures available for calculating winter discharge records and there have been numerous studies into the calculation of winter record; however, suffice it to say that the calculation of winter discharge data is fraught with uncertainties. The Peace River example demonstrates the fact that winter data cannot be computed in isolation when other stations exist on the same stream.

5.0

REVISIONS

This section of the report contains a year-by-year and gauging station-by-gauging station report on the revisions made to the discharge data at the Peace River stations at Dunvegan, Peace River, Fort Vermilion, and Peace Point during the period 1959 to 1984, inclusive. Details are presented on the preliminary review, which utilized combined hydrographs to spot anomalies and which then used additional tools such as a review of the streamflow measurements and a review of the stage-discharge relations.

Once the identification of anomalies and suggested revisions were made, the data were forwarded to the respective responsibility centres (as detailed in Section 2, "Review Procedures", of this report). The actual revisions are detailed in this section of the report with corresponding reasoning for the revisions.

Most of the revisions were made to the Peace River and Peace Point data and thus a summary of monthly revision magnitudes for these sites are contained in this section for each year. Revisions to the Dunvegan data were minor. The major revisions made to the Fort Vermilion data were the expunging of all ice-affected records and thus are not contained in the "Summary of Revision" tables.

For further reference, individual gauging station revision reports have been prepared and are contained in the WSC files. Similarly, all the work data, including the preliminary combined hydrographs with initial observations written on them, are contained in the WSC office in Calgary and are available for perusal.

5.1 1959

5.1.1 Preliminary Review

Peace River

Peace River data anomalies were identified in the latter part of December through hydrograph comparison techniques with the upstream stations at Hudson Hope and Taylor, and with the downstream station at Peace Point.

Peace Point

Hydrograph comparisons indicated that the originally computed data appeared consistent except for the October to December period. Much of the original data at Peace Point from mid-October through to early December were estimated because of a manometer malfunction. Also, the winter streamflow discharge

measurement made on December 5 was investigated. It was determined that a number of the vertical sections of the measurement were slush-affected and hence it was felt that the flow measurement was adversely affected. Measurement inaccuracy was felt to be in the neighborhood of ten percent.

5.1.2 Actual Revisions

Peace River at Peace River

The peaks, as initially computed, were not evident elsewhere and thus backwater conditions were redefined and data revised.

Peace River at Peace Point

Flows during the estimated period October 23 to late November were revised on the basis of hydrograph comparisons. Late November to December 5 flows were revised on the basis of backwater revisions due to an upward revision of the December 5 measurement.

5.1.3 Periods of Revision

Peace River @ Peace River: December 19 and 20
 December 23 to 31

Peace River @ Peace Point: October 23 to December 5
 December 31

5.1.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
OCT.				52 160	54 740	+4.9
NOV.				42 286	36 124	-14.6
DEC.	19 292	18 512	-4.0	22 698	23 750	+4.6

5.2 1960

5.2.1 Preliminary Review

Dunvegan

The hydrograph comparison showed an inexplicable trough during the period August 8 to 14. Reviewing the observer's readings indicated that the wire weight gauge was misread by one foot.

Peace River

Two of the four measurements made during the January to April period exhibited slush conditions and were felt to under-represent flows by about 10%.

The peak flows for the latter part of June and early July were felt to be too high, with recommendations being made to revise the data on the basis of a composite stage-discharge relation.

The data as initially computed for the freeze-up period of late November and for the early winter period in December exhibited peculiar drops in discharge. It is not unusual to encounter sudden and large drops in discharge during the freeze-up period, but the flat bottom of the drop was most peculiar. Backwater shifts were calculated as -0.152 metres for the entire November period, which was suspect.

It was felt that the actual hydrograph should have exhibited a sudden drop, with gradual recovery. A minimal amount of slush ice was present in the December measurement cross-section and thus no revision was recommended to the data for the period around the measurement date.

Peace Point

The two measurements made at "Peace Point" in January and March appeared slush-free and hence it was recommended that they be used as is. The flows between measurements were computed on a relatively straight line basis and could have been slightly reinterpreted, but monthly totals would likely be unaffected and it was recommended that no revision should be attempted.

The estimated record for "Peace Point" for the latter part of March and all of April is open to interpretation, but a sketched, estimated hydrograph for this period gave a total similar to that of the estimated period. No revisions were deemed to be necessary.

The measurements at "Peace Point" for December 15, 1960 and January 7, 1961 were considerably affected by slush conditions. Likely, each measurement result could be increased by 10% to more closely represent the true discharge. It was recommended that the daily values for December be revised upwardly by approximately 10%.

5.2.2 Actual Revisions

Dunvegan

The original computations showed an inordinately large drop in flows during the period August 9 to 14 at Peace River at Dunvegan. Hydrograph comparisons indicated computed flows were too low. Upon examination of the manual gauge readings for that period, it was determined that the gauge had been misread by 0.3 metres.

Peace River

Discharge measurements of January 14 and February 10 were considered to be distorted by the slush ice conditions present and were not used. Flows for the period January 1 to March 4 were revised. Revisions were relatively minor, approximately 9%, and roughly followed the sketched hydrograph.

The flow on April 22 was revised by reducing the amount of backwater correction, which increased the flow, making it more consistent with other sites.

Observer readings for June 3, 4 and 5 were examined and were believed to be incorrect. A technician's reading on June 6 was widely divergent from the observer's reading and the observer's reading of that date had already been discarded. Flows for June 3, 4 and 5 were estimated on the basis of hydrograph comparisons.

The peak flow period of June 22 to July 2 was revised on the basis of a better defined stage-discharge relation. Curve No. 9 was utilized.

The periods November 24 to December 4 and December 22 to 26 were revised much as originally suggested, although the trough of November 24 to December 4 was revised with less drop than initially sketched.

Peace Point

Although the initial recommendation was for some revisions to the December period only, a closer scrutiny by the Yellowknife office produced significant additional revisions.

Flows for the period January 1 to 12 were revised on the basis of hydrograph comparisons. Flows for the period March 11 to May 7 had previously been shown as five-day bracketed figures. These were re-estimated on a daily basis, utilizing hydrograph comparisons.

For the open water period May 8 to May 28 the shifts were reinterpreted and applied accordingly. The estimated periods for August 23 to 28, September 21 to 30 and October 28 to 31 were redone on the basis of hydrograph comparisons to eliminate the bracketed figures.

The discharge measurement of December 15 was examined and the velocities were felt to be suspect and affected by slush conditions. Accordingly, backwater conditions between November 1 and December 31 were reinterpreted and flows correspondingly revised.

5.2.3 Period of Revision

Peace River at Dunvegan:	August 9 to 14
Peace River at Peace River:	January 1 to March 4 April 22 June 3 to 5 June 22 to July 2 June 23 (Inst. Peak) November 24 to December 4 December 22 to 29
Peace River at Peace Point:	January 1 to 12 March 11 to May 7 May 8 to May 28 August 23 to 28 September 21 to 30 October 28 to 31 November 1 to December 31

5.2.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	11 336	11 794	+4.0	14 202	14 444	+1.7
FEB.	8 310	9 232	+11.1	11 612	11 612	0
MAR.	11 871	11 887	+0.1	13 542	13 033	-3.8
APR.	31 946	32 507	+1.8	36 990	35 092	-5.1
MAY	134 360	134 360	0	116 670	118 050	+1.4
JUNE	225 430	214 330	-4.9	215 790	215 790	0
JULY	144 700	143 530	-0.8	194 580	194 580	0
AUG.	61 370	61 370	0	69 990	69 980	0
SEPT.	41 890	41 890	0	56 270	55 390	-1.6
OCT.	45 456	45 456	0	45 280	44 430	-1.9
NOV.	27 717	27 911	+0.7	32 532	38 047	+17.0
DEC.	13 030	13 709	+5.2	12 587	15 096	+19.9

5.3 1961

5.3.1 Preliminary Review

Dunvegan

Peaks recorded on September 10, September 22 and October 19 appeared too low on the basis of hydrograph comparison, but a cursory review of observer's readings found no inconsistencies in the readings.

Peace River

Three measurements were made at "Peace River at Peace River" during January to March; however, they were all ignored when doing the daily discharge computation and rightly so. The front sheets indicate that the meter was freezing between holes and at the same time significant slush conditions were encountered. No revisions were recommended for the ice period.

It was felt that the May 29 and 30 data could be reduced on the basis of a better defined stage-discharge relation.

The December 6, 1961 measurement appeared entirely erroneous. The mean velocity for the measurement was less than one-half of what was expected. It was recommended that the measurement be disregarded and revisions be made from November 30 to December 14.

Fort Vermilion

Flows from October 20 were initially estimated, probably utilizing hydrograph comparison with data as initially computed at Peace River and possibly at Peace Point.

Peace Point

The first measurement of 1961, January 7, was affected by slush conditions in several sections, with corresponding reduced velocities even in the slush-free portion of the slush-affected sections. It was felt that significant flow could have occurred through the slush, and the measurement could be revised upward from 443 to 480 cms. The measurements made in February and March were only slightly affected by slush conditions and thus only slight revisions were recommended. The May 3 measurement was most propitious and defined very well the breakup discharges (field technicians were certainly brave). Perhaps the flows for April 5 to 20 should have been higher on the basis of the "Peace River at Peace River" hydrograph.

The front sheet for December 11, 1961 measurement indicated there was some slush in the measurement section, but this was not readily discernible from the measurement notes and thus the measured value should be close to the true value. It would appear, however, that the flow at the end of November appeared too high, whereas the dip in mid-December appeared too low. A suggested possible interpretation was sketched on the hydrograph.

5.3.2 Actual Revisions

Dunvegan

Observed readings using the wire weight gauge were judgmental to some degree at this station because of the distance to the water from the gauge (located on the pier top) and the turbulence caused by the pier. With those factors in mind, readings for the periods September 10 to 13 and September 22 to 25 were discarded and the discharges were estimated on the basis of the combined hydrographs.

Peace River

Troughs during the period January 14 to 16 and February 5 to 10 appeared to be too deep and were revised upwards on the basis of hydrograph comparison.

A sharp drop shown on April 7 was revised. It was assumed that the observer had read the gauge 0.3 metres too low.

The May 29 and 30 peak was not revised, as the percentage difference of the potential revised data on May 29 was less than 1% using the more precisely defined stage-discharge relation.

The December 6 measurement was obviously too low and was discarded. Flows for the period November 30 to December 14 were revised upwards, as suggested in the preliminary review.

Fort Vermilion

The data for the period May 1 to 8 had been bracketed and thus were subsequently revised to give individual daily discharges, based on hydrograph comparisons.

The October 17 to 20 gauge readings did not reflect the peak indicated at other stations and thus were deleted and flows revised on the basis of hydrograph comparisons. The period October 22 to 31 had been estimated and bracketed figures used. These were revised on the basis of hydrograph comparisons.

No stage record was available from October 22 to December 31 and the measurement of December 7 was obviously in error. Therefore, all flows for November to December were deleted, as there was little advantage in estimating these data.

Peace Point

The flow measurement of January 7 was affected by slush ice conditions and it was felt that it under-represented flows. Subsequently, flows for January 1 to February 16 were revised. Flows for April 7 to 18 were revised on the basis of hydrograph comparisons.

Data for the periods November 12 to December 4 and December 14 to 24 were revised on the basis of backwater adjustments to make the hydrograph at this site correspond with those of Peace River and Slave River.

5.3.3 Periods of Revision

Peace River at Dunvegan: September 10 to 13
September 22 to 25

Peace River at Peace River: January 14 to 16
February 5 to 10
April 7
November 30 to December 13

Peace River at Fort Vermilion: May 1 to 8
October 17 to 20
October 22 to 31
Nov. 1 to Dec. 31, (flows deleted)

Peace River at Peace Point: January 1 to February 16
April 7 to 18
November 12 to December 4
December 14 to 24

5.3.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	12 459	12 547	+0.7	13 143	14 778	+12.4
FEB.	10 068	10 206	+1.4	11 209	12 079	+7.8
APR.	27 643	27 851	+0.8	25 875	27 354	+5.7
NOV.	26 564	26 599	+0.1	38 751	32 290	-16.7
DEC.	9 698	11 389	+17.4	14 851	14 987	+0.9

5.4 1962

5.4.1 Preliminary Review

Dunvegan

The flows for the October 5 to 15 period at Dunvegan appeared erroneous (too low for the first five days and perhaps too high for the last 5 days). However, the observer read the gauge daily through this period and although one could

suspect erroneous readings there was no substantiation and therefore no recommendation for revision.

Peace River

Some slush of a minor nature existed in the measurement cross-sections of the four measurements made from January to April. Daily discharge computations actually were greater than the measurements in January and March and thus some compensation had already been made for the possible flow through slush. Although there is no substantiating information the flow for the period February 7 to March 11 appeared too high and it was recommended that the flows be recalculated on the basis of hydrograph comparisons.

The September 30 daily discharge was incorrectly calculated as 30 000 cfs (850 m³/s) whereas it should have been 40 000 cfs (1 130 m³/s).

At first appearance, the flows for December appeared too low, but upon examination of the measurements (the first winter measurement was made January 5, 1963) compensation to some extent had been made for slush conditions and even with a 15% increase to the measured flow of January 5, only some upward revision to the latter part of December could be recommended. Flows for Taylor and Hudson Hope were estimated and should be re-examined.

Fort Vermilion

The measurement results of February 8 and March 10 appear suspect because of slow velocities. An earlier measurement in January had to be abandoned because of layers of ice and slush. Flows for January 1 to May 27 were suggested for revision.

Vast amounts of slush were encountered during the December 18 measurement and should be disregarded as it obviously under-metered the flow by a considerable margin. Flows for November 29 to December 27 were suggested for revisions based on hydrograph comparison.

Peace Point

The measurements for January to April, inclusive appear slush-free and should accurately define the flows at the time of each measurement. Although nothing substantiated the suspicion, it appeared the peak in February was too high and it was suggested that it be redefined. It would appear that too much backwater was applied from April 16 onward to the

end of ice conditions and that the flows should be revised, utilizing hydrograph comparison.

The measurement on December 5, 1962 at Peace River at Peace Point exhibited some slush conditions, but revising the flows upward increased the metered flow by only 4% and since this was within the realm of measurement and computation errors, no revisions were suggested to November and December daily discharges.

5.4.2 Actual Revisions

Dunvegan

For reasons cited in the review of 1961 data, observed readings for October 6 to 9 were discarded and the discharges were estimated by hydrograph comparison.

Peace River

Flows for the periods February 8 to 12 and February 21 to March 8 were revised on the basis of hydrograph comparisons.

The flow value for September 30 was incorrectly calculated as 30 000 cfs (850 m³/s) and was subsequently corrected to 40 000 cfs (1 130 m³/s).

Flows were revised for December 13 to 31 on the basis of hydrograph comparisons, but this revision disregards the first measurement of the winter. Some additional review of this period may be warranted.

Fort Vermilion

Measurements made from January through March were investigated and felt to be in error because of submerged ice layers in January and significant slush presence in February and March. The April 5 measurement was felt to be of marginal acceptable accuracy. Because of the winter discharge measurement inaccuracies, daily discharge for the ice-affected period January 1 to April 30 were deleted.

Few gauge readings were available in May and subsequently flows for May 1 to 28 were revised on the basis of hydrograph comparison.

Estimated periods during June, July and August had formerly been estimated using mean flows for approximately 10-day bracketed periods. These were re-estimated on a daily basis, using hydrograph comparisons.

Flows, with the exception of the period November 13 to 15, for November and December were deleted. Flows for a 15-day period in November had been estimated originally and the December 18 measurement was obviously grossly in error.

Peace Point

Slight revisions to the April 8 to 10 data were made. Initially, it was felt that the flows for the period April 10 to 30 should also be revised, but the suggested revisions would have produced positive shifts under ice conditions and thus were not made. Flow data for the ice jam period April 30 to May 13 were also revised.

The periods October 14 to 21 and October 26 to November 1 were initially bracketed estimated flow figures and were subsequently revised on a daily basis by hydrograph comparison.

Flows for November 7 to 12 were recomputed as open water conditions (formerly had been computed with backwater corrections).

Flows for November 13 to December 16 and for December 31 were recomputed, using hydrograph comparisons.

5.4.3 Periods of Revision

Peace River at Dunvegan:	October 6 to 9
Peace River at Peace River:	February 8 to 12 February 21 to March 8 September 30 December 13 to 31
Peace River at Fort Vermilion:	Jan. 1 to April 30 (flows deleted) May 1 to 28 June 3 to 7 June 24 to 30 July 1 to 6 July 11 to 16 July 18 to 24 July 27 to 31 August 1 to 8 August 19 to 31 November 1 to 12 (flows deleted) Nov. 16 to Dec. 31 (flows deleted)

Peace River at Peace Point: April 8 to 10
 April 30 to May 13
 October 14 to 21
 October 26 to November 1
 November 7 to 12
 November 13 to December 16
 December 31

5.4.4. Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
FEB.	12 989	12 395	-4.6	13 261	13 261	0
MAR.	8 197	7 797	-4.9	10 717	10 717	0
APR.	48 648	48 648	0	29 518	29 770	+0.9
MAY	102 250	102 250	0	107 240	107 100	-0.1
SEPT.	45 610	45 890	+0.6	65 620	65 620	0
OCT.	45 517	45 517	0	46 750	50 060	+7.1
NOV.	46 116	46 116	0	42 232	47 990	+13.6
DEC.	14 571	17 479	+20.0	18 302	18 636	+1.8

5.5 1963

5.5.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

The measurements of January 5 and February 6 did not appear to be affected by slush conditions, but it appeared some revisions could still be made. Suggested revisions were based on hydrograph comparisons. A substitute gauge reader was used during September as the automatic gauge was not working. On the basis of hydrograph comparison, it appeared that the period from September 5 to 15 was read erroneously and should be revised downwardly.

The measurement of December 10, 1963 was only slightly affected by slush. Since revisions were required to the November-December 1963 period in any event, the flow was revised slightly upward. The time lag for rise to peak at Peace River appears to have been 5 days late (based on Taylor and Hudson Hope) and was subsequently recommended for revision, as sketched. The manometer malfunctioned from November 10 to November 30 and only one observer reading was made during the questionable period, which resulted in the flat-bottomed hydrograph trough, which seemed unreasonable.

Fort Vermilion

No discernible slush problems were evident in the April 4 measurement and only slight evidence on the January 30 measurement; however, from measurements at Peace River and at Peace Point it would appear Fort Vermilion flows should be revised upward.

The peak flows for June and July appeared to have too much attenuation. Further investigations were recommended through use of a composite stage-discharge relation.

The manometer malfunctioned during the November-December ice period and blocks of 5 to 10 days were estimated (same flow value assigned to each day in the block). It was felt that total flows for November and December would be close to actual and thus no revisions were suggested.

Peace Point

The measurements of January to April 1963 exhibited no, or very little, slush conditions and thus revisions were not recommended. Computed daily flow swings appear erratic, but no supporting data are available to revise them. Flow data for the first fifteen days of April, however, should likely be revised upward.

The period of July 10 to July 18 was estimated on a straight line basis, whereas it should have been estimated on the basis of peaks recorded at Peace River by hydrograph comparison.

The 26th of November measurement had several sections affected by slush conditions, but the metered velocities in these sections were greater, thus compensating for most, if not all, of the normal under-metering of flow through the slush. The manometer appears to have been malfunctioning for the November-December period and thus flows were suggested for revision, as sketched.

5.5.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

Data for the period January 1 to March 3 were revised on the basis of hydrograph comparisons. The discharge measurements of January 5 and February 6 were affected by slush ice and hence were felt to under-represent the true discharge, and therefore flows were revised upwardly. The January 5 measurement only indicated minor evidence of slush, but the final revisions indicate that flow values were greatly under-metered.

The high water period of June 4 to August 5 was recalculated on the basis of discharge measurement (July 3) adjustment, using a standard sounding approach.

Gauge heights for the period September 7 to 10, September 12, 13, 16, and 17 and December 1 and 2 were erroneously read by the observer and subsequently have been deleted and flows revised accordingly.

The period November 24 to December 31 was revised on the basis of hydrograph comparisons with upstream and downstream stations.

Fort Vermilion

A closer review of flows during the period January to April showed them to be consistently too low. Hence, the flows were deleted.

The stage-discharge relation used to compute flows was investigated and found to be poorly defined above flows of 5 380 m³/s (190 000 cfs). These flows were recomputed on the basis of a better defined relation. Subsequently, flows for June 1 to 6, 8 to 10 and 15 to 26 were revised.

No measurements were made in November nor December. The manometer malfunctioned for most of this period and the initial estimates appeared to be grossly in error. Therefore, discharges for the period November 10 to December 31 were deleted.

Peace Point

Flows during the ice-affected periods of January 1 to 27 and March 29 to April 15 were revised on the basis of hydrograph comparisons with Slave River at Fitzgerald and Peace River at Peace River.

The recorder malfunctioned during the period April 16 to June 26. Daily flows were fabricated for this period, using hydrograph comparison techniques. There were several additional periods of missing record (July 10 to 22, August 19 and 20, August 22 to 27, August 29 to September 4, September 6 to 9 and September 17 and 18), which also were revised by hydrograph comparison techniques. These data formerly were represented by estimated block discharge sections.

The November 26 measurement was affected by slush conditions and it was estimated that the flow was under-metered by 43 m³/s (416 to 459). Subsequently, flow data for the period November 14 to December 31 were revised.

5.5.3 Periods of Revision

Peace River at Peace River:	January 1 to March 3 June 4 to August 5 September 7 to 17 November 24 to December 31
Peace River at Fort Vermilion:	January 1 to April 30 (flows deleted) June 1 to 6 June 8 to 10 June 15 to 26 Nov. 10 to Dec. 31 (flows deleted)
Peace Point:	January 1 to 27 March 29 to April 15 April 16 to June 26 July 10 to 22 August 19 and 20 August 22 to 27 August 29 to September 4 September 6 to 9 September 17 and 18 November 14 to December 31

5.5.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	7 745	14 339	+85.1	18 234	19 148	+5.0
FEB.	9 723	11 773	+21.1	13 492	13 492	0
MAR.	12 643	12 676	+0.3	13 833	13 895	+0.4
APR.	76 119	76 119	0	-	41 526	
MAY	177 520	177 520	0	-	202 880	
JUNE	186 500	183 480	-1.6	-	205 940	
JULY	117 770	114 630	-2.7	123 700	127 400	+3.0
AUG.	55 320	55 260	-0.1	70 870	72 340	+2.1
SEPT.	42 660	42 010	-1.5	49 680	50 210	+1.1
OCT.	44 120	44 120	0	49 530	49 530	0
NOV.	20 484	21 802	+6.4	26 686	27 752	+4.0
DEC.	13 471	15 890	+18.0	12 901	17 286	+34.0

5.6 1964

5.6.1 Preliminary Review

Dunvegan

During the period April 25 to May 15 the flows of the Smoky River added to those at Dunvegan were significantly greater than at Peace River at Peace River.

Peace River

The flow for January and the first half of February appears very low when compared to Hudson Hope/Taylor and to the downstream station, Peace Point. Peace Point was well defined by measurements during the period (the measurements appear reasonable) and are considerably higher than the Peace River flow. The measurement at Peace River on January 21 and 22 was made over a two-day period and while no mention was made

of slush the mean velocity for the measurement was very low when compared to the December 1963 and February 1964 measurement. Tentative revisions were sketched on the hydrograph.

While investigating the June peak, it was apparent that either Peace River at Peace River was too high or Peace Point was too low. Upon further investigation, it appeared that the Peace River at Peace River curve was too far to the right above 10 000 m³/s. Subsequently, all flows above a gauge height of 10.5 metres (auto gauge) were recommended for revision. This could require revisions to daily discharges for June 4 to 23, for June 30 and for August 4 to 7.

The December 16 measurement was significantly affected by slush conditions and it obviously vastly under-estimated the actual flow. Looking at the notes, it appears that the flow could have been under-metered by 20 to 25% and flows for the latter part of November and all of December were subsequently recommended for revision.

Fort Vermilion

The March 18 measurement was disregarded because of very slow velocities in the measuring section. Upon further examination, the measurements of January 31 and February 26 also had slow velocities although faster than the March measurement.

Comparing with the hydrographs of Peace Point and revised Peace River data, it was recommended that the Fort Vermilion data be revised as sketched on the combined hydrograph.

The measurement of December 8 exhibited extremely low velocities (0.09 m³/s mean) with velocities in many holes showing only a "trace". This measurement was undoubtedly completely inaccurate and therefore must be ignored. December flows were recommended for revision based on flows for Peace Point and Peace River.

Peace Point

The January measurement exhibited some slush conditions, but investigating more closely, adjusting flows liberally upward would only increase metered flow by about 3.5%. Subsequent winter measurements showed only a trace of slush present. No revisions were recommended to January-April daily discharges.

A small amount of slush was evident in the December 4 measurement. The manometer wasn't working through November and December, and since Peace River at Peace River had been

revised upward for the same period, it was found necessary to recommend revision to Peace Point for November and December as well.

5.6.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

The streamflow measurements of mid-January were made over a two-day period (January 21 and 22) because of equipment and slush problems (velocities very low) and thus data for the period January 1 to February 26 were revised, disregarding the measurement result. The initially-computed flows for March 18 to 29 were very low when compared to Taylor and Hudson Hope and were subsequently revised.

Flows for the period May 29 to June 23, June 30, July 1 and August 3 to 7 were revised by utilizing stage-discharge curve No. 9 (all flows revised above a gauge height of 10.5 metres as the curve was redefined above this level, utilizing measurements made after 1964).

The December 16 measurement was significantly affected by slush and it was felt that the measurement considerably under-metered the true flow. Subsequently, flow data for November 26 to December 31 were revised.

Fort Vermilion

Several measurements were made during the winter period January through April, but all appeared to under-represent the flows. The metered velocities were extremely low in spite of no immediate detection of slush. Flow data for January 1 to April 30 were deleted.

