TENTH BIENNIAL REPORT

OF

North Dakota State Water Conservation Commission

FOR THE PERIOD

JULY 1, 1954 — JUNE 30, 1956

TENTH BIENNIAL REPORT

of the

State Water Conservation Commission

and the

TWENTY-SEVENTH BIENNIAL REPORT

of the

STATE ENGINEER

of

North Dakota

July 1, 1954 to June 30, 1956

BISMARCK TRIBUNE
86176

MAPS, GRAPHS AND PICTURES

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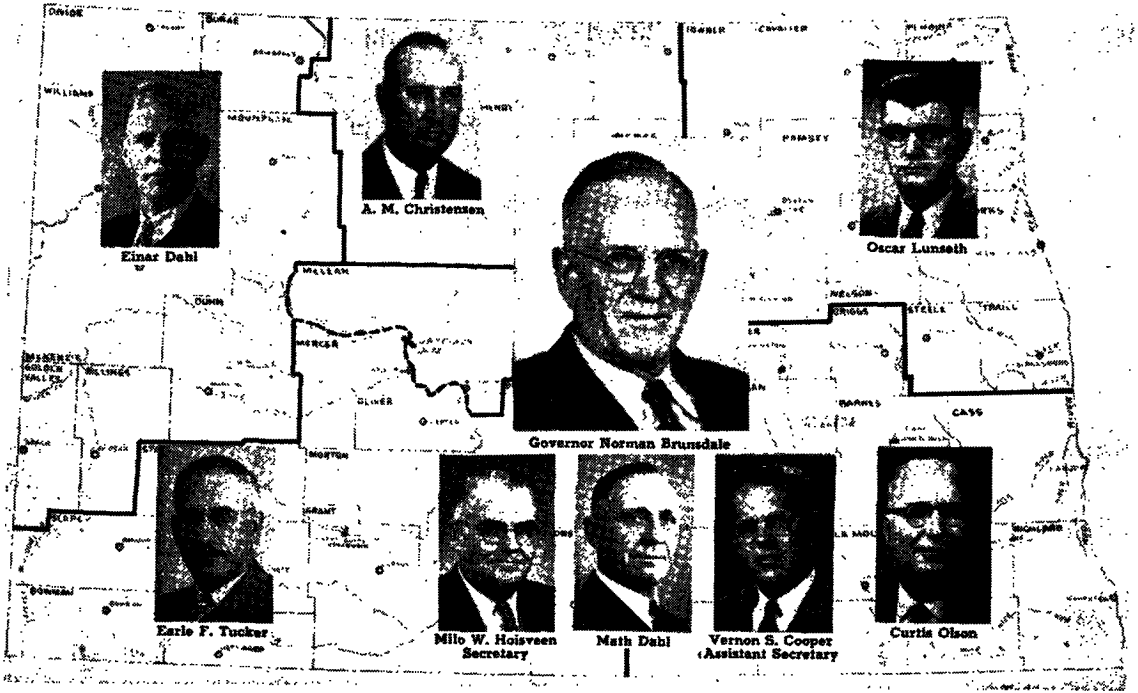

Einar Dahl
A. M. Christensen
Governor Norman Brunsdale
Oscar Lunseth
Earle F. Tucker
Milo W. Hoisveen
Secretary
Math Dahl
Vernon S. Cooper
Assistant Secretary
Curtis Olson

LETTER OF TRANSMITTAL

Honorable Norman Brunsdale
Governor of North Dakota

Dear Sir:

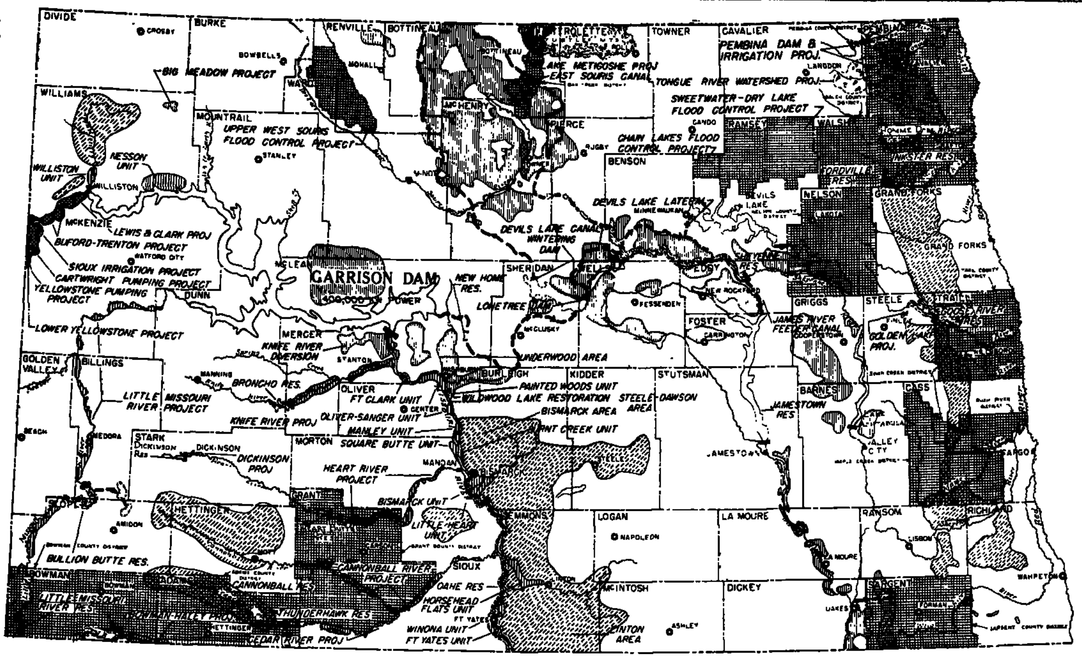
In compliance with the provisions of the laws of North Dakota we transmit herewith for your information and consideration the Ninth Biennial Report of the North Dakota State Water Conservation Commission and the Twenty-seventh Biennial Report of the North Dakota State Engineer covering the period July 1, 1954 to June 30, 1956.

Respectfully submitted,

N. D. STATE WATER CONSERVATION COMMISSION

CURTIS OLSON, Vice Chairman
EINAR H. DAHL
EARLE F. TUCKER
A. M. CHRISTENSEN
MATH DAHL
OSCAR LUNSETH

Milo W. Hoisveen
Secretary and Chief Engineer
State Engineer



NORTH DAKOTA STATE WATER CONSERVATION COMMISSION

WATER AND POWER RESOURCES DEVELOPMENT PLAN

GOV NORMAN BRUNSDALE,
CHAIRMAN
CURTIS OLSON,
VICE CHAIRMAN
MILO W. HOISVEEN
SECRETARY AND STATE ENGINEER
EINAR H DAHL
EARLE F TUCKER
A M CHRISTENSEN
MATH DAHL
OSCAR LUNSETH

EXISTING IRRIGATED AREAS

EXISTING PROPOSED RESERVOIR SITES

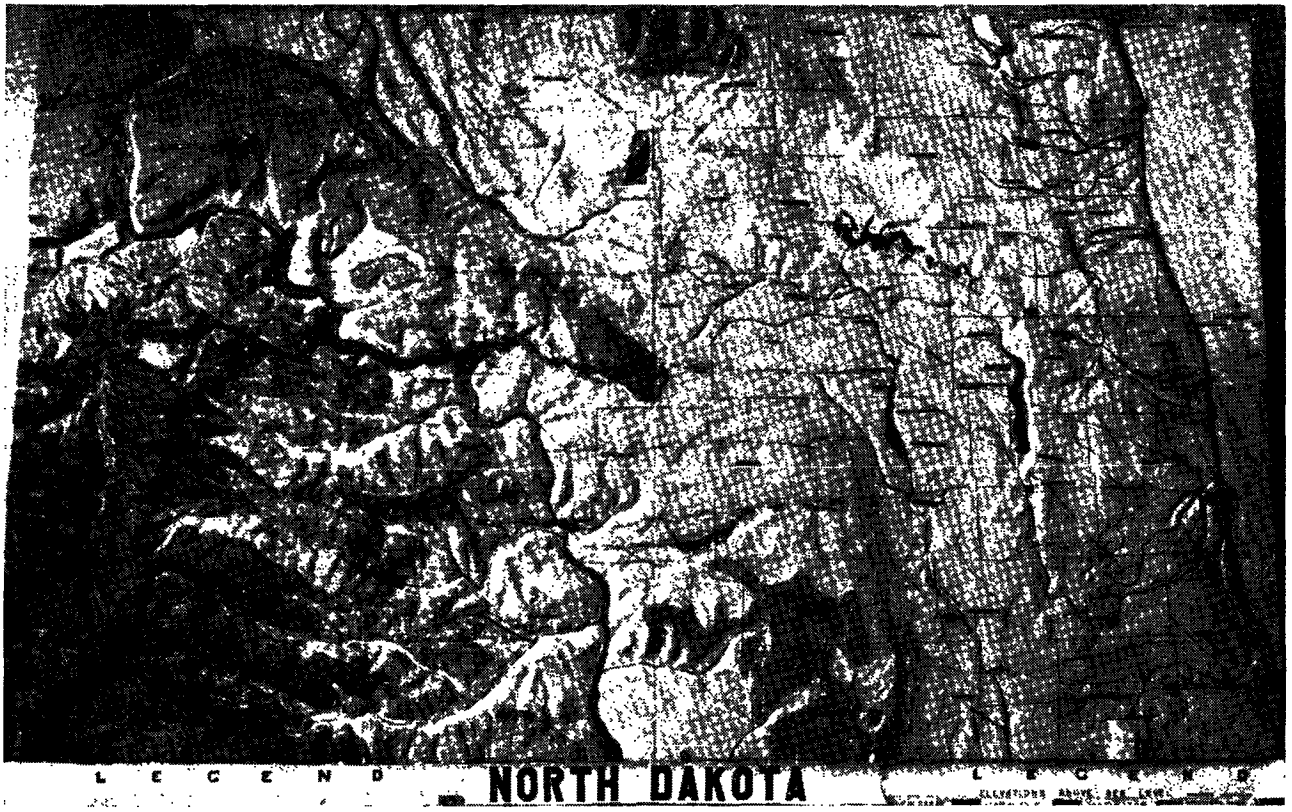
CANAL LOCATIONS

POTENTIAL IRRIGATED AREAS

AREAS UNDER INVESTIGATION

FLOOD CONTROL PROJECTS

Chapter 1
GENERAL DATA


LEGEND
NORTH DAKOTA
LEGEND

ORGANIZATION OF THE COMMISSION

The North Dakota State Water Conservation Commission was created in 1937 by the 25th Session of the Legislative Assembly of North Dakota. The Governor was designated as ex-officio chairman of the Commission and was given authority to appoint six other qualified electors of the state to serve as members of the Commission. In 1939 the legislature reduced the number of members of the Commission to five including the Governor and in 1949 the Commission was increased in size to seven members including the Governor and the Commissioner of Agriculture and Labor. The Commission selects one of its members to serve as Vice Chairman.

The State Water Conservation Commission is presently composed of the following members:

Name	Appointed	Present Term Ends
Governor Norman Brunsdale, Ex-Officio Chm.	Jan. 2, 1952	
Curtis Olson, Valley City, Vice-Chm.	Jan. 1, 1948	July 1, 1957
Einar Dahl, Watford City	April 3, 1939	July 1, 1959
Earle F. Tucker, Bismarck	May 1, 1948	July 1, 1961
A. M. Christensen, Minot	May 27, 1949	July 1, 1961
Oscar Lunseth, Grand Forks	May 1, 1951	July 1, 1959
Math Dahl, Comm. of Agriculture and Labor, Ex-Officio Member	May 27, 1949	
Milo W. Hoisveen, Secretary and Chief Engineer, State Engineer	July 1, 1954	

The Commission meets at irregular intervals at the call of the Chairman or, in his absence, of the Vice Chairman, either in the principal office at Bismarck or at such special places as may be designated. During the period July 1, 1954 to June 30, 1956 the State Water Conservation Commission held 16 meetings in Bismarck and six meetings in other cities throughout the state.

PERSONNEL EMPLOYED BY THE COMMISSION

Full time personnel employed by the Commission on June 30, 1956, are as follows:

Milo W. Hoisveen..Secretary and Chief Engineer, State Engineer
Vernon S. Cooper.....Assistant Secretary
Sam S. Westgate.....Assistant State Engineer
I. A. Acker.....Special Assistant Attorney General
Marvin Sheldon.....Office Engineer
Albin Anderson.....Field Engineer
Lloyd Johnson.....Construction Foreman
Duane Torvik.....Construction Engineer
Arthur Radspinner.....Instrumentman
Roger Middaugh.....Instrumentman
Howard Walterson.....Operator
Ole Ronning.....Operator
Roy Putz.....Exhibit Attendant
Elmer Gilbertson .....Rodman
DuWayne Baranyk .....Rodman
Gordon Baesler .....Draftsman
Luella Schweigert .....Chief Stenographer
Lorraine Clark .....Bookkeeper
Nancy Sell .....File Clerk
Esther Karch .....Clerk-Typist
Fred J. Fredrickson .....Planning Coordinator

In addition to the above personnel the Commission usually employs about six temporary employees as instrumentmen and rodmen to assist in survey work during the summer season and several construction crews consisting of skilled operators, truck drivers and laborers for work on the various construction projects undertaken by the Commission.

MEETINGS, CONFERENCES AND HEARINGS

During the period of this report the State Water Conservation Commission has met 22 times to take up routine business of the Commission. Sixteen of these meetings were held in Bismarck and six in other cities in the state. At these meetings the Commission met with various delegations to discuss matters pertaining to the water resources of the state and development of these resources. Meetings were held at places indicated on the following dates:

August 13, 1954—Bismarck
September 16, 1954—Bismarck
October 14, 1954—Grand Forks
Ocotber 27, 1954—Bismarck
October 28, 1954—Bismarck
December 17, 1954—Bismarck
January 10-11, 1955—Bismarck
January 31, 1955—Bismarck
March 24, 1955—Bismarck
April 25, 1955—Bismarck
June 10, 1955—Devils Lake
July 18, 1955—Harvey
August 17, 1955—Lake Metigoshe
September 23, 1955—Bismarck
November 1, 1955—Minot
November 14, 1955—Harvey
December 9, 1955—Bismarck
January 20, 1956—Bismarck
March 9, 1956—Bismarck
April 11, 1956—Bismarck
May 11, 1956—Bismarck
June 8, 1956—Bismarck

Commission members or employees of the Commission have attended many meetings and held a number of hearings during the period of this report relative to the organization of irrigation districts, water conservation and flood control districts and drainage districts as well as meetings with various federal and state agencies concerning the water program in North Dakota. These meetings include monthly meetings of the Missouri Basin Inter-Agency Committee, meetings of the Missouri River States Committee, meetings with Corps of Engineers and Bureau of Reclamation officials relative to the various projects in the state and meetings with local groups in North Dakota relative to problems existing in their areas. All conferences and meetings of this nature are in addition to those listed above.

GEOGRAPHICAL DATA CONCERNING NORTH DAKOTA

I. Boundary Lines (to nearest tenth mile).
   - A. North—310.0 miles—Follows the 49° parallel.
   - B. East—213.5 miles—air-line-river boundary approximately 416 miles.
   - C. South—360.6 miles—7th Standard parallel.
   - D. West—210.8 miles—27th Standard meridian.

II. Boundary Corners (to nearest second of latitude or longitude).
   - A. Northeast—49° 00′ 02″ N. Lat.; 97° 13′ 41″ W. Long.
   - B. Southeast—45° 56′ 07″ N. Lat.; 96° 33′ 41″ W. Long.
   - C. Southwest—45° 56′ 43″ N. Lat.; 104° 02′ 17″ W. Long.
   - D. Northwest—49° 00′ 00″ N. Lat.; 104° 02′ 53″ W. Long.

III. Areas
   - A. Of State ..... 70,665 Square Miles
     1. Land area ..... 69,362 Square Miles
     2. Water area (including Garrison Reservoir at 1,850) ..... 1,303 Square Miles
   - B. Of Basins (Based on line of Bureau of Reclamation)
     1. Red-Souris-Devils Lake to Hudson Bay (Approximately) ..... 29,500 Square Miles
     2. Missouri to Gulf of Mexico (Approximately) ..... 41,200 Square Miles

DRAINAGE BASIN AREAS—NORTH DAKOTA
(Approximate areas in square miles)

I.	Hudson Bay Drainage Basin			
a.	Devils Lake	3,450 sq. mi.	5%	
b.	Lower Red River	7,850 " "	11%	
c.	Sheyenne River	7,350 " "	10%	
d.	Souris River	8,550 " "	12%	
e.	Wild Rice River	2,050 " "	3%	
			41%	29,250 sq. mi.
II.	Missouri River Drainage Basin			
a.	Cannonball River	4,550 sq. mi.	7%	
b.	Grand River	950 " "	1%	
c.	Heart River	3,150 " "	4%	
d.	James River	7,200 " "	10%	
e.	Knife River	2,600 " "	4%	
f.	Little Missouri River	4,650 " "	7%	
g.	Missouri River (main stem)	17,700 " "	25%	
h.	Yellowstone River	600 " "	1%	
			59%	41,400 sq. mi.
	TOTAL			70,650 sq. mi.

POWERS AND DUTIES, STATE WATER COMMISSION

Powers and Duties of the Commission. The commission shall have full and complete power, authority, and general jurisdiction:

1. To investigate, plan, regulate, undertake, construct, establish, maintain, control, and supervise all works, dams, and projects, public and private, which in its judgment may be necessary or advisable:

a. To control the low-water flow of streams in the state;

b. To impound water for the improvement of municipal and rural water supplies;

c. To control and regulate flood flow in the streams of the state to minimize the damage of such flood waters;

d. To conserve and develop the waters within the natural watershed areas of the state and, subject to vested and riparian rights, to divert the waters within watershed area to another watershed area and the waters of any river, lake or stream into another river, lake or stream.

e. To improve the channels of the streams for more efficient transportation of the available water in the streams;

f. To provide sufficient water flow for the abatement of stream pollution;

g. To develop, restore and stabilize the waters of the state for domestic, agricultural and municipal needs, irrigation, flood control, recreation, and wildlife conservation, by the construction and maintenance of dams, reservoirs and diversion canals;

h. To promote the maintenance of existing drainage channels in good agricultural lands and to construct any needed channels;

i. To provide more satisfactory subsurface water supplies for the smaller villages of the state;

j. To finance the construction, establishment, and maintenance of public and private works, dams, and irrigation projects, which in its judgment may be necessary and advisable;

k. To provide for the storage, development, diversion, delivery, and distribution of water for the irrigation of agricultural land;

l. To provide for the drainage of lands injured by or susceptible of injury from excessive rainfall or from the utilization of irrigation water and, subject to the limitations prescribed by law, to aid and cooperate with the United States and any department, agency, or officer thereof, and with any county, township, drainage district or irrigation district of this state, or of other states, in the construction or improvement of such drains;

m. To provide water for stock; and

n. To provide water for the generation of electric power and for mining and manufacturing purposes;

2. To define, declare, and establish rules and regulations:

a. For the sale of waters and water rights to individuals, associations, corporations, and political subdivisions of the state, and for the delivery of water to users;

b. For the full and complete supervision, regulation, and control of the water supplies within the state; and

c. For the complete supervision and control of acts tending to pollute watercourses, for the protection of the health and safety of all the people of the state;

3. To exercise full power and control of the construction, operation, and maintenance of works and the collection of rates, charges, and revenues realized therefrom;

4. To sell, lease, and otherwise distribute all waters which may be developed, impounded, and diverted by the commission under the provisions of this chapter, for the purpose of irrigation, the development of power, and the watering of livestock, and for any other private or public use; and

5. To exercise all express and implied rights, powers, and authority, that may be necessary, and to do, perform, and carry out all of the expressed purposes of this chapter and all of the purposes reasonably implied incidentally thereto or lawfully connected therewith.

6. To acquire, own and develop lands for irrigation and water conservation and to acquire, own and develop dam sites and reservoir sites and to acquire easements and rights-of-way for diversion and distributing canals.

7. To cooperate with the United States and any department, agency or officer thereof in the planning, establishment and maintenance of dams, reservoirs, diversion and distributing canals, for the utilization of the waters of the state for domestic and municipal needs, irrigation, flood control, water conservation, generation of electric power and for mining, agricultural and manufacturing purposes, and in this connection the State Water Conservation Commission is hereby authorized, within the limitations prescribed by law, to acquire, convey, contribute or grant to the United States real and personal property, including land or easements for dams and reservoir sites and rights-of-way and easements for diversion and distribution canals.

THE STATE ENGINEER

The State Water Conservation Commission appoints the State Engineer, who shall be a qualified and experienced hydraulic engineer and also shall be an experienced irrigation engineer. He shall serve as secretary and chief engineer of the commission.

He is required to make a formal printed report to the Governor for the biennium preceding each legislative session. He passes on applications for permits to appropriate water, records the permit when granted, and issues certificates of construction of irrigation works or dams when completed, examines and approves plans and specifications for dams or irrigation works, inspects dam sites and construction works, and collects state fees for same as required by law.

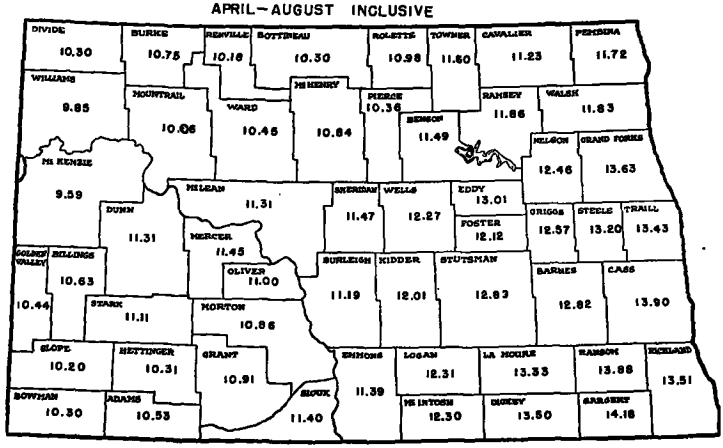
His records are open to public inspection during business hours. He is the custodian of General Land office maps, field notes and records of surveys of land turned over by the government to the state.

He shall make such rules and regulations necessary to carry into effect the duties devolving upon his office, relating to applications for permits to appropriate water, for the inspection of works, for the issuance of licenses, and for the determination of rights to use of water.

He cooperates with Federal agencies in making hydrographic surveys and investigations of each stream system and source of water supply in the state, and shall obtain and record all available data for the determination, development and adjudication of the water supply of the state, and other duties pertaining thereto.

He cooperates with the U. S. Geological Survey in making topographic maps and surveys.

NORTH DAKOTA
AVERAGE ANNUAL PRECIPITATION
APRIL—AUGUST INCLUSIVE



IRRIGATION IN NORTH DAKOTA

Irrigation in the world is as old as civilization itself. Ancient history indicates that irrigation was practiced in Egypt as early as 2000 B.C. Some of the canals and other facilities developed in these ancient periods are still in use today. In the United States it has been found that Indians in the arid southwest irrigated corn and vegetable crops long before white man arrived. Modern irrigation in the United States had its beginning when the Mormon pioneers, in 1847, constructed a small irrigation system in the Salt Lake valley. Since that time irrigation in the United States, particularly in the 17 western states, has grown steadily until today there are over 29,000,000 acres in these states under irrigation.

In North Dakota the first irrigation practiced dates back to the 1880's when it is estimated that 450 acres of land were irrigated. Since that time irrigation in the state has developed relatively slowly and today we have an estimated 80,000 acres under irrigation. There is a total of about 2,500,000 additional acres of land in North Dakota that are suitable for irrigation. Some of the factors that have resulted in the relative slow development of irrigation in North Dakota are:

(1) The climate and weather conditions in the state during many years provides for an adequate supply of moisture from rainfall for crop production.

(2) The required facilities for the storage or diversion of water to irrigable areas have been beyond the ability of the water users to finance.

Following the passage of the Reclamation Act by Congress in 1902 there was an increased interest in irrigation development in North Dakota. In 1903 the North Dakota Irrigation Association was organized and as a result of their efforts the Williston and Buford-Trenton projects were authorized. In 1904 a number of the state's citizens advanced $5,000 to employ Professor E. F. Chandler of the University of North Dakota to act as State Engineer and to assist in bringing to the attention of the Reclamation Service the irrigable areas in the State. In 1905 the state irrigation code was passed by the State Legislature which provided for the Office of State Engineer. A. L. Fellows of Denver, Colorado, was appointed to this position and served until 1907.

In adopting the State Irrigation Code in 1905, the Legislature provided a means whereby farmers could obtain water rights for the beneficial use of water from the rivers and streams for irrigation. The Office of the State Engineer also assisted in promoting irrigation throughout the State. During the following years there were many public spirited citizens who actively supported the development of the water resources of the state for irrigation and other uses. Their efforts

have resulted in the progress that has been made throughout the state in our water resource program.

During the drought period of the 1930's it became apparent that the state needed an agency who would be primarily responsible for the control and development of the state's water resources. In 1937 the State Water Conservation Commission was created by the Legislature and given broad powers over the waters of the state as are listed in another section of this report.

The Commission has been active since its organization in promoting many of our water resource projects that are in existence and others that are proposed for development. This program has involved planning, investigating, coordinating the activities of other state and federal agencies concerned and in the actual construction of many projects.

Although notable progress has been made in our water resource program, a continued concerted effort by the State of North Dakota is necessary if the many benefits available to the people of the State are to become realities. As irrigation develops through the Garrison Diversion Project and numerous other proposed smaller projects, the need for a strong state and local control of the water resources will become more apparent. Through the State Water Conservation Commission and the many local entities provided by law for the various types of water resource projects, this control can be provided.

Irrigating with Siphon Tubes

WATER RESOURCE DEVELOPMENT IN NORTH DAKOTA

Water—our most precious resource is the focal point of a development program that will bring untold new wealth to North Dakota. Through the construction and development of the facilities proposed for the many projects in North Dakota's water resource program flood and surplus waters will be stored in reservoirs for use for irrigation, production of hydro-electric power, municipal and industrial water supplies, stream pollution abatement, recreation, fish and wildlife conservation and propagation, and many other purposes. In addition it is proposed that water stored in our underground aquifers be utilized for irrigation, municipal and other uses. As the need for water for these purposes grows, the problem in North Dakota will not be—"what to do with our surplus runoff": but rather—"where can we get additional water to meet the demand?"

There are many phases to North Dakota's water resource development program. Each proposal is designed to meet the demand for the area for which the water resource project is required. Basically they all are concerned with controlling the destructive flood water and utilizing such water for the greatest possible benefit. These uses, although they require years to become realities are inevitable as the water resource program moves ahead and North Dakota develops. The anticipated benefits from this program are listed below:

Irrigation

Irrigation is becoming increasingly popular throughout North Dakota and the entire nation, as farmers recognize the value of being able to supply water to their crops when they need it. In North Dakota we have about 2,500,000 acres of rich agricultural farmland that can be irrigated through organized irrigation projects and an additional sizeable number of acres that can be developed for irrigation by other farmers on an individual basis. Only a small portion of our North Dakota farms are benefiting by irrigation now, although there is a growing interest in irrigation throughout the State. Areas suitable for irrigation in North Dakota include about 2,000,000 acres in the 23 county Garrison Diversion Conservancy District, about 150,000 acres along the Missouri River and tributary stream in southwestern North Dakota, about 25,000 acres in Pembina, Walsh and Cavalier counties, several sizeable areas that can be served from underground water sources in Kidder, Ramsey, Grand Forks, Ransom, Wells, Dickey and Stutsman counties and the numerous small individual tracts in every part of the State. Through irrigation development the farm net income can be doubled, the detrimental effect of the recurring droughts will be minimized and the economy of the areas benefited will be stabilized and expanded.

Municipal and Industrial Water Supplies

Many cities, towns and villages in North Dakota are in need of a good and adequate water supply for municipal use that can be economically developed. With the increasing per capita requirements for water this problem is becoming more acute. Since 1945 the State Water Conservation Commission has cooperated in a program of conducting underground water surveys for more than 42 municipalities. These surveys have resulted, in many instances, in locating a desirable water supply for the municipality concerned and in a few cases located a sufficient supply for future irrigation development. Augmenting our surface water supplies through the Garrison Diversion Project, the Bowman-Haley Dam and other projects will result in an improved water supply for many cities, towns and future industries.

Hydro-Electric Power

As North Dakota develops and expands the demand for additional electric power will grow. The initial production of power from Garrison Dam in January 1955 was significant in that it was the first hydro-electric power produced in North Dakota. Many other opportunities exist in North Dakota for additional hydro-power installation in connection with future development of the state's water resources. Notable among these are the proposed Pembina River Dam, the main canal power drops along the McClusky canal of the Garrison Diversion Project and three lowhead dams on the Missouri River between Bismarck and the Garrison Dam proposed for consideration by the State Water Conservation Commission. Hydro-power produced in connection with these projects would be available to partially fill the increasing demands for power.

Recreation

North Dakota's recreational opportunities will be greatly enhanced through the development of our many water resource projects. Fresh water lakes will exist in areas that were once devoid of these facilities. Many other alkali lakes will be converted to fresh water lakes. Citizens of the State who before had to travel many miles for fishing, camping, boating, swimming will have access to such facilities much nearer their homes.

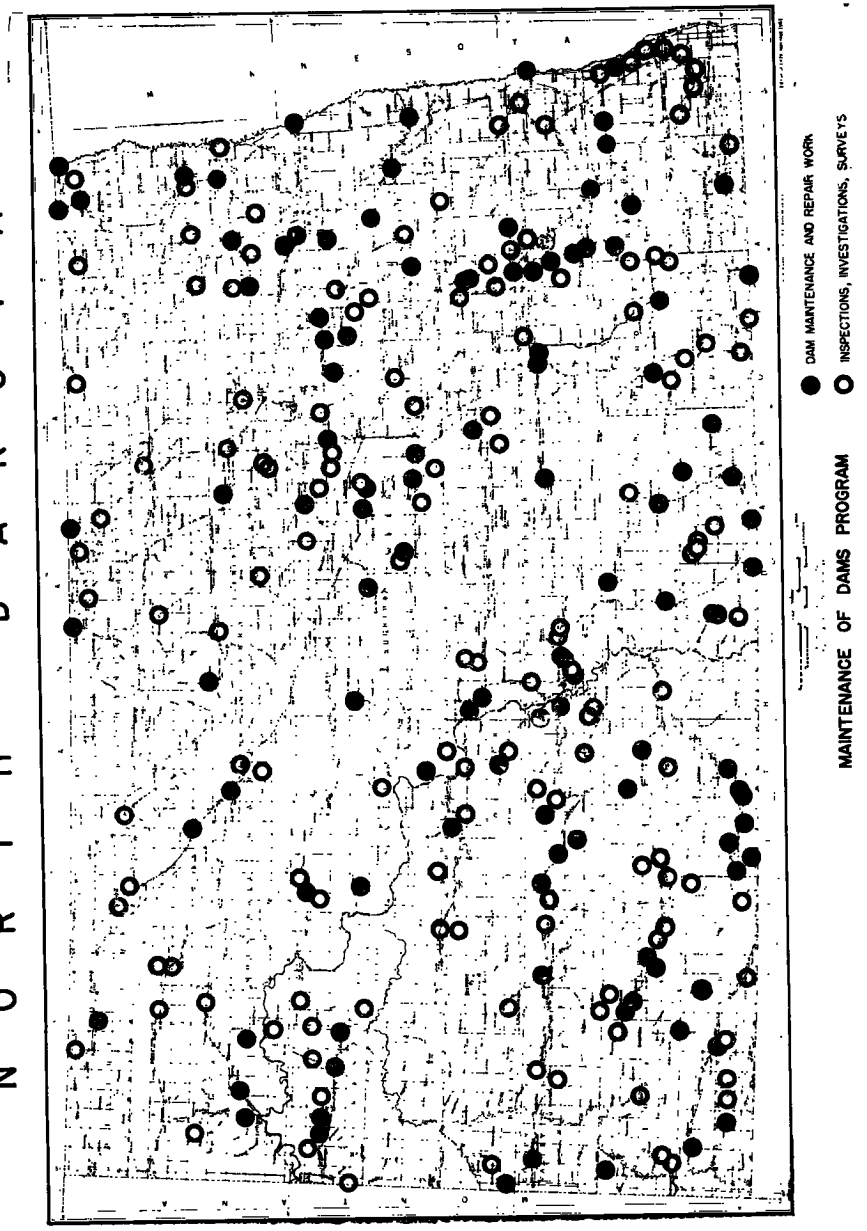
The several reservoirs that have been created by dams constructed on our rivers in recent years have already proven themselves as excellent recreational attractions. As the State's water resource program is expanded and developed, the economy of the State will be stimulated by the expenditures for recreation that before were channeled to other states.

