NINTH BIENNIAL REPORT

of the

State Water Conservation Commission

and the

TWENTY-SIXTH BIENNIAL REPORT

of the

STATE ENGINEER

of

North Dakota

July 1, 1952 to June 30, 1954

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MAPS, GRAPHS AND PICTURES

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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-Fifth Biennial Report of the North Dakota State Engineer covering the period July 1, 1952 to June 30, 1954.

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

Chapter 1
GENERAL DATA

Members of North Dakota State Water Conservation Commission

Einar Dahl

Curtis Olson

Earle F. Tucker

Governor Norman Brunsdale

Oscar Lunseth

A. M. Christensen

Milo W. Hoisveen

Math Dahl

ORGANIZATION OF THE COMMISSION

The North Dakota State Water Conservation Commission was created in 1937 by the 25th Session of the Legislatiive 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 Chairman	Jan. 2, 1952	
Curtis Olson, Valley City, Vice Chairman	Jan. 1, 1948	July 1, 1957
Einar Dahl, Watford City	April 3, 1939	July 1, 1959
Earle F. Tucker	May 1, 1948	July 1, 1955
A. M. Christensen, Minot	May 27, 1949	July 1, 1955
Oscar Lunseth, Grand Forks	May 1, 1951	July 1, 1959
Math Dahl, Comm. of Agriculture & Labor, Ex-Officio member	May 27, 1949	
J. J. Walsh, Secretary and Chief Engineer, State Engineer	1941	June 30, 1954
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, 1952 to June 30, 1954 the State Water Conservation Commission held 20 meetings in Bismarck and 6 meetings in other cities throughout the state.

PERSONNEL EMPLOYED BY THE COMMISSION

Full time personnel employed by the Commission on June 30, 1954 are as follows:

J. J. Walsh	Secretary and Chief Engineer, State Engineer to June 30, 1954
Milo W. Hoisveen	Secretary and Chief Engineer, State Engineer appointed July 1, 1954
Vernon S. Cooper	Assistant Secretary
I. A. Acker	Special Assistant Attorney General
Marvin Sheldon	Construction Engineer
Roy Tyson	Construction Engineer
Albin S. Anderson	Field Enginieer
Lloyd Johnson	Construction Foreman
Franz Nordstrom	Equipment Foreman
Arthur Radspinner	Instrumentman
Roy Putz	Rodman
Wasilij Kudinow	Draftsman
Thomas L. Myers	Draftsman
Joyce Vettel	Stenographer
Marlene Pederson	Stenographer
Lorna Erickson	Bookkeeper
Lynda Hughes	File Clerk
Esther Duppong	Clerk-Typist
Einar Berge	Technical Assistant
Fred J. Fredrickson	Planning Coordinator

In addition to the above personnel the Commission usually employs about twelve temporary employees as instrumentmen and rodmen to assist in survey work during the summer season and several crews of skilled construction 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 26 times to take up routine business of the Commission. Twenty 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 4, 1952 – Bismarck
Sepetmber 4, 1952 – Bismarck
September 20, 1952–Valley City
October 7, 1952 – Bismarck
October 17, 1952 – Fargo
December 16, 1952 – Bismarck
January 16, 1953 – Bismarck
February 18, 1953 – Bismarck
March 9, 1953 – Valley City
March 10, 1953 – Bismarck
April 8, 1953 – Bismarck
June 11, 1953 – Riverdale
June 22, 1953 – Bismarck
June 23, 1953 – Bismarck
August 13, 1953 – Bismarck
September 11, 1953 – Bismarck
September 29, 1953 – Fargo
November 3, 1953 – Bismarck
November 9, 1953 – Williston
December 14, 1953 – Bismarck
January 11, 1954 – Bismarck
March 1, 1954 – Bismarck
April 5, 1954 – Bismarck
April 19, 1954 – Bismarck
May 21, 1954 – Bismarck
June 25, 1954 – Bismarck

Commission members or employees of the Commission have attended many meetings 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 wtih local groups in North Dakota relative to problems existing in their areas. All conferences and meetings of this nature are not indicated in 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	69,971 Square Miles
2. Water area	694 Square Miles
Garrison Dam when reservoir pool is at 1850 will cover	609 Square Miles
B. Of Basins (Based on line of Bureau of Reclamation)	
1. Red-Souris-Devils Lake to Hudson's Bay	29,500 Square Mi. (Approximately)
2. Missouri to Gulf of Mexico	41,200 Square Mi. (Approximately)

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.

PROPOSED RESERVOIRS

RESERVOIR	STREAM
1 Arlington	Gasconade River
2. Richland	Gasconade River
3 South Grand	South Grand River
4 Pomme De Terre	Pomme De Terre River
5. Osceola	Osage River
6 Hickory *	Thompson River
7 Pattonsburg *	Grand River
8 Tuttle Creek	Big Blue River
9 Harlan County	Republican River
10 Norton	Prairie Dog Creek
11 Medicine Creek	Medicine Creek
12 Red Willow	Red Willow Creek
13 Enders	Frenchman Creek
14 Culbertson	Republican River
15 Wray	N Fork Republican River
16 Pioneer	Arikaree River
17 Bonny	S Fork Republican River
18 Glen Elder	Solomon River
19 Kirwin	N Fork Solomon River
20 Webster	S Fork Solomon River
21 Wilson	Saline River
22 Kanopolis	Smoky Hill River
23 Cedar Bluff	Smoky Hill River
24 Loretto	Beaver Creek
25 Erickson	Cedar River
26 Davis	North Loup River
27 Boetus	South Loup River
28 Dismal	Dismal River
29 Plum Creek	Plum Creek
30 Glendo	North Platte River
31 Kortes	North Platte River
32 Narrows	South Platte River
33 Cherry Creek	Cherry Creek

* Alternate for Chilicothe Reservoir

RESERVOIR	STREAM
34. Gavins Point	Missouri River
35. Jamestown	James River
36 Bald Hill	Sheyenne River
37 Box Butte	Niobrara River
38. Fort Randall	Missouri River
39 Rocky Ford	White River
40. Big Sand	Missouri River
41 Phillip	N Fork Bad River
42 Oahe	Missouri River
43 Deerfield	Rapid Creek
44 Angostura	Cheyenne River
45. Edgemont	Beaver Creek
46 Keyhole	Belle Fourche River
47 Green Grass	Moreau River
48. Bixby	Moreau River
49 Blue Horse	Grand River
50 Shade Hill	Grand River
51. Thunder Hawk	Cedar River
52 Cannon Ball	Cannon Ball River
53 Heart Butte	Heart River
54 Dickinson	Heart River
55 Broncho	Knife River
56 Garrison	Missouri River
57 Sheyenne	Sheyenne River
58 Moorehead	Powder River
59 Lake De Smet	Piney Creek
60 Willow Park	S Fork Piney Creek
61 Triangle Park	Rock Creek
62 Butt Creek	Clear Creek
63 Smith	N Fork Powder River
64 Middle Fork	Middle Fork Powder River
65 South Fork	S Fork Tongue River
66 Little Horn	Little Horn River
67 Yellowtail	Big Horn River
68 Kane	Big Horn River
69. Oregon Basin	Shoshone R Offstream
70 Red Gulch	Shell Creek
71 Lake Solitude	Pointrock Creek
72 Anchor	S Fork Owl Creek
73. Boysen	Big Horn River
74 Badwater	Badwater Creek
75. Onion Flat	Little Popo Agie River
76. Sand Creek	N Fork Popo Agie River
77 Raft Lake	N Fork Little Wind River
78 Du Noir	Wind River
79. Sunlight	Sunlight Creek
80 Thief Creek	Clark Fork
81 Hunter Mtn	Clark Fork
82 Sweetgrass	Sweetgrass Creek
83 Kiss on	Yellowstone River
84. Antelope	Shields River, Offstream
85 Medicine Lake	Big Muddy Creek
86 Crosby	Missouri R Offstream
87 Stanford	Skull Creek
88. Hobson	Judith River
89 Ross	Ross Fork
90 Snowy	Cottonwood Creek
91. Tiber	Marias River
92 Wilson	N Fork Sun River
93 Nilan	S Fork Sun River
94 Newland	Newland Creek
95 Wells	Rock Creek
96 Canyon Ferry	Missouri River
97 Bridger	Bridger Creek
98 Taylor	Taylor Fork, Gallatin River
99 Terry	Boulder River
100. Whitetail	Whitetail Creek
101. Apex	Birch Creek
102, Kelley	Rattlesnake Creek
103 Landon	Blacktail Creek
104 Clark Canyon	Beaverhead River
105. Brenner	Horse Prairie Creek

MISSOURI RIVER BASIN

RESERVOIRS FOR FLOOD CONTROL IRRIGATION AND ALLIED PURPOSES
INCLUDED IN PLANS AUTHORIZED BY 1944 FLOOD CONTROL ACT.

OFFICE OF THE DIVISION ENGINEER MISSOURI RIVER DIVISION
WAR DEPARTMENT

I.

II.

III.

I.

II.

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

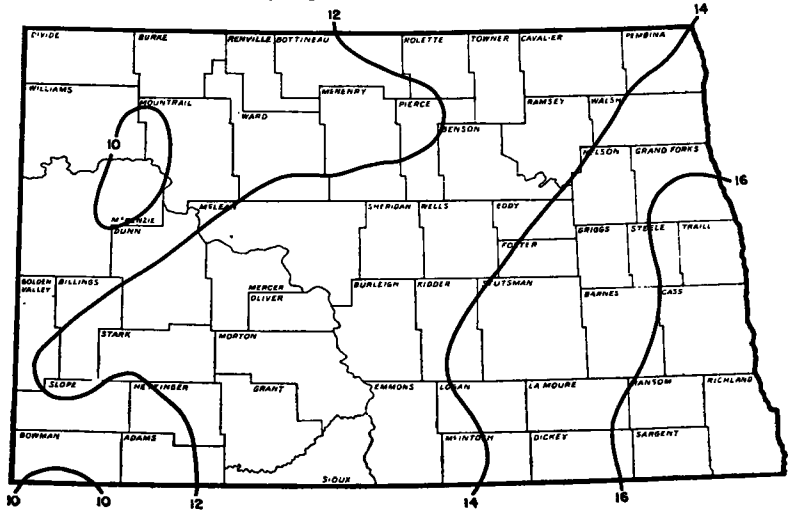
5. To exercise all express and implied rights, powers, and authority, that may be necessary, and to do, perform, and carry out all of the expressed purposes of this chapter and all of the purposes reasonably implied incidentally thereto or lawfully connected therewith.

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, diversioin 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.

NORTH DAKOTA

AVERAGE WARM-SEASON PRECIPITATION (INCHES)
(APRIL TO SEPTEMBER INCLUSIVE)



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.

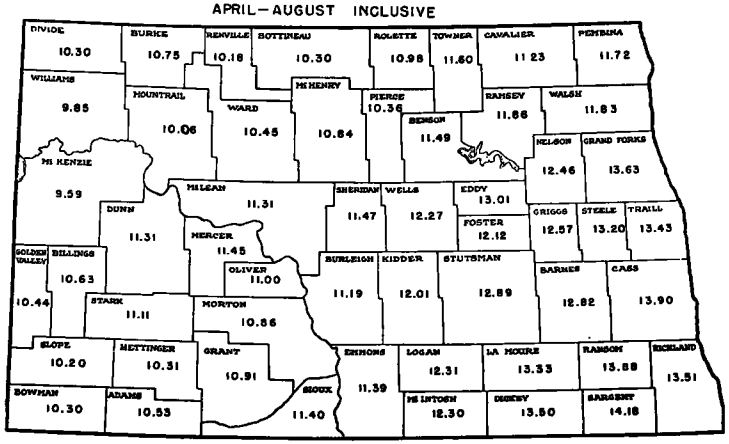
His records are open to public inspection during business hours. He is the custodian of General Land office maps, field notes and records of surveys of land turned over by the government to the state.

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 investigation 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

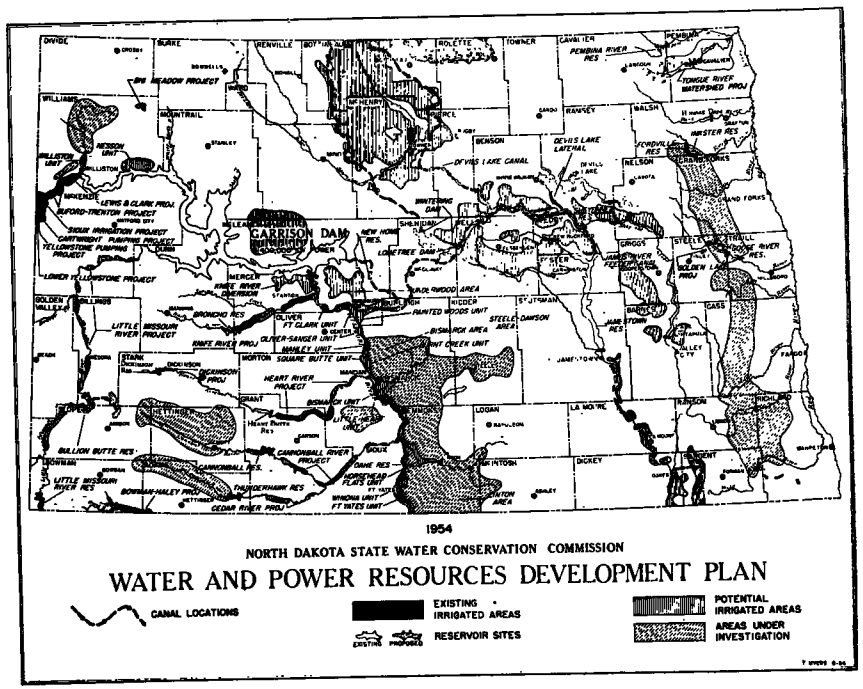


IRRIGATION IN NORTH DAKOTA

Records show that irrigation in North Dakota dates back to 1889, its first year of statehood, when 445 acres were irrigated. In that same year at a convention at Grand Forks, North Dakota, the public attention was attracted to the value of irrigation in this state through the adoption of a memorial whereby Congress was urged to take preliminary steps to the construction of a canal from the Misssouri River in Montana eastward through Montana and North Dakota to the Red River. In 1891 North Dakota established a department of irrigation and forestry. This department functioned until 1901 when the Legislature abolished it because of the lack of interest shown on the part of the stock growers and ranchers in some areas. With the passage of the Federal Reclamation Act by Congress in 1902 considerable enthusiasm in irrigation in North Dakota resulted.

This new interest in irrigation in the state led to the meeting of the first irrigation congress in Bismarck, North Dakota, in October, 1903. At this meeting the North Dakota Irrigation Association was formed. This association was active in helping to secure for the state the Williston and Buford-Trenton projects.

In the summer of 1904 a number of prominent citizens of the state 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 tracts of land in the state. As a result of Professor Chandler's work, the State Legislature in 1905 passed a state irrigation code. This code provided for the creation of the office of State Engineer. A. L. Fellows of Denver, Colorado, was appointed to fill the position of State Engineer and served in that position until July 1, 1907. In the following years, through the efforts of the office of the State Engineer, the interest of the United States Reclamation Service was obtained in several reclamation and irrigation projects in North Dakota.



During North Dakota's first years of statehood the number of acres irrigated in the state and the size of the individual tracts were small. In 1899 the Census report shows that there were 4,872 acres in North Dakota under irrigation with an average of 90.2 acres per farm on which irrigation was practiced. The total irrigated acreage in North Dakota has increased gradually since then until at the present there are an estimated 70,000 acres irrigated in the state. Included in this area are individual projects and land in organized irrigation districts.

By far, the greater part of the irrigated area in North Dakota is in the western part of the state, mainly in Williams and McKenzie counties where organized irrigation districts have been operating since the early 1900's. These districts include the Lower Yellowstone, located in McKenzie county and constructed in 1910 by the Federal government, the Lewis and Clark project in McKenzie county constructed in 1939 by the State Water Conservation Commission, the Sioux project in McKenzie county constructed in 1940 by the Commission and the Buford-Trenton project in Williams county constructed by the Federal government in 1940. Crop returns from these projects show that the income per acre of irrigated land is more than double of that of non irrigated land in the same area.

WATER DEVELOPMENT IN NORTH DAKOTA

North Dakota's water resources, one of its most important resources and long one of its least developed, are today the center of a program that will provide many benefits to the people of the state and nation. This program provides for the storage of flood-waters in multi-purpose dams and smaller retention structures for use for irrigation, production of hydro-electric power, municipal water supplies, stream pollution abatement, recreation facilities, conservation and propagation of fish and wildlife, restoration of lake levels and for other multiple benefits. This water development program involves not only the construction of storage dams but also construction of drains, river channel improvement projects, levee, floodwalls and other flood protective works.

Of the many benefits that will accrue from this program to North Dakota irrigation is of prime importance. There are over a million acres of North Dakota farmland that can be irrigated so as to stabilize and increase the production from those acres and hence stabilize the economy of the state. In addition there are another million acres of land that may be irrigated in the future. The irrigation of these areas will be accomplished by the diversion of water from the Missouri at Garrison, and utilization of

An aerial view of Snake Creek embankment which was completed last fall except for paving and relocating the Soo Line railroad which will be accomplished by Aug. 1. The picture was taken looking north, with Garrison Reservoir area on the left and Snake Creek sub-impoundment on the right. Snake Creek Dam, the second largest in North Dakota (second to Garrison Dam), is nearly three miles long and 65-feet high. Diversion to central and eastern North Dakota will be accomplished from the Snake Creek sub-impoundment.

the water resources of the smaller rivers and streams in the state and from the groundwater sources.

The largest and most extensive plan for irrigation development in North Dakota and perhaps in the nation is the plan to divert water eastward from the Garrison Reservoir to serve large blocks of irrigable lands in the central and eastern part of the state. This plan envisions irrigating 1,000,000 acres of land, supplying water to at least 34 North Dakota cities, restoring Devils Lake and Stump Lake and augmenting and stabilizing the flows in the Souris, James, Sheyenne and Red rivers. It is forecast that 1,000,000 acres of new irrigation will provide the following specific benefits, due to irrigation alone:

1. $54,000,000 increase each year in North Dakota's farm income.
2. $200,000,000 increase each year in business.
3. 20,000 new jobs.
4. 3,600 new homes.
5. 93,000 increase in population statewide.

Engineering studies are to be completed by January, 1957, so that construction can begin in the late summer of 1957. It will probably take four or five years to get the water over the divide into the eastward flowing streams after construction begins. Full development of the 1,000,000 acre project could take 20 years or as much as 50 years depending on the speed with which irrigation takes hold.

The project plan divides into two parts. The Principal Water Supply Works will be a single canal system diverting the water out of the Garrison Reservoir to the headwaters of the Sheyenne between McClusky and Harvey. It is the heart of the diversion plan. The water use works will be a great network of canals and reservoirs reaching out to the major areas of use throughout central and eastern North Dakota. Major features of the proposed plan are:

Principal Supply System

1. Snake Creek Pumping Plant.

Located on Snake Creek Dam north of Coleharbor. Maximum lift 75 feet. Minimum lift 0 feet. Capaacity 8,000 cubic feet per second. Will pump 1,920,000 acre-feet in an average year.

2. McClusky Canal.

Will carry water from Snake Creek Reservoir through a low saddle in the Altamont moraine for delivery to Lonetree Reservoir. The canal will be 70 miles long with an initial capacity of 7,500 cubic feet per second. Located mainly on the contour, the canal has a maximum cut of about 100 feet.

3. Canal-drop power plants.

There will be a total drop of 195 feet between Snake Creek and Lonetree reservoirs. A power plant could be built to capture the energy of the falling water. It could provide about 240,000,000 kw-hr of generation annually. Such a plant will not be constructed, however, until the need for summertime power makes it economically feasible.

4. Lonetree Reservoir.

Lonetree Reservoir will be in the extreme headwaters of Sheyenne River. Water will be stored behind Lonetree Dam, located about seven miles southwest of Harvey. 280,000 acre-feet of useful storage are to be provided between elevations 1620 and 1640. Additional dikes are needed to prevent escape of water to the James and Mouse Rivers. The reservoir will cover about 29,000 acres of land. It provides a suitable means for making releases to the main water use canals which will distribute water widely over central and eastern Dakota.

Water Use System – Main Canals

1. Velva Canal.

(Water supply system for the Mouse, or Souris River Basini). Delivers water from Lonetree Reservoir to the Mouse River lands (500,000 acres). Canal is 128 miles long and terminates near the Canadian border west of Westhope.

a. East Souris Canal.

This canal will serve the Mouse River lands which lie east of the river. It will be supplied by Westhope pumping plant located on the Mouse River and its water supply will principally be return flows from irrigation of land west of the river. The plant will have a capacity of 3,100 cubic feet per second and a lift of about 85 feet. The canal is to be 122 miles long and it will discharge unused return flow water into the North Fork Sheyenne River for later diversion to Devils Lake. Annual deliveries to this canal will average about 637,000 acre-feet. 168,000 acres in the Mouse River Basin lie east of the river.

2. Devils Lake Canal.

Takes water from Lonetree Reservoir eastward along the north side of Sheyenne River for 156 miles. Serves 142,000 acres of land and ends in the vicinity of McVille. It can be extended into western Traill and Grand Forks Counties without difficulty.

3. New Rockford Canal System.

(Including Sykeston Canal and Pumping Plant.) Takes water from Lonetree Reservoir eastward along the south side of Sheyenne River past New Rockford, Binford and Hannaford. Present studies indicate that New Rockford Canal may terminate near New Rockford (a distance of about 70 miles) with a separate canal from Sheyenne Reservoir makinig deliveries to the land in Nelson, Griggs and Barnes Counties.

4. James River Canal System.

(Including Oakes area.) Water can be supplied from Lonetree Reservoir to the headwaters of the James River. These releases will be re-regulated in Jamestown Reservoir and used to supply irrigated lands between Jamestown and the South Dakota line. Principal demand will be south of Oakes where about 140,000 acres of arable land can be developed. Delivery will be accomplished by pumping from the James River.

5. Devils Lake Restoration.

Devils Lake Restoration will probably be most economically done by making a direct gravity diversion from Sheyenne Reservoir to Devils Lake at times when the reservoir is at a high stage. Irrigation return flow will be the principal source of water.

6. Red River Valley Section.

About 1,000,000 acres along the shoreline of ancient Lake Agassiz have been found generally suitable for irrigation. These lands lie in Richland, Cass, Steele, Traill, Grand Forks and Pembina Counties. They have not been included in the first stage development plan but are considered as a possibility for ultimate expansion of the project up to nearly 2,000,000 acres in size. It is recognized, however, that land development costs will be very low on much of this land and income from irrigation can be very high. For that reason it is expected that there may be an early demand for irrigation in some of these Red River Valley areas. It is anticipated that the diversion plan may have to be modified so as to provide early delivery of water to some of the Red River Valley lands, even before some land further west is ready for irrigation. Regardless of such an adjustment, however, there will be between 100,000 and 200,000 acre-feet of byproduct water for release to the Red River during low-flow periods of each year. These releases are expected to be beneficial to both industrial development and the abatement of pollution in the Red River below Fargo.

SMALL IRRIGATION PROJECTS

For a number of years various organizations and groups interested in irrigation have endeavored to interest the federal government in granting federal aid for the establishment of small irrigation projects. It is recognized by the Bureau of Reclamation that some states are equipped to perform the engineering and construction of such projects at a considerably lower cost than the federal government. As a consequence that federal agency is not opposed to releasing projects that fit into this category to the interested states. It is proposed that the federal government grant states money to develop the small projects on the same benefit ratio used in the development of the larger federal projects. The State Water Commission has recognized the possibility of this program becoming an actuality and has hired experienced irrigation engineering personnel capable of forming a nucleus for such a program.

The State Water Conservation Commission constructed two such projects in the late 30's. Both projects are successful and are described in this report under the Sioux and the Lewis and Clark Irrigation Projects. Some of the projects which have been studied by the Water Conservation Commission and the Bureau of Reclamation are included in the following table.

No.	Project Name	County Location	Source of Water Supply	Irrigable Acres
1.	Lower Yellowstone Pumping Unit	McKenzie	Yellowstone River	1,800
2.	Cartwright	McKenzie	Yellowstone "	840
3.	Sioux Extension	McKenzie	Yellowstone "	440
4.	Williston	Williams	Missouri River	9,100
5.	Nesson	Williams	Missouri "	7,400
6.	Hancock Flats	McLean	Missouri "	5,400
7.	Coleharbor	McLean	Missouri "	45,000
8.	Oliver-Sanger	Oliver	Missouri "	8,300
9.	Painted Woods	McLean	Missouri "	2,800
10.	Manley	Oliver	Missouri "	1,200
11.	Wagonsport	Burleigh	Missouri "	1,600
12.	Square Butte	Morton	Missouri "	1,900
13.	Burnt Creek	Burleigh	Missouri "	1,300
14.	Bismarck	Burleigh	Missouri "	5,000
15.	Little Heart	Morton	Missouri "	2,300
16.	Glencoe-Stout	Burleigh, Emmons	Missouri "	2,400
17.	Long Lake-Kyes	Emmons	Missouri "	2,100
18.	Horsehead Flats	Emmons	Missouri "	6,500
19.	Winona	Emmons	Missouri "	4,500
20.	Fort Yates	Sioux	Missouri "	7,650
21.	Little Missouri	Slope, Billings, McKenzie	Little Missouri River	20,000
22.	Knife River Diversion	Mercer	Missouri River	12,000
23.	Dickinson	Stark	Heart River	900
24.	Heart-Butte	Grant, Morton	Heart "	13,100
25.	Cannonball	Grant, Sioux, Morton	Cannonball River	12,400
26.	Thunderhawk	Grant, Sioux, Morton	Cedar River	6,100
27.	Bowman Haley	Bowman, Adams	Grand "	5,000

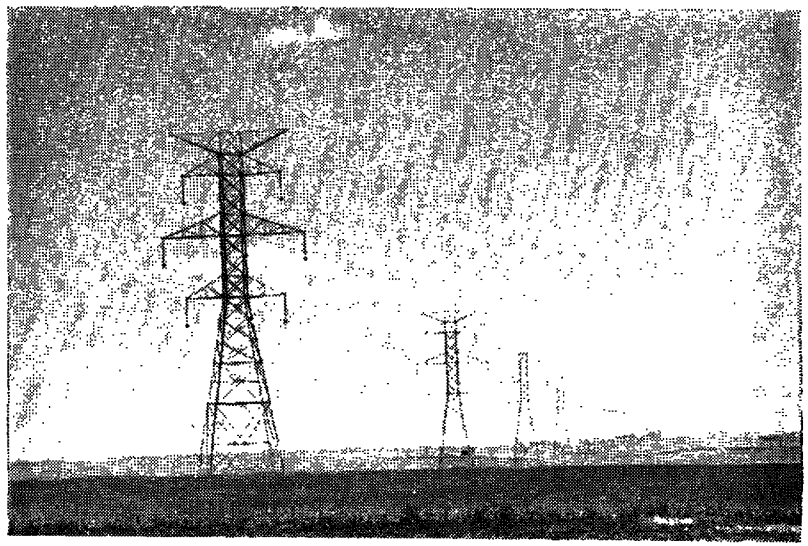
The water supply for the projects above is the Yellowstone and Missouri Rivers which in all cases will provide an adequate supply. Construction of the Oahe and Garrison dams will provide reservoirs which will have capacities to meet most drought conditions. Pumping plants will be required to elevate the water to the elevations that will best serve the irrigable areas. Ample electric energy devlopd from the Garrison rservoir should be available at reasonable rates for off peak pumping usage. A description of these projects can be found in other sections of this report.

The importance of the irrigation development undertaken and completed by the individual farmers throughout the state to the state's water program cannot be over-emphasized. Through the utilization of the water resources available they have been able to irrigate small acreages of their farms in order to provide an assured feed crop and otherwise stabilize their production. The

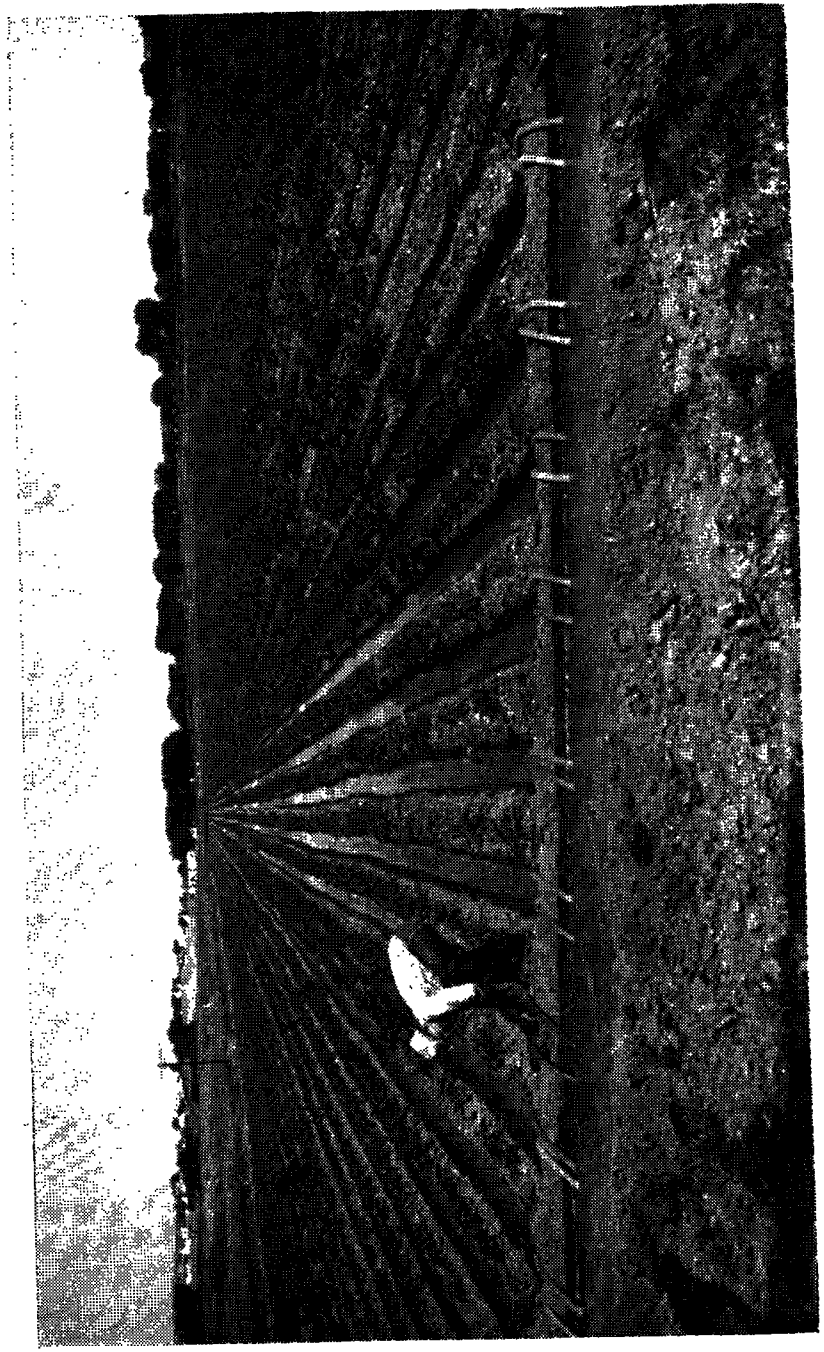
extent of the development by these farmers is indicated by the water right applications filed in the office of the State Engineer, a discussion of which can be found in another section of this report.

Studies are underway and projects have been proposed to provide flood protective works for the areas along most of our rivers and streams that are subject to flooding, particularly in the spring of the year. Many of the areas where this flooding occurs are subject to drought conditions later on in the summer and it would be desirable to have facilities available that could store these floodwaters for later use for irrigation. Such consideration has been given in the case of several of the projects proposed for irrigation development listed above. Other projects that provide for levees and floodwalls, river channel improvement and and drainage ditches are under construction or being studied. The drainage program of several of the Red River Valley counties in which the state cooperates by providing financial assistance has permitted the farming of much rich farm land that may otherwise not have been available.

All of these aspects of the water development program will make up the program as a whole and when completed will provide, to a great extent, for the beneficial use of one of our most valuable resources—water.



230,000 Volt Power Transmission Line



Chapter 2

Summary of North Dakota State Water Conservation Commission Activities

SUMMARY OF NORTH DAKOTA STATE WATER CONSERVATION COMMISSION ACTIVITIES

Since its organization in 1937 the State Water Conservation Commission has been active in all phases of the development of the water resources of North Dakota. The Commission's program has included the following:

1. Conducting surveys of areas in the state for use in planning for the development of irrigation and drainage.
2. Designing and constructing irrigation works.
3. Investigating small projects for future irrigation development.
4. The construction and repair of small dams.
5. Assistance to counties for the construction and repair of legal drains, and to irrigation districts for repairs to irrigation works.
6. Processing water right applications received from individual farmers, cities, and industries.
7. Negotiating river compacts with other states.
8. Organization of conservation and irrigation districts.
9. Cooperating in and assisting in the coordination of programs of federal agencies for the development of the water and other resources of the Missouri River Basin as pertains to North Dakota.
10. Cooperation with the U. S. Geological Survey in conducting topographic, hydrographic and underground water surveys.
11. Cooperating in conducting soil surveys in areas proposed for irrigation development.
12. Cooperating with local groups and federal agencies in the developing of flood control projects.
13. Administering the water laws of North Dakota and fostering and promoting irrigation and water development including the many administrative details connected therewith.

A summary of the accomplishments in each of these phases of the Commission's program is as follows:

In the construction and repair of small dams in the state the Commission has, since the beginning of this program in 1939, assisted in the repair and construction of 118 dams located in all sections of the state. The Commission has received appropriations totaling $429,000 for the period July 1, 1939 to June 30, 1955 of which $330,630.71 has been used to date and a balance of $69,196.35 is available for the remainder of the current biennium. Cooperating agencies during this period have contributed $160,328.32 toward the cost of these repairs. During the period covered by this report 26 dams were repaired or reconstructed at a cost of $84,495.38 to the Commission and $66,039.30 to other cooperating groups.

The program of assisting counties and irrigation districts in work on legal drains and irrigation facilities has included assistance to drainage districts in 12 counties and 4 irrigation districts in the state since 1945 when the first appropriation for this program was received. Since that time the Commission has paid $633,933.30 to these agencies for the construction or repair of 125 projects. The payments made by the State Water Conservation Commission represents approximately 40% of the construction costs of this work. During the period covered by this report 12 counties and irrigation districts have received $222,148.22 from the Commission for the construction and repair of 30 projects. An additional $98,985.26 was allocated to 7 counties and irrigation districts to pay the states 40% share of the costs of work underway.

Accomplishments of the Commission's cooperative program with the various branches of the U. S. Geological Survey since their beginnings include the topographic mapping of 12,400 square miles of the state, gathering and compiling stream flow records on the Missouri, Souris and Red Rivers and their tributaries to provide basic data needed in planning the water resource development in the state, and conducting ground water surveys for 40 areas in North Dakota to locate an adequate ground water for a municipal water supply for these localities. During the period of this report a total of about 2,600 square miles of the state was topographically mapped, stream flow measurements were gathered from 70 gaging stations located at various points on rivers and streams in the state of which the State Water Conservation Commission cooperated in maintaining over half and ground water studies were conducted for 9 localities.

During the past biennium the Engineering Department of the Commission have surveyed and mapped an estimated 50,000 acres of land in detail for use in planning and developing the water resources of the state for irrigation and other beneficial use. Survey work has been conducted in cooperation with the Bureau of Reclamation in connection with the Garrison Diversion project and for several other projects including the Big Meadow, Lake Metigoshe, Golden Lake and Knife River Diversion projects.

Negotiations for a compact on many of the interstate and international streams flowing through North Dakota have been instituted since the Commission was organized including the Yellowstone, Red, Souris and others. A compact on the Yellowstone River between Wyoming, Montana and North Dakota has been approved by the states, ratified by Congress and enacted into law. The Commission has also participated in conferences of the International Joint Commission concerning problems of diversion of water of the Souris and Red Rivers between the United States and Canada and has conducted preliminary negotiations for a compact with Minnesota relative to the division of the waters of the Red River of the North.

The extensive activity of the various federal agencies in developing the water resources of North Dakota and of the Missouri River Basin has required an active interest in assisting in the coordination of the programs of the federal and state agencies and cooperating with all groups who are interested in the program. The Governor, as a member of the Missouri Basin Inter-Agency Committee, has been in constant close contact with the Missouri Basin Resources Development Program. Other groups with whom the Commission has participated in conferences are the Missouri River States Committee, the National Reclamation Association, the State Reclamation Association, the National Rivers and Harbors Congress, the National Water Conservation Conference and others.

At the present time over 750 water-right applications have been received by the State Engineer and the State Water Conservation Commission since the enactment of the law providing for water right permits in 1905. These permits are, for the most part, for individual farmers ,cities and industries. To date the applications approved cover the appropriation of water for the irrigation of 118,570 acres of which 45,150 acres are in organized irrigation districts and 73,420 acres for individual farmers. During the period of this report 171 water-right applications have been received for the irrigation of 25,250 acres.

In 1948 the Commission entered into a cooperative agreement with the Department of Agriculture through the North Dakota Agricultural College to conduct soil surveys of areas in the state for which irrigation is possible. To date a total of 275,000 acres have been classified in this program.

There are 9 organized irrigation districts and 7 water conservation and flood control districts in North Dakota. The irrigation districts include 48,700 acres and the water conservation and flood control districts include 5 entire counties and portions of 3 others. During the past biennium 2 new water conservation and flood control districts were organized. In addition the Commission assisted in organization and operation problems of several of the irrigation districts.

Since its organization the Commission has designed and constructed the works for two irrigation districts in the state, both of which have operated successfully since their completion. Although no construction of irrigation projects was undertaken during the past biennium, work was carried on investigating areas for possible future small project development.

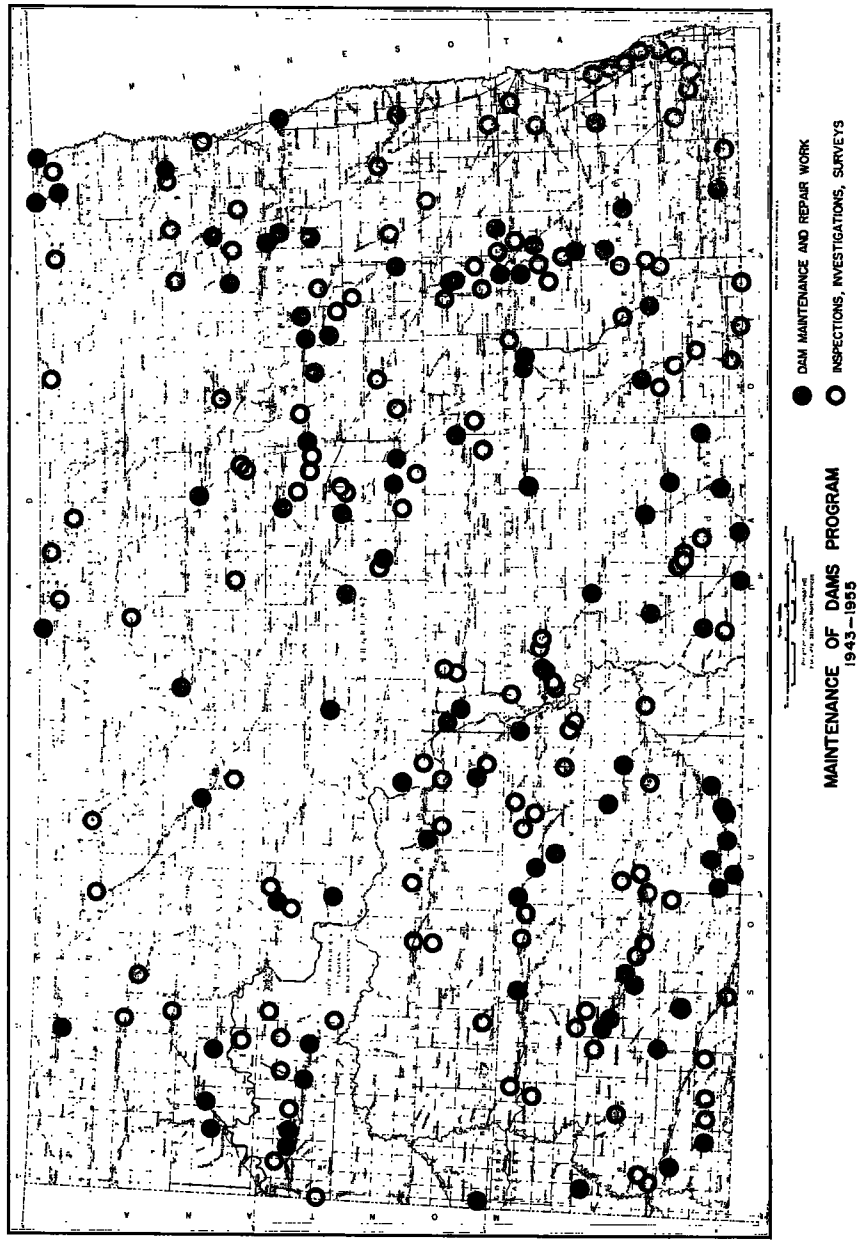
Assistance from the Commission has been given several localities in the state in providing flood control works for those areas by coordinating the activities of local and federal groups, providing necessary assurances and investigating and planning for the projects. Some of the proposals in which the Commission has cooperated during the past biennium include the Rush River snagging and drainage project in Cass County, levee protection in the Lower Heart River Basin in Morton County, the Eaton irrigation project, Swan Creek flood control project, the Tongue River Watershed project and others.

In administering the water laws of North Dakota there are multitude of administrative activities in which the Commission is involved. Activities such as providing information pertaining to data on file with the Commission and the programs for development of the water resources of the state, making engineering investigations to determine the feasibility of various proposals as well as to provide a satisfactory basis for solution to various problems of water control and development, and preparing reports for various agencies and groups are but a few of these miscellaneous functions of the Commission.

A detailed discussion of these and other activities of the Commission is contained in this chapter under appropriate headings.

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 verious federal agencies, who had constructed over 1,500



small dams in the state, were terminated without makinig 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.

Upon termination of the programs of the federal agencies the counties were delegated to maintain and repair those dams within their boundaries that were not in water conservation districts. At that time there were very few such districts organized so the responsibility fell almost entirely on the counties. In delegating the counties with this additonal responsibility no consideration was given to providing the counties with the means to raise revenue to finance the work. It was necessary for the counties to resort to their general fund for finances for any dam maintenance and repair work they undertook. The counties in many cases, did not have the trained engineering personnel available to supervise and conduct a program of this nature.

Recognizing the difficulties that faced the counties the legislature, in 1939, made provision for the State Water Conservation Commission to assist in this work. Since that time the legislature has appropriated additional funds each biennium to take care of the increased demand for the maintenance and repair of these small dams throughout the state.

The Commission's program provides for the investigation, survey, design and construction or supervision of construction of the many projects in need of attention. In nearly all cases the actual construction work is done on a force account basis by crews employed by the Commission. The work undertaken is financed on a cooperative basis with the Commission, and the counties or locally interested groups participating. The North Dakota State Game and Fish Department shares in the cost of the projects in which fish and wildlife conservation and propagation benefits are adequate.

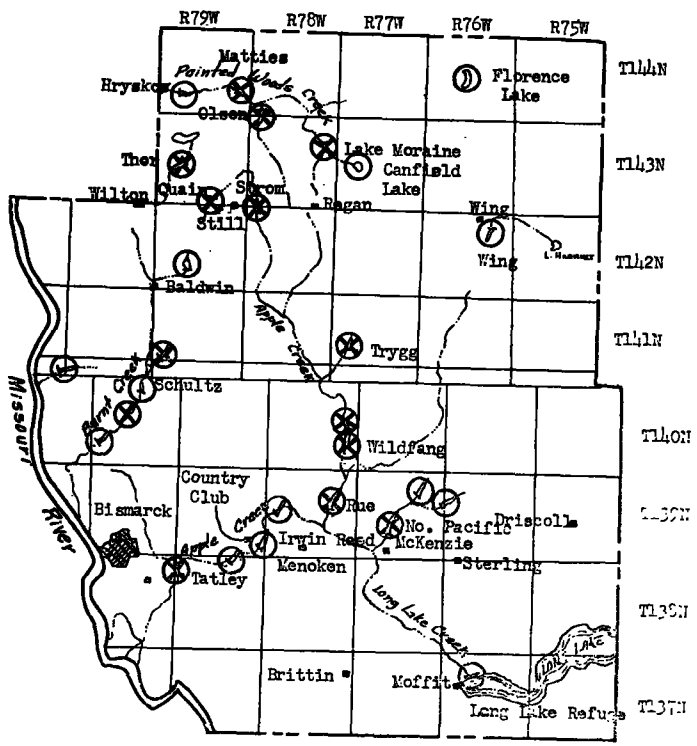
The predominant type of construction used by the federal agencies originally in constructing the spillways is the rubble masonry type in which native field stone was laid on a clay core. Due to frost and water action many of the spillways of this type were soon damaged and required repair if they were to continue to serve the purpose for which they were constructed. The Commission's program provides for the repair of structures so damaged to the extent of the resources available in the most practical and economical method possible. Concrete construction has been used entirely to replace the damaged portions of structures of the original unsatisfactory rubble masonry construction. Generally the work itself involves the repair of damaged spillway structures, including the placement of steel sheet piling or concrete cutoff walls where necessary, repair or replacement of overflow sections with either rubble, plain or reinforced concrete sections and when required, the replacement of riprap or earth fill materials.

