

PROVINCE OF MANITOBA

DEPARTMENT OF AGRICULTURE



AND CONSERVATION

WATER CONTROL AND CONSERVATION BRANCH

ST. MALO RESERVOIR OPERATION STUDY

60-7
NOT TO BE
TAKEN FROM
FILE

May 1960
Winnipeg, Manitoba.

Prepared By:
Planning Division

Province of Manitoba
Department of Agriculture and Conservation
WATER CONTROL AND CONSERVATION BRANCH

ST. MALO RESERVOIR OPERATION STUDY

May 1960
Winnipeg, Manitoba.

Prepared By:
Planning Division

SYNOPSIS

During the early summer of 1959 the P.F.R.A. on behalf of the Province completed the construction of an earthfill dam on the Rat River just east of the Village of St. Malo. In accordance with the agreement between Manitoba and the P.F.R.A., the responsibility for the operation and maintenance of the dam and reservoir will be assumed by the Province, one year after completion of the project.

A study has been undertaken of various uses which can be made of the St. Malo Reservoir with the object of determining the use which would be of the greatest benefit to those concerned. This use has been found to be that of water conservation for municipal supply and domestic purposes including stockwatering.

This method of operation would provide a dependable flow in the Rat River below the reservoir of 5 c.f.s. Over the past 35 years the flow of this river has been less than 5 c.f.s. 30% of the time. The type of operation set forth herein, which has as its main objective water conservation for domestic, municipal, industrial and agricultural purposes, would at the same time provide reservoir levels reasonably well suited to the minor use of recreation.

This report deals with the study described above and presents its results and conclusions along with a recommended method of regulation to be followed if it is agreed that the reservoir is to be operated for the prime purpose of water conservation. The report also recommends certain precautions which should be taken by the Government should it decide to authorize recreational development in the vicinity of this reservoir.

TABLE OF CONTENTS

	Page
Introduction	1
St. Malo Dam and Reservoir	3
Flood Control	4
Water Requirements Downstream from St. Malo Reservoir	6
Recreation	9
Reservoir Operation,	10
Conclusions	12
Recommendations	13

LIST OF FIGURES

Fig.1 Key Plan St. Malo Reservoir

Fig.2 St. Malo Reservoir Levels with Proposed Method of Operation

INTRODUCTION

The construction of an earthfill dam on the Rat River near St. Malo will create a storage reservoir with a capacity of 1,750 acre feet. The total cost of the project was approximately one quarter of a million dollars. The dam was completed by the P.F.R.A., on behalf of the Province, during the summer of 1959 and the reservoir was filled during the spring of 1960.

The type of operation selected depends on the water conservation, flood control and recreational benefits which may be derived, together with the extent of such benefits and their relative importance. In view of the negligible flood control benefits, emphasis has been placed on the water conservation and recreational advantages which could accrue.

A method of operation is suggested which will provide a dependable flow in the Rat River below the reservoir adequate for uses which will occur in the future. Estimates of future municipal supply requirements of the Villages of St. Malo, St. Pierre and Otterbourne as well as agricultural requirements along the Rat River indicate that a minimum volume of 300 acre feet per month, (or a continuous rate of 5 c.f.s.) will be required. The method of operation outlined herein will provide these estimated requirements. Such a reliable source of supply will encourage these communities to make provision for installing waterworks and sewerage systems. A method of regulation has been determined to ensure that operation of the reservoir will provide maximum water conservation benefits. This method of regulation is recommended for adoption.

It has been found that the method of operation referred to above would result for the most part in reservoir levels subject to comparatively small fluctuations during the summer months. This would suggest the possibility of some recreational development being undertaken adjacent to the reservoir. Various aspects of this type of development near the St. Malo Reservoir are discussed and certain recommendations are made concerning precautions which should be taken prior to authorization of recreational development around this reservoir.

ST. MALO DAM AND RESERVOIR

The St. Malo dam is a rolled earthfill structure on the Rat River in Sec.24 Tp.4 Rge.4E, about one mile east of the Town of St. Malo. The reservoir is about one and one half miles long with an average width of about 1,000 feet. The storage capacity at full supply level is 1,750 acre feet. The reservoir when full is 30 feet deep at the dam and covers an area of 145 acres. The dam is 1,500 feet long having a maximum height of 42 feet and a top width of 20 feet. Flood flows are passed by a fixed crest overflow spillway 100 feet wide and 145 feet long. The stored water can be released for downstream use through a three foot diameter corrugated metal pipe 215 feet long controlled by a slide gate operated from the top of the dam. The construction of the project began in the spring of 1958 and was completed in the summer of 1959. The location of the St. Malo Dam and Reservoir is shown on Fig.1.

