TWELFTH BIENNIAL REPORT

of the

State Water Conservation Commission

and the

TWENTY-NINTH BIENNIAL REPORT

of the

STATE ENGINEER

of

North Dakota

July 1, 1958 to June 30, 1960

BISMARCK TRIBUNE
95892

"Buy Dakota Maid Flour"

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COMMISSIONERS

Einar Dahl
Member
Watford City
Northwest District

Oscar Lunseth
Member
Grand Forks
Northeast District

Earle Tucker
Vice Chairman
Bismarck
Southwest District

Gov. John E. Davis
Chairman

A. R. Weinhandl
Member
Minot
North Central District

Wm. Corwin
Member
Fargo
Southeast District

Math Dahl
Ex-Officio Member
Bismarck
Commissioner of Agriculture and Labor

LETTER OF TRANSMITTAL

Honorable John E. Davis
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 Twelfth Biennial Report of the North Dakota State Water Conservation Commission and the Twenty-ninth Biennial Report of the North Dakota State Engineer covering the period July 1, 1958, to June 30, 1960.

Respectfully submitted,

North Dakota State Water Conservation Commission
Earle F. Tucker, Vice Chairman
Einar H. Dahl
A. R. Weinhandl
Oscar Lunseth
Math Dahl
William W. Corwin

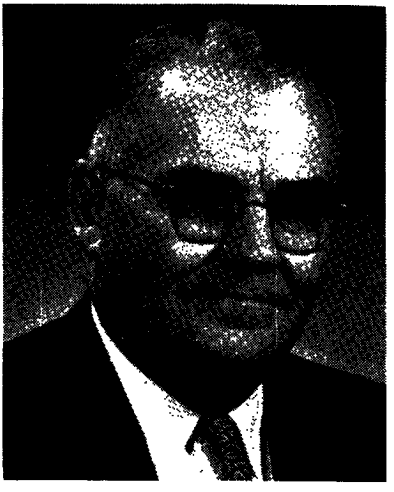
Milo W. Hoisveen
Secretary and Chief Engineer
State Engineer

STAFF

Robert J. Timm
Asst. State Engineer

Hazen Sandwick
Office Engineer

Vernon S. Cooper
Assistant Secretary



Milo W. Hoisveen
Chief Engineer and Secretary State Engineer

Victor E. Ziegler
Investigation Engineer

C. Philip Nelson
Drainage Engineer

Alan Grindberg
Construction Engineer

Chapter I

GENERAL DATA

NORTH DAKOTA STATE WATER CONSERVATION COMMISSION

WATER RESOURCES DEVELOPMENT PLAN

ORGANIZATION OF THE COMMISSION

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

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

Name	Appointed	Present Term ends
Governor John E. Davis, Ex-Officio Chairman	Jan. 1, 1957	
Earle F. Tucker, Vice Chairman, Bismarck	May 1, 1948	July 1, 1961
Einar H. Dahl, Watford City	April 3, 1939	July 1, 1965
A. R. Wienhandl, Minot	June 20, 1959	July 1, 1961
Oscar Lunseth, Grand Forks	May 1, 1951	July 1, 1965
William W. Corwin, Fargo	July 1, 1957	July 1, 1963
Math Dahl, Comm. of Agriculture and Labor, Ex-Officio Member	May 27, 1949	
Milo W. Hoisveen, Secretary and Chief Engineer, State Engineer	July 1, 1954	

The Commission meets at irregular intervals at the call of the Chairman, or, in his absence, of the Vice Chairman, either in the principal office at Bismarck, or at such special places as may be designated. During the period July 1, 1958 to June 30, 1960, the State Water Conservation Commission held 16 meetings in Bismarck and three meetings in other cities throughout the State.

PERSONNEL EMPLOYED BY THE COMMISSION

Full time personnel employed by the Commission on June 30, 1960, are as follows:

Milo W. Hoisveen	Secretary and Chief Engineer, State Engineer
Vernon S. Cooper	Assistant Secretary
Robert J. Timm	Assistant State Engineer
I. A. Acker	Special Assistant Attorney General
Hazen A. Sandwick	Office Engineer
Victor E. Ziegler	Investigations Engineer
Alan Grindberg	Construction Engineer
C. Philip Nelson	Drainage Engineer
Howard Walterson	Construction Superintendent
Daniel Reiter	Construction Superintendent
Eugene Sackman	Chief of Party
Joseph Krebsbach	Chief of Party
Donald Schwinkendorf	Assistant Party Chief
Roy Putz	Office Assistant
Gordon Baesler	Draftsman
Jean E. Walterson	Draftsman
Irvin Moser	Rodman
Larry Anderson	Rodman
Loren L. Schock	Rodman
Leone Hiland	Chief Stenographer
James Schulz	Accountant
Edna Gehring	File Clerk
Darlene Silbernagel	Receptionist
Fred J. Fredrickson	Planning Coordinator
George E. McMaster	Driller
Ahmed Kamoni	Driller
Lewis Knutson	Assistant Driller

In addition to the above personnel, the Commission usually employs several temporary employees to assist in engineering work during the summer season and several construction crews consisting of skilled operators, truck drivers, and laborers for work on the various construction projects undertaken by the Commission. A drill crew is maintained by the Commission on a seasonal basis to obtain data on ground water supplies throughout the State.

MEETINGS, CONFERENCES AND HEARINGS

During the period of this report the State Water Conservation Commission has met nineteen times to take up routine business of the Commission. Sixteen of these meetings were held in Bismarck and three in other cities of 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 7, 1958, Bismarck
September 15, 1958, Dickinson
October 13, 1958, Bismarck
October 26, 1958, Fargo
December 12, 1958, Bismarck
January 16, 1959, Bismarck
March 16, 1959, Bismarck
April 10, 1959, Bismarck
May 20, 1959, Bismarck
June 19, 1959, Bismarck
August 28, 1959, Bismarck
October 7, 1959, Bismarck
November 20, 1959, Bismarck
January 7, 1960, Bismarck
March 25, 1960, Bismarck
April 19, 1960, Grand Forks
April 22, 1960, Bismarck
May 19, 1960, Bismarck
June 30, 1960, Bismarck

Commission members or employees of the Commission have attended many meetings and held a number of hearings during the period of this report. The classification of those meetings is as follows:

One hundred fifty-six man days spent in conferences with city officials and local groups throughout the state on problems concerning municipal water supplies, pollution abatement, project investigation and construction.

Thirty-nine man days in speaking engagements before civic clubs, conservation training programs, Chambers of Commerce, television appearances and miscellaneous.

Fifty-four man days in meeting with various departments of the Corps of Engineers, U. S. Army and Bureau of Reclamation.

Ninety-eight man days spend in meetings on drainage problems, with County Drain Boards and with Water Conservation and Flood Control Districts.

One hundred forty-nine man days pertaining to Garrison Diversion Conservancy District and the establishment of irrigation districts under the Garrison Diversion Unit, including elections held for these irrigation districts.

Fifty-five man days attending meetings of North Dakota Water Users — National Reclamation Associations.

Eight man days, Western State Engineers conferences.

Twenty-two man days in meetings with inter-state or Canadian officials in regard to joint development of water control projects.

Forty-five man days, Water Resources Association and various Lower Basin interests.

Twenty-seven man days for appearances before Congressional hearings held in Bismarck, North Dakota, and Washington, D. C.

Sixty-five man days — exhibits.

Fifty-five man days attending meetings of the Missouri Basin Inter-Agency Committee and Missouri River States Committee.

All of the above listed meetings and conferences are in addition to meetings of the State Water Conservation Commission and the regular duties of Commission field employees involved in construction and investigation activities.

Members of North Dakota State Water Commission in Session at one of their regular meetings

NORTH DAKOTA'S WATER RESOURCES

North Dakota's most important non-human resource is water. It is the one resource that holds the key to the future development and prosperity of the state. Water is not only a resource. It is a necessity of life and as such, it must be guarded and wisely conserved and used. When good water is plentiful and cheap it is taken for granted; when it is poor in quality, costly or scarce everyone is concerned. Water problems exist in all parts of the United States. These problems are becoming more acute and widespread as our nation grows and develops. There is an urgent need for a better understanding of the nature of water problems and the solutions to these problems.

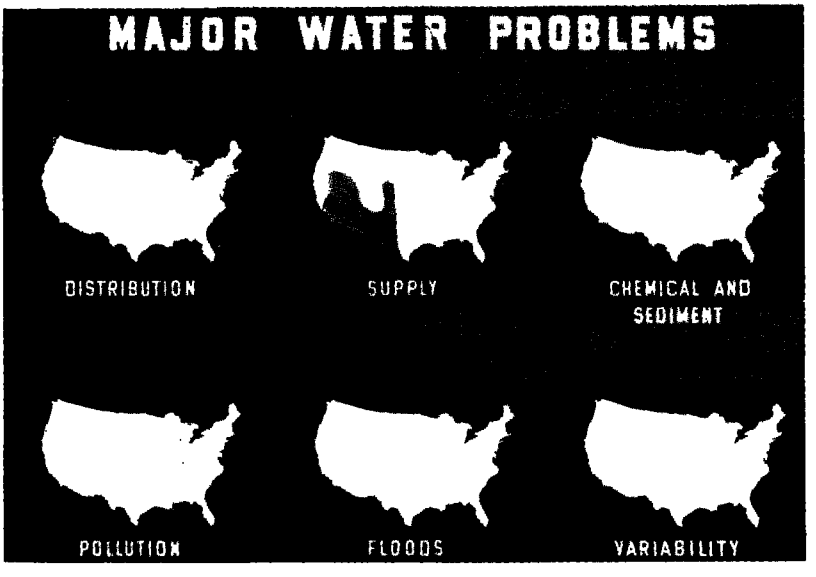
North Dakota is richly blessed with most of the essential elements of a sound and prosperous agricultural economy—an abundance of rich soil, an industrious and progressive people, and long hours of sunshine during the growing season. The one basic element lacking is an adequate and assured supply of moisture. This shortage exists not so much because of the lack of quantity but because of the poor distribution of water as to time and place. The solution to the problem lies in the proper management of our streams through the control of flood waters and regulation of their release as needed for beneficial purposes.

The conservation of water in man made storage reservoirs is not in itself sufficient. The solution to water problems facing the state and nation lies in the wise use of the available water for the greatest possible benefit of the people. Water conservation, as it is referred to today, must include such use of available water resources. Without this use, we are wasting this important resource as surely as if we should allow it to flow to the sea unchecked. North Dakota's water resources program is directed not only to the control and conservation of the waters we have but also to the utilization of our water resources to the fullest possible degree.

Water problems may be classified as problems of supply, distribution, quality (chemical and sediment), pollution, floods, and variability. This classification applies to the water problems throughout the United States as well as to the problems in North Dakota.

Water supply problems—Precipitation is the source of the entire fresh water supply in North Dakota. Our total annual precipitation in North Dakota varies from an average of 15 inches in the extreme southwestern part of the state to approximately 20 inches in the eastern part of the state. Our average annual precipitation statewide is 17.11 inches and of this three-fourths of an inch reaches our rivers and streams and constitutes the runoff that makes up our manageable water supplies. This runoff averages 2½ billion gallons per day. In addition to this water supply it is estimated that ground

water aquifers exist throughout the state that could yield approximately 250 million gallons a day for beneficial use without adversely affecting these sources of water. North Dakota does not have to rely entirely on the rainfall and runoff existing within the boundaries of the state alone. Several of our streams have their sources in, or flow, through other states and consequently the surplus runoff from these states adds to the manageable water supply in North Dakota. The amount of water is one side of the supply—demand situation; the amount of water used and how we use it is the other side. In the region in which North Dakota is located a far greater percentage of the water is used for irrigation purposes than for industrial or public use. Irrigation consumes 60% of the water devoted to this purpose while industrial use consumes only 2% and returns the remainder to the rivers and streams. Public use is approximately 10% consumptive and 90% non-consumptive. The most important use of water in North Dakota, irrigation, therefore depletes the limited supply of water available in the state in comparison to the principal use of water in the more humid areas of the east where industrial use is predominant. This situation points out the need for wise conservation and utilization of the available water in the state if we are to realize the greatest potential benefit from this all important resource.



The variability problem—Even though the average water supply is adequate to meet average demands, variability is a problem because it means that demands exceed the supply at certain times. Although the supply is more variable than demand, the variability of each contributes to the problem. The supply of water varies from day to day, month to month and even year to year. Although the supply may be either greater or less than average for several successive years, no over-all increase or decrease in the total supply can be seen. There have been numerous periods of intense drouth; however, it will be noted that wetter than average years preceding and following a dry period tend to compensate for the deficiency occurring during that dry period and the over-all average for the country over a period of years is not appreciably changed. Again this situation points out the need for the conservation of water during periods of excess for use during dry periods.

Climate causes much of the variability of our water supply, but geology is also an important factor. This is particularly true insofar as our ground water supplies are concerned and the discharges from our ground water aquifers to our streams. In some areas porous soils exist that absorb large quantities of water that contribute to the ground water supplies in those areas. In others the soil is so tight that it does not absorb appreciable quantities of water and therefore little is contributed to the underground storage in those areas. The characteristic of the soils and the underground storage in an area has a direct effect on the stream flow of the streams in those areas. In areas of porous soils precipitation is absorbed into the ground water aquifer and when the aquifer is full is discharged from that aquifer into the streams draining the area. A good example of this situation exists in the Sheyenne River in the Warwick area in North Dakota where it is estimated that approximately 20 cubic feet per second were being discharged from an extensive ground water aquifer into the Sheyenne River along a 20 mile stretch of that river during 1958. This discharge represents the overflow from the ground water aquifer and can be compared to the flow of water over the spillway of a dam that is uncontrolled. In other words, when the aquifer or the reservoir of the dam becomes filled to its capacity, the excess water flows over the barrier creating the underground impoundment and escapes downstream. Too frequently these waters are unused and flow from our state.

The geology and soils of an area determine not only the runoff that reaches the stream or river but also, in the case of overflows from ground water aquifers, determines the rate that is discharged in the river. In many of our smaller rivers and streams the major source of water in the late summer and fall months is from springs and overflows from ground water aquifers. They are more in evidence in the fall after the plants have lost their foliage and are no longer consuming water.

The climatic and geologic factors are natural situations that affect the variability problem. The demand for water is the other side of this problem. In North Dakota while demands for public supply are almost constant, irrigation demands are highly seasonal. Most irrigation water is used during the three to four month growing season and practically none the remainder of the year. In our semi-arid climate ordinarily the greatest demand for irrigation water occurs during the months of July and August when our normal stream flow is at its lowest. This factor again points out the need for the construction of storage reservoirs to store surplus runoff for use when the demand is greatest. The demands for industrial water are less variable than those for irrigation water; however, there is some variation from month to month and place to place in this respect. Such demands are not a problem in North Dakota at the present; however, if we are to have increased industrial development in the state we must be in a position to provide a constant and adequate source of water for these industries. Again storage of surplus flood waters is the answer.

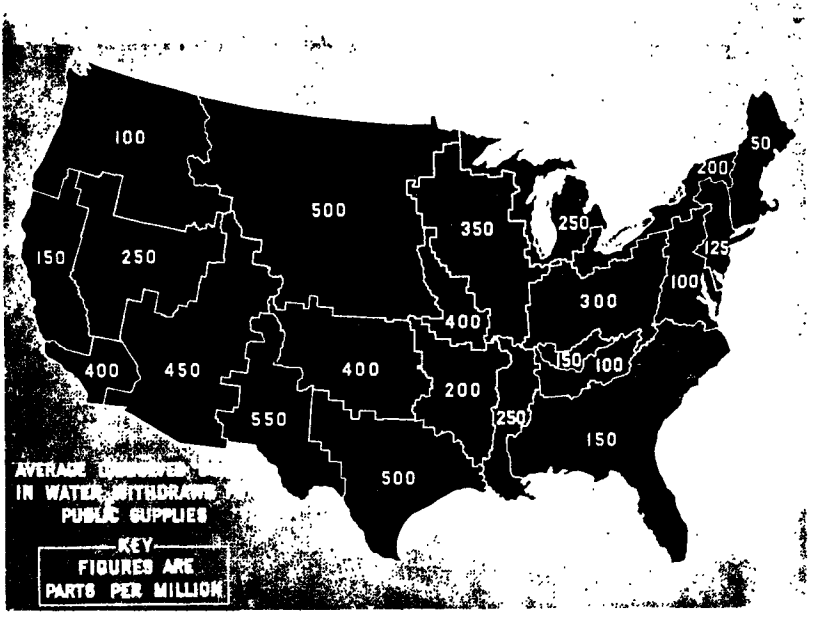
Water may be stored either under the ground or above the ground in times of plentiful supply and withdrawn in times of need. This stored water is in effect money in the bank and, just as it is important for an individual to have a reserve of funds to fall back on, so is it important for the state to have a reserve of water to fall back on during drouth periods. Fortunately nature automatically captures some of the water income we have and stores it in our underground aquifers. This is a most efficient method of storage because the matter of evaporation is practically eliminated. It perhaps is not as effective as man made storage because it depends on natural forces to store and release water. However, in this respect, man can assist nature by withdrawing water stored in the ground through wells for use as needed, thereby providing capacity for further storage. In certain areas it is possible through relatively simple devices to recharge the ground water storage artifically. In North Dakota several smaller dams have been built in conjunction with municipal water supplies, specifically for this purpose. Examples are the Portland Dam, the Hunter Dam, the McVille Dam, the Tioga Dam and an underground dam constructed at Ellendale. Our main concern in the use of water from ground water aquifers should be directed to the prevention of mining of water, that is removing more water from the aquifer than is recharged into the aquifer by natural or artificial methods.