Because of the many dams in the state and the existing limitation on the extent that the program can be carried forward maintenance of many of these dams has been neglected and as a result serious damage has occurred to those structures. On the other structures the damage is minor and of more recent origin. Prompt attention to those dams will mean a great savinig in the costs of the repairs required and in some cases saving a costly structure that, if destroyed, may never be replaced.

BURLEIGH COUNTY

STATUS OF EXISTING DAMS

November, 1953



⊗ NO IMPOUNDMENT (Spillway or embankment needs major repair)

○ RESERVOIR EXISTS (Spillway and embankment [illegible])

In 1953 the Commission undertook a reconnaissance survey of the federally constructed small dams in Burleigh County in order to determine their condition. Approximately 70% of the dams investigated required either major or minor repair work. This survey revealed that of the 28 dams located in Burleigh County that were investigated, 12 were destroyed to the extent that they needed to be reconstructed, 7 were in need of minor repair and 9

were in from fair to good condition. It is estimated that the total cost of restoring and repairing the structures as needed at present is $169,000.00. An accompanying map indicates the location of the dams inspected and their condition.

The State Water Conservation Commission's program for the repair and reconstruction of small dams since its inception in 1939 has included work on 118 dams located in all sections of the state. For this work the state legislature has appropriated $429,000.00 to the Commissioin for the period July 1, 1939 to June 30, 1955. A total of $330,630.71 of this amount has been utilized in the Commission's dam repair program and a balance of $69,196.35 is available for the remainder of the current biennium. Cooperating agencies have contributed $160,328.32 to the costs of the projects included in this program making the combined total costs of the dams repaired $490,959.03. In addition work contemplated for the balance of the current 1954 construction season will cost an estimated $65,000.00 of which cooperating agencieis will contribute about $25,000.00.

The accompanying table contains a summary of the dams repaired during the period covered by this report. The map shows the location of dam repair or reconstruction projects in which the Commission has cooperated since the beginning of its dam repair program.

DAMS CONSTRUCTED OR REPAIRED—July 1, 1952 - June 30, 1954

Project No.	Name	County	State Water Commission	Game and Fish	Local	Total
264	Braddock	Emmons	$ 719.86	$ 719.84	$ 719.84	$ 2,159.54
538	Burlington Park	Ward	14,616.51		10,000.00	24,616.51
526	Cat Coulee	Grant	949.52	949.51	949.51	2,848.54
353	Cedar Lake	Slope	2,787.44			2,787.44
341	Center	Oliver	1,036.08		714.00	1,750.08
412	Apple Creek	Burleigh	3,856.19		3,856.19	7,712.38
389	Fessenden	Wells	1,884.69		1,869.83	3,754.52
520	Grand Forks Park	Grand Forks	6,137.11		14,780.10	20,917.21
342	Hanson	Barnes	9,298.39		3,129.00	12,427.39
363	Iverson	Benson	591.75	463.38	335.00	1,390.13
253	Jackson	McKenzie	4,591.94		256.50	4,848.44
271	Meissner	Morton	1,056.66	200.00	547.82	1,804.48
394	Odland	Golden Valley	971.77	971.77	971.77	2,915.31
522	Parshall	Mountraill	2,347.39		1,650.00	3,997.39
338	Pishek	McKenzie	1,028.82			1,028.82
511	Reed	Burleigh	668.03		150.00	818.03
518	Sheyenne	Eddy	1,330.44	1,015.27	700.00	3,045.71
311	Sivertson	McKenzie	47.96			47.96
521	Soldiers Home	Ransom	9,725.84		4,000.00	13,725.84
417	Squaw Creek	Hettinger	192.99		192.99	385.98
431	Strawberry Lake	McLean		9,657.19		9,657.19
450	Sykeston	Wells	1,966.31		450.00	2,416.31
472	LeRoy	McLean	4,697.18		2,483.22	7,180.40
440	Watford City	McKenzie	809.31			809.31
359	Wolf Butte	Adams	918.78	600.00		1,518.78
364	Yanktonai	McLean	12.264.42		3.706.57	15.970.99
			$84,495.38	$14,576.96	$51,462.34	$150,534.68

A summary of data concerning the dams that were repaired during the period of this report is as follows:

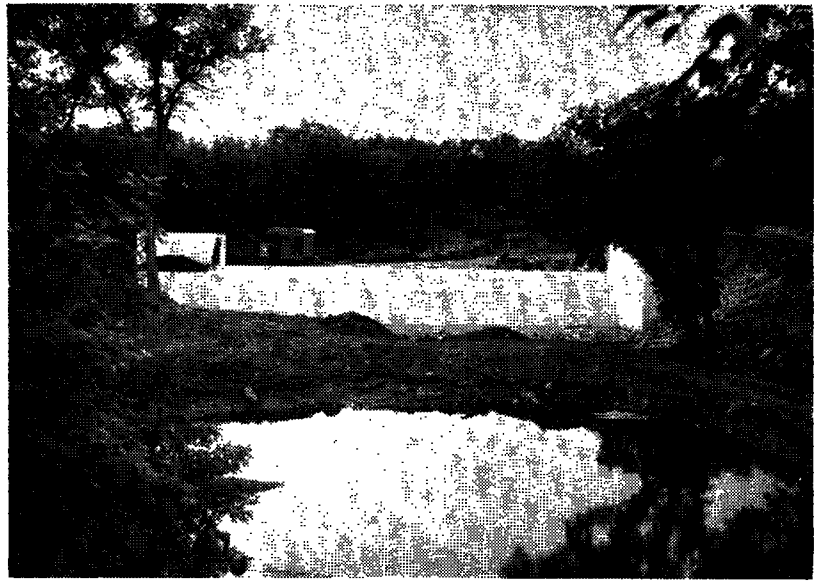
Braddock Dam—Emmons County

Scope of Work: Filling large void in weir section of spillway. Closing of water course around left wing.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Emmons County.

Quantities: Reinforced Concrete — 14 cubic yards .

Burlington Park Dam—Ward County



After Reconstruction

Before Reconstruction

Burlington Park Dam—Ward County

Scope of Work: Reconstruction of Spillway.

Sponsors: State Water Conservation Commission, Ward County Park Board.

Quantities: Concrete—322 cubic yards, Steel Piling—1,860 square feet, Reinforcing Steel—23,000 pounds.

Cat Coulee Dam—Grant County

Scope of Work: Replacing section of Embankment.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Grant County.

Quantities: Earth-fill material—6,730 cubic yards, Riprap—135 cubic yards.

Cedar Lake Dam—Slope County

Scope of Work: Repairing scoured area at toe of Spillway.

Sponsors: State Water Conservation Commission.

Quantities: Rubble Concrete—70 cubic yards.

Center Dam—Oliver County

Scope of Work: Repairing channel bank and placing riprap for bank protection below spillway.

Sponsors: State Water Conservation Commission and City of Center.

Quantities: Earth-fill—1,500 cubic yards, Rock Riprap—105 cubic yards, 27 Car Bodies emplaced for bank protection.

Apple Creek Dam—Burleigh County

Scope of Work: Reconstruction of Spillway.

Sponsors: State Water Conservation Commission, Apple Creek Country Club.

Quantities: Concrete—186 cubic yards, Reinforcing Steel—135 pounds, Steel Sheet Piling—439 square feet.

Fessenden Dam—Wells County

Scope of Work: Placement of steel sheet piling cutoff wall with concrete cap to prevent undermining.

Sponsors: State Water Conservation Commission, City of Fessenden.

Quantities: Concrete—24 cubic yards, Sheet Steel Piling—977 square feet, Reinforcing Steel—551 pounds.

Grand Forks Park Dam—Grand Forks County

Scope of Work: Replacement of timber weir section.

Sponsors: State Water Conservation Commission, City of Grand Forks, City of East Grand orks, Minnesota.

Quantities: Steel Plates—10,600 pounds, Timber—7,030 FBM.

Hanson Dam—Barnes County

Scope of Work: Reconstruction of Spillway.

Sponsors: State Water Conservation Commission, Barnes County.

Quantities: Concrete—264 cubic yards, Reinforcing Steel—5,456 pounds.

Odland Dam—Golden Valley County

Scope of Work: Construct secondary drop below spillway.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Golden Valley County.

Quantities: Concrete—52 cubic yards.

Parshall Dam—Mountraill County

Scope of Work: Reconstruct Spillway.

Sponsors: State Water Conservation Commission, City of Parshall.

Quantities: Concrete—47 cubic yards, Reinforcing Steel—1330 pounds, Sheet Steel Piling—123 square feet.

Pishek Dam—McKenzie County

Scope of Work: Replacing section of embankment.

Sponsors: State Water Conservation Commission, Arnegard Park Association.

Quantities: Sheet Steel Piling—149 square feet, Riprap—90 cubic yards.

Sheyenne Dam—Eddy County

Scope of Work: Construction of wier section.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Village of Sheyenne.

Quantities: Concrete—65 cubic yards, Reinforcing Steel—2689 pounds.

Reed Dam—Burleigh County

Scope of Work: Repair wing wall and fill voids in wier section.

Sponsors: State Water Conservation Commission, Irvin Reed.

Quantities: Concrete—37 cubic yards.

Iverson Dam—Benson County

Scope of Work: Repair wing wall and fill voids in wier section.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Leeds Rod and Gun Club.

Quantities: Concrete—16 cubic yards, Rock—12 cubic yards.

Jackson Dam—McKenzie County

Scope of Work: Provide bank protection and place riprap.

Sponsors: State Water Conservation Commission.

Qauntities: Rock—50 cubic yards.

Meissner Dam—Morton County

Scope of Work: Construct secondary drop and repair wing wall.

Sponsors: State Water Conservation Commission, State Game and Fish Department, Local organization.

Quantities: Concrete—18 cubic yards, Rock—20 cubic yards, Sheet Steel Piling—147 square feet.

Sivertson Dam—McKenzie County

Scope of Work: Replacing washed-out backfill.

Sponsors: State Water Conservation Commission.

Quantities: Earth-fill—50 cubic yards.

Soldiers Home Dam—Ransom County

Scope of Work: Construction of Spillway.

Sponsors: State Water Conservation Commission, N. D. Soldiers' Home.

Quantities: Reinforced Concrete—125 cubic yards, Reinforcing Steel—4,860 pounds, Sheet Steel Piling—1,237 square feet.

Squaw Creek Dam—Hettinger County

Scope of Work: Constructing secondary drop at toe of spillway.
Sponsors: State Water Conservation Commission, Hettinger County .
Quantities: Concrete – 12 cubic yards.

Strawberry Lake Dam—McLean County

Scope of Work: Reconstruction of Spillway.
Sponsors: State Water Conservation Commission, State Game and Fish Department.
Quantities: Reinforced Concrete—80 cubic yards, Reinforcing Steel—6,804 pounds, Sheet Steel Piling—256 square feet.

Sykeston Dam—Wells County

Scope of Work: Construction of secondary drop at toe of spillway.
Sponsors State Water Conservation Commission, City of Sykeston.
Quantities: Concrete—40 cubic yards.

LeRoy Dam—McLean County

Scope of Work: Repair downstream wing wall.
Sponsors: State Water Conservation Commission, McLean County.
Quantities: Concrete—33 cubic yards.

Watford City Dam—McKenzie County

Scope of Work: Filling void under wier section of spillway.
Sponsors: State Water Conservation Commission.
Quantities: Concrete—10 cubic yards.

Wolf Butte Dam—Adams County

Scope of Work: Filling voids under wier section of spillway.
Sponsors: State Water Conservation Commission, State Game and Fish Dapartment.
Quantities: Concrete—34 cubic yards.

Yanktonai Dam—McLean County

Scope of Work: Reconstruction of Spillway.
Sponsors: State Water Conservation Commission, McLean County.
Quantities: Concrete—317 cubic yards, Reinforcing Steel—4,657 pounds.

Souris River Dam—Ward County

Scope of Work: Repair wing wall.
Sponsor: State Water Conservation Commission.
Quantiies: Concrete—2½ cubic yards.

RECOMMENDATIONS

1. It is recommended that the State Water Conservation Commission's Maintenance of Dams program be continued in order that assistance can be provided to counties and local communities in protecting and keeping these structures in the state in which there has been such a large investment and are of value to the communities where they are located.

2. In view of the fact that adequate information is not available as to the present condition, exact location and utilization of many of these structures, it is recommended that provisions be incorporated in funds appropriated to the State Water Conservation Commission to conduct a survey of the existing public works dams in the state to determine these factors.

3. Results of this study would permit local interests the opportunity to raise money locally to contribute to the repairs of dams when needed. It would also, in many instances, afford repair crews the opportunity to make minor repairs before they develop into major ones or before they become total failures.

STATUS OF FUTURE WORK

Mike Olson Dam—Grand Forks County:
Investigation completed; estimate not complete.

Logan Center Dam—Grand Forks County:
Investigation completed; estimate not complete.

Olson Dam—Burleigh County:
Investigation completed; estimate not complete.

Pioneer Lake Dam—Walsh County:
Estimated cost of repairs $1,300.

Sorge Dam—Motron County:
Estimated cost of repairs $1,200.

Stromberg (Hesper) Dam—Benson County:
Estimated cost of repairs $29,700.

Riggins Dam—Benson County:
Estimated cost of repairs $15,000.

Danzig Dam—Morton County:
Estimated cost of repairs $3,000.

Dougherty Dam—Walsh County:
Estimated cost of repairs $5,300.

State Training School Dam—Morton County:
Investigation pending; estimate not complete.

Cat Coulee Dam—Grant County:
Estimated cost of repairs $7,000.

Wolf Butte Dam—Adams County:
Estimated cost of repairs $7,500; construction to start in November.

Sellie Dam—Wells County:
No estimate available pending investigation.

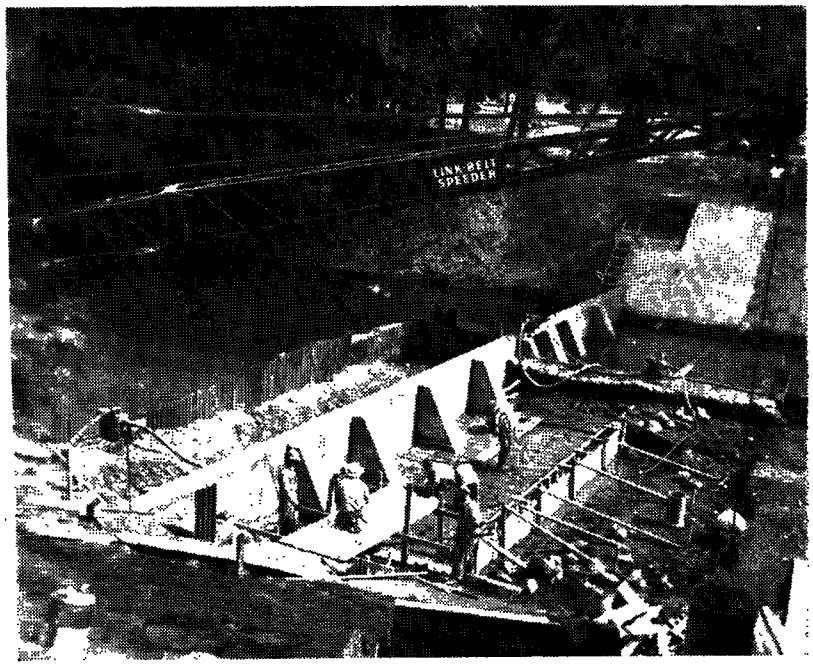
Melville Dam—Stutsman County:
Investigation pending.

Square Butte Dam—Morton County:
Investigation not completed; estimate not complete.

Center Dam—Oliver County:
No estimate available pending further investigation.

Dakota Lake Dam—Dickey County:
Investigation completed; estimate not complete.

State Line Dam—Dickey County:
Estimated cost of repairs $15,600.
Bouret (Twin Tree) Dam—Benson County:
Estimated cost of repairs $2,000.
Welk Dam—Emmons County:
Estimated cost of repairs $1,500.
Fort Ransom Dam—Ransom County:
Construction started June, 1954; estimated cost of repairs $16,000.
Lisbon Dam—Ransom County:
Estimated cost of repairs $3,000.
Knodel Dam—Well County:
Estimated cost of repairs $2,100.
Jamestown Dam—Stutsman County:
Estimated cost of repairs $6,000; construction to start in October.
Coyote Creek Dam—Bowman County:
Estimated cost of repairs $5,700.
Vigness Dam—Walsh County:
Estimated cost of repairs $14,200; construction to start in September.
Enderlin Dam—Ransom County:
Investigation pending; estimate not complete.
North Lemmon Lake Dam—Adams County:
Estimated cost of repairs $3,000.



Soldier's Home Dam, Lisbon

CONSTRUCTION AND RECONSTRUCTION OF DRAINS OR IRRIGATION

In many areas of North Dakota good agricultural land is subject to periodic flooding during the spring snow melt and periods of heavy rainfall. This condition has resulted in the construction of many drainage ditches that provide the necessary drainage to these lands in order that they may be cultivated. This flood problem is much more acute in the Red River valley in eastern North Dakota where the terrain is extremely flat and the waters drain off very slowly or form large shallow lakes that are dissipated by evaporation and as a result, a greater concentration of drainage ditches exist in this area. Many of these drains are from 40 to 50 years old while others have been more recently constructed. All of them have paid for themselves many times by making land available for cultivation that otherwise would be useless because of inundation by flood waters.

During the 30's because of the drought conditions the maintenance of existing drainage ditches was neglected. As a result many of the drainage ditches were filled by brush, trees, sand and dirt from dust storms and other debris and were rendered ineffective In the 1940's as the need for these drains again became apparent along with the increased precipitation it was found that an extensive clean-out and rebuilding program was necessary before the drains could be of service. Financing this clean-out program was beyond the means of the drainage districts and the counties concerned and, recognizing this problem, the state legislature in 1943 made an appropriation of $50,000 to the State Water Conservation Commission to assist the counties in this work. Additional appropriations have been made to the Commission each biennium since that time to continue this drainage program.

Since 1943 when the state legislature made its first appropraition to the State Water Conservation Commission for assisting the counties in their drainage programs the Commission has paid $633,933.30 to 16 counties and irrigation districts in the state as a share of costs of doing the necessary construction work on more than 125 different projects. Funds appropriated to the Commission for this purpose have varied each biennium depending upon the need, the demand and activity in the various counties. The extent of the drainage programs of the various counties is dependent mainly on the spring runoff and the amount of precipitation received in these counties and the resulting damage to crop lands and to the drains. A summary of the Commission's appropraitions and allocations existing at the present is listed on a schedule in this section of this report.

In addition to the assistance offered to the counties and drainage districts by the Commission in its drainage program these districts have had the cooperation and assistance of the U. S. Soil Conservation Service in providing the engineering service necessary to plan, organize, survey and supervise construction work on the various drainage projects. These services of the U. S. Soil Conservation Service, provided through their area conservationists in the state, are furnished at no cost to the drainage district or to the Commission.

Funds appropriated to the State Water Commission for drainage work by the state legislature are allocated to the various counties who require as-

Pembina County Drain No. 13 before clean-out

Pembina County Drain No. 55 after clean-out

sistance on the basis of their need. These funds are allocated by the Commission so as to provide the greatest benefit possible to the areas of need in the state. The State Water Conservation Commission provides this financial assistance to the counties on a 60-40 basis with the county drain district paying 60 per cent of the costs of the drain and the state 40 per cent. The state's 40 per cent share is based on construction costs of the drain only.

In addition to the program of assisting the counties and drainage districts in drainage work the Commission has used funds appropriated to this item in their appropriation to assist several of the irrigation districts in the state. Assistance given these districts has been for the repair and improvement of the irrigation facilities and for the drainage of lands within those districts.

Various rules have been adopted by the Commission for use in administrating their drainage activities. These rules have been amended as necessary from time to time and can be found in the Eighth Biennial Report of the State Water Conservation Commission.

During the period of this report the Commission has cooperated with twelve counties and irrigation districts in the construction, reconstruction or repair of thirty different projects located within those counties or districts. The work involved in these projects includes the excavation of new drains, clean-out of old drains, construction of farmstead crossings, purchase of right-of-way, installation of field inlets, spoil bank leveling, and other incidental items. The total cost of these projects was $222,148.22 of which the Commission contrbiuted $89,923.06 and the counties or drain districts contributed $132,225.16. A summary of the county or irrigation districts receiving assistance from the Commission during the period of this report along with the projects for which such assistance was received is listed on the following schedule:

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION DRAINAGE AND EXPENDITURES

July 1, 1952-June 30, 1954

Payments to Counties

County & Drain	State Share	District Share	Total Cost
Barnes			
No. 1	$ 3,838.72	$ 5,758.07	$ 9,596.79
Cass			
No. 2	9,207.37	13,811.06	23,018.43
No. 12	5,227.82	7,841.73	13,069.55
No. 27	6,747.43	10,121.16	16,868.59
No. 42	2,409.29	3,613.94	6,023.23
No. 46	12,644.49	18,966.74	31,611.23
No. 47	8,918.31	13,377.47	22,295.78
Total	$45,154.71	$ 67,732.10	$112,886.81

Cavalier			
Roseau Lake	$ 4,856.85	$ 7,285.27	$ 12,142.12
Dickey			
Elliot	$ 3,478.63	$ 5,217.95	$ 8,696.58
Grand Forks			
Falconer Twp. No. 2	$ 827.78	$ 1,241.66	$ 2,069.44
Falconer Twp. No. 3	452.61	678.91	1,131.52
Rye Twp. No. 2	964.22	1,446.34	2,410.56
Rye Twp. No. 3	411.06	616.58	1,027.64
Total	$ 2,655.67	$ 3,983.49	$ 6,639.16
Pembina			
No. 13	$ 1,631.95	$ 1,777.07	$ 3,409.02
Proj. No. 1	380.88	571.32	952.20
No. 3	1,043.33	1,564.99	2,608.33
No. 4	1,158.19	1,737.29	2,895.48
No. 5	517.92	776.80	1,294.80
Total	$ 4,732.27	$ 6,427.47	$ 11,159.74
Richland			
No. 7	$ 4,486.80	$ 6,730.20	$ 11,217.00
No. 12	6,852.18	10,278.26	17,130.44
No. 21	719.14	1,078.70	1,797.84
Total	$12,058.12	$ 18,087.16	$ 30,145.28
Sargent			
No. 3	$ 1,259.94	$ 1,889.92	$ 3,149.86
Traill			
Herberg Twp. No. 1	$ 916.40	$ 1,374.60	$ 2,291.00
Herberg Twp. No. 2	280.40	420.60	701.00
No. 22	2,727.40	4,502.60	7,230.00
No. 23	472.60	708.90	1,181.50
No. 42	1,600.00	3,173.88	4,773.88
Total	$ 5,996.80	$ 7,006.70	$ 13,003.50
Walsh			
No. 28	$ 1,940.38	$ 2,910.56	$ 4,850.94
Payments to Irrigation Districts			
Eaton Project	$ 2,471.19	$ 3,706.78	$ 6,177.97
Sioux Project	1,479.78	2,219.69	3,699.47
Total	$89,923.06	$132,225.16	$222,148.22

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.	1951-1953 $90,000 Appropriation		1953-1957 $140,000 Appropriation		Total 1943-1955 $870,000 Appropriated	
					Allocation	Expenditure	Allocation	Expenditure	Unexpended Allocation Available	Expenditure
Barnes	$	$	$	$	$ 3,838.72	$ 3,838.72	$	$	$	$ 3,838.72
Bottineau		2,785.31								2,785.31
Cass	8,930.00	72,171.51	27,823.73	19,446.82	31,610.72	29,591.72	45,240.00	8,918.31	38,367.69	166,885.09
Cavalier				1,595.03	4,856.85	4,856.85				6,452.78
Dickey					3,478.63	3,478.63				3,478.63
Grand Forks	1,954.12	7,820.92	4,618.74	1,415.25	1,792.00	1,792.00	11,663.67	863.67	10,800.00	18,464.70
Morton	2,995.00									2,995.00
Pembina	3,760.00	11,212.19	3,945.08	83,013.39	3,100.32	3,100.32	2,500.00		2,500.00	105,030.98
Richland	27,001.01	70,782.51	343.12	18,150.93	8,717.14	5,205.94	12,000.00		15,513.20	121,483.51
Sargent			2,436.55	1,227.94	32.00	32.00	2,000.00		2,000.00	3,696.49
Traill	2,350.00	30,756.83	58,817.26	12,331.98	5,996.80	5,996.80	23,641.21		23,641.21	110,282.87
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
Burlington Irrigation Project			2,144.80							2,144.80
Eaton Flood Irrigation District			420.00		2,451.19	2,451.19				2,871.19
Lewis & Clark Irrigation District			8,456.35							8,456.35
Sioux Irrigation District		4,816.64	614.64	1,479.78						6,910.60
Miscellaneous and Unallocated		140.44	13,979.51	1,343.23	21,093.63		41,014.74		41,014.74	15,463.18
	$ 50,000.00	$239,451.28	$127,954.17	$144,458.32	$ 90,000.00	$ 60,347.17	$140,000.00	$ 11,722.36	$133,836.84	$633,933.30

Survey Party Gathering Topographic Data

ENGINEERING INVESTIGATIONS AND SURVEYS

One of the most important aspects of the State Water Conservation Commission's program is that of conducting engineering surveys and investigations throughout the state and, from the information gathered, preparing project plans and reports. The construction of many of the projects included in this program will be under the supervision of the Commission. The state legislature has appropriated funds to the Commission for this purpose each biennium which have been used in the solution of many problems in connection with the waters of the state and in determining the feasibility and plan for development of other projects. This work includes topographic surveys, water supply studies, soil surveys and analysis and the related compilation and application of this data in preparing plans and reports. All of the material gathered is available to all interested parties and much of it has been utilized by the Bureau of Reclamation, Corps of Engineers, the U. S. Geological Survey and other federal and state agencies in their activities in North Dakota. During the period of this report the Commission has maintained one topographic mapping crew which has worked with Bureau of Reclamation crews in the area included in the Garrison Diversion project. In addition survey parties have completed areas proposed for development in the Knife River Diversion project, the Big Meadow Reclamation project, the Golden Lake Restoration project, Lake Metigoshe project, dam site and reservoir surveys in southwestern North Dakota, several surveys for fish and wildlife projects and for other problems.

A summary of these surveys and the project reports is as follows:

WESTERN SLOPE AREA DAM INVESTIGATIONS

The State Water Conservation Commission is continuing to make surveys of proposed dam and reservoir sites in the western slope area. The Commission recognizes that this area, probably more than any other geographic location in the state, suffers most adversely when drouths occur. This area has also shown a definite interest in irrigation as a large number of water right applications originate in this section of the state.

The topographic conditions here constitute a rapid runoff of precipitation also contribute to the fact that normally less moisture is available in the root zone of the soil. It also increases cost in dam construction as the increased runoff resulting from steep topography necessitates additional spillway requirements. The reservoir capacities are generally less per foot of elevation than most aras as a result of the gradient in the western streams. Considerable time is usually required in locating satisfactory dam sites.

The Commission is desirous of establishing reservoirs in the area as the reservoirs might afford this section of the state a valuable water supply during periods of drouth. Reservoirs will also afford irrigators a much needed supply of water during the periods of water demand for irrigation when stream flow is generally at a minimum.

The Bureau of Agricultural Economics made a survey in the area in 1938 relative to reservoir sites. The survey obtained by the Bureau of Agricultural Economics is lacking much information as it was preliminary in nature.

Some form of a federal subsidy would be required to make this program a reality as the obvious benefits are not sufficient to defray the cost of the contemplated structures. Valuable facilities such as these would probably be achieved if a federal works program should again become necessary.

There are 26 of these potential dam and reservoir sites for which the Commission has conducted preliminary investigations or gathered some data. Investigations are being continued for these projects in order to gather sufficient data to determine the feasibility of these projects and the benefits that will accrue if they are developed in the future.

Although the demand for the construction of dams and projects of this nature has not been extensive during the past decade of relatively wet periods, it is essential that a "shelf" of projects on which preliminary plans are complete be available in order to be prepared for another drought period similar to that of the 1930's. Investigations similar to these that have been carried out in the southwestern part of the state are planned for other sections of the state as funds permit.

A summary of the data concerning these dam and reservoir sites is as follows:

SLOPE AREA DAMS

Creek	Location	County	Area Acres	Height	Capacity Acre ft.
Sweetbriar	14-139-84	Morton	754	63	15,500
Antelope	3-138-95	Stark	1134	64	27,700
Government	10-138-92	Stark	96	22	685
Cedar	23-132-97	Adams	998	45	13,400
Thirty Mile	17-134-91	Hettinger	615	37	7,600
Cedar	6-131-95	Adams	1330	46	15,000
Little Heart	29-137-81	Morton	3040	47	30,000
Antelope	33-139-94	Stark	463	35	7,400
Hailstone	9-138-86	Morton	263	45	4,600
Philbrick	17-136-98	Slope	1175	40	16,100
Government	3-137-91	Stark	475	60	9,900
Knife	1-143-96	Dunn	840	52	14,800
Thirty Mile	36-139-91	Hettinger	480	50	4,960
South Heart	32-139-98	Stark	874	40	11,900
Green	15-141-98	Billings	1140	30	11,300
Green	5-140-96	Stark	415	20	2,600
North Creek	1-139-98	Stark	560	35	7,400
Heart Butte	36-138-89	Morton	320	25	2,300
Cannonball	20-136-98	Slope	763	35	8,900
Green	21-140-95	Stark	800	50	16,800
Sweetbriar	23-139-84	Morton	200	40	4,200
Antelope	10-134-88	Grant	1160	40	19,800

KNIFE RIVER DIVERSION PROJECT

The proposed Knife River Diversion Project is located in the low rainfall belt in the southwestern portion of the state. The irrigable lands lie adjacent to Antelope Creek, a tributary of the Knife River, and along the Knife River from Beulah to where the Knife flows into the Missouri. It is possible to develop between 12,000 and 15,000 acres of irrigable land in this project. Additional acreage could be obtained through the installation of a relatively small relift station.

It is proposed that the water be obtained from the Garrison Reservoir through the use of a pumping plant located on the south bank of the reservoir approximately 12 miles north of Zap, North Dakota. The water would be pumped into a canal at elevation 1250 which would require lifting the water between 100 and 140 feet. The water would be conveyed by canal a distance of five miles to an equalizing reservoir. The capacity of the reservoir would approximate 24,000 acre feet of storage and could be increased 36,000 acre feet with an additional 10 foot pumping lift.

The creation of the proposed reservoir could be accomplished at a relatively low cost per acre foot of storage as little or no spillway would be required. The reservoir, located at the headwaters of Antelope Creek, would be created by an earth-fill dam. It would be constructed in Section 30 and

31, Township 145, Range 88, approximately 5 miles north of Beulah. The height of the dam would be between 50 and 60 feet. It is possible that municipal water could be made available from the reservoir to Beulah and Hazen should it be desired. Off peak power could be used in pumping water for storage in the reservoir.

Water could be delivered to the irrigable area adjacent to Antelope Creek, through a canal system originating from the left side of the dam. The water for the irrigable land between Spring Creek, Beulah and Hazen can be released through the natural channel and diverted from the channel at one or more desirable diversion points. This procedure could also be used in making water available to the irrigable land between Hazen and the Missouri River, as water could be released into and diverted from Antelope Creek.

The Water Conservation Commission made a topographic survey covering approximately 8,000 acres along the diversion route. Additional topograhy in excess of 16,000 acres was obtained on the proposed irrigable lands. The above topography was made on a 1"=1000' foot scale. The Bureau of Reclamation has obtained 1"=400' topography on approximately 12,000 acres between Beulah and the Missouri River.

Feasibility studies will be made on the project as a part of the 1955 winter program. The Soil Department of the North Dakota State College has made a reconnaissance soil survey of the area.

Further soil investigations will be made in the near future. The Bureau of Reclamation has completed a soil survey of the area between Beulah and the Missouri River.

LAKE METIGOSHE DIVERSION PROJECT

Location and General Description:

Lake Metigoshe is located in the West Central portion of the Turtle Mountains approximately 15 miles north of Bottineau, North Dakota. The Turtle Mountains represent one of North Dakota's most beautiful scenic areas. Lake Metigoshe adds much brilliance to this area and has contributed greatly to the popularity of the Turtle Mountains. The lake covers an area of 1520 acres of which 60 acres are located in Canada. It has a shore line 26 miles in length including its five islands. On November 6, 1953, the point of greatest depth was 22.3 feet. The average depth was 15.7 feet. The water surface elevation on the above date was 2137.0 above sea level. When the lake is at spillway elevation one more foot of depth may be added to the above figures.

Project Proposal:

It is proposed that facilities be constructed whereby a water level constituting the present spillway elevation be maintained as near as possible. The success of such a proposal is difficult to ascertain in view of small unreliable drainage areas supplying water to Metigoshe. Diversions from other watersheds are impossible.

In 1931 the State Engineer Department made topographic surveys of Lake Metigoshe and a portion of the Rost Lake drainage area relative to a possible storage reservoir for use in replenishing receding waters in Metigoshe. The topography and datum presented therein has been of much value in

studying the proposed reservoir area. Supplemental surveys were obtained in November, 1953 for further studies. The surveys consisted of profiles between Canadian and American lakes for the study of drainage and reservoir possibilities.

Approximately 16 square miles in Canada contribute water to Lake Metigoshe through Lake Dromore. Sharpe Lake which is the largest Canadian lake in the Metigoshe drainage area has an area of 717 acres. It would provide an ideal reservoir site for storing water in years of runoff. A profile was run between Lakes Metigoshe and Sharpe and the latter was found to be nineteen feet higher than Lake Metigoshe. The level of Sharpe Lake was 14 inches below outlet flow line at the time the levels were taken on November 6, 1953. A profile was also obtained between Partridge Lake and Metigoshe. It has an area of 111 acres. After continued drouth periods considerable runoff is required before these lakes spill into Metigoshe. Reports indicate that both lakes were dry during the 1930-1940 drouth period.

Canadian farmers residing along Sharpe Lake were contacted relative to the possibility of using this lake for storage purposes. Those contacted expressed a desire to see the lake raised but stated opposition to lowering the level for the benefit of other lakes.

Elimination of possible Canadian storage then limits storage to the Rost and School Section Lake area, unless diversion works could be constructed between the Dromore drainage area and Rost Lake.

The State Engineer's plan made in 1931 suggested the construction of a dam between Metigoshe and School Section Lakes; the resulting reservoir would inundate 808 acres at a contour elevation of 2155. The top reservoir elevation would be 17.0 feet higher than that of Metigoshe at spillway crest. The total storage capacity would be 7463 acre feet of which 227 acre feet would be dead storage. Thus 7263 acre feet would be available for Lake Metigoshe not considering the water that would be lost through evaporation. The drainage area feeding into the proposed reservoir is 11 square miles including the reservoir site. Evaporation records taken from the surface of Lake Metigoshe during 1931 and 1932 show an average annual loss of 1.82 feet or 21.89 inches from Metigoshe. The total computed drainage area for Lake Metigoshe is 37 square miles.

Watershed Improvement:

Watershed improvement into Lake Metigoshe should receive consideration if it is not feasible to commence an immediate reservoir program. The drainage system could be made to conform with the requirements of the low water drainage system for the reservoirs. In November, 1953, Rost Lake impounded approximately 1042 acre feet of water between elevations 2142 and 2146. School Section Lake, through the construction of an improvised dam, impounded approximately 370 acre feet between the Metigoshe spillway elevation 2138 and elevation 2143.4 as of November 1, 1953. This would permit the draining of 1412 acre feet of water into Lake Metigoshe. Theoretically this would raise Metigoshe approximately 11 inches.

A dam could be constructed between Lake Metigoshe and School Section Lake which would impound water up to the 2155 level or higher if found

practical. The proposed dam site is in the NW¼ of Section 36, Township 164 N., Range 75 W. The dam could be provided with a regulatory gate to permit water to be drawn down to the levels lower than the Metigoshe spillway elevation as may be required during extreme dry periods. Should it be found practical to divert the Dromore Lake drainage area into Rost Lake this dam would then be used to regulate the flow of both drainage areas into Lake Metigoshe. The spillway capacity would necessarily have to be increased to accommodate the flow from the increased drainage area.

In the event that the diversion of the Dromore Lake drainage area cannot be accomplished one other possibility exists whereby water may be added to the Rost Lake reservoir from the Canadian drainage area. This could be accomplished through the use of a pumping plant located at the proposed Rost Lake reservoir dam site. The pumping plant could be employed during periods when ample water is available in Lake Metigoshe. Improvements have been made in pumping equipment during recent years that might justify consideration of this feature. The pump would necessarily be of large capacity to take advantage of short interval flows into Metigoshe through Dromore and the western drainage area. An extensive study of costs and benefits would be necessarybefore a recommendation for a pumping plant could be made.

Estimated Construction Costs:

A.	Drainage System Between Rost Lake and Metigoshe Via Hanson Meadow.	
1.	35,100 cu. yds. earth @ $.20	$ 7,020.00
	Clearing and grubbing 4 acres @ $100.00	400.00
2.	Right-of-way	300.00
3.	Engineering and Supervision	500.00
4.	Contingencies, 10%	820.00
	Total	$ 9,040.00
B.	Construction of Rost Lake Reservoir Dam-Top Pool Level—2155.0. Located in the NW¼ of Section 36, Township 164 North, Range 75 West.	
1.	Clearing of site	$ 350.00
2.	Structural excavation, 950 cu. yds. @ $1.50	1,425.00
3.	Dewatering site	700.00
4.	Reinforced concrete, 85 cu. yds. @ $70.00	5,950.00
5.	Riprap, 50 cu. yds. @ $7.00	350.00
6.	Control and pipe inlet	450.00
7.	Earth-fill (compacted), 2800 cu. yds. @ $.50	1,400.00
8.	Supervision and Engineering	1,100.00
9.	Right-of-way and right-of-way clearance	7,200.00
10.	Contingencies and right-of-way	1,700.00
	Total	$20,625.00
	Grand Total	$29,665.00*

Should culverts or additional roads be required it is believed that the county would be responsible for that portion of the program.

*The estimate for the dam is not based on an actual design but was derived from costs for similar structures constructed under like conditions. Yardage computed from the actual channel profile showed a yardage quantity of 25,450 cubic yards. An increase of 40% was made over this figure in view of additional yardage that will occur as the present channel possesses very steep slopes which is not reflected in the channel profile and would be available only through cross sections of the channel. Information relative to runoff in this area is as follows:

RED RIVER OF THE NORTH BASIN

Lake Metigoshe near Bottineau, N. Dak.

Location. Lat. 48°59', long. 100°22', in SE¼ SW¼ sec. 35, T. 164 N., R. 75 W., at "Maid of Moonshine" bridge over Lake Metigoshe, 11.7 miles northeast of Bottineau.

Records available. September 1953 to September 1954.

Gage.– Staff gage on southeast abutment of bridge. Datum of gage is 2130.00 ft. above mean sea level, datum of 1929, Emerson-Crookston Supplementary Adjustment of 1941.

Extremes. Maximum stage observed during the year, 8.72 feet June 19 (outflow discharge 51 cfs) minimum stage observed, 6.78 feet December 2 (no outflow discharge September 1953 to June 10).

Remarks. Gage read about once weekly September 1953 to December and during March, and once daily after April 4; no regular readings during February.

Outlet of lake is a fixed crest concrete dam, elevation 21.38.0 ft. above mean sea level. Outflow discharge records are based upon daily lake gage readings and stage-discharge relation for flow over dam based on current meter measurements. Inflow discharge records are estimated on the basis of ten discharge measurements of each of the two main tributaries, weather records, and comparison with lake stage and outflow records.

Monthly Gage Height, Inflow from Principal Tributaries, and Outflow

Month	Gage Height in Feet at month end	Monthly Discharge in Acre Feet		
		Inflow from Lake Dromore	Inflow from School Section Lake	Outflow
September 1953	7.02	.....	.....	.....
October	6.88	.....	.....	.....
November	6.90	.....	.....	.....
December	.....	.....	.....	.....
January 1954	.....	.....	.....	.....
February	6.90	.....	.....	.....
March	6.90	.....	.....	.....
April	7.08	50	.....	.....
May	7.00	50	.....	.....
June	8.54	380	400	1,370
July	8.26	540	250	930
August	8.24	210	3	120
September	8.30	170	1	250
October	.....	178	37	280*
November	.....	154	25	246*
		1,732	716	3,126

Summarization of Water Entering Lake Metigoshe
April-December 1, 1954

Water required to fill lake to overflow before runoff	1,824 Ac.f.t
Flow over spillway between June and December 1, '54	3,126 " ft.
Total amount of water entering lake less evaporation, 1954 season	4,950 Ac. ft.

FUTURE STUDIES

Consideration will be given to locating a diversion route from Sharpe Lake which is located in Canada to the proposed Rost Lake Reservoir. Efforts will be made to locate the diversion canal on the Canadian Forest Reserve in view of simplifying negotiations. A diversion of the Sharpe Lake Drainage area into Rost Lake would greatly enhance the success of the Rost reservoir as it would concentrate approximately 75% of the Lake Metigoshe drainage area in the Rost Lake reservoir. The estimated cost of the reservoir contained in this report does not inculde the proposed Sharpe Lake Diversion.

As a result of efforts made by the State Water Conservation Commission the U.S.G.S. Topographich Branch is now engaged in making a topographic survey of an area comprising approximately 150 square miles in the vicinity of Lake Metigoshe. The topography will be taken on the 5 foot contour interval and will aid greatly in future studies of the area. This topography will also afford a complete topographic layout of the Turtle Mountains. The survey is being performed without cost to the state. The Commission in their efforts to obtain the survey pointed out the advantage of having topography adjacent to the Canadian border for defense purposes. The higher elevation of the Turtle Mountains may also afford advantages for radar installations.

BIG MEADOW RECLAMATION PROJECT

Location:

The Big Meadow Reclamation Project is located in Sections 21, 22, 23, 25, 26, 27, 28, 34, 35 and 36, Township 159 N., Range 96 W., Sections 1, 2, 3 and 11, Township 158 N. Range 96 W. The project lies in the north central portion of Williams County and covers an area approximating 2810 acres of land at sea level elevation 2280. The project is pproximately 10 miles southeast of Wildrose, North Dkota and 11 miles north of Temple, North Dakota.

TOPOGRAPHY:

The topography of the basin that forms the Big Meadow and which was inundated as of December, 1952, is generally flat varying in depth from a few inches at the shore line to maximum depth of 28 inches near the northern end of the main body. The meadow has a maximum width of two miles and is approximately four miles in length. It possesses a general slope to the northwest.

The maximum depth of the meadow is in a small cove located in the extreme northwest area. Water depth in the cove was measured at a maximum depth of 44 inches in December, 1952.

The topography of the drainage area that contributes water to the meadow is undulating and frequented by potholes. The run-off from this area into the meadow is rapid during periods of ample moisture. The numerous potholes in the area become filled and the soils, which are generally underlaid by a fairly compact subsoil, become saturated and readily shed surplus water. During periods of drouth the reverse may be true as considerable runoff is required to fill the potholes before water is discharged into channels feeding the meadow, consequently, some years little or no water reaches tthe meadow. Ideal conditions for maximum runoff have occurred during recent years. Esti-

mates indicate that at times approximately 500 c.f.s. have been discharged into the meadow for short periods.

Water entering the meadow becomes trapped as there is no natural outlet from the meadow. This has greatly complicated the matter of eliminating excess water from the meadow.

Project Proposal:

The State Water Conservation Commission has made studies relative to a controlled drainage of the Big Meadow through gravity and pumping. Pumping the water from the meadow appears to be the only feasible method of draining the meadow since there are no available dam and reservoir sites that may be found to control and regulate maximum flows and excavating a gravity drainage ditch appears to be infeasible.

