

PRAIRIE PROVINCES WATER BOARD

MEMORANDUM #8

STREAMFLOW FORECASTS

IN

THE PRAIRIE PROVINCES

AS OF JANUARY, 1965

Prepared by

E. F. DURRANT  
Engineering Secretary  
Prairie Provinces Water Board.

March, 1965

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Table 1: Summary of Streamflow Forecasts

Figure 1: Map showing locations for which streamflow forecasts can be made.

Regina, Saskatchewan,  
March 1st, 1965!

Members,  
Prairie Provinces  
Water Board.

Gentlemen:

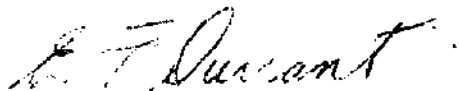
You have requested that a Summary be prepared of current streamflow forecasting activities in the Prairie Provinces. Your request is contained in the minutes of the Prairie Provinces Water Board meeting which was held on November 10th, 1964. Minute 30-7 of that meeting reads as follows:

"The subject of flow forecasting was discussed briefly. The Secretary was instructed to write to the members of the Board requesting for each Province, information as to:

- (a) what forecasting is being done and by whom;
- (b) purpose of forecasts;
- (c) method and type of forecasts. After receiving this information, the Secretary is to prepare a brief report on the matter for distribution to the Board Members".

In order to collect background information, the Secretary sent questionnaires to the Board Members. An excellent response was obtained. Some of the Members provided considerably more information than was requested.

This report is an attempt to summarize current forecasting activities for quick reference. In order to preserve the supplementary information received, the questionnaires and other material received have been brought together in an Appendix.



E. F. Durrant,  
Engineering Secretary,  
Prairie Provinces Water Board.

EFD-db

STREAMFLOW FORECASTS

IN THE PRAIRIE PROVINCES

The information supplied by the Board Members did not in all cases follow the outline suggested in the questionnaire. In order to present a useful reference table, some modification has been made to the submitted material. If the reader finds the resulting compilation, Table 1 too condensed for some purposes, it is suggested that reference be made to Appendix 1 which contains the original data submitted to the Secretary.

Both Table 1 and the Appendix are self-explanatory.

TABLE 1

SUMMARY OF STREAMFLOW FORECASTS

TABLE 1

## SUMMARY OF STREAMFLOW FORECASTS

STREAM	POINT FOR WHICH FORECAST MADE	AGENCY	FOR PUBLIC OR INTERNAL USE	TYPE & PURPOSE OF FORECAST	METHODS OF FORECAST	NO. ON MAP
South Saskatchewan River	Medicine Hat	Water Resources Branch (Canada)	Public	Stage Forecast for Flood Warning	Correlation upstream to downstream discharge converted to stage.	1
St. Mary River	International Boundary	Water Resources Branch (Canada)	Public	Volume forecast for long-term reservoir and irrigation operations.	Correlation of run-off volumes with snow surveys.	2
Bow River	Calgary	Water Resources Branch (Canada)	Public	Volume forecast for long-term reservoir & irrigation operations.	Correlation of run-off volumes with snow surveys.	3
Cypress Hills Area (International Streams)	International Boundary	Water Resources Branch (Canada)	Public	General run-off outlook. No quantitative predictions.	Comparison of current snow surveys and run-off with historical conditions.	4
Athabasca River	Lower Reaches	Water Resources Branch (Canada)	Public	Forecast of barge drafts for navigational purposes.	Upstream - downstream stage correlation.	5
MacKenzie River		Water Resources Branch (Canada)	Public	Stage forecast for navigational purposes.	Upstream - downstream discharge correlations converted to elevations.	6
Red River	Winnipeg	Red River Flood Forecasting Committee	Public	Stage and discharge for Flood Warning.	Multiple correlation of discharge with precipitation & antecedent conditions.	7
Bow River	Storage Reservoirs	Calgary Power Ltd.	Internal	Discharge Forecast for long-term reservoir operation.	Correlation of discharge with snow surveys.	8
Paddle River		Water Resources Branch (Alberta)	Internal	Stage & Discharge Forecasts for general internal use.	Correlation of discharge with snow surveys.	9
Marmot Creek	Main Weir	Eastern Rockies Forest Conservation Board.	Internal	Volume & Discharge Forecasts for research purposes.	Correlation of discharge with snow surveys.	10
Saskatchewan River	Squam Rapids	Saskatchewan Power Corporation	Internal	Discharge forecasts for Flood Warning, short term reservoir operation and system loading of hydro station.	Upstream - downstream discharge correlation.	

TABLE I  
SUMMARY OF STREAMFLOW FORECASTS

STREAM	POINT FOR WHICH FORECAST MADE	AGENCY	FOR PUBLIC OR INTERNAL USE	TYPE & PURPOSE OF FORECAST	METHOD OF FORECAST	NO. ON MAP
North Saskatchewan River	Prince Albert	Saskatchewan Water Resources Commission	Y	Winter Water Supply Forecast for short term reservoir operation planning and short term construction scheduling.	Multiple correlation of discharge (natural) with antecedent conditions.	11
North Saskatchewan River	Prince Albert	Saskatchewan Water Resources Commission	Y	Winter Water Supply Forecast for long term reservoir operation planning and long term construction scheduling.	Multiple correlation of discharge (natural) with antecedent conditions.	12
North Saskatchewan River	Prince Albert	Saskatchewan Water Resources Commission	Y	Spring & Summer Water Supply Forecast for long term reservoir operation planning, long term construction scheduling and flood warning.	Multiple correlation of discharge (natural) with precipitation and antecedent conditions.	13
North Saskatchewan River	Prince Albert	Saskatchewan Water Resources Commission	Y	River forecast for immediate reservoir operation planning, immediate construction scheduling and flood warning.	Upstream - downstream discharge correlation. Forecasts made as required during open water season.	14
South Saskatchewan River	Alberta/Saskatchewan Boundary	Saskatchewan Water Resources Commission	Y	Winter Water Supply Forecast for short term reservoir operation planning and short term construction scheduling.	Multiple correlation of discharge (natural) with antecedent flow.	15
South Saskatchewan River	Alberta/Saskatchewan Boundary	Saskatchewan Water Resources Commission	Y	Winter Water Supply Forecast for long term reservoir operation planning and long term construction scheduling.	Multiple correlation of discharge (natural) with antecedent flow.	16
South Saskatchewan River	Alberta/Saskatchewan Boundary	Saskatchewan Water Resources Commission	Y	Spring & Summer Water Supply Forecast for long term reservoir operation planning, long term construction scheduling & flood warning.	Multiple correlation of discharge (natural) with precipitation and antecedent conditions.	17