The distribution problem—Distribution becomes a problem when demands or uses for water in one part of a region exceed the supply although there may be a surplus of water in other parts of the region or adjacent regions. Many of North Dakota's water problems are distribution problems because the supply and the demand for water do not coincide geographically. The distribution problem can, in

most instances, be solved by the construction of canals and aqueducts. Many existing and proposed water resources projects in North Dakota are designed to provide a solution to the distribution problem. The Golden Lake Restoration Project, the Lake Metigoshe Restoration Project, and the Sheyenne Diversion Project that will provide the City of Fargo a municipal water supply, are examples. An outstanding example of a proposed project designed to provide a solution to the distribution problem is the mammoth Garrison Diversion Unit whereby eventually 2½ million acre-feet of water from the Garrison Reservoir on the Missouri River will be diverted into eastern and central North Dakota for irrigation and other beneficial uses. Other possible diversion projects in the state designed to solve distribution problems include the Knife River Diversion Project and the Little Missouri Diversion into the headwaters of the Heart and Cannonball Rivers. Some diversion projects such as these may not appear economically feasible at the present; however, as the demand and need for water increases these projects may become feasible in the not too distant future.

Water Quality Problems—Of all future water problems those associated with quality promise to be most troublesome. Water supplies can be of poor quality from natural conditions or because of man's actions. In great parts of the nation the water has always been of poor quality; however, our changing ways of life have caused us to view this problem differently today than we did yesterday. Most of the minerals and salts found in our waters are of natural origin. In North Dakota they are the principal reason for the relatively poor quality of water that we have in many sections of the state. Man's efforts to clean up our streams and thereby improve the quality of water, if only directed to the pollution of the rivers and streams that is caused by man, can be effective in maintaining the quality of our water but are not the entire answer. The solubles in our water supply from natural origin come from the weathering of soils and rocks and from biologic reactions in the soil and water. Where precipitation is abundant, a plentiful supply of water dilutes these soluble products of weathering and the concentrations in natural water are low. Conversely, where precipitation is light, the concentration of the salts and minerals in natural water is higher. For this reason, in North Dakota where our precipitation is relatively light and because of variances in the precipitation received during the year we have problems of water quality in the case of several of our rivers and streams and many of our ground water aquifers. Water quality presents problems not only in the method and procedures used in the treatment of public water supplies but also in the use of water for irrigation purposes. The peak demand for water for irrigation often coincides with the period of poor quality in the river or stream that serves as the source for irrigation. In North Dakota the State Water Commission is making an effort to obtain

a sufficient number of water samples from all the streams in the state to determine their water quality pattern. Impoundment in surface reservoirs of surplus waters helps minimize the variations in water quality because it permits the mixing of high flows of relatively good quality water with low flows of poor quality water. Another problem of water quality results from the sedimentation that occurs in some of our various streams. Sedimentation varies with the geology, relief, stream velocity, vegetation in the drainage basin and abundance of flow for dilution. Some geologic formations that are easily eroded are particularly large producers of sediment. Erosion resulting from poor soil management on our farms also contributes materially to this problem. The problem of sedimentation is further aggravated when we attempt to build reservoirs or otherwise slow the velocity of a stream. Here sedimentation can be a major consideration in determining the life of a man made reservoir and must be considered in the design and cost of such reservoirs. If a stream carries a high concentration of sediment an otherwise feasible and highly desirable reservoir may be impractical because of a relatively short life in comparison to the cost involved. Adequate space must be provided in the reservoir for the trapped sediment. The amount of sediment in a stream is of concern to all water users particularly to the municipalities and industries relying on the stream for their water supply because they must provide means to settle the sediment before they use the water.



In North Dakota many of our ground water aquifers and lakes and other sources of water are highly mineralized and must be treated before they are used for domestic and other industrial purposes. In many cases the methods of treatment are often so expensive as to prohibit the development of an available water supply for the public use. Recent studies and investigations by the Department of Interior in saline and brackish water conversion may provide the solution to the problem in the near future. This source of water in North Dakota, if an economical method is devised to provide necessary treatment, could provide a large water supply for the economic growth and development of the State.

Pollution problems—In many areas of the country pollution is the major water problem. Pollution problems are man made and in most cases result from the discharge of raw sewage, industrial and agricultural wastes into our rivers and streams. Although there are areas in North Dakota where pollution problems insofar as our rivers and streams exist, this over-all problem is not an acute one statewide. Adequate methods exist for the control of pollution of our rivers and streams and, through the cooperation of the State Health Department, municipalities and industries concerned, much has been done to eliminate the pollution of North Dakota streams. North Dakota was a pioneer state in the use of lagoons for the treatment of municipal sewage, a method of sewage treatment that is now being widely used throughout the Midwest. As our state grows in population and as industries move into the state we must be continually alert that adequate sewage and waste disposal provisions are made. As irrigation becomes more widespread in the state we must make provisions to prevent the contamination of our streams by the discharge of return flows from irrigation that will carry a higher concentration of salts from the soils.

Flood problems—Floods are a problem in many parts of North Dakota. They are a problem, not so much because of the high flow of water in the river or stream concerned, but more because of man's settlement along the rivers. Flood plains have many attractive features and man has often overlooked or ignored the threat to homes, industry and agriculture from this destructive force. As the flood plains have been settled, man has attempted to solve this problem through the construction of dikes or levees to confine the river to its normal channel. These protective works have encouraged greater use of the flood plain and, when the once in a lifetime flood occurs, the gains that have been made by the construction of flood protective facilities are offset by higher flood damages. As a result, the annual damage from floods is fairly constant in spite of the progress made in the construction of flood control facilities. Although the only way to eliminate flood damage entirely would be to abandon the use of the flood plain of our rivers, such a solution is impractical

because of the extensive existing development in these plains and the desirability of using them for urban, industrial and agricultural purposes. The man made problem of flood damage then becomes a major problem for man to solve.

The solution, which at best can be only a partial one because of the cost involved to provide total flood protection, can be provided in several different ways. Each has its application depending on the problem, the cost and the extent of control desired. Channel improvements will improve the carrying capacity of the stream and can alleviate a flood problem in a particular vicinity although such improvements may aggravate the problem further downstream. Levees or dikes can restrict the stream flow to the channel and are often the most practical solution to the flood problem in many areas and localities in North Dakota. The third method, that of constructing storage reservoirs to contain the surplus runoff during flood periods for use during later dry periods, is the most logical solution in North Dakota where such possibilities exist. The conservation of water through improved agricultural practices can be a major factor in the prevention of flood damage particularly to the agricultural land itself. The watershed program of the Soil Conservation Service is designed to conserve as much water as possible where it falls and by treating an entire watershed can greatly reduce runoff and thereby curtail flood damages. Such projects do not eliminate the need for larger flood control dams nor do they provide for adequate storage of water to serve all needs of the people of an area.

North Dakota has examples of every type of flood control structure. The huge Garrison Dam provides for the storage of 23 million acre-feet of water and provides flood protection for downstream areas, particularly those in the lower Missouri River Basin states. The Heart Butte, Baldhill and Jamestown Dams provide storage on three of the major tributary streams in North Dakota and have greatly reduced downstream flood damages. In the case of the Red River, little opportunity exists for large flood control dams because of the flat terrain and lack of reservoir sites. Here the only logical solution was in the construction of levees, dikes and flood walls to protect the cities of Grand Forks and Fargo. In the Red River Valley area another type of flood control installation exists in the numerous drains that have been constructed. These drains provide for the removal of the surplus spring runoff and flood waters from heavy rains thereby greatly enhancing the use of this valley land for agricultural purposes.

These are the basic problems dealing with water resources development. All must be considered in proper perspective if the full and wise use of our water resources is to be accomplished.

THE STATE WATER CONSERVATION COMMISSION AND THE STATE ENGINEER

Prior to 1937 the responsibility for the administration of the water laws of North Dakota was vested in the State Engineer. He was also required by law to provide technical assistance in matters related to the rivers and streams of the state. The drouth of the 1930s pointed out the need for a state agency with broad powers, duties and responsibility in water resource development and, as a result, in 1937 the North Dakota Legislature established the North Dakota State Water Conservation Commission.

The Commission was virtually given complete authority over the waters of the state and was made the responsible state agency for the development of many needed water resources projects. It was given the authority and responsibility to investigate, plan, construct and develop such projects throughout the state as were required and were within its ability. A complete list of the powers and duties of the State Water Conservation Commission has been listed in previous biennial reports and can be found in Chapters 61-02 of the North Dakota Code.

When the Commission was organized on March 27, 1937, four principal objectives were set forth as guide lines for the program that was to be followed. These four objectives still serve as goals for our North Dakota water resources program. They are:

1. Providing water for human needs such as drinking, sanitation, and recreation.

2. Water for animal needs such as livestock and game and fish life.

3. Water for irrigation to insure crop production for the stabilization of a diversified farming and livestock industry.

4. Providing for flood control facilities where needed.

The solution to the basic water problems in North Dakota outlined above is essential if these objectives are to be met. The logical method to provide the solution lies in the construction of dams, canals, drains, flood protective structures and related works to meet the needs of an area. Involved in the development of every water resources project are several specific requirements including:

1. The collection and assembly of basic data and proper dissemination thereof.

2. The investigation, survey and planning of the proposed water resources projects.

3. A review of the project plan to determine the feasibility of the project and to acquaint the local beneficiaries with its merits and problems involved.

4. The organization of a legal entity as provided by state law through which the local project proponents and beneficiaries can effect the development of the project.

5. Making necessary arrangements for financing the construction and development of the project.

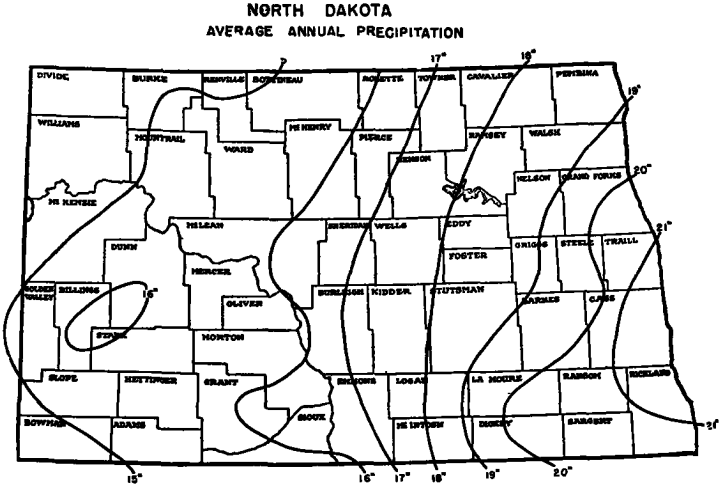
6. Accomplishing the actual construction of the project works, and assisting the local beneficiaries in the operation and use of these facilities to assure that the maximum benefits from the project at the most economical cost will accrue.

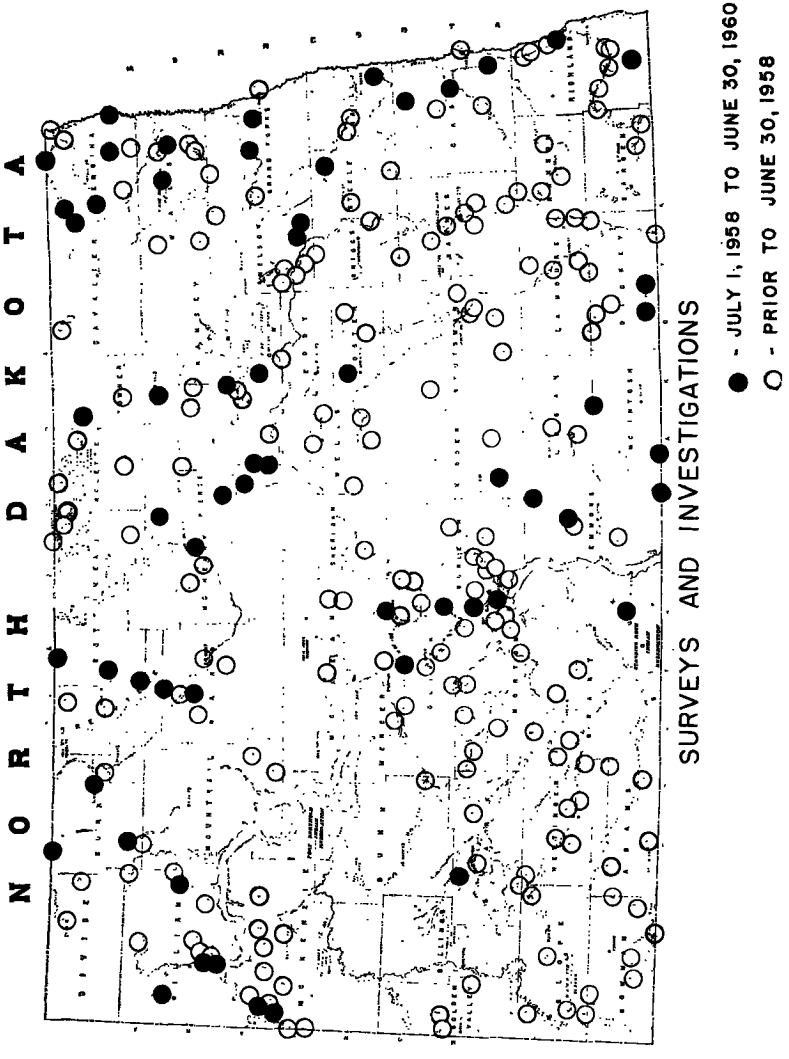
In developing such a project it is apparent that a great deal of cooperative effort is required by local project proponents and federal and state agencies concerned whether these projects be irrigation, flood control, municipal and industrial water, drainage or recreation. The degree of success attained in the development of a water resources project is directly proportional to the extent of cooperation that is received from the various cooperating individuals, organizations, and agencies. The North Dakota Water Conservation Commission plays an important part in the development of all water resources projects in the state for it is the state agency that has been designated by the legislature as specifically responsible for the control, development and utilization of the waters of North Dakota.