Flows for the period May 1 to 7 were revised on the basis of hydrograph comparisons.

Data for the period June 2 to 17 were recomputed on the basis of a better defined stage-discharge relation.

The winter measurement of December 8 was suspect and thus the winter records, November 10 to December 31, were deleted.

Peace Point

Daily discharge data for January 1 to 16 were revised on the basis of hydrograph comparisons.

Flows for the estimated periods of August 20 to September 28 and October 17 to November 3 were revised on the basis of the recovery of additional gauge height data.

Flows for November 8 to 17 were recalculated as open water conditions (formerly assumed to have been affected by ice conditions).

Data for November 18 to December 31 were revised on the basis of hydrograph comparisons.

5.6.3 Periods of Revision

Peace River at Peace River:	January 1 to February 26 March 18 to 29 May 29 to June 23 June 30, July 1, Aug. 3 to 7 November 26 to December 31
Peace River at Fort Vermilion:	January 1 to April 30 (flows deleted) May 1 to 7 June 2 to 17 Nov. 10 to Dec. 31 (flows deleted)
Peace River at Peace Point:	January 1 to 16 August 20 to September 28 October 17 to November 3 November 8 to 17 November 18 to December 31

5.6.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	8 282	12 148	+46.7	13 931	15 125	+8.6
FEB.	8 155	9 218	+13.0	11 356	11 356	0
MAR.	8 090	8 241	+1.9	10 657	10 657	0
APR.	26 542	26 542	0	19 823	19 823	0
MAY	109 560	109 410	-0.1	115 150	115 150	0
JUNE	328 700	312 910	-4.8	293 840	293 840	0
JULY	169 710	169 370	-0.2	194 250	194 250	0
AUG.	154 100	151 360	-1.8	175 930	175 340	-0.3
SEPT.	62 250	62 250	0	67 010	67 380	+0.6
OCT.	62 270	62 270	0	69 620	72 400	+4.0
NOV.	33 845	34 454	+1.8	41 980	44 640	+6.3
DEC.	10 429	13 514	+29.6	15 115	19 678	+30.2

5.7 1965

5.7.1 Preliminary Review

Dunvegan

No revisions were recommended for the year.

Peace River

Each of the measurements made from January to April exhibited a minor amount of slush conditions with the most occurring in the cross-section of the January 15 measurement, decreasing to very little on the March 31, 1965 measurement. Since daily discharges for the first part of January required revisions (to be consistent with December 1964 data), it was recommended that revisions be made from January 1 to January 21, as sketched on the combined hydrograph.

The peak flows during June, July and August were felt to be O.K. as computed, as they had been computed on the basis of an upgraded well defined rating.

The measurement of December 21 was affected by slush conditions and hence it was felt that it under-metered flows by about 10%. Revisions on the basis of hydrograph comparisons were recommended for the period from mid-November to the end of December.

Fort Vermilion

As has been the case with nearly all of the winter measurements made at Peace River at Fort Vermilion, the measurements of February 26 and April 6, 1965 exhibited extremely low velocities. Flows at Peace Point and Peace River indicated that these measurements were under-metering the flows by a considerable amount. Therefore, it was recommended that they be ignored and that the winter discharges be estimated on the basis of hydrographs at Peace River and Peace Point.

It was recommended that flows for November and December be revised on the basis of hydrograph comparisons.

Peace Point

The January to March measurements were virtually unaffected by slush; however, the gauge did not work from January 1 to May 7 and subsequently daily discharges for the winter were calculated in flat blocks of mostly 10 day stretches. It would appear that for the most part these values were O.K. except for January 1 to 14 (which, it is suggested, be revised to be consistent with December 1964) and the period April 1 to May 7, which should be revised to more accurately reflect the shape of the hydrograph at Peace River and at Fort Vermilion.

The Arctic River Study Group began their investigations in the winter of 1965/66 and frequently and very carefully metered the flows at Peace Point. It would appear that no revisions were required.

5.7.2 Actual Revisions

Dunvegan

No revisions were required.

Peace River

Some slush ice was present in the discharge measurement of January 15 and thus it was felt that the flow was under-metered. Subsequently, discharge data for January 1 to 20 were revised upwards.

The gauge was working erratically June 1 to 4 and hence manual gauge readings were substituted for these days and flows were recalculated.

The December 21 measurement contained slush in the section and thus flows for the period November 15 to December 31 were revised.

Fort Vermilion

Discharges for the period January 1 to April 30 were deleted, as flow measurements were made under extremely adverse conditions (very low velocities) and appeared to grossly under-represent flows.

Flows for June 2 to 16 were recomputed on the basis of a more accurately defined stage-discharge relation. Similarly, flows for July 1 to 5 and July 11 to 16 were also revised.

No discharge measurements were made during November nor December. Hydrograph comparisons indicated significant revisions were required to this period. To be consistent with previous years, flows were deleted rather than revised.

Peace Point

The gauge did not work during the period January 1 to May 16. Several measurements were made during this period, all of which appeared to be unaffected by slush conditions. The data for this period were revised, eliminating the 10-day blocked figures utilizing hydrograph comparisons and the measurement results.

Data for the period November 10 to 27 were revised on the basis of hydrograph comparisons.

Data for the period December 22 to 31 were revised slightly on the basis of hydrograph comparisons.

5.7.3 Periods of Revision

Peace River at Peace River: January 1 to 20
 June 1 to 4
 November 15 to December 31

Peace River at Fort Vermilion: Jan. 1 to April 30 (flows
 deleted)
 June 2 to 16
 July 1 to 5
 July 11 to 16
 Nov. 18 to Dec. 31 (flows
 deleted)

Peace River at Peace Point: January 1 to May 16
 November 10 to 27
 December 22 to 31

5.7.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	9 410	10 849	+15.2	15 284	16 839	+10.2
FEB.	9 480	9 480	0	12 874	13 424	+4.3
MAR.	10 976	10 976	0	12 998	11 862	-8.7
APR.	61 462	61 462	0	37 950	33 804	-10.9
MAY	134 080	134 080	0	144 420	146 820	+1.7
JUNE	218 190	216 190	-0.9	210 040	210 040	0
NOV.	30 740	32 378	+5.3	49 046	48 585	-0.9
DEC.	14 315	16 279	+15.2	19 686	19 821	+0.7

5.8 1966

5.8.1 Preliminary Review

Dunvegan

Flows for September and October appeared to be too low and a subsequent investigation of these flows was requested.

Peace River

The two measurements made in January 1966 were affected by a great deal of slush ice. In addition, the measurement of January 7 was a partial measurement only as darkness forced the field technicians to miss a number of verticals. It was suggested that flows be revised for January and the first part of February on the basis of hydrograph comparisons.

An anomalous situation appears to have occurred in that the measurements of December 2 and 16 encountered horrendous ice conditions and yet the metered value appears to conform with what one might expect when compared with Peace Point and Taylor flows. The only explanation would appear to be the consolidation of the slush pack [i.e., These are the only measurements where slush was present that showed a consistent thickness of slush (1.8 to 1.7 metres) under the ice cover, all the way across the river, with velocities below the slush pack being very fast ($>70.6 \text{ m}^3/\text{s}$), indicating no interference with the meter.]. In addition, during the December 2 measurement, several verticals could not be metered, but liberal estimates were made for the discharges in these verticals. No changes were recommended to the daily discharges.

Fort Vermilion

No measurements were made during the 1965/66 winter period. Daily flows had been estimated using Peace River at Peace River flows, but since the first month was revised, this necessitated revisions to Fort Vermilion. Also, the initial computations indicated flows at Fort Vermilion nearly identical to Peace River, whereas they should have been somewhere between flows at Peace River and at Peace Point.

The daily and peak flows for June through October all appeared too low. A thorough review of the data was required to pinpoint the problem and to potentially revise the information. If the problem did not readily lend itself to a solution, it was suggested that the discharge values be scrapped for all of 1966.

Peace Point

The winter flows were verified by weekly measurements made for the Arctic Rivers Work Group study and hence are used as is, as a slush-free section was used for the control measurements. The only question would be the peak period around April 15. Flows appeared too low and it is suggested they be revised as sketched.

A minor peak lasting over a 10-day period occurred at the end of October and the beginning of November at Peace River (verified by peaks on Smoky River plus Dunvegan, as well as at Taylor). Computations at Peace River at Peace Point did not reflect this peak. The strip charts were not available, but it was suggested that the flows at Peace Point should approximate a sketched hydrograph based on comparisons of the combined hydrograph.

5.8.2 Actual Revisions

Dunvegan

The daily discharge data for the period September 15 to October 26 were revised on the basis of a redefined curve of stage-discharge relation.

Peace River

January 1 to February 7 flows were revised because the two streamflow measurements made in January were greatly affected by slush conditions.

Data for April 1 to 25 were revised downwards on the basis of hydrograph comparisons.

November 16 to 22 data were also revised downwardly on the basis of hydrograph comparisons.

Fort Vermilion

January 1 to April 30 flows were deleted as no measurements had been made to define the initially computed flows and as well, many inconsistencies occurred throughout this period when the flows were compared with Peace River or Peace Point flows.

Flows for the period May 1 to 31 were revised utilizing a better defined stage-discharge relation.

Similarly, flows for October 1 to 31 were revised on the basis of the re-defined stage-discharge relation.

Peace Point

The Arctic Rivers Work Group made weekly (as well as concurrent) measurements during the winter of 1965/66 and 1966/67 and thus data for the winter period required very little revision. A slight revision was made to the data for January 1 to 6.

Data for the period October 26 to November 14 were revised to reflect the peaks at the upstream stations (at Peace River, Hudson Hope and Taylor).

5.8.3 Periods of Revision

Peace River at Dunvegan: September 15 to October 26

Peace River at Peace River: January 1 to February 7
April 1 to 25
November 16 to 22

Peace River at Fort Vermilion: Jan. 1 to April 30 (flows deleted)
May 1 to 31
October 1 to 31

Peace River at Peace Point: January 1 to 6
October 26 to November 14

5.8.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	8 846	12 309	+39.1	15 436	15 480	+0.3
FEB.	9 871	10 051	+1.8	11 779	11 779	0
APR.	53 536	42 774	-20.1	42 629	42 629	0
OCT.	39 159	39 159	0	39 137	39 348	+0.5
NOV.	25 283	24 752	-2.1	23 107	26 246	+13.6
DEC.	17 197	17 197	0	18 968	18 968	0

5.9 1967

5.9.1 Preliminary Review

Dunvegan

The flows for Smoky River at Watino plus Dunvegan, were considerably less than at Peace River for July to October and Dunvegan was less than Taylor for this period, indicating flows at Peace River at Dunvegan were too low.

Peace River

All the measurements taken during the 1966/67 ice period (9) encountered a very thick slush pack across the entire stream. Early in the winter this pack was up to 4 metres thick, whereas the last measurement of the winter had a 1.8 metre thick slush pack. These slush conditions were entirely different from those experienced in earlier winters in that previously only portions of the stream were affected and these with less dense slush conditions. Similarly, the previous measurements showed very erratic velocity patterns (slush affecting the meter?) whereas in the 1966/67 winter the velocities below the slush pack were fast and for the most part, consistent. Because of these unique conditions it was felt that only a very small percentage of unmetered flow was passing through the slush, whereas previously significant amounts of flow through slush or meter interference were occurring. Certainly this decision was subjective and perhaps all measurements should have been adjusted upwardly by perhaps as much as 10%. No revision was recommended.

The measurement of December 20 was greatly affected by slush conditions, and by reviewing the measurement it was conceivable that flows were under-metered by at least 10% (inconsistencies of velocities below slush layer). Suggested revisions were sketched on the combined hydrograph.

Fort Vermilion

Flows for the entire open water period appeared to be too low.

Peace Point

The 1966/67 winter was the second year of the Arctic Rivers Work Group study and as such weekly measurements (unslushed section) were again made. Hence, no winter flow revisions were recommended.

The peak flow for the period of June 5 to 25 appears to have attenuated too much. The Peace River at Peace River peak was corroborated by the peak of Peace River at Dunvegan plus Smoky River. Upon reviewing the composite curves, it would appear that a major shift in the control took place during this period, with the actual flow in May being to the right of the previous curve and the actual flows in the latter half of June being to the left (hysteresis loop?). In any event it appeared that flows for June 5 to 15 should have been 1 000 to 1 500 m³/s higher. At the same time there may have been a problem with the manometer and improper corrections may have been applied. Suggested approximate flows were sketched on the combined hydrograph, although it was recommended that the values on the form should not be used as is, but rather should be recomputed, based on a revised curve, shifts and/or strip chart corrections (likely from May 25 to June 25).

5.9.2 Actual Revisions

Dunvegan

Daily data for July 27 to October 12 and October 19 to 31 were computed on the basis of a later, better defined stage-discharge curve. In addition, the gauge readings of July 29 to August 4 were suspect and hence were discarded and daily data estimated for this period.

Peace River

The January 20 measurement appeared low and had to be abandoned the previous day because of equipment, cold and slush problems. Therefore, data for the period January 16 to February 2 were revised.

A chart reversal was previously missed. Subsequently, data for the period May 13 to 15 were revised.

Data for the period November 30 to December 11 were revised, based on hydrograph comparisons.

A measurement made on December 20 was greatly affected by slush ice, thus under-representing the flow. Therefore, revisions were made to the December 17 to 28 flow records.

Fort Vermilion

Missing data for the period May 1 to 10 were estimated on the basis of hydrograph comparison in order to complete the "standard period".

Flows for June 1 to 30 and September 1 to November 5 were recomputed on the basis of a better defined stage-discharge relation.

Peace Point

The 1966/67 winter season again saw Arctic River Work Group activity at Peace River at Peace Point (weekly measurements) and therefore, no revisions were felt necessary during the winter period.

Flows for the open water period May 18 to June 15, on the other hand, were revised, as these data had previously been computed using the wrong stage-discharge curve (No. 4 instead of No. 5).

5.9.3 Periods of Revision

Peace River at Dunvegan: July 27 to October 12
October 19 to 31

Peace River at Peace River: January 16 to February 2
May 13 to 15
November 30 to December 11
December 17 to 28

Peace River at Fort Vermilion: May 1 to 10
June 1 to 30
September 1 to November 5

Peace River at Peace Point: May 18 to June 15

5.9.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	12 364	13 045	+5.5	19 659	19 659	0
FEB.	9 187	9 203	+0.2	12 700	12 700	0
MAY	171 750	171 250	-0.3	143 530	161 730	+12.7
JUNE	277 020	277 020	0	253 140	262 210	+3.6
NOV.	22 332	22 376	+0.2	23 348	23 348	0
DEC.	11 679	12 589	+7.8	13 285	13 285	0

5.10 1968

5.10.1 Preliminary Review

Dunvegan

Flows for the period April 15 to 17 were far too high when compared with Hudson Hope, Taylor and Peace River data.

Peace River

Winter discharge measurements were taken on seven different dates from January to April. On two of those dates measurements were made at two different sections. A measurement was made on seven occasions at the so called slush-free section 1.3 kilometres above the gauge, with the two repeat measurements made at the slush section 2.5 kilometres above the gauge. The anomalous feature of the two measurements made at the slush section was that more water was metered here than at the so called slush-free section. Upon reviewing the measurement notes, the slush-free section was found not to be slush-free, but there was less consolidated slush with very low velocities being recorded in a large portion of the cross-section. On the other hand the "slush section" measurement showed a thick consistent slush pack across the stream with high velocities consistently measured across the stream below the slush pack. It was believed that the measurements made in the "slush" section more truly represented the actual flows. This is consistent with the findings of the 1966/67 winter discharge data review, which were based on measurements made in the "slush" section.

Three sharp peaks occurred in the winter which looked very peculiar, but the strip charts showed the rises and much attenuated rises are also evident downstream at Peace Point. Suggested revisions were sketched on the hydrograph.

Considerable slush existed at the measurement section in December and it is likely the measurement under-metered the flows. Also, very low flows were computed for November 20 to December 20. Using Hudson Hope as a guide, daily flows were upped by about 100 m³/s, which then coincided quite nicely with Peace River at Peace Point, but which were lower than at Taylor. No doubt Taylor flows should be investigated for potential revision. A possible interpretation for flows at Peace River were sketched on the hydrograph.

Fort Vermilion

No recommendations were made for revisions.

Peace Point

Measurements made during the period January through April appeared slush-free and ice-affected flows from January through to May looked O.K. as computed.

Some slush existed in the sections of the measurements made in November and December, but this was contained in two sections with slush to the bottom. It was felt that the measurement results should be quite close in spite of the slush conditions. However, a peak was recorded at Peace River at the beginning of November (verified by strip chart and by Dunvegan) which was not reflected at Peace Point.

It was suggested that the data from November 5 to 20 be revised, as sketched.

5.10.2 Actual Revisions

Dunvegan

Flows for the period April 15 to 22 were incorrectly calculated as open water flows. This period was actually ice-affected and backwater conditions were not defined. Therefore, the flows for this period were deleted.

Peace River

Winter flows for the periods January 3 to March 25 and March 31 to April 9 were revised on the basis of hydrograph comparisons and because the measurement section during this period was affected by the presence of slush ice.

Flows for the winter periods November 22 to December 20 and December 27 to 31 were also revised on the basis of hydrograph comparisons and because the December measurement was slush-affected.

Fort Vermilion

No revisions were found to be necessary.

Peace Point

Flows for the period October 26 to November 19 were revised on the basis of hydrograph comparisons.

The flows for December 20 to 31 were revised because slush ice was present in the measurement section of the January 1969 measurement.

5.10.3 Periods of Revision

Peace River at Dunvegan: April 15 to 22

Peace River at Peace River: January 3 to March 25
March 31 to April 9
November 22 to December 20
December 27 to 31

Peace River at Peace Point: October 26 to November 19
December 20 to 31

5.10.4 Table of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	9 453	10 531	+11.4	11 142	11 142	0
FEB.	8 999	9 660	+19.3	11 821	11 821	0
MAR.	12 183	12 585	+3.3	11 923	11 923	0
APR.	19 029	19 935	+4.8	23 264	23 264	0
OCT.	18 693	18 693	0	23 086	23 234	+0.6
NOV.	15 240	16 199	+6.3	15 751	19 898	+26.3
DEC.	9 567	11 507	+20.3	12 193	12 555	+3.0

5.11 1969

5.11.1 Preliminary Review

Dunvegan

No specific recommendations for revisions were made.

Peace River

All measurements made from January to April were affected by slush conditions although much of it appeared to have

been a densely packed slush. In some sections, however, recorded velocities were very low. It was felt that each of the measurements could be increased by 5 to 10%. Computed daily discharges were correspondingly recommended for increases, using the re-estimated discharge measurement values as the base, combined with hydrograph comparisons.

The measurement on December 3 was only partially affected by ice conditions (on one bank only) and thus was a good measure of discharge. From the middle of December onward, however, the computed daily discharges appeared to vastly under-estimate true discharge and it was recommended that they be revised on the basis of hydrograph comparisons.

Fort Vermilion

No recommendations were made for revision.

Peace Point

The January to April winter discharge measurements were unaffected by slush conditions and thus the measurements should be a true representation of discharges on those days. However, it appeared that the troughs and peaks were flattened out when computing daily discharges between measurements. It was recommended that the daily discharges be revised on the basis of hydrograph comparisons.

The spring runoff peaks of late April and early May appeared to be excessive. It was true that the spring runoff in late April at such tributary streams as the Ponton and Boyer rivers was very high (second highest for period of record), but the computed 5 000 m³/s inflow between Peace River and Peace Point appeared completely unrealistic. It would appear that the stage-discharge relation from April 25 to May 8 was actually ice-affected (originally computed as open water). A sketched revision was indicated on the hydrograph. This could still be too high and must be further investigated, utilizing the chart record at Peace Point.

The flows during August and September at Peace Point appear low when compared with Peace River (Peace River appears to be verified by Smoky River plus Dunvegan data). The measurements at Peace Point during this period show very large plus shifts and perhaps a new curve should be utilized to compute the daily data (i.e., No. 6 rather than No. 5). Alternately, there could have been channel storage (usage) which was later released in October.

The measurement of November 28, 1969 was very severely affected by slush conditions and no doubt very much under-represented actual flow. It was recommended that the measurement be adjusted upward by 20%, giving flows more in the line of the dashed line on the hydrograph. This was further confirmed by the very high backwater 1.73m (5.69 feet), as compared to the next measurement of January 12, 1970 with a backwater of 0.97 metres (3.17 feet).

5.11.2 Actual Revisions

Dunvegan

Revisions of data were required for a number of short periods of record in 1969. Flows for June 23 to 25 had previously been estimated on a straight line basis, but were revised on the basis of hydrograph comparisons. Observer's readings for the period July 26 to 28 and August 5 and 6 were believed erroneous. Subsequently, the readings were discarded and the daily discharge data estimated for these periods.

Peace River

Flows for January 1 to April 10 were revised upwardly, as all six measurements made during January to April were slush-affected and believed to be under-representing the actual flows.

The December 8 to 30 flows were revised on the basis of hydrograph comparisons.

Fort Vermilion

In order to complete the standard period of record, flows were estimated for May 1 to 13 on the basis of hydrograph comparisons.

Flows for October 17 to 31 were estimated using hydrograph comparisons in order to complete the standard period of record.

Peace Point

Daily discharge data for January 1 to 23 and February 8 to April 2 were revised on the basis of hydrograph comparisons.

The period of April 19 to May 12 had initially been computed so that it indicated an inordinate amount of inflow

between Peace River and Peace Point. Upon review of the record, it was determined that a huge ice jam had occurred 60 to 100 km below Peace Point, which affected the stage - discharge relation at Peace Point, even though it wasn't visually discernible. Subsequently, flows for this period were revised by applying substantial backwater corrections.

The measurement of November 29, 1969 was very severely affected by slush ice and thus flows for the period November 5 to December 31 were revised upwardly. It should be noted that with the beginning of the Bennett Dam operations, the slush ice conditions, for the most part, became much worse at Peace Point.

5.11.3 Periods of Revision

Peace River at Dunvegan: June 23 to 25
 July 26 to 28
 August 5 and 6

Peace River at Peace River: January 1 to April 10
 December 8 to 30

Peace River at Fort Vermilion: May 1 to 13
 October 17 to 31

Peace River at Peace Point: January 1 to 23
 February 8 to April 1
 April 19 to May 12
 November 5 to December 31

5.11.4 Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	12 482	13 839	+10.9	11 896	13 506	+13.5
FEB.	10 966	12 108	+10.4	11 970	12 182	+1.8
MAR.	14 518	15 741	+8.4	13 468	14 940	+10.9
APR.	37 995	38 527	+1.4	72 132	40 976	-43.2
MAY.	71 400	71 400	0	99 430	97 530	-1.9
NOV.	32 548	32 548	0	27 437	31 477	+14.7
DEC.	27 262	30 684	+12.6	28 115	33 855	+20.4

5.12 1970

5.12.1 Preliminary Review

Peace River

The measurements from January through March were affected by slush conditions. The measurements seem to have underestimated flows (by a diminishing amount, as time progressed). The January 20 measurement, in particular, seemed to be some 40% low, others about 20% low, until April 20, which seemed O.K. Estimates for daily flow were based on hydrograph comparisons.

The December measurements were affected by slush conditions and it was felt they under-represented the actual flow. Suggested revisions were based on hydrograph comparisons.

Fort Vermilion

No revisions were suggested.

Peace Point

The measurements from January to April appeared to be unaffected by slush conditions. However, the daily discharges appeared to have been computed too low; likely the backwater was misinterpreted. Suggested revisions were based on hydrograph comparisons.

Uncharacteristically, the December measurement was very severely affected by slush conditions and thus it was felt that it under-represented the actual flow. The backwater, using the measurement result, was 1.93m (6.34 feet), whereas, normally in December it was in the 1.0m (3.3 feet) range. The increased slush conditions are likely attributable to the operation of the Bennett Dam. Estimates for flows were based on hydrograph comparisons with upstream stations and also were based on metered flow at Slave River at Fitzgerald.

5.12.2 Actual Revisions

Peace River

The data for the period January 1 to March 19 were revised on the basis of hydrograph comparisons. In January, flows were revised upwards by as much as 40%, with ever diminishing upward revisions through to the end of the period. The decreasing magnitude of revision requirement was attributed to the large amounts of slush ice present in January, with

decreasing amounts in the cross-section as the winter progressed.

Data for the period November 25 to December 31 were revised because of the presence of slush ice in the cross-section. Overall this revision amounted to an average upward revision of about 10%.

Fort Vermilion

No revisions were found necessary.

Peace Point

Data were revised for the period January 1 to May 4 on the basis of hydrograph comparisons (average upward revision of about 10%).

Major upward revisions to the flow data for the period November 26 to December 31 were made, as it was felt that the December measurement was severely affected by slush ice. Some flows were revised upwardly by as much as 100%, which is difficult to rationalize, but hydrograph comparisons indicated revisions of these magnitudes were required.

5.12.3 Period of Revision

Peace River at Peace River: January 1 to March 19
 November 25 to December 31

Peace River at Peace Point: January 1 to May 4
 November 26 to December 31

5.12.4 Summary of Revision
(Flow values in m^3/s -days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	24 926	30 420	+22.0	25 020	31 860	+27.3
FEB.	25 065	26 980	+7.6	20 683	29 070	+40.6
MAR.	29 894	32 600	+9.1	23 789	31 970	+34.4
APR.	53 120	53 120	0	40 717	51 040	+25.4
MAY	63 330	63 330	0	73 320	73 910	+0.8
NOV.	27 188	28 187	+3.7	29 040	29 677	+2.2
DEC.	30 226	34 206	+13.2	21 305	34 450	+61.7

5.13 1971

5.13.1 Preliminary Review

Peace River

Seven discharge measurements under ice cover were made during the period January to April. Slush conditions diminished from significant to very little. It was suggested that daily discharges be revised in a similar manner (i.e., large corrections upwardly at the beginning of January to a very small percentage increase in April). This revision would give flows that were consistent with Hudson Hope and Taylor.