Forecast procedure developed, but not yet operational.

TABLE I

## SUMMARY OF STREAMFLOW FORECASTS

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STREAM	POINT FOR WHICH FORECAST MADE	AGENCY	FOR PUBLIC OR INTERNAL USE	TYPE & PURPOSE OF FORECAST	METHOD OF FORECAST	NO. ON MAP
Oleman River	Lethbridge	Saskatchewan Water Resources Commission	X	Water Supply Forecast for long, immediate and short term reservoir operation planning, long and short term & immediate construction scheduling and flood warning.	Recession curve at forecast station. Forecasts made after peak flow reached.	18
South Saskatchewan River	Medicine Hat	Saskatchewan Water Resources Commission	X	Water Supply Forecast for long and short term & immediate reservoir operation planning, long and short term and immediate construction scheduling and flood warning.	Recession curve at forecast station. Forecasts made after peak flow reached.	19
Red Deer River	Blindios (points downstream in Saskatchewan)	Saskatchewan Water Resources Commission	X	Water Supply Forecast for long & short term and immediate reservoir operation planning, long & short term and immediate construction scheduling and flood warning.	Recession curve at forecast station. Forecasts made after peak flow reached.	20
Winnipeg River		Water Control & Conservation Branch (Manitoba)	Public	Flood Stage Forecast to serve recreational interests.	Upstream - downstream stage relationships established by inflow - outflow routing.	21
Assiniboine River		Water Control & Conservation Branch (Manitoba)	Public	Stage, volume and discharge forecasts for flood warning, short term reservoir operation planning and operation of Rivers Reservoir to ensure minimum of 100 c.f.s. at Brandon.	(a) Upstream - downstream stage correlation, (b) multiple correlation of discharge with precipitation and antecedent conditions, (c) combination of (a) & (b), & (d) upstream - downstream stage relationships established by inflow - outflow routing.	22
Red River	Winnipeg	Water Control & Conservation Branch (Manitoba)	Public	Stage, volume & discharge forecasts for flood warning, and long range estimates of flow at Winnipeg concerning adequacy of dilution of treatment plant effluent.	(a) Upstream - downstream stage correlation, (b) multiple correlation of discharge with precipitation and antecedent conditions, (c) combination of (a) & (b), & (d) Upstream - downstream stage relationships established by inflow - outflow routing.	23

X - Forecast procedure developed, but not yet operational.



TABLE J

## SUMMARY OF STREAMFLOW FORECASTS

STREAM	POINT FOR WHICH FORECAST MADE	AGENCY	FOR PUBLIC OR INTERNAL USE	TYPE & PURPOSE OF FORECAST	METHOD OF FORECAST	NO. ON MAP
Saskatchewan River	The Pas & downstream	Water Control & Conservation Branch (Manitoba)	Public	Stage, volume & discharge forecasts for flood warning also for advance notice for operation of Summerberry Fur Block and Pasqua Reclamation Projects.	Upstream - downstream discharge correlation, upstream - downstream stage relationships established by inflow - outflow routing. (Procedures not revised since Squam Rapids Generating Station became operational; complete revision necessary when South Saskatchewan Reservoir becomes operational).	24
Saskatchewan River	The Pas & downstream	Manitoba Hydro	Internal	Spring volume forecast for long term reservoir operation planning.	Multiple correlation of discharge with precipitation and antecedent conditions. Correlation of discharge with snow surveys. (Not yet operational).	25
Winnipeg River		Manitoba Hydro Lake of the Woods Control Board Ontario Hydro	Internal	Volume forecast for long term reservoir operation planning, discharge forecast for short term reservoir operation planning.	Multiple correlation of discharge with precipitation and antecedent conditions (summer and fall run-off), correlation of volume with snow surveys (spring run-off).	26

APPENDIX



Department  
of Northern Affairs  
and National Resources Water Resources Branch

Ministère  
du Nord canadien et  
des Ressources nationales Direction des ressources hydrauliques

E.F. Durrant, Esq.,  
Engineering Secretary,  
Prairie Provinces Water Board,  
614 Motherwell Building,  
Regina, Saskatchewan.

Ottawa 4, February 8, 1965

our file / notre dossier

your file / votre dossier

204-G

Dear Mr. Durrant:

Thank you for your reminder of February 5 requesting completion of the questionnaires of flow forecasting.

The Branch provides, flood warnings and volume and stage forecasts to a limited extent. These services have been provided on request, as a result of the Branch's knowledge of critical run-off conditions or through the Branch's responsibilities for international waterways.

The Winnipeg District Office takes part in the work of the Red River Flood Forecasting Committee and the completed questionnaire for this activity is attached as Enclosure 1.

