NORTH DAKOTA
STATE PLANNING BOARD

Summary Report of A Plan of Water Conservation for North Dakota

VOLUME 3

NORTH DAKOTA

STATE PLANNING BOARD

SUMMARY REPORT

OF

A PLAN OF WATER CONSERVATION

FOR

NORTH DAKOTA

VOLUME 3

SOURIS AND DEVILS LAKE DRAINAGE BASINS

STATE WATER CONSERVATION COMMISSION
BISMARCK, NORTH DAKOTA

JANUARY 1, 1937

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North Dakota State Geological Survey
Agricultural Dept., N. Dak. Agric. College
State Department of Health

U.S. Geological Survey
National Resources Committee
Engineering College, Univ. of N.Dak.
Resettlement Administration
State Engineer

North Dakota County Planning Boards

1/ The Cooperating Agencies are not responsible for the opinions, conclusions, or recommendations of the State Planning Board as expressed in this report.

CHAPTER 1

SOURIS RIVER SUB BASIN

CHAPTER I

SOURIS RIVER SUB-BASIN

GENERAL

The Souris River, sometimes called the Mouse River, rises in southeastern Saskatchewan. It flows in a southeasterly direction across the International Boundary into North Dakota and continues through Minot and on to Velva. Here the general direction of flow is changed to the northeast until the river reaches Towner, where it curves to the northwest. It continues in this direction until it crosses into Manitoba, Canada. In entering and leaving North Dakota the river encircles an area known as the Mouse River Loop, which comprises in general, an area of untimbered rolling prairie, much of it having poorly defined drainage. At the point where the main stream reaches North Dakota its theoretical drainage area is 8,170 square miles of which 6,930 square miles are in Saskatchewan, 30 in Montana, and 1,210 in North Dakota. Ten miles upstream from Minot the Mouse receives the waters of the Des Lacs River, which heads at the International Boundary and has a total drainage area of about 1,510 square miles. When the Souris River leaves the United States and enters Manitoba, it has encircled about 2,600 square miles of the Mouse River Loop. Land outside the loop that is drained by it brings the total drainage area, before the river reaches Canada, to 16,400 square miles, of which 8,804 square miles (or more than one eighth the area of the entire State) is in North Dakota.

INDUSTRIES

Agriculture is the chief enterprise of the Mouse River Sub-basin. However, some lignite coal mining is carried on along the Des Lacs River.

POPULATION

According to the 1930 census the total population of the Souris River Sub-basin in North Dakota was 94,439 persons. There were about 15 towns in the area having a population of 500 persons or over and included in this group are: Bottineau, 1322; Bowbells, 695; Columbus, 516; Crosby, 1,271; Drake, 644; Kenmare, 1,494; Minot, 16,099; Mohall,676; Portal, 512; Rugby, 1,512; Towner, 622; Velva, 872; Westhope, 521; Willow City, 577; and Berthold, 511.

FEDERAL AID

During the month of peak load, March 1935, 38,077 persons or 40.3 percent of the population were receiving federal aid. This compares with the peak state average of 31.6 percent. During the peak month of W.P.A. employment 1,768 persons were employed on work projects in or near cities and villages, and 7,274 persons were employed on rural projects, making a total of 9,042 persons employed in October, 1936.

TOPOGRAPHY

Above Minot the Souris River Valley is comparatively straight

and of a fairly constant width of about one-half mile, with sides rising sharply 100 feet or more to broad level benches. From Minot to Verendrye the valley has the same general characteristics but is wider in places, and the benches are somewhat lower and more broken. Below Verendrye the bench on the north side diminishes to a low ridge, and the lands toward Bantry and Upham tend to merge with the valley. Through the valley the Souris River winds in a tortuous channel averaging somewhat less than 100 feet wide and 15 to 25 feet deep. The total channel length is about twice that of the valley proper. The channel capacity is sufficient only for small floods. As a result there is occasional general inundation, sometimes causing considerable damage to Minot and other towns in the valley and to the valley in general.

SLOPE OF THE RIVER

The fall is very small for a stream having an average flow of less than 200 cubic feet per second. From the international boundary to Minot, 64 miles down the valley, the fall is from elevation 1605 to ~~1535~~, only one foot per mile of valley or less than a half foot per mile of channel. The next 52 miles down the valley to Towner, where the river level is about elevation 1446, has a foot and two-thirds fall per mile of valley. The remaining 57 miles to the international boundary has less than forty feet of fall, so that the entire fall in the 170 miles of valley length (about 360 channel miles) in North Dakota is slightly less than 200 feet. Except at flood stage, a peak reached at only a very small fraction of the time, the water flowing in the channel is only a few feet or a few inches deep.

DRAINAGE

A strip east of the river and only a few miles in width, extending from the international boundary to Minot and Velva, drains westward to the upper portion of the river. The remainder of the "Mouse River Loop" slopes eastward so as to drain into the lower section of the river. The land in this area is fairly smooth and even. The eastern and north eastern two-thirds of the "Loop" is at an elevation of less than 1500. All of the eastern part of the "Loop" and the strip east of the river, previously mentioned, up to an elevation considerably above 1500 was included in Lake Souris when the outlet of the river was closed by the polar glacier. The water from the melting ice then flowed southward by several different successive routes. The drainage was probably over the divide into the upper James River, then into the upper Sheyenne River, and finally through Devils Lake and Stump Lake into the Sheyenne River, after which the northern ice barrier was removed and the drainage again to the north.

TRIBUTARIES

The principal tributaries above Minot are the Des Lacs River, entering the Souris River about 7 miles above Minot, near Burlington; Moose Mountain Creek, which receives run-off from the Moose Mountains in Canada; and Long Creek. The latter two enter the Mouse River in Canada. The most important tributary in North Dakota is the Des Lacs River which rises just north of the international boundary line in

Canada, entering North Dakota about 12 miles west of where the Mouse enters the State. It flows in a general southerly direction about 37 miles through a system of narrow lakes, occupying practically the entire valley of approximately one-half mile in width. From the Des Lacs Lakes it flows in a southeasterly direction some 35 miles to its junction with the Souris River. This valley resembles the Souris River Valley in its general characteristics, but the stream appears to be considerably smaller and the channel not nearly as wide. There are three lakes in the Des Lacs Lakes system mentioned above. These all lie at practically the same elevation. (The upper one is approximately 28 miles in length, the second, that at the town of Kenmare, about 3 miles, and the lower one, near Baden, about 5 miles in length.) The normal area of the Upper Des Lacs Lake is 6.7 square miles; of Middle Des Lacs Lake, one square mile; and of Tower Des Lacs Lake it is 0.4 of a square mile. The total area is thus 8.1 square miles. These surface areas have been increased considerably by the construction of the various units of the U. S. Biological Survey Des Lacs Lakes Migratory Waterfowl Refuge so that the total area with all units full would exceed 10 square miles. The three are separated by short channels running though marshy lands. The north end of Upper Des Lacs Lake in Canada is considerably higher than the Souris River, probably at least 100 feet which lies three miles to the North. The tributary area of the Des Lacs Lakes is insufficient to feed any very large lake as it is only about 530 square miles. The average annual run-off from this area would not, on the most generous estimate, be enough to supply the evaporation from more than 20 square miles of total lake surface and more likely not more than 10 square miles. Therefore, the run-off from these lakes is usually very small. The lakes are all at an elevation about 1780 above mean sea level.

RUN-OFF

The precipitation is almost completely consumed by evaporation and transpiration, so that in the greater portion of the area the small intermittent channels carry the water only to hollows, sloughs or temporary lakelets, where, except in unusually wet years, it evaporates entirely and no run-off therefrom reaches the main stream.

STREAM FLOW

The Souris River drainage being typically glaciated, practically all of the run-off reaching the streams comes from melting snow in the spring months of April and May. In years of plentiful snowfall the effect of the spring break-up is carried over into June, but during the remainder of the year little or no flow occurs. Summer rains seldom increase the river appreciably, and there is no record of a

MINOT FLOODS

flood stage occurring due to a rain after the spring melting has occurred. Flood stage has been considered by all investigations as being 2,500 feet at Minot. The theoretical drainage area at Minot is 10,270 square miles, and the maximum flood (1904) was 12,000 cubic feet per second. A flow of over 3,000 cubic feet per second has occurred in Minot during 6 years. The average flow is only 158

cubic feet per second, and in fifteen different years since 1903 the flow has remained below 10 cubic feet persecond for at least a month of the open season, besides frequently dropping below this in winter months.

CHANNEL CAPACITY

The channel in different sections has a carrying capacity of approximately 3,000 cubic feet per second. When the flow is greater, water spreads, the depth varying from a few inches to a few feet, over the valley bottoms to a width of a quarter mile or more and remains there until the flood period is over. These flat bottom lands make excellent hay meadows. When they have been covered by spring flooding, and the water drains off within a few weeks, the residents are assured of two heavy cuttings of excellent hay during the season. The hay crop in a normal year is sufficient not only to care for the stock of a large area during the winter, but also to provide feed for them during a record dry summer.

FLOOD IRRIGATION

In view of the fact that there are fertile bottoms along the river, there are, between Velva, Towner, and Upham, about a half dozen good locations for flood irrigation projects. A flood irrigation project consists of an earth retaining wall or dam, a few feet high and a quarter mile to a mile in length, which is built across the valley bottoms at a suitable narrow place, and a dam perhaps 15 or 20 feet high and 100 feet long built across the river channel in open frame form, so that it can be quickly closed with stop logs. The dam is left entirely open until the flood weeks have passed, and then (unless it was a flood spring with stage high enough to flood the meadows already) the dam is closed for a week or two thus raising the water so as to flood the bottom lands as desired for the entire width of the valley and for a length of 5 to 10 miles. The stop logs are then removed and the water allowed to drain off the land. Through legislative appropriation and the cooperation of the U. S. Geological Survey in making topographic surveys, tentative sites for these dams were located and three projects have been designed. These three projects are:

1. Eaton Flood Irrigation Project, 8000 acres;
2. Hardy Flood Irrigation Project, 6000 acres;
3. Lee Flood Irrigation Project, 6000 acres.

The water may be relayed from one flood irrigation dam to the next if the spring flow is not great enough to overflow the first dam and fill the lower dam.

Another practicable project, as surveyed by the office of the State Engineer (see biennial report, 1924-26, of North Dakota State Engineer), is the Buffalo Lodge Lake diversion and storage plan. This could take about 200 cubic feet per second when as much as that were available, from the Souris River near Verendrye, where natural low water level is about 1471, with a lift of about 25

feet by a dam. If the Missouri River Diversion Project were installed, a portion of its flow could easily be brought down the side of the Souris Valley to an elevation of at least 50 feet above the river level and taken across the river channel with a flume or inverted siphon without need for the cost of a dam in the Mouse River or the causing of any flowage damages. By means of a small gravity canal the water would be carried from the north bank of the river channel about 15 miles north to Buffalo Lodge Lake of which the approximate elevation is 1476. This is a natural lake having a normal water surface of 2.4 square miles. An adjoining lake (North Lodge Lake) has an area of 0.7 square miles. Together the total area is approximately 3 square miles.

If raised by a dam to elevation 1485 the possible storage in these lakes would be 29,000 acre feet, and if raised to elevation 1488 a total storage of 55,000 acre feet would be possible although this would increase the total surface area to about 12 square miles and hence bring larger evaporation losses. The first part of the stored water, however, would increase the natural lake area so little as to involve no noticeable additional evaporation losses.

Thus a small canal could bring a small flow (from the Souris River or from the Missouri River Diversion) continuously, or through the major portion of such years as it could be spared. The water would be stored without too serious evaporation or seepage losses until the dry season or even until a following dry year or years. It could then be released when needed, in large quantities for short periods of time and diverted for the benefit of any selected portions of the lands north and northeast, toward and beyond Upham. The topography is well adapted for this. The total area that is adapted to irrigation in this area, if sufficient water were available, is at least 30,000 acres.

MISSOURI RIVER DIVERSION

In the event the Missouri River Diversion Project is installed for the primary benefit of the Sheyenne River Valley, James River Valley, and Devils Lake Area, a short branch canal could be built with a very small additional cost, to bring a portion of the diverted water to the side slope of the Souris River Valley west of Balfour or southeast of Velva. This would be at elevation 1600 or slightly more, depending upon the precise form of the Missouri River Diversion Project finally adopted. Due to the fact that during half the years there is deficiency in water supply and during a quarter of the years there is a great deficiency for either agriculture or stock feeding, two-thirds of the Mouse "Loop", much of the area east of Towner, and the Lower International Boundary Region would be greatly benefited.

Although the Souris is an international stream, the project would introduce no international complications as it could easily be operated so as not to make the slightest increase in the flow of the Souris River except at times of medium low stage. At all such times the Canadians would be in need of the increased flow.

FLOOD CONTROL AND RIVER REGULATION

For the purpose of flood storage and complete release during dry seasons one or more large reservoirs, large enough to hold 100,000 acre feet or more, have been suggested. Topography is best adapted for such reservoirs at points in North Dakota above Minot. However, such a reservoir would conflict with the Biological Survey Migratory Waterfowl Reservoirs now being installed. Furthermore, the part time flowage would ruin thousands of acres of the best bottom lands in the valley so it is doubtful whether the benefits justify the cost if approximately the same results can be obtained by other projects. However, there are several good locations above the international boundary in Saskatchewan that are well adapted for this purpose. The Canadians are desirous of having the projects adopted and would pay a major portion of the cost. They would operate them almost as exactly for our benefit as if they were in North Dakota. The reservoirs would be used for detaining flood waters and releasing a small steady flow thereafter. If by any cooperative arrangement these projects can finally be installed at some time in the future it would be very desirable and they ought to be included in the water plan.

FLOODS

The location of Minot and Velva on the river bottom lands causes them to suffer great losses when the river is at the highest flood levels. They would be greatly benefited by any plan for reducing flood heights, such as the building of large flood detention reservoirs. Other projects such as small channel reservoirs may reduce the heights of minor floods but cannot appreciably help during larger floods. Levees along the river banks at each town are of some use and in former years have been built along some short sections of the river in Minot. These assist in preventing minor floods from escaping the river channel and flooding the streets and basements. At Minot, and similarly at Velva, even with continuous levees to give two feet additional channel depth, the channel capacity in present location and form would be only about 2000 cubic feet per second; hence it could not carry the larger floods such as can be expected at about five-year intervals. If overstopped at all, the levees would then not be of the slightest use but rather would be a nuisance and injurious. Thus it is seen that this method cannot be relied upon for general relief.

CHANNEL IMPROVEMENT

At Minot, by cutting across channel loops at several points in the lower part of the city and for some miles below, with cross

cuts perhaps 15 feet deep, 80 feet wide, and 100 to 600 feet long, the channel would be shortened and given greater slope. Hence, at comparatively small cost, heights of ordinary floods could be reduced one to several feet and the heights of extreme floods nearly a foot, wihtout the slightest damage to residents below. For these residents the flood crest-height would not be increased at all but would merely reach them a few hours earlier.

A more extensive project for the same purpose plans to excavate a relief channel, through most of the City of Minot and for eight miles below, paralleling the present channel and of equal or larger cross sectional area. This channel would be nearly straight and therefore scarcely more than one-third as long as the present crooked natural channel. This would almost completely eliminate serious losses even from floods greater than those yet experienced but would cost about $1,200,000. The project is described in detail by a special report of the State Engineer, R. F. Kennedy.