Upon reviewing the strip charts the minor peaks which occurred at the end of November and early December appeared to be strictly backwater conditions due to ice formation, and thus, it was suggested that the flow be reduced to coincide with Taylor and Hudson Hope. The dip at the end of December appeared excessive and suggested revisions were sketched on the hydrograph.

Fort Vermilion

Some peak flow inconsistencies were detected.

Peace Point

The measurements of January, March and April were relatively slush-free, although there was some indication of meter interference in the odd section of the January measurement. The January measurement did appear as though it could be somewhat low, as the calculated backwater was very high. With the exception, perhaps, of the January measurements, flows on the days metered should be close to actual. However, the interpretations in-between measurements are open to question, as the daily data were formerly based on Peace River at Peace River computation interpretation, which had been subsequently revised to correspond with open water conditions at Hudson Hope and Taylor. Suggested changes were based on revised hydrograph comparisons.

The flows for the latter part of May through to June 20 (and perhaps to the end of June) looked too low, particularly when the peaks of June 3 and June 17 were compared with those of Fort Vermilion and Peace River. However, open water measurements were made on June 29 (first of the year), July 19, August 31 and September 30, with shifts of -.207, -.201, -.137 and -.052 metres, respectively. No

doubt, the shift of $-.207$ was extended forward to the first day of open water conditions, whereas, perhaps the change in rating actually took place during the peak flow of June 23 and thus no shifts should have been applied from the beginning of open water to June 23 and the $-.207$ metre shift should have been applied from June 24 to June 28. Using this type of stage-shift would certainly put the flows at Peace Point more in line with what was expected when comparing with Fort Vermilion and Peace River data.

The measurements of November 25 and December 21 were affected by slush conditions; determined more from observation of erratic velocities than from slush ice depths. The latter measurement seems to be the more severely affected. It was suggested that flows in late November be upped less than 10%, while the December 21 measurement could be upped by about 20% (using information from Arctic Rivers Work Group) and the computed daily discharges by a corresponding amount.

5.13.2 Actual Revisions

Peace River

Seven measurements were made during the January to April period with slush conditions diminishing from significant to very little. As a result, flows were revised from January 1 to April 7 with the largest corrections occurring at the beginning of the year, decreasing as the winter period progressed.

The minor peaks which showed in the original records during the periods November 23 to 27, November 29 to December 4 and December 6 to 14 were reassessed as having been primarily caused by increases in backwater due to ice formation and the revised data have been substantially reduced to more closely conform to upstream hydrograph conditions. The originally computed dip in flows for December 25 to 31 looked excessive on hydrograph comparison and thus the data were subsequently revised.

Fort Vermilion

Peak flows for the high water periods in June and July were recomputed on the basis of a better defined stage-discharge relation.

Peace Point

Data for the period January 1 to February 26, March 15 to April 8, April 16 to May 3 were revised on the basis of hydrograph comparison.

Flows for the period May 4 to June 22 were recomputed on the basis of changes to the shift correction application procedures, which made the revised flows conform more closely to upstream hydrograph conditions.

Flows for the period November 18 to December 31 were also revised as the two measurements (November 25 and December 21) exhibited slush conditions in the cross-section. Subsequently, flows were revised to conform more closely to upstream hydrograph comparisons.

5.13.3 Periods of Revision

Peace River at Peace River: January 1 to April 7
 November 23 to 27
 November 29 to December 4
 December 6 to 14
 December 25 to 31

Peace River at Fort Vermilion: June 20 and 21
 July 14 to 17

Peace River at Peace Point: January 1 to February 26
 March 15 to April 8
 April 16 to May 3
 May 4 to June 22
 November 18 to December 31

5.13.4 Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	25 277	30 754	+21.7	25 182	33 340	+32.4
FEB.	23 510	27 250	+15.9	25 610	29 260	+14.3
MAR.	31 515	33 858	+7.4	31 230	33 325	+6.7
APR.	45 781	46 115	+0.7	46 162	36 571	-20.8
MAY	67 870	67 870	0	78 240	81 560	+4.2
JUNE	112 970	112 970	0	97 290	101 660	+4.5
NOV.	35 100	34 700	-1.1	32 870	34 030	+3.5
DEC.	33 051	35 504	+7.4	26 466	32 835	+24.1

5.14 1972

5.14.1 Preliminary Review

Peace River

Six measurements were made during January to March. All measurements were slush-affected to varying extents, with the last measurement in March being only slightly affected. In particular, the measurement of February 23 showed much reduced velocities compared to those made before and after. It was felt that all measurements under-represented the flow to some extent. The slush pack was highly variable with densely packed slush and also porous slush of varying degrees. It was recommended that the hydrographs of Taylor and Hudson Hope be followed in estimating winter discharge records. Hudson Hope and Taylor had open water conditions throughout the winter period.

The December discharges appeared to have been computed too low when compared with Taylor and Hudson Hope. A proposed reinterpretation was sketched on the hydrograph. The dip in discharges from December 7 to 9, while not reflected at Taylor nor Hudson Hope, appeared to be valid, as it was the beginning of the freezeup period and was likely due to a loss of water to ice storage.

Fort Vermilion

No revisions were recommended.

Peace Point

The measurements for January to April were only slightly affected by slush conditions and should closely represent the discharge at that time. The December 1971 discharges were accordingly increased. This carries over into January 1972 and proposed increased daily discharges were sketched on the hydrograph. Similarly, based on the revised Peace River at Peace River hydrograph, the February daily discharges were suggested for revision.

The computed (estimates) peaks from mid-May to early June appeared too low in comparison with those of Peace River and Fort Vermilion. Upon further investigation these periods were found to be either during ice conditions or the values were estimated at Peace Point. It was recommended that values be revised as sketched on the hydrograph.

The peak of June 14 at Peace River at Peace River was very high and sharp and greatly attenuated from Peace River to Peace Point. Curve No. 7 had been extended by logarithmic extension from 11.0 to 12.5 metres, and this extension seemed to be confirmed by an earlier measurement of June 18, 1964. The peak flow originated in the Smoky/Wapiti basins, with no significant contribution from tributaries downstream of Peace River, and thus it was expected that significant peak attenuation would occur. There was no basis for revising the peak at Peace River, nor at Peace Point.

Significant slush was evident in the November 29, 1972 measurement. Thus, it was likely that the measurement under-represented the flow at the time. Also, it was felt that the daily flows from late November through December would more likely be represented by estimates based on hydrograph comparisons.

5.14.2 Actual Revisions

Peace River

Discharge measurements made during January to March were affected to varying extents by slush ice in the measurement cross-section. Revisions were subsequently made to flows during the ice-affected periods January 1 to February 3, and February 12 to March 16.

Flows for the period December 4 to 29 were also revised on the basis of hydrograph comparisons.

Fort Vermilion

The peak flow period in the last half of June was recomputed on the basis of re-distributed shifts (stage-shifted instead of time shifted).

Peace Point

Flows for the ice-affected periods of January 1 to March 1 and May 4 to 12 were revised on the basis of hydrograph comparisons.

The previously estimated values for the period May 16 to June 9 were re-estimated on the basis of hydrograph comparisons.

Slush ice was present in the measurement cross-section of November 29. Thus, it was felt that the measurement under-represented flows. Subsequently, data were revised for the period November 12 to December 31.

5.14.3 Periods of Revision

Peace River at Peace River: January 1 to February 3
 February 12 to March 16
 December 4 to 29

Peace River at Fort Vermilion: June 15 to 30

Peace River at Peace Point: January 1 to March 1
 May 4 to 12
 May 16 to June 9
 November 12 to December 31

5.14.4 Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	26 958	34 112	+26.5	29 734	37 740	+26.9
FEB.	25 116	30 804	+22.6	25 084	28 540	+13.8
MAR.	33 166	35 365	+6.6	33 372	33 392	+0.1
MAY	118 820	118 820	0	147 630	137 710	-6.7
JUNE	167 150	167 150	0	154 610	156 900	+1.5
NOV.	46 310	46 310	0	48 110	50 960	+5.9
DEC.	40 667	45 880	+12.8	42 400	47 640	+12.4

5.15 1973

5.15.1 Preliminary Review

Peace River

Seven discharge measurements were made under ice cover during January to April. The peculiarity of these measurements was that slush conditions varied from significant to very little to significant to none (i.e., the January 10 measurement was greatly affected by slush; the January 25 measurement had slush, but considerably less than the previous measurement; the February 8 measurement reverted back to a considerable slush pack; on February 22 slush

was present, but only to a minor degree; March 8 had no, or very little, slush; the March 21 measurement again exhibited some slush conditions; the April 3 measurement had a tiny amount of slush present (less than previous measurements). A sketched line on the hydrograph representing estimated revisions was based on adjustments to the measurements because of the presence of slush ice. This period clearly demonstrated the effect of slush on discharge measurement accuracy. The more slush present, the more under-metered was the discharge. This was poignantly depicted on the hydrograph showing the plotted measurements and flows at Taylor and Hudson Hope.

Comparing Peace River at Peace River to Taylor and Hudson Hope during the November and December period, the trends appear to be O.K.; however, at times the peaks appeared too small and the troughs too deep. Proposed revisions were sketched on the hydrograph.

Fort Vermilion

No revisions were recommended.

Peace Point

The four measurements made from January to April had only a very minor amount of slush ice present and thus it was felt that they were fairly representative of the true discharge on those dates. However, it appeared that some reinter-pretation of daily discharges was required between the measurements. Based on the revised hydrograph at Peace River and the four discharge measurements the suggested revisions were sketched on the hydrograph.

The difference between Peace River at Peace River and Peace Point during July to September was quite large. However, inflow from such tributaries as Ponton, Boyer, etc., was also much above normal in 1973 and therefore flows appeared correct for this period.

The measurements of December 7 and 18, 1973 were affected by slush conditions. Only by investigating the measurements themselves, in particular the mean velocities, does it become apparent how much the measurements were affected by these slush conditions. For example, the mean velocities were less than two-thirds of measurements made at similar times in previous years. Undoubtedly the two measurements greatly under-estimated true discharge conditions and hence proposed revised discharges were sketched on the hydrograph.

5.15.2 Actual Revisions

Peace River

Slush ice was present in varying amounts in the cross-sections of the seven measurements made from January to April. Flows were subsequently revised, using hydrograph comparisons for the periods January 4 to February 18, February 26 to March 4 and March 12 to April 2.

Hydrograph comparisons were used to revise the data for the periods November 10 to 27, December 2 to 8 and December 14 to 31.

Fort Vermilion

No revisions were made.

Peace Point

Data for the period January 1 to March 12 were revised on the basis of hydrograph comparisons. In addition to the hydrograph comparison with the upstream stations, an additional tool was used to revise the Peace Point data. This tool was the utilization of Slave River at Fitzgerald flows, minus Alberta Environment metered flows at Riviere des Rochers.

Similarly, the data for the period April 26 to May 3 was revised by hydrograph comparison.

Measurements of December 7 and 18 (the measurement of December 18 was a check measurement because of the peculiar results of the December 7 measurement, but it produced the same anomalous results) were assumed to have been affected by slush because of the very low velocities and subsequently flows for the period November 15 to December 31 were revised upwardly, utilizing hydrograph comparisons. In addition to the hydrograph comparison, the Slave River/Riviere des Rochers tool was also used. These comparisons are depicted in Figure 3.

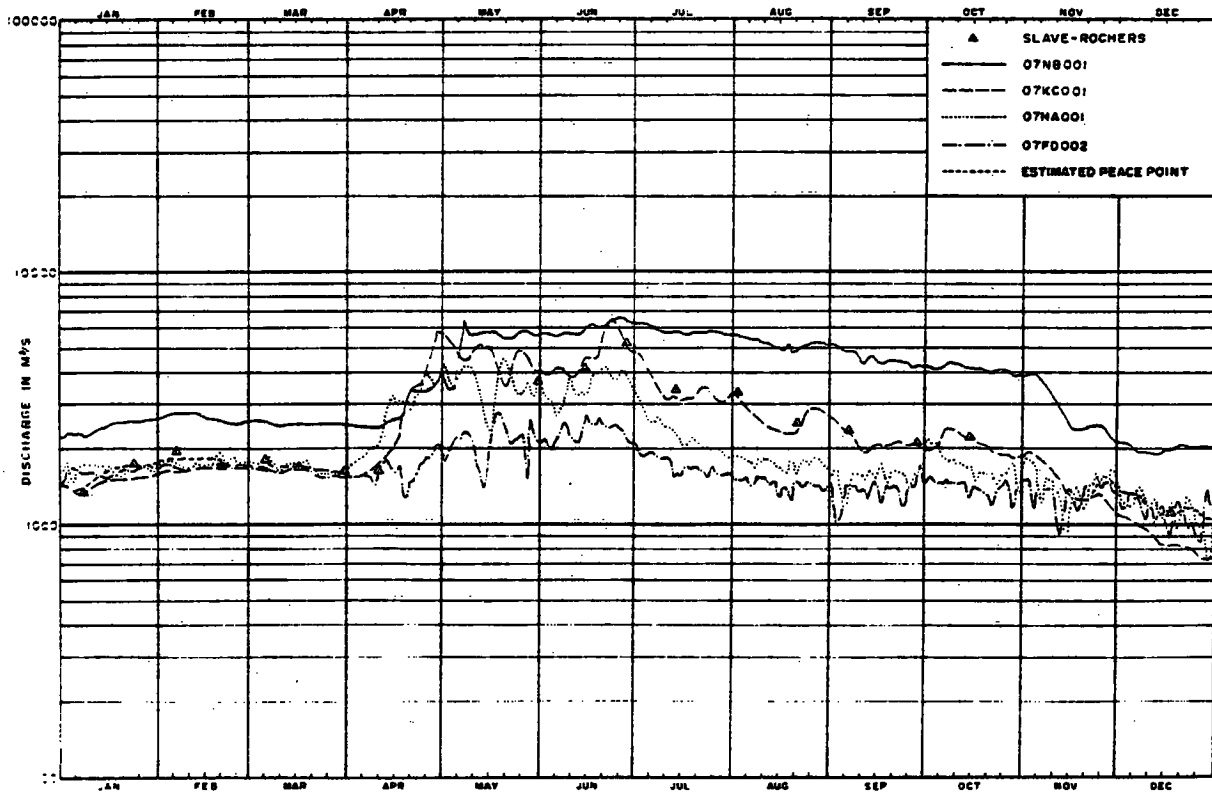


Figure 3: 1973 Hydrograph Comparisons

5.15.3 Periods of Revision

Peace River at Peace River:

January 4 to February 18
February 26 to March 4
March 12 to April 2
November 10 to 27
December 2 to 8
December 14 to 31

Peace River at Peace Point:

January 1 to March 12
April 26 to May 3
November 15 to December 31

5.15.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	44 650	50 850	+13.9	44 680	49 040	+9.8
FEB.	44 910	48 450	+7.9	45 800	49 360	+7.8
MAR.	48 730	51 560	+5.8	49 940	50 650	+1.4
APR.	84 020	84 090	+0.1	83 850	80 230	-4.3
MAY	110 020	110 020	0	140 210	137 900	-1.6
NOV.	39 833	42 146	+5.8	43 030	46 010	+6.9
DEC.	31 768	34 747	+9.4	26 603	36 640	+37.7

5.16 1974

5.16.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

Seven measurements were made from January through March; all were severely affected by slush conditions with some of the later measurements showing very packed conditions forcing water through a narrow channel with velocities of over one metre per second. Likely all of the measurements under-metered the flow to some extent or other. Proposed revisions were sketched on the hydrograph.

Flows for the latter part of October and through November were lower (small amount) than the Smoky River, plus Peace River at Dunvegan. Upon investigation, it was ascertained that the measurements at Peace River at Peace River throughout the open water period showed percentage difference from the rating curve from +1.6 to +3.6%. If the curve had been shifted that far to the right it is likely more flow would have been computed at Peace River

than at Smoky River plus Dunvegan; however, since these values are within the accuracy criteria, no revisions were deemed necessary.

Ice conditions did not exist in either November or December 1974. Thus the computed flows should be an accurate reproduction of the flows for this period, with the exception of the previously noted plus percentages of the open water measurements. Computed daily flows at Peace River at Peace River are a tad less than Peace River at Taylor, which could be because of the previously noted percentage difference, or perhaps due to ice storage upstream or some backwater conditions existing, but not recognized, at Taylor. In any event the difference was small (within accuracy limits) and hence, revisions were not required for this period.

Fort Vermilion

No revisions were recommended.

Peace Point

The three measurements made in February, March and April were significantly affected by slush conditions and thus the metered flow likely under-estimated the true flow conditions. From the front sheet of the measurement made on February 15 it was noted that the orifice line was frozen up and likely there was no chart trace of the peaks and troughs, particularly the peak flow period in mid-January. A suggested daily data line was sketched on the hydrograph.

The measurement of December 12 was significantly affected by slush ice conditions (not a consolidated pack, but rather loose slush, which considerably slowed recorded velocities in many of the verticals). It was felt that the measurement under-metered the flow. Suggested revisions were sketched on the hydrograph.

5.16.2 Actual Revisions

Dunvegan

No Revisions were made.

Peace River

Varying slush conditions were encountered in the cross-sections of the measurements made during January to March.

Upon re-assessment of the flows, it was felt that the flows were under-metered by varying amounts. Consequently, flows were revised utilizing hydrograph comparisons for the periods January 1 to 4, January 17 to February 14, March 13 to 20 and March 27 to April 3.

The river did not experience any backwater conditions due to ice formation in November nor December; however, upon reviewing the data, it was decided to apply the open water shifts (formerly used O.K.). Subsequently, flows were revised upwards for the period October 18 to December 31.

Fort Vermilion

No revisions were made.

Peace Point

The three measurements made between January and March encountered slush conditions. Hence, flows were revised by hydrograph comparison for the periods January 1 to April 11 and April 23 to May 5.

The large percentage increases in the revised flows for January and February, in particular, were confirmed in two ways. In addition to the normal hydrograph comparison with upstream stations, revised data were also confirmed by Slave River at Fitzgerald flows minus measured flow at Riviere des Rochers. These comparisons are depicted in Figure 4.

The measurement of December 12 was also significantly affected by slush conditions and therefore flows were revised upward for the period November 26 to December 31.

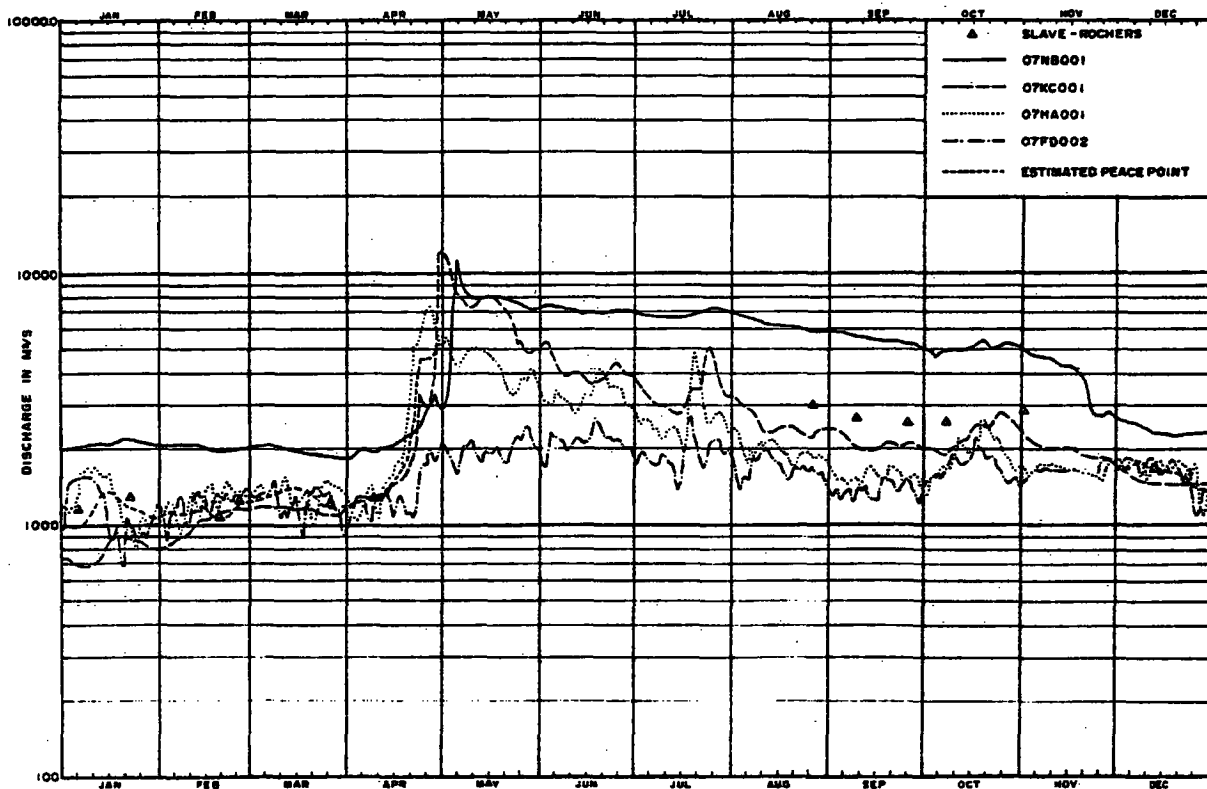


Figure 4: 1974 Hydrograph Comparison

5.16.3 Periods of Revision

Peace River at Peace River:

January 1 to 4
 January 17 to February 14
 March 13 to 20
 March 27 to April 3
 October 18 to December 31

Peace River at Peace Point:

January 1 to April 11
 April 23 to May 5
 November 26 to December 31

5.16.4 Summary of Revisions
(Flow values in m³/s-day)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	35 763	38 562	+7.8	24 359	37 360	+53.4
FEB.	32 161	34 621	+7.6	28 026	34 460	+23.0
MAR.	40 023	41 258	+3.1	35 070	40 080	+14.3
APR.	90 576	90 950	+0.4	74 320	65 990	-11.2
MAY	131 390	131 390	0	221 370	212 720	-3.9
OCT.	57 570	58 600	+1.8	70 510	70 510	0
NOV.	47 300	49 260	+6.3	57 940	58 370	+0.7
DEC.	48 490	50 560	+4.3	45 170	52 850	+17.0

5.17 1975

5.17.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

The first measurement of the 1975 winter season (February 6) was severely affected by slush conditions. The mean velocity for the measurement was determined to be 0.45 metres/second (1.46 feet/second) while subsequent measurements had mean velocities of 0.72, 0.65, 0.73 and 0.71 metres/second (February 20, March 10, March 24 and April 7, respectively). These latter measurements had little or no slush ice present. It appeared that the February 6 measurement considerably under-measured the flow on that date and that flows should be revised upwardly. Suggested revisions were sketched on the hydrograph.

Based only on the flow values for Hudson Hope and Taylor, it would appear that some revision to December flows were necessary. Suggested revisions were sketched on the hydrograph.

Fort Vermilion

The peaks during July appeared too low when compared with those of Peace River and Peace Point. The problem was either a manometer correction problem or a curve definition problem.

Peace Point

Three measurements were made during the January to April winter season. Looking at the measurements themselves, only a small amount of slush ice could be detected; however, looking at the mean velocities of the measurements, it would appear that the February measurement was considerably affected by the presence of unconsolidated slush ice. The mean velocity of the February measurement was 0.47 metres/second, whereas in followup measurements the mean velocity was 0.61 and 0.67 metres/second. The recommended revisions for the winter period were sketched on the hydrograph.

The ice conditions measurement of December 23 appeared slush-free except it had a somewhat lower mean velocity than one would expect, although certainly the mean gauge height was also lower, and thus velocities would be lower. Daily flow data in November and December seemed to be somewhat misinterpreted, with a suggested reinterpretation sketched on the hydrograph.

5.17.2 Actual Revisions

Dunvegan

No revisions were required.

Peace River

A significant amount of slush ice was present in the first measurement of the 1975/76 winter season (February 6). Subsequently, flows for the period January 1 to February 19 were revised. Flows were also revised for March 12 and March 25 to April 6 on the basis of hydrograph comparisons.

On the basis of hydrograph comparisons the data for the period December 4 to 21 and December 30 and 31 were revised.

Fort Vermilion

No revisions were made.

Peace Point

For the periods January 1 to April 27 and November 5 to December 31 the data were revised on the basis of hydrograph comparisons, as the mean velocities in the metered cross-sections made during these periods were much lower than expected.

5.17.3 Periods of Revision

Peace River at Peace River: January 1 to February 19
 March 12
 March 25 to April 6
 December 4 to 21
 December 30 and 31

Peace River at Peace Point: January 1 to April 27
 November 5 to December 31

5.17.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	41 220	47 760	+15.9	43 600	49 840	+14.3
FEB.	41 418	47 880	+15.6	38 240	46 880	+22.6
MAR.	49 430	50 270	+1.7	46 360	53 160	+14.7
APR.	56 410	57 480	+1.9	53 450	60 770	+13.7
NOV.	40 189	40 189	0	40 250	42 470	+5.5
DEC.	36 573	38 675	+5.7	39 920	44 880	+12.4

5.18 1976

5.18.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

Varying quantities of slush were evident in the cross-sections of the discharge measurements made during January to March. In particular, nearly every section of the January 9 measurement was affected by slush varying from 1.5 to 3.7 metres in depth. The velocities were very erratic from section to section. Similarly, the January 23 measurement showed slush conditions throughout most of the cross-section, but slush depths varied from 1.2 to 3.0 metres and velocities were consistent from section to section, indicating a consolidated slush pack with little flow through it. The February 6 and 20 and March 5 measurements also indicated significant amounts of slush with some erratic velocity behaviour. The March 19 and April 2 measurements also indicated that some slush ice was present in the cross-section, but maximum depths of the slush were 1.8 metres, with fast and consistent velocities being recorded in the slush-free portions, indicating little flow through the slush, or meter interference. Daily discharges for the period January 1 to March 10 were suggested for revision based on hydrograph comparison.