The Calgary District Office of the Branch provides flow forecasts on four rivers and stage forecasts on 3. Enclosure 2 is the completed questionnaire summarizing those activities. Further explanation of these activities is as follows:

**Flood Warnings:**

To City of Medicine Hat  
Prediction of stage to  $\pm 0.25$  feet  
Upstream-downstream discharge  
Correlation mainly - converted to stage.

**Reservoir Operations:**

St. Mary River Snow Survey  
Bow River Snow Survey  
Mainly for irrigation purposes

**Navigation:**

Athabasca River: Upstream-downstream stage correlation -  
accuracy unknown - forecast given in  
barge drafts.  
Mackenzie River: Upstream-downstream discharge - converted  
to elevations - 1964 accuracy ranged  
from 0.01 to over 1.0 foot.

General Run-off Conditions:

Cypress Hills Snow Survey: quantitative indications only  
-ns definite run-off predicted.

St. Mary River:           ▪  $\pm$  20%.

Yours sincerely,



R.H. Clark,  
Chief Hydraulic Engineer

Encl.

Enclosure 1.

FLOOD FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of Agency: THE FLOOD FORECASTING COMMITTEE

2. (a) River - Red

2. Type of forecast: \_\_\_\_\_ (stage X : volume : discharge X :)

3. Purpose of forecast:

(a) For issuing flood warnings

(b) For planning short-term reservoir operation  
(two weeks or less)

(c) For planning long-term reservoir operation  
(more than two weeks)

(d) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

(a) Upstream-downstream stage correlation

(b) Multiple correlation of discharge with precipitation and antecedent conditions  (Reliability Not Known)

(c) A combination of (a) and (b)

(d) Correlation of discharge with snow surveys

(e) Upstream-downstream stage relationships established by inflow-outflow routing

(f) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Reliability of forecasts:

(i)  $\pm 20\%$  or less

(ii)  $\pm 20\%$  to  $\pm 50\%$

(iii) Not known

(iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2-10-1960

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Water Resources Branch

2. Number of each  
Type of forecast: \_\_\_\_\_ (stage 3 : volume 4 : discharge :)

3. Purpose of forecast:

- (a) For issuing flood warnings  1
- (b) For planning short-term reservoir operation  
(two weeks or less)
- (c) For planning long-term reservoir operation  
(more than two weeks)  2
- (d) Other (please specify) Navigation  2  
General run-off conditions to be expected on  
International streams. 2

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation  ± 0.5 feet
- (b) Multiple correlation of discharge with precipitation and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys  5
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

5. Reliability of forecasts:

- (i) ± 20% or less
- (ii) ± 20% to ± 50%
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) None.

DEPARTMENT WATER RESOURCES



ALBERTA

104-00  
FILE NO.

TERRACE BUILDING  
EDMONTON, ALBERTA.  
January 11, 1965.

Mr. E. F. Durrant  
Engineering Secretary  
Prairie Provinces Water Board  
614 Motherwell Building  
Regina, Saskatchewan.

Dear Mr. Durrant:

Your letter of January fourth with questionnaires regarding flow forecasting has been received.

The feeling here is that flow conditions in the Saskatchewan River, as revealed in the hydrometric records, indicate a reasonably satisfactory condition. In order to improve flow conditions we now need upstream storage dams that we can operate to take care of the unpredictable irrigation demands.

You will appreciate that, although Calgary Power Ltd. upstream storage dams are highly beneficial in ironing out the flow, there is a definite limit to the demands we can make on them. Neither of the senior governments contributed to the cost of these reservoirs.

The St. Mary and Waterton dams helped to iron out the 1964 Waterton flood but when full development of the St. Mary and Milk Rivers Development is reached these reservoirs will be primarily for irrigation.

Our present arrangements for flow regulation call for watermastering at times when flow is too high or too low. As you know, the Department of Northern Affairs carry on an active and valuable snow survey program. they also broadcast warnings of high water and alert the downstream interests to rising river stages. In recent years the meteorological

Mr. E. F. Durrant

January 11, 1965.

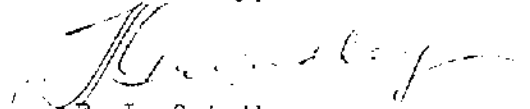
people keep us advised of any extraordinary precipitation and this, too, is a valuable service. In addition, our Hydrology Division keep in touch with the overall picture. All of these agencies combined have produced reasonably satisfactory results.

The creation of upstream storage in Alberta, that we can operate to counteract the unpredictable demands of irrigation, is absolutely essential. When we have this upstream storage we can think seriously about flow forecasting and regulation.

Much of the credit for the excellent flow conditions being maintained in the North and South Saskatchewan Rivers during the winter should go to a member of our staff, Mr. J. L. Reid. Because of his experience and knowledge and constant liaison with Calgary Power Limited, he has combined all the various components that go into flow forecasting to produce very valuable results to everyone concerned. For many years he has labored with the problems associated with operating hydro plants in winter and is now an authority on ice movements and measures to mitigate the effects of the complex forces involved in icing.

I would suggest that copies of this letter be forwarded to the other members of the Board.

Yours truly,



P. L. Grindley

Director of Water Resources.

c.c. - R. E. Bailey  
J. L. Reid  
A. G. Underhill



204-67

DEPARTMENT WATER RESOURCES



ALBERTA

FILE No. Gen. 52

TERRACE BUILDING  
EDMONTON, ALBERTA.

January 26, 1965.

Mr. E. F. Durrant  
Engineering Secretary  
Prairie Provinces Water Board  
Motherwell Building  
Regina, Saskatchewan.

Dear Mr. Durrant:

Re: Flow Forecasting

Attached are three forms of your Questionnaire which have been filled out, and an explanatory memorandum from Mr. Underhill in this connection.