CHANNEL OBSTRUCTION

A very necessary provision in future plans is that through Minot and for twenty miles below, care must be taken to prevent the channel and its margins from being artifically obstructed in any appreciable degree by bridge, buildings or earth work fills along the banks. The projects mentioned above are solely for the relief of Minot so that the initiative in putting into effect any of them should come from the people of Minot. However, these plans can properly be mentioned in the general water plan as they do no harm to anyone above or below Minot.

RECREATION

There is a great need for the development of recreational areas and suitable water facilities in this Sub-basin. Renville County, for example, has reported only four places suitable for swimming, and at times during the year the water in the river is so low that these cannot be used. Buffalo Lodge Lake in McHenry County could be developed into a desirable recreation spot if the water flow was controlled. McHenry County now reports only 4 swimming places, and the water in these is often so low as to render the pools unfit for such purposes. Bottineau County has a series of small lakes and streams which require a means of controlling the flow of water to make them useable for recreational purposes. The water in most of them is at present too low for either swimming or boating. Rolette County reports only two places suitable for swimming although there are many small lakes that only need to have the flow of spring flood waters controlled in order to make them suitable for recreational purposes.

CONSERVATION OF THE TURTLE MOUNTAIN LAKES

The Turtle Mountain Region is the outstanding recreational area in North Dakota. There are a number of fine lakes in the area but during recent years the water level in these has dropped considerably. Lake Metigoshe and Lake Upsilon, the two most im-

portant lakes, are in great need of additional water to properly serve recreational needs.

In the "Fifteenth Biennial Report of the State Engineer" Mr. R. E. Kennedy outlines a method for improving the lakes of the Turtle Mountains. This includes a drainage ditch from Rost Lake to Lake Metigoshe to restore the latter. Rost Lake would not be destroyed but would merely be lowered. The outlet to this ditch would have a control gate so that during wet years additional water could be stored in Rost Lake to be used to maintain the level and desired freshness in Lake Metigoshe during drought years. A reservoir downstream from the outlet of Lake Metigoshe would store any overflow therefrom and would serve as a waterfowl refuge. Lake Upsilon would be restored by creating a reservoir on Wakopa Creek which would serve to divert the creek run-off to Lake Upsilon partly by gravity flow and partly by pumping. Pumping from a small reservoir on Wakopa Creek into Lake Upsilon has been carried on very successfully and at low cost. The present reservoir is not of sufficient size, however, for fully restoring Lake Upsilon. Other proposed developments include the adding of 5 square miles of drainage area to that tributary to Carpenter Lake by constructing a ditch 6800 feet long and estimated to cost $7,000 and by joining Jarvis and Long Lakes by means of a canal estimated to cost $2500. This would lower the water level in Long Lake 2½ feet and would raise Jarvis Lake one foot. The benefits would be one large lake of about 340 acres, 8 miles shore line, and with four miles of boat travel. The average depth would be about 12 feet.

The projects for the improvement of Lake Metigoshe and Lake Upsilon can be undertaken immediately, but before any of the additional projects are undertaken a detailed hydrological survey and study of the probable available water for the various lakes should be undertaken. Future programs of construction should be planned according to the findings of this survey.

U.S. BIOLOGICAL SURVEY

The U. S. Bureau of Biological Survey has three large waterfowl refuges in the Souris River Basin. Two of these are on the Souris River, and the other is a development of the Des Lacs Lakes. The series of reservoirs comprising the Des Lacs Lakes project have a water surface of 6,300 acres and store 15,600 acre feet of water. The Lower Souris Project, on the Souris River from Upham downstream to the international boundary, includes a series of small dams creating marsh and lake areas having a total water surface of 30,000 acres and a storage capacity of 60,000 acre feet. The Upper Souris Project is located on the Souris River northwest of Minot in Ward and Renville counties and has a water surface of 16,500 acres and a storage capacity of 114,000 acre feet. Of the total storage, 113,000 acre feet is created by a dam at the Ward-Renville county line.

The Des Lacs and the lower Souris Project are of use primarily for waterfowl refuges although the recreational facilities are greatly increased, particularly in the Des Lacs Lakes. The Upper Souris project however, will have great flood control and river regulating benefits. Indeed, the large reservoir provides approximately one-half the necessary flood control and river regulating storage necessary to provide the greatest benefit to the valley below. This feature is incidental to the regulation of the flow by the Biological Survey to maintain a constant level of water in the marshes of both the Upper Souris and Lower Souris projects.

THE REHABILITATION CORPORATION PROJECT

The North Dakota Rehabilitation Corporation has constructed a dam at Burlington on the Des Lacs River which impounds 320 acre feet of water, 250 acre feet of which are used for irrigating the Burlington subsistence homestead project by gravity flow. A number of small plots of land have been equipped with buildings and have been sold to families which use the areas for intensive farming to supplement their winter work in nearby lignite mines. In spite of a very damaging hailstorm during the current summer this project has proved very successful during this, its first year of operation.

EXISTING SMALL DAMS

There are approximately 165 small dams in the Basin. These were built by various agencies. Their total storage capacity is approximately 11,000 acre feet. These small reservoirs provide recreational facilities for many localities. They also provide stock watering facilities and assist in maintaining waterfowl nesting areas in the region. These are listed in Table A and are shown on Plate II.

THE WATER PROBLEM

In years past there have been frequent damaging floods along the Souris River particularly at Minot and Velva. These floods occur during spring break-ups and have caused considerable damage at times. During summer months the flow in the Souris River is very low often becoming less than 2 cubic feet per second for a period of from one to two months. As a result sewage discharged into the stream is not sufficiently diluted. The large U. S. Biological Survey reservoir at present maintains a flow through Minot during summer months and this greatly alleviates the pollution problem. Stream regulation during winter months is also needed, however. There is also a need for irrigation projects, improvements in sewage disposal and water supply, and some additional small dams for recreational purposes.

THE WATER PLAN

For flood protection and river regulation it is proposed:

1. That a survey and study be undertaken immediately to work out an agreement with the Saskatchewan government whereby, in return for the payment of part of the cost of three large power reservoirs on the headwaters of the Souris River, as proposed by them, these reservoirs would be operated to our ad-

vantage as flood control and river regulating reservoirs. Estimated cost of this survey and study is $10,000. These reservoirs together with the already constructed Biological Survey reservoir on the Souris River, which has a capacity of 112,000 acre feet, would give ample flood protection and stream flow regulation. These reservoirs will provide a storage capacity of 125,490 acre feet at an estimated cost to the United States of $125,000.

2. That a plan for straightening and improving the Souris River Channel in Minot be surveyed and designed. The cost of the survey is estimated at $5,000.

3. That the channel straightening and improvement in Minot be undertaken and completed at an estimated cost of $250,000.

For irrigation it is proposed:

1. That a dam be built on the Des Lacs River and another in Larsen's Coulee above the Burlington Rural Rehabilitation Corporation project to provide reserve storage capacity for irrigation of this project. Cost is estimated at $50,000 with 320 acre feet of storage.

2. That numerous individual irrigation systems be installed in the sand hill area of the "Mouse River Loop" using shallow wells for supply. Such wells will irrigate 10 to 20 acres per farm and on this land the farmer may grow hay and feed during drought years. An estimate for irrigation for 100 to 200 farms is $100,000.

3. That an additional flood irrigation dam be constructed in the Souris River in the vicinity of Towner to insure winter feed during drought years.

4. That a hydrological study of the Souris River be made to determine what additional irrigation projects could be supplied with sufficient water after present and proposed uses as listed above are provided for.

5. That a detailed soil survey and land classification be begun as soon as is possible on all lands that appear to be irrigable in order to ascertain the suitability of the lands for irrigation in each of the several areas. These surveys should follow the aerial mapping of the irrigable regions. This mapping will provide, in addition to its utility as the basis of the proposed soil survey and land-classification, much needed data on present land use. The cost of the aerial mapping would approximate 5 ¢ per acre. The cost of the detailed soil survey and land

classification would be an additional 5¢ per acre.

6. That irrigation projects found feasible in the light of the two surveys listed above be constructed.

All towns needing improvements in their water supply and sewage disposal systems should be given assistance in developing adequate facilities. Proposed Improvements are listed in Table B and C and are shown on Plate I.

It is proposed that additional small dams having a total storage of approximately 15,000 acre feet and costing $250,000 be built in the Basin to provide recreational facilities.

It is further proposed:

1. That projects for the restoration of the Turtle Mountain Lakes as outlined by Mr. R. E. Kennedy, be constructed.

2. That a number of additional small dams be installed where needed for recreational and other purposes. All dams constructed hereafter in the Sub-basin should be provided with outlet gates for releasing the water stored when a great need arises for it downstream or when it becomes so polluted that it is a definite health hazard to the community. Many existing dams should also be provided with outlet gates. The small dams, including the Turtle Mountains development, are listed in Table D and are shown on Plate II.

RURAL WATER SUPPLY

A large number of small reservoirs have been proposed for the Sub-basin by various agencies. Those that would serve purposes of recreation, irrigation, and waterfowl refuges have been included in the proposed program. It is proposed that before any more small dams for stock watering purposes be constructed in the Sub-basin, a detailed survey of rural water supply be undertaken to determine the best and most economical method of securing adequate and satisfactory water supplies for stock watering purposes. Where an adequate ground water supply is available it is probable that this would be through the construction of community wells. In other localities not having a reliable ground water supply the construction of surface reservoirs would be the only alternative. Following such a survey it is proposed that assistance be given in developing an adequate rural water supply.

STREAM GAGING AND WEATHER OBSERVATIONS STATIONS

Active weather recording and stream gaging stations are shown on Plate III. No additional stations of either type are included in the proposed program but it is strongly urged that all existing stations be maintained.

TABLE A

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legen
U. S. BIOLOGICAL SURVEY "UPPER SOURIS MIGRATORY WATERFOWL REFUGE" ON SOURIS RIVER:										
1.	Ward	1	157	85	112,000		I,VII	E	Dam--Souris River. At river mile 83.	*****
2.	Ward	34	157	84			VII	G	Dam--Souris River. At river mile 96.	*****
3.	Ward	8	157	84			VII	G	Dam--Souris River. At river mile 87.	*****
4.	Renville	25	161	86			VII	G	Dam--Souris River. At river mile 41.	*****
	Total of "Upper Souris Migratory Waterfowl Refuge" Reservoirs (Reservoirs 1 to 4):				114,000	$288,000				
U. S. BIOLOGICAL SURVEY "LOWER SOURIS MIGRATORY WATERFOWL REFUGE" ON SOURIS RIVER:										
5.	McHenry	3	159	78			VII	F	Dam--Souris River. At river mile 326.	*****
6.	McHenry	18	159	77			VII	G	Dam--Souris River. At river mile 320.	*****
7.	Bottineau	14	161	79			VII	F	Dam--Souris River. At river mile 341.	*****
8.	Bottineau	19	160	78			VII	G	Dam--Souris River. At river mile 322.	*****
9.	Bottineau	31	164	79			VII	P	Dam--Souris River. At river mile 357.	*****
10.	Bottineau	16	162	79			VII	P	Dam--Souris River. At river mile 347.	*****
	Total of "Lower Souris Migratory Waterfowl" Reservoirs (Reservoirs 5 to 10)				60,000	$169,000				

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
U. S. BIOLOGICAL SURVEY "DES LACS LAKES MIGRATORY WATERFOWL REFUGE":										
11.	Ward	7	160	88	9,000		VII	F	Dam--Outlet to Upper Des Lacs Lake.	*****
12.	Ward	19	160	88			VII,III	E	Dam--Middle Des Lacs Lake at Konnaro.	*****
13.	Ward	29	160	88			VII,III	E	Dam--Middle Des Lacs Lake Outlet.	*****
14.	Ward	29/32	160	88			VII	G	Dam--Des Lacs River.	*****
15.	Ward	4 33	159 160	88 88			VII	G	Dam--Des Lacs River.	*****
16.	Ward	3	159	88			VII	G	Dam--Des Lacs River.	*****
17.	Ward	10	159	88			VII	G	Overflow Dike--across Middle Des Lacs Lake.	*****
18.	Ward	14	159	88			VII	G	Dam--Outlet to Lower Des Lacs Lake.	*****
19.	Ward	14	159	88			VII	G	Dam--Des Lacs River.	*****

Total of "Des Lacs Lake Migratory Waterfowl Refuge" Reservoirs
(Reservoirs 11 to 19): 15,600 $79,600

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Leger
20.	Renville	2	161	86 ✓	64	$ 3,900	III,IV	E	Dam---Souris River.	*
21.	Renville	16	158	81 ✓	30	1,800	IV	F	Dam--Spring Coulee.	*
22.	Renville	1	158	84 ✓	115	2,000	IV	F	Dam---Egg Creek.	**
23.	Renville	16	162	85 ✓	59	1,500	IV	F	Dam---Seven Mile Creek.	**
24.	Renville	20	158	81	65	1,100	IV	G	Dam---Spring Coulee.	**
25.	Renville	35	159	84	15	500	IV	E	Dam---Egg Creek.	**
26 to 29.	Renville	7/36	158	83	40	500	IV	P	Four dams---Cut Bank Creek.	*
30 to 31.	Renville	9/35	158	83	20	400	IV	F	Two dams---Creek.	**
32 to 33.	Renville	3/13	158	83	20	400	IV	F	Two dams---Seven Mile Creek.	**
34.	Renville	28	161	84	20	1,500	IV	F	Dam---Seven Mile Creek.	**
35.	Renville	1	163	85	51	400	III	F	Dam---Creek.	**
36.	Renville	16	163	85	40	400	IV	F	Dam---Coulee.	**
37.	Renville	31	163	84	20	4,400	IV	F	Dam---Creek.	**
38.	Renville	4	163	84	22	4,200	IV	G	Dam---Deep River.	**
39.	Renville	36	163	84	20	4,000	IV	F	Dam---Deep River.	**
40.	Renville	27	158	82	25	500	IV	G	Dam---Seven Mile Creek.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Leger
41.	Renville	35	158	82	20	$ 500	IV	F	Dam--Seven Mile Creek.	**
42.	Renville	35	158	86	16	800	IV	E	Dam--Des Lacs River.	**
43.	Renville	4	162	86	8	800	III	F	Dam--Coulee.	**
44.	Renville	31	159	85	21	2,100	IV	E	Dam--Creek.	**
45.	Renville	31	164	84	42	700	IV	E	Dam--Deep River.	**
46.	Renville	20	158	82	17	500	IV	E	Dam--Seven Mile Creek.	**
47.	Renville	25	163	84	21	900	III	G	Dam--Deep River.	**
48.	Renville	5	163	84	32	800	IV	E	Dam--Deep River.	**
49.	Renville	2	161	85	30	1,600	IV	F	Dam--Seven Mile Creek.	**
50.	Renville	26	160	84	24	2,400	IV	F	Dam--Seven Mile Creek.	**
51.	Renville	13	161	85	16	1,600	IV	F	Dam--Seven Mile Creek.	**
52.	Renville	36	164	85	19	1,900	IV	P	Dam--Coulee.	**
53.	Renville	9	163	83	22	2,200	IV	G	Dam--Creek.	**
54.	Renville	28	163	86	140	14,000	IV	P	Dam--Coulee.	**
55.	Renville	8	162	84	53	5,300	IV	F	Dam--Spring Coulee.	**
56.	Renville	5	158	85	120	12,000	IV	F	Dam--Coulee.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legen
57.	Renville	13	159	84	6	600	IV	F	Dam---Dam Coulee.	**
58.	Renville	28	158	82	9	900	IV	F	Dam---Coulee.	**
59.	Rolette	36	162	73	1	1,800	III,IV	E	Dam---Willow Creek at Dunseith.	*
60.	Rolette	36	162	73	2	800	III,IV	E	Dam---Willow Creek at Dunseith.	*
61.	Rolette	5	159	71	14	600	IV	E	Dam---Ox Creek.	*
62.	Rolette	8	159	71	11	500	IV	G	Dam---Ox Creek.	*
63.	Rolette	18	159	71	7	300	IV	G	Dam---Ox Creek.	*
64.	Rolette	1	160	72	400	300	IV	G	Dam---Creek.	*
65.	Rolette	12	160	72	180	400	IV	F	Dam---Creek.	*
66.	Rolette	34	160	73	5	500	IV	G	Dam---Creek.	*
67.	Rolette	5	159	71	10	700	IV	F	Dam---Ox Creek.	*
68.	Rolette	14	159	72	37	600	IV	F	Dam---Ox Creek.	*
69.	Rolette	8	160	73	10	1,000	IV	G	Dam---Willow Creek.	*
70.	Rolette	18	159	73	20	2,200	IV	E	Dam---Ox Creek.	*
71.	Rolette	8	163	70	28	2,000	IV	E	Dam---Creek.	*
72.	Rolette	23	160	71	50	3,000	III,IV	E	Dam---Ox Creek.	***