The State Water Conservation Commission's program has been directed to meeting the objectives set forth by the Commission in 1937. The Commission is engaged in a variety of activities, each which is vital to the total over-all development of the state's water resources. These activities which have been authorized and directed by the North Dakota State Legislature are discussed in detail in this report. A listing of them is as follows:

1. Engineering, surveys, investigations and plans of the proposed project regardless of the purpose that it will serve; 2. Designing and constructing the various facilities for water resources projects; 3. Constructing and repairing dams, irrigation systems and other facilities related to water resources projects; 4. Assisting counties, drainage districts and water conservation and flood control districts in the planning and construction of drainage ditches and other facilities; 5. Cooperating with the various branches of the U. S. Geological Survey in programs dealing with the collection and compilation of basic data on topographic, hydrographic, underground water and quality of water studies in the state; 6. Cooperating with the Bureau of Reclamation, the Corps of Army Engineers, the Soil Conservation Service, and other Federal agencies in matters dealing with the development of the water resources of the state; 7. Representing the state in various conferences relative to the coordination of the activities of Federal and state agencies in the water resources development program for North Dakota and the Missouri River

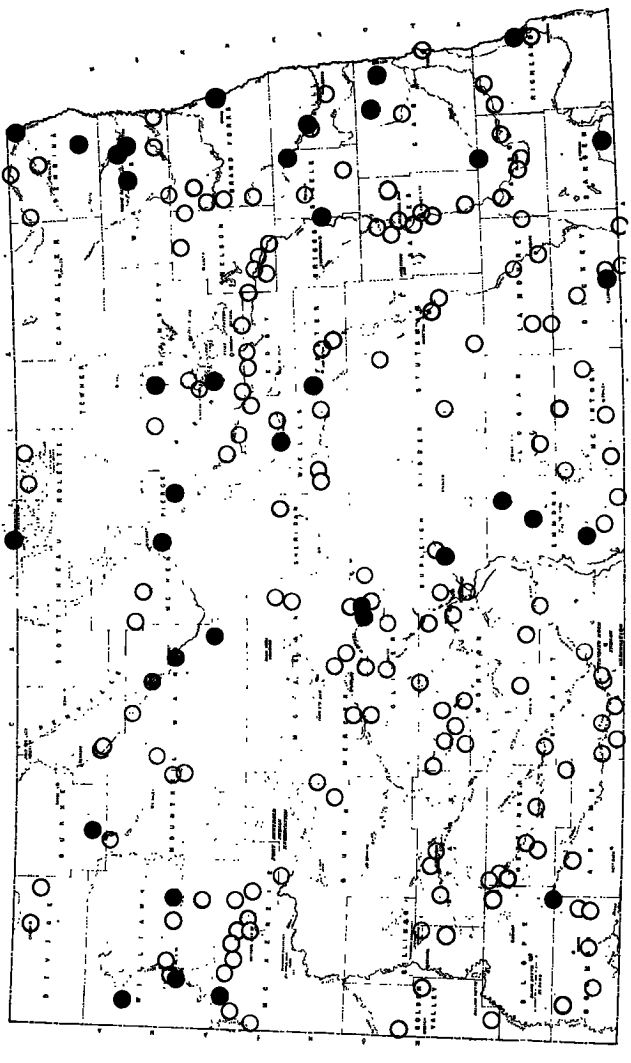
Basin as well as in matters from a national standpoint that would affect this program; 8. Representing the State of North Dakota in compact negotiations with other states and with the International Joint Commission and the allocation and use of the waters of international and interstate rivers and streams; 9. Processing water right applications received from individuals, cities and industries; 10. Organizing irrigation districts and water conservation and flood control districts upon request and petition from the local sponsors and cooperating with these districts in planning, investigating, and operating their project facilities; 11. Administering the water laws of North Dakota; 12. Fostering and promoting irrigation and water resources development in North Dakota throughout the state, the region, the Missouri River Basin and the nation.




NORTH DAKOTA
SURVEYS AND INVESTIGATIONS
● - JULY 1, 1958 TO JUNE 30, 1960
○ - PRIOR TO JUNE 30, 1958

Chapter II

N. D. SWCC ACTIVITIES



CONSTRUCTION, RECONSTRUCTION AND MAINTENANCE OF WATER CONSERVATION FACILITIES

●-JULY 1, 1958 TO JUNE 30, 1960

○-PRIOR TO JUNE 30, 1958

PROJECTS

The activities of the State Water Conservation Commission are directed toward the investigation, planning, design and, if feasible, the construction of many water facility projects throughout the state. The development of these projects in all cases results at the instigation of local proponents. The projects are designed to serve one or more of the variety of purposes with particular emphasis being placed on multiple-purpose developments. Commission activities are directed mainly to the smaller water resources projects that are not so costly as to require financing by the Federal government except, in many cases, the Commission investigates and compiles basic data to prepare essential plans for numerous projects that are proposed to appropriate Federal agencies for development. This effort has expedited the construction of several important water resources projects in the state. Many of the projects that have been of concern to the Commission are of a nature that they could be constructed either by a Federal or state agency. Local project proponents and the Commission have found that often it is less costly to the local interests if projects are constructed by state agencies rather than Federal agencies because of the procedures and standards to which the Federal agencies must conform in the development of a water resources project.

Projects of concern to the Commission in this activity include those designed for irrigation, recreation, municipal and industrial water supplies, drainage and flood protection. Regardless of the project purposes, a great deal of preliminary engineering, investigation, design and planning is essential to determine whether or not the project is worthwhile and feasible. In all cases a definite indication of local interest is required before the Commission undertakes a water resources project development. The local interest requirement includes provision for participation in the cost of the project if it is constructed. This program is conducted through appropriations made by the state to the Commission on a biennial period to finance the operations of the Commission.

One of the most important phases of the State Water Conservation Commission's program in the development of these water resources projects is that of conducting engineering investigations and surveys of proposed developments and preparing the essential reports and plans from these surveys. The Commission's investigation program includes gathering stream flow data, topographic mapping, test drilling, and the design of the structures needed for the project under consideration. The Commission has two full time survey parties and two full time test drilling crews that are devoted to the investigation program. The survey crews gather and compile basic data dealing with the topography required for the design and construction of the project. In addition they gather information relative to land ownerships and easement requirements for the project development. One

of the drill crews is assigned to the cooperative ground water investigation program conducted with the U. S. Geological Survey. The other drill crew directs its efforts to gathering undisturbed soil samples to determine the suitability of the soils for the construction of earthfill structures and also in connection with foundation studies for various structures. The foundation studies made possible through this phase of the Commission's investigation activities have proved to be indispensable in evaluating the feasibility of various water resources projects.

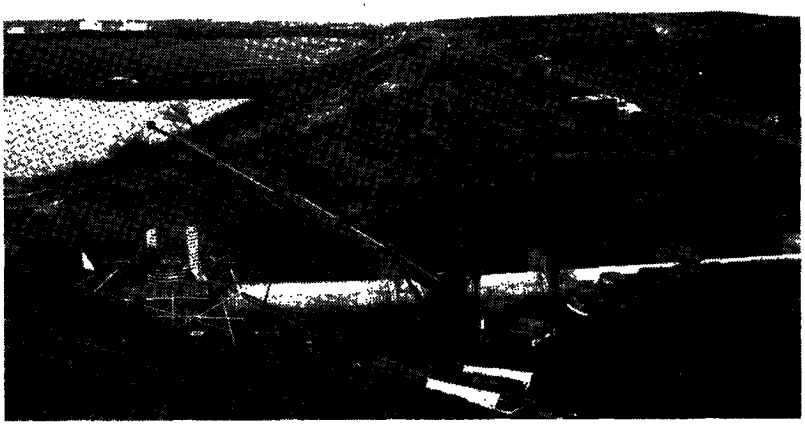
Recent discoveries of ground water aquifers in various locations of the state through the Commission's ground water investigation program and the increasing interest in irrigation development brought on primarily by recent dry years has stimulated the interest in the development of irrigation from ground water sources. Because of this interest and need the Commission has obtained a drill unit capable of installing large diameter test wells in conjunction with its investigation program to determine the quantity and quality of ground water available in the areas in which irrigation development is proposed. The acquisition and use of this unit has lead to the development of wells to supply the irrigable lands in the Cartwright and Sioux Irrigation Districts. It is contemplated that in connection with the Commission's irrigation development program additional test wells will be installed in other aquifers that would otherwise be impossible if this drill unit were not available.

In connection with the utilization of our ground water resources for irrigation purposes it has become apparent that there is a definite need for basic research dealing with the quality of water available from these aquifers and the reaction of that water to the different soil types that exist in the area. This information is essential and in many cases the successful development of irrigation from the ground water aquifers depends entirely on the quality of water that exists in these aquifers. The Commission has inaugurated a cooperative program with the U. S. Geological Survey on quality water studies insofar as our surface waters in certain areas are concerned. A need exists for an additional cooperative program with the North Dakota Agricultural Experiment Station and the Agricultural Research Service of the U. S. Department of Agriculture to determine the affect of water from our ground water aquifers on various soil types.

Although the greater part of the Commission's investigation activities are directed to projects of immediate concern a continuous effort is put forth to the investigation of potential water resources projects that could be developed if the situation should ever arise that due to economic conditions in the country a large scale public works program were to be conducted. This shelf of projects includes potential development of dams and storage reservoirs that can be

utilized to provide water for irrigation, municipal and industrial purposes as well as providing benefits for recreation, fish and wildlife propagation and conservation, stream pollution abatement, and stock watering uses. As the need develops and the demand for water becomes more critical it is very possible that many of these projects will be constructed without the occurrence of an economic depression.

Involved in the Commission's program dealing with the development of water resources projects is that phase devoted to the construction of new projects or the repair of existing structures. The Commission has two crews that are highly trained in the construction and maintenance of structures essential in water conservation projects. These crews have modern and specialized construction equipment that they utilize in their repair and construction of these projects. Their construction work includes the placement of high quality concrete, blasting, pile driving, earth moving, welding and the placement of concrete by pneumatic methods. The availability of these crews and the modern equipment which they have has made it possible for the Commission to repair or install various water resources structures by the most economical and satisfactory method possible. The Commission's program directed toward the repair of various rubble masonry structures has been greatly augmented through the use of equipment to place high quality concrete pneumatically. The use of this equipment was inaugurated about four years ago and it has been instrumental in extending the life of many small dams that otherwise would have been destroyed. Whenever possible the Commission contracts with local contractors for various segments of the construction or repair of a water resources project.



Kota-Ray Dam — Construction Underway

A greater portion of the Commission's construction program is directed toward the repair and construction of numerous small dams located throughout the state. Many of these dams were originally constructed during the 1930's by Federal agencies that were set up as a part of the relief and public works program. It is estimated that over 1,500 small dams of this nature were built in North Dakota. When these Federal programs were terminated there were no adequate provisions made for the maintenance and repair of these structures. The counties were designated as being responsible for this work but no provision was made for a means whereby the counties could raise the funds necessary to finance this activity. In 1943 the North Dakota Legislature recognized the need for this repair work and made a small appropriation to the State Water Commission to undertake a cooperative program of dam repair.

North Dakota has a present day inventory of small dams that can be valued at over $21 million. It is further estimated that during the past 25 years dams valued at approximately $16 million have deteriorated or have failed. Although many of the failures were due to original faulty design or poor construction, many of the others have deteriorated because of inadequate maintenance. The Commission's dam repair program has been directed to providing this needed maintenance and has been responsible to a large extent, in retarding this progressive loss of the valuable water resources investment that the state has.

The policy that has been adopted by the State Water Conservation Commission in conducting this dam repair program requires participation in the cost of the repairs by a local sponsoring group or governmental entity. This program is thereby directed to those dams or structures that are of value and interest to the local communities. During the period of this report 39 dams or drains have been included in the construction program of the Commission. The cost of the construction work involved in these projects totaled $409,354 of which the Commission paid $165,799, the State Game and Fish Department and U. S. Fish and Wildlife Service $78,200, local participants $157,150, and other agencies $8,204. Included in the program were 10 new dams or drainage structures and 29 repair jobs ranging from the reconstruction to the minor repair of existing structures. In addition to those projects involved in the Commission's construction program 45 separate investigations were conducted by the Commission during the period of this report. Of the projects investigated, facilities for seven were constructed and these projects are presently serving the communities and areas in which they are located. The projects included in the Commission's investigation and construction program during the past biennium are discussed in the following section of this report.

PROJECTS INVESTIGATED AND CONSTRUCTED

Lake Metigoshe Improvement

Sharpe Lake Dam - Project No. 330

Lake Metigoshe, located in the Turtle Mountains about 15 miles north of Bottineau, is a highly developed resort area. There are over 500 summer cottages, a Boy Scout camp, a State park and numerous other facilities located around the lake. Because there is practically no inflow to the lake after the spring runoff, the level of Lake Metigoshe has been subject to extreme fluctuations. In an effort to determine a means to stabilize the level of Lake Metigoshe, the Commission made extensive investigations of the area to determine if surplus spring runoff could be stored in one of the other lakes in the area and released to Lake Metigoshe later in the year as needed. A plan for such storage in Sharpe Lake in Canada provided a partial solution to the problem. Arrangements were made with Canadian officials and landowners for the necessary easements and rights-of-way and the project was constructed in the Fall of 1958. The project included a dam with a control gate and a channel from Sharpe Lake to Lake Metigoshe.

Sharpe Lake Dam is located at the outlet of Sharpe Lake in Manitoba, Canada, about five miles north of Lake Metigoshe. It is a reinforced concrete arch spillway built into the outlet channel of Sharpe Lake. The height of the weir is 10 feet above the outlet channel. This additional 10 feet to the elevation of Sharpe Lake provides for the storage of 9,500 acre-feet of water, which would raise the level of Lake Metigoshe 6½ feet if released at one time.

Included in the dam which contains 77 cubic yards of concrete and 216 lineal feet of steel sheet piling is an 18" pipe and gate used to provide controlled releases to Lake Metigoshe.

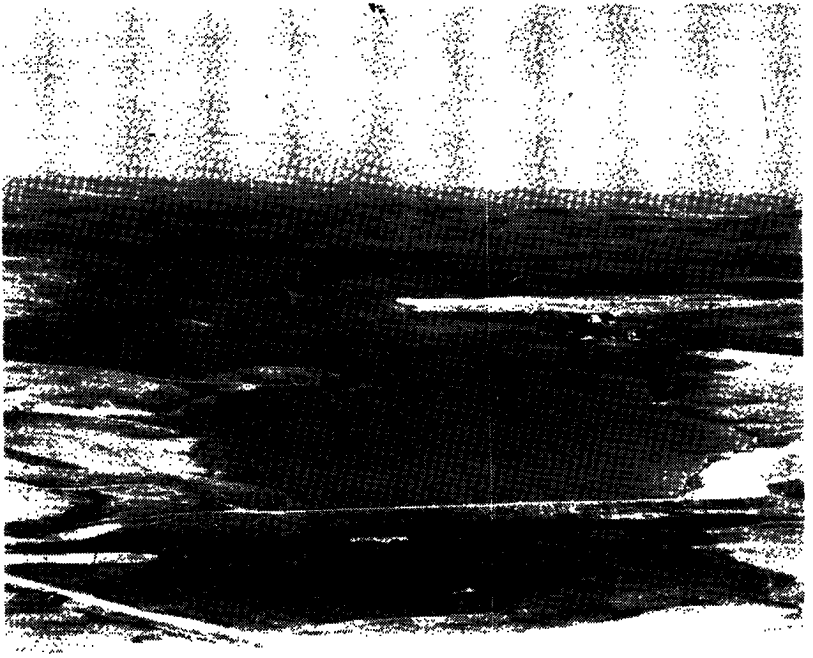
After the spring runoff in 1960, water in Sharpe Lake was raised to an elevation six feet above the outlet channel elevation. Presently 5,500 acre-feet of water is stored in Sharpe Lake which is sufficient water to raise the level of Lake Metigoshe approximately four feet.

The total cost of the structure was $10,633.14, which was shared by the North Dakota State Game and Fish Department, Oak Creek Water Conservation and Flood Control District and the North Dakota State Water Conservation Commission. In addition, the Lake Metigoshe Improvement Association cooperated in obtaining the necessary easements and land purchases. The cost of water storage in this reservoir is only $1.10 per acre foot. This extremely low figure points up the financial advantage of increasing the storage of an existing lake as compared to creating a new reservoir.

SCHMISEK LAKE DAM - PROJECT No. 575

Schmisek Lake, located about six miles northwest of Powers Lake in Burke County, was a shallow lake with insufficient depth to sustain fish life or area to permit boating and other types of recreation. The lake did receive an ample supply of fresh water from numerous active springs, however, most of this supply drained away through the lake's outlet channel. At the request of the Powers Lake Community Club, the Commission investigated the possibility of raising the lake elevation by constructing a dam at the lake outlet. This proposal was found to be feasible and arrangements for construction of the dam were made. The Commission investigation also included a metes and bounds survey of the land required for the reservoir for use of the State Game and Fish Department in acquiring this land.

The dam consists of an earth embankment across the outlet of the lake. Utilization of an old channel west of the lake as a natural spillway greatly reduced the cost of the structure. The dam increases the maximum depth of the lake from 10 to 26 feet and increases the surface area from 22 acres to 197 acres and the capacity to 2,000 acre-feet.



Schmisek Dam

During the first spring runoff in 1960, the reservoir was filled and some water flowed over the spillway. The active springs have served to maintain the lake at very near spillway elevation throughout the summer as was anticipated.