Consideration was given to the cutting of a channel from the meadow to the White Earth river shed. The channel was to serve as a gravity route. Excavation of 1,400,000 cubic yards of earth would be necessary to provide a gravity outlet, consequently, this plan was not considered feasible.

Borings indicate that the meadow is underlain by a compact layer of clay which is relatively impervious. Evaporation and transpiartion are the only apparent methods by which water now escapes from the meadow.

Topography, with sufficient detail, to permit the preparation of construction estimates was obtained on 1" to 1000' scale. The topography included the meadow proper and two possible routes over which the disposal canal could be constructed. The east route has been selected as it provides a shorter and more direct route to a White Earth river tributary.

From the surveys and studies that have been made it is proposed that a drain with necessary laterals be constructed through the meadow proper. The drain would be so constructed as to take advantage of the natural slope from the south end of the meadow to the northwest portion. A pumping plant is proposed at the northerly end of the meadow. The pumping plant will be so designed to permit water to be pumped from a level approximately four feet below the lowest elevation in the meadow.

It is proposed that the pumping plant consist of two pumps each having a capacity of no less than 25 c.f.s. The pumps would be powered by individual motors of approximately 125 H.P. capacity. The plant capacity would permit the pumping of 100 acre feet of water per day against a pumping head of 30 feet. Pumping units possessing this capacity would permit dewatering the meadow at its present level in approximately 35 days. Seepage of free water from the soil would occur for some time. One pump would be adequate to care for dewatering when the water level has been reduced to the ground line. The present accumulation of water in the madow is believed to be the highest since the area was settled, consequently, it is assumed that the initial year of operation will require the longest sustained period of pumping.

The proposed pumping plant capacity of 50 c.f.s is believed to be adequate to remove excess water resulting from extremely heavy rains before it becomes injurious to most crops that will be grown in the meadow. Reports from most farmers living adjacent to the meadow would indicate that the extreme high inflow does not last over 24 hours. This flow would probably not

discharge over a 1000 acre feet into the meadow at one time. Under extreme moisture conditions when the soil moisture is up to field capacity and little or no evaporation is taking place a maximum pumping run of ten dys would be required to care for water accumulated in the meadow after such rain storms.

A hazard to crops will always exist in that the pumping plant will not be of sufficient size to meet extreme run-off conditions. This is a calculated risk that must be taken to hold the project within feasible limits.

ANNUAL PUMPING PLANT OPERATION COST COMPARISON

Electric Driven Pumping Units Plant Cost $18,000		**Diesel Driven Pumping Units** Plant Cost $19,982	
Interest	$ 900.00	Interest	$1,000.00
Depreciation	450.00	Depreciation	500.00
Operation:		Operation:	
* 250 H. P. demand @ $5.00	1,250.00	11,952 gals. diesel @ $.16 per gal.	717.00
122,400 KWH @ .01 per KWH	1,224.00	90 gals. lub. oil @ $.60 per gal.	54.00
Attendnt—30 days	350.00	2 attendants	625.00
Oil—5 gals. @ $.60	3.00	Estimated Maintenance:	
Estimated Maintenance:		Diesel $1.00 per H.P.	240.00
Electric $.50 per H.P.	125.00		$3,136.00
	$4,302.00		
Average cost for pumping 1 acre foot by eletric unit	$ 1.43	Average cost for pumping 1 acre foot by diesel unit	$1.04

The above figures are based on pumping for a 30 day period which is believed to be the maximum pumping required in any given year.

*The minimum seasonal load of $8.00 per H.P. will be charged when electric energy consumed is less than $2,000.00, consequently, the minimum annual charge for electric energy will be $2,000.00 whether the plant is in operation or not.

Unless unforeseen factors develop it would appear as though the use of energy developed through diesel motors would be best adapted to this project. Past history of this area would indicate that there are years in which no pumping will be required. During such periods a minimum charge of $2,000.00 would still be required to meet the H.P. demand charge for electric energy. It is conceivable that these periods may occur when the returns from the meadow are low as a result of drouth. No operational cost would be required on a diesel plant during these periods.

Drainage System:

There are several factors which tend to favor delaying the construction of the drainage system in the meadow until the results of the first year or two of pumping have been studied. The estimate for the excavation of the drains in the meadow proper were based on dry excavation, consequently, if the drains were to be constructed under present conditions the bid price would possibly be two or three times the present estimate. The topography shows that one

area in sections 26, 27, 34 and 35, approximately 300 acres, will be inundated to a depth of six inches by not constructing the drains at this time. This area is about a mile and one half from the main inlet and a considerable discharge would be required before water would be conveyed to this low area. There is a reasonable possibility that evaporation would render the low area suitable for cultivation in relatively short time after the main abody of water has been removed. Future studies may show that the drain may not be required beyond the low area which would eliminate the construction of approximately two miles of drain.

Disposal Canal:

The disposal canal will be approximately four and one half miles in length It will accommodate a flow of approximately 58 c.f.s. Water will be pumped into a concrete structure which will serve as a stilling basin and decrease the velocity so it will be non-erosive when it enters the earth canal.

The disposal canal will discharge its flow into the White Earth tributary in the vicinity of Station 235. The water will be dropped approximately 40 feet from the canal to the tributary. It is proposed that this drop be made through the use of four hundred feet of 42 inch reinforced concrete pipe with the necessary control structtures at the inlet and outlet.

Cost of Project:

The following is the aestimated cost of the project on present plans and tentative designs of necessary structures:

ESTIMATED COST OF BIG MEADOW RECLAMATION PROJECT

Pumping Plant:		
Structural Excavation and backfill	$ 2,105.00	
Intake	3,609.00	
Discharge Line	2,151.00	
Outlet Structure	1,710.00	
Pump House	1,920.00	
Total Cost For Pumping Plant		$ 11,495.00
Pumps and Motors:		
Pumps operated through use of diesel power units—2 120 H.P. units equipped with electric motors, generators, batteries, panels and controls	$18,032.00	
1—4000 gallon tank, mounted and installed	750.00	
Hauling, installing and testing	1,200.00	
		$ 19,982.00
Turnout Gate, Station 49/00:		$ 1,000.00
Turnout Gate, Station 180/00:		$ 1,000.00
County Highway and Farm Crossings (Outlet Canal):		$ 4,286.00
Outlet Structure from Disposal Canal to Stream		$ 8,936.00
Disposal Canal Excavation:		
Sta. 0/00 to Sta. 235/00		
49,900 cu. yds. @ $.25 per cu. yd.	$12,500.00	
Alternate Sta. 49 to Sta. 62		
2, 300 cu. yds @ $.25 per cu. yd.	575.00	
		$ 13,075.00

[1]**Meadow Drainage System Excavation:**		
Sta. 0/00 to Sta. 245/00		
63,756 cu. yds. @ $.25 per cu. yd.	$15,940.00	
80' 42" Concrete pipe installed @ $12.00 per lin. ft.	960.00	
		$ 16,900.00
[2]Channel Improvement Below Disposal Canal— Cost Dependent on Survey:		$ 6,000.00
Right-of-way for System:		$ 5,000.00
Formation of Reclamation District:		$ 1,000.00
Engineering, Design and Inspection:		$ 6,500.00
Contingencies:		$ 9,500.00
TOTAL AMOUNT OF ESTIMATE		$104,674.00
Average Construction Charge per Acre	$ 37.25	

[1]This estimate is based on the drainage excavation being performed during a period when the meadow is sufficiently dry to permit dry excavation.

[2]Surveys will soon be completed which will permit a more accurate estimate on this item.

OPERATION AND MAINTENANCE:

Factors such as operation and maintenance are difficult to evaluate on a project of this nature as the operational duties will vary considerably from year to year. A part time maintenance crew will be required from time to time to patrol the canal, operate the pumping plant, control weeds and maintain canals and structures. As the District members acquire experience in operating the project, more efficient methods of operation will result. Frequently districts of this size endeavor to provide for maintenance through community effort. This is not too successful and the district generally returns to the assessment plan of operation.

The following chart has been prepared to determine the annual cost of operating the project and the annual payment that will be required by the District to meet their obligation.

ANNUAL COST OF OPERATION AND MAINTENANCE

OF

BIG MEADOW RECLAMATION PROJECT

2810 Acres

	Total Annual Cost per Acre	Total Annual Cost
INTEREST (4% on total investment $104,674.00)	$1.49	$4,186.96
Total Interest	$1.49	$4,186.96

OPERATION, MAINTENANCE AND ADMINISTRATION		
Pump and motor-diesel plant—		
Fuel, operators and misc. expend.	$.60	$1,396.00
Replacement and repairs on irrigation system—		
2% of original investment	.61	1,722.00
Ditchrider for night patrol duty—1 month	.13	350.00
Mileage, 2,000 miles @ $.10	.07	200.00
Contingencies	.13	350.00
Administration—Notices, legal and collections	.25	700.00
Total—Operation, Maintenance	$1.79	$5,018.00
DEPRECIATION		
Pumping Unit—Based on a cost of $20,000 with a life expectancy of 20 years at an annual use averaging 500 hrs. per year	$.36	$1,000.00
Drainage System—Based on 40 years for system costing $66,124.00	$.59	$1,353.00
Total—Depreciation	$ .95	$2,653.00
Repayment of Bonded Indebtedness		
Payment on 30 year basis for $104,674.00 indebtedness	$1.24	$3,489.00
Total annual repayment on indebtedness	$1.24	$3,489.00
Total Annual Payment		
Interest, Depreciation, Operation, Maintenance, and Retirement of Indebtedness	$5.47	$15,346.96

THE GOLDEN LAKE RESTORATION PROJECT NO. 475

Location

The Golden Lake Restoration Project is located in Sections 25, 26, 27, 28, 34, and 35, Township 148 N., Range 55 W., Sections 2, 3, 10, and 11, Township 147 N., Range 55 W. The project lies in the northeast portion of Steele County approximately 13 miles northeast of Finley, county seat of Steele It is approximately 19 miles from the Portland-Mayville area. The survey and estimated cost of the project was made at the request of the Commissioner of the Game and Fish Department. Several diversion routes were checked and this location and report covers the most feasible route.

Project Proposal:

It is proposed that Golden Lake be restored to a level approximating elevation 97.0 assumed datum, which would raise the level approximately 15.0 feet above the water surface as of April, 1954. The depth would approximate 19.0 feet. The lake when restored would be used primarily for fiishing, bathing and boating. It would provide this area with much needeed recreational facilities. The meandered area of Golden Lake is 301 acres. Increased area resulting from the greater depth of water would approximate 330 acres. It would require 4,732 acre feet of water to raise Golden Lake to the desired elevation.

It is proposed that the restoration of the lake level be accomplished by

diverting water from Beaver Creek at a point in the east half of Section 28, Township 148 N., Range 55 W. The stream bed at this point is 102.7 which is only 5.7 feet above the proposed Golden Lake elevation.

It is also proposed that Rush Lake which is in the suggested diversion route be established as a nesting area for water fowl. Rush Lake is a shallow marsh area which would have an area of 278 acres if established at elevation 102.7. This would add a 2.5 feet depth of water to the present 100.2 water elevation recorded in March, 1954. The initial water requirement for Rush Lake would amount to 695 acre feet. A total of 5,427 acre feet would be required to establish the two lakes at the desired elevation.

Initial Water Requirements:

Golden Lake	4,732 acre feet
Rush Lake	695 acre feet
Total	5,427 acre feet

Thirty percent is being added to the total initial demand to offset anticipated evaporation, canal and lake seepage losses.

A canal having a capacity of 43 c.f.s is being proposed to convey the diverted water. If properly patrolled during the initial peak demand, the flow could be stepped up to 53 c.f.s. The flow requirementts of the canal would be as follows:

Days of Flow Required to Fill Golden Lake and Rush Lake

Initial Demand is 7,055 acre feet= 82 days of flow with 1.0 freeboard

Daily normal capacity is 86 acre feet in canal.

Initial Demand is 7,055 acre feet=66 days of flow with .70 ft. freeboard

Daily Flow above normal capacity 106 feet.

The District Engineer of the U.S. Geological Survey was contacted relative to making hydrological studies on the Beaver Creek in an effort to determine what flow may be expected at the proposed point of diversion. Beaver Creek is a tributary to the Goose River. A gaging station has now been located near the point of diversion by the U. S. Geological Survey and results will be soon available for use in determining anticipated water yields from Beaver Creek.

A gaging station was established on the Goose River near Portland in 1939 by the U. S. Geological Survey. This station records flows for a drainage area of 544 square miles. The drainage area of Beaver Creek at the point of diversion is 193 square miles which is 35.5 percent of the Goose River watershed at the Portland station. The following table was compiled by assuming that the drainage area of Beaver Creek is similar to that of the remaining Goose River drainage area which is measured at Portland and the Beaver Creek contribution would be 35.5 percent.

Year	Max. Flow C.F.S. U.S.G.S. Station Portland	Possible Max. Flow C.F.S. at Beaver Diversion	Run Off in Acre Feet U.S.G.S. Station Portland	Possible Run off Acre Feet; Beaver Creek Diversion
1940	487	173	2,980	1,058
1941	1,130	455	16,340	5,800
1942	800	284	11,190	3,972
1943	1,100	390	15,360	5,453
1944	169	60	2,910	1,033
1945	340	121	5,380	1,910
1946	520	187	8,310	2,950
1947	260	94	8,180	2,903
1948	4,700	1,669	53,830	12,109
1949	1,200	426	19,780	7,022
1950	8,090	2,872	155,200	55,096
1951	650	230	9,575	3,400
1952	600	213	10,726	3,807
1953	367	130	7,102	2,521

In view of the fact that flow records are not available on either Beaver Creek or Goose River at Portland during the 1930 drouth period, a pro-rated flow on the basis of drainage areas has been computed. This flow is based on the Goose River flow at Hillsboro. The 193 square mile drainage area at the point of diversion constitutes 16.1% of the Goose River shed at Hillsboro which totals 1,200 square miles.

POSSIBLE RUN-OFF OF BEAVER CREEK BASED ON U. S. G. S. RECORDS AT HILLSBORO

YEAR	AT HILLSBORO RUN-OFF IN ACRE FEET	BEAVER CREEK AT DIVERSION POINT 16.1%
1931	2,660	428
1932	33,470	5,382
1933	9,726	1,564
1934	3,280	527
1935	11,620	1,868
1936	10,100	1,624
1937	2,330	375
1938	2,830	455
1939	8,930	1,436

Extreme Drouth Conditions:

If and at such a time that the lake levels are established evaporation would be the chief water depleion factor, alhtough some seepage and transpiration losses would also occur. The mean annual evaporation occuring in the vicinity of Golden Lake is approximately 28 inches. The mean annual precipitation at the Sharon Weather station, 12 miles distant, is 19.10 which indicates a defficiency of 9 inches. If an allowance of 30 percent were made for seepage and transpiration, the annual defficiency would approximate 12 inches for each acre of water surface. The annual demand resulting from these losses would amount to 608 acre feet.

A minimum annual rainfall of 11.70 inches was recorded in 1936 at the Sharon station. Nineteen thirty-six was an extremely high evaporation year.

Computations based on evaporation and precipitation at other stations would indicate that the Golden Lake area could have had a possible evaporation approximating 40 inches which would require 1416 acre feet to bring the lake levels to flow line the following spring. Four years of low runoff followed 1937, consequently, it would be doubtful if the level of the two lakes could have been brought back to the Golden Lake flow line for a period of 5 or 6 years in that period.

Should a drought period similar to the one in 1930 period occur during the period the lake is being restored it is possible that ten years may be required to build the lake levels to the desired level. However, it would always be possible to raise one lake more rapidly if done so at the expense of the other. The above points are being brought to attention as the filling of the lakes could be disheartening to the project boosters during adverse runoff periods. It is also possible that the water requirements for stock and domestic purposes may not permit the diversion at canal capacity during drouth periods for according to our state law water for domestic and stock is accorded top priority.

PRELIMINARY COST ESTIMATE OF GOLDEN LAKE RESTORATION PROJECT

NO.	ITEM	ESTIMATED COST
1	Construction of 10' high spillway and embankment system	$25,000.00
	Installation of control structure near dam-site Station 0/00	3,000.00
1	County Road crossing station 16/50	
	2-36" section 40' long with riprap headwalls	1,900.00
2	Section line crossing stations 26/00; 96/00	
	2-36" sections 32' long with riprap headwalls	1,600.00
3	Farm road crossing stations 44, 79 and 106	
	2-36" sections 28' long with riprap headwalls	2,200.00
1	Drop structure station 108/00	1,500.00
1	Control structure outlet of Rush Lake	2,400.00
1	Section line crossing between Rush and Golden Lake with	
	3 foot drop structure	2,400.00
	Excavation for canal 6' bottom 1½:1 slopes	
	46,000 cubic yards @ $.20 per cubic yard	9,200.00
	Dike construction outlet structure if Golden Lake is raised to 97.0 elevation:	
	Dike construction – 4,000 cubic yards @ $.35	1,400.00
	Dumped riprap – 560 cubic yards @ $5.00 per cubic yard	2,800.00
	Concrete pipe outlet to serve as drop line to North Lake	7,600.00
	Engineering	3,000.00
	Contingencies	5,000.00
		$69,100.00

The cost of Right-of-Way for canals and Rush Lake is not included in this estimate.

Run off data relative to Beaver Creek is as follows:

RED RIVER OF THE NORTH BASIN
Beaver Creek Near Hatton, N. Dak.

Location.—Lat. 47°37', long 97°40', on line between secs. 27 and 28, T. 148 N., R. 55 W., on downstream end of right abutment of county highway bridge, 10 miles west-southwest of Hatton and 15 miles upstream from mouth.

Drainage area.—Approximately 193 square miles.

Extremes.—Maximum discharge observed during period, 21 cfs Aug. 21 (gage height, 2.75 ft); on flow Aug. 5, 6 as a result of construction work above station.

Monthly discharge in cubic feet per second, May to September, 1954

Month	Maximum	Minimum	Mean	Runoff in acre feet
May 11-31, 1954	0.9	0.5	0.60	25
June	3.0	.2	.85	50
July	.2	.2	.20	12
August	19	0	1.35	83
September	.5	.2	.26	16
The period — 143 days	19	0	.66	186

Goose River near Portland, N. Dak.

Location.—Lat 47°33'; long. 97°28', on line between secs. 12 and 13, T. 147 N., R. 54 W., on upstream side of highway bridge, 1½ miles downstream from Beaver Creek and 6½ miles northwest of Portland.

Drainage area.—531 square miles.

Records available.—October 1939 to September 1954.

Average discharge.—15 years, 30.3 cfs; median of yearly mean discharge, 14 cfs.

Extremes.—Maximum discharge observed during the year, 58 cfs June 15 (gage height, 4.28 ft); no flow during several months.

1939-54: Maximum discharge 8.090 cfs May 9, 1950; no flow for several months in each year.

Monthly discharge in cubic feet per second, May to September 1954

Month	Maximum	Minimum	Mean	Runoff in acre feet
May 11-31, 1954	4.5	0.9	2.47	103
June	47	.7	4.63	276
July	.6	0	.24	15
August	0	0	0	0
September	0	0	0	0
The period — 143 days	47	0	1.39	393

MAUVAIS COULEE DRAINAGE PROBLEMS

Mauvais Coulee drains between 800 and 1,000 square miles of land located in Pierce, Benson, Towner, and Ramsey counties. Considerable flooding has occurred in the vicinity of Mauvais coulee during the past 10 years. This has caused much loss to farmers as a result of inundated farm land. This condition was accentuated during the past summer when from 18" to 20" of rainfall occurred during a 45 day period in the months of May and June, 1954.

Lake Alice and Lake Irvin are a part of Mauvais Coulee. The coulee enters Lake Alice in the upper portion of Ramsey County and then flows into Lake Irvin. Leaving Lake Irvin at the extreme southern point. Approximately 10 miles south of Lake Irvin it is joined by a tributary called Little Coulee. Little Coulee drains approximately 110 square miles of land located in Pierce and Benson counties. The two streams empty into Devils Lake approximately seven miles south of their junction.

During the 1930 drouth period, the stream bed of Mauvais Coulee between Lake Irvin and Devils Lake became partially filled with drift material. As a result the capacity of the stream has been greatly reduced. The average fall in Mauvais Coulee between Lake Irvin and Devils Lake is .8 of a foot per mile. With the added siltation, the stream flow is very sluggish.

The heavy rainfall that occurred in the upper reaches of Mauvais Coulee during the past summer moved rather rapidly into the Lake Alice and Lake Irvin areas. Water collected in the Lake Alice and Lake Irvin areas as a result of the sluggish flow of Mauvais Coulee. As a result between 12,000 and 20,000 acres of land were inundated in the vicinity of these two lakes. The flood damages were considerably greater in this area than in recent years in view of the fact that farmers had already put their lands into crop. As a consequence, most farmers suffered a loss of appr oximately $10 per acre.

The State Water Conservation Commission was contacted by a group of farmers affected by the flood conditions relative to methods of correcting this condition. Efforts are being made on the part of the Commission to obtain surveys to correct this situation. The Commission has also taken steps towards interesting the Corps of Engineers and the Soil Conservation Service in constructing flood protection works and watershed improvement facilities.

Several meetings have been held with interested government agencies in an effort to gain project support for the area. The State Water Conservation Commission contacted the water resources branch of the U. S. Geological Survey relative to making water discharge measurements in the vicinity of Lake Alice and Lake Irvin. This survey estimated that the maximum flow into Lake Alice was 600 cubic feet per minute. This flow would be sufficient to cover 1,200 acres of land to a depth of one foot in a 24 hour period. It was determined that the maximum flow from Lake Irvin amounted to 136 cubic feet per second. Consequently only 272 acre feet of water were being removed from the lakes in a 24 hour period by Mauvais Coulee whereas 928 acre feet were being deposited in the area to constitute flood conditions.

The following record of flows in Mauvais Coulee are incorporated in this report and are significant in their relationship to flood conditions.

RED RIVER OF THE NORTH BASIN
Mauvais Coulee Near Churchs Ferry, N. Dak.

Location.—Lat. 48°10'50", long. 99°13'20" in NE¼NE¼ sec. 11, T. 154 N., R. 67 W., on left downstream wingwall of bridge on U. S. Highway 281, ½ mile below Little Coulee, and 6 miles south of Churchs Ferry.

Records available.—May 1950 to September 1954 (fragmentary).

Extremes.—Maximum discharge during year, 329 cfs June 30 (gage height, 4.42 ft); no flow during many months.

1950-54: Maximum discharge, 660 cfs during early part of June 1950 (gage height 4.6 ft); no flow much of the time.

Monthly discharge, in cubic feet per second, water year October 1953 to September 1954

Month	Maximum	Minimum	Mean	Runoff in acre feet
October, 1953	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January, 1954	0	0	0	0
February	0	0	0	0
March	3.2	0	0.44	27
April	0	0	0	0
May	0	0	0	0
June	327	0	64.2	3,820
July	325	192	277	17,060
August	182	85	138	8,520
September	105	70	81.4	4,840
Water Year 1953-54	327	0	47.3	34,270

Miscellaneous discharge measurements made in the Mauvais Coulee Basin during the water year 1953-54 are given in the following table.

Date	Stream	Tributary to	Locality	Discharge (cfs)
July 7	Mauvais Coulee	Devils Lake	NW¼ sec. 2, T. 156 N., R. 66 W., 1 mile north of Lac Aux Mortes and 4½ miles east of Maza.	136
July 20	do	do	do	64.4
Aug. 8	do	do	do	13.3
July 7	Little Coulee	Mauvais Coulee	SW¼NW½ sec. 2, T. 154 N., R. 67 W., ½ mile east of outlet to Silver Lake & 0.8 mile above mouth.	200
July 20	do	do	do	84.3
Aug. 4	do	do	do	44.8

DAKOTA LAKE

Investigations relative to methods of regulating the level of Dakota Lake, to the satisfaction of wildlife and agricultural interests, will be undertaken by the Commission. The Dakota Lake dam is located south and west of the town of Ludden on the James River near the North Dakota-South Dakota state line. It is proposed that an auxiliary spillway 50 feet in width be constructed to the left of the present spillway. The new spillway would be equipped with stop logs to permit the regulation of the water elevation to the level of the Mud lake dam which is located in South Dakota.

The Federal Wildlife has agreed, should appropriations be made available to their service and the commission, to participate in the construction of the spillway to the extent of 50 per cent of the cost. Plans, specifications and the estimate of costs will be prepared by the Commission. The supervision of the construction will also be a function of the Commission. It is doubtful if construction will be undertaken until after July 1, 1955 in view of the necessity of waiting for appropriations with which to conduct this work.

The project appears well justified in view of the acreage that will be returned to agriculture when a satisfactory reservoir pool level is attained. An estimated 2,000-2,500 acres is now adversely affected by the present pool level.

GARRISON DIVERSION

In conjunction with the investigation of the large area that will be affected by the Garrison Diversion project by the Bureau of Reclamation the State Water Conservation Commission has had a survey party engaged in conducting topographic surveys in this area that will be used in determining the location of irrigable areas and the location and design of project facilities. This survey party has worked along with parties from the Bureau of Reclamation. Areas in which these surveys have been made include the Minot, Towner, Bottineau, Upham, New Rockford, Carrington and Fessenden areas as well as on the location of the canal for the main supply works in the Turtle Lake area. All of the information gthered in these surveys will be used to prepare the definite plan report for the Garrison Diversion Project. The topographic surveys are made in detail so as to furnish definite information for laying our irrigation facilities. These maps re on a scale of 1"=400 feet. The State Water Conservation Commission crew has completed surveys on about 25,000 acres on this project.

KELLY SLOUGH SURVEY

The State Water Conservation Commission conducted a survey of the Kelly Slough are in Grand Forks county in order to determine the feasibility of developing a wildlife habitat in that area. In this survey the boundaries of the area involved were determined and possible sites for structures located.

VERENDYRE DIVERSION

The Verendyre Diversion project involved determination of a method whereby the flooding of lands in the area during high flow conditions in the Souris River could be prevented. The problem involved was that water from the Souris River was being diverted from the Souris River through a man made channel and flooding farmland adjacent to the Souris River. Recommendations as the result of these surveys proposed the construction of control structures at the point of diversion.

MISCELLANEOUS SURVEYS

Several miscellaneous surveys were made throughout the state for a variety of purposes. Included are surveys in the Cedar Creek valley, Potter's Lake Restoration project, Fullers Lake, several refuge boundary surveys, and dam site surveys used in connection with the Commission's program for the repair of small dams nd surveys for water right applications.

INTERNTIONAL AND INTERSTATE RIVER COMPACTS

The development and utilization of the water resources of our rivers and streams for irrigation, municipal and industrial use and other beneficial uses is recognized as essential if our nation is to grow and prosper. All of the major rivers and many of the smaller ones are interstate or international streams and because of this, a problem exists as to the division and utilization of the waters of those streams. This division can be accomplished through court litigation among the states affected, or by direct congressional action or through a compact whereby the states would agree as to the proper diversion of the waters of those streams. The most satisfactory method by far is the compact method.

When our forefathers drew up our constitution they provided that the states could not without the consent of Congress enter into compacts or agreements. In the early history of our country the device so provided was used very little, however, in more recent years, many modern interstate problems have been solved through compacts. The use of interstate compacts in solving problems as to the division of water of interstate streams has proved very successful mainly because the states, who are directly affected because of the vital interest they have in the waters of the streams within their boundaries, have negotiated and agreed as to the equitable division of those waters with other states concerned.

Negotiating a compact for the division of waters of an interstate stream is usually time consuming because of the many complex problems involved. An interest must exist among the states involved and an active effort must be made by those states to obtain congressional authorization for compact negotiations. Following receipt of such authorization the state and the federal agencies that are to form the compact commission must meet to consider the matter of the division of the waters of that particular stream. In compact negotiations the entire drainage of a stream must be considered which may or may not further complicate the problem. North Dakota has taken the inititive in the preliminary negotiations for compacts for several of our rivers and streams.

In North Dakota there are seven rivers that are either international or interstate in nature. These rivers are the Red River of the North, which forms the boundary between North Dakota and Minnesota; the Souris River in north central North Dakota; the James River, in central North Dakota, the Grand River and Little Missouri River in southwestern North Dakota, the Yellowstone River in the northwestern part of the state and the Missouri River which drains the western 60% of North Dakota. The Red River of the North and the Souris River are international streams affecting both Canada and the United States and negotiations concerning these rivers are conducted under the direction of the International Joint Commission. The other rivers listed above are interstate streams effecting one or more states other than North Dakota and negotiations concerning these rivers must be made with those states with the authorization and approval of Congress. A discussion of compacts on these rivers and the status of negotiations for such compacts is given on the following pages.

INTERSTATE COMPACTS – APPROVED

Yellowstone River Compact

The Yellowstone River has its source in Yellowstone National Park in northwestern Wyoming and flows in a northeasterly direction across the state of Montana to its confluence with the Missouri River a few miles across the Montana-North Dakota border near Buford, North Dakota. It is one of the principal rivers contributing flow to the Missouri River. The Yellowstone drains a large part of the Montana and Wyoming and a comparatively small section in northwestern North Dakota. Because of the relatively large areas drained by the Yellowstone in Wyoming and Montana in relation to that in North Dakota and the extensive irrigation development along the Yellowstone and its tributaries in Wyoming and Montana those states have a greater interest in the Yellowstone River Compact than does North Dakota. Montana and Wyoming therefore have the greater representation on this Compact Commission and contribute the costs of the Commission in carrying out the provisions of the Compact.

Authorization for the Yellowstone River Compact was made by Congress June 2, 1949, which permitted the states of North Dakota, Montana and Wyoming to enter into negotiations for the division of the waters of the Yellowstone River and its tributaries. The first meeting on these negotiations was held on November 29, 1949, at Billings, Montana,at which engineering and compact drafting committees were organized. Several other meetings were held to consider the reports of these subcommittees and to complete negotiations for the compact.

On December 8, 1950, a compact was approved by the representatives of the various states and was then submitted to the legislatures of the three states for approval. During the 1951 legislative sessions of these three states the compact as adopted was approved by the states. It was submitted to Congress for consideration and was approved and signed by the President on October 30, 1951. A summary of the provisions of the compact as it affects North Dakota is as follows:

All existing rights to the beneficial use of waters of the Yellowstone River in the States of Montana and North Dakota, below Intake, Montana, valid under the laws of these States as of January 1, 1950, are hereby recognized and shall be and remain unimpaired by this Compact. During the period May 1 to September 30, inclusive, of each year, lands within Montana and North Dakota shall be entitled to the beneficial use of the flow of waters of the Yellowstone River below Intake, Montana, on a proportionate basis of acreage irrigated. Waters of tributary streams, having their origin in either Montana or North Dakota, situated entirely in said respective States and flowing into the Yellowstone River below Intake, Montana, are allotted to the respective States in which situated.

INTERNATIONAL JOINT COMMISSION

On January 11, 1909, the United States and Great Britain entered into a treaty relating to boundary waters and questions arising between these two countries. This treaty provided that an International Joint Commission

be created to have jurisdiction over the use of boundary waters by the United States and Canada. This Commission consists of six members, three from each country.

Members of the International Joint Commission representing the United States are: A. O. Stanley, chairman, U. S. Section, Washington, D. C.; R. McWhorter, member, chief engineer of the Federal Power Commission. Washington, D. C., and E. W. Weber, member, Army Corps of Engineers. Washington, D. C. Canadian members are: A. G. L. McNaughton, George Spencer and J. Lucien Dansereau.

Matters relating to international waters are referred to the International Joint Commission for study and decision. Such studies were titled "References" and may be instituted by the Commission upon application by an interested government or private party. To date there have been two References that affect North Dakota, which are:

Souris (Mouse) River Reference

Souris–River Rivers Reference

SOURIS (MOUSE) RIVER REFERENCE

The Souris (Mouse) River, an international stream located in the Hudson Bay Drainage area, has its source in southern Saskatchewan, Canada, and flows in a loop for a distance of 300 river miles, through North Dakota, returning to the Province of Manitoba, Canada.

In October 1940, the International Joint Commission issued interim recommendations concerning the apportionment of waters of the Souris River between the State of North Dakota, and the Provinces of Saskatchewan and Manitoba. These recommendations were made to care for the immediate needs of the state and affected provinces pending permanent settlement of the reference. The original interim measure was amended in November 1942 increasing the amount of water to be released from North Dakota to Canada.

These interim measures which are to remain in effect until permanent measures are adopted by the International Joint Commission or unless they are qualified or modified are as follows:

1. The province of Saskatchewan shall be permitted to continue its present use of the waters of the Souris river, and in addition, to construct a reservoir with usable epacity not exceeding 4,000 acre feet, for the purpose of providing an adequate water supply for the town of Weyburn and the Mental Hospital at Weyburn.
2. The State of North Dakota shall be permitted to continued its present use of the waters of the Souris River, and in addition, to construct a small reservoir on Long Creek, with capactiy of 200 acre feet, to provide an adequate water supply for the town of Crosby, North Dakota.

3. A regulated flow of not less than 10 cubic feet per second shall be released from the State of North Dakota to the Province of Manitoba during the months of June, July, August, September and October of each year.
4. In the event that the State of North Dakota or the provinces of Saskatchewan or Manitoba should desire to construct any additional storage works, or otherwise make additional use of the waters of the Souris river basin, application shall be made to the International Joint Commission for authority to construct the desired storage works or otherwise to make use of additional waters.
5. The interim measures for which provision is hereinbefore made shall remain in effect unless subsequently qualified or modified by the Commission prior to the adoption of permanent measures in accordance with the requirement of "Questions (1) and (2) of the Reference."

On November 17, 1942, after two years of operation under the terms of original report, the International Joint Commission issued an interim order in the matter of the apportionment of the waters of the Souris (Mouse) river which increased the amount of water released at the Westhope dam in North Dakota from 10 ot 20 cubic feet per second. This action was taken in order to augment the original allocation to Manitoba, which was found to be inadequate.

SOURIS-RED RIVERS REFERENCE

In January, 1948, the governments of the Dominion of Canada and of the United States of America initiated a Reference to the International Joint Commission to investigate the use of the waters of the Souris and Red Rivers and make recommendations for the apportionment of waters between Canada and the United States.

An Engineering Committee, composed of Canadian and United States engineers, was appointed to review the problems of this Reference and to determine the water requirements of the two counties for municipal, industrial, irrigation, hydro-electric and stream pollution abatements uses. Separate reports are being prepared to cover the Red and the Souris rivers. The reports are to be submitted to the International Joint Commission so it can determine allocation of waters of these rivers.

The Reference is composed of four paragraphs, as follows:

1. To investigate and report on the water requirements arising out of the existing dams and other works or projects located in the waters which are of common interest along, across, or in the vicinity of the International Boundary from the eastern boundary of the Milk River drainage basin on the west up to and including the drainage basin of the Red river of the North on the east.

2. To report whether in the judgment of the Commissioner further uses of these waters within their respective boundaries by Canada and the

United States would be practicable in the public interest from the points of view of the two governments.

3. Having regard to the report made under paragraphs 1 and 2, and for those streams where in the judgment of the International Joint Commission apportionment of the waters is advisable, to make advisory recommendations concerning the apportionment which should be made between Canada and the United States of such of the waters under reference as cross the International Boundary, and with respect to each such crossing of the International Boundary.

4. To conduct necessary investigations and to prepare a comprehensive plan or plans of mutual advantage to the two countries for the conservation, control, and utilization of the waters under reference in accordance with the recommended apportionment thereof.

In the conduct of its investigations, and otherwise in the performance of its duties under this Reference, the International Joint Commission may utilize the services of engineers and other specially qualified personnel of technical agencies of Canada and the United States, and will, as far as possible, make use of information and technical data which have been acquired by such technical agencies or which may become available during the course of the investigation, thus avoiding duplication of effort and unnecessary expense.

Several investigations and studies by the Engineering Committee concerning the water use and water supply of these two rivers have been conducted and reports are in the process of being prepared. The State Water Conservation Commission has cooperated in supplying available information on these rivers to this Engineering Committee. This information and other that will be gathered will be used in preparing the recommendations to the International Joint Commission for consideration in preparing their recommendations for permanent measures for the apportionment of the waters of these two rivers.

Members of this Engineering Sub-Committee of the International Joint Commission from the United States and Canada are as follows:

From Canada:

G. N. Munro, Regina, Saskatchewan
B. B. Hogarth, Winnipeg, Manitoba
H. L. Johnston, Winnipeg, Manitoba
E. J. Schammel, Regina, Saskatchewan

From the United States:

F. M. Clinton, Bureau of Reclamation, Billings, Montana
W. V. Taylor, U. S. Fish and Wildlife, Minneapolis, Minnesota
Col. Otto Rohde, Corps of Engineers, St. Paul, Minnesota
H. C. Beckman, U. S. Geological Survey, Rolla, Missouri

INTERSTATE COMPACTS UNDER NEGOTIATION
RED RIVER OF THE NORTH

Tri-State Waters Commission

A compact was made by the states of South Dakota, North Dakota and Minnesota in June, 1937, for which congress gave its approval on April 2, 1938, providing for the organization of the Tri-State Waters Commission of nine members, three from each of the three states, to supervise the drainage area of the Red river except the Otter Tail river and its tributaries. It has power to maintain and control lake levels, stream flood and boundary waters in cooperation with state, federal and municipal agencies; to make studies and surveys for construction, maintenance and operation of water projects within the scope of its jurisdiction. Meetings of the Commission are called as matters come up in the area it supervises.

In recent years the Tri-State Commission has been inactive because of the lack of interest on the part of South Dakota in administering the provisions of the compact. According to these provisions, as they have been approved and enacted into law, a majority of the members from each state shall constitute a quorum for the transaction of business in the exercise of any powers or the performance of any duties, but no action of the Tri-State Commission shall be binding unless at least two of the members from each state shall vote in favor thereof. The difficulty of the Tri-State Waters Commission in holding meetings at which action can be taken under the provisions of this compact has prevented the proper consideration of problems in the Red River of the North drainage basin.

Of primary concern to North Dakota relative to the division and utilization of the waters of the Red River of the North is the allocation of waters stored in Lake Ashtabula by Baldhill Dam on the Sheyenne River, a tributary of the Red River. The Baldhill Dam was constructed as the result of assurances given to various cities and industrial interests along the Sheyenne and Red Rivers that a portion of the water stored in the reservoir would be available to them and as a result cash contributions were made by those interests toward the costs of that project. Irrigation is becoming more and more popular in the eastern part of North Dakota and the development undertaken in all cases will utilize the waters of the Red River drainage basin. For these reasons an agreement between the states affected in that drainage basin should be made, particularly between Minnesota and North Dakota the states primarily interested in and affected by the use of waters in the Red River drainage basin.

In May 1951 a preliminary meeting was held with the officials of Minnesota relative to negatiating a compact on the Red River of the North. Since that time several other meetings have been held and preliminary studies by North Dakota have been undertaken. Representatives from North Dakota conferring on this matter are:

Curtis Olson, Vice Chairman, North Dakota State Water Conservation Commission, Valley City

Oscar Lunseth, Member, North Dakota State Water Conservation Commission, Grand Forks

Milo W. Hoisveen, Secretary, North Dakota State Water Conservation Commission, Bismarck

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. the northwestren 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.

James River

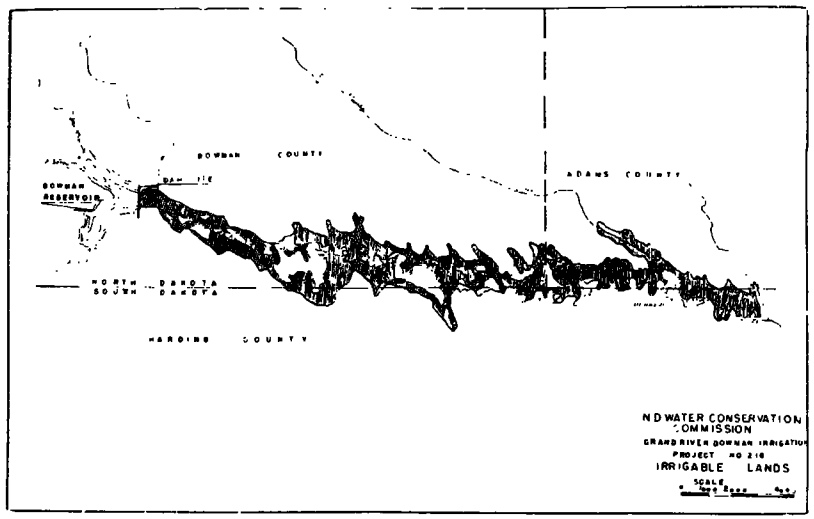
The James River, a tributary of the Missouri, has its source in central North Dakota and flows in a southerly direction through North Dakota and South Dakota joining the Missouri River near Yankton. Irrigation development along this river in both states is included in the Missouri River basin program. 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.

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 Districtt.



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 topograhic mapping program, a stream gaging program and and 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 development 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 thte Missouri River Basin program for which other development 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.

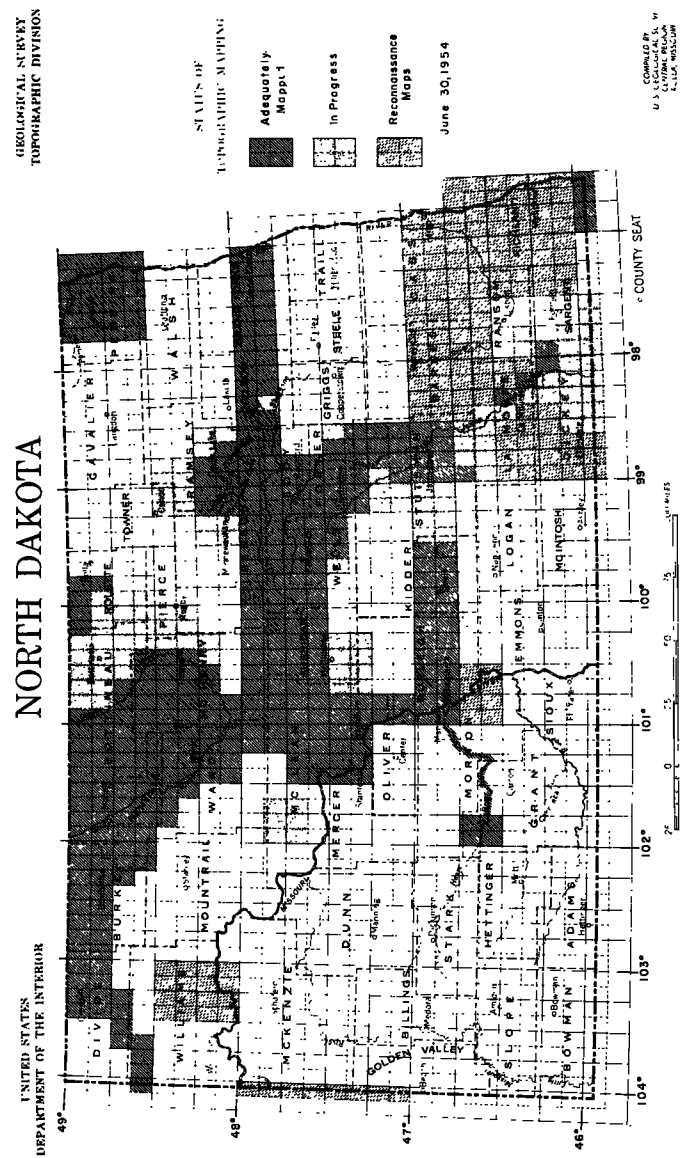
The topographic quadrangles produced by the Geological Survey are commonly called the "mother map". These related maps include, among many others, geologic, mineral and water resource data, road maps, county and state maps, as well as the base map of the United States, its territories and possessions.

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 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 civilian needs for basic data in the form of good topographic maps. Both irrigation and flood control projects must be planned with knowledge 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.

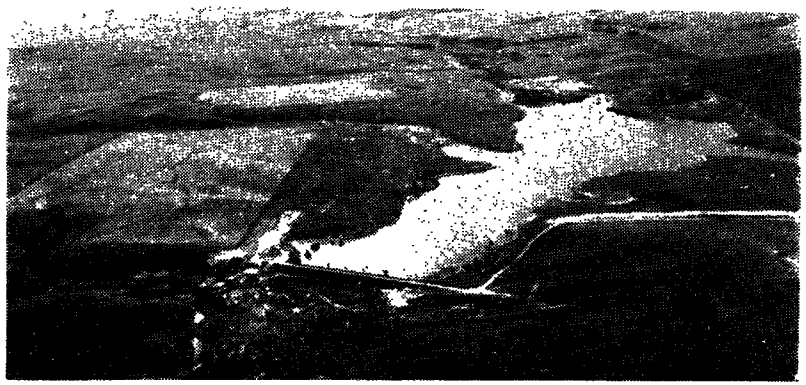
Standard topographic maps of the Federal Government are required to comply with national map accuracy specifications as adopted in 1941, and map sheets are tested to insure compliance with these specifications. The published map carries a note on its lower margin which states, "This map complies with 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 parellels of latitude and meridians of longitude and usually cover either 7½ minutes or 15 minutes in latitude and longitude. The 7½ minute quad-quadrangle maps are prepared at a scale of 1:24,00 (1 inch equals 2,000 feet) and cover an area of approximately 49 square miles, and the 15 minute qudranges 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 of this report 2-15′ and 6-7½′ quadrangle maps under the State Water Conservation Commission cooperative program and 1-15′ and 34-7½′ quadrangle maps under the Missouri River Basin program have been completed and published. In addition work was in progress on 19-7½ quadrangle maps under the State Water Conservation Commission cooperative program and 87—7½ quadrangle maps under the Missouri River Basin program on June 30, 1954. The State Water Conservation Commission was appropriated $30,000.00 for their 50% share of this program for the 1953-1955 biennium.