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
73.	Roletto	23 24	160 160	71 71	500	$ 1,000	VII	G	Diversion Ditch--Ox Creek to Long Lake.	***
74.	Roletto	25	162	73	20	2,000	IV	G	Dam--Willow Creek.	**
75.	Roletto	16/19	163	72	2,000	10,000	VII	G	School Section Lake Project.	*****
76.	Ward	16	153	81	10	4,700	IV	E	Dam--Creek.	*
77.	Ward	16	153	81	18	9,100	IV	E	Dam--Creek.	*
78.	Ward	7	155	81	4	1,600	IV	E	Dam--Creek.	*
79.	Ward	7	155	81	5	2,100	IV	F	Dam--Creek.	*
80.	Ward	15	156	86	5	4,000	IV	E	Dam--Creek.	*
81.	Ward	17	155	83	48	3,200	IV,III	G	Dam--Souris River west of Minot.	*
82.	Ward	7	155	83	388	5,900	IV,III	G	Dam--Souris River northwest of Minot.	*
83.	Ward	5	157	81	80	7,500	III	E	Dam--Little Deep River.	(*) (**)
84.	Ward	6	154	83	29	6,300	IV	F	Dam--Creek.	*
85.	Ward	15/16	157	82	20	2,600	IV	E	Dam--Egg Creek.	*****
86.	Ward	7	157	85	36	1,700	III	E	Dam--Des Lacs River at Carpio.	(*) (**)
87.	Ward	34	156	84	320	83,000	II	E	Dam--Dos Lacs River.	*****
88.	Ward	27	155	83	200	28,000	VIII	E	Dam--Souris River.	***

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
89.	Ward	23	155	83	46	$ 6,900	VI	E	G. N. Dam--Souris River.	****
90.	Ward	23	155	83	115	2,800	VI	E	Soo Dam--Souris River.	****
91.	Ward	11	155	85	183	27,500	VI	E	G. N. Dam--Creek at Des Lacs.	***
92.	Ward	19	158	87	20	1,000	IV	F	Dam--Creek.	***
93.	Ward	24	155	83	280	32,000	III	E	Dam--Souris River. Minot Park Board.	****
94.	Ward	20	156	86	24	3,600	VI	F	G. N. Dam--Creek, at Berthold.	****
95.	Ward	25	157	87	13	2,000	III,IV	G	Dam--Creek. Near Hartland.	**
96.	Ward	16	157	86	10	1,000	IV	F	Dam--Creek.	***
97.	Ward	16	157	83	9	1,400	IV	G	Huizenga Dam--Creek.	**
98.	Ward	12	157	83	21	2,000	IV	P	Dam--Coulee.	**
99.	Ward	15	154	83	70	4,500	IV	G	Schaeffer Dam--Creek.	**
100.	Ward	16	156	83	15	2,800	IV	G	Dam--Creek.	**
101.	Ward	16	156	82	44	4,000	IV	F	Dam--Creek.	**
102.	Ward	14	158	87	50	5,000	III,IV	E	Dam--Des Lacs River. At Donnybrook.	**
103.	Ward	1	157	86	10	1,000	IV	F	Dam--Coulee.	***
104.	Ward	28	152	82	22	2,400	IV	F	Dam--Creek.	**
105.	Ward	21	152	81	25	2,300	IV	G	Dam--Coulee.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legen
106.	Ward	30	153	81	32	$ 3,000	IV	F	Dam--Creek.	**
107.	Ward	34	155	81	30	3,000	IV	G	Dam--Creek.	**
108.	Ward	36	156	81	30	3,000	IV	F	Dam--Creek.	**
109.	Ward	23	157	82	10	1,000	IV	F	Dam--Egg Creek.	**
110.	Ward	8	156	85	11	1,500	IV	P	Dam--Coulee.	**
111.	Ward	6	157	85	10	1,000	IV	F	Dam--Coulee.	**
112.	Ward	16	156	86	11	1,500	IV	F	Dam--Creek.	**
113.	Ward	15	158	87	10	900	IV	F	Dam--Coulee.	**
114.	Ward	15	161	88	10	1,200	IV	F	Dam--Coulee.	**
115.	Ward	7	154	84	15	1,500	IV	F	Dam--Creek.	**
116.	Ward	23	156	84	11	1,000	IV	P	Dam--Coulee.	**
117.	Bottineau	15	159	82	114	7,800	IV	E	Dam--Spring Coulee.	*
118.	Bottineau	30	162	75	2	1,700	III	E	Dam--Oak Creek. At Bottineau.	*
119.	Bottineau	19	162	75	2	200	IV	E	Dam--Oak Creek.	*
120.	Bottineau	11	162	80	40	2,200	IV	G	Dam--Creek.	*
121	Bottineau	13	161	83	59	1,400	IV	F	Dam--Deep River.	*
122.	Bottineau	30	160	78	160	600	IV	E	Dam--Deep River.	*

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legen
123.	Bottineau	17	162	83	40	$ 1,400	IV	P	Dam--Deep River.	*
124.	Bottineau	1	162	82	15	3,200	IV	G	Dam--Creek.	*
125.	Bottineau	1	162	80	30	4,800	IV	F	Dam--Creek.	*
126.	Bottineau	12	159	75	23	2,600	III	E	Dam--Willow Creek. At Willow City.	*
127.	Bottineau	14	162	74	1,102	2,700	IV	E	Diversion Ditch.	*
128.	Bottineau	9	161	78	39	1,100	IV	E	Dam--Boundary Creek.	*
129.	Bottineau	36	160	74	16	1,900	IV	F	Dam--Willow Creek.	*
130.	Bottineau	3	161	78	20	500	IV	E	Dam--Boundary Creek.	*
131.	Bottineau	18	159	75	1	900	IV	E	Dam--Coulee.	*
132.	Bottineau	14	159	83	64	1,000	IV	E	Dam--Branch of Seven Mile Creek.	**
133.	Bottineau	10	163	77	53	3,900	IV	E	Dam--Branch of Boundary Creek.	**
134.	Bottineau	28	164	79	21	2,200	IV	E	Dam--Creek.	**
135.	Bottineau	31	164	78	8	2,200	IV	E	Dam--Coulee.	**
136.	Bottineau	24	161	83	86	8,600	IV	F	Dam--Deep River.	**
137.	Bottineau	9	162	80	10	800	IV	G	Dam--Creek.	*
138.	Bottineau	6	161	83	32	3,200	IV	F	Dam--Creek.	*
139.	Bottineau	7	162	83	35	3,500	IV	F	Dam--Deep River.	*

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
140.	Bottineau	32	161	82	179	$17,900	IV	F	Dam---Deep River.	*
141.	Bottineau	19	160	81	52	5,200	III	G	Dam---Deep River. Near Hurd.	*
142.	Bottineau	14	163	80	5	500	III	E	Dam---Creek. Near Westhope.	*
143.	Bottineau	7	159	74	18	1,000	IV	E	Dam---Willow Creek.	*
144.	Bottineau	5	159	74	45	1,000	IV	E	Dam---Willow Creek.	*
145.	Bottineau	25	160	74	7	400	IV	G	Dam---Willow Creek. Near Overly.	*
146.	Bottineau	31	160	75	73	900	IV	E	Dam---Oak Creek.	*
147.	Bottineau Rolette	11/14	161	74	+,700	7,500	VII,III	F	Diversion dam---Lord's Lake.	(**) (*****
148.	Bottineau	10	163	81	90	5,000	III,IV	G	Hinlo Dam---Coulee.	**
149.	Burke	31	164	89	18	3,800	IV	G	Dam---Creek. At Northgate.	*
150.	Burke	3	161	89	70	9,200	III	F	Dam---Coulee. Near Bowbells.	*
151.	Burke	2	163	94	55	8,000	IV	E	Dam---Creek.	**
152.	Burke	15	163	89	90	300	IV	E	Dam---Creek.	**
153.	Burke	26	163	94	8	700	III,IV	E	Dam---Creek.	**
154.	Burke	30	164	93	140	4,850	III,IV	G	Dam---Short Creek.	**
155.	Burke	4	163	93	250	11,420	IV	G	Dam---Short Creek.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
156.	Burke	31	161	89	10	$ 1,000	IV	F	Dam--Creek.	**
157.	Burke	36	162	92	75	7,000	IV	P	Dam--Creek.	**
158.	Burke	24	162	92	20	2,000	IV	F	Dam--Creek.	**
159.	McHenry	33	156	79	95	7,000	IV	P	Dam--Coulee. Near Granville.	(*) (*
160.	McHenry	16	156	76	14	1,400	III	E	Dam--Souris River. At Towner.	*
161.	McHenry	23	159	76	25	900	IV	E	Dam--Oak Creek.	*
162.	McHenry	3	151	79	80	8,000	VII	E	Halverson Dam--Wintering River.	*****
163.	McHenry	30	154	78	9	1,800	VI	E	G. N. Dam--Souris River. At Verendry.	****
164.	McHenry	4	153	77	30	3,000	III	G	Karlsruhe Park Dam--Wintering River.	**
165.	McHenry	14	159	80	40	4,000	III	G	Pratt Twp. Dam--Deep River.	**
166.	McHenry	21	159	76	30	3,000	III	G	Willow Creek Dam--Willow Creek.	(**) (
167.	McHenry	13 to 23	157 158	75 76	10,000	100,000	II	E	Hardy Flood Irrigation Project on Souris River. To irrigate approximately 8,000 acres of hay land.	*******
168.	McHenry	21/28 33	151	78	2,000	10,000	VII	F	Cottonwood Lake Project	*****
169.	Divide	5	163	97	6	400	IV	E	Dam--Long Creek.	**
170.	Divide	16	162	95	20	4,200	IV	F	Dam--Coulee.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Designation	Description and Remarks	Legend
171.	Divide	8	163	98	15	$ 1,500	IV	F	Dam--Creek.	**
172.	Divide	22	162	97	25	2,500	IV	G	Dam--Creek.	**
173.	Divide	29	162	96	100	10,000	IV	F	Dam--Coulee.	**
174.	Divide	1	163	96	100	10,000	III,IV	E	Dam--Long Creek.	**
175.	Divide	25	164	98	100	10,000	III,IV	E	Dam--Long Creek.	**
176.	Divide	35	164	98	180	18,000	IV	F	Dam--Creek.	**
177.	Divide	31	164	95	35	3,500	IV	G	Dam--Long Creek.	**
178.	Divide	26	163	98	150	15,000	IV	F	Dam--Coulee.	**
179.	Divide	2/1	163	97	200	20,000	IV	F	Dam --Long Creek.	**
180.	Bolette	30	163	73	3,000	5,000	III,IV VII	G	Dam--Outlet to Willow Lake.	*****
181.	Rolette	16/9	163	72	500	5,000	VII	G	School Section Lake Project.	*****
	TOTAL EXISTING RESERVOIRS:				22o,668	$1,312,170				

TABLE A (Cont'd.)

EXISTING RESERVOIRS

SOURIS RIVER SUB-BASIN

LEGEND:

*	Constructed by CCC
**	Constructed by FERA and WPA
***	Constructed by Individuals
****	Constructed by Railways and Municipalities
*****	Constructed by U. S. Biological Survey
******	Constructed by Rural Rehabilitation Corporation
*********	Constructed Under Public Works Administration.

USE:

I	Flood Control and Stream Regulation
II	Irrigation
III	Recreation
IV	Stock Watering and Water Conservation
VI	Railway Supply
VII	Waterfowl Refuge
VIII	Industrial Use

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SOURIS RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist System	Total Estimate
1.	Ambrose	23½	Inadequate	Survey and 1 well	100	600			700
2.	Antler	318	Inadequate	Survey and 2 wells.	100	1200			1,300
3.	Berthold	511	Unsatisfactory. Inadequate	Survey and 2 wells. Distribution system and Treatment Plant	100	1200	15,000	20,000	36,300
4.	Balfour	197	Unsatisfactory. Inadequate	Survey and 1 well.	100	600			700
5.	Bottineau	1322	Highly mineralized.	Treatment Plant			10,000		10,000
6.	Crosby	1271	Danger of Pollution. Inadequate, Highly mineralized	Survey, 2 wells and Treatment Plant. Construction changes.	100	1200	10,000	2,000	13,300
7.	Columbus	516	Inadequate. Danger of pollution.	Survey and 2 wells. Distribution System. Construction Changes.	100	1200	15,000	26,500	42,800
8.	Des Lacs	205	Unsatisfactory	Treatment Plant			10,000		10,000
9.	Deering	192	Inadequate	Survey and 1 well	100	600			700
10.	Dunseith	198½	Inadequate	Treatment Plant and Distribution System.			15,000	20,000	35,000

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SOURIS RIVER SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
11.	Flaxton	123	Inadequate	Survey, 2 wells Treatment Plant and Distribution System.	100	1200	15,000	20,000	36,300
12.	Glenburn	263	Inadequate. Unsatisfactory.	Survey and 1 well	100	600			700
13.	Granville	150	Unsatisfactory	Distribution System and Treatment Plant			15,000	20,000	35,000
14.	Gardena	120	Inadequate. Unsatisfactory.	Survey and 1 well	100	600			700
15.	Karlsruhe	258	Highly mineralized.	Treatment Plant			10,000		10,000
16.	Larson	89	Inadequate. Unsatisfactory. Highly mineralized.	Survey and 1 well	100	600			700
17.	Loraine	92	Inadequate.	Survey and 1 well	100	600			700
18.	Mohall	676	Inadequate. Hard. Danger of pollution.	Survey and 3 wells. Construction changes.	100	1800		3,000	4,800
19.	Lansford	353	Unsatisfactory	Survey and 2 wells.	100	1200			1,300