FLOOD CONTROL

The storage capacity of the St. Malo Reservoir is 1,750 acre feet at full supply level, which represents the volume of runoff that may be expected during a flood occurring on the average once every two years. It is therefore obvious that the effectiveness of the reservoir in reducing flood peaks is negligible. An additional factor which limits the use of the reservoir as a flood control project is the discharge capacity of the conduit through the dam which is 124 c.f.s. at full supply elevation. This relatively low conduit capacity does not allow large volumes of water to be passed during the early stages of a flood and thus little or no capacity is available at the peak to reduce high discharges downstream. A study was made of the recorded flows on the Rat River near Otterbourne, some 20 miles downstream from St. Malo. From this study, peak frequency and volume frequency relationships were developed for the Rat River Basin above St. Malo, and with these relationships, floods of various magnitudes were routed through the reservoir to find the peak reduction due to the reservoir. The results are as follows:

<u>Frequency</u>	<u>Peak inflow c.f.s.</u>	<u>Volume Acre ft.</u>	<u>Peak Reduction c.f.s.</u>
2% (50 year flood)	3,020	49,300	15 c.f.s.
3.3% (30 year flood)	2,440	43,900	10 c.f.s.
5% (20 year flood)	1,855	38,000	10 c.f.s.
6.7% (15 year flood)	1,560	32,700	10 c.f.s.
10% (10 year flood)	1,210	27,000	10 c.f.s.
20% (5 year flood)	710	15,100	10 c.f.s.
40% (2.5 year flood)	360	5,700	171 c.f.s.

From the above table it is seen that the reductions in flood peaks effected by the storage capacity of the reservoir are insignificant except for small peak inflows. The calculations were all based on the assumption that the reservoir would be empty at the beginning of the flood runoff, and therefore the peak reductions shown are the maximum possible. In view of the comparatively small peak flow reductions obtainable it is concluded that flood control benefits need not be considered in determining an operational procedure.

WATER REQUIREMENTS DOWNSTREAM FROM ST. MALO RESERVOIR

General

The principal use along the Rat River which would be made of water available from the St. Malo Reservoir would be to supply the municipal and industrial requirements of the villages of St. Malo, St. Pierre, and Otterbourne, as well as providing a live stream for the use of farmers living along the river below the reservoir. As discussed below it is estimated that the total future demands for such uses will be about 300 acre feet per month, which corresponds to an average rate of flow of 5 c.f.s. Under unregulated conditions the flow is less than 300 acre feet per month 30% of the time.

Village of St. Malo

At the present time the municipal supplies for St. Malo are supplied by a well near the town and by hauling from a well at St. Pierre. Although there is now no water supply system for municipal distribution in the Village much interest has been expressed by the residents in having a water supply and sewerage system installed. The most attractive source of water supply for the Village is the St. Malo Reservoir because of the reliability and proximity of this supply as well as the quality of the water in the reservoir. It has been estimated that if the population of the Village increases at four per cent annually the future consumptive requirements will be about 25 acre feet per month in the next 35 years.

Village of St. Pierre

The Village of St. Pierre with a population of about 1,000 does not have a water supply system at present. The municipal require-

ments are being met by an artesian well at St. Pierre. The water from this well is fairly hard and no information is available as to the reliable yield. It is expected that in the near future this community will take steps to proceed with the installation of water and sewerage system. The two possible sources of good quality water would be Joubert Creek or the Rat River. The greater reliability of the Rat River due in large measure to the St. Malo Reservoir would favour its selection as the source of supply. It is estimated that the consumptive requirements for municipal and industrial purposes will be about 55 acre feet per month by the year 1995.

Village of Otterbourne

The present population of Otterbourne is about 200. The Village has no municipal water supply system but there is every likelihood that in the near future such a system will be installed. The Rat River, being adjacent to the Village is the logical source. It is estimated that the municipal and domestic water supply requirements in the future from the Rat River for the Village of Otterbourne will be about 20 acre feet per month.

Other Requirements

In addition to the potential uses of the Rat River below the St. Malo Reservoir, described above, there are also those pertaining to stockwatering and other agricultural uses. There are several farmsteads adjacent to the river that are dependent on the river as a source of domestic water including stockwatering. It is estimated that an allowance of 200 acre feet per month would be adequate for

these needs. This estimate allows for seepage and other transmission losses occurring along the course of the river in maintaining a live stream adequate for agricultural purposes. Under natural conditions the discharge in the Rat River is below 200 acre feet per month about 15% of the time.