The November/December ice condition period discharges were obviously computed based on flows at Taylor and Hudson Hope. There are two peaks in late December which were somewhat suspect, but percentage difference would be small and therefore no revisions were recommended.

Fort Vermilion

The data for all of 1976 appeared suspect; particularly the peak events which, as computed, were lower than both the Peace River at Peace River peaks and the Peace River at Peace Point peaks.

Peace Point

The winter records for the period January 1 to April 10 were computed showing very little fluctuation. Suggested revisions, based on the revised Peace River at Peace River data for this period, as well as Slave River at Fitzgerald minus metered flows on the Riviere des Rochers were sketched on the combined hydrograph. The January 22 measurement was not available to the author, but it was suspected that it may have been slush-affected. The measurements made in April appeared slush-free.

While the discharge measurement of December 14 did not indicate that slush ice was present, the metered velocities

indicated that the entire section appeared to be affected by the presence of unconsolidated slush ice; that is, the mean velocity of the measurement was at least one-third less than one would expect at the gauge height encountered. This was confirmed by the inordinately high backwater conditions indicated by the 'as-measured' flow. It was further confirmed by utilizing flows at Slave River at Fitzgerald minus Riviere des Rochers metered flows as a comparison. This value indicated a flow at Peace Point on December 9 of 1 500 m³/s whereas the initially computed flow was 1 070 m³/s. Suggested revisions were sketched on the hydrograph.

5.18.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

Slush ice was in evidence in the measurement cross-sections during January to March. Subsequently, flows were felt to be under-metered and therefore data were revised upwards for the periods January 1 to 21 and January 25 to March 10, based on hydrograph comparisons with upstream stations.

The November/December winter work had initially been computed utilizing comparisons with flow data at Taylor. Consequently, no revisions were required for this period.

Fort Vermilion

No revisions were made as any changes which could rationally be made were in the order of one per cent and thus well within the 'no revision required' criteria.

Peace Point

The January 1 to April 9 data were revised on the basis of hydrograph comparisons.

Similarly, the November 12 to December 31 data were revised by hydrograph comparison, as the results of the December 14 measurement were suspect as flow velocities were one-third less than expected. The revisions to December flows were very significant with the total flow for December being revised upward by 65.7%. This revision was confirmed by utilizing two separate procedures. The first was the

utilization of hydrograph comparison with upstream stations. The second procedure utilized flows at Slave River at Fitzgerald minus flows metered by Alberta Environment on the Riviere des Rochers. These comparisons are depicted in Figure 5.

5.18.3 Periods of Revision

Peace River at Peace River: January 1 to 21
 January 25 to March 10

Peace River at Peace Point: January 1 to April 9
 November 12 to December 31

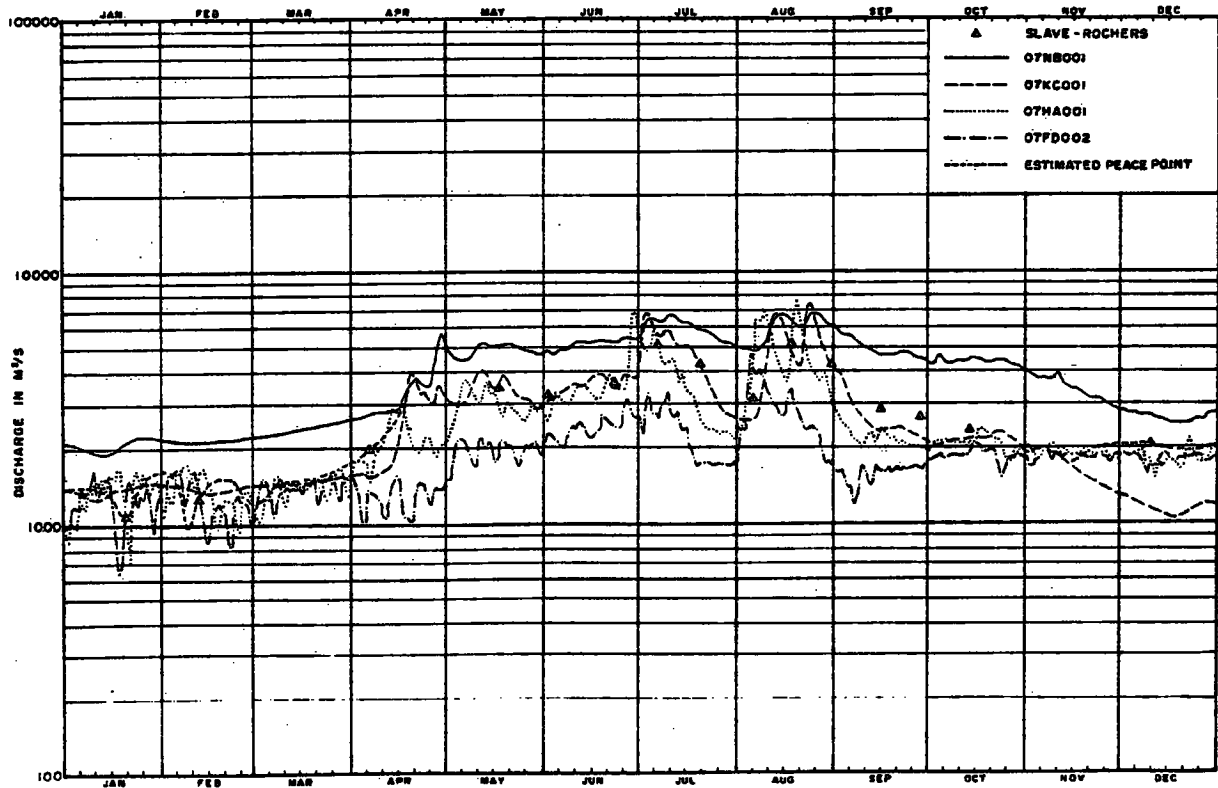


Figure 5: 1976 Hydrograph Comparisons

5.18.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	34 318	40 882	+19.1	41 930	43 740	+4.3
FEB.	33 857	38 761	+14.5	39 690	43 550	+9.7
MAR.	41 502	42 710	+2.9	45 270	47 000	+3.8
APR.	63 360	63 360	0	73 440	73 700	+0.4
NOV.	56 480	56 480	0	49 050	56 780	+15.8
DEC.	55 800	55 800	0	35 120	58 210	+65.7

5.19 1977

5.19.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

The three measurements made under ice conditions all contained slush ice across the cross-section. The first measurement was made relatively late in the winter season (February 8), allowing time for consolidation of the slush ice. This indeed seemed to be the case, as upon reviewing the measurement notes it was noted that velocities are fast and consistent across the section, indicating little or no interference of the meter by slush ice. With consolidation of the slush it was felt that there was no significant flow through the slush ice. Upon reviewing the hydrograph there was little requirement for revision, although the dip around the first of March was too pronounced and flows around March 10 were also likely too low. Suggested revisions were sketched on the hydrograph.

No revisions appeared necessary in the November/December period as data compared favorably with Taylor and Hudson Hope hydrographs.

Fort Vermilion

The initial recommendation was to review the entire open water period.

Peace Point

Upon reviewing the January to April discharge measurements, the velocities appeared fairly consistent, although some small amount of slush might be present near the left bank, but this should affect the measurement results very little. Daily discharge data for the first seventeen days of January appeared to have been computed utilizing the December 1976 measurements, which were felt to be significantly in error. Potential revisions were sketched on the hydrograph.

The flow data from January 18 to April 7 was computed ignoring the sharp rises and falls at Peace River. Although the true hydrograph more than likely has peaks and troughs which parallel Peace River at Peace River's (although smoother and flatter), it was not felt necessary to revise the flows for this period, as the volumes of runoff appeared to be correct.

The peak around May 13 at Peace River at Peace Point appeared too low, with the peak likely being around 5 500 m³/s rather than the 4 500 m³/s indicated. It was recommended that the strip chart be reviewed for this period to determine whether the peak was misinterpreted. The Peace River at Peace River peak was corroborated by summing flows at Peace River at Dunvegan and at Smoky River at Watino.

A measurement was made on November 25 which showed some evidence of slush in a few sections (ice depth = 0.2 metres, but the odd section showed depths of 0.6 metres), although the velocities were much slower than would be expected, indicating slush interference with the meter in most of the sections. It was suggested that the November/December data be revised, as sketched on the combined hydrograph.

5.19.2 Actual Revisions

Dunvegan

No revisions were recommended.

Peace River

Only three very short periods, February 22 to 28, March 1 to 2, and March 8 to 11 required revisions. These data were revised on the basis of hydrograph comparisons.

Fort Vermilion

The recorder had malfunctioned on May 9 and 10. Data were revised on the basis of hydrograph comparisons.

Peace Point

Data for the period January 1 to February 9 were revised to be consistent with revisions made to December 1976 data. These revisions were confirmed by utilizing Slave River at Fitzgerald minus Alberta Environment metered flows at Riviere des Rochers.

No revisions were made to the May peak flow data.

Measurements during February to April 1977 appeared to be unhindered by slush ice and hence computed data for the remainder of the 1976/77 winter period were accepted as computed. The November 25 measurement again exhibited velocity anomalies, indicating slush interference. Consequently, flows for the period November 15 to December 31 were revised upwards. These revisions were confirmed, utilizing the Slave River/Riviere des Rochers data.

5.19.3 Periods of Revision

Peace River at Peace River:	February 22 to 28 March 1 and 2 March 8 to 11
Peace River at Fort Vermilion:	May 9 and 10
Peace River at Peace Point:	January 1 to February 9 November 15 to December 31

5.19.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	49 860	49 860	0	43 370	52 000	+19.9
FEB.	33 023	33 549	+1.6	38 410	39 090	+1.8
MAR.	28 118	28 875	+2.7	30 411	30 411	0
NOV.	55 990	55 990	0	48 670	57 560	+18.3
DEC.	59 220	59 220	0	40 700	60 460	+48.6

5.20 1978

5.20.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

Slush of varying thickness was present in the measuring section on January 9. Because of slush, one section could not be measured at all and hence it was felt that the measurement under-represented the flow. Significant slush was still present in the measurement section on January 24, although it appeared that it was more consolidated; however, on the right bank side, velocities appeared to be interfered with, particularly the 0.80 point velocity. As the season progressed it appeared that the presence of slush ice had less effect on the measurement of true discharge. The initial daily discharge computations used the measurement results, with the computed hydrograph dipping down each time a measurement was made and then back up to parallel Taylor flows until the next measurement, which forced another hydrograph dip. Suggested revisions were sketched on the hydrograph.

The daily discharges for the period December 19 to 31 appeared to be too high (i.e., not enough backwater applied). An open water discharge measurement was made on

December 14 but it appeared that shortly thereafter significant ice formation occurred, causing backwater conditions. The suggested revision was sketched on the hydrograph. The initial computations for this period were computed on an open water basis, but it appeared from the chart trace that a small amount of backwater began to occur on December 15 with the afternoon of the 18th and 20th, particularly, having an increase in backwater.

Fort Vermilion

No revisions were recommended.

Peace Point

The January 9 measurement was not available to the author, but it appeared from the measurement listing that the mean velocity was somewhat less than would be expected and hence the computed daily discharge for January and February were considered too low. The computed flows for March and the first half of April were flat and should probably have had more peaks and troughs roughly paralleling Peace River at Peace River, but the total discharge for this period was likely quite close to the true amount and hence this period was not recommended for revision. Suggested revisions for January, February and the first part of March were sketched on the hydrograph.

It was recommended that the July 19 and 20 measurement should be investigated. It appeared too low when compared with the peaks at Peace River and at Fort Vermilion; also appeared low in comparison with other peaks during the year. It appeared that perhaps the manometer wasn't working or incorrect gauge corrections were applied. The trough preceding the peak (July 14 to 16) also appeared too low.

Upon reviewing the measurement of December 13 significant slush ice had been encountered, hence the measurement likely significantly under-metered the flow. The suggested revision was sketched on the hydrograph.

5.20.2 Actual Revisions

Dunvegan

No revisions were required.

Peace River

Slush ice was present in the measurement sections made during January to April. Subsequently, flows were revised for the periods January 3 to 15, January 18 to 28, February 3 to 5 and February 17 to March 12.

A follow-up review meeting was held on May 20, 1987 where it was felt further revisions were required to an early April peak, as it was too high compared to other hydrographs. Therefore, the period March 30 to April 16 was revised.

For the period December 19 to 31 flows had originally been computed as open water. When combined hydrographs were plotted the data for this period appeared too high. Upon re-examination of the recorder chart trace, it was evident that the stage-discharge relation was affected by backwater from ice conditions and therefore flows were recomputed.

Fort Vermilion

Initial estimates for the period August 14 to 17 was found to be too high when hydrograph comparisons were used. These estimates were revised.

Peace Point

Flows for the periods January 1 to March 9, March 20 to April 12 and April 16 to May 4 were recomputed on the basis of hydrograph comparisons.

No revisions were made to the July flows.

The December 13 measurement encountered considerable slush in the cross-section, hence it was felt that flows were under-metered. Daily discharge data were revised for the period November 21 to December 31. The Slave River/Riviere des Rochers technique did not hold up in this case. Perhaps the Slave River data was computed on the basis of initially computed flows for Peace Point. It was felt that Slave River computations should be reviewed.

5.20.3 Periods of Revision

Peace River at Peace River:	January 3 to 15
	January 18 to 28
	February 3 to 5
	February 17 to March 12
	March 30 to April 16
	December 19 to 31

Peace River at Fort Vermilion: August 14 to 17

Peace River at Peace Point: January 1 to March 9
 March 20 to April 12
 April 16 to May 4
 November 21 to December 31

5.20.4 Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	48 730	54 340	+11.5	51 220	55 400	+8.2
FEB.	50 370	49 330	-2.1	45 660	49 800	+9.1
MAR.	44 715	44 305	-0.9	47 520	48 700	+2.5
APR.	48 840	45 620	-6.6	53 630	52 540	-2.0
MAY	69 540	69 540	0	89 890	88 330	-1.7
NOV.	44 163	44 163	0	46 750	47 010	+0.6
DEC.	58 900	55 540	-5.7	48 950	54 710	+11.8

5.21 1979

5.21.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

During the January to March period six streamflow discharge measurements were made with, it appears, mixed results; that is, the first two measurements (January 12 and 25) appeared to be close representations of the true discharge value, although slush ice was present. The velocities were consistent from section to section and thus likely there was very little interference with the meter. Conversely, the measurements in February (12 and 27) were fraught with problems and anomalies. The February 12 measurement showed large discrepancies in depths of panels (compared to other

measurements made in the same cross-section) and both the February 12 and 27 measurements had mean velocities which were at least one-third less than would be expected compared to the other measurements. The suggested revised discharges were sketched on the hydrograph.

The peaks on April 6 and April 14 appeared to be too high; however, there was nothing which could corroborate this and possibly significant spring runoff occurred between Taylor and Peace River at that time. Therefore, no revisions were recommended.

Flows during November and December at Peace River may have been computed slightly too low when compared with data at Taylor and Hudson Hope; however, any revisions would give only a small percentage increase and thus revisions were not felt warranted. In fact, ice conditions, didn't begin at Peace River until December 12 and thus any computed flows prior to this period must be deemed to be accurate.

Peace Point

Some slush ice was present in both the February 14 and April 17 discharge measurement and likely these somewhat under-represented the flows on these days. The initial daily discharge computations for January to April were done on a very smooth hydrograph basis, ignoring the considerable ups and downs recorded at gauging stations upstream on the Peace River. Suggested revisions based on some additional flow for measurement days and on variations recorded upstream, were sketched on the hydrograph. The strip charts were not available to the author so the precise timing of peaks and troughs may be inaccurate, as might the magnitude.

Some potential existed for a revision downward for the last few days in December (i.e., a quicker drop than a flattening out) but overall, it was felt that the revision would be small and inconsequential from a total discharge point of view, and thus, no revisions were recommended for this period.

5.21.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

Six streamflow measurements were made during January to March, with a varying amount of slush ice present in each. Subsequently, flows were revised by hydrograph comparison for the periods January 1 and 2, January 5 to 24, January 28 to March 6, March 10 to 13 and March 16 to 22.

Initially, the computed data for early April showed a peak, which would indicate significant spring runoff had occurred; however, upon investigation of gauged tributaries, it was determined that this was not the case and therefore flows for the period March 30 to April 19 were revised downwards. The period December 13 to 29 was revised upwards to conform to upstream hydrographs.

Peace Point

Flows were revised utilizing hydrograph comparisons for the period January 1 to 9, January 14 to February 28, April 18 to May 7, and May 15 to 24.

Similarly, revisions to the periods November 4 to December 2, December 6 to 14 and December 26 to 31 were made by hydrograph comparison.

5.21.3 Periods of Revision

Peace River at Peace River:	January 1 and 2 January 5 to 24 January 28 to March 6 March 10 to 13 March 16 to 22 March 30 to April 19 December 13 to 29
Peace River at Peace Point:	January 1 to 9 January 14 to February 28 April 18 to May 7 May 15 to 24 November 4 to December 2 December 6 to 14 December 26 to 31

5.21.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	51 090	54 010	+5.7	47 010	52 370	+11.4
FEB.	36 446	45 810	+25.7	44 930	48 830	+8.7
MAR.	35 255	36 531	+3.6	47 210	47 210	0
APR.	60 075	51 797	-13.8	34 767	35 747	+2.8
MAY	91 840	91 840	0	136 320	124 080	-9.0
NOV.	43 630	43 630	0	43 080	45 440	+5.5
DEC.	30 831	32 726	+6.1	43 834	43 810	-0.1

5.22 1980

5.22.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

Three measurements were made during the winter period, with significant slush ice being present on January 17 and February 14. The measurement on March 13 had some slush ice present in the cross-section, but it appeared to be consolidated and likely little or no under-metering occurred. Suggested revisions for January to March were sketched on the hydrograph.

The open water period was revised in 1984 to take into account a plus shift on August 21 (formerly used O.K.), but this had not been previously submitted to update the flow files. It was recommended that these be used.

Comparing the flow hydrograph of Peace River at Peace River with Taylor and Hudson Hope it appeared that Peace River data were low for the first 15 days in December. Suggested revisions were sketched on the hydrograph.

Peace Point

Some slush was encountered during both measurements (January 3 and April 2) and likely flows were under-metered. The computed daily discharges for January to April appeared considerably too low, with suggested revisions being sketched on the hydrograph, based on suggested revisions for flows for Peace River at Peace River.

The peaks on June 12 and 26 appeared to be somewhat low as more attenuation than normal was indicated on the hydrograph (from Peace River to Peace Point). Similarly, the flows in September at Peace Point appeared too low, as the total for the month at Peace Point was less than at Peace River. Peaks of September 10 and 16 appeared too low. It was recommended that the chart traces should be investigated for incorrect interpretation or barring that, the curve and/or shifts used (none were used) should be re-examined.

Some slush existed in the cross-section of the December 19 measurement and it was likely that flows were somewhat under-metered. Suggested revisions (based on revised Peace River at Peace River flows) were sketched on the hydrograph.

5.22.2 Actual Revisions

Dunvegan

No revisions were required.

Peace River

Flows for the period January 3 to March 12 were revised, based on hydrograph comparison with upstream stations.

Similarly, the period of December 1 to 18 was revised by hydrograph comparison.

Peace Point

Slush was encountered in the two measurements (January 3, April 2) made during the winter and subsequently flows were likely under-metered. Therefore, flows for the period January 1 to April 19 and April 23 to 29 were revised, utilizing hydrograph comparison.

No revisions were made to the open water period.

The measurement of December 19 also encountered slush and hence flows for November 12 to December 31 were revised.

5.22.3 Periods of Revision
(Flow values in m³/s-days)

Peace River at Peace River: January 3 to March 12
December 1 to 18

Peace River at Peace Point: January 1 to April 19
April 23 to 29
November 12 to December 31

5.22.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	39 181	45 850	+17.0	26 450	44 202	+67.1
FEB.	32 604	37 745	+15.8	22 696	38 270	+68.6
MAR.	27 523	28 846	+4.8	28 600	35 015	+22.4
APR.	31 031	31 031	0	38 044	36 142	-5.0
NOV.	45 330	45 330	0	47 188	50 040	+6.0
DEC.	30 909	33 138	+7.2	26 786	37 870	+41.4

5.23 1981

5.23.1 Preliminary Review

Dunvegan

The initial hydrograph review determined that flows for the period August 9 to 20 looked too low.

Peace River

The January 5 and 27 measurements both contained slush in the cross-section, thus likely under-metering the flow. However, upon viewing the hydrograph plot, it would appear that if flows were too low around the 5th they were likely too high around the 10th. Totals for the 10-day period, if revised, would likely be the same as pre-revision and thus it was not felt necessary to revise this period. However, the flows from January 18 to February 4 appeared too low and it was felt that they required upward revision (based on the Taylor and Hudson Hope traces). Similarly, two other segments in February appeared too low. Suggested revisions were sketched on the hydrograph.

The flow data for the open water period was revised in 1984, but had not been submitted to Ottawa (will be done upon completion of this review).

No revisions were deemed necessary for the November/December period.

Peace Point

The measurements during January to April seemed to have had very little or no slush present and thus should be a good representation of flow values. However, the daily flows were computed without much regard for the flow hydrograph at Peace River and therefore suggested revisions were sketched on the hydrograph.

The metered value on December 11 indicated a very large backwater, 3.3 metres (>10 feet), which is inordinately large, and at the same time the mean velocity of the measurement was considerably less than would be expected. Possibly an unconsolidated slush pack was interfering with measurement velocities. In any event, it is assumed that this metering under-represented the true flow and December data was suggested for revision accordingly. Proposed revisions were sketched on the hydrograph.

5.23.2 Actual Revisions

Dunvegan

With the exception of the 3rd and 8th the first 15 days of August had been estimated. These estimated records were revised on the basis of hydrograph comparisons.

Peace River

Flow data were revised for the periods January 6 to 11, January 14 to 24, January 28 to February 4, February 6 to 13 and February 22 to March 8 on the basis of hydrograph comparisons. Flow data for the entire open water period were revised (in November 1983) on the basis of a change in the application of shift corrections.

Peace Point

The computed discharges for the period January 1 to April 28 were revised on the basis of hydrograph comparisons.

The streamflow measurements made on December 11 encountered very slow velocities and hence an inordinately large back-water shift correction. This seemed unreasonable and so flows for the periods November 9 to 20 and November 26 to December 31 were revised upwards.

5.23.3 Periods of Revision

Peace River at Dunvegan:	August 1 and 2 August 4 to 7 August 9 to 15
Peace River at Peace River:	January 6 to 11 January 14 to 24 January 28 to February 4 February 6 to 13 February 22 to March 8 Open water period
Peace River at Peace Point:	January 1 to April 28 November 9 to 20 November 26 to December 31

5.23.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	23 806	25 048	+5.2	28 766	33 275	+15.7
FEB.	31 494	34 892	+10.8	31 335	34 040	+8.6
MAR.	52 534	53 870	+2.5	40 390	48 700	+20.6
APR.	69 810	69 810	0	65 540	67 350	+2.8
NOV.	53 740	53 740	0	52 700	53 360	+1.3
DEC.	51 283	51 283	0	42 930	53 790	+25.3

5.24 1982

5.24.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

Extreme slush conditions existed at the time of the February 2 discharge measurement. In fact, the slush ice forced the field technicians to miss metering several of the verticals. It was felt that the measurement result vastly under-metered the true flow (initial computations used the measurement result, but force-fitted the data by computing an artificial dip in flow for several days). Some slush existed at the time of the March 4 measurement and thus it was likely that the metered flow was somewhat less than the true discharge. Suggested revisions to the daily discharge computations were sketched on the hydrograph.

A very large early July peak occurred on the Peace River, which primarily originated from high up in the basin. This caused a very sharp peak at Peace River. The value of this peak was substantiated by summation of peaks at Dunvegan and the Smoky River at Watino. There may be some room for revising the Peace River at Peace River peak downward, but any revisions would be less than 10% and thus a revision was not felt warranted.

Peace Point

When compared with the flows at Peace River at Peace River, and Taylor as well, the flows for the January to April winter period appeared significantly too low. Looking at the measurements, there appeared to be some slush ice interference, but it was hard to rationalize the amounts of under-measurement. Nonetheless, it was felt that stream-flows should be revised upward, as sketched on the hydrograph.

The attenuation of the July and August peaks from Peace River to Peace Point seemed too much, even though the rainstorm event occurred high in the basin, and thus a certain amount of attenuation was expected. Even if these two peaks proved out at Peace Point, the plateau peak from August 26 to September 5 was most certainly too low when compared with Peace River, and in fact, the flows for the rest of the open water period also appeared too low. It was felt that perhaps a chart correction was missed or a shift correction was inappropriately applied.

The velocities for the November 23 and December 14 measurements appeared very much lower than would be expected and as a result the indicated backwaters were very high. It very much looked like there was significant slush ice interference with the meter during the November measurement and to a lesser extent on the December measurement. Suggested revisions were sketched on the hydrograph.

5.24.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

Slush was in evidence for measurements made on February 2 and March 4. Flows were revised for the periods January 4 to 8, February 2 to 8 and February 26 to March 7.

During the open water period when water levels were below a gauge height of 8.1 metres the flows were revised. This was done as a result of a change in the method of shift distribution. Previously, shifts were distributed on a time basis, whereas they have now been applied on a stage shift basis.

Peace Point

The period January 1 to April 30 was revised on the basis of hydrograph comparisons.

The measurements of November 23 and December 14 exhibited very low velocities and hence inordinately large backwater corrections. This was felt to be erroneous and hence flows were revised upwards for November 8 to December 31.