It is recommended that additional topography on the 5 foot contour interval be obtained in Lake Alice-Lake Irvine areas above the Devils Lake and Graham's Island surveys. This topography is much needed in the study and the solution of the flood problems that recurred in this area during the past summer. It is proposed that an area approximating 280 sqaure miles be surveyed during the ensuing biennium. This survey would be an extension of topography now available in the area and would greatly increase the value of the available topography relative to the solution of the drainage problems existing in the Dry and Sweetwater Lakes as well as the Lake Irvine-Lake Alice areas.



Yanktonai Dam—McLean County

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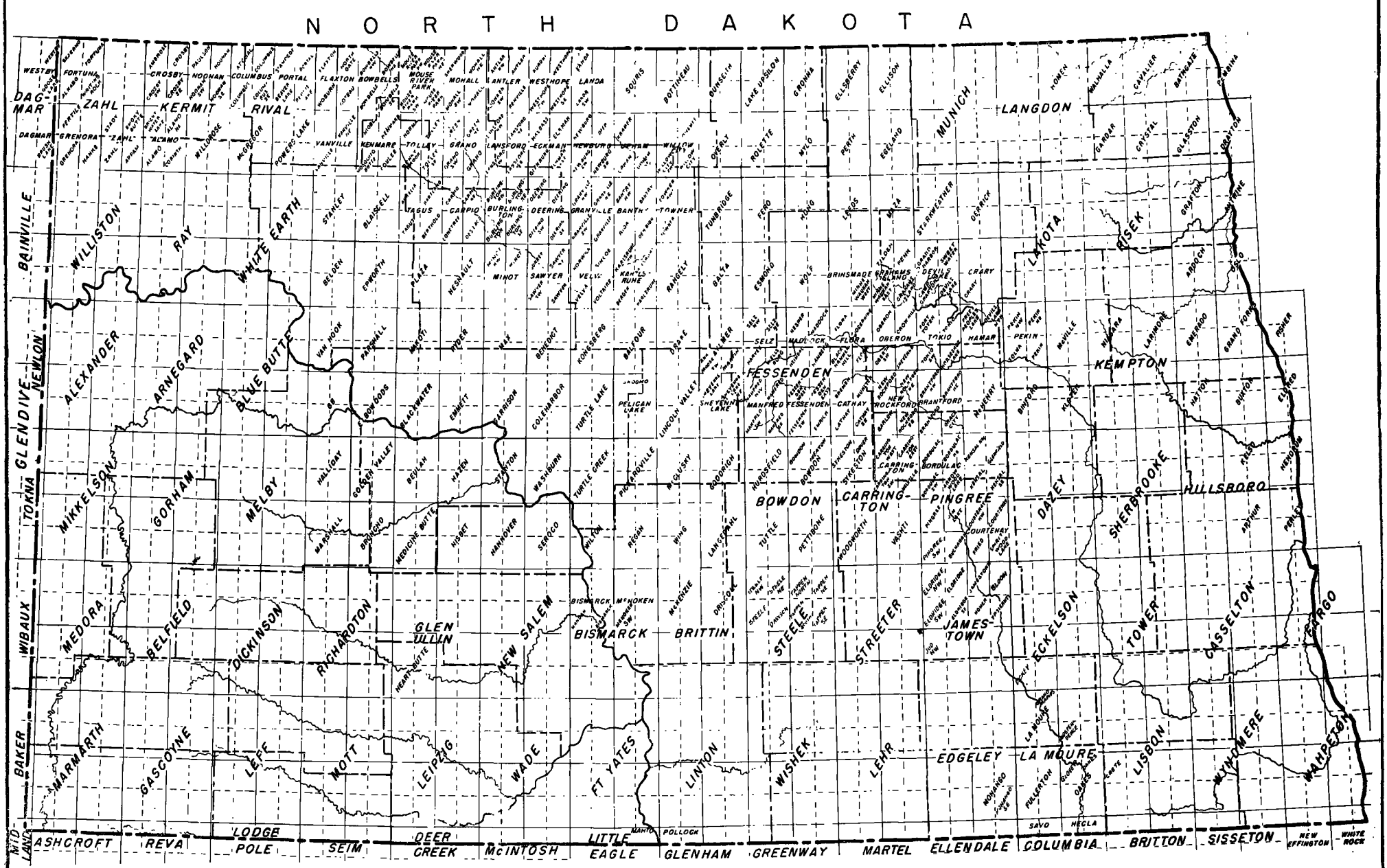

INDEX OF QUADRANGLE NAMES

U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAPS

JUNE 30, 1954

AREAS MAPPED BY U S G S IN COOPERATION WITH STATE AND FEDERAL AGENCIES

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PROGRESS OF USGS QUADRANGLE MAPS

Maps in Progress June 30, 1954

Name	Scale	Cooperator
Alamo	7½	MRB
Appam	7½	MRB
Blackwater NE	7½	COOP
Blackwater NW	7½	COOP
Bloom	7½	MRB
Bottineau NE	7½	TS
Bottineau NW	7½	TS
Bottineau SE	7½	MRB
Bottineau SW	7½	MRB
Britton 1 NE	7½	MRB
Britton 1 NW	7½	MRB
Britton 2 NE	7½	MRB
Britton 2 NW	7½	MRB
Corinth	7½	MRB
Crary SE	7½	MRB
Dickey 3 SW	7½	MRB
Dunseith SE	7½	MRB
Dunseith SW	7½	MRB
Eldridge SE	7½	MRB
Ellendale 1 NE	7½	MRB
Emmett NE	7½	COOP
Emmett NW	7½	COOP
Fero NE	7½	MRB
Fero NW	7½	MRB
Fertile	7½	MRB
Fullerton NE	7½	MRB
Fullerton SE	7½	MRB
Fullerton SW	7½	MRB
Glover NW	7½	MRB
Grand Forks	7½	COOP
Hecla NE	7½	MRB
Hecla NW	7½	MRB
Jamestown 3 NE	7½	MRB
Jamestown 3 SE	7½	MRB
Jamestown 3 SW	7½	MRB
Jamestown 4 NE	7½	MRB
Jamestown 4 NW	7½	MRB
Jamestown 4 SE	7½	MRB
Jamestown 4 SW	7½	MRB
Lake Upsilon SW	7½	MRB
LaMoure NW	7½	MRB
LaMoure SE	7½	MRB
Landa NE	7½	MRB
Landa SE	7½	MRB
Lisbon 2 SE	7½	MRB
Lisbon 2 SE	7½	MRB
Lisbon 3 NE	7½	MRB
Lisbon 3 SE	7½	MRB
Lisbon 3 SW	7½	MRB
Makoti SE	7½	COOP
Makoti SW	7½	COOP
Maza SE	7½	MRB
McClusky NE	7½	MRB

Maps in Progress June 30, 1954

Name	Scale	Cooperator
McClusky SE	7½	MRB
McClusky SW	7½	MRB
McClusky NW	7½	MRB
Minnewaukan W	7½	MRB
Monango SE	7½	MRB
Oakes SE	7½	MRB
Oakes SW	7½	MRB
Omemee	7½	MRB
Overly NE	7½	MRB
Overly NW	7½	MRB
Overly SE	7½	MRB
Overly SW	7½	MRB
Pickardville NE	7½	MRB
Pickardville NW	7½	MRB
Pickardville SE	7½	MRB
Pickardville SW	7½	MRB
Rangely NE	7½	MRB
Rangely NW	7½	MRB
Rouette NW	7½	MRB
Rollette SW	7½	MRB
Ryder SE	7½	COOP
Ryder SW	7½	COOP
Savo NE	7½	MRB
Savo NW	7½	MRB
Souris NE	7½	TS
Souris NW	7½	MRB
Souris SE	7½	MRB
Souris SW	7½	MRB
Starkweather SE	7½	MRB
Steele NW	7½	COOP
Steele 2 SW	7½	COOP
Streeter 1 NE	7½	COOP
Streeter 1 NW	7½	COOP
Streeter 1 SE	7½	COOP
Streeter 1 SW	7½	COOP
Streeter 2 NE	7½	COOP
Streeter 2 NW	7½	COOP
Streeter 2 SE	7½	COOP
Streeter 2 SW	7½	COOP
Towner NE	7½	MRB
Towner SE	7½	MRB
Tunbridge NE	7½	MRB
Tunbridge NW	7½	MRB
Tunbridge SE	7½	MRB
Tunbridge SW	7½	MRB
Upham NE	7½	MRB
Vashti NE	7½	MRB
Vashti NW	7½	MRB
Vashti SE	7½	MRB
Vashti SW	7½	MRB
Willow City NW	7½	MRB
Willow City SE	7½	MRB
Wyndmere	30	

PROGRESS OF USGS QUADRANGLE MAPS

Maps Completed July 1, 1952, to June 30, 1954

Name	Scale	Cooperator
Anamoose SW	7½	MRB
Blackhammer Hill	7½	MRB
Bordulac	7½	MRB
Bowdon	7½	MRB
Courtenay	7½	MRB
Crete	7½	MRB
Dawson	7½	COOP
Dover	7½	MRB
Driscoll	15	COOP
Eldridge	7½	MRB
Eldridge NW	7½	MRB
Eldridge SW	7½	MRB
Flora	7½	MRB
Fort Totten	7½	MRB
Glenfield	7½	MRB
Grand Rapids	7½	MRB
Hamberg	7½	MRB
Heaton	7½	MRB
Heimdal	7½	MRB
Hesper	7½	MRB
Homer	7½	MRB
Horseshoe Lake	7½	MRB
Josephine	7½	MRB
Jud NW	7½	MRB
Kensal	7½	MRB
Kensal NW	7½	MRB
Kensal SE	7½	MRB
Maddock	7½	MRB
Martin	7½	MRB
McKenzie	15	COOP
Oakes	7½	MRB
Pekin	7½	MRB
Pingree	7½	MRB
Pingree SW	7½	MRB
Selz	15	MRB
Selz NE	7½	MRB
Selz NW	7½	MRB
Steele NE	7½	COOP
Sykeston	7½	MRB
Tappen South	7½	COOP
Tappen SE	7½	COOP
Tappen NE	7½	COOP
Tappen NW	7½	COOP
Tolna	7½	MRB

Maps Completed to July 1, 1952

Name	Scale	Cooperator
Alamo NE	7½	MRB
Ambrose	7½	MRB
Antler	7½	MRB
Antler NW	7½	MRB
Arrowhead Lake	7½	MRB
Atcoal	7½	MRB
Aylmer	15	MRB
Balfour	15	MRB
Bantry	7½	MRB
Bantry NW	7½	MRB
Barlow	7½	MRB
Bathgate	15	COOP
Beaver Lake	7½	MRB
Benedict	15	COOP
Bismarck	30	
Bismarck	15	COOP
Bismarck	7½	COOP
Bordulac SW	7½	MRB
Bowbells	15	TS
Bowbells	7½	MRB
Bowbells NE	7½	MRB
Bowbells	7½	MRB
Bowbells SE	7½	MRB
Brantford	15	MRB
Brantford	7½	MRB
Brantford NE	7½	MRB
Brantford NW	7½	MRB
Bremen	7½	MRB
Brightwater Lake	7½	MRB
Brush Lake	7½	MRB
Buchanan	7½	MRB
Burlington	15	MRB
Burlington	7½	MRB
Burlington NE	7½	MRB
Burlington NW	7½	MRB
Burlington SE	7½	MRB
Camp Grafton	7½	MRB
Carpio	7½	MRB
Carpio NE	7½	MRB
Carrington	15	MRB
Carrington E	7½	MRB
Carrington W	7½	MRB
Carrington SW	7½	MRB
Casselton	30	
Cathay	15	MRB
Cathay	7½	MRB
Cathay SE	7½	MRB
Cavalier	15	TS
Coleharbor	15	COOP
Columbia	30	
Columbus	15	TS
Columbus	7½	MRB
Columbus SE	7½	MRB
Columbus SW	7½	MRB

PROGRESS OF USGS QUADRANGLE MAPS

Maps Completed to July 1, 1952

Name	Scale	Cooperator
Coteau	7½	MRB
Coulee	7½	MRB
Courtenay NW	7½	MRB
Crary	7½	MRB
Crosby	15	MRB
Crosby	7½	MRB
Crosby SW	7½	MRB
Crosby SE	7½	MRB
Crow Hill	7½	MRB
Crystal	15	TS
Deep	7½	MRB
Deering	15	MRB
Deering	7½	MRB
Deering NW	7½	MRB
Deering SE	7½	MRB
Deering SW	7½	MRB
Denbigh	7½	MRB
Des Lacs	7½	MRB
Devils Lake	15	MRB
Devils Lake	7½	MRB
Devils Lake Mountain	7½	MRB
Dokken SW	7½	MRB
Donnybrook	7½	MRB
Drake	15	COOP
Drayton	15	TS
Dunseith	15	COOP
Eckelson	30	MRB
Eckman	7½	MRB
Eckman SE	7½	MRB
Edgeley	30	MRB
Ellendale	30	
Emerado	15	TS
Emrick	7½	MRB
Fargo	30	
Fessenden	7½	MRB
Fessenden E	7½	MRB
Fessenden W	7½	MRB
Fessenden SW	7½	MRB
Flaxton	15	MRB
Flaxton	7½	MRB
Flora	15	COOP
Flora SE	7½	MRB
Free Peoples Lake	7½	MRB
Fried	7½	MRB
Fullerton	15	
Garrison	15	COOP
Glasston	15	TS
Glenburn	7½	MRB
Glendive	60	
Grace City	7½	MRB
Grahams Island	15	COOP
Grahams Island	7½	MRB

Maps Completed to July 1, 1952

Name	Scale	Cooperator
Grand Forks	15	COOP
Grand Harbor	7½	MRB
Grano	15	MRB
Grano	7½	MRB
Grano SW	7½	MRB
Granville	7½	MRB
Granville NE	7½	MRB
Granville NW	7½	MRB
Granville SW	7½	MRB
Green	7½	MRB
Green NE	7½	MRB
Grenora	7½	MRB
Hamar	15	COOP
Hanks	7½	MRB
Hartand	7½	MRB
Harvey	7½	MRB
Heart Butte	15	MRB
Hecla	15	
Independence	7½	MRB
Jamestown	30	
Jamestown	7½	MRB
Jim Lake	7½	MRB
Karlsruhe NE	7½	MRB
Karlsruhe NW	7½	MRB
Kenmare	15	MRB
Kenmare	7½	MRB
Kongsberg	15	COOP
Kramer	7½	MRB
Kuraki	7½	MRB
Lake Upsilon	15	COOP
LaMoure	30	
Landa	7½	MRB
Landa SW	7½	MRB
Lansford	15	MRB
Lansford NE	7½	MRB
Lansford NW	7½	MRB
Lansford SE	7½	MRB
Lansford SW	7½	MRB
Larimore	15	COOP
Lincoln Valley	15	COOP
Maddock	15	COOP
Mandan	7½	COOP
Manfred	15	MRB
Manfred	7½	MRB
Manfred NW	7½	MRB
Manfred SE	7½	MRB
Manfred SW	7½	MRB
Maxbass	7½	MRB
McVille	15	COOP
Melville	7½	COOP
Menoken	15	COOP
Menoken SW	7½	COOP
Minnewaukan E	7½	MRB
Minot	15	COOP

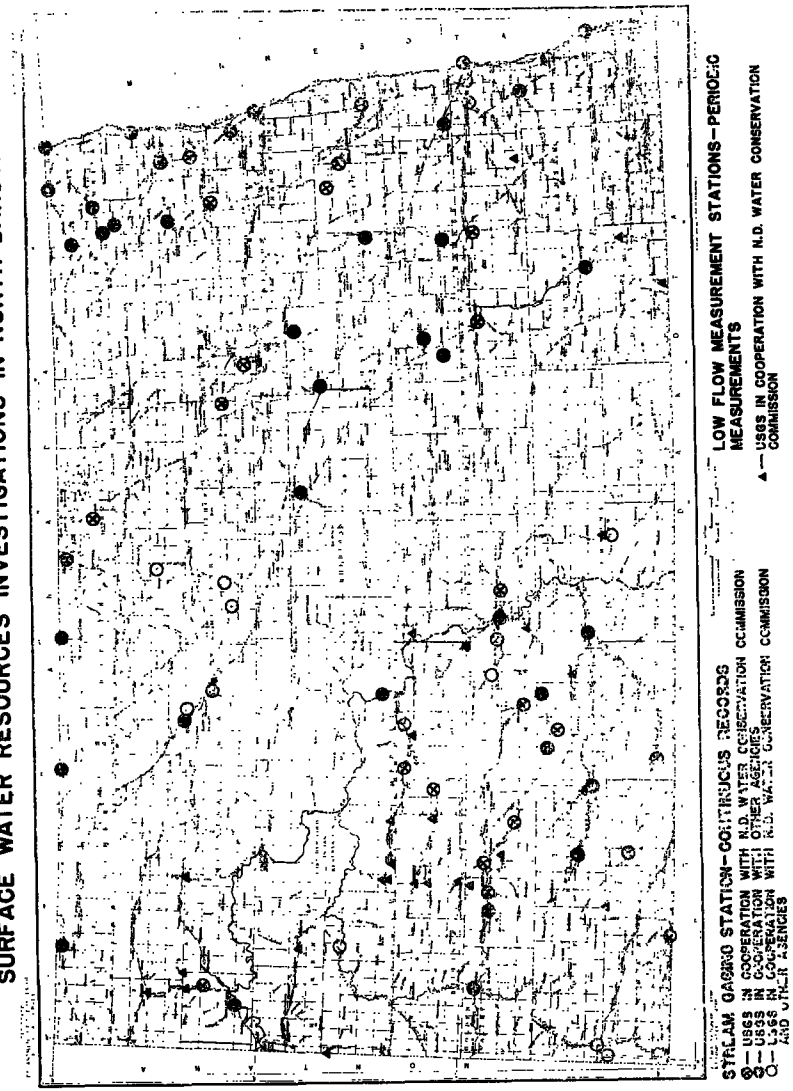
PROGRESS OF USGS QUADRANGLE MAPS

Maps Completed to July 1, 1952

Name	Scale	Cooperator
Minot	7½	MRB
Minot NW	7½	MRB
Mohall	15	TS
Mohall	7½	MRB
Mohall NE	7½	MRB
Mohall SW	7½	MRB
Mosquitoe Butte	7½	MRB
Mouse River Park	15	MRB
Mouse River Park	7½	MRB
Mouse River Park NE	7½	MRB
Mouse River Park NW	7½	MRB
Mouse River Park SW	7½	MRB
Munster	7½	MRB
Newburg	7½	MRB
Newburg SE	7½	MRB
Newburg SW	7½	MRB
New Effington	15	
New Rockford	15	COOP
New Rockford	7½	MRB
New Rockford NE	7½	MRB
New Rockford SE	7½	MRB
Niagara	15	COOP
Niobe	7½	MRB
Noonan	15	MRB
Noonan	7½	MRB
Noonan SE	7½	MRB
Noonan SW	7½	MRB
Norma	7½	MRB
Northgate	7½	MRB
Norwich	7½	MRB
Oakes	15	
Oberon	15	COOP
Oberon	7½	MRB
Oberon SW	7½	MRB
Paulson	7½	MRB
Pekin	15	COOP
Pekin NE	7½	MRB
Pekin NW	7½	MRB
Pelican Lake	15	COOP
Pembina	15	TS
Penn	7½	MRB
Pingree	30	
Portal	15	TS
Portal	7½	MRB
Ray	30	
Rennic Lake	7½	MRB
Renville	7½	MRB
Riga	7½	MRB
Savo	15	
Sawyer	15	COOP
Sawyer	7½	MRB
Sawyer NE	7½	MRB
Sawyer SW	7½	MRB
Selz	15	MRB
Sherwood	7½	MRB
Sheyenne	7½	MRB
Sheyenne Lake	15	COOP
Sheyenne Lake	7½	MRB

Maps Completed to July 1, 1952

Name	Scale	Cooperator
Sheyenne Lake NE	7½	MRB
Simcoe	7½	MRB
Smoky Butte	7½	MRB
Spiritwood Lake	7½	MRB
Stady	7½	MRB
Stampede	7½	MRB
Stanton	15	COOP
Surrey	7½	MRB
Sweetwater	7½	MRB
Tilden	7½	MRB
Tokio	15	COOP
Tokio	7½	MRB
Tokio SW	7½	MRB
Tolley	15	TS
Tolley	7½	MRB
Tolley SE	7½	MRB
Tower	30	
Towner	7½	MRB
Towner NW	7½	MRB
Turtle Creek	15	COOP
Turtle Lake	15	COOP
Upham	7½	MRB
Upham SE	7½	MRB
Vanville NE	7½	MRB
Velva	15	MRB
Velva	7½	MRB
Voltaire	7½	MRB
Wahpeton	30	
Washburn	15	COOP
Wellsbury	7½	MRB
Westhope	7½	MRB
Westhope SE	7½	MRB
Westhope SW	7½	MRB
White Rock	15	
Willow City SW	7½	MRB
Wilton	15	COOP
Woburn	7½	MRB
Wyndmere	30	
Ypsilanti	7½	MRB
Zahl	7½	MRB



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.

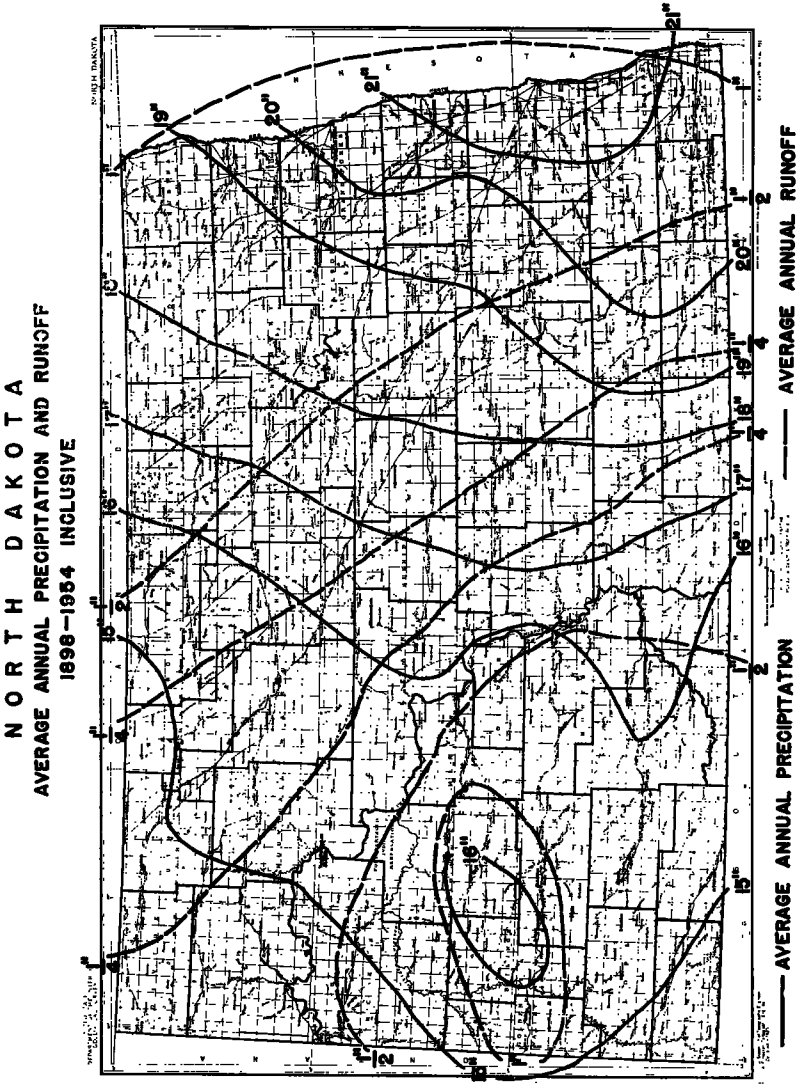
Upon cooling, the vapor forming the clouds is condensed and falls upon the earth in the form of rain, snow or ice. If this precipitation occurs during the growng season part of that which falls on plants is taken directly into their structures or is held on their surfaces until it is evaporated and returned 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.

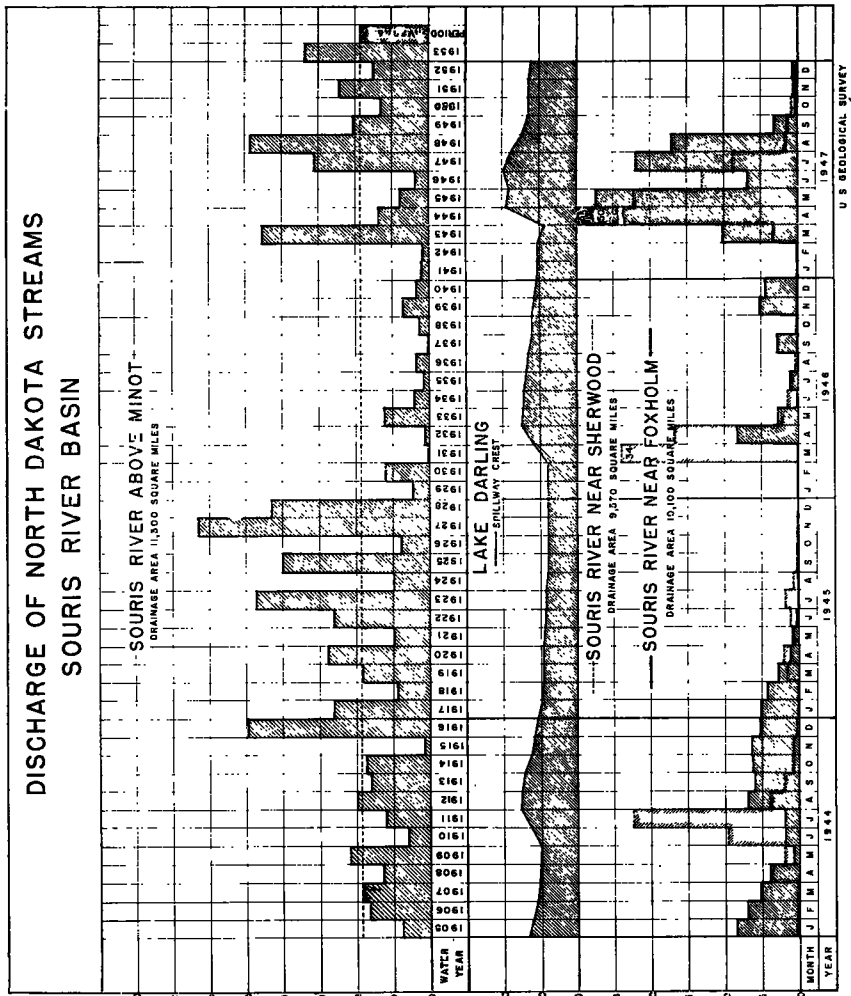
If precipitation falls upon the earth faster than the earth's immediate capacity to absorb it, the excess flows over the surface of the earth or at shallow depths in the soil and enters the stream channels directly. Thus it is apparent that our surface-water supplies are composed of water from two sources: 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.

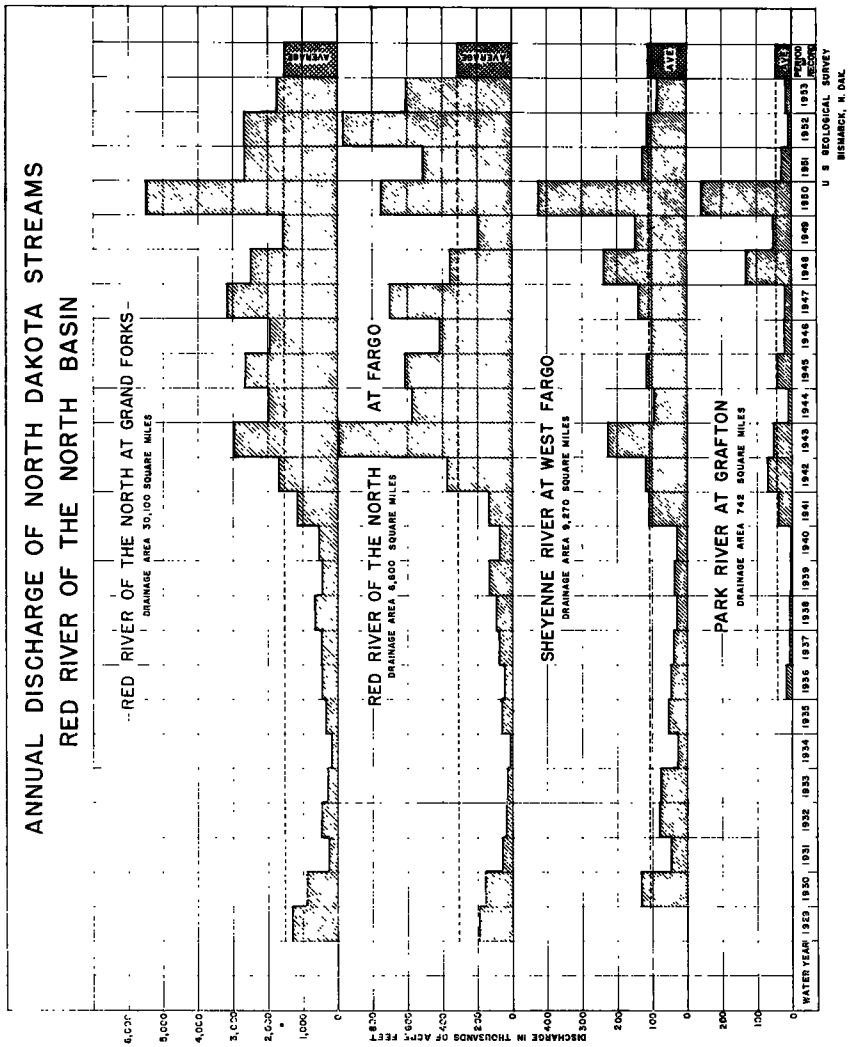
Water that reaches the streams, flows toward the sea, and in this process is continuously being evaporated from the streams as well as from the sea. Through this perpetual motion device set up by nature, the water will eventually return to the clouds and then back to the earth in the form of precipitation.

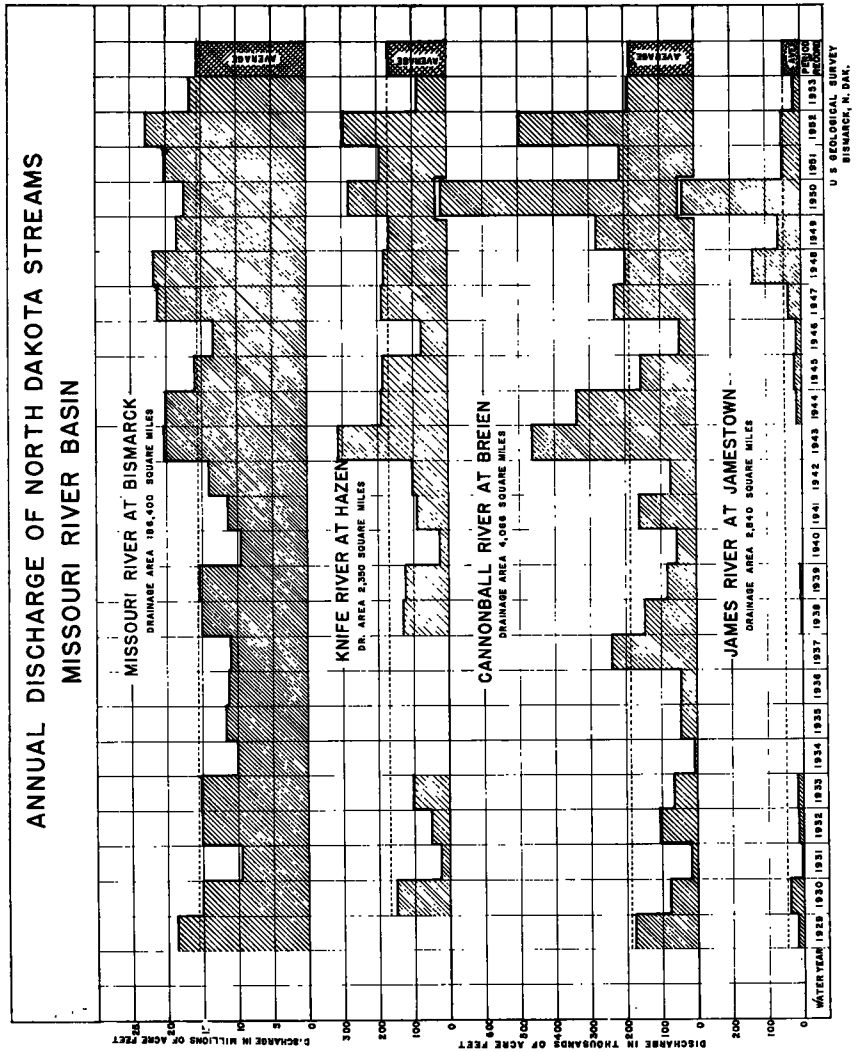
The discharge hydrograph of a typical North Dakota stream is illustrated in Figure 1. The condition that prevails in our streams a greater part of the time is a gradual recession as illustrated by the dashed line near the left side of the figure. Here the flow is composed entirely of water coming from 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.

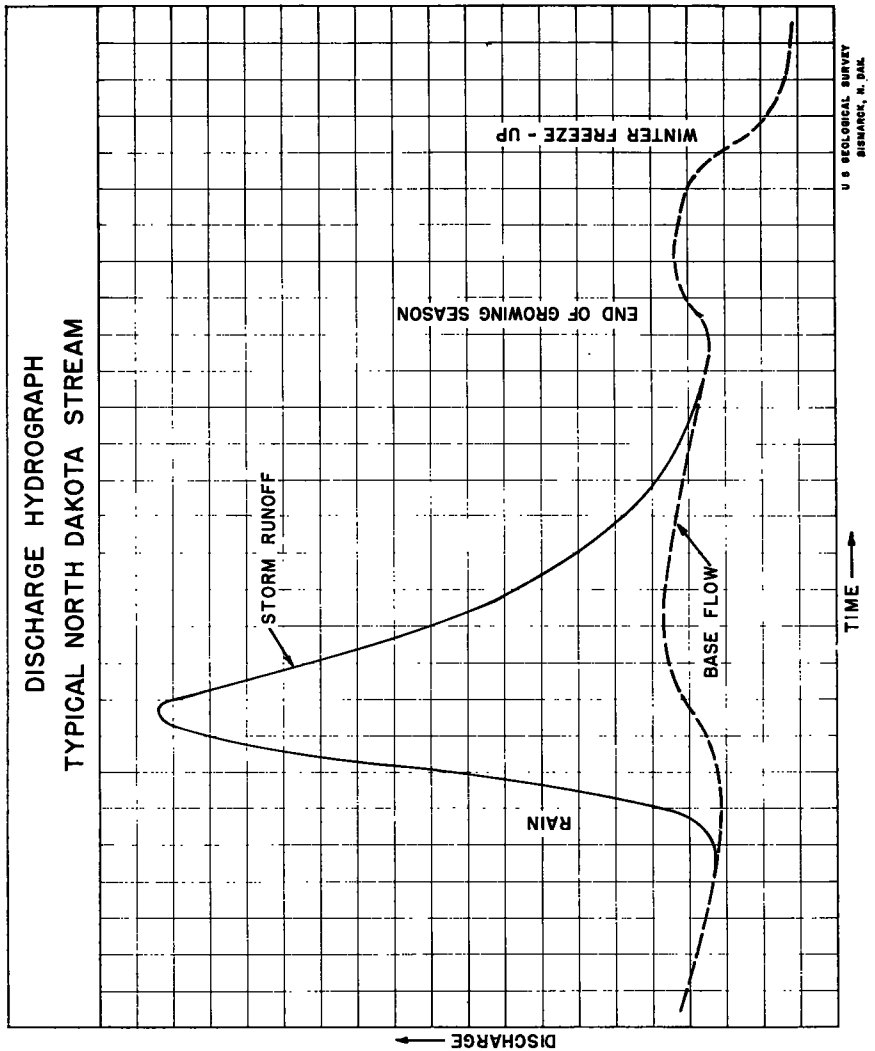
The solid line termed storm runoff illustrates what happens when rainfall or snowmelt occurs at a rate in excess of the soil's capacity to absorb it. Part of the precipitation reaches the stream channel as direct flow causing most of the rise shown. At the same time a portion of the precipitation is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

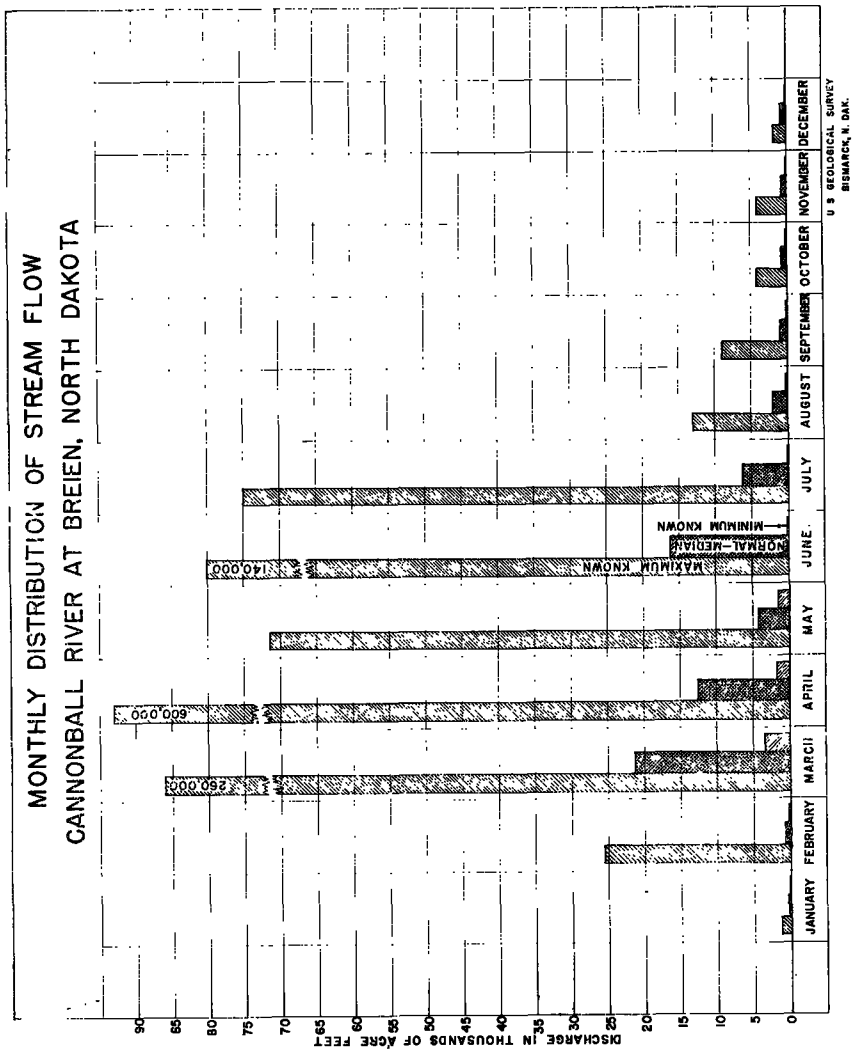



DISCHARGE OF NORTH DAKOTA STREAMS
SOURIS RIVER BASIN
SOURIS RIVER ABOVE MINOT
DRAINAGE AREA 11,300 SQUARE MILES
LAKE DARLING
SPILLWAY CREST
SOURIS RIVER NEAR SHERWOOD
DRAINAGE AREA 9,570 SQUARE MILES
SOURIS RIVER NEAR FOXHOLM
DRAINAGE AREA 10,100 SQUARE MILES
DISCHARGE IN THOUSANDS OF ACRE FEET
WATER YEAR
MONTH
YEAR
U S GEOLOGICAL SURVEY
BISMARCK, N. DAK.


ANNUAL DISCHARGE OF NORTH DAKOTA STREAMS
RED RIVER OF THE NORTH BASIN
RED RIVER OF THE NORTH AT GRAND FORKS
DRAINAGE AREA 30,100 SQUARE MILES
RED RIVER OF THE NORTH AT FARGO
DRAINAGE AREA 6,600 SQUARE MILES
SHEYENNE RIVER AT WEST FARGO
DRAINAGE AREA 9,270 SQUARE MILES
PARK RIVER AT GRAFTON
DRAINAGE AREA 748 SQUARE MILES
DISCHARGE IN THOUSANDS OF ACRE FEET
WATER YEAR
U S GEOLOGICAL SURVEY
BISMARCK, N. DAK.


ANNUAL DISCHARGE OF NORTH DAKOTA STREAMS
MISSOURI RIVER BASIN
MISSOURI RIVER AT BISMARCK
DRAINAGE AREA 184,400 SQUARE MILES
KNIFE RIVER AT HAZEN
DR. AREA 2,350 SQUARE MILES
CANNONBALL RIVER AT BREIEN
DRAINAGE AREA 4,066 SQUARE MILES
JAMES RIVER AT JAMESTOWN
DRAINAGE AREA 8,840 SQUARE MILES
AVERAGE
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 RECORD
DISCHARGE IN MILLIONS OF ACRE FEET
DISCHARGE IN THOUSANDS OF ACRE FEET
U S GEOLOGICAL SURVEY
BISMARCK, N. DAK.


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



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 substantial 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 relatives 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 information 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 streamflow information and began to assist with the financing of the program.

Figure 2 is a map of North Dakota showing the location of the 70 gaging stations being operated in the state at this time. The basic financing of nearly half 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.

The existing program is providing data which appears to be adequate at the present time as far as our larger streams are concerned; however, the small amount of work on the smaller streams provided for in our present program is inadequate to meet the steadily increasing need for flow data from representative small drainage areas.

In addition to maintaining the existing program at the regular gaging stations during the period of this report the Commission has made arrangements to extend their cooperative program with the U.S.G.S. so as to establish low flow measurement stations at about 30 points on streams not adequately covered by the regular gaging program. A number of measurements are obtained at each of these points during low flow periods primarily to provide necessary data for proper consideration of pending and potential water-right applications. This supplemental cooperative program has provided information concerning other special problems that have developed from time to time such as the problem of supplementing the flow into Lake Metigoshe and thereby maintaining the level of that lake, determining the available water supply for restoring Golden Lake in Steele County, determining the source and inflow into the area in Ramsey and Towner Counties that experienced the severe flooding conditions during 1954 and several other problems. Information from these measurements is included in the section of this report on Engineering Surveys on the specific projects concerned.

Although the regular overall program now in operation gives a moderately good coverage on the larger streams in the state it is becoming increasingly apparent that there is a growing need for data regarding the smaller streams in the state. It would be impractical and almost impossible to gage the flow of all the smaller streams where this type of data is likely to be needed; however, it is believed feasible to gage several such streams carefully selected so as to be representative of the various areas of the state. The data made available by such a program would be of great value for water right investigations, dam design and repair work, lake restoration projects and highway bridge and culvert design and requirements.

UNDERGROUND WATER SURVEYS – Cooperation with U. S. G.S.

During the past nine 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 Commission in their program.

