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NORTH DAKOTA STATE AGENCY

Second Biennial Report

OF THE

State Water Conservation Commission

AND THE

Nineteenth Biennial Report

OF THE

State Engineer

OF

North Dakota

TC824.N9 A32 BIE

From December 1, 1938 to November 30, 1940

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From December 1, 1938 to November 30, 1940

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LETTER OF TRANSMITTAL

December 15, 1940.

Honorable John Moses
Governor of North Dakota
Bismarck, North Dakota

Dear Governor:

We submit herewith the joint report of the State Water Conservation Commission and the State Engineer, covering activities from December 1st, 1938 to November 30th, 1940.

Respectfully submitted,

STATE WATER CONSERVATION COMMISSION.
HENRY HOLT, Vice Chairman
KENNETH W. SIMONS
SIVERT W. THOMPSON
EINAR H. DAHL

H. F. McColly,
Secretary and Chief Engineer.
E. J. Thomas,
State Engineer.

Excerpt from the address "Interstate Migration of Destitute Citizens," delivered by the Hon. Carl T. Curtis, Congressman from Nebraska, at the ninth annual convention of the National Reclamation Association held in Great Falls, Montana, September 24 to 26, 1940:

"A somewhat different type of reclamation program is being actively developed in the Great Plains areas. Here the problem is not only one of developing new areas of irrigation, but in bringing about necessary readjustments in types of farming which have proved unsuited to one area characterized by scant and uncertain rainfall. I do not need to expand for this group upon the hazards of one crop farming in the dust bowl and northern Great Plains. Farmers on the roads in flight from these areas have been a familiar sight to most of you. Perhaps many of these farmers would never have had to move if it had been possible for them to follow a type of diversified farming, with irrigated crops and livestock in connection with grain production. More emphasis upon this type of agriculture in the future promises to stabilize farming in areas which otherwise may experience further extreme distress."

ORGANIZATION AND PERSONNEL

The State Water Conservation Commission was created by Chapter 255, Session Laws of 1937, which provided that the Governor be ex-officio chairman. Six other members were appointed by Governor William Langer and the first meeting was held March 23, 1937.

Chapter 256 of the Session Laws of 1939 amended and re-enacted the Water Conservation Act under which Governor John Moses re-organized the Commission by the appointment of four members beginning office on April 3rd of that year. Three of the original members were re-appointed and the Governor continued as Chairman.

Commission of Five Members as now Organized

	Term Began	Term Ends
Governor John Moses, Chairman	April 3, 1939	.....
Henry Holt, Vice Chairman	" 3, 1939	July 1, 1945
Kenneth W. Simons, Member	" 3, 1939	" 1, 1943
Sivert W. Thompson, Member	" 3, 1939	" 1, 1941
Einar H. Dahl, Member	" 3, 1939	" 1, 1941
H. F. McColly, Secretary & Chief Engineer	July 1, 1939	.....
E. J. Thomas, State Engineer	July 1, 1935	.....

Associated Organizations

Agricultural College, Experiment Station, and Extension Service

Contact with the Agricultural College and Experiment Station at Fargo and the County Agricultural Agents is maintained by the Extension Irrigationist, W. H. Farmer, who is jointly associated with the Extension Service and the State Water Conservation Commission. Secretary and Chief Engineer, H. F. McColly, on leave from the staff of the Agricultural College and Experiment Station, directs the operation of the Lewis and Clark Irrigation Experiment Farm at Williston.

State Engineer

Very close co-operation exists between the State Water Conservation Commission and the office of State Engineer. The activities of the two departments are joined in this report.

State Advisory Board

This unofficial board, appointed by the Governor and operating without compensation or expenses, was set up at the request of, and to keep contact with, the National Resources Planning Board. H. F. McColly is the Secretary.

Other Co-operating Agencies

The agencies listed below co-operate in water conservation development. The brief statement made for each agency indicates how they have or can work with us on our program; but the statement does not necessarily imply the scope of that agency's activity.

Federal Departments:

Army Engineers, concerned with river projects, flood control, Missouri River Diversion.
Bureau of Reclamation, investigation and construction of Federal irrigation projects.
Bureau of Agricultural Economics, investigations and plans for water facilities developments.
Bureau of Biological Survey, water storage for wild life.
Farm Security Administration, agricultural phases of water conservation developments.
Geological Survey, stream gaging and topographic mapping.
International Joint Commission, regulation and use of International waters.
National Resources Planning Board, national consideration of desirable projects.
National Youth Administration, co-operating on operation and maintenance irrigation experiment farm on Lewis and Clark Project.
Reconstruction Finance Corporation, financial resources for construction and improvement of irrigation projects.
Soil Conservation Service, investigates, finances and constructs water facilities under Water Facilities Act.
Weather Bureau, temperature, precipitation, and river stages records.
Work Projects Administration, assists in project construction, development and maintenance.
Yellowstone River Compact Commission, formulation of regulation and use policies for Yellowstone River Drainage Basin. Federal Power Commission, states of Montana, North Dakota, and Wyoming co-operating.

State Departments:

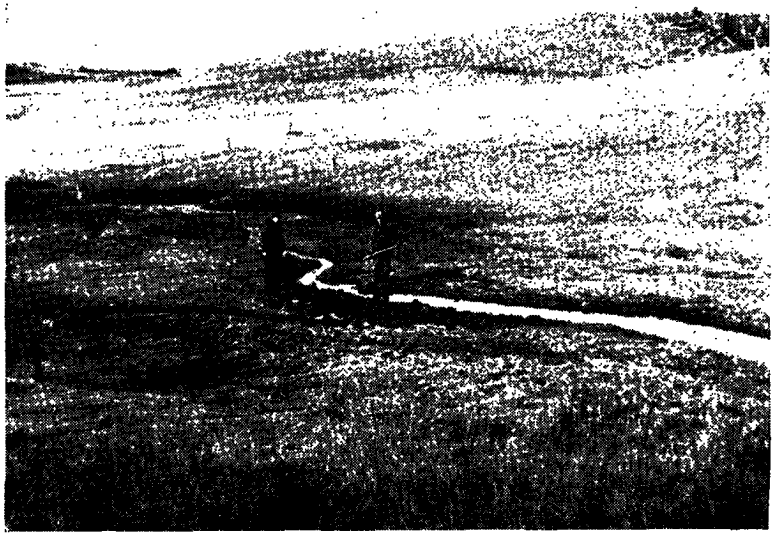
Bank of North Dakota, Trustee for Water Commission Revenue Bond holders, and purchased certain irrigation project bonds.
Department of Public Health, quality and sufficiency of water supplies.
Game and Fish Department, maintains reservoirs for game and fish. Has assisted in financing repair of certain dams.
Rural Rehabilitation Corporation, purchased Commission Revenue Bonds, purchases and develops land on irrigation projects.
Tri-State Waters Commission, regulation and development Red River Drainage Basin. States of Minnesota, North Dakota, and South Dakota co-operating.
Other State Departments assist in the many features involved in the water conservation program.

Miscellaneous Organizations:

Greater North Dakota Association, assists in irrigation development program.
National Reclamation Association, aids in obtaining federal appropriations for desirable irrigation projects.
National Rivers & Harbors Congress, aids in obtaining Federal appropriations for desirable river development projects.
North Dakota Reclamation Association, assists in co-ordinating a state water conservation program.
National Wildlife Federation, assists in obtaining consideration for water resources developments for wild life.

Members of Congress:

The members of Congress have assisted greatly in obtaining Federal legislation and action effecting water conservation and reclamation work.



Diverting waters from a coulee over a flat meadow located at the foot of the hills. Note small earth barrier in front of men, which has diverted stream from its original channel so the water may flow along toe of hill and spread over meadow.

THE USE OF WATER

Water conservation is the control and the utilization of available water resources for the most beneficial uses of mankind. It is to be recognized that there are several types of water problems involved, all of them important and pressing for solution. The four main problems in North Dakota may be grouped as follows:

1. Water for human needs such as drinking, sanitation and recreation.
2. Water for animal needs such as livestock watering, and game and fish life.
3. Water for irrigation to insure crop production for stabilization of diversified farming and the livestock industry.
4. Water controlled to avert flood damage.

The water conservation work has been directed toward solving these problems, but it is apparent that each of them, due to the magnitude of the program, will require long years of intelligent consideration and effort. Different parts of this report will point out the need, the accomplishments, and the possibilities of a sound water conservation program.

Virtually every economic problem which confronts the people of North Dakota, including the problem of public debt and taxation, is, and has in the past been largely due to the instability of production on our farms. The crop records from 1916 to 1939 of the Extension Service of

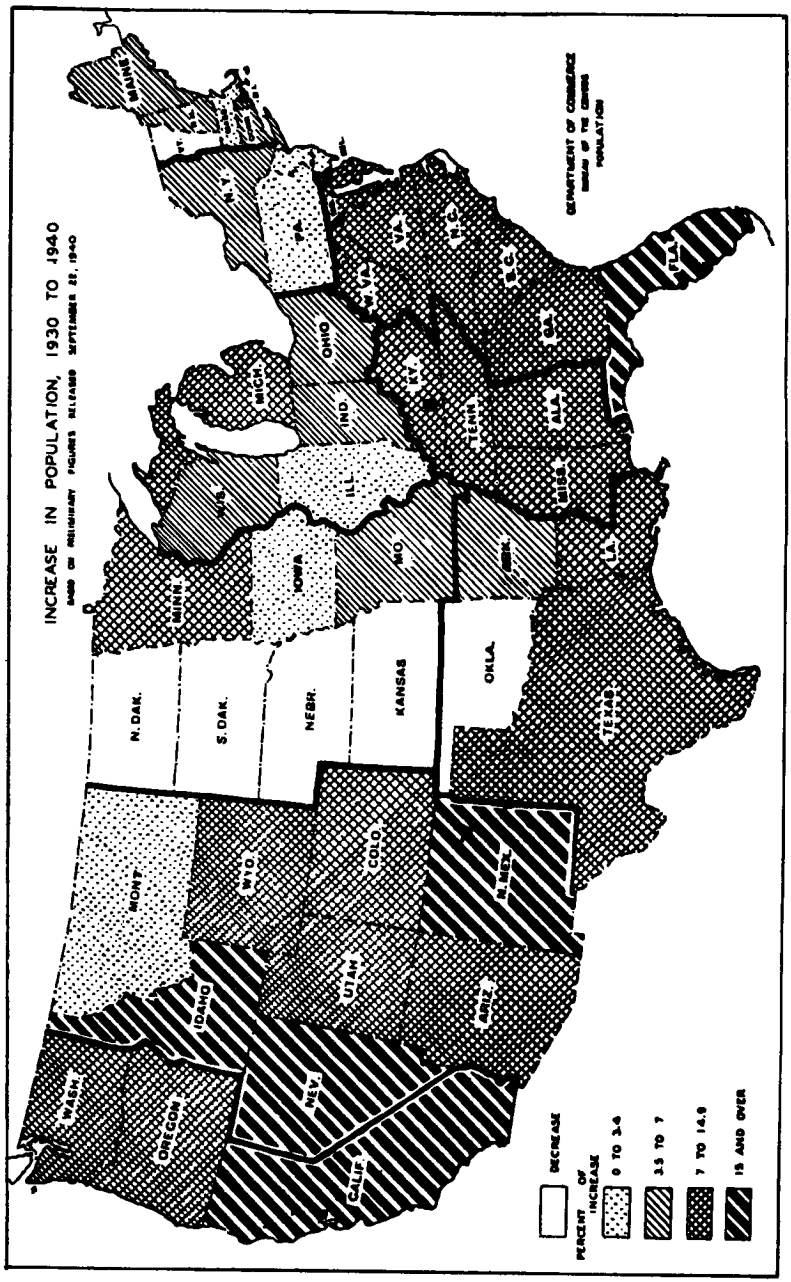
the State Agricultural College show that in an average year one out of every eight North Dakota farmers has had a complete crop failure. The drouth years, 1933, 1934, 1936 and 1937, brought economic disaster to the people of North Dakota. Because of drouth, our farmers did not produce sufficient feed, and because they did not have adequate reserve feed supplies, many of them lost their livestock. Since 1937 farmers have endeavored to restore sufficient livestock and much progress has been made. Loans made by various federal and independent agencies have aided the program, but it must be recognized that these loans cannot be made with a very definite assurance of repayment unless the production of feed crops is made more certain.

The development of irrigation projects in North Dakota, wherever such development is feasible, will insure the production of alfalfa, corn and other feed crops in every year. The insured production of ample feed crops will enable North Dakota farmers to retain their herds and to condition their stock for market when desired rather than having to sell feeders on the market. Wherever possible, upland farmers should have tracts of bottom land which they can irrigate. Twenty to thirty acres of land under irrigation will produce the feed and also the garden that is ordinarily needed on the average livestock farm.

The establishment of irrigation projects in North Dakota is not a process of reclaiming waste or desert lands. The lands which can be irrigated in North Dakota are the level farm lands usually lying along streams or at the foot of hills and coulees, where the water may be pumped or diverted over them. When rainfall is sufficient they are highly productive lands and have been under cultivation for many years, but there are dry periods during the growing season of virtually every year when supplementation of water by some method of irrigation will be of much benefit. Supplementary irrigation of such lands is not reclaiming waste lands. It is, however, a sound combined use of two of our most important national resources — land and water.

A study of the map showing the population trends in the United States for the ten-year period 1930 to 1940 brings out some very definite facts. The five Great Plains States lost 302,492 persons. North Dakota ranked second highest in loss of population by having 41,155 or six per cent of her 1930 population leave. Then note where population increases were apparent. The 17 western states are classed as reclamation states. The 12 states to a westerly direction from us gained population, Montana being the lowest because the eastern part lost but the western part of the state gained so the net was a little more than the loss. It cannot be construed in any other way than that many of the drouth stricken farmers moved to irrigated areas and established themselves. North Dakota as well as other states in the same category should establish irrigation projects on which to rehabilitate a definite portion of their farm families so they will not need to leave for irrigation opportunities elsewhere.

Early history of the first State Constitutional Convention of the



Population trends from 1930 to 1940. Note the decrease in the five Great Plains States and the increase in other western states.

State of North Dakota, shows the importance they attached to the future development and utilization of irrigation water through its proper use. After listening to the following address made before the Constitutional Convention by Major J. W. Powell, Director of the U. S. Geological Survey, the convention adopted laws for controlling and regulating all waters within the state.

ADDRESS BY MAJOR POWELL TO THE NORTH DAKOTA CONSTITUTIONAL CONVENTION IN BISMARCK AUGUST 5, 1889

"Mr. President, and gentlemen of the convention, I am not accustomed to speak on occasions like this. In the first place, I never have made a political speech in my life and it seems to me I am almost out of place here. When I was a boy they used to bring to the table the dinner, and the finest things came at the last part of the feast, but somehow in the high falutin' dinners they give now, they fill the people with wines and viands of many kinds and then end with strong cheese and hard crackers. I think that is what your president is doing today. He wants to top off with something very plain. I know nothing about the silver question, but I have studied somewhat the subject of irrigation.

"I was a farm boy and have been engaged in farming and have spent a good deal of time studying many of the problems which interest your people. I remember in my childhood my father moved into Illinois. Then I remember when Minnesota and Wisconsin were making states, and now you are making two states of Dakota. All these years I have watched the march of progress across the continent and have seen all this western half of America grow up, as it were, from a wilderness. Of the questions that practically interest the people who are engaged in farming, I have made some study and in my remarks I will confine myself wholly to some practical questions relating to irrigation and then I will show what the Constitutional Convention should have to say about them.

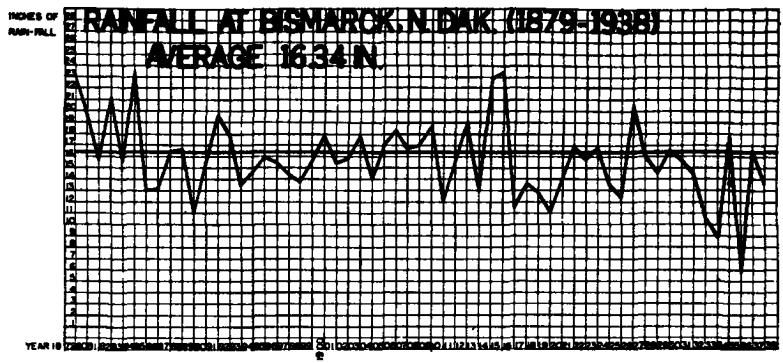
"The State of North Dakota has a curious position geographically in relation to agriculture. The eastern portion of the state has sufficient rainfall for agricultural purposes; the western part has insufficient rainfall, and the western portion is, practically, wholly dependent on irrigation. In the western portion all dependence on rains will ultimately bring disaster to the people. They are unwilling yet, a good many of them to admit it, but the study of the physical conditions which prevail in this country, and the application of the knowledge which has been given to mankind through the study of these same problems in Europe and Asia and Africa, all prove this one fact—that in the western portion of this state they will have to forever depend on artificial irrigation for all agriculture. In the eastern portion they may depend upon the storms that come from the heavens, and there is a middle belt between the two regions which is of very great interest. They will soon learn in the western portion to depend upon irrigation and provide themselves with agencies for the artificial fortifying of the soil with water. In the

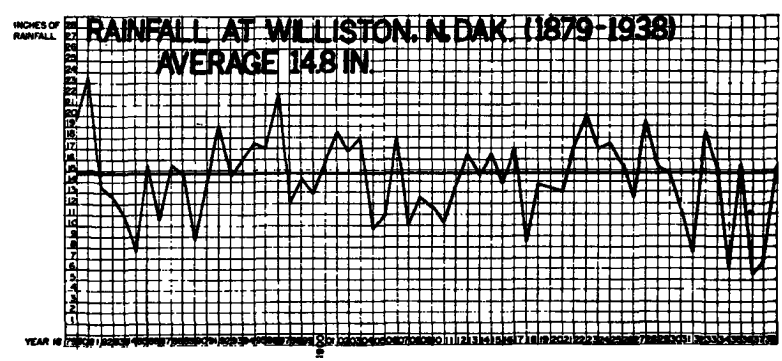
Irrigated alfalfa on the Grantier stock farm, McKenzie County. Diversion of water from impounded reservoir. No worry of feed shortage for this stockman.

eastern part they will depend on the rainfall, and in the middle portion they will have a series of years when they will have abundant crops; then for two or three years they will have less rainfall and there will be failure of crops and disaster will come on thousands of people who will become discouraged and will leave. Up and down the temperature of agriculture will rise and fall with the seasons in this manner and the only practical thing to do is to look the thing squarely in the face and remember that in middle Dakota agriculture will always be liable to meet with failure unless you provide against it. That is the history of all those who live on the border between the humid and the arid lands. Years will come of abundance and years will come of disaster, and between the two the people will be prosperous and unprosperous and the thing to do is to look the question squarely in the face and provide for this and for all years. You hug to yourselves the delusion that the climate is changing. This question is four thousand years old. Nothing that man can do will change the climate. A long succession of years will give you the same amount of rainfall that any other succession of the same length will give you. The settlement of the country, the cultivation of trees, the building of railroads—all of these matters will have no influence upon your climate. You may as well not hope for any improvement in this direction. There is almost rainfall enough for your purpose. But one year with another and you need a little more than you get. It is flowing past you in the rivers. Storms come and spread over the land and the waters run off into the rivers and is carried into the waters of the Gulf of Mexico. There are waters rolling by you which are quite ample to redeem your land and you must save these waters. I say it from the standpoint of the history of all such lands. Civilization

was born in arid lands. Taking the world at large, most of the agriculture of the world has depended on irrigation for more than 4,000 years. The largest populations have depended on irrigation, so it is an old problem and it has been solved time and again so that it may be said that there is nothing to learn. All you have to do is to learn the lessons already taught by history, and that is that in these lands you have to depend on placing the water on the soil and when you have learned to do that you are in no unfavorable condition. In the humid region the storms come and the fields receive the gentle shower but frequently just before the harvest comes, a great storm devastates it all. In this arid region, if you depend on artificial irrigation, you are independent of storms. The waters that are brought on the lands by irrigation are sources of fertilization beyond all other sources. There are fields in the eastern world that have been cultivated for 4,000 years—where water was brought on the land to irrigate and all other fertilization is unecessary. Now in all lands of high culture where fields are irrigated they are ceasing to use any other fertilizer. In France where they are irrigating their lands they have commenced a system in every county and township —the same in Spain and Germany. They find that they must pour the waters of their streams on their lands.

As members of this Convention, that is what I have to say to you. Not being a public man, it may be considered a little presumptuous for me to say—in Dakota you are to depend hereafter in a great measure on the running streams, in a small part on your artesian wells, and in part on the storage of storm waters. The chief source will be the running streams. These waters are to be preserved and stored during the season of non-irrigation. There are, say, two months of the year when you need it to irrigate and ten months when you should store the water. All other wealth falls into insignificance compared with that which is to come from these lands from the pouring on them of the running streams of this country. Don't let these streams get out of the possession of the people. If you fail in making a constitution in any other respect, fail not in this one. Take lessons from California and Colorado. Fix it in your constitution that no corporation—no body of men—no capital can get possession and right of your waters. Hold the waters in the hands of the people. Think of a condition of affairs in which your agriculture, which you have to depend on largely—depending on irrigation, is at the mercy of twenty companies who own all the water. They would laugh at ownership of land. What is ownership of land when the value is in the water? You should provide in the constitution which you are making that the water which falls from the heavens and rolls to the sea down your great rivers should be under the control of the people, subject always to the will of the people; that property in water should be impossible for individuals to possess. You should forbid the right to acquire property in water. The property should be in the land and the right to the water should inhere in the land and no company or individuals should have property in the running streams. Such a





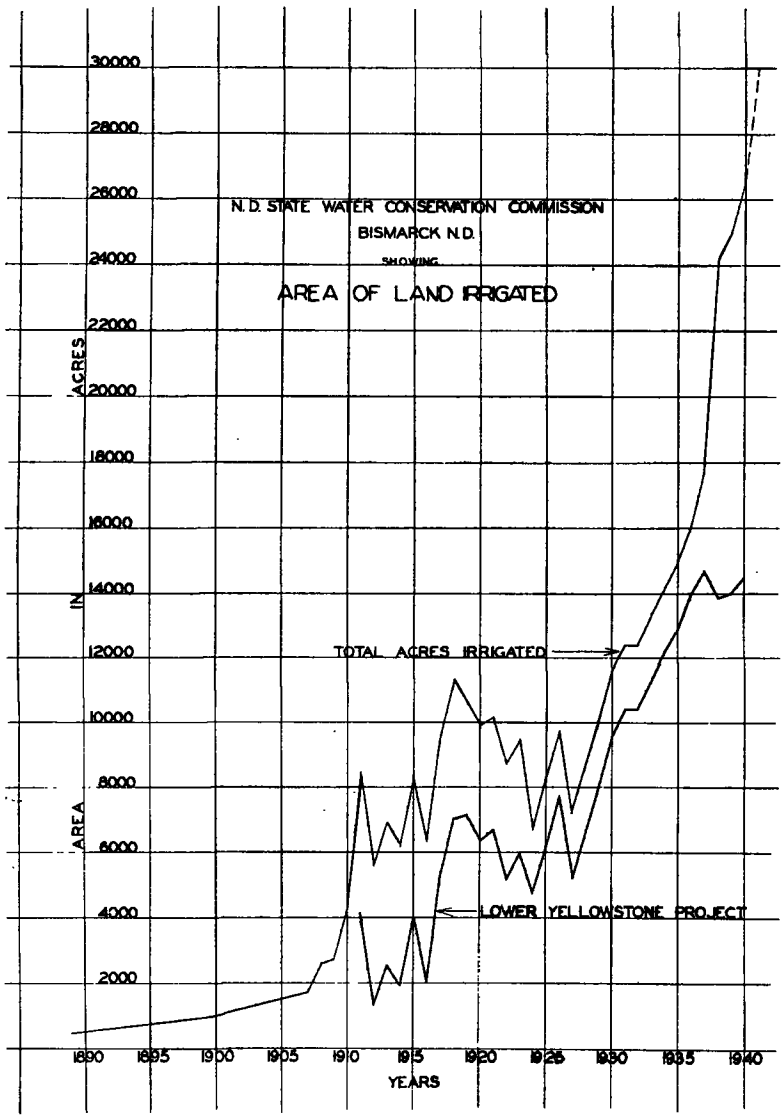
Rainfall records at Bismarck and Williston from 1879 *to* 1938. *So many years has the precipitation been below normal that dry land farming is often uncertain.*

provision will prevent your great agricultural sources falling into the hands of the few."

No statements have ever come more true as a prophecy than those included in Major Powell's address. Still, it really took too many years before North Dakota heeded the recommendations as far as the need for irrigation was concerned.

IRRIGATION DEVELOPMENT

A study of the charts showing rainfall at Bismarck and Williston for the period 1879 to 1938 will reveal that there are a considerable number of periods of decrease in precipitation from the normal. Bumper crop yields are obtained when the rainfall exceeds the normal to any extent. Fair to good yields are obtained under normal moisture conditions, if preceding droughts have not been too severe or frequent. Without question, it is apparent that for a stable agriculture, supplementary moisture is necessary whenever it is possible to apply it.



Area of land irrigated in North Dakota from 1889 *to* 1941. *The upper line shows the total acres and the lower line the acres in the Lower Yellowstone Project alone.*

Records show the irrigated acreage in North Dakota as 445 acres in 1889, the year North Dakota became a state. The acreage increased at the rate of about 50 to 100 acres per year until 1910 when it increased

more rapidly, with decreases showing in some particular years with an eventual increase over former amounts. Major state droughts occurred in the years 1886, 1893, 1897, 1900, 1910, 1917, 1931, 1934 and 1936. Usually irrigation increased during the drought years with a larger increase the year following.

In 1936 there were 16,014 acres irrigated in the state with all but 2,000 acres of this located in McKenzie county on the Lower Yellowstone Project west of Cartwright, North Dakota. In 1937 the state irrigated acreage was 17,750, in 1938 it increased to 24,048, and 26,500 acres were irrigated in 1940. The chart shows the acres irrigated in the state during the period from 1889 to 1940, a period of 51 years, and the contemplated acreage in 1941, based on the developments under consideration and under construction. It is to be noted that during the last three years since 1937, the year of the organization of the North Dakota State Water Conservation Commission, irrigation has increased over 33 per cent as a result of the development of the Lewis and Clark, Sioux, and small irrigation projects by the Commission and associated agencies.

In the early days of irrigation project development, the irrigation works were constructed and the land owner was left with the problem of clearing and developing his land for irrigation farming. Most irrigation projects are located in river valleys and these valleys usually have a growth of trees or brush. In addition, some parts of the valleys have hummocky land that cannot be irrigated without proper preparation.

The last few years the trend has been to clear and develop the lands for irrigation so that new irrigation farmers will be able to get their farms into production as soon as possible. This is the only way that they can be expected to repay their assessments on projects that are financed where repayments start quite soon after the project is completed. Unless the land is prepared, it would be necessary to give the farmer a period of many years free of assessments in order that he may try to get his land cleared and developed.

The main difficulty with the individual farmer clearing and developing his own land is that he does not have the equipment, the supervision or the finances to do the job. If he does it with his own farm labor and equipment, it takes him too long.

The first program of land clearing and development in North Dakota was started by the North Dakota Rural Rehabilitation Corporation with the Work Projects Administration cooperating. This program has proven the soundness of land development work. The success of the portion of the Lewis and Clark Project that is finished is due entirely to the fact that the land is developed. The land on that project that is not developed is not in production.

The development of projects under the Great Plains Program of the Federal Government follows the same general procedure as that followed

Trucking produce to market from Burlington irrigated gardens.

on the Lewis and Clark Project. The Farm Security Administration purchases available excess lands on the project, then develops these lands. The Bureau of Reclamation constructs the irrigation works. In this way the settlement, production, and repayment success of the project is rendered more certain. The Buford-Trenton Project is being constructed under the Great Plains Program.

IRRIGATION PROJECTS

A brief statement and tabulation is made in the following pages, of the various irrigation developments in the state, together with the potential projects that are being considered for future development.

Burlington Irrigated Gardens

The Burlington Mutual Aid Irrigated Gardens, sponsored by the North Dakota Rural Rehabilitation Corporation and the Farm Security Administration, are located at Burlington, N. D., and constitute an area of approximately 977 acres, 472 of which were irrigated in 1940.

The garden land was irrigated two to three times during the dry part of the summer. The hay land received but one irrigation. Lath box irrigation was adopted generally for the gardens. Crops were good and diseases were negligible.

Besides the garden crops that were grown on all of the plots, several had plantings of small fruits, berries, and flowers that added variety and

The vegetable stand for the Burlington irrigated gardens. Notice the strawberries being held.

beauty, and even in some cases financial reward, to the owners.