Fish and Wildlife Conservation and Propogation

Closely allied to recreational development is that of fish and wildlife conservation and propagation. The recently created reservoirs have become popular to North Dakotans because of the excellent fishing provided which surpasses the fishing in lakes in neighboring states. In addition these reservoirs provide rest areas and breeding grounds for waterfowl and will materially contribute to an increase in the facilities available for these and other species of wildlife.

These are the major direct benefits that will accrue through North Dakota's water resource development program. There are many

secondary benefits that will affect the State's economy to a remarkable degree. New business and industry will be attracted to the State as the economy is expanded and stabilized. The gross annual income of the State will be materially greater and the tax base will thereby be broadened permitting the improvement and expansion of our roads and highways, our schools and the many other facilities that are essential in our modern day life. We can expect a significant growth in our population and will be able to provide the opportunity to all our citizens for a prosperous living.



Chapter 2
N.D. SWCC ACTIVITIES

SUMMARY OF NORTH DAKOTA STATE WATER CONSERVATION COMMISSION ACTIVITIES

The North Dakota State Water Conservation Commission has been active in the several programs concerned with the development of the state's water resources since its organization in 1937. During the past biennium there has been a very noticeable increase in the public interest in and demand for the early development of these resources for the greatest possible benefit. The Commission's activities have been directed toward several functions which are as follows:

1. Conducting engineering surveys, investigations and preparing plans for use in developing irrigation, drainage and other water resources development projects in the state;

2. Designing and constructing irrigation works;

3. Making preliminary investigations of small irrigation projects;

4. Constructing and repairing small dams and other water facility projects;

5. Assisting local drainage districts in their drainage construction programs;

6. Processing water right application received from individual farmers, cities and industries;

7. Conducting compact negotiations with other states and Canadian provinces for the allocation and use of interstate and international rivers and streams;

8. Organizing water conservation and flood control districts and irrigation districts and cooperating with these districts in the planning, investigating and operations of the facilities for their projects;

9. Cooperating with the U.S. Geological Survey in conducting topographic, hydrographic and underground water surveys throughout the state;

10. Cooperating with local groups, counties, state and federal agencies in the development of water facility, flood control, irrigation and drainage projects;

11. Reviewing the plans and specifications for the construction of projects in the state proposed by federal agencies;

12. Participating in conferences relative to the coordination of the activities of federal and state agencies in the water resources development program for North Dakota and the Missouri River Basin;

13. Administering the water laws of North Dakota and fostering and promoting irrigation and water resources development including the many administrative details connected therewith.

A brief summary of these functions is as follows:

Since the inauguration of its program for repairing small dams in 1939 the Commission has cooperated in the repair of 139 small dams in all sections of the state. During this period the Commission has received appropriations totaling $529,000 for this work. The Commission and cooperating agencies have invested $651,000.00 for the repair of dams during this period. A balance of appropriated funds available for the period to June 30, 1957 of $67,000. During the period of this report the Commission has repaired or constructed 21 small dams at a total cost of about $160,000.00, of which $69,000 was paid by the Commission and $91,000.00 by cooperating groups.

In the Commission's program of assisting counties in the construction and reconstruction of drains, the Commission has received appropriation totaling $1,010,000 since the program began in 1943. Of this amount $703,383.96 has been paid to counties and drainage districts for the repair or construction of 145 separate projects. A balance of $281,000 is available for future work of this nature. During the biennium the Commission contributed $69,450.66 for 17 projects in 8 counties. Of the remaining balance $150,000 has been allocated for projects that are under construction or for which construction is proposed in the near future.

Surveys and investigations for numerous projects have been completed by the Commission during the past biennium including recreational projects, irrigation, flood control, municipal water supply studies and fish and wildlife projects. The development of each is related to the utilization of the water resources in various areas of the state. During the period of this report the Commission has surveyed the Golden Lake Project, Mauvais Coulee, Mirror Pool, Wildwood Lake, Lake Metigoshe, Pembilier Dam, investigated municipal water supply problems for Sherwood, Bowbells, Crosby and others in addition to cooperating with federal agencies in connection with the Bowman-Haley Dam, the Mauvais Coulee flood problem and the Garrison Diversion investigations.

The Commission inaugurated a program of channel clearing during the biennium in cooperation with Cass County in which the 33 miles of the channel of the Sheyenne River in the County was snagged and cleared. The total cost of this work was $24,000 of which the County paid 60% and the Commission 40%.

Cooperative activities with the various branches of the U.S. Geological Survey were continued during the biennium. These programs included completing topographic mapping of 13 areas under the Commission's cooperative program and 34 areas under the Missouri River Basin program and surveys were underway in an additional 57 areas.

Stream gaging work was continued at 85 stations throughout the state of which 27 are wholly supported in the state's cooperative program. Underground water surveys were initiated for 4 cities and towns and one county-wide area. In total 8,000 square miles of the state have been covered by underground water surveys under the Commission's program.

The Commission has organized water conservation and flood control districts for 1 county-wide district and 8 others encompassing portions of counties. These districts have been requested to provide the necessary local entities to cooperate with various federal and state agencies in the development of flood control projects, watershed projects and also to provide for the construction and operation of facilities for projects they wish to develop.

The increase demand for water throughout the country has pointed up the need for early consideration of compacts with neighboring states and provinces for the allocation of waters from international and interstate rivers and streams. The Commission has been active in appearing at hearings of the International Joint Commission relative to state rivers and is proposing the early consideration of compacts with other states for the use of water in the Grand, Little Missouri, James and Red Rivers.

During the biennium the Commission conducted an investigation of all existing water rights in accordance with a directive by the 34th Legislative Assembly. This report will be published and available by January 1, 1957. There are over 800 water right applications filed with the State Engineer and Commission of which 58 have been filed during the period of this report.

The extensive activities of the various federal agencies in the water resources development program in North Dakota and the Missouri River Basin has required that the state actively participate in the coordination of these programs with the various federal and state agencies of other states. The Governor, as a member of the Missouri Basin Interagency Committee and the Missouri River States Committee has been in close contact with the Missouri River Basin program. The Commission has also cooperated with other voluntary organizations and coordinating groups in this work.

In administering the water laws of North Dakota and promoting the water resources development program in North Dakota the Commission has a multitude of duties and administrative activities to perform. Providing information in answer to many requests, participating in numerous meetings and hearings and assisting the citizens of North Dakota all are important functions of the Commission.

CONSTRUCTION

MAINTENANCE OF DAMS

The Commission's Maintenance of Dams program was inaugurated in 1939 when the North Dakota legislature provided an appropriation of $7,000 for this work. The need for this program became apparent when the programs of the various federal agencies, that had constructed over 1,500 small dams in the state, were terminated without making adequate provision for maintenance and repair of these structures. The dams were constructed by the WPA, CCC, PWA, FERA and other federal agencies as a part of the relief program during the 1930 drought period. The reservoirs created by these dams provide a number of conservation needs. They provide water for livestock, municipal use, recreation purposes, irrigation and fish and wildlife conservation and propagation.

North Dakota has a present day inventory of over twenty millions of dollars of small dams. This inventory is based on the current cost of replacing spillways that have deteriorated beyond repair. Fourteen such structures have been reconstructed within the last three bienniums at a total cost of $288,000—or an average of $20,570 per structure.

During the past twenty-five years North Dakota has lost about sixteen millions of dollars worth of small dams. Many of these dams failed due to the original faulty design, poor construction by the federal agencies engaged in this work during the drouth period of the 1930's, and also the neglect of State and County agencies to provide adequate maintenance for the structures placed in their custody.

North Dakota, through the combined efforts of the State Water Conservation Commission and cooperating agencies and organizations, has to a large extent retarded this progressive loss of water resource assets by a coordinated program of small dam repair.

During the past biennium about $160,000 has been spent for the maintenance, repair and reconstruction of small dams with about 44% or $69,000 of this cost representing the Commission's participation through engineering and construction services, as well as cash contribution.

This sets the total current ratio of maintenance and reconstruction costs at less than one percent of the present day value of the structures —a ratio which is obviously too small to completely halt the small dam failures.

The present policy of requiring local funds and interest for the maintenance of small dams has greatly aided in the selective maintenance of only those dams which serve a useful local purpose such as municipal water supply, irrigation, flood control, swimming, fishing, boating and waterfowl habitat.

With the present "hold the water where it falls" national water policy, it appears that North Dakota is now making a very substantial

contribution to the major watersheds by virtue of its numerous small dams.

In September of 1955 the Commission modernized the maintenance and repair work by the purchase of "spray concrete" equipment and the training of operators. This modern equipment makes possible the application of a dense, high strength pneumatically placed concrete to the surface of old masonry, or concrete structures. The same equipment can wet or dry sandblast the old structures to insure good bonding of the new concrete. It can also be used to grout beneath the structures to fill voids caused by settlement or seepage erosion. This method has very materially improved the quality of repairs as well as reducing the cost. During this period the Commission also trained key construction employees to the use of demolitions and substantially reduced the cost of removing old masonry as well as to enable their construction forces to construct channels by the use of ditching dynamite.

North Dakota in the past biennium has reconstructed three spillways, has raised the water levels of three reservoirs and has conducted major and minor repairs to 18 structures.

Following is a table showing the names and locations of dams constructed or repaired during the past biennium with the actual cost of each.

Fort Ransom Dam

No.	Name	County	Date	S.W.C.C.	Game and Fish U.S. Wildlife	Local	Total
275	Fort Ransom	Ransom	July-Sept. '54	16,961.63	4,200.00	2,200.00	23,361.63
354	Jamestown	Stutsman	September '54	3,997.77	.....	1,998.88	5,996.65
375	Knodel	Wells	October '54	451.46	451.46	106.25	1,009.17
359	Wolf Butte	Adams	November '54	2,528.41	2,528.40	.....	5,056.81
487	Welk	Emmons	November '54	395.19	395.19	395.18	1,185.56
557	Gascoyne Lake	Bowman	April '55	507.99	507.97	507.97	1,523.93
264	Braddock	Emmons	May '55	1,215.14	1,215.13	1,215.13	3,645.40
545	State Training School	Morton	May '55	257.81	.....	200.00	457.81
•544	Mirror Pool	Ransom	May '55	502.14	4,619.17	.....	5,121.31
240	Warwick	Benson	June '55	425.44	.....	300.00	725.44
242	Jund	Emmons	June '55	55.17	.....	55.17	110.34
437	Sellie	Wells	June '55	500.44	.....	70.00	570.44
374	Danzig	Morton	July-Oct. '55	14,484.84	30,969.69	1,000.00	46,454.53
498	Lake Patricia	Morton	September '55	.....	531.83	.....	531.83
388	Spring Lake	Bowman	September '55	1,694.11	1,694.10	.....	3,388.21
546	Vigness	Walsh	September '55	8,471.25	.....	7,100.00	15,571.25
564	Carpio	Ward	September '55	854.42	.....	1,254.41	2,108.83
526	Cat Coulee	Grant	October '55	1,911.05	1,911.04	1,003.00	4,825.09
316	Lisbon	Ransom	November '55	3,598.73	5,394.71	3,284.94	12,278.38
456	Dakota Lake	Dickey	November '55	961.25	961.24	.....	1,922.49
394	Odland	Golden Valley	May '56	3,728.71	1,500.00	1,500.00	6,728.71
346	Epping	Williams	June '56	1,631.65	1,631.64	1,631.64	4,894.93
574	Sentinel Butte	Golden Valley	June '56	1,715.10	.....	1,715.10	3,430.20
409*	Portland	Traill	June '56	4,016.19	.....	4,016.19	8,032.37
				70,865.89	58,511.57	29,553.86	158,931.31

*Not completed as of July 1, 1956.

Following shows scope of work on dams repaired or constructed during past biennium:

1. Reconstruction of spillways: Danzig, Fort Ransom, Portland.
2. Dams refaced or repaired by pneumatically placed concrete: Spring Lake, Carpio, Cat Coulee, Odland, Epping, Sentinel Butte.
3. Dams whose reservoir levels have been raised by construction methods: Knodel, Wolf Butte, Vigness.
4. Dams on which major repairs have been made: Jamestown, Braddock, Vigness, Lisbon.
5. Dams on which minor repairs have been made: Welk, Gascoyne Lake, State Training School, Mirror Pool, Warwick, June, Sellie, Lake Patricia, Dakota Lake.

Following are dams on which investigations have been made and on which future construction is anticipated in the next biennium.

Name	Location-County	Status
Olson	Burleigh	Estimate and design complete
Pembina	Pembina	Estimate and design complete
Apple Creek	Burleigh	Estimate and design complete
Portland	Steele	Construction to be completed
Golden Lake	Steele	Construction to be completed
Lake Oliver	Oliver	Investigation complete Estimate and design pending
Noonan	Divide	Investigation complete Estimate and design pending
Schmisek Lake	Divide	Investigation complete Estimate and design pending
Bowbells	Burke	Investigation complete Estimate and design pending
Wildwood Lake	McLean	Investigation complete Estimate and design pending
Mirror Lake	Ransom	Investigation pending
Valker	Ward	Investigation complete
Island Park	Cass	Investigation complete
Riverside Park	Grand Forks	Investigation complete
Buffalo Lodge	McHenry	Construction to be completed
Crosby	Divide	Investigation complete
Jackson	McKenzie	To be repaired
Twin Lakes	Williams	Investigation complete
Mirror Lake	Hettinger	Investigation pending
State Training School	Morton	Investigation pending
Fort Totten Narrows	Ramsey	Investigation pending
Enderlin	Ransom	Construction to be completed
Johnson (Tolna No. 1)	Nelson	Construction to be completed
Minto	Walsh	Construction to be completed
Beaver Creek	Stutsman	Investigation in progress
Alexander	Dickey	Investigation complete
Hyatt Slough	Stutsman	Investigation in progress
Metigoshe	Canada-U.S.	Investigation in progress

CONSTRUCTION AND RECONSTRUCTION DRAINS OR IRRIGATION FACILITIES

The water resources program as proposed in North Dakota has as its principal objective, insofar as agriculture is concerned, the control of our water so as to provide maximum production from our rich soils. In many areas of the state some of our best agricultural lands are subject to periodic flooding from the spring snow melt and periods of heavy rainfall. As a result many drainage ditches have been constructed that provide for the removal of this excess water thereby permitting the cultivation of the land. Greatest emphasis on the drainage program exists in the Red River Valley area. Here in the former lake bottom of glacial Lake Agassiz the extremely flat terrain provides a poor drainage pattern that must be improved if the rich potential of the area is to be consistently realized. Over the past 50 years many drainage ditches have been constructed in the valley by the landowners. These drains have paid for themselves many times by making land available for cultivation that otherwise would often be useless because of inundation by floodwaters.

The Red River Valley area in North Dakota is similar to many other areas in the country in at least one respect—that is it is subjected to periods of drougth. It has been the experience in the past that during such periods the development and maintenance of the drainage system has been neglected. During the 1930's this condition was particularly aggravated. Then there was no need for drainage and, in addition, there was not sufficient ready cash available to those who wished to prepare for the floods they were sure would come. As a result many of the drainage ditches that had been constructed were neglected and rendered useless when they were filled with brush, trees, blowing sand and other debris.

In 1943 and 1944 the wet years returned and because of the neglected drainage system the flood damages were severe. Department of Agriculture statisticians estimated that in 1943, 634,000 acres of land were damaged in six valley counties by the floodwaters resulting in a loss of $10,852,000. In 1944 they estimated 1,026,000 acres were damaged in ten counties at a loss of $13,565,000. During the period 1943 to 1953 it is estimated the loss from inadequate drainage to be almost $60 million.

In 1905 a study of the drainage problem in the Red River valley was made by John T. Stewart of the Department of Agriculture with the assistance of the North Dakota State Engineer. It was his recommendation that 1,820 miles of main drains be constructed in the counties of the valley excluding Richland. Including Richland county it has been estimated the total would exceed 2,000 miles. These drains would benefit more than 1¾ million acres. Up to 1955 about half of the main drains needed have been constructed. During the ten year period ending in 1955 a total of 3,176 miles of main drains,

laterals and farm drains were constructed or rehabilitated involving the movement of more than 18,600,000 cubic yards of earth.

In the early 1940's when the need for the reconstruction and repair of the many drains in the state became apparent it was found that the costs of the work would, in many cases, be beyond the ability of the landowners to raise. Recognizing this problem and the importance to the state of attaining full production from these flood damaged lands the North Dakota legislature, in 1943, appropriated $50,000 to the State Water Conservation Commission to assist counties and drainage districts in their drainage program. Since that time a total of $1,010,000 has been appropriated for the Commission's program of assisting drainage districts.

Funds appropriated to the State Water Conservation are allocated to counties who require assistance on the basis of their need and requests. The allocations are set up on the basis of the county or district paying 60% of the cost and the state 40%. State funds are available for matching construction costs only. Rules and regulations for administering the state's drainage program have been adopted and are available at the office of the State Water Conservation Commission.

In addition to the drainage phase of this program the funds appropriated are also available to assist irrigation districts. Several districts have been allocated funds for the repair of their facilities, although these expenditures compose only a small portion of the total appropriation.

During the winter of 1955-56 the Commission authorized a program of channel straightening for the Sheyenne River that was completed on 36 miles of the river. Cass County cooperated with the State Water Conservation in this work. The obstructions that were removed from the river channel in this program has greatly increased the capacity of the Sheyenne River thereby alleviating the flow of flood waters from the agricultural lands.

Of the amount appropriated $703,383.96 has been paid to 17 counties and other entities as a share of the costs of constructing more than 145 separate projects. In addition almost $70,000 has been allocated by the Commission for other projects under construction or planned and $190,000 is available for future work. Funds appropriated to the Commission have varied with the need and demand from the individual counties and districts. In 1955 the North Dakota Legislature in appropriating funds to the State Water Conservation Commission for drainage purpose appropriated $200,000 as a continuing appropriation and not for a specific biennial period. This procedure was recommended because of the difficulty in maintaining the continuing program necessary under the biennial period appropriation basis. Under the present arrangement the future appropriations can be more accurately requested on the basis of remaining funds and current demands. Because the demand during the past biennium has not been too extensive the

Commission's appropriation request will be scaled down to $50,000, the lowest request since the program was inaugurated. It is the Commission's recommendation that this continuing fund be retained and the available balance in the fund be augmented by legislative appropriations as is required.

The following schedules indicate the expenditures from the State Water Conservation Commission drainage appropriations during the past biennial period and since 1943.

DRAINAGE EXPENDITURES
July 1, 1952 - June 30, 1956

County and Drain	State Share	District Share	Total Cost
Cass			
No. 146	$ 8,694.15	$13,041.15	$ 21,735.30
No. 47	10,719.38	16,079.07	26,798.45
Sheyenne R. Clearance	12,883.85	14,973.02	27,856.87
	$32,297.38	$44,093.24	$ 76,390.62
Dickey			
Elliot No. 1	$ 319.19	$ 480.62	$ 799.81
	$ 319.19	$ 480.62	$ 799.81
Grand Forks			
Falconer Twp. No. 3	$ 452.61	$ 678.91	$ 1,131.52
Falconer Twp. No. 4	954.08	1,431.13	2,385.21
Falconer Twp. No. 5	346.94	520.40	867.34
Rye Twp. No. 3	411.06	616.58	1,027.64
No. 27	3,744.04	5,616.06	9,360.10
	$ 5,908.73	$ 8,863.08	$ 14,771.81
Ramsey			
Lake Alice—Lake Irvine	$ 1,056.25		$ 1,056.25
	$ 1,056.25		$ 1,056.25
Richland			
Kjos	$ 869.00	$ 869.00	$ 1,738.00
No. 6	3,076.86	4,615.24	7,692.10
No. 7	773.40	1,160.10	1,933.50
No. 62	4,404.59	6,606.88	11,011.47
	$ 9,123.85	$13,251.22	$ 22,375.07
Sargent			
No. 6	$ 1,582.00	$ 2,373.00	$ 3,955.00
	$ 1,582.00	$ 2,373.00	$ 3,955.00
Traill			
Leirness No. 34	$17,222.88	$25,834.33	$ 43,057.21
	$17,222.88	$25,834.33	$ 43,057.21
Walsh			
No. 28	$ 1,940.38	$ 3,010.56	$ 4,950.94
	$ 1,940.38	$ 3,010.56	$ 4,950.94
TOTAL ALL COUNTIES	$69,450.66	$97,906.05	$167,356.71
	$69,450.66	$97,906.05	$167,356.71

SUMMARY OF DRAINAGE APPROPRIATIONS AND EXPENDITURES — 1943-1955

County or Irrigation District	1943-1945 $50,000 Approp.	1945-1947 $240,000 Approp.	1947-1949 $200,000 Approp.	1949-1951 $150,000 Approp.	1953-1957 $90,000 Approp. Expenditure	1953-1957 $140,000 Approp. Allocation	Expenditures	Continuing Appropriation $200,000	Total $1,070,000 Unexpended Allocation Available	Appropriated Expenditure
Barnes	$	$	$	$	$ 3,838.72	$ 1,600.00	$	$	$ 1,600.00	$ 3,838.72
Bottineau		2,785.31								2,785.31
Cass	8,930.00	72,171.51	27,823.73	19,446.82	38,288.87	39,800.00	10,719.38		29,080.62	177,380.31
Cavalier				1,595.93	4,856.85					6,452.78
Dickey					3,797.82					3,797.82
Grand Forks	1,954.12	7,820.92	4,618.74	1,415.25	1,792.00	12,964.69	5,908.73		7,055.96	23,509.76
Morton	2,995.00									2,995.00
Pembina	3,760.00	11,212.19	3,945.38	83,013.39	3,100.32	6,500.00			6,500.00	105,030.98
Ramsey						1,056.25	1,056.25			1,056.25
Richland	27,001.01	70,782.51	343.12	18,150.93	6,848.34	10,000.00	7,481.45		2,518.55	130,607.36
Sargent			2,436.55	1,227.94	32.00	7,000.00	1,582.00		5,418.00	5,278.49
Traill	2,350.00	30,756.83	58,847.26	12,331.98	5,996.30	23,641.21	17,222.88		6,418.33	127,505.75
Walsh	3,009.87			4,453.07		1,940.38	1,940.38			9,403.32
Walsh-Pembina		38,964.93	4,324.85							43,289.78
Ward						7,200.00			7,200.00	
Burlington Irrigation Project			2,144.80							2,144.80
Eaton Flood Irrigation District			420.00		2,451.19	320.00			320.00	2,871.19
Lewis & Clark Irrigation District			8,456.35							8,456.35
Sheyenne River Clearing						12,914.32	12,914.32			12,914.32
Sioux Irrigation District		4,816.64	614.64	1,479.78						6,911.06
Flood Control Projects								72,000.00	72,000.00	
Snagging and Clearing						11,691.43	11,691.43			11,691.43
Miscellaneous and Unallocated		140.44	13,979.51	1,343.23		15,063.15		148,000.00	163,063.15	15,463.18
	$ 50,000.00	$239,451.28	$127,954.63	$144,458.32	$ 71,002.91	$140,000.00	$ 70,516.82	$200,000.00	$301,174.61	$703,383.96

SNAGGING AND CLEARING

Prior to the construction of Homme Dam at Park River and the Baldhill Dam north of Valley City, the State Water Conservation Commission gave assurances to the Corps of Engineers that the channels below these structures would be kept reasonably free of obstructions caused by trees, brush and miscellaneous debris.

During the past biennium, many obstructions in the water courses of the Sheyenne River in Cass County and on the Park River in Walsh County have been brought to the attention of the State Water Conservation Commission by the Corps of Engineers. Therefore, as a start toward the solution of this problem, the State Water Commission has inaugurated a snagging and clearing program of the Sheyenne River in cooperation with Cass County. Work was commenced in November of 1955 and work was stopped when the spring runoff started. From November to April, 36 miles of the Sheyenne River from the mouth to Horace was completed at a cost of $24,000. Of this amount, 60% was contributed by Cass County in the form of equipment and labor and the remainder by the State Water Commission in the form of equipment and supervision.

Snagging and clearing consisted of sawing down trees, the blasting of stumps, removal of dead falls and the removal of the refuse. In addition action has been taken to replace unsatisfactory bridges and to enforce the laws prohibiting the dumping of refuse into the channel of the stream.

During the spring runoff, it was determined by the U. S. Geological Survey's stream gaging station at West Fargo that the river stage was reduced 1½ feet at a 1500 c.f.s. discharge from the previous year's discharge. This study has shown that the snagging and clearing program has justified the expenditure made. The remainder of the Sheyenne River in Cass County will be completed this winter. Also anticipated in the future are similar programs on the Park River in Walsh County and the Pembina River in Pembina County.

GOLDEN LAKE PROJECT

In addition to the construction, reconstruction and maintenance of dams and drains the State Water Conservation Commission has initiated construction on the Golden Lake Project in Steele County. Under this project it is proposed to divert water from the Beaver Creek through a two mile long canal to restore the level of Golden Lake and thereby enhance its possibilities as a recreational and fish and wildlife conservation and propagation area. Actual construction of the project facilities got underway in June and it is expected that the entire project will be completed during the current construction season. The estimated cost of the project including right-of-way costs, construction of a diversion dam in Beaver Creek and the diversion canal is $100,000. The State Game and Fish Department and the Golden Lake Restoration Corporation are cooperating in the project with the Commission. The State Water

Conservation Commission is limiting its cooperation to a share of the costs of constructing the dam in Beaver Creek. The State Game and Fish Department, through its Federal Aid Division, and the Golden Lake Restoration Corporation are financing the balance of the costs.

Initial construction consisted of placing the earth embankment material for the Beaver Creek dam. Scheduled as the next phase of the project will be the construction of the reinforced concrete spillway for the dam and proceeding concurrently will be the excavation of the diversion canal. All earth work for the project has been contracted and the spillway for the dam will be constructed by the State Water Conservation Commission crew.

When completed the project will serve to divert 5,427 acre feet of water initially into Golden Lake and thereafter sufficient water annually to maintain the level of the lake. The restoration project also includes a proposal to divert water into Rush Lake so as to establish that lake as a water fowl nesting area. Through this diversion the Golden Lake would be raised about 15 feet over its 1954 level. The project report prepared by the State Water Conservation Commission stated that during extended drought periods as were experienced during the 1930's the water supply in Beaver Creek would not be sufficient to provide the requirements for Golden Lake, however in normal years the supply would be adequate to provide for the full operation of the project. When restored Golden Lake will cover an area of 330 acres compared to its present size of 301 acres. The lake will have a maximum depth of about 19 feet. In addition Rush Lake will cover an area of 278 acres with a depth of 2½ feet. The canal for the project will have a capacity of 43 cubic feet per second.

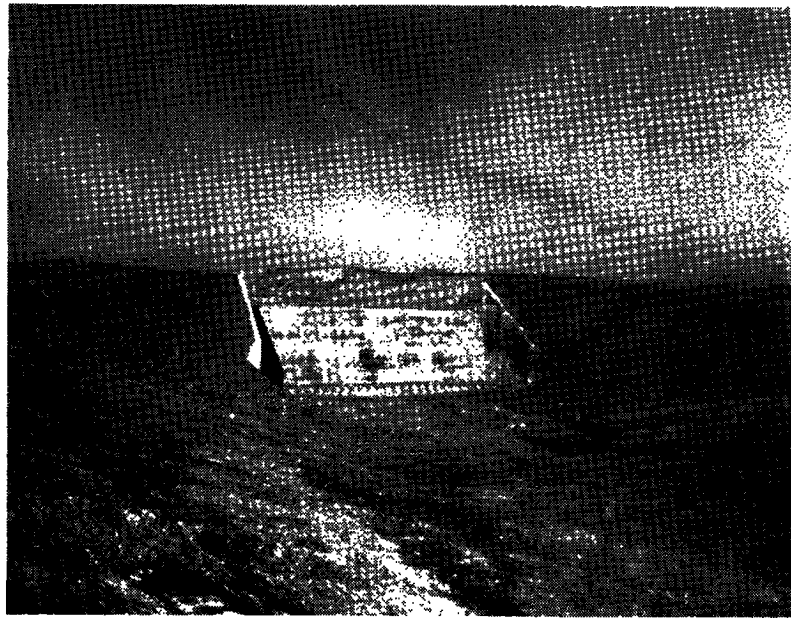
Noteworthy in connection with the Golden Lake Project is the organization and effort of the local proponents in providing their share of the costs. A non-profit corporation known as the Golden Lake Restoration Corporation consisting of citizens from the entire area was set up. Each community was assigned quotas of funds to be raised for the project. Through various promotions approximately $20,000 was raised which has been used to provide the necessary right-of-way for the project, development of recreational facilities and other features of the project.

MIRROR POOL

The Mirror Pool project is located about 20 miles southeast of Enderlin along the Sheyenne River in Ransom County. The project was constructed originally as a recreation project but in more recent years has been utilized by the State Game and Fish Department in their fish propagation program. Facilities included in the project are a dam adjacent the Sheyenne River that impounds water from a spring to create Mirror Pool which covers about 3 acres that is 13½ feet deep. A diver-

sion from a spring fed creek was made whereby Horseshoe is filled to a 3 feet depth.

In operating this fish propagation project the State Game and Fish Department experienced difficulty in the fish escaping from Mirror Pool into a shallow lake where they were subject to winter kill. In 1955, in cooperation with the State Game and Fish Department, the Commission installed a sheet steel piling wall 200 feet long, two structures and an earth dam that would prevent the fish from escaping from Mirror Pool. In 1956 the project was developed further to include two 6 inch aluminum siphons that are used to drain Mirror Pool permitting the removal of the fish for propagation purposes. Future proposals for the project include construction of an outlet structure and canal at Horseshoe Lake in order to permit the draining or filling of that lake as desired.



Danzig Dam Spillway

INVESTIGATIONS

SMALL PROJECTS

With the enactment of Public Law 984 by the 84th Congress provided legislation for the development of Small Irrigation projects. This legislation provides that a state or local agency can obtain interest-free loans for small irrigation projects for the amount in excess of 25% of the reimburseable costs for a project planned and investigated by the group proposing the project if the total cost of the project does not exceed $5,000,000. Features of any such project that are of the nature that they are non-reimburseable will be paid for by the Federal government in the same manner as is the case in larger projects developed by the Federal government. The balance of the reimburseable cost would be repaid over a 50 year period under a repayment contract with the Department of Interior.

The Small Project Law sets up a new concept of irrigation development that should be of extensive value to the State of North Dakota. Under the provisions of the bill it will be possible to develop several of our attractive irrigation projects that heretofore have been neglected because of difficulty in financing the projects in that the high federal costs in comparison to benefits could not justify construction of the project. It can be expected that several of the proposed projects in North Dakota will be developed under this program in the next few years.

The State Water Conservation Commission has made a preliminary reconnaissance of some of the small project possibilities and have determined that these are at least 25 possible small projects in the state that would provide irrigation for about 137,000 acres. The total estimated construction cost would be between 16 and 25 million. A list of these projects is on a following page.