5.24.3 Periods of Revision

Peace River at Peace River: January 4 to 8
 February 2 to 8
 February 26 to March 7

Peace River at Peace Point: January 1 to April 30
 November 8 to December 31

5.24.4 Summary of Revisions
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	57 670	58 740	+2.0	41 010	54 440	+32.7
FEB.	47 670	49 260	+4.1	44 750	55 610	+24.3
MAR.	36 670	37 430	+2.1	31 781	41 300	+30.0
APR.	51 740	51 740	0	37 780	48 600	+28.6
NOV.	49 340	49 340	0	35 330	48 680	+37.8
DEC.	50 710	50 710	0	43 400	57 280	+32.0

5.25 1983

5.25.1 Preliminary Review

Dunvegan

No revisions were suggested.

Peace River

Three measurements were made during the January to March period. Each measurement was affected by slush conditions, which was taken into account when the daily discharge data were computed. No revisions were deemed necessary.

The July 10 peak flows at Peace River at Peace River (and flows leading up to this peak) were less at Peace River than the sums of Smoky River at Watino, plus Peace River at Dunvegan. Upon reviewing the charts it was found that the manometer at Peace River at Peace River encountered silting problems, gradually getting worse from July 10 to 18. A negative pen correction was applied on a straight line time basis distribution from June 21 to July 17, whereas it was likely the correction should have started only from July 10 onward. This would result in increased flows at Peace River. At the same time the orifice at Smoky River at Watino was washed out and a chart, based on observer's readings, was digitized. Potentially, there may also be some room for revision.

Peace Point

Some slush ice was evident in the cross-section of the winter measurements. Some provision had been made for this in the initial daily discharge computations. However, the gauge was unserviceable during the first part of January and it would appear that the daily discharge computations could be reinterpreted, based on a time lag and the shape of Peace River at Peace River hydrograph. The reinterpreted discharges were sketched on the hydrograph.

Significant slush was also encountered during the December 14 measurement and thus it was felt that flows could have been significantly under-metered. Suggested revisions were sketched on the hydrograph.

5.25.2 Actual Revisions

Dunvegan

The flows for June 14 and 15 were estimated. These estimated data were revised, based on hydrograph comparisons.

Peace River

Only one period (June 23 to July 17) was revised. These data were revised by applying pen corrections and silt corrections in a different manner.

Peace Point

Daily discharge data for January 1 to February 8, and February 13 to 28 were revised on the basis of hydrograph comparisons.

Flow data for November 23 to December 31 were also revised, as the December 14 measurement was affected by slush ice in the cross-section.

5.25.3 Periods of Revision

Peace River at Dunvegan: June 14 and 15
 Peace River at Peace River: June 23 to July 17
 Peace River at Peace Point: January 1 to February 8
 February 13 to 28
 November 23 to December 31

5.25.4 Summary of Revisions
 (Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	32 332	32 332	0	31 438	43 160	+37.3
FEB.	17 763	17 763	0	21 094	22 043	+4.5
JUNE	77 760	78 030	+0.3	79 310	79 310	0
JULY	145 530	146 130	+0.4	152 040	152 040	0
NOV.	42 391	42 391	0	51 420	49 350	-4.0
DEC.	47 241	47 241	0	38 241	42 660	+11.6

5.26 1984

5.26.1 Preliminary Review

Dunvegan

No revisions were recommended.

Peace River

No revisions were recommended.

Peace Point

The January 12 measurement was affected somewhat by slush ice conditions, whereas the measurements of February and April seemed O.K. It was recommended that January discharges be revised to more closely parallel the Peace River at Peace River hydrograph. These revisions were sketched on the hydrograph. Some revisions could possibly be applied to the March flows to more closely approximate the Peace River hydrograph, but the monthly total would probably be quite close and thus a revision was not deemed necessary.

The two measurements made in November and December were severely affected by slush conditions and thus it appeared very likely that they greatly under-metered the true discharge at the time. It was suggested that November and December flows be revised as sketched on the hydrograph.

5.26.2 Actual Revisions

Dunvegan

No revisions were made.

Peace River

The second review found some revisions were required to the March 10 to 19 period as the measurement used to define this period had encountered slush conditions in the cross-section.

Peace Point

The flow data for the period January 1 to January 11 were revised on the basis of hydrograph comparisons.

The two streamflow measurements made in November and December were severely slush-affected. Consequently, flows for the period November 6 to December 31 were revised.

5.26.3 Periods of Revision

Peace River at Peace River: March 10 to 19

Peace River at Peace Point: January 1 to 11
November 6 to December 31

5.26.4 Summary of Revision
(Flow values in m³/s-days)

MONTH	PEACE RIVER @ PEACE RIVER			PEACE RIVER AT PEACE POINT		
	Original	Revised	% Difference	Original	Revised	% Difference
JAN.	42 832	42 832	0	45 690	47 900	+4.8
MAR.	24 966	25 543	+2.3	32 960	32 960	0
NOV.	55 450	55 450	0	42 800	57 340	+34.0
DEC.	60 240	60 240	0	47 710	64 680	+35.6

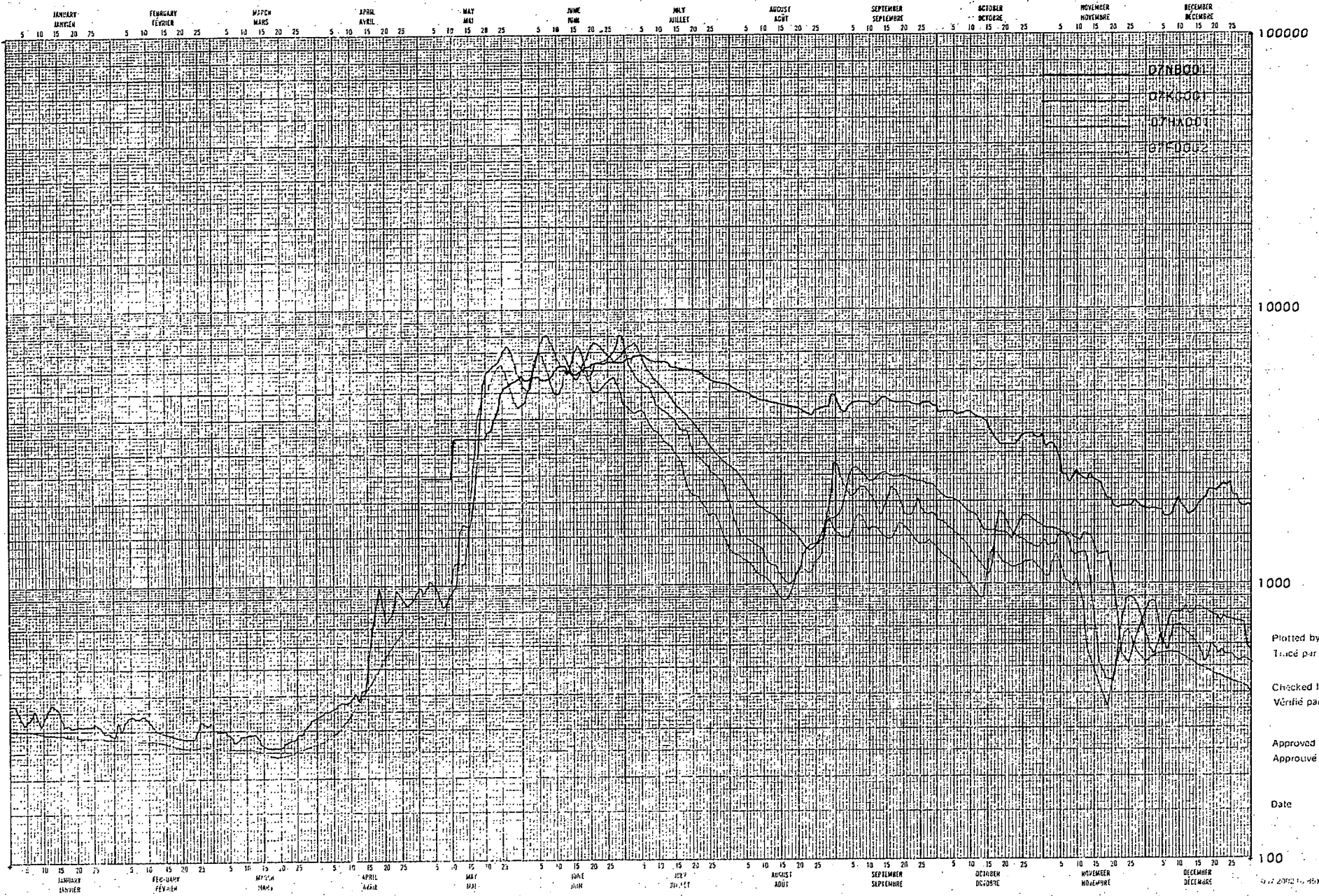
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A P P E N D I X

COMBINED HYDROGRAPHS: 1959 TO 1984



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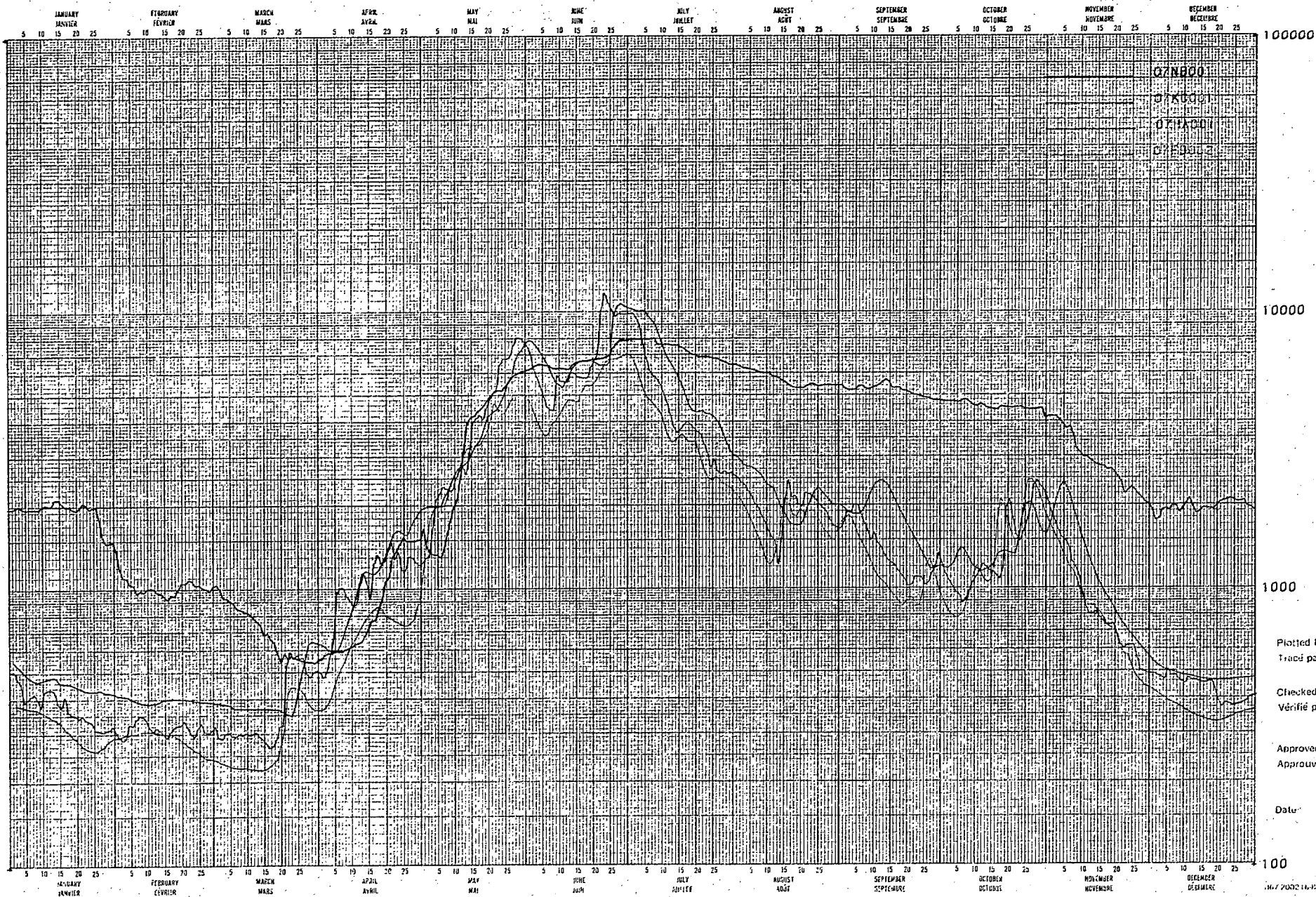
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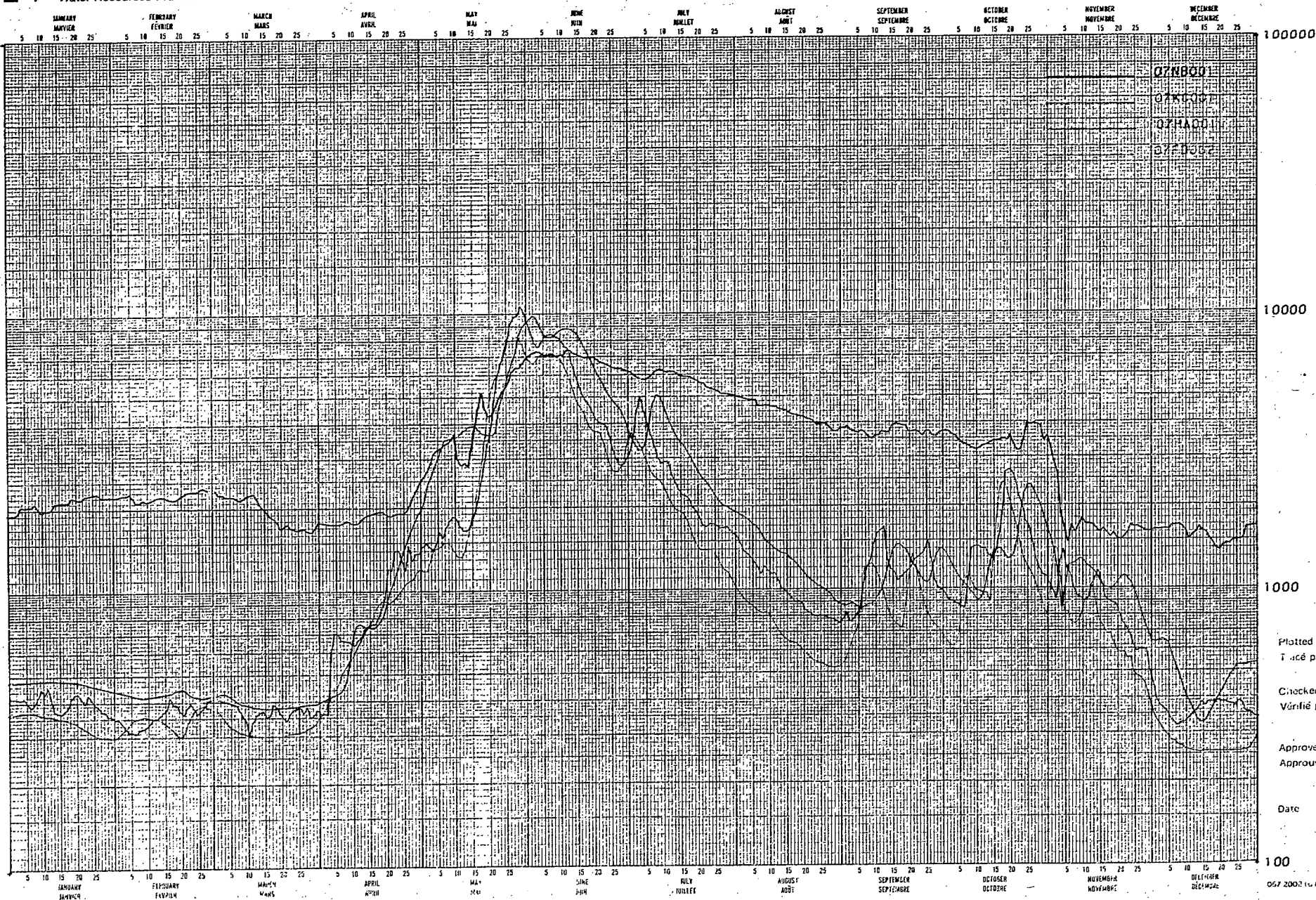
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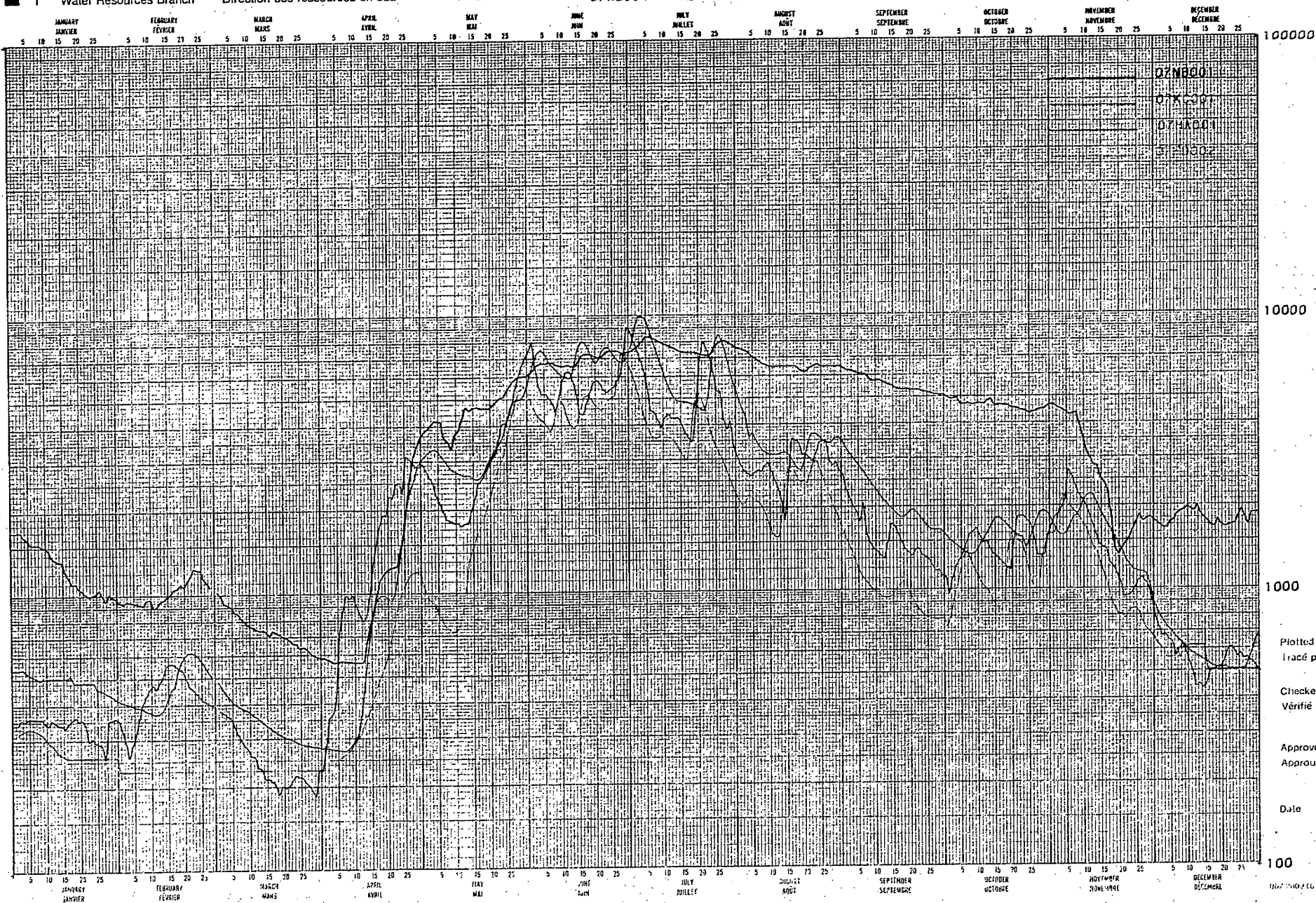


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1962
Année

Station 07N001 - SLAVE RIVER AT FITZGERALD



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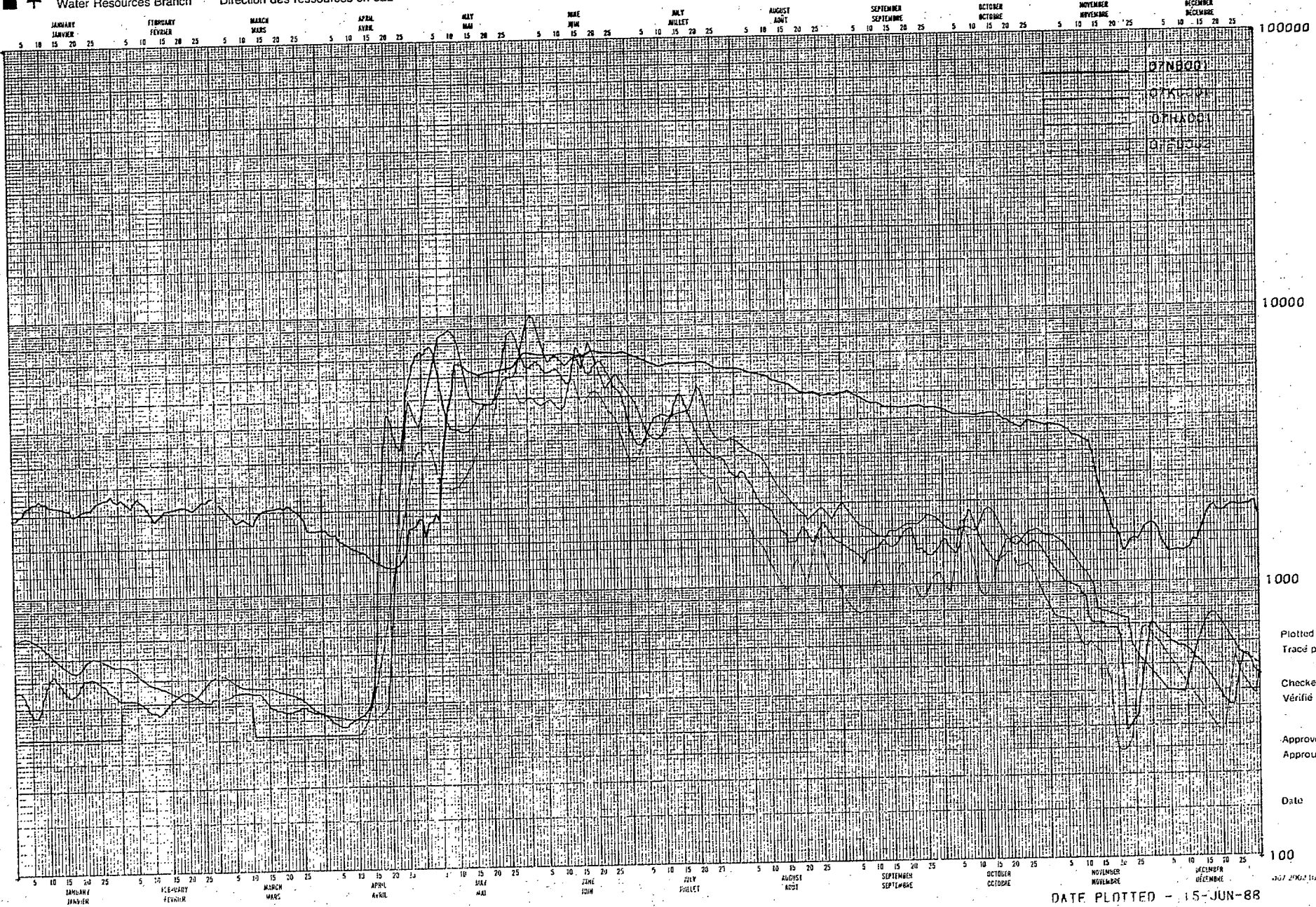


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1963
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



DISCHARGE IN M³/S

Plotted by
Tracé par

Checked by
Vérifié par

Approved by
Approuvé par

Date

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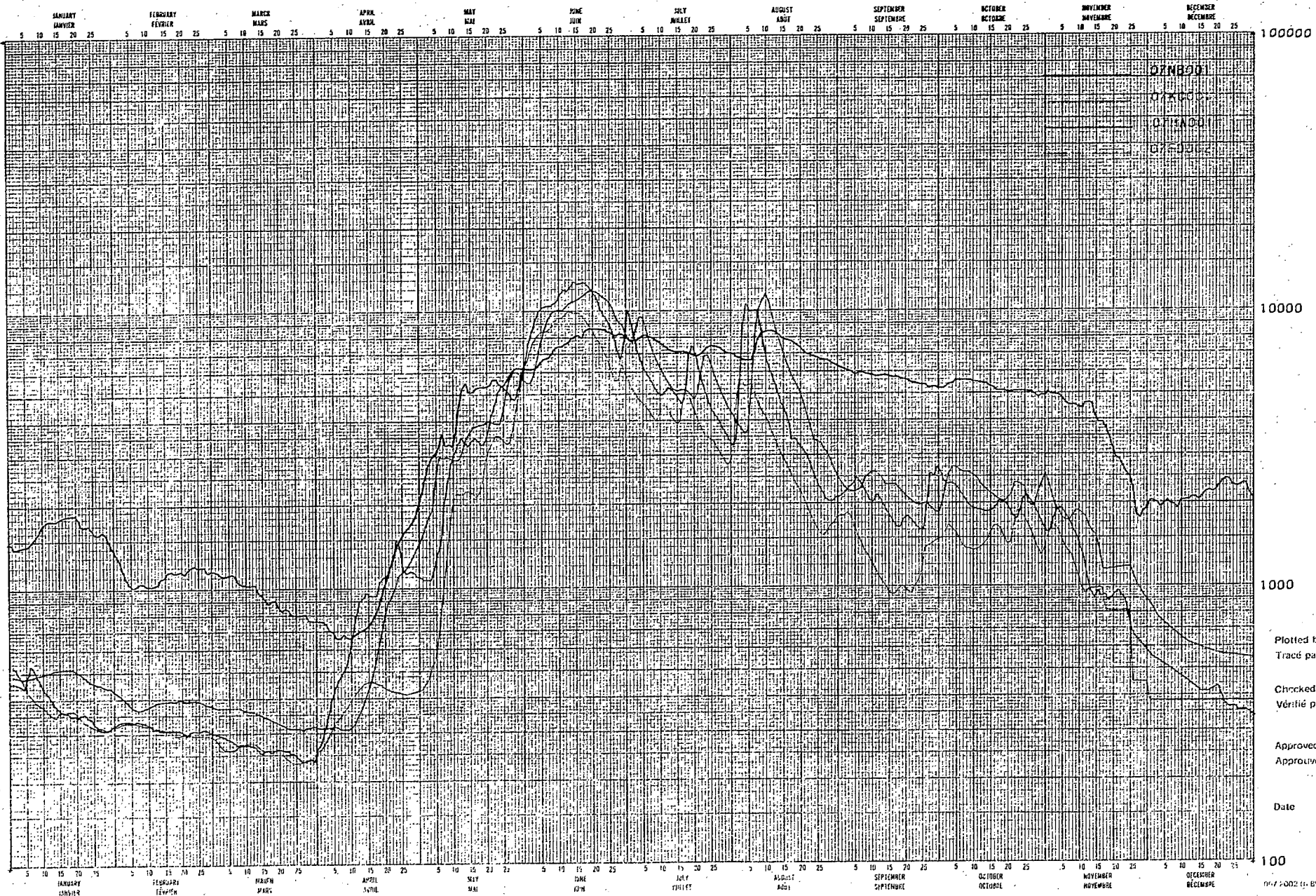