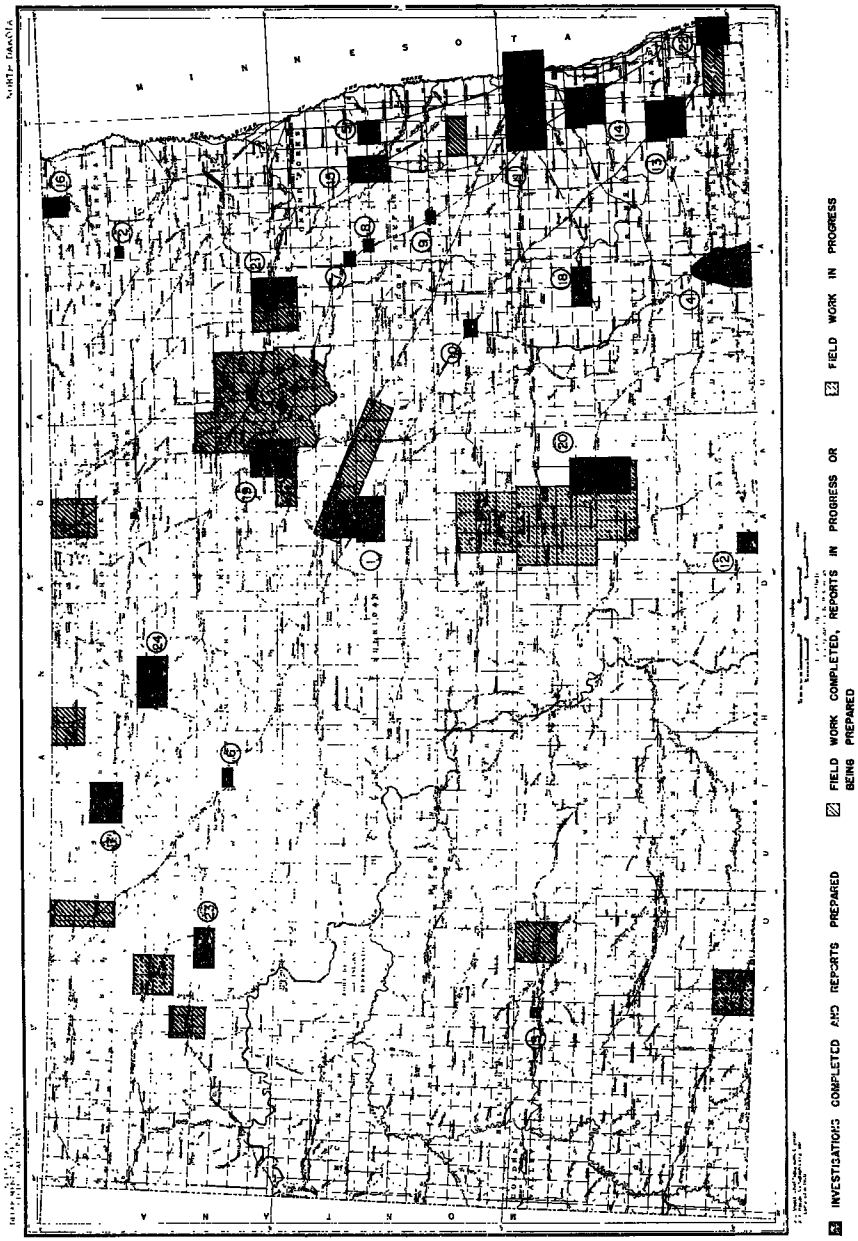
The ultimate aim of the program is to obtain an overall knowledge of the ground-water resources in the entire State which would be adequate for effectvely directing the optimum development of this resource for domestic, municipal, industrial and irrigation purposes and for effectively programming conservation and administrative measures which may be necessary or desirable 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 40 areas in the State. Reports have been released on 22 areas. Two 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 6,000 square miles of area.

Up to July 1, 1953, more than 1,000 test holes had been drilled with the State-owned drilling rig in connection with investigational work. These



holes represent approximately 118,000 feet or equivalent to over 22 miles of test drilling.

During the past two years investigations have been conducted in the vicinities of the towns of Stanley, Aneta, Upham, Minnewaukan, Grafton, Tioga, Powers Lake, Hunter, and Hankinson. Three reports have been duplicated and released to the public during the two year period and two other reports are essentially complete and will be duplicated in the near future.

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 Commission by the State Geologist and is available at the office of the State Water 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 Dkota, 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 Gology 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, Steel 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, 952. 1

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 Fairmount 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, Mountraill County, North Dakota, by Quentin F. Paulson, (This report has not yet received final review prior to release to the public).

No. 24 Ground Water in the Upham Area, McHenry County, North Dakota, by Quentin F. Paulson, (This report has not yet received final review prior to release to the public).

SOIL SURVEY PROGRAM

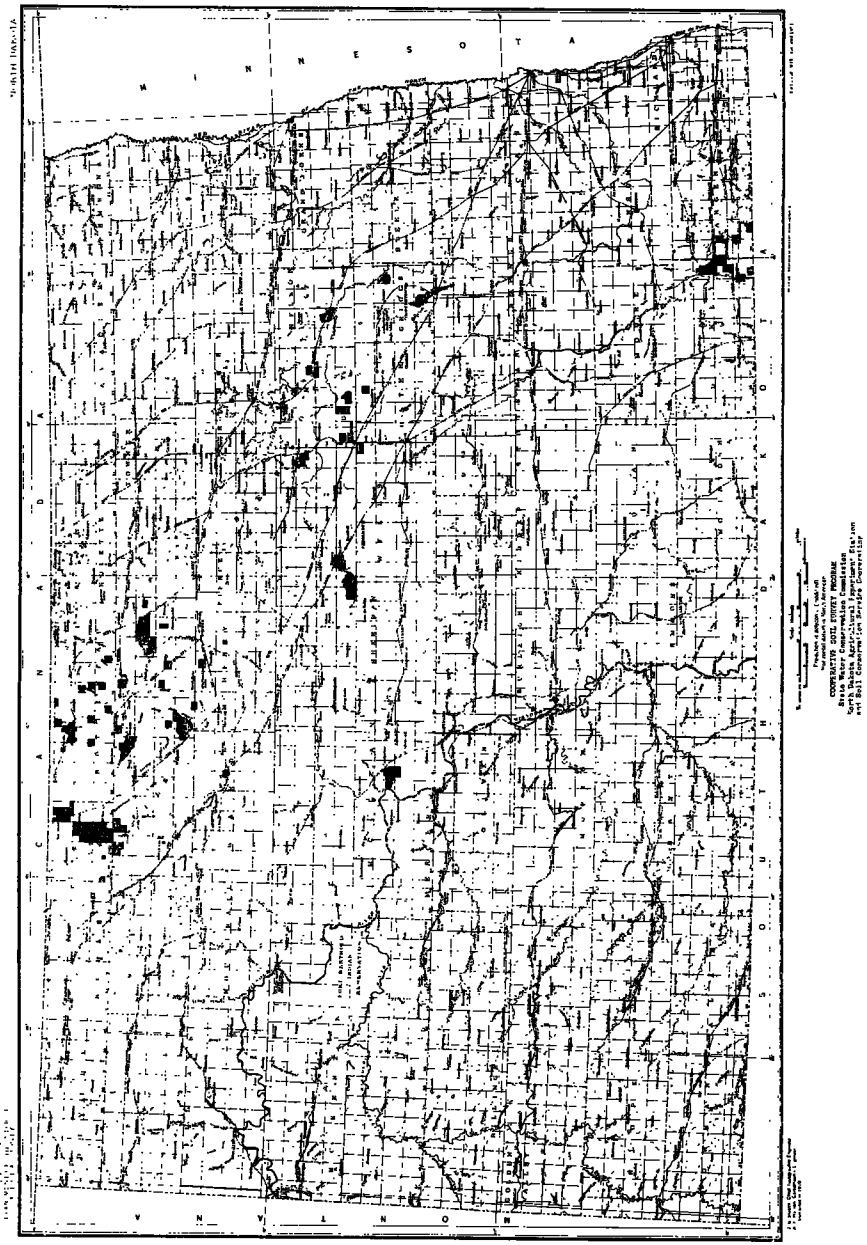
The cooperative soil survey program for areas being considered for irrigation development in North Dakota originated in 1948. At that time the North Dakota State Water Conservation Commission agreed to allocate funds to the North Dakota Agricultural Experiment Station to initiate and supervise this program. An agreement between the Experiment Station and the Soil Survey Division of the Bureau of Plant Industry, Soils and Agricultural Engineering (now incorporated into the Soil Conservation Service), was also made for cooperation in furthering the soil survey program in the areas proposed for irrigation. This agreement is still being followed. No formal understanding exists with the Bureau of Reclamation but soil surveys are being conducted in areas in which there is mutual agreement that the best interests of all concerned can be served.

Prior to August of 1952 the object of the soil survey program was to obtain detailed soil information in the areas being considered for irrigation. The procedure adopted was to survey blocks of soils of 2 to 6 square mile sin extent procedure adopted was to survey blocks of soils of 2 to 6 square miles in extent pleted in order to determine whether the entire area warranted further study. By August 1952 it was apparent that large acreages of land suitable for irrigation were available in North Dakota. These conclusions were in agreement with the findings of the Bureau of Reclamation.

In August of 1952 the Bureau of Reclamation decided to concentrate their efforts in a relatively small number of representative soil areas. These areas were selected so that they formed practically complete irrigation projects in themselves, each being served by one or two main water distribution canals and by a drainage system. From detailed topographic and soils information the costs of water distribution and drainage per irrigible acre could be determined. In addition a detailed land classification based on detailed soils and topographic surveys was necessary to determine how much land is suitable for irrigation in each area and to estimate levelling costs for the irrigable land. The cooperative soil survey agreed to make soil surveys in the areas designated by the Bureau of Reclamation. At the present time this plan of opreations is being followed.

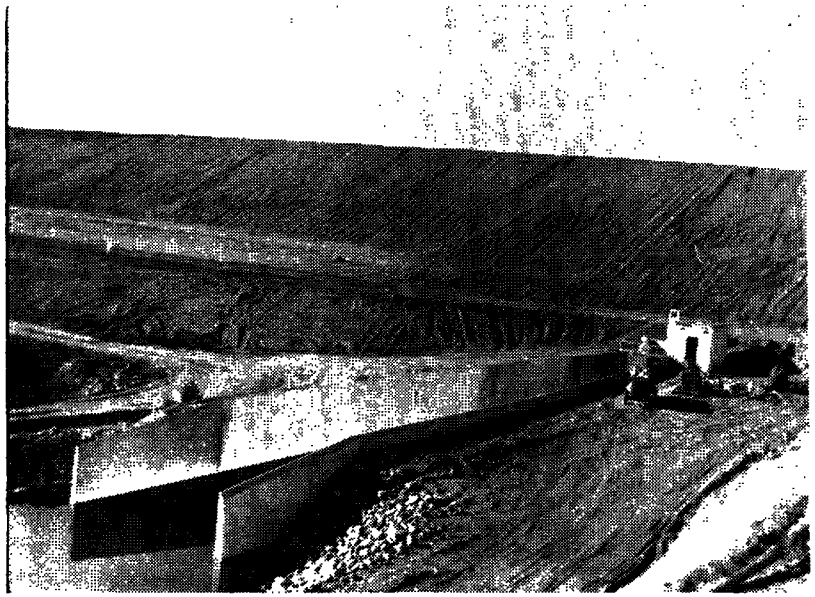
During the 1953-55 biennium $30,000.00 was allocated by the North Dakota State Water Conservation Commission to continue the soil survey program. The immediate objective of the soil survey is to study the physical and chemical properties of the soils, both in the field and in the laboratory, in relation to their ability to produce crops under irrigation. The soil survey shows on maps the extent of each type of soil. The soil survey is also essential information that should be available to the farmer once irrigation is undertaken. It will assist him in solving water use and management problems . In addition it is basic information for the establishment of a comprehensive research and extension program in that it shows on maps the location and extent of the principal types of soils and their characteristics. The information obtained is equally applicable to dryland farming.

From July 1953 to November 1954 approximately 105,000 acres have been covered by the cooperative soil survey in Bottineau, McHenry, Benson, Nelson, McLean, Sheridan, Wells, Eddy and Griggs Counties. It is anticipated that another 35,000 acres will be completed by June 30, 1955. The soil survey involved examining the soil to 5 foot depths of over 10,000 locations besides numerous examinations to shallower depths. Such features as the texture or relative amounts of gravel, sand, silt and clay in the different layers of soil, depth of dark topsoil, slope, erosion, drainage (both surface and internal), depth to lime, salt content where evident and stoniness were noted in the field. In addition about 2,000 locations were sampled to depths of 5 feet for routine laboratory investigations by the Bureau of Reclamation. About 60 sites were sampled in detail for laboratory studies by soil survey personnel. Costs of the entire soil survey program to the state for the current biennium average about 27 cents per acre. This is about 9 cents an acre greater than



for the preceding biennium because of the large number of samples that were obtained.

The routine laboratory analysis include determination of PH (alkalinity), water soluble salt content or salinity, permeability or rate water moves through the soil and water retention or the amount of water a particular soil will hold before water will be lost below the zone from which plant roots can absorb it. Detailed laboratory studies include additional information particularly with regard to soil fartility problems, soil structure and kinds and quantities of the various salts present in the soil. Whereas all of the soils being investigated are not suitable for irrigation, field and laboratory studies indicate that large areas of land within the area that can be served by diversion of water from the Missouri River are suitable for irrigation.



Jamestown Dam

WATER RIGHTS

North Dakota recognizes both the riparian and appropriation doctrines in relation to the use of water for beneficil 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 generally requires the following:

1. An application must be made by the landowner to the State Engineer for water to irrigate his lands in the form prescribed by the State Engineer. This application must contain an accurate description of the lands proposed for irrigation, the stream from which the water supply is to be obtained and the point of diversion; a map of the proposed irrigation development prepared from an actual survey, and other plans for the project. A $5.00 filing fee must accompany the application.

2. The priority date for the application is determined as of the date the application is received by the State Engineer in the proper form. The State Engineer sets a date for a hearing on the application and advertises a "Notice of Hearing" once a week for four consecutive weeks in the official newspaper of the county in which the project is located. At this hearing interested parties may express their views on the application either in person or in writing.

3. Following the hearing the State Engineer determines from the evidence whether or not the application should or should not be granted. The action of the State Engineer on the application is subject to approval by the State Water Conservation Commission.

4. If the application is approved, the applicant must complete the development of his irrigation facilities and apply the water to beneficial use with five years. This period can be extended by the State Engineer for three years and two years respectively if, because of unforseen delays, completion cannot be accomplished.

5. Following the completion of the works and inspection by the State Engineer, a certificate of completion and license to appropriate water will be issued to the appropriator if the works are satisfactory.

Since the provision for the appropriation of water was made in the North Dakota code in 1905 over 750 water-right applications have been filed with the State Engineer for purpose of irrigation, municipal use and industrial use. Water rights established prior to the enactment of the 1905 law are

recognized as valid and vested rights. The right to use water for irrigation becomes appurtenant to the land to be irrigated and the transfer of title to the land irrigated and the transfer of title to the land carries with it the right to the beneficial use of water.

The increasing recognition of the need for irrigation in recent years is apparent from an inspection of the number of applications received. From 1905 to 1950, approximately 375 applications had been received, and during the 4 year period, 1950-1954, over 375 new applications have been filed. This increase in filings is due partly to the popularity of modern portable sprinkler irrigation systems but mainly to recognition of the fact by farmers that being able to provide water to their crops when needed will give them the assurance of livestock feed and stable crop production. With the increase of water-right applications, the need for extreme caution in considering approving them has become much more apparent in order to prevent the over-appropriation of water of many of our streams. Many of the water-right applications filed with the State Engineer may not be valid existing rights because the yhave not been developed as required by law or the facilities have been abandoned. A thorough investigation must be made in order to determine the amount of development that can be supported by the various streams of North Dakota.

During the period July 1, 1952, to June 30, 1954, 171 water-right applications were filed with the State Engineer whereby the applicants propose to irrigate 25,249.5 acres of land, and to use water for industrial and municipal purposes. Of the water-right applications filed during this period, 55 have been approved and action on the remaining 116 is being delayed pending further study and determination of various questions pertaining to these applications, approval of the International Joint Commission, and compact negotiations with Minnesota. Seventeen applications that were listed as pending in the last biennial report of the State Water Conservation Commission were approved during the period covered by this report. A summary of pending water-right applications filed during the period of this report or listed as pending on the records of the State Engineer as June 30, 1954, is as follows:

Water-right Applications Approved	72
Pending International Joint Commission Action	10
Pending Compact Negotiations with Minnesota on Red River of the North	52
Pending Review and Study of Water Supply and Objections presented at hearings	91

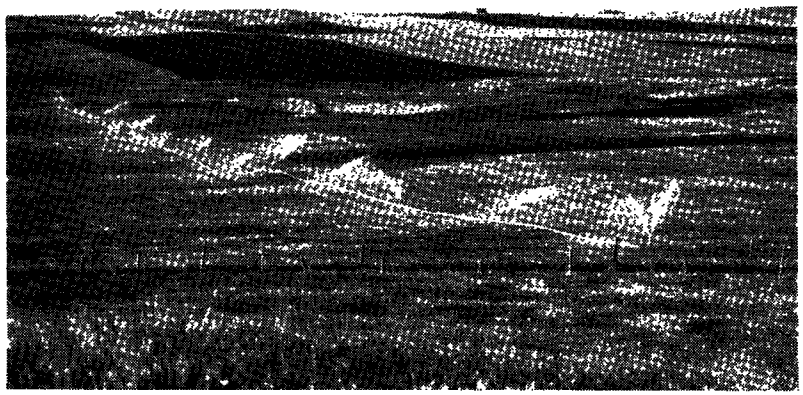
Several water-right applications have been filed whereby the applicants propose to use water from ground water sources for irrigation. There is a conflict in existing statutes as to the validity of such applications that are approved by the State Engineer and State Water Conservation Commission. These applications for ground water have been filed in the office of the State Engineer in order to establish priority as to beneficial use of underground waters in the event that the appropriation doctrine is judicially recognized as legally applicable to such waters.

RECOMMENDATIONS

The intense interest shown in irrigation in North Dakota during the past four years has greatly increased the demand for water-rights. This has resulted in an increased amount of work on the part of the Commission as on site investigations as well as a considerable amount of administrative work is required in processing water-rights.

According to the present water-right records, many of the streams on which water-right filings are made appear to be overappropriated. This condition may not actually exist as many of the filings that are now being honored may be water-rights in name only. Our state law provides that the water must be put into beneficial use before a water-right becomes permanent. It is doubtful, in many cases, if the water has ever been put to beneficial use; consequently, some streams that appear overappropriated may not fall in this category if a thorough investigation were made of the existing rights. The investigation of questionable rights may result in the cancellation of non-existant right and permit the granting of water-rights to individuals desirous of irrigating but now being denied this right.

Further investigations of stream flow should also be made as in some cases rights are granted on streams that do not have adequate flows for sustained irrigation. Some individuals have purchased expensive irrigation equipment and have made attempts to irrigate and have quickly exhausted the water supply. This has resulted in financial loss to the farmer and in some instances an adverse feeling towards irrigation in general.



Sprinkler Irrigation

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for Before June 30, 1952

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
	Chester Olson, Towner	NW¼ ; W½NE¼ ; SW¼ ; W½SE¼ Sec. 6-157-75	McHenry	Mouse River		445	3-26-40
296	Wendel Sand, Glastone	SE¼SW¼ ; SW¼SE¼ Sec. 26-142-94	Dunn	Deep Creek, trib. of Knife River	.75	60	5-8-47
297	W. T. Krebsbach, Reeder	NW¼SW¼ Sec. 34-133-98	Slope	Cedar Creek, trib. of Cannonball R.	.5	40	5-31-47
312	J. E. Harding, Medora	S½NW¼ ; NE¼ ; W½SW¼ Sec. 21 ; NE¼NE¼, SE¼NE¼ ; W½SE¼ Sec. 29-139-102	Billings	Little Missouri R.	3.0	246	7-30-49
313	D. L. McLeod, Medora	NE¼NW¼, SE¼NW¼ ; NW¼NE¼, S½NE¼ ; N½SE¼, SE¼SE¼ Sec. 23 ; SW¼NW¼ ; N½SW¼, SW¼SW¼ Sec. 24-142-102	Billings	Little Missouri	2.0	164	8-3-49
316	Georgia Olsen, Medora	S½SW¼ Sec. 1 ; SE¼SE¼ Sec. 2 ; NW¼ ; N½SW¼ Sec. 11 ; NE¼NW¼, SE¼NW¼ ; S½NE¼ Sec. 14-104-102	Billings	Little Missouri R.	3.7	292	8-15-49
318	Ray Schnell, Dickinson	NE¼NW¼ ; NE¼ ; NE¼SW¼, SE¼SW¼ ; SE¼ Sec.11 ; NW¼ ; S½NE¼ ; SW¼ ; SE¼ Sec. 12-139-96	Stark	Heart River	7.54	603.7	8-29-49
345	Olaf Falkvold, Skarr	**Stock Dam:** NW¼ Sec. 6-145-104, (Montana) **Lands:** Secs. 31-32-33-34-146-104 ; Secs. 4-5-6-7-8-9-10-15-16-17-18-146-104 ; Sec. 35-36-146-105 ; Secs. 1-2-3-11-12-13-145-105	McKenzie	Poison Spring Creek & Trib.	4.0	200	5-8-50
346	Edward F. Pfliiger, Carson	SW¼NW¼ ; W½SW¼ Sec. 31-158-102 ; NW¼ Sec. 3-152-103	Williams	Heart River Eight Mile Creek trib. Missouri R.	3	256.3	9-9-50
356	Paul Motzko, Buford						
386	R. C. Lewis, Jr., Fargo	NW¼ ; SW¼ ; W½SE¼ Sec. 21-141-49	Cass	Sheyenne River	4.15	332	3-8-51
387	Leo L. Anderson, Fargo	NW¼ ; SW¼NE¼ ; N½SW¼ ; NW¼SE¼ Sec. 1-141-49	Cass	Red River	2.35	188	3-14-51
388	William Fowler, West Fargo	SE¼NW¼ ; NE¼ Sec. 18-140-49	Cass	Sheyenne River	.89	72	3-19-51
389	A. L. Nordhougen, Fargo	SW¼SW¼ Sec. 19-139-48	Cass	Red River	.125	10	3-27-51
397	Donald C. Holand, Lisbon	SW¼SW¼ Sec. 1-134-56	Ransom	Sheyenne	Less than 1 gal. per sec.	1.0	5-7-51
399	Donald Novak, Alexander	NE¼NE¼, SE¼NE¼ ; NE¼SW¼ ; N½SE¼ Sec. 10-153-101	McKenzie	Lewis & Clark drain ditch Missouri River	.75	66.6	6-1-51

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for July 1, 1952 to June 30, 1954

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Ft.	Acres	Claim
				Cannonball River	1.2	90.3	5-5-53
408	Henry Knudsen, Cartwright	NE¼SW¼ Sec. 27; NW¼SE¼ Sec. 28-151-103	McKenzie	Charbonneau Creek, trib. Yellowstone River	1.0	80	9-14-51
409	Andrew Nelson, Foxholm	S½NE¼; N½SE¼ Sec. 26-157-85 (Pending International Joint Commission action)	Ward	Des Lacs R.	.26	31.1	9-6-51
422	Joe Feist, Velva	NE¼SE¼ Sec. 23: NW¼SW¼ Sec. 24-153-80 (Pending International Joint Commission action)	McHenry	Spring Creek, trib. Souris R.	3.0	67.5	1-3-52
425	Eugene E. Johnson & George Gilbert, Lisbon	E½SE¼ Sec. 23; W½SW¼ Sec. 24-134-56	Ransom	Sheyenne R.	1.5	132.3	3-7-52
427	T. Clem Casey, Bismarck	NW¼; W½NE¼; S½SW¼ Sec. 22-139-78	Burleigh	Apple Creek, trib. of Missouri R.	1.0	163.2	3-19-52
432	Alvin Schreiber, Fairmount	NE¼ Sec. 33; NW¼; SW¼NE¼ Sec. 34-131-47	Richland	Bois des Sioux, trib. Red River	2.0	290.2	3-31-52
438	Floyd Monteith, Leonard	S½NW¼; N½SW¼ Sec. 8-135-52	Richland	Sheyenne R.	.5	35	4-29-52
443	M. M. Lunde, Cooperstown	W½SW¼ Sec. 3; E½SE¼ Sec. 4; NW¼SW¼, S½SW¼ Sec. 10-145-58	Griggs	Permanent lagoons & Sheyenne R.	1	98.8	6-6-52
448	Northwest Nursery Company, Valley City	S½NW¼; SW¼ Sec. 15; E½NW¼ Sec. 22-140-58	Barnes	Sheyenne R.	1.3	103	6-20-52
449	Sunset Memorial Gardens, Inc., Fargo		Cass	Red River			6-28-52

NO.	Name of Applicant	Municipal Water Supply	County	Source of Supply	Amount of	Date of
	American Crystal Sugar Co.	NE¼NW¼ Sec. 5-139-48	Cass	Sheyenne R.	7.75 c.f.s.	6-4-48
	City of Fargo	NW¼NW¼ Sec. 5-138-49	Cass	Sheyenne R.	0 to 25	6-5-48
	Grand Forks	NE¼SE¼ Sec. 10-151-50	Grand Forks	Sheyenne R.	7.2	6-8-48
	Great Northern Railway	NE¼NW¼ Sec. 5-136-50	Richland	Sheyenee R.	g.p.d. 50,000	6-9-48
	Northern Pacific Railway			Sheyenne R.	10	
	Soo Line Railway	SW¼NE¼ Sec. 16-140-58	Barnes	Sheyenne R.	0.0297	6-14-48
	Northern States Power Co., Fargo, North Dakota	In City of Fargo — 4th St. S. & 4th Ave S. - Projected to Red River	Cass	Sheyenne R.	1.33	6-14-48
	Union Stock Yards	NE¼ Sec. 6-139-49	Cass	Sheyenne R.	g.p.d. 1,500,000	6-28-48
	Valley City		Barnes	Sheyenne R.	56	3-22-49
	Lisbon (Contrib. to Baldhill Dam)		Ransam	Sheyenne R.		Pending
	Southwest Fargo		Cass	Sheyenne R.	0 to 5	7-23-48

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for July 1, 1952 to June 30, 1954

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
450	Clayton Pederson, Valley City	N½NW¼, SW¼NW¼ Sec. 3-139-58	Barnes	Sheyenne R.	1	79	7-1-52
451	Mrs. Peter Schmitz, Burlington	N½NW¼, SW¼NW¼ Sec. 9; SE¼SW¼ Sec. 4-156-84 (Pending International Joint Commission action)	Ward	Souris R.	3	62.8	7-10-52
452	Herlof Huso, Aneta	E½NW¼; W½NE¼ Sec. 12-148-58	Griggs	Elongated slough, trib. Sheyenne R.	1	59	7-15-52
453	James E., J. Loren, Robert E., Brooks, Burlington	W½NW¼; N½SW¼, SW¼SW¼ Sec. 29; E½NE¼ Sec. 30-156-85 (Pending International Joint Commission action)	Ward	Des Lacs R.	1	84.6	7-17-52
454	Ole A. Flaat, Grand Forks	S½SW¼; S½SE¼ Sec. 15; SW¼SW¼ Sec. 14; NW¼; N½NE¼, SW¼NE¼ Sec. 22; NW¼NW¼ Sec. 23-151-50	Grand Forks	Red River	2.67	441.02	7-31-52
455	E. W. Kjorlien, Warwick	NE¼; SE¼ Sec. 25-151-63; NW¼; NE¼NE¼, S½NE¼; N½SE¼ Sec. 30; NW¼; S½NE¼; NE¼SW¼; N½SE¼ Sec. 29; NE¼; N½SE¼, SE¼SE¼ Sec. 32; SW¼NW¼; SW¼; W½SE¼ Sec. 33-151-62	Benson	Wells	13.67	1093	8-3-52
466	U. S. Bureau of Reclamation	SW¼NE¼; NE¼SW¼; W½SE¼ Sec. 13-159-79 (Pending International Joint Commission action)	McHenry	Deep River	3	125	10-14-52
470	Theo. Polsfut, Benedict	S½SE¼ Sec. 3; N½NE¼ Sec. 10-151-82 (Pending International Joint Commission action)	Ward	Unnamed Creek	2	61.41	11-12-52
473	R. C. Hastings, Fargo	S½NE¼; E½SW¼; SE¼ Sec. 34-146-51	Traill	Goose River	1	170.6	12-20-52
474	Wallace Pelton, Dunn Center	E½SW¼; SW¼SE¼ Sec. 30-145-93	Dunn	Spring Creek, trib., Knife River	.80625	64.5	12-20-52
476	F. R. Eddy, Chicago	SW¼ Sec. 1; NE¼NW¼; NW¼NE¼ Sec. 2-140-65	Stutsman	Pipestem Creek, trib., James River	1.8	150.7	12-30-52
481	E. James Boyd, Deering	N½NW¼, SW¼NW¼; NW¼SW¼ Sec. 25-157-80 (Pending International Joint Commission action)	McHenry	Little Reep R.	850 gpm	114	1-14-53
482	Clinton Perhus, Taylor	SW¼NE¼: N½NW¼, SE¼NW¼ Sec. 5-142-93	Dunn	Knife River	.99625	79.7	1-16-53
485	Donald R. Hanson, Hillsboro	N½SE¼ Sec. 35; SW¼ Sec. 36-146-51	Traill	Goose River	.9	69.9	1-21-53
488	Anton Kadrmas, Manning	NE¼SW¼, S½SW¼ Sec. 1; E½SE¼ Sec. 2-143-96	Dunn	Knife River	.98875	79.1	1-31-53
489	Roy L. Peterson, Minot	Gravel Washing Plant.	Ward	Souris River	1.5	.....	2-5-53
490	Mike Hlebechuk, Fairfield	NE¼NE¼; S½NW¼ Sec. 35-144-98	Billings	Knife River	.95	79.6	2-7-53
494	Arthur Greenberg, Grand Forks	E½SW¼; SE¼ Sec. 22; W½SW¼ Sec. 23; SE¼ Sec. 35; NW¼SW¼, S½SW¼ Sec. 36-151-50; Sec. 2-150-50	Grand Forks	Red River	3	491	2-13-53

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for July 1, 1952 to June 30, 1954 (CONTINUED)

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
495	A. W. Gustafson, Marshall	S½NW¼ ; NW¼SW¼ Sec. 7-142-92 ; N½SE¼ Sec. 12-142-93	Dunn	Knife River	.995	79.6	2-14-53
496	Lloyd Butts, Carrington	NW¼ ; NE¼ ; SW¼ Sec. 6-146-66	Foster	Wells	4.37	350.8	2-17-53
498	Andrew Kirsch, Gladstone	NW¼NW¼ Sec. 7-138-94 ; N½NE¼, SW¼NE¼ ; S½NW¼ Sec. 12-138-95	Stark	Antelope Creek, trib. Heart River	.93	74.4	2-24-53
499	Art Anderson, Dunn Center	SE¼ Sec. 27-145-94	Dunn	Spring Creek, trib., Knife River	.5925	47.7	2-26-53
500	Matt Neurohr, Dodge	SW¼SE¼ Sec. 4-144-91	Dunn	Spring Creek, trib., Knife River	.293	24.5	2-26-53
501	Merle Mattson, Tioga	E½NE¼ ; N½SE¼ Sec. 8-155-96	Williams	Beaver Creek, trib., Missouri R.	1.6	135.2	3-2-53
502	Elder Bohrer, Valley City	S½NW¼ ; NW¼SW¼, S½SW¼ Sec. 28 ; E½SE¼ Sec. 29 ; NE¼NE¼ Sec. 32-140-58	Barnes	Sheyenne R.	1	77.5	3-3-53
503	Leo Goetz, Halliday	SW¼SE¼ Sec. 24 ; N½NE¼ Sec. 25-145-93	Dunn	Spring Creek, trib., Knife River	.9925	79.4	3-9-53
504	H. R. Morgan, Bismarck	SW¼ ; W½SE¼ Sec. 20-136-51	Richland	Sheyenne R.	1.0	89.8	3-11-53
506	Gerald Glynn, Fullerton	SW¼ ; NW¼SE¼ Sec. 16-131-62	Dickey	Maple River, trib., James River	1	79.8	3-12-53
507	William J. Miller, Valley City	NE¼SE¼, S½SE¼ Sec. 33-140-58	Barnes	Sheyenne River	1	73	3-12-53
508	Robert F., Edmond R., & John C. Kadrmas, Dickinson	NE¼ ; NE¼SE¼ Sec. 33-141-95	Dunn	Spring Creek, trib., Green River	1	78.7	3-14-53
510	L. C. Hart, Williston	NE¼ ; NW¼ ; SW¼ ; SE¼ Sec. 5 ; NE¼ ; E½NW¼ ; NE¼SW¼ ; NW¼SE¼ Sec. 8-155-100	Williams	Little Muddy R., trib., Missouri R.	10	833.26	3-16-53
511	Orvil P. Gilleshammer, Grafton	E½NE¼ ; E½SW¼ ; W½SE¼ Sec. 13-157-51 ; NW¼NE¼, S½NE¼ ; NW¼ ; NE¼SE¼ Sec. 18 ; SW¼NW¼ ; NW¼SW¼ Sec. 17-157-50	Walsh	Red River	2.225	178	3-21-53
513	Ralph L. Harmon, Carrington	NW¼ Sec. 1 ; SW¼SE¼ Sec. 36-147-67	Foster	Wells	1.63	130.4	3-24-53
514	George Ferebee, Halliday	S½NW¼ ; N½SE¼, SE¼SE¼ Sec. 23-145-92	Dunn	Spring Creek, trib., Knife River	.96625	77.3	3-27-53
515	Henry Loberg, Fargo	SW¼SW¼ Sec. 20-139-49	Cass	Sheyenne R.	.5	40	3-28-53
516	Jacob Gegelmann, Halliday	S½ SE¼ Sec. 21 ; SW¼SW¼ Sec. 22-145-92	Dunn	Spring Creek, trib., Knife River	.97	77.6	3-30-53
520	Olaf Hagen, Williston	S½NW¼ ; N½SW¼, SE¼SW¼ ; W½SE¼ Sec. 25-155-102	Williams	Sand Creek, trib., Missouri R.	1	75.2	4-1-53
521	Glenn D. Keef, Williston	W½SW¼ Sec. 7 ; NW¼ ; W½SW¼ Sec. 18-156-100	Williams	Little Muddy R. trib., Missouri R.	3	280.2	4-1-53

522	A. L. Gramlow, Fullerton	NE¼ ; SE¼ Sec. 26-131-62	Dickey	Maple River trib., James River	4	311.9	4-2-53
523	Rex Brace, Lisbon	SW¼ ; SE¼ Sec. 12 ; NE¼NW¼ ; N½NE¼, SE¼NE¼ ; NE¼SE¼ Sec. 13-135-57 ; SW¼SW¼ Sec. 7 ; NW¼NW¼, S½NW¼, N½SW¼ Sec. Sec. 18-135-56	Ransom	Sheyenne R.	4	347.5	4-4-53
525	Harold Berger, Williston	NE¼NE¼ Sec. 4 ; NW¼NW¼ Sec. 3-156-100 ; SE¼ Sec. 36-157-100	Williams	East Fork Little Muddy, trib., Missouri	1.6	133.6	4-14-53
526a	Herm Allmaras, New Rockford	W½ SW¼ Sec. 3 ; E½SW¼ ; SE¼ Sec. 4-149-64	Eddy	Robinson Coulee, trib., Sheyenne R.	1	80	4-14-53
526b	Herm Allmaras, New Rockford	W½SW¼ Sec. 3 ; E½SW¼ ; SE¼ Sec. 4-149-64	Eddy	Sheyenne R.	1	80	4-14-53
527	Lloyd Dillon, Buford	W½NE¼ ; SE¼NW¼ ; N½SW¼, SE¼SW¼ ; NW¼SE¼ Sec. 11-154-104	Williams	Unnamed Creek	1	77.4	4-15-53
528	Alvin E. Foss, Cummings	NE¼ ; NW¼ Sec. 2 ; NW¼NE¼ ; NW¼ Sec. 11-146-49	Traill	Red River	1.6	326.1	4-16-53
529	Orville Haugen, Buford	NW¼NW¼ Sec. 12-154-104	Williams	Unnamed Creek	1	24.1	4-17-53
530	Lloyd Pfeilschiefter, Velva	NW¼NE¼, S½NE¼ ; E½NW¼ Sec. 32-152-80 (Pending International Joint Commission action)	McHenry	No Name Coulee, trib., Souris River	1	39	4-20-53
531	Emmer Folvag, Grenora	NW¼ Sec. 22-158-103	Williams	Willow Creek trib., Cotton Wood Creek	1	34.9	4-20-53
532	Henry Bartels, Springbrook	SE¼SW¼ ; SE¼ Sec. 27-157-99	Williams	East Fork Little Muddy, trib. Missouri	2	81.1	4-22-53
534	S. W. Thompson, Bismarck	Lot 2 is 35A ; Lot 3 is 18A ; Lot 4 is 20A in Sec. 30-150-63 ; Lot 1 is 20A ; Lot 2 is 6A ; Lot 3 is 15A ; Lot 4 is 6A in Sec. 25-150-64	Eddy	Sheyenne R.	1.5	120	4-27-53
537	Earl Larson, Fullerton	SW¼ Sec. 24-131-62	Dickey	Maple River, trib., James River	1.87	149	5-2-53
538	Eugene Romanyshyn, Belfield	S½SW¼ ; S½SE¼ Sec. 33-144-98	Billings	Knife River	.85	68	5-5-53
541	A. W. Mosbrucher, Beulah	NW¼ Sec. 20-144-88	Mercer	Spring Creek, trib., Knife River	.34125	27.3	5-6-53
542	Floyd B. Sperry, Golden Valley	N½NE¼, SW¼NE¼ ; NE¼NW¼, S½NW¼ Sec. 20 ; SE¼SW¼ ; NE¼SE¼, S½SE¼ Sec. 17-144-90	Mercer	Spring Creek, trib., Knife River	2.091	167.3	5-6-53
543	Robert L. Odum, Werner	SE¼SW¼ Sec. 19 ; NE¼NW¼ Sec. 30-145-92	Dunn	Spring Creek, trib., Knife River	.26875	21.5	5-6-53
544	Clarence F. Vogel, Lark	SW¼NE¼ ; NW¼ ; W½SE¼ Sec. 4 ; N½NE¼, SW¼NE¼, SE¼ Sec. 9 ; N½NE¼, SE¼NE¼ ; SE¼SW¼ Sec. 16-134-85	Grant	Louse Creek, trib., Cannonball	1.90	153.9	5-13-53

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for July 1, 1952 to June 30, 1954 (CONTINUED)

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
545	Joe E. Bosch, Dodge	W½NE¼ Sec. 13; NW¼NE¼, S½NE¼; NE¼SW¼ Sec. 24-143-92	Dunn	Fish Creek, trib., Knife River	.70	64	5-13-53
546	Herbert E. Chase, Hebron	NW¼SE¼; S½SE¼ Sec. 27-140-90	Morton	Little Knife R.	1	73.8	5-13-53
547	Ronald Wagner, Englevale	NW¼; SW¼; SE¼ Sec. 1-133-58	Ransom	Underground	unknown	480	5-15-53
548	Orrin R. Streich, Englevale	E½NE¼ Sec. 13-134-58; W½NW¼ Sec. 18-134-57	Ransom	Underground	unknown	160	5-15-53
549	August J. Wagner, Englevale	SW¼; NE¼; NW¼ Sec. 30; NE¼; NW¼; SE¼ Sec. 31; SW¼ Sec. 19; NE¼; E½NW¼; SW¼ Sec. 18-134-57; SW¼ Sec. 7-133-57; NE¼ Sec. 36; SW¼; SE¼ Sec. 24; SW¼ Sec. 12; NW¼; SW¼ Sec. 14; SW¼ Sec. 11-134-58; NW¼; SW¼ Sec. 36-133-58	Ransom	Underground	unknown	3070	5-15-53
551	Agnes Cook, Werner	SW¼SW¼; S½SE¼ Sec. 19; N½NE¼ Sec. 30-145-92	Dunn	Spring Creek, trib., Knife River	.9925	79.4	5-23-53
553	Adam F. Wysocki, Minto	W½NW¼ Sec. 12-155-53	Walsh	Forest River, trib., Red River	.72	57.5	5-29-53
554	Geo. A. Christie, Minto	N½NW¼ Sec. 6-155-52	Walsh	Forest River, trib., Red River	1.1	44.9	6-1-53
555	Frank Lenzmeier, Wahpeton	SE¼NW¼; SW¼NE¼; SW¼; NW¼SE¼ Sec. 33-133-47	Richland	Red River	2.0	171.5	6-1-53
556	Henry Polsfut, Minot	N½SE¼ Sec. 3-151-82 (Pending International Joint Commission action)	Ward	Unnamed Creek, trib., Souris River	.34	25.7	6-1-53
557	Stanley Metelmann, Walhalla	SE¼NE¼ Sec. 33; W½NW¼; N½SW¼; W½SE¼ Sec. 34-163-57	Cavalier	Pembina River	1.08	86.4	6-2-53
558	O. P. Hedstrand, Fisher	SE¼NE¼; SW¼NW¼; N½SW¼; NW¼SE¼ Sec. 30-154-81 (Pending International Joint Commission action)	Ward	Souris River	1.19	105.4	6-3-53
559	Jacob Schiller, Forest River	NW¼ Sec. 14-155-53	Walsh	Forest River, trib., Red River	1.7	140.9	6-3-53
560	John A. Wagner, Lark	NE¼SW¼; SE¼ Sec. 5-134-85	Grant	Louse Creek, trib., Cannonball R.	.7975	63.8	6-4-53
561	Roger Johnson, Werner	SW¼SW¼ Sec. 20; N½NW¼ Sec. 29-145-92	Dunn	Spring Creek, trib., Knife River	.58125	46.5	6-10-53
562	Roger Johnson, Werner	S½SE¼ Sec. 20-145-92	Dunn	Deep Creek, trib., Spring Creek	.4025	32.2	6-10-53
563	Vincent Rife, Sheldon	E½SE¼ Sec. 13-137-54	Cass	Maple River, trib., Sheyenne R.	.30	24	6-10-53

565	John E. & Norman Saugstad, Valley City	E½SW¼; W½SE¼ Sec. 27-138-58	Barnes	Sheyenne River	1	80	6-12-53
566	Ernest Kapaun, Fargo	SE¼SE¼ Sec. 16-137-51	Cass	Maple River, trib., Sheyenne R.	.29	23.5	6-13-53
567	Karrie Nelson, Walhalla	NE¼SW¼; S½SW¼ Sec. 29-163-56	Pembina	Pembina River	.8	63.7	6-16-53
570	State Hospital, Jamestown	NE¼; NW¼ Sec. 6-139-63	Stutsman	James River	2	176	6-23-53
571	Keith Jury, Ellendale	N½NE¼, SW¼NE¼ Sec. 15-129-62	Dickey	Maple River, trib., James River	.7	58.6	6-24-53
573	Francis J. Archbold, Sheldon	SW¼ Sec. 11-137-54	Cass	Maple River, trib., Sheyenne R.	.50	40.5	7-16-53
576	Peter Storholm, Cartwright	SW¼SW¼ Sec. 32-150-104; W½NW¼; NW¼SW¼ Sec. 5; E½NE¼; SE¼ Sec.6; N½NE¼ Sec. 7-149-104	McKenzie	Cheney Creek, trib., Yellowstone R.	3.75	296.6	8-1-53
577	Jay Ullman, Hettinger	NW¼SE¼, S½SE¼ Sec. 25-131-94	Adams	South Fork of Connonball River	.479	38.30	8-3-53
580	Charles H. Lohstretter & Sons, Mandan	SW¼ Sec. 28; E½SE¼ Sec. 29-140-81	Morton	Square Butte Creek, trib., Missouri River	1.99	159	9-5-53
581	Harry Larkin, Rhame	SE¼NE¼; E½SE¼ Sec. 2; W½SW¼ Sec. 1-131-106	Bowman	Little Missouri R.	1	80	10-17-53
583	A. T. Foreman, Marmarth	NW¼; N½SW¼ Sec. 18-133-105	Slope	Little Missouri R.	1.1	88.7	11-2-53
584	Art S. Nelson, Northwood	NE¼; NW¼; SW¼ Sec. 31-150-54	Grand Forks	Goose River trib., Red River	2	384.5	11-6-53
585	Art S. Nelson, Northwood	NE¼; NW¼; SE¼ Sec. 7-149-52	Grand Forks	Groundwater	2	453.6	11-6-53
586	J. Larimore, Jr., Larimore	NE¼; NW¼; SW¼; SE¼ Sec. 13; NE¼; NW¼; SW¼; SE¼ Sec. 14; NE¼; NW¼; SW¼; SE¼ Sec. 23; NE¼; NW¼; SW¼; SE¼ Sec. 24-151-55	Grand Forks	Wells	4	2391.80	11-9-53
587	Peter Schabinger & J. Weingardt, Marmarth	S½NE¼; SE¼ Sec. 3; NE¼; SE¼NW¼; NW¼SE¼ Sec. 10-131-106	Bowman	Little Missouri R.	2.5	208.9	11-12-53
588	Joe Schorsch, New England	NW¼; NW¼NE¼, S½NE¼; NW¼SE¼ Sec. 25-135-96	Hettinger	North Fork of the Cannonball River	1	80	11-12-53
589	Walter H. Hall, Jamestown	NW¼SW¼ Sec. 36-140-64	Stutsman	James River	1/5	4.5	12-3-53
590	Russell Schumacher, New England	S½NE¼; E½SW¼; N½SE¼, SW¼SE¼ Sec. 27-136-99	Slope	North Fork of Cannonball River	1	75.4	12-10-53
591	John Voigt, Shields	NW¼NW¼, S½NW¼; E½SW¼; W½SE¼ Sec. 30; SE¼NE¼; NE¼SE¼ Sec. 31; S½NW¼; N½-SW¼; N½SE¼ Sec. 32-131-85	Grant	Cannonball River	2.5	201.9	12-11-53
592	Valley City Country Club, Valley City	W½NE¼; E½NW¼ Sec. 22-140-58	Barnes	Sheyenne River	1	80	12-21-53