RECREATION

Considerable interest has been expressed in developing recreational facilities around the St. Malo Reservoir. If it is possible to maintain this reservoir close to a reasonably constant elevation, then conditions might be favorable for such development. However if this reservoir will be operated for the prime purpose of meeting the requirements of downstream riparians, then it can be expected that a constant water level can not be maintained. In view of the fact that the future water needs of the Villages of St. Malo, St. Pierre and Otterbourne will be dependent upon flows in the Rat River, an operation study has been undertaken with this being the primary objective of the reservoir regulation. The pattern of reservoir levels available with this type of regulation has been analyzed to ascertain the extent of the variation in levels which would occur.

If recreational interests decide to proceed with development they should be made aware of the fact that the primary use to be made of the reservoir is to provide for the requirements of downstream riparians. They must be prepared to accept without protest such unfavorable reservoir levels as may result due to operation of the reservoir for water conservation purposes.

RESERVOIR OPERATION

Inflows and Losses

Before undertaking a reservoir study it is necessary to know the inflows that may be expected. For the purpose of this study the 35 year period, 1921 to 1956 was chosen as being representative of the runoff conditions that may be expected in the future. During this period both floods and droughts were experienced. The study was based on flows as recorded in the Dominion Water Resources Papers for the Rat River at Otterbourne, modified by the ratio of the drainage areas above Otterbourne and St. Malo.

Evaporation from the surface of the reservoir, which at times is as much as 6 inches per month, was determined in accordance with estimates given in the report entitled "Evaporation from Lakes and Reservoirs on the Canadian Prairies" prepared by the Prairie Provinces Water Board. Other reservoir losses which are significant are seepage and bank storage and for the purpose of this study it has been assumed that these reservoir losses will be 0.07 feet per month.

Method of operation

The St. Malo Reservoir may be operated for various purposes. It has been established that the major purpose is to maintain a reliable source of supply for municipal and stockwatering purposes for communities along the Rat River downstream from the Reservoir. It has further been established that flood control benefits would be negligible and may therefore be neglected. A secondary benefit could be recreation depend-

ing on the extent of fluctuations in levels which result from operating the dam for water conservation purposes. In order to determine the potential reliable yield from the reservoir routing calculations were carried out using the inflows and losses as outlined above. The routing calculations indicated that during the 35 year period considered, the reservoir would have been able to maintain a minimum flow of 5 c.f.s. in the Rat River. Under unregulated conditions the flow would be less than 5 c.f.s. 30% of the time.

Under the type of operation outlined above the maximum and minimum mean monthly reservoir levels were found to be 842.29 and 814.16 respectively, a range of about 28 feet. The maximum daily reservoir level was calculated to be 845. With an estimated two feet of wind set-up and wave uprush, parts of the reservoir area would be flooded up to the 847 contour which is seven feet above the spillway crest. During the summer seasons, the lowest and highest mean monthly elevations were found to be 834.6 and 842.0 respectively, giving a range of 7.4 feet.

The mean monthly reservoir elevations for the 35 year period as determined from the routing calculations are shown on Fig.2.

CONCLUSION

The flood control benefits of the St. Malo Reservoir are negligible and may therefore be ignored in establishing the rules of regulation to be followed in operating this reservoir.

The use of the St. Malo Reservoir which would be of the greatest benefit to those concerned is water conservation for municipal and agricultural purposes. It was found that the reservoir could be operated to maintain a minimum flow of 5 c.f.s. Under unregulated conditions it estimated that a flow of 5 c.f.s. or less occurs 30% of the time. This flow would be adequate to meet the estimated future demands for the municipal requirements of the Villages of St. Malo, St. Pierre and Otterbourne, as well as the domestic and stockwatering requirements for those living adjacent to the Rat River below the Reservoir.

This method of operation of the St. Malo Reservoir, if it had been followed over the 35 year period from 1921 to 1956, would have resulted in a 7.4 foot range between the maximum and minimum mean monthly elevations obtaining during all of the summer seasons in that period. The maximum fluctuation in any one summer would have been five feet. Having regard to these variations in elevation it would appear that the recommended method of operation for water conservation would provide, on the whole, a pattern of reservoir levels reasonably well suited to recreational development.