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SOURIS RIVER SUB-BASIN

PLATE I MAP NO.	Municip-ality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
20.	Minot	16,099	Highly mineralized. Danger of pollution.	Treatment Plant. Remove wells from the pits and re-pair storage tank.			20,000	5,000	25,000
21.	Rugby	1,512	Unsatisfactory. Danger of pollution	Remove wells and pumping equipment from pits. Treat-ment plant.			10,000	3,000	13,000
22.	Rolette	428	Inadequate. Danger of pollution.	Pump covering, Distribution System and Treatment Plant.			10,000	100	10,100
23.	Souris	218	Inadequate.	Survey and 1 well	100	600			700
24.	Sherwood	455	Inadequate. Unsat-isfactory.	Survey, 1 well, Distribution system and Treatment Plant.	100	600	13,000	17,000	30,700
25.	Tagus	136	Inadequate. Unsat-isfactory.	Survey and 1 well	100	600			700
26.	Tolley	285	Inadequate	Survey and 1 well	100	600			700
27.	Newburg	87	Inadequate.	Survey and 1 well	100	600			700
28.	Overly	151	Inadequate. Unsat-isfactory.	Survey and 1 well	100	600			700

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

SOURIS RIVER SUB BASIN

PLATE I MAP NO.	Municip-ality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist System	Total Estimate
29.	Portal	512	Inadequate. Unsatis-factory.	Survey, 3 wells, Distribution system and Treatment Plant.	100	1800	13,000	17,000	31,900
30.	Ruso	104	Inadequate	Survey and 1 well	100	600			700
31.	Thorne	38	Inadequate	Survey and 1 well	100	600			700
32.	Velva	870	Inadequate	Survey and 3 wells.	100	1800			700
33.	Willow City	577	Unsatisfactory	Distribution System and Treatment Plant.			13,000	17,000	30,000
34.	Westhope	521	Unsatisfactory.	Distribution System and Treatment Plant.			13,000	17,000	30,000
35.	Sawyer	206	Unsatisfactory. Inadequate	Survey and 1 well	100	600			700
			Sub-Totals:		2,500	22,200	207,000	187,600	

TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY: $ 419,300

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SOURIS RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS REQUIRING IMMEDIATE ATTENTION:		
Local surveys of available sources	$ 2,500	
Distribution systems - Berthold, Crosby, Columbus, Westhope, Dunseith, Mohall, Minot, Rugby, Rolette, Portal, Willow City,	130,600	
Treatment Plants - Berthold, Columbus, Dunseith, Portal Willow City and Westhope.	84,000	
Total Class "A" Projects:		$ 217,100
CLASS "B" PROJECTS REQUIRING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Shallow Wells		22,200
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Distribution Systems	57,000	
Treatment Plants	123,000	
Total Class "C" Projects:		180,000
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:		$ 419,300

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

SOURIS RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:					
36.	Velva	870	Comb.- No Treatment	Treatment Plant	$ 25,000
37.	Towner	622	Comb.- No Treatment	Treatment Plant	25,000
38.	Bowbells	695	Sewerage System. No Treatment, Inadequate.	Treatment Plant	30,000
39.	Kenmare	1,194	Comb.- No Treatment	Treatment Plant	35,000
40.	Willow City	577	No Sewerage System	System and Treatment Plant	40,000
41.	Westhope	521	No Sewerage System	System and Treatment Plant	35,000
42.	Columbus	516	No Sewerage System	System and Treatment Plant	40,000
43.	Dunseith	484	No Sewerage System	System and Treatment Plant	40,000
44.	Berthold	511	No Sewerage System	System and Treatment Plant	40,000
45.	Portal	512	No Sewerage System	System and Treatment Plant	35,000
			Total Class "A" Projects:		$ 345,000

TABLE C (Cont'd) PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

SOURIS RIVER SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
46.	Rugby	1,512	Comb.-Septic Tank, Inadequate.	Treatment Plant	$ 30,000
47.	Bottineau	1,311	Comb.-Septic Tank. Inadequate.	Treatment Plant	30,000
48.	Crosby	1,271	Comb.-Septic Tank. Sl.B.	Treatment Plant	30,000
49.	Mohall	676	Comb.-Septic Tank, Inadequate.	Treatment Plant	25,000
50.	Drake	644	Comb.-Septic Tank. Inadequate.	Treatment Plant	30,000
51.	Sherwood	455	No Sewerage System	System and Treatment Plant	35,000
52.	Granville	450	No Sewerage System	System and Treatment Plant	35,000
53.	Rolette	428	No Sewerage System	System and Treatment Plant	35,000
54.	Flaxton	423	No Sewerage System	System and Treatment Plant	35,000
55.	Noonan	423	No Sewerage System	System and Treatment Plant	35,000
			Total Class "C" Projects:		$ 320,000
TOTAL PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL:					$ 665,000

LEGEND FOR SEWAGE AND SEWAGE TREATMENT:

Comb. Combined System
Sl.B. Sludge Bed

TABLE D

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:											
1.	Bottineau	30	164	74	1,228		$ 4,900	III,IV	E	6,500 foot drainage ditch from Rost Lake to Lake Metigoshe to raise and maintain the level of the latter.	*******
2.	Bottineau	36	164	75	7,390		12,500	III,IV	E	Dam--Rost Lake Outlet. Dam would be in drainage canal inlet and would provide additional storage during wet years.	*******
3.	Rolette	3	163	71	6,120		1,500	III	E	Dam--Wakopa Creek. To raise Lake Upsilon by gravity flow and pumping.	******
4.	Rolette	3 10/15	163 163	71 71			1,000	III	E	Lake Upsilon improvement. Raising engine and building new pump house. Improving present dam at lake outlet.	******
5.	Ward	31	154	83	500		5,000	VII	F	Dam--Lake Outlet.	******
6.	McHenry	23	152	80	343		11,000	III,IV	E	Johnson dam and canal to refill a dry lake bed.	*****
7.	Ward	32	156	84	320		50,000	II	G	Dam on Des Lacs River to provide additional storage for Burlington Rehabilitation project.	*******

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
8.	McHenry					2,000	$100,000	II	E	Wells and equipment for small individual farm irrigation projects in the Sand Hill region. Sub-surface sources would irrigate approximately 10 acres per 160 acre tract.	*********
9.	McHenry	156	76		8,000	6,000	75,000	II	G	Eaton flood irrigation dam on Souris River to assure an annual hay crop.	*******
(10)	Bottineau Rolette						1,000	III		Hydrological study of Turtle Mountain watershed to determine feasibility of additional projects for the restoration of the lakes of the area.	*
11. 12. 13.	Souris River Headwaters in Sask. Canada						10,000	I		Survey and study of flood control and river regulation by means of headwater reservoirs.	*
14.	Ward, Minot N. Dak.						5,000	I		Survey and study of flood prevention for Minot by straightening and improving the Souris River Channel.	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig- nation	Description and Remarks	Survey
(15)	Entire Basin						$ 1,000			Hydrological study of Souris River to determine what additional irrigation projects could be supplied with sufficient water after present and proposed uses as listed above are provided for.	*
(16)	Entire Basin						10,000			Survey of small dams proposed for flood irrigation, recreation, and waterfowl refuge purposes. Survey of available water resources for stock watering where present supplies are inadequate or unsatisfactory. Recommendations to be made for the most satisfactory and economical solution of the problem through construction of community wells or surface reservoirs.	*
	Total Class "A" Projects:				23,901	8,000	$287,900				

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-- A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surve
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION IF HYDROLOGICAL STUDIES SHOW SUFFICIENT WATER IS AVAILABLE OR IF MISSOURI RIVER DIVERSION IS UNDERTAKEN:											
17.	McHenry		154 156	78/79 78/79			$ 5,000	II		Survey and design of Buffalo Lodge irrigation project. Investigate relative merits of Souris River dam and Canal to Buffalo Lodge Lake or a pumping system instead of the dam.	*********
18.& 19.	Ward	18	155	83			1,000	II		Survey and design of Foote-Graham irrigation projects on Souris River.	**
20.	McHenry & Ward		153	80/81			1,000	II		Survey and design of Sawyer-Velva irrigation project on Souris River.	**
	Total Class "B" Projects:						$ 7,000				
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":											
14.	Ward	Minot, N. Dak.					250,000	I	E	Straighten and improve the channel of the Souris River in Minot and for a few miles downstream, contingent on Survey.	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surve
17.	McHenry		154 to 156	78/79 78/79	29,000	10,000	$100,000	II	G	Dam in Souris River near Verendrye. Canal from reservoir so formed to Buffalo Lodge Lake to divert part of excess spring flow of the Souris River or water from Missouri River diversion. Irrigation by gravity flow between Buffalo Lodge Lake and Upham. Contingent on hydrological study and survey. Note: With Missouri River diversion 20,000 additional acres could be irrigated by this project.	*********
21.	McHenry		155	77	8,000	6,000	75,000	II	G	Lee flood irrigation dam on Souris River to assure an annual hay crop. Contingent on hydrological study and survey.	*******
18.	Ward	18	155	83	6,000	3,000	10,000	II	G	Foote Graham Irrigation project # 1. Irrigation by lateral ditches and by flood irrigation contingent on hydrological study and survey.	**

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surve
20.	McHenry & Ward		153	80/81	4,000	2,000	$50,000	II	G	Sawyer-Velva Irrigation Project. Contingent on hydrological study and survey.	*
11.	Sask., Canada N. W. of Estevan				53,000		50,000	I	G	Furnish a portion of cost of Estevan power reservoir on the Souris River. This reservoir would help prevent floods in North Dakota and would give additional stream flow regulation.	*
12.	Sask., Canada S. W. of Estevan				47,440		50,000	I	G	Furnish a portion of the cost of the Long Creek power reservoir. This reservoir would help prevent floods in North Dakota and would give additional stream flow regulation in the Souris River.	
13.	Sask., Canada North of Oxbow				25,050		25,000	I	G	Furnish a portion of the cost of the Mountain Creek power reservoir. This reservoir would help prevent floods in North Dakota and would give additional stream flow regulation in the Souris River.	*

TABLE 5 (Cont'd)

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap. A.F. Est.	Irr. Land Acres Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
22.	Ward	3	155	84	50		$ 5,000	II	F	Dam on Larson's Coulee for additional reserve storage for Burlington Rehabilitation project.	*
23.	Ward	17	156	84	300		60,000	II	F	Dam on Des Lacs River for additional reserve storage for Burlington Rehabilitation project.	*
19.	Ward	22/23	156	84	6,000	3,000	100,000	II	F	Foote-Graham Irrigation Project #2. Irrigation by lateral ditches and flood irrigation. Contingent on hydrological study and survey.	**
24.	Rolette	10	163	72	1,500		7,000	III, VII	F	6,800 foot ditch to add 4 sq. miles of additional watershed to that of Carpenter Lake. Contingent on hydrological study.	*******
25.	Rolette	28	163	71			2,500	III	F	Channel between Jarvis and Long Lakes making one large lake.	*******
26.	McHenry	14	156	80	20		3,000	IV	G	Dam--Egg Creek.	*****
27.	Bottineau	22	163	83	15		2,000	IV	G	Dam--Creek.	*****

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- Ac. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
28.	Bottineau	1	163	78	16		$ 2,000	III,IV	E	Dam--Creek.	*****
29.	Bottineau	33	163	75	2,000		5,000	IV,VII	F	Dam--Oak Creek Reservoir including two Jacobson Lakes, Duck Lake and Harmon Lake to catch overflow from Lake Metigoshe and Rost Lake. Contingent on hydrological study.	*******
30.	Bottineau	26	164	82	57		2,000	III,IV	E	Dam--Creek.	*****
31.	Bottineau	35	162	81	28		3,000	III,IV	E	Dam--Creek.	*****
32.	Bottineau	24 to 30	160 to 160	71 to 70	1,000		5,000	VII	F	Diversion ditch to Long Lake by way of a lake in S 25-126-71.	**
33.	McHenry	10	152	77	274		14,000	III,IV	G	Etteslad Dam--Creek. Near Balfour.	****
34.	McHenry	34	152	78	158		10,000	IV	G	Torgrimson Dam--Wintering River.	****
35.	Ward	9	153	83	27		2,000	IV	G	Dam--Creek.	*****
(16).	Entire Basin						50,000	IV		Construction of community wells for stock watering and the construction of surface water reservoirs in certain communities after surveys have shown that ground water resources in the areas are unsatisfactory. Possible reservoir sites are: Divide County, S 11-162-96; S 10-162-96; S 36-164-95; S 36-163-96; S 36-163-95; S 18-163-95; S 4-162-96; and S 31-163-95; Ward County, S 1-150-82; S 36-153-81; S 13-154-81; S 9-153-83; S 36-160-89; S 11-156-81; and S 20-154-81; McHenry County, S 27-159-78; S 25-157-80; S 18-159-78; and S 4-159-80; Rolette County, S 17-161-70; and Burke County; S 12/13	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SOURIS RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-A. F.-Est.	Irr. Land Acres-Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
	Total Class "C" Projects				183,935	24,000	$882,500				
	TOTAL PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES:				210,836	32,000	$1,182,400				

SURVEY:

*	None
**	Field Inspected by State Engineer
****	Surveyed by CCC
*****	Surveyed by FERA and WPA
******	Surveyed by County Engineers
*******	Surveyed by State Engineer
********	Surveyed by Rehabilitation Corporation Engineer
*********	Surveyed by U. S. Bureau of Reclamation

USE:

I	Flood Control and Stream Regulation
II	Irrigation
III	Recreation
IV	Stock Watering and Water Conservation
VII	Waterfowl Refuge