This list does not include all the possibilities in the state. As investigations are made there undoubtedly will be several more projects proposed that will fall in the small project category.

SMALL PROJECTS

No.	Project Name & County	Source of Water Supply	Water Supply Facilities	Preliminary Estimated Project Cost	Number of Irrigable Acres	Crop Return/Acres		Increased Crop Return Thru Irrigation
						Dry Land	Irrigated	
1	Yellowstone Pumping (McKenzie)	Yellowstone River	Pumping From River	$ 180,000	1,800	$15[1]	$55[2]	$ 72,000
2	Cartwright (McKenzie)	Yellowstone River	Pumping From River	200,000	1,810	15	55	72,400
3	Sioux (McKenzie)	Yellowstone River	Pumping From River	50,000	500	15	55	20,000
4	Williston (Williams)	Garrison Reservoir	Pumping From Reservoir	1,100,000	9,100	15	50	318,500
5	Nesson Valley (Williams and Mountrail)	Garrison Reservoir	Pumping From Reservoir	570,000	6,000	15	55	240,000
6	Shell Creek (Williams and Mountrail	Garrison Reservoir	Pumping From Reservoir	300,000	2,800	15	50	98,000
7	Hancock Flats (McLean)	Missouri River	Pumping From River	600,000	5,400	15	50	189,000
8	Oliver-Sanger (Oliver)	Missouri River	Pumping From River	750,000	6,880	15	55	275,200
9	Painted Woods (McLean)	Missouri River	Pumping From River	370,000	3,680	15	55	147,200
10	Manley (Oliver)	Missouri River	Pumping From River	225,000	2,160	15	55	86,400
11	Wogansport (Burleigh)	Missouri River	Pumping From River	250,000	2,400	15	55	96,000
12	Square Butte (Oliver)	Missouri River	Pumping From River	275,000	2,750	15	55	110,000
13	Burnt Creek (Burleigh)	Missouri River	Pumping From River	200,000	1,940	15	55	77,600
14	Bismarck (Burleigh)	Missouri River	Pumping From River	475,000	5,000	15	55	200,000
15	Little Heart (Morton)	Missouri River	Pumping From River	400,000	3,900	15	55	156,000
16	Glencoe-Stout (Emmons)	Missouri River	Pumping From River	230,000	2,100	13	50	77,700
17	Long Lake-Kyes (Emmons)	Missouri River	Pumping From River	250,000	2,100	14	50	75,600
18	Horsehead Flats (Emmons)	Missouri River	Pumping From River	1,000,000	9,710	15	50	339,850
19	Winona (Emmons)	Missouri River	Pumping From River	550,000	5,500	15	50	192,500
20	Fort Yates (Sioux)	Missouri River	Pumping From River	800,000	7,650	15	50	267,750
21	Little Missouri (Slope, Bilings, McKenzie	Little Missouri River	Pumping From Reservoir	3,000,000	20,000	13	40	540,000
22	Knife River Diversion (Mercer)	Garrison Reservoir	Pumping From Reservoir	1,800,000	13,500	14	50	486,000
23	Cannonball (Grant)	Cannonball River	Pumping From Reservoir	1,860,000	12,400	13	45	396,800
24	Bowman-Haley (Bowman-Adams)	Grand River	Pumping From Reservoir	750,000	5,000	12	40	140,000
25	Big Meadow (Williams)	None	Reclaimed by Pumping	112,000	2,810	10	40	84,300
	TOTALS			$16,297,000	136,890			$4,758,800

[1] Estimated Crop Return for Project Area, Dry Land
[2] Estimated Crop Return for Project Area. Irrigated

FLOOD PROTECTIVE WORKS

The State Water Conservation Commission has as one of its responsibilities that of "to control and regulate flood flow in the streams of the state to minimize the damage of such flood waters". During the past biennium and since its organization the Commission has been active in promoting the construction of facilities that will provide flood protection for several communities in the state. Most of the effort of the Commission has been concentrated in the cooperative program with the various counties in the construction of drains, with Corps of Engineers in the various protection projects discussed in another section of this report and with the Soil Conservation Service in their Watershed projects.

It has been the Commission's experience that the facilities constructed by these Federal agencies are excellent and provide the protection for which they are designed. However, the time required from getting such a project authorized until it is constructed and placed in operation is often extensive with the result that relief from flood damages is not obtained as quickly as is desired. In other cases projects require an integration of the proposals of both Federal agencies and the State in order to provide complete protection. The state through the State Water Conservation Commission has investigated several projects in recent years for which the cooperative approach appears to offer the best solution.

MAUVIS COULEE PROJECT

During the past several years investigations of the flood and drainage problem in Ramsey, Pierce, Towner and Benson counties have been conducted by the State Water Conservation Commission and various Federal agencies. The problem stems from the fact that Mauvis Coulee, which drains from 800 to 1,000 square miles of area located in these counties became partially filled with drift material during the drought period and during the recent years of heavy runoff the capacity has not been sufficient to provide the necessary drainage. Mauvis Coulee drains this area into Devils Lake. During nine out of the last 12 years approximately 20,000 acres of good farmland in the Lake Alice, Lake Irvine area in Ramsey county have been inundated from the surplus floodwaters preventing any production from these lands.

Through efforts on the part of the State Water Conservation Commission the Corps of Engineers and Soil Conservation Service have began surveys for the project in order to determine an overall solution to the flood problem. In the meantime the State Water Conservation Commission has cooperated with the local Water Conservation and Flood Control District to provide facilities that will afford partial relief from the damages and still be incorporated in the overall project. During the winter of 1954-1955 the Commission cooperated with the U. S. Fish and Wildlife Service in blasting a channel between Lake Alice and Lake Irvine that permits the more rapid flow of water out

of the Lake Irvine area. The cost of this work was $2,112.50 that was shared equally by these two agencies.

The Commission at the request of the local Water Conservation and Flood Control Districts are preparing a plan to provide for the increased capacity and a controlled flow in Mauvis Coulee through the installation of laminated box culverts at the outlet of Lake Alice into Mauvis Coulee and the installation of larger bridges over the coulee. Also included is a partial clean out of the coulee channel and possibly a cutoff from the channel into six-mile bay of Devils Lake rather than discharging the water into western portion of Devils Lake in Benson county.

HYATT SLOUGH DIVERSION PROJECT

Hyatt Slough is located in Sections 25 and 36, Township 129 North, Range 60 West, just north of the South Dakota border about 12 miles south and west of the city of Oakes.

The North Dakota State Game and Fish Department purchased this property for the establishment of a duck propagation and a public shooting area. This shooting area is primarily for migratory waterfowl and consequently water in the area is of prime importance. Hyatt Slough is now dry as the backwater is prevented from flowing north by the dike system.

The Game and Fish Department requested the assistance of the State Water Conservation Commission in an effort to make waters available to the Hyatt area. A survey was again made relative to the problem. The survey revealed that a diversion ditch from the James River to Hyatt Slough would supply ample water for replenishing of the duck propagation and shooting area.

Plans have just been completed on the Hyatt Slough project. The proposed diversion ditch would run on the north side of the east-west county road on the North Dakota - South Dakota border. The ditch is approximately 5,300 feet long and requires 17,500 cubic yards of excavation. Arrangements have been made with Dickey county and Brown county to have the spoil placed in the county road grade raising the low spots on the present roadway.

The ditch will have a capacity of 30 c.f.s. when the James River is at flood stage. The outstanding feature of the project is a combination highway crossing and control structure. The control structure is equipped with automatic flood gates which will permit water to enter Hyatt Slough during times of high flow and will close to retain the water in Hyatt Slough after the highwaters recede. A farm crossing will also be provided near the James River for access to farm lands from the county road.

This diversion would fill Hyatt Slough with water to elevation 1,288 (see level datum). At this elevation, the slough would have approximately 400 acres under water with an average depth of three

feet. This would be ample water to fulfill its purpose as a public shooting area. The estimated total cost of this project is $8,000.00

GROUNDWATER INVESTIGATIONS

In addition the regular cooperative groundwater survey program the State Water Conservation Commission has in effect with the U. S. Geological Survey investigations to determine the availability of groundwater supplies for irrigation and municipal purposes have been undertaken by the Little Missouri River in southwestern North Dakota and in the vicinities of Bowbells, Sherwood and Crosby in northwestern North Dakota.

LITTLE MISSOURI GROUNDWATER INVESTIGATIONS

At the request of local proponents for irrigation development along the Little Missouri River the State Water Conservation Commission conducted a survey of the Little Missouri River Bottoms from Medora to the South Dakota border. The Commission's mobile drill rig was used in the survey. A total of 72 test holes varying in depth from about 25 feet to 70 feet were drilled to determine if an underground acquifer existed in this area that could be developed. The survey indicated that the water bearing materials were very limited in size and thickness and did not provide an adequate source of water that could be developed for irrigation.

The U. S. Geological Survey cooperated with the Commission in making this study by analyzing the samples of materials obtained and providing the technical supervision required.

MUNICIPAL WATER SUPPLIES

The State Water Conservation Commission during the summer of 1956 utilized its rotary test drill rig in connection with investigation for municipal water supplies for the cities of Crosby, Bowbells and Sherwood. The purpose of these investigations was to either locate an adequate groundwater supply or find a means whereby the surface water in rivers and streams in the vicinity could be utilized.

SHERWOOD

A promising water bearing acquifer was located approximately three miles northeast of the city of Sherwood. Investigations were made in an effort to trace the acquifer at points located closer to Sherwood. This was done in an effort to reduce the amount of pipe that would be required to convey water from the distant location. Indications are that a very fine supply of water can be tapped within three-fourths of one mile of this city. The tests are expected to be made in the very near future in an effort to determine the quantity of water available at this site. The tests will be performed by commercial well drilling firms.

CROSBY

The present water supply being utilized by the city of Crosby is high in mineral content and undesirable for lawn, irrigation, or gardens. The quality is not too potable for domestic purposes. The Commission was asked to make investigations in the area to determine whether or not a more potable supply of water could be obtained. Drilling operations were performed in the vicinity of the Long Creek reservoir, which is located approximately three and one-half miles north of the city of Crosby. Indications are that potable acquifers may be encountered in the immediate vicinity of the Long Creek Dam. It has been recommended that quantity and quality tests be run on this water supply to determine whether or not an adequate supply exists for the city of Crosby. It seems reasonable to assume that this acquifer is being fed from the Long Creek reservoir. Should the supply be found to be adequate and of good quality, additional storage could be obtained in the Long Creek reservoir by adding eighteen inches on to the spillway crest of the Long Creek Dam. Examinations showed that the spillway was structurally sound and that the spillway elevation could be raised without detrimental effects upon the structure.

BOWBELLS

Several damsites were examined in the vicinity of Bowbells in an effort to locate sites where water could be entrained into water bearing acquifers. Surveys were made on several storage sites. Water surveys were made on several reservoir sites. No success was had in locating water bearing stratas adjacent to the sites. The drilling operations were limited to the fifty foot depths obtainable through the use of the Commission's rotary drill.

PORTLAND

In September, 1955, representatives of the city of Portland accompanied by their consulting engineer appeared before the State Water Conservation Commission relative to the municipal water shortage that had developed in the community. The consulting firm had previously located a well system near the bank of the Goose River in the Portland community park. Apparently water from the Goose River trickled into the well system through a natural sand and gravel filter. As the water in the Goose River receded, the supply of water in the well diminished. The city was confronted with the problem of entering the winter with inadequate supply of water for domestic and fire protection uses. Water Commission technicians recommended that the city employ a bulldozer to place an earth embankment in the channel in an effort to dam up waters for winter time use. The city acted upon this recommendation and found that their water supply was greatly increased by the impoundment resulting from the earth barrier. The State Water Conservation Commission in cooperation with the city constructed a dam approximately ten feet in height in the Goose River

channel which has improved the city water supply materially. The height of the water in the well has now attained the same elevation as the spillway crest of the Goose River Dam. The city is now assured an ample supply of water which should take care of all future requirements.

SENTINEL BUTTE

Located in the arid southwest of our State, the Village of Sentinel Butte is completely dependent on their dam and reservoir for fire protection water. The failure of this water source could very easily result in the complete destruction of the village by fire.

In the Spring of 1956, the Water Commission, in cooperation with the County of Golden Valley and the village of Sentinel Butte completely rapaired and reintegrated the spillway structure. This structure would, doubtlessly, have failed during the next spill due to severe undermining of the wing walls and the resultant abutment erosion.

PEMBINA RIVER

During the past several years the Corps of Engineers has investigated a proposed dam on the Pembina River to provide flood control for the cities of Neche, Pembina and rural areas in the lower Pembina River Basin.

These investigations have failed to establish a favorable cost-benefit ratio for a dam. During the past biennium the State Water Conservation Commission has cooperated in this project in an effort to increase the feasibility through the diversion of water for irrigation and other benefits.

In connection with the development of the dam one of the main difficulties encountered is the limitations resulting from the available water supply. The Commission has made some preliminary studies on the possibility of diverting water on the Souris River in Canada to increase the water supply of the river.

Prior to the last glacial intrusion, the present Pembina River was actually the lower section of the present Souris River. The glacier blocked the ancient Souris River at the top of its loop, forcing the Souris to find a new outlet to the Red River of the North by way of the Assiniboine River. Even though the flood destruction of these ancient rivers has been reduced, the flood destruction capabilities to North Dakota from both of the present rivers results in a great deal of agricultural and municipal damage to North Dakota.

The flood damage in Manitoba from the present river system is perhaps greater than in North Dakota because now the Souris River contributes considerably to the flood stage in the Assiniboine River which joins the Red River of the North in the city of Winnipeg.

The State Water Commission proposal provides for the diversion of water from the Souris into the Pembina River in Canada by construc-

tion of a diversion dam in the Souris River in Manitoba. Water would be diverted through the ancient channel of the Souris River into the Pembina River where it could be stored and utilized for various beneficial purposes. Such diversion would also reduce the flood stage of the Souris River and the Assiniboine River in Canada.

Once an assured water supply is available in the Pembina River it would be possible to develop a large irrigable area in Pembina County, develop a firm hydro electric supply and also provide recreational opportunities and for municipal and industrial water supply.

In that the Pembina and Souris Rivers are international rivers it would be necessary to effect an agreement between the state of North Dakota and the province of Saskatchewan and Manitoba. The jurisdiction over these rivers is in the International Joint Commission.

The State Water Conservation Commission proposes that the Provinces of Saskatchewan and Manitoba and the State of North Dakota jointly agree on a general plan for the development of this diversion project which can be presented to the International Joint Commission for their consideration.

Test Drill Rig

WATER RIGHTS

North Dakota recognizes both the riparian and appropriation doctrines in relation to the use of water for beneficial purposes. Under the riparian doctrine the owner of land contiguous to a stream has certain rights in the flow of the water by virtue of such land ownership. Under the appropriation doctrine, the first user of the water acquires a priority right to continue the use, and contiguity of land to the watercourse is not a factor. In North Dakota the application of the appropriation doctrine requires the filing of a water right application for the use of water from a watercourse with the State Engineer.

Section 61-0402 of the North Dakota Revised Code provides that "Any person, association or corporation intending to acquire the right to the beneficial use of any waters, before commencing any construction for such purpose, or before taking the same from any constructed works, shall make application to the State Engineer for a permit to appropriate." Chapter 61-04 of the North Dakota Revised Code sets out the provisions and procedure to be followed in obtaining water rights which were outlined in the Ninth Biennial Report of the State Water Conservation Commission.

Since the provision for the appropriation of water was made in the North Dakota Code, in 1905, over 800 water right applications have been filed with the State Engineer for the purpose of irrigation, municipal and industrial use. Water rights established prior to the enactment of the 1905 Law are recognized as valid and vested rights. During the period July 1, 1954, to June 30, 1956, 58 water right applications were filed with the State Engineer, whereby the applicants propose to irrigate 13,140.8 acres of land and to use water for industrial and municipal purposes. During the period of this biennial report, 134 water right applications were approved by the State Engineer and the State Water Conservation Commission. In addition there are on file with the Commission 57 applications that are pending approval that would provide for the irrigation of 12,721.3 acres of land. Of the pending applications, 38 were filed prior to June 30, 1954, and 19 during the biennial period of this report.

RECOMMENDATIONS

It is the recommendation of the State Water Commission that the results of the water right investigation conducted by the Commission during the past biennium be carefully considered by the North Dakota Legislature during the 1957 session in order to enact the necessary corrective legislation that would make our system of water right filings more operative. In addition the Commission would recommend to all of the municipalities in North Dakota that they make a water right filing for their municipal water supply, whether or not they obtain it from surface sources or ground water sources. Provision now exists in the North Dakota Code for filing water right applications on ground water sources which would apply in the case of most of our municipalities in the State. By establishing a water right, these municipalities would be protected insofar as their future right to water is concerned.

WATER-RIGHT FILINGS
Water-Rights Approved Since June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
386	R. C. Lewis, Jr., Fargo	Cass	Sheyenne River	413.0	332.0	3- 8-51
387	Leo L. Anderson, Fargo	Cass	Red River	235.0	182.0	3-14-51
388	William Fowler, West Fargo	Cass	Sheyenne River	90.0	72.0	3-19 51
389	A. L. Nordhougen, Fargo	Cass	Red River	12.5	10.0	3-27-51
397	Donald C. Holand, Lisbon	Ransom	Sheyenne River	1.0	1.0	5- 7-51
425	Eugene E. Johnson and George Gilbert, Lisbon	Ransom	Sheyenne River	165.0	132.3	3- 7-52
432	Alvin Schreiber, Fairmount	Richland	Bois des Sioux, trib. Red River	363.0	290.2	3-31-52
438	Floyd Monteith, Leonard	Richland	Sheyenne River	44.0	35.0	4-29-52
443	M. M. Lunde, Cooperstown	Griggs	Sheyenne River	124.0	98.8	6- 6-52
448	Northwest Nursery Company, Valley City	Barnes	Sheyenne River	206.0	103.0	6-20-52
450	Clayton Pederson, Valley City	Barnes	Sheyenne River	99.0	79.0	7- 1-52
452	Herlof Huso, Aneta	Griggs	Elongated slough, trib. Sheyenne River	104.0	59.0	7 15-52
454	Ole A. Flaat, Grand Forks	Grand Forks	Red River	440.0	441.0	7-31-52
476	F. R. Eddy, Chicago	Stutsman	Pipestem Creek, trib. James River	60.0	40.0	12-30-52
482	Clinton Perhus, Taylor	Dunn	Knife River	70.0	40.0	1-16-53
490	Mike Hlebechuk, Fairfield	Billings	Knife River	70.0	40.0	2- 7-53
494	Arthur Greenberg, Grand Forks	Grand Forks	Red River	490.0	491.0	2-13-53
495	A. W. Gustafson, Marshall	Dunn	Knife River	70.0	40.0	2-14-53
496	Lloyd Butts, Carrington	Foster	Wells	430.0	322.4	2-17-53
498	Andrew Kirsch, Gladstone	Stark	Antelope Creek, trib. Heart River	43.0	21.2	2-24-53
499	Art Anderson, Dunn Center	Dunn	Spring Creek, trib. Knife River	24.0	15.6	2-26-53
500	Matt Neurohr, Dodge	Dunn	Spring Creek, trib. Knife River	19.0	12.7	2-26-53
501	Merle Mattson, Tioga	Williams	Beaver Creek, trib. Missouri River	105.0	70.0	3- 2-53
502	Eldor Bohrer, Valley City	Barnes	Sheyenne River	97.0	77.5	3- 3-53
503	Leo Goetz, Halliday	Dunn	Spring Creek, trib. Knife River	24.0	16.0	3- 9-53

WATER-RIGHT FILINGS
Water-Rights Approved Since June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
504	H. R. Morgan, Bismarck	Richland	Sheyenne River	112.0	89.8	3-11-53
506	Gerald Glynn, Fullerton	Dickey	Maple River, trib. James River	42.0	28.0	3-12-53
507	William J. Miller, Valley City	Barnes	Sheyenne River	91.0	73.0	3-12-53
508	Robert F., Edmond R. and John C. Kadrmas, Dickinson	Dunn	Spring Creek, trib. Green River	39.0	22.0	3-14-53
510	L. C. Hart, Williston	Williams	Little Muddy River, trib. Missouri River	120.0	80.0	3-16-53
511	Orvil P. Gilleshammer, Grafton	Walsh	Red River	178.0	178.0	3-21-53
513	Ralph L. Harmon, Carrington	Foster	Wells	100.0	74.8	3-24-53
514	George Ferebee, Halliday	Dunn	Spring Creek, trib. Knife River	24.0	16.0	3-27-53
515	Henry Loberg, Fargo	Cass	Sheyenne River	50.0	40.0	3-28-53
516	Jacob Gegelmann, Halliday	Dunn	Spring Creek, trib. Knife River	24.0	16.0	3-30-53
520	Olaf Hagen, Williston	Williams	Sand Creek, trib. Missouri River	45.0	30.0	4- 1-53
521	Glenn D. Keff, Williston	Williams	Little Muddy River, trib. Missouri River	120.0	80.0	4- 1-53
522	A. L. Gramlow, Fullerton	Dickey	Maple River, trib. James River	120.0	80.0	4- 2-53
523	Rex Brace, Lisbon	Ransom	Sheyenne River	434.0	347.5	4- 4-53
525	Harold Berger, Williston	Williams	East Fork Little Muddy, trib. Missouri River	75.0	50.0	4-14-53
526a	Herm Allmaras, New Rockford	Eddy	Robinson Coulee, trib. Sheyenne R.	100.0	80.0	4-14-53
526b	Herm Allmaras, New Rockford	Eddy	Sheyenne River		80.0	4-14-53
527	Lloyd Dillon, Buford	Williams	Unnamed Creek	63.0	36.0	4-15-53
528	Alvin E. Foss, Cummings	Traill	Red River	250.0	326.0	4-16-53
529	Orville Haugen, Buford	Williams	Unnamed Creek	42.0	24.1	4-17-53
531	Emmer Folvag, Grenora	Williams	Willow Creek, trib. Cottonwood Creek	25.0	14.5	4-20-53
532	Henry Bartels, Springbrook	Williams	East Fork, Little Muddy, trib. Missouri River	75.0	50.0	4-22-53

534	S. W. Thompson, Bismarck	Eddy	Sheyenne River	120.0	120.0	4-27-53
537	Earl Larson, Fullerton	Dickey	Maple River, trib. James River	58.0	38.5	5- 2-53
538	Eugene Romanyshyn, Belfield	Billings	Knife River	28.0	16.0	5- 5-53
541	A. W. Mosbrucher, Beulah	Mercer	Spring Creek, trib. Knife River	18.0	12.0	5- 6-53
542	Floyd B. Sperry, Golden Valley	Mercer	Spring Creek, trib. Knife River	30.0	20.0	5- 6-53
543	Robert L. Odum, Werner	Dunn	Spring Creek, trib. Knife River	15.0	10.0	5- 6-53
544	Clarence F. Vogel, Lark	Grant	Louse Creek, trib. Cannonball River	203.0	119.9	5-13-53
546	Herbert E. Chase, Hebron	Morton	Little Knife River	57.0	33.0	5-13-53
551	Agnes Cook, Werner	Dunn	Spring Creek, trib. Knife River	25.0	16.6	5-23-53
553	Adam F. Wysocki, Minto	Walsh	Forest River, trib. Red River	71.0	57.5	5-29-53
554	George A. Christie, Minto	Walsh	Forest River, trib. Red River	55.0	44.9	6- 1-53
559	Jacob Schiller, Forest River	Walsh	Forest River, trib. Red River	107.0	75.0	6- 3-53
560	John A. Wagner, Lark	Grant	Louse Creek trib. Cannonball River	63.0	42.0	6- 4-53
561	Roger Johnson, Werner	Dunn	Spring Creek, trib. Knife River	22.0	14.6	6-10-53
563	Vincent Rife, Sheldon	Cass	Maple River, trib. Sheyenne River	36.0	24.0	6-10-53
565	John E. and Norman Saugstad, Fingal	Barnes	Sheyenne River	100.0	80.0	6-11-53
566	Ernest Kapaun, Fargo	Cass	Maple River, trib. Sheyenne River	35.0	23.5	6-13-53
571	Keith Jury, Ellendale	Dickey	Maple River, trib. James River	37.0	24.5	6-24-53
573	Francis J. Archbold, Sheldon	Cass	Maple River, trib. Sheyenne River	51.0	40.5	7-16-53
577	Jay Ullman, Hettinger	Adams	South Fork of Cannonball River	37.5	25.0	8- 3-53
580	Charles H. Lohstretter and Sons, Mandan	Morton	Square Butte Creek, trib. Missouri River	120.0	60.0	9- 5-53
581	Harry Larkin, Rhame	Bowman	Little Missouri River	120.0	80.0	10-17-53
583	A. T. Foreman, Marmarth	Slope	Little Missouri River	112.0	75.0	11- 2-53
585	Art S. Nelson, Northwood	Grand Forks	Groundwater	320.0	453.6	11- 6-53
586	J. Larimore, Jr., Larimore	Grand Forks	Wells	500.0	2391.8	11- 9-53

WATER-RIGHT FILINGS
Water-Right Approved Since June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
587	Peter Schabinger and J. Weingardt, Marmarth	Bowman	Little Missouri River	240.0	160.0	11-12-53
588	Joe Schorsch, New England	Hettinger	North Fork of Cannonball River	18.0	12.0	11-12-53
589	Walter H. Hall, Jamestown	Stutsman	James River	4.5	3.0	12- 3-53
590	Russell Schumacher, New England	Slope	North Fork of Cannonball River	30.0	15.0	12-10-53
591	John Voigt, Shields	Grant	Cannonball River	60.0	40.0	12-11-53
592	Valley City Country Club, Valley City	Barnes	Sheyenne River	100.0	80.0	12-21-53
593	Fred Berger, Watford City	McKenzie	Cherry Creek, trib. Little Missouri River	31.0	21.2	12-31-53
594	Arland Frost, Harvey	Wells	Sheyenne River	27.0	21.8	1- 8-54
595	Lloyd Stewart, Brisbane	Grant	Cannonball River	47.0	30.8	1-15-54
596	Henry Gatzke, Jr., New England	Slope	North Fork of Cannonball River	30.0	15.0	1-20-54
597	Irvin Torgerson, Pettibone	Kidder	A lake with no name	298.0	170.8	1-22-54
599	E. James Boyd, Deering	McHenry	Underground	160.0	160.0	1-30-54
600	Paul Charnetzki, Valley City	Barnes	Sheyenne River	50.0	58.5	2- 8-54
601	James Sandvik, Pettibone	Kidder	A lake with no name	162.0	92.7	2- 8-54
602	Herbert Oberlander, Stanton	Mercer	Knife River	136.0	68.0	2-11-54
603	E. M. Lee, Valley City	Barnes	Sheyenne River	87.0	69.5	2-11-54
605	T. H. Cousins, Carrington	Foster	James River	172.0	137.6	2-27-54
606	T. H. Cousins, Carrington	Foster	Wells	111.0	76.4	2-27-54
607	Osborne Galde, Aneta	Nelson	Sheyenne River	120.0	96.3	3-26-54
608	Werner Hehn, Leith	Grant	Cannonball River	70.0	40.0	4- 5-54
609	Louis Michel, Marmarth	Bowman	Duck Creek, trib. Little Missouri River	76.0	75.9	4- 9-54
610	Art Kongslie, Upham	McHenry	Deep River	45.0	30.0	4-21-54
611	Leo L. Anderson, Fargo	Ransom	Wells	240.0	160.0	4-23-54
612	Maurice Flatness, Marmarth	Slope	Little Missouri River	225.0	150.0	4-30-54
613	Howard White, Bowman	Bowman	Spring Creek, trib. Grand River	20.0	20.0	4-30-54
614	Alwin C. Carus, Oakdale	Dunn	Intermittent stream, trib. Little Missouri River	420.0	210.3	5-17-54

615	Richard Quast, Grand Rapids	LaMoure	Groundwater and James River	100.0	80.0	5-17-54
616	Adolph Hauck, Wilton	McLean	Goose Creek, trib. Missouri River	35.0	20.0	5-17-54
617	Levon Olson, Grand Forks	Grand Forks	Red River	90.0	90.2	6- 3-54
618	M. W. Thatcher, St. Paul	Williams	East Fork Creek and Little Muddy Creek, trib. of Missouri River	75.0	50.0	6- 7-54
619	A. F. Nagel, Lisbon	Ransom	Sheyenne River	104.0	83.0	7-13-54
622	F. O. Beck, Bismarck	Burleigh	Missouri River	33.0	21.9	8- 4-54
623	Arne Nelson, Grenora	Divide	Unnamed Creek	62.0	31.0	8-27-54
624	Lewis Larson, Grenora	Williams	Two Unnamed Creeks	95.0	47.8	8-27-54
625	Victor Schmidt, Flasher	Morton	Dog Tooth Creek	35.0	20.0	9-15-54
626	T. Clem Casey, Bismarck	Burleigh	Old Ox Bow in Apple Creek	70.0	40.0	9-24-54
627	William Wolf, Center	Oliver	Square Butte Creek	60.0	40.0	11-26-54
628	Stephen J. Dunn, Center	Oliver	Missouri River	103.0	51.6	1-18-55
629	Valley City State Teacher's College	Barnes	Sheyenne River	66.0	44.0	1-24-55
630	Stephens Brothers, Hazen	Mercer	Knife River	190.0	95.0	1-17-55
631	James F. Hazard, Cooperstown	Griggs	Sloughs on Hazard property	285.0	190.0	2-23-55
632	Leonard Hovland, Northwood	Grand Forks	Goose	36.0	24.0	2-24-55
635	Ben F. Thomas, Hazen	Mercer	Knife River	120.0	60.0	3-10-55
636	George Lenno, LaMoure	LaMoure	James River	72.0	47.6	5-14-55
639	Ivan Shafer, Oakes	Dickey	James River	72.0	47.1	5-18-55
640	Loyd Amsbaugh, Springbrook	Williams	Stony Creek	23.0	15.0	5-20-55
641	Martin Thompson, Charles M. Code, Robert Jodsaas, William M. Jones, C. A. Berlin and Richard Rustvang, Lisbon	Ransom	Sheyenne River	1.0	1.0	5-26-55
643	Benedictine Sisters of the Annunciation, Bismarck	Stark	Green River	23.0	38.0	6- 9-55
644	Henry Gatzke, New England	Slope	Underground	40.0	30.0	6-24-55
646	Gilmore Severson, Buxton	Traill	Red River	182.0	145.5	6-29-55
647	City of Bismarck, Bismarck	Burleigh	Missouri River	50 M g.p.d.		6-20-55
648	Glenn E. Penfield, Rutland	Sargent	Silver Lake	125.0	83.0	7-27-55
650	Louis Whetfield, Oakes	Dickey	James River	254.0	203.6	9- 8-55
652	Oliver L. LaVoy, Fargo	Barnes	Sheyenne River	2,534		9-23-55
653	Stuart Herzberg, Valley City	Barnes	Sheyenne River	101.0	81.0	9-27-55

WATER-RIGHT FILINGS
Water-Rights Approved Since June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
655	Anton Schulz, New England	Slope	Phil Brick Creek	77.0	44.0	11- 9-55
656	Liel Beeber, Dickey	LaMoure	James River	100.0	79.8	9-22-55
657	Sheyenne Development Farm, Sheyenne	Eddy	Sheyenne River	250.0	109.6	12-12-55
659	Central Power Electric Cooperative	McHenry	Wells, Groundwater	9 c.f.s.		2- 3-56
660	Russell Miller Milling Co.	Ward	Mouse River	723.8		2- 6-56
663	Westland Oil Co., Williston	Williams	Little Muddy	240 a.f.		2-17-56
665	Albert Lorenz, Dodge	Dunn	Spring Creek	18	12	3-22-56