A total of 23,000 cubic yards of random fill and 6,870 cubic yards of impervious fill were used in the construction of the embankment. The total cost of the project was $12,543.34, which was shared by Burke County, North Dakota State Game and Fish Department, Burke County Water Conservation and Flood Control District and the North Dakota State Water Conservation Commission. The reservoir sited provided an opportunity to store water at a cost approximately $5.00 per acre foot which is a very reasonable figure. It is possible to store water at this low cost by improving an existing lake and making use of the natural spillway. Burke County's share of the costs was made up by placing the random fill and the riprap under Water Commission supervision. The Powers Lake Community Club aided in obtaining easements and making land purchases.

Schmisek Lake now provides excellent recreation facilities for the area and is used for fishing, boating and swimming. A large area bordering the lake is being developed by the community through tree planting and beach improvement.

HUNTER DAM — PROJECT No. 619

The Hunter Dam was investigated, designed and constructed by the State Water Conservation Commission to provide a municipal water supply for the Village of Hunter. The Village desired to install a municipal water system, but efforts to locate an adequate supply were unsuccessful. At the request of the Village Board of Trustees, the Commission investigated this problem and discovered a large area in the vicinity of the present dam was underlain with sand and gravel that could be developed as an underground aquifer if a method of recharging these sands could be devised. A dam was proposed and arrangements for its construction were made by the Village. Water from the reservoir recharges this aquifer. A well was constructed by the Village in the aquifer and by this means the water is pumped from the aquifer into the Village's distribution mains. In this way the sands form a filtration system and the water needs little or no additional treatment. This eliminates the necessity for the construction of an expensive water treatment facility. The Village of Hunter now has a dependable supply of excellent quality water at a remarkably low total investment.

The dam consists of a rolled earth embankment with a reinforced concrete buttress type spillway. The spillway has a crest elevation of 15 feet above the channel bed and is 40 feet long. The addition of flashboards adds three feet to the height of the spillway. A total of 220 cubic yards of concrete was used to construct the spillway.

During the spring runnoff of 1960, the reservoir was completely filled to a height of 18 feet. It was expected that the recharging of the aquifer, coupled with evaporation losses from the reservoir would cause considerable drawdown of the impoundment, particularly during the first season. The drawdown has not been as large as expected, and the reservoir will undoubtedly provide new recreation opportunities to the community not originally anticipated. No seepage loss from the reservoir is yet apparent in the channel below the reservoir. The reservoir capacity is 3,900 acre feet and the cost per acre foot of storage is $80.

The total cost of Hunter Dam is $29,708.28, which has been shared by the Village of Hunter and the State Water Conservation Commission. Some additional minor work is scheduled to be completed late in the 1960 construction season.

Hunter Dam and Reservoir

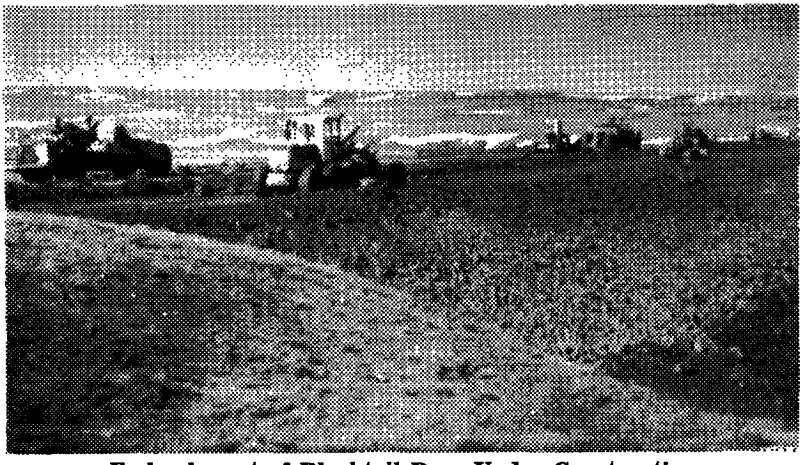
BLACKTAIL DAM — PROJECT No. 560

Blacktail Creek, in northwest Williams County, flows through a deep valley and empties into Little Muddy Creek. At the request of the Williams County Park Board, the State Water Commission investigated the possibility of constructing a dam on Blacktail Creek for recreational and fish and wildlife purposes. The Commission's investigations, which included topographic, hydrographic, and foundation studies, resulted in the location of a suitable site for a dam about 25 miles northwest of Williston. The dam was constructed in 1959 and the reservoir filled in the 1960 spring runoff.

Blacktail Dam consists of a rolled earth embankment with a natural spillway for emergency use and a small trickle tube spillway for normal use. Runoff from melting snow and rain that is stored in the reservoir will be allowed to drain out gradually through the 18 inch corrugated metal pipe trickle tube. The embankment contains 235,000 cubic yards of select rolled earth fill and rises 60 feet above the old stream bed. The dirt work was accomplished by an independent contractor under Commission supervision. The trickle tube spillway was installed by the Commission. Six thousand, five hundred yards of rock riprap were placed during the winter of 1959-1960 under contract.

The impoundment created by this dam has a surface area of 125 acres with a maximum depth of over 40 feet and a capacity of 1,800 acre-feet of water. The cost of storage is approximately $45 per acre foot. This reservoir is fed by many springs which should maintain the level at or very near spillway elevation throughout the season. The Williams County Park Board owns over 90% of the shore line and has made the land available for public use. The project provides excellent facilities for water sports, fishing and for waterfowl habitat.

The northwestern portion of North Dakota experienced a near record runoff in the spring of 1960. This was reflected in the storage at Blacktail Dam. When in planning, it was expected that it would take from three to five years to fill the reservoir; however, the large runoff received completely filled the reservoir the first year, indicating that a flood of a 50-year frequency occurred during the spring of 1960.



Embankment of Blacktail Dam Under Construction

The total cost of the project to date is $74,202.47 which was shared by the Williams County Park Board, State Game and Fish Department, U. S. Fish and Wildlife Service and the State Water Conservation Commission.

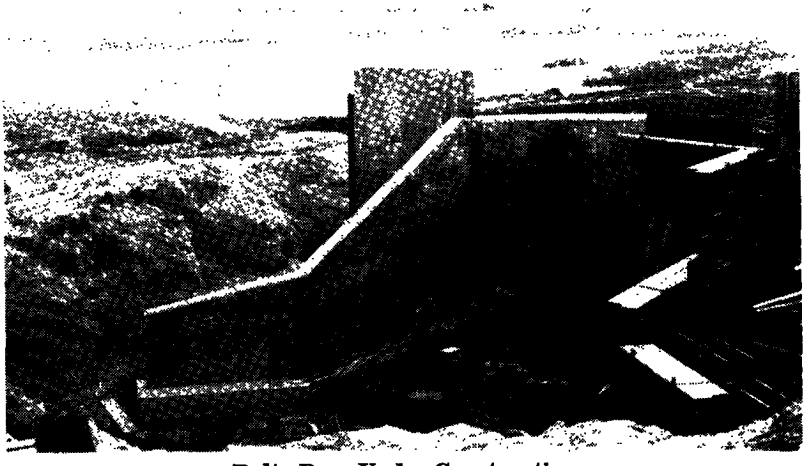
ELLENDALE CITY DAM — PROJECT No. 615

The City of Ellendale, like many of her sister communities in North Dakota, found that she was faced with a water supply that was not meeting the needs of a growing and progressive community. In 1956, at the request of the city, the State Water Commission's ground water survey team conducted an investigation in the area in an effort to locate additional water supplies for the community. This drilling survey established the fact that an excellent gravel aquifer was located beneath Dry Branch Creek which flows past Ellendale on the east edge of the city. Dry Branch Creek is an intermittent stream that shows flow only during times of excess runoff. It was evident that this aquifer was an underground portion of the surface stream. The water in the underground portion of the stream, of course, was flowing the same as the surface stream although at a much reduced rate. After analyzing these facts, it was evident that this aquifer would make an excellent water source but would likely be depleted during times of extended drouth. With this in mind and at the request of the city, further drilling investigations along the course of Dry Branch Creek were conducted by Water Commission drill crews. This was done in an effort to locate a point at which the underground portion of the stream might be dammed. Such a site was located about two miles south of Ellendale. After considerable study the city decided to proceed with the proposed project.

The underground dam was constructed by excavating a trench across the valley floor with sufficient depth to completely intercept the gravel aquifer. The trench was then back filled with clay which was highly compacted. This forms an effective block to the underground flow and the success of the operation was evident since water has since been flowing over the clay block on the surface. The excavation for the block was up to 30 feet deep and about 20 feet wide. It involved 12,000 cubic yards of excavation. The work was accomplished by private equipment under the supervision of Water Commission engineers and inspectors. The project cost $6,949.87.

The City of Ellendale has located two wells in the underground reservoir formed by this underground dam. Present plans call for the construction of a surface dam on top of the present underground dam. This would add considerably to the water available to the community and guarantee it a sufficient supply of water to withstand extended drouth periods. The construction of the surface dam will be commenced late in 1960.

This project again takes advantage of the excellent natural filtration facilities and allows the community to effect a considerable saving in water treatment costs.



Balta Dam Under Construction

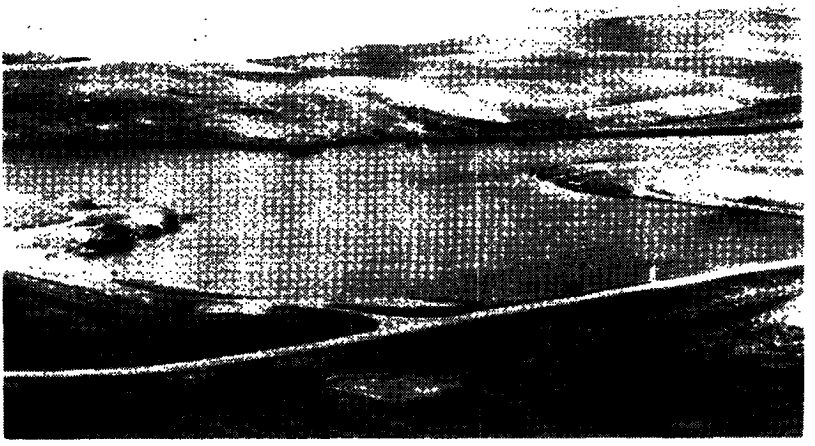
BALTA DAM — PROJECT No. 362

The original Balta Dam was built by the WPA in 1937. In 1941, the spillway failed completely and the project was rendered useless. The original WPA dam created a lake with an area of 60 acres and a maximum depth of ten feet. The reservoir of the reconstructed dam will have an area of 108 acres and a maximum depth of 18 feet. This depth is sufficient to sustain fish life. The Commission made a survey of the dam and reservoir area for land acquisition purposes and also conducted test borings for a study of foundation conditions for the spillway.

The reconstructed structure consists of a reinforced concrete arch spillway with a drop of 16 feet and a rolled earth embankment 800 feet long. The embankment built by the WPA was incorporated into the new and higher fill. The spillway was constructed by Water Commission construction crews and the embankment was built by the Pierce County Highway Department under State Water Conservation Commission supervision.

The spillway contains 140 cubic yards of concrete and the embankment 25,000 cubic yards of selected and compacted fill material. As of July 1, 1960, the spillway structure has been completed and the embankment is 90% complete with construction underway. Fourteen hundred cubic yards of rock riprap will be placed on the embankment during the fall of 1960. The estimated total cost of this

project is $30,475, which will be shared by the State Water Conservation Commission, Pierce County and the North Dakota State Game and Fish Department.



Kota Ray Dam and Reservoir

KOTA-RAY DAM — PROJECT No. 489

The Kota-Ray Dam is located in Williams County nine miles south of Ray. The dam is located at the site of a smaller WPA dam that was constructed during the 1930s and was in need of repair. Because of the size of the original WPA dam, only limited use was made of the small reservoir. The lake was not of sufficient depth to sustain fish life. The construction of the Kota-Ray Dam by the Commission consisted of raising the embankment and using it for a road crossing for a county highway. A modified "glory-hole" type spillway was incorporated in the embankment of the dam which eliminated the need for a bridge. The "glory-hole" spillway or drop inlet consists of a sectional corrugated metal pipe 78 inches in diameter. The spillway has a drop of 30 feet and a length of 158 feet.

The Kota-Ray Dam, as it has been reconstructed, creates a reservoir of approximately 50 acres in size with a storage capacity of 340 acre-feet. The maximum depth of the reservoir is 30 feet. The embankment contains 80,000 cubic yards of selected rolled earth fill and 55 cubic yards of concrete, and 188 feet of 78 inch sectional corrugated metal pipe was used in the construction of the "glory-hole"

spillway. The cost of the project was $38,746.42 which was shared by the State Water Commission, the State Game and Fish Department, Williams County and View Township of Williams County. The Ray Wildlife Club cooperated in obtaining easements, making land purchases and constructing recreational facilities. Trees have been planted and a picnic area and beach have been developed at the reservoir.

Since the initial construction of Kota-Ray Dam was completed, additional work has been found necessary. During the course of the Commission's investigations of the project and its test drillings to determine foundation conditions, a coal vein was discovered in one abutment of the embankment. It was recognized that this vein might become a seepage vein later and have to be sealed off. In order to keep the cost of the project at a minimum, a calculated risk was taken when the project was constructed that this vein might not cause a seepage condition and therefore the cost of sealing it off could be eliminated. About three months after the reservoir filled, a spring possessing a flow of 12 gallons per minute appeared on a hillside downstream from the dam, which in effect was seepage through this coal vein. Efforts to control this seepage failed and a minor slide occurred in the hillside during the summer of 1960. Work is in progress at the present time to provide for the sealing of the coal vein to eliminate this seepage condition.

WILDWOOD LAKE RESTORATION — Project No. 550

Wildwood Lake is located in McLean County in the Missouri River bottoms. At one time, before Garrison Dam was constructed, this lake was used extensively for recreational purposes and numerous cabin and group camp developments were built around the lake. The lake depended primarily on the spring floods of the Missouri River for its source of water supply. With the construction of Garrison Dam, the spring floods below the dam were eliminated and Wildwood Lake gradually receded so that it became practically useless. At the request of local interests, the Commission in 1957 completed investigations and prepared a plan for the restoration of Wildwood Lake. This plan contemplated the diversion of water from Painted Woods Lake through a canal into Wildwood Lake. The plan envisioned the construction of a control structure at the outlet of Wildwood Lake to control the elevation of the lake. Because of certain problems that the local interests faced relative to obtaining easements, the development of this project could not be accomplished. Local proponents, however, were anxious to proceed with some installation that would partially provide for restoring Wildwood Lake.

Local proponents of the project proposed to install a pump on the Missouri River to pump water from the river through a canal into Wildwood Lake. The State Water Commission cooperated in

this installation by providing a second hand 12 inch pump and motor and supervising its installation. The local proponents constructed a canal and arranged for the installation of a power line to the pump site. The cost of operating and maintaining the pump is being paid by the local project proponents. This installation was successfully used during 1959 and 1960 in raising and maintaining the level of Wildwood Lake. The State Game and Fish Department and the State Water Conservation Commission participated in the costs of the pump and its installation. The total cost of the installation of $1,594.27, which was shared equally by the two departments.

ZIEBAUGH PASS (Culvert Installation) — PROJECT No. 631

Ziebaugh Pass is located about 18 miles southwest of Devils Lake. It is one of the channels in the Devils Lake chain, and much of the water draining into the lake from the north passes through this location. For the past several years, extensive investigations have been made by the State Water Commission and the Corps of Engineers to determine a feasible means of providing for the drainage of flood waters from farm lands in the Churchs Ferry area and to improve the opportunities for drainage and control of floods in other areas of the Upper Basin. These investigations are presently underway and no definite complete project proposal has been made. In order to provide a partial solution to the problem, the Water Conservation and Flood Control Districts which have been organized requested that the Commission's proposal that a box culvert be placed in the drainage channel at the Ziebaugh Pass area be accomplished. The structure installed actually provides flood protection for a county road and replaces culverts that were inadequate to handle the flow of water. It is anticipated that, when the final project plan for the flood control project in the Churchs Ferry and upper region, or the plan to raise the level of Devils Lake is accomplished, this structure will be incorporated in those project facilities. Provision was made in the installation of the culvert for the future installation of control gates.