About 250 acres of hay land received pumped water from the Mouse River. A 12-inch pump and 18 H. P. gas engine were used. The garden received its water supply by gravity flow from impounded water of the Des Lacs River.

1940 Crop Yields
(Per Acre)

Crop	Variety	Irrigated	Non-Irrigated
Potatoes	Warba	250-275 Bu.	50 Bu.
	Russet	150-200 Bu.	50 Bu.
	Triumph	175-250 Bu.	60 Bu.
Cabbage	Danish Ballhead	9½ T.	1 T.
	Golden Acre	9 T.	1 T.
Onions	Yellow Globe	500-700 Bu.	250 Bu.
	Bermuda	750 Bu.	250 Bu.
	Sweet Spanish	700 Bu.	250 Bu.
Carrots	Chantenay	600 Bu.	250 Bu.
Tomatoes	Bison	700 Bu.	200 Bu.
	Allred	1100 Bu.	200 Bu.
	Victor	1000 Bu.	200 Bu.
	Pritchard	950 Bu.	200 Bu.
Cucumbers	Arlington Chicats	500 Bu.	.....
Cantaloupe	Sugar Rock	6 T.	1 T.
	Hales Best	11 T.	1 T.
Watermelons	Northern Sweets	10 T.	.....
Sweet Corn	Sunshine	1200 Doz. Ears	.....
Hay	Meadow	1¼ T.	½ T.

Part of a group visiting the Westphal Community garden in Sioux County during an "Agriculture in the News" broadcast, summer of 1939. Note the irrigation water in furrows.

State Prison Demonstration Irrigation Farm

This project is located five miles south of Bismarck, N. Dak., on the Missouri River bottoms. Crops received four irrigations during the growing season by pumping from Missouri River. Yield data has been kept on this demonstration farm since its development in 1937. The yields in 1940 are shown below.

Crop	Yield Per Acre	
Beets (Detroit Dark Red)	8.7	Tons
Parsnips (Hollow Crown)	7.7	Tons
Carrots (Chantenay)	7.2	Tons
Carrots (Oxhart)	12.0	Tons
Rutabagas (Purple Top)	16	Tons
Potatoes (Triumph)	250	Bushels
Beans (Great Northern)	22	Bushels
Beans (Stringless Green Pod)	90	Bushels
Corn (Golden Bantam)	49	Bu. Grain
	2	T. Fodder
Corn (White Flint)	53	Bu. Grain
	4	T. Fodder
Squash (Buttercup)	6.0	Tons
Onions (Yellow Globe)	560	Bushels
Onions (Prize Taken)	172	Bushels
Peas (Lincoln)	130	Bushels
Cabbage (Danish Ballhead)	12.4	Tons
Cabbage (Flat Dutch)	12.5	Tons
Tomatoes (Allred)	500	Bushels
Tomatoes (Earliana)	310	Bushels
Tomatoes (John Bear)	315	Bushels
Beans (Lima)	40	Bushels

No yields were kept on melons, cucumbers, peppers, rhubarb, eggplant, citrons, dill and radishes. They had produced sufficient vegetables on the 10-acre irrigated garden to care for vegetable needs of the inmates at the State Penitentiary.

Over 1,000 gallons of tomatoes and tomato juice were canned, as

Irrigated cucumbers on the Palmer Community gardens in Sioux County.

well as large quantities of vegetables including corn, beans, cucumber pickles, peas and beets. Potatoes, squash, parsnips, and carrots were stored in sufficient quantity for the coming winter's use.

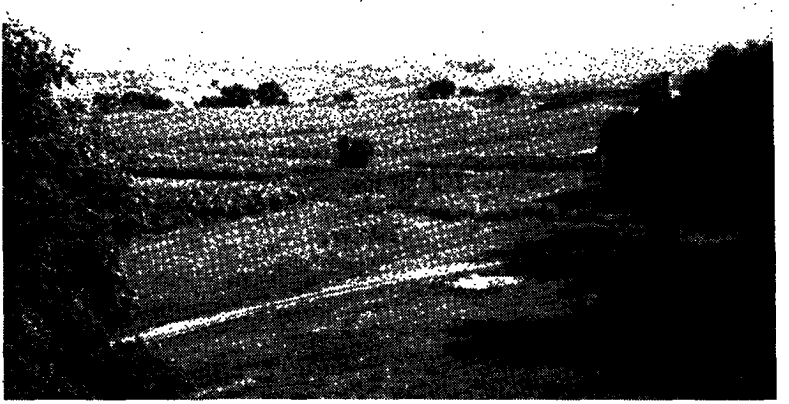
Yields of Fruit and Berries

Crop	Variety	Yield
Plums	(Waneta)	1 Bu. from 15 young trees
Currants	(Red Lake)	3 Gallons from 30 bushes
Gooseberries	(Pixwell)	6 Gallons from 90 bushes
Raspberries	(Chief Latham)	32½ Gal. from 4 rows 200′ long
Strawberries	(Progressive)	64 Gallons from 1/5 acre

These fruits and berries received two irrigations during the growing season.

Community Irrigated Gardens

Community irrigated garden Mutual Aid Corporations have been organized in Adams, Grant and Sioux counties, for producing vegetables for family consumption and feed for livestock. The State Water Conservation Commission, acting as sponsor, furnished engineering, supervision and made its services available in developing the projects. Other agencies cooperating were the Rural Rehabilitation Corporation in purchasing the land; and the Work Projects Administration doing the construction work and furnishing labor for construction of the dams, ditches and the installation of pumping equipment. The Extension Service and Farm Security Administration have assisted in carrying on an



A view from hillside of the Ed Hinker irrigated gardens along the Cedar River in Grant County.

educational program to aid the farmers in obtaining information on up-to-date methods of irrigation, crop rotations, increasing yields, and procuring certified seeds.

Each project has installed a small centrifugal pump for supplying irrigation water with power for operating, furnished by either stationery or tractor type gasoline engines. Supervision of operation and division of water is under control of a regularly appointed project manager.

There were 10 projects under operation during 1940 as follows:

Spring Butte Mutual Aid, Lemmon, S. D. Adams County, N. D.
Odessa Garden, Odessa, Grant County
Hoerauf Garden, Elgin, Grant County
McGregor Garden (Black Hawk), Sioux County
Knoke Garden, Sioux County
McCormick (Nehl), Sioux County
Steiner Garden (Palmer), Sioux County
Jahnel Garden, Thunder Hawk, Sioux County
Halverson Garden, Sioux County
Westphal Garden, Sioux County

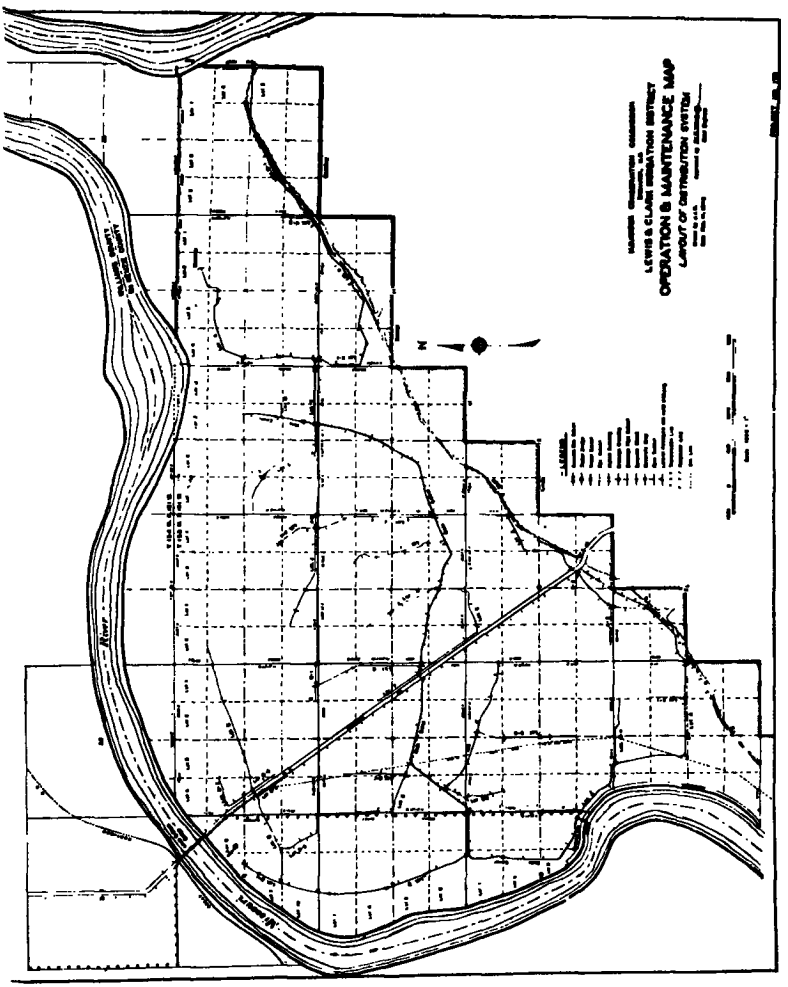
The average community garden contains approximately 20 acres of irrigated land and is divided into 10 plots of two acres each, assigned to each farmer for gardening and growing produce to supplement feed for livestock.

Assuming that each project is contributing in the support of ten families, we have 100 families directly benefited, also the dairy and live-

stock industry stabilized in an area where the drouth during the past several years has been most severe. The success of the gardens has created an interest for further expansion and development of additional community garden projects in the area.

The Lewis and Clark Irrigation District

This newly constructed project lies on the McKenzie County side of the Lewis and Clark highway bridge, which crosses the Missouri River southwest of Williston. The area comprises about 7,700 acres of which about 5,600 acres are being developed for irrigation. Construction, land clearing and leveling were started during the fall of 1937. Much of this work was supplied by 100 to 450 WPA workers and farmers from the



Map showing general plan of Lewis and Clark Project

surrounding territory. Because WPA employees could not work on private land it was first purchased by the North Dakota Rural Rehabilitation Corporation then cleared, grubbed and leveled.

The Rehabilitation Corporation purchased the $150,000 bond issue covering our construction of the irrigation system, then in 1940 purchased an additional $25,000 bond issue for construction of the drainage system and for operation and maintenance. With purchase of additional land in 1940 and funds necessary for completion, the Corporation will have invested approximately $300,000 in the project. By September, 1939, the pumping plant and main ditches were constructed so the 1,000 acres of prepared land could be fall flooded with 20 inches of water before freeze-up.

The State of North Dakota owned 560 acres of land situated within the Lewis and Clark Irrigation District. This land was not being developed for irrigation and since some of it was located along U. S. Highway No. 85, the appearance to the project was not enhanced by this undeveloped land. Early in 1940, the Commission realized that this land should be purchased and developed for irrigation farming if the project was to succeed.

Negotiations were made with the Bank of North Dakota for the purchase of revenue bonds, Series F, in the amount of $27,000 in order to purchase and develop 160 acres of Bank of North Dakota land and 400 acres of school land. This transaction was made in accordance with second paragraph (a), of subdivision (1), Section 10, Chapter 256, Session Laws of 1939.

Under a co-operative arrangement with the Farm Security Administration farmers will be settled on the project land. So far 18 disadvantaged dry land farmers from McKenzie and Williams counties have had the benefit of irrigated land. When the project is completed, there will be about 60 farm units, each about 90 acres in size.

Average yields obtained on 1,232 acres of crop land by these new irrigation farmers for the 1940 crop season were as follows:

Crop	Acres	Average Yield	Best Yield	Market Value Gross Income
Flax	325	11 bu.	15 bu.	$ 3,360.00
Wheat	223	38 bu.	56 bu.	6,042.00
Barley	198	31 bu.	40 bu.	1,170.00
Oats	157	85 bu.	110 bu.	945.00
Corn	126	30 bu. + 2½ T.	42 bu. + 3 T.	1,184.00
Potatoes	111	217 bu.	300 bu.	5,460.00
Millet & Sudan Grass	38	2¼ T.	3 T.	135.00
Garden	14	$100-$150		2,100.00
				$20,513.00

The production results exceeded expectations for a new project where some of the land had been leveled, and in addition some of the crops were planted late in the spring due to the development work under way on much of the acreage. It was necessary to have considerable cash crop the first year on the land, therefore the acreage of small grains was more than may be true in the future. Flax was used as a nurse crop for alfalfa, and millet and sudan grass were seeded on lands available late due to development. Most of the potatoes were certified for seed.

Yields on dry land immediately adjoining the project varied from crops not worthy of harvesting expense to those barely paying expenses.

Assessments

Lands in the project are separated into six classes for the purpose of (1) apportioning construction charges, (2) making land appraisals, (3) planning project development, and (4) determining agricultural adaptation. Irrigable lands include all lands served by the irrigation ditch system that are suitable for crop production. Class 1, 2 and 3 are considered as irrigable, class 4 as semi-irrigable, class 5 as temporarily non-irrigable, and class 6 as rights-of-way, permanently non-irrigable or not worthy of development under irrigation. Classes 4 and 5 are generally used only to show there may be some future value to land which is now unsuitable to irrigation agriculture.

Construction benefits were apportioned and assessments levied during 1940, being due and payable in 1941.

Funds were invested in the project from time to time starting in June, 1938. Interest has accrued on the funds invested and the first interest coupons on the bonds are due January 1, 1941. In order to meet contingencies, an assessment was made for that purpose on a uniform rate per acre.

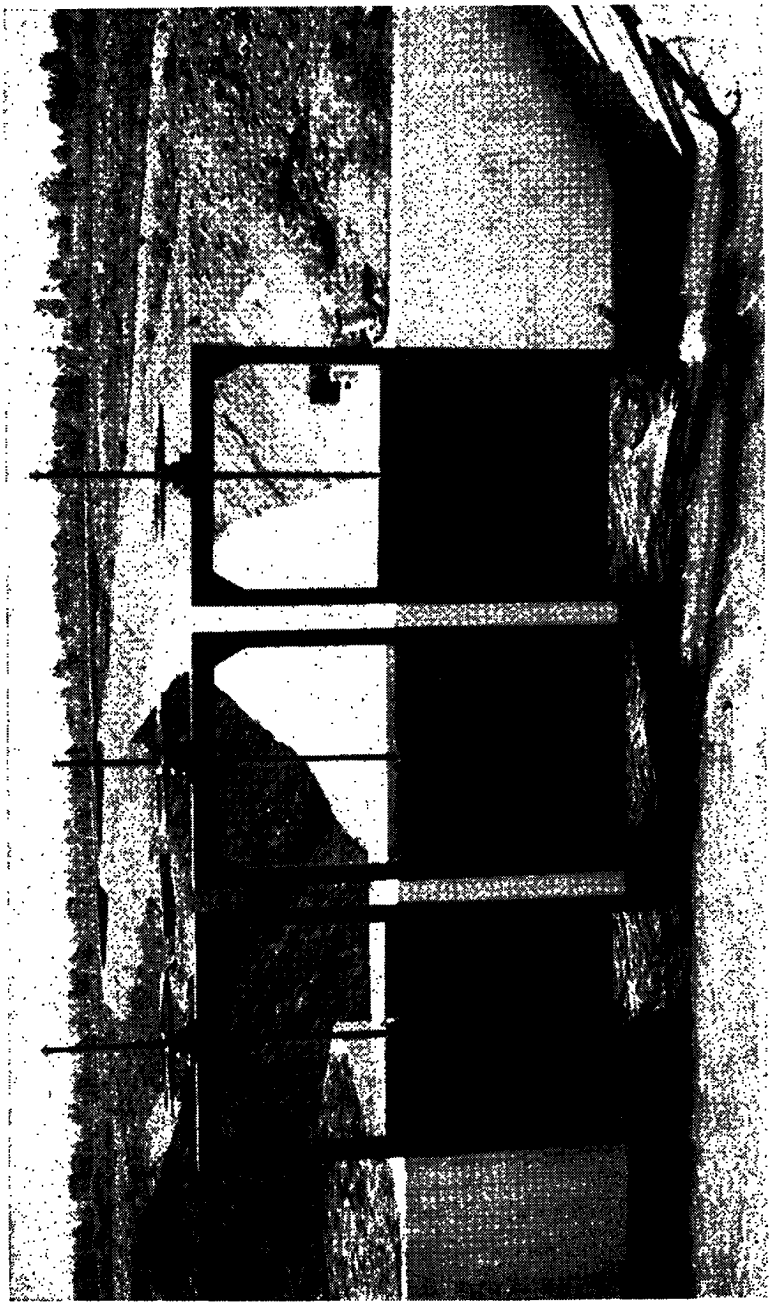
The operation and maintenance charge is levied uniformly per acre on irrigated land and is based on a budget for the district. The budget totals $9,997.20, which for 5,554 acres is $1.80 per acre.

The various items of assessment are shown in the following tabulation:

Interest	$17,862.61
Contingent	778.38
Operation and Maintenance	9,997.20
Total	$28,638.19

Retirement of construction costs are due to start in 1943 for the irrigation portion and in 1944 for the drainage portion. These costs will

Pump discharge pipes from one 20-inch and two 24-inch pumps, Lewis and Clark Project, Williston. Combined capacity 36,000 gallons per minute.



Gates to control water flow in Lewis and Clark Project canal. The canal in background is 8 feet wide in bottom, 26 feet wide at top and 5 feet deep. This main canal is 5 miles long, and there are about 25 miles of smaller canals.

have to be spread the year previous to their due period. Distribution of the unit costs of construction are as follows:

Construction Benefits
Apportioned Per Acre

Class of Land	Irrigation	Drainage	Total
1	$36.85	$ 6.16	$43.01
2	29.48	4.93	34.41
3	11.05	1.98	13.03
4	4.40	.55	4.95
5	1.10	....	1.10

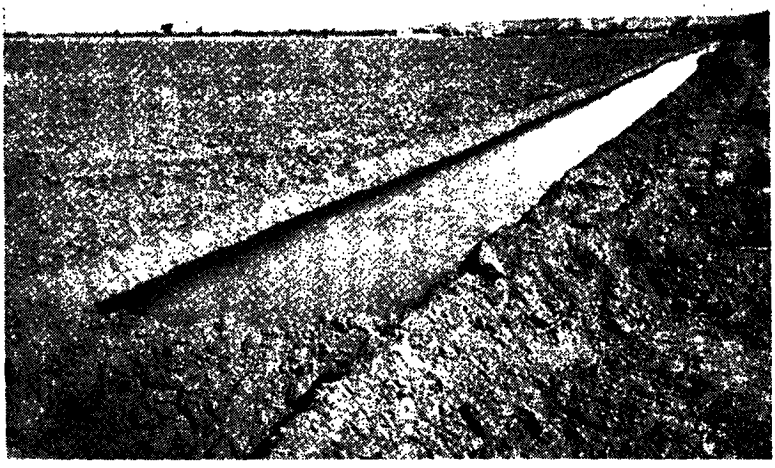
The total assessments for 1941 are as follows:

Class of Land	Acres of Each Class	Interest Rate Per Acre		Contingent Fund Rate Per Acre		Operation & Maintenance Per Acre	Total Per Acre
		Irrigation	Drainage	Irrigation	Drainage		
1	2111.0	$3.91	$ .08	$ .13	$ .01	$1.80	$5.93
2	2585.0	3.12	.07	.13	.01	1.80	5.13
3	858.0	1.17	.03	.13	.01	1.80	3.14
4	162.1[1]	.48	.01	0	0	0	.49
5	708.0[1]	.12	0	0	0	0	.12
6	.....	0	0	0	0	0	.....

[1] Irrigation classification. Drainage classification is 106.4 and zero acres respectively.

Irrigation Experiment Farm on Lewis and Clark Project

Chapter 221, Session Laws 1939, transferred certain school lands, situated within the Lewis and Clark Irrigation District, to the State of North Dakota to be used for irrigation experimental and demonstration work under the direction and control of the North Dakota Agricultural Experiment Station. The land conveyed is described as the north half



Farm ditch on Lewis and Clark Project carrying first water pumped in fall of 1939.

Fall irrigation in lister furrows for pre-watering parched soil on Lewis and Clark Project.

(N½) of the southwest quarter (SW¼) of section sixteen (Sec. 16), township one hundred fifty-three (Twp. 153), north of range one hundred one (Rge. 101), west of the fifth principal meridian, McKenzie County, North Dakota, less that portion of said premises heretofore transferred and conveyed for highway right-of-way, said premises containing 79.32 acres, more or less, according to the United States Government survey thereof.

This tract of land was investigated and appraised for its value as an experimental tract and was found not entirely suitable for the purposes of experimental and demonstration work. About 30 acres were classified as irrigable and represented only one soil type common to the Missouri River bottoms. The remaining 50 acres were classed as non-irrigable, it being located mostly in a slough formed by an earlier river channel.

A search was made by a committee of technicians for a tract favorably located containing soil types representaive of the area as well as of the typical Missouri River bottoms. A tract of 30 acres was found containing three soil types. Adjacent to it a 10-acre tract, containing a fourth soil type, was obtained. A 40-acre tract was then secured, containing some irrigable land and some upland grazing area. This total selection of 80 acres was then exchanged for the 80 acres transferred by the Act in compliance with the second paragraph of Section 2, of Chapter 221, Session Laws 1939. In selecting these tracts of more suitable land, there was consequently an increase in cost of some thirteen hundred dollars. Through the efforts of the Williston Chamber of Commerce, funds were raised to pay this difference in cost.

The final establishment of the experimental tracts was accomplished in latter May, 1940, and the planting of experimental plots proceeded.

Controlling water in farm irrigation ditches by canvas dams.

Since this experimental farm is to be associated with the dry land experimental sub-station north of Williston, it was possible to make use of some of the machinery located there, but there were some kinds of machinery not available. Some of the more important implements were purchased this year and some of the work was customed by farmers on the project. A small tractor, single bottom tractor plow, and one row cultivator were purchased this year. A recording rain guage was purchased so that precipitation received at the farm would be recorded so that this moisture could be correlated with the irrigation practices.

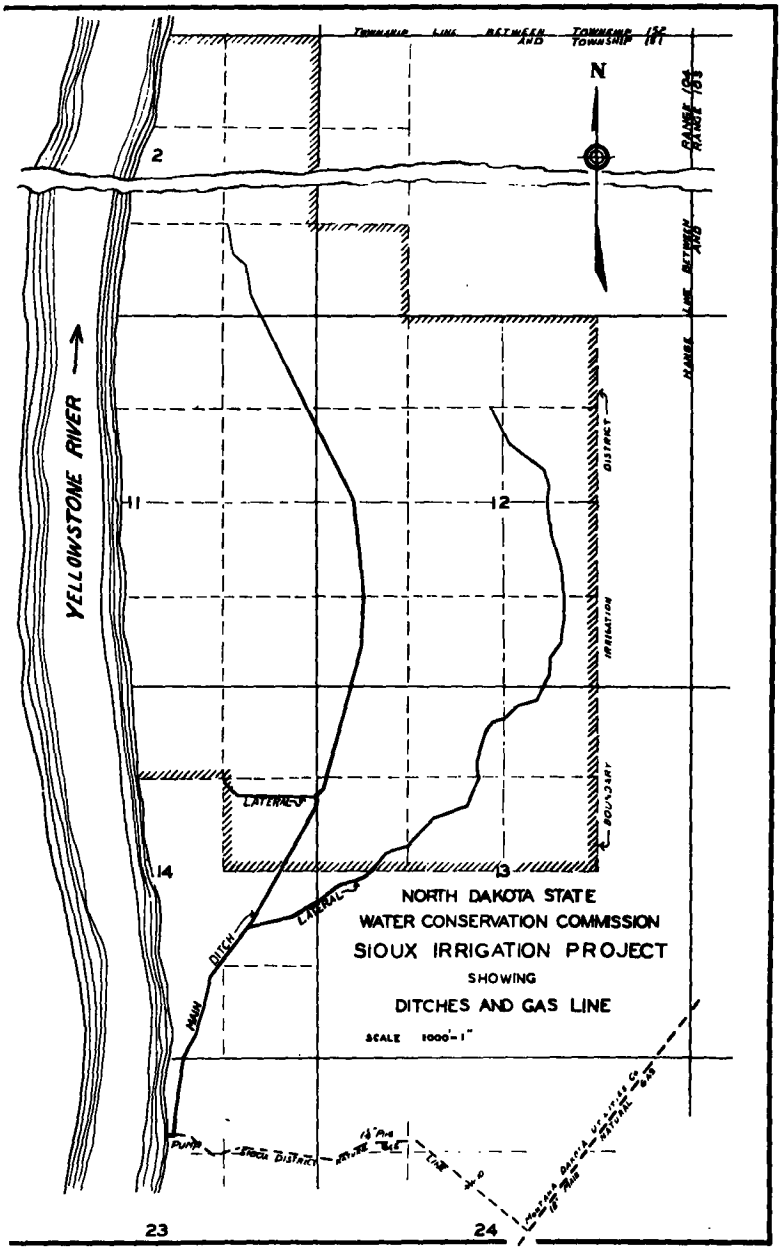
The appropriation for operation and maintenance of the irrigation experimental farm for the biennium 1939-41 was $4,000.00, or an average of $2,000.00 per year. It is readily apparent that the funds were inadequate to pay salary of a supervisor, wages of labor on the farm and operating expenses. Therefore, in order to operate the farm, is was necessary to make arrangements for assistance in this work. A cooperative agreement between the Williston High School and the National Youth Administration was entered into and by paying part of the salary of the Smith-Hughes instructor and organizing a project under the NYA whereby boys enrolled under that program might work on the project, it was possible to operate this year. However, at critical times such as during harvest, labor was not available and it was necessary to hire labor for certain periods. Through the NYA some lumber from salvaged buildings was obtained for use on the farm. It is hoped that a machine shed, work room and granary may be built in this way.

The arrangement for the operation of this irrigation experimental farm is not entirely satisfactory as many procedures cannot be definitely controlled. As soon as possible, the irrigation experimental farm should be established on a sound approved basis so that fundamental irrigation investigations may be conducted.

In spite of the late planting of the crops and the destructiveness of bugs, for which equipment for control was not available, the yields of crops exceed every expectation. The results of the 1940 season were:

Crop and Variety	Yield Per Acre
Oats—	
Victory	75 Bu.
Gopher	80 Bu.
Barley—	
Wisconsin 38	54 Bu.
Trebi	99 Bu.
Corn—	
Northwestern Dent	65 Bu.
Falconer	55 Bu.
Wisconsin 25	45 Bu.
Potatoes—Bliss Triumph	322 Bu.
Cane—Amber (Seed)	Total yield 3200 Lbs.

A more complete report of the description of the irrigation experimental farm and the results during 1940 will be available from the North Dakota Agricultural Experiment Station, Fargo.



General map of Sioux Irrigation Project.

The Sioux Irrigation District

This project of 1,030 acres is located on the east bank of the Yellowstone River north of the town of Cartwright, McKenzie County. Construction was started on the project in the fall of 1938, which involved reconstruction of some existing facilities that were not adequately installed during 1936-37. The cost of the project was $25,000.00, which included adequate funds for operation and maintenance for the year 1940, financed by the North Dakota Rural Rehabilitation Corporation and supported by a bond issue, Series D.

Five hundred and eight acres of this project were irrigated once the first crop season in 1940. Average yields on the project, with the gross income figured at market value, are shown as follows:

Crop	Acres	Average Yield Per Acre	Market Value Gross Income
Alfalfa	28	3 T. plus 3 bu. seed	$ 1,200.00
Wheat	326	35-41 bu. (Dry land 8-12 bu.)	8,796.00
Barley	70	40 bu.	700.00
Flax	60	15 bu.	1,170.00
Beans	43	15 bu.	1,161.00
Potatoes	12	200 bu.	1,440.00
Garden and Miscellaneous	57	$25.00	1,425.00
			$ 15,892.00

On the basis of 508 acres in production, the gross income averaged $31.28 per acre.

A view of part of the Sioux Irrigation District looking northwest from the top of a bluff at edge of flat. Note Yellowstone River at upper left. Main canal crosses picture diagonally just above center.

Assessments

Lands in the project were separated into four classes for the purpose of apportioning construction charges, which was done in 1940, the first assessment due in 1941.

Retirement of construction costs is due to start in 1943. Until that time, it is planned that interest, operation and maintenance, and a district general fund should be levied and thus enable the new system of irrigation farming to become established.

Funds were invested in the project from time to time starting early in 1939. Interest has accrued on these funds and on the bonds. Assessments were levied on 798 acres of the district as follows:

Class of Land	Acres of Class	Dist. General Fund Per Acre	Operation & Maintenance Per Acre	Interest Per Acre	Total Assessment Per Acre
1	500	$ .56	$1.25	$2.45	$4.26
2	79	.45	1.25	1.96	3.66
3	39	.28	0	1.23	1.51
4	180	.09	0	.41	.50

The total of the levy made on the district being:

Interest on bonds	$1,501.68
Operation and Maintenance	723.79
District General Fund	342.67
Total	$2,568.14

The average levy per acre is approximately $3.22.