Yours truly,

F. L. Grindley  
Director of Water Resources.

Att'd

MEMORANDUM

OUR FILE NO

YOUR FILE NO

FROM A.S. Hosenbill, P. Eng.,  
District Engineer, Water Resources

TO Mr. F.H. Grindley, Director  
Water Resources Office,  
Terrace Building,  
Edmonton, Alberta.

DATE January 22, 1965.

Re: Flow Forecast - F.P.W.R. Forms

I have discussed this problem with Mr. May. He has received similar forms from Mr. R.H. Clark and so he will be submitting these to Mr. Durrant. It would seem, therefore, the only other forms which could be submitted would be on (a) our own snow and forecast surveys made by the Edmonton office or (b) the forecasts made by private organizations i.e. Calgary Power.

I do not think that these forms were intended to take into account reservoir operation but rather whether any method of forecasting the flows into the reservoir was undertaken. Also whether any forecasting was done on our rivers during high flows for flood protection.

The only work that I would suggest that we should submit is:

(a) Calgary Power which actually can be very simply filled in without any further information from the Power company. i.e. they use snow surveys etc to forecast the amount of runoff which will come into their reservoirs. This is all I can see that could be included here.

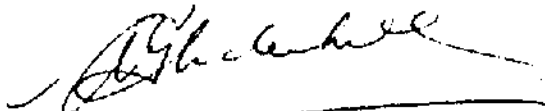
(b) The snow surveys etc which R. Deeprose undertakes in the area north of Edmonton. i.e. Paddle river could be included, if they are still operated i.e. snow surveys used for stage estimation using a correlation of discharge with snow surveys.

While Calgary Power might have estimated their reliability I would hesitate to include on the sheet so I would propose to leave this blank.

There may be other flow forecasting stations or operations. Those operated by the Federal Water Resources will be reported by them so that we need only to report the ones operated privately or by ourselves.

I have filled in three of these forms which could be submitted to the P.P.W.B. If they are submitted a note should be included stating that the flow forecasting done by the Federal Water Resources in Alberta will be submitted by them. They of course have the St Mary River snow survey, the Bow River survey, Elbow River survey and the Cypress Hills surveys etc operating in Alberta.

I hope this meets their requirements. The remaining forms are attached hereto.



A.W. UNDERHILL, P. Eng.,  
District Engineer.

AGU:lg  
enc.

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Calgary Power Co. Ltd.

1. (a) River - Bow

2. Type of forecast: \_\_\_\_\_ (stage : volume : discharge x :)

3. Purpose of forecast:

(a) For issuing flood warnings

(b) For planning short-term reservoir operation  
(two weeks or less)

(c) For planning long-term reservoir operation  
(more than two weeks)

(d) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_.

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

(a) Upstream-downstream stage correlation

(b) Multiple correlation of discharge with precipitation  
and antecedent conditions

(c) A combination of (a) and (b)

(d) Correlation of discharge with snow surveys

(e) Upstream-downstream stage relationships established  
by inflow-outflow routing

(f) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_.

5. Reliability of forecasts:

(i)  $\pm 20\%$  or less

(ii)  $\pm 20\%$  to  $\pm 50\%$

(iii) Not known

(iv) Other (please specify)

6. Forecasting procedures presently under study but not  
yet operational

(Please describe briefly) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_.

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Alberta Government, Water Resources Branch

1. (a) River - Paddle

2. Type of forecast: \_\_\_\_\_ (stage ✓ ; volume ; discharge ✓ ;)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation  
(two weeks or less)
- (c) For planning long-term reservoir operation  
(more than two weeks)
- (d) Other (please specify) General office use

\_\_\_\_\_  
\_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Eastern Rockies Watershed Research Group

1. (a) River - Marmot Creek ( Experimental Watershed )

2. Type of forecast: \_\_\_\_\_ (stage : volume : discharge :)

3. Purpose of forecast:

(a) For issuing flood warnings

(b) For planning short-term reservoir operation  
(two weeks or less)

(c) For planning long-term reservoir operation  
(more than two weeks)

(d) Other (please specify) \_\_\_\_\_

Research  
\_\_\_\_\_  
\_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

(a) Upstream-downstream stage correlation

(b) Multiple correlation of discharge with precipitation  
and antecedent conditions

(c) A combination of (a) and (b)

(d) Correlation of discharge with snow surveys

(e) Upstream-downstream stage relationships established  
by inflow-outflow routing

(f) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Reliability of forecasts:

(i)  $\pm$  20% or less

(ii)  $\pm$  20% to  $\pm$  50%

(iii) Not known

(iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Province of  Saskatchewan

SASKATCHEWAN WATER RESOURCES COMMISSION

WATER RIGHTS BRANCH

REGINA

11th Floor  
SPC Building

RECEIVED  
JAN 18 1965  
CENTRAL REGISTRY  
P.F.R.A.  
REGINA

Your file: 204-~~E~~

REFER TO FILE

35051 Q

January 15, 1965.

Mr. E. F. Durrant,  
Engineering Secretary,  
Prairie Provinces Water Board,  
c/o P.F.R.A.,  
Motherwell Building,  
Regina, Saskatchewan.

Dear Mr. Durrant:

Re: Flow Forecasting

Attached herewith are two copies of three tables indicating details of flow forecasting currently being undertaken by the Investigation and Planning Branch of S.W.R.C. This tabulation was used in lieu of the questionnaire form attached to your letter of 4 January 1965. I understand Roy Rodgers discussed this change with you.

Enclosed also are four reports by R. R. Rodgers on flow forecasting techniques entitled:

1. Preliminary Report: A Study of Time of Water Travel on the Saskatchewan Rivers and Tributaries dated January, 1964.
2. Preliminary Report on River Flow Forecasting - North Saskatchewan River dated January, 1964.
3. Forecasting Winter Water Supply on the North and South Saskatchewan Rivers revised to July, 1964.
4. Spring and Summer Water Supply Forecasts for the North and South Saskatchewan Rivers dated October, 1964.