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

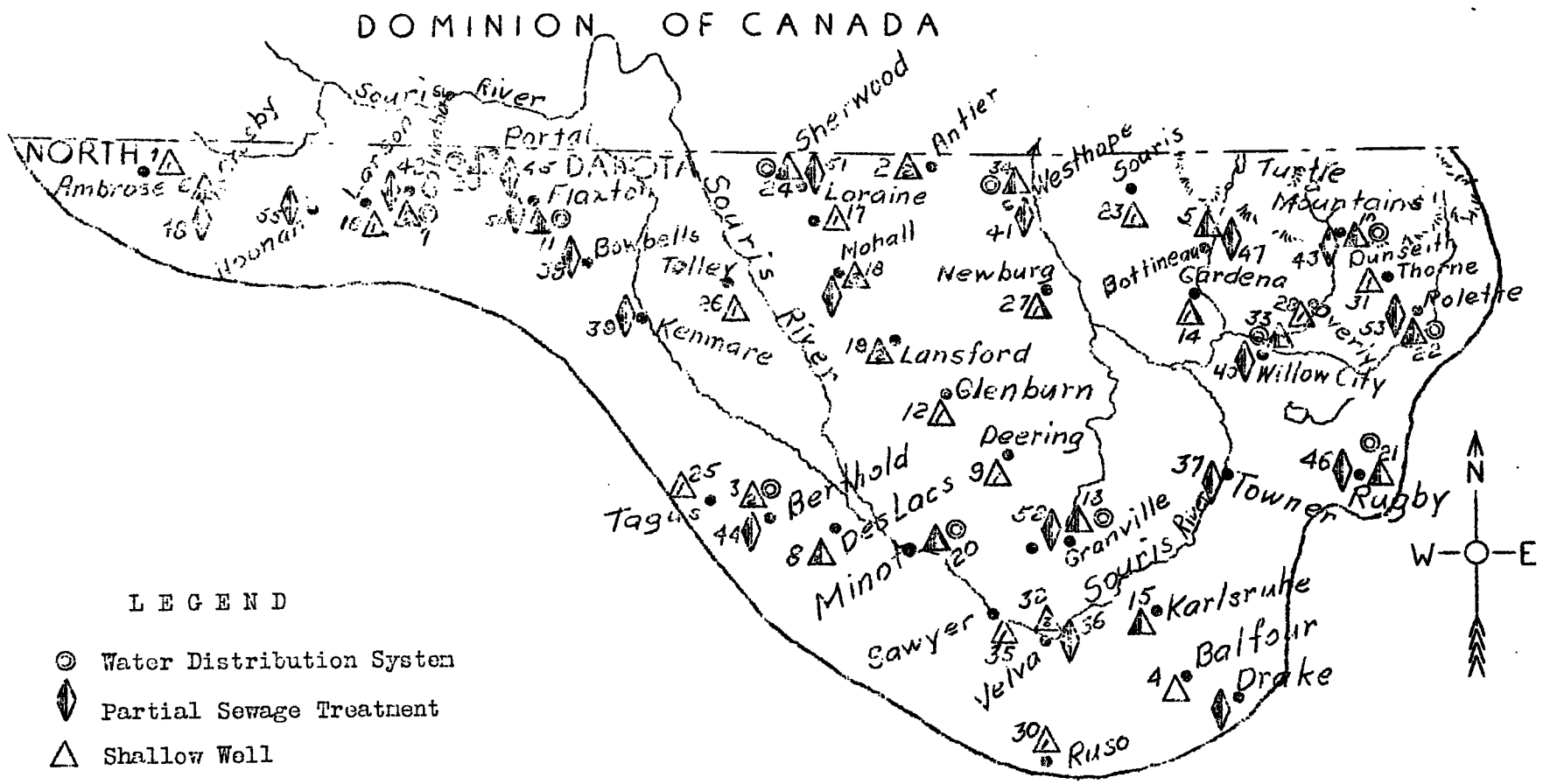
TABLE E

PROPOSED PROJECTS

SOURIS RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Proposed Improvements in Water Supply	$ 217,100	
Proposed Improvements in Sewage Disposal	345,000	
Proposed Improvements in Use of Surface Water Resources	287,900	
Total Class "A" Projects:		850,000
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Proposed Improvements in Water Supply	22,200	
Proposed Improvements in Use of Surface Water Resources	7,000	
Total Class "B" Projects:		29,200
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Proposed Improvements in Water Supply	180,000	
Proposed Improvements in Sewage Disposal	320,000	
Proposed Improvements in Use of Surface Water Resources	882,500	
Total Class "C" Projects:		$ 1,382,500
TOTAL PROPOSED PROJECTS:		2,251,700



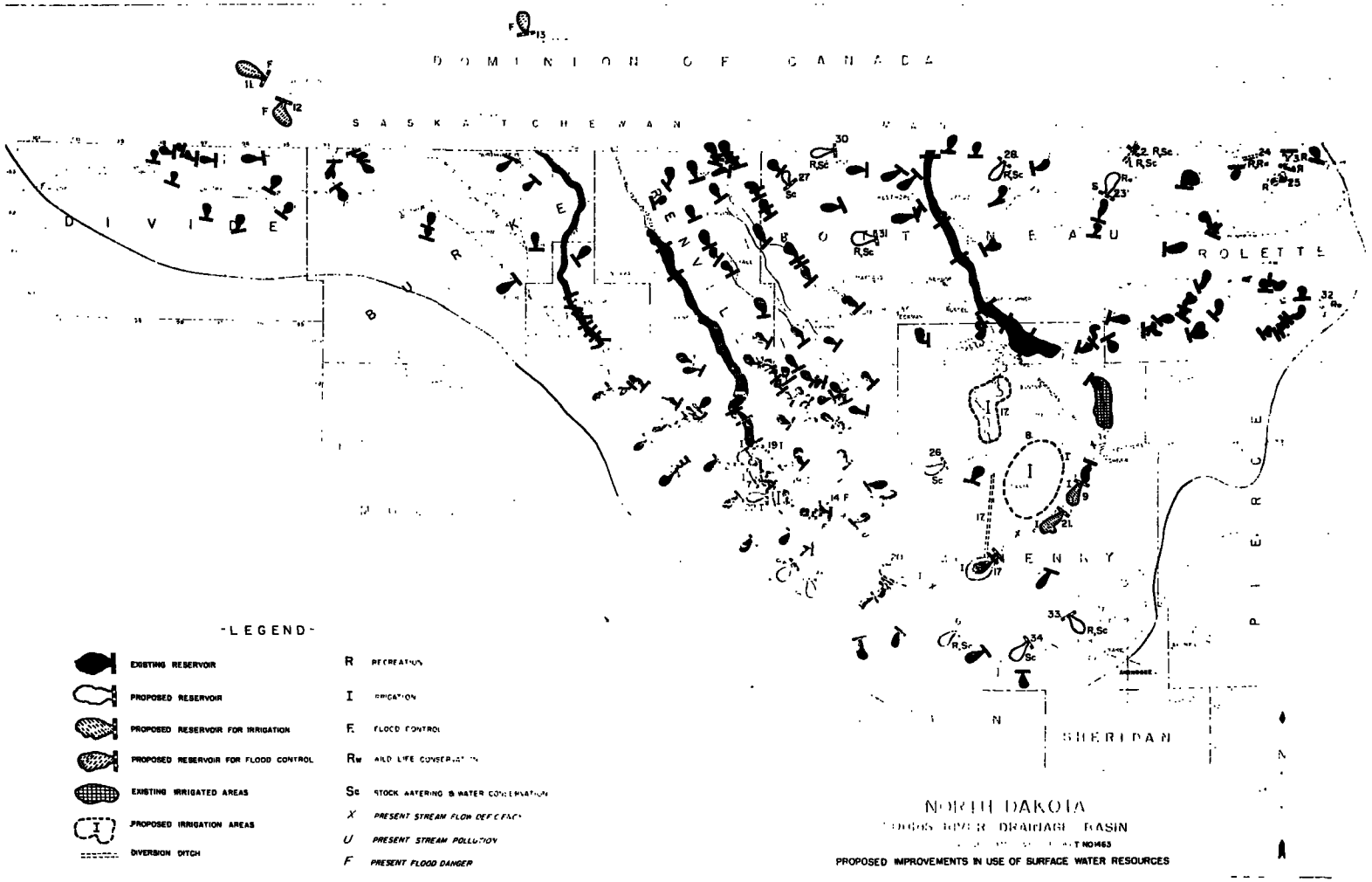
L E G E N D

- ◎ Water Distribution System
- ◆ Partial Sewage Treatment
- △ Shallow Well
- ◭ Partial Water Treatment

SOURIS RIVER SUB-BASIN

PROPOSED IMPROVEMENTS
in
WATER SUPPLY and SEWAGE DISPOSAL

Plate I

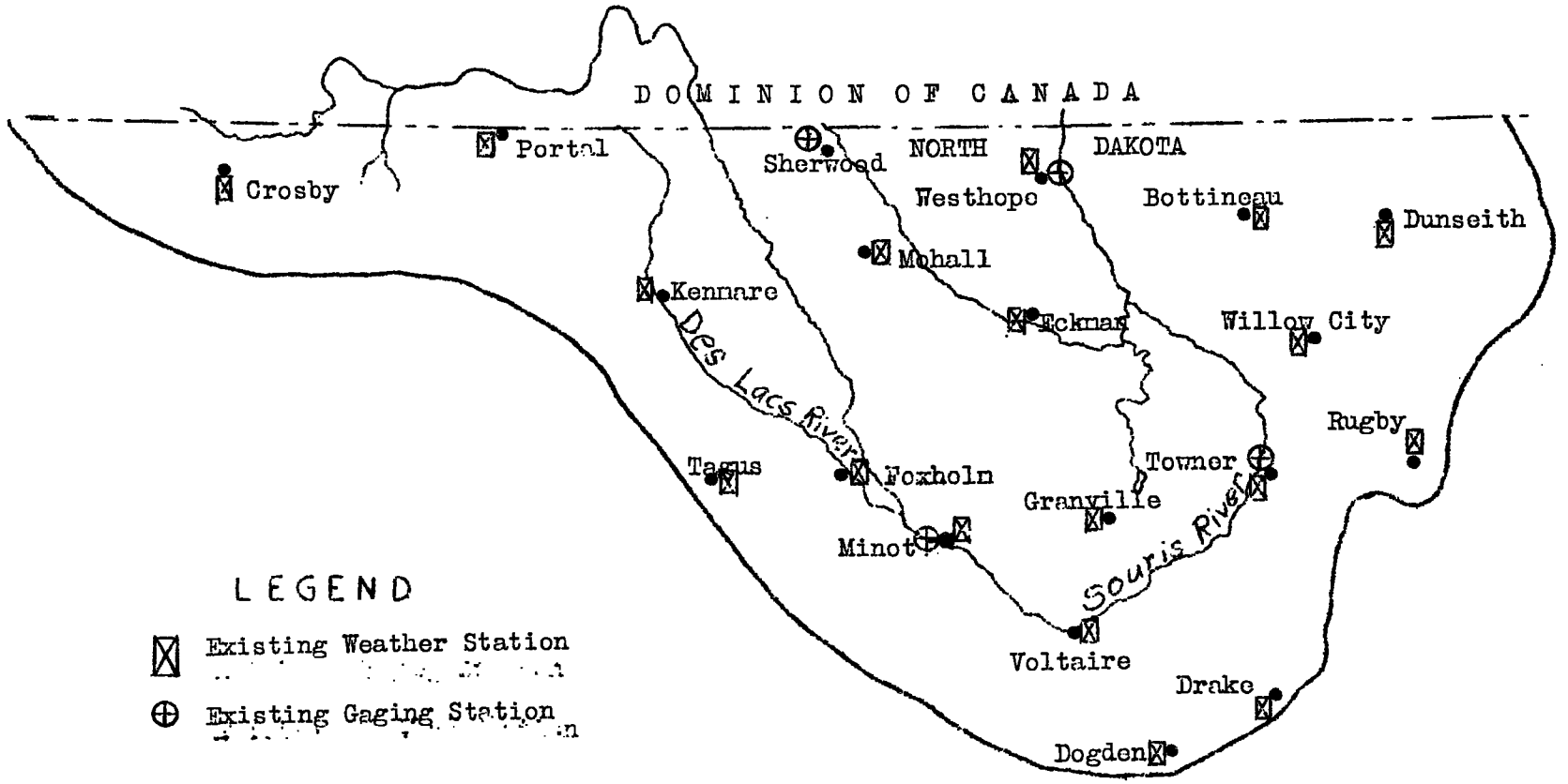


NORTH DAKOTA

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

PREPARED IN THE OFFICE OF THE CONSULTANT

PLATE II



SOURIS RIVER SUB-BASIN

STREAM GAGING
and
WEATHER OBSERVATION FACILITIES

Plate III

CHAPTER II

DEVILS LAKE SUB-BASIN

CHAPTER II

DEVILS LAKE SUB-BASIN

ENERAL

Devils Lake occupies, in part, the very irregular depression immediately to the south of the city of Devils Lake and along the south edge of Ramsey County. The tributary drainage area is located in the midst of the Drift Prairie of North Dakota, a region transitional between the Prairies of the Midwest and the Great Plains, and includes most of Ramsey County, a large part of Towner County, and smaller parts of Rolette, Benson, Nelson and Cavalier Counties. The area draining to Devils Lake, most of which is north of the lake, is 3406 square miles and that to Stump Lake is 410 square miles. This is considered as one basin in this report.

ATURAL RAINAGE

There is no marked surface drainage in the Sub-basin but such as there is is southward to Devils Lake. The slight slope, the irregularity of the surface, and the porous character of the drift causes most of the waters which reach Devils Lake from its interior drainage basin to reach it by underground seepage, the waters moving slowly down the slope from the north, through the sandy portions of the drift and over the impervious floor of the blue-grey shale beneath.

OPULATION

The total population of the Basin according to the 1930 census was 41,323 persons of which 26,681 resided in rural areas and 14,642 resided in incorporated cities or villages. There were but four towns in the area with a population in excess of 500 in 1930. Devils Lake had 5,451; Cando had 1,164; Leeds had 725; and Bisbee had 531.

ELIEF

The number of persons receiving relief in the Sub-basin during the peak month, March 1935, was 10,044 or 243 per cent of those residing therein. This compares with a state average for the same month of 31.6 per cent. During the peak month of W. P. A. employment 631 persons were employed on work projects in or near cities and villages and 1743 persons were employed on rural projects, making a total of 2374 persons employed in October, 1936.

ATER PROBLEM

The problem of water for human consumption in the Devils Lake Sub-basin is not acute. Because of the nature of the terrain a larger part of the moisture which falls on the area is absorbed by the soil than in other localities. As a result the sub-surface sources of water are good. Farms and small towns readily obtain their water supplies by tapping ground reservoirs in gravel pockets or in sand veins in the Pierre Shale at a depth of 60 to 400 feet. Although the latter source is ample for moderate demands it will not furnish a sufficient source for a city such as Devils Lake as far as present information indicates.

Devils Lake has a water problem in that its present supply from an artesian well is very salty. A more satisfactory source is sought. Several small towns noteably Minnewaukan, have a water supply of unsatisfactory quality. In the case of Minnewaukan this is due to its proximity to the old lake bed where waters absorb much alkali before seeping to the vein from which the town receives its supply.

AINAGE, OODS & REAM GULATION

There are no drainage problems or projects as such in the Sub-basin although some individual land owners have installed ditches to provide drainage for small tracts of marshy hay lands. The many small lakes serve as natural detention reservoirs retarding the spring run-off and thus preventing floods along the streams and coulees of the area. A large part of the run-off reaching these lakes does so during the one or two months of spring break-up. There are no streams in the Sub-basin serving a sufficient drainage area or having storage possibilities sufficient to make regulated stream flow feasible.

OLOGICAL RVEY

The U. S. Bureau of Biological Survey is at present engaged in the restoration of several lakes and marsh areas in the Sub-basin for use as migratory waterfowl refuges. The largest and most important of these developments is that on Lake Alice, just northeast of Churchs Ferry, which will have a water surface of 3,462 acres. Another project is that of improving Pleasant Lake in the northeast corner of Benson County by the construction of a dam at the outlet. The water surface will be 490 acres. A third project is that of restoring Billings Lake, a few miles south of Loma, to a water surface of 130 acres. The development in each case is a dam at the outlet of the lake that will increase the storage of spring run-off in the lake.

LD LIFE

The Devils Lake Sub-basin with its many lakes and marshes probably produces more migratory waterfowl than any other area of equal size in the state. The Biological Survey projects under construction will materially help to maintain and perhaps increase this production. Another project that should be undertaken is the construction of a spillway under the bridge on the road which crosses Prosey Slough on the section line along the north side of section 27-156-61. This spillway would raise the level part of the slough about two feet. The road would be used as the dam. It has been proposed that a dam be built at the outlet to the slough but the tributary drainage area is too small to support the entire slough. However, it would probably support the portion above the proposed spillway very well. The cost of such construction would be materially less than a dam at the outlet.

VILS LAKE

Devils Lake was formerly one of North Dakota's most beautiful lakes. In 1867 it had an area of 142 square miles and was nearly 40 feet deep. Since that time it has steadily, although

irregularily, declined in area and depth until at present it covers an area of perhaps 30 square miles to a depth of from a few inches to a maximum of perhaps 7 feet. There have been many contributary factors to this decline of Devils Lake but the largest single factor, perhaps, is the plowing up of the native sod and the growing of cultivated crops thus retarding run-off and increasing evaporation from the ground surface and the transpiration from plant life.