The diversion dam and intake structure near Savage, Montana, on the Lower Yellowstone Project. The project canal is in the foreground and the dam may be noted by the riffle extending across the river between the two towers.

The Lower Yellowstone Project

The first major irrigation project undertaken in North Dakota was the Lower Yellowstone Irrigation Project located along the west side of the Yellowstone River. The total project comprises about 58,000 acres with almost 20,000 acres located in McKenzie County, North Dakota. The project was constructed by the U. S. Reclamation Service and water was first available for irrigation in 1909. The valley at that time was largely owned by stockmen who thought that nearly a section of land was necessary in order to make a comfortable living and set aside something for retirement. It has been proven impractical to farm large acreages under irrigation, so most of the larger holdings have been reduced to smaller tracts, the average size of farm on the project at the present time being approximately 100 acres.

In 1939 there were 14,131 acres irrigated in the North Dakota portion of the project with yields of the major crops raised as follows:

Crop	Average Yield Per Acre	Value Crop Per Acre
Barley	36.8 Bu.	$11.03
Corn, Grain	37.8 Bu.	15.14
Fodder	1.8 T.	5.53
Oats	37.0 Bu.	8.88
Wheat	27.3 Bu.	13.65
Flax	13.3 Bu.	19.90
Alfalfa, Hay	1.8 T.	7.05
Seed	5.3 Bu.	47.57
Sugar Beets	14.3 T.	62.18
Sugar Beet Tops	.....	2.86
Beans, Commercial	9.0 Bu.	11.78
Potatoes	83.2 Bu.	45.76

Successful farming on the project is largely due to the dairying and livestock industries that are possible. In 1939, there was the following livestock on the North Dakota part of the project:

Kind	Number	Total Value
Horses and Mules	403	$26,675.00
Beef Cattle	419	17,140.00
Range and Feeder Cattle	376	18,361.00
Dairy Cattle	679	26,723.00
Sheep, farm flock	668	2,977.00
Sheep, range, feeders	15,756	78,780.00
Hogs	767	6,113.00
Turkeys	315	473.00
Fowls	7,803	3,943.00
Miscellaneous	.....	2,281.00
Total		$183,466.00

Buford-Trenton Project

In the fall of 1937 the Commission entered into a cooperative arrangement with the Federal Bureau of Reclamation, for a joint investi-

gation of irrigation possibilities on the Missouri River bottom lands located between Buford and Williston in Williams County. The Commission invested about $1,800.00 in this project for preliminary investigations. This investigation, made with engineers of the U. S. Bureau of Reclamation, showed the 13,400 acre project to be entirely feasible.

In September 1939, the Buford-Trenton project was approved at a Federal cost of $1,500,000.00, under the Great Plains Program, the Department of the Interior (Bureau of Reclamation) and the Department of Agriculture (Farm Security Administration) to cooperate in its construction and development. The reimbursible cost of the project was estimated at $630,000.00, repayable without interest over a 40-year period. The remaining $870,000.00 of cost represents WPA or other Federal non-reimbursible labor costs. Construction and development on this project is now well under way with six miles of the main canal completed. A good initial acreage should be irrigated in the first unit during 1942.

The Bismarck Project

Located immediately south of the City of Bismarck, this project of approximately 5,000 acres was approved early in 1940 for construction under the Case-Wheeler Great Plains Act. Total cost of the undertaking was set at $590,000.00 of which $250,000.00 would come from the $5,000,000.00 federal appropriation made under the Act. This portion of the cost would be repaid without interest over a 40-year period. The balance of the cost would be furnished by the Work Projects Administration largely in the form of relief labor.

The project has been delayed in its final approval for construction by its failure to meet certain federal requirements, the chief one being the restriction that any one ownership of land may not exceed 160 acres. Some landowners have not expressed a willingness to meet the requirement. Another factor is that lands available for purchase cannot exceed a reasonable appraised value as speculation in land cannot be permitted under federal regulations.

To assist the project in getting underway, the Commission has purchased 100 acres of land known as the Dullam Estate, and has had the promise of lands formerly belonging to the Mellon Estate. The Bank of North Dakota has agreed to purchase $16,500.00 of Series G bonds to finance the purchase of these tracts of land. There are other tracts of land that will undoubtedly need to be purchased before the success of the project is established.

The Cartwright Project

Located southwest of the town of Cartwright, along the east bank of the Yellowstone River, this project of 840 acres was investigated by the Commission in 1937 and plans and specifications prepared. The federal Water Facilities Board took the project under consideration in 1938 and in 1939 it was authorized for construction. The location of the

A watermelon for Governor Moses. Irrigated garden of H. J. Geigle on Bismarck Flat.

pumping plant was changed to a more central part of the project and a few changes were made in the plans. All bids received for construction ran considerably in excess of estimates which were placed at $26,000.00.

Changes in plans and construction methods will undoubtedly be necessary in order to reduce the possible cost of the project down to the estimates. It is felt that the project cannot bear a heavier cost than original estimates.

The Kyes Project

This project is located in Emmons County near Livona, along the Missouri River, northeast of Cannonball, including approximately 1,400 acres.

Cooperating in the development of this project, the Soil Conservation Service, under the Water Facilities Act, made a complete detailed topographic and soil survey available for our use in making preliminary plans and designing the irrigation system. Cost estimates are being prepared and as soon as completed, application will be made for the sale of bonds to enable the North Dakota State Water Conservation Commission to proceed with construction and development of the project.

The North Dakota State Water Conservation Commission has approved the issuance of revenue bonds in the amount of $70,000.00 in order to construct the irrigation works and to purchase and develop the land.

The Yellowstone Pumping Irrigation District

The project in which we are interested is that commonly known as Unit No. 3 of the Sidney Pumping Project, the other two units of this same project being a little farther upstream and located entirely in Montana, all three units being on the east side of the Yellowstone River. The North Dakota portion is 10 miles southwest of Cartwright, N. Dak., and about eight miles northeast of Sidney, Montana.

The Unit No. 3 consists of approximately 1,939 acres of irrigable land in North Dakota with an additional 410 acres of Montana land located where the river makes a bend back into Montana after it has entered North Dakota. The entire irrigation system of all three units was originally proposed by the Montana Water Board under the PWA program, but Unit No. 3 was not constructed under the program before funds were exhausted and the PWA was out of existence.

A common type of individual farm pumping plant installation.

A source of revenue for the construction of Unit No. 3 was necessary, therefore an application for a loan was made to the Reconstruction Finance Corporation for $50,000.00 in the summer of 1940. An inspection and appraisal of the project has been made by the RFC and it is under consideration. The construction of this project will also involve negotiations between the states of North Dakota and Montana.

Early in January, 1939, the North Dakota Rural Rehabilitation Corporation made a loan to the State Water Conservation Commission in the sum of $3,500.00 in order that the size of the intake, at the Montana Pumping Station No. 3, could be increased beyond the original Montana contract to a size sufficient to serve the North Dakota lands of 1,939 acres, and the 410 acres of Montana land previously mentioned. It was estimated that if the intake was not increased in size at the time, while the Montana Water Board was constructing its Pumping Station No. 3, that it would cost the Yellowstone Pumping Irrigation District an additional $18,000.00 to construct its own pumping plant.

Assessments

To pay interest on the investment made two years ago in the enlargement of the intake, and to furnish a small contingent fund for the year, the district levied 20 cents per acre for 1941 or $387.80.

Sprinkler irrigation of onions by Fred Schafer of Schafer, N. D.

OPERATION AND FINANCIAL STATUS OF IRRIGATION PROJECTS

November 30, 1940

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
	Adams County					
106A	Gordon Krauser	Lemmon	20			
107A	John Ostenburg	Lemmon	3	3		
108A	Val Braun	Reeder		2		
31A	Cliff Solseth	Bucyrus	2	2		
110A	John Campbell	Lemmon	3	3		
111A	Lee Hague	Lemmon	2	2		
112A	Joe Moe	Regent		2		
113A	Ernest Donner	Desart		1		
60A	B. Byron Bobb	Haynes		5		
234	Spring Butte Mut. Aid	Lemmon		4	395.82	
100A	Earl Wallace	Lemmon		2		
	Barnes County					
51A	Bergseth Project	Kathryn	2	2		
101A	Andrew Fitch	Valley City	10	10		
17A	Lars Reiten	Hastings	25	25		
	Benson County					
203	Alvin Liudahl	Maddock		10	34.55	
	Billings County					
44A	W. S. Pesheck	Gorham	33	33		
121A	John Ott	Belfield		6		
129	George Gerbig	Ranger	'25	24	295.81	295.81
122A	Joseph Malkowski	Belfield		3		
	Bottineau County					
	None					
	Bowman County					
75A	J. H. Lamb	Rhame		1		
28A	Guy Johnson	Marmarth	12	15		
216	Grand Riv.-Bow. Proj.	Bowman	Proposed		124.44	
	Burleigh County					
115	State Penitentiary	Bismarck		10	99.05	60.00
58A	Sam Eck	Bismarck	5	5		
2A	George Will	Bismarck	20			
52A	H. J. Geigle	Bismarck	1	1		
40A	I. J. Reed	Menoken	25	25		
6	V. M. Craven	Menoken			220.35	100.00
2	A. W. Gussner	Bismarck		60	203.74	115.00
21	Wagon Wheel Bluff	Bismarck	Proposed		86.51	
55	Frank Slag	Bismarck			31.56	31.56
116	Harry Tatley	Bismarck			13.18	13.18
132	Park Hill District	Bismarck	Proposed		187.31	
170	H. E. Wildfang	Bismarck			18.10	18.10
215	Bismarck Project	Bismarck	Proposed		414.54	
206	W. E. Berwman	Bismarck			34.48	11.61
	Burke County					
122	Vern A. Soderquist	Columbus	5	5	331.51	50.00
	Cass County					
93A	Peter Stroud	Casselton		15		
120A	A. B. Wichman	Leonard		2		
148	Emil Piper	Durbin		110		
119A	A. L. Eggert	Mapleton	160	160		
118A	Frank Lynch (M. G. Kittel)	Casselton	160	160		
117A	Allen H. Houd	Durbin		30		
41A	R. V. Powers	Durbin	80	80		
95A	Henry Loberg	Fargo		10		
96A	Carl Houkom	Fargo		10		
115A	Warner Project	Durbin		10		

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
		Cavalier County				
		None				
		Dickey County				
1D	Forest Service	Oakes	60	60		
49A	W. J. Schafer	Oakes	5	5		
50A	Fred Sletvold	Oakes	20			
		Divide County				
94	T. S. Stuart	Crosby		20	316.68	
		Dunn County				
11	Alf Olafson	Halliday	17	17	190.81	
51	Emma L. Sampson	Fayette	5	5	235.21	10.00
83	Janie B. Scott	Manning	22	22	7.76	7.76
139	Lewis Dinehart	Manning	20	25	229.82	20.00
21A	Jack Dvirnak	Killdeer	1	1		
22A	L. W. Veigel	Killdeer	1	1		
20A	Vistern Hurienko	Killdeer	1			
33	Louis Signalness	Croff		40	299.94	
77	Theo. Semerad	New Hradec	8	8	240.41	
130	Mary B. Materna	Manning			165.45	10.00
		Eddy County				
10A	Olaf Birkeland	Sheyenne	25	25		
11A	Henry Keifer	Warwick	30	30		
		Emmons County				
164	J. F. Schiermeister	Linton	2	2	24.42	
47A	Engelman & Seultz	Braddock	15	20		
6A	Martin Sahli	Hague	5	5		
26A	Godfrey Grenz	Livona	10	10		
69A	Carl Riedlinger	Linton		7		
70A	B. E. Ketchum	Linton		2		
71A	John Senger	Linton		1		
72A	Jake Schiermeister	Livona		1		
73A	Clarence Goehring	Hazelton		½		
79	Kyes Irrigation Proj.	Livona	Proposed		192.28	
66	Klonda Lynn	Linton			12.56	
78	Charles Clark	Livona			311.81	200.00
79	Wallace Kyes) D. W. Casey)	Livona			372.90	69.30
150	Stout Irrigation Dist.	Hazelton			1,414.48	
226	Drake & Newcomer	Braddock			205.18	190.59
174	T. B. Meinhover	Bismarck			14.67	14.67
		Foster County				
		None				
		Golden Valley County				
218	T. E. Hudson	Beach		20		
124A	Theo. Kunick	Beach		1		
		Grand Forks County				
8A	Ole A. Flaat	Grand Forks	17			
29A	A. L. Peterson	Grand Forks	10	10		
74A	Ray Miller	Inkster		10		
		Grant County				
191	Odessa Garden	Odessa	25	30	569.32	450.00
200	Hoerauf Garden	Elgin	10	10	512.76	450.00
30A	Grant County Garden	Thunder Hawk	12	10		
76	Adolph Sprenger	Elgin	13	13	228.04	45.00
32	Ed Nuss	Elgin		1	244.90	144.86
49	Martin E. Mickelson	New Leipzig			15.36	15.36
3A	Ed Hinker	Watauga, S. Dak.	6	6		
16A	Christ Hilluis	Elgin	1	1		
32A	Adolph Ganthner	Elgin	10	10		
126A	B. L. Vandeventer	Shields		25		

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
	Grant County—(Continued)					
31	Ralph McGirl	Elgin			18.83	
180	Grant Co. Gar. No. 180				114.70	
181	Grant Co. Gar. No. 181				209.88	
184	Grant Co. Gar. No. 184				154.79	
185	Grant Co. Gar. No. 185				125.82	
186	Grant Co. Gar. No. 186				149.44	
192	Grant Co. Gar. No. 192				176.23	
193	Grant Co. Gar. No. 193				121.85	
64	A. M. Johnson	Almont			12.11	
114	Bank of North Dakota	Bismarck			20.06	18.75
	Griggs County					
66A	S. C. Severson	Hannaford		4		
	Hettinger County					
37	Anton A. Bolte	Regent	4	10	277.38	33.82
61A	Arthur Leno	Mott		30		
62A	Joseph Kohl	New England		3		
63A	Matt Meisner	Mott	25	25		
	Kidder County					
25A	Commerce J. Calkins	Steele	1	1		
	LaMoure County					
64A	Elvin Anderson	Adrian		25		
65A	Nick Tischer	Grand Rapids		12		
166	Thos. W. Lynch	LaMoure	4		16.38	
159	Bk. of N. D. No. 159	Bismarck			17.80	17.80
	Logan County					
	Information Not Available					
	McHenry County					
1E	Forest Service	Towner	40	40		
1B	Eaton Irrigation Proj.	Towner	4500	4000		
16	Arne Moen	Upham	5	5		
	McKenzie County					
7	Frank Lassey	Cartwright	10	5	209.04	50.00
86	Magnus Gudbranson	Charlson	40	40	463.24	25.00
104A	Roy Johnson	Cartwright	20	20		
14	Frank Erickson (Millhouse)	Cartwright	120	80	790.01	275.00
213	Sioux Irrigation Proj.	Cartwright		508	23,631.49	23,631.49[1]
142	Joseph Seibold	Watford City	16	16	21.42	10.78
151	Gust Johnson	Watford City	50	30	315.87	63.18
156	John Wendike	Watford City	40	20	306.91	175.00
23	T. E. McGregor	Arnegard	50	50	10.50	10.50
42A	Fred Schafer	Schafer	7	7		
71	Jay Grantier	Banks	200	200	1,912.45	1,910.96[1]
35	Roy McColl	Cartwright	40		338.42	150.00
188	Woodie Watson	Watford City	14	14	493.22	149.32
29	H. J. Houser	Sanish	40	35	510.79	508.77
175	Lewis & Clark Proj.	Williston		2000	169,439.34	165,904.46[1]
1A	Lower Yellowstone	Sidney, Mont	14,000	14,200		
38	Osmund Hamre	Watford City	12		111.91	37.30
36	Cartwright Project	Cartwright	Proposed		857.74	
52	Emil Peterson	Charlson			242.98	134.42
92	Halvor Rolfsrud	Keene			181.21	127.02
138	D. W. Miller	Dore			398.09	178.04
140	H. P. Lundin	Watford City			28.46	
154	W. T. Hall	Cartwright			217.36	135.59
155	Wm. Rehberg	Alexander			19.69	15.00
163	F. M. Hendrixson	Arnegard			36.31	
171	Seneschal Irrig. Proj.	Banks	Proposed		255.10	
195	Einar H. Dahl	Watford City			11.89	
214	Yellowstone Pumping Project	Cartwright	Proposed		3,799.10	
105	F. M. Shatswell	Buford			198.91	125.00

[1] Represents repayments to the Commission through bond sales.

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
	McIntosh County					
	None					
	McLean County					
33A	Benzi Truck Garden	Washburn	5	5	----	----
34A	William Redlinger	Washburn	2	2	----	----
35A	Fred Krause	Washburn	9	9	----	----
28	Robert Maxwell	Turtle Lake	5	5	715.86	----
2G	Indian Service	Elbowoods	62	62	----	----
99A	Hank Janke	Garrison	----	10	----	----
15	H. T. Burns	Garrison	----	15	----	----
133A	Fred O. Hanson	Emmet	----	60	----	----
24	Oscar Oberg	Washburn	----	----	30.07	30.07
160	Painted Woods	Washburn	----	----	2,167.02	----
	Mercer County					
132A	Ben Janssen	Stanton	15	22	----	----
202	Murry Moxley	Beulah	5	10	14.06	----
82	R. E. O'Neil	Beulah	10	10	72.45	72.45
98A	Frank A. Morris	Hebron	----	4	----	----
105A	John Winkler	Beulah	----	10	----	----
8	Fred Sinerius	Beulah	----	----	738.93	478.36
17	Harvey Moxley	Beulah	----	----	301.89	100.00
	Morton County					
27	R. H. LeRoy	Mandan	16	20	441.60	25.00
48A	R. H. Lankford	Mandan	25	25	----	----
61	W. A. Leach	Mandan	15	15	352.25	125.00
26	Henry J. Rix	Mandan	24	24	702.47	70.00
114A	Graner Brothers	Huff	10	10	----	----
97	G. A. Richardson	Mandan	5	5	14.16	14.16
1H	S. C. S. Nursery	Mandan	100	110	----	----
56A	Harold Oss	Mandan	----	30	----	----
1F	Forest Service	Mandan	40	----	----	----
116A	John Mason	Mandan	10	10	----	----
10	F. W. McGillic	Mandan	----	----	21.22	----
72	A. C. Graner)	Huff	----	----	357.11	210.00
	J. W. O'Rourke)	Mandan				
136	State Training Sch.	Mandan	----	----	323.87	231.25
236	J. F. Sullivan	Mandan	----	----	68.18	34.69
	Mountrail County					
83A	Bartelson & Ness	Sanish	----	300	----	----
84A	Albert N. Winge	Van Hook	----	7	----	----
85A	Ben Saitherwaite	Van Hook	----	20	----	----
46A	Kenneth Auveson	Van Hook	5	5	----	----
1I	WPA Garden	Van Hook	20	20	----	----
86A	Ed Larson	Van Hook	----	32	----	----
87A	A. N. Winge	Van Hook	----	8	----	----
88A	C. E. Stewart	Sanish	----	40	----	----
89A	Geo. Frye	Stanley	----	8	----	----
90A	Chas. Panzer	Stanley	----	8	----	----
91A	Raymond Sattergren	Van Hook	----	14	----	----
92A	G. T. Gullickson	Van Hook	----	13	----	----
	Nelson County					
	None					
	Oliver County					
41	Fred C. Keck	Washburn	----	----	231.62	----
	Pembina County					
127A	Walter Welford	Cavalier	----	5	----	----
	Pierce County					
	None					
	Ramsey County					
	None					

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
		Ransom County				
1G	Forest Service	Enderlin	26	26		....
		Renville County				
		Information Not Available				
		Richland County				
		None				
		Rolette County				
		None				
		Sargent County				
		None				
		Sheridan County				
		Information Not Available				
		Sioux County				
187	McGregor Gardens	McIntosh, S. D.	18	18	1,166.23	292.40
179	Knoke Gardens	Morristown, S. D.	18	18	1,022.35	1,022.35
190	McCormick (Nehl)	Watauga, S. D.	12	5	972.89	.....
194	Steiner Gar. (Palmer)	Morristown, S. D.		15	1,088.90	893.65
178	Jahnel Garden	Thunder Hawk	15	14	180.32	.....
211	Halverson Garden	McIntosh, S. D.	10	12	900.00	626.87
220	Westphal Garden	Morristown, S. D.	18	18	900.05	900.05
161	Harry W. Long	Solen	12	13	605.03	.....
2A	Swift Elk)	Ft. Yates	10	10	....	.....
2B	Porcupine)	Shields	13	13	.....	.....
2C	Big Lake) Indian	Cannonball	8	8	.....	.....
2D	Fairview) Gardens	Ft. Yates	16	16	.....	.....
2E	Cannon Ball)	Cannonball	8	8	.....	.....
2F	Riverside)	Ft. Yates	6	6	.....	.....
76A	Gottfried LaBrensz	Ft. Yates	....	1	.....	.....
77A	John Wolf	Ft. Yates	....	1	.....	.....
78A	Geo. Walker, Sr.	Selfridge	....	1	.....	.....
79A	Geo. Walker, Jr.	Selfridge	....	1	.....	.....
80A	Mike Froelich	Selfridge	....	1	.....	.....
182	Cedar River Mutual Aid No. 182		....	....	192.93	.....
183	Cedar River Mutual Aid No. 183		....	....	92.51	.....
210	Cedar River Mutual Aid No. 210		15	....	906.71	605.20
		Slope County				
9	W. T. Krebsbach	Reeder	50	60	366.95	116.95
128A	John Maixneo	Buffalo Springs	....	1	.....	.....
129A	C. I. Ware	Amidon	....	1	.....	.....
		Stark County				
3	Bob Gilliam	Dickinson	....	5	27.69	27.69
146	B. O. Thorkelson	Dickinson	8	20	712.55	40.00
18A	F. W. Braun	Dickinson	5	5	.....	.....
24A	Max Bloom	Taylor	6	6	.....	.....
73	Harry Semerad	Dickinson	....	....	11.45	11.45
		Steele County				
		None				
		Stutsman County				
153	State Hospital	Jamestown	50	30	287.22	286.32
		Towner County				
		None				

Project Number	Name	Address	Acres Irrigated 1939	Acres Irrigated 1940	Amount Invested	Amount Repaid
		Traill County				
53A	Ole L. Olson	Buxton	35	35	----	----
27A	Jens Letnes	Hillsboro	35	35	----	----
		Walsh County				
165	State School	Grafton	----	5	347.05	347.05
135A	J. C. Kenney	Park River	----	20	----	----
217	Park River Project	Grafton	Water Supply		407.56	407.56
		Ward County				
1C	Burlington Project	Burlington	435	435	180.99	180.99
130A	George Johnson	Burlington	80	80	----	----
131A	Harvey Johnson	Burlington	100	100	----	----
40	M. D. Graham	Burlington	200	100	11.47	11.47
36A	Oscar Hedstrand	Logan	12	80	----	----
37A	Harry O'Brien	Burlington	25	25	----	----
38A	Jim Fisher	Burlington	15	15	----	----
82A	Albert Lowe	Minot	----	12	----	----
134A	John Kassens	Berthold	2	2	----	----
221	Burlington Dam	Burlington	----	----	4,330.52	4,330.52
		Wells County				
		None				
		Williams County				
69	John Mercer	Buford	9	5	263.32	120.00
90	J. G. Houston	Buford	8	8	4.56	4.56
57A	Ernest Vick	Ray	40	40	----	----
102A	Frank Rogers	Buford	----	3	----	----
15A	Ivan Metzger	Williston	35	35	----	----
43A	Floyd Phleg	Williston	5	5	----	----
197	Pearl Van Allen	Williston	5	5	208.94	41.78
1J	WPA Garden	Williston	100	110	----	----
97A	Orville Davidson	Tioga	----	10	----	----
118	Richard C. Ike	Williston	8	2	466.55	125.00
205	Stephen Westdal	Williston	20	20	160.85	112.57
103A	O. A. Bjella	Epping	----	5	----	----
59A	T. A. Stenehjem	Williston	----	40	----	----
5	R. L. Williamson	Buford	----	----	376.53	10.00
30	Arthur Hartosh	Ray	----	----	5.27	----
62	C. E. Stewart	Ray	----	----	485.28	186.55
80	T. A. Stenehjem	Williston	----	----	180.00	90.00
104	Bruno Upmeyer	Williston	----	----	280.17	50.00
141	Joseph Hackenburg	Williston	----	----	322.44	193.00
152	Leona F. Myrhow	Williston	----	----	12.48	----
147	Clifford Hanson	Buford	----	----	8.44	----
222	Buford-Trenton Proj.	Buford	Under Const.		1,823.08	----
120	C. H. Parker	Minot	----	----	19.47	19.47

Topping onions in the Adolph Sprenger 13-acre irrigated garden near Elgin, North Dakota. Over 400 bushels per acre raised with four irrigations.

A 350 bushels per acre crop of onions raised in Metzger's Oasis gardens. Thirty-five acres of garden crops, fruit and flowers are raised. Irrigated from spring fed pools.

BONDS

The Water Conservation Act of 1939 authorized the Commission to guarantee or insure the payment of a part of the principal of any series of Water Conservation Commission Revenue Bonds in order to sell or market such bonds, such guarantee to be an amount not to exceed twenty per cent of the par value of the bonds. The aggregate amount of the guarantee fund for the biennium ending June 30, 1941, is not to exceed fifty thousands dollars. The bond guarantee fund to be placed under a trust indenture by and between the Commission and a corporate trustee. The Bank of North Dakota has recently been named as trustee for the various issues of Commission Revenue Bonds.

The guarantee feature of the Commission Revenue Bonds has increased their marketability and a few inquiries are being received as to available bonds for purchase. Most purchasers desire to obtain bonds on a finished project as they can then see exactly what they are investing in. It is necessary to prepare complete plans and specifications for a proposed project for submission with the application offering bonds for sale. The prospective bond purchaser can then appraise the project, and investigate the success of operating projects in the area.

The Commission does not have funds to finance a project through to completion before receiving the revenue from bonds. Before construction can start on a project, revenue from bonds must be received or a loan obtained subsequent to the issuance of bonds.

The North Dakota Rural Rehabilitation Corporation purchased the first bonds of the Commission in 1938, a time when the new program of the Commission was at a crucial stage. This initial aid to the Commission enabled its program of water conservation to proceed successfully and without delay. At the time the Corporation purchased the first bonds, they were not supported by a guarantee fund, and it was impossible to sell them to any other agency.

The following tabulation shows the amount of bonds issued or authorized for various projects, the guarantee fund hypothecated, and the purchaser or holder:

TABULATION OF BOND ISSUES

Project	Series	Year Issued	Year of Maturity	Amount of Issue	Interest Rate Per Cent	Guarantee Fund	Purchaser or Holder
Lewis & Clark—Irrigation	A	1938	1949	$ 25,000.00	3	.....	North Dakota Rural Rehabilitation Corporation
Lewis & Clark—Irrigation	A	1938	1968	125,000.00	3	.....	North Dakota Rural Rehabilitation Corporation
Grantier—Irrigation	C	1938	1948	2,000.00	3	.....	North Dakota Rural Rehabilitation Corporation
Sioux—Irrigation	D	1939	1969	25,000.00	3	$ 5,000.00	North Dakota Rural Rehabilitation Corporation
Lewis & Clark—Drainage	E	1940	1971	25,000.00	3	5,000.00	North Dakota Rural Rehabilitation Corporation
Lewis & Clark—Land	F	1940	1970	27,000.00	4	5,400.00	Bank of North Dakota
Bismarck—Land	G	1940	1970	16,500.00	4	3,300.00	Bank of North Dakota
Yellowstone Pumping—Irrigation				50,000.00*	4	10,000.00	Reconstruction Finance Corporation
Kyes—Irrigation				70,000.00**	4	14,000.00	
				$365,500.00			

*Application made to Reconstruction Finance Corporation
**Issue authorized, preliminary project plans underway

PROPOSED LARGE IRRIGATION DEVELOPMENTS

Project	Source of Water	Acres
Lower Yellowstone Addition	Yellowstone River	6,000
Sidney Pumping	" "	2,000
Cartwright	" "	840
Buford Trenton	Missouri River	13,400
(Under construction)		
Williston	" "	8,600
Birdhead	" "	2,900
Nesson	" "	14,580
Seneschal	" "	1,820
Goodall	" "	3,800
Shell Creek	" "	4,830
Independence	" "	4,130
Fort Berthold	" "	8,850
Old Agency	" "	9,130
Fort Stevenson	" "	6,830
Mannhaven	" "	1,550
Hancock	" "	5,030
Stanton	" "	3,450
Fort Clark	" "	2,750
Oliver-Sanger	" "	6,880
Painted Woods	" "	3,670
Manley	" "	2,160
Wogansport	" "	2,400
Square Butte	" "	2,750
Burnt Creek	" "	1,940
Bismarck	" "	4,880
(Partially approved)		
Little Heart	" "	3,930
Glencoe-Stout	" "	4,010
Long Lake-Kyes	" "	2,100
Horsehead	" "	17,600
Winona	" "	5,940
Fort Yates	" "	7,650
Heart Valley	Heart River	15,000
Knife Valley	Knife River	16,000
Cannonball and Cedar Valleys	Cannonball River	18,000
Souris Valley	Souris River	30,000
Little Missouri Valley	Little Missouri River	24,000
Grand Valley	Grand River	5,000
Oakes Area	Wells	3,000
Tappen Area	"	1,000
Napoleon Area	"	1,000
Towner Area	"	2,000
Turtle Lake Area	"	1,000
Total		282,400
Potential acreage along miscellaneous streams		17,600
Total Potential Acreage		300,000

Irrigated alfalfa is becoming established on new irrigation projects.