The structure that has been installed is a laminated creosote treated wood box culvert, consisting of 10 — 5'x5' sections 30' long, 500 lineal feet of corrugated sheet steel piling and a concrete slab consisting of three cubic yards of concrete were emplaced in connection with this installation and to provide for the future control gates. The total cost of the project was $15,259.13, which was shared by Ramsey County, Benson County, the State Water Conservation Commission and the Department of Interior.

Ziebaugh Pass Culvert Installation

DROP STRUCTURES FOR DRAINS

During the past biennium, the State Water Conservation Commission has constructed erosion retarding structures or drop structures in three drainage ditches in the Red River Valley area in cooperation with the drainage districts or water conservation and flood control districts concerned. In the case of several of the drains that have been constructed in the Red River Valley during the past years, severe erosion is occurring along certain stretches of the drain due to excessive gradient in the drain. In order to eliminate this problem, the Commission has proposed that drop structures be placed in the drainage ditch which would permit the concentration of the drop in gradient, so as to reduce the velocity in the flow of water and thereby curtail the erosion that now occurs. These structures are made either from reinforced concrete type structures or sheet steel piling installations.

Pembina County Drain No. 13 — Excessive erosion has occurred near the outlet of this drain destroying one bridge and threatening to destroy a considerable quantity of good farm land. Continued erosion would have impaired bridges on U. S. No. 44. In order to solve this problem, the Commission in cooperation with the Pembina County Drain Board, installed two drop structures that concentrate the 24

foot drop of the drainage ditch to the river level. The first of these structures was built upstream in the drain to handle a ten foot drop. This structure consisted of three rows of corrugated sheet steel piling driven in a step fashion, across the drain with a concrete stilling basin installed below each. The lower or downstream drop handled the remaining 14 feet through a drop inlet or "glory-hole" spillway structure. This type of structure permitted the use of the embankment across the drain as a road crossing to replace the bridge that had been destroyed. The total cost of these two structures, which were built by State Water Conservation Commission crews, was $20,201.44, which was shared by the Pembina County Drain Board, Pembina County and the State Water Conservation Commission.

Richland County Drain No. 2 or **The Colfax Drain** — Extensive erosion was noted along this drain at its outlet into the Wild Rice River. In order to correct this situation, the State Water Commission constructed a reinforced concrete buttress type drop structure with a ten foot drop near the outlet of the drain. The total cost of the structure was $13,584.09, which was shared by the State Water Conservation Commission and the Richland County Water Conservation and Flood Control District.

Cass County Drain No. 22 — Erosion was occurring near the outlet of this drain where it empties into the Red River. The State Water Commission constructed a reinforced concrete structure with a drop of 12 feet near the outlet of this drain to prevent this erosion. The total cost of the project was $14,525.38, which was shared by the State Water Commission and the Cass County Drain Board.

MAYVILLE DAM — PROJECT No. 625

The Mayville Dam is located on the Goose River within the city limits of the City of Mayville in Traill County. This dam is used in connection with the City of Mayville's water supply and its reservoir is located in the city park. The city experienced difficulties during periods of low flow on the Goose River in securing an adequate water supply. At its request, the Commission investigated the possibility of raising the Mayville Dam to provide for more reservoir storage. These investigations resulted in the proposal that a row of structural steel sheet piling be driven across the river, 25 feet upstream from the existing dam at an elevation two feet higher than the spillway crest of the dam, which would be backfilled with rock. This piling type dam was installed by the State Water Conservation Commission in cooperation with the City of Mayville and is being used to augment the city's water supply and enhance the use of the reservoir for recreational purposes. The total cost of the project was $9,355.97, which was shared equally by the city and the Commission. A total of 1,335 lineal feet of steel piling and 611 tons of rock were used in connection with this project.

VIGNESS DAM — PROJECT No. 546

Vigness Dam is located on the Park River in the City of Grafton in Walsh County. It is used by the City to provide a source for its municipal water supply. The dam is a rubble masonry gravity type channel structure. Due to the growth of the City of Grafton and the increased use and demand for water, the city faced the problem of providing for additional storage of water for its municipal use. Following an investigation of this problem by the Commission, it was proposed that provision be made for the installation of flashboards at Vigness Dam, which would permit a two foot increase in the level of the reservoir and could be controlled so as to avoid any additional flooding of land in the reservoir area during periods of spring runoff or heavy rains. Commission crews made the necessary provision for the installation of these flashboards by installing steel flashboard holders in the dam. The total cost of this work was $4,252.16, which was shared equally by the City of Grafton and the State Water Conservation Commission.

EATON IRRIGATION PROJECT — PROJECT No. 227

The main dam at the Eaton Irrigation Project was built in 1937 and was designed to divert water to flood irrigate 8,000 acres of hay land about seven miles southwest of Towner in McHenry County. The dam was constructed by driving two rows of structural steel sheet piling 20 feet apart across the Souris River and placing earth fill between these rows of piling and includes eight 72" corrugated metal pipes with control gates to allow the passage of normal river flow when not being used in conjunction with the irrigation system.

In the fall of 1958, the irrigation district operators found that the lowest pipe in the dam was not carrying water to its fullest capacity and could not be closed making it difficult to control the river flow during periods when irrigation was being attempted. At a period of low flow, State Water Conservation Commission crews inspected this problem and found that this gate and pipe had become clogged with trees and trash. The problem was aggravated by Y shaped struts placed in the pipe to prevent its collapse. The gate and pipe were cleared by snagging and blasting and some of the struts removed in the process of this work.

When the gates were closed to begin irrigation in the spring of 1959, it was found that the lowest pipe had collapsed, causing much of the fill between the piling to wash out. Emergency repairs were made so that irrigation during 1959 was possible. After the irrigation season, a cofferdam was constructed across the river and the water was diverted around the end of the dam through a ditch dug for this purpose. The area between the piling was excavated and the damaged pipe and the gate were removed. The backfill material

found around the pipe was very unsatisfactory for fill, being a combination of mostly gravel mixed with trash, brush, and cinders. This undoubtedly caused an earlier failure which led to the installation of the struts.

A new pipe was installed on a concrete base and a new gate with a concrete headwall and a heavy trash rack was installed. Select clay material was hauled to the dam and the excavation was backfilled with this material, which was hand tamped to insure a solid fill. The cofferdam was then removed, allowing the river to flow through the dam. A row of corrugated steel sheet piling was driven across the diversion ditch to prevent seepage, and the ditch backfilled with compacted clay.

In the spring of 1960, when the gates were closed to provide irrigation water, the water which was at flood stage, began flowing around the dam through the closed diversion ditch and threatened to erode a new channel around the dam. Water Commission crews aided by local contractors, working on a near "round the clock" schedule, were able to seal off the ditch again and allow irrigation to continue on schedule. After the water had receded, investigation showed that the breach to the diversion ditch resulted from the poor fill material used in constructing the dam originally and the failure of

Eaton Irrigation Project—Installation of trash rack underway

the piling cutoff wall to control the seepage, because it was installed when this fill material was frozen, added to the difficulty of obtaining a good bond.

The method of diverting a river or creek around a structure through a ditch has been used by Water Commission crews many times and has always proven itself to be extremely successful. It is a fast, economical method of water control and has always before proven to be safe. It appears that this failure occurred because soil and weather conditions were most unsatisfactory. The major portion of the eroded diversion ditch remains to be filled as of the date of this report. The remainder of the work will be completed during the 1960 construction season. During the past biennium, a total cost of this project was $21,026.68, which was shared by the Eaton Irrigation District and the State Water Conservation Commission.

WELK DAM — PROJECT No. 400

Location: Six miles southwest of Strasburg in Emmons County.

Type of structure: Chute type spillway and earth embankment.

Purpose: Recreation and Wildlife propagation and fishing.

Condition before repair: Spillway spalling and broken up, large voids under concrete of spillway.

Repair work accomplished: Voids were pressure grouted and maintenance coat of pneumatic concrete was applied to spillway structure.

Costs and sponsors: $5,691.57 shared by Emmons County, Game and Fish Department and State Water Conservation Commission.

Quantities: 60 cubic yards pneumatic concrete.

ENDERLIN PARK DAM — PROJECT No. 580

Location: In the City of Enderlin in Ransom County on the Maple River.

Type of Structure: Rubble masonry, gravity channel dam.

Purpose: Recreation. Located in a city park and creates a reservoir that is used for swimming and enhancement of the natural beauty of the park.

Condition before repair: Backfill around wing of dam was being eroded.

Repair work accomplished: Wing extended and backfilled.

Costs and sponsors: $584.48, shared by the State Water Conservation Commission and Enderlin Park Board.

SILVER LAKE DAM — PROJECT No. 391

Location: Five miles south of Forman in Sargent County on the Wild Rice River.

Type of structure: Reinforced concrete spillway with earth embankment.

Purpose: Recreation and wildlife propagation, fishing and a large waterfowl nesting area.

Condition before repairs: One-half of spillway broken up and undermined, all of spillway spalling badly, and considerable erosion had occurred below apron.

Repair work accomplished: Voids pressure grouted, spillway given maintenance cost of pneumatic concrete and sheet piling driven downstream to form a stilling basin.

Costs and Sponsors: $4,918.24, shared by Sargent County, State Game and Fish Department and North Dakota State Water Conservation Commission.

Quantities: 376 feet corrugated steel sheet piling, 25 cubic yards concrete, and 20 cubic yards rock.

FESSENDEN DAM — PROJECT No. 389

Location: Two miles north of Fessenden in Wells County on the James River.

Type of structure: Rubble masonry gravity spillway with earth fill embankment.

Purpose: Recreation, swimming, and used in conjunction with the municipal water system.

Condition before repair: Seepage through spillway, concrete spalling and rocks loosening and apron breaking up.

Repair work accomplished: Maintenance coat applied to spillway and apron. Cracks grouted and sealed.

Costs and sponsors: $2,463.88, shared by City of Fessenden and State Water Conservation Commission.

Quantities: 26 cubic yards pneumatically placed concrete.

BRILLIAN TOWNSHIP DAM — PROJECT No. 630

Location: Ten miles southwest of Velva in Ward County.

Type of structure: Rubble masonry with reinforced concrete pipe and earth fill embankment.

Purpose: Recreation and waterfowl propagation

Condition before repair: Chute broken up, concrete spalling and rock loose.

Repair work accomplished: Maintenance coat of pneumatic concrete applied.

Costs and sponsors: $905.57 shared by Ward County, Brillian Township and State Water Conservation Commission.

Quantities: Nine cubic yards of pneumatic concrete.

WYARD DAM (Kiwanis Dam) — PROJECT No. 467

Location: Six miles west of Carrington in Foster County on the Pipestem River.

Type of structure: Reinforced concrete gravity spillway with earth fill embankment.

Purpose: Recreation — fishing, swimming, boating and picnic area.

Condition before repair: Concrete spalling and rocks loosening.

Repair work accomplished: Maintenance coat of pneumatic concrete applied to weir and wing walls.

Costs and sponsors: $3,567.72 shared by Foster County and State Water Conservation Commission.

Quantities: 34 cubic yards of pneumatically applied concrete.

PEMBINA CITY DAM — PROJECT No. 299

Location: In the City of Pembina in Pembina County on the Pembina River.

Type of structure: Rubble masonry gravity type channel dam.

Purpose: Municipal water supply.

Condition before repair: Concrete spalling, backfill eroded from behind retaining walls.

Repair work accomplished: Weir given maintenance coat of pneumatically placed concrete; retaining walls raised with pneumatic concrete and backfilled.

Costs and sponsors: $8,586.00 shared by City of Pembina and State Water Conservation Commission.

Quantities: 90 cubic feet pneumatically placed concrete.

CEDAR DAM — PROJECT No. 353

Location: On the Cedar River, 17 miles north of Reeder in Slope County.

Type of structure: Concrete gravity spillway with earth embankment.

Purpose: Recreation, and game refuge and waterfowl habitat.

Condition before repair: Gate inoperative and excessive scour below structure.

Repair work accomplished: New gates installed, gate wall raised and sheet piling driven to form stilling basin.

Costs and sponsors: $7,170.52 shared by Game and Fish Department, Federal Fish and Wildlife, State Water Conservation Commission.

Quantities: Two control gates and 920 lineal feet corrugated steel sheet piling.

TWIN LAKES — PROJECT No. 486

Location: In Williston City Park in Williams County

Type of structure: Two artificial lakes in watercourse with dikes and corrugated steel sheet piling drop.

Purpose: Recreation and park area; lakes are used in connection with zoo.

Condition before repair: Lake area filled with silt.

Repair work accomplished: Silt from bottom of lakes removed.

Costs of sponsors: $1,642.50 shared by State Water Conservation Commission and Williston Park Board.

BRADDOCK DAM — PROJECT No. 264

Location: Three miles south of Braddock in Emmons County.

Type of structure: Rubble masonry spillway with earth embankment.

Purpose: Recreation, fishing, boating and fish propagation. A fish hatching pond has been constructed below the dam.

Condition before repair: Seepage under spillway through large voids filled by pressure grouting.

Costs and sponsors: $7,691.65 shared by the Game and Fish Department and the State Water Conservation Commission.

Quantities: 150 cubic feet of neat cement grout.

Comments: The spillway was originally constructed on an excavated section on the right of the dam to permit rubble shell construction. The foundation materials are porous in nature and will cause considerable maintenance until this material has been replaced.

BURLINGTON DAM No. 1 — PROJECT No. 221

Location: Ward County on the Des Lacs River, two miles west of Burlington.

Type of structure: Rubble masonry arch spillway with rolled earth embankment.

Purpose: Water supply for the Burlington Irrigation Project.

Work accomplished: Outlet gate to irrigation canal replaced.

Costs and sponsors: $574.71, paid by the Bank of North Dakota.

TEMVIK DAM — PROJECT No. 441

Location: One mile east of Temvik in Emmons County.

Type of Structure: Rubble masonry spillway and earth fill embankment.

Purpose: Recreation, fishing, swimming and waterfowl habitat.

Condition before repair: Concrete on spillway spalling, rocks loose, large voids under apron and outlet channel eroded.

Repair work accomplished: Voids pressure grouted, spillway given a 4" coarse of pneumatic concrete and a steel sheet piling stilling basin installed.

Costs and sponsors: $5,128.35 shared by Emmons County, Game and Fish Department, and the State Water Conservation Commission.

Quantities: 353 feet of corrugated steel sheet piling, 71 cubic yards pneumatic concrete.

KATZ DAM — PROJECT No. 653

Location: Five miles southeast of Washburn in McLean County

Type of structure: Rubble masonry gravity section channel dam.

Purpose: Recreation-fishing and swimming.

Condition before repair: Concrete spalling on spillway and rocks loosening.

Repair work accomplished: Maintenance coat of pneumatic concrete applied to all exposed surfaces.

Costs and sponsors: $3,274.16 shared by McLean County and State Water Conservation Commission.

Quantities: 3,375 square feet pneumatic concrete.

JACKSON DAM — PROJECT No. 253

Location: Ten miles west of Alexander in McKenzie County.

Type of structure: Concrete gravity section spillway with earth embankment.

Purpose: Recreation, fishing and waterfowl habitat.

Condition before repair: Seepage passing behind wing wall through cracks at joint with spillway.

Repair work accomplished: Concrete blocks poured to patch cracks.

Costs and sponsors: $1,541.44 paid by the State Water Conservation Commission.

UELAND DAM — PROJECT No. 460

Location: Four miles east of Cooperstown in Griggs County on the Sheyenne River.

Type of structure: Rubble masonry gravity section.

Purpose: Municipal water supply and fishing. The reservoir recharges the Cooperstown city wells.

Condition before repair: Concrete spalling, rocks loose and one wing wall collapsed.

Repair work accomplished: Wing wall rebuilt and spillway coated with pneumatic concrete.

Costs and sponsors: $6,220.98 shared by the City of Cooperstown, Game and Fish Department and the State Water Commission.

Quantities: 65 cubic yards of pneumatic concrete.

PARK RIVER DAM — PROJECT No. 217

Location: In the City of Park River in Walsh County on the Park River.

Type of structure: Rock filled timber crib spillway with earth embankment.

Purpose: Municipal water supply.

Condition before repair: No facilities for drawing down reservoir.

Work accomplished: The Commission made a detailed topographic survey of the area in connection with the proposed installation of a 36" corrugated metal pipe with gate installed to allow drawdown of control facilities.

Costs and sponsors: $3,957.76 shared by the City of Park River, the Walsh County Water Conservation and Flood Control District and State Water Conservation Commission.