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1964
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



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DISCHARGE IN M³/S

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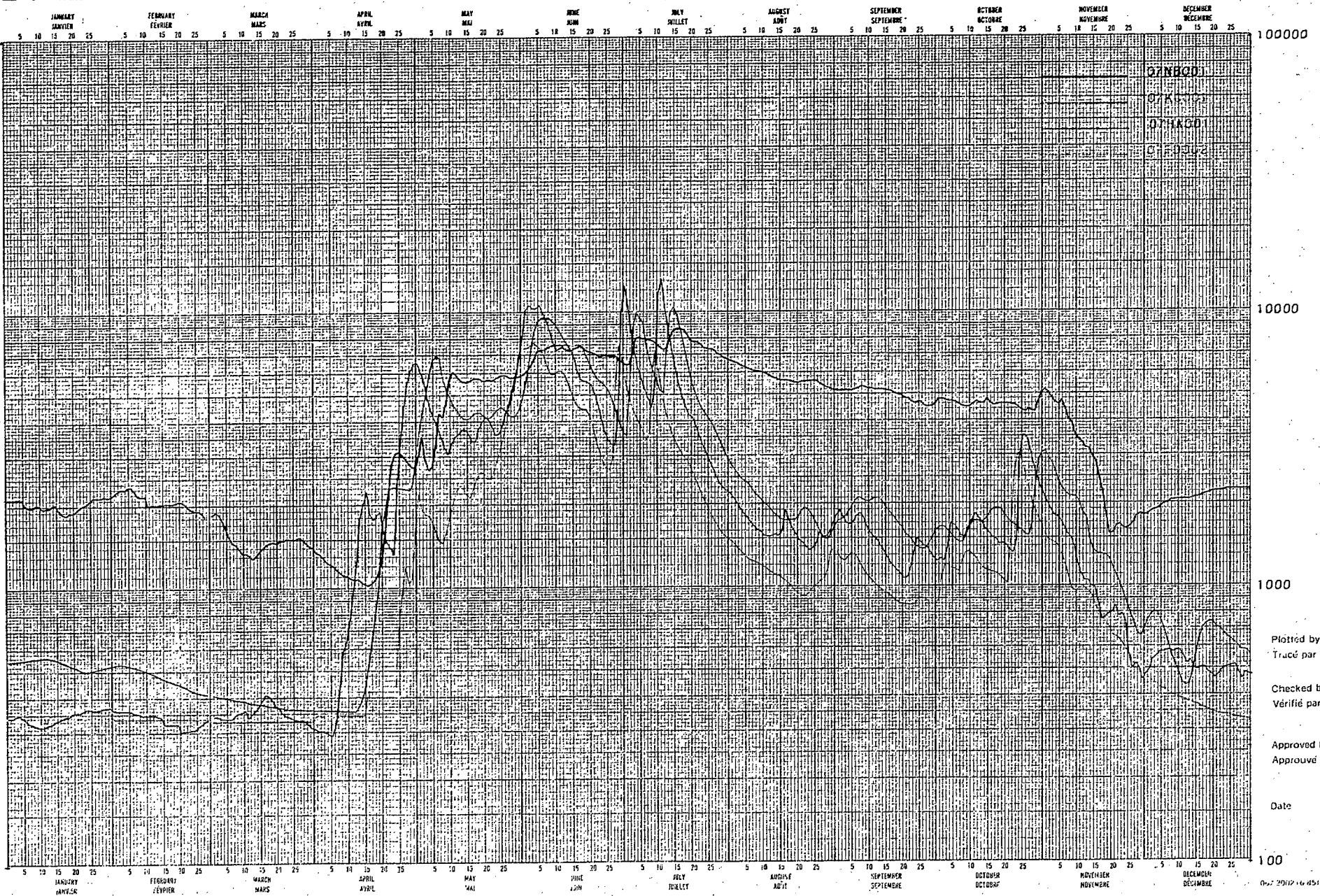
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DISCHARGE IN M³/S

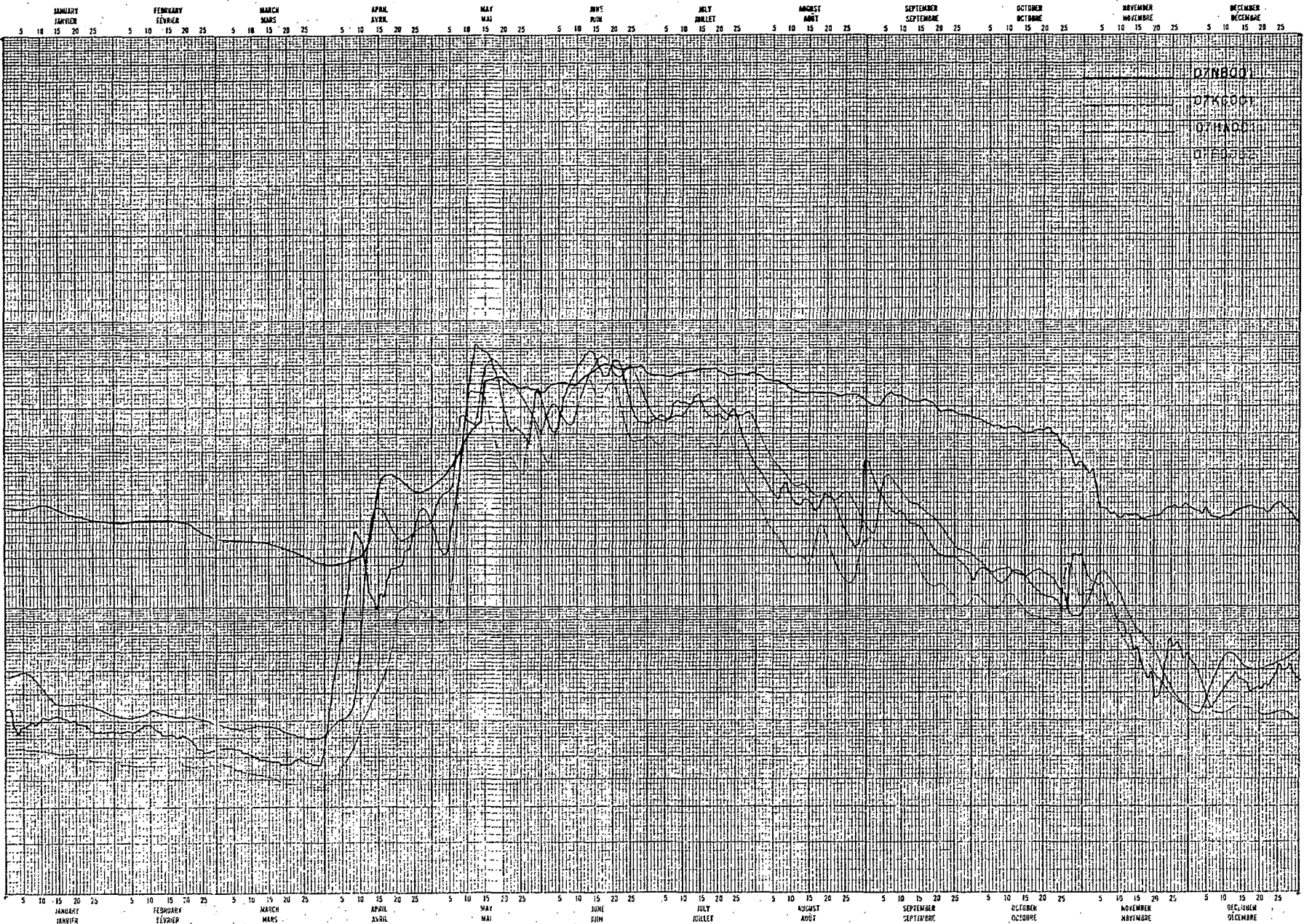
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DISCHARGE IN M³/S

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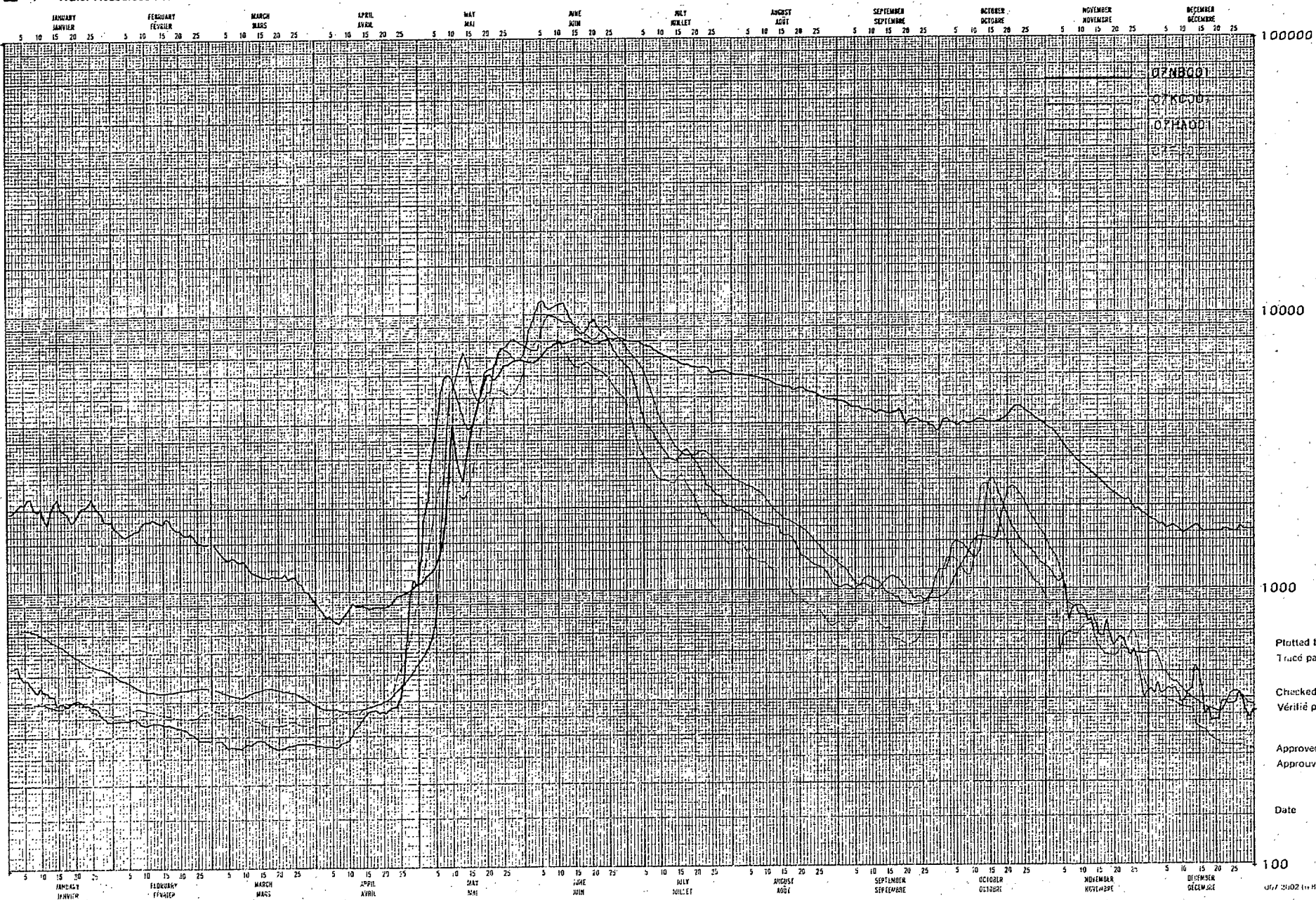


Environment Canada
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Direction des ressources en eau

Year 1967
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



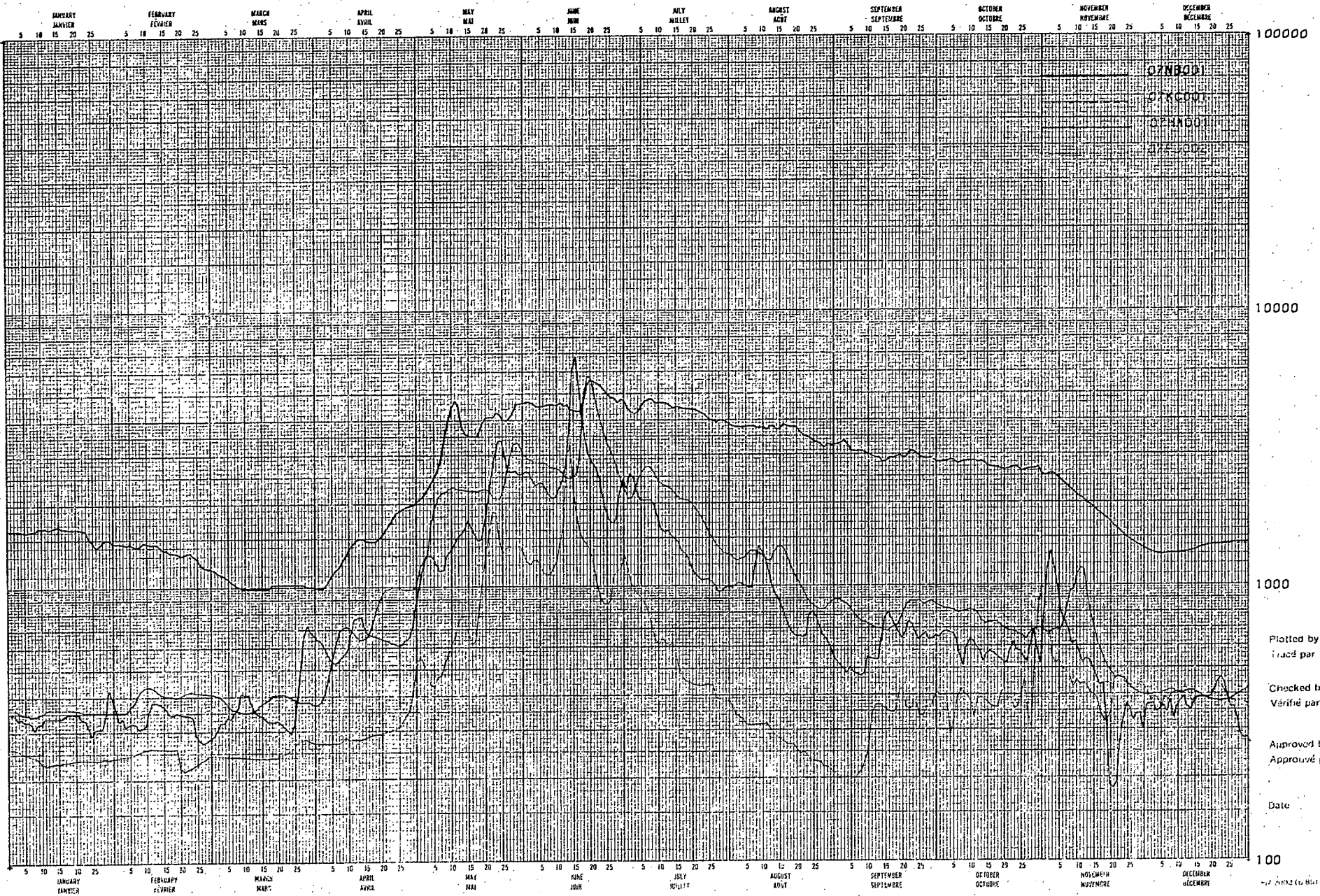


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1966
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



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DISCHARGE IN M³/S

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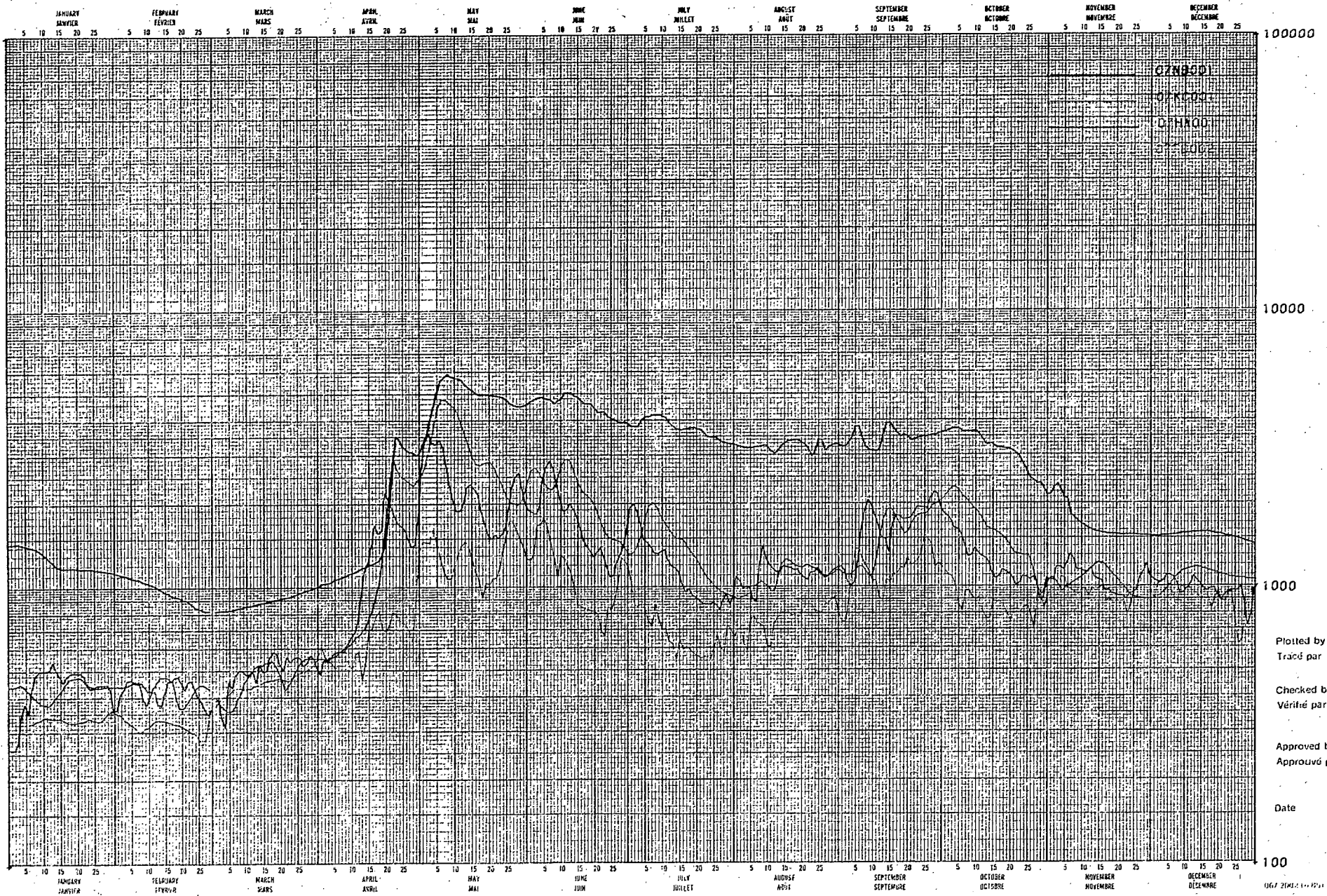
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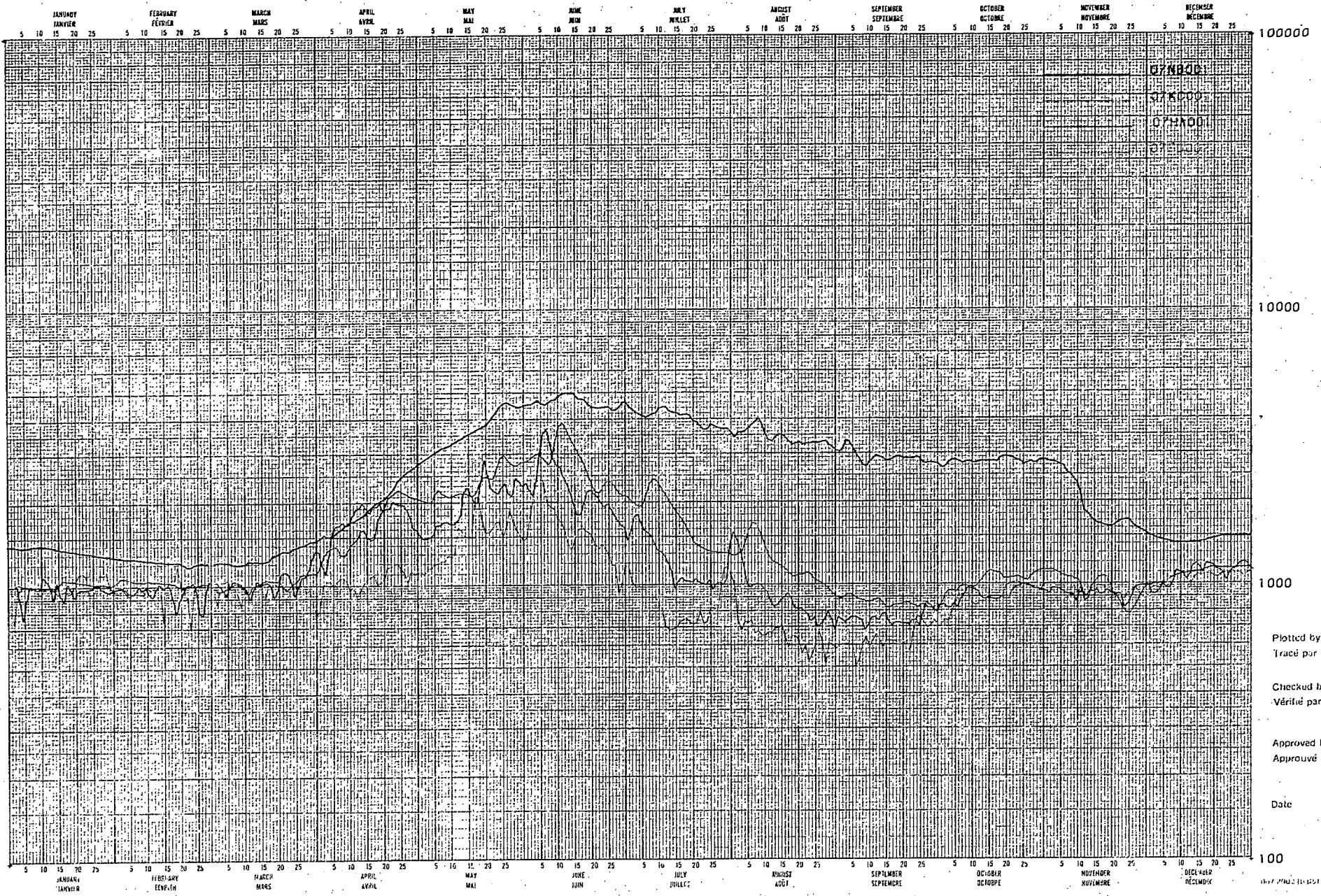


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1970
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