ACTIVITIES OF THE U. S. BUREAU OF RECLAMATION IN NORTH DAKOTA

During 1939 and 1940, the Bureau of Reclamation has been carrying on extensive investigations of the irrigation possibilities in North Dakota. The State Water Conservation Commission has actively cooperated with the Bureau by furnishing office quarters in the State Capitol building, blueprinting costs and all information gathered by the Commission relating to irrigation development in the State.

Bureau surveys have been made on 27 projects along the main stem of the Missouri River from the Montana State line to the South Dakota State line, comprising a total of 144,000 acres of irrigable land.

Reconnaissance of irrigable acres on the tributaries of the Missouri in North Dakota have shown acreages as follows:

Knife River—16,000
Heart River—15,000
Cannonball—26,000
Grand River—incomplete

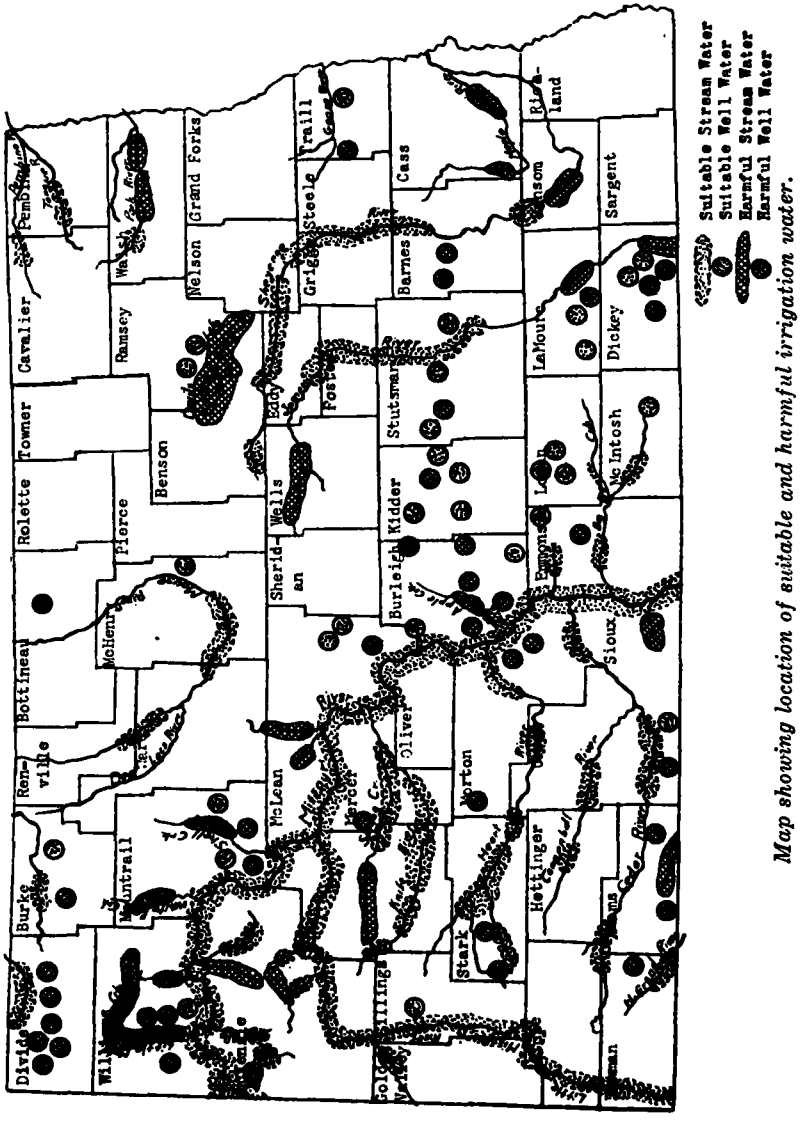
Projects on the Knife and Heart rivers appeared to have sufficient merit to justify further study and detailed investigations have been made of them in the field but reports have not yet been completed.

As a part of a study being made of irrigation possibilities utilizing the power and storage facilities created by Fort Peck Dam, one project is being studied which includes over 1,000,000 irrigable acres in the vicinity of Crosby and Mohall, North Dakota. These surveys also include plans for furnishing water to restore the former level of Devils Lake, municipal supplies for the Sheyenne and James rivers and all purposes

contemplated in the Missouri River diversion plan which has so long been considered by the people of North Dakota.

Reports on all these investigations by the Bureau in North Dakota will be released for the information of the state as soon as completed.

During the two-year period a total of approximately $100,000 has been expended on the above investigations.



Map showing location of suitable and harmful irrigation water.

IRRIGATION WATER ANALYSES FOR NORTH DAKOTA

Over 200 analyses of streams, wells and lakes have been taken in the last four years. From these, a fairly accurate chart has been prepared showing the suitable and unsuitable irrigation water in the state. To run these chemical analyses, an agreement was made between the State Health Laboratory at Bismarck, North Dakota, and the Commission, whereby the Laboratory would make free analyses according to Bureau of Agricultural Chemistry and Engineering standards on samples submitted. Before any irrigation development was undertaken in doubtful areas of the State, chemical analysis of the water was taken to determine its suitability for use on plants.

The above procedure was made necessary as an educational feature because many farmers and gardeners had suffered substantial loss by buying pumping equipment and preparing land for irrigation, then finding the water would kill their crops and render their land unproductive. Harmful water areas were located and avoided. Field methods of recognizing these harmful areas were developed and publicized. An Agricultural Extension Service leaflet was prepared, listing indications of harmful soil and irrigation water. Special forms were prepared for showing the chemical analysis in such a way that the quality of water could be readily determined by the farmer. Where water contained intermediate amounts of harmful salts, the user was cautioned to use the water sparingly, to counteract harmful effects by heavy applications of manure, and to furnish drainage on heavy soils.

A 350 gallons per minute spring fills these pools for irrigation, recreation, game and fish. Metzger Oasis gardens, 13 miles northeast of Williston, N. D.

The studies made showed that no large area in the state could be sure it had suitable irrigation water. In some localities it was found that the 20-ft. well was good but in the same place water at a 40-ft. depth below a clay layer was extremely salty. The studies further showed that water coming from lignite coal veins, salty watersheds or artesian wells, was nearly always unsuitable. On the other hand, water from the large streams and shallow wells was generally quite free of salts. Streams that were good during flood stage often contained large amounts of alkali when low or stagnant.

Water containing more than 350 P. P. M. (parts per million) Sodium Bicarbonate (baking soda), 550 P. P. M., Sodium Chloride, or 700 P. P. M. Sodium Sulfate, is not considered suitable for irrigation purposes by the Bureau of Agricultural Chemistry and Engineering. Under ordinary conditions, total sodium salts should not exceed 700 P. P. M.

The map paints a darker picture than actually exists for unsuitable water because samples were taken only in areas where there was doubt. All of these studies show that much is yet to be done on soil and water testing to avoid serious irrigation failures.

Extensive tests have been made over the State showing water analyses, location of wells and streams, and suitability for irrigation. These records are on file in the office of the North Dakota State Water Conservation Commission at Bismarck, North Dakota, and are available to the public.

UNDERGROUND WATERS IN NORTH DAKOTA

Status of Well Irrigation Developments

The extent of underground waters in the State for irrigation and other uses is indefinite. For a number of years water from wells has been used for garden and other small-scale irrigation. A number of underground reservoirs are known to exist at various locations as shown on the large map accompanying this biennial report. The extent of the water supplies at these several locations are not definitely known. Extensive explorations and pump testing of the favorable areas are needed to determine the extent of the underground supply.

As a rule shallow underground waters in gravel formations are supplied directly from snow water and rainfall.

The following is a description of ground water areas in connection with which the North Dakota State Water Conservation Commission has made preliminary investigation with a view to the development of small-scale irrigation tracts.

The most promising of these areas is in the vicinity of Oakes, North Dakota. The U. S. Forest Service now has about 60 acres under irrigation in this area. The groundwater elevation is being maintained under the present conditions of pumping for this irrigaton development.

One of the largest underground water areas in the State is in the vicinity of Towner, in McHenry County. The U. S. Forest Service maintains a forest nursery just north of Towner, where about 40 acres are irrigated from two wells. In addition to this area north of Towner, favorable indications for ground water developments exist in the vicinity of Upham and Denbigh.

An underground water area of importance is located northwest of Turtle Lake in McLean County. The water bearing formation consists of a considerable thickness of coarse gravel. A modern irrigation well was put down on the Maxwell farm in this area by the State Water Conservation Commission in 1937. This well has been successfully used.

At the town of Tappen and vicinity in Kidder County, surface indications point to the possibility of developing a number of tracts by well irrigation.

A large number of garden tracts are being irrigated at Napoleon in Logan County and at Wishek in McIntosh County. It is probable that more extensive well irrigation can be developed in this region. A report of the State Geological Survey shows a large water-bearing formation in the vicinity of Lignite in Burke County.

Before further well irrigation developments are undertaken, additional investigations of the underground water supplies for the various locations are necessary. This should be done in cooperation with the U. S. Geological Survey.

NEW DAMS CONSTRUCTED

The Burlington dam located on the Mouse (Souris) River, near Burlington, Ward County, in Section 36, T. 156 N., R. 84 W., is of the rubble masonry type, built with flashboard regulating control, and was constructed for providing storage water to irrigate the upper meadows on the Burlington Mutual Aid Project.

The State Water Conservation Commission, the sponsor of the project, has done the engineering work, including the designing and preparing of plans. The Work Projects Administration has furnished the labor and part of the material. The North Dakota Rural Rehabilitation Corporation is cooperating in the purchase of materials and supplies, also on supervising the construction work.

Construction work on the dam commenced in February, 1940. Delays were caused several times by the releasing of water from Lake Darling to take care of the needs for irrigation and bird refuges on the lower Mouse River. Delay was experienced in securing an extension of WPA time limit. It is anticipated that the project will be completed before March, 1941.

In Sioux County, seven dams were constructed on the Cedar River to provide an adequate supply of water storage during low summer flows in connection with the irrigation development of the Cedar River Community Garden Projects.

The dams were designed by the State Water Conservation Commission and were constructed under its supervision. They were constructed as a WPA project with the State Water Conservation Commission as sponsor. The Work Projects Administration and the State Water Conservation Commission cooperated in the construction of the project and in the furnishing of material and supplies. All labor was furnished by the Work Projects Administration.

These low dams are of the rock fill type and were constructed at the upper end of rock riffles. All rock and clay were readily found available in the surrounding districts. It was necessary to purchase only the timber for the cutoff walls and the woven wire used in binding the hand placed rock fill in place.

Construction features were governed largely by conditions found at each dam site, and by the profile and cross-section of the stream bed. Varying quantities of material for each dam were required. The height of the dams were variable also, averaging between three and four feet. Plans called for placing the rock by hand in the stream bed and for riprapping the slopes.

This type of construction has proved permanent and economical, especially when the WPA furnishes the labor and hauling. Only a small amount of money was necessary for purchasing lumber and wire. Some maintenance work may be required after the spring breakup and high flood water, when scouring and washing may remove the riprapping and damage the main section.

MAINTENANCE OF EXISTING DAMS

During the biennium, the North Dakota State Water Conservation Commission has been cooperating with the Work Projects Administration on the maintenance of existing dams. The work is being done under a statewide WPA project, which was approved in March, 1940.

In 1933 and the years following, a number of small dams were constructed by the CCC, the FERA and other agencies. These are of community value, providing boating, swimming, fishing and wildlife conservation as well as water storage for towns, railroads, irrigation and livestock. The original investment in the dams with which we are concerned averages perhaps $8,000 per dam, which without maintenance may be lost.

Under this cooperative program, the North Dakota Water Conservation Commission acts as sponsor. The Commission has limited its expenditure for each repair job to $300, which amount can be used for investigation, engineering, materials and supplies. The labor required and some funds for materials and supplies are furnished by the Work Projects Administration. Many difficulties arise in connection with meeting the requirements of the program and these preliminary arrangements are very largely taken care of by the State Water Conservation Commission as sponsor. It is often required that funds, other than those furnished by the Commission and the WPA are necessary. The State Game and Fish

Commission has been cooperating by contributing to several projects. Local organizations have been active in promoting and contributing funds where reconstruction costs were exceeding the sponsor's contribution and WPA funds.

In order to meet the requirements of the Work Projects Administration covering the repair of dams, the land for the site of the dam and reservoir must be owned by the state, county or other governmental subdivision. It is also necessary that there be permanent easements for rights-of-way giving access to such property.

Following is a list of repair projects showing progress made and amount of work accomplished. In addition to the dams which have been repaired under this program, there are a number on which the field investigations and engineering work only have been completed.

Project No. 224

Odessa Dam, located one mile southwest of Odessa, in Section 5, Township 133 North, Range 90 West, on the Cannonball River in Grant County.

Repair job on old concrete dam, built by the Northern Pacific Railroad and abandoned several years ago. Repair work consisted of closing sluice opening, installing flashboards and placing riprap below structure. This work was planned and supervised by the North Dakota State Water Conservation Commission, also furnishing supplies and materials, cooperating with the Work Projects Administration in charge of construction work.

Work on the project started on November 6, 1939, and was completed on November 15, 1939.

This project provides an additional supplemental supply of storage water for use in irrigating the community gardens on Project No. 191.

Project No. 240

Warwick Dam, located 3½ miles south of Warwick, in Section 15, Township 150 North, Range 63 West, on the Sheyenne River.

Work consists of repairs to cutoff wall, the main overflow section being undermined. Investigations, engineering and supervision by North Dakota State Water Conservation Commission, the sponsor, with all labor being furnished by Work Projects Administration.

Contributing to purchase of supplies and truck hire were the following:

North Dakota State Game and Fish Department.
Ramsey County Wildlife Federation.
New Rockford Wildlife Association.
Eddy County (Cement).
Benson County.
Cash collected by C. L. Reeves, Warwick.

Repair work was started on October 21, 1940, by the Work Projects Administration and has continued throughout November and December with good progress being made. Under present plans this job will be completed before the spring high water flow commences.

Project No. 241

Dodge Dam, located in Stutsman County, west of Vashti, Section 24, Township 143 North, Range 67 West, in Dodge Coulee.

Work consisted of repairing the spillway structure, engineering and supervision by North Dakota State Water Conservation Commission, sponsor. Labor furnished and repairing done by the Work Projects Administration, which commenced work in December, 1940. Contributing to purchase of supplies and materials were the North Dakota State Water Conservation Commission and North Dakota State Game and Fish Department. Work Projects Administration commenced repair work during December.

Present plans call for completion of the project during the early part of 1941 .

Project No. 242

Jund Dam, located in McIntosh County, east of Zeeland, Section 19, Township 129 North, Range 72 West.

Repairing spillway structure, engineering and investigations under direction of North Dakota State Water Conservation Commission. Reconstruction labor and work performed by the Work Projects Administration. Temporary repairs to spillway were commenced on May 3, 1940. Only temporary repairs were made.

Project No. 243

Tioga Dam, located in Mountrail County east of Tioga, Section 30, Township 157 North, Range 94 West.

Investigations were made by the Engineering Department of the North Dakota State Water Conservation Commission. It found that the present spillway was practically washed away, requiring the construction of a new structure. The citizens of Tioga, who have been cooperating in promoting this project, to date, have been unable to give any financial aid. The State Water Conservation Commission has limited its expenditures for each project to $300.00. This amount is insufficient to cover costs of materials and supplies which will be necessary before the Work Projects Administration will commence work.

Project No. 245

Soland Dam, located in Mercer County, southeast of Hazen, Section 32, Township 144 North, Range 86 West.

Work consists of reconstruction of old spillway with a reinforced concrete structure. The North Dakota State Water Conservation Commis-

sion has been active in contributing engineering services and funds amounting to $300.00 in cooperating with the Work Projects Administration, which has assumed charge of rebuilding this structure, furnishing labor and a large portion of the materials and supplies. Commencing work on July 18, 1940, making good progress and expecting to complete the job in 1941.

Project No. 246

Antelope Creek Dam, located in Mercer County, northwest of Hazen, Section 3, Township 144 North, Range 87 West.

North Dakota State Water Conservation Commission, the sponsor, and cooperating with Work Projects Administration in furnishing material for completing work on new reinforced concrete spillway structure, work was completed during July, 1940.

Project No. 247

Located in Steele County, southwest of Finley, Section 8, Township 146 North, Range 56 West.

Work covers repairs to spillway and dam, investigations, engineering and supervision by the North Dakota State Water Conservation Commission, acting as sponsor, and aiding in purchase of materials and supplies, and the Work Projects Administration, furnishing labor and in charge of repairs. Work was commenced September 24, 1940 and will be completed during 1941.

Project No. 249

Mott Dam, located in Mott, on the North Fork of the Cannonball River, Section 2, Township 133 North, Range 93 West.

The dam was built by the Northern Pacific Railroad Company and is used jointly by the railroad company and the City of Mott for operating and recreational purposes. Considerable repairs are necessary to protect the present concrete structure from disintegrating and wearing away. Present plans call for construction of a reinforced concrete protection covering the dam. The North Dakota Water Conservation Commission, acting as sponsor, is cooperating with the City of Mott, the Northern Pacific Railroad Company, and the Work Projects Administration. Plans have been prepared by the Commission and railroad company, work to commence in 1941.

Project No. 250

Paulson Dam, located in Mountrail County, about 5 miles southwest of Plaza, Section 13, Township 152 North, Range 89 West.

Work consists of repairs to concrete rubble masonry spillway, North Dakota State Water Conservation Commission acting as sponsor, contributing engineering, supervision, materials and supplies, and the Work

Projects Administration furnishing labor. This repair job has been practically completed, with the exception of some concrete grouting. The W.P.A. plans on finishing the project after the 1941 spring thaws.

Project No. 252

Fertile Dam, located in Mountrail County, about 3½ miles south of Parshall, Section 14, Township 151 North, Range 90 West.

Proposed work calls for repairs and construction of a new spillway. Investigations have been made by the North Dakota State Water Conservation Commission. Extra funds will have to be made available from other sources to match the amount the Commission contributes for supplies and materials necessary to build a new spillway and before the Work Projects Administration can proceed with the work. The citizens of Parshall and vicinity have petitioned the Water Commission for sponsoring this work, promising to contribute their share of funds for materials, furnishing trucks and teams.

Project No. 253

Jackson Dam, located in McKenzie County, east of Cartwright, on Charbonneau Creek, Section 25, Township 151 North, Range 103 West.

Proposed work consists of constructing a new, reinforced concrete spillway to protect the present dam and prevent a new channel being formed by erosion. Project to be sponsored by the North Dakota State Water Conservation Commission.

The present artificial lake is used for recreational purposes by the people living in Charbonneau, Cartwright, Alexander and surrounding farming communities. It is likely some contributions may be collected locally to match North Dakota Water Conservation Commission funds that are available under our present program.

Following statement shows expenditures on repairs and maintenance of existing dams as of November 30, 1940:

Summary Showing Present Status

Number of Projects	Present Status	Expenditures	
		By W.P.A. and Others	Water Conservation Comm.
3 Dams	Repairs Completed	$ 4,788.08	$ 357.39
5 "	Work Underway	11,555.86	361.05
5 "	Projects Pending	.....	208.40
1 Dam	Abandoned	.....	5.73
	Miscellaneous Costs	.....	16.50
14 Dams	Totals	$ 16,343.94	$ 949.07

Summary of Expenditures by Projects

Project Number	Name and Location	Expenditures to Nov. 30, 1940 By W.P.A. and Others	Water Conservation Comm.
217	Park River Dam, at Park River, Walsh County	.....	$ 152.01
224	Odessa, Northern Pacific Dam	$ 124.44	321.41
	Irrigation Project No. 191	Supplies only	
231	Johnson Dam, South of Watford City, McKenzie County	.....	5.78
240	Warwick Dam, South of Warwick, Eddy County	2,802.00	138.43
241	Dodge Dam, West of Vashti, Stutsman County	.....	24.00
242	Jund Dam, N. E. of Zeeland, McIntosh County	2,979.74	27.17
243	Tioga Dam, East of Tioga, Williams County	.....	19.15
245	Soland Dam, South of Hazen, Mercer County	8,550.00	129.27
246	Antelope Creek Dam, Northwest of Hazen, Mercer County	1,683.90	8.81
247	Finley Dam, South of Finley, Steele County	203.86	33.10
249	Mott Dam at Mott, Hettinger County	.....	37.24
250	Paulson Dam, Southwest of Plaza, Mountrail County	.....	36.25
252	Fertile Dam, South of Parshall, Mountrail County (Under consideration)	.....	.....
253	Jackson Dam, Northwest of Charbonneau, McKenzie County (Under consideration)	.....	.....
	Miscellaneous Costs on All Projects	.....	16.50
	Total	$16,343.94	$ 949.07

APPROVAL OF LARGE AAA DAMS

According to Section 9, Chapter 256, Session Laws 1939, "no dam exceeding ten feet in maximum height, or capable of impounding more than thirty acre feet of water, shall be constructed in the State, either in a water course or elsewhere, without prior written approval of the Commission."

Occasionally dams to be constructed under the agricultural conservation program involves the construction, by a farmer, of a dam 10 feet or more in maximum height. The construction of dams of this size is carefully considered by the engineering department of the state AAA office. Most of these dams are for stock watering purposes.

After the State AAA office has approved the proposed dams, the Agricultural Conservation Association in the county where the dam is to be built, submits to the Commission the necessary estimates, specifica-

tions and pertinent data with a request for approval of the dam. Fifteen dams have been approved in five different counties as follows:

Grant	1	Mountrail	4
McIntosh	1	Slope	3
Morton	6		

No dams have been disapproved after sufficient data was secured explaining them. We have not found it necessary to make special inspection, but usually work the inspection in along with other duties in the county.

RED RIVER BASIN WATER SUPPLY PROBLEMS

Of special interest has been the changing conditions of flood and drought in the Red River Valley. During the early history of this region, its people were confronted with the problems of flood-control and drainage. Less than a quarter of a century ago, they were concerned with the matter of controlling devastating floods. A long wet cycle in which several floods occurred, ended with the year 1921 and was followed by 10 years of moderate precipitation. In these years of above-normal and normal water supplies in the Red River watershed, extensive drainage work was undertaken and investigations and studies were made for the solution of flood-control problems. During the past 10 years, severe drought conditions have prevailed in the Red River Basin and the following discussions are more particularly with respect to activities and accomplishments in connection with investigations, studies, project and basin planning and project construction which have been undertaken during this drought period with a view to obtaining an adequate and a dependable water supply for the needs of the basin.

The critical drought situation in the Red River Basin, amounting in recent years to an emergency, is being attacked in a vigorous manner by interstate and federal cooperation. While this emergency has existed for a period of about 10 years, it has been only a little over five years since the Interstate Committee, representing the states of Minnesota, South Dakota and North Dakota, was formed and the first definite action was taken to remedy the situation. The water shortage then long drawn out from year to year, seriously threatened the economic life of the Red River Valley, one of the greatest and most fertile agricultural areas in the world. Since that time the Interstate Committee under the technical direction of consultants for the National Resources Committee prepared a unified Water Plan for the Red River Basin. The three states have implemented the plan by an interstate compact which provides for the creation of the Tri-State Waters Commission to represent the three states in the development and operation of the Water Plan. Since its establishment in 1937, the Tri-State Waters Commission has done most effective work in advancing the status of the Red River program. A report of its activities and accomplishments has just been made by the Tri-State Waters Commission.

In July, 1937, the Corps of Engineers, United States Army, made a report on the Water Plan proposed in the report of the Interstate Committee on the Red River of the North Drainage Basin. These studies and a report thereon were made at the request of the Works Progress Administration and were made specifically for that federal agency with a view to indicating the merit of the entire plan and the feasibility, cost, relative priority and suitability for WPA construction of the individual projects in the plan.

The following are major projects considered by the Interstate Committee as essential to the successful operation of the Recommended Water Plan for the Red River Basin:

1. Four dams in the Ottertail Basin.
2. Ottertail-Red River Low Water Channel Improvement.
3. Red Lake River Project.
4. Baldhill Dam, Sheyenne River.
5. Sheyenne-Wild Rice Low Water Diversion.
6. Sheyenne River Low Water Channel Improvement.
7. Lake Traverse—Bois de Sioux River Project.
8. Small dams in Minnesota (43 in number).
9. Small dams in North Dakota (54 in number).
10. Sewerage and Sewage Treatment Projects (72 in number).
11. Municipal Water Supply and Water Treatment Projects (large number).
12. Tongue River Project.
13. Park River Levee Project.
14. General Channel Improvement Project.
15. Walhalla Dam, Pembina River.
16. Steele County Reservoir, Goose River.

Since 1937, the Corps of Engineers, U. S. Army, has been making investigations, surveys and reports for the stream basins of a number of Red River tributaries in North Dakota. These investigations include those for the Pembina River and its tributaries, for the Park River and its tributaries, for the Forest River and its tributaries, for the Goose River and its tributaries and for the Sheyenne River and its tributaries. The Corps of Engineers, U. S. Army is authorized to review previous reports on the Red River of the North. Investigations of the watersheds of these Red River tributaries are being made by the Department of Agriculture with a view to prosecuting measures for run-off and water-flow retardation and soil-erosion prevention. In the following statements, further information is given with respect to these stream basin studies. The discussions also include the Lake Traverse-Bois de Sioux Project. A more detailed discussion is made for this project because of its advanced status and because of it being an outstanding example of what can be done by interstate and federal cooperation.

Pembina River Survey

The Flood Control Act of June 22, 1936, amended by the Acts of August 28, 1937, and June 28, 1938, authorized the Secretary of War and the Secretary of Agriculture to make preliminary examinations for flood control of the Pembina River together with all its tributaries, including the Tongue River. The preliminary examinations indicated justification for a more detailed investigation, survey and report, which was undertaken. The major projects being investigated in this watershed are the Walhalla Dam on the Pembina River and the Tongue River Project on the Tongue River. A public hearing was held at Cavalier, North Dakota, on October 12, 1938, at which testimony showing extensive benefits from the project was submitted by local interests and by the North Dakota Water Conservation Commission. All field work in connection with this survey has been completed and office studies are nearing completion. The report is scheduled for submission to the Division Engineer on February 1, 1941.

Park River Survey

A RESOLUTION of the Committee on Commerce of the United States Senate, adopted December 1, 1938, authorized the Board of Engineers for Rivers and Harbors to review the reports on the Red River of the North with a view to determining if the recommendation therein submitted should be modified to provide for flood control works on the Park River. A public hearing was held by the District Engineer of the War Department in Grafton, North Dakota, on March 1, 1939. At this Hearing testimony was submitted by local citizens and by the State Water Conservation Commission, showing extensive benefits from proposed improvements of the Park River. Included in these proposed improvements are flood levees east of the town of Park River and a dam and reservoir just west of the town of Park River, the main purpose of this dam and reservoir being for municipal water supplies for the cities of Park River and Grafton.

A cross-sectional survey of the stream channel from the mouth to the vicinity of the town of Park River has been completed as has also a flood damage survey of the basin. Office studies are in progress with the report scheduled for submission July 1, 1941.

Forest River Survey

The Forest River investigation, survey and report was also authorized by the resolution providing for the Park River studies. In connection with the investigation, a Public Hearing was held at Minto, North Dakota, on April 26, 1939, at which local interests and the State Water Conservation Commission presented facts and data relative to floods on the Forest River. A cross-sectional survey of the stream channel from the mouth to the vicinity of Fordville has been completed as has also a flood damage survey of the basin. It is not believed that extensive office studies in connection with this report can be started before the

spring of 1941. The scheduled date for submission of the report is May 1, 1941.

Goose River Survey

Section 6 of the Flood Control Act approved August 11, 1939, authorized a preliminary examination and survey for flood control of the Goose River and its tributaries. In this connection, a public hearing was held by the District Engineer, November 3, 1939, at Hillsboro, North Dakota. A written brief was submitted at this Hearing by the State Water Conservation Commission and the State Engineer. Views in regard to occurrence of floods and their control were expressed by local interests. It was shown that extensive benefits would accrue from the construction of multi-purpose projects having the primary object of flood control.