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1956

Applied for Before June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
296	Wendel Sand, Gladstone	Dunn	Deep Creek, trib. of Knife River	120	60	5- 8-47
297	W. T. Krebsbach, Reeder	Slope	Cedar Creek, trib. of Cannonball River		40	5-31-47
312	J. E. Harding, Medora	Billings	Little Missouri River	492	246	7-30-49
313	D. L. McLeod, Medora	Billings	Little Missouri River	328	164	8- 3-49
316	Georgia Olsen, Medora	Billings	Little Missouri River	584	292	8-15-49
318	Ray Schnell, Dickinson	Stark	Heart River	754.6	603.7	8-29-49
345	Olaf Falkvold, Skarr	McKenzie	Poison Spring Creek and trib.	2,000	200	5- 8-50
346	Edward F. Pfliger, Carson	Grant	Heart River			
356	Paul Motzko, Buford	Williams	Eight Mile Creek trib. Missouri River	512	256.3	9- 9-50
399	Donald Novak. Alexander	McKenzie	Lewis & Clark Drain Ditch, Missouri River	133.2	66.6	6- 1-51
408	Henry Knudsen, Cartwright	McKenzie	Charbonneau Creek, trib. Yellowstone River	160	80.0	9- 4-51
427	T. Clem Casey, Bismarck	Burleigh	Apple Creek, trib. Missouri River	326	163.2	3-19-52
449	Sunset Memorial Gardens Inc., Fargo	Cass	Red River			6-28-52
455	E. W. Kjorlien, Warwick	Benson	Wells	2,186	1,093	8- 3-52
474	Wallace Pelton, Dunn Center	Dunn	Spring Creek, trib. Knife River	129.0	64.5	12-20-52
488	Anton Kadrmas, Manning	Dunn	Knife River	158.2	79.1	1-31-53
489	Roy L. Peterson, Minot	Ward	Souris River	675 g.p.m.		2- 5-53
545	Joe E. Bosch, Dodge	Dunn	Fish Creek, trib. Knife River	108	64.0	5-13-53
547	Ronald Wagner, Englevale	Ransom	Underground	600	480	5-15-53
548	Orrin R. Streich, Englevale	Ransom	Underground	200	160	5-15-53
549	August J. Wagner, Englevale	Ransom	Underground	3,838	3,070	5-15-53
*557	Stanley Metelmann, Walhalla	Cavalier	Pembina River	172.8	86.4	6- 2-53
562	Roger Johnson, Werner	Dunn	Deep Creek, trib. Spring Creek	64.4	32.2	6-10-53

* Deferred

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1956
Applied for Before June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
*567	Karrie Nelson, Walhalla	Pembina	Pembina River	127.4	63.7	6-16-53
570	State Hospital, Jamestown	Stutsman	James River	352	176	6-23-53
576	Peter Storholm, Cartwright	McKenzie	Chaney Creek, trib. Yellowstone River	350	296.6	8- 1-53
*584	Art S. Nelson, Northwood	Grand Forks	Goose River trib. to Red River	320	384.5	11- 6-53
682a	American Crystal Sugar		Sheyenne River	1,228 to 1841		6- 4-48
b	City of Fargo	Cass	Sheyenne River			6- 5-48
c	City of Grand Forks	Grand Forks	Sheyenne River	4,660		6- 8-48
d	Great Northern Railroad	Richland	Sheyenne River	50,000 g.p.d.		6- 9-48
e	Northern Pacific Railroad	Barnes	Sheyenne River	250		
f	Soo Line Railroad	Barnes	Sheyenne River	21.5		6-14-48
g	Northern States Power	Cass	Sheyenne River	500		6-14-48
h	Union Stock Yards	Cass	Sheyenne River	1,500,000 g.p.d.		6-28-48
i	Valley City	Barnes	Sheyenne River	2,000		3-22-49
j	Lisbon (Contrib. to Baldhill Dam)	Ransom	Sheyenne River			
k	Southwest Fargo	Cass	Sheyenne River	219.0		7-23-48
*633	Harold Gowin, Glenburn	Ward	Little Deep Creek	276	138.2	2-24-55
*634	Harold Gowin, Glenburn	Renville	Little Deep Creek	114	57.1	2-24-55
642	Mervel Hall, Newton	McKenzie	Bear Den Creek, Springs and runoff water	100	60	6- 9-55
645	L. E. Lilyquist, Lisbon	Ransom	Underground	50	120	6-22-55
654	Ryan Farms, Grand Forks	Grand Forks	Unnamed stream, trib. to Forrest River		2,880	10-21-55
*658	John A. Winberg, Jamestown	Stutsman	Pipestem	1,468	73.4	1-12-56
661	Einar N. Hegg, Watford City	McKenzie	Cherry Creek, trib. Little Missouri River	86.8	43.4	2- 8-56
662	Ray Schnell, Dickinson	Stark	Cedar Creek, trib. Cannonball River	250	125	2-17-56
666	Fred Bentz, Harvey	Wells	Sheyenne River	48.8	24.4	4-16-56
667	Minot Park District	Ward	Souris River	17.4	233.9	4-13-56
668	Ervin Bourgois, Bismarck	Burleigh	Missouri River	566	283	4-30-56
669	City of Drayton	Pembina	Red River	5,100		5- 3-56

* Deferred

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1956
Applied for Before June 30, 1954

No.	Name of Applicant	County	Source	Acre Ft.	Acres	Date of Claim
670	Arthur and Robert Lee, Jamestown	Stutsman	James River	4.0	2.0	4-24-56
671	D. C. Bleecker, Lisbon	Ransom	Sheyenne River	84.0	56.2	5- 4-56
672	C. J. Kugler, Cayuga	Sargent	Lake Tewaukan	198.0	131.9	5- 9-56
673	C. C. Larsen, Bismarck	Burleigh	Apple Creek	3	3.0	6- 6-56
674	Paul Roney, Oakes	Dickey	Groundwater sources	298	149.3	6-11-56
675	Avery Briar, Cartwright	McKenzie	Unnamed Creek, trib. Missouri River	122	60.9	6-20-56
676	Alois Klandl, Sidney, Montana	McKenzie	Bennie Pierre Creek, trib. Yellowstone River	57.8	57.8	6-27-56

WATER CONSERVATION AND FLOOD CONTROL DISTRICTS

Provision exists in North Dakota statutes for the organization and establishment of water conservation and flood control districts. These districts are legal entities through whom people in a specific area can solve various local water problems. Water conservation and flood control districts are usually formed upon petition from the Board of County Commissioners of the county in which the district is located. The district has certain powers and duties of which the more important are to contract with governmental agencies for the construction, operation and maintenance of the facilities for various types of water resource projects. They can raise funds through a tax levy not to exceed three mills on the property within the boundaries of the district to finance the district's costs. The District may also levy special assessments on property according to the benefits received by that property from the development of the project facilities. The law under which these districts are established provides that upon the receipt of a petition requesting that a water conservation and flood control district be organized, the State Water Conservation Commission will hold a hearing in the area involved to determine the sentiment of the people towards its organization. If, following the hearing, the State Water Conservation Commission determines that organization of the district is feasible and is desired by the local people, the Commission will issue its Order creating the district. Water Conservation and Flood Control Districts that have been organized in North Dakota vary in size from townships and drainage areas to entire counties. Sixteen water conservation and flood control districts have been organized in North Dakota and two petitions have been received by the State Water Conservation Commission requesting that districts be established. County-wide districts that have been organized are Adams, Bowman, Grant, Traill, Nelson and Pembina Counties. Of these districts those in Adams, Grant and Nelson Counties were organized to provide a means whereby these counties could cooperate with the State and Federal governments in the repair and maintenance of dams located within their boundaries. The dams concerned were originally constructed by various Federal agencies during the 1930's. No provision was made for their maintenance and repair. The powers given to water conservation and flood control districts gives this type of district the responsibility for the maintenance of these dams. Several spillways and pertinent reservoir structures have been repaired by the State Water Conservation Commission in cooperation with these districts.

Other districts that have been organized are:

BOWMAN COUNTY DISTRICT

The Bowman County Water Conservation and Flood Control District was organized in 1949 to provide a local entity that could cooperate with the State and Federal agencies relative to construction of the

Bowman Haley Dam and associated irrigation projects. This district had been relatively inactive until in June of 1956 when it was reactivated. At that time the Corps of Engineers proposed to the State Water Conservation Commission that the Grand River investigations be dropped from the list of authorized projects. Sentiment expressed at a public meeting held in Scranton in May, 1956, which was attended by over 200 residents of the area was that the Grand River investigations should be reviewed so as to take into consideration the recent floods and the possibility of providing a municipal and industrial water supply for the municipalities of Bowman, Bucyrus, Hettinger, Reeder, Gascoyne and Scranton, and a uraniferous processing plant located in that area. Since its reactivation in June, the Board of Commissioners of this district has agreed to provide the assurances for the Scranton flood protective works, a project which had been requested by the City of Scranton and is being investigated by the Corps of Engineers. It is estimated that the project will cost $131,000, of which $38,000 has been allocated as the City of Scranton's share. The Corps of Engineers proposes to construct this project under an authority given them by Congress, which permits the construction of projects that do not exceed $400,000 in cost without additional Congressional approval. The Scranton project received the approval of the State Water Conservation Commission, the Omaha Division Office of the Corps of Engineers and is presently being reviewed by the Corps of Engineers in Washington, D. C.

In connection with the review of the Bowman Haley Dam, the Bowman County Water Conservation and Flood Control District actively participated in obtaining flood damage information for use of the Corps of Engineers. The State Water Conservation Commission has cooperated with the district and the Grand River Development Association in conducting a municipal and industrial water survey of the area in an effort to determine a means to supply water for municipalities and a proposed uraniferous lignite processing plant.

PEMBINA COUNTY DISTRICT

This district was organized in 1950 to provide the county the means through which various needed flood control facilities and river channel improvement projects could be accomplished. It has actively cooperated with the U. S. Soil Conservation Service in connection with the Tongue River watershed project in Pembina County. The Tongue River project was authorized as a pilot watershed project by Congress in 1952. The project is under the direction of the Soil Conservation Service. It involves the protection of the entire 415,000 acre Tongue River watershed through the construction of 18 dams, 30 miles of stream channel improvement, 31½ miles of major floodways, 5 miles of smaller floodways, tree and shrub planting and the application of conservation practices. It is estimated that a five year period will be required in order to complete the project.

The need for the project resulted from the fact that snow melt and heavy rains occurring in the upper reaches of the Tongue River moved into the flat or Red River valley area with considerable velocity. The channel capacity and the grade of the Tongue River in the vicinity of Akra was such that the major portion of the flow spread over agricultural lands in a Southeasterly direction causing much damage to agricultural lands, as well as highways, roads and bridges. It is expected that the watershed treatment will also take place in portions of the upper reaches of the Park River when the work on the Tongue River has been completed.

Possibly the District will also sponsor the Rhineland drain which is international in scope. Farmers living on the Canadian side of the boundary constructed a drain approximately 12 miles in length adjacent to the international boundary. The excavated materials from the drain were cast towards the American side creating a dike which periodically caused the flooding of 2,200 acres of land in North Dakota. The State Water Conservation Commission arranged a meeting with Canadian farmers and interested provincial authorities whereby it was agreed to reconstruct the drain at a cost of 60% to the Canadians and 40% to the American residents. The project has been surveyed and construction is expected to start in 1957.

TRAILL COUNTY DISTRICT

The Traill County District was organized in 1956 in connection with the proposed Elm River watershed project located in Traill County. This project is being investigated by the Soil Conservation Service and would provide for the construction of dams in the upper reaches of the watershed and improvement of river channels and drainage facilities in the lower portions of this project. In addition the Traill County Water Conservation and Flood Control District will become interested in other watershed projects that will be proposed in the county in the future.

RUSH RIVER DISTRICT

The Rush River District was established in 1949 in connection with the Rush River channel improvement project that was investigated and constructed by the Corps of Engineers. This project involved improvement of 14 miles in channel of the Rush River so as to provide protection for 125,000 acres in Northeastern Cass County. Construction of these facilities was substantially completed by the Corps of Engineers in 1956 with only some clean up work remaining to be accomplished.

SWAN CREEK DISTRICT

This district was organized in 1953 to provide an entity that can cooperate and negotiate with the Corps of Engineers for the construction of river channel improvements on Swan Creek in the vicinity of Casselton in Cass County. At the present a plan has been proposed that would include the Swan Creek area in a Swan-Buffalo watershed project. The district was recently absorbed by the newly formed Maple River

District. It is expected that the construction features involved in this project will be cared for through a watershed project which may be constructed by the Soil Conservation Service.

MARMARTH DISTRICT

The Marmarth District was organized in 1956 and includes the area located within the City of Marmarth. This district has provided the assurances to the Corps of Engineers for the construction of protective works for the city. The District is in the process of acquiring rights-of-way for the project and it is expected that construction of the facilities will get underway in the spring of 1957.

UPPER WEST SOURIS DISTRICT

The Upper West Souris District contains about 220,000 acres of land located in Ward and Renville Counties between the Des Lacs and Souris Rivers.

In May, 1955, hearings were held at Tolley in Renville County, and Kenmare in Ward County, relative to the establishment of a water conservation and flood control district. The district was the first one to be requested in which more than one county was involved. This district included portions of Ward and Renville Counties. Public opinion in both areas favored the formation of the bi-county district. It was formed to relieve flood conditons that occurred in a closed basin lying between the DesLacs and Souris River watersheds. Heavy run-off resulting from snow melt and rain fall has greatly impaired farming operations in the lower elevations of the basin. The Corps of Engineers and the Soil Conservation Service are much interested in developing a plan whereby the inter-basin area may be afforded drainage into the Souris River watershed. It is proposed that the Soil Conservation Service care for the drainage problems in the Upper reaches of the basin and that the Corps of Engineers construct the connecting channel between the lower elevation of the basin and the Souris River. Sizeable drop structures will be required as part of the channel excavation in view of the significant elevation change between the basin and the Lake Darling reservoir. The Corps of Engineers is presently making a survey of the area.

LOWER HEART DISTRICT

The Lower Heart District was organized in 1953 and embraces the area along the Heart River, including the City of Mandan. The main purpose for the district is to provide a legal entity that can deal with the Corps of Engineers in the Construction, operation and maintenance of the additional facilities needed for flood protection for the City of Mandan and the area along the Heart River below the City of Mandan. At the present time the district is securing the required rights-of-way for the construction of the project facilities and which is expected to get underway in 1957. Funds have been made available to the Corps of Engineers for additional surveys.

It is anticipated that levees and channel capacities will be increased to permit a flow of 50,000 c.f.s. without adversely affecting the property included in the district. The plan calls for the raising of the Northern Pacific bridge and railroad bed approximately 5½ feet. Channel improvements and cut-offs would be effected through the west and south side of Mandan. A flood plain with a levee on the north and east of the present Heart River channel would be constructed from the Northern Pacific Cannonball branch to the Missouri River. Efforts are now being made to work out problems confronting the State Highway Department and the Northern Pacific Railroad Company relative to the raising of the bridges and roadbeds.

MAPLE RIVER WATER CONSERVATION AND FLOOD CONTROL DISTRICT

The State Water Conservation Commission has received a petition from Cass County for the organization of the Maple River Water Conservation and Flood Control District located in that county. This district would absorb the existing Swan Creek Water Conservation and Flood Control District which was organized in 1953. The district has been proposed primarily for the purpose of providing the legal entity that can negotiate with the Soil Conservation Service for the development of the Maple River watershed project. Under this project it is proposed that a number of retardation structures be constructed in the upper reaches of the Maple River basin. Also proposed is channel improvement on the Maple River and the enlargement of drains or floodways in the vicinity of Casselton. The Soil Conservation Service is presently investigating this project and indications are that a satisfactory benefit cost ratio will be obtained.

WALSH COUNTY WATER CONSERVATION AND FLOOD CONTROL DISTRICT

The State Water Conservation Commission has received a petition from the Board of County Commissioners of Walsh County requesting the establishment of a county-wide water conservation and flood control district for that county. The district is requested to provide a legal entity to cooperate with the Soil Conservation Service, the Corps of Engineers and the State Water Conservation Commission to provide the facilities that would alleviate flood damage occurring in that county. The county is located in the drainage basins of the Forest and Park Rivers.

The lands located in the central and eastern portion of the county lie between elevation 850′ and 1,000′ sea level datum. The remaining portion of the county rises from the 1,000′ elevation up to 1,700′ sea level datum. Snow melt and heavy rainfall courses its way from the western part into the Forest and the Park Rivers at a rapid rate. The channels of these two streams are unable to accommodate the heavy run-off and the water then over-flows the banks and spreads over the fertile prairies

in the central and eastern portion of the county. The cities of Grafton and Minto have had frequent and costly floods. It is proposed that retardation structures be constructed in the upper reaches of the Forest and Park Rivers to impede the rapid run-off. The waters would then be released from the reservoirs at a much slower rate after the major portion of the floods have passed on. It is also expected that a system of floodways would be constructed in the basin lying between the Forest and Park Rivers. The floodways would in some instances return the water to the Forest and the Park River and would also be constructed directly to the Red River.

CHAIN LAKES

The Chain Lakes Water Conservation and Flood Control District is located in northwestern Ramsey County. The district was organized in the spring of 1955 for the purpose of providing a means to alleviate flooding of lands located in the Lake Alice - Lake Irvine areas. Approximately ten to fifteen thousand acres of fertile agricultural land have been inundated eight out of the past eleven years resulting in considerable financial losses to many of the residents of this district.

Staff members of the State Water Conservation Commission recommended to the district that a project be instituted which would involve participation between the Soil Conservation Service, the Corps of Engineers, and the State Water Conservation Commission. It was proposed that the Soil Conservation Service be charged with the responsibility of conducting a watershed development program in the upper reaches of Mauvais Coulee. The Corps of Engineers be authorized to construct a channel for the outlet of Lake Irvine to Devils Lake proper and through the present Mauvais Coulee.

It was found that approximately two to four feet of soil drift had filled in the channel during the 1930 drought period to contribute materially to the retarding flow of waters in the Mauvais Coulee. The State Water Conservation Commission was requested by the board to provide a control structure at the outlet of Lake Irvine which would permit the regulation of waters from the Lake Alice - Lake Irvine area which could constitute reservoirs during the flood stage. In February and March, 1955, the State Water Conservation Commission was authorized to make a survey from the outlet of Lake Alice to the inlet of Mauvais Coulee in Devils Lake proper. The survey has been completed. The State Water Conservation Commission also participated with the Federal Fish and Wildlife Service in the "blowing out" of a channel between Lake Alice and Lake Irvine. This was done in an effort to expedite the flow of water from inundated areas adjacent to Lake Alice. The costs of the project were shared equally by these two agencies.

Time is of the essence in accomplishing some partial flood relief for this area. The Chain Lakes District requested the State Water Conservation Commission to furnish them with an estimate of a project

that would provide them with partial relief. The State Water Conservation Commission estimated the cost of such a project to be approximately $50,000. This would provide a 40-foot channel from the outlet of Lake Irvine to Pelican Lake and care for incidentals incurred in the required excavation.

The district is now spreading a special assessment levy against all benefited lands in an effort to obtain sufficient funds to permit them to participate in a project that would provide partial relief. The State Water Conservation Commission in cooperation with the Ramsey County Board of Commissioners plans to install control structures in the lower end of Lake Irvine. It is believed that this project will provide relief under most conditions and will permit the farming of a considerable portion of the land until the federal government is in a position to construct a project affording maximum relief.

DRY LAKE - SWEETWATER WATER CONSERVATION AND FLOOD CONTROL DISTRICT

The Dry Lake - Sweetwater Water Conservation and Flood Control District consists of approximately 720 square miles located in Northern Ramsey County. Frequent flooding has occurred on approximately 72,000 acres of valuable agricultural land within the district. The district is created by action of the State Water Conservation Commission on June 10, 1955.

It is proposed by the State Water Conservation Commission that the Corps of Engineers, the Soil Conservation Service and the State Water Conservation Commission cooperate in a project to provide relief from future floodings in this area. The State Water Commission's proposal is that the Soil Conservation Service provide the upper area of the district with soil treatment in accordance with their watershed program. The Corps of Engineers provides diversion facilities whereby considerable of the floodway could be diverted into Sweetwater Lake increasing the recreation potential of that lake. In time of extreme flooding, this water could be diverted directly into Dry Lake. Dry Lake would be provided with an outlet cutting across in a southwesterly direction to Six Mile Bay in Devils Lake. This proposal would aid considerably in relieving some of the flooding that occurs in the Chain Lakes area. The present outlet for Dry Lake is in the Northwest and water flowing from this outlet spreads over a wide area in the Chain Lakes District. It eventually courses its way into Mauvais Coulee which has inadequate capacity to care for the drainage area to the North of Chain Lakes district. The project when complete will provide farmers in the area with facilities whereby they can eliminate much of the flooding that now occurs in the upper reaches of the Edmore and Starkweather coulees.

OAK CREEK

On January 5, 1956, the State Water Conservation Commission issued an order establishing the Oak Creek Water Conservation and Flood Control District. The District boundaries were commensurate with the Oak Creek watershed located in eastern Bottineau County.

The nucleus of the Oak Creek District was the Lake Metigoshe Improvement Association which expressed a desire to organize a legal entity containing lands adjacent to Lake Metigoshe, for the purpose of constructing water facility projects which would assist in maintaining Lake Metigoshe at the approximate spillway elevation. The residents in the lower portion of the Oak Creek watershed expressed a desire to the Board of County Commissioners to incorporate all land in the watershed into this District. A legal entity of this size could cooperate with the Soil Conservation Service and other federal agencies in developing and improving the lower watershed basin. Excellent storage areas exist in the upper reaches of Oak Creek in Northern Bottineau County and in the Dominion of Canada. The State Water Conservation Commission is currently making surveys on reservoir sites in Canada. The legal entity provided through the organization of the District will permit the district to negotiate with provincial authorities relative to reservoir sites in Canada. Storage of water in the upper reaches will aid materially in reducing floods in the lower basin. The State Water Commission has prepared a tentative plan whereby water could be stored and released for the benefit of Lake Metigoshe during periods of drouth. Approximately 500 cottages have been constructed on the shores of Lake Metigoshe.

FREMONT TOWNSHIP WATER CONSERVATION AND FLOOD CONTROL DISTRICT

On May 11, 1956 the Board of Township Supervisors of Fremont Township, located in Northeastern Cavalier County, petitioned the State Water Conservation Commission to form a water conservation and flood control district covering Fremont Township, which contains 54 sections. Floods resulting from snow melt in the Pembina escarpment has caused much damage in the way of soil erosion. Over burdened waste ways and natural drains were damaged extensively during the 1956 spring run-off. The district covering Fremont Township was established by the North Dakota State Water Conservation Commission on the 13th of June, 1956. All of the lands within the district lie north and east of the Little Pembina River. In view of its proximity to Pembina County, this district has expressed a desire to cooperate with the Pembina County Water Conservation and Flood Control District in caring for the water problems which are common to both.

IRRIGATION DISTRICTS

Provision exists in North Dakota laws for the establishment of irrigation districts. These districts are public corporations comprising a defined area of land containing land that can be irrigated from a common source and water supply system. They serve to provide the irrigators of the district a means whereby they can govern their affairs, finance the district costs of operation, maintenance and construction through special assessments, and operate, and if they desire, construct the facilities to irrigate their land. The district is organized upon petition of the landowners and governed by directors elected by the landowners. The district boundaries are determined by the land to be served and can overlap county and township boundaries. Each landowner has a voice in the affairs of the district through his vote which is based on the acres of irrigable land he owns—one vote for each 20 acres or major portion thereof, not to exceed a total of 8 votes. The district has powers and duties prescribed by law which governs its operations and functions.

North Dakota's irrigation district laws are similar to those of the other 17 western states. The procedure for the organization of an irrigation district involves several steps including:

1. A petition signed by a majority of the landowners owning a majority of the land proposed for inclusion in the district to the State Engineer requesting the district be organized.
2. A hearing on the petition by the State Engineer and an investigation of the proposed plan for development of the irrigation facilities.
3. An election by the landowners at which they either approve or disapprove the Order of the State Engineer establishing the district. At this election the electors also vote for directors who will serve if establishment of the district is approved.

It can be expected that a considerable number of new irrigation districts will be organized in North Dakota in the next few years as construction of the proposed water projects is undertaken. Districts will be required in connection with each of these projects and will ultimately include the estimated 2,500,000 acres of irrigable land in the State. During the next year it is planned to have irrigation districts organized in the Garrison Diversion Project area that will encompass the first 100,000 to 150,000 acres to be developed under that project. These districts will most likely vary in size from 10,000 to 50,000 acres. The Small Projects legislation recently enacted by Congress will undoubtedly encourage the development of our many other potential irrigable areas outside the Garrison Diversion project. Each of these developments will require the organization of an irrigation district. It can be expected that the demand for the organization of new irrigation districts will be stepped up considerably during the next few years.

In North Dakota we have nine organized irrigation districts and one organized flood irrigation district. Irrigation facilities have been constructed and are in use in seven of these districts and in the remaining three construction has not been started. The organization and operation of these organized districts will serve as a guide for other districts that will be organized in the future.

Of these organized districts the oldest is the Lower Yellowstone District located in McKenzie County, which has been operating since 1909. This district presently encompasses over 20,000 acres. Four other districts are located in McKenzie, one in Williams County, one in Bowman County, one in Oliver and Mercer Counties, one in Grant County and one flood irrigation district in McHenry County.

Lower Yellowstone Irrigation District

The Lower Yellowstone Irrigation Project is located in eastern Montana and northwestern North Dakota in McKenzie County. The 57,200 acres of irrigable lands of the project lie along the Yellowstone River. 20,000 acres of the project are in North Dakota and the remaining 37,200 in Montana. The project was one of the first built under Federal Reclamation law in 1902. Construction of the project facilities was started in 1905 and completed in 1909 with first water being delivered to the irrigable lands of the project April 30, 1909.

The construction costs chargeable to this project amounted to $66.00 per acre. The annual repayment charge is based on the value of crops produced and averages about $3.00 per acre. In addition the annual operation maintenance charge for the district is, at the present, $2.25 per acre.

The principal crops raised are alfalfa, wheat, corn, barley, beans and sugar beets. The feeding of lambs and cattle is one of the major operations of the project, and grain and forage crops are utilized in the feeding operation. Dairying is also an important operation.

Sioux Irrigation Project

The Sioux Irrigation Project is located on the right bank of the Yellowstone River in McKenzie County approximately six miles northwest of Cartwright and 20 miles southwest of Williston. The project was constructed by the North Dakota State Water Conservation Commission in 1938 and 1939. The original project petition called for the irrigation of 1,460 acres of Yellowstone bench land. At present about 700 acres are being irrigated with a possibility of the remaining area being developed at some future date.

Water is obtained by pumping from the Yellowstone River. The pump is powered through the use of 110 H.P. natural gas motor and has a capacity of 15 cubic feet per second.

The farmers residing on the project were for the most part the original settlers. The topography was generally very favorable for irrigation and little leveling was required prior to irrigating. Some brush and timber clearing has been done in recent years. As a result

of channel changes when the river is at flood stage some loss of project lands has occurred.

Construction of the facilities for the project was financed through a bond issue that the North Dakota State Water Commission is now holding. The principal of the original issue was $25,000.00 and the balance of the issue as of the date of this report is $20,500.00. The bonds are to be retired over a period of 30 years and have an interest charge of 2¼%.

Lewis and Clark Irrigation Project

The Lewis and Clark Irrigation Project is located along the Missouri River about six miles southwest of Williston. The project was constructed by the State Water Conservation Commission in cooperation with the North Dakota Rural Rehabilitation Corporation. Construction was started in 1938 and completed in 1940. By 1943 about 5,000 acres of the project's 6,000 irrigable acres were under irrigation. The project is divided into 58 units varying in size from 100-160 acres of irrigable land. Water to serve the project is pumped from the Missouri River by two 24" pumps and one 20" pump.

Construction and development of the Lewis and Clark project was undertaken and completed under a different principle than that ordinarily applied, and which may have application in the development of future projects in the state. The land included in the project was acquired by the Rural Rehabilitation Corporation from the owners under a contract whereby the owners could repurchase the land at the same price they sold it for plus the costs of the facilities of the project chargeable to that land and the costs of leveling and preparing the land for irrigation. After the construction of the facilities was complete and the land levelled the irrigable lands of the project were divided into units and resold to the original owners or, if they did not desire to make the repurchase under their contract, to other settlers. The purchase price included all costs chargeable to the land, therefore there is no assessment for construction charges on the project. These costs are included in the financing of the purchasers of the units. The total costs of constructing the project facilities and levelling the land was about $75.00 per acre. The annual operation and maintenance assessment is $3.00 per acre.

At the present the Lewis and Clark Irrigation District is negotiating with the Corps of Engineers for the sale of the project lands to the Federal Government. A considerable portion of the project will be effected by the operation of the Garrison Reservoir and in the Garrison project plan it was proposed to install a system of levees to protect the project. The landowners have objected to the installation of the levees because they maintain the characteristics of the soil are such that extensive seepage would occur when Garrison Reservoir is high resulting in damage to the land. They have proposed that rather than build the levees the Corps of Engineers acquire the project lands and that the owners lease back these lands for agricultural purposes. $1,935,000 was

appropriated by Congress for this purpose but the law authorizing the purchase contained a provision that 100% of the effected landowners had to agree to the sale. At the present several of the landowners have not agreed.

Buford - Trenton Project

The Buford - Trenton Project was developed under the Case Wheeler Act by the Department of Agriculture and the Bureau of Reclamation. The project is located along the left bank of the Missouri River in Williams County between the towns of Buford and Trenton and contains about 14,000 acres of land. The project was constructed by the Department of Agriculture and recently has been turned over to the Bureau of Reclamation. The project was operated for several years by the Buford - Trenton Mutual Aid Corporation and in 1950 the landowners of the project voted to organize an irrigation district.

The facilities of the project include a pumping plant consisting of three pumps of 80 cubic feet per second capacity, 14½ miles of main canal and 42 miles of laterals. Water for the project is pumped from the Missouri southwest of Trenton, North Dakota.

Development of the irrigable land on the project including land clearing and leveling and the construction of dwellings and other farm buildings was accomplished by the Department of Agriculture. The units as developed were sold to the project operators.

Eaton Project

The Eaton Flood Irrigation Project is located along the Souris River in Towner County. The facilities of the project provide for the flood irrigation of about 8,000 acres of land adjacent to the Souris River from which large hay crops are produced. This project was built in 1936 under the direction of the North Dakota State Engineer and financed by the P.W.A. The total cost of the project was approximately $53,000.00 or about $7.00 per acre.

Facilities of the project include a 12-foot dam on the Souris River that impounds the spring runoff in an extensive channel reservoir on that river. Additional floodwaters impounded about this height are diverted into a series of seven ponds adjacent to the river channel and along the river below the dam, six on the west side and one on the east side. A natural levee exists between the river and the ponds allowing for the retention of water in the ponds for a period after the spring flood period is over. In addition to the main dam there are a series of 12 headgates and waste gates by which the flow into and out of the ponds is controlled.

Briefly, the operation of the project is as follows: As the spring flood comes the gates in the main dam are closed causing the water to rise and flow through the channels into the ponds, the levels of which are controlled by the gates provided. After the ponds are filled the gates to the main dam are opened allowing for the normal flow in

the river channel. The water is retained in the ponds for a period of from two to four weeks and then is drained back into the river through wastegates. Normally a period of five days is required to fill all seven ponds. The water elevations in the ponds provide for approximately 1¼ acre feet of water for each acre of land flooded.

The main dam is a sheet steel piling, earth-fill type consisting of two rows of sheet steel piling with a maximum length of 45 feet, 18 feet apart. There are eight 72-inch diameter corrugated metal pipes extending through the dam equipped with metal slide gates through which the impoundment of the floodwaters is controlled.