Devils Lake at one time supported abundant fish life but the water has become such that only a few fish live in it. These are unfit for human food. Other lakes in the area are too shallow to support fish life.

REEL BAY

Creel Bay extending north from the main body of Devils Lake in Sections 7 and 18-153-64 and into section 13-153-65 formerly was used for swimming and boating. In 1934 the water in this bay was condemned for swimming purposes and the cottages and the Lakewood Chatauqua grounds along the east shore of the bay in section 18 have become practically worthless. People in Devils Lake propose to construct a dam along the south line of section 13 and another in the north end of section 7 so as to enclose a portion of this bay and fill this either by pumping from the main body of Devils Lake or from an artesian well put down for the purpose. While this project would be desirable to restore the value of the adjacent property and also to provide recreational facilities for the people of Devils Lake the cost of such a project would probably be much greater than the benefits derived. Other objections are than an artesian well would not give sufficient flow to maintain the evaporation or if water were pumped from Devils Lake it would probably not be accepted by the health department. However, before a definite conclusion is reached a more detailed study should be undertaken.

ECREATION

There are a number of recreational areas in the Devils Lake Sub-basin. Some of these are quite well developed at the present time but others should have some work done on them to best serve the surrounding areas. Devils Lake is constructing a swimming pool at the camp grounds south of the city. There is camping and recreational facilities, along the lake in Twp. 154-64. There is some swimming in Sweetwater Lake several miles north of Devils Lake but some work should be done to develop the possibilities. There is a natural park and camping place at the town of Pleasant Lake. Here there is a fresh water lake and flowing springs. This lake is being raised by the U. S. Biological Survey. Wood Lake, in township 151-64 supports a summer resort with cottages, stores, and a pavilion. There are many trees around this lake. There is good swimming and camping at a small lake near Sullys Hill Park in township 152-64. Leeds has a municipal swimming pool which is filled by an artesian well. There is swimming in the reservoir a few miles north of Minnewaukan during part of

each year. A dam was constructed across Rock Lake in section 28-162-66, by F. E. R. A. and the Biological Survey. This dam divides Rock Lake and causes the south portion of the lake to raise and overflow to the south rather than to the north. This is an excellent recreational spot. A dam in Boulder Creek several miles west of Crocus in section 17 or 18-160-66 would create a fine reservoir for recreational use of the surrounding area. Another dam in a creek in section 13-158-69 would also produce an excellent recreational spot. Silver Lake was formerly an excellent recreational center but has been dry the past 7 years. The flood waters of a nearby coulee could be diverted into the lake by constructing a dam in section 8-154-67. A part of Stump Lake could also be improved for recreational purposes making an excellent spot for camping and swimming.

VERSION
DEVILS
KE

The restoration of the recreational value of Devils Lake can only be realized through some method of bringing in water from outside the drainage area to restore the lake and support evaporation therefrom. The flow in the Sheyenne River or the Souris River is so small that probably only enough water could be diverted to maintain evaporation from the present lake surface. The only available source of a large quantity of water for the restoration of the lake is the Missouri River. Several methods of diverting water to Devils Lake from the Missouri River have been proposed.*

There is no possibility of replenishment of Devils Lake from natural precipitation in the Sub-basin. This is already completely used by evaporation from shallow lakes and earth's surface and by transpiration from plants. Small canals or ditches could be dug to drain some of the small lakes and swamps in the area and carry their water to Devils Lake. This would result in only a very small increase in the level of Devils Lake. It would be detrimental to local needs in that it would destroy local lakes now used for recreational and other purposes and would also probably lower the ground water somewhat in these localities. Indeed the opposite proceedure seems to be desirable. Several small dams should be built to create reservoirs for local needs. This additional storage outside of Devils Lake in the Sub-basin would tend to decrease the inflow to Devils Lake.

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* 1. 308 Report on James River in North & South Dakota.
2. "Report on Missouri River Dam and Diversion Project in North and South Dakota" by Burns and McDonnell Engineering Co.
3. "Report on Missouri River Diversion in North Dakota" by R. E. Kennedy, North Dakota State Engineer.

SUGGESTED METHODS OF REPLENISHING DEVILS LAKE

Five different methods for replenishing Devils Lake have been suggested. These are: 1. Diversion from the Souris River; 2. Diversion from the Sheyenne River; 3. Pumping project utilizing waters from the Missouri River; 4. Diversion from the Missouri River by means of a high dam, canals, and tunnel; and 5. Diversion from the Missouri River at river elevation or with a small dam by means of canals and tunnels.

SOURIS RIVER DIVERSION

The first method, that of diversion from the Souris River at some point between Minot and Devils Lake, has been surveyed and found feasible from an engineering standpoint. There are, however, several objections to this project. During ordinary years the flow in the Souris River is so small that during most of the year none could be diverted from it. Although there are some periods of good flow and occasional disasterous floods, these amount to but a few months out of each 20 year period. The plan would be ineffective for any satisfactory replenishment of Devils Lake unless the canal, gates, and reservoirs were made so enormous as to make the expense prohibitive for the benefits derived.

SHEYENNE RIVER DIVERSION

The second method involves the construction of a dam on the Sheyenne River directly south of Devils Lake. The reservoir would have a storage capacity of 27,000 acre feet and would cover 2,100 acres. The total drainage area would be 1,700 square miles. The average annual run-off would be approximately 36,000 acre feet. The maximum annual run-off would be 90,000 acre feet, and the minimum annual run-off would be about 2,000 acre feet. The present net evaporation from Devils Lake is approximately 24,000 acre feet per year. If the entire flow of the Sheyenne River at this point were diverted to Devils Lake it would merely serve to raise the lake level a few inches and would not materially increase its value. Moreover, a large pumping plant would have to be operated continuously with an average lift of approximately 50 feet.

There would probably be serious objections, made by people living downstream, to the diversion of any water from the Sheyenne River. The Sheyenne River has a very small flow through at least five-sixths of each year, less than 20 cubic feet per second, and only a few cubic feet per second during at least half the year. The river flow would be diminished by the filling of the reservoir during the few weeks of flood flow in each year. During this time the inhabitants in the valley below would not need the water and would perhaps prefer a reduction in the flow. However, if the Baldhill Reservoir is constructed this flood flow will be needed to fill it and insure stream flow regulation for the rest of the year.

The objections to diversion from the Sheyenne River are that no real benefit would be derived, the operating as well as the

initial cost would be excessive, and the water available in the SheyenneRiver is needed for stream regulating purposes to be accomplished by the proposed Baldhill Reservoir.

DIVERSION FROM MISSOURI RIVER BY PUMPING

The third proposed plan calls for a huge pumping plant at the nearest point of the Missouri River, about 110 miles away, to pump water across the continental divide into Devils Lake to refill it and supply the increased evaporation. The lift over the intervening ridge would be approximately 400 feet. In addition to the original cost, estimated at $34,000,000 this plan would involve additional costs for operation of the pumping plant exceeding $500,000annually. Unless some form of gravity flow is employed diversion from the Missouri River would not be feasible from an economic standpoint.

DIVERSION FROM MISSOURI RIVER BY HIGH DAM

A fourth plan includes the building of an earth fill dam approximately 150 feet high on the Missouri River near Garrison. This would back the water up Garrison Creek as far as it was economical to dredge a canal. From this point a tunnel about 20 miles in length would carry the water through the continental divide and would emerge on the eastern side of this ridge at a height that would allow the water to flow readily into the head waters of the Sheyenne River and also, through comparatively simple canals of not very great depth or a few short tunnels, into Devils Lake, into the James River, and into the Souris River if desired. This project is fully described in the printed report to the Missouri River Diversion Association of Devils Lake, North Dakota, submitted by Burns and McDonnell Engineering Company in 1933.

The lake formed by the dam in the Missouri River Valley would extend upstream about 150 miles to Williston and it would be several miles wide along much of its length. The total water surface would be about 600 square miles and the storage capacity would be approximately 10,000,000 acre feet. This reservoir would provide a means for regulating the flow and lessening the flood damages of the river below.

Because of its regulating features this reservoir would not be kept at a uniform elevation but the head at the dam would vary from 50 to 140 feet. This would not be satisfactory for the development of power nor would it permit the use of the lake for navigation because the constantly changing shore line would prevent the erection of suitable piers.

The total cost of the Missouri River Diversion in this form has been estimated at from $65,000,000 to $80,000,000 of which almost 75% would be for the dam and power house. It has been proposed that a power house capable of developing 40,000 horse

power placed at the dam. As noted above the variable head available would not make the development of power entirely satisfactory. Some income from the sale of power would be derived but it is questionable, even after the demand was fully developed, whether the total income would pay the interest on the cost of the dam.

The lake would cover thousands of acres of the best bottom lands on both sides of the Missouri River for half its length in North Dakota.

The chief objection to the building of such a large dam is the uncertain foundation conditions which are clay, shale, and soft sandstone. The dam could be built presumably safe, but, if it should ever fail, the sudden release of so enormous a body of water would be such a stupendous disaster that it is not permissable to run such a risk. The U. S. Army Engineers Corps have investigated this project and have reported unfavorably because of this consideration. This is contained in their report "James River, North Dakota and South Dakota", House Document No. 83, 73rd Congress, 1st session.

ORIGINAL MISSOURI RIVER DIVERSION PLAN

The fifth plan is that orinally suggested at least a dozen years ago for the diversion of water from the Missouri River. This method is free from the dangers and objections outlined for that above and could be constructed for one third or at most one half the cost of the high dam project. This plan seems entirely feasible although the initial cost would be very great, probably $30,000,000.

This project is primarily for the benefit of the Sheyenne and James River Valleys. Great benefits would also be derived by the Souris River Valley and also by the towns on both sides of the Red River from Fargo-Moorhead north. The refilling of Devils Lake is but a small part of the total benefit that would be derived from the project.

If this plan were adopted water would be diverted from the Missouri River at a point found to be most practicable, probably in the vicinity of Garrison, North Dakota. A series of canals and tunnels would carry it northeastward then eastward and southeastward onto the shoulders of the Souris, the Sheyenne, and the James River valleys. A part of this water would be diverted from the Sheyenne River to Devils Lake by gravity flow and would raise the level of the lake and provide for the increased evaporation from the larger area.

The direct straight-line distance from the Missouri River bend south of Garrison to Devils Lake is 110 miles but the

course the water would take would be perhaps 130 to 140 miles in length. The low water elevation of the Missouri River is about 1,690 feet and the present elevation of Devils Lake is about 1,410 feet. From this it is apparent that there is sufficient fall even if the water is diverted at natural river level. In this case about 40 miles of the diversion would be through a tunnel having a drop of 3 feet per mile.

A modification of this plan would include a dam of a height of perhaps 40 feet. This would probably be preferable. A decrease of 5 miles in length of the tunnel would partly compensate for the cost of the dam. The additional elevation obtainable at the outlet of the tunnel would make it easier and less expensive to lead the water to the deisred points of use; northeast, east, and southeast. Such a dam would be in line with the tentative program of the U. S. Army Engineers calling for a series of such dams on the Missouri River. If the tunnel had a diameter of 18 feet, it could carry approximately 1500 cubic feet per second. If full flow were carried during one third of the year and half flow during at least another one third of a year the tunnel could bring more than 500,000 acre feet per year to the areas of need. With its present shrunken area Devils Lake would be raised one foot annually with only 5% of this inflow. Even at the level at which Devils Lake stood 50 years ago approximately 17% of this annual inflow would raise its elevation one foot. Only 12.5% or 62,500 acre feet would be required to provide the net annual evaporation at this level. It is probably not desirable to raise the lake even as high as this because of greatly increased property damage. Equally great benefits could be derived by raising it to a lower elevation than this, perhaps 20 feet above the present level.

Devils Lake would assist in the advantageous operation of the entire project. During periods when the flow was not needed elsewhere and during spring floods in the streams, the entire diverted flow could be directed into Devils Lake and at periods when the water was needed elsewhere the flow into Devils Lake could be stopped and the water directed thereto. The water of Devils Lake now contains more dissolved solids than does sea water.

The diversion project would be particularly beneficial if it included such short canals and tunnels as would carry water from Devils Lake into Stump Lake and from Stump Lake into the Sheyenne River. Devils Lake would then be ultimately freshened to such an extent as to be satisfactory for a water supply for Devils Lake. Fish would thrive in the lake and wild fowl would be present in great numbers. The area would become a great recreational center for the entire state and would profit greatly from tourist trade drawn to the area by the lake.

The U. S. Army Engineers Corps are at present making surveys to determine the estimated cost of diversion at river level and of diversion by means of a 40 foot dam and to compare the costs and benefits of these with those of the 180 foot dam project with a view to determining the best method of diversion. Reliable estimates will, therefore, soon be available. For purposes of this report it is sufficient to estimate the total cost at between $25,000,000 and $35,000,000 and to state that only a fraction of this should be charged to the Devils Lake Sub-basin because of the great benefits that would be derived over a wide territory.

IRRIGATION

Irrigation is not practiced in the Sub-basin because of the necessity of a large amount of pumping to make water available where it is needed for such purposes. If water were available at high elevations, as it would be in the case of Missouri River diversion, large tracts would doubtless be irrigated.

NAVIGATION

The only commercial navigation that has existed in the Sub-basin was on Devils Lake between Devisl Lake and Minnewaukan. If the lake were restored it is doubtful if this route would be reopened because of the service given by trucks and busses at present. However, the lake would be used for a large number and variety of pleasure craft.

STORAGE FACILITIES

Although there are a number of small dams in the Sub-basin and a few fresh water lakes the major portion of the run-off reaches Devils Lake and other stagnant lakes where it is spread over a large area, in many cases only a few inches deep, and the resulting loss from evaporation is enormous. Some method should be provided for storage of this water, before it reaches such lakes, in reservoirs having a relatively high ratio of storage capacity to water surface. This would decrease the loss by evaporation and would provide a number of small fresh waterlakes which would be of great value for recreational purposes. The total average annual run-off in the Sub-basin is approximately 45,000 acre feet. Present artificial reservoirs and lakes on which improvements have been made have a storage capacity of approximately 16,000 acre feet.

WATER POWER

There are no present water power developments within the Sub-basin nor are there any streams suitable for such development.

STREAM IMPROVEMENT

There is little that can be done to improve existing streams in the Sub-basin. Channels are ample to carry away any excess water during high run-off periods. As stated above there is not a flood problem in the area so there is no need for improved channels or levees, nor is there a need or a possibility of

providing stream regulation.

MUNICIPAL SUPPLY PROBLEMS

Several towns in the Devils Lake Sub-basin notably Devils Lake and Minnewaukan have water supply problems. The chief problem seems to be one of quality rather than one of quantity.

PROPOSED IMPROVEMENTS IN MUNICIPAL WATER SUPPLY

It is proposed that local surveys be undertaken at once to locate potable water supplies for those towns now using water of unsatisfactory quality. It is further proposed that when such sources of water are located that immediate steps be taken to make them available for use. For Devils Lake it is proposed that the survey follow the proposals as outlined in Mr. Simpson's report of June 30, 1934, an excerpt of which is listed below. However, instead of the farmers participating in the cost of such survey this work could now be done by relief labor.