A cross-sectional survey of this stream from the mouth of the Steele-Traill County line has been completed. It is contemplated to make a flood damage survey of the basin early next spring and to begin office studies sometime next summer. The scheduled date for the submission of this report is October 1, 1941.

Sheyenne River Survey

The Sheyenne River investigation, survey and report was authorized by a resolution of the Committee on Commerce of the United States Senate, adopted September 1, 1938, the same being with reference to the Red River of the North Report and its modification to provide for flood control works on the Sheyenne River. A public hearing was held by the District Engineer of the War Department at Fargo, North Dakota, on January 25, 1939, at which full expression of views was made by all parties interested. A written statement was submitted by the Chief Engineer of the State Water Conservation Commission. The testimony submitted was with special reference to the occurrence of floods of damaging magnitude and the construction of multi-purpose projects on the Sheyenne River for the control of floods and for other purposes. A restudy is being made of the Baldhill Dam project.

An alignment and cross-sectional survey of the stream channel from the mouth of the Baldhill Dam site has been completed as has also a flood damage survey of the basin. Office studies in connection with this report cannot be started until next spring. The present scheduled date for the submission of the report is March 1, 1941.

Red River of the North Review Report

A resolution by the Committee on Commerce of the United States Senate, adopted September 1, 1938, authorizes the Board of Engineers for Rivers and Harbors, to review the reports on the Red River of the North, submitted in House Document No. 67, 56th Congress, 1st Session. Investigations under this authorization as above indicated are being made for the Park River, Forest River and Sheyenne River sub-basins only.

Ottertail Basin Survey

An investigation, survey and report by the War Department is desired for the Ottertail Basin. Because of the private interests involved in the use of water in this sub-basin, difficulties are being experienced in obtaining congressional authorization.

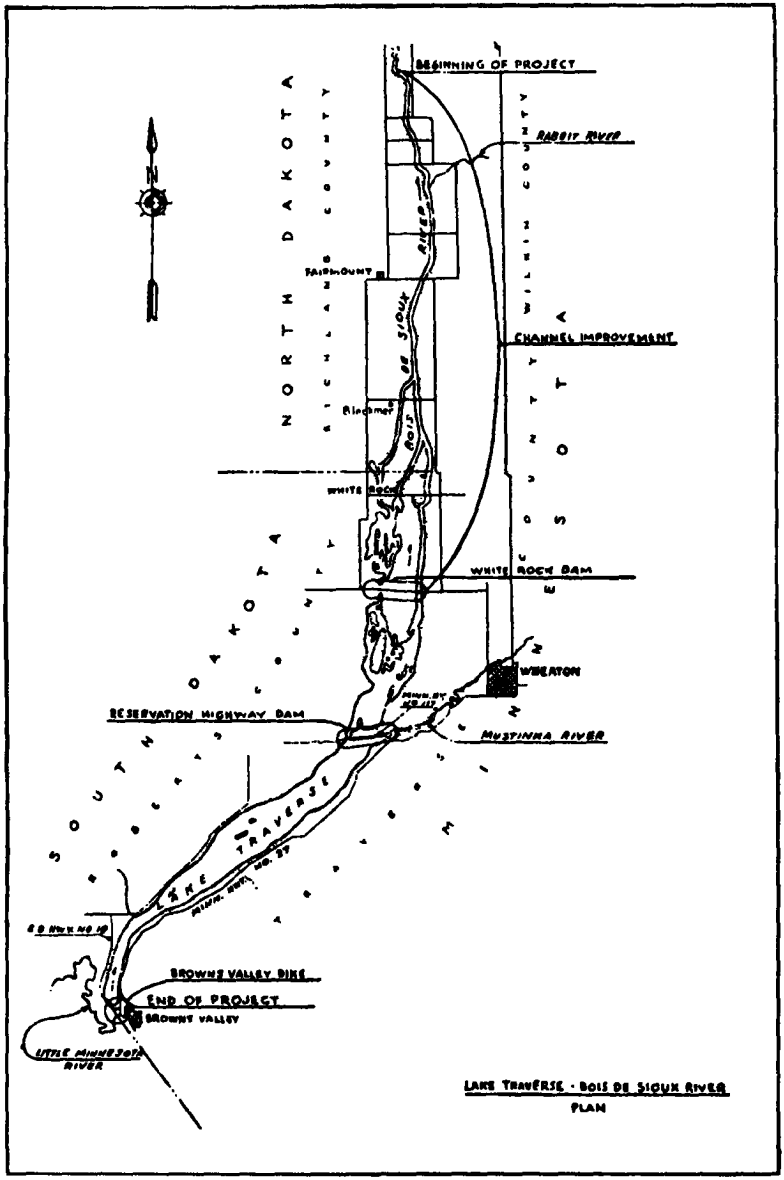
Lake Traverse-Bois de Sioux Project

Lake Traverse is located on the boundary between the states of Minnesota and South Dakota, the north end of an extension to the lake reaching within one mile of the North Dakota border. The main lake lies in a narrow valley and extends in a northeasterly direction from the town of Browns Valley in Minnesota, a distance of 20 miles, to a point about four miles south of the town of White Rock in South Dakota. It varies from about one-half mile to one and one-half miles in width. The Bois de Sioux River is the outlet stream for Lake Traverse. It flows from the lower end of Lake Traverse between the state of Minnesota and the states of South Dakota and North Dakota to Wahpeton, North Dakota, and Breckenridge, Minnesota, where it joins the Ottertail River to form the Red River of the North.

The Lake Traverse-Bois de Sioux Project was first conceived about fifty years ago when it was proposed that a dam be constructed at the north end of Lake Traverse. During the many years of pioneering effort in the promotion of the project, a number of forward movements for advancing the status of the project were inaugurated. Of particular significance were the activities following the disastrous Red River Valley floods of 1897 and 1916.

The project is of special benefit to the States of Minnesota, South Dakota and North Dakota. From the time of its conception, the need for interstate cooperation has been recognized. In 1900, the Tri-State Drainage Association was formed. In 1916, the attention of the U. S. Department of Agriculture was called to the need of flood-control in the Red River Valley. With the cooperation of the states and counties especially interested in the project, extensive investigations and surveys were undertaken by the Division of Drainage of the Department of Agriculture. In 1922, a report on these investigations, known as the Simons and King report, was published in which it was recommended that flood-control and water conservation works be constructed. The Lake Traverse-Bois de Sioux project was included in these investigations, the cost of the same being estimated at $1,500,000. The Simons and King report has been extensively used as a basis for later water supply studies in the Red River Basin.

With the inauguration of the President's Public Works Program in 1933, the Lake Traverse-Bois de Sioux Drainage and Conservation Project Committee of Minnesota, South Dakota and North Dakota was formed. A number of meetings were held by this organization during that same year at which much interest in the project was shown.



The Lake Traverse-Bois de Sioux flood control and water conservation project.

The project was included in the 1936 Flood Control Act without the usual preliminary examination or survey by the War Department. The estimated cost of $1,474,000, as contained in the project item was based on data in the Simons and King report.

In the meantime, the Interstate Committee, representing the states of Minnesota, South Dakota and North Dakota was organized. The work of this Committee in formulating a coordinated water plan for the Red River Basin was carried on under the technical direction of consultants for the National Resources Committee. Special studies for the water supply problems of the Red River Basin were made about this same time by the Corps of Engineers, U. S. Army. These studies included the Lake Traverse-Bois de Sioux project. They were made at the request of the Works Progress Administration for a report on the Water Plan by the Interstate Committee and were not to be considered as a regular investigation, survey and report made by the War Department at the request of Congress. In the Recommended Plan as formulated by the Interstate Committee, the Lake Traverse-Bois de Sioux project was considered as one of the major projects and as essential to the operation of the Plan.

It was represented to the three interested states by the National Resources Committee that in the long-time planning program for the Red River Valley, it would be necessary to form a Board or Commission with power to act on interstate problems. Accordingly, in 1937, the Tri-State Waters Commission was created by the states of Minnesota, South Dakota and North Dakota. The compact entered into by the three states was approved by Congress in 1938. This arrangement was considered a necessary pre-requisite to further advancing the status of the Lake Traverse-Bois de Sioux Project.

In 1938, the House and Senate of the United States passed the Flood Control Act for that year. This Act contained provisions of great importance affecting the states of Minnesota, South Dakota and North Dakota. The Act provides that, in the case of any dam and reservoir project, or channel improvement or channel rectification project authorized for flood control, title to all lands, easements and rights-of-way shall be acquired by the United States and the Federal Government shall operate and maintain the project. The Lake Traverse-Bois de Sioux Project came within this provision of the Act. Previous to the passage of this Act, it would have been necessary to take care of these costs by the three states. In this instance, costs in the sum of $24,000, allotted as North Dakota's share, as well as much larger sums for Minnesota and South Dakota, are being taken care of by the United States. The funds for the Lake Traverse-Bois de Sioux Project were included in the War Department Civil Appropriation Act approved June 28, 1939.

It is evident that the very active efforts of the Army Engineers in connection with the project and their favorable recommendations have been the most important factor in advancing the Lake Traverse-Bois de

Sioux project to the construction stage. Much credit for this cooperation is due Lt. Col. Dwight F. Johns and Colonel Philip B. Fleming, former District Engineers of the St. Paul Office and to Major J. W. Moreland, the present District Engineer.

Major Moreland has carefully compiled information with respect to the project and has made a written record of the same available for this discussion. The following is a resume of the information compiled by him:

Purposes of Project

As its name indicates, the Lake Traverse-Bois de Sioux Flood-Control and Water Conservation Project is designed to serve more than one need. Its main purpose is to provide complete protection for some 42,000 acres of agricultural lands against the flood which may be expected to occur once every 30 years and to provide partial protection to these same lands and to 12,000 additional acres against greater and less frequent floods. A secondary benefit to be achieved is the creation of a lake between Browns Valley and Minnesota State Highway No. 117 (Reservation Highway) with the water surface approximately 5 feet higher than that which now exists. The raising of this lake should provide an ideal spot for boating, swimming, fishing and wild life conservation. Also, the level of the lake between the highway just mentioned and the White Rock dam, which is located four miles south of White Rock, South Dakota, may be raised approximately 3 feet above its present level. The raising of this lake level should provide an ideal place for duck breeding and hunting. Still another benefit, which cannot be weighed too heavily because of the relative infrequence of major floods, is an increased low water flow to communities north of the White Rock dam.

Construction Features

The construction features, based on their physical location, are readily divided into—

(1) The Bois de Sioux Channel Improvement,
(2) The White Rock Dam,
(3) The Reservation Highway, and
(4) The Browns Valley Dike.

Channel Improvement:

The work in connection with the channel improvement consists of enlarging and straightening about 24 miles of the Bois de Sioux channel so that it can carry, with one foot freeboard, a discharge at the lake outlet dam of 1,100 cubic feet per second. In order to accomplish this, a bottom width of 60 feet, with side slopes of 1 on 3 was selected. The longitudinal slope from this dam to the junction of the Rabbit River with the Bois de Sioux River is 1 to 10,000 and the slope for the next 7 miles downstream to the end of the project is 14 in 100,000. This increased slope and resulting depth increases the capacity to 2,000 second feet.

In some places it was advantageous economically as well as hydraulically, to construct cutoffs, both straightening and shortening the channel.

The White Rock Dam:

The White Rock Dam is of impermeable rolled earth fill construction. It is about 3 miles long with a top width of 26 feet and a maximum height of 16 feet. It is not designed for overtopping. The upstream slope is 1 on 2½ and the downstream slope is 1 on 2. The upstream slope is protected by a six inch bed of gravel upon which is laid 12 inches of riprap. A toe drain is incorporated in the base of the downstream slope. It consists of a six inch layer of sand sandwiched between two six inch layers of gravel and revetted with 12 inches of riprap.

The White Rock Dam control structure consists of a highway bridge between piers of which are three Tainter gates, 17 feet high and 13 feet wide. They are hand operated and of welded construction.

The Reservation Highway Dam:

The Reservation Highway dam consists of a control structure placed just below the bridge on Minnesota State Highway No. 117 and the raised portion of the highway where it crosses the lake bed. The control structure is 113 feet long and consists of an earth fill dam with steel sheet piling cut-off walls and grouted riprap surface. This is topped by a concrete fill through which passes a series of vertical H sections, which, in turn, support a walkway. This provides 17 bays, 6′ - 8″ in length, which may be partially blocked with stop logs. The elevation of the sill is 974 feet and 3 feet of stop logs are provided to maintain a water surface of 977 feet. In addition to this, two 18-inch culverts, controlled by gates, were placed through the dam with the bottom of the culvert at elevation 970. Next spring it is planned to surface this road with soil cement.

The desired elevation of 977 for the conservation pool cannot always be maintained. In that connection, the District Engineer of the St. Paul Office of the War Department has been directed by a Congressional Committee Resolution to prepare a report on the advisability of diverting flood waters from the Little Minnesota River to Lake Traverse. This diversion, if carried through, would aid in maintaining the conservation pool.

The Browns Valley Dike

The Browns Valley Dike is for the purpose of preventing the pooled water in Lake Traverse from overflowing across the divide southward into the Minnesota River Basin. It has only one main feature, a dike 3,700 feet long extending northeast and southwest between the south limit of South Dakota State Highway No. 10 and Minnesota State Highway No. 27. The maximum height of the dike is 10 feet and the top width is also 10 feet. The north or lake side of the dike above elevation 981 and the south side of the dike will have a slope of 1 on 4. Below elevation 981

the lake side will have a slope of 1 on 15. The dike is not designed for overtopping.

Controlling Conditions of Design

Among other conditions, the following were determined as a basis for design:

(1) The Bois de Sioux channel must carry 1,100 second feet to the junction of the Rabbit River, and 2,000 second feet below that point.
(2) The elevation of both pools for a flood equivalent to that of 1916 will be 981.
(3) The elevation of both pools for any possible flood will be 982 if a 4,000 second foot outflow after the stage reaches 981 is maintained.
(4) The normal pool level north of the Reservation Highway should not be higher than 972.
(5) The normal conservation pool level south of the Reservation Highway should be 977.

The hydraulic design of the Lake Traverse-Bois de Sioux project was complicated by lack of records. This lack applied to records of inflows and outflow and of lake levels. Because of this lack of information, it was necessary to construct inflows, outflows and lake levels for a series of years, from the meager existing records and by interpolations and computations.

Operation of Control Structures

The present general plan for the operation of the two control structures is here described. During the winter the lower pool elevation will not exceed 972. About March 1st, the gates of the White Rock Dam will be closed and inflow retained in the reservoir until May 1st. After that date, flows will be discharged from the White Rock dam not exceeding an outflow of 1,100 cubic feet per second, until the pool has been drawn down to levation 972, which elevation will be maintained as far as possible. If the pool tends to exceed elevation 981 before May 1st, the Tainer gates will be opened and flows up to 4,000 second feet will be passed in an effort to maintain the pool at elevation 981. At all times the water level in the upper pool will be maintained at elevation 977 as far as possible. As soon as the level tends to exceed this elevation, flow will be discharged into the lower flood control pool. The stop logs may be removed to expedite this discharge.

Status of Construction Work

At the present time, the Bois de Sioux channel excavation is 64% complete. With the exception of the railroad bridge at White Rock, all bridge changes are finished. The White Rock Dam is about 98% complete. All work on the Reservation Highway Dam is completed except for the road surfacing and seeding of side slopes. Plans for the Browns Valley Dike are practically complete and advertisement for bids will be made this winter. The entire project will be ready for operation in the fall of 1941.

THE MISSOURI RIVER DIVERSION

For the period included in its first biennial report (1937-1938), the State Water Conservation Commission showed in its report that much progress had been made in advancing the status of the Missouri River Diversion Project. A continuation of the activities in connection with the project has been carried on in the biennium covered by this report. Only a brief outline of these activities and of the accomplishments pertaining to the project can be here recorded. If the large map folded in the back of this publication is followed as this report is read a clearer conception will be gained.

In December 1938, a Board of Review for a restudy of the Missouri River Diversion was established by the Corps of Engineers, U. S. Army. The Board consists of four members, the District Engineer of the Omaha Office, the District Engineer of the St. Paul Office, and Military Assistants to the Division Engineers of the Upper Mississippi Valley and the Missouri River Divisions.

Immediately upon its establishment, a Hearing was held by this Board at Bismarck on December 15th and 16th, 1938, at which time testimony was submitted relative to benefits to be derived from the construction of the project. At the close of the Bismarck Hearing, the known evaluated benefits submitted at the Devils Lake Hearing in 1936, the Washington Hearing in 1937 and the Bismarck Hearing in 1938, together with evaluated benefits submitted to the District Offices of the Army Engineers from time to time during these years, aggregated 68 million dollars. Benefits to the project subsequently evaluated bring the present total to a sum which is undoubtedly in excess of one hundred million dollars.

The estimated cost for the Army Engineer plan as contained in the 1937 report was 54 million dollars and that of the Water Commission modified plan was 39 million dollars. The benefits as evaluated by the Army Engineers in their 1937 report were only about 7½ million dollars. The present total of possibly one hundred million dollars in benefits is with special reference to the Water Commission modified plan, to the Army Engineer 1938 plan, or to any plan by the Board of Review, the cost of which will not exceed that of the 1937 plan. The picture as to comparison of costs to benefits is now quite the reverse to that for the 1937 plan of the Army Engineers. The State Water Conservation Commission has been most active in the matter of evaluating benefits for the project. Very largely through its efforts has this showing of greatly increased benefits been made.

Extensive investigations and studies have been made of the water needs and the water resources of the Red River Basin by the Army Engineers and by the North Dakota State Water Conservation Commission. These investigations have been made with special reference to the Red River Plan and to the Missouri River Diversion. In connection with the use and regulation of the waters in the Red River Basin as provided for

in an interstate compact, the Ottertail sub-basin has been excluded from the provisions of that compact.

The War Department in its report to the Works Progress Administration in 1937 states that the main water plan for the Red River Basin could not be operated to obtain minimum required flows in drouth years if the Ottertail Basin were not included. Reports of the North Dakota Water Commission point very definitely to the conclusion that during a series of drouth years, such as have occurred during the past ten years, that there is an insufficient water supply in the Red River Basin, including the Ottertail Region, for the needs of the basin. It has also been found that the Missouri River Diversion is the only available means for supplying the deficiencies in the Red River Basin.

The North Dakota Water Commission has also made studies of the Sheyenne River water supply. Reports on these studies and actual stream measurements at Valley City show the annual average water supplies in that stream to be far below those previously determined for showing the available water resources of the Sheyenne River sub-basin. This new stream flow information further establishes more definitely the water supply deficiencies in the Red River Basin and the need of Missouri River waters.

A brief has been submitted by the Water Commission and the State Engineer to the Board of Review in which it was proposed that any plan or program for taking care of the water supply needs of the Red River Basin should be based on the conditions during a series of drouth years such as we have experienced during the past ten years. As an example, it was pointed out that, at the Grand Forks stream gaging station, the average annual water supply for the ten-year drouth period was only about one-third the average annual water supply for a 56-year period which included wet cycles and several floods. It is understood that the water supply conditions during this ten-year drouth period is being used as a basis for water resources and water needs in the Red River Basin and for the supplying of deficiencies by means of the Missouri River Diversion. In previous reports, the water resources of the basin were based on water supply records for the longer periods.

Sewage and waste pollution has contaminated the surface water available to municipalities in the Red River region to an extent not approached in most parts of the United States. In order to correct this condition, sewage treatment plants are needed, and in addition, the stream flow should be increased to furnish satisfactory oxygen balance and make the streams suitable for water supply and recreation. Minimum required flows in the Red River of the North at population centers during winter months were computed for the earlier studies of the Army Engineers. These minimum flows were based on a partial theoretical approach and on the assumption that the oxygen demand of sewage and wastes entering the streams will be reduced 85 per cent by treatment. To authentically establish these flows an extensive field and laboratory research investiga-

tion has been completed along the Red River of the North. A final report thereon has been completed but is not yet published. The report has, however, been made available to the District Engineer of the St. Paul Office of the Army Engineers for use in connection with the restudy of the Missouri River Diversion project. The pollution study has been undertaken by the North Dakota Department of Health in collaboration with the Minnesota Board of Health, the United States Public Health Service and the Public Health Departments of the Province of Manitoba and of

Polluted creek entering river. Note floating scum.

the Dominion of Canada. This study will furnish an authentic basis for accurately computing necessary flows in the Red River at population centers and the deficiencies to be supplied by the Missouri River Diversion. Prior to the undertaking of these studies, the State Water Conservation Commission very strongly urged that they be made.

The Board of Review for a restudy of the Missouri River Diversion has been making very extensive surveys, investigations and economic studies with respect to the project. Field surveys, preliminary plans and estimates of cost are being made under the direction of the District Engineer of the Omaha Office. The headquarters for the field surveys was at Bismarck. The economic studies are being made under the direction of the District Engineer of the St. Paul Office.

Contrary to the basis assumed in previous investigations of the Army Engineers, the present investigations are based on conclusions that the diversion of Missouri River waters is definitely needed to supply deficiencies in the Red River Basin and in the James River Basin. Studies in connection with field investigations now point to again diverting Missouri River waters at the former Big Bend location near Garrison and to the adoption of a more southerly route of diversion as compared to the route proposed in the 1937 report. It is now proposed to carry the diverted waters across the divide by pumping and by gravity canals rather than by means of a tunnel as was proposed in the 1937 plan.

From following closely the investigations as they are being made, some knowledge of what is contemplated in connection with the proposed new plan has been gained. Office studies in connection with the project are now being made by the Army Engineers and the route location and other features of the project as finally determined may be somewhat at variance with the description here made.

It is now proposed to construct a dam about 50 feet high across the Missouri River at the place of diversion. Low cost electric power will be generated at this dam. The power would serve for pumping in connection with the operation of the project and for taking care of commercial power requirements over a vast region.

A pump-lift would be located along the reservoir created by the dam and the diversion waters would be raised to the higher bench land. The waters would then be carried easterly and northeasterly by canal to the Sheyenne River at a point about ten miles upstream from Harvey — in the Sheyenne River by way of Harvey to Wellsburg—in a Sheyenne-James River diversion canal to the James River at Bremen — in the James River to a dam and reservoir north of Jamestown — in canals and through a chain of lakes including Spiritwood Lake to the Sheyenne River at Valley City — in the Sheyenne River and in a Sheyenne-Wild Rice diversion canal to the Red River of the North and in that stream.

It is proposed to have extensive storage in a series of natural lakes along the first canal course. These natural lakes are in the vicinity of Turtle Lake and Mercer. At the junction of this first canal course with the Sheyenne River, a storage reservoir will be located in the valley of that stream. At this point would also be located a power drop in the canal. A diversion dam would be located in the Sheyenne River at Wellsburg. A dam and power drop would be located on the James River at Branford, also north of Jamestown. A dam and power drop would also be located on the Sheyenne River seven miles upstream from Lisbon. A lateral diversion would extend to Devils Lake from the James River at New Rockford. A siphon would carry the water across the Sheyenne River Valley on this lateral diversion. Diversion to the lower James River would be made at the dam on the James River north of Jamestown.

A considerable portion of the power for pumping at the place of diversion would be recovered by generating plants at the power drops

along the route of diversion. The storage in the natural lakes and in the reservoirs will provide for increasing the rate of pumping at the place of diversion during periods of greater flow in the Missouri River when the lower cost secondary power is available. By the regulation of these storages in connection with the operation of the project, the secondary power will be converted to firm or year-'round power at the generating plants along the route. It is estimated that the sale of electric power will very largely take care of the construction and operating costs of the project.

Another proposed project contemplates the diversion of Missouri River waters at Bismarck where they will be pumped 180 feet to the top of a high hill just east of the city waterworks plant. Power for this lift will be supplied by a dam in the Missouri River at a suitable location upstream from Bismarck. This dam would also be about 50 feet in height. From the lift-station, the water from the Missouri River would be carried in a canal passing north of the State Capitol and by way of Sterling, Steele, Tappen and Cleveland to the James River just north of Jamestown. Below this point of discharge would be a dam in the James River. From the reservoir created by this dam, Missouri River waters would be carried along a route proposed for the Garrison project to the Sheyenne River at Valley City. Diversion along the Sheyenne River and to the Red River would also be as proposed for the first described project. From this reservoir in the James River, diversion would also be made to Devils Lake by way of Lake Juanita—by way of canal to the Sheyenne River valley—across that valley by means of a siphon to Stump Lake and through Stump Lake and by canal to Devils Lake. Power drops and generating plants would be located at Jamestown and at Valley City where much electric power would be recovered. Extensive irrigation possibilities exist along this route. Diversion to the lower James River would be made at the Jamestown dam. Construction and operating features not specifically mentioned for this project will be similar to those for the Garrison project.

In connection with its Missouri River investigations of irrigation possibilities and in connection with ascertaining the market requirements for low cost electric power to be generated at Fort Peck, the Bureau of Reclamation has also made route surveys of the Missouri River diversion and in connection therewith has made investigations of the irrigable lands along the proposed routes.

A route being investigated by the Bureau of Reclamation and found most favorable to irrigation developments, contemplates the diversion of Missouri River waters at or in the vicinity of Fort Peck reservoir. The original proposal was to divert the waters directly from the reservoir. Later studies indicate that it will be best to divert the waters directly from the Missouri River opposite the town of Nashua and just below the junction of the Milk River with the Missouri River. No pumping would be required at the place of diversion and the waters would be transported easterly in a main gravity canal by way of Wolf Point, Culbertson and

Medicine Lake in Montana and by way of Grenora, Zahl, Crosby and Bowbells to the Upper Des Lacs Lake north of Kenmare. Missouri River waters will then flow in the Des Lacs and Mouse Rivers to a diversion dam in the Mouse River at Verendrye. From this point of diversion the Missouri River waters will be carried in canal and in natural lakes and water courses by way of Balta and Lake Girard to connect with the headwaters of the Sheyenne River near Esmond. They will then flow down the Sheyenne River to the Red River and lateral diversions will be made to Devils Lake and to the James River.

In connection with this proposed project, there are a number of very interesting construction and operating features. Extensive storage will be afforded in the large lake at the town of Medicine Lake. Connected with this lake will be a large storage in the Big Muddy Creek Valley which will extend north to Plentywood. A canal will extend from the lake at Medicine Lake to a point about 2 miles southwest of Grenora, North Dakota. At this point the water being carried eastward will be pumped to a height of 120 feet to the higher bench land. A reservoir of very large capacity will be created in the hilly region along the route of diversion between Zahl and Crosby. A 75-foot power drop will be located at the outlet of this reservoir. It is proposed to use the Upper Des Lacs Lake as a storage reservoir. A 125 foot power drop with generating plant for recovery of power will be located at the place of canal discharge into this lake. This place of discharge will be located near the south end of the lake. These large storages along the route of diversion will make it possible to obtain the most advantageous arrangements for pumping for regulation of flows and for the operation of irrigation developments. It is estimated that the recovery of power at the two drops totaling 200 feet will compensate for the power used at the 120-foot lift.

Adjoining the power drop and generating plant near the south end of the Upper Des Lacs Lake will be located the west end of a siphon which will carry sufficient water across the lake to irrigate the area between the lake and the Mouse River near the international boundary and between the Upper Des Lacs Lake and the Mouse River Valley is a natural depression or saddle and along this valley-like depression a canal will transport the stored Missouri River waters to the Mouse River Valley. Across this valley a siphon will carry the water to the Mouse River Loop for distribution in an irrigation system. The area to be irrigated in the loop will extend east to a line running north of Minot. Seepage and return-flow waters from the irrigated areas will drain to and will be collected in the Des Lacs and Mouse Rivers and will be carried downstream for diversion easterly at Verendrye.

A dam will be constructed in the Sheyenne River near Warwick, North Dakota. The diversions to Devils Lake and to the James Rivers will be made in natural water courses from the reservoir created by this dam. Studies have been made in connection with this project of irrigation possibilities in the vicinity of New Rockford.

The proposed Diversion along this northern route would be a project of immense magnitude. The proposed irrigation developments in connection therewith are comparable to those of the Grand Coulee project. When considered with reference to the many uses which would be made of the diverted waters, it can be said that it would be one of the largest multipurpose projects in the world.

In connection with the Missouri River Diversion Project, two projects are proposed which can be considered as extensions to a Main Diversion Plan. These two projects are the Goose River Diversion and the James River-Lake Traverse Diversion. Of course, these projects would be constructed only in case the main diversion project were constructed.