The Eaton Flood Irrigation District has been organized to operate the project.

Fort Clark Irrigation Project

The Fort Clark Irrigation Project, located on the west bank of the Missouri River in Mercer and Oliver Counties between Stanton and Fort Clark, North Dakota is served by pumping water from the Missouri River to the irrigable land of the project. The Fort Clark is the first of the five pumping units authorized under Missouri River Basin to be developed.

The project has 2,039 acres of irrigable land for which the initial delivery of water was made in 1953. The 25 landowners in the project voted unanimously to organize an irrigation district in 1948 and in 1950 approved a repayment contract with the Bureau of Reclamation for the construction of the facilities of the project.

The irrigable lands in the project are served by a pumping plant consisting of three vertically mounted, electrically driven pumps that discharge water through conduits into two main canals which convey the water to two bodies of land that were separated topographically. In addition there are two relift pumping plants to serve land above one of the main canals. The distribution system is designed to provide delivery of water to the high point of each 80 acres.

The total cost of the project to the Federal Government including planning, investigations, construction of the facilities and overhead was $763,000. The repayment contract entered into by the District with the Bureau of Reclamation calls for the repayment to the government of $66,000 over a period of 40 years.

In 1956 the development period for the Fort Clark Irrigation District began. Under the terms of the contract with the Federal government, the irrigators are required to pay the operation and maintenance cost for the project. Because the program of land development had moved forward slowly, the landowners of the district experienced some difficulty in meeting their obligation. A committee composed of representatives from the various Federal and state agencies was organized for the purpose of providing technical help and assisting the landowners in an advisory capacity. On June 30, 1956, approximately 600 acres of the 2,039 acres were prepared for irrigation.

Western Heart River Irrigation Project

The Western Heart River Irrigation Project comprises 2,463 acres of land along the Heart River in Grant County below the Heart Butte Dam. This land is served by pumping water from the Heart River released from the Heart Butte Reservoir to the 25 tracts of irrigable land adjacent to the river. A separate pumping plant will serve each irrigable tract. There are 26 ownerships in the district including from ten acres to 240 acres of irrigable land.

The Western Heart River project was originally a part of the project in which irrigation of some 13,000 acres of land between the Heart Butte Dam and the confluence of the Heart and Missouri Rivers was proposed. Because of difficulties encountered in negotiating a contract for the construction of the facilities for the entire project the original Heart River Irrigation District was dissolved and plans were revised for the development of the areas in the western third of the project. The Western Heart River Irrigation District was organized in December, 1953, and a repayment contract was negotiated in 1955. Construction of the irrigation facilities was substantially completed by June 30, 1956.

The combination repayment and water service contract provides for a seven year development period and following that a repayment by the district of $145,200 for the distribution facilities in 40 years and $20,550 for the supply works construction (Heart Butte dam) in 30 years.

Bowman - Haley Project

The Bowman - Haley Irrigation Project includes about 5,000 acres of irrigable valley land along the North Fork of the Grand River in Bowman County in southwestern North Dakota. A plan for the development of the project includes the construction of a 90 foot high dam on the North Fork of the Grand River southeast of Bowman that will store 45,000 acre feet of water for irrigation and other purposes. The project has long been advocated by local people and has been investigated several times by various agencies over a period of nearly 50 years. Agencies who have conducted these investigations are the North Dakota State Engineer, the Corps of Army Engineers and the Bureau of Reclamation. First project reports determined the project to be feasible; however, the last investigation by the Bureau of Reclamation found the project infeasible. In order to protect the interests of the local people in the project and to assure an adequate water supply the North Dakota State Water Conservation Commission in 1950 adopted a resolution reserving all the unappropriated water of the North Fork of the Grand River in North Dakota for the District.

In 1956 the State Water Conservation Commission proposed that the Bowman - Haley Dam be re-examined so as to take into consideration the recent floods in that vicinity and the need for an industrial water

supply for a proposed uraniferous lignite processing plant. The review is underway by the Corps of Engineers at the present.

Cartwright Irrigation District

The Cartwright Irrigation District was organized in 1939 for the purpose of developing irrigation of about 800 acres along the Yellowstone River in McKenzie County. The Cartwright Unit was authorized for investigation by the Bureau of Reclamation under the Missouri River Basin Project authorized by Congress in 1944. Recently the Bureau of Reclamation issued a "wrap-up report" on the Cartwright Unit in which the development of the irrigation facilities for the project was determined infeasible because the costs of the facilities proposed exceeds the anticipated benefits.

Because of the relatively small size of the project and the elaborate facilities proposed by the Bureau it is the Commission's contention that the project could be more economically and feasibly developed by the State or local irrigation district. Standards that must be adhered to by the Bureau and the higher overhead costs for a project developed by a Federal agency result in many of the smaller projects being infeasible.

With the passage of the Small Projects legislation by Congress in 1956 a means now exists that will permit the development of many projects such as the Cartwright Unit. Preliminary meetings have been held with the local project proponents at which they indicate they desire to attempt to develop the project under the Small Project program through the State Water Conservation Commission.

Yellowstone Pumping Irrigation

The Yellowstone Pumping Irrigation Project encompasses about 2,000 acres along the right bank of the Yellowstone River in McKenzie County. This project was originally considered for development in connection with the Sidney Project in Montana which was constructed by the Montana Water Board in 1939. The Yellowstone Pumping Irrigation District including the area proposed for development in North Dakota was organized in 1938 to negotiate for the construction of that portion of the project. Due to difficulties in financing, facilities for the North Dakota portion of the project and a 300 acre area in Montana were not constructed at that time. Provision was made in the installation of the pumping station in Montana for an intake large enough to adequately serve the North Dakota irrigable lands when developed. The North Dakota Water Conservation Commission advanced $3,500.00 to the Yellowstone Pumping Irrigation District to pay for the enlargement of the pumping station as required.

It is expected that the Yellowstone Pumping Irrigation District facilities will be developed in the future under the Small Projects program.

GARRISON DIVERSION CONSERVANCY DISTRICT

The 1955 North Dakota Legislature enacted a law that established the Garrison Diversion Conservancy District consisting of 22 counties in the state that contained areas that would be benefitted by the development of the Garrison Diversion Project. The Conservancy District was established to provide the over-all legal entity through which this project could be constructed and operated.

Various proposals to divert water from the Missouri River into eastern and central North Dakota have been advanced over the past 70 years. These proposals have evolved into the present plan to divert water from the Garrison Reservoir eastward through a 70 mile long canal to a storage reservoir known as the Lonetree Reservoir and then to the irrigable lands in the project area that total between 1,500,000 acres and 2,000,000 acres. In addition to irrigation water would be available for municipal and industrial supplies, recreation, lake restoration, stream pollution abatement, fish and wildlife conservation and propagation and other purposes. A detailed discussion of the project plan can be found under the Bureau of Reclamation section of this report.

In enacting the Garrison Diversion Conservancy District law the North Dakota Legislature not only provided a means whereby the project could be developed but is also demonstrated the good faith of the state in promoting the project by providing an organization that had the power to negotiate for the construction of the project and further to finance the contracts they entered into.

The Conservancy District law provided that the District would be activated by the State Water Conservation Commission when the need arose. The Commission was given the responsibility of notifying each of the counties included that the District was to be activated and that the Board of County Commissioners of each county was to name a Director to the District's Board of Directors. In July, 1955 the Commission took this action and on July 18, 1955 at Harvey, North Dakota the District Board of Directors was formally organized. There was a considerable amount of preliminary effort by members of the State Water Conservation Commission and its staff members, representatives of the Bureau of Reclamation and water development organizations in meeting with the various Board of County Commissioners of the District counties so that they would be familiar with the project proposal and the necessity for appointing the best available Director from each of the counties concerned. These meetings resulted in the counties naming a very qualified and highly capable Board of Directors. At their organization meeting Roy A. Holand of LaMoure County was elected chairman, Henry Steinberger of Renville County, vice chairman and Vernon S. Cooper, assistant secretary of the State Water Conser-

vation Commission, secretary-treasurer. Directors appointed to the Board of Directors with their terms of office, including the Director for Traill County, which county was admitted to the District subsequent to its establishment upon petition by that County are:

LIST DIRECTORS AND TERMS OF OFFICE

County	Director's Name	Address	
Barnes	William Miller	Valley City	June 30, 1957
Benson	Edward Reeves	Warwick	June 30, 1958
Bottineau	Lester Wyman	Westhope	June 30, 1958
Cass	Mark Andrews	Mapleton	June 30, 1959
Dickey	Forest M. Gottschalk	Oakes	June 30, 1959
Eddy	Russell L. Belquist	New Rockford	June 30, 1959
Foster	Ralph L. Harmon	Carrington	June 30, 1958
Grand Forks	James H. Erickson	Larimore	June 30, 1958
Griggs	Leon Sayer, Jr.	Cooperstown	June 30, 1957
LaMoure	Roy A. Holand	LaMoure	June 30, 1958
McHenry	Walter J. Boye	Willow City	June 30, 1959
McLean	Clarence W. Johnson	Underwood	June 30, 1957
Nelson	S. B. Tingelstad	McVille	June 30, 1958
Pierce	A. F. Gronvold	Rugby	June 30, 1957
Ramsey	James B. Collinson	Devils Lake	June 30, 1959
Ransom	Mark M. Johnson	Fort Ransom	June 30, 1959
Renville	Henry J. Steinberger	Donnybrook	June 30, 1958
Sargent	Reese A. Bartlett	Cogswell	June 30, 1958
Sheridan	Ben F. Kludt	McClusky	June 30, 1959
Stutsman	H. W. Lyons	Jamestown	June 30, 1957
Traill	Gilman Wastvedt	Hatton	June 30, 1957
Ward	W. M. Harrington	Minot	June 30, 1957
Wells	William F. Heitmann	Harvey	June 30, 1957

The Conservancy District law provides that Directors shall be appointed for terms of three years with the exception that the terms of the Directors first appointed shall be determined by lot with ⅓ for three years, ⅓ for two years and ⅓ for one year. The law gives the District certain powers and duties relative to the purpose for which it was organized which are:

LIST POWERS AND DUTIES

1. To sue and be sued in the name of the district;
2. To exercise the power of eminent domain for the construction of facilities for the project and to secure the right of access to such works and to waters impounded for the project or emanating therefrom;
3. To accept funds, property and services from public and private sources for the purpose of aiding and promoting the establishment and construction of the project;
4. To furnish assurances of cooperation as principal and guarantor or either to enter into contracts with the U. S. Government or public corporations of North Dakota for the project;
5. To cooperate and contract with the State Water Conservation Commission and any municipality or sub-division in promoting the establishment and construction of the project;
6. To equip, maintain and operate an office and to appoint such employees as necessary;

7. To appoint an executive committee from their number and vest that committee with such powers and duties as the board may desire;
8. To levy a tax of one mill on all taxable property in the district to pay the operating costs of the district and to accumulate a fund to pay the costs of the contracts it enters into with the United States. The district operating costs cannot exceed 10% of the total levy authorized. In other words 1/10 of a mill levy is authorized for the district operating costs and 9/10 for the costs of contracts the district may enter into.

During its first year of operation the Garrison Diversion Conservancy District has actively spearheaded the program for the early development of the Garrison Diversion project. Through its Directors an information program has been set up that has resulted in a concerted effort on the part of the several agencies and organizations in North Dakota bringing information about the project to the farmers who will be effected. Farm development committees have been set up in most of the District counties having irrigable land composed of farmers who own and operate this land. These committees serve to get information down to their neighbors so that when the time the farmers are to make their decision as to whether or not they want irrigation they will have sufficient information to base their decision on facts.

The Conservancy District reports that there is a growing interest and enthusiasm in the project throughout the state and particularly in the project area. The District has established a goal of having about 100,000 acres organized into irrigation districts in 1957. The Bureau of Reclamation Definite Plan Report is scheduled for completion by January 1, 1957 and it is planned to make the first appropriation request for the construction of the project facilities from Congress in 1957. If this schedule is maintained it can be expected that the first irrigation water will be available in 1962 or 1963.

As the project develops and the need for local control and operation of the project facilities becomes apparent it is expected that the Conservancy District's role will become increasingly more important.

COMPACTS

INTERSTATE COMPACTS APPROVED

Yellowstone River Compact:

The Yellowstone River Compact between the States of Wyoming, Montana and North Dakota was approved by the State representatives in 1950 and by the State Legislature and Congress in 1951, and was enacted into law when signed by the President on October 30, 1951. This compact has been successfully operated during the past five years. The provisions of the Yellowstone River Compact have been set forth in the Eighth and Ninth Biennial Report of the State Water Conservation Commission.

COMPACTS UNDER NEGOTIATION

INTERNATIONAL JOINT COMMISSION

In 1909 the United States and Great Britain entered into a treaty relating to the boundary waters of Canada and the United States and questions arising between these two countries concerning the use of these waters. This treaty provided that an International Joint Commission be created which would have jurisdiction over the use of the boundary waters of Canada and the United States. The United States and Canada have three members of the International Joint Commission.

Matters relating to international waters are referred to the International Joint Commission for consideration and decision. The Commission has established various sub-committees to study specific problems referred to it. The State Water Conservation Commission has participated in the deliberations of these sub-committees in matters dealing with our two International streams, namely the Souris River and the Red River. During the past biennium the division of water from the Souris River between Canada and the United States has been the principal matter under consideration by the International Joint Commission and its sub-committees that effects the state of North Dakota.

INTERNATIONAL JOINT COMMISSION ACTIVITIES

A meeting of the engineering committee of the I. J. C. was held in Minot in May, 1955. Consideration was given to the feasibility of added storage on the Souris River in view of stimulating better use of the Souris waters. Various sites in the Province of Saskatchewan and the State of North Dakota were examined by the committee.

In July of 1955 a meeting was held in Winnipeg relative to the studies made by the reservoir sub-committee pertaining to additional possibilities. A report was also considered on the delineation of contributing and non-contributing areas in the Souris River Basin. It was agreed that the information obtained by the sub-committee would be forwarded to the International Joint Commission for study.

In September of 1955 hearings were held by both sections of the International Joint Commission relative to water uses in the Provinces

of Saskatchewan and Manitoba and in the State of North Dakota. Representatives of the State Water Conservation Commission appeared at and supported North Dakota waters users in a meeting held in September at Minot, North Dakota by both sections of the International Joint Commission.

The Chief Engineer and the Assistant Attorney General attended a meeting of the American section of the International Joint Commission in Washington, D. C. The water users along the Souris River were defended by the Commission representatives before the American section. Special emphasis were placed on the municipal needs of Minot, Westhope and Crosby.

On October 5th the Chief Engineer and the Assistant Attorney General for the State Water Conservation Commission appeared before the American and Canadian sections of the International Joint Commission in Ottawa, Canada. Pleas were made before the joint group requesting that rights of the North Dakota users be recognized be allocated for future uses from the Souris River.

Canadian members stressed their demands and request allocations for various projects the most important being the boundary dam which contemplates storing 28,000 acre feet.

An award of 6,700 acre feet of water was made to the City of Minot for municipal uses. This was the only sizeable apportionment made from Souris River waters since an interim agreement was effected in 1943. The interim agreement permitted the Province of Saskatchewan and the State of North Dakota to allocate waters for various uses not to exceed a total of 1,000 acre feet.

Red River of the North

In 1937 the Congress of the United States authorized the states of North Dakota, South Dakota and Minnesota to establish the Tri-State Water Commission to supervise the drainage area for the Red River with the exception of the Otter Tail River and its tributaries. This Commission was active for a few years after its organization but the lack of interest on the part of the State of South Dakota in administering the affairs of the Commission has resulted in the ineffectiveness of that organization. According to the provisions of the authorizing legislation, a majority of the members of each State shall constitute a quorum of the Commission for the transaction of business, but no action of the Tri-State Commission shall be binding unless at least two members of each of the States shall vote in favor thereof. Because of South Dakota's lack of interest in the Commission, no effective action could be taken by the Tri-State Water Commission.

The division of the waters of the Red River is of primary interest to the States of North Dakota and Minnesota. Particularly to North Dakota, in view of the development of the Sheyenne River, which is a tributary of the Red. Representatives from the North Dakota Water

Commission have, during the past several years, attempted to conduct preliminary negotiations with officials of the State of Minnesota in an effort to draw up a workable compact agreement. During the time that these negotiations were underway, the North Dakota State Water Commission held pending all water right applications it received requesting allocations of water from the Red River or its tributaries in North Dakota. It has become apparent there is little interest in the State of Minnesota in negotiating a compact on the division of waters of the Red River. Therefore, in 1955 the State of North Dakota decided to table any further negotiations with Minnesota until an interest in such a compact in that State became more apparent. As a result of this action, the Commission has acted on all water rights that were pending on the Red River and has considered all recent applications in due course as required by law. The need for a compact between the States of North Dakota and Minnesota on the division of waters of the Red River will undoubtedly become more critical in future years and at that time negotiations will most likely be resumed again. Any existing and developed water rights on the Red River or its tributaries in North Dakota will of course be recognized by the provisions of the compact that might be negotiated.

MATTERS OF INTERNATIONAL SIGNIFICANCE

It has been the experience of North Dakota in their dealings with the International Joint Commission that decisions and determinations of that body are often delayed, consequently matters for which a decision is required prior to development of projects are unnecessarily delayed. Attention of the State Water Conservation Commission has been directed to several of these situations during the past biennium. The commission feels that in many instances it is possible for the State and the Province concerned to reach an agreement on an equitable and satisfactory solution to the problem. Some examples of these situations are given below:

INTERNATIONAL AGREEMENT

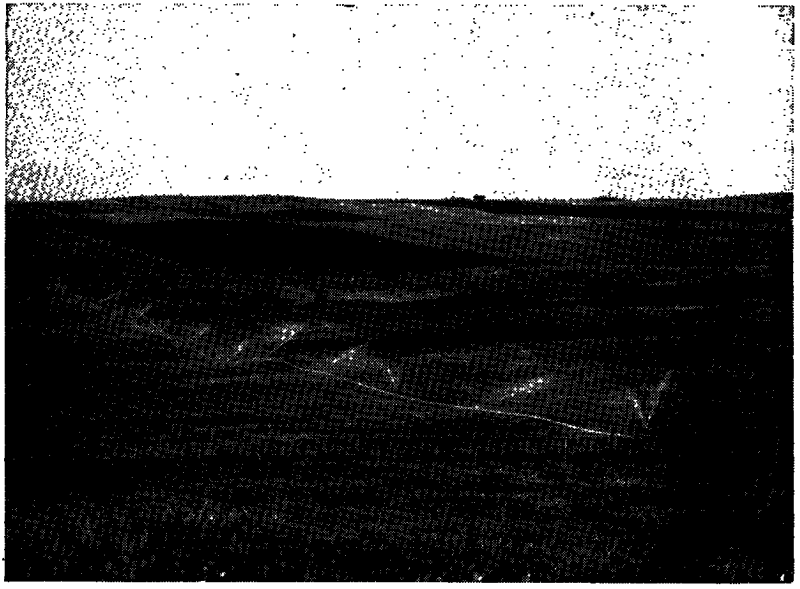
On June 30, 1956, the Pembina County Drainage Board notified the Chief Engineer of the State Water Conservation Commission that a drain had been constructed by the Rhinelander municipality in Manitoba which was adversely affecting agricultural lands in the Neche area in North Dakota. The authorities of the municipality had caused the excavation of a drain paralleling the American border for a distance of 12 miles. The spoil materials were deposited towards the American side of the drain. This constituted a levee which held back waters resulting from snow melt and heavy rainfall. This condition has resulted in flooding approximately 2,200 acres of land at frequent intervals. A meeting of Canadian and North Dakota authorities was effected in August of 1956. An agreement was reached with the Water Resources Branch, the Public Works Administration of Manitoba and the municipality whereby North Dakota and Manitoba farmers

would reconstruct the drain to make it serviceable to all landowners in that particular watershed. It is expected that the work of rehabilitating the drain will be commenced in the spring of 1957.

LAKE METIGOSHE DRAINAGE AREA MEETING

In August, 1955, the Minister of the Manitoba Natural Resources Board and the Chief Engineer for the Manitoba Water Resources Branch met with members of the State Water Conservation Commission had, at the request of the Lake Metigoshe Improvement Association, made surveys and recommendations relative to methods of maintaining the elevation of Lake Metigoshe at or near the spillway crest elevation. The proposal made by the Commission envisioned the storage and diversion of waters originating in the Turtle Mountain area of Manitoba into a reservoir located on the International boundary. This proposal, if effected, would require close cooperation with Canadian authorities. Lake Metigoshe is an international lake and the possibilities of obtaining Canadian cooperation is enhanced by this fact as it also is a site for Canadian resort development.

The authorities from Canada were of the opinion that favorable consideration would be given the proposal at such a time as surveys had been made on the Canadian side which would show the affect the storage and diversion of waters would have upon Canadian properties. It is expected that negotiations will be resumed with Canadian authorities relative to this matter in the near future.



Sprinkler Irrigation

LITTLE MISSOURI RIVER

The Little Missouri has its source in northeastern Wyoming and flows in a northerly course through the extreme southeastern corner of Montana, and northwestern corner of South Dakota and then north and east through the western portion of North Dakota emptying into the Missouri River near Elbowoods. The greater portion of the drainage basin of this river is in North Dakota. The course of this river in North Dakota is through the portion of the state where precipitation is often insufficient for farming purposes and, consequently, the demand for water for irrigation is great.

In 1940 Congress authorized Wyoming, South Dakota, Montana and North Dakota to enter into compact negotiations for the allocation of the waters of the Little Missouri River. Preliminary fact finding surveys were undertaken but no agreement was reached prior to the expiration of the authorization on January 1, 1943. The equitable apportionment of the waters of this stream is a complicated problem and it is most important that North Dakota be allocated its fair share of the waters of this river for irrigation and other agricultural purposes.

The 1955 Legislature of the State of North Dakota in adopting House Concurrent Resolution J-1, requested Congress to authorize the States of North Dakota, South Dakota, Montana and Wyoming to enter into a compact for the equitable division of the water supply of the Little Missouri along the States. Authorizing legislation was introduced in Congress and passed the Senate but was not acted on by the House of Representatives. It is anticipated that authorizing legislation will again be introduced in the Congress that will convene in January, 1957.

JAMES RIVER

The James River, a tributary of the Missouri, has its source in central North Dakota and flows in a southerly direction through North Dakota and South Dakota joining the Missouri River near Yankton. Irrigation development along this river in both states is included in the Missouri River basin program. Because of this development and the continued increased use of the waters of the James River it will perhaps be desirable to consider a compact for the division of the waters of the James River in the future. Although plans call for irrigation of areas along this river along with water diverted from the Missouri River at Garrison Dam, the division of the waters of the river itself between North and South Dakota excluding such waters diverted should be determined to avoid future conflicts. The James River Development Association, an organization consisting of representatives from the States of North Dakota and South Dakota has been interested in promoting a compact on the James River. However, no definite action has been taken at the date of this report to securing authorizing legislation in Congress for this purpose.

NORTH BRANCH OF THE GRAND RIVER

The North Fork of the Grand River has its source in the extreme southwestern part of North Dakota and flows in an easterly direction into South Dakota joining the South Fork of the Grand River immediately above the Shadehill Dam near Lemmon, South Dakota. The apportionment of the waters of the North Fork of the Grand River between the states of North and South Dakota is a problem that should be determined in the near future. The Bureau of Reclamation recently completed the Shadehill Dam in South Dakota, constructed to provide water for irrigation in that state. This dam will store a major portion of the runoff from both forks of the Grand River.

In North Dakota the Bowman-Haley Irrigation Project is located along the North Fork of the Grand River. An irrigation district was organized for this area in the early 1930's that would provide for the irrigation of several thousand acres of land in Bowman and Adams Counties. The development of this project is still pending. Although North Dakota's rights to waters originating within the state are set forth in the Constitution, these rights should be protected by a compact providing for the reasonable and equitable division of the waters in this river. In order to protect the interests of this district, the State Water Conservation Commission in 1951 passed a resolution reserving the waters of the North Fork of the Grand River in North Dakota for the beneficial use of the Bowman-Haley Irrigation District.

BASIC DATA

COOPERATIVE PROGRAMS WITH THE U. S. GEOLOGICAL SURVEY

In any program for the development of the water and other natural resources of an area such as is underway in North Dakota at the present, one of the most important phases is that of collecting basic data for use in the planning for this program. This data takes several forms of which the more important are preparation of topographic surveys, measurement of stream flows and surveys of ground water resources. From the information gathered in these surveys the many features of the water development program can be planned and designed based on accurate data.

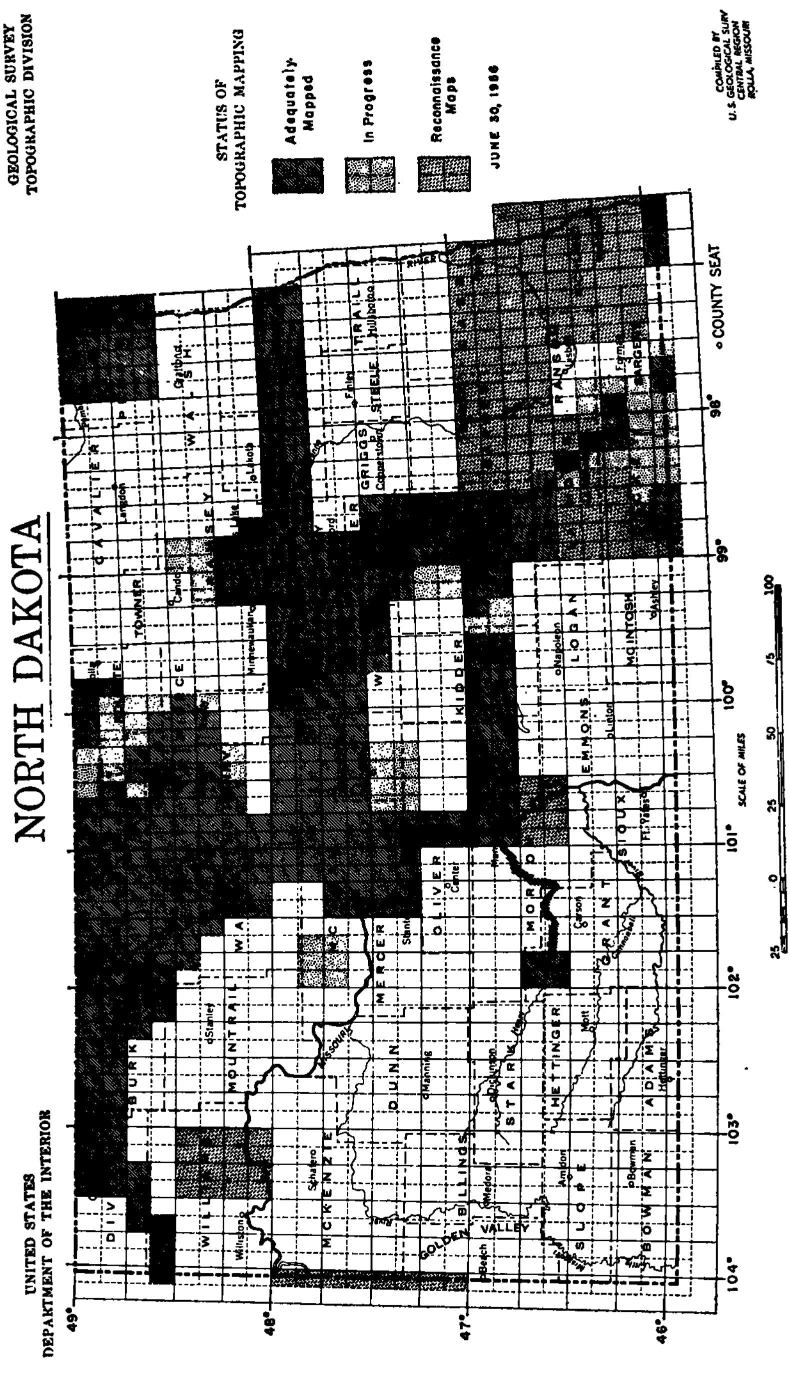
The State Water Conservation Commission has cooperated with the branches of the U. S. Geological Survey who have as their function the collecting and compilation of this type of basic data. These cooperative programs are accomplished under the direction of the U. S. Geological Survey with the state and the survey each contributing 50 per cent of the costs. During the past several bienniums the State Water Conservation Commission has received appropriations from the state legislature to participate in a topographic mapping program, a stream gaging program and an underground water survey. These programs are discussed individually on the following pages.

TOPOGRAPHIC SURVEYS

The U. S. Geological Survey cooperates with states and other federal agencies in making these surveys. In North Dakota a large portion of the area mapped has been accomplished under the Missouri River Basin program at no cost to the state. Such surveys have been confined to areas that are included in the area proposed for developmnt under the Missouri River Basin program. The cooperative mapping program between the State of North Dakota and the U. S. Geological Survey has covered areas not included in the Missouri River Basin program for which other develpment is proposed. In all cases the U. S. Geological Survey does the actual survey work, and compiles the data gathered and publishes the quadrangle maps.

The topographic quadrangles produced by the Geological Survey are commonly called the "mother map". These related maps include among many others, geologic, mineral and water resource data, road maps, county and state maps, as well as the base map of the United States, its territories and possessions.

In its published form the modern topographic quadrangle provides essential basic data for a wide variety of land and water utilization projects. Because it is a graphic portrayal of a part of the earth's surface, it shows such features as roads, railroads, highways, buildings, section lines, canals, ditches and reservoirs, rivers, streams, lakes, and other


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
TOPOGRAPHIC DIVISION
NORTH DAKOTA
STATUS OF
TOPOGRAPHIC MAPPING
Adequately Mapped
In Progress
Reconnaissance Maps
JUNE 30, 1956
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U.S. GEOLOGICAL SURV
CENTRAL REGION
ROLLA, MISSOURI

bodies of water. These features are shown in their correct size and true position. The topographic quadrangle, however, is unique in that it shows the elevations, slope and configuration of all the ground surfaces. In short, it presents the same information as represented by a true scale model of the terrain.

After a project is authorized studies are made to determine the proper scale and the contour interval which may be 5, 10, 20, 40 or 80 feet, depending on the scale and the type of terrain to be mapped.

The Missouri River Basin development plan presents a striking example of the cilivlian needs for basic data in the form of good topographic maps. Both irrigation and flood control projects must be planned with knowledeg of the topography of the area involved. Dam sites can be selected and properly located, and the capacity of large and small reservoirs can be estimated on the map. Preliminary location of ditches and canals that conform to the slope of the land can be made in the office. In fact, topographic maps of the Basin might well be called "blue prints for progress". It is axiomatic that topographic maps, to be of maximum value, should be available in the early stages of project planning.

Standard topographic maps of the Federal Government are required to comply with national map accuracy specifications as adopted in 1941, and map sheets are tested to insure compliance with these specifications. The published map carries a note on its lower margin which states, "This map complies with national map accuracy standards". Several worthwhile objectives motivated the adoption of these specifications. One objective is to make each original topographic map of sufficient accuracy so that it can be revised at any time without the necessity of a basic resurvey.

The State Water Conservation Commission cooperative program with the U. S. G. S., Topographic Branch, provides for surveying of designated areas in the state and preparing topographic maps for those areas. These maps are called quadrangle maps. The unit of survey of a quadrangle map is bounded by parallels of latitude and meridians of longitude and usually cover either 7½ minutes or 15 minutes in latitude and longitude. The 7½ minute quadrangle maps are prepared at a scale of 1:24,000 (1 inch equals 2,000 feet) and cover an area of approximately 49 square miles, and the 15 minute quadrangles have a scale of 1:62,500 (1 inch equals nearly 1 mile) and cover an area of about 195 square miles.