In 1959 the Park River Dam required further repairs as follows:

Park River Dam — Project No. 217

Condition before repair: Embankment overtopped and washed out during a period of extremely high flow in the spring of 1960.

Repair work accomplished: Earth fill embankment temporarily reconstructed to protect municipal water supply until permanent repairs are made.

Costs and Sponsors: $5,548.94 shared by the City of Park River and the State Water Conservation Commission.

EARL CYPERT PARK DAM — PROJECT No. 412

Location: On Apple Creek, eight miles east of Bismarck in Burleigh County.

Purpose: Recreation and fish propagation is central feature of Earl Cypert Park which includes swimming, fishing and boating.

Type of structure: Reinforced concrete channel dam.

Condition before repair: Earth embankment eroding.

Repair work accomplished: Riprap placed throughout the affected area.

Costs and sponsors: $2,020.32 shared by the State Water Conservation Commission, Burleigh County and local sponsors.

GRAFTON RAILROAD DAM — PROJECT No. 660

Location: In the City of Grafton, Walsh County on the Park River.

Type of structure: Rock filled timber crib channel dam.

Purpose: Municipal water supply.

Conditions before repair: It was necessary to use a siphon to obtain water from the impoundment.

Work accomplished: A corrugated metal pipe and gate was installed around the dam to allow water to be released from the reservoir.

Costs and sponsors. $2,029.29 shared by the City of Grafton, the Walsh County Water Conservation and Flood Control District and the State Water Conservation Commission.

Quantities: 162 feet of 12" corrugated metal pipe.

LAKE IRVINE DRAINAGE — PROJECT No. 416

Location: Five miles northeast of Churchs Ferry in Ramsey County had silted fill retarding flow of water between lakes.

Condition before repair: Ditch between Lake Alice and Lake Irvine had silted full retarding flow of water between the lakes.

Work accomplished: Ditch blasted clean.

Costs and sponsors: $567.78 paid by the Chain Lakes Water Conservation and Flood Control District.

Quantities: 850 pounds of ditching dynamite.

GOLDEN LAKE RESTORATION — PROJECT No. 475

Location: Ten miles northeast of Finley in Steele County.

Purpose: Recreation and waterfowl, wildlife and fish propagation and boating and swimming.

Condition before repair: Banks of diversion canal settled and eroded, reducing capacity of the diversion ditch.

Work accomplished: Select clay placed to rebuild spoil banks. In 1958 Commission survey crews completed a survey to lay out a cabin area and a survey was made relative to raising the banks of the canal.

Costs and sponsors: $7,250.88 shared by the Golden Lake Restoration Corporation, the State Game and Fish Department and the State Water Conservation Commission.

CUT BANK CREEK — PROJECT No. 657

Location: Bottineau County, six miles east of Mohall on Cut Bank Creek.

Purpose: To determine feasibility of a proposed multiple purpose low level dam incorporated with new State Highway No. 5 bridge, to impound water near city wells and improve municipal water supply.

Work accomplished: Detailed topographic surveys completed of the area to aid in planning and design work. Further investigation will be carried on when adequate interest in the project is manifested by local proponents.

ARMOURDALE DAM — PROJECT No. 665

Extreme interest is being shown by sportsmen in Towner County for development of a recreation and fishing area near Armourdale.

The State Water Conservation Commission made a detailed topographic survey of the area north and west of Armourdale and a site for a reservoir was located. The reservoir would cover approximately 200 acres and impound an estimated 900 acre-feet of water which would be 40 feet in depth and sufficient to sustain fish life.

A soil boring survey will have to be made to locate a site for the dam and to determine feasibility of the project. This work is scheduled during the summer of 1960.

The State Water Conservation Commission and the State Game and Fish Department and local proponents are cooperating in this project.

TURTLE RIVER STATE PARK — PROJECT No. 672

Location: One mile north of Arvilla in Grand Forks County in Turtle River State Park.

Purpose: Fishing and recreational facilities.

Work accomplished: A topographic survey was made of the proposed area to determine the feasibility of either raising the existing dam or constructing a new dam on the Turtle River in the state park

that would be used for recreation purposes. The park is used extensively by tourists and residents from Grand Forks and other surrounding communities.

Sponsors: State Park Commission, State Historical Society and State Game and Fish Department.

FORT CLARK LAND SURVEY

Location: Along the Missouri River from approximately two miles north to two miles southeast of Fort Clark in McLean County.

Purpose: Re-define property line locations.

Work accomplished: Surveys in this area, to re-establish property lines of the property adjoining the Missouri River affected by a channel change of the Missouri and to be used in determining ownership of accretion land, were made by the Commission.

Sponsors: State Historical Society and State Land Department.

UPPER MAUVAIS COULEE SURVEY — PROJECT No. 604

Location: Various locations in Towner, Benson and Ramsey Counties.

Purpose: Topographic maps to determine drainage benefits.

Work accomplished: The State Water Commission cooperated with the U.S. Army Corps of Engineers, St. Paul District, in making topographic maps of ten test areas composed of four sections each to be used in assessing benefits that would accrue from the drainage of lands and flood protection as a result of the development of the proposed Mauvais Coulee Improvement Project.

Sponsors: U. S. Corps of Engineers, St. Paul District and State Water Conservation Commission.

DOUGLAS CREEK IRRIGATION — PROJECT No. 648

Location: Three miles west of Garrison in McLean County.

Purpose: Irrigation development from Garrison Reservoir.

Work accomplished: Preliminary survey work was begun along the Douglas Creek area to gather data to determine the feasibility of developing an irrigation project by pumping water from Garrison Reservoir. This project is on a pending status and investigation work will continue if local landowners indicate further interest in the project proposal.

MISSOURI RIVER LOW HEAD DAMS

Shortly after the closure of the Garrison Dam it became evident that the clear water being released from Garrison Reservoir turbines and outlet works were causing extensive erosion along the banks of the Missouri River below the dam. Previously the river deposited as much silt as it eroded. Along the portion of the river between Bismarck and Garrison Dam approximately five hundred acres of bottomland were lost annually, and according to reports of the Corps of Engineers, this may be increased to one thousand acres annually if the releases from Garrison Reservoir are increased.

At the request of the North Dakota State Water Conservation Commission, the Missouri Slope Development Association, a voluntary organization was formed during a citizens' meeting held in Bismarck on October 3, 1958, to study the possible benefits of these dams. Congress appropriated money for a study of the feasibility of a low head dam at Bismarck, North Dakota. It was proposed that the low head dam be used for the interstate highway crossing of the Missouri. The Corps of Engineers, who made the study, contended in its report that the river picked up sufficient silt between Garrison Dam and Bismarck to fill the reservoir that would be created by this dam in less than four years and that the project was not feasible.

To correct the problem, a study of other methods of stabilization along the river is under way. Congress has appropriated $15,200 to the Corps of Engineers for this study. At a hearing held in Bismarck concerning the problem, local people were unanimous in their claim that damaging erosion without replacement of land had and is occurring along the Missouri River below Garrison Dam. They were also unanimous in requesting that the Corps of Engineers take steps to stop this erosion.

One possible method of bank stabilization could be accomplished by installing a series of low head dams below Garrison Dam.

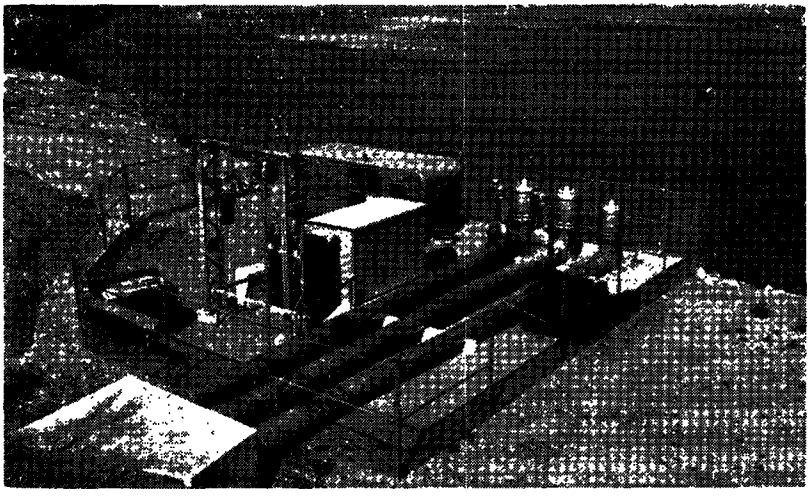
It has been noted that, in many areas, the cost-benefit ratio for bank stabilization in rural areas has been low. The North Dakota State Water Conservation Commission contends that the bank erosion is a negative benefit from Garrison Dam and could be partially justified as a part of Garrison Dam construction costs.

SIOUX IRRIGATION PROJECT — No. 213

The Sioux Irrigation Project is located on the right bank of the Yellowstone River about six miles north of Cartwright or 20 miles southwest of Williston, just south of the confluence of the Yellowstone and Missouri Rivers. The original irrigation facilities for this project were constructed by the North Dakota State Water Commission in 1938 and consisted of a pumping station on the Yellowstone River and a canal distribution system. The cost of this project was financed by the State through a bond issue which is being repaid by the Sioux Irrigation District.

The Sioux Irrigation District requested the aid of the Water Commission in helping to find a solution to a water shortage problem which has become critical in recent years. Increased use of water by other irrigation projects upstream and the constant degradation of the Yellowstone River now leaves their pump intake on the Yellowstone high and dry, and as a result, they have no water during the season when it is most needed.

Since this project is similar to the Cartwright Project, on which the Commission has done considerable research, it was decided that a ground water source may be the answer to their problem. The Commission's drill crew drilled a series of test holes and discovered an excellent aquifer that could be utilized for the irrigation system. To confirm the quantity and quality of water, a production test well was drilled by the Commission with the results being very satisfactory. The irrigation well drilled was found to produce a maximum of 3,000 gallons per minute and the quality of the water is similar to the Yellowstone River water. Plans are now being prepared by the Water Commission to determine the costs of drilling additional wells to meet the water requirements for this project. Preliminary figures indicate that a well field can be installed for less money than it would cost to lower the present river intake to provide water for this facility, with the added advantage of being able to provide water free from silt.



Pumping Plant — Fort Clark Project

CARTWRIGHT IRRIGATION PROJECT No. 36

The Cartwright Irrigation Project contains about 700 acres of irrigable land and is located along the Yellowstone River about two miles southwest of Cartwright in northwestern McKenzie County. An irrigation district for this project was organized in 1936. Studies of this project were made by the Bureau of Reclamation and the Soil Conservation Service in which the installation of a pumping station on the Yellowstone River was contemplated. Neither agency obtained a favorable benefit-cost ratio for this project from their studies.

In 1957 the State Water Commission was asked to study the project to determine if, under present economic conditions, a favorable benefit-cost ratio could be obtained. During the course of this study, the possibility of using wells from a ground water source for an irrigation water supply was investigated. As a result of test drilling by the Commission, it was found that a plentiful ground water supply existed and the project studies were directed toward using water as the source of supply.

A test well was drilled in 1958 and a small test pump was installed to determine the suitability of the quality of this water for irrigation. The water quality from the control well did not prove satisfactory for irrigation. As a result, the Commission, through its experimental work, then drilled a well adjacent to the river. This well was test pumped and the water quality and well yields were found to be very satisfactory for irrigation.

The Cartwright Irrigation District has now taken over the research well from the Commission and has installed an electric pump with a capacity of 1,200 gallons per minute in this well as the initial water supply for their project. Two additional wells will be required to provide sufficient water for the full development of their project and it is expected they will be installed in the near future. By using wells and ground water as the irrigation supply source, instead of installing a pumping station on the Yellowstone River, the costs of the project have been materially reduced.

The Commission's research work on the Cartwright Project has resulted in an entirely new approach to the development of irrigation projects along the Yellowstone and Missouri Rivers in North Dakota.

PEMBILIER DAM — PROJECT No. 567

The Commission has continued work on investigations of the proposed Pembilier Dam located on the Pembina River west of Walhalla.

A survey was made in conjunction with the North Dakota State Highway Department for the purpose of locating an economical site for a replacement of the present Vang bridge. As a result of this survey, the estimated cost of a bridge was reduced approximately $750,000 because the new location will permit the installation of a bridge with a much shorter span than at its present location.

During the fall of 1959, the Commission cooperated with Canadian survey crews in making a detailed topographic survey of the area from Walhalla to the Canadian border. This data was needed to locate a proposed route for a diversion canal which would carry water from the Pembilier Reservoir to the irrigable lands lying in Canada, and will enable the Canadian engineers to estimate the costs of irrigation development in Canada from this reservoir.

TIOGA DAM — PROJECT No. 561

At the request of the City of Tioga, the State Water Commission personnel investigated the possibilities of constructing a dam on a coulee approximately one-half mile north of Tioga to create a reservoir to augment municipal supplies and also provide recreational facilities in the area.

The project area was surveyed to determine the size and capacity of the proposed reservoir. A soils foundations survey at the site location was also made. A preliminary design on this project has been completed. This project is in the pending status and additional work will be done when a renewed interest is shown by the local project proponents.

BOWBELLS STONEY CREEK DAM — PROJECT No. 650

Proponents of this project requested the State Water Commission to investigate the feasibility of constructing a multi-purpose dam on Stoney Creek approximately four miles east of Bowbells on the Ward-Burke County line. Stoney Creek cuts a ravine through the relatively flat terrain in this area. Since local proponents also were interested in getting the road rebuilt along the county line, it was proposed that a large earthfill dam with a modified glory-hole spillway be constructed which could be used for a road crossing.

The project was surveyed by Commission topographic crews and a soil foundations survey was made. From this data design and cost estimates were prepared and presented to the local group. The cost of the project was approximately $40,000 and, after review, the various proponents decided that this project was too costly for the benefits that would be obtained.

Sponsors of this project were the Burke County Board of Commissioners, Ward County Board of Commissioners, and the Burke County Water Conservation and Flood Control District.

SURVEYS OF DRAINS

During the period covered by this report the State Water Conservation Commission participated in surveys of county drainage systems in eastern North Dakota. Work accomplished by State Water Conservation Commission survey crews during this period include the following:

Drain 21, Cass County: Cross section survey of drainage ditch.

Drain 22, Cass County: Cross section survey of drainage ditch prior to construction of drop structure.

Drain 43, Pembina County: Cross sections of drainage ditch prior to construction of drop structure.

Rhinelander International Drain, Pembina County: Cross section survey of drainage ditch.

Traill County Drains 4 and 14: (McCoy-McCrady) Spot checks on ditch gradient and spoil banks, inspections of drop structure constructed by the county with financial aid by the State Water Conservation Commission.

These projects are discussed more fully in another section of this report.

ANTLER CREEK DAM — PROJECT No. 632

The State Water Conservation Commission was requested to investigate the possibilities of constructing a dam on Antler Creek north of the village of Antler. Antler Creek crosses the border between the United States and Canada and returns again to Canada. Approximately five miles of its channel is in North Dakota. A multipurpose type structure has been proposed that would serve as a county road crossing which would replace a bridge that is in need of repair or replacement.

A topographic survey was made of the area to determine the capacity of the proposed reservoir. It may be necessary to make a soil foundations survey at the proposed site to determine suitability of foundation materials for dam construction purposes. Designs and cost estimates of this proposed project are presently being prepared. If this project is constructed an agreement must be made with Canadian interests for the storage of water in this reservoir.

Sponsors of this project are the City of Antler and the Bottineau County Board of Commissioners.

BOWBELLS DAM — PROJECT No. 579

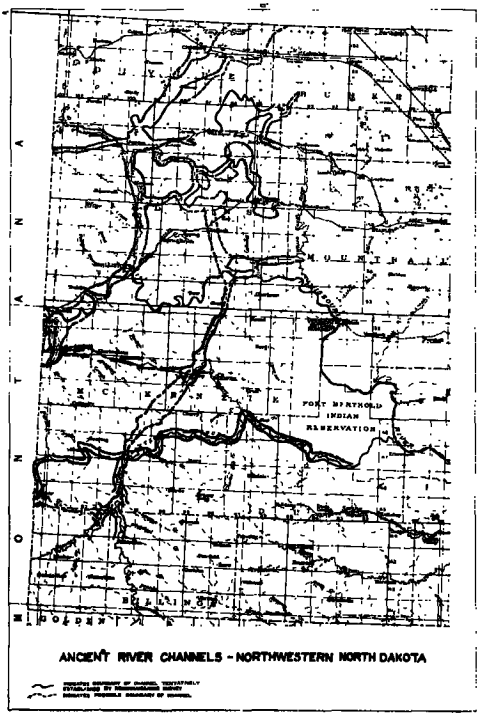
Investigations of the proposed Bowbells Dam in Burke County for use in connection with the city's municipal water supply resulted in the preparation of plans and cost estimates by the Commission. These plans were submitted to all interested proponents of the project for their consideration.