The Goose River Diversion contemplates the diversion of Missouri River waters from Stump Lake to the Goose River. At the east side of Stump Lake the waters would be pumped to a height of about 50 feet to the higher ground adjoining the lake. The waters would then be carried by canal in the headwaters drainage of the Goose River to a well defined channel of that stream where it would flow throughout its course to its junction with the Red River of the North. This diversion would be for the purpose of making available additional water supplies to farmers and municipalities. Very severe water shortage conditions exist for the cities of Mayville and Hillsboro. The State Water Conservation Commission has made surveys and investigations of this project. This proposed diversion is shown on a map attached to this report. The cities of Portland, Mayville and Hillsboro in Traill County have submitted briefs to the Board of Review setting forth the benefits to be derived from the construction of the project.

Adequate water supply would decrease wildfowl losses from botulism.

The James River-Lake Traverse Project contemplates the diversion of Missouri River waters from the James River at a point about two miles north of the town of Oakes. At this point the waters will be lifted a height of about 20 feet to the top of the east bank of the James River. The waters would then be carried in a canal easterly and southerly by way of Crete, Stirum and to the west of Cogswell to the headwaters of a drainage to Lake Tewaukon and in a natural water-course in that drainage to Lake Tewaukon. From Lake Tewaukon, the diverted waters would flow in the Wild Rice River to a point north of the town of Geneseo. The waters would then be carried by canal southeasterly through a series of lakes which lie southwesterly from the town of Hankinson. The canal would then continue to the South Dakota border at a point north of the town of New Effington, South Dakota. The diversion would then follow the Big Coulee drainage in South Dakota to Lake Traverse. The North Dakota State Water Conservation Commission has also made surveys and investigations of this project. This James River-Lake Traverse Project would be for the purposes of lake restoration, recreation, agricultural and municipal uses, the propagation of fish and wild life, wild-life refuges and small-scale irrigation developments. Purposes of much significance would be the restoration of Lake Tewaukon — providing a supplemental water supply to Lake Traverse and insuring a dependable water supply to the cities of Wahpeton, North Dakota, and Breckenridge, Minnesota. A statement has been submitted to the Board of Review by State Senator Wm. J. Braun of Wahpeton, which sets forth in detail the benefits to be derived from the project. The route of this proposed diversion is also shown on a map attached to this biennial report.

It has been recognized throughout the nation that the Great Plains area is necessary to our economic structure. The territory to be benefited by the Missouri River Diversion is a part of the Great Plains area and the Diversion Project must be considered a definite and an integral part of the program for the rehabilitation of that area. The fundamental need of this portion of the larger drouth stricken area is a supplemental water supply. The Missouri River Diversion will supply that need.

The proponents of the divergent interests—navigation, irrigation and power development, are pressing for final determinations with respect to the use of Missouri River waters. North Dakota will contend most vigorously that an equitable share of these waters will be allotted for its needs, including the Missouri River Diversion requirements.

Of special significance is the endorsement of the project by the National Rivers and Harbors Congress and by the National Wild Life Federation. Reference is made to remarks by the Hon. Joseph J. Mansfield, chairman of the Committee on Rivers and Harbors of the House of Representatives, made in Congress on January 3, 1939. In his remarks, Congressman Mansfield outlined the main features of the Missouri River Diversion Project and of the benefits to be derived therefrom. It is the feeling of many that the project is approaching the stage when it should

become more widely known and it is expected that hereafter, the Proposed Diversion will be a subject for frequent discussions in Congress.

The Board of Review anticipates that its report on a restudy of the Missouri River Diversion Project will be completed in February, 1941. Those who are familiar with the investigations made by the Army Engineers and with the information and data assembled feel that the forthcoming report of the Board of Review will be most favorable to the project.

A preliminary engineering report of the proposed plan for the northern, Fort Peck, route has been submitted to the Commissioner of the Bureau of Reclamation. It is known that engineers of the Bureau are impressed with the practicability of the project and it is believed that its further study and consideration will soon result in the undertaking of more detailed investigations.

The needs of the project have been definitely established; federal departments have manifested a more active interest in the project; present plans provide a means for taking care of the costs of the project; the project has become more definitely a part of the Great Plains Program; the proposed diversion is becoming increasingly of greater nationwide importance and interest and it is very evident that engineers of the federal departments engaged on investigations and studies of the project have been impressed with its feasibility and soundness. In view of these accomplishments and favorable conditions, it can be confidently stated that the Missouri River Diversion has been greatly advanced in status and that good progress is being made in moving it forward to the construction stage.

PUBLIC HEARINGS AND INVESTIGATIONS

MISSOURI RIVER AND TRIBUTARIES

Flood Control on the Missouri River at Bismarck and Mandan:

A public Hearing was held at Bismarck, North Dakota, on July 7, 1939, by the District Engineer, Omaha Office of the War Department, under authority of a resolution, adopted May 2, 1939, by the Committee on Flood Control, House of Representatives of the United States, which authorized a review of the 308 Report of the War Department, with a view to determining whether flood control at Bismarck and Mandan, North Dakota, is advisable at this time.

Testimony was submitted by citizens of Bismarck and Mandan with regard to floods of damaging magnitude in the Missouri River and in the Heart River.

A written statement was submitted by the Chief Engineer of the State Water Conservation Commission and the State Engineer. Included in this statement was a record of: (1) past floods of damaging magnitude, the areas affected, and the amount of damage; (2) existing pro-

tection works and their effect on controlling floods; (3) general and specific proposals for protective measures.

Investigations were made by the War Department for the protection of an irrigable area known as the Bismarck Irrigation Project. A report on this proposed flood protection was made by the War Department to the Bureau of Reclamation. Investigations have also been made with respect to floods and flood control on the Heart River at Mandan. A report on flood conditions in the Heart River and on flood protective works for the City of Mandan will be made in a forthcoming report by the District Engineer.

Missouri River overflowing Highway No. 10 in spring of 1939. Looking west from approach to Memorial Bridge. Note row boat traveling over highway.

Knife River Hearing, Beulah, North Dakota

A Public Hearing was held at Beulah, North Dakota, on October 11, 1939 under provisions of Section 6 of the Flood Control Act, approved August 11, 1939 which authorized a preliminary examination and survey for flood control of the watershed of the Knife River, North Dakota.

At the Hearing, testimony was submitted with respect to the following: (1) A record of past floods of damaging magnitude, the area affected, and the amount of damages; (2) A record of existing protection works and their effect on controlling floods; (3) The nature of protective measures proposed by local interests; (4) Data relative to run-off and water flow retardation and soil erosion prevention.

A written brief was submitted by the Chief Engineer of the State Water Conservation Commission and the State Engineer, in which it was proposed to control the floods on the Knife River in connection with a multi-purpose project involving flood control, irrigation and water conservation. Extensive surveys have been made by the Bureau of Reclamation. This survey shows that about 16,000 acres can be irrigated in the Knife River Basin. This survey by the Bureau of Reclamation will be of great value in connection with the development of a water plan for the basin. Upon completion of the surveys and investigations, a report will be made by the District Engineer.

Missouri River Hearing, Pierre, South Dakota:

A public Hearing was held by the District Engineer of the Omaha Office of the War Department at Pierre, South Dakota, on March 4, 1940, under authority of a resolution adopted January 19, 1940, by the Committee on Rivers and Harbors of the House of Representatives of the United States, which authorizes a review of the report on the Missouri River known as the 308 Report. The Hearing was for the purpose of obtaining views with respect to proposed improvements on and along the Missouri River. Included in the matters discussed and included in written briefs were the construction of a dam on the Missouri River in South Dakota; the generation of electric power and the development by irrigation of bottom lands along the Missouri River. The review is also with a view to determining the desirability of improving the river in South Dakota to make power available for developing deposits of manganese and other strategic minerals.

A written brief was submitted by the Chief Engineer of the North Dakota State Water Conservation Commission and the State Engineer. It was pointed out in the statements by its engineers that North Dakota was interested in obtaining low cost power for irrigation, for rural electrification, for municipal use and for industrial development. It was urged that a large storage reservoir be created by the construction of a dam on the Missouri River in South Dakota which would provide re-regulation of the stream for navigation downstream and permit the development of the upstream areas for irrigation, diversion and other purposes.

Hearing on Heart River and Grand River

During the summer of 1940 a Hearing was held at Washington, D. C., by the Board of Engineers for Rivers and Harbors on the War Department investigations of the Heart River and the Grand River in North Dakota. A written brief was submitted by Mr. C. F. Kelsch, Assistant Attorney General, who represented the North Dakota State Water Conservation Commission. Members of Congress from North Dakota made representations at the Hearing.

The Souris (Mouse) River Reference

The Souris (Mouse) River, an international stream located in the Hudson Bay drainage area, has its source in the region northwest of

Weyburn, Saskatchewan. It flows in a southeasterly direction about 170 miles when it crosses the international boundary into the State of North Dakota. The River then flows southeasterly for about 80 miles by way of Minot to the town of Velva where it turns northerly to Canada, again crossing the international boundary at a point about 45 miles east of its entrance into the United States. It then flows through the Province of Manitoba to join the Assiniboine River near the town of Wawanesa. The Assiniboine River joins the Red River of the North at Winnipeg.

Following a series of drouth years in the Souris River Basin during which there were severe water shortage conditions in that basin and depleted flows in the Souris River, the Province of Manitoba, in December 1939, initiated the Souris (Mouse) River Reference. It was contended by the Province of Manitoba that these depleted flows of the Souris River in Manitoba were largely due to water storages along the stream in the Province of Saskatchewan and in the State of North Dakota.

Under date of January 15th, 1940, the following Reference was communicated by the Governments of the United States and Canada to the International Joint Commission:

"I have the honour to inform you that the Governments of Canada and the United States have agreed to refer to the International Joint Commission, under the provisions of Article 9 of the Boundary Waters Treaty, 1909, for investigation, report, and recommendation, the following questions with respect to the waters of the Souris (Mouse) River and its tributaries which cross the International boundary from the Province of Saskatchewan to the State of North Dakota and from the State of North Dakota to the Province of Manitoba.

"**Question 1.** In order to secure the interests of the inhabitants of Canada and the United States in the Souris (Mouse) River drainage basin, what apportionment should be made of the waters of the Souris (Mouse) River and its tributaries, the waters of which cross the international boundary, to the Province of Saskatchewan, the State of North Dakota, and the Province of Manitoba?

"**Question 2.** What methods of control and operation would be feasible and desirable in order to regulate and use the flow of the waters of the Souris (Mouse) River and its tributaries, the waters of which cross the International boundary, in accordance with the apportionment recommended in the answer to Question 1?

"**Question 3.** Pending a final answer to Questions 1 and 2, what interim measures of regime should be adopted to secure the foregoing objects?

"To assist the Commission in obtaining any information it may desire in the course of its investigation, the two Governments have nominated from their technical services the following

group of engineers, who are familiar with the problems on both sides of the border, and representative of the various interests.

Mr. S. H. McCrory—Assistant Chief, Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture, Washington, D. C.

Mr. Brice McBride—Hydraulic Engineer, Bureau of Biological Survey, Department of the Interior, Washington, D. C.

Mr. E. J. Thomas—Chairman of the Group of Engineers representing the United States, State Engineer of the State of North Dakota, Bismarck, North Dakota.

Mr. C. J. McGavin—Chief Engineer, Water Rights Branch, Department of Natural Resources, Regina, Saskatchewan.

Mr. D. M. Stephens—Deputy Minister, Department of Mines and Natural Resources, Winnipeg, Manitoba.

Mr. Victor Meek—Chairman of the Group of Engineers representing Canada, Assistant Controller, Dominion Water and Power Bureau, Department of Mines and Resources, Ottawa, Canada.

In view of the conditions obtaining in the Souris River watershed, I request that early consideration be given to Question 3, with a view to the consideration of the possibility of recommending interim measures to relieve the present situation."

Briefly, the objects of the Reference are the satisfactory regulation and equitable apportionment of the waters of the Souris (Mouse) River. The Governments involved in the solution of the problem are the Dominion of Canada, the United States of America, the Provinces of Saskatchewan and Manitoba and the State of North Dakota.

The International Joint Commission is a body created under the provisions of the Boundary Waters Treaty of 1909. Its present members are: For Canada—Mr. Charles Stewart, Chairman; Mr. Geo. W. Kyte and Mr. J. E. Perrault. For the United States—Mr. A. O. Stanley, Mr. Roger B. McWharter and Mr. R. Walton Moore. Before being members of the Commission, all had a record of distinguished public service.

In the meantime, the International Joint Commission held an executive session in Washington, D. C., on February 21 and 22, 1940. At this meeting the engineers were duly appointed by the Commission. Arrangements were made for a Conference with the engineers at Washington on April 2 and recommendations were adopted that steps be taken by the two Governments to ensure that no new works be undertaken, and that existing temporary arrangements for the passage of water be continued until after the Commission had adopted its report.

At about the same time the engineers for the two Governments met in St. Paul, Minnesota, when procedure for assisting the Commission

was outlined. Arrangements were made at this meeting for a joint assembling and compilation of stream-flow records on the Souris (Mouse) River in the United States and in Canada by the District Engineer of the United States Geological Survey at St. Paul and the District Engineer of the Dominion Water and Power Bureau at Winnipeg. An outline for the factual data reports to be presented to the Commission was adopted.

As previously arranged, the engineers met with the International Joint Commission at its office in Washington April 2. At this conference the engineers made a report to the Commission of the proceedings at the St. Paul meeting and discussed with the Commissioners the nature and scope of the investigation and how it might most successfully be carried out. The discussions were continued on April 3, when a tentative schedule was adopted for the time of completion of reports, for the making of field inspections and for the holding of Hearings. Good progress was reported on the compilation of stream-flow records.

All reports were completed about May 15, 1940, and were made available to the members of the Commission and to each of the engineers of the two Governments. Following a study of these reports the engineers made a field inspection of the watershed, the same being with particular reference to the existing conservation and regulation works in the Souris (Mouse) River.

A conference was held by the engineers assisting the Commission at Winnipeg on June 17th, at which various phases of the problem were discussed. These discussions included a clarification of matters in the reports, the order and method of presenting the reports to the Commission and the general principles which would govern in the apportionment of the waters.

On June 18th and 19th, 1940, the engineers met with the International Joint Commission at Winnipeg. The stream-flow and factual data reports were formally presented to the Commission. An oral summary and explanations were made for each of the reports. Progress was made at this meeting in approaching a basis for a temporary solution of the problem.

Following the meetings at Winnipeg, hearings were held by the Commission at Melita, Manitoba, on June 20th, at Minot, North Dakota on June 22nd, and at Estevan, Saskatchewan on June 24th. A large number of citizens of Manitoba, North Dakota and Saskatchewan attended these hearings and presented testimony with respect to water supply conditions in the Souris (Mouse) River and its tributaries. In addition to the State Engineer, the State of North Dakota was represented at hearings by Mr. Sivert W. Thompson, a member of the State Water Conservation Commission, by Mr. H. F. McColly, Secretary and Chief Engineer of the State Water Conservation Commission and by Mr. C. F. Kelsch, Assistant Attorney General. Mr. Thompson was the personal representative of the Governor. Legal representatives of the Dominion of Canada and of the United States were present at conferences and attended the hearings.

Much testimony was submitted by local people at the Minot hearing. This was well presented under the leadership of Attorney Halvor L. Halvorson, who represented the Minot Association of Commerce.

At Regina, Saskatchewan, on June 25th, the engineers assisting the Commission went into executive session and discussed at length various matters in connection with the problem. A report was prepared recommending interim measures and an apportionment of the waters to the Province of Saskatchewan.

On June 26th, the engineers met with the International Joint Commission at Regina and presented their report. Members of the Commission expressed themselves as pleased with the report and stated that their recommendations to the two Governments would undoubtedly follow very closely those of the engineers.

In the meantime, a report was formulated and recommendations to the Governments of Canada and the United States were made with respect to the Souris (Mouse) River Reference, which report was formerly approved by the International Joint Commission at its meeting in Ottawa, Canada, on October 2, 1940. In the report, no apportionment of the waters was made for the Province of Saskatchewan. Otherwise, the recommendations in the report as was suggested at the Regina meeting follow closely the recommendations of the engineers.

The report of the International Joint Commission on the Souris River investigation is composed of the following entitled Sections: I. Reference; II. History of Legislation and Projects; III. Description of Watershed; IV. Summary of Investigation; V. Engineering Reports; VI. Conclusions; VII. Recommendations.

The report is somewhat lengthy and only Section VII is here set forth:

Recommendations

"In view of the incompleteness of available stream flow data, it is the judgment of the Commission that no permanent method of control and operation designed to regulate the flow and use of the waters of the Souris River and its tributaries should be adopted at this time. Flow measurements now being obtained are superior to those obtained prior to the present drought cycle both as to standard of accuracy and continuous gaugings at critical points. By 1945 available flow records should be much more dependable and informative.

The Commission deems it advisable to continue the investigation of the principal questions embodied in the Reference for such period of time as may be found necessary, and in the conduct thereof to avail itself of such technical service and advice as it may require. The Commission proposes to appoint a joint board of engineers consisting of two members, one to be drawn from the public service of the United States and one from the public service of Canada, to be officially designated as the Inter-

national Souris Board of Control; the Board to be charged, during the intervening period prior to the adoption of permanent measures, with the responsibility of ensuring compliance with the interim measures set out hereinafter, and of submitting to the Commission regular semi-annual reports and also such special reports as the Commission may require, or the Board in its discretion may desire to file. In event of disagreement between members of the Board, the matters in controversy shall be referred to the Commission for decision.

The Commission recommends interim measures, pending permanent settlement of the questions presented in the Reference, as follows:

1. The Province of Saskatchewan shall be permitted to continue its present use of the waters of the Souris River, and, in addition, to construct a reservoir with usable capacity not exceeding 4,000 acre feet, for the purpose of providing an adequate water supply for the town of Weyburn and the Mental Hospital at Weyburn.

2. The State of North Dakota shall be permitted to continue its present use of the waters of the Souris River, and in addition, to construct a small reservoir on Long Creek, with capacity of 200 acre feet, to provide an adequate water supply for the town of Crosby, North Dakota.

3. A regulated flow of not less than 10 cubic feet per second shall be released from the State of North Dakota to the Province of Manitoba during the months of June, July, August, September and October of each year.

In the event that the State of North Dakota or the Provinces of Saskatchewan or Manitoba should desire to construct any additional storage works, or otherwise make additional use of the waters of the Souris river basin, application shall be made to the International Joint Commission for authority to construct the desired storage works or otherwise to make use of additional waters.

The interim measures for which provision is hereinbefore made shall remain in effect unless subsequently qualified or modified by the Commission prior to the adoption of permanent measures in accordance with the requirements of "Questions (1) and (2) of the Reference."

YELLOWSTONE RIVER BASIN COMPACT

It became apparent in recent years that the shortage of waters in the Yellowstone River Basin for taking care of the present and potentially large acreage of irrigable lands within that basin was a most serious problem.

This basin lies almost entirely within the states of Montana and Wyoming, a small portion being within the State of North Dakota. Recognizing the need for a division of the waters of the basin between the states

of Montana and Wyoming, these states entered into a compact for the division of such waters, which was approved by the Congress of the United States on August 2, 1937. This interstate compact and its approval by Congress provided for the establishment of a Yellowstone River Basin Compact Commission. It further provided that the compact should be consummated not later than June 1, 1939, and that it would become binding when approved by the legislatures of the States and by the Congress of the United States. Pursuant to this authorization, each State appointed a member on the Compact Commission to represent its interests.

The first meeting of the Yellowstone River Compact Commission was held at Billings, Montana, on May 5, 1938. It was called for the purpose of adopting a program of procedure and for initiating the compilation of the basic factual data required for the Commission's consideration in negotiating the Compact. At a later Commission meeting held in Thermopolis, Wyoming, on November 21 and 22, 1938, the Commission reported that it would be impossible to secure information necessary for drafting and negotiating the compact within the time set in the Act. Based on this report, Congress amended the original Act so as to provide for the inclusion of the State of North Dakota as a signatory to the Compact and extended the time for the negotiation and completion of the Compact until June 1, 1943.

AN ACT

Granting the consent of Congress to the States of Montana, North Dakota, and Wyoming to negotiate and enter into a compact or agreement for division of the waters of the Yellowstone River.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of Congress approved August 2, 1937 (50 Stat. 551), granting the consent of Congress to the States of Montana and Wyoming to negotiate and enter into a compact or agreement for division of the waters of the Yellowstone River, be, and it is hereby amended to provide that the consent of Congress is given to the State of North Dakota to negotiate and to enter into the compact or agreement therein authorized providing for an equitable division and an apportionment between the States of the water supply of the Yellowstone River and of the streams tributary thereto, upon condition that the representative appointed by the President of the United States under the Act of August 2, 1937, to participate in said negotiations as the representative of the United States and to report to Congress of proceedings and of any compact or agreement entered into, shall continue to represent the United States and to report under this Act: **Provided,** That such Act of August 2, 1937, is amended by striking out "June 1, 1939," and inserting in lieu thereof "June 1, 1943": **Provided,** That such compact or agreement shall not be binding or obligatory upon any of the parties thereto unless and until the same shall have been approved by the legislatures of each of the said States and by the Congress of the United States: **Provided further,** That nothing in this Act shall apply to any waters within

or tributary to the Yellowstone National Park or shall establish any right or interest in or to any lands within the boundaries thereof.

Approved, June 15, 1940.

On August 12, 1940, Governor John Moses appointed Mr. Frank P. Whitney of Dickinson, to represent North Dakota as member on the Yellowstone River Compact Commission and Mr. H. F. McColly, Secretary and Chief Engineer of the North Dakota State Water Conservation Commission as assistant to aid in collection of technical, basic and factual data.

The first meeting of the Compact Commission was held in Billings, Montana, on October 10, 1940. A list of those attending the meeting is as follows:

Name	Organization and Title	Address
Clyde L. Seavey	Member, Federal Power Commission	Washington, D. C.
E. B. Winter	Montana Member, Compact Commission	Miles City, Montana
H. F. McColly	Secretary and Chief Engineer, North Dakota Water Conservation Comm.	Bismarck, N. D.
Frank P. Whitney	N. D. Member, Compact Commission	Dickinson, N. D.
Lt. Col. Wm. M. Hoge	District Engineer, U. S. Engineer Dept.	Omaha, Nebraska
W. G. Sloan	U. S. Bureau of Reclamation	Denver, Colorado
H. M. Tice	Assistant State Engineer	Helena, Montana
J. W. Emmert	Yellowstone National Park	Yellowstone Park
Wesley A. D'Evart	Montana Member, Compact Commission	Wilsall, Montana
E. Walter Hunke	State Supervisor, W.P.A. Research Projects	State College, Bozeman, Montana
O. W. Monson	Montana State College	Bozeman, Montana
Carl G. Krueger	Forest Supervisor, Shoshone National Forest	Cody, Wyoming
Clifford H. Stone	National Resources Planning Board	Denver, Colorado
L. A. Campbell	Forest Service, Region 1	Missoula, Montana
Walter L. Schipull	Forest Service, Region 2	Denver, Colorado
Fred E. Buck	Secretary, Montana State Planning Board	Helena, Montana
L. C. Bishop	Wyoming State Engineer and Wyoming Interstate Streams Commissioner	Cheyenne, Wyoming
E. B. Donohue	Montana Member, Compact Commission	Helena, Montana
C. J. Dousman	Attorney, Montana Water Board	Helena, Montana
R. G. Lyman	W.P.A. District Supervisor, Water Resources Projects	
Rockwood Brown	Montana Water Board and Member of Compact Commission	Billings, Montana
L. F. Thornton	Member, Wyoming Planning and Water Conservation Board; Member, Compact Commission	Thermopolis, Wyo.
Will G. Metz	Wyoming Member, Compact Commission	Buffalo, Wyoming
Kenneth R. L. Simmons	District Counsel, Indian Service	Billings, Montana
W. S. Hanna	District Engineer, Indian Service	Billings, Montana
J. C. Cory	W.P.A.	Butte, Montana
O. Leon Anderson	Area Conservationist, Soil Conservation Service	Billings, Montana
Edgar Reeves	State Coordinator, Soil Conservation Service	Laramie, Wyoming
L. S. Wing	Federal Power Commission	Denver, Colorado
H. O. Caperton	Federal Power Commission	Denver, Colorado

It will be noted that in addition to the members of the Compact Commission, there were present a large number of representatives from the states of Montana and Wyoming and of federal departments who are actively interested in the proceedings of the Compact Commission.

Formation and discussion of policies were presented for drafting the Compact, and all basic, technical and factual data submitted outlining progress of surveys, plans and studies for development of storage as prepared by the Federal Power Commission, U. S. Army Engineers, U. S. Bureau of Reclamation, U. S. Indian Service, State Engineers of Montana and Wyoming and the Montana State Water Conservation Board. It was agreed that the Federal Power Commission should submit to each State copies of the report. Such data as are now available have been compiled by the Federal Power Commission.

In previous reports of the Wyoming and Montana Compact Commission, before North Dakota became a signatory to the Compact, estimates were prepared showing the amount of lands in the drainage area of the Yellowstone River Basin under irrigation and potential developments of the Yellowstone River Basin as follows:

	Average Area Irrigated 1930-1938	Irrigable Area Present Systems	Ultimate Irrigable Area
Wyoming	457,205	621,615	1,137,330
Montana	422,352	514,857	1,058,135
North Dakota	15,400	21,080	24,740
Total Yellowstone Basin	894,957	1,157,552	2,220,205

Following is list of irrigation projects showing present development and ultimate irrigable areas in North Dakota in the Yellowstone River Basin:

Name of Project	Irrigated Area	Irrigable Area Under Present System	Ultimate Irrigable Area
Main Stem	15,400	21,030	24,240
Sioux Irrigation District	650	1,030	1,300
Lower Yellowstone Project	14,750	20,000	20,000
Cartwright Irrigation Dist.	0	0	840
Yellowstone Pumping Irrig. District	0	0	2,100
Tributaries	10	50	500
Frank Lassey Ditch	10	50	50
Jackson Bros. Ditch	0	0	100
F. T. Martell Ditch	0	0	200
Potential Projects			150
Total North Dakota	15,400	21,080	24,740

DRAINAGE AREA OF THE YELLOWSTONE RIVER BASIN

Sub-Basin	DRAINAGE AREA (Square Miles) Wyoming	Montana	North Dakota	Total
Yellowstone (Main Stem)	2,162	22,852	740	25,754
Clark Fork	1,184	1,664	.....	2,848
Big Horn	18,259	4,683	.....	22,942
Tongue	1,645	3,796	.....	5,441
Powder	9,710	3,705	.....	13,415
Total	32,960	36,700	740	70,400

The Yellowstone River contributes approximately 60 per cent of the water in the Missouri River at Williston. North Dakota is using water from the Missouri River on the Lewis and Clark Project and will be irrigating over 5,000 acres. In addition, there are a number of small individual projects operating along the Missouri River as it passes through the State.

Surveys were made during 1939 by the U. S. Bureau of Reclamation of the Missouri River bottom lands showing a potential area of over 200,000 acres of rich agricultural lands suitable for irrigation development, divided into projects of variable sizes, ranging from 1,000 to 20,000 acres. Surveys and studies of the proposed Missouri River Diversion Project for replenishing the water supply and restoration of Devils Lake, also supplementing flows in the Sheyenne, the Red and the James Rivers have been made by the State of North Dakota, U. S. Army Engineers and U. S. Bureau of Reclamation. Those reports and investigations have shown the feasibility and needs of this project.

Any negotiations by the Compact Commission should not only consider all present and potential uses and rights involved in the Yellowstone River Basin but also those along the main stem of the Missouri River below the confluence of the two rivers where other interests will be affected as a result of the diversion of water from the Yellowstone River which contributes the greater portion of the flow in the main stem of the Missouri River below the point of confluence. It is the contention of North Dakota that in addition to its uses of water along the Yellowstone River, it is also entitled to an equitable apportionment of Yellowstone River waters flowing in the Missouri River through the state for use in irrigating the large acreages of Missouri River bottom lands and for diverting into central and eastern North Dakota by means of the Missouri River Diversion Project.

LITTLE MISSOURI RIVER COMPACT

The consent of Congress has been granted to the states of Montana, North Dakota, South Dakota and Wyoming to negotiate and enter into a compact or agreement for division of the waters of the Little Missouri

River. *The following are the provisions of the Act granting consent of* Congress:

> "Be is enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That consent of Congress is hereby given to the States of Montana, North Dakota, South Dakota, and Wyoming to negotiate and enter into a compact or agreement not later than January 1, 1943, *providing for an equitable division and apportionment* among the States of the water supply of the Little Missouri River and of the streams tributary thereto, upon conditions that one suitable person, who shall be appointed by the President of the United States, shall participate in said negotiations as the representative of the United States and shall make report to Congress of the proceedings and of any compact or agreement entered into: PROVIDED, That any such compact or agreement shall not be binding or obligatory upon any of the parties thereto unless and until the same shall have been approved by the legislature of each of said States and by the Congress of the United States."