Topographic maps for a large part of North Dakota have been completed and are available from the U. S. Geological Survey or the North Dakota State Water Conservation Commission at a nominal cost. The status of this mapping program is shown on a map accompanying this section of the report. During the period covered by this report 13-7½' quadrangle maps under the State Water Conservation Commission cooperative program and 34-7½' maps under the Missouri River Basin program have been completed and published. In addition mapping was in

progress on 11-7½' quadrangle maps under the Commission cooperative program and on 46-7½' maps under the Missouri River Basin program. The State Water Conservation Commission's appropriation for this cooperative mapping program was $30,000 for the 1955-57 biennium.

During the 1957-1959 biennium the Commission proposes to have topographic maps started for areas in the Dickinson and Williston vicinities that would be available in connection with future industrial development in those areas. It is proposed that 3-7½' quadrangle maps for each vicinity be made with the specific areas to be determined cooperatively by the Commission and representatives from the municipalities.

MAPS COMPLETED IN NORTH DAKOTA
During The Period From July 1, 1954, to June 30, 1956

Name	Size	Cooperator*	Name	Size	Cooperator*
Adrian	7½	MRB	Newark	7½	MRB
Berwick	7½	MRB	Nortonville	7½	MRB
Cleveland	7½	COOP	Oakes	7½	MRB
Cleveland NW	7½	COOP	Omemee	7½	MRB
Cleveland SE	7½	COOP	Overly SE	7½	MRB
Cleveland SW	7½	COOP	Overly SW	7½	MRB
Crete	7½	MRB	Roth	7½	MRB
Dawson	7½	COOP	Round Lake	7½	MRB
Dickey	7½	MRB	Rugby NW	7½	MRB
Ellendale South	7½	MRB	Souris	7½	MRB
Gardena	7½	MRB	Souris SE	7½	MRB
Glover	7½	MRB	Souris SW	7½	MRB
Grand Rapids	7½	MRB	Steele	7½	COOP
Homer	7½	MRB	Steele NE	7½	COOP
Independence	7½	MRB	Steele NW	7½	COOP
Jud	7½	MRB	Tappen NE	7½	COOP
Jud SE	7½	MRB	Tappen North	7½	COOP
Kidder	7½	MRB	Tappen SE	7½	COOP
Landa SE	7½	MRB	Tappen South	7½	COOP
Leverich	7½	MRB	Towner NE	7½	MRB
Medina	7½	COOP	Towner SE	7½	MRB
Millarton	7½	MRB	Tunbridge	7½	MRB
Montpelier	7½	MRB	Willow City	7½	MRB
Montpelier NW	7½	MRB			

***Coop—State Cooperative Program.**
MRB—Missouri River Basin.

PROGRESS OF USGS QUADRANGLE MAPS IN NORTH DAKOTA

Maps In Progress June 30, 1956

Name	Size	Cooperator*	Name	Size	Cooperator*
Blackwater NE	7½	COOP	McClusky SE	7½	MRB
Blackwater NW	7½	COOP	McClusky SW	7½	MRB
Bottineau NE	7½	SIR	Monango SE	7½	MRB
Bottineau NW	7½	SIR	Oakes SE	7½	MRB
Bottineau SE	7½	MRB	Oakes SW	7½	MRB
Bottineau SW	7½	MRB	Overly NE	7½	MRB
Britton 1 NE	7½	MRB	Overly NW	7½	MRB
Britton 2 NW	7½	MRB	Pickardville NE	7½	MRB
Dunseith SE	7½	MRB	Pickardville NW	7½	MRB
Dunseith SW	7½	MRB	Pickardville SE	7½	MRB
Emmett NE	7½	COOP	Pickardville SW	7½	MRB
Emmett NW	7½	COOP	Rangely NE	7½	MRB
Fero SW	7½	MRB	Rangely NW	7½	MRB
Fullerton NE	7½	MRB	Rangely SE	7½	MRB
Fullerton SE	7½	MRB	Rangely SW	7½	MRB
Fullerton SW	7½	MRB	Rolette NW	7½	MRB
Hecla NE	7½	MRB	Rolette SW	7½	MRB
Hecla NW	7½	MRB	Ryder SE	7½	COOP
Lake Upsilon SW	7½	MRB	Ryder SW	7½	COOP
La Moure NW	7½	MRB	Savo NE	7½	MRB
La Moure SE	7½	MRB	Savo NW	7½	MRB
Lisbon 2 SE	7½	MRB	Souris NE	7½	SIR
Lisbon 2 SW	7½	MRB	Streeter 2 NW	7½	COOP
Lisbon 3 NE	7½	MRB	Streeter 2 SE	7½	COOP
Lisbon 3 SE	7½	MRB	Streeter 2 SW	7½	COOP
Lisbon 3 SW	7½	MRB	Upham NE	7½	MRB
Makoti SE	7½	COOP	Vashti NE	7½	MRB
Makoti SW	7½	COOP	Vashti NW	7½	MRB
McClusky NE	7½	MRB	Vashti SE	7½	MRB
McClusky NW	7½	MRB	Vashti SW	7½	MRB

***COOP—State Cooperative Program.**
MRB—Missouri River Basin.
SIR—Federal Topographic Mapping.

UNDERGROUND WATER SURVEYS

Cooperation with U. S. G. S.

During the past eleven years ground-water investigations by the Ground Water Branch of the United States Geological Survey have been in progress in various parts of the State. These investigations are being made in financial cooperation with the North Dakota State Water Conservation Commission, under the general supervision of the State Geologist who acts as technical advisor for the State Water Conservation Commission in their program.

The ultimate aim of the program is to obtain an overall knowledge of the ground-water resources in the entire State which would be adequate for effectively directing the optimum development of this resource for domestic, municipal, industrial and irrigation purposes and for effectively programming conservation and administrative measures which may be necessary or desireable in connection with its development and use.

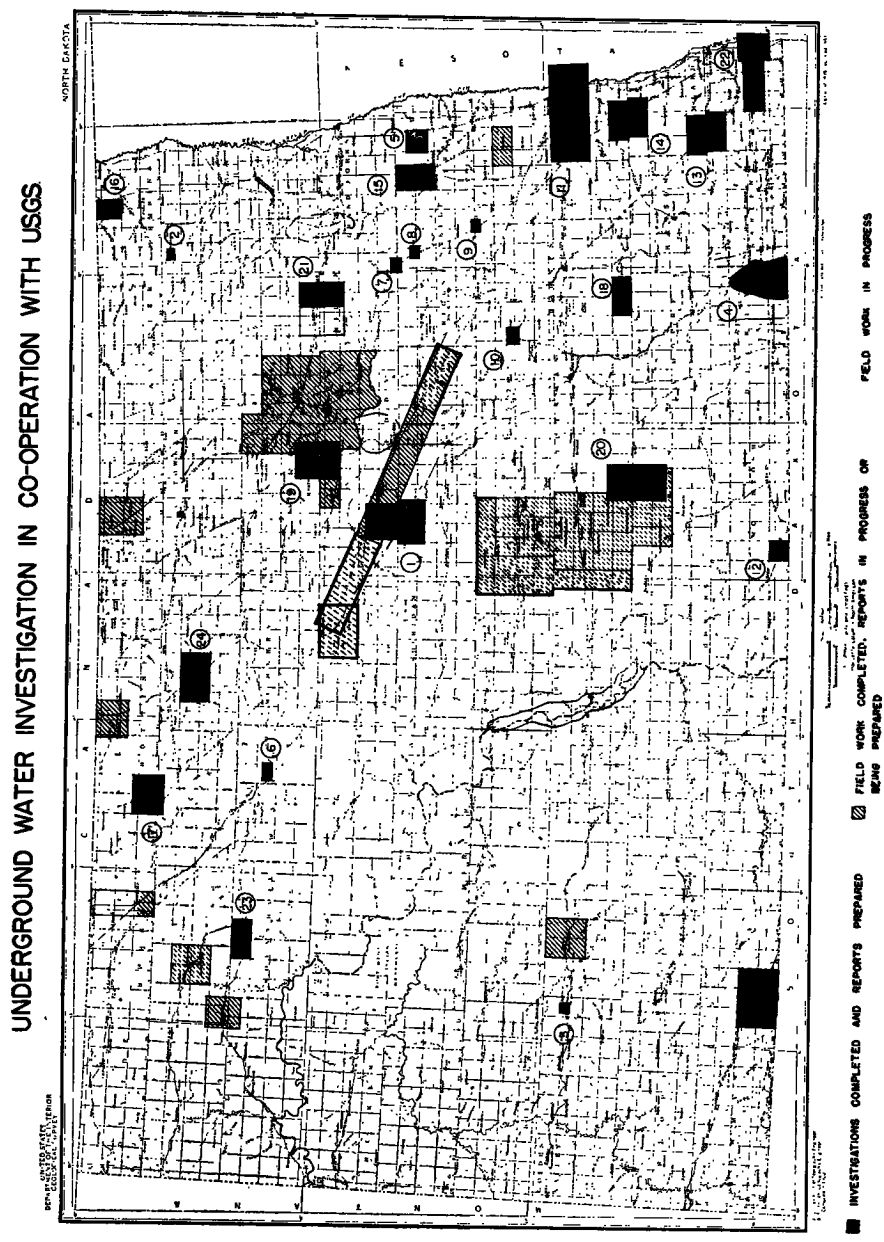
However, there has been and currently is a great need for adequate and perennial ground-water supplies for numerous communities throughout the State which are attempting to construct public water-supply and sewage facilities for the first time or which have experienced shortages under present facilities. Therefore, the bulk of the investigational work has been directed toward securing data on the ground-water resources that would be within reach of these communities.

Through contacts with the State Geologist and the State Water Conservation Commission. Many of these communities no longer appear to be actively interested in obtaining the benefits of any real investigation at the present time. On the other hand, many of the communities are still much interested in obtaining assistance but are waiting until facilities for conducting the work are more readily available.

At the present time, investigations have been completed or are under way in 42 areas in the State. Reports have been released on 23 areas. Three other reports have been completed but not officially released as yet. It is expected that the field work will be completed on all of these projects that are now under way during the forthcoming field season but it probably will be two years or longer before all the reports can be completed and released. In all, the reports will present information for more than 8,000 square miles of area.

Up to July 1, 1956, more than 1200 test holes had been drilled with the State-owned drilling rig in connection with investigational work. These holes represent approximately 155,000 feet or equivalent to over 27 miles of test drilling.

During the past two years investigations have been conducted in the vicinities of the towns of Westhope, Hettinger, Drake, Lehr, and all of Kidder County. One report has been duplicated and released to the public during the two year period and three other reports are essentially complete and will be duplicated in the near future.


UNDERGROUND WATER INVESTIGATION IN CO-OPERATION WITH USGS
NORTH DAKOTA
INVESTIGATIONS COMPLETED AND REPORTS PREPARED
FIELD WORK COMPLETED, REPORTS IN PROGRESS OR BEING PREPARED
FIELD WORK IN PROGRESS

The reports on the investigations may be had free of charge unless the supply for distribution has been exhausted, in which case copies may be examined in any of the State College libraries, the North Dakota Research Foundation library in Bismarck, offices of the State Water Conservation Commission in Bismarck, North Dakota Geological Survey and the United States Geological Survey both at the University of North Dakota in Grand Forks. Requests for reports should be made to one of the following agencies:

North Dakota State Water Conservation Commission
Bismarck, North Dakota
North Dakota Geological Survey
University Station
Grand Forks, North Dakota
United States Geological Survey
University Station
Grand Forks, North Dakota

The following list shows the reports that have been completed and whether or not they are currently available. A brief abstract giving the essential information has been prepared for the State Water Conservation Commission by the State Geologist and is available at the office of the State Water Conservation Commission on request:

No. 1. Ground Water in the Fessenden Area, Wells County, North Dakota by Leonard Filaseta, 1946. (Edition exhausted.)

No. 2. Ground Water in Beach Deposits of Glacial Lake Agassiz near Mountain, Pembina County, North Dakota, by P. D. Akin, 1946. (Edition exhausted.)

No. 3. Ground Water at Dickinson, North Dakota, by T. G. McLaughlin, 1946. (Edition exhausted.)

No. 4. Ground Water in the Deposits of Ancient Lake Dakota, Dickey County, North Dakota by William C. Rasmussen, 1947.

No. 5. Ground Water near Buxton, Traill County, North Dakota, by P. E. Dennis, 1947. (Edition exhausted).

No. 6. Geology and Ground Water Conditions at Minot, North Dakota, by P. D. Akin, 1947. (Edition exhausted.)

No. 7. Ground Water in the Aneta Area, Nelson County, North Dakota, by P. E. Dennis, 1947. (Edition exhausted).

No. 8. Ground Water in the Sharon Area, Steele County, North Dakota, by P. E. Dennis, 1947. (Edition exhausted).

No. 9. Ground Water in the Hope Area, Steele County, North Dakota, by P. E. Dennis, 1948. (Edition exhausted).

No. 10. Ground Water in the Wimbledon Area, Barnes and Stutsman Counties, North Dakota, by P. E. Dennis, 1948. (Edition exhausted).

No. 11. Geology and Ground Water Resources of Parts of Cass and Clay Counties, North Dakota and Minnesota, by P. E. Dennis, P. D. Akin and G. F. Worts, 1949. (Edition exhausted).

No. 12. Ground Water in the Zeeland Area, North Dakota, by Wilson M. Laird, 1948.

No. 13. Ground Water in the Wyndmere Area, Richland County, North Dakota by P. E. Dennis, P. D. Akin, and Suzanne L. Jones, 1950.

No. 14. Ground Water in the Kindred Area, Cass and Richland Counties, North Dakota by P. E. Dennis, P. D. Akin, and Suzanne L. Jones, 1950.

No. 15. Ground Water in the Portland Area, Traill County, North Dakota, by P. E. Dennis and P. D. Akin, 1950.

No. 16. Ground Water in the Neche Area, Pembina County, North Dakota, by Quentin F. Paulson, 1951.

No. 17. Ground Water in the Mohall Area, Bottineau and Renville Counties, North Dakota, by P. D. Akin, 1951.

No. 18. Ground Water in the Litchville Area, Barnes County, North Dakota, by P. D. Akin, 1952.

No. 19. Geology and Ground Water Resources in the Minnewaukan Area, Benson County, North Dakota, by Saul Aronow, P. E. Dennis and P. D. Akin, 1953.

No. 20. Geology and Occurrence of Ground Water in the Streeter Area, Stutsman, Logan, and Kidder Counties, North Dakota, by Quentin F. Paulson, 1952.

No. 21. Geology and Ground Water Resources of the Michigan City Area, Nelson County, North Dakota, by Saul Aronow, P. E. Dennis, and P. D. Akin, 1953.

No. 22. Ground Water in the Fairmont Area, Richland County, North Dakota and Adjacent Areas in Minnesota, by Quentin F. Paulson, 1953.

No. 23. Geology and Occurrence of Ground Water in the Stanley Area, Mountrail County, North Dakota, by Quentin F. Paulson.

No. 24. Geology and Ground Water Resources of the Hettinger Area, Adams County, North Dakota by C. J. Robinove. (This report has not yet received final review prior to release to the public.)

No. 25. Geology and Ground Water Resources of the Hankinson Area, Richland County, North Dakota, by J. E. Powell. (This report has not yet received final review prior to release to the public.)

No. 26. Geology and Occurrence of Ground Water in the Stanley Area, Mountrail County, North Dakota by Q. F. Paulson. (This report has not yet received final review prior to release to the public.

HYDROGRAPHIC SURVEYS

The world's total water supply is constant for all practical purposes. The perpetual process through which it moves is usually called the hydrologic cycle. The movement of a quantity of water in this cycle can be traced by beginning with its position in the clouds.

Upon cooling, the vapor forming the clouds is condensed and falls upon the earth in the form of rain, snow or ice. If this precipitation occurs during the growing season part of that which falls on plants is taken directly into their structures or is held on their surfaces until it is evaporated and returned to the atmosphere as vapor. Part of the remainder that reaches the soil enters the ground, and a part of this is taken up by plant roots to enter the plant structure or to be evaporated from the plant surfaces and returned to the atmosphere. Another part of the water that enters the soil and remains at shallow depths is evaporated to the atmosphere directly from the land surface, while still another part may percolate downward to varying depths to add to the ground-water supply. This ground-water supply, which varies greatly in depth and quantity depending upon the porosity of the soil and the precipitation, tends to move slowly but steadily toward an outlet at some lower level and thus eventually returns to the earth's surface from seeps and springs.

If precipitation falls upon the earth faster than the earth's immediate capacity to absorb it, the excess flows over the surface of the earth or at shallow depths in the soil and enters the stream channels directly. Thus it is apparent that our surface-water supplies are composed of water from two sources: direct or storm runoff and ground water flowing from seeps and springs. In the case of precipitation in the form of snow, the process is similar except that the movement through and over the earth's surface is merely delayed until thawing takes place.

Water that reaches the streams, flows toward the sea, and in this process is continuously being evaporated from the streams as well as from the sea. Through this perpetual motion device set up by nature the water will eventually return to the clouds and then back to the earth in the form of precipitation.

The discharge hydrograph of a typical North Dakota stream is illustrated in Figure 1. The condition that prevails in our streams a greater part of the time is a gradual recession as illustrated by the dashed line near the left side of the figure. Here the flow is composed entirely of water coming from seeps and springs and is referred to as base flow. The flow from the ground-water reservoirs lowers the elevation of the ground-water table, and thus the head or pressure on the seeps and springs decreases so that the rate of flow from them declines.

The solid line termed storm runoff illustrates what happens when rainfall or snowmelt occurs at a rate in excess of the soil's capacity to absorb it. Part of the precipitation reaches the stream channel as direct flow causing most of the rise shown. At the same time a portion of the

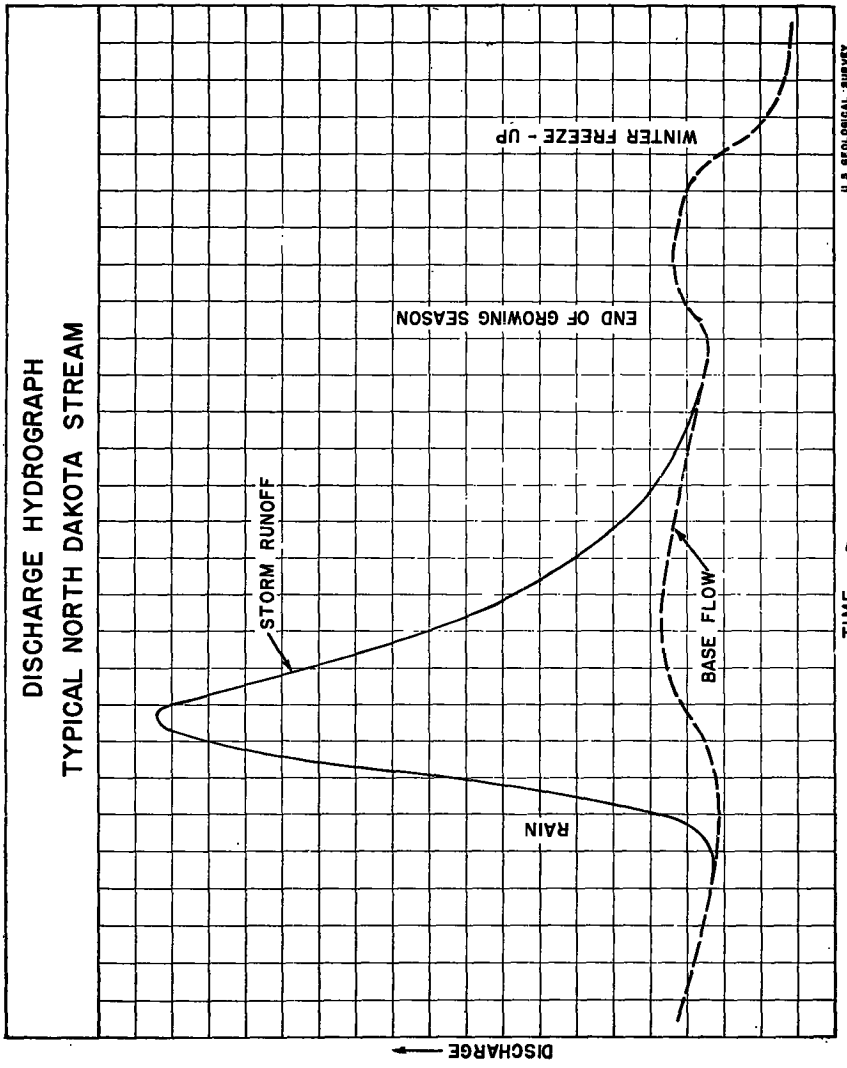

DISCHARGE HYDROGRAPH
TYPICAL NORTH DAKOTA STREAM
U S GEOLOGICAL SURVEY
BISMARCK, N. DAK.
WINTER FREEZE - UP
END OF GROWING SEASON
STORM RUNOFF
RAIN
BASE FLOW
TIME
DISCHARGE

FIGURE 1

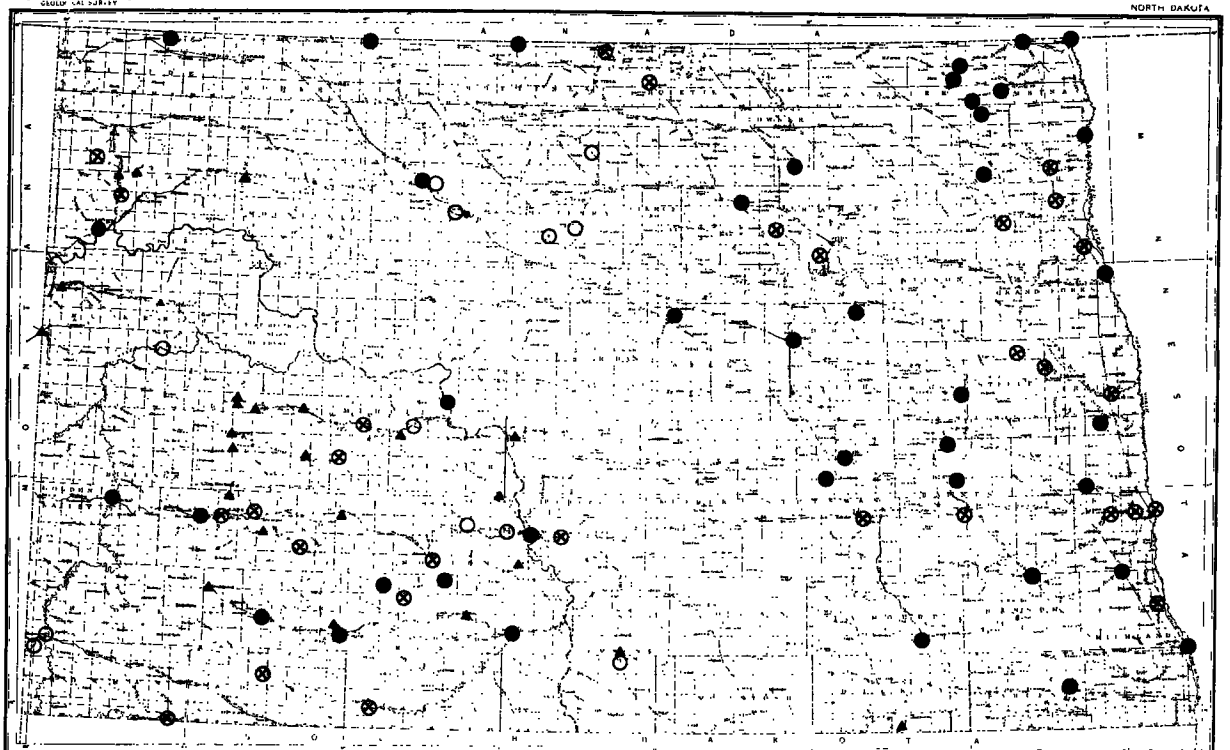
precipitation is seeping further into the ground causing a rise in the ground water level with a corresponding increase in the base flow. Sometime after the storm or snowmelt period, all of the storm runoff will have passed down the stream. This point is illustrated by the merging of the solid and the dashed line and signifies a return to the base flow condition.

In the fall of the year a small increase in stream flow usually occurs near the end of the growing season. This is attributed to a reduction in the amount of water that plants are drawing from the ground water, (thus permitting an increase in outflow from seeps and springs), a decrease in the amount of water being consumed by the plants in the area adjacent to and closely bordering the streams, and a decrease in evaporation from the land as well as water surfaces as a result of lower temperatures.

During the initial part of the severe winter period we experience a sharp decrease in stream flows as illustrated in the sharp drop in the dashed line at the right-hand side of the figure. During this period a large part of the flow entering the stream channels goes into storage in the form of a heavy ice cover on the streams. This ice in turn increases the resistance to flow for the remaining flowing water so that it must build up a higher head in order to force its way down the restricted channel. This increase in head (depth) results in a substanial additional amount of water being held in storage in the stream channels. Also much of the water from seeps and springs is frozen as it comes from the ground, or the ground is frozen so intensely that the seeps are entirely shut off for the remainder of the winter period. Frequently all these factors combine to produce very low flows, sometimes the minimum for the year, during the first period of severe freezing weather each winter.

It is essential that we know what to expect of our streams in order that they be made to serve the needs of mankind and in order that they be controlled where necessary. For public and industrial water supplies, for considerations involving the dilution of wastes, and for irrigation purposes, we must know the minimum flows that may be expected at various times during the year. If the minimum flows are less than the amount needed to meet the demand, storage of water must be considered. The amount of storage necessary to make up the deficiency during the low flow periods must be determined, and the amount of runoff the stream will yield to fill this storage must be known to satisfactorily solve such problems. Similar problems must be answered in connection with power development studies. The administration of water rights and the equitable distribution of water among the people competing for its use requires factual information relative to the available supply. In considering flood control and drainage projects it is essential that the peak flow rates and volume of runoff during major flood periods be known in order that satisfactory solutions may be found for the complex problems associated with them. It is important that there be adequate infor-

SURFACE WATER RESOURCES INVESTIGATIONS IN NORTH DAKOTA



STREAM GAGING STATION—CONTINUOUS RECORDS

- ⊗ — USGS IN COOPERATION WITH N.D. WATER CONSERVATION COMMISSION
- ● — USGS IN COOPERATION WITH OTHER AGENCIES
- ⊙ — USGS IN COOPERATION WITH N.D. WATER CONSERVATION COMMISSION AND OTHER AGENCIES

LOW FLOW MEASUREMENT STATIONS—PERIODIC MEASUREMENTS

- ▲ — USGS IN COOPERATION WITH N.D. WATER CONSERVATION COMMISSION

mation relative to the magnitude and frequency of flood flows, particularly on the smaller streams, if culvert and bridge designs are to be economically sound.

The only means we have of determining our water supplies and the probable future behavior of our streams is on the basis of their past performance. This requires the collection of continuous records of stream flow at strategic points over long periods of time.

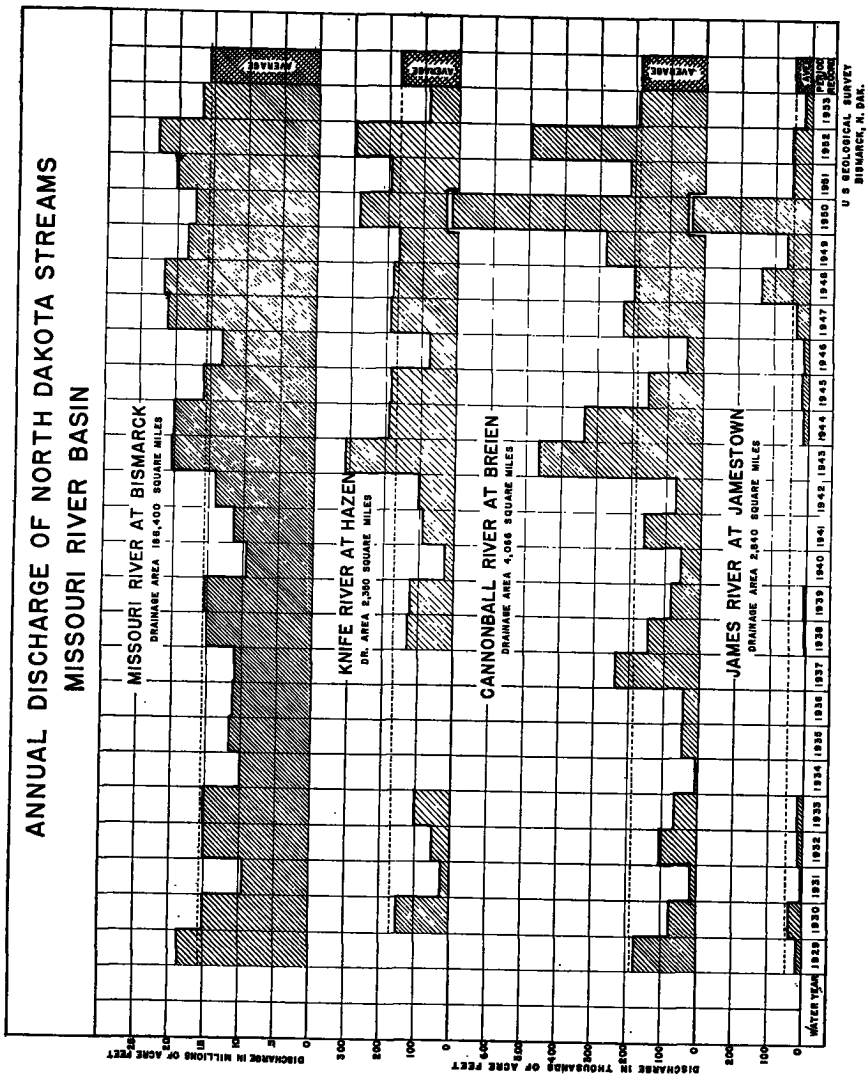
Congress recognized that work of this kind was essential in connection with the proper use and development of our water resources, and as early as 1888 instructed the U. S. Geological Survey to make an irrigation survey which resulted in the beginning of a program for systematically gaging the flow of streams in the United States. This was a huge assignment and during the early years relatively little could be done in view of the meager funds available and the vast area over which they had to be used.

In 1902 and 1903 several gaging stations were established in North Dakota and flow records obtained primarily in connection with possible irrigation development. Most of these stations were operated only a few years and discontinued. A few were operated rather sporadically until about 1929. At about this time the federal government undertook flood control activities on a nation-wide basis and gaging stations were established and operated on several of our large streams. The State of North Dakota took an active part in the program a few years later. Federal agencies interested in water development and conservation soon found that they had urgent need for stream-flow information and began to assist with the financing of the program.

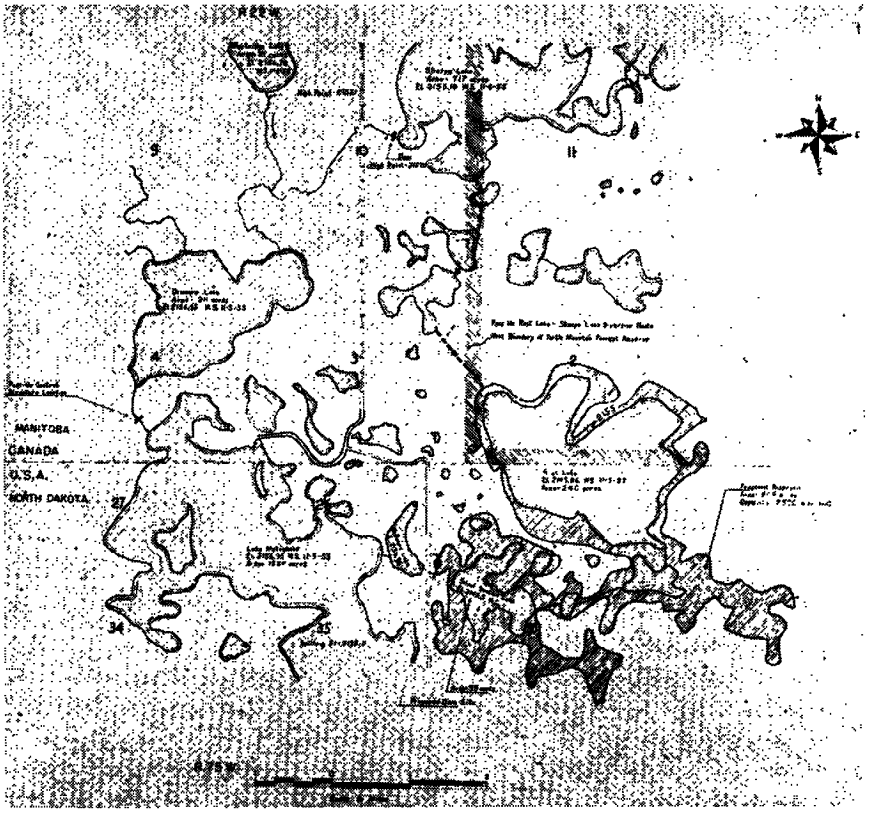
Figure 2 is a map of North Dakota showing the location of the 85 gaging stations being operated in the state at this time. The basic financing of 27 of these stations is through a cooperative arrangement between the North Dakota State Water Conservation Commission and the U. S. Geological Survey whereby the cost is shared equally by these agencies. A few stations on larger streams are financed entirely with Geological Survey funds.