The local proponents felt that, because the storage capacity of the proposed reservoir was limited, the use of this source for a municipal supply would be limited during extreme drouth conditions. Further work on this project has been discontinued and the local proponents are planning to add additional wells to provide a sufficient quantity of water for their needs.

THE ANCIENT CHANNELS OF THE MISSOURI RIVER AND ITS TRIBUTARIES

The State Water Commission has initiated investigations to redefine the Ancient Channel of the Missouri River and determine if this channel is in effect a ground water aquifer that can be developed. While it has been definitely established that the Missouri River at one time flowed north and emptied into Hudson Bay, the definite channel of this ancient water course has not been re-established. It is possible that the lower glacial ice cap that formed the Max Moraine may have filled the ancient channel of the Missouri River with huge quantities of rock and gravel that would provide an excellent water bearing aquifer which, if developed, could supply water for irrigation and industry. Many believe that the Ancient Channel is in the vicinity of the Little Muddy River north of Williston.

Findings by seismograph crews working in the oil exploration fields tend to substantiate this contention. Several artesian wells have been encountered which have been almost impossible to control. The City of Crosby has also found a good quality water supply from a well located east of that city. It appears that this well tops an aquifer that is an extension of this Ancient Channel.



ANCIENT RIVER CHANNELS - NORTHWESTERN NORTH DAKOTA

The State Water Commission directed an investigation of this area for its water bearing potential. Work was commenced in the lower reaches of the Little Muddy near Williston and will extend north to Crosby. Some test drilling has been accomplished during the past biennium and work will continue on this study until the geologic conditions of the area can be determined and the Ancient Channel redefined. The work is being done under the cooperative program the Commission has with the Ground Water Branch of the U. S. Geological Survey.

Efforts will also be made to trace out the channel of the Little Missouri River which was also affected by the closure made by the polar ice cap. It is believed that this ancient channel extends from the Little Missouri River through the valley west of Watford City and into the Tobacco Garden Creek area. State Water Commission drill crews attempted to locate a dam site on Tobacco Garden Creek just north of Watford City and found that it was virtually impossible to construct a dam due to underground water bearing strata. This finding substantiated earlier contentions. More exploratory drilling is being done to trace this aquifer and ascertain its potential as a water source for irrigation and other uses.

LAKE IRVINE — LAKE ALICE DRAINAGE

Because of flood damage in the vicinity of Lake Irvine and Lake Alice, which occurs nearly every spring, local residents requested the North Dakota State Water Conservation Commission to assist in finding a solution to the problem. At the request of the North Dakota State Water Conservation Commission, the Corps of Engineers initiated an over-all study of the Mauvais Coulee drainage area to prepare a plan to provide a complete flood control system for the 1,000 square mile Lake Irvine-Lake Alice drainage area as well as the drainage channel required for removing flood waters from the lakes. Present information indicates that it will be several years before this study is completed. According to preliminary findings it is expected that the project the Corps will propose will be rather expensive.

The channel draining Lake Irvine was almost completely filled with debris during the periods of drouth and now will carry a flow of only slightly over 100 cubic feet per second. Comparing this restricted capacity to the 1,500 c.f.s. which has been observed entering the Lake Irvine - Lake Alice area and the 3,700 c.f.s. which U.S. Geological Survey charts show as the maximum inflow to the area which can be expected once every twenty-five years, it can be readily understood that channel improvement in Mauvais Coulee below Lake Irvine is needed.

At the request of the Chain Lakes Water Conservation and Flood Control District, the North Dakota State Water Conservation Commission is preparing plans which will partially relieve the situation by increasing the capacity of the outlet channel 300 cubic feet per second. Headgates have been installed at the outlet to Lake Irvine

which can be used to regulate the outflow and will permit the use of Lake Irvine and Lake Alice as flood control reservoirs.

An extensive survey is under way at the present time to be used in locating the route of the canal, obtaining easements and in making final plans for canal construction. This work consists of a triangulation net which will tie into the network of the U. S. Coast and Geodetic Survey and the remains of the original land survey. This work was necessary because the original land survey boundary marking in this area was almost completely obliterated, making it impossible to obtain accurate land descriptions for easement purposes.

ESMOND GROUND WATER RESEARCH — PROJECT No. 655

Drouth conditions in Benson County created an active interest in irrigation development on the part of farmers in the Esmond area. Several of these dryland farmers contacted the State Water Conservation Commission and requested an investigation into the possibility of locating an underground supply of irrigation water.

The State Water Conservation Commission initiated an investigation of the area and drilled a series of test holes to determine the extent of the ground water aquifer of the area. Plans for development of the project have been submitted to the proponents. Further development will be undertaken when financial arrangements have been completed with the participants.

KELLY SLOUGH — PROJECT No. 527

At the request of residents in Grand Forks County, an investigation was made relative to the improvement of drainage facilities, and developing a recreational area in the vicinity of Kelly Slough. Kelly Slough is located nine miles west of Grand Forks on U. S. Highway No. 2. The area is a Migratory Waterfowl Refuge.

Studies made of this project were directed to determining the possibility of building a diversion structure on Saltwater Coulee in Section 4, Township 151 North, Range 52 West, that would divert the water from Saltwater Coulee through U. S. Highway No. 2 and northward into Kelly Slough. The diversion structure would consist of a dam in the NW¼ of Section 27, Township 152, Range 52, with a spillway elevation approximately 20 feet above the channel bottom. This dam would create a reservoir adequately deep enough to maintain fish life and enhance boating and other recreational activities. The reservoir would have a surface area of 736 acres with a capacity approximating 6,000 acre-feet.

The State Water Conservation Commission made a detailed topographic survey of the area on the scale of 1″ = 400′ and a survey of the immediate proposed dam site on the scale of 1″ = 100′.

Soil borings were made at the site of the proposed dam to determine the suitability of soil foundations material for the dam. A layer of clay averaging nine feet in thickness was found which would provide

a suitable impervious base for the dam. Residents of the area have manifested their interest by forming the Kelly Lake Improvement Association to promote this project.

The Commission is in the process of determining a cost estimate. Additional studies of the effect of this impoundment required for the project on the ground water table in the area have been proposed in connection with this project.

WALHALLA PARK CUTOFF — PROJECT No. 635

The Pembina River flows in a meandering course through the City of Walhalla and its sharp bends and curves have created a serious erosion problem particularly in the Walhalla City Park. The Walhalla City Council requested the assistance of the State Water Conservation Commission to develop a solution to this erosion problem.

Based on these surveys it was determined that the problem could best be solved by excavating a new channel for the river that would eliminate the sharp curves it now follows as it flows through the park. A small channel dam with a five foot weir is included in the proposal to impound some of the flow to be used to stabilize the municipal water supply for Walhalla.

The project is in the preliminary planning stage.

TONGUE RIVER BRIDGE — PROJECT No. 632

The original proposal for this project was presented to the State Water Conservation Commission by the Board of County Commissioners, the Flood Control Board and the Soil Conservation Board of Supervisors of Pembina County. They requested an investigation of the bridge on Highway No. 32 over the Tongue River to determine whether the opening of the structure was adequate to permit excessive flows in the river to pass without flooding the surrounding agricultural lands.

A complete investigation was made by the Commission and it was determined that the bridge opening is adequate for all expected flows; however, the sharp twists and turns of the river channel above the bridge could conceivably cause ice jams and result in flooding. This situation, should it develop, could be corrected by a channel straightening project. It is expected that the Tongue River Watershed Project being constructed by the Soil Conservation Service project to provide flood protection for this area may eliminate this potential problem. If the watershed project does not prevent flood conditions at this bridge, further investigations will be undertaken to determine the extent to which a channel straightening project would be needed.

RICHLAND COUNTY DRAINAGE — PROJECT No. 629

Because of the drainage problems encountered in Richland County the County Commissioners requested the State Water Conservation Commission to undertake a complete topographic survey of the entire

county to determine the best methods of alleviating such problems. During the summer of 1958, a Commission survey crew completed topographic mapping of 42 square miles in the southeastern portion of the county. Work was then discontinued, but will be resumed as available funds permit.

Further discussion of the drainage problems in Richland County will be found in the portion of this report devoted to drains.

LAKE ETTA IMPROVEMENT — PROJECT No. 643

Lake Etta, located one and a half miles south of Dawson in Kidder County, was at one time a favorite duck hunting spot for North Dakota sportsmen. A complaint was filed with the Commission by duck hunting enthusiasts that the water level of the lake has been rising gradually over the years because of improper drainage conditions and that the area is no longer suitable for duck propagation.

An investigation was made by the State Water Conservation Commission including a detailed survey of the diversion route between Lake Etta and Alkaline Lake. This investigation revealed that Lake Etta has actually receded during the present drouth period and the resultant exposed alkaline lake bottom will not support reed growth. The higher shore lines resulting from 1950 flooding apparently improved conditions for reed growth and thereby enhanced wildlife propagation.

The Commission will maintain this project in the pending status and further investigations may be made to determine a feasible method restoring Lake Etta for waterfowl and wildlife propagation purposes.

UPPER WEST SOURIS FLOOD CONTROL — PROJECT No. 626

Investigation work on this project was initiated during the previous biennium and the survey work was continued into the summer of 1958. Purpose of the survey was to obtain data to determine a means to alleviate flood problems in the Tolley area through utilization of the existing Macabee Coulee, a natural watercourse, to drain this area. The Soil Conservation Service and U. S. Army Corps of Engineers are cooperating in the project. Survey data obtained by the Commission was turned over to the Corps of Engineers for their evaluation.

Construction of facilities for this project depends on further study by the Corps of Engineers and on the desire of local interests to develop the project.

ELM RIVER DAM — PROJECT No. 501

The proposed Elm River Dam, located seven miles west of Ellendale in Dickey County, was originally investigated in 1951; however, because of difficulties in obtaining easements, the project was deferred. This difficulty was apparently resolved in 1959 and project proponents from Ellendale requested the State Water Conservation Commission to renew investigations of the project.

A detailed topographic survey and a soils foundation study were made by Commission crews to determine the feasibility of the project, and a preliminary design of the dam has been made.

The dam will be a multi-purpose structure incorporating an earth-fill embankment with a glory-hole type spillway which will also serve as the roadway for State Highway No. 11. Use of the embankment for the state highway greatly enhances the project and will provide convenient public access to the recreation facilities at the reservoir. The reservoir will cover an area of 188 acres with a capacity of 1,068 acre-feet. The depth of the water will be adequate to sustain fish life.

Construction will begin when easements are obtained and financial arrangements completed with project sponsors.

LITTLE MUDDY RIVER DAM — PROJECT No. 637

An investigation was made at the request of local landowners to determine the feasibility of construction of a dam on the Little Muddy River, north of the Williston flood protective works, to provide for storage of water for irrigation, recreational facilities and a wildlife propagation area.

A detailed topographic survey was made on the scale of 1" = 100' for determination of the most feasible site for a dam. This project is located in the area of the Ancient Channel of the Missouri River. Commission investigations included a ground water survey to ascertain quality and quantity of ground water as an alternate source for irrigation purposes. The ground water was found to be questionable for irrigation because of the high alkaline content.

Further investigations of the project are presently under way and include study of the quality and quantity of the available surface water. Additional survey work will be required to determine the irrigable lands which can be served by this project.

FROELICH DAM — PROJECT No. 627

At the request of local proponents the State Water Conservation Commission investigated the possibility of constructing a dam ten miles northwest of the village of Selfridge. The proposed dam would create a reservoir that would cover an area of 176 acres with a storage capacity of 2,286 acre-feet. It would provide much needed recreational facilities in an area where practically none exist at present.

The Commission completed a detailed topographic survey of the area and soil borings were made to determine suitability of foundations material for the dam. The construction of the dam was found to be feasible and preliminary design work was initiated for an earth embankment with glory-hole type spillway and emergency bypass. Participants in the project will be the State Water Conservation Commission, State Game and Fish Department, Sioux County, Men's Club of Fort Yates and the Selfridge Sportsman's Club.

Construction of this project is contemplated in the near future after necessary easements for the reservoir have been obtained.

DES LACS CITY DAM — PROJECT No. 636

The Des Lacs City Dam is located in the northwestern corner of the town of Des Lacs. The dam is a timber crib structure built by the Great Northern Railway and has now been turned over to the town of Des Lacs by the railroad.

Part of the timber deck has failed and repairs on the dam are needed. The town of Des Lacs requested the State Water Conservation Commission to make an investigation of the dam and to determine the possibility of repairing the structure for recreational facilities and a future city water supply.

Studies made by the Commission revealed that the cost of renovating the dam would approximate $30,000. Further investigation will be needed before a firm cost estimate can be made.

Commission survey crews completed a topographic survey at the scale of 1" = 50' to aid in further evaluation of the project.

McVILLE RAILWAY DAM — PROJECT No. 616

The McVille Railroad Dam is located one-half mile east of the City of McVille. It was constructed by the Great Northern Railway and donated to the City of McVille. The dam is a timber crib structure and is so badly deteriorated that repairs are impractical. This dam and the reservoir it creates are used in conjunction with McVille's municipal water supply. At normal flood stage the water in the coulee does not gain an elevation sufficiently high to recharge the aquifer. It is necessary to maintain the reservoir at a depth of 25 feet to accomplish recharge, it is therefore essential that the structure be rebuilt. At the request of local proponents the commission investigated the possibility of incorporating the structure with the reconstruction of Highway No. 15.

A detailed topographic survey was made which included soil borings and it was determined that the highway fill could be utilized for the embankment of the dam. This multi-purpose structure will result in a considerable savings as it eliminates the necessity for a bridge on the highway and also the earthfill serves a dual purpose of highway route and dam embankment. The reservoir will assure the City of McVille a continued adequate municipal water supply through recharge of the ground water aquifers.

The structure is estimated to cost approximately $32,000, to be shared by the City of McVille, the State Water Conservation Commission and the Game and Fish Department. Construction will begin during the summer of 1960.

SHORT CREEK DAM — PROJECT No. 586

The Short Creek Dam is located in Section 4, Township 163 N., Range 93 W., five miles north and one mile east of Columbus in Burke County. It is a rubble masonry structure built in 1939 by the WPA and FERA. The spillway has deteriorated beyond repair and the dam will have to be completely rebuilt.

A detailed topographic survey was made to determine feasibility of constructing a new dam one and one-fourth miles downstream from the old dam. The resultant reservoir would cover 113 acres with storage capacity for 1,260 acre-feet of water, which would be adequate for recreational use and would sustain fish life. The dam, as proposed, would consist of an earth embankment 600 feet long and a concrete chute spillway. The depth of water in the reservoir would be approximately 40 feet. Estimated cost of the structure is $40,000. A soils survey must be conducted to determine the suitability of foundations materials at the site before definite feasibility of the project can be determined.

PETRIFIED LAKE — PROJECT No. 666

At the request of local proponents the State Water Conservation Commission investigated the proposal to raise the level of Petrified Lake, located in Pierce County about nine miles south of the town of Balta, by building a dam at the outlet to Petrified Lake and also draining other nearby shallow lakes into Petrified Lake to create one large lake. Petrified Lake, if restored in this manner, would have a surface area of approximately 860 acres and a storage capacity approximating 10,300 acre-feet. It would be an ideal recreation area and very suitable for fish propagation.

Soil borings were made by the State Water Commission to determine suitability of foundations material for construction of a dam. A feasible site was located in Section 7, Township 153 North, Range 72 West, which is within a few hundred feet of State Highway No. 3 assuring convenient public access to the recreation area.

A detailed topographic survey will be made of the Petrified Lake region by the State Water Commission before a complete evaluation of the project can be ascertained. It is expected that a favorable benefit to cost ratio will be attained.

ROUND LAKE DAM — PROJECT No. 659

The State Water Conservation Commission investigated the proposed Round Lake Project on request of interested local proponents to determine the feasibility of constructing a dam at the outlet to Round Lake to raise the water level ten to 15 feet. Neighboring lakes would be drained into Round Lake and would enhance the use of the lake for fishing and as a recreational area.