DISCHARGE IN M³/S

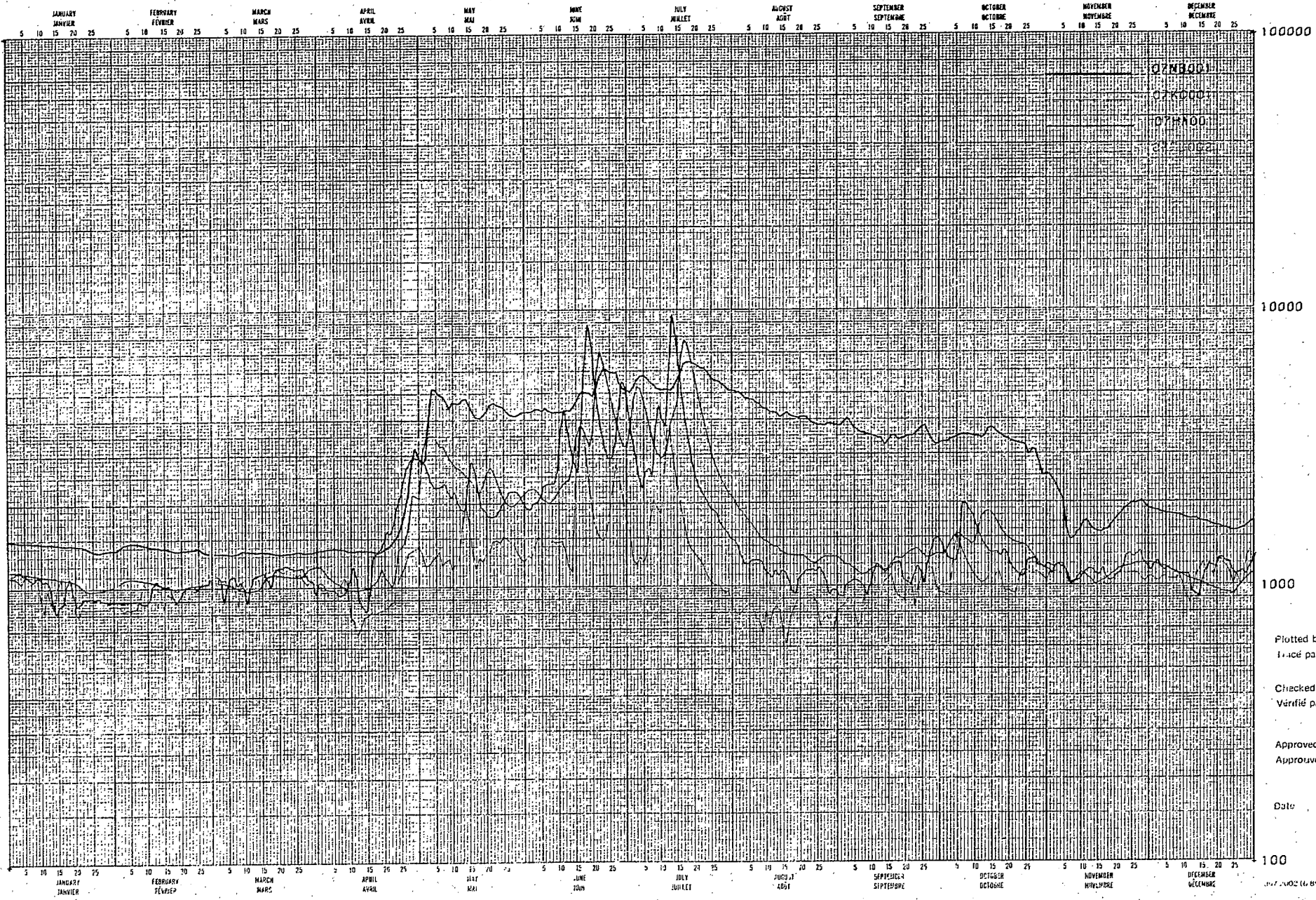
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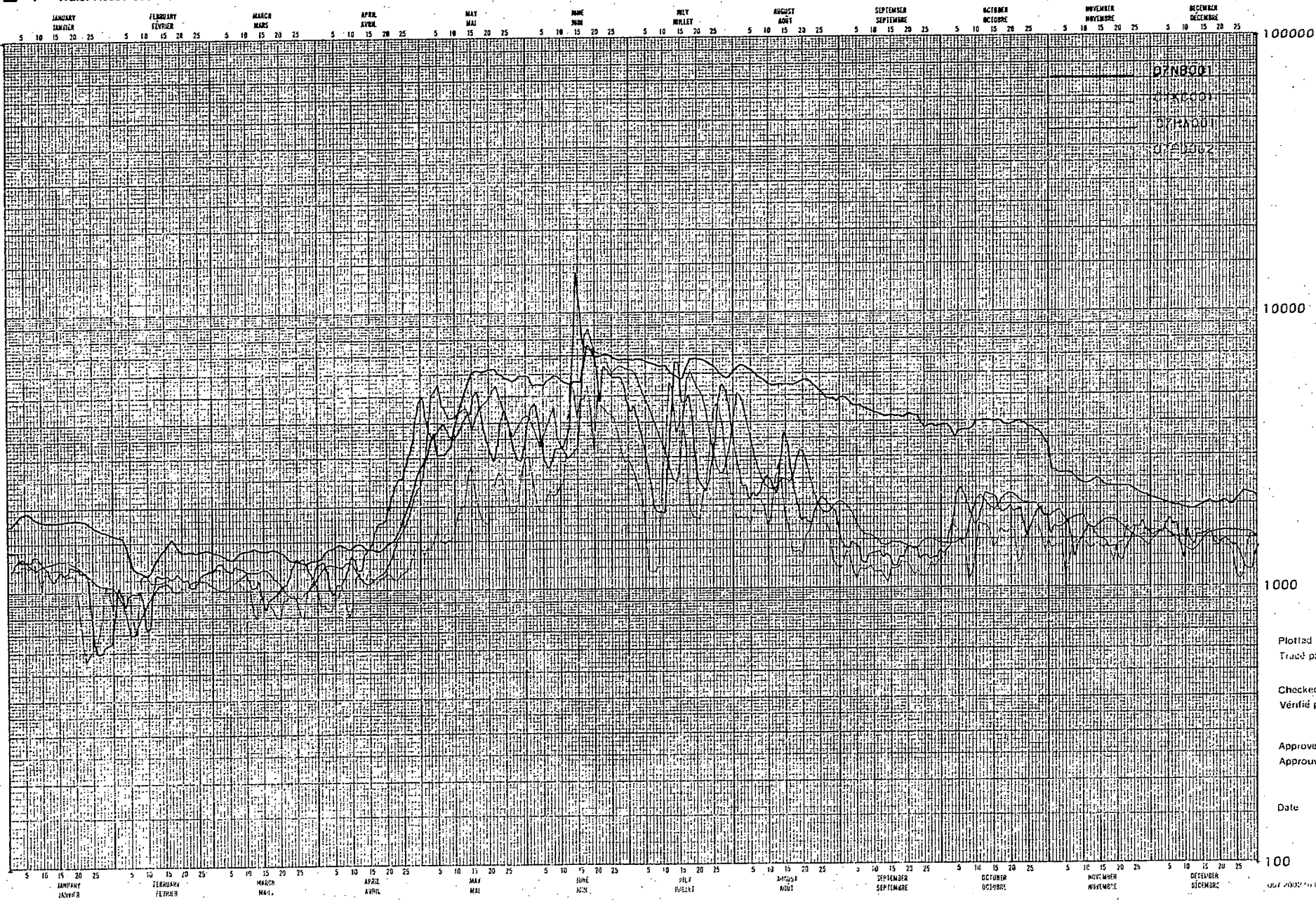
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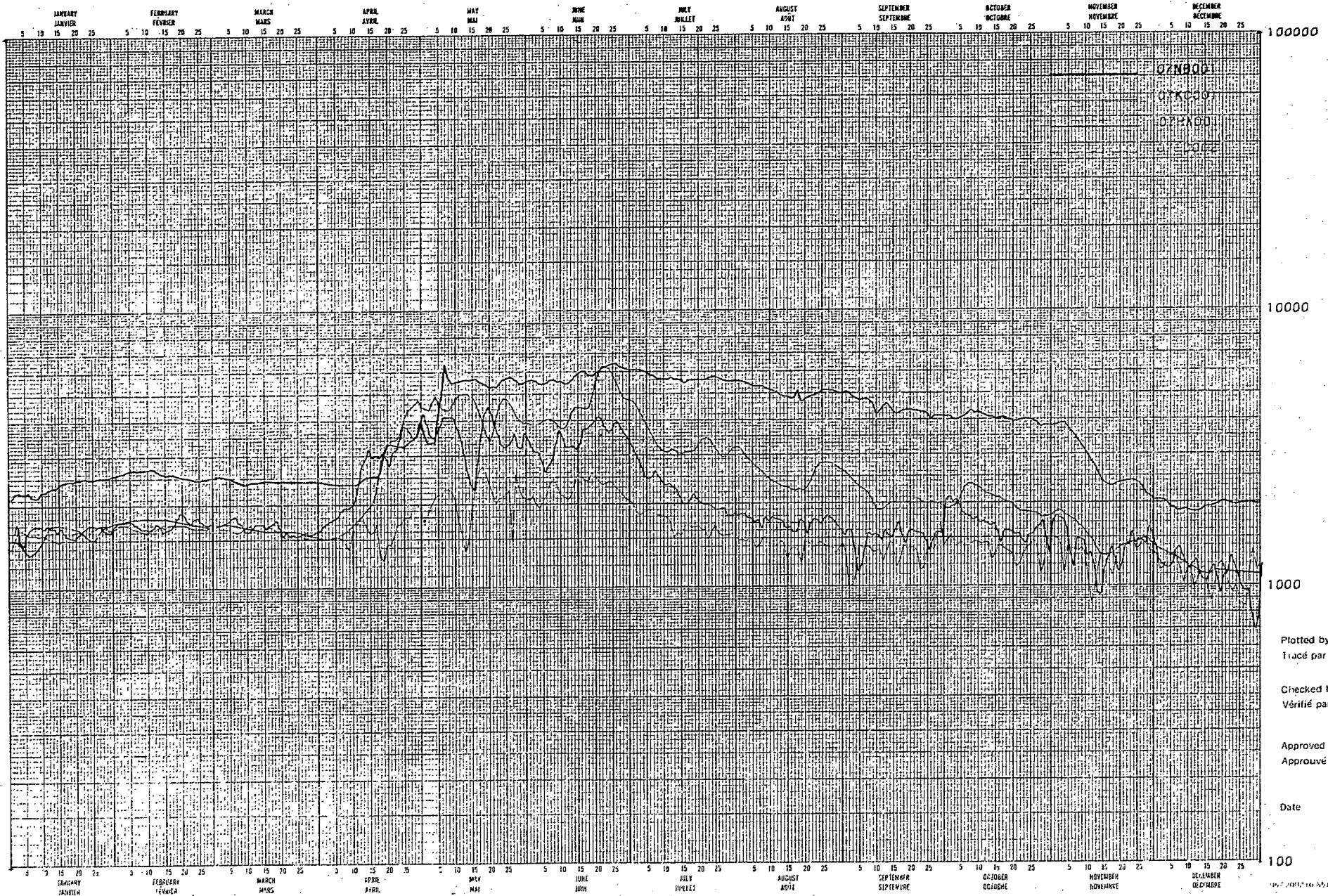
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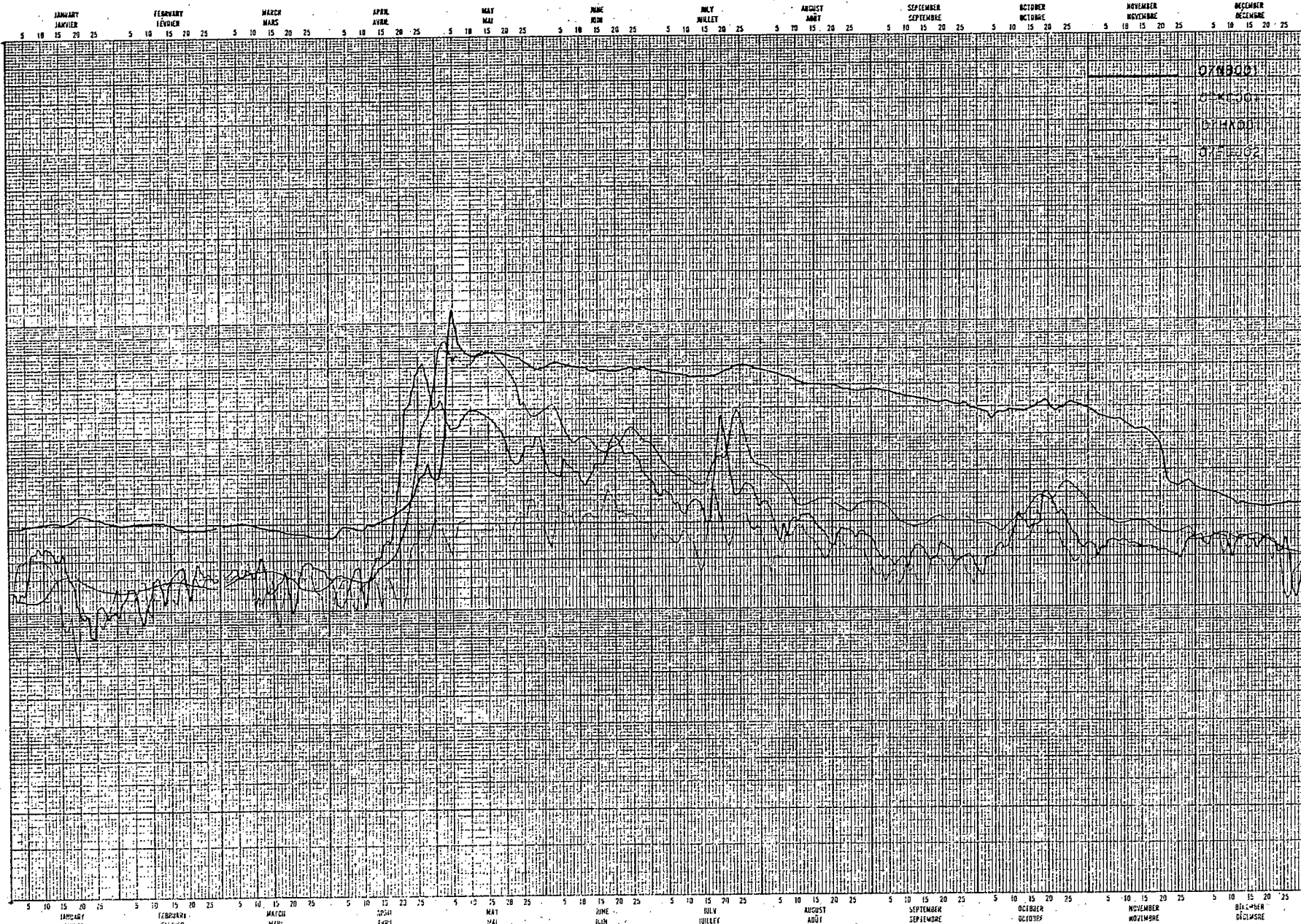
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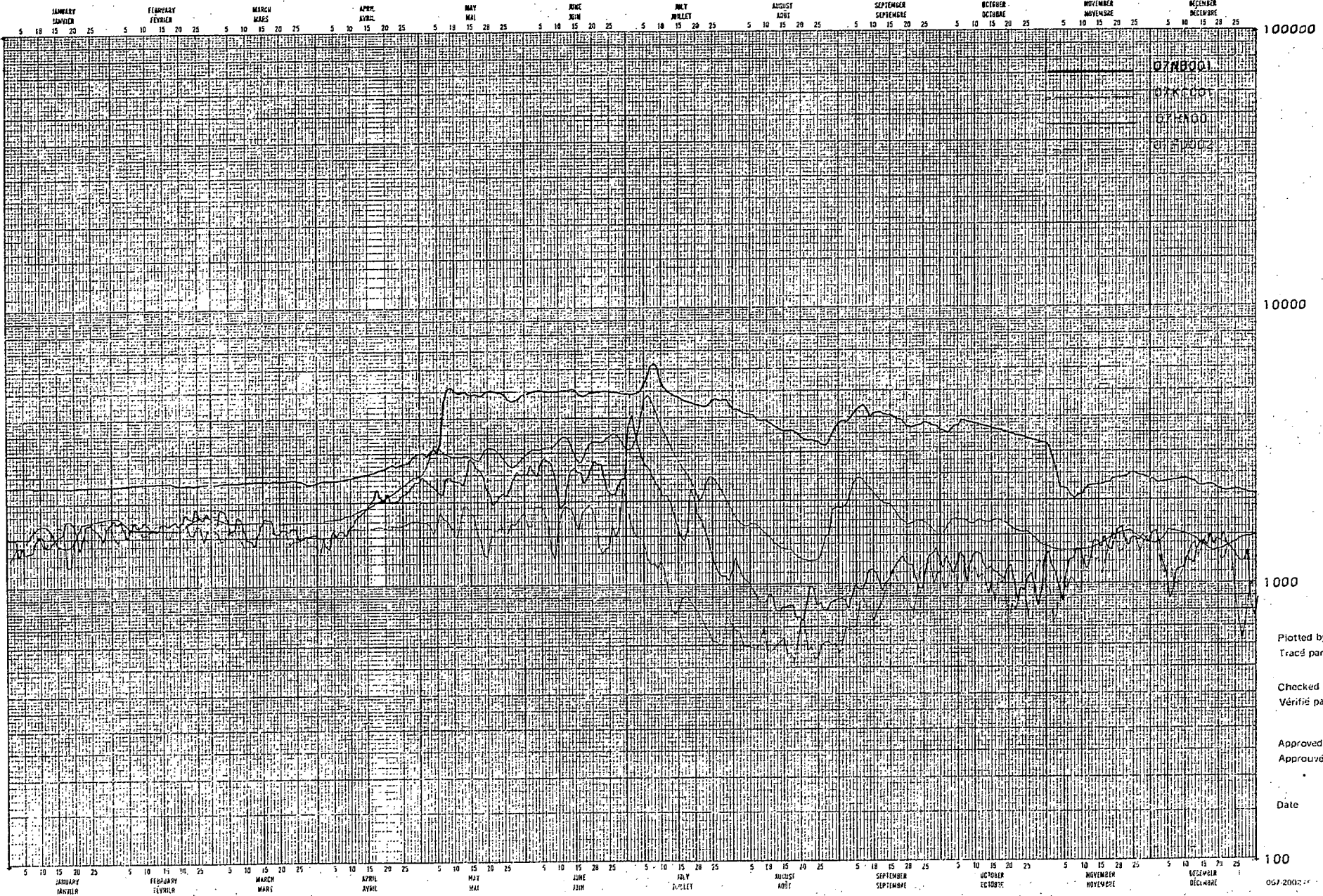


Environment Canada
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Year 1975
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



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DISCHARGE IN M³/S

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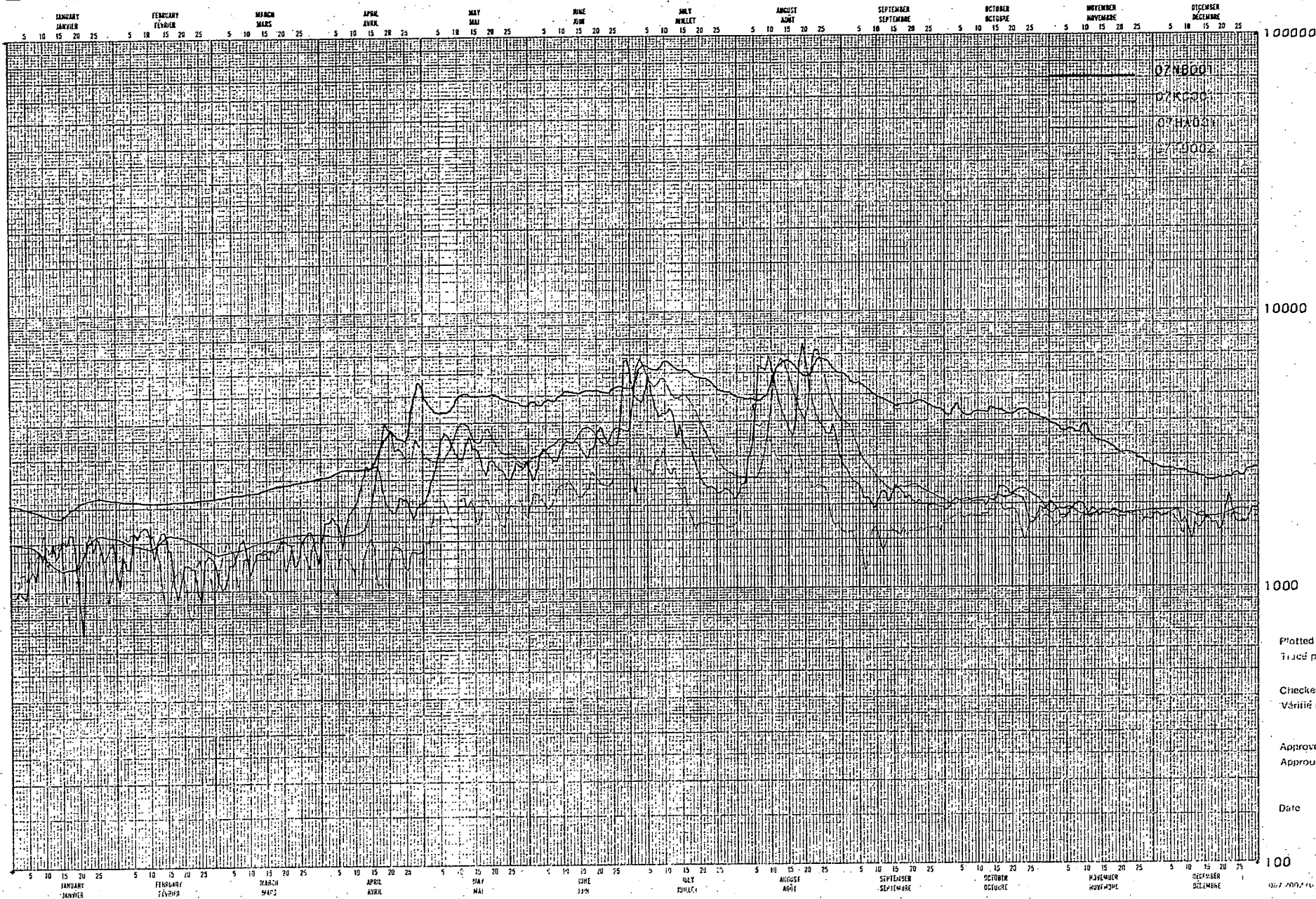


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Year 1976
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



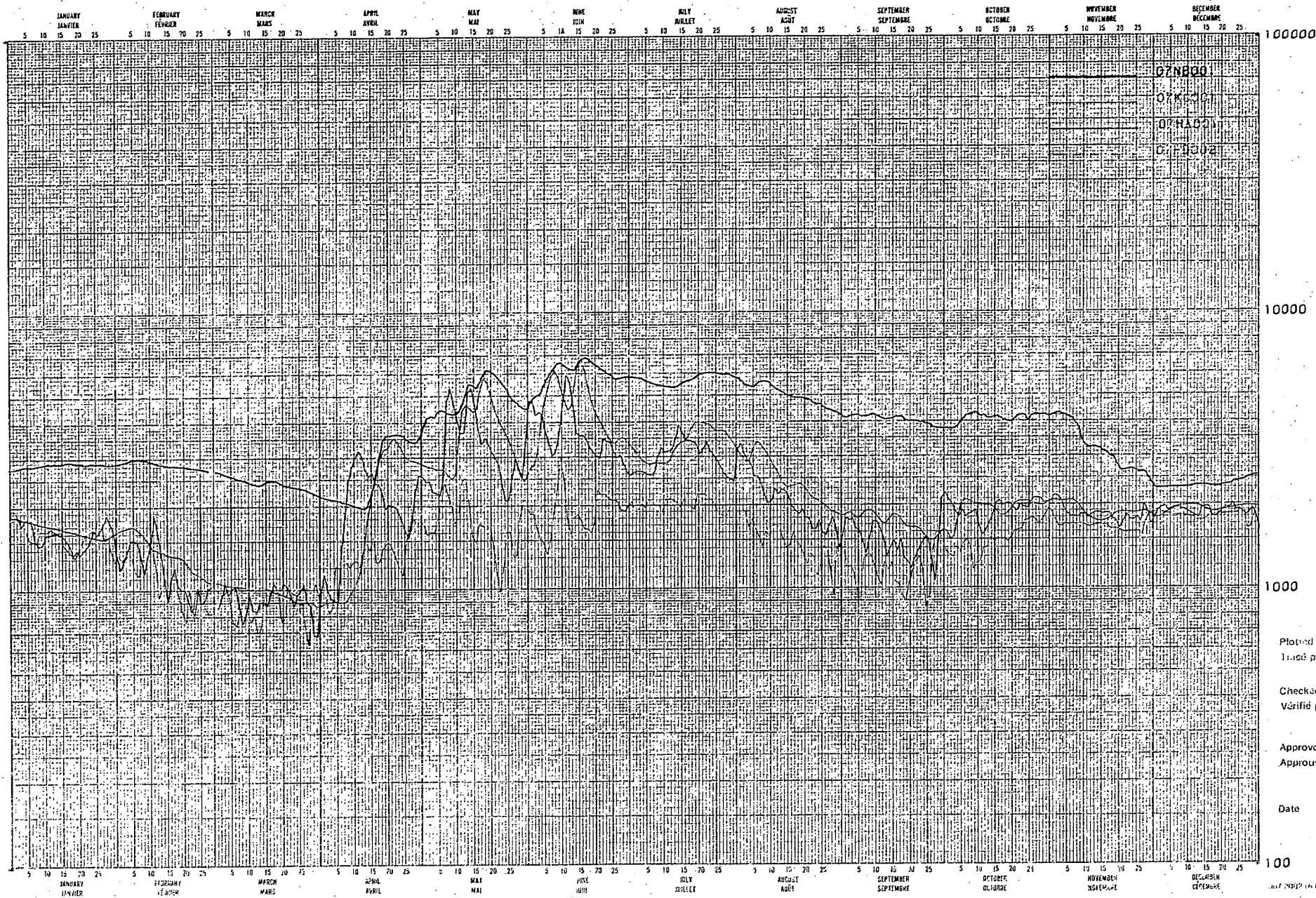
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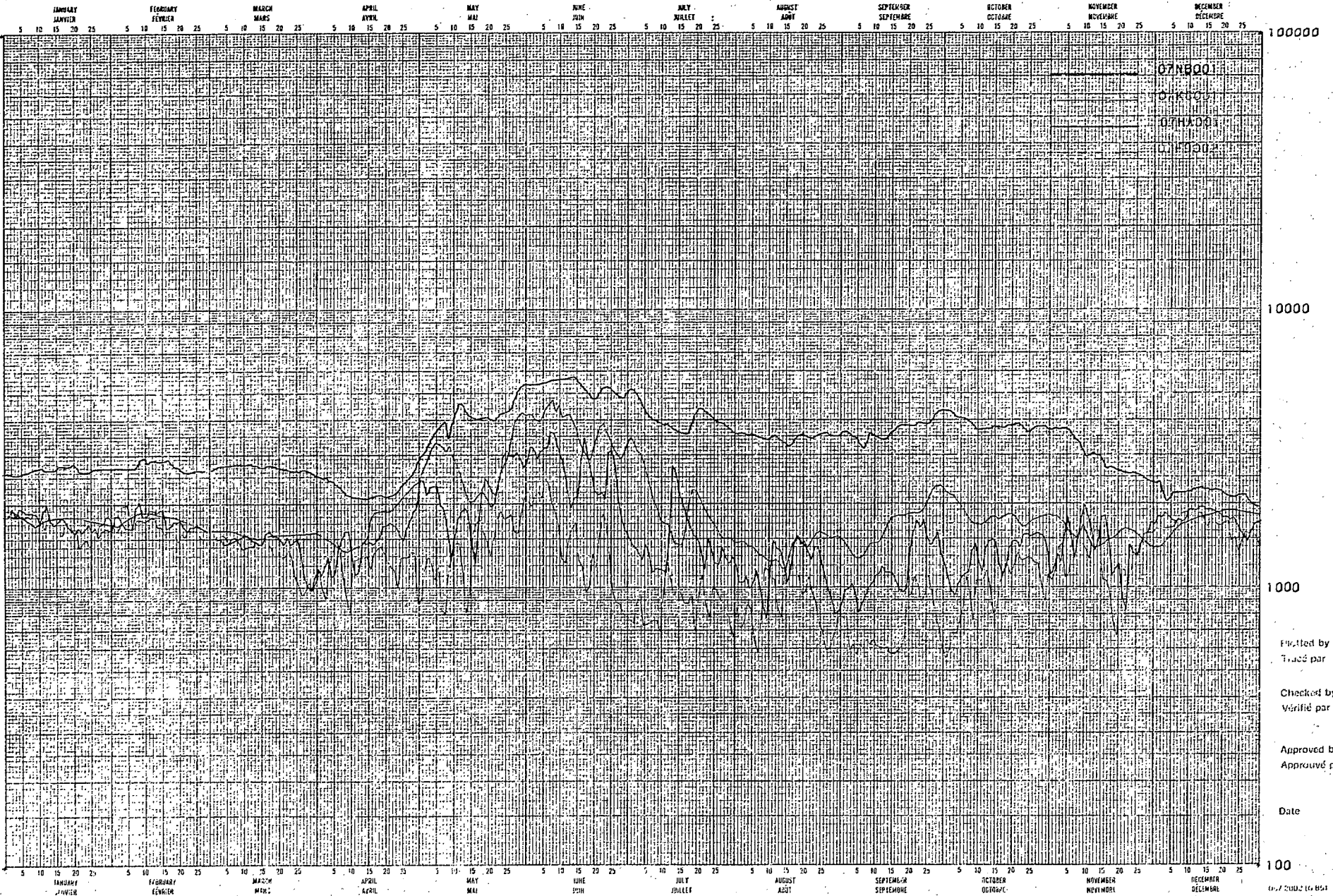


Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Year 1976
Année

Station 07NB001 - SLAVE RIVER AT FITZGERALD



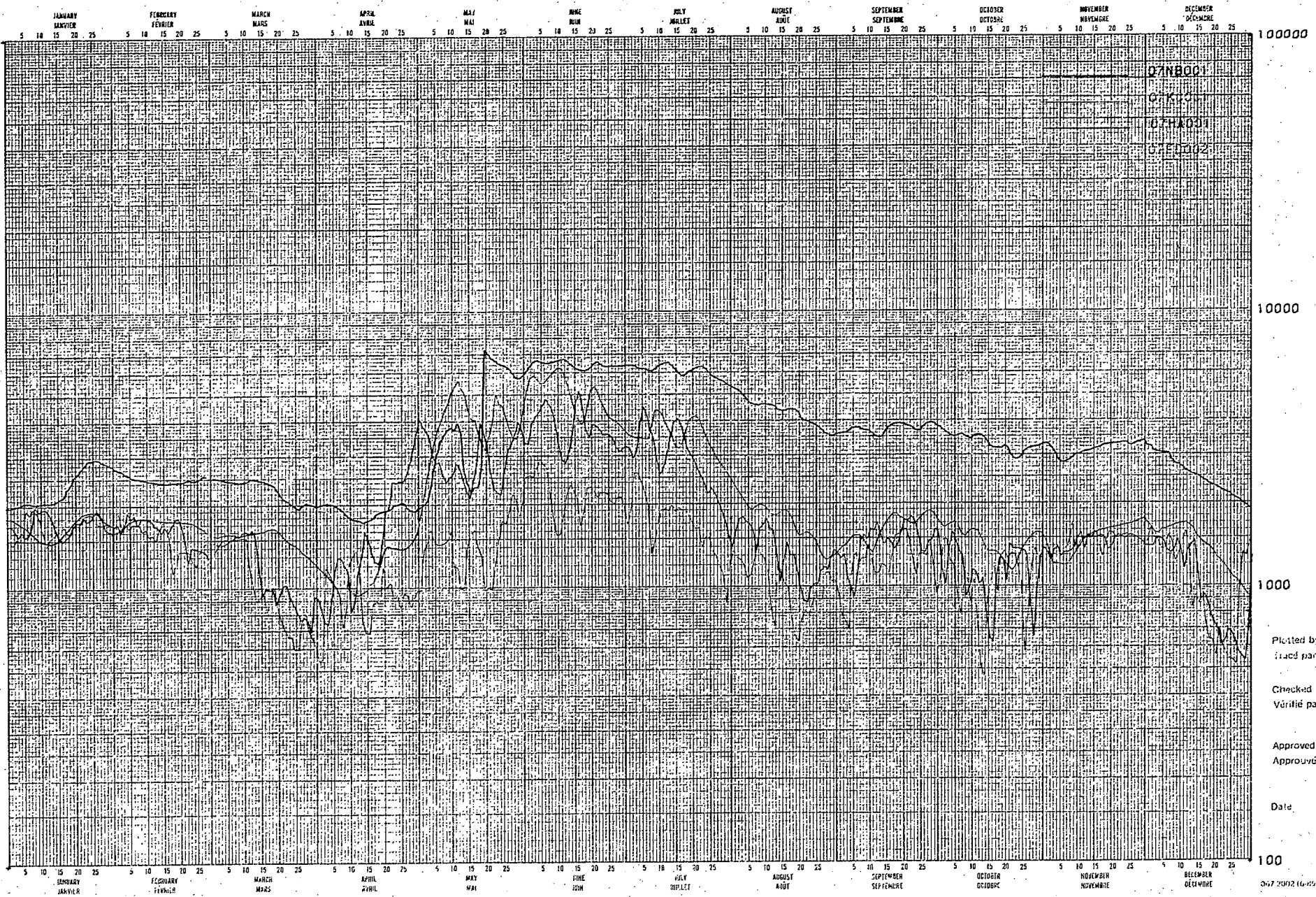
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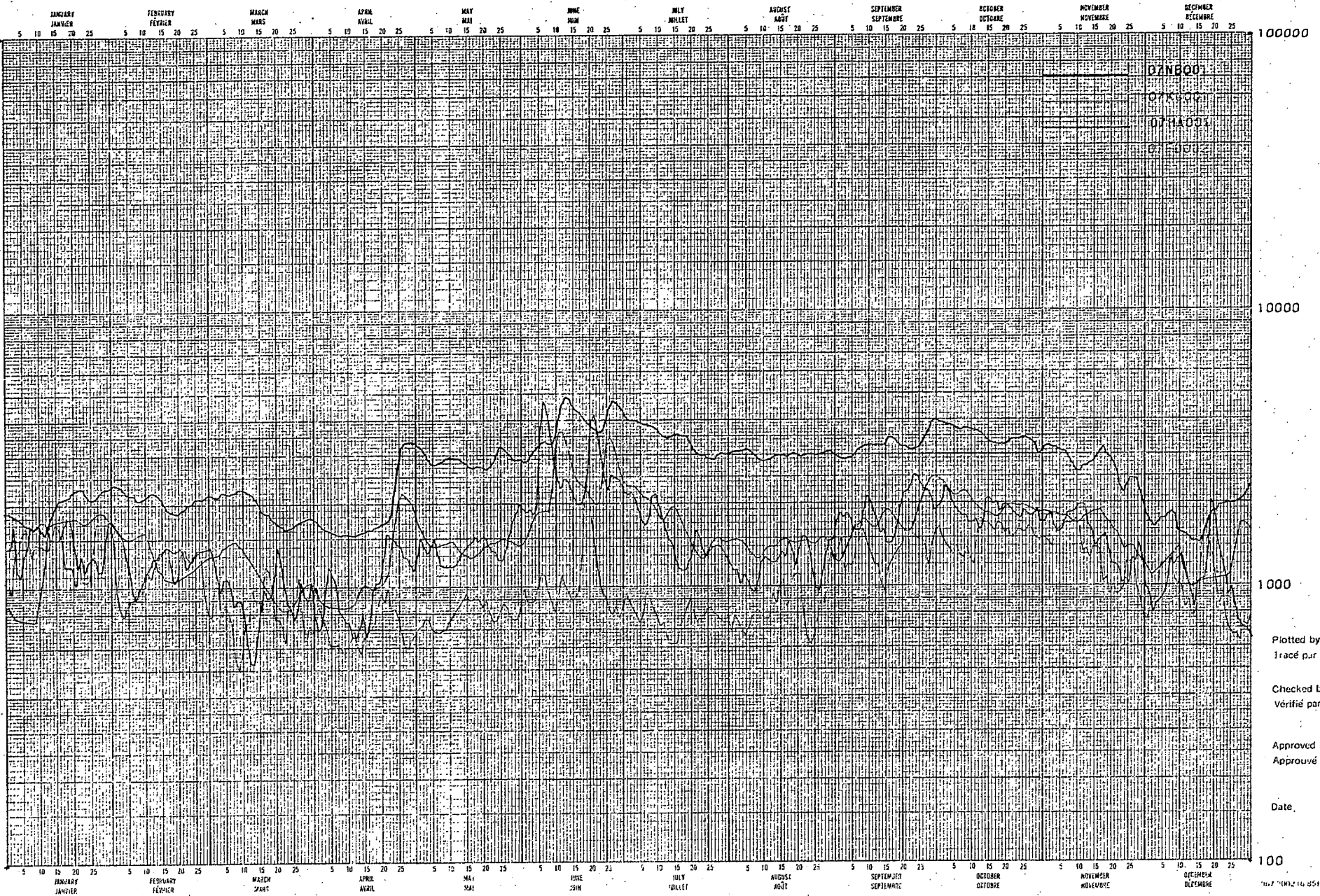
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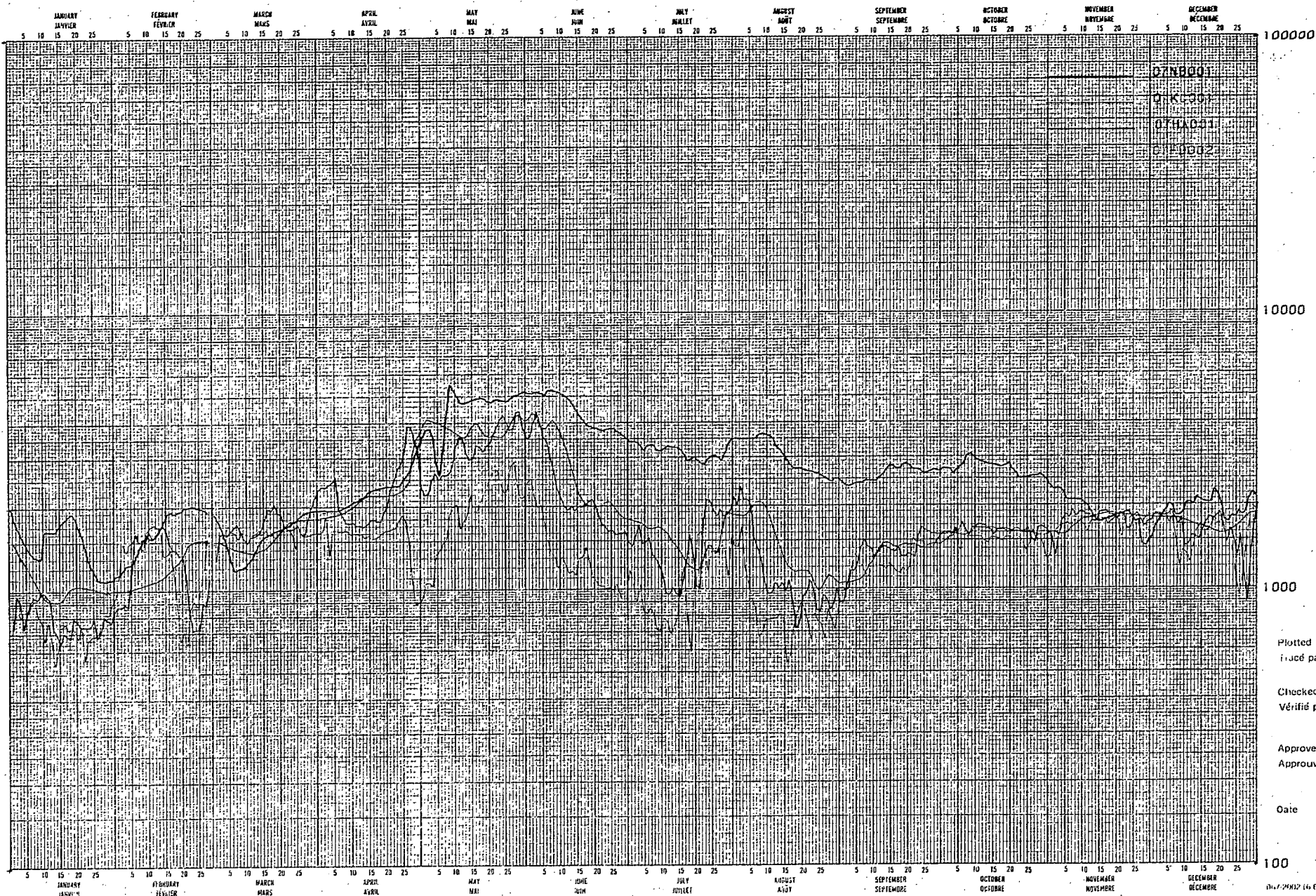
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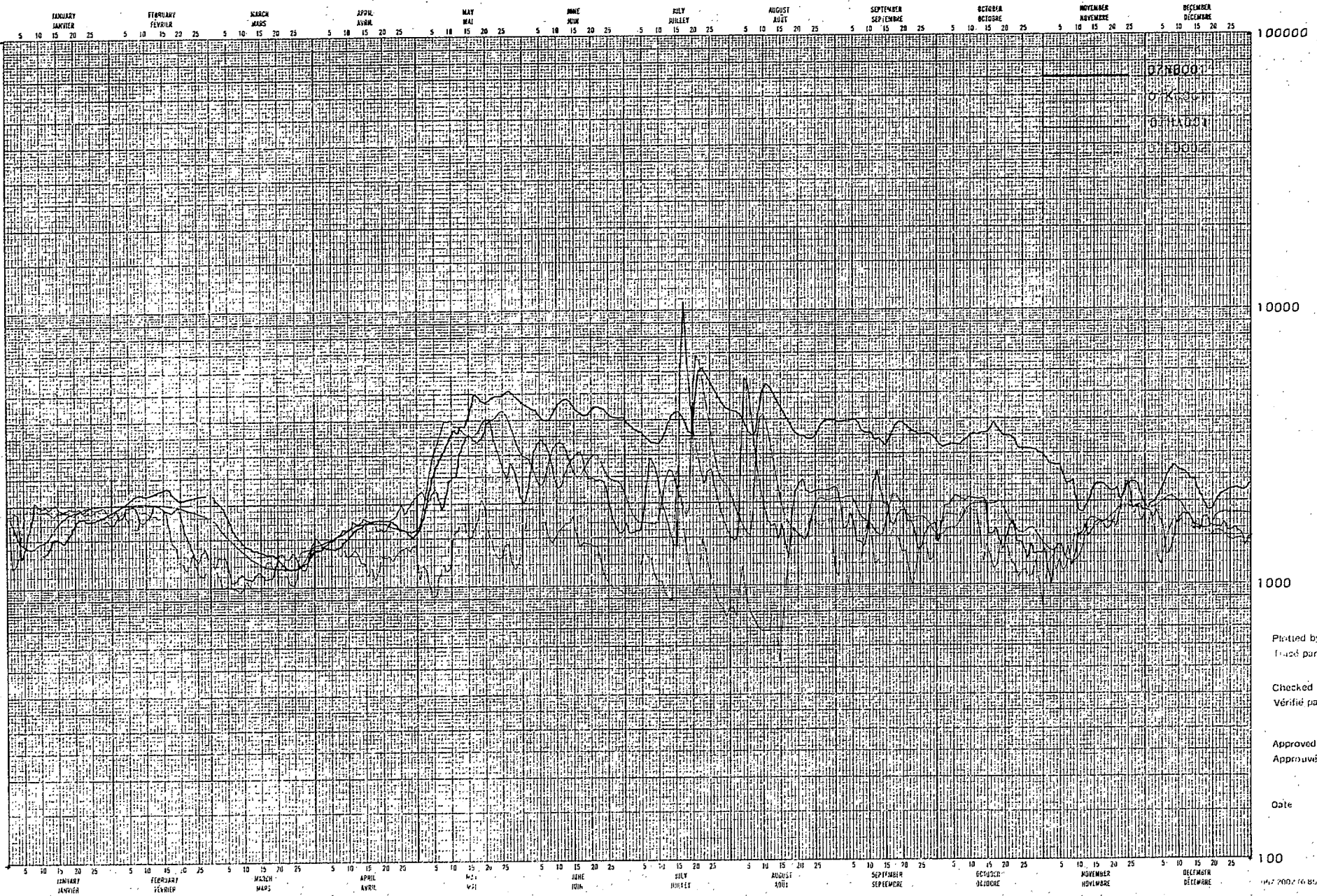
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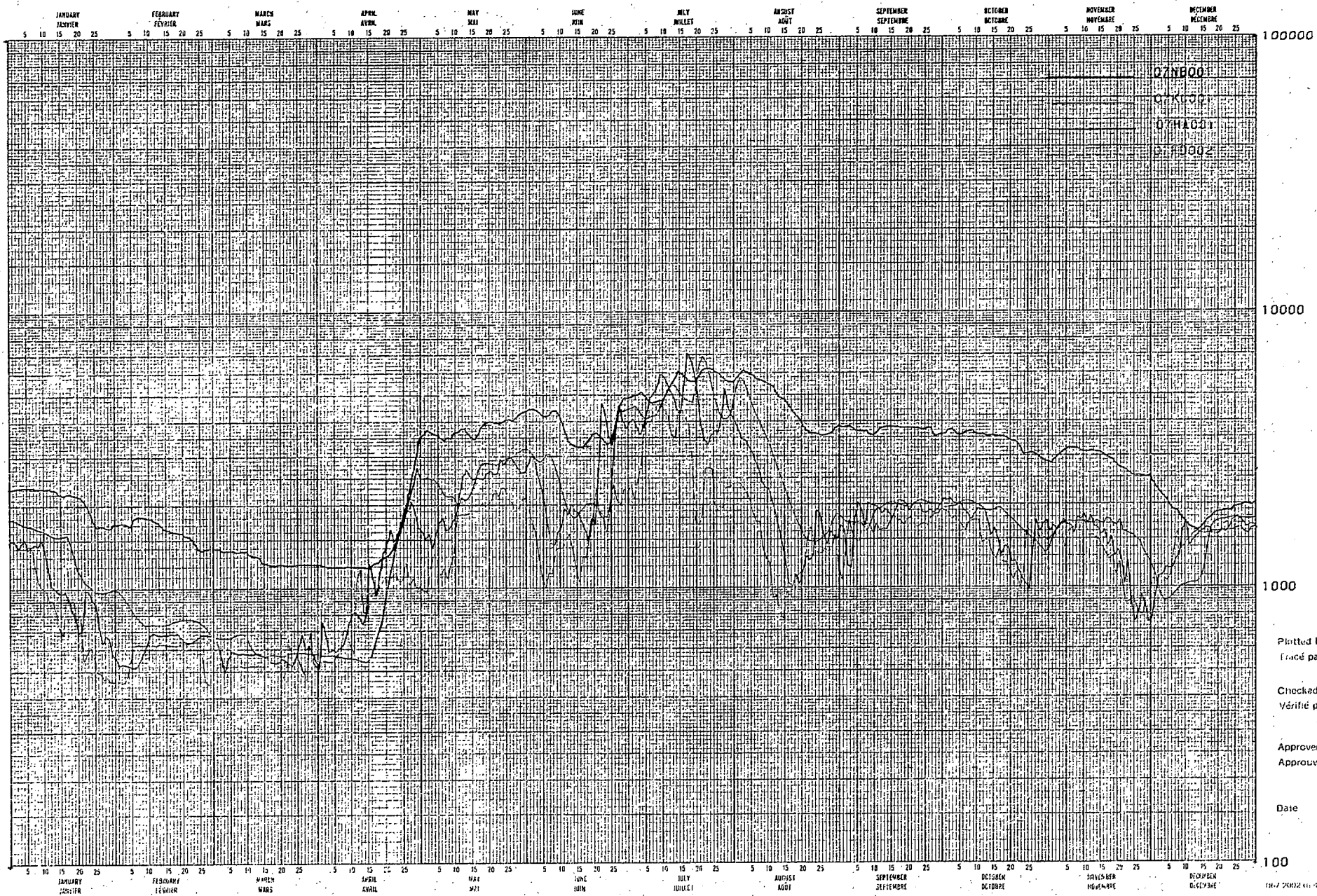


Environment Canada
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Environnement Canada
Direction des ressources en eau

Year 1963
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Station 07NB001 - SLAVE RIVER AT FITZGERALD



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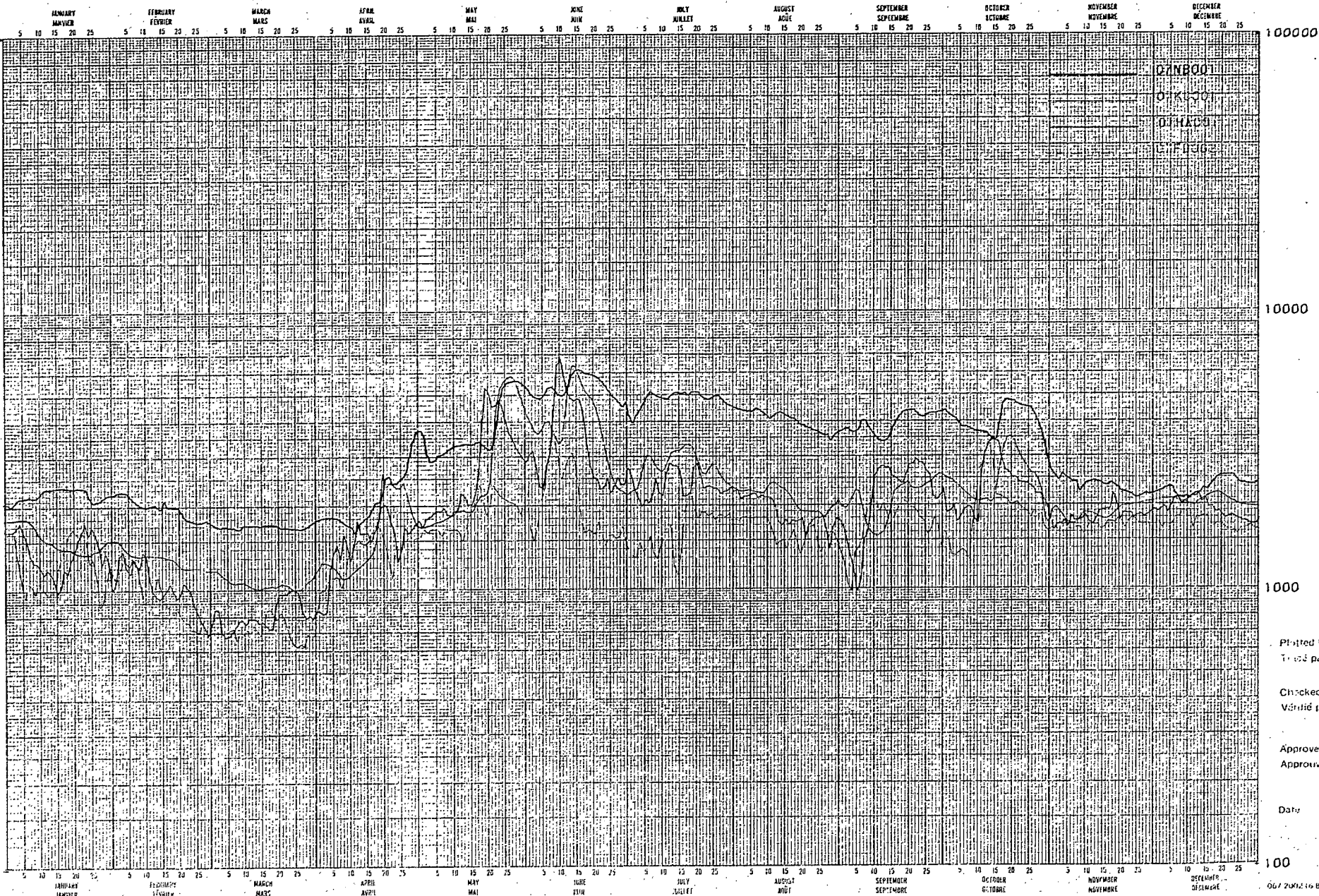
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