WATER-RIGHT APPLICATIONS PENDING JUNE 30, 1954
Applied for July 1, 1952 to June 30, 1954 (Continued)

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
593	Fred Berger, Watford City	E½SE¼ Sec. 1-149-98	McKenzie	Cherry Creek, trib., Little Missouri R.	.3775	21.2	12-31-53
594	Arland Frost, Harvey	S½NW¼ Sec. 24-150-72	Wells	Sheyenne River	1	21.8	1-8-54
595	Lloyd Stewart, Brisbane	N½NW¼, SE¼NW¼; SW¼ Sec. 32-132-86	Grant	Cannonball River	.88	70.4	1-15-54
596	Henry Gatzke, Jr., New England	SE¼ Sec. 7; W½NE¼; S½NW¼; N½SW¼ Sec. 8-135-99	Slope	North Fork of the Cannonball River	1	86.1	1-20-54
597	Irvin Torgerson, Pettibone	W½NE¼; N½SE¼, SE¼SE¼ Sec. 10; N½NE¼ Sec. 15-142-70	Kidder	A lake with no name	2.17	171.8	1-22-54
600	Paul Charnetzki, Valley City	NW¼SW¼, S½SW¼ Sec. 34-140-58	Barnes	Sheyenne River	1	58.5	2-8-54
601	James Sandvik, Pettibone	SW¼NE¼; S½NW¼; SW¼ Sec. 29-142-70	Kidder	A lake with no name	1.16	92.7	2-8-54
602	Herbert Oberlander, Stanton	S½NE¼; NE¼SE¼ Sec. 33-145-84	Mercer	Knife River	1.26	100.8	2-11-54
603	E. M. Lee, Valley City	NE¼SE¼; NE¼ Sec. 36-141-59	Barnes	Sheyenne Rivtr	1	69.5	2-11-54
605	T. H. Cousins, Carrington	W½SE¼ Sec. 28; NW¼; NE¼SW¼ Sec. 33-145-64	Foster	James River	1	137.6	2-27-54
606	T. H. Cousins, Carrington	N½NE¼, SW¼NE¼; E½NW¼; NE¼SW¼; NW¼-SE¼ Sec. 28-145-64	Foster	Wells	1	85.2	2-27-54
607	Osborne Galde, Aneta	S½NE¼; SE¼SE¼ Sec. 31; SW¼SW¼ Sec. 32-149-58	Nelson	Sheyenne River	1.2	96.3	3-26-54
608	Werner Hehn, Leith	S½SW¼; SE¼ Sec. 10; NW¼NE¼; NW¼ Sec. 15-132-88	Grant	Cannonball River	1.78	142.3	4-5-54
609	Louis Michel, Marmarth	NW¼ Sec. 11-131-106	Bowman	Duck Creek, trib., Little Missouri River	948	75.9	4-9-54
610	Art Kongslie, Upham	NE¼NW¼ Sec. 18-159-78	McHenry	Deep River	1/2	38	4-21-54
611	Leo L. Anderson, Fargo	NW¼ Sec. 7-134-57; SE¼ Sec. 12-134-58	Ransom	Wells	4.	320	4-23-54
612	Maurice Flatness, Marmarth	S½NE¼; E½NW¼; E½SW¼; SE¼ Sec. 7-133-105	Slope	Little Missouri R.	2.843	227.5	4-30-54
613	Howard White, Bowman	SE¼ Sec. 2-131-103	Bowman	Spring Creek, trib.,Grand River	1.153	92.3	4-30-54
614	Alwin C. Carus, Oakdale	SW¼NE¼; NW¼; SW¼; NW¼SE¼ Sec. 14-147-97	Dunn	Intermittent stream, trib., Little Missouri R.	2.62875	210.3	5-17-53
615	Richard Quast, Grand Rapids	SW¼ Sec. 30-135-61	LaMoure	Graundwater & James River	1	80	5-17-54
616	Adolph Hauck, Wilton	S½SW¼ Sec. 16-143-81	McLean	Goose Creek, trib., Missouri R.	.98	78.3	5-17-54
617	Levon Olson, Grand Forks	NE¼SE¼ Sec. 20; S½NW¼; N½SW¼ Sec. 21-152-50	Grand Forks	Red River	1.1	90.2	6-3-54
618	M. W. Thatcher, St. Paul	N½NE¼; NW¼ Sec. 7-156-100	Williams	East Fork Creek & Little Muddy Creek, trib., of Missouri River	69/80	69.1	6-7-54

WATER-RIGHT FILINGS
Listed as Pending in Supplement "A" of the Eighth Biennial Report Approved Since June 30, 1952

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
188	Woodie Watson, Watford City	NE¼ Sec. 1-147-99	McKenzie	Little Missouri R.		42	12-10-37
354	Herbert, George C., & Oscar Indergard, Sidney, Montana	W½SW¼ Sec. 8; E½SW¼; SE¼ Sec. 7-147-103	McKenzie	Baye Creek, trib., Bennie Pierre Creek	2.75	217.8	8-12-50
363	Henry Iszley, Cartwright	NW¼ Sec. 1-150-104	McKenzie	2 dry runs, trib., Yellowstone River	1.5	131	9-23-50
384	City of Bismarck, Bismarck		Burleigh	Missouri River	23.2		2-5-51
402	Chester Davis, Sidney, Montana	SW¼NW¼; N½SW¼ Sec. 27; NW¼; NE¼; NW¼SW¼; W½SE¼ Sec. 28-146-103	McKenzie	Unnamed Creeks	2.5	200.6	7-12-51
403	Harry Kruger, Sidney, Montana	NE¼NW¼, S½NW¼; W½NE¼; SW¼; SW¼-SE¼ Sec. 21-146-103	McKenzie	Unnamed Creek, trib., Bennie Pierre Creek	2.5	198.4	7-13-51
437a	Nels Buckmon, Gascoyne	W½SW¼ Sec. 4-130-99	Bowman	Buffalo Creek	1/2	42.5	4-28-52
437b	Nels Buckman, Gascoyne	SE¼NW¼; NE¼SW¼ Sec. 10-130-99	Bowman	Buffalo Creek	3/8	28	4-28-52
439	Elmer Flor, Marmarth	S½SW¼ Sec. 26; NE¼ Sec. 34-133-106	Slope	Beaver Creek, trib., Little Missouri	1	79.8	5-12-52
440a	Richard Palczewski, Haley	SW¼ Sec. 14-129-99	Bowman	Lightning Creek,	5/8	53.5	5-24-52
440b	Richard Palczewski, Haley	SW¼NE¼ Sec. 34-129-99	Bowman	Grand River	1/4	9.0	5-24-52
441	Flora & R. H. Weinhandl, Mandan	Lot AF and Lot Q of NE¼ Sec. 26-139-81	Morton	Missouri River	.20	13.56	6-2-52
442	Lloyd Dennis, Belfield	SW¼NE¼; E½SW¼; W½SE¼ Sec. 29-142-9[illegible]	Billings	Spring Creek, trib., Green River	1	69.1	6-5-52
444	Thomas Tarnavsky, Watford City	SE¼NE¼; SE¼ Sec. 34; SW¼NW¼; NW¼SW¼ Sec. 35-148-99	McKenzie	Little Missouri R.	2	92.0	6-12-52
445	Albert Schmidt, Dickinson	N½SE¼ Sec. 12-138-96	Stark	Antelope Creek, trib., Heart River	.63	50.7	6-12-52
446	John Schmidt, Jr., Dickinson	S½SW¼ Sec. 3; SW¼SE¼ Sec. 4-138-95	Stark	Antelope Creek, trib., Heart River	.15	12.3	6-12-52
447	John Blees, Bowman	NE¼ Sec. 18-130-101	Bowman	Spring Creek, trib.,Grand River	1 1/8	90.5	6-18-52

WATER-RIGHT APPLICATIONS
Filed and Approved July 1, 1952 to June 30, 1954

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
456	Arnold F. Luhman, Gladstone	NW¼NW¼; NW¼SW¼, S½SW¼ Sec. 26-140-95	Stark	Green River, trib., Heart River	1	78.5	8-4-52
457	Guy Johnson, Marmarth	Lot 2 SW¼NW¼ Sec. 6; E½NW¼; N½NE¼, SW¼NE¼; NE¼SW¼ Sec. 7; W½NW¼ Sec. 18-132-106; E½NE¼ Sec. 13-132-107	Bowman	Little Beaver Creek trib., Little Missouri	1	80	8-8-52
458	Raymond C. Schnell, Dickinson	W½NW¼ Sec. 28; E½NE¼ Sec. 29-130-92	Adams	South Fork of Cannonball River	1	79.4	8-11-52
459	Harold Fuchs, Marmarth	W½SE¼ Sec. 19-133-105	Slope	Little Missouri R.	1	80	8-11-52
460	Mrs. Harold Fuchs, Marmarth	E½SW¼ Sec. 19-133-105	Slope	Little Missouri R.	1	80	8-11-52
461	Kenneth Dohrmann, Taylor	E½NW¼; NW¼NE¼, S½NE¼; N½SE¼ Sec. 23-140-94	Stark	An intermittent creek, trib., Knife River	1	75.8	8-15-52
462	Joe Thielen, Dickinson	S½SW¼ Sec. 5-138-95	Stark	Antelope Creek, trib., Heart River	1	36.4	9-8-52
463	Montana Dakota Utilities Co., Mandan		Morton	Missouri River	170		11-19-52
464	Joe Herberholtz, New England	S½NW¼; SW¼NE¼; NE¼SW¼; N½SE¼, SE¼-SE¼ Sec. 35-135-96	Hettinger	Coal Bank Creek, trib., Cannonball River	.86	68.9	10-2-52
465	Joe Bagley, Marmarth	W½SW¼ Sec. 28; W½NW¼ Sec. 33-130-106	Bowman	Little Missouri R.	1	78	10-2-52
467	Frank Bradoc, Marmarth	SE¼SW¼; E½SE¼ Sec. 13; N½NW¼, SE¼NW¼; NW¼NE¼ Sec. 24-132-107	Bowman	Beaver Creek, trib., Little Missouri	1	79	10-14-52
468	Martin Tonn, New Rockford	NW¼NE¼, S½NE¼ Sec. 33-149-66	Eddy	James River	1	76	10-28-52
469	Harvey Candee, Gladstone	SW¼ Sec. 33-139-94	Stark	Antelope Creek, trib., Heart River	.936	74.9	12-8-52
470	Theo Polsfut, Benedict	S½SE¼ Sec. 3; N½NE¼ Sec. 10-151-82 (Pending International Joint Commission action)	Ward	Unnamed Creek, trib., Newmon Coulee	2	61.41	11-12-52
471	Ivan Hinshaw, Halliday	NW¼; NE¼SW¼ Sec. 33-145-91	Dunn	Spring Creek, trib., Knife River	.860	68.8	12-11-52
472	Waldo Woodbury, Brisbane	NE¼NE¼ Sec. 25-132-87; NW¼NW¼, S½NW¼; N½SW¼, SE¼SW¼; SE¼ Sec. 30-132-86	Grant	Cannonball River	2.2	178.9	12-19-52
475	Walter Wagy, Shields	N½NW¼, SE¼NW¼; N½NE¼, SW¼NE¼ Sec. 2-131-84	Grant	Cannonball River	1.76	140.8	12-30-52
477	Windon W. Keller, Dodge	N½NW¼; NW¼SE¼, S½SE¼ Sec. 14-144-91	Dunn	Spring Creek, trib., Knife River	.996	79.7	1-2-53

478	Bernard Andre, Grenora	NW¼SE¼, S½SE¼ Sec. 34-158-102	Williams	Unnamed Creek, trib., Blacktail Creek	1.5	120	1-5-53
479	Laudie Sykora, Dickinson	N½SW¼, SE¼SW¼; N½SE¼, SE¼SE¼ Sec. 8-140-95	Stark	Green River	.8725	69.8	1-10-53
480	Erick Carlson, Halliday	N½SW¼, SE¼SW¼ Sec. 34-145-91	Dunn	Spring Creek, trib., Knife River	.92875	74.3	1-12-53
481	E. James Boyd, Deering	N½NW¼, SW¼NW¼; NW¼SW¼ Sec. 25-157-80 (Pending International Joint Commission action)	McHenry	Little Deep River	850 gals per minte	114	1-14-53
483	Standard Oil Company, Mandan Refinery		Morton	Missouri River			1-17-53
484	Ray Watkins, Manning	NW¼NW¼, S½NW¼ Sec. 24-143-95	Dunn	Knife River	.99125	79.3	1-17-53
486	Marten Dahlen, Halliday	NW¼NW¼ Sec. 28; N½NE¼ Sec. 29-145-92	Dunn	Spring Creek, trib., Knife River	.8475	67.8	1-22-53
487	Leonard Peterson, Marmarth	S½NE¼; E½NW¼; NE¼SW¼; NW¼SE¼ Sec. 30-133-105	Slope	Little Missouri R.	1	80	1-29-53
491	Joe V. Ridl, Dickinson	W½NE¼ Sec. 30-140-96	Stark	Intermittent watercourse, trib., Heart River	.44125	35.3	2-7-53
492	Carl Scheuneman, Reeder	NE¼SW¼; NW¼SE¼ Sec. 32-129-98	Adams	North Fork of the Grand River	.450	36	2-9-53
493	Art Scheuneman, Reeder	SE¼SW¼; SW¼SE¼ Sec. 32-129-98	Adams	North Fork of the Grand River	.50	40	2-9-53
497	Frank J. Bogner, Gladstone	W½NE¼; E½NW¼ Sec. 17-139-94	Stark	Heart River	.24625	19.7	2-24-53
503	Hillsboro Park Board, Hillsboro	N½NE¼, SW¼NE¼; NE¼NW¼ Sec. 5-145-50	Traill	Goose River	.33	25.7	3-11-53
509	Elmer F. C. Tank & Sons, Ray	NE¼ Sec. 2-156-98	Williams	Unnamed Creek	1.2	94.8	3-16-53
512	Adolph Olson, Ray	S½SE¼ Sec. 31-157-97	Williams	Unnamed Creek	.3	19.5	3-23-53
517	Weyrauch Bros., Ray	S½NE¼; N½SE¼ Sec. 31-157-97	Williams	Unnamed Creek	1	88.3	3-30-53
518	C. J. Weyrauch, Ray	NE¼NW¼ Sec. 2-156-98	Williams	Unnamed Creek	.6	22.5	3-30-53
519	City of Carrington		Foster	Well	200		3-30-53
524	Vernon & Harris Goldsberry, Trotters	SW¼NE¼; NW¼NW¼, S½NW¼; N½SW¼; NW¼SE¼ Sec. 5; NE¼ Sec. 6-144-102	Billings	Little Missouri R.	2.8475	227.8	4-8-53
530	Lloyd Pfeilschiefter, Velva	NW¼NE¼, S½NE¼; E½NW¼ Sec. 32-152-80 (Pending International Joint Commission)	McHenry	No Name Coulee, trib., Souris R.	1	78	4-20-53
533	Fred Port, Mandan	NE¼SE¼, S½SE¼ Sec. 3; SW¼; SE¼ Sec. 2; N½NW¼, SE¼NW¼ Sec. 11-132-83	Grant & Sioux	Cannonball River	2.9	233.5	4-24-53
536	Roy Ekstrom, Dickinson	S½SE¼ Sec. 11-140-97	Stark	Intermittent Creek	.61	48.8	5-2-53
539	Nick Fergal, Shields	NE¼SW¼, S½SW¼; W½SE¼ Sec. 26; NW¼-NE¼; N½NW¼ Sec. 35-131-85	Grant & Sioux	Cannonball River	1	81.9	5-5-53

WATER-RIGHT APPLICATIONS

Filed and Approved July 1, 1952 to July 30, 1954 (CONTINUED)

NO.	Name of Applicant	Lands to be Irrigated	County	Source	Sec. Ft.	Acres	Date of Claim
540	John Fergal, Shields	NE¼; SE¼NW¼; NE¼SW¼; N½SE¼ Sec. 30-131-84	Grant & Sioux	Cannonball River	1.2	903	5-5-53
550	W. A. Seader, Fairview, Montana	N½NE¼ Sec. 27; S½SE¼ Sec. 22; NW¼NW¼ Sec. 26-152-104	McKenzie	Yellowstone R.	2	161.2	5-18-52
552	O. L. Adams, Steele	W½NW¼ Sec. 7-138-72; NE¼NE¼, S½NE¼; SE¼NW¼; NW¼SE¼ Sec. 12-138-73	Kidder	Lake Etta	1.47	117.5	5-26-53
556	Henry Polsfut, Minot	N½SE¼ Sec. 3-151-82 (Pending International Joint Commission action)	Ward	Unnamed creeks, trib., Souris River	.34	25.7	6-1-53
558	O. P. Hedstrand, Fisher, Minn.	SE¼NE¼; SW¼NW¼; N½SW¼; NW¼SE¼ Sec. 30-154-81 (Pending International Joint Commission action)	Ward	Souris River & Unnamed Creek	1.19	105.4	6-3-53
564	John J. Wentz, Napoleon	S½NW¼; SW¼ Sec. 30-135-72	Logan	Unnamed Lake	2	161.3	6-11-53
568	Charles O. McCutchan, Medora	S½NE¼; N½SE¼ Sec. 6-138-102	Billings	Little Missouri R.	1.23625	98.9	6-17-53
569	Fred Weight, Oakes	S½NW¼; N½SW¼ Sec. 28-131-59	Dickey	Groundwater	1	77	6-18-53
572	Kenneth Bagley, Marmarth	E½NE¼ Sec. 29; W½NW¼ Sec. 28; NW¼SW¼ SE¼SW¼ Sec. 21-130-106	Bowman	Little Missouri R.	.962	77	7-16-53
574	Oswald Skiftun, Breien	E½NE¼; SE¼SW¼; W½SE¼ Sec. 15-133-82	Morton	Cannonball River	1.09	87.2	7-17-53
575	J. D. Brewster, Timmer	NE¼; NW¼; NE¼SW¼; N½SE¼, SW¼SE¼ Sec. 21-133-82	Morton	Cannonball River	2.6	208.2	7-24-53
578	Fort Lincoln Tree Nursery, Bismarck	NW¼; SW¼ Sec. 15-138-80	Burleigh	Well	3	241.2	8-6-53
579	Louis Michel, Marmarth	SW¼NW¼; N½SW¼ Sec. 13-131-106	Bowman	Little Missouri R.	1	73.5	8-26-53
604	Ted Steinmetz, New England	S½NE¼; N½SE¼ Sec. 12-135-97	Hettinger	North Fork of the Cannonball R.	.93	74.4	2-20-54

WATER RIGHT STREAM FLOW INVESTIGATIONS

Many of the water right applications received by the Water Conservation Commission for diversion of water are from streams of which little or no flow data is available. The State Engineer and the Water Conservation Commission have been apprehensive over promiscuous granting of water rights on streams that have small or intermittent flows. As a consequence, the Water Resources Division of the U. S. Geological Survey was contacted relative to obtaining flow measurements on a number of these streams.

As yet records on the questionable streams are not conclusive; however, they have been of aid to the Commission in determining the amount of water that may be available to irrigators during the critical months in the growing season. As a result of the available records, it has been found advisable in many instances to reduce the amount of water requested by the applicant to be more commensurate with the flow.

The Commission also endeavors to evaluate streams of minimum flow so water will be available to a number of irrigators rather than permitting the entire flow to be used by one operation.

A summary of these stream flow measurements on the smaller streams in the state can be found on the following pages.

Bennie Pierre Creek at State Line Near Sidney, Mont.

LOCATION:

Station can be reached from Sidney, Mont. by driving southeast to bridge on Yellowstone River. Follow hard-top road 4.7 miles to gravel road, then turn right and proceed 2.9 miles southeast to State Line.

The measuring section is located at a riffle about 150 yds. east of this point.

Date	Width	Area	Velocity	Discharge	Remarks
7-29-54	1.9	.47	1.66	.78	5" of rain in ½ hr. upstream about 1 week ago. Stream usually dry.

Charbonneau Creek at Cartwright, N. Dak.

LOCATION:

Station can be reached by crossing the Great Northern tracks in Cartwright and driving 0.5 mi. south on dirt road to bridge.

The measuring section is located 100 yds. upstream from the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-29-54	1.8	.28	1.06	.30	"No flow over dam 5 mi. upstream."

East Fork Little Muddy River Near Williston, N. Dak.

LOCATION:

Station can be reached from Williston by driving 9 miles north and 3 miles east on U. S. Highway No. 2; thence 4 miles north on gravel road; thence 1 mile west and ½ mile north on grass trail to bridge.

The measuring section is located at a riffle 100 ft. upstream from bridge

Date	Width	Area	Velocity	Discharge	Remarks
4-26-54	4.0	1.32	2.45	3.23	
5.24-54	3.80	1.06	2.16	2.29	
6-23-54	1.6	.38	1.87	.71	
7-21-54	.....	.....	.....	.20	Est.
8-16-54	2.10	.44	1.11	.49	

East Fork Little Muddy Near Springbrook, N. Dak.

LOCATION:

Station can be reached from Williston by driving 9 miles north and 7 miles east on U. S. Highway No. 2 to intersection of gravel road known as Spring Brook Road; thence north 6½ miles to bridge on East Fork. Station can also be reached by driving 9½ miles north from Spring Brook.

The measuring section is located 200 ft. downstream from bridge and 150 ft. below riffle.

Date	Width	Area	Velocity	Discharge	Remarks
7-16-53	3.60	.93	1.58	1.47	According to old residents this stream has never gone dry at site of measurement, but has gone dry farther downstream.
8-24-54	2.10	.89	.32	.28	
10- 1-53	2.0	0.30	1.87	0.56	
4-26-54	3.0	.87	1.36	1.18	
5-24-54	3.0	.80	.95	.76	
6-23-54	2.2	.43	.79	.34	
7-21-54	.....	.....	.....	0	
8-16-54	2.20	.38	.71	.27	

Little Muddy River Near Appam, N. Dak.

LOCATION:

Station can be reached from Appam by driving 1½ mi. west to intersection with Hwy. 85; thence south for 1½ mi.; thence west for 0.6 mi. on gravel road to bridge . The station can also be reached from Williston by driving north on Hwy. 85 for 27 miles; thence west for 0.6 mi on gravel road to bridge.

The measuring section is located 30 ft. above the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
4-20-54	.....	.....	.....	0	At site 1 mile upstream.
5-24-54	2.00	.71	1.39	.99	
6-23-54	1.8	.55	.48	.26	
7-21-54	.....	.....	Less than	.10	
8-16-54	.70	.12	.75	.09	

Cherry Creek Near Watford City, N. Dak.

LOCATION:

Station can be reached from Watford City bty driving east on Hwy. No. 23 for about 1 mile, then turn left and enter pasture through gate at corner. Follow car track N.N.W. 0.6 mile to dam.

The measuring section is located 300 ft. below the dam.

Date	Width	Area	Velocity	Discharge	Remarks
8-26-53	1.80	.422	.53	.223	Seepage under and through dam High
9-23-53	1.00	.116	.22	.026	
11- 4-53	2.00	.31	1.32	.41	
4-22-54	2.40	1.62	1.56	2.53	
5-18-54	1.2	.59	.56	.33	
6.21-54	2.5	.85	1.00	.85	
7-19-54	.....	.....	.....	0	
8-18-54	.....	.....	.....	0	

White Earth River Near White Earth, N. Dak.

LOCATION:

Station can be reached from Ray by driving east for 18 miles on U. S. Hwy. No. 2 to bridge, thence upstream along left bank on car trail for 0.2 mile.

The measuring section is 100 ft. upstream from parking area and 100 ft. below a rocky riffle.

Date	Width	Area	Velocity	Discharge	Remarks
7-17-53	20.0	24.9	2.41	59.9	According to old residents stream not known to have been dry in past 50 years.
8-24-53	12.0	7.76	1.55	12.0	
10- 1-53	.....	.....	.....	Est. 6.0	
10-29-53	13.0	14.0	.30	4.24	
5-12-24	16.0	16.8	1.17	19.6	
5-26-54	14.0	12.5	.98	12.2	
6-25-54	12.0	5.75	1.90	10.9	
7-23-54	5.0	1.81	.83	1.50	
8-20-54	2.6	.59	1.97	1.16	
9- 7-54	8.0	3.73	1.33	4.95	
9-29-54	18.0	9.54	1.07	10.2	

Knife River at Manning, N. Dak.

LOCATION:

Station can be reached by driving 0.4 mile north from Manning on Hwy. No. 22 to bridge. Measuring section is located 300 ft. upstream at a riffle and just below asmall beaver dam

Date	Width	Area	Velocity	Discharge	Remarks
7- 8-53	5.2	2.32	0.49	1.14	
9- 3-53	3.50	1.06	0.25	0.27	
9-29-53	1.0	0.13	0.15	0.02	
10-29-53	5.0	2.07	0.35	0.72	
4-20-54	14.1	7.24	0.84	6.05	
6-21-54	15	7.09	.99	7.01	
7-19-54	6.0	2.11	0.50	1.06	
8-11-54	3.6	1.18	0.56	0.67	
9-27-54	5.3	2.32	1.51	3.50	

Knife River at Marshall, N. Dak.

LOCATION:

Station is located at bridge on Hwy. No. 8 at Marshall. The measuring section is about 100 ft. downstream from the bridge and 20 ft. above a riffle.

Date	Width	Area	Velocity	Discharge	Remarks
7- 8-53	10.2	5.48	1.28	7.02	
8-31-53	9.1	4.19	1.14	4.78	
9-28-53	7.7	2.40	0.54	1.29	
10-29-53	10.4	5.82	1.53	8.88	
4-20-54	27.5	19.9	1.45	28.8	
6-21-54	26	22.0	1.50	33.0	
7-19-54	9.0	5.26	0.88	4.65	
8-11-54	...			3	Estimate
9-27-54	22	12.4	0.98	12.1	

Otter Creek at Mouth Near Beulah, N. Dak.

LOCATION:

Station can be reached from Beulah or Hazen by taking the River Road. From Beulah drive one block east from the V.F.W. hall and intersection with Hwy. 7, thence south one block across R.R. tracks, thence east about 1½ miles to bridge on Otter Creeek.

The measuring section is located about 50 ft. above the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-14-53	12.5	3.68	0.93	3.43	
8-25-53	3.0	0.64	0.95	0.61	
9-25-53	3.4	0.82	0.73	0.60	
10-20-53	3.3	0.99	0.77	0.76	
4-29-54	8.2	3.40	1.14	3.89	
6- 4-54					Est. 10 to 15 c.f.s. from
7- 9-54	5.2	1.43	1.40	2.00	
8- 9-54	4.4	1.07	0.36	0.38	

Thirty Mile Creek Near Bentley, N. Dak.

LOCATION:

Station can be reached from Mott (school) by driving 12.3 miles east on Hwy. 21 to bridge. The station is 0.5 mi. east of Bentley turnoff, 1 mile west of county line, and 6 miles west of New Leipzig.

The measuring section is located 15 feet above the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-22-53	4.3	1.60	1.18	1.88	
8-25-53	3.1	0.73	0.58	0.42	
9-23-53	4.0	1.32	0.92	1.21	
10-22-53	5.4	2.38	.92	2.20	
4-27-54	9.3	6.00	1.04	6.21	
6-15-54	7.6	3.76	1.01	3.80	
7-15-54	1.7	0.46	0.48	0.22	
8-13-54	2.6	0.49	1.82	0.89	
9-10-54	3.8	1.94	0.92	1.78	

Crooked Creek Near Manning, N. Dak.

LOCATION:

The station is located 4.7 miles south of Manning on N. D. Hwy. No. 221. It can also be reached by driving north from Dickinson for about 20 miles.

The measuring section is located just below the channel and small grass dam about 200 ft. downstream from bridge

Date	Width	Area	Velocity	Discharge	Remarks
9- 3-53	2.3	0.49	0.96	0.47	
9-29-53	2.0	.45	0.80	.36	
10-29-53	2.6	0.89	1.09	0.97	
4-20-54	2.9	2.34	.77	1.81	
6-21-54	3.5	7.25	0.65	4.73	"Rain"
7-19-54	1.7	0.38	0.92	0.35	
8-11-54	2.7	0.48	0.75	0.36	
9-27-54	3.7	1.15	0.75	0.86	

Little Knife at Hebron, N. Dak.

LOCATION:

Station can be reached by driving 3 blocks south from depot in Hebron or by turning off from Hwy. 10 about 2 blocks east of the Texaco Service Station; thence 1 block north.

The measuring section is under the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-29-54	.....	------	----	0	
8-30-54	------	------	.	.01	
9- 8-54	------	------	.	0	
9-29-54	... ..	------	------	0	

South Fork Spring Creek Below Killdeer, N. Dak.

LOCATION:

This station can be reached by driving ¾ mile east from center of Killdeer, thence 0.3 mi. north on county road to bridge on S. Fk. The measuring section is located 200 ft. below bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7- 8-53	2.9	0.82	0.51	0.42	About ½ of flow is sewage
9- 3-53	2.5	0.67	0.63	0.42	
9-29-53	2.2	0.44	.59	0.26	
10-29-53	2.2	0.70	0.81	0.57	
4-20-54	4.80	1.43	0.90	1.28	
6-21-54	1.5	0.64	1.44	0.92	Includes Killdeer sewage
7-19-54	1.0	0.20	0.40	0.08	
8-11-54	2.4	0.30	0.50	0.15	
9-27-54	2.0	0.70	0.74	.052	

North Fork Spring Creek Below Killdeer, N. Dak.

LOCATION:

This station can be reached from Killdeer by driving ¾ mi. east from center of town, thence 0.55 mi. north on county road to bridge on N. Fk.

The measuring section is located 600 ft. downstream from bridge and 5 ft. below an old discarded car tire.

Date	Width	Area	Velocity	Discharge	Remarks
7- 8-53	1.2	0.14	0.64	0.09	
9- 3-53	1.4	0.25	0.80	0.20	
9-29-53	1.4	0.16	0.87	0.14	
10-29-53	1.4	0.28	0.93	0.26	
4-20-54	6.60	3.00	0.08	0.23	
6-21-54	1.3	0.32	0.59	0.19	
7-19-54	0.25	0.021	0.14	0.003	
8-11-54	1.1	0.22	0.14	0.03	
9-27-54	1.1	0.23	0.52	0.12	

Spring Creek at Halliday, N. Dak.

LOCATION:

Station can be reached by driving on Hwy. 8 to bridge at northeast corner of town. The measuring section is located 25 to 75 feet downstream depending on stage. The section located 75 feet downstream is just above a large boulder; the upper section is just above a riffle.

Date	Width	Area	Velocity	Discharge	Remarks
4- 6-53	18	9.56	0.46	4.57	
7- 8-53	11.1	11.0	0.34	3.79	
8-31-53	13.5	4.74	0.43	2.06	
9-29-53	7.0	2.08	0.95	1.98	
10-29-53	4.2	2.26	1.46	3.29	
4-20-54	13.0	7.94	1.74	13.8	
6-21-54	13	22.7	0.72	16.3	Local Rains
7-19-54	4.1	1.72	1.08	1.86	
8-11-54	4.1	1.54	1.10	1.69	
9-27-54	4.4	1.86	1.40	2.60	

Spring Creek Below Ilo Dam Near Dunn Center, N. Dak.

LOCATION:

Station can be reached from Dunn Center by driving about 1 mile straight west on park road, thence 0.4 mile south along base of earth fill dam to concrete ford.

Measuring section is located about 100 ft. downstream from ford and about 400 ft. below spillway.

Date	Width	Area	Velocity	Discharge	Remarks
4- 1-53	------	------	. ...	.05	Estimated. Seepage.
7- 8-53	1.4	0.20	0.85	0.17	90% seepage
9- 3-53	2.4	1.04	1.06	1.10	
9-29-53	2.4	0.56	0.32	0.18	
10-29-54	1.1	.33	.18	.06	Seepage
4-20-54	4.1	1.45	0.63	0.90	
6-21-54	10	14.2	1.34	19.0	Local rains
7-19-54	1.3	0.30	0.29	0.09	
8-11-54	1.5	.15	.53	0.08	
9-27-54	1.4	0.15	0.40	.06	

Painted Woods Creek Near Washburn, N. Dak.

LOCATION:

Station can be reached from Wilton by driving 9.3 mi. northwest on U. S. highway 83 to junction with road to Wildwood, then 1 mi. north, 1 mi. east, and 1.2 mi. north to bridge.

Measuring section is 75 ft. below the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-20-53	6.0	2.94	1.27	3.72	
8-13-53	5.2	1.28	.35	.44	
9-10-53	. .	----	.....	0.3	Estimate
10- 9-53	1.2	.18	.94	.17	
10-30-53	4.5	1.92	.52	1.0	
12- 3-53	6.0	1.54	.64	0.98	
5-18-54	6.4	2.37	.47	1.10	
7-11-54	11.0	12.4	.81	10.1	
8-25-54	3.10	0.75	0.77	0.58	
9-16-54	8.50	3.98	1.55	6.17	
10- 7-54	4.50	1.81	.58	1.05	

Antelope Creek Near Gladstone, N. Dak.

LOCATION:

Station can be reached from Gladstone by driving 4 mi. south on county road.

The measuring section is 50 ft. below the bridge and just above a rocky riffle.

Date	Width	Area	Velocity	Discharge	Remarks
8-31-53	14.0	4.84	0.32	1.55	At least ½ of flow from spring above bridge.
9-30-53	1.1	0.20	0.45	0.09	
10-29-53	4.0	1.00	1.22	1.22	
4-29-54	17	5.97	0.96	5.72	
6-22-54	6.0	1.40	0.72	1.01	
7-12-54	2.0	0.78	0.56	0.44	
8-30-54	7.3	2.00	0.72	1.43	
9-29-54	1.3	0.30	0.67	0.20	

Little Heart River Near St. Anthony, N. Dak.

LOCATION:

Station may be reached from Mandan by driving 10 mi. south on N. Dak. highway 6, or by driving 4.3 mi. north from St. Anthony to bridge.

Measuring section is 50 ft. below the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-20-53	4.4	1.26	.40	0.51	
8-14-53	5.8	1.87	.016	0.30	
9-22-53	2.0	0.28	.068	0.19	
10- 6-53	3.0	0.53	0.37	0.20	
10-21-53	3.6	------	0.50	0.45	Estimate
11-18-53	1.8	0.38	0.74	0.28	
5-19-54	-- . .	----	------	0.10	
7- 7-54	7.00	2.90	1.42	4.12	
8- 6-54	------	------	. ...	0.25	
8-24-54	------	--	------	0.05	
9-23-54	------	------	------	0	

Green River Near Dickinson, N. Dak.

LOCATION:

Station can be reached from Dickinson by driving 6 miles north on Hwy. 22 to bridge.

Measuring section is located 150 ft. below present bridge, 25 ft. below fence, and 75 ft. above riffle.

Date	Width	Area	Velocity	Discharge	Remarks
7- 8-53	10.1	5.16	0.50	2.58	
9- 3-53	5.0	1.24	1.07	1.33	
9-29-53	5.0	1.05	.81	.85	
10-29-53	7.0	5.48	0.57	3.14	Water now flowing in channel
4-20-54	14.0	6.94	1.35	9.38	
6-21-54	. .	------		14.9	Rain
6-23-54	14	8.18	1.11	9.06	
7-19-54	5.4	1.29	0.73	0.94	
8-11-54	6.2	1.35	.58	0.78	
9-27-54	5.3	1.63	0.83	1.36	

Louise Creek at Flesher, N. Dak.

LOCATION:

Station may be reached by traveling east along railroad tracks for 800 feet from main street in Flasher.

The measuring section is at rock fill under the railroad bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-23-54	1.2	0.29	.28	0.08	
8-16-54	-----	---	-----	0.05	
8-24-54	..	-----	-----	0.02	
9-22-54	-----	... ---	---- .	.02	

Cannonball River at New England, N. Dak.

LOCATION:

Station can be reached from New England by driving 0.45 mi. south from R.R. tracks to bridge on Cannonball River.

Measuring section is located 150 feet upstream from bridge above a riffle.

Date	Width	Area	Velocity	Discharge	Remarks
7-13-53	10	2.46	0.21	0.52	
8-24-53	2.9	0.62	0.48	0.30	
9-22-53	2.3	0.38	0.42	0.16	
10-21-53	6.0	1.54	.73	1.13	
4-27-54	4.6	2.58	0.99	2.56	
6-15-54	4.2	2.06	0.17	0.34	
7-16-54	1.1	0.16	0.25	0.04	
8-13-54	3.05	0.54	0.33	0.18	
9-23-54	1.8	0.33	0.52	0.17	

Square Butte Creek Near Harmon, N. Dak.

LOCATION:

Station may be reached from Mandan by driving 15 mi. north, from edge of town, on state highway 25, or 9.7 mi. north of junction 25 and old U. S. highway 10 fo bridge on Square Butte Creek.

Measuring section is 50 ft. below bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-20-53	5.2	2.42	1.12	2.70	
8-11-53	5.3	2.25	.37	0.83	
8-14-53	5.8	3.35	2.39	0.80	
9-22-53	5.4	2.64	.33	.88	
10- 8-53	6.0	2.82	0.18	0.52	
10-22-53	20	21.4	0.46	9.83	
11-19-53	6.4	3.91	0.89	3.48	
5-18-54	8.50	4.84	0.77	3.73	
7- 7-54	9.50	5.00	1.04	5.20	
7-28-54	6.5	1.99	1.05	2.09	
8-26-54	11.0	1.54	0.86	1.33	
9-23-54	8.0	6.26	.39	2.47	

Russian Spring Creek Near New Hradec, N. Dak.

LOCATION:

Station can be reached from Dickinson by driving 9 mi. north from Sax Motor Co. on Hwy. 22 or 2 mi. north from county line; thence 2 mi. east to bridge and measuring section.

Date	Width	Area	Velocity	Discharge	Remarks
7-29-54	-----	-----	-----	0	
8-11-54	-----	.....	-----	0	
9-27-54	-----	-----	------	0	

Cedar Creek Below Cedar Creek Dam Near Reeder, N. Dak.

LOCATION:

The station can be reached from New England by driving 22 mi. north on Hwy. 22 from junction Hwys. 22 and U. S. 12 near Reeder to bridge.

The measluring section is located 200 ft. below the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-13-53	0.5	.05	0.14	.007	
8-24-53	-----	-----	-----	0	
9-22-53	-----	-----	-----	0	
10-21-53	.....	-----	-----	0	
4-27-54	4.4	0.97	1.77	1.72	
5-18-54	-----	-----	-----	0	
6-15-54	0.5	0.14	0.21	0.03	
7-16-54	-----	-----	-----	0	
8-16-54	-----	. ...	.....	0	
9-16-54	-----	-----	-----	0	

Sprink Creek Near Linton, N. Dak.

LOCATION:

Station can be reached by driving 2½ miles north from Linton, N. Dak.

Date	Width	Area	Velocity	Discharge	Remarks
8-23-54	3.6	1.21	1.06	1.28	
9-21-54	2.4	1.11	1.00	1.12	

Maple River Near Ellendale, N. Dak.

LOCATION:

At north line Sec. 22, T. 129 N., R. 62 W. May be reached by going 4 mi. east of Ellendale on N. D. 11, then 1.5 mi. south on gravel road, then .4 mi. east to bridge.

Established Aug. 30, 1954, by K. Nelson. RP2 - 14.00 is top of downstream handrail of bridge 13' right of left abutment. Low water section 200' ca nbe used up to g.th. 3.8'±.4'. Zero flow at g.th. 0.8'±.05' Max. g.th. 10'±2', disch. 1,500 to 2,00 c.f.s. Few trees on bank.

Date	Width	Area	Velocity	Discharge	Remarks
8- 5-54	20	16.7	.10	1.73	
8-19.54	2.0	0.75	0.75	0.56	
8-30-54	7	2.43	.46	1.11	
9-23-54	-----	-----	-----	0.02	Results not comparable. Measurment made at different location.

Maple River Near Enderlin, N. Dak.

LOCATION:

In SW¼ Sec. 15, T. 137 N., R. 54 W., Cass County. May be reached by going 5 mi. east of Enderlin on N. D. 46, then 3.2 mi. north on gravel road.

Established 8-5-54 by K. Nelson. R.P.1=14.00 is top of steel railing of bridge 2' right of downstream left abutment. Wading section is 500' below bridge for stage up to 3.2'. "O" flow at g.th. 0.4'±.4'. Approx, max. g.th.= 9.5'±1' with disch.=1,500 to 2,000 c.f.s. Banks heavily wooded.

Date	Width	Area	Velocity	Discharge	Remarks
8- 5-54	18	9.08	.34	3.07	
8-18-54	14.2	5.52	.35	1.94	
8-30-54	12	4.13	.49	2.03	
9-25-54	6.5	5.08	.45	2.29	

Turtle River at Mekinock, N. Dak.

LOCATION:

At bridge on north-south gravel road ½ mi. N.E. of Mekinock. May be reached from Grand Forks by driving 14 mi. west, then 6.2 mi. north to station.

Low water measurements may be made 30 feet below the bridge or about 200 feet above the bridge.

Date	Width	Area	Velocity	Discharge	Remarks
7-30-54	------	------	------	0.26	Meas. made 200' above
8-20-54	------	------	------	0.09	the bridge.
9-30-54	------	------	------	0.27	

Bear Creek Near Oakes, N. Dak. (Dickey County) James River Basin

LOCATION:

In NE¼ sec. 8, T. 131 N; R. 59 W. May be reached by going 3 mi. north from Oakes on N. D. 1. Established August 30, 1954 by K. B. Nelson. R.P.1=16.00 top of downstream handrail 5.5' left of right abutment. Wading section is 200' below bridge up to g.th. 0.95.

Date	Width	Area	Velocity	Discharge	Remarks
8-30-54	------	------	------	.01	
9-23-54	------	------	------	.01	

ORGANIZED IRRIGATION DISTRICTS

There are in North Dakota 9 organized irrigation districts. Of the districts organized 6 are operating, 1 is under construction and 2 are organized but construction of irrigation facilities has not been undertaken. The operations of these organized irrigation districts will offer a guide for other districts that will be organized in the future as irrigation development in the state progresses.

Of the organized districts that are operating, the oldest is the Lower Yellowstone Project located in McKenzie County first irrigated in 1909 and comprises some 20,000 acres in North Dakota. Of the other operating projects 3 are located in McKenzie and Williams counties on the Yellowstone and Missouri Rivers. These were organized and constructed during the 30's and early 40's.

A brief discussion of these projects is as follows:

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 is about $3.00 per acre. In addition the annual operation maintenance charge for the district is, as 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 on the project, and all grain and forage crops are consumed in the feeding operation. Dairying together with hogs, sheep and poultry are also important operations.

Data concerning the project facilities are as follows:

1. Location

State ..... Montana and North Dakota
Counties ..... Richland and Dawson, Montana; McKenzie, North Dakota
Project Headquarters ..... Sidney, Montana

2. History

Authorized ..... By Secretary of Interior May 10, 1904
Construction began ..... Summer of 1905
First water available ..... April 30, 1909
Transferred ..... Irrigation Districts Nos. 1 and 2 Board of Control January 1, 1932

3. Irrigation Plan

Scheme of Development

Diversion of water from Yellowstone River 18 miles below Glendive, Montana, into canal on west side of river, to confluence of Missouri and Yellowstone Rivers.

Engineering Features

Diversion Works

Dam—Lower Yellowstone

Location	Intake, Montana
Type	Rock filled timber weir, earth dike
Hght. above foundation	12 feet
Hght. above stream channel	9½ feet
Base thickness	50 feet
Crest length	1,600 feet (dam 700; dike 900)
Volume	17,386 cubic yards

Spillway

Type	Ogee type

Outlet Works

Type	11—5′ vertical gates

Canal—Main

Location	From dam at Intake, to confluence of Missouri and Yellowstone Rivers
Length	71.6 miles
Initial capacity	830 second feet
Present capacity	1,200 second feet

Laterals

Length	225 miles

Drains

Length	105 miles

4. Area of Irrigable Lands

Area for which Project was prepared—to supply water.