This Act was approved June 13, 1940. No action with respect to this compact has yet been taken by the four states. It is estimated that there are 24,000 acres of irrigable lands along the Little Missouri River in North Dakota. The equitable apportionment of the waters of this stream is a highly complicated problem and it is most important that this state be allotted its equitable share of the waters for irrigation and for general agricultural purposes. Inasmuch as the consent of Congress provides for negotiating and entering into the compact not later than January 1, 1943, members of the Compact Commission for each of the states should be appointed at once so that work can be started on the assembling and compilation of data.

PROPOSED MISSOURI RIVER BASIN COMPACT

In connection with the division of the waters of the Missouri River Basin for various purposes including irrigation, navigation, power development, diversion, and municipal supplies, the interests involved are pressing for a final determination for the division of the waters of the entire basin and feel that in such apportionment, the basin should be considered as a whole. All of the states involved are interested in storage and regulated flows, also in water supplies for municipal use.

The States of Montana and Wyoming are interested in power development and irrigation. The State of North Dakota is interested in irrigation, power development and diversion. South Dakota is interested in irrigation, navigation, power development and diversion. The States of Nebraska and Kansas are interested in navigation and irrigation. The States of Iowa and Missouri are interested in navigation.

Federal Departments including the War Department, the Department of the Interior, the Department of Agriculture and the Federal Power

Commission are known to be anxious for a final determination as to the apportionment of Missouri River waters for their uses.

Consideration is being given to the initiating of a movement for negotiating and entering into a compact by all the states in the basin. It is proposed to call a meeting of representatives of the several states and the federal departments involved to discuss the matter and to formulate a plan of procedure.

PROPOSAL OF COMPACT FOR THE GRAND RIVER

Reclamation projects are proposed along the Grand River in South Dakota and in North Dakota. Before undertaking the construction of projects along this interstate stream, a compact should be negotiated and entered into by the States of South Dakota and North Dakota.

WATER CONSERVATION MAP OF THE STATE

Attention is called to the large map, folded into the back of this publication, which gives information on all water conservation projects that are developed, proposed or potential. The table giving the status of irrigation projects has the projects numbered, and those that are still operating will be found on the map with the same identifying number. The location of existing dams that are being repaired may also be found. Proposed diversion routes are indicated and also the possibilities of well irrigation developments. Indication is made in most cases as to the agency that constructed or aided in the construction of the project.

WATER RIGHT FILINGS

From December, 1938 to December, 1940

Twenty-eight water right filings were made by the State Water Conservation Commission and the State Engineer as shown in the following tabulations:

State Water Conservation Commission Water Filings

Proj. No.	Name of Applicant	Lands to Be Irrigated	Source of Supply	Amount of Water Claimed in Second Feet	No. of Acres	Date of Claim
220	Cedar River Mutual Aid Corporation (Westphal)	Parts of Sec. 2-133-89	Cedar River	.23	18	Dec. 13, 1939
211	Cedar River Mutual Aid Corporation (Halverson)	Parts of Sec. 28-130-86	Cedar River	0.30	24	Dec. 13, 1939
194	Cedar River Mutual Aid Corporation (Palmer-Steiner)	Parts of Sec. 10-129-88	Cedar River	.25	20	Dec. 13, 1939
179	Cedar River Mutual Aid Corporation (Knoke)	Parts of Sec. 34-130-89	Cedar River	.25	20	Dec. 13, 1939
210	Cedar River Mutual Aid Corporation (Jahnel-Wallace)	Parts of Sec. 29-130-90	Cedar River	.19	15	Dec. 14, 1939
220	Harold Beyers (Supplement)	Parts of Sec. 33-130-89	Cedar River	.025	2	Dec. 14, 1939
187	Blackhawk Gardens, Incorporated	Parts of Sec. 8 and 17, Twp. 130, Range 85	Cedar River	0.375	30	April 19, 1940
175	Lewis & Clark	Parts of Township 153-101	Missouri River	75	5,000	May 9, 1939
165	Grafton State School	Parts of Sec. 13-157-58	Park River	0.125	10	Nov. 15, 1939
213	Sioux Irrigation District	Parts of Sec. 1, 2, 11, 12, 13 and 14-151-104	Yellowstone River	15	1,000	May 9, 1939
214	Yellowstone Pumping Irrigation District	Parts of Sec. 5 and 6, Twp. 149, Range 104, and parts of Sections 19, 20, 21, 28, 29, 30, 31 and 32-150-104	Yellowstone River	25.0 4525 Acre Feet Annual Diversion	1,810	July 25, 1940

NOTE: Annual Diversion granted 2 acre feet per acre except as stated.

State Engineer Water Right Filings

No.	Name of Applicant	Lands to Be Irrigated	Source of Supply	Amount of Water Claimed in Second Feet	No. of Acres	Date of Claim
227	L. A. Corey	Parts of Sec. 11 and 12-153-81	Mouse River	0.75	60	Aug. 9, 1939
228	Carl Krause, Village Clerk of Neche	No Irrigation. Reservoir in Sec. 31-164-53 for village purposes	Pembina River	0.10 72 Acre-feet Annually	Reservoir Capacity 45 Ac.-Ft.	April 17, 1939
229	John Otheim, Pres., Park Board of Crosby	No Irrigation. Storage for recreation by means of dam in Sec. 5-163-97	Long Creek	165 Acre-feet Annually	Reservoir Capacity 165 Ac.-Ft.	Oct. 2, 1939
230	Albert N. Winge	Parts of Sec. 26-152-91	Shell Creek	.10	7.7	May 27, 1939
231	Katz Estate	Parts of Sec. 4-143-81	Painted Woods Creek	.625	50	Oct. 2, 1939
232	Edith L. Brown	Parts of Sec. 5-138-51 and Sec. 32-139-51	Maple River	2.03	162.7	Nov. 9, 1939
233	W. S. Pesheck	Parts of Sec. 21-144-102	Little Missouri River	0.42	33.52	Jan. 10, 1940
234	Minot Country Club	Parts of Sec. 7-155-83	Mouse River	1.5 250 Acre-feet Annually	169.81	Jan. 29, 1940
235	A. L. Eggert	Parts of Sec. 11 and 12-139-51	Maple River	3 160 Acre-feet Annually	160	Jan. 3, 1940
236	Emil Piper	Parts of Sec. 18 and 19-138-51	Maple River	2 160 Acre-feet Annually	160	Jan. 27, 1940
237	Frank Lynch Estate	Parts of Sec. 28-139-51	Maple River	2 160 Acre-feet Annually	160	Feb. 2, 1940

238	Allan H. Houd	Parts of Sec. 18-138-51	Maple River	1.5 120.6 Acre-feet Annually	120.6	Feb. 20, 1940
239	Mandan Park Board	Parts of Sec. 33 and 34-139-81	Heart River	134 Acre-feet Annually	67	April 16, 1940
240	E. R. Fritch	Parts of Sec. 28 and 29, Township 140, Range 58	Sheyenne River	0.31 37.5 Acre-feet Annually	25	March 30, 1940
241	Ruth Ackerson (Mrs.)	Parts of Sec. 9-136-49	Wild Rice River	0.5 40-Acre-feet Annually	40.7	July 15, 1940
242	Arthur Leno	Parts of Sec. 9-133-91	Cannonball River	0.37	30	June 15, 1940
243	William Oelke	Parts of Sec. 8-133-90	Cannonball River	0.34	27	March 15, 1940

Note: The annual diversion permitted is two acre-feet per acre unless otherwise shown.

ACTIVITIES OF THE U. S. GEOLOGICAL SURVEY IN NORTH DAKOTA

The Geological Survey has been co-operating with the State Geologist in making underground water investigations and studies of the Red and James River Valleys, to determine the possibilities of water for municipal, industrial and irrigation uses. The U. S. Geological Survey is co-operating with the City of Fargo on investigations for a ground water supply to supplement its municipal and industrial needs.

The topographic mapping division has been making surveys along the International Boundary in Pembina County and has completed the Heart Butte Quadrangle in Grant and Morton Counties.

The hydrographic branch has been co-operating with the State Engineer, the Tri-State Waters Commission and the State Water Conservation Commission on stream gaging, water supply investigations and records. A detailed statement is made with respect to co-operation on stream gaging in connection with tabulations of stream flow records.

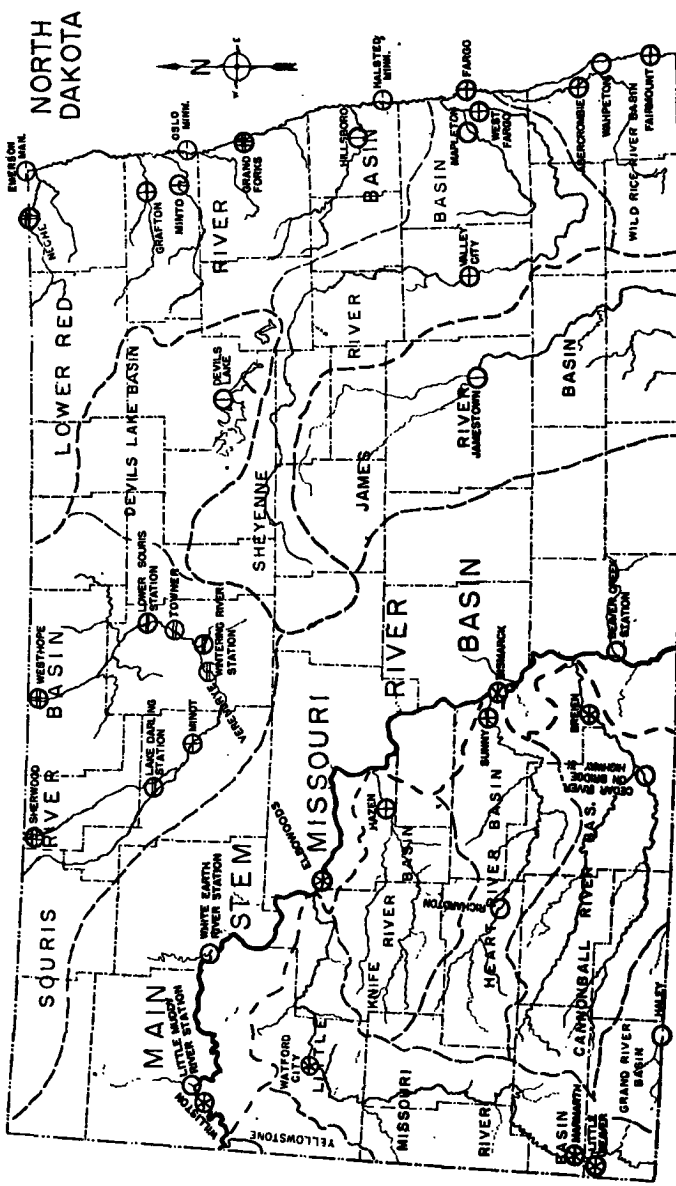
STREAM-FLOW MEASUREMENTS

The Office of State Engineer and the State Water Conservation Commission are the departments of state government which have as one of their functions the obtaining of information and data relating to the flow of streams.

This work is done in cooperation with the Water Resources Branch of the United States Geological Survey. The Office of State Engineer is the State cooperating agency. These data are published in Water Supply Papers of the U. S. Geological Survey and in state reports so that they will be properly recorded and made available to those concerned with problems of water supply, use and control. All stream flow data compiled up to September 30th, 1937, have been previously published in state reports. Cooperation of the State of North Dakota with the U. S. Geological Survey, is on the basis of equal contribution. Included in this report and following this discussion is a map showing existing and proposed stream gaging stations in North Dakota.

It will be noted on this map that in addition to the stations on which the state cooperates, there are a number of stations on which federal departments including the War Department, the U. S. Department of State, and the U. S. Fish and Wildlife Service (formerly the U. S. Biological Survey) cooperate with the U. S. Geological Survey. The interests of the War Department are involved in activities pertaining to the improvement of navigation and control of floods while the interests of the U. S. Department of State are involved in international water problems.

It is becoming more and more apparent that reliable and continuous information of stream flow and of water supply is highly important and



Map showing existing and proposed stream gaging stations.

that it is essential for the solution of many problems relating to the use and control of waters throughout the nation and is involved in local, state, interstate and international projects and interests.

With the liberal 50-50 basis for cooperation offered by the United States Geological Survey, it is very much to the advantage of the state to make its contribution as large as possible. With the granting of additional water rights, it is becoming increasingly more necessary to expand our program of stream flow measurements. International and interstate compacts are now under consideration. Others will be considered later. In the consideration and formulation of the provisions of these compacts, it is most necessary that stream flow data be available.

It has been recognized for some time that throughout the nation the need existed for rehabilitating and replacing inefficient equipment of river gaging stations beyond the scope of funds available from regular sources. To take care of this need, there was obtained from the Public Works Administration large sums to be used for this purpose in the entire nation. There was allotted for North Dakota the sum of $6,000. During the last two years there have been constructed in the state with these funds and without state contribution, a number of automatic recording gaging stations and needed improvements and repairs have been made at other stations. These new recording stations, improvements and repairs contribute to a more accurate collection of important basic information concerning the water supply in the State.

Data on stream flow are compiled by climatic years which begin on October 1st. The data compiled for North Dakota for the years 1938 and 1939 are shown in Tables 1 to 30.

TABLE No. 1 MONTHLY DISCHARGE OF MISSOURI RIVER AT WILLISTON, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	19,600	8,880	11,580	711,900
November	9,540	5,190	7,809	464,600
December	6,270	2,820	4,821	296,400
January	8,280	5,190	6,815	419,000
February	5,400	3,240	4,579	254,300
March	.....	.....	32,620	2,005,000
April	12,300	7,100	10,250	609,800
May	36,100	8,950	16,820	1,034,000
June	86,200	41,400	55,560	3,306,000
July	106,000	28,100	52,240	3,212,000
August	29,200	18,900	22,480	1,382,000
September	35,000	18,300	21,030	1,252,000
Totals				14,947,000

Maximum Stage 18.22, Mar. 14. Discharge 106,000 Cfs. July 6.
Minimum Stage 1.60, Nov. 18. Discharge 2,660 Cfs. Dec. 18.
Drainage Area 164,500 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	25,100	9,030	13,780	847,300
November	21,500	10,200	17,290	1,029,000
December	15,300	8,830	11,750	722,600
January	13,800	7,930	10,500	645,600
February	8,520	5,240	6,740	374,300
March	128,000	8,520	32,530	2,000,000
April	50,900	18,100	27,210	1,619,000
May	42,200	18,100	33,030	2,031,000
June	56,400	34,100	44,580	2,653,000
July	39,900	12,100	22,700	1,396,000
August	14,200	7,650	11,680	718,400
September	8,420	6,630	7,364	438,200
Totals				14,474,400

Maximum Stage 15.28, Mar. 24. Discharge 152,000 Cfs. Mar. 26.
Minimum Stage 1.94, Sept. 8. Discharge 5,240 Cfs. Feb. 17.

TABLE No. 2 MONTHLY DISCHARGE OF MISSOURI RIVER AT BISMARCK, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	15,300	6,290	10,540	648,300
November	9,430	4,800	7,470	444,500
December	4,720	4,400	4,486	275,900
January	7,350	4,700	6,327	389,100
February	6,200	3,500	4,241	235,500
March	148,000	4,100	31,260	1,922,000
April	20,200	9,100	11,230	668,200
May	28,800	10,900	15,450	949,900
June	85,500	21,800	54,470	3,241,000
July	111,000	30,600	58,020	3,567,000
August	32,600	19,400	23,930	1,472,000
September	28,600	18,900	20,470	1,218,000
Totals				15,031,400

Maximum Stage 19.60, Mar. 19. Discharge 190,000 Cfs.
Minimum Stage 2.65, Oct. 1. Discharge 3,500 Cfs. Feb. 14-16.
Drainage Area 186,400 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	23,100	9,710	15,080	927,300
November	21,000	9,100	15,290	909,800
December	12,700	9,300	10,600	651,800
January	12,100	9,500	10,800	663,900
February	9,100	5,700	7,118	395,300
March	212,000	7,800	35,980	2,213,000
April	73,900	18,400	32,050	1,907,000
May	44,600	18,400	31,580	1,942,000
June	67,000	37,600	47,170	2,807,000
July	47,900	14,800	27,010	1,661,000
August	15,100	10,000	12,760	784,900
September	9,400	7,120	7,833	466,100
Totals				15,329,100

Maximum Stage 21.45, Mar. 28. Discharge 222,000 Cfs.
Minimum Stage 3.15, Sept. 17. Discharge 5,700 Cfs, Feb. 17, 18.

TABLE No. 3 MONTHLY DISCHARGE OF LITTLE MISSOURI RIVER NEAR WATFORD CITY, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	610.0	12.0	87.5	5,380
November	17.0	3.0	8.1	480
December	4.0	0.0	2.5	153
January	0.0	0.0	0.0	0
February	610.0	0.0	34.1	1,890
March	13,800.0	370.0	2,955.0	181,700
April	1,280.0	92.0	309.0	18,410
May	980.0	56.0	310.0	19,070
June	5,640.0	62.0	1,147.0	68,250
July	5,640.0	117.0	1,263.0	77,460
August	1,350.0	16.0	180.0	11,060
September	1,090.0	14.0	252.0	14,970
Totals				399,003

Maximum Stage ..... Discharge 14,600 Cfs. Mar. 15, June 18.
Minimum Stage ..... Discharge 0.0 Cfs. Dec. 31 to Feb. 24.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	298.0	18.0	60.3	3,710
November	22.0	.....	12.3	734
December	12.0	.....	9.32	573
January	.....	0.0	4.03	248
February	0.0	0.0	0.0	0
March	25,500.0	0.0	3,217.0	197,800
April	2,090.0	132.0	428.0	25,450
May	250.0	51.0	106.0	6,530
June	2,010.0	268.0	788.0	46,860
July	4,280.0	106.0	837.0	51,440
August	657.0	26.0	132.0	8,130
September	117.0	6.7	29.2	1,730
Totals				343,205

Maximum Stage ..... Discharge 26,500 Cfs. Mar. 22.
Minimum Stage ..... Discharge 0.0 Cfs.

TABLE No. 4 MONTHLY DISCHARGE OF LITTLE MISSOURI RIVER AT MARMARTH, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 27			
January				
February				
March	.....	.....	60.8	603
April	105.0	19.0	38.4	2,290
May	724.0	25.0	121.0	7,430
June	1,990.0	31.0	397.0	23,630
July	1,250.0	17.0	293.0	18,000
August	121.0	4.0	27.9	1,720
September	780.0	5.0	197.0	11,720
Totals				65,393

Maximum Stage ..... Discharge 3,540 Cfs., June 24.
Minimum Stage ..... Discharge 4 Cfs., Aug. 24.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	18.0	2.8	7.70	474
November	11.0	2.0	5.17	308
December	12.0	0.0	3.87	238
January	0.0	0.0	0.0	0
February	0.0	0.0	0.0	0
March	6,120.0	0.0	1,531.0	94,140
April	600.0	45.0	157.0	9,330
May	233.0	10.0	40.1	2,470
June	1,560.0	54.0	481.0	28,610
July	7,200.0	23.0	676.0	41,590
August	150.0	16.0	45.3	2,780
September	34.0	2.6	7.04	419
Totals				180,359

Maximum Stage 9.70, July 7. Discharge 9,770 Cfs.
Minimum Stage ..... Discharge 0 Cfs. Dec. 18 to Mar. 16.

TABLE No. 5 **MONTHLY DISCHARGE OF KNIFE RIVER AT HAZEN, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	26.0	9.0	16.0	982
November	34.0	14.0	22.2	1,320
December	17.0	4.0	8.14	501
January	11.0	5.0	7.6	468
February	5.0	2.0	3.03	168
March	2,330.0	7.0	482.0	29,650
April	504.0	24.0	70.7	4,210
May	393.0	11.0	86.6	5,330
June	675.0	15.0	185.0	11,030
July	7,420.0	44.0	979.0	60,180
August	1,640.0	31.0	187.0	11,520
September	36.0	28.0	32.3	1,920
Totals				127,279

Maximum Stage 23.00, July 5. Discharge 7,540 Cfs.
Minimum Stage 3.46, Oct. 1. Discharge 2.0 Cfs. Feb. 16-18.
Drainage Area 2,352 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	43.0	20.0	29.5	1,820
November	54.0	15.0	23.7	1,410
December	19.0	14.0	16.7	1,030
January	14.0	13.0	13.3	815
February	13.0	10.0	11.7	651
March	9,180.0	10.0	1,474.0	90,610
April	357.0	90.0	142.0	8,470
May	96.0	54.0	66.7	4,100
June	198.0	44.0	73.8	4,390
July	485.0	27.0	88.0	5,410
August	103.0	22.0	33.0	2,030
September	68.0	15.0	21.8	1,300
Totals				122,036

Maximum Stage 24.47, Mar. 24. Discharge 9,300 Cfs.
Minimum Stage 4.26, Sept. 24, 25. Discharge 10 Cfs. Feb. 26-Mar. 11.

TABLE No. 6 **MONTHLY DISCHARGE OF HEART RIVER NEAR MANDAN, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	13.0	2.0	7.71	474
November	14.0	2.0	6.95	414
December	1.6	0.0	0.21	13
January	0.0	0.0	0.0	0
February	25.0	0.0	0.96	54
March	3,000.0	2.0	709.0	43,610
April	135.0	50.0	79.7	4,740
May	95.0	35.0	49.9	3,070
June	1,700.0	21.0	248.0	14,730
July	9,010.0	114.0	1,695.0	104,200
August	114.0	32.0	64.2	3,950
September	47.0	9.0	23.8	1,420
Totals				176,675

Maximum Stage 16.9, July 7. Discharge 12,200 Cfs.
Minimum Stage 4.45, Oct. 1. Discharge 0 Cfs.
Drainage Area 3,362 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	18.0	9.0	11.8	724
November	22.0	2.0	9.25	550
December	22.0	8.0	12.2	750
January	8.0	1.0	5.36	330
February	0.4	0.0	.02	1.2
March	10,600.0	0.0	1,796.0	110,400
April	722.0	78.0	178.0	10,600
May	78.0	29.0	50.4	3,100
June	132.0	42.0	65.4	3,890
July	268.0	22.0	101.0	6,210
August	22.0	8.0	13.6	837
September	108.0	1.8	10.0	595
Totals				137,987.2

Maximum Stage 23.4, Mar. 22. Discharge 10,600 Cfs. Mar. 23.
Minimum Stage 4.25, Sept. 16, 25, 26. Discharge 0 Cfs.

TABLE No. 7 **MONTHLY DISCHARGE OF CANNONBALL RIVER AT BREIEN, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	22.0	10.0	14.9	914
November	20.0	3.0	10.2	605
December	8.0	5.0	6.45	397
January	7.0	6.0	6.65	409
February	44.0	6.0	7.50	417
March	1,330.0	36.0	374.0	22,990
April	582.0	26.0	72.1	4,290
May	306.0	17.0	44.8	2,750
June	2,740.0	10.0	543.0	32,290
July	4,410.0	89.0	1,206.0	74,160
August	89.0	16.0	39.8	2,450
September	413.0	13.0	55.4	3,300
Totals				144,972

Maximum Stage 8.49, July 9. Discharge 4,850 Cfs.
Minimum Stage .40, Nov. 2. Discharge .7 Cfs.
Drainage Area 4,066 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	12.0	8.0	10.2	627
November	13.0	10.0	11.1	659
December	22.0	1.3	12.1	746
January	4.9	0.9	3.84	236
February	1.0	0.2	.30	17
March	3,280.0	2.3	712.0	43,790
April	493.0	50.0	143.0	8,480
May	83.0	15.0	32.9	2,020
June	1,520.0	17.0	227.0	13,490
July	618.0	12.0	170.0	10,470
August	223.0	0.6	15.2	935
September	51.0	0.7	6.16	367
Totals				81,837

Maximum Stage 9.06, Mar. 22. Discharge 4,520 Cfs.
Minimum Stage 0.34, Aug. 25. Discharge 0.2 Cfs. Feb. 6-22.

TABLE No. 8 **MONTHLY DISCHARGE OF CEDAR CREEK NEAR RALEIGH, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January				
February	STATION ESTABLISHED APRIL 16, 1939			
March				
April				
May				
June				
July				
August				
September				

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	STATION ESTABLISHED APRIL 16, 1939			
January				
February				
March				
April	436.0	18.0	58.1	1,730
May	48.0	2.9	11.9	729
June	285.0	3.6	41.2	2,450
July	285.0	0.6	55.5	3,410
August	1.1	0.0	.16	10
September	0.0	0.0	0.0	0
Totals				8,329

Maximum Stage 7.5, April 25. Discharge 1,380 Cfs.
Minimum Stage 1.52, Sept. 30. Discharge 0.0 Cfs.
Drainage Area 1,720 Sq. Miles.

TABLE No. 9 **MONTHLY DISCHARGE OF SOURIS RIVER NEAR SHERWOOD, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 13			
January				
February				
March	1,030.0	0.0	408.0	25,080
April	452.0	32.0	129.0	7,690
May	60.0	22.0	39.4	2,420
June	22.0	2.5	8.04	478
July	5.2	0.8	2.05	126
August	0.8	0.0	0.31	19
September	0.0	0.0	0.0	0
Totals				35,813

Maximum Stage 10.19, Mar. 20. Discharge 1,040 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	0.0	0.0	0.0	0
November	0.0	0.0	0.0	0
December	0.0	0.0	0.0	0
January	0.0	0.0	0.0	0
February	0.0	0.0	0.0	0
March	2,460.0	0.0	542.0	33,300
April	1,920.0	72.0	560.0	33,350
May	68.0	15.0	35.5	2,180
June	19.0	5.2	9.70	577
July	53.0	3.9	11.8	728
August	4.9	0.2	1.86	115
September	0.2	0.0	.05	2.8
Totals				70,252.8

Maximum Stage 19.08, Mar. 28. Discharge 2,480 Cfs.
Minimum Stage -0.02, Oct. 15. Discharge 0.0 Cfs.

TABLE No. 10 **MONTHLY DISCHARGE OF SOURIS RIVER NEAR FOXHOLM, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 25			
January				
February				
March	184.0	0.0	11.9	732
April	418.0	0.1	96.2	5,730
May	2.2	0.0	.38	24
June	12.0	0.0	1.68	100
July	49.0	0.0	12.7	778
August	43.0	29.0	36.7	2,260
September	92.0	29.0	46.5	2,770
Totals				12,394

Maximum Stage 7.52, Apr. 6. Discharge 464 Cfs. Apr. 5.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area 10,120 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	92.0	0.0	29.0	1,790
November	16.0	0.2	1.90	113
December	7.7	0.6	1.72	106
January	.7	--	0.56	35
February			0.40	22
March	110.0		14.6	900
April	656.0	1.0	363.0	21,600
May	0.8	0.0	0.18	11
June	35.0	0.1	7.38	439
July	0.3	0.0	0.08	4.8
August	0.3	0.0	0.02	1.0
September	0.7	0.0	0.24	14
Totals				25,038.1

Maximum Stage 8.92, Apr. 17. Discharge 663 Cfs.
Minimum Stage 2.06, Aug. 10. Discharge 0.0 Cfs.

TABLE No. 11 **MONTHLY DISCHARGE OF SOURIS RIVER ABOVE MINOT, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH			
January				
February				
March	141.0	0.5	33.8	2,080
April	407.0	0.1	102.0	6,090
May	2.4	0.0	0.41	25
June	0.0	0.0	0.0	0
July	32.0	0.0	5.61	345
August	32.0	27.0	30.5	1,880
September	44.0	24.0	35.2	2,100
Totals				12,520

Maximum Stage 6.00, April 7. Discharge 418 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area 11,280 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	85.0	0.1	29.9	1,840
November	9.0	0.3	.853	51
December	17.0	0.2	3.63	223
January	.....	..	.1	6.1
February	0.0	0.0	0.0	0
March	1,400.0	0.0	164	10,090
April	668.0	5.1	377	22,440
May	11.0	0.2	2.64	162
June	30.0	0.4	6.06	361
July	2.0	0.0	.34	21
August	0.2	0.0	.02	.99
September	0.0	0.0	0.0	0
Totals				35,195.09

Maximum Stage 12.80, Mar. 26. Discharge 1,480 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.

TABLE No. 12 **MONTHLY DISCHARGE OF SOURIS RIVER NEAR VERENDRYE, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH			
January				
February				
March	300.0	17.0	111.0	6,850
April	330.0	12.0	98.0	5,830
May	12.0	3.6	6.80	418
June	3.3	1.4	2.33	138
July	56.0	0.8	7.96	489
August	49.0	0.8	12.8	786
September	27.0	12.0	21.2	1,260
Totals				15,771

Maximum Stage 8.30, Mar. 2. Discharge 342 Cfs. Apr. 10.
Minimum Stage 3.22, Aug. 5. Discharge 0.6 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	76.0	3.9	38.7	2,380
November	4.5	2.4	3.37	201
December	3.6	1.5	2.44	150
January				
February	NO RECORD JANUARY TO MARCH 21			
March	1,200.0	4.8	839.0	18,310
April	662.0	55.0	405.0	24,120
May	52.0	9.6	19.1	1,170
June	25.0	6.0	11.1	657
July	52.0	2.8	8.75	538
August	5.6	1.4	2.35	144
September	1.6	0.4	.81	48
Totals				47,718

Maximum Stage 13.58, Mar. 30. Discharge 1,260 Cfs.
Minimum Stage 3.25, Aug. 6. Discharge 0.4 Cfs. Sept. 29, 30.