These reports have not yet been submitted to the Water Resources Commission for approval and are not intended to indicate procedures now in effect. However, they may serve as an indication of the

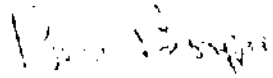
Mr. E. F. Durrant

January 15, 1965.

general type of flow forecasting proposed by the Investigation and Planning Branch of S.W.R.C. and to emphasize the need for Interprovincial planning of flow forecasting.

Copies of the Flow Forecasting questionnaire are expected from S.P.C. and will be forwarded to you on receipt.

Yours sincerely,



Bert Boyson,  
Director.

BB/eft  
Encl.

c.c. for: J. W. MacNeill  
S. R. Blackwell



FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Saskatchewan Power Corporation

1. (a) River - Saskatchewan

2. Type of forecast: \_\_\_\_\_ (stage : volume : discharge<sup>✓</sup> :)

3. Purpose of forecast:

(a) For issuing flood warnings

(b) For planning short-term reservoir operation  
(two weeks or less)

(c) For planning long-term reservoir operation  
(more than two weeks)

(d) Other (please specify) Day-to-day forecasts are  
used to plan system load dispatching in regards  
to Squaw Rapids Hydro-Electric Station

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

(a) Upstream-downstream stage correlation

(b) Multiple correlation of discharge with precipitation  
and antecedent conditions

(c) A combination of (a) and (b)

(d) Correlation of discharge with snow surveys

(e) Upstream-downstream stage relationships established  
by inflow-outflow routing

(f) Other (please specify) Please find attached  
sheet.

5. Reliability of forecasts:

(i) ~~± 20% or less~~

(ii) ± 20% to ± 50%

(iii) Not known

(iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) None

4. (f) Method of Forecasting Used is as Follows:

Gauge height readings are received from the following stations: Red Deer, Calgary, Lethbridge, Bindloss, Medicine Hat, Edmonton, Saskatoon, St. Louis, and Prince Albert.

The only stations used for forecasting are Medicine Hat, Bindloss, and Edmonton.

The gauge heights received from the three above stations are corrected and converted to discharge in CFS. taking flow lag to Squaw Rapids. The flows from Bindloss, Medicine Hat, and Edmonton are added together to give the forecast flow at Squaw Rapids some days later which is an approximate 10 day forecast.

The sum of flows at Prince Albert and St. Louis are used as the flow which will reach the Squaw Rapids Hydro-Electric Station with two days lag period.

Reliability of forecasts from Bindloss, Medicine Hat, and Edmonton to actual flows has been approximately  $\pm 20\%$ .

Table I

FORECASTS AVAILABLE IN NORTH SASKATCHEWAN BASIN  
As of January, 1965

NO.	TYPE OF FORECAST	FORECAST STATION	DATE OF FORECAST	FORECAST PERIOD (Inc.)	USES OF FORECAST	RELIABILITY <sup>1/</sup> OF FORECASTS				METHOD OF FORECAST
						F	2/	3/	4/	
1	Winter Water Supply	North Sask. @ Prince Albert	Sept. 30	Oct.	C, F	0.62	1,050	0.17		Multiple correlation of discharge (natural) with antecedent conditions
2	"	"	Sept. 30	Oct.-Mar.	B, E	0.82	2,490	0.17		"
3	"	"	Oct. 31	Nov.	C, F	0.87	500	0.17		"
4	"	"	Oct. 31	Nov.-Mar.	B, E	0.83	1,120	0.13		"
5	"	"	Nov. 30	Dec.	C, F	0.74	393	0.23		"
6	"	"	Nov. 30	Dec.-Mar.	B, E	0.74	1,030	0.19		"
7	"	"	Dec. 31	Jan.	C, F	0.69	310	0.23		"
8	"	"	Dec. 31	Jan.-Mar.	B, E	0.81	610	0.15		"
9	"	"	Jan. 31	Feb.	C, F	0.85	160	0.13		"
10	"	"	Jan. 31	Feb.-Mar.	B, E	0.62	380	0.15		"
11	"	"	Feb. 28 (29)	Mar.	C, F	0.74	260	0.20		"
12	Spring & Summer Water Supply	North Sask. @ Prince Albert	Feb. 28 (29)	Mar.-Sept.	B, E, H	0.84	12,770	0.15		Multiple correlation of discharge (Natural) with precipitation & antecedent conditions
13	"	"	Mar. 31	Apr.-Sept.	B, E, H	0.81	13,620	0.16		"
14	"	"	Apr. 30	May -Sept.	B, E, H	0.75	14,800	0.20		"
15	Water	"	As req'd (in open water Season)	1 - 9 days	D, G, H	About ± 6% (based on results from one year)				Upstream-downstream discharge correlation

Uses of Forecast

- A. Water Supply Guide.
- B. Long Term Reservoir Operation Planning.
- C. Short Term Reservoir Operation Planning (1 month or less).
- D. Immediate Reservoir Operation Planning.
- E. Long Term Construction Scheduling.
- F. Short Term Construction Scheduling.
- G. Immediate Construction Scheduling.
- H. Flood Warning.

1/

Measures of reliability given are for theoretical forecasts based on Natural flows. Until an arrangement can be made with Alberta for exchange of data regarding anticipated water requirements for irrigation and power, some accuracy will be lost in converting to working forecasts since these requirements must now be estimated on the basis of limited recorded data. Coefficient of correlation.

2/ Standard error of estimate (in cfsm).

3/ m = mean flow value of forecast period for the years of record used in developing forecast.