MR. SIMPSON'S RECOMMENDATION

"Secure the permission and co-operation of the owners of the shallow drift wells located near the barns of the following mentioned farms. Enter and clean these wells and sink them through the gravel layer from which they draw their supply. Stop the well at the drift clay or shale formation laying immediately beneath the gravel or sand and then make a thorough pumping test to determine the yield of the gravel vein through a shallow open well of this type. The following locations are recommended: Mr. O. T. Thon, SW¼ section 23; Mr. Nootnaugle, NE½ section 14; Mr. C. Frank, SW½ section 14; Mrs. F.M. Jurgens, NE¼ section 22. These all lie between one and two miles to the north of the city of Devils Lake.

Because of the value to the owners in the cleaning, improving and strengthening of these wells, arrangements should be made which will divide the cost of all the work upon the wells, except the pumping tests, share and share alike between the owners and the city. A careful record of the depth of the gravel vein, the thickness of the vein, together with samples of the gravels for each foot penetrated should be kept, also accurate records of the pumping tests should be made, including the time of the test and the time necessary for the recovery of the head following the test.

Since the result of these tests will throw much light on the possibility of securing an adequate supply from the gravels, I think it advisable to do the work upon these wells as soon as possible and before any expense is incurred in test drilling."

In the body of Mr. Simpson's report he states that the Pierre Shale as a whole slopes to the south towards Devils Lake. In view of this, it is proposed that a study be made contemplating

a collection gallery to be placed at right angles to the line of drainage in the gravel strata resting on the Pierre Shale. Should this not supply enough water, a pipe line could be placed from Sweetwater Lake to transport water to this collection gallery. The water would be released in the gravel above the collection gallery and the gravel beds would thus be utilized as a filter.

As the city of Minnewaukan has a serious water problem in that its present supply is very alkaline, it is proposed that a survey crew prospect the gravel strata to the west of the town to see whether or not a satisfactory water supply can be developed at this source.

If Devils Lake were refilled by the diversion of water from the Missouri River the water in the lake would be satisfactory for municipal use when treated. Devils Lake would not need to search farther for a satisfactory water supply. The municipal water supply problems and the proposed projects for their solution is given in Table B.

POLLUTION OF STREAMS

A few towns along streams in the Sub-basin do not have sewage disposal plants or systems. Others already have systems but need improved treatment plants to reduce the pollution of the streams. There is much pollution of the waters in the Sub-basin due to weed growth and the stagnation in marshes and coulees. Little can be done to relieve this situation.

PROPOSED IMPROVEMENT TO SEWAGE SYSTEMS

It is proposed that sewage systems and treatment plants be installed in towns along streams and creeks in the Sub-basin where it is feasible to do so and to modernize existing treatment plants. Sewage problems and the proposed solutions are given in Table C.

EXISTING RESERVOIRS

A total of 18 dams have been constructed within the Sub-basin. Some of these are merely small channel dams creating reservoirs in creek and coulee beds while others serve to refill old lake beds or raise the level of existing lakes. In all a reservoir capacity of approximately 17,000 acre feet has been created at a cost of $70,800. A list of existing dams is given in Table A. Several of these reservoirs are used for migratory waterfowl refuges, many are used for recreation, and all serve water conservation purposes by keeping the water out of dry or shallow lakes where it would be quickly lost by evaporation. In addition to those under construction it is proposed that several additional reservoirs be created.

DIKES TO RAISE THE LEVEL OF SWEETWATER LAKE

It is proposed that a dike be placed in the inlet to the lake which lies in section 20-153-63 and another in the inlet to the lake which lies in section 28, 29, 32, and 33-155-63 and

thus exclude the water from these lakes and divert it to Sweetwater Lake proper. The locations of these dikes would be in the SE¼ of section 20-155-63 and in the SW¼ of section 29-155-63 respectively. The combined water surface of these lakes is 17,990 acres and that of Sweetwater Lake is 51,100 acres. At present there is a net annual evaporation from the surface of the two smaller lakes of 22,700 acre feet during an average year and 34,900 acre feet during y ars of minimum precipitation. This amount of water diverted to Sweetwater Lake would raise its level 5 inches during an average year and 8 inches during a dry year over the level it would maintain without such additional supply. This would continue to raise Sweetwater Lake until it reached an elevation of approximately 1,458 or several feet higher than its present elevation. It would reach this elevation without appreciably increasing in area but beyond that it would overflow into several other lake beds and the evaporation would again be increased to such an extent as to take care of all inflow.

EXPLANATION OF PROPOSED SITES

One proposed dam is in the drainage area of Sweetwater Lake and three are in that of Lake Alice. However, as these are far up in the drainage areas and as their water surface is very small the effedt on the lakes would be negligible. There is also a definite need for reservoirs at the points where these are proposed. It is proposed that these reservoirs be made as small as is consistent with the recreational use to which they are to be put. The Posey Slough project, although it is in the Sweetwater Lake drainage area, will not affect the latter because the project calls for using a present road grade across the slough as a dam and installing a spillway under a bridge, thus increasing the water level in the upper portion about two feet at the expense of the lower part. In this way a smaller marsh would be maintained a greater share of the time. The remaining proposals are primarily for water conservation. The object of these is to maintain the water in relatively deep reservoirs having a small area exposed to evaporation rather than allow it to run into the dry bed of Devils Lake. At present it spreads over the lake bed in a thin sheet and is quickly lost by evaporation. These reservoirs would be located at convenient distances from small towns and would doubtless be used for recreation when the water was of satisfactory quality. The proposed program of dams and dikes is given in Table D.

RUN-OFF

The average annual run-off for the Devils Lake Sub-basin is estimated to be 0.22 of an inch. Dean E. F. Chandler of the University of North Dakota makes this estimate by considering the similarity of the topography with that of the Souris River Sub-basin. This value was checked by noting the decline in Devils Lake which shows an excess of evaporation over run-off. The

assumed net annual evaporation minus the annual decline in lake level equals the run-off to the lake. This was found to check the estimated value of 0.22 of an inch very closely. The minimum annual run-off was estimated in a similar manner.

RUN-OFF EVAPORATION STUDIES

Hydrological calculations were carried out to determine the behavior of the various proposed and existing reservoirs during dry to average years. The average annual precipitation for the Sub-basin was 16.50 inches and the average of the station minimums was 8.35 inches. Although the year of minimum precipitation was not identical for all stations this figure was used in the computations. As determined in experiments by Dean Chandler, evaporation does not materially vary from wet to dry years. This is explained by the fact that the percentage of sunshine, the relative humidity, and wind velocities and directions are practically the same during a year of minimum precipitation as they are in all other years. The average yearly evaporation from water surface as determined by Chandler was 31.63 inches. Therefore, the annual net evaporation for an average year was 15.13 inches and that for a year of minimum precipitation was 23.28 inches. These represent values of 1.26 and 1.94 acre feet per acre of water surface respectively. The run-off figures of -.22 inches and 0.02 inches represent run-offs of 11.7 and 1.07 acre feet per square mile per year respectively. From the above it was determined that the run-off from one square mile of drainage would support evaporation from 9.2 acres of water surface during an average year and that from 0.55 acres during a year of minimum precipitation and run-off.

RURAL WATER SUPPLY

A large number of small reservoirs have been proposed for the Sub-basin by various agencies. Those that would serve purposes of recreation, irrigation, and waterfowl refuges have been included in the proposed program. It is proposed that before any more small dams for stock watering purposes be constructed in the Sub-basin, a detailed survey of rural water supply be undertaken to determine the best and most economical method of securing adequate and satisfactory water supplies for stock watering purposes. Where an adequate ground water supply is available it is probable that this would be through the construction of community wells. In other localities not having a reliable ground water supply the construction of surface reservoirs would be the only alternative. Following such a survey it is proposed that assistance be given in developing an adequate rural water supply.

LAKE GAGING AND WEATHER OBSERVATION STATIONS

Active weather recording stations in the Sub-basin are shown on Plate III. A lake gage is located near Devils Lake and readings have been taken at irregular intervals for many years. No additional facilities are proposed but it is strongly urged that all existing stations be maintained.

TABLE A

EXISTING RESERVOIRS

DEVILS LAKE SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
1.	Rolette	23	160	70	30	1,000	II,IV	P	Dam-Creek. Near Mylo	*
2.	Towner	28	162	66	2826	19,300	III,IV,VII	F	Dam across neck of Rock Lake	** *****
3.	Towner	1	160	68	23	800	III	E	Dam-Creek, Near Perth	*
4.	Towner	13	157	66	20	2,000	III	F	Dam-Creek. Recommended recreational center.	***
5.	Towner	30	161	67	39	4,600	IV	E		*
6.	Cavalier	26	159	60	63	3,000	III,IV	G	Dam-Creek. Near Nekoma	**
7.	Cavalier	15	159	61	400	1,300	VII	G	Dam-Outlet to Billings Lake	*****
8.	Cavalier	10	160	61	52	6,800	IV	F	Dam-Creek	*
9.	Ramsey	21	156	66	10,000	3,100	IV,VII	F	Dam-Outlet to Lake Alice	*****
10.	Ramsey	13	157	61	9	3,200	III	E	Dam-Creek at Edmore	**
11.	Benson	16/17	156	71	1,950	800	IV,VII	F	Dam-Outlet to Pleasant Lake	*****
12.	Benson	35	154	67	18	1,900	III,IV	G	Dam-Creek. Near Minnewaukan	*
13.	Benson	35	153	67	340	2,200	IV	P	Dam-Coulee .	*
14.	Benson	21	152	65	28	4,300	IV	F	Dam-Coulee . Near Fort Totten	**
15.	Benson	10	151	64	168	2,000	VII	P	Dam-Wood Lake Marsh Project	*****

TABLE A (Cont'd)

EXISTING RESERVOIRS

DEVILS LAKE SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Designation	Description & Remarks	Legend
16.	Nelson	10	152	61	558	7,700	IV	F	Dam-Creek.	*
17.	Nelson	19	152	60	130	2,000	III,IV	G	Dam-Creek. Several miles south of Lakota.	*
18.	Benson	33	154	67	22	4,800	IV	E	Dam-Creek.	**
19.	Rolette	17	162	69	14	800	III,IV	F	Dam-Creek. At Rolla	*
20.	Benson	12/13	162	65	500	5,000	VII	F	Court Lake Project.	*****
TOTAL EXISTING RESERVOIRS:					17,190	$ 76,600				

Legend:

*	Constructed by CCC.
**	Constructed by FERA and WPA
***	Constructed by Individuals
*****	Constructed by U.S. Biological S urvey

Use:

III Recreation
IV Stock Watering and Water Conservation
VII Waterfowl Refuge.

Designation:

E Excellent
G Good
F Fair
P Poor

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

DEVILS LAKE SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
1.	Bisbee	531	No Water System	Water System and Treatment Plant.			$10,000	$25,000	$35,000
2.	Brinsmade	199	High mineral and fluoride content.	Survey and 1 well.	$100	$600			700
3.	Bartlett	67	Inadequate for fire protection	Survey and 1 well.	100	600			700
4.	Calvin	330	Inadequate. Very hard.	Survey and 3 wells. Softening plant.	100	1,800	5,000		6,900
5.	Cando	1,164	High mineral content. Inadequate pumping equipment.	Treatment plant New pumping equipment			10,000	8,000	18,000
6.	Church's Ferry	295	Inadequate	Survey and 2 wells.	100	1,200			1,300
7.	Crary	278	Inadequate	Survey and 2 wells.	100	1,200			1,300
8.	Devils Lake	5,451	Highly mineralized.	Development of new source of supply. Treatment Plant	2,000	12,000	50,000	20,000	82,000
9.	Egeland	333	Inadequate for fire protection. High mineral content.	Survey and 2 wells.	100	1,200			1,300

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

DEVILS LAKE SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
10.	Hampden	222	Inadequate for fire protection. No analysis.	Survey and 1 well	100	600			700
11.	Leeds	725	Inadequate. Highly mineralized. Faulty construction.	Survey, 3 wells, treatment plant and construction changes.	100	1,800	10,000	100	12,000
12.	Lakota	860	Unsatisfactory. High mineral and solid content. Faulty construction.	Survey, 4 wells, treatment plant and construction changes.	100	2,400	15,000	1,500	19,000
13.	Minnewaukan	480	Inadequate	Survey, 2 wells, and water system.	100	1,200	10,000	20,000	31,300
14.	Mylo	134	Inadequate. No analysis	Survey and 1 well	100	600			700
15.	Hansboro	176	Inadequate. Highly mineralized.	Survey and 1 well	100	600			700
16.	Perth	153	Inadequate. Deep wells are salty.	Survey and 1 well	100	600			700
17.	Penn	150	Inadequate. No analysis.	Survey and 1 well	100	600			700

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

DEVILS LAKE SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
18.	Rock Lake	279	Inadequate	Survey and 2 wells.	100	1,200			1,300
19.	Starkweather	312	High mineral content, Hard.	Survey and 2 wells.	100	1,200			1,300
20.	York	943	No Water System	Water System and Treatment Plant.			10,000	20,000	30,000
			Sub-Totals:		$ 1,600	$ 29,400	$120,000	$94,600	

TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY: $ 245,600

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

DEVILS LAKE SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Local surveys of available sources	$ 1,600	
Distribution Systems - Bisbee, Cando, Leeds and Lakota	34,600	
Treatment Plants - Bisbee	10,000	
Total Class "A" Projects:		$ 46,200
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Shallow Wells		29,400
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Distribution Systems	60,000	
Treatment Plants	110,000	
Total Class "C" Projects:		$ 170,000
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:		$ 245,600

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

DEVILS LAKE SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:					
21.	Devils Lake	5,451	Comb. Septic Tank. Inadequate	Treatment Plant	$ 60,000
22.	Cando	1,104	Comb. Septic Tank. Inadequate	Treatment Plant	35,000
23.	Bisbee	531	No Sewage System	System and Treatment Plant	35,000
24.	Leeds	725	Comb. No Treatment. Inadequate	Treatment Plant	30,000
25.	Lakota	860	Comb. No Treatment. Inadequate	Treatment Plant	30,000
	Total Class "A" Projects:				$190,000
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
26.	Rolla	852	Comb. Septic Tank. Inadequate	Treatment Plant	30,000
27.	York	500	No Sewerage System	System and Treatment Plant	35,000
28.	Minnewaukan	480	No Sewerage System	System and Treatment Plant	30,000
	Total Class "C" Projects:				95,000
TOTAL PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL:					$ 285,000

LEGEND FOR SEWAGE AND SEWAGE TREATMENT:

Comb. Combined System

TABLE D

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

DEVILS LAKE SUB-BASIN

PLATE II MAP. NO.	County	Sec.	Twp.	Rge.	Storage Cap. A.F. Estimate	Cost Estimate	Use	Designation	Description & Remarks	Survey
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:										
1.	Ramsey	20 29	155 155	63 63	100,000	10,000	III,V,VI,VII	E	Dikes at intlets to two lakes would divert additional water to Sweetwater Lake.	*
2.	Ramsey	Vicinity of Devils Lake				2,000	V		Survey to determine feasibility of developing a ground water supply for Devils Lake or advisability of laying a pipe line to Sweetwater Lake to supplement the ground water supply.	*
3.	Devils Lake, Souris, James Sheyenne and Lower Red Basins				1,000,000 (In Devils Lake)	30,000,000	I,II,III,IV,V IV, Vi, VII	E	Diversion of approximately 1000 C.F.S. from the Missouri River into the Sheyenne, James, Souris, and Devils Lake Basins.	***
4.	Entire Sub-Basin					5,000			Survey of small dams proposed for flood irrigation, recreation, and waterfowl refuge purposes. Survey of available water resources for stock watering where present supplies are inadequate or unsatisfactory. Recommendations to be made for the most satisfactory and economical solution of the problem through construction of community wells or surface reservoirs.	*

TABLE D (Cont'd)

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

DEVILS LAKE SUB-BASIN

PLATE II MAP NO.	County	Sec.	Twp.	Rge.	Storage Cap. A.F. Est.	Cost Estimate	Use	Desig-nation	Description & Remarks	Survey
5.	Towner	18	160	66	20	2,000	III	E	Dam-Boulder Creek	*
6.	Towner	36	160	68	20	500	III	E	Dam-Creek near Bisbee	*****
7.	Nelson		151	60/61		2,000	III	E	Dredge beach in Sturp Lake to improve recreational facilities.	
8.	Benson	13	156	69	60	6,000	III	E	Dam-Creek. Preliminary survey made.	*****
9.	Rolette	24	159	69	20	4,000	III,IV	E	Dam-Creek	*****
10.	Ramsey	22/27	156	61	1,000	500	VII	F	Construction of a concrete spillway under a bridge on the section line grade. Posey slough would be raised almost two feet.	**
Total Class "A" Projects:					1,101,120	$ 30,032,000				

TABLE D (Cont'd)

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

DEVILS LAKE SUB-BASIN

PLATE II MAP NO.	County	Sec.	Twp.	Rge.	Storage Cap. A.F. Est.	Cost Estimate	Use	Desig-nation	Description & Remarks	Survey
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":										
11.	Benson	2	154	67	1,911	10,000	VII	F	Dam-Creek	*
12.	Entire Basin					25,000	IV		Construction of community wells for stock watering and the construction of surface water reservoirs in certain communities after surveys have shown that ground water resources in the areas are unsatisfactory. Possible reservoir sites are: Benson County, S-26-155-69, S-34-153-67, S-27-154-69, S-9-156-70, S-31-154-67, S-19-154-67, S-13-154-69, S-4-154-69, and S-34-154-69.	*
Total Class "C" Projects:					1,911	$ 35,000				
TOTAL PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES:					$1,103,031	$30,067,000				

Survey:
- * None
- ** Field inspected by State Engineer
- *** Surveyed by U.S. Army Engineers.
- ***** Surveyed by FERA and WPA.