RECOMMENDATIONS

Rules of Regulation

The study which has been undertaken indicates that certain water supply and stream flow regulation benefits would have been available over the 35 year period covered by the study. On the assumption that runoff conditions in the future will be similar, it may be expected that these benefits will be available if the same type of operation is followed. The rule of regulation followed in the operation study and which is recommended for implementation by the Government in establishing policy for the operation of the St. Malo Reservoir is as follows: Release at least 5 c.f.s. continuously, which is 300 acre feet per month, from the Reservoir.

In the event of a drought more severe than any recorded in the 35 year period studied it would be necessary to modify the method of operation. Such modifications, when and if required, will have to be left to the judgment of those responsible for operation of this reservoir at that time. If such a situation arises, cognizance will have to be taken of the minimum requirements along the Rat River at that time.

Recreational Development

Since operation of the reservoir as recommended will, for the most part, produce levels reasonably well suited to recreational development, it may be anticipated that there will be a demand for approval of such schemes. To minimize complaints likely to arise in the future from such groups, it is recommended that the following

measures be taken prior to the authorization by the Department of Agriculture and Conservation of any recreational development or activities in the immediate vicinity of the reservoir.

1. The applicants shall be formally advised that their rights will be subject to such fluctuations in reservoir level as may occur either due to flood conditions or as a result of the operation of the reservoir for the prime purpose of meeting water supply requirements of downstream interests.

2. The Department shall satisfy itself that no recreational development shall be permitted or located which will increase the hazard of pollution of the water in the reservoir.

3. Construction of buildings, boat-houses, docks, or other facilities likely to be affected by flooding shall not be permitted below elevation 847.