2/

3/

4/

Table II

FORECASTS AVAILABLE IN SOUTH SASKATCHEWAN BASIN

As of January, 1965

NO.	TYPE OF FORECAST	FORECAST STATION	DATE OF FORECAST	FORECAST PERIOD (Inc.)	USES OF FORECAST	RELIABILITY 1/ OF FORECASTS			METHOD OF FORECAST
						2/ F	3/ E	4/ S/m	
16	Winter Water Supply	South Sask. @ Alta.-Sask. Bdy.	Sept. 30	Oct.	C, F	0.90	1,490	0.22	Multiple correlation of discharge (natural) with antecedent flow
17	"	"	Sept. 30	Oct.-Mar.*	B, E	0.85	3,920	0.19	"
18	"	"	Sept. 30	Oct.-Mar.	B, E	0.79	5,310	0.24	"
19	"	"	Oct. 31	Nov.	C, F	0.88	860	0.20	"
20	"	"	Oct. 31	Nov.-Mar.*	B, E	0.94	1,480	0.11	"
21	"	"	Oct. 31	Nov.-Mar.	B, E	0.73	3,500	0.25	"
22	"	"	Nov. 30	Dec.	C, F	0.86	440	0.17	"
23	"	"	Nov. 30	Dec.-Mar.*	B, E	0.67	2,130	0.22	"
24	"	"	Nov. 30	Dec.-Mar.	B, E	0.59	3,720	0.12	"
25	"	"	Dec. 31	Jan.	C, F	0.66	780	0.37	"
26	"	"	Dec. 31	Jan.-Mar.*	B, E	0.67	1,690	0.24	"
27	"	"	Dec. 31	Jan.-Mar.	B, E	0.58	3,260	0.37	"
28	"	"	Jan. 31	Feb.	C, F	0.53	870	0.36	"
29	"	"	Jan. 31	Feb.-Mar.*	B, E	0.62	1,230	0.25	"
30	"	"	Jan. 31	Feb.-Mar.	B, E	0.75	2,380	0.36	"
31	"	"	Feb. 28 (29)	Mar.*	C, F	0.65	560	0.21	"
32	"	"	Feb. 28 (29)	Mar.	C, F	0.70	1,830	0.41	"
33	Spring & Summer Water Supply	"	Feb. 28 (29)	Mar.-Sept.	B, E, H	0.90	15,380	0.14	Multiple correlation of discharge (natural) with precipitation & antecedent cond.
34	"	"	Mar. 31	Apr.-Sept.	B, E, H	0.88	16,610	0.16	"
35	"	"	Apr. 30	May -Sept.	B, E, H	0.91	13,510	0.14	"
36	Water Supply	Oldman River @ Lethbridge	After peak flow reached	Until recession flow alters	A to H incl.	Not known, but believed reliable			Recession curve at Forecast Station
37	"	South Sask. River @ Medicine Hat	"	"	"	"	"	"	"
38	"	Red Deer River @ Bindloss	"	"	"	"	"	"	"

Table II --- continued

Uses of Forecast

- A. Water Supply Guide.
- B. Long Term Reservoir Operation Planning.
- C. Short Term Reservoir Operation Planning. \*\*
- D. Immediate Reservoir Operation Planning.
- E. Long Term Construction Scheduling.
- F. Short Term Construction Scheduling.
- G. Immediate Construction Scheduling.
- H. Flood Warning.

\* Forecast valid when late spring runoff occurs.

1/ Measures of reliability are for theoretical forecasts based on Natural flows. Until an arrangement can be made with Alberta for exchange of data regarding anticipated water requirements for irrigation and power, some accuracy will be lost in converting to working forecasts since these requirements must now be estimated on the basis of limited recorded data.

2/ Coefficient of correlation.

3/ Standard error of estimate (in cfsm).

4/ m = mean flow value of forecast period for the years of record used in developing forecast.

\*\* 1 month or less.

Table III

## ADDITIONAL FORECASTS TO BE DEVELOPED IN THE SASKATCHEWAN-QU'APPELLE SYSTEM

NO.	TYPE OF FORECAST	FORECAST STATION	DATE OF FORECAST	FORECAST PERIOD (incl.)	USES OF FORECAST	PROB. DATE AVAILABLE 1/	PROBABLE METHOD OF FORECAST
A -- SASKATCHEWAN RIVER BELOW THE FORKS							
	River	Sask. River @ Tobin Reservoir	As req'd	1 day to about 2 wks.	D, G, H	Apr., 1965 (1)	Combine N & S Sask. River forecasts to yield inflow to Tobin Reservoir.
	Flood	Sask. River @ Tobin Reservoir	As req'd	N.A.	D, G, H	Oct., 1965 (6)	Recession Curve at Nipawin.
	Water Supply	Sask. River @ Tobin Reservoir	After peak flow reached	Until recession flow alters	D, G, H	May, 1965 (2)	
B -- NORTH SASKATCHEWAN RIVER BASIN							
	River	N.Sask. R. @ Prince Albert	As req'd	1 day to about 2 wks.	D, G, H	Apr., 1965 (1)	Revise fore. #15. Try "stage" forecasts & compare with discharge forecasts.
	Flood	N.Sask. R. @ Prince Albert	As req'd	N.A.	D, G, H	Sept., 1965 (5)	Upstream-downstream stage correlation.
	Flood	N.Sask. R. @ Edmonton	As req'd	N.A.	D, G, H	Sept., 1965 (5)	Upstream-downstream stage correlation. Unit hydrographs, etc.
	Flood	N.Sask. R. @ Rocky Mtn. House	As req'd	N.A.	D, G, H	Sept., 1965 (5)	Unit hydrographs, etc.
	Flood	Brazeau Dam on Brazeau River	As req'd	N.A.	D, G, H	Sept., 1965 (5)	Unit hydrographs, etc.
	Water Supply	N.Sask. R. @ Prince Albert	As req'd	Until recession flow alters	A to H	May, 1965 (2)	Recession curve at Forecast Station.
	Water Supply	N.Sask. R. @ Edmonton	As req'd	Until recession flow alters	A to H	May, 1965 (2)	Recession curve at Forecast Station.
	Water Supply	N.Sask. R. @ Rocky Mtn. House	As req'd	Until recession flow alters	A to H	May, 1965 (2)	Recession curve at Forecast Station.
C -- SOUTH SASKATCHEWAN RIVER BASIN							
	River	S.Sask. R. @ Lemsford Ferry	As req'd	1 day to about 2 wks.	D, G, H	Apr., 1965 (1)	Upstream-downstream stage correlation.
	River	S.Sask. R. @ St. Louis	As req'd	1 day to about 2 wks.	D, G, H	Apr., 1965 (1)	Upstream-downstream stage correlation.
	Flood	S.Sask. R. @ Lemsford Ferry	As req'd	N.A.	D, G, H	July, 1965 (4)	Upstream-downstream stage & recession curve correlations. Unit hydrographs, etc.