The Corps of Engineers, Bureau of Reclamation, and Fish and Wildlife Service cooperate by furnishing funds for use in the operation of stations closely associated with projects of these agencies, and the U. S. State Department furnishes financial support for several stations along the Canadian border where international considerations are involved.

An investigation recently completed indicates that there is a definite need for 12 additional primary stream gaging stations in the state. These stations would be established on a permanent basis and would provide the information on stream flow essential to provide the basic coverage for North Dakota. In order to provide a means whereby runoff data for a specific area or stream not covered in the stream gaging


ANNUAL DISCHARGE OF NORTH DAKOTA STREAMS
MISSOURI RIVER BASIN
MISSOURI RIVER AT BISMARCK
DRAINAGE AREA 186,400 SQUARE MILES
KNIFE RIVER AT HAZEN
DR. AREA 2,350 SQUARE MILES
CANNONBALL RIVER AT BREIEN
DRAINAGE AREA 4,096 SQUARE MILES
JAMES RIVER AT JAMESTOWN
DRAINAGE AREA 2,840 SQUARE MILES
AVERAGE
DISCHARGE IN MILLIONS OF ACRE FEET
DISCHARGE IN THOUSANDS OF ACRE FEET
WATER YEAR
1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953
Period of Record
U S GEOLOGICAL SURVEY
BISMARCK, N. DAK.

program can be obtained by correlation from existing stations it is further recommended that consideration be given to the establishment of a series of secondary stations to be operated for a short period. The information from these secondary stations along with that available from the primary stations would provide sufficient information to serve as a basis for estimating the run-off in any area in the state with a reasonable degree of accuracy.



Lake Metigoshe Project

PROJECT REVIEW

It is the responsibility of the State Water Conservation Commission to review all proposed Federal water-use projects to make certain that the interests of North Dakota are being fully considered.

This has become an increasingly important phase of the Commission's activities during the last decade due to the increasing development of our interstate and international waters.

Although even the largest of the proposed federal projects have been locally conceived and partially investigated, economics have dictated that the federal government prepare the expensive detailed surveys and reports. These reports are prepared by various agencies in the Department of Agriculture, Interior and Army and are then forwarded to the State Water Conservation Commission for their review and approval.

Of the many various projects of the Corps of Engineers, Bureau of Reclamation, Federal Fish and Wildlife, Soil Conservation Service and the United States Geological Survey, the Commission assigns top priority to those that deal with the waters of the Missouri River.

Extensive studies have been made relative to the adequacy of water in the Missouri River, taking into consideration the potential storage of the mainstem dams, to meet the many uses proposed for the Missouri River water. Indications are that the supply will be sufficient if a well coordinated water management is initiated. As yet this goal in water management has not been attained. The huge demands for a downstream single purpose use on the lower Missouri, during the past four years, have created the paradox of there now being less water in storage on the Missouri River than was stored in Fort Peck reservoir alone before the post war construction of the giant multipurpose reservoirs on the main stem. This condition exists even though single purpose interest, during the past several seasons, has reluctantly submitted to curtailment of their water use. The Commission has objected to this heavy use of water on the basis that the demands of the user should be modified until an adequate supply of water is available in the reservoirs. Subnormal precipitation also has contributed to this peculiar situation.

A series of above normal water production years on the Missouri River watershed could alter the present water shortage and the resultant storage would make it possible for the federal agencies to maintain full navigation seasons and to also market significant blocks of firm hydro power. This would be of advantage to North Dakota because it is from power revenue profits that our Garrison Diversion Project will be primarily financed.

With the knowledge that there will never be sufficient water flowing normally in the Missouri River for all demands, once irrigation in the upper states is developed, the Commission is presently examining and commenting on all regulatory schemes for the use of Missouri River waters so that our natural heritage will not be lost through application of the "priority of time" doctrine.

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
MONTHLY REPORT OF APPROPRIATIONS AS OF JUNE 30, 1956
1953 - 1955 APPROPRIATIONS

FUND NUMBER		Available July, 1953	Expended to April 30, 1956	Balance June 30, 1956
1.	Commissioners — Per Diem and Expenses	$ 6,000.00	$ 5,294.61	$ 706.29
2.	Administration	40,000.00	40,111.34	120.50
	Collections and Refunds	231.84	.....	.....
3.	Maintenance of Dams	100,000.00	156,170.17	87.62
	Refunds and Deposits	56,257.79	.....	.....
4.	International and Interstate Commissioners Conference Expenses	8,000.00	8,000.00	NIL
5.	Topographic & Conservation Cooperation with U.S.G.S.	30,000.00	33,000.00	NIL
	Transfer from No. 10	3,000.00	.....	.....
6.	Hydrographic & Conservation Cooperation with U.S.G.S.	25,000.00	27,499.98	.02
	Transfer from No. 10	2,500.00	.....	.....
7.	Salary — State Engineer	6,000.00	6,000.00	NIL
8.	Engineering & Geological Survey and Dem —	35,000.00	38,500.00	NIL
	Transfer from No. 10	3,500.00	.....	.....
10.	Cooperation with U.S. Department and for Organizing Conservation and Irrigation Districts	50,000.00	40,935.81	64.19
	Less Transfers	9,000.00	.....	.....
11.	Small Projects and Other Investigations	100,000.00	102,399.70	3[illegible]3.92
	Collections and Refunds	2,536.62	.....	.....
		$459,026.25	$457,910.71	$1,115.54

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
MONTHLY REPORT OF APPROPRIATIONS AS OF JUNE 30, 1956
1955 - 1957 APPROPRIATIONS

FUND NUMBER		Available July, 1955	Expended to June 30, 1956	Balance June 30, 1956
1.	Commissioners — Per Diem and Expenses	$ 6,000.00	$ 1,341.54	$ 4,658.46
2.	Administration	40,000.00	17,895.82	22,494.30
	Collections and Refunds	390.12	.....	.....
3.	Maintenance of Dams	100,000.00	81,722.39	67,249.55
	Collections and Refunds	48,971.94	.....	.....
4.	International and Interstate Commission's Conference Expenses	8,000.00	3,510.28	4,489.72
5.	Topographic and Conservation Cooperation with U.S.G.S.	30,000.00	15,008.00	14,992.00
6.	Hydrographic and Conservation Cooperation with U.S.G.S.	25,000.00	10,575.18	14,424.82
7.	Engineering and Geological Survey and Dem.	35,000.00	17,462.47	17,537.53
8.	Cooperation with U.S. Departments and for Organizing Conservation and Irrigation Districts	40,400.00	24,791.56	15,601.58
9.	Small Projects and Investigations and Surveys	106,000.00	46,636.75	59,370.11
10.	Water Right Investigations	12,000.00	6,178.80	5,821.20
		$451,762.06	$225,122.79	$226,639.27

OTHER COOPERATIVE ACTIVITIES

MISSOURI BASIN INTER-AGENCY COMMITTEE

The Missouri Basin Inter-Agency Committee was established in 1945 shortly after the passage of the Flood Control Act of 1944 by the Congress which provided for the Missouri River Basin projects. The Inter-Agency Committee was established for the purpose of coordinating the programs of the various federal agencies and states concerned in the development of the land and water resources of the Missouri River Basin. The committee, as it is presently set up, consists of representatives of 7 federal agencies, namely: Department of the Interior, Department of Agriculture, Corps of Engineers, Department of Labor, Department of Commerce, Department of Health, Education and Welfare and Federal Power Commission and the ten States in the Missouri River Basin. The committee meets from six to eight times each year to consider various matters concerning the resource development program in the Missouri River Basin. The State of North Dakota is represented on the committee by the Governor and a member of the State Water Conservation Commission, who represents the Governor in his absence. In addition various sub-committees have been established for the Missouri Basin Inter-Agency Committee to study specific matters for consideration of the committee in future meetings. The State of North Dakota, through the Governor and the State Water Conservation Commission, has been very active in the affairs of the Missouri Basin Inter-Agency Committee.

ASSOCIATION OF WESTERN STATE ENGINEERS

The Association of Western State Engineers is a volunteer association consisting of the State Engineers of the 17 western states. It was established to provide a means whereby the State Engineers could discuss and consider problems in connection with water resources common to all member states. This association meets once a year in one of the member states at which time these problems are discussed. The State Engineer of North Dakota, who is also Secretary of the State Water Conservation Commission, represents the State of North Dakota in this association.

MISSOURI RIVER STATES COMMITTEE

The Missouri River States Committee was originally set up in 1945 and it was through this organization that the Missouri Basin Inter-Agency Committee was established. The Missouri River State Committee consists of the Governors of the ten states in the Missouri River Basin and two representatives from each State, as named by that State's Governor. Representing the State of North Dakota on the Missouri River States Committee at the present time is Curtis Olson of Valley City, Vice Chairman of the State Water Conservation Commission, and Mr. A. R. Weinhandl of Minot. This committee has been very influential in establishing the policy under which the Missouri River Basin project has been developed. It represents the position of the various states in this project and undoubtedly will be active in providing the guidance necessary for the future development in the Missouri River Basin.

NORTH DAKOTA STATE AGENCIES

The North Dakota State Water Conservation Commission in carrying out its duties designated by law cooperates with several other state agencies in problems and matters affecting both agencies. The principal agencies with whom the Commission cooperates are the State Health Department, the State Game and Fish Department and the State Highway Department.

The State Health Department. According to North Dakota laws, the State Water Conservation Commission has been given the responsibility for the control of all waters in the State of North Dakota and has certain responsibilities as to the control of pollution of these waters in cooperation with the State Health Department. In connection with carrying out this responsibility, the Commission and State Health Department approves plans for the construction of municipal water supply and sewage facilities, and establishes rules and regulations relative to the control of pollution of the streams of the State. The Commission also received cooperation from the State Health Department in representing the State of North Dakota before the International Joint Commission and other interstate organizations concerned with the water resources of North Dakota.

State Game and Fish Department: In connection with the development of water resources of North Dakota, one of the primary benefits is that derived from the enhancement of recreation and game and fish propagation and conservation. The Commission works very closely with the State Game and Fish Department on many projects that will provide these benefits. The greater amount of the cooperative work with the State Game and Fish Department is concerned with the repair and construction of small dams having a fish and wildlife value. The extent of the cooperation with the State Game and Fish Department is reviewed in the section on maintenance of dams in this report. In addition the Commission provides engineering services to the Game and Fish Department in connection with other projects that have a specific value for fish or wildlife conservation and propagation.

State Highway Department: The State Highway Department and the State Water Conservation Commission cooperate in matters pertaining to the construction of roads and their effect on the water courses and drainage in particular areas in the State. The development of water resource projects for flood control purposes have an affect on highways in the state and these matters are of concern to the Commission and the State Highway Department. Particular problems in which the Commission and the Highway Department have actively cooperated during the past biennium are the flood problem in Ramsey County caused by the restricted flow in Mauvais Coulee. The establishment of drains in several Red River Valley counties and their effect on the existing highways in those areas and the relocation of roads in the Devils Lake area made necessary because the lake level has increased as a result of natural run-off. It is expected that the State Highway Department

and the State Water Conservation Commission will have many additional problems to consider on a cooperative basis as the development of the water resources in North Dakota moves forward.

OTHER ORGANIZATIONS AND AGENCIES

In addition to the State and Federal agencies with whom the Commission cooperates, there are several volunteer private organizations in North Dakota that are active in the State's water resource program and have provided much of the needed support and promotion for this program. These organizations include the North Dakota Reclamation Association, the Greater North Dakota Association, the Missouri Souris Projects Association, the railroads and power companies operating in the state, farm organizations and others. Those primarily concerned with the State's water resource development program are discussed below.

MISSOURI SOURIS PROJECTS ASSOCIATION

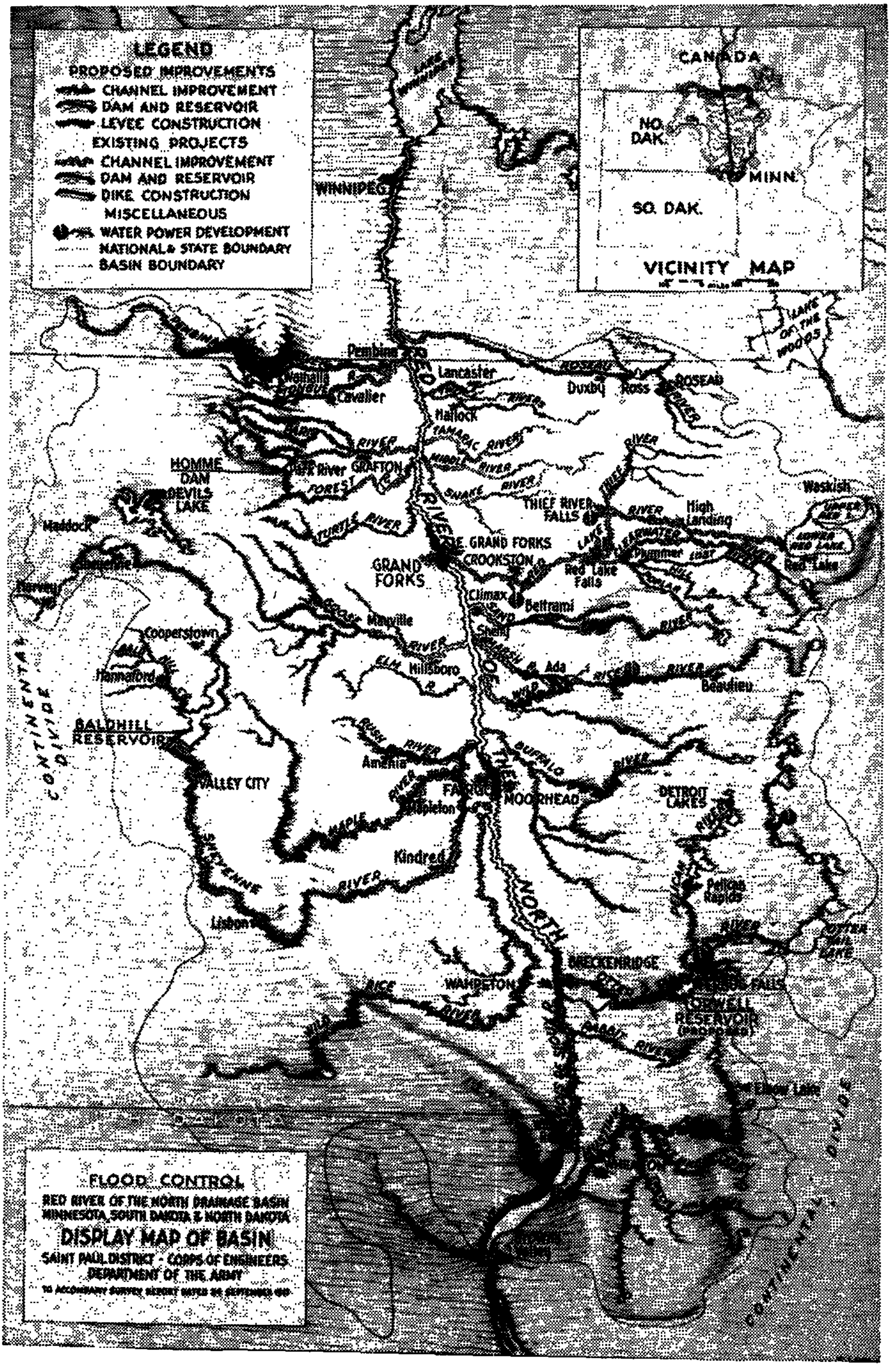
The Missouri Souris Projects Association is an organization consisting of voluntary members who are interested primarily in the development of the project that would provide for the diversion of waters from the Missouri River as is proposed in the Garrison Diversion project. This organization has actively promoted the development of this project in the State of North Dakota and has contributed much in time and effort in obtaining the appropriation of funds from Congress for the investigation of the project, and in connection with other matters pertaining to development of the project. President of the Missouri Souris Projects Association is R. L. Dushinske of Devils Lake. The organization's secretary is Oscar Berg of Minot.

GREATER NORTH DAKOTA ASSOCIATION

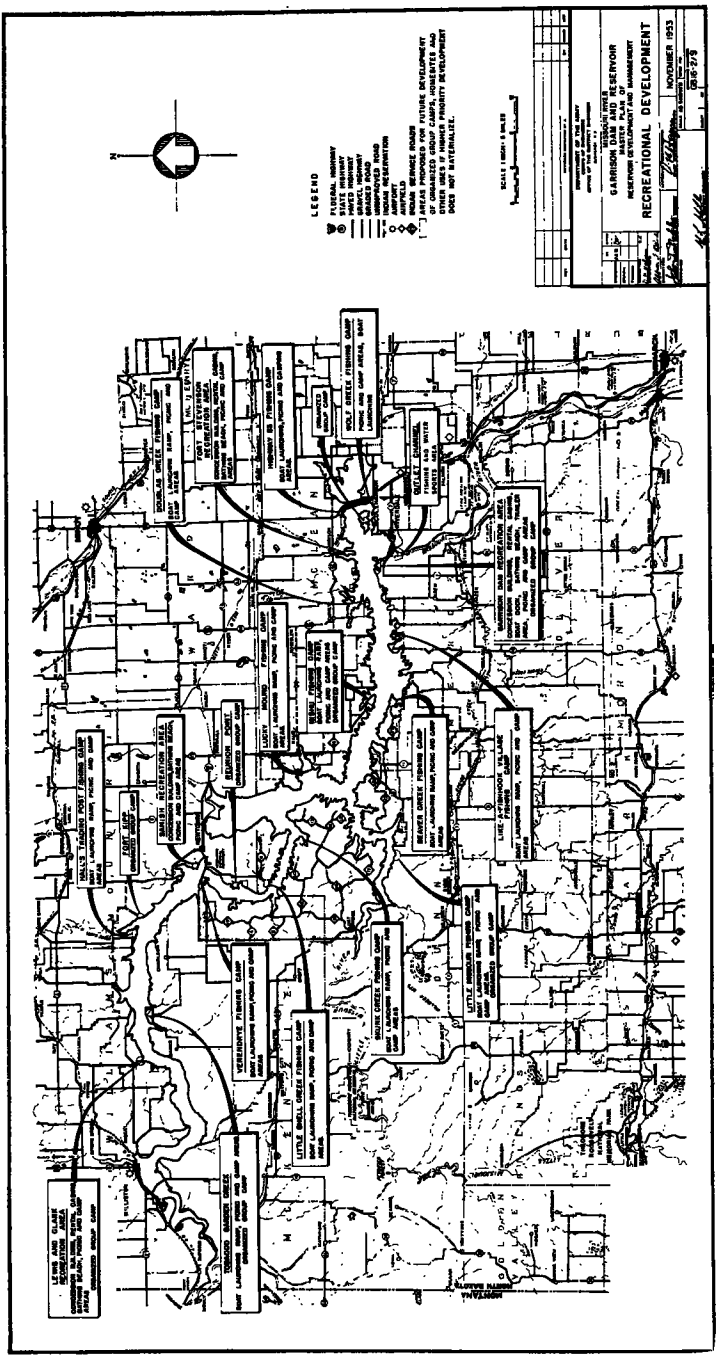
The Greater North Dakota Association has actively supported the development of the State's water resources through the construction of the various projects proposed in the State's water resource plan. This organization is also active in obtaining Congressional appropriations for the investigation, construction and development of many of the water resource projects in North Dakota. The Greater North Dakota Association has prepared a pictorial record of the State's water resource projects that has been used extensively by the Commission.

NORTH DAKOTA RECLAMATION ASSOCIATION

The North Dakota Reclamation Association is composed of volunteer members from all sections of the State of North Dakota who are interested in the development of our water resources. Through its affiliation with the National Reclamation Association, which is composed of similar organizations and all of the 17 western states, this organization has a great deal of influence relative to policies and matters relating to water resources. Although primarily interested in reclamation the Association has been active in promoting the development of water resource projects, both large and small, for all sections of the state. The President of the North Dakota Reclamation Association is Robert Masse of Grand Forks.


LEGEND
PROPOSED IMPROVEMENTS
CHANNEL IMPROVEMENT
DAM AND RESERVOIR
LEVEE CONSTRUCTION
EXISTING PROJECTS
CHANNEL IMPROVEMENT
DAM AND RESERVOIR
DIKE CONSTRUCTION
MISCELLANEOUS
WATER POWER DEVELOPMENT
NATIONAL & STATE BOUNDARY
BASIN BOUNDARY
CANADA
NO. DAK.
MINN.
SO. DAK.
VICINITY MAP
WINNIPEG
LAKE OF THE WOODS
Pembina
Walhalla
Cavalier
Lancaster
Hallock
Duxby
Ross
ROSEAU
GRAFTON
HOMME DAM
DEVILS LAKE
Maddock
THIEF RIVER FALLS
High Landing
Waskish
E. GRAND FORKS
GRAND FORKS
CROOKSTON
Red Lake Falls
Red Lake
Climax
Beltrami
Mayville
Cooperstown
Hannaford
Hillsboro
Ada
Beaulieu
BALDHILL RESERVOIR
CONTINENTAL DIVIDE
VALLEY CITY
Amenia
FARGO
MOORHEAD
DETROIT LAKES
Kindred
Pelican Rapids
Lisbon
BRECKENRIDGE
WAHPETON
ORWELL RESERVOIR
NORTH
FLOOD CONTROL
RED RIVER OF THE NORTH DRAINAGE BASIN
MINNESOTA, SOUTH DAKOTA & NORTH DAKOTA
DISPLAY MAP OF BASIN
SAINT PAUL DISTRICT - CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

COOPERATIVE ACTIVITIES WITH FEDERAL AGENCIES


LEGEND
FEDERAL HIGHWAY
STATE HIGHWAY
GRAVEL HIGHWAY
IMPROVED ROAD
UNIMPROVED ROAD
INDIAN RESERVATION
AIRFIELD
AREAS WITHHELD FROM FUTURE DEVELOPMENT
OF ORGANIZED GROUP CAMPS, HOMESITES AND
OTHER USES IF HIGHER PRIORITY DEVELOPMENT
DOES NOT MATERIALIZE.
GARRISON DAM AND RESERVOIR
RECREATIONAL DEVELOPMENT
NOVEMBER 1953
GARRISON DAM — RECREATIONAL PLAN

SOIL CONSERVATION SERVICE

The Soil Conservation Service has cooperated with the State Water Conservation Commission in many activities. The soil and water conservation program and the more recent watershed protection program administered by the Soil Conservation Service supplements the water development activities of the Commission.

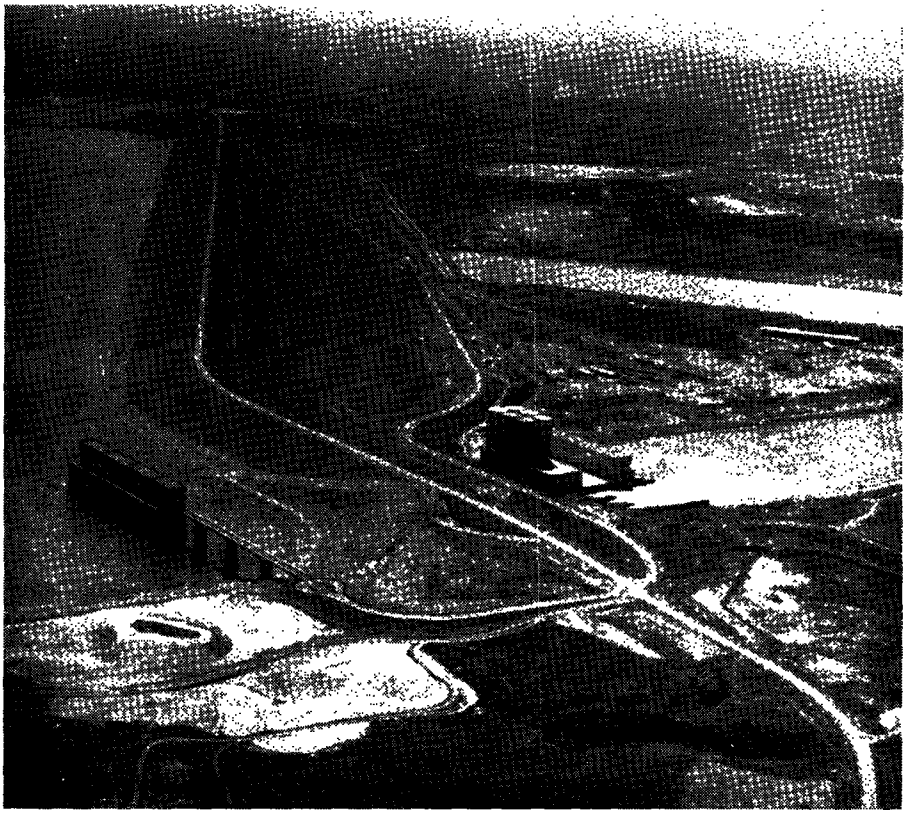
The watershed protection and flood prevention program administered by the Soil Conservation Service has expanded rapidly within the past two years and has received active support from the State Water Commission. There are now 28 applications on file for watershed protection projects. This program approaches the problem of flooding on the basis of an active watershed. In developing the protection plan, consideration is given to all measures that will reduce floodwater damage. A program of land treatment practices that will increase the amount of water held in the soil is of primary importance. Such farming practices as contour stripcropping, stubble mulch management, grass rotations on crop land to provide protective cover and to improve the soil structure are but a few of the practices that farmers on the watershed are encouraged to establish. Detention dams are constructed in the upper watershed designed with outlet tubes that will allow the water to be released at a slow rate. If necessary, floodways are constructed and channels cleared and straightened. All measures are planned to give the greatest possible amount of protection for the money spent.

The State Water Conservation Commission has been active in support of this program by assisting in the review of applications to determine priority and feasibility and the review of completed plans. Assistance is also rendered by helping local people in the organization of water conservation and flood control districts necessary to meet the financial obligations of the people within the watershed. These special purpose districts have been organized to support 8 of the 28 applications on file.

The Tongue River Pilot Watershed Protection Project in Pembina County is now under construction with two detention dams completed and two under construction. Contracts will be awarded on eight more dams within the next three years. Some channel clearing has been completed with a total of 45 miles needed for the project. There will be a total of 31 miles of floodways constructed, and 11½ miles are now completed or under contract. The land treatment program is over 50% applied.

The Elm River project in Traill and Cass Counties has been submitted to Congress for approval. Planning is under way on the Swan-Buffalo Watershed in Cass County; Louse Creek in Grant and Morton Counties; and the Storm Lake-Elk Creek, Wild Rice Creek and Tewaukon Watersheds in Richland, Ransom and Sargent Counties. These watersheds are tributaries of the Wild Rice River.

The Red River Valley drainage program has been a cooperative program carried out by the two agencies with the Soil Conservation Service providing the engineering assistance for the design and construction of the legal drains and the Commission reviewing the plans, assisting the county commissioners in establishing the necessary legal authority and providing financial assistance.



Garrison Dam and Reservoir

CORPS OF ENGINEERS
ST. PAUL DISTRICT

The St. Paul District of the Corps of Engineers have been given the responsibility for the flood control improvement of the Hudson Bay Drainage area in North Dakota. This area includes all lands in the state drained by the Red River of the North and the Souris River. Projects that are completed include the Baldhill and Homme Dams, the Lake Traverse and Bois de Sioux Project, and several other river channel improvement projects. These projects are discussed below under headings designating their stage of progress.

PROJECTS COMPLETED

Baldhill Dam and Lake Ashtabula

This project is located on the Sheyenne River 16 miles upstream from Valley City, North Dakota, and about 271 river miles above the mouth of the river. The dam creates a reservoir that is used to provide a substantial degree of flood control to the cities, villages, and urban areas along the Sheyenne River and to provide water supply and pollution abatement for the section of the Sheyenne River below the dam and a section of the Red River of the North. The plan also provides for the construction of a low diversion dam in the Sheyenne River 35 miles above the mouth and a short ditch leading thence to the existing Stanley ditch, the latter to be cleared and deepened to the Red River of the North which it enters about 9 miles above Fargo so as to provide the city of Fargo with a supplemental city water supply from water stored in Lake Ashtabula.

Homme Reservoir and Dam

This project is located on the South Branch of the Park River about 4 miles upstream from Park River, North Dakota. The 3,650 acre-feet reservoir created by the dam affords partial flood protection to areas below the dam and provides a minimum flow of about 5 second-feet in the river to meet the water supply and pollution abatement needs from the dam to Grafton, N. Dak. In addition, a 16-inch cast iron pipe water supply outlet through the dam has been provided at the request of local interests.

Lake Traverse and Bois de Sioux Project

Lake Traverse located on the boundary between the States of Minnesota and South Dakota and the north end of an extension to the lake reaches within one mile of the North Dakota border. The Bois de Sioux River is the outlet stream from 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 Otter Tail River to form the Red River of the North.

The main features of this project are: (1) the Bois de Sioux channel improvement (2) the White Rock Dam, (3) the Reservation Highway Dam, (4) the Brown's Valley Dike. The main purpose of the project is to provide flood protection for some 50,000 acres of agricultural land located in this area. Other benefits to be achieved are the creation of a lake that will be ideal for boating, swimming, fishing and wildlife conservation. Construction of this project was completed in 1941.

Snagging and Clearing Operations

During the period of this report, snagging and clearing operations were initiated in June 1956 on the Park River in the vicinity of Hoople, North Dakota, and on the Maple River at Enderlin, North Dakota. This work consists of the removal of snags, debris, brush and timber within the channel banks to eliminate obstructions to an otherwise free flow of water, thus reducing flooding in the affected portions of the streams. About 2 miles of channel are affected on the Maple River and costs are estimated to be $20,000. About 33.3 miles of the Park River are affected, and the work is estimated to cost about $47,000.

PROJECTS UNDER CONSTRUCTION

Grand Forks Protection System

On March 5, 1954, a contract was awarded for improvements at Grand Forks, North Dakota. This unit of work is a part of the comprehensive flood control project on Red River of the North authorized in 1948. Improvements consist of construction of a levee totaling about 6,550 feet in length with the necessary interceptor lines, sewers and pumping plant to provide for interior drainage. Local interests are required to (a) provide all lands, easements and rights-of-way, and spoil disposal areas for construction and maintenance; (b) hold and save the United States free from damages due to construction and maintenance of the works; (c) maintain the channels in accordance with regulations prescribed by the Secretary of the Army; and (d) make all necessary changes to utilities, highways and bridges, including approaches. The local interests have provided necessary lands. Construction is about 67.5 percent complete. Due to foundation difficulties, the contract has been suspended since August 1954. Estimated Federal cost is $885,000. Work is expected to be completed by August 1957.