PROVINCE OF MANITOBA
DEPARTMENT OF AGRICULTURE AND CONSERVATION
WATER CONTROL AND CONSERVATION BRANCH

ST MALO RESERVOIR OPERATION STUDY

KEY PLAN

ST. MALO RESERVOIR

FIG. 1

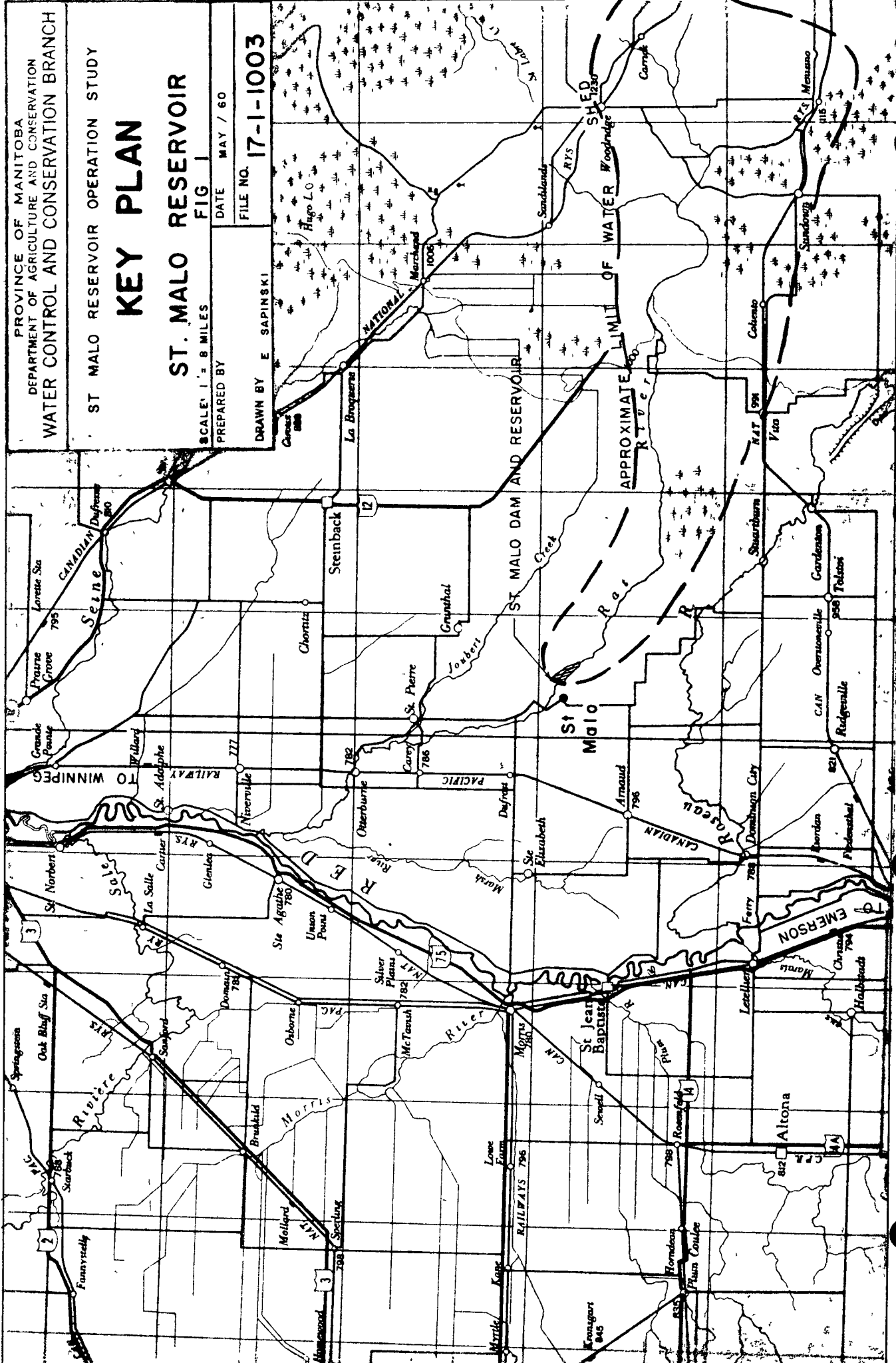
SCALE: 1" = 8 MILES

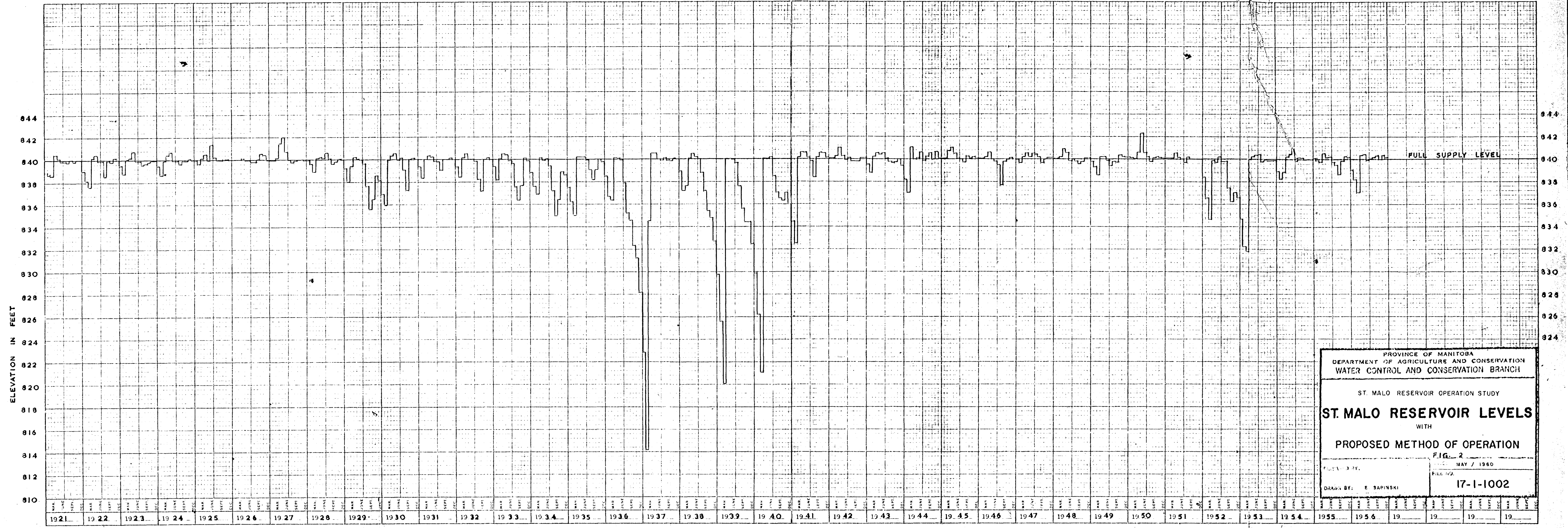
PREPARED BY

DATE MAY / 60

FILE NO. 17-1-1003

DRAWN BY E. SAPINSKI





PROVINCE OF MANITOBA
 DEPARTMENT OF AGRICULTURE AND CONSERVATION
 WATER CONTROL AND CONSERVATION BRANCH

ST. MALO RESERVOIR OPERATION STUDY
ST. MALO RESERVOIR LEVELS
 WITH
PROPOSED METHOD OF OPERATION

FIG. 2
 MAY / 1960

FILE NO.
 17-1-1002

DRAWN BY: E. SAPINSKI