continued - - -

Table III ----- continued

NO.	TYPE OF FORECAST	FORECAST STATION	DATE OF FORECAST	FORECAST PERIOD (Incl.)	USES OF FORECAST	PROB. DATE AVAILABLE 1/	PROBABLE METHOD OF FORECAST
SOUTH SASKATCHEWAN RIVER BASIN							
	Flood	Red Deer R. @ Dindigos	As req'd	N.A.	D, G, H	July, 1965 (4)	
	Flood	S. Sask. R. @ Macleod	As req'd	N.A.	D, G, H	July, 1965 (4)	
	Flood	Oldman R. @ Lethbridge	As req'd	N.A.	D, G, H	July, 1965 (4)	
	Flood	Oldman R. @ Macleod	As req'd	N.A.	D, G, H	July, 1965 (4)	Upstream-downstream stage & recession curve correlations. Unit hydrographs, etc.
	Flood	Bow R. @ Calgary	As req'd	N.A.	D, G, H	July, 1965 (4)	
	Water Supply	S. Sask. R. @ Lonsford Ferry	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)	
	Water Supply	Oldman R. @ Macleod	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)	
	Water Supply	Bow R. @ Calgary	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)	Recession curve at Forecast Station.
QU'APPELLE RIVER COMPLEX							
	Spring & Summer Water Supply	Qu'Appelle R. @ Buffalo Pound	March 15		B, E, H	Apr., 1965 (1)	
	Spring & Summer Water Supply	Qu'Appelle R. @ Craven Inc. L.M.	March 15		B, E, H	Apr., 1965 (1)	
	Spring & Summer Water Supply	Qu'Appelle R. @ Katopwa	March 15		B, E, H	Apr., 1965 (1)	Multiple correlation of discharge with precipitation & antecedent conditions.
	Spring & Summer Water Supply	Qu'Appelle R. @ Round Lake	March 15		B, E, H	Apr., 1965 (1)	
	Spring & Summer Water Supply	Moose Jaw Cr. @ Mouth	March, 15		B, E, H	Apr., 1965 (1)	
	Flood	Various Locations	As req'd	N.A.	D, G, H	June, 1965 (3)	Upstream-downstream stage & recession curve correlations. Unit hydrographs, etc.

continued - - -

Table III ----- continued

NO.	TYPE OF FORECAST	FORECAST STATION	DATE OF FORECAST	FORECAST PERIOD (Incl.)	USES OF FORECAST	PROB. DATE AVAILABLE I/	PROBABLE METHOD OF FORECAST	
SOUTH SASKATCHEWAN RIVER BASIN								
	Flood	Red Deer R. @ Windloss	As req'd	N.A.	D, G, H	July, 1965 (4)	Upstream-downstream stage & recession curve correlations, Unit hydrographs, etc.	
	Flood	S. Sask. R. @ Wind. Est.	As req'd	N.A.	D, G, H	July, 1965 (4)		
	Flood	Oldman R. @ Lethbridge	As req'd	N.A.	D, G, E	July, 1965 (4)		
	Flood	Oldman R. @ Macleod	As req'd	N.A.	D, G, H	July, 1965 (4)		
	Flood	Bow R. @ Calgary	As req'd	N.A.	D, G, H	July, 1965 (4)		
	Water Supply	S. Sask. R. @ Lonsford Ferry	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)	Recession curve at Forecast Station.	
	Water Supply	Oldman R. @ Macleod	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)		
	Water Supply	Bow R. @ Calgary	After peak flow reached	Until recession flow alters	A to H	May, 1965 (2)		
QU'APPELLE RIVER COMPLEX								
	Spring & Summer Water Supply	Qu'Appelle R. @ Buffalo Pound	March 15		B, E, H	Apr., 1965 (1)	Multiple correlation of discharge with precipitation & antecedent conditions.	
	Spring & Summer Water Supply	Qu'Appelle R. @ Craven Inc. LML	March 15		D, E, H	Apr., 1965 (1)		
	Spring & Summer Water Supply	Qu'Appelle R. @ Katapwa	March 15		B, E, H	Apr., 1965 (1)		
	Spring & Summer Water Supply	Qu'Appelle R. @ Round Lake	March 15		B, E, H	Apr., 1965 (1)		
	Spring & Summer Water Supply	Moose Jaw Cr. @ Mouth	March 15		B, E, H	Apr., 1965 (1)		
	Flood	Various Locations	As req'd	N.A.	D, G, H	June, 1965 (3)		
								Upstream-downstream stage & recession curve correlations, Unit hydrographs, etc.

continued - - - -



Table III ----- continued

<u>Uses of Forecast</u>	<u>Proposed Order of Forecast Development</u>
A. Water Supply Guide.	(1) April, 1965
B. Long Term Reservoir Operation Planning.	(2) May, 1965
C. Short Term Reservoir Operation Planning.**	(3) June, 1965
D. Immediate Reservoir Operation Planning.	(4) July, 1965
E. Long Term Construction Scheduling.	(5) September, 1965
F. Short Term Construction Scheduling.	(6) October, 1965
G. Immediate Construction Scheduling.	
H. Flood Warning.	