	Acres
Class 1	12,915
Class 2	20,797
Class 3	11,273
Class 4	2,380
Class 5	9,835
Total and ultimate irrigable area	57,200
Average Size of Farms	100 acres
Feeder Cattle, Approximate	10,000
Feeder Lambs and Sheep, Approximate	150,000

5 Agriculture

Principal products	Corn, oats, wheat, alfalfa, other forage crops, and sugar beets
Character of soil	Deep sandy loam,very little alkali and gumbo
Annual rainfall (1930-1944)	12.62
Length of growing season	5½ months
Temperatures (1944)	Max. 95; Min. –23; Ave. 44

Sioux Irrigation Project

The Sioux Irrigation Project is located on the right back of the Yellowstone River in McKenzie County approximately six miles northwest of Cartwright and twenty 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 1460 acres of Yellowstone bench land. At present about 700 acres are being irrigated with a possibility of the remaining area being irrigated 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 $21,500.00. 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 6 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 th 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 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 constructionof 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.

Average crop yields on the project are:

Alfalfa—3½ to 5 tons per acre
Corn (Silage)—7 to 12 tons per acre
Oats—40 to 80 bushels per acre
Barley—35 to 75 bushels per acre
Wheat—20 to 35 bushels per acre
Flax—15 to 25 bushels per acre
Potatoes—200 to 350 bushels per acre

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 fo land. Construction of the project was operated by the Buford-Trenton Mutual Aid Corporation with the project being under the direction of the Department of Agriculture and recently the Bureau of Reclamation. In 1950 the landowners of the project voted to organize an irrigation district. At the present time negotiations are underway between the Bureau of Reclamation and the district for a repayment contract for the land and the irrigation facilities of the district.

The facilities of the project include a pumping plant consisting of 3 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 $53,000.000 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 above this height are diverted into a series of 7 ponds adjacent to the river channel and along the river below the dam,

6 on the west side of the river and one on the east side. A natural levee between the river and the ponds exists 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 2 to 4 weeks and then is drained back into the river through wastegates. Normally a period of 5 days is required to fill all 7 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 2 rows of sheet steel piling with a maximum length of 45 feet, 18 feet apart. There are 8 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 Stantion 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 about 2,100 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 Korshoj Construction Company held the prime contract for 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 tc 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 $789,000. 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. The project facilities provided by the Bureau of Reclamation do not include land leveling and farm structures required by the individual operators on the project.

The Fort Clark Irrigation District was organized in 1948 and the electors of the district voted to accept the repayment contract offered by the Bureau of Reclamation in October 1950. The proceedings leading to the organization of the district and acceptance of the repayment contract were reviewed by the Supreme Court and validated in July, 1951.

Western Heart River Irrigation Project

The Western Heart River Irrigation Project comprises 2537 acres of land along the Heart River in Grant County below the Heart Butte Dam. This land will be 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 10 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 negotiations are underway at the present between the district and the Bureau of Reclamation for a repayment contract.

During the period that construction of the irrigation facilities of the project were delayed by negotiations and litigation, several of the farmers owning irrigable land included in the district made arrangements from the Bureau of Reclamation to purchase water from that stored in Heart Butte and accomplish their own irrigation. The Bureau sold the water under this arrangement for 1.50 per acre.

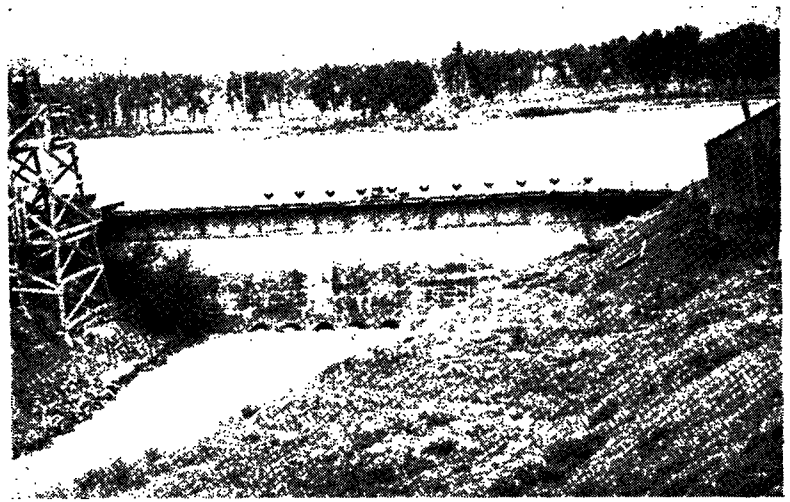
Bowman-Haley Project

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. The 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, although this report on the project has not been made public. 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.

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.

Recently landowner in the district have indicated a desire to develop the North Dakota project. The extension of the Sidney project to include the North Dakota area will require increasing the pumping plant capacity of the Sidney project from the present 22 cubic feet per second capacity to 62 cubic feet per second. The main canal would have to be extended 6½ miles and a second canal about 5 miles long to serve some higher bench lands would have to be constructed. A relift pumping plant with a capacity of about 16 cubic feet per second would have to be installed to serve these higher areas. About 2½ miles of transmission line would also have to be constructed to serve the relift plant.



Intake Structure—Lower Yellowstone Project

WATER CONSERVATION AND FLOOD CONTROL DISTRICTS

Provision has existed in the North Dakota water laws since 1935 whereby Water Conservation and Flood Control Districts can be organized to provide a local governmental entity through which construction, operation and maintenance of facilities to cope with local water problems can be accomplished. The districts organized under this law have wide powers in carrying out their duties. They have the power to levy a tax of up to 3 mills on the property within the district, levy special assessments, contract with other governmental agencies for the construction and operation and maintenance of works of their projects and to do all things necessary to carry out the duties assigned to the district by the act.

The district is organized by the order of the State Water Conservation Commission upon receipt of a petition by the Commission from the board or boards of county commissioners, in which the proposed district is located, municipalities involved, or 50% or more of the freeholders in the district, and if it is determined that such a district is necessary and proper. Following the order of the Commission organizing such district the board of county commissioners in which the district is located appoints 3 members as the board of commissioners for such district, or if the district encompasses an area in two or more counties, 3 from the county with the largest area and 2 from each of the counties of the smaller area.

Several of these districts have been organized in North Dakota to cope with various problems within their boundaries. A list of these districts and a summary of their activities is as follows:

Bowman County Water Conservation and Flood Control District

Organized in 1949 to provide a local agency in connection with efforts on the part of local interests to obtain the construction of the Bowman-Haley Irrigation Project. Action as far as constructing this project is concerned has been delayed.

Pembina County Water Conservation and Flood Control District

Organized in 1950 to provide district through which facilities for various needed flood control facilities could be provided. This district has been active in providing for the construction of several river channel improvement projects that have alleviated flood conditions in that county. Recently this district has been used in connection with the Tongue River Watershed Project in Pembina County that is being constructed by the Department of Agriculture, U. S. Soil Conservation Service.

Nelson County Water Conservation and Flood Control District

Organized in 1946 to provide a local agency that could provide for the maintenance of the various dams constructed in that county by federal agencies during the 1930's.

Rush River Water Conservation and Flood Control District

Organized in 1949 to provide a local agency that could sponsor the construction of facilities that would provide for flood control and drainage of area within the District in Cass County and for the operation and maintenance of those facilities. This district has been active in working out a solution of their problems of accomplishing the necessary work for their project. The construction of the project will be under the Corps of Engineers and will proceed in the near future. The district has obtained all the necessary easements for the project without cost to the District or the government and have functioned very effectively in solving their problems.

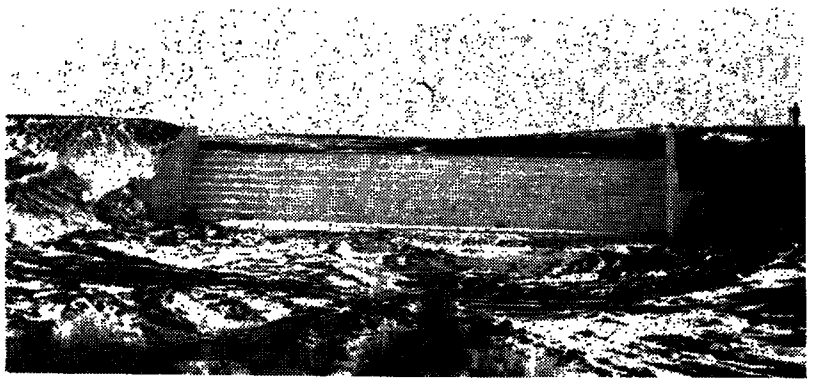
Swan Creek Water Conservation and Flood Control District

Organized in 1953 to provide a district that could act in securing the construction of river channel improvement of Swan Creek in the vicinity of Casselton in Cass County. Negotiations with the Corps of Engineers for the facilities for this project have been temporarily delayed and an application has been submitted to have the area in this district included in a watershed project.

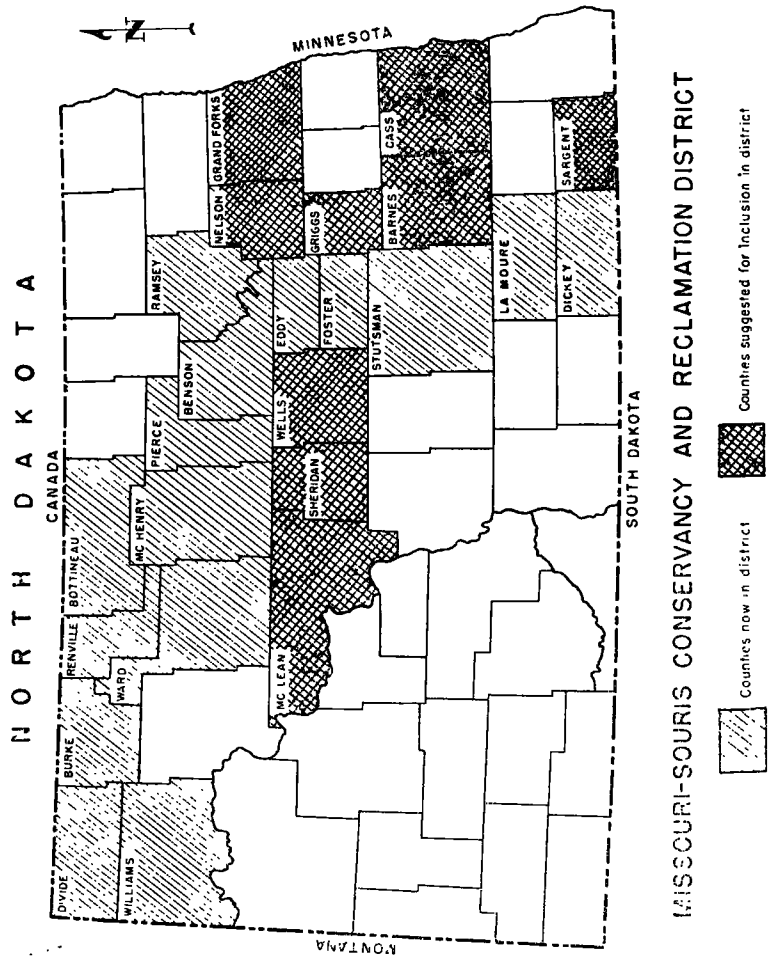
Lower Heart River Water Conservation and Flood Control District

Organized in 1953 and embracing the area along the Heart River in Morton County including the City of Mandan, the district's main function is to provide a local entity that can deal with the Corps of Engineers for the construction and operation and maintenance of added facilities needed for flood control along the lower Heart River. The district has been active in fulfilling local requirements for an existing project and in completing the survey and design of the added proposed facilities.

With the introduction of the watershed protection projects by the Soil Conservation Service, the need for water conservation and flood control districts has grown. This type of organization lends itself very well to the establishment and operation and maintenance of such projects. Many requests have been received from other states by the State Water Conservation Commission for information as to this type of district for their use in setting up similar districts for such projects.



Cedar Dam Spillway



GARRISON DIVERSION CONSERVANCY DISTRICT

The original authorization for the Missouri River Basin program included a plan for diversion of water from the Missouri River Below Fort Peck in Montana eastward into North Dakota. This plan contemplated the irrigation of large areas in northwestern and central North Dakota. In 1949, while the investigations were being made of this plan, the North Dakota State Legislature enacted what is known as the Missouri-Souris Conservancy and Reclamation District law. Two of the reasons for enacting such legislation at that time were: 1] to have a provision in our North Dakota laws for the organization of a legal entity that could contract for the construction and operation and maintenance of the project and 2] to demonstrate the state's good faith in promoting this project by providing for a tax levy through which the areas in the state to be affected by the development could provide for their share of the costs of the project.

In the plan being studied at that time the areas proposed for irrigation were located in 15 counties in the state which are as follows: Divide, Burke, Renville, Bottineau, Williams, Ward, McHenry, Pierce, Benson, Ramsey, Eddy, Foster, Stutsman, LaMoure, Dickey. It should also be noted that the plan anticipated other benefits to this area in providing municipal water, stream pollution abatement, recreation facilities, fish and wildlife conservation and propagation and restoration of lake levels. The 1949 Conservancy District law provided that the district would be organized upon the request of the State Water Conservation Commission and would have a Board of Directors composed of one director from each county appointed by the resepective Boards of County Commissioners of counties in the district. The District would have the power to levy a tax up to one mill on the taxable valuation of all the property in the district to pay the costs of contracts entered into by the District. It should be noted that although the district contained the entire areas of all the 15 counties included, the direct benefits from irrigation would not accrue to all areas in those counties. The theory followed in establishing the district boundaries as they were set out was that the entire county would benefit as a result of the development in a more stable economy, increased business and in recreation facilities, municipal water, etc., and therefore should share in the costs of the district. The organization of the Conservancy District and the ability of the District to levy a 1 mill tax did not preclude the organization of irrigation districts within the Conservancy district to contract for the construction of their facilities and to levy special assessments for the costs of such facilities.

As investigations proceeded on the plan for the development of the Missouri-Souris Project it was determined that much of the land proposed for irrigation in the project originally was non-irrigable because of poor drainage characteristics of the soils and therefore it would be necessary to eliminate these lands from the project. In the course of these investigations, however, it was found that there were several other large areas, not included in the original plan, that provided excellent possibilities for irrigation development. It was determined further that it would be more economical and feasible to divert water from the Garrison Reservoir than from below Fort

Peck in Montana and therefore investigations were directed to the Garrison Diversion Plan.

As a result of the change in the plan the Missouri-Souris Conservancy District as provided in the 1949 law did not include all counties containing areas that would be served by the development and, on the other hand, contained areas that might not be benefited. It became apparent that some revision to Conservancy District law would have to be made by the legislature in order that the area included in the district would conform to the plan being developed.

In January of this year, a committee known as the Missouri-Souris Conservancy and Reclamation Committee composed of 24 legislators and community leaders from the 24 counties in the state that will be affected by the project, was appointed by the Governor, and organized. The additional counties that would be affected most by the project are: McLean, Sheridan, Wells, Nelson, Grand Forks, Griggs, Barnes, Cass, Sargent. The purpose of this committee was to study the water program for the North Dakota and existing Missouri-Souris Conservancy law with the view of proposing revisions to the 1955 session of the legislature.

It is anticipated that when the project is developed the Conservancy District and water users will have to pay the costs of operating and maintaining the facilities. In the first few years it is not anticipated that the irrigation development will be sufficient to pay these costs for the initial supply works necessary to bring water to points from which it will be available for diversion to the lateral canals and the irrigable areas. The estimated initial annual costs of operating and maintaining these facilities is $265,000.00 As the project is developed and the facilities are expanded this cost would increase until at full development the costs would be between 3½ and 4 million dollars. Because of the limited irrigation development in the first few years it can be expected that the Conservancy District would be required to pay these costs during this time. It can also be expected that as irrigable areas are developed the additional operation and maintenance costs will be paid by the water users themselves.

There are several changes that this committee will most likely wish to consider in their work. Some of these are:

1. Expanding the district so that it will include up to the 24 counties represented on the committee.

2. Providing a more equitable method of paying the expenses of the directors of the district.

3. Making the approval of contracts by the Board of Directors of the District final.

4. Providing an "escape clause" whereby counties that will not benefit sufficiently from the project might be able to be excluded from the district.

5. Providing a more flexible method of providing funds for the operation of the district.

FINANCES

When the legislature organized the State Water Conservation Commission in 1937, it made an appropriation to the Commission and provided that the Commission could issue its revenue bonds for the construction of irrigation projects in the state. Each legislature since that time has appropriated funds to the Commission to carry out the duties and functions assigned to it. The Commission has an outstanding bond issue that was made to cover the costs of several projects constructed during the late 1930's and early 1940's. A summary of the appropriations received by the State Water Conservation Commission for the 1953-1955 biennium and an explanation of the purpose for which these appropriations are used can be found on the following pages.

Commissioners Per Diem and Expenses—$6,000.00

Appropriations for this item are used to pay the per diem allowance and travel and maintenance expenses of the members of the Commission while attending meetings and conferences and conducting other official business for the Commission in the state.

Administration—$40,000.00

This item is used to cover the general administrative expense of the Commission. Included are salaries and travel expenses of administrative personnel, office supplies, equipment, and all other expenses connected with the administrative work of the Commission.

Maintenance of Dams—$100,000.00

The Commission's share of the cost of repairing small dams throughout the state is paid from this item. This dam repair program is financed on a cooperative basis with local groups or agencies and the State Game and Fish Department sharing in the costs. These funds are used to cover the purchase of materials and supplies, labor and salaries, equipment rental and all other expenses of the various repair jobs. The actual work is done by repair crews of the Commission using state equipment.

International and Interstate Commissioners and Conference Expenses—$8,000.00

Expenses incurred by the members and employees of the Commission while attending out-of-state meetings and conferences of an international or interstate nature such as river compact meetings, congressional hearings, Missouri River Basin meetings and similar activities are paid from this item.

Topographic Surveys—Cooperation with U. S. Geological Survey—$30,000.00

Appropriations for this item are used to pay the state's 50% share of the costs of conducting topographic mapping of the state in cooperation with the U.S. Geological Survey.

Hydropraphic Surveys—Cooperation with U.S. Geological Survey—$25,000.00

The state's 50% share of the costs of maintaining stream gaging stations and gathering and compiling stream flow data is paid from this appropriation. The U.S. Geological Survey is in charge of this program.

Salary—State Engineer—$6,000.00

The Secretary and Chief Engineer of the State Water Conservation Commission is also designated State Engineer. He is the supervisor of the use of all the waters of the state. The item of the appropraition is used to pay his salary as State Engineer for the biennium.

Engineering and Geological Surveys and Demonstrations—$35.000.00

This item is used to pay the state's share of the costs of conducting underground water surveys for communities in the state in cooperation with the U.S. Geological Survey and the local communities. The U.S. Geological Survey pays 50% of the costs of this work and state constitutes the other 50%. The State Water Conservation Commission has designated the State Geologist as its representative in matters dealing with underground water surveys.

Cooperation with U.S. Departments and for Organizing Conservation & Irrigation Departments—$50,000.00

This appropriation is used to finance cooperative programs for development of water resources in the state with various federal agencies such as the Bureau of Reclamation, Corps of Engineers, Soil Conservation Service, Department of Agriculture and others. These programs include soil surveys, surveys of areas for irrigation development and other investigations. This appropriation is also used to assist in organizing irrigation and conservation district.

Small Projects, Other Investigations, Demonstrations, etc.—$100,000.00

This appropriation is used by the Commission in making surveys, investigations and plans for development of areas in the state not covered under other programs of federal or state agencies. Information compiled in these investigations is available to other agencies for use in their programs.

Construction and Reconstruction Drains or Irrigation

Since 1943 the State Water Conservation Commission has received an appropriation for Construction and Reconstruction of Drains or Irrigation as discussed on pages 37-41 of this report. In administering payments to the counties from this appropriation for drainage work, difficulties arose because of the time limit as to the availability of that appropriation. In many cases allocations were made to counties for various projects and then because of delays resulting from litigation and for other reasons construction was not completed before the appropriation expired and was no longer available. In order to eliminate this difficulty, the appropraition request submitted to the 1953 legislature requested that the funds appropriated for this purpose be continuing so that specific allocations could be made for projects and definite assurance could be given that such funds would be available. The legislature approved this recommendation partially in appropriating $140,000.00 for the period July 1, 1953, to June 30, 1957. Almost the entire amount of this appropriation has been allocated for various drainage projects and several

payments have been made to counties as outlined in the section on Drainage of this report.

BONDS OUTSTANDING

When the State Water Conservation Commission undertook the organization and construction of several irrigation projects during the 1930's and early 1940's several bond issues were sold to obtain funds to finance the work. These bond issues were secured by bonds of the districts for whom the projects were developed. In 1945 the Commission consolidated these outstanding bond issues into one Series J issue of 63,000.00. These bonds bear interest at and are 2%, due December 10, 1957.

This bond issue is secured by a Sinking Fund composed of U. S. Government Bonds, Sioux Irrigation District Bonds and cash not invested in securities and is on deposit with the Bank of North Dakota as Sinking Fund Trustee. The status of this issue is as follows:

Series J Bonds—2%	63,000.00

Secured by Sinkink Fund on Deposit with Bank of North Dakota as Sinking Fund Trustee, composed of:

Cash	$ 1,519.99
Series G & K U.S. Government Bonds—2½%	71,500.00
U.S. Treasury Bonds—2½%	3,000.00
Sioux Irrigation Bonds—3%	21,500.00
	$97,519.99

SIOUX IRRIGATION DISTRICT BONDS

Construction of the Sioux Irrigation Project was financed with funds in the amount of $25,000 borrowed by the State Water Conservation Commission from the Rural Rehabilitation Corporation. The district in turn issued its bonds to the Commission in the amount of $25,000.00. The Commission's obligation to the Rural Rehabilitation Corporation was settled in the transaction of the Series J Refunding issue discussed above.

In July 1949 the Sioux Irrigation District had retired $3,500.00 of the outstanding bond issue and had paid all interest due up-to-date. At that time the district requested that their outstanding bond issue be refunded and a schedule of repayment be set up by which the district could set up an assessment that would remain the same each year and would be sufficient to retire their obligation. The blance of the issue outstanding as of July 1, 1949 was refunded on April 1, 1954 so that the Refunding Bonds would be retired over a 30-year period and would draw 2¼% interest during this time. The first of the Refunding Bonds are to be retired on April 1, 1955.

CONSTRUCTION BOND GUARANTY FUND

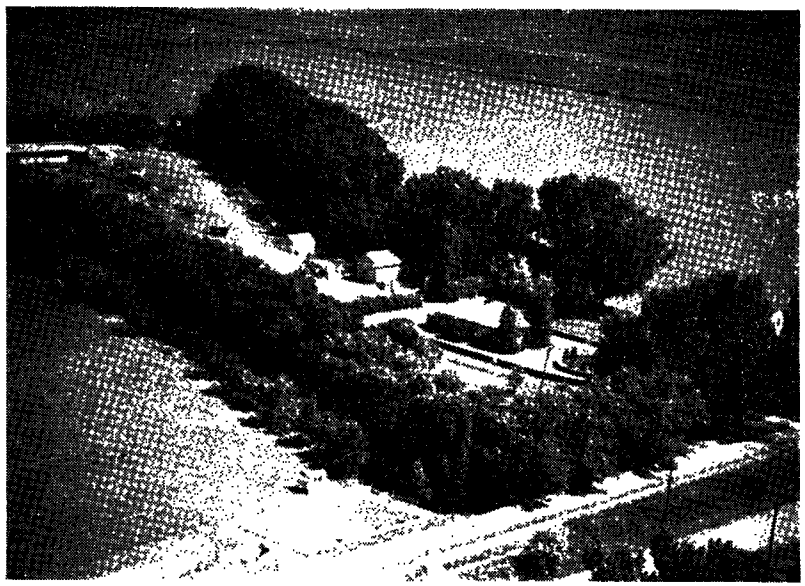
The legislature in 1939 appropriated $50,000.00 to the State Water Conservation Commission as a Construction Bond Guaranty fund to be used by the Commission to provide security, up to 20% of bond issues of irrigation districts. The purpose was to provide additional security for these bond issues so the irrigation districts would be able to secure a more favorable

interest rate. This appropriation is continuing and does not revert to the General Fund. The 1941 legislature appropriated an additional $40,000.00 for this purpose making the total appropriated to this fund $90,000.00.

Of this appropriation $19,459.00 has been deposited with the Bank of North Dakota as collateral for various bond issues and is included in the Sinking Fund for the Commissions Series J Bond issue.

YELLOWSTONE PUMPING IRRIGATION DISTRICT WARRANTY

In 1939 the State Water Conservation Commission loaned $3,500.00 to the Yellowstone Pumping Irrigation District to finance the enlargement of the intake structure of the Sidney project in Montana so that it would be sufficient to serve the Yellowstone Pumping Irrigation Districts in North Dakota. The district issued a construction warrant to the Commission covering this advance. Assessments were to be levied on lands in the district to pay this construction warrant. Tax collections applied to interest and principal of this warrant to June 30, 1954 total $2,021.65.



Axel Danielson Farm, Lower Yellowstone Irrigation Project

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
MONTHLY REPORT OF APPROPRIATIONS AS OF JUNE 30, 1954
1953 - 1955 Appropriations

Fund No.	Appropriation Title	Available July, 1953	Expended to May, 1954	Expended June, 1954	Balance June 30, 1954
1.	Commissioners—Per Diem and Expenses	$ 6,000.00	$ 1,899.74	$ 217.18	$ 3,883.08
2.	Administrations	40,000.00	16,641.50	1,586.49	21,900.75
	Collections and Refunds	128.74			
3.	Maintenance of Dams	$100,000.00	36,142.75	4,445.20	69,196.35
	Refunds	9,784.30			
4.	International and Interstate—Commissioner's Conference Expenses	8,000.00	2,374.60	99.69	5,525.71
5.	Topographic and Conservation Cooperation with U.S.G.S.	30,000.00	14,129.00	3,371.00	12,500.00
6.	Hydrographic and Conservation Cooperation with U.S.G.S.	25,000.00	7,564.82	3,686.16	16,249.02
	Transfer from No. 10	2,500.00			
7.	Salary—State Engineer	6,000.00	2,750.00	250.00	3,000.00
9.	Engineering and Geological Surveys and Demonstrations	35,000.00	15,214.54	773.00	22,512.46
	Transfer from No. 10	3,500.00			
10.	Cooperation with U.S. Departments and for Organizing Conservation and Irrigation Districts	50,000.00	15,867.43	4,701.50	29,431.07
11.	Small Projects, Other Investigations, Surveys, Etc.	100,000.00	43,679.11	3,918.20	54,939.31
	Collections and Refunds	2,536.62			
		$418,449.66	$156,263.49	$23,048.42	$239,137.75

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION

MONTHLY REPORT OF APPROPRIATIONS AS OF JUNE 30, 1954

1951 - 1953 Appropriations

Fund No.	Appropriation Title	Available July 1954	Expended to June, 1954	Balance June, 1954
1.	Commissioner—Per Diem and Expense	$ 6,000.00	$ 5,720.71	$ 279.90
	Collections and Refunds	35,000.00	38,293.58	1,191.70
2.	Administration	4,485.28		
3.	Maintenance of Dams	120,000.00	170,143.34	12,084.34
	Collections and Refunds	62,227.68		
4.	International and Interstate—Commissioner's Conference Expenses	14,000.00	7,517.59	6,482.41
5.	Topographic and Conservation Cooperation with U.S.G.S.	35,000.00	35,000.00	
6.	Hydrographic Surveys, Cooperation with U.S.G.S.	25,000.00	25,000.00	
7.	Salary—State Engineer	6,000.00	6,000.00	
8.	Construction and Reconstruction Drains and Irrigation	90,000.00	53,699.02	36,300.98
9.	Engineering and Geological Surveys and Demonstrations	35,000.00	38,500.00	
	Add: Transfer from No. 10	3,500.00		
10.	Cooperation with U.S. Departments and for Organizing Conservation and Irrigation Districts	65,000.00	60,028.99	1,471.01
	Less Transfer No. 9	3,500.00		
11.	Small Projects, Other Investigations, Surveys, Etc.	150,000.00	104,992.25	45,007.75
		$647,712.96	$555,895.48	$102,817.48

Chapter 3

U. S. Bureau of Reclamation Activities

BUREAU OF RECLAMATION ACTIVITIES

The Bureau of Reclamation, originally called the Reclamation Service, was created in 1902 by order of the Secretary of the Interior to administer the Reclamation Act adopted in that year. The primary objective of the Bureau of Reclamation is the transformation of arid and semi-arid land into productive farms through irrigation. Utilization of waters stored for irrigation to provide for flood control, hydroelectric power, municipal water supplies, recreation, stream pollution abatement and propagation of fish and wildlife are other of the multiple-purpose objectives of the Bureau of Reclamation's program.

The Bureau of Reclamation's activities in North Dakot are under the direction of Frank M. Clinton, Regional Director of Region 6, whose office is at Billings, Montana. Bruce Johnson is Supervising Engineer of the Missouri-Souris Projects Office which has jurisdiction over the greater part of North Dakota in which the Bureau of Reclamation is carrying on its work.

MISSOURI-SOURIS DIVISION

Garrison Diversion Unit

Recent investigations and surveys have revealed that the more than 1,000,000 acres of irrigable land in North Dakota can be served by diversion of Missouri River water from the Garrison Reservoir more efficiently and economically than by diversion from Fort Peck as originally proposed. In the original plan to serve the large Missouri-Souris Division located in Montana and North Dakota water was to be diverted from the Missouri River in Montanta as regulated by the Fort Peck Reservoir. This plan proposed 1,403,500 acres in North Dakota and Montana for development, of which over 1,000,000 acres was located in the Crosby-Mohall area in North Dakota and almost 200,000 acreas in other areas in the state.

As investigations of the plan for diversion from Fort Peck progressed it was found that much of the large Crosby-Mohall area was unsuitable for sustained irrigation development because of impervious subsoils which would prevent adequate drainage of the lands. Additional land resource investigations and engineering surveys have indicated that North Dakota still has about 1,000,000 acres of land suitable for irrigation development in or near the areas first proposed for development. There are about 500,000 acres of irrigable land in Bottineau, Renville, McHenry, Ward and Pierce Counties and additional land in the Devils Lake, New Rockford, Jamestown and Oakes areas. Furthermore, preliminary reconnaissance studies indicate there are three large delta areas in the western part of the Red River Valley in eastern North Dakota that together contain over 1,000,000 acres of land, much of which may be irrigable. The lands that have been determined irrigable as a result of these investigations are so located that they can be served either by diversion from the Garrison Reservoir or the Fort Peck Reservoir. Engineering studies show conclusively, however, that Missouri River Diversion for North Dakota is simpler, cheaper, and more economical

in operating cost if water is diveretd from Garrison Reservoir near Turtle Lake rather than from Montana as first proposed.

The Garrison Diversion Unit is (at present) a plan to put Garrison Reservoir to work, to irrigate 1,000,000 acres in central North Dakota, to supply water to at least 34 North Dakota cities, to raise and freshen Devils Lake, Stump Lake and others; and to provide a year-long flow of clear water to the Mouse, James, Sheyenne and Red Rivers. Eventually—if necessary—the Unit can irrigate 2,000,000 acres of land in North Dakota. The Unit includes areas formerly designated as Crosby-Mohall, Devils Lake, New Rockford and Oakes Units, and the irrigation previously associated with Jamestown Unit. It also includes lands of the former Coleharbor Unit and areas near Baldhill Dam along the Sheyenne River. The plan for Garrison Diversion Unit has all the earmarks of being the first feasible plan for Missouri River Diversion in North Dakota. The possibility is that this will someday be the biggest irrigation project in the United States.

It is forecast that 1,000,000 acres of new irrigation will provide the following specific benefits—due to irrigation alone:

1. $54,000,000 increase each year in North Dakota's farm income.
2. $200,000,000 increase each year in business.
3. 20,000 new jobs.
4. 3,600 new farms.
5. 93,000 increase in population statewide.

Engineering studies are to be completed by January 1957 so that construction can begin in the late summer of 1957. It will probably take 4 or 5 years to get the water over the divide into the Lonetree Reservoir.

The project plan for the Garrison Diversion project can be found under the section of this report on page 15 titled "Water Development in North Dakota." Planning and investigations of this project is under the direction of the Bureau of Reclamation.

Requirement for Repayment

While most of the cost of construction of the Garrison Diversion Unit will be paid from revenues received for power generated at Garrison Dam, there still remains a requirement that water diverted be sold to water users at a fair price. Before construction can start there will have to be a clear understanding that the water can eventually be sold and used for beneficial purposes. Contracts for the sale of water will be negotiated with cities and irrigation districts. It is hoped that a Conservancy District can be formed to assist in meeting the costs of operating the project — especially during the early years when irrigation is becoming established. The speed with which construction begins will depend in large measure on the speed with which the first payment contracts can be negotiated. In all likelihood, a minimum requirement for starting construction will involve a contract with the Conservancy District plus contracts for the purchase of water with at least enough irrigation districts to assure that the diversion system will have work to do when it is ready for operation.

Jamestown Unit

Jamestown Unit consists of Jamestown Dam and Reservoir, in Foster and Stutsman Counties, with an earthfill embankment across the James River about a quarter of a mile north of Jamestown. Construction of the dam began in March 1952 and was completed September 30, 1953. Incidental work included reservoir clearing, reconstruction of the Buchanan bridge, raising the Edmonds bridge, raising the approach embankments for each, and relocation of an REA power line, completed in the summer of 1954. The construction, reservoir right-of-way, engineering and investigations add up to a total cost of approximately $3,600,000. The dam provides much-needed flood control for Jamestown and other cities and farmland in North and South Dakota. It will impound return irrigtion flows from areas of Garrison Diversion Unit for diversion to irrigable lands along the James River and in the Oakes Area. The dam is built to provide a future municipal water supply for Jamestown. The reservoir has a storage capacity of 230,000 acre-feet, of which 190,000 acre-feet is for flood control.

Future work contemplated includes construction of additional public use facilities (some have been completed), protection of the Arorowhead Wildlife Refuge buildings and related facilities, and construction of relief wells below the dam if needed.

The recreational plan for the Jamestown Reservoir area includes playgrounds, picnicking areas, a swimming beach and boat-launching areas. The entire plan coincides with the program of the North Dakota Game and Fish Department which carried on an extensive rough fish eradication program in 1953. Later the reservoir will be stocked with game fish—walleyed pike, northern pike and bass, and should prove to be an excellent fishing spot.

The Board of County Commissioners of Stutsman County has assumed the responsibility for administration, operation and maintenance of the reservoir area.

Data on Jamestown Dam and Reservoir

Earthfill, excavation—1,400,000 C.Y. Embankment—940,000 C.Y.
Concrete—5,500 C.Y.
Height—86 feet. Length—1,400 feet.
Spillway—Gloryhole type. Capacity—2,930 c.f.s.
Reservoir capacity—230,000 acre-feet.
Drainage area—1,291 square miles.

North Dakota Pumping Division

The North Dakota Pumping Division consists of 15 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. The total area proposed for irrigation in the 15 units is approximately 63,000 acres. These units and their irrigable acreages are as follows:

Williston	9,100 acres
Nesson	7,400 acres
Hancock Flats	5,400 acres
Fort Clark	2,000 acres
Oliver-Sanger	8,300 acres
Painted Woods	2,800 acres
Manley	1,200 acres
Wogansport	1,600 acres
Square Butte	1,900 acres
Burnt Creek	1,300 acres
Bismarck	8,500 acres
Little Heart	2,300 acres
Horsehead Flats	6,500 acres
Winona	4,500 acres

Construction of Fort Clark Unit, begun in 1952, was substantially completed in 1953. All other units are in an inactive status at the present time.

Fort Clark Unit

Fort Clark Unit, located along the west bank of the Missouri River between Stanton and Fort Clark about 45 miles northwest of Mandan, comprises 1882 acres of bottom and first bench land that is being initially developed for irrigation and an ultimate net irrigable acreage in the district of 2,039 acres. There are some 20 holdings represented in the irrigable land in the district most of which contain less than 160 acres.

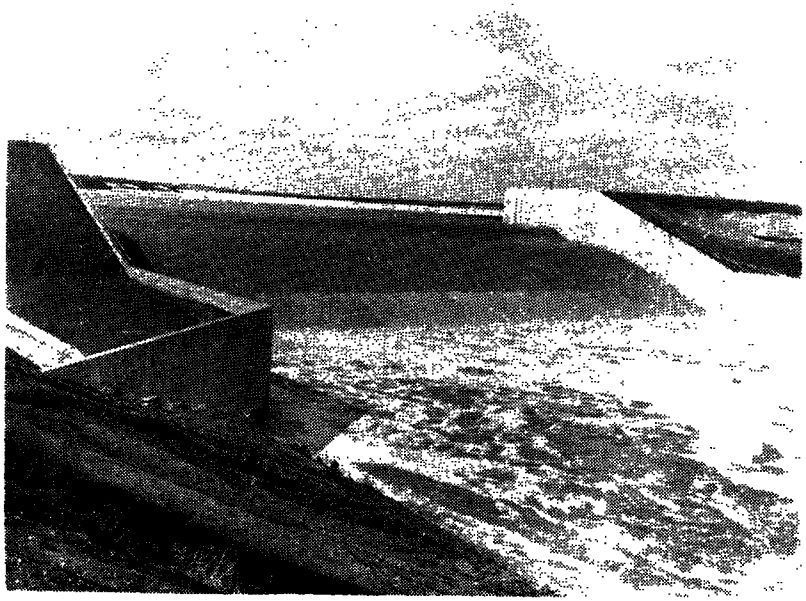
The irrigable land of the Fort Clark Unit is served through a system of three pumping plants, two canals and a lateral system. The main plant pumps water from the Missouri River to the two main canals, A and B, which in turn convey water to two bodies of land which are separated topographically. Two relift plants on Canal B serve land above the canal. The distribution system has been planned to provide delivery to the high point of each 80 acres.

Project facilities were constructed under a contract entered into by the Fort Clark Irrigation District with the Bureau of Reclamation which does not include land leveling and structures for the individual farm tracts. Development of the tracts is being accomplished by the farmers and the irrigation district. The Soil Conservation Service has assisted the local farmers and the district in preparing farm irrigation layouts and providing other technical assistance.

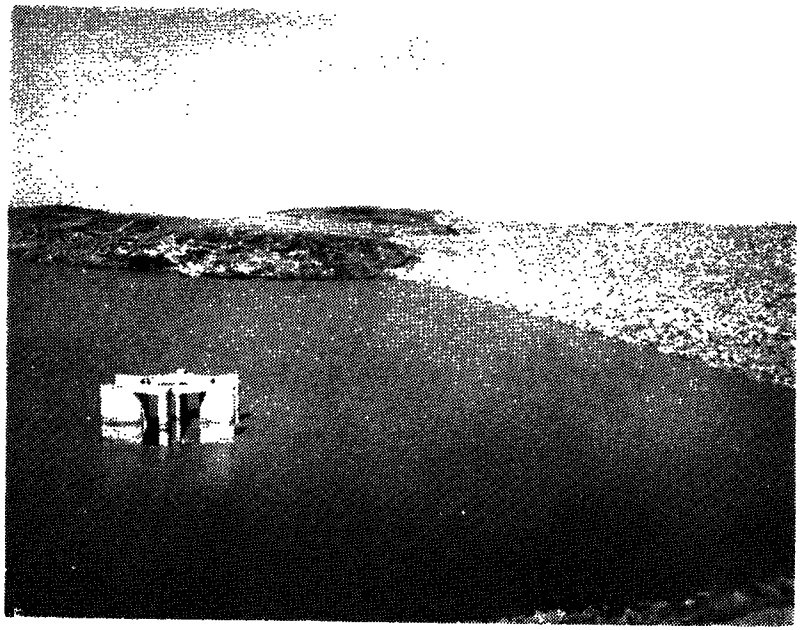
A formal dedication ceremony was held August 14, 1953, when the first water was delivered to the project lands. Although, under terms of the repayment contract, the 10-year development period does not begin until 1956, water is being furnished to the irrigators until then under an interim agreement at the rate of 1.000 per acre irrigated. Total construction cost of the unit is approximately $754,000, including an estimate for future drains.

Little Missouri Division

The Little Missouri Division begins at the headwaters of the Little Missouri River in northeastern Wyoming and extends downstream along the course of the river through southeastern Montana, northwestern South Da-



Dickinson Dam Spillway



Heart Butte Dam and Reservoir Showing Intake of Glory-Hole Spillway

kota and western North Dakota to the point where the river empties into Garrison Reservoir.

Under the present plan, water stored in the proposed Bullion Butte Reservoir located northwest of Amidon and northeast of Marmarth, North Dakota, would be used to irrigate about 20,000 acres of the Little Missouri bottoms in North Dakota.

The multiple benefits that will accrue as a result of the development of the water resources of the Little Missouri Basin in addition to the irrigation benefits include the control of floods, retention of silt, expansion of recreational possibilities, and fish and wildlife conservation.

There are no investigations presently underway on this division, but topographic and land classification surveys have been made.

Knife River Division

The Knife River development includes the Broncho Dam, located on the Knife River about 10 miles south of Golden Valley, near Mercer County, North Dakota, that will store water to irrigate about 15,400 acres of land along the lower 37 miles of the Knife River. According to present plans 60,000 acre feet of water would be stored in the Broncho Reservoir of which 50,000 acre feet would be available for irrigation.

There are no investigations presently underway on this division, but topographic and land classification surveys have been made.

Heart Division

The Heart Division includes the Heart Butte and Dickinson dams and reservoirs, both of which are constructed, and about 14,000 acres of irrigable land along the Heart River.

Dickinson Unit

Dickinson Unit, located in southwestern North Dakota, extends east and west from Dickinson for a total length of about ten miles.

Dickinson Reservoir, 1½ miles above the City of Dickinson, provides water for municipal use and for irrigation of 400 acres of land. The 16,500 acre-foot reservoir provides capacity for silt storage, for active irrigation and municipal water storage, and for flood water storage. Lands irrigated and to be irrigated consist primarily of small parcels which are being developed by the landowners. Water is made available to the irrigators at $1.00 per acre per year under individual water service contracts.

The prime contract for construction of Dickinson Dam was completed in August 1950. Subsequent work has been confined to extension of the intake end of the outlet works farther into the reservoir, clean-up and miscellaneous improvements. Emergency repairs are nearing completion on the spillway which was damaged in the spring of 1954.

Dickinson City Park Board administers the Dickinson Reservoir recreational area. The State Game and Fish Department has planted fish in the reservoir the past several years. The reservoir was opened for fishing in 1954.

Heart Butte Unit

Heart Butte Unit is located in Grant and Morton Counties in southwestern North Dakota, and extends east along Heart River for about 60 miles to the City of Mandan. It includes Heart Butte Dam and Reservoir, 15 miles south of Glen Ullin on the Heart River, and 13,100 acres of irrigable land downstream from the dam to the Missouri River.

The unit has already provided much-needed flood protection to the City of Mandan and the lower-lying farms adjacent to the river below Heart Butte Dam.

Heart Butte Dam is an earthfill structure with a height of 124 feet above stream bed and a crest length of 1,850 feet. The reservoir has a total storage capacity of 225,500 acre-feet: 6,800 acre-feet for inactive conservation storage, 68,700 acre-feet for active irrigation storage, and 150,000 acre-feet for flood control. The reservoir area (land and water surface) is administered by the State Game and Fish Department under an agreement between that agency and the Bureau of Reclamation. Irrigation of the land below Heart Butte Dam will be accomplished by lifting water from the river channel to the separate tracts of land by means of 55 pumping plants, ranging in capacity from 3 to 50 c.f.s A system of canals and laterals will deliver water to the irrigable land. Several relift pumping stations are also included in the plan of development.

Pumping Area No. 3, consisting of 70 acres. is in operation as the Mandan Development Farm by the State Training School.

Opposition to irrigation development and resulting court actions have delayed construction of irrigation facilities. The original Heart River Irrigation District was dissolved in November 1953 and a new district was formed the following month. The new district is called the Western Heart River Irrigation District. It includes only those ownerships favorable to irrigation and practicable for service as an initial development. After execution of a repayment contract, construction is scheduled to begin early in 1955 on facilities to serve the 2,537 irrigable acreas in 24 separate areas of the Western Portion of the unit.

Cannonball Division

Cannonball Division, in southwestern North Dakota, includes the Cannonball, Thunderhawk and Mott units.