Rush River Improvements

The Rush River unit is a part of the comprehensive flood control project on the Red River of the North authorized in 1948. Improvements consist of clearing and snagging along approximately 14 channel miles and excavation for deepening, widening and straightening the present channel throughout an additional 14 miles. The entire 28 miles extends upstream from the mouth of the river. Local interests are required to (a) provide all lands, easements and rights-of-way, and spoil disposal areas for construction and maintenance; (b) hold and save the United States free from damages due to construction and maintenance of the works; (c) maintain the channels in accordance with regulations prescribed by the Secretary of the Army; and (d) make all necessary

changes to utilities, highways and bridges, including approaches. Local interests have provided necessary lands.

Estimated Federal cost is about $242,000. Work is expected to be complete by August 1956.

OTHER AUTHORIZED PROJECTS

Improvements have been authorized at Wahpeton and Fargo, North Dakota and on the Sheyenne, Maple, and Rush Rivers under the comprehensive flood control project on Red River of the North authorized in June 1948. No work is being done on the Wahpeton, Sheyenne, and Maple River units. Design studies are being made for work at Fargo, and local interests at that locality have under advisement a proposed plan of improvement.

PROJECTS UNDER INVESTIGATION

Red River of the North Drainage Basin Studies

A study has been undertaken by the St. Paul District of the Corps of Engineers of the Red River of the North Drainage Basin. This report will include consideration of flood problems on the main stem of the Red River to the Canadian boundary and of tributaries including several of those in North Dakota. Funds for completion of this report have been made available. Included in this report will be a separate interim survey report covering the flood and major drainage situation in the vicinity of Devils Lake, North Dakota.

Souris River Study

A preliminary examination on the Souris River has been submitted and recommended a survey of the flood and major drainage problems in the basin.

Pembina and Tongue Rivers Surveys

A survey of the Pembina and Tongue Rivers has been undertaken. Public hearings have been held at three locations on this matter and work on the report is 60 percent complete at the present. Current Corps of Engineers activities are confined largely to consideration of the feasibility of a multiple purpose dam and reservoir on the Pembina River near Walhalla.

CORPS OF ENGINEERS
GARRISON DISTRICT

GARRISON DAM AND RESERVOIR

Garrison Dam is located on the Missouri River in McLean and Mercer Counties, N. Dak., about 11 miles south of Garrison, N. Dak., and 9 miles west of Coleharbor, N. Dak. It is 1,455.0 miles above the mouth of the river and 77 miles above Bismarck, N. Dak.

Existing project. The project plan provided for the construction of a dam and reservoir for flood control, irrigation, navigation, hydroelectric power, and other purposes. The dam is a rolled earthfill structure with a crest length of 11,300 feet and a maximum height of 210 feet. The spillway, located in the east abutment, is controlled by 28 tainter crest gates, 29 feet high and 40 feet long. The outlet works, containing 5 power tunnels and 3 flood-control tunnels, is located in the west abutment. A hydroelectric power-generating plant is located on the downstream toe of the dam below the outlet works. The reservoir has a gross storage capacity of 23,000,000 acre-feet for multiple purpose use including 4,900,000 acre-feet for dead storage. The existing project was authorized by the Flood Control Act approved December 22, 1944 as part of the general comprehensive plan for flood control and other purposes in the Missouri River Basin. The estimated cost for the project, which includes a power installation of five 80,000 kilowatt units and initial protection in the vicinity of Williston, N. Dak., is $294,000,000.

Operations and results during the fiscal year. Surveys, foundation explorations, and engineering studies were continued throughout the fiscal year. Design memoranda were completed for a railroad overpass, Little Muddy bridge and approaches, protective works Williston levee section I, reservoir clearing stage III (schedule A), and pavement and guard rail along the embankment. Negotiations were initiated, continued or completed for a number of utilities, roads, railroads, and other relocation items. Construction features completed during the fiscal year included: Mountrail County roads, North Dakota highways contract number I, McKenzie County roads, Sanish branch—Soo railroad, Sanish bridge superstructure, Snake Creek sluice gates, east abutment grouting section spillway gate hoists, spillway monorail hoist, station switchgear and transformers, 15 kilovolt switchgear and generator leads, auto-transformers, carrier current equipment, turbines, generators 1 and 2, and a number of items of permanent operating equipment.

In addition to the work completed, the following work items were initiated or carried on during the year: Williams County roads, Little Muddy Creek bridge, Reservation Mutual Aid Telephone Corporation, protective works Williston levee section I, main embankment stage V

(final), east abutment grouting section IV A, concrete aggregates lot 3, spillway stilling basin, penstocks and surge tanks, powerhouse and switchyard, replacement of habitat, generators, pavement and guard rail on the embankment, purchase of a number of items of permanent operating equipment, and maintenance of construction facilities. Preparation of engineering data, tract maps, appraisal reports, oil impairment estimates, court actions for acquisition of lands in the reservoir area were carried on during the fiscal year.

Operation and maintenance. The storage in the reservoir in this second year of partial operation, was used to control flood flows, to maintain navigation flows on the lower Missouri and Mississippi Rivers, to produce hydroelectric power at Garrison and Fort Randall Dams and to serve downstream municipalities in providing adequate water for domestic and industrial consumption and flows for stream sanitation. The reservoir was also used for recreational purposes, boating, fishing, etc. The total release from the reservoir amounted to approximately 15,169,500 acre feet, which is about equal to a mean average annual flow of 20,900 cubic feet per second. Two generators went "on-the-line" during the year and produced a gross electrical energy amounting to 189,939,000 kilowatt-hours. The net electrical energy, exclusive of power for station use, was 188,564,000 kilowatt-hours. In addition to full operation of the intake structure and partial operation and maintenance of the reservoir, dam and Snake Creek embankment a program of sediment studies was carried on. An experimental study of high winter releases and a continued basin-wide reservoir regulation study was accomplished.

Condition at end of fiscal year. In addition to the completed contract plans and specifications listed under operations and results above, during the fiscal year, design memoranda, design and preparation of plans and specifications are under way for protective works—Great Northern Railway, Williams Electric Co-operative, Montana-Dakota Utilities Company, penstocks and surge tanks (units 4 and 5), powerhouse and switchyard (units 4 and 5), turbines and governors (units 4 and 5), generators (units 4 and 5), main transformers (units 4 and 5), roads and parking areas, and permanent operating equipment. Negotiations for agreements and plans and specifications are in progress for a number of relocation items. A program of sediment studies and degradation investigations is being continued. Condition and operation studies for a coordinated basin reservoir operation plan is under way. Field investigations and laboratory tests for determining the foundation consolidation, action of structures and embankment materials are in progress. Permanent work on the project is about 85 percent complete. The percentages of completion of major features, based on project estimate (July 1956) which contemplates purchase of the irrigation districts at head of the reservoir, construction of bank protection for the pumping plant of the Buford-Trenton irrigation district and installation of power units 4 and 5 are as follows:

Features	Percent Complete
Lands and damages	74
Relocations	78
Roads	90
Railroads	82
Cemeteries, utilities, structures	52
Reservoir	80
Dam	93
Fish and Wildlife facilities	36
Power plant	67
Powerhouse	84
Turbines and generators	53
Switchyard, accessory, and miscellaneous	76
Roads, railroads, and bridges	96
Recreation facilities	30
Bank stabilization	0
Buildings, grounds, and utilities	98
Permanent operating equipment	58
Engineering and design	86
Supervision and administration	83

MANDAN, N. DAK.

Location. This project is located on both banks of the Heart River at Mandan, N. Dak.

Existing project. The plan of improvement provides for the construction of levees and appurtenant works along the left bank of the Heart River for the protection of municipal areas and along the right bank of the Heart River for the protection of the State Training School.

The existing project was authorized in the Flood Control Act approved July 24, 1946 and modified by the Flood Control Act approved May 17, 1950. The estimated cost of improvement is $806,000, of which $667,000 is Federal cost for construction and $139,000 is local cost for lands and relocations.

Local cooperation. Local interests have met the requirements of local cooperation in connection with the levee project. Assurances in connection with interior drainage facilities were furnished by letter dated June 2, 1955. By letter dated June 1, 1956, the Board of City Commissioners for Mandan indicated that they are proceeding to obtain the required easements of rights-of-way needed for the interior drainage work.

Operation and results during the fiscal year. Preparation of design memorandum and plans and specifications was resumed in June 1956 subsequent to the transfer of all interior drainage work from the Lower Heart River project to the Mandan project.

Condition at end of fiscal year. Construction of levees and appurtenant facilities is complete. Operation manual and record drawings for

this portion of the project are also finished. Design memorandum and plans and specifications for interior drainage, including portion transferred from the Lower Heart River project, are about 50 percent complete.

LOWER HEART RIVER, N. DAK.

Location. This project is located on both banks of the Heart River in the 14-mile reach extending upstream from the mouth of the river. It is in the vicinity of Mandan, N. Dak.

Existing project. The plan of improvement provides for raising the present Mandan levees, provides a closure levee extending from U. S. Highway 10 to high ground upstream (west) from Mandan, and provides for channel improvement and levee construction downstream (east) of Mandan. Improvement will increase protection to the city of Mandan and the State Training School and will provide protection for two additional areas which are rural in development.

The project was authorized in the Flood Control Act approved September 3, 1954. The estimated cost of improvement is $2,255,000, of which $1,750,000 is Federal Cost of construction and $505,000 is local cost.

Local cooperation. Local officials have indicated that assurances of local cooperation will be forthcoming.

Operation and results during the fiscal year. Preparation of design memorandum was initiated in January 1956. In May 1956 interior drainage facilities were transferred to the Mandan, N. Dak. project.

Condition at the end of the fiscal year. Preparation of design memorandum is about 10 percent complete.

MARMARTH, N. DAK.

Location. On the left banks of the Little Missouri River and Little Beaver Creek at Marmarth, N. Dak.

Existing Project. The plan of improvement provides for the raising and extending of the present inadequate levees. Approximately 6,200 feet of levee will be raised and 4,000 feet of new levee will be constructed. The project will provide the city of Marmarth with virtually complete protection against flood from the Little Missouri River and Little Beaver Creek. The project was authorized in the Flood Control Act approved September 3, 1954. The estimated cost of improvement (July 1956) is $272,000, of which $260,000 is Federal cost of construction and $12,000 is local cost for lands and utility modifications.

Local cooperation. Local interests have indicated that requirements of local cooperation will be met. The city already owns considerable portion of the necessary rights-of-way.

Operation and results during the fiscal year. Design memorandum and plans and specifications were initiated and completed during the fiscal year.

Condition at the end of the fiscal year. Design memorandum and plans and specifications are complete. Construction has not been initiated.

FLOOD CONTROL WORK UNDER SPECIAL AUTHORIZATION

Snagging and clearing of navigable streams and tributaries in the interests of flood control.

Study and report to determine the extent of clearing needed on the Heart River at Belfield, N. Dak. to provide a reasonable degree of flood protection for that city was completed and a favorable report submitted in October 1955. General design memorandum was approved in November 1955 and funds for construction provided. By a letter dated April 17, 1956, the city of Belfield recommended that due to anticipated opposition to the project no further action be taken at this time. Balance of funds were revoked in June 1956.

Small Flood Control Projects not specifically authorized by Congress. (section 212 of the 1950 Flood Control Act.) Design memorandum submitted in June 1955 on the feasibility of providing flood protection for Linton, N. Dak. from Spring and Beaver Creeks, indicated only marginal economic justification. Balance of available funds have been revoked.

BUREAU OF RECLAMATION

MISSOURI RIVER BASIN PROJECT
GARRISON DIVISION

Garrison Diversion Unit

The diversion of Missouri River water to central and eastern North Dakota has been urged by local and State interests for nearly 70 years. In 1890 the Geological Survey investigated a proposal to divert water from the Missouri River in eastern Montana to central North Dakota but found it financially infeasible at that time. In the 1920's diversion from the Missouri in the vicinity of Garrison, North Dakota was first investigated and reported on by the State Engineer. During the 1930's, the Corps of Engineers, State Engineer and several consulting engineers made studies and reports on Garrison Diversion.

The Bureau of Reclamation made its first investigations of the scheme for Missouri River diversion in the late 30's and early 40's. These investigations and the report on them provided the basis for part of the Department of Interior's plan of development for the Missouri River Basin contained in Senate Document 191, 78th Congress. This plan and the Corps of Engineers' plan were coordinated in the basin plan authorized by Congress in the Flood Control Act of 1944 and the Rivers and Harbors Act of 1945.

The development consists of three main parts—Garrison Reservoir, the Principal Supply Works and the water use works. Garrison Reservoir, on the main stem of the Missouri River, is the storage facility from which the water supply for the unit will be diverted. The reservoir, being constructed by the Corps of Engineers, has a capacity of 23,000,000 acre-feet at the top of its flood control storage pool. It will be operated for irrigation, power, navigation, flood control, recreation and silt detention. The range in operating level is expected to be about 75 feet—from elevation 1,775 to 1,850. The Principal Supply Works will extend from the diversion point at Garrison Reservoir to and including Lonetree Reservoir, a regulating basin in the headwaters of the Sheyenne River southwest of Harvey.

Major features of the Principal Supply Works are:

1. **Snake Creek Pumping Plant.** This structure is to be designed and constructed by the Bureau of Reclamation. It will pump water from Garrison Reservoir into the adjacent Snake Creek Reservoir which is just beginning to form behind the Snake Creek embankment, already built by the Corps of Engineers northwest of Coleharbor. When the level in Garrison Reservoir is lower than elevation 1,850, water must be pumped into Snake Creek Reservoir. A maximum pump lift of 75 feet may be required during prolonged dry spells. The pumping plant will have a capacity of about 8,850 cubic feet per second (6 units, 1,475 c.f.s. each) for a 1,007,000-acre project and pump about 2,632,000 acre-

feet a year for irrigation and other uses. Power requirements of the plant will be about 80,200 kilowatts; the average annual energy requirement, 118,600,000 kilowatt-hours.

2. **McClusky Canal.** This canal, to be built by the Bureau of Reclamation, will carry water from Snake Creek Reservoir, through low country south of Turtle Lake and Mercer, and thence northeasterly into Lonetree Reservoir. It will be about 73 miles long and have a beginning capacity of about 8,200 second-feet. Along the canal route between Snake Creek and Lonetree Reservoirs there is a total drop of over 217 feet that could ultimately be used for power generation. Plants to capture the energy from water falling through this drop will not be constructed, however, until the value of power generated exceeds the cost of the power generation.

3. **Lonetree Reservoir.** This reservoir is located in the uppermost reaches of the Sheyenne River southwest of Harvey. It is so near the drainage basins of the James and Souris Rivers that dikes will be needed at several points to prevent escape of stored waters to these rivers. The reservoir taking area will be about 30,000 acres and the reservoir will have a maximum depth of 70 feet. The reservoir, which will act as a regulator for water flowing through the McClusky Canal, will have a storage capacity available for regulating purposes of 280,000 acre-feet. Because of its function as a regulator, the reservoir water surface is expected to fluctuate about 20 feet in elevation each year. Lonetree Reservoir will be the focal point for main canals reaching out to the major areas of water use.

The water use works will consist of the main canal systems originating at Lonetree Reservoir and the pumping plants, laterals and drains within the bodies of irrigable land. Major features of the water use works will be:

1. **Velva Canal.** This canal, which will run in a northwesterly direction from Lonetree Reservoir, will deliver water to 333,000 irrigable acres in the Souris River Basin. It will have an initial capacity of about 5,270 c.f.s. and be about 132 miles long, terminating near the Canadian boundary west of Westhope. Major structure along this canal is a 3,000-foot siphon across the Souris River near Velva.

2. **East Souris Canal.** This canal will irrigate 152,000 acres lying east of the Souris River and deliver excess Souris River flows to the Sheyenne River. The canal, with an initial capacity of about 3,000 c.f.s., will begin near the Canadian boundary and run in a southeasterly direction for 117 miles, emptying into the north fork of the Sheyenne. The water supply, consisting mainly of return flows from irrigation west of the river, will be pumped from the Souris River at a point east of Westhope.

3. **Devils Lake Canal.** This canal will lead from Lonetree Reservoir in a northeasterly and easterly direction to serve 86,000 irrigable acres in the Harvey-Maddock Area. It will have an initial capacity of 1,620

c.f.s. and be 81 miles long, terminating near Oberon, North Dakota. Major structure along the canal is a siphon across the north fork of Sheyenne River. A relatively short feeder canal through Round, Stoney and Long Lakes south of Minnewaukan will lead from the Devils Lake Canal into Devils Lake. Through this canal, water can be diverted to restore the level of Devils Lake from its present elevation of about 1,418 to about 1,425. A feeder canal connecting Devils Lake with Stump Lake, and an outlet canal from Stump Lake to the Sheyenne River will permit continuous flow through the system. The Devils Lake Feeder Canal will be about 10 miles long and the smaller Stump Lake Feeder Canal about 9½ miles long. The outlet canal from Stump Lake will be about 2½ miles long and will empty into the Sheyenne River via Tolna Coulee.

4. **Sykeston Canal.** The canal will originate at the McClusky Canal just above the drop into Lonetree Reservoir. It will run in an easterly direction for about 72 miles, terminating near Carrington. The canal will serve about 37,000 acres and have an initial hydraulic capacity of 700 c.f.s.

5. **New Rockford Canal.** For the first 30 miles this canal will utilize the channel of the James River which flows in an easterly direction from Lonetree Reservoir. The canal capacity, at its beginning point, will be 4,380 c.f.s. It will supply water to 67,000 irrigable acres in the New Rockford Area, 41,000 acres in the Warwick-McVille Area, and 97,000 acres in the Baldhill Area. It will also supply water to supplement return and natural flows in the James River for the irrigation of about 12,000 acres in the LaMoure Section and 108,000 acres in the Oakes Section. At a point about three miles southwest of the town of Bremen, the Hamburg Diversion Dam will divert the canal to the north of the James River. From that point it runs in an easterly and southeasterly direction for 42 miles. At the Hamburg Diversion Dam, water will also be diverted to the James River Feeder Canal to the south of the James River. This canal will transport water for about 5,600 acres south of the river and also for release to the James River below New Rockford for regulation through Jamestown Reservoir and a water supply for the LaMoure and Oakes Sections. The James River Feeder Canal will have a capacity of 1,000 c.f.s. and will be 22 miles long.

6. **Warwick Canal.** This canal will begin at a point 27 canal miles northeast of the Hamburg Diversion Dam. The canal, with an initial capacity of 782 c.f.s. and a total length of 65 miles, will terminate near the town of McVille. From a point near its beginning where it will be siphoned across the Sheyenne River, the canal will extend along the north edge of the Sheyenne River Valley, serving 41,000 irrigable acres.[2]

[2]Warwick Canal can be extended to the east to serve irrigable lands in Steele, Grand Forks, Traill and Cass counties. Plans for such an extension are now under study. These plans must be perfected or abandoned before final design of the Warwick Canal can begin. This also applies to the New Rockford Canal which will feed the Warwick Canal.

7. **Baldhill Canal.** This canal will begin at the end of the New Rockford Canal. It will have an initial capacity of 1,850 c.f.s. and will bring irrigation water to 97,000 acres in the Baldhill Area. The canal will run in a southeasterly direction from its beginning point west of McHenry for about 74 miles, terminating near Rogers, North Dakota. A major canal about 42 miles long will branch off the Baldhill Canal near its beginning and will run down the left bank of Baldhill Creek to the Cooperstown locality.

8. **Jamestown Dam and Reservoir.** This feature of the water use system has already been constructed and is discussed separately.

9. **Oakes Canal.** This canal, together with the Oakes Pumping Plant, will deliver water from the James River near Oakes to the 108,000-acre Oakes Section in North and South Dakota. (About 52,000 acres of this section is in North Dakota.) The canal will have an initial capacity of 1,420 c.f.s. and will extend 11 miles eastward to be regulated at Taayer Reservoir. For the western portion of Oakes Section, water will be taken directly from the Oakes Canal; for the eastern section, it will be supplied both from the Oakes Canal and storage in Taayer Reservoir.

In addition to the major features of the water use works, there will be the usual pumping plants, laterals and drains that are found within the bodies of irrigable land. About 74,000 acres of irrigable land in scattered but substantial tracts will obtain their water supply directly from Snake Creek Reservoir; the remaining areas are scattered 40,000-acre Coleharbor Section which will be irrigated by pumping directly from Snake Creek Reservoir; the remaining areas are scattered along the McClusky Canal route or will pump from Lonetree Reservoir.

Municipal and industrial water supplies will be delivered at canal-side. Consequently, no works will be constructed specifically for these purposes. Seasonal off-peak canal capacity will be adequate for these deliveries.

A feasibility type report on the unit is to be completed in December 1956.

Red River Valley Areas

In the Red River Valley about 1,000,000 acres along the shoreline of ancient Lake Agassiz have been found generally suitable for irrigation. This land is in Richland, Ransom, Cass, Steele, Traill, Grand Forks, Walsh and Pembina Counties. It has not been included in the first-stage development plan but is regarded as a possible extension of the unit. It is recognized that land development costs will be low on much of this land and income from irrigation can be very high. For these reasons it is expected there may be an early demand for irrigation in some of this area. If such a demand develops, the diversion plan may be modified to provide early delivery of water to some land in the Red River Valley, even before land further west is ready for irrigation. Delivery can be made to Red River Valley lands in Grand Forks,

Cass and Ransom Counties by extending the Warwick Canal past Finley and by diversion from the Sheyenne River below Lisbon. These possibilities are being investigated in more detail.

Lands in the Sheyenne Delta seem to offer particular advantages to the Garrison Diversion Unit. They are less scattered than normal for the unit, they appear to be unusually smooth, and can be served by a simple and compact diversion system. Even more significant, however, they can be supplied in large part, if not entirely, by return flow or waste water and the canal system to be built for the first stage will require little or no enlargement.

Jamestown Unit

Jamestown Unit is located on the James River in Foster and Stutsman counties in east-central North Dakota. Jamestown Dam is about ¼ mile north of Jamestown and the reservoir extends about 40 miles upstream from that city. It is a multiple-purpose unit with flood control for Jamestown and other cities being the initial purpose to be served. It will impound natural runoff and return irrigation flows from areas of the Garrison Diversion Unit for use on irrigable lands in the LaMoure and Oakes Sections. Other benefits are: recreation, fish and wildlife conservation, municipal water and silt control.

The main feature of the unit is Jamestown Dam and Reservoir. The dam is of rolled earth-fill construction with a glory-hole type spillway and gated outlet works. The dam was designed to permit future installations for power generation when it becomes feasible, and it was so constructed that connections can be made to provide Jamestown with municipal water. The reservoir capacity is 230,000 acre-feet. Development of public-use and recreation facilities in the reservoir area is well advanced. Relocation of Arrowwood Wildlife Refuge facilities and installation of relief wells downstream from the dam remain to be done.

Management of the reservoir area is the responsibility of the Stutsman County Park Commission under an agreement with that organization.

As indicated above, Jamestown Reservoir will function in connection with the Garrison Diversion Unit.

Irrigation Development Farms

Two development farms have been established by the Bureau of Reclamation in cooperation with the North Dakota Agricultural College and the United States Department of Agriculture. They have been developed to demonstrate the influence of irrigation on crops and livestock production and the reaction of soils to irrigation water. The benefits and operation methods of irrigation under soil and climatic conditions in the Garrison Diversion Unit are being observed on these farms.

The Deep River Farm is located in McHenry County about three miles west of Upham. It includes 215 acres, 143 of which are irrigated. Seventeen of the irrigated acres are reserved for research. This farm has been in operation since the spring of 1953.

The Sheyenne Farm is located in Eddy County immediately west of and adjacent to Sheyenne, North Dakota. This farm includes 394 acres, with 119 acres irrigated. Operation of the Sheyenne Farm was started in the spring of 1956.

The development farms illustrate the integrated dryland and irrigated type of farm unit which is expected to evolve in the Garrison Diversion Unit.

HEART DIVISION

The Heart Division consists of Dickinson and Heart Butte Units.

Dickinson Unit

Dickinson Unit is located in Stark County in southwestern North Dakota. Dickinson Dam and Reservoir are on the Heart River, about 1½ miles upstream from the City of Dickinson. It is a multiple-purpose unit which provides storage for municipal water, flood control for downstream areas, sedimentation control, fish and wildlife conservation and recreation opportunities.

The principal feature of the unit is a rolled earth-fill dam with a combined concrete spillway and outlet works structure and a 16,500 acre-foot reservoir. Construction of the dam was started in March 1949 and substantially completed in August 1950. Subsequent work has included extension of the outlet works farther into the reservoir, and repair of the spillway damaged by flood in the spring of 1954. Funds are presently available for some further development of public-use areas adjacent to the reservoir.

Dickinson's rapidly increasing requirement for municipal water has restricted irrigation to 400 acres in individual tracts which are being developed by the landowners. Water has been made available to the irrigators at $1.00 per acre per year under individual water service contracts. The irrigators are now in the process of forming a water user's organization so they can contract as a group for their water supply. A water service contract with the City of Dickinson provides for payment of $950,000 to the federal government in 40 years.

Dickinson Reservoir, including the public-use or recreational facilities, is administered by the Dickinson City Park Board. Fish have been planted in the reservoir during the past several years by the State Game and Fish Department. Use of this reservoir by the public has steadily increased.

Heart Butte Unit

Heart Butte Unit is located on the Heart River in Grant and Morton counties in southwestern North Dakota. State Highway No. 49 crosses Heart Butte Dam about 15 miles south of Glen Ullin and the

irrigable areas extend eastward from there for about 60 miles along the Heart River to the City of Mandan. The unit is a multiple-purpose development designed to provide controlled conservation storage for irrigation of 13,100 acres, flood control for downstream areas, sedimentation control, fish and wildlife conservation and recreational benefits.

The principal features of the unit include a rolled earth-fill dam with a combined glory-hole spillway and gated outlet works, a 225,500 acre-foot reservoir, wildlife habitat areas to replace those inundated by the reservoir, and the necessary pumping plants, laterals and drains to serve the irrigable lands. Construction of the dam was substantially completed in December 1949, and it has since played a major role in providing flood protection, particularly to the City of Mandan. Wildlife habitat replacement areas and minimum recreational facilities have been essentially completed. Construction of pumping plants, laterals and drains to serve the 2,463 irrigable acres of the Western Heart River Irrigation District was substantially complete by June 30, 1956. Construction of facilities to serve the rest of the 13,100 irrigable acres will not be started until appropriate repayment arrangements have been made.

The reservoir area is administered by the State Game and Fish Department under an agreement between that agency and the Bureau of Reclamation.

The 70-acre Mandan Development Farm, which is Pumping Area No. 3 in the ultimate development, is operated by the State Training School.

Opposition to irrigation development and resulting court actions have delayed construction of irrigation facilities. The original irrigation district was dissolved in November 1953 and a new one was formed the following month. The new district includes only those ownerships favorable to irrigation and grouped to make a practical initial development. The combination repayment and water service contract provides that, following a seven-year development period, the irrigation district will repay $145,200 of the distribution facilities construction cost in 40 years and an estimated $20,550 of the supply works construction cost in 30 years, plus an allocated share of the water supply works O & M cost.

NORTH DAKOTA PUMPING DIVISION

The North Dakota Pumping Division consists of 14 separate pumping units along the course of the Missouri River in North Dakota. These units will be irrigated by pumping from the Missouri River or from Garrison and Oahe reservoirs. A total of approximately 63,000 acres can be irrigated in the potential units. Included in the division are Williston, Nesson, Hancock Flats, Fort Clark, Oliver-Sanger, Painted Woods, Manley, Wogansport, Square Butte, Burnt Creek, Bismarck, Little Heart, Horsehead Flats and Winona units.

Construction of Fort Clark Unit, started in 1952, was substantially completed in 1953. All other units are in an inactive status.

Fort Clark Unit

Fort Clark Unit is located in Oliver and Mercer counties in west-central North Dakota near the town of Stanton and about 45 miles northwest of Mandan. Facilities of the unit provide a full water supply for the irrigation of 2,039 acres of new land lying on two benches adjacent to the Missouri River. These irrigation facilities consist of a river pumping plant, two relift plants and a system of canals, laterals and drains. Except for deferred drains, construction of these facilities was substantially completed in August 1953. A formal dedication ceremony on August 14, 1953 marked the first delivery of water to the unit lands.

The Soil Conservation Service is assisting the farmers with farm irrigation layouts and land leveling. By June 30, 1956 approximately 600 acres had been prepared for irrigation.

Although the ten-year development period did not begin until 1956, water was furnished to the irrigators until then under an interim agreement for $1.00 per year for each acre irrigated. Total construction cost of the unit is approximately $763,000, including an estimate for future drains.

TRANSMISSION DIVISION

Under the Flood Control Act of 1944, the responsibility for marketing the power generated by Missouri River Basin project power plants, was assigned to the Secretary of the Interior. The Bureau of Reclamation has been designated as the agency responsible for prosecution of the power marketing program. In North Dakota the major source of Missouri River Basin power will be Garrison Dam, although exchange of mainstem power between areas has been provided for in the design of the high voltage transmission system. The Garrison Power plant will have an installed capacity of 400,000 kilowatts and an average annual energy production in excess of one billion kilowatt hours.

To market this power an adequate and efficient power transmission system is necessary. A backbone grid of 230-kilovolt transmission lines will interconnect the Missouri River power plants and provide power at the major load centers. A network of 115-kilovolt and 69-kilovolt lines will supply power to smaller load centers and irrigation pumping developments throughout the State.

A portion of the system was used initially under contracts with Central Power Electric Cooperative, Inc. to transmit power from its Voltaire steam plant, and with Otter Tail Power Company to carry its power to their customers in North Dakota.

As of June 30, 1956 the following lines and substations were complete or substantially so:

Lines	Length, Miles	Substations	Capacity Kva
Garrison-Bismarck 230-kv[1]	62.68	Washburn, Stage 01 & 02	15,000
Bismarck-Mobridge 230-kv	94.97	Bismarck, Stage 01 & 02	32,000
Bismarck-Jamestown 230-kv	98.32	Jamestown, Stage 01 & 02	77,000
Jamestown-Fargo 230-kv	83.03	Watford City, Stage 01	1,500
Williston-Garrison 115-kv	170.39	Beulah	7,500
Garrison-Voltaire 115-kv	57.23	Rugby	15,000
Voltaire-Rugby 115-kv	55.95	Devils Lake, Stage 01	15,000
Rugby-Devils Lake 115-kv	58.85	Lakota	15,000
Devils Lake-Lakota 115-kv	26.09	Leeds	16,500
Leeds-Rolla 69-kv	42.55	Bisbee	1,500
Devils Lake-Carrington 115-kv	52.46	Rolla	4,500
Carrington-Jamestown 115-kv	48.35	Carrington	11,500
Jamestown-Valley City 115-kv	35.01	Valley City	15,000
Jamestown-Edgeley 115--kv	37.36	Edgeley	21,500
Edgeley-Groton 115-kv	80.49	Ellendale	15,000
Edgeley-Forman 69-kv	66.42	Forman	12,000
Bismarck-DeVaul 69-kv	45.03	Custer Trail	1,500
		DeVaul	2,500
		Fort Clark	750
TOTALS	1,115.18		280,250

[1]This is a double circuit line.

Accomplishment during the past two years include construction of extensions, into the Garrison switchyard, for Williston-Garrison, Garrison-Voltaire and Garrison-Bismarck lines; also, construction of the Jamestown-Fargo and Edgeley-Groton lines, the Ellendale substation and additional stages on other substations. On June 30, 1956 construction of the first stage of Fargo substation was well advanced and good progress was being made on the Fargo-Grand Forks 115-kv line. Several equipment contracts had been awarded for the Grand Forks substation. Upon completion of the line extensions into Garrison switchyard, there was no further need for the Garrison-Fort Peck temporary tie and it has been dismantled.

Although they were not yet producing up to designed capacity because of the limited water supply, the first three units of the Garrison Power plant are putting out power for transmission to North Dakota load centers over facilities of the Transmission Division.

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