1/ Work on forecast development is continuing.  
 Date forecasts will be available depends  
 primarily on staff availability.

\*\* 1 month or less.



PROVINCE OF MANITOBA



DEPARTMENT OF AGRICULTURE AND CONSERVATION  
WATER CONTROL AND CONSERVATION BRANCH  
LEGISLATIVE BUILDING  
WINNIPEG 1

PLANNING DIVISION

Your File 204-G  
Our File No. 8.2

January 13, 1965.

Mr. E. F. Durrant,  
Engineering Secretary,  
Prairie Provinces Water Board,  
614 Motherwell Building,  
Regina, Saskatchewan.

Dear Mr. Durrant:

Your letter of January 4, 1965 to Mr. Griffiths has been referred to me for direct action and reply. The attached questionnaires have been completed with regard to flow forecasting in Manitoba. I have taken the liberty of adding an item 1 (a) to indicate the river concerned since the type, purpose and method of forecast varies from river to river.

Yours very truly,

N. MUDRY, P. Eng.,  
Chief, Planning Division.

VMA/ms  
Encl.

# FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Water Control and Conservation Branch
  
1. (a) River - Winnipeg
  
2. Type of forecast: (stage X : volume : discharge :)
  
  
3. Purpose of forecast:
  - (a) For issuing flood warnings to recreational interests
  - (b) For planning short-term reservoir operation (two weeks or less)
  - (c) For planning long-term reservoir operation (more than two weeks)
  - (d) Other (please specify) \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  
  
4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):
  - (a) Upstream-downstream stage correlation
  - (b) Multiple correlation of discharge with precipitation and antecedent conditions
  - (c) A combination of (a) and (b)
  - (d) Correlation of discharge with snow surveys
  - (e) Upstream-downstream stage relationships established by inflow-outflow routing
  - (f) Other (please specify) \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  
  
5. Reliability of forecasts:
  - (i)  $\pm 20\%$  or less
  - (ii)  $\pm 20\%$  to  $\pm 50\%$
  - (iii) Not known
  - (iv) Other (please specify)
  
  
6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Water Control and Conservation Branch

1. (a) River - Assiniboine

2. Type of forecast: \_\_\_\_\_ (stage X ; volume X ; discharge X ;)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation (two weeks or less)
- (c) For planning long-term reservoir operation (more than two weeks)
- (d) Other (please specify) operation of Rivers   
Reservoir to insure a minimum flow of 100 c.f.s. at Brandon

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_   
\_\_\_\_\_  
\_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$  X
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Water Control and Conservation Branch

1. (a) River - Red

2. Type of forecast: (stage X ; volume X ; discharge X ;)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation (two weeks or less)
- (c) For planning long-term reservoir operation (more than two weeks)
- (d) Other (please specify) long range estimates of flow at Winnipeg re adequacy of dillution of treatment plant effluent

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$  X
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Manitoba Hydro

1. (a) River - Saskatchewan River

2. Type of forecast: \_\_\_\_\_ (stage ; <sup>spring</sup> volume X ; discharge :)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation  
(two weeks or less)
- (c) For planning long-term reservoir operation  
(more than two weeks)
- (d) Other (please specify) \_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation  
and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys
- (e) Upstream-downstream stage relationships established  
by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$  X
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) The method is not yet operational. It is anticipated that forecasts will be made on the above basis with the noted degree of accuracy.

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Manitoba Hydro

1. (a) River - Saskatchewan River

2. Type of forecast: \_\_\_\_\_ (stage ; spring volume X ; discharge ;)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation (two weeks or less)
- (c) For planning long-term reservoir operation (more than two weeks)
- (d) Other (please specify) \_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation and antecedent conditions
- (c) A combination of (a) and (b)
- (d) Correlation of discharge with snow surveys
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$  X
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) The method is not yet operational. It is anticipated that forecasts will be made on the above basis with the noted degree of accuracy.

FLOW FORECASTING

(Please fill in blanks or indicate appropriate answer)

1. Name of agency: Manitoba Hydro in co-operation with Lake of the Woods Control Board and Ontario Hydro.

1. (a) River - Winnipeg River

2. Type of forecast: \_\_\_\_\_ (stage : volume X : discharge X ;)

3. Purpose of forecast:

- (a) For issuing flood warnings
- (b) For planning short-term reservoir operation (two weeks or less)  discharge
- (c) For planning long-term reservoir operation (more than two weeks)  volume
- (d) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

4. Method of Forecasting (indicate reliability of forecast by using the appropriate number from Part 5):

- (a) Upstream-downstream stage correlation
- (b) Multiple correlation of discharge with precipitation and antecedent conditions  summer and fall runoff
- (c) A combination of (a) and (b)
- (d) Correlation of <sup>volume</sup> discharge with snow surveys  spring runoff
- (e) Upstream-downstream stage relationships established by inflow-outflow routing
- (f) Other (please specify) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Reliability of forecasts:

- (i)  $\pm 20\%$  or less
- (ii)  $\pm 20\%$  to  $\pm 50\%$  X
- (iii) Not known
- (iv) Other (please specify)

6. Forecasting procedures presently under study but not yet operational

(Please describe briefly) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_