Studies completed in 1953 show that dams at Mott and Elgin on the Cannonball River and at the Thunderhawk site on Cedar Creek are infeasible under present economic conditions. Construction costs for storage reservoirs are so high as to exceed the benefits.

Mott Dam was proposed to provide flood control at Mott and to supply water for irrigation and municipal purposes. The Cannonball Dam, near Elgin, was proposed principally to supply water to about 12,000 acres of irrigation along the lower Cannonball River. Thunderhawk Reservoir was considered mainly for irrigation and municipal uses.

Rising construction costs, problems of irrigability of the land and foundation problems at the dam site combined first to defer and finally to stop construction.

Mott Dam was considered as a substitute for Elgin Dam. Further upstream, it would serve only about 5,000 acres of irrigation even with full development of the water supply. However, it offered the promise of protection against destructive floods at Mott and could provide a dependable water supply to the city. High costs of reservoir lands and railroad relocations, a large spillway, and the comparatively wide river valley above Mott combined to increase construction costs beyond present-day limits of project feasibility. Additional work is not planned until economic changes show a greater need for the development of this water resource.

Transmission Division

Under the Flood Control Act of 1944, the responsibility for marketing the power generated by Missouri River Basin project plans, 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-kilowatt transmission lines will interconnect the Missouri River powerplants 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 is being 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.

Construction of the following lines and substations is complete, except for minor work remaining to be done on a few:

Lines	Substations
Garrison-Bismarck 230-kv double Circuit	
Bismarck-Jamestown 230-kv	Bismarck (Stage 1)
Bismarck-Mobridge 230-kv	Washburn (Stage 1)
Garrison-Voltaire 115-kv	Jamestown (Stage 1)
Voltaire-Rugby 115-kv	Rugby
Rugby-Devils Lake 115-kv	Devils Lake (Stage 1)
Devils Lake-Lakota 115-kv	Lakota
Leeds-Rolla 69-kv	Leeds

Devils Lake-Carrington 115-kv	Bisbee
Carrington-Jamestown 115-kv	Rolla
Jamestown-Edgeley 115-kv	Carrington
Jamestown-Valley City 115-kv	Edgeley (Stage 1)
Edgeley-Forman 69-kv	Valley City (Stage 1)
Garrison-Fort Peck 115-kv	Forman
Temp. Tie (Line and Sub.)	DeVaul (Stage 1)
Bismarck-DeVaul 69-kv	Beulah
Williston-Garrison 115-kv	Watford City

The Jamestown-Fargo 230-kv. line, the Fargo Substation and the Washburn, Bismarck and Jamestown substation additions are under construction, and work will begin early in 1955 on the Edgeley-Groton 115-kv line and Ellendale substation. The following year work is scheduled to start on the Grand Forks-Fargo 115-kv line and the Grand Forks substation.

During the past two years, Fort Peck power was delivered to 13 REA-financed cooperatives at 38 points of delivery in North Dakota. Except for deliveries at the Bureau's Williston, Watford City, Custer Trail and DeVaul substations, this power was transmitted over the facilities of the Montana-Dakota Utilities Co. In addition, deliveries were made directly from Bureau facilities to the Lewis and Clark Irrigation District, the Corps of Engineers at Garrison Dam, and to Montana-Dakota Utilities Co. at Williston, Watford City, Beulah and Bismarck.

Deep River Development Farm

The farm unit, leased and operated by Stener Hillerud, has been developed by the Bureau of Reclamation in cooperation with the North Dakota Agricultural College and the United States Department of Agriculture. The Deep River Development Farm is located in McHenry County about 3 miles west of Upham, North Dakota.

The farm has been developed to study effects of irrigation on crop and livestock production and the reaction of soils to irrigation water. Here farmers can observe the problems and benefits of irrigation under soil and climatic conditions found in this area.

The farm unit includes 215 acres; 143 acres are irrigated, 40 acres dry-farmed, and the balance is non-crop areas such as farmstead, roads, and dry pasture. Seventeen irrigated acres are reserved for research. The lessee farms 126 acres irrigated, 40 acres of dry farm land, and the non-cropped area. It is typical of a straight-irrigated type of farm unit which is expected to develop with irrigation. About 30% of the farms would be of this type. The predominant farm pattern expected in this part of the Garrison Diversion Unit will combine more dry-farming with irrigation.

A group of 12 farmers and three County Agents serves as an advisory committee. This group has assisted the Bureau of Reclamation and Extension Service in planning the crops and management program for the farm.

Chapter 4

Activities of Corps of Engineers, U. S. Army

CORPS OF ENGINEERS—GARRISON DISTRICT

Garrison Dam

Garrison Dam, now 76 per cent complete, is a key structure in the Pick-Sloan plan to harness the Missouri River.

Although development of the upper Missouri River was considered and investigations for suitable dam sites were initiated by the Corps of Engineers prior to 1900, it was not until the U. S. Congress passed the Flood Control Act of 1944 that Garrison Dam and Reservoir construction became a reality. Prior to the passage of this act, Lt. General Lewis A. Pick, Chief of Engineers, and W. G. Sloan, former Field Representative of the U. S. Department of Interior, had independently developed plans for control of the Missouri River. The two plans were integrated into one comprehensive program which envisions the construction of over 100 reservoirs in the Missouri River Basin.

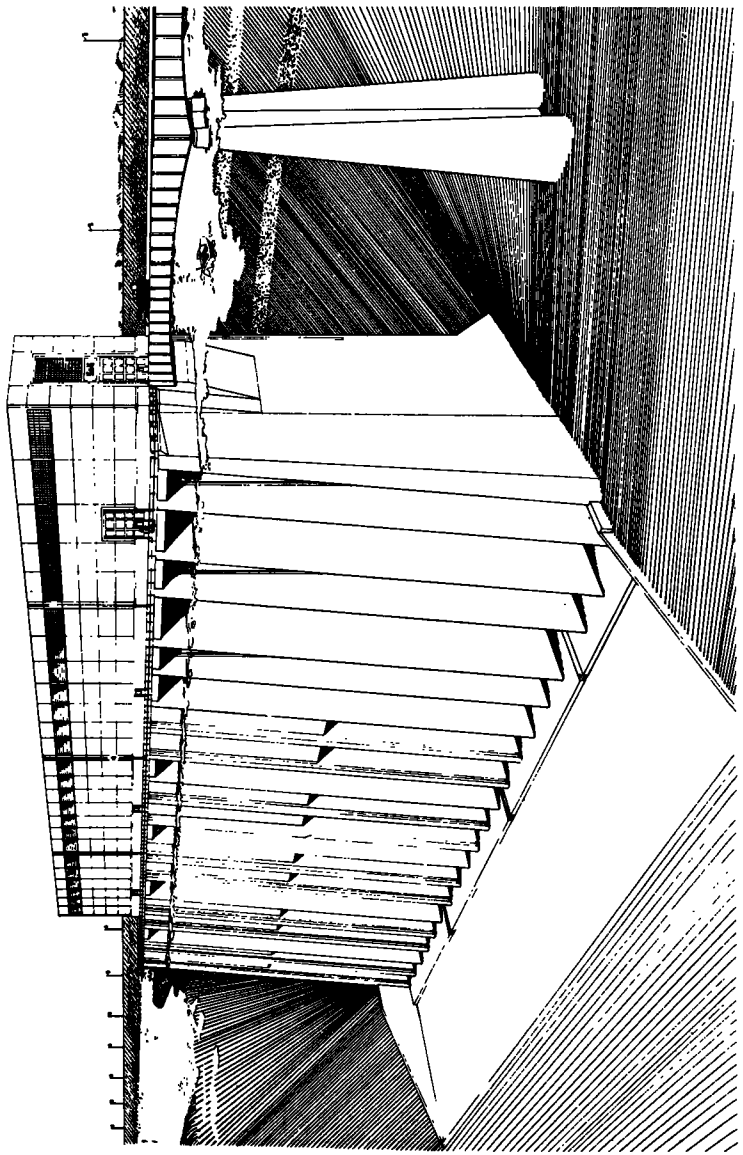
Garrison Dam, located in central North Dakota at the federal government built town of Riverdale, is creating a multi-purpose reservoir that will stretch 200 miles upstream from the dam. The project will produce 400,000 kilowatts of hydroelectric power; it will provide protection against flood damage along the Missouri River downstream from the dam; provide water for irrigation in central and eastern North Dakota; help improve navigation from Sioux City, Iowa south to New Orleans, La. during natural low water periods; provide water for improvement of health and sanitation conditions during natural low water periods along the Missouri River and the reservoir area will provide facilities for recreation, fish, and wildlife preservation areas.

Starting in 1946 the town of Riverdale, an access road leading from U. S. Highway 83, a construction bridge over the river, and a railroad spur were all built in advance of construction of the dam. On October 4, 1947 the first earth was hauled into place on the embankment. In the fall of 1953 the final (stage five) embankment contract was awarded for construction of the center section of the dam. The entire embankment which will be 210 feet high and 12,000 feet long with a base width of 2,600 feet will be virtually completed at the close of the 1954 construction season.

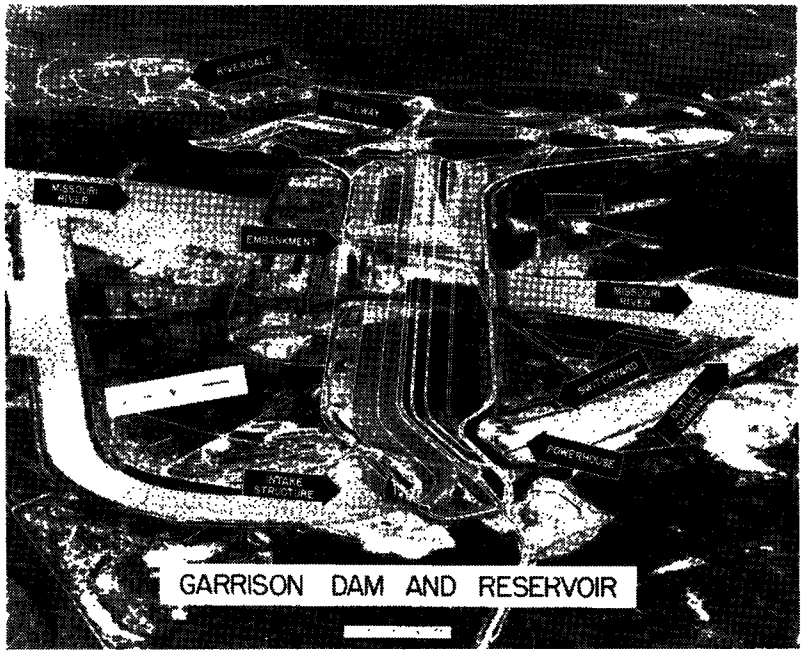
In 1949 construction was started on the three regulating tunnels and five power tunnels, extending under the dam from the intake structure to the powerhouse and stilling basin on the downstream side of the dam. These 22-foot to 29-foot diameter tunnels were completed in 1951 and the 269-feet high intake structure, which houses gates and hoists for the tunnels, was completed and accepted by the Corps of Engineers in 1954.

A contract for the construction of the powerhouse, surge tanks, and switch yard was awarded in May 1953 and power from the first unit is scheduled for April 1955. All three of the initially authorized units are scheduled to be producing power in 1956.

Work on the first stage of the spillway section of the dam started in 1952 and is scheduled for completion in September 1955. The spillway, the dam's "insurance policy," is designed to prevent the dam from being overtopped in case of unprecedented flood conditions. The stage one contract includes the placing of approximately 300,000 cubic yards of concrete and



Garrison Dam Intake Structure



the construction of the pre-stressed spillway bridge and the installation of 28 gates needed to control the flow of water through the spillway channel reading to the river on the downstream side of the dam. State Highway 7 is scheduled to be completed over the spillway and crest of the dam by 1957. The second and final stage of the spillway is scheduled to be awarded late in 1954.

Construction of the second largest embankment in the state, Snake Creek Dam, was started in 1951 about five miles north of Coleharbor, N. Dak. This three-mile long, 85-feet high embankment serves as a relocation for a portion of Sioux Line railroad track and highway 83 that will be inundated by the Garrison Reservoir. Telephone and telegraph lines have been relocated and train and highway traffic diverted over this embankment during the 1954 construction season. As a result of irrigation potential in North Dakota, Snake Creek reservoir will function as a sub-impoundment area of the Snake Creek arm of Garrison Reservoir.

In the upstream areas of the reservoir, work has been completed on about 225 miles of Fort Berthold Indian Reservation roads, the former townsites of Sanish and Van Hook cleared, and numerous houses and public buildings constructed. Work is continuing at a rapid pace on the largest bridge in North Dakota, near New Town. The old Elbowoods bridge was removed and now forms the center span of the new 4500-foot bridge. This bridge is scheduled to be open for traffic January 1956.

With the exception of minor work and "clean up" details, Garrison Dam will be essentially complete and in full operation by the close of the 1956 construction season. Relocations and protective works in the upper reaches of the reservoir, and various recreational and wildlife habitat areas planned for the reservoir are scheduled for completion at later dates. It is planned, upon approval of the Master Plan for Reservoir Development and Management, to initially develop a major recreational area for public use north of Pick City, near the west abutment of the dam, and another recreation area south of Garrison, North Dakota. Other recreation areas will be developed in accordance with public demands and economic and engineering feasibility.

ADDITIONAL GARRISON DISTRICT FLOOD CONTROL ACTIVITIES

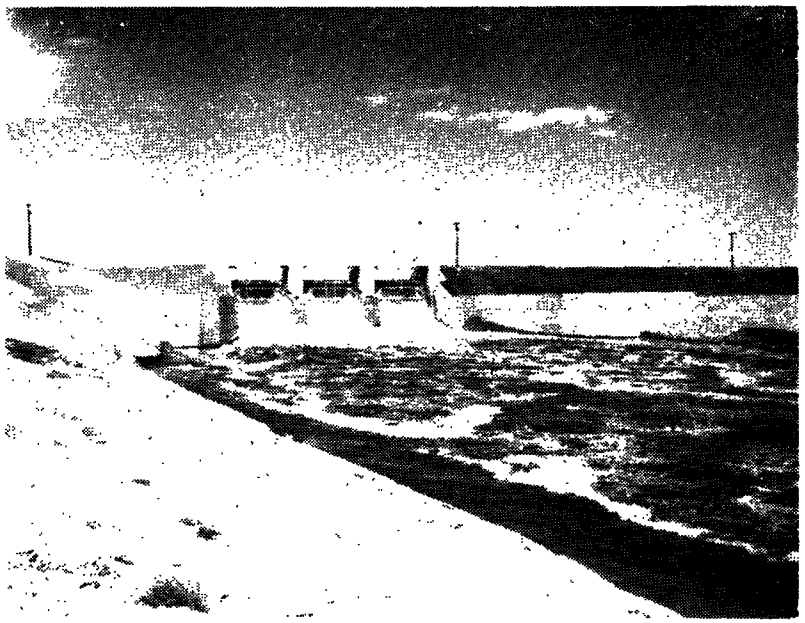
In addition to contruction of Garrison Dam, this district is charged with flood control measures in other areas of the district. The Mandan protective works, constructed in 1949-1950, has already aided in preventing flood damages many times in excess of the construction costs. Since completion, the Mandan protective works have prevented an estimated $4,500,000 in flood damages.

Repair of bank protection works along the Missouri River on the Lewis and Clark Irrigation project, near Williston, N. Dak., was accomplished in 1949 at a cost of $53,627.89. Repair of the Marmarth, N. Dak. levee was accomplished following the flood at a cost of $2,549.95. Emergency bank protection works were constructed in 1952 to protect a power substation and the Buford-Trenton Irrigation District's pumping plant at a cost of $47,397.40.

Flood control projects have been authorized for construction at Marmarth, N. Dak., and along the lower Heart River, in the vicinity of Mandan, N. Dak. In addition, studies are underway on potential flood protection projects in the James and Cannonball River Basins.

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, Lake Traverse and the Bois de Sioux Project and several other river channel improvement projects. These projects are discussed below under headings designating their stage of progress.



Baldhill Dam Spillway

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.

This project was constructed subject to the following conditions:

1. That local interests contribute $208,000.00 toward the first cost of the reservoir.

2. That local units hold and save the United States free from damage due to construction works.

3. That they bear the expense of all necessary alterations of utilities, roads, highways, and bridges and that they construct, operate, and maintain the Fargo division dam and the diversion ditch improvements in accordance with plans and regulations to be approved by the Secretary of War.

4. That they maintain the channels below the reservoir in satisfactory condition for the flow of water released from storage, to include the prevention of encroachments on the channel.

5. That they establish and enforce suitable regulations to prevent pollution of the waters of the Sheyenne River.

Local interests have complied with these conditions except for the construction of the Fargo diversion dam and ditch.

The major portion of construction has been completed and the reservoir was placed in full operation in the fall of 1950. During the record breaking high water during the spring of 1950 the reservoir was operated in an emergency status with large benefits to the downstream interests, particularly at Valley City. The cost of initial capital outlay to the United States is estimated to be about $2,653,200. There are no directly repayable features of the project except the provisions of local cooperation outlined above. The Corps of Engineers operates and maintains the control structures. Construction of features for public use remaining to be initiated have been deferred until after the present economic situation is stabilized.

A summary of data on the dam and reservoir is as follows:

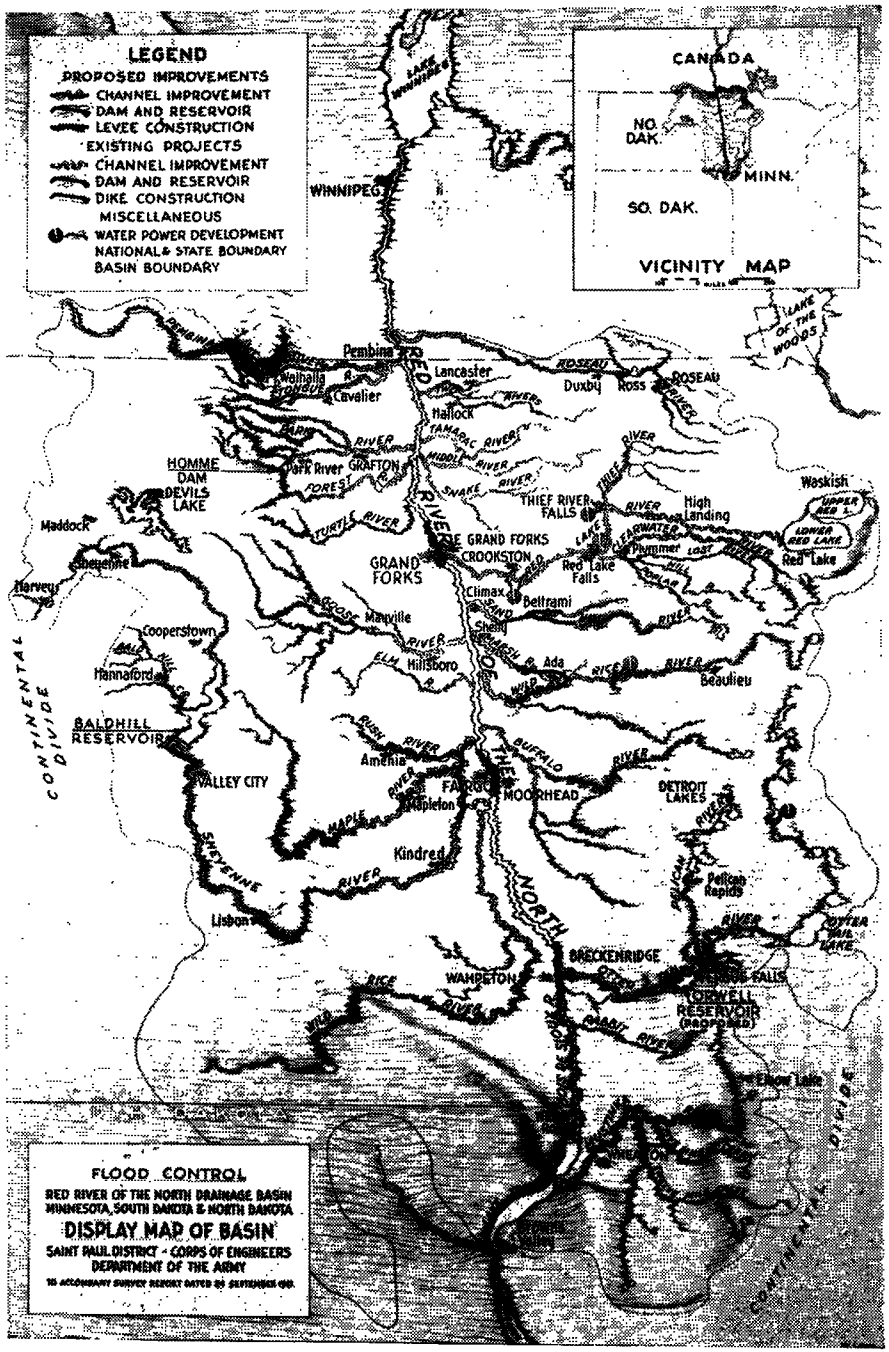
Type	Earth fill
Length	1,650 feet
Height	61 feet
Earth Fill	296,800 cubic yards
Excavation	439,000 cubic yards
Concrete	13,915 cubic yards
Riprap	11,100 cubic yards
Control Length	120 feet
Reservoir Drainage rea (Exclusive of Devils Lawe Lake Basin)	4,138 sq. mi.
Capacity	Max. Pool, 70,700 acre feet
Reservoir Area	5,430 acres
Length	27 miles
Federal Cost of Construction	$2,653,200
Local Cost	$270,000

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-foot reservoir created by the dam will afford partial flood control protection to areas below the dam and will be used to provide a flow of about five second-feet in the river to meet the water supply and pollution abatement needs from the dam to Grafton, North Dakota. In addition a sixteen inch cast iron pipe water supply outlet through the dam has been provided at the request of local interests.

The improvement is subject to the following conditions:

1. That local interests make a cash contribution of $40,000 toward the construction costs.



Homme Dam Spillway

2. That they provide without cost to the United States all lands easements, and rights of way necessary for the construction of the project.

3. That they make necessary changes in roads, bridges, and utilities.

4. That they maintain the channel below the reservoir.

5. That they hold and save the United States free from damages due to construction works.

6. That they limit construction of dams below the reservoir.

7. That they prevent the discharge of raw sewage into the river by municipalities.

An additional cash contribution of $16,220.00 was required for the sixteen inch water supply outlet that was requested by them. The local interests have provided the $56,220 cash contribution and all the necessary lands.

The major portion of construction work has been completed and the reservoir was placed in full operation on August 4, 1950. The total cost to the United States is estimated to be about $1,339,000. There are no directly repayable features of the project except the requirements of the local cooperation outlined above. The Corps of Engineers is maintaining and operating the control structures. Already completed are construction of two bathing beaches for public use, however, construction of additional public use facilities have been curtailed for the present.

Data concerning the dam is as follows:

Type	Earth fill
Length	865 feet
Height	67 feet
Earth Fill	332,000 cubic yards
Excavation	419,000 cubic yards
Concrete	6,750 cubic feet
Riprap	9,050 cubic yards
Control Length	150 feet
Reservoir Drainage Area	265 square miles
Capacity	Max. Pool, 3,650 acre-feet
Reservoir Area	194 acres
Length	2¼ miles
Federal Cost of Construction	$1,339,000
Local Cost	$56,220

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 is the creation of a lake that will be ideal for boating, swimming, fishing and wildlife conservation. A third important benefit is the increased low water flow to communities north of the White Rock Dam. Construction of this project was completed in 1941.

Data pertaining to the White Rock Dam and the Reservation Highway Dam is given below:

	Reservation Control Structure	White Rock Dam
Type	Earth fill	Earth fill
Length	9,100 feet	14,400 feet
Height	14.5 feet	16 feet
Earth Fill	3,880 cubic yords	329,244 cubic yards
Excavation	3,350 cubic yards	636,042 cubic yards
Concrete	13 cubic yards	1,245 cubic yards
Riprap	290 cubic yards	18,842 cubic yards
Control Lengths	100 feet	39 feet
Reservoir Drainage Area	1,160 square miles	
Capacity, Max, Pool	249,500 acre-feet	

Reservoir Area	22,900 acres
Length	25 miles
Federal Cost of Construction	$1,332,200
Local Cost	

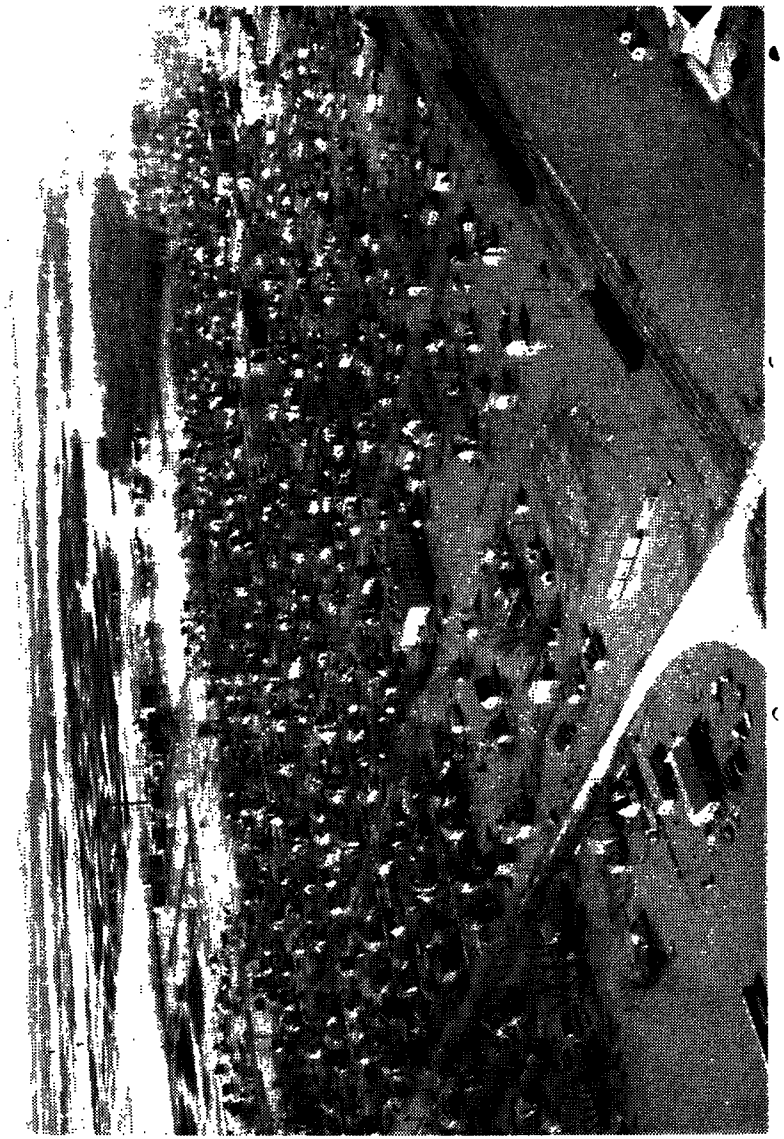
SNAGGING AND CLEARING OPERATIONS

During the period of this report snagging and clearing operations were performed on the Sheyenne, Park and Forest Rivers. Work on the Sheyenne River extended from the Red River of the North to the mouth of Rush River, a distance of 11.6 miles, and was completed in the period from November 1, 1952 to January 5, 1953. Snagging and clearing on the Park River was accomplished in the reach from 10 miles above the mouth to Grafton, North Dakota, during the period July 31 to November 29, 1952. Work on the Forest River extending from a point about 3 miles below Minto, North Dakota, upstream to the Grand Forks county line was accomplished from August 13 to November 17, 1952. 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 allowing proper discharge of water to reduce flood states in the affected portion of the streams. Approximately $22,700 was expended on the Sheyenne River, $26,900 on the Forest River and $43,-700 on the Park River in accomplishing this work.

PROJECTS UNDER CONSTRUCTION

Grand Forks Flood 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 50 percent complete. Estimated Federal cost is about $555,500. Work is expected to be completed by June, 1956.



Flood at Grafton

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 and Maple River units. Plans and specifications for the Rush River improvements are being prepared and the work will be advertised in the fall of 1954. Design studies are being made for work at Fargo, and local interests at that locality have under advisement a proposed plan of improvement. Design studies were made for the Sheyenne River improvement, but will be reviewed in order to determine the feasibility of some changes suggested by local interests. No further work will be done on the Maple River improvement until local interests evidence their continued interest in this feature.

PROJECTS UNDER INVESTIGATION

Swan Creek

A study was made in order to determine the feasibility of improvements to relieve the flood problems due to Swan Creek at Casselton, and funds were allocated by the Chief of Engineers for the construction of this project. However, local interests subsequently requested indefinite deferment of the project and funds have been withdrawn.

Red River of the North Drainage Basin Studies

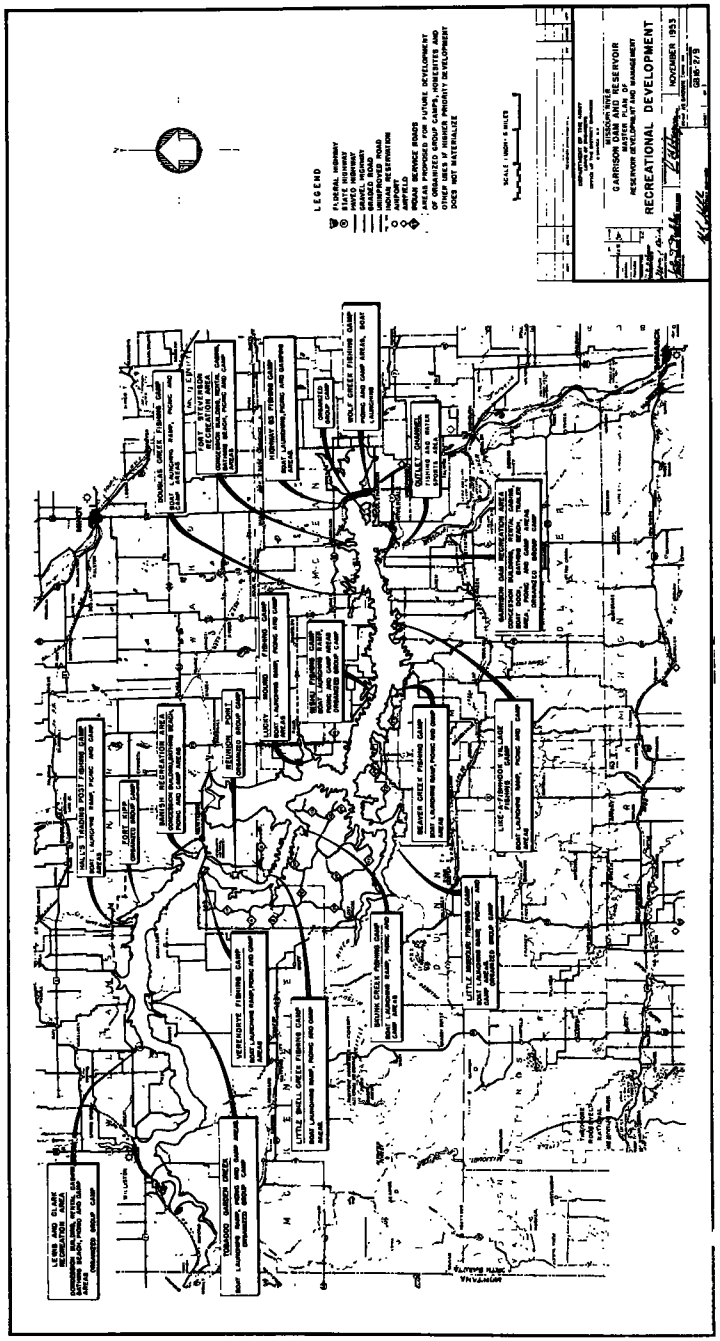
A study has been undertaken by the St. Paul District of the Corps of Engineers of the Red River of the North Drainage Basin. This report will include consideration of flood problems on the main stem of the Red River to the Canadian boundary and of tributaries including several of those in North Dakota. Funds for this report have been greatly curtailed due to the present economic situation. Included in this report will be a separate interim survey report covering the situation at Grafton, North Dakota.

Souris River Study

A preliminary examination on the Souris River which will be used to determine the feasibility of improvements on this river principably at Minot, North Dakota, has been undertaken by the St. Paul District of the Corps of Engineers. Work on this report has been suspended pending completion of the plan of the Bureau of Reclamation for irrigation in this area.

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 45% complete at the present.



Chapter 5

Other Activities

OTHER ACTIVITIES

The State Water Conservation Commission has cooperated closely with several other state and federal agencies and organizations in planning for and developing the water resources of the state. The duties and work of the Commission is closely related with those of these other agencies and it is through the cooperative work of all concerned with the various phases of our water resource development program that this development can progress to the best advantage to the state. A brief discussion of the cooperative work of these agencies with the Commission is as follows:

NORTH DAKOTA STATE HEALTH DEPARTMENT

In matters concerning municipal water and sewage systems the State Department of Health, through the Division of Sanitary Engineering, cooperates closely with the Water Commission and the State Engineer and his staff. All plans and specifications for the installation and improvements to municipal water and sewage facilities and industrial waste disposal systems have been reviewed and approved by the two departments. An active interest and participation in all water development programs in North Dakota was continued by the State Health Department with the objective of furthering improvements in sources of municipal water supply.

The North Dakota State Department of Health reports that during the past biennium plans and specifications have been approved for 28 municipal sewage treatment facilities and three oil refinery waste treatment plants in North Dakota. All of these units are now completed and operating. Nine of the municipal treatment facilities are for new sewerage systems, while nineteen are replacements for existing inadequate treatment units.

All of the new municipal units consist of treatment of raw sewage in sewage lagoons. The success of these economical and efficient units in North Dakota has led to their adoption as the best type of treatment, not only in North Dakota but in many other Missouri River Basin States. The Division of Water Polultion Control, North Dakota State Department of Health, has answered over 100 out-of-state requests for information on sewage lagoons. The positive water pollution control provided by lagoons is another step forward in water conservation.

Until this year, lagoons have been used for small communities with populations under 3,000. The City of Jamestown, North Dakota, population 10,000, is now completing a sewage lagoon. The successful operation of this unit at Jamestown will not only remove a considerable pollution load from the James River, but will also show the feasibility of the use of lagoons for a community of this population. By November 1, 1954, there were 31 operating sewage lagoons in North Dakota, all providing positive water pollution control benefits.

Three oil refineries are being built in North Dakota at Mandan, Dickinson, and Williston. Plans for waste treatment facilities for all three of these units have been approved. Treatment in each case will consist of passing the waste water through oil water separators and lagoons before discharge to receiving waters. Stream surveys have been made of the various courses receiving these wastes, prior to refinery operation, so that any pollution effects due to oil wastes may be accurately evaluated. The treatment provided in each case has been built to assure the best possible pollution control.

BUREAU OF LAND MANAGEMENT

The United States Bureau of Land Management, formerly General Land Office, has been resurveying many areas in the state to bring the original General Land Office Plats and Field Notes of North Dakota up to date These surveys are used to re-establish section corners and boundaries of areas in the state. The surveys as they are completed are filed with the State Engineer and are available for inspection to all interested parties. Areas for which these resurveys have been completed are as follows:

BUREAU OF LAND MANAGEMENT RESURVEYS

Township 129 N, R 106 W.
Township 130 N, R 106 W.
Township 131 N, R 106 W.
Township 132 N, R 106 W.
Township 133 N, R 105 W.
Township 134 N, R 105 W.
Township 135 N, R 104, 105 W.
Township 136 N, R 102, 103, 104 W.
Township 137 N, R 101, 102 W; Sec. 19, R 79 W.; Sec. 23 and 24, R 80 W.
Township 138 N, R 102 W.
Township 139 N, R 102 W.
Township 140 N, R 102 W.
Township 141 N, R 101 W.
Township 142 N, R 102 W.
Township 143 N, R 102 W.
Township 144 N, R 102 W.
Township 145 N, R 84, 102 W.
Township 146 N, R 84 W.
Township 147 N, R 84, 89, 100 W.
Township 148 N, R 97 W.
Township 153 N, R 79, 80, 81 W.
Township 154 N, R 78, 79, 80, 81, 82 W.
Township 155 N, R 78, 79, 80, 81, 82, 83, 84 W.
Township 156 N, R 78, 79, 80, 81, 82, 83, 84, 85 W.
Township 157 N, R 78, 79, 80, 81, 82, 83, 84, 85, 86 W.
Township 158 N, R 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88 W.
Township 159 N, R 79, 80, 81, 82, 83, 84, 85, 86, 87 W.
Township 160 N, R 81, 82, 83, 84, 85, 86, 87, 88, 89 W.
Township 161 N, R 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92 W.
Township 162 N, R 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 W.

Township 163 N, R 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 W.
Township 164 N, R 84, 85, 86, 87, 88, 89, 91, 92, 93, 94, 95, 96, 97, 98 W.

NORTH DAKOTA RECLAMATION ASSOCIATION

The primary purpose of the North Dakota Reclamation Association and the National Reclamation Association is to foster and promote a program for irrigation, reclamation and development of the arid and semi-arid West. It is through the efforts of the state and National Reclamation Associations and other groups and agencies that the water development program has developed to its present stage.

The State Reclamation Association is composed of over 1,000 members from all sections of the state. The activities of the State Association are administered by directors from the four districts into which the state is divided. The president of the Association is James Flannery of Jamestown and the Secretary is John I. Rovig of Mandan. Harry E. Polk of Williston is the State Director of the National Reclamation Association for North Dakota.

Both of these organizations have been active in informing the people of the state of the values and need for the development of the water resources for beneficial use of the state and the nation. Representatives of these groups have appeared at congressional hearings in the support of various reclamation projects.

Both the National and State Association have supported a well-balanced program for the development of the water resources of the west. This support includes encouragement of a plan for development of small irrigation projects, continued investigations to assure orderly development of the state's authorized water projects and support of other phases of the land and water resource development programs.

SOIL CONSERVATION SERVICE

The U. S. Soil Conservation Service and the North Dakota State Soil Conservation Committee has cooperated with the State Water Conservation Commission in several activities affecting North Dakota's water development program. The cooperative efforts on behalf of the Area Conservationists of counties in the eastern part of the state where the construction and maintenance of drains has been extensive has been an important factor in the progress in this program. Of major importance to the development of irrigation in the state is the assistance given the individual farmers in surveying and laying out irrigation tracts for use of these farmers in submitting applications for water-right applications.

The watershed projects that are being undertaken are under the direction of the Soil Conservation Service. The State Water Conservation Commission has cooperated both with the U. S. Soil Conservation Servicea and the State Soil Conservation Committee in reviewing the plans for these projects and reviewing the projects to determine feasibility and priority.

INFORMATION PROGRAM

The water resource development program in North Dakota has brought about a great demand from people in North Dakota and from other states for information concerning the various projects and progress being made. It is important that the people of the state be given all available information relative to the water development program so that they can determine whether or not they desire the various proposed developments. The State Water Conservation Commission has received specific requests for information of this nature from over 2,500 individuals during the period of this report. In addition approximately 1,000 community leaders have requested to be retained on a permanent mailing list to receive material on North Dakota's water program that becomes available from time to time.

In 1952 the State Water Conservation Commission undertook to prepare a summary of the information on the water program in North Dakota from time to time in a bulletin form and send it to interested persons throughout the state. Nine issues of this bulletin, titled "North Dakota Water Conservation News," have been prepared and distributed. The State Water Conservation Commission has also displayed an exhibit depicting the state's water program at 30 fairs, conventions and meetings during the biennium covered by this report. This exhibit has been shown in all sections of the state with particular emphasis being placed on the phase of the water's development program pertaining to that section of the state.

GREATER NORTH DAKOTA ASSOCIATION

The Greater North Dakota Association has been active in furthering the water development program in the state through its education program of motion pictures, exhibits and circular literature concerning the various water development projects in the state. This association has prepared a motion picture depicting the state's water development program since 1946 for showing to various meetings throughout the state. In addition they have provided a great deal of publicity concerning this program in their literature, public meetings and news releases.

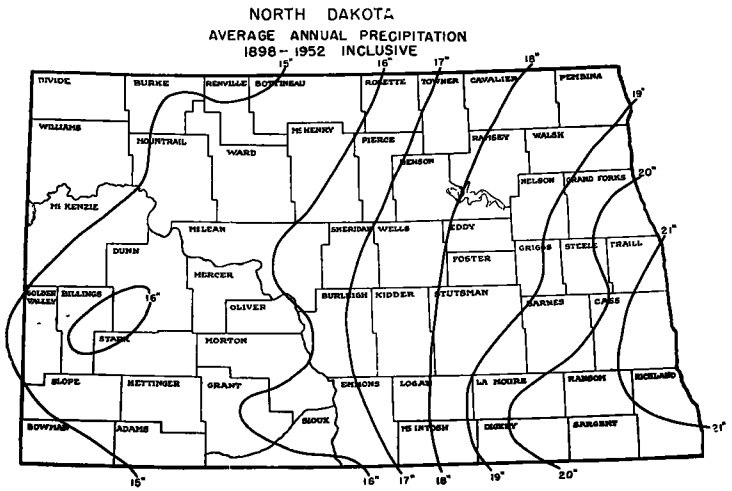
U. S. WEATHER BUREAU

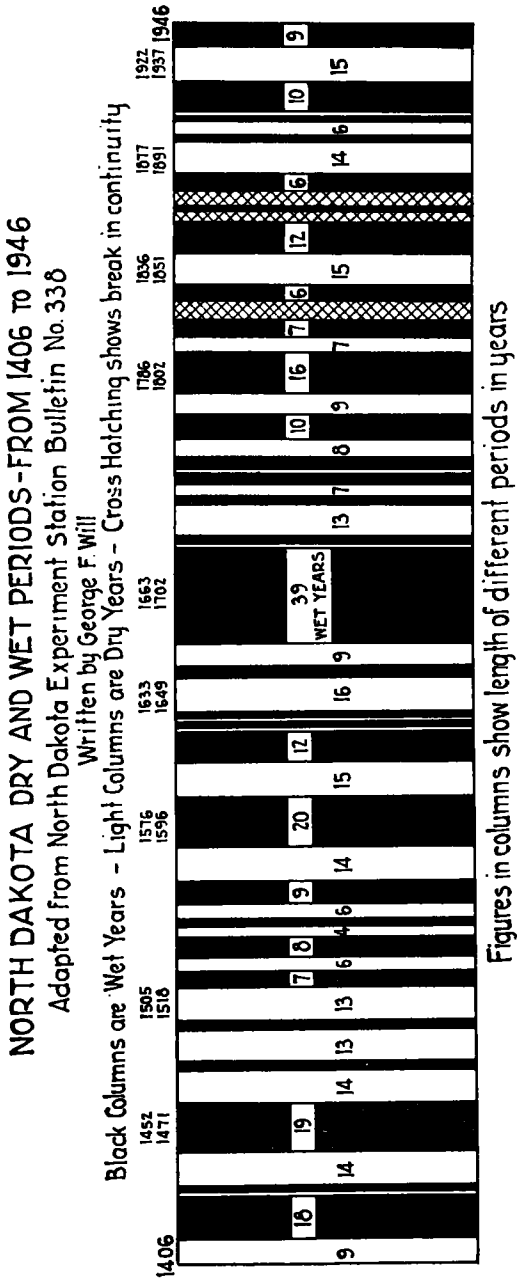
Climate is a natural resource that cannot be exhausted by exploitation as in the case with most natural resources such as soils, forests, and mineral deposits. As civilization becomes more complex, our dependence upon an intimate knowledge of climate and weather increases. Today this knowledge is so indispensable that every civilized country has an extensive weather service. While it is impossible for man to change the climate materially, it is possible for him to plan his activities in such a manner that he will realize the maximum benefit from the forces of nature.

As of 1952 there are 4 first-order Weather Bureau stations in North Dakota, and 4 Airway stations, all rendering 24-hour service. There are also 180 cooperative weather observers in the state supervised by the Bismarck office. These cooperative observers take daily readings, recording the high and low temperature, 24-hour precipitation, sky condition and wind. About 60 of the stations have recording rain gages showing hourly precipitation.

The first weather records available for North Dakota were made by Lewis and Clark in 1804 and 1805 at Mandan. Regular daily observations were begun at a few stations by the Army in 1860, but a good distribution of stations was not secured until 1892, when there were 42 stations in the state.

"Climate and Weather in North Dakota," prepared by Meteorologist Frank J. Bavendick and published by the State Water Conservation Commission in 1952 contains a digest of weather records for 80 years. It notes unusual and unfavorable weather conditions to prepare residents for possible recurrence in future years. This book contains a wealth of information of the vagaries of North Dakota weather including floods, blizzards, drought, dust storms, hail, precipitation, snowfall, sunshine, etc. The book is for sale at the office of the State Water Commission at $1.00 a copy.





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