Use:
- I Flood control and Stream Regulation
- II Irrigation
- III Recreation
- IV Stock Watering and Water Conservation
- V Municipal Water Supply
- VI Railway Supply
- VII Waterfowl Refuge.

Designation:
- E Excellent
- G Good
- F Fair
- P Poor

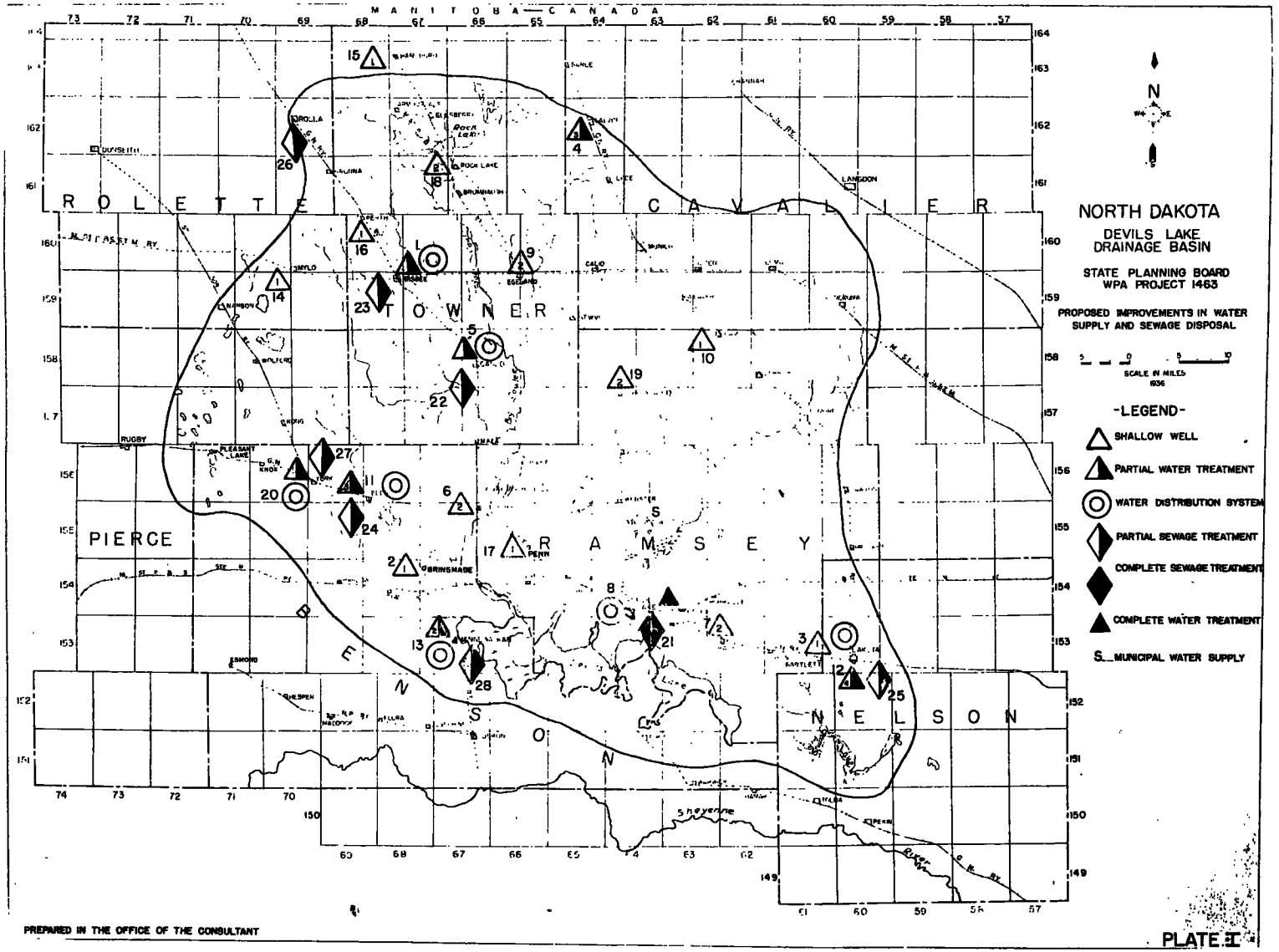
TABLE E

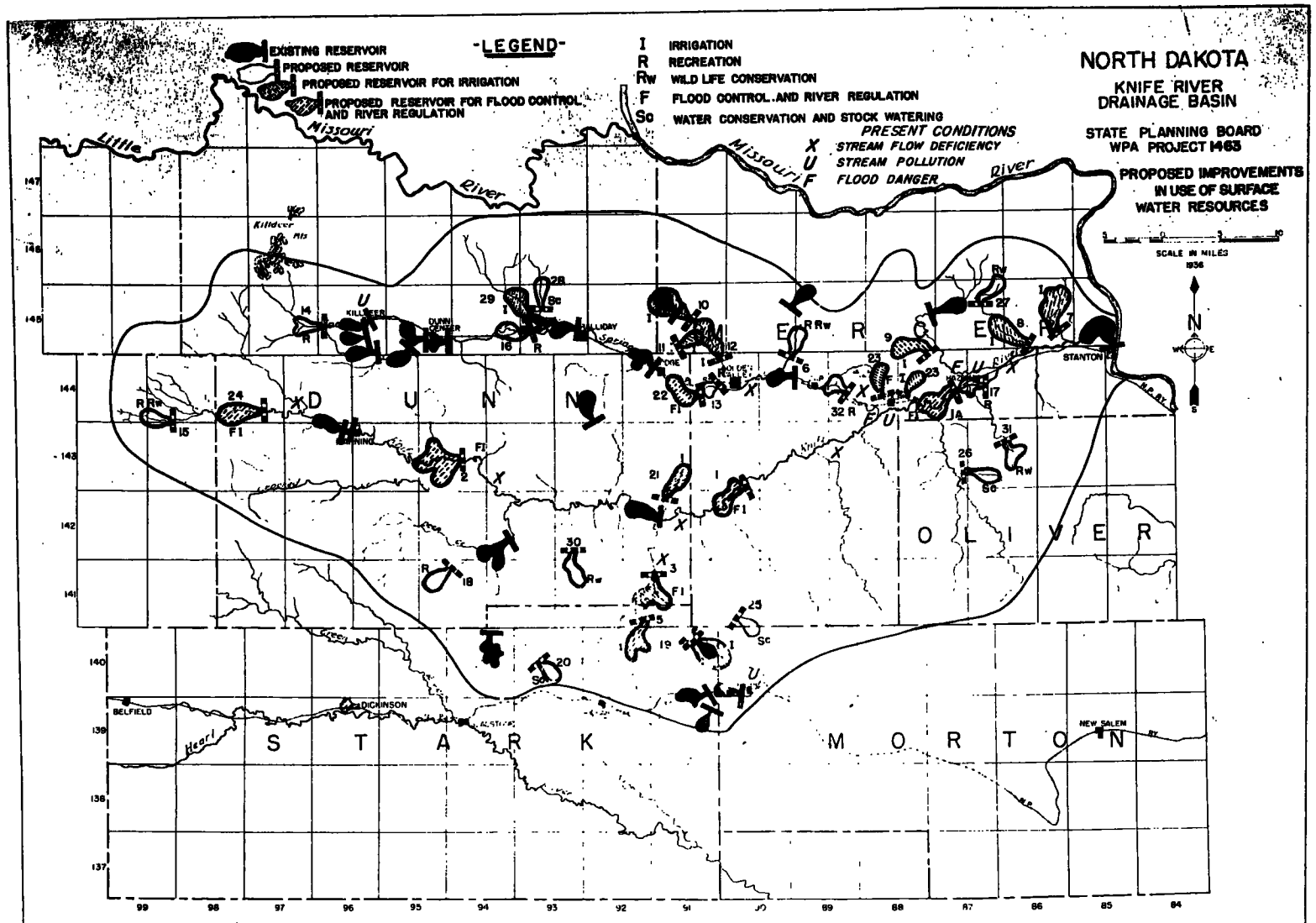
PROPOSED PROJECTS

DEVILS LAKE SUB-BASIN

SUMMARY

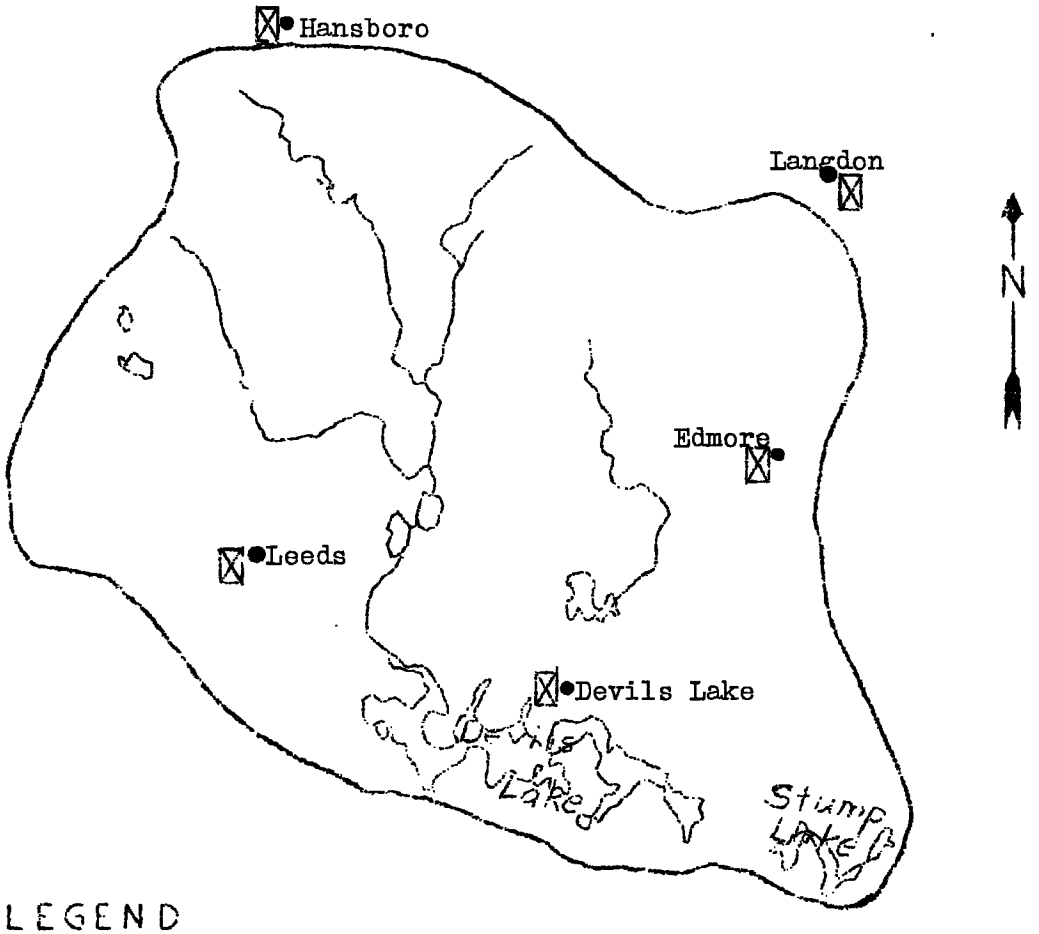
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Proposed Improvements in Water Supply	$ 46,200	
Proposed Improvements in Sewage Disposal	190,000	
Proposed Improvements in Use of Surface Water Resources.	30,032,000	
Total Class "A" Projects:		$ 30,268,200
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Proposed Improvements in Water Supply		29,400
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Proposed Improvements in Water Supply	170,000	
Proposed Improvements in Sewage Disposal	95,000	
Proposed Improvements in Use of Surface Water Resources.	35,000	
Total Class "C" Projects:		300,000
TOTAL PROPOSED PROJECTS:		$ 30,597,600


MANITOBA — CANADA
ROLETTE
CAVALIER
TOWNER
PIERCE
RAMSEY
BENSON
NELSON
NORTH DAKOTA
DEVILS LAKE
DRAINAGE BASIN
STATE PLANNING BOARD
WPA PROJECT 1463
PROPOSED IMPROVEMENTS IN WATER SUPPLY AND SEWAGE DISPOSAL
SCALE IN MILES
1936
-LEGEND-
SHALLOW WELL
PARTIAL WATER TREATMENT
WATER DISTRIBUTION SYSTEM
PARTIAL SEWAGE TREATMENT
COMPLETE SEWAGE TREATMENT
COMPLETE WATER TREATMENT
S. MUNICIPAL WATER SUPPLY
PREPARED IN THE OFFICE OF THE CONSULTANT
PLATE I



PREPARED IN THE OFFICE OF THE CONSULTANT

PLATE II



LEGEND

Existing Weather Station

DEVILS LAKE SUB-BASIN

STREAM GAGING
and
WEATHER OBSERVATION FACILITIES

Plate III

NORTH DAKOTA

STATE PLANNING BOARD

SUMMARY REPORTS

OF

A PLAN OF WATER CONSERVATION

FOR

NORTH DAKOTA

Volume 1 Letter of Transmittal
Foreward
Red River of the North Drainage Basin

Volume 2 James River Drainage Basin

Volume 3 Souris River--Devils Lake Drainage Basins

Volume 4 Main Stem Missouri River Basin

Volume 5 Slope Area Drainage Basins