TABLE No. 13 MONTHLY DISCHARGE OF SOURIS RIVER NEAR TOWNER, N. DAK.

1937-1938					1938-1939				
	Discharge in Second Feet			Run-off in Acre Feet		Discharge in Second Feet			Run-off in Acre Feet
Month	Maximum	Minimum	Mean		Month	Maximum	Minimum	Mean	
October	4.2	0.5	1.75	90	October				
November					November				
December	NO RECORD NOVEMBER TO MARCH 12				December				
January					January				
February					February				
March	19.0	0.8	5.84	232	March	RECORD NOT YET COMPUTED			
April	5.1	-21.0	0.033	2.0	April				
May	307.0	10.0	36.4	2,240	May				
June	9.5	3.6	6.07	361	June				
July	77.0	3.3	21.5	1,320	July				
August	44.0	1.3	14.5	892	August				
September	23.0	8.1	16.7	996	September				
Totals				6,133					

Maximum Stage 6.73, May 3. Discharge 431 Cfs. May 2.
Minimum Stage ..... Discharge ..... Cfs.
Drainage Area ..... Sq. Miles.

TABLE No. 14 MONTHLY DISCHARGE OF SOURIS RIVER NEAR BANTRY, N. DAK.

1937-1938					1938-1939				
	Discharge in Second Feet			Run-off in Acre Feet		Discharge in Second Feet			Run-off in Acre Feet
Month	Maximum	Minimum	Mean		Month	Maximum	Minimum	Mean	
October					October	98.0	11.0	43.6	2,680
November					November	9.7	3.8	5.58	332
December	NO RECORD OCTOBER TO MARCH 16				December				
January					January	NO RECORD DECEMBER TO MARCH 23			
February					February				
March	60.0	0.0	16.4	1,010	March	240.0	1.0	33.0	590
April	145.0	0.7	7.04	419	April	850.0	283.0	519.0	30,860
May	334.0	36.0	102.0	6,270	May	226.0	18.0	65.8	4,040
June	31.0	4.3	12.3	730	June	23.0	14.0	17.4	1,040
July	59.0	7.6	26.2	1,610	July	19.0	5.5	11.0	675
August	24.0	2.1	8.70	535	August	6.5	0.1	2.01	124
September	16.0	7.0	11.6	690	September	0.1	0.0	.01	.6
Totals				11,264	Totals				40,341.6

Maximum Stage 5.14, May 4. Discharge 338 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area 13,370 Sq. Miles.

Maximum Stage 9.19, Apr. 2. Discharge 866 Cfs. Apr. 4.
Minimum Stage -0.07, Sept. 22. Discharge 0.0 Cfs.

TABLE No. 15 MONTHLY DISCHARGE OF SOURIS RIVER NEAR WESTHOPE, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	NO FLOW OCTOBER TO MARCH			
November				
December				
January				
February				
March	0.8	0.0	0.16	9.7
April	0.3	0.0	0.03	1.6
May	0.0	0.0	0.0	0
June	42.0	0.0	7.46	444
July	0.2	0.0	0.01	0.40
August	20.0	0.0	7.85	483
September	3.2	0.0	0.28	17
Totals				955.70

Maximum Stage 4.25, June 18. Discharge 51 Cfs.
Minimum Stage 0. Discharge 0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	NO FLOW OCTOBER TO MARCH			
November				
December				
January				
February				
March	0.2	0.0	.05	2.8
April	0.3	0.0	.22	13
May	0.2	0.0	.01	.79
June	26.0	0.0	8.46	503
July	0.0	0.0	0.0	0
August	20.0	0.0	4.6	282
September	12.0	0.0	1.19	71
Totals				872.59

Maximum Stage 6.94, Mar 31. Discharge 27.5 Cfs., June 16.
Minimum Stage 2.52, Nov. 15. Discharge 0 Cfs.

TABLE No. 16 MONTHLY DISCHARGE OF WINTERING RIVER NEAR KARLSRUHE, N. DAK. (Souris Tributary)

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	1.5	0.8	1.19	66
November	NO RECORD NOVEMBER TO MARCH			
December				
January				
February				
March	54.0	0.0	15.1	927
April	7.2	2.3	3.92	233
May	3.7	1.6	2.39	147
June	1.6	0.6	1.17	69
July	10.0	0.6	2.47	152
August	3.1	0.1	.95	58
September	0.4	0.1	.19	12
Totals				1,664

Maximum Stage 5.51, March 15. Discharge 66 Cfs., Mar. 17.
Minimum Stage 0. Discharge 0 Cfs.
Drainage Area 675 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	1.3	0.1	.70	43
November	1.6	1.1	1.30	77
December	2.2	--	1.13	70
January	NO RECORD			
February				
March	18.0	3.0	13.9	248
April	16.0	3.8	6.22	370
May	3.8	1.3	2.06	127
June	3.4	0.9	1.92	114
July	1.2	0.0	.53	32
August	1.0	0.0	.33	20
September	0.4	0.0	.07	4
Totals				1,105

Maximum Stage 7.01, Mar. 26-27. Discharge 18 Cfs., Mar. 29.
Minimum Stage 2.25, Sept. 26-27. Discharge 0 Cfs.

TABLE No. 17 — WATER LEVEL ELEVATION — DEVILS LAKE

1937-1938

Month	Elevation
October 26	1,403.81
November	-
December	-
January	-
February	-
March 21	1,403.08
April 15	1,404.00
May 19	1,403.68
June 11	1,403.64
July 2	1,403.64
August 6	1,403.50
September 15	1,402.99

1938-1939

Month	Elevation
October 8	1,402.64
November 21	1,402.14
December	-
January	-
February	-
March	-
April 25	1,402.66
May 8	1,402.21
May 15	1,402.31
June 18	1,402.46
July 25	1,401.86
August 19	1,401.79
September 21	1,401.46

Elev. Bottom of Lake Bed Approx. 1,400—Sea Level Datum.

TABLE No. 18 — MONTHLY DISCHARGE OF RED RIVER AT EMERSON, MANITOBA

1937-1938

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	590.0	244.0	402.0	24,700
November	355.0	160.0	281.0	16,710
December	130.0	48.0	72.0	4,450
January	84.0	34.0	53.0	3,280
February	96.0	60.0	76.0	4,210
March	6,270.0	96.0	1,450.0	89,330
April	3,310.0	768.0	1,280.0	76,280
May	7,530.0	943.0	4,870.0	299,400
June	4,330.0	1,260.0	2,580.0	153,700
July	1,150.0	441.0	855.0	52,560
August	414.0	124.0	218.0	13,370
September	327.0	138.0	193.0	11,510
Totals				749,500

Maximum Stage 758.20, Mar. 27. Discharge 7,530 Cfs. May 20.
Minimum Stage 744.22, Aug. 31. Discharge 34.0 Cfs. Jan. 7.
Drainage Area 34,600 Sq. Miles.

1938-1939

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	250.0	166.0	200.0	12,280
November	300.0	148.0	207.0	12,330
December	215.0	136.0	182.0	11,180
January	270.0	156.0	198.0	12,150
February	287.0	212.0	255.0	14,180
March	499.0	204.0	260.0	15,980
April	6,700.0	555.0	3,720.0	221,200
May	2,460.0	647.0	1,190.0	73,360
June	878.0	520.0	659.0	39,190
July	766.0	275.0	566.0	34,790
August	260.0	118.0	188.0	11,530
September	331.0	123.0	230.0	13,700
Totals				471,870

Maximum Stage 20.20, Apr. 10. Discharge 6,700 Cfs.
Minimum Stage 4.09, Aug. 18. Discharge 118 Cfs.

TABLE No. 19 MONTHLY DISCHARGE OF RED RIVER AT GRAND FORKS, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	484.0	166.0	316.0	19,440
November	336.0	94.0	214.0	12,710
December	95.0	30.0	55.9	3,440
January	91.0	36.0	61.3	3,770
February	113.0	63.0	89.5	4,970
March	4,360.0	106.0	1,309.0	80,480
April	1,880.0	659.0	954.0	56,770
May	6,630.0	1,040.0	4,560.0	280,400
June	3,170.0	927.0	1,990.0	118,500
July	1,150.0	197.0	697.0	42,880
August	271.0	127.0	190.0	11,660
September	392.0	152.0	208.0	12,390
Totals				647,410

Maximum Stage 15.49, May 13. Discharge 6,660, May 12.
Minimum Stage 1.57, Dec. 26-28. Discharge 29 Cfs.
Drainage Area 25,500 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	315.0	147.0	216.0	13,280
November	268.0	140.0	190.0	11,320
December	220.0	150.0	199.0	12,260
January	280.0	180.0	237.0	14,580
February	260.0	170.0	229.0	12,690
March	3,000.0	180.0	455.0	27,950
April	6,500.0	1,560.0	3,126.0	186,000
May	1,600.0	566.0	912.0	56,050
June	1,100.0	450.0	687.0	40,850
July	739.0	155.0	388.0	23,830
August	208.0	68.0	118.0	7,270
September	332.0	115.0	225.0	13,410
Totals				419,490

Maximum Stage 20.13, Apr. 6, 7. Discharge 6,500 Cfs.
Minimum Stage 1.44, Aug. 10. Discharge 60 Cfs.

TABLE No. 20 MONTHLY DISCHARGE OF PEMBINA RIVER AT NECHE, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	5.1	0.1	.81	50
November	0.8	0.2	.36	22
December	0.2	0.1	.17	10
January	0.0	0.0	.0	0
February	0.0	0.0	.0	0
March	630.0	0.0	179	11,030
April	154.0	64.0	101	6,010
May	103.0	55.0	78.3	4,820
June	54.0	22.0	36.6	2,180
July	22.0	.8	12.5	766
August	0.8	0.0	.05	3.2
September	0.0	0.0	0.0	0
Totals				24,891.2

Maximum Stage 7.92, Mar. 20. Discharge 630 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area 2,960 Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	0.0	0.0	0.0	0
November	0.0	0.0	0.0	0
December	0.0	0.0	0.0	0
January	0.0	0.0	0.0	0
February	0.0	0.0	0.0	0
March	0.0	0.0	0.0	0
April	50.0	4.0	24.7	1,470
May	22.0	6.0	11.8	723
June	27.0	4.1	10.8	640
July	5.0	0.0	.60	37
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				2,870

Maximum Stage 6.30, April 4. Discharge 52 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.

TABLE No. 21 **MONTHLY DISCHARGE OF TONGUE RIVER AT CAVALIER, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	STATION ESTABLISHED MARCH 26, 1939			
January				
February				
March				
April				
May				
June				
July				
August				
September				

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	STATION ESTABLISHED MARCH 26, 1939			
January				
February				
March	15.0	0.0	.484	30
April	30.0	5.0	14.2	846
May	6.1	1.4	2.87	177
June	4.0	0.5	1.28	76
July	0.6	0.0	.09	5.4
August	0.0			
September	0.0			
Totals				1,134.4

Maximum Stage 4.10, April 1. Discharge 30 Cfs. April 2.
Minimum Stage ..... Discharge ..... Cfs.
Drainage Area ..... Sq. Miles.

TABLE No. 22 **MONTHLY DISCHARGE OF PARK RIVER AT GRAFTON, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD			
January				
February				
March	291.0	0.0	53.7	3,300
April	12.0	2.3	5.40	321
May	21.0	1.0	5.88	362
June	1.8	0.0	.35	21
July	88.0	0.0	4.71	290
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				4,294

Maximum Stage 6.12, Mar. 21. Discharge 291 Cfs.
Minimum Stage, 0.0. Discharge 0.0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD			
January				
February				
March	130.0	0.0	8.77	540
April	80.0	7.7	23.7	1,408
May	7.7	.1	2.05	126
June	20.0	0.0	2.83	169
July	1.0	0.0	.12	7.5
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				2,250.5

Maximum Stage 7.68, Mar. 30. Discharge 130 Cfs.
Minimum Stage, 0.0. Discharge 0.0 Cfs.

TABLE No. 23 MONTHLY DISCHARGE OF FOREST RIVER AT MINTO, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 14			
January				
February				
March	148.0	0.0	24.1	1,480
April	18.0	7.6	11.0	657
May	16.0	4.7	9.06	557
June	5.0	.8	2.41	143
July	7.1	0.0	1.40	86
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				2,923

Maximum Stage 4.96, Mar 16. Discharge 166 Cfs.
Minimum Stage, 0.0. Discharge 0.0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 28			
January				
February				
March	180.0	0.0	20.6	1,270
April	100.0	15.0	38.0	2,260
May	15.0	3.5	6.93	426
June	5.4	0.1	1.61	96
July	118.0	0.1	13.1	808
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				4,860

Maximum Stage 9.44, Mar. 28. Discharge 180 Cfs.
Minimum Stage, 0.0. Discharge 0.0 Cfs.

TABLE No. 24 MONTHLY DISCHARGE OF GOOSE RIVER AT HILLSBORO, N. DAK.

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 13			
January				
February				
March	104.0	10.0	53.9	2,030
April	10.0	3.7	6.51	387
May	8.2	..	5.35	329
June	....	0.0	1.35	81
July	.2	0.0	.01	.79
August	....	....	....	.....
September	....	....	....	.....
Totals				2,827.79

Maximum Stage 4.47, Mar. 13. Discharge 104 Cfs. Mar. 15.
Minimum Stage 0.0. Discharge 0.0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December	NO RECORD OCTOBER TO MARCH 22			
January				
February				
March	460.0	0.0	92.9	5,710
April	160.0	4.1	37.5	2,230
May	2.6	.3	1.12	69
June	67.0	.1	9.02	537
July	0.4	0.0	.12	7.3
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				8,553.3

Maximum Stage 11.0, Mar. 26. Discharge 480 Cfs.
Minimum Stage 0.0. Discharge 0.0 Cfs.

TABLE No. 25 MONTHLY DISCHARGE OF SHEYENNE RIVER AT VALLEY CITY, N. DAK.

1937-1938					1938-1939				
	Discharge in Second Feet			Run-off in Acre Feet		Discharge in Second Feet			Run-off in Acre Feet
Month	Maximum	Minimum	Mean		Month	Maximum	Minimum	Mean	
October					October	0.7	0.0	0.22	14
November					November	0.5	0.0	0.21	13
December	NO RECORD OCTOBER TO MARCH 18				December	0.4	0.1	0.16	9.7
January					January	0.4	0.1	0.25	15
February					February	1.4	0.0	0.33	18
March	244.0	60.0	119.0	3,320	March	240.0	0.7	67.7	4,160
April	131.0	20.0	45.3	2,690	April	293.0	41.0	114.0	6,810
May	36.0	15.0	26.6	1,640	May	39.0	11.0	21.1	1,300
June	29.0	2.2	8.43	502	June	28.0	5.8	14.6	869
July	131.0	4.2	52.8	3,240	July	7.2	0.0	1.65	101
August	41.0	0.0	8.64	531	August	0.2	0.0	.03	1.6
September	0.7	0.0	0.13	7.7	September	0.2	0.0	.01	.60
Totals				11,930.7	Totals				13,311.9

Maximum Stage 3.90, Mar. 29. Discharge 244 Cfs.
Minimum Stage 0. Discharge 0 Cfs.
Drainage Area ..... Sq. Miles.

Maximum Stage 4.76, Mar. 27. Discharge 307 Cfs. Apr. 6.
Minimum Stage 0.99, July 19-21. Discharge 0 Cfs.

TABLE No. 26 MONTHLY DISCHARGE OF SHEYENNE RIVER AT WEST FARGO, N. DAK.

1937-1938					1938-1939				
	Discharge in Second Feet			Run-off in Acre Feet		Discharge in Second Feet			Run-off in Acre Feet
Month	Maximum	Minimum	Mean		Month	Maximum	Minimum	Mean	
October	19.0	9.0	13.5	828	October	16.0	8.8	11.9	729
November	20.0	12.0	16.5	982	November	20.0	12.0	15.2	902
December	15.0	8.8	11.3	697	December	16.0	9.5	12.0	740
January	17.0	9.6	12.0	738	January	13.0	9.5	11.4	703
February	18.0	10.0	12.9	718	February	12.0	9.0	10.1	560
March	222.0	12.0	93.7	5,760	March	550.0	10.0	105.0	6,460
April	222.0	75.0	116.0	6,920	April	600.0	105.0	259.0	15,400
May	105.0	58.0	70.8	4,350	May	102.0	27.0	61.7	3,790
June	59.0	24.0	39.4	2,340	June	98.0	16.0	55.6	3,310
July	27.0	13.0	19.3	1,190	July	56.0	13.0	26.7	1,640
August	124.0	16.0	41.1	2,530	August	15.0	9.0	11.3	695
September	26.0	11.0	16.8	1,000	September	11.0	7.0	9.06	539
Totals				28,053	Totals				35,468

Maximum Stage 5.50, Mar. 27. Discharge 249 Cfs.
Minimum Stage 2.10, July 14. Discharge 8.8 Cfs. Dec. 16.
Drainage Area ..... Sq. Miles.

Maximum Stage 9.96, Mar. 28. Discharge 600 Cfs. Apr. 3 and 4.
Minimum Stage 1.94, Sept. 24. Discharge 6.2 Cfs.

TABLE No. 27 — **MONTHLY DISCHARGE OF RED RIVER AT FARGO, N. DAK.**

1937-1938

Month	Discharge in Second Feet: Maximum	Minimum	Mean	Run-off in Acre Feet
October	165.0	44.0	89.0	5,470
November	158.0	0.2	59.0	3,510
December	0.0	0.0	0.0	0
January	12.0	0.0	5.34	328
February	22.0	8.1	14.9	828
March	606.0	21.0	236.0	14,540
April	383.0	123.0	164.0	9,740
May	1,160.0	300.0	426.0	26,180
June	502.0	184.0	330.0	19,640
July	244.0	24.0	98.9	6,080
August	37.0	7.3	18.5	1,140
September	226.0	3.8	57.7	3,430
Totals				90,886

Maximum Stage 9.97, May 2. Discharge 1,160 Cfs.
Minimum Stage 6.76, Dec. 23, 24. Discharge 0 Cfs.
Drainage Area 6,420 Sq. Miles.

1938-1939

Month	Discharge in Second Feet: Maximum	Minimum	Mean	Run-off in Acre Feet
October	54.0	18.0	29.0	1,790
November	32.0	8.0	19.1	1,140
December	40.0	14.0	21.8	1,340.
January	132.0	40.0	93.9	5,770
February	106.0	76.0	98.1	5,450
March	3,600.0	101.0	739.0	45,460
April	3,600.0	231.0	706.0	41,990
May	274.0	158.0	213.0	13,100
June	244.0	49.0	130.0	7,760
July	279.0	24.0	85.4	5,250
August	28.0	0.0	12.0	738
September	0.0	0.0	0.0	0
Totals				129,788

Maximum Stage 12.97, Mar. 30. Discharge 3,700 Cfs. Apr. 1.
Minimum Stage 6.14, Sept. 2. Discharge 0 Cfs.

TABLE No. 28 — **MONTHLY DISCHARGE OF JAMES RIVER AT JAMESTOWN, N. DAK.**

1937-1938

Month	Discharge in Second Feet: Maximum	Minimum	Mean	Run-off in Acre Feet
October	1.5	0.6	.98	60
November	1.9	0.7	1.00	60
December	1.0	0.6	.87	53
January	1.0	0.8	.96	59
February	2.7	0.9	1.12	62
March	98.0	0.9	15.4	947
April	2.3	1.5	1.83	109
May	1.7	1.2	1.38	85
June	3.5	1.1	1.39	83
July	3.2	0.8	1.61	99
August	1.1	0.7	.95	59
September	1.9	0.4	.76	45
Totals				1,721

Maximum Stage 3.71, Mar. 15. Discharge 127 Cfs.
Minimum Stage 1.74. Discharge .4 Cfs. Sept. 17 and 18.
Drainage Area 2,740 Sq. Miles.

1938-1939

Month	Discharge in Second Feet: Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January				
February	NO RECORD BECAUSE OF			
March				
April	BEAVER DAM INTERFERENCE			
May				
June				
July				
August				
September				

Maximum Stage ..... Discharge ..... Cfs.
Minimum Stage ..... Discharge ..... Cfs.

TABLE No. 29 **MONTHLY DISCHARGE OF WILD RICE RIVER AT ABERCROMBIE, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January	NO RECORD			
February				
March	285.0	8.2	133.0	5,280
April	73.0	6.8	12.6	752
May	108.0	12.0	33.3	2,050
June	20.0	2.1	9.33	555
July	3.1	0.0	.36	22.2
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				8,659.2

Maximum Stage 7.28, March 17. Discharge 318 Cfs.
Minimum Stage 0.0, July 6 to Sept. 30. Discharge 0.0 Cfs.
Drainage Area ..... Sq. Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January	NO RECORD			
February				
March	1,700.0	0.0	252.0	15,520
April	192.0	2.5	45.8	2,730
May	11.0	0.0	3.21	198
June	85.0	0.0	23.4	1,390
July	70.0	1.2	23.4	1,440
August	11.0	0.0	1.85	114
September	0.0	0.0	0.0	0
Totals				21,392

Maximum Stage 15.17, Mar. 25. Discharge 1,800 Cfs.
Minimum Stage 5.33, Mar. 21. Discharge 0.0 Cfs.

TABLE No. 30 **MONTHLY DISCHARGE OF BOIS DE SIOUX RIVER NEAR FAIRMOUNT, N. DAK.**

1937-1938

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January				
February	NO FLOW FROM LAKE TRAVERSE DURING			
March				
April	THIS YEAR			
May				
June				
July				
August				
September				

Maximum Stage ..... Discharge ..... Cfs.
Minimum Stage ..... Discharge ..... Cfs.
Drainage Area 1,460 Square Miles.

1938-1939

Month	Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October				
November				
December				
January	NO RECORD OCTOBER TO MARCH 26			
February				
March	100.0	0.0	13.1	803
April	65.0	0.0	13.6	807
May	1.0	0.0	0.18	11
June	2.0	0.0	0.33	20
July	2.0	0.0	0.15	8.0
August	0.0	0.0	0.0	0
September	0.0	0.0	0.0	0
Totals				1,649.9

Maximum Stage 5.9, Mar. 27. Discharge 100 Cfs., Mar. 19.
Minimum Stage 0. Discharge 0 Cfs.

1937 APPROPRIATION
FINANCIAL STATEMENT
of
STATE WATER CONSERVATION COMMISSION

From December 1, 1938 to November 30, 1940

INCOME

Balance Legislative Appropriation, December 1, 1938	$ 9,945.65		
Application Fees	5.00		
Plans and Specifications, Payments	30.00		
Resale of Construction Supplies	139.00		
	$ 10,119.65		
Repayments from Private Projects		$ 4,517.73	
Repayments from Rural Rehabilitation Corporation		78,545.85	
		$ 83,063.58	
TOTAL INCOME			$ 93,183.23

EXPENSES

ACCOUNT	Chargeable to Administration	Chargeable to Projects	
Administrative Salaries	$ 4,167.57	$ 7.20	
Administrative Mileage and Expense	363.08	.....	
Administrative Office Equipment	108.91	.....	
Administrative Office Supplies	292.47	.....	
Engineering Salaries, Mileage and Expense	1,952.43	13,945.78	
Engineering Office Equipment	103.26	45.77	
Engineering Field Equipment	18.83	.....	
Engineering Office Supplies	65.22	48.25	
Maps (Blue Prints, Etc.)	161.38	160.37	
Commissioners' Per Diem	1,387.50	258.00	
Commissioners' Mileage and Expense	1,039.04	199.20	
Tri-State Per Diem and Expense	219.19	.....	
Legal Service and Publications	1.25	381.81	
Printing and Advertising	351.02	35.60	
Telephone and Telegraph	364.57	99.82	
Missouri River Diversion	1,349.23	.....	
Fieldmen (Salaries, Mileage and Expense)	.....	852.60	
Projects (Materials, Supplies, Etc.)	.....	61,903.71	
Preliminary Invest. and Research	.....	7.00	
Workmen's Compensation	132.66	.....	
Construction Supplies	.....	.....	
Membership in National Associations	150.00	.....	
Miscellaneous	67.70	.....	
	$ 12,295.31	$ 77,945.11	
TOTAL EXPENSES			$ 90,240.42
Balance in hands of State Treasurer November 30, 1940			$ 2,942.81

Outstanding Accounts, repayable projects November 30, 1938	$ 27,247.77
Collections on Projects, above project expense December 1, 1938 to November 30, 1940	5,118.47
Outstanding Accounts, November 30, 1940	$ 22,129.30

FINANCIAL STATEMENT OF STATE WATER CONSERVATION COMMISSION

From December 1, 1938, to November 30, 1940

	Item	Appropriation	Agreed Reduction	Balance Available	Expended from July 1, 1939 to Dec. 1, 1940	Balance Dec. 1, 1940
1.	Commissioner's Per Diem	$ 4,200.00	$ 1,200.00	$ 3,000.00	$ 1,085.00	$ 1,915.00
2.	Administration	30,000.00	1,000.00	29,000.00	*18,823.67	10,176.33
3.	Cons't. Bond Guarantee	50,000.00	10,000.00	40,000.00	5,400.00	34,600.00
4.	Lewis & Clark Experiment Farm	4,000.00	250.00	3,750.00	2,034.89	1,715.11
5.	Sponsor's Share—Dams	7,000.00	2,000.00	5,000.00	949.07	4,050.93
6.	Engineering and Soil Surveys	1,000.00	180.00	820.00	163.50	656.50
7.	Designs and Reports—Missouri River	500.00	300.00	200.00	165.71	34.29
8.	Goose River Diversion	500.00	100.00	400.00	375.00	25.00
9.	James River-Lake Traverse	1,600.00	750.00	850.00	804.21	45.79
10.	Invest. and Survey—Missouri River	3,000.00	2,000.00	1,000.00	547.25	452.75
11.	Evaluation Economic Benefits	1,000.00	700.00	300.00	246.04	53.96
12.	Reports and Conferences	1,000.00	300.00	700.00	727.93	-27.93
13.	Tri-State Waters Commission	5,600.00	600.00	5,000.00	3,177.35	1,822.65
14.	Independent Investigations and Reports	1,600.00	600.00	1,000.00	990.55	9.45
	Totals	$111,000.00	$ 19,980.00	$ 91,020.00	$ 35,490.17	$ 55,529.83

* "Revolving Fund" cost of work on projects.	47,902.42
* "Revolving Fund" collections on projects.	48,357.00
* "Revolving Fund" Administrative collections.	546.93

STATE ENGINEER DEPARTMENT

Status of Budget on June 30, 1939

Item	Present Budget	Total Expenditures	Balance
Salary, State Engineer	$ 4,400.00	$ 4,400.00	$ .....
Clerkhire, Stenographer	1,920.00	1,920.00	.....
Postage	100.00	1.45	98.55
Office Supplies	400.00	138.53	261.47
Furniture & Fixtures	200.00	182.42	17.58
Printing	300.00	300.00	.....
Miscellaneous	400.00	367.30	32.70
Travel Expense	2,000.00	1,821.43	178.57
Field Assistants	1,200.00	1,126.02	73.98
Water Conservation, Irrigation and Hydrographic Survey	3,000.00	2,886.08	113.92
TOTALS	$ 13,920.00	$ 13,143.23	$ 776.77

FINANCIAL STATEMENT OF STATE ENGINEER

From July 1, 1939, to November 30, 1940

Item	Appropriation	Agreed Reduction	Balance Available	Expended from July 1, 1939 to Dec. 1, 1940	Balance Dec. 1, 1940
Salary	$ 4,400.00	$	$ 4,400.00	$ 3,116.61	$ 1,283.39
Clerkhire	1,920.00	460.00	1,460.00	940.00	520.00
Postage	100.00	75.00	25.00	.....	25.00
Supplies	200.00	175.00	25.00	42.15	—17.15
Furniture & Fixtures	200.00	200.00	.....	.....	.....
Printing	300.00	250.00	50.00	28.44	21.56
Miscellaneous	200.00	.....	200.00	149.58	50.42
Travel	1,000.00	.....	1,000.00	630.97	369.03
Field Assistants	1,200.00	700.00	500.00	239.00	261.00
Water Conservation, Irrigation and Hydrographic Survey	3,000.00	400.00	2,600.00	2,248.53	351.47
TOTALS	$ 12,520.00	$ 2,260.00	$ 10,260.00	$ 7,395.28	$ 2,864.72
Prior	776.77			700.79	75.98