Soil borings were made by the Commission in an attempt to locate suitable foundation material for a dam. The outlet area of

the lake was found to be underlain with pervious materials and would not be suitable for footings for a dam.

This project was abandoned and, as an alternative, the Petrified Lake Project is being investigated.

NECHE DAM — PROJECT No. 274

The Neche Dam is a rubble masonry structure built on the Pembina River in 1938 by the WPA. The City of Neche requested the Commission to investigate the condition of the dam to determine the extent of repairs needed, and the possibility of raising the spillway an additional two and a half feet. The additional water impounded by raising the spillway is desired to provide an adequate and stable municipal water supply for the city and enable the city of Neche to supply the municipalities of Gretna and Altona, Manitoba, two Canadian cities north of Neche, which has inadequate municipal water supplies. Cross sections of the river above the dam were made to determine the capacity that could be attained by raising the spillway.

The Commission recommends that the present structure be rehabilitated with the application of a three inch wearing surface of pneumatically applied concrete and that the present spillway crest be raised one and a half feet and facilities be provided for the installation of one foot flashboards. These flashboards can then be installed after the peak of the spring floods to retain an additional foot of storage in the reservoir. Estimated cost of the project is $8,200. It is expected that construction of this project will be initiated during the summer of 1960. Sponsors of this project are the City of Neche and the State Water Conservation Commission.

LAKE TOBIASON — PROJECT No. 670

At the request of local proponents, an inspection was made of the Lake Tobiason Project, located in Section 11, Township 148 North, Range 55 West in Steele County, to determine needed repairs. This project was originally constructed by the WPA in the early thirties and provided for the diversion of water from a coulee during each spring runoff of Lake Tobiason to maintain its level.

The Farmers Union camp and a public recreational area are located at the lake.

The present structures are in poor condition and are in need of repair. A cost estimate for the needed repairs has been provided the local proponents and work on repair of this facility will be initiated as soon as financial arrangements have been completed.

HARVEY DAM — PROJECT No. 671

At the request of local proponents an inspection was made of the existing dam on the Sheyenne River at Harvey to determine the advisability of raising the present reservoir level to increase the recreational value of the reservoir.

This project will be studied to determine the costs and feasibility of the project. A field survey may be necessary to determine the affect an increase in the reservoir level will have on existing buildings and municipal water supply facilities.

CRESCENT LAKE — PROJECT No. 668

The State Water Conservation Commission was asked by local proponents to make an investigation on the possibilities of the construction of a dam just northeast of the City of Sheyenne on the Sheyenne River for recreational use. An inspection of the site area was made and it appears that the proposed location possesses features of a good dam site. The Commission will make topographic and foundation surveys in the near future in order to determine the cost and feasibility of this project.

GREEN RIVER DAM, BELFIELD — PROJECT No. 647

At the request of local proponents, an investigation was made of a proposal for a dam on the Green River north of Belfield in Stark County. Belfield has been having difficulty in obtaining an adequate water supply and feels that eventually they will have to import water from the Green River in order to obtain sufficient quantity for its municipal and industrial uses.

The State Water Commission investigated a site and made topographic maps of the project area. A soil foundations survey was also made at the proposed dam site. The data gathered was compiled and turned over to the Corps of Engineers when it was determined that the scope of the project was too large to be financed by the state and local sponsors. As a result of these basic surveys, the U. S. Congress has now authorized the Corps of Engineers to proceed with an investigation of this project.

CONSTRUCTION PROGRAM SUMMARY

July 1, 1958 to June 30, 1960

No.	PROJECT	County	Date	SWCC	G & F USF & W	Local	Other	Total
400	Welk Dam	Emmons	May-June '58	1,897.19	1,897.19	1,897.19		5,691.57
580	Enderlin Park Dam	Ransom	June '58	584.48				584.48
391	Silver Lake Dam	Sargent	June-July '58	1,639.42	1,639.41	1,639.41		4,918.24
389	Fessenden Dam	Wells	July '58	1,231.94		1,231.94		2,463.88
630	Brillian Township Dam	Ward	July-Aug. '58	301.86		603.71		905.57
	Pembina County Drain No. 13	Pembina	July-Aug. '58	8,080.55		12,120.89		20,201.44
467	Wyard Dam	Foster	August '58	1,783.86		1,783.86		3,567.72
299	Pembina City Dam	Pembina	Aug.-Sept. '58	2,500.53		2,500.53		5,001.06
520	Grand Forks Park Dam	Grand Forks	Aug.-Oct. '58	9,379.22		18,758.43		28,137.65
330	Lake Metigoshe Improvement Sharpe Lake Dam	Manitoba, Canada	Oct.-Nov. '58	5,568.63	5,064.51			10,633.14
489	Ray Dam	Williams	Oct.-Dec. '58	20,246.42	2,500.00	16,000.00		38,746.42
546	Vigness Dam	Walsh	Nov.-Dec. '58	2,126.08		2,126.08		4,252.16
631	Ziebaugh Pass	Ramsey-Ransom	Nov.-Dec. '58	2,543.20		5,086.36	7,629.57	15,259.13
227	Eaton Irrigation Project	McHenry	Dec. '58	719.26		1,078.90		1,798.16
353	Cedar Dam	Slope	Dec. '58-Jan. '59	680.52	6,490.00			7,170.52
625	Mayville Dam	Traill	Jan.-Feb. '59	4,677.99		4,677.98		9,355.97
486	Twin Lakes	Williams	Mar. '59	803.08		1,204.63		2,007.71
264	Braddock Dam	Emmons	Mar.-Apr. '59	3,845.83	3,845.82			7,691.65
221	Burlington Dam No. 1	Ward	Apr. '59				574.71	574.71
575	Schmisek Lake Dam	Burke	Mar.-May '59	7,243.34		5,300.00		12,543.34
	Richland County Drain No. 2	Richland	May-June Oct.-Dec. '59	9,264.09		4,320.00		13,584.09
441	Temvik Dam	Emmons	May-June '59	1,709.45	1,709.45	1,709.45		5,128.35

653	Katz Dam	McLean	June-July '59	1,637.08		1,637.08		3,274.16
253	Jackson Dam	McKenzie	June-July '59	1,541.44				1,541.44
460	Ueland Dam	Griggs	July '59	2,106.66	2,073.66	2,073.66		6,253.98
550	Wildwood Lake Restoration	McLean	July-Aug. '59	797.14	797.13			1,594.27
619	*Hunter Dam	Cass	Aug.-Oct. '59	14,854.14		14,854.14		29,708.28
560	*Blacktail Dam	Williams	Aug.-Nov. '59	16,452.47	39,000.00	18,750.00		74,202.47
660	Grafton Railway Dam	Walsh	Sept.-Nov. '59	676.43		1,352.86		2,029.29
217	Park River Dam	Walsh	Sept.-Nov. '59	1,319.26	2,638.50			3,957.76
615	Ellendale City Dam	Dickey	Oct.-Nov. '59	3,474.94		3,474.93		6,949.87
227	Eaton Irrigation Dam	McHenry	Nov.-Dec. '59	7,702.87		7,702.86		15,405.73
412	Earl Cypert Park Dam	Burleigh	Jan. '60	1,014.66		1,014.66		2,029.32
22	Cass County Drain No. 22	Cass	Jan.-Mar. '60	9,525.38		5,000.00		14,525.38
227	Eaton Irrigation Dam	McHenry	Mar.-Apr. '60	1,911.49		1,911.48		3,822.97
362	**Balta Dam	Pierce	May-June '60	10,158.34	10,158.33	10,158.33		30,475.00
416	Lake Irvine Drainage	Ramsey	May '60			567.78		567.78
217	Park River Dam	Walsh	May-June '60	2,774.47		2,774.47		5,548.94
475	Golden Lake Restoration	Steele	June '60	3,025.44	3,025.44	1,200.00		7,250.88
				165,799.15	78,200.94	157,150.11	8,204.28	409,354.48

*Work not complete as of July 1, 1960, Costs shown are to date.

**Work underway on July 1, 1960, Costs shown are estimated.

BENCH MARK DATA

Lake Patricia Dam, Project No. 498

Near Flasher in Morton County. Bench Mark No. 6.

Location: Four-tenths of a mile west of the east quarter corner of Section 36, Township 135 North, Range 84 West.

Description: A steel pin, embedded in a concrete post and projecting three inches above ground marked "State Engineer 1958." Bench Mark Elevation 1854.86 M.S.L.

Meissner Dam, Project No. 271

North of Glen Ullin in Morton County. Bench Mark No. 8.

Location: Five hundred feet east of Meissner Dam spillway on north-south quarter section line road, in Section 24, Township 139 North Range 89 West.

Description: A steel pin in a concrete post, marked "State Engineer 1958 B.M. No. 8." Bench Mark Elevation 2126.12 M.S.L.

Hebron Dam, Project No. 317

Southwest of Hebron in Morton County. Bench Mark No. 7.

Location: At east quarter corner of Section 32, Township 140 North, Range 90 West.

Description: A steel pin in a concrete post projecting three inches above ground, marked, "State Engineer 1958." Bench Mark Elevation 2169.20 M.S.L.

Stoney Creek Dam, Project No. 650

Four miles east of Bowbells in Burke County.

Location: Fifty feet west and fifty feet north of corner to sections 1, 6, 7 and 12, Township 161 North, Ranges 88 and 89 West.

Description: Bridge spike in center of brass plate in concrete post, marked "State Engineer". Bench Mark Elevation 1916.12 M.S.L.

Green River Dam, Project No. 647

In east central Billings County.

Location: Forty six feet southwest of the corner to sections 10, 11, 14 and 15, Township 141 North, Range 89 West.

Description: Top of steel pin in a concrete post with brass cap, marked "State Engineer". Bench Mark Elevation 2553.17.

Short Creek Dam, Project No. 586

Six miles north of Columbus in Burke County.

Location: 1115' east and 830' north of the corner to sections 29, 30, 31-32, Township 164 North, Range 93 West.

Description: Brass cap in concrete post marked, "State Engineer". Bench Mark Elevation 1896.05 M.S.L.

Blacktail Dam, Project No. 560

Williams County.

Location: 1,200 feet south and 195 feet east of corner to sections 9, 10, 15, and 16, Township 157 North, Range 101 West.

Description: Pipe set in concrete with brass cap marked "State Engineer". Bench Mark Elevation 2096.27 M.S.L.

Sweetbriar Creek, Project No. 642

Three miles northeast of Judson in Morton County.

Location: Two-tenths mile west and 335 feet south of North quarter corner of Section 14, Township 139 North, Range 84 West.

Description: Brass cap set in concrete, marked "State Engineer BM No. 1". Bench Mark Elevation 1981.69 M.S.L.

Sykeston Dam, Project No. 450

North of town of Sykeston in Wells County.

Location: Four-tenths of a mile west of corner to sections 1, 6, 7, and 12, Township 146 North Range 68 & 69 West.

Description: Brass cap embedded in concrete, six inches above ground, marked "State Engineer BM No. 103, July, 1960 Elevation 1625.47".

Balta Dam, Project No. 362

One and one-half miles southwest of Balta in Pierce County.

Location: 365 feet north of railroad on quarter section line, Section 15, Township 154 North, Range 73 West.

Description: Spike embedded in concrete with brass cap marked "State Engineer BM No. 104, Elevation 1533.92, July 1960".

Armourdale Dam, Project No. 665

North of village of Armourdale.

Location: In southwest corner of Section 6, Township 162 North Range 67 West.

Description: Steel rod embedded in concrete with brass cap marked "State Engineer BM, Elevation 1653.69".

Location: In Section 6, Township 162 North Range 67 West on top of large knoll 300 feet north of the bridge near west section line.

Description: Steel rod embedded in concrete with brass cap marked "State Engineer BM, Elevation 1677.95".

THE DRAINAGE PROGRAM

North Dakota's water problems can be summed up as either too much water or too little water. In many areas of the state the need to remove excess water is as great as the need to provide additional water is in other areas. If the agriculture of the state is to be expanded and stabilized the state's water program must provide a means for the effective management of the water resources. Dollar wise, the loss of agricultural production due to excess water is, in some areas, more serious than the loss due to the lack of water.

Much of our agricultural land that is subject to damage from excess water is located in the eastern portion of the state where the rainfall is greater. Because of more favorable climatic conditions this highly productive Red River Valley land can be counted on to produce a good crop even when crops fail on higher and drier land. It is this land, however, that is most likely to fail to return a crop because of water damage during the spring runoff period or during periods of heavy rains. The solution to this problem lies in providing adequate drainage of excess waters from agricultural lands by properly designed artificial drainage ditches.

The construction and installation of drainage channels in North Dakota, particularly in the Red River Valley, dates back many years. The benefits that have resulted from these drains have proven their worth by reducing planting delays and crop losses due to heavy rains between seeding and harvest. The cost of the investment in the drains has been justified emphatically year after year, not only through direct and indirect benefits to the individual farmer, but also benefits to the economy of the community and the state as a whole. Although most of the drainage ditches which have been constructed are located in the Red River Valley counties many drains have been built in other areas in the state in recent years.

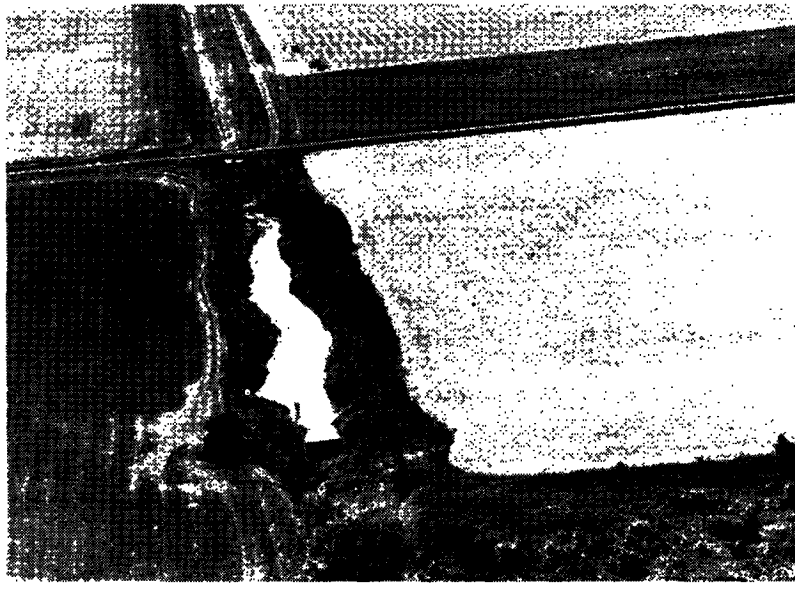
The activity of providing and maintaining an adequate drainage program has varied in accordance with the current need. The drought period in the mid 30's had the effect of reducing the current need and providing little incentive or financial ability to maintain the existing drains and construct others to take care of the excess water when the wet years would return. As a result, a great many of the drains were neglected and rendered useless when they were filled with blowing soil, brush and trees.

When the wet years returned the result of this neglect was apparent. Many areas in the state particularly in the Red River Valley suffered severe flood damage because of neglected drainage systems. The need for a greatly accelerated drainage construction program was recognized; however, the very owners of land who needed the drains most were the ones, by reason of flood damage and drop loss, least able to finance it. In 1943 the North Dakota State Legislature recognized this problem and appropriated the sum of

$50,000 to the State Water Conservation Commission to assist countries in the construction and reconstruction of existing drainage ditches. Subsequent appropriations by the legislature to the State Water Conservation Commission kept this program in force and expanded it to include assistance to irrigation districts and for other water resources projects.

In 1957 the legislature further expanded the purpose for which this appropriation could be used and designated the fund as the multiple-purpose fund. Appropriations to the multiple-purpose fund were made for a continuing period so as to overcome difficulties that existed in administering the fund that existed when it was made for a biennial period. In 1959 the legislature made a further appropriation to the Commission's multiple-purpose fund to restore it to an amount estimated necessary for the coming two years. Another budget request will be submitted to the 1961 legislature to again restore this fund to take care of the anticipated need during the 1961-63 biennium.

The State Water Conservation Commission, in administering that portion of this fund used for drainage, has adopted the policy of allocating funds for the construction of legal drains or those constructed under the sponsorship of a legal entity such as a Board of Drainage Commissioners in a county, a Board of County Commissioners, a Township Board or a Board of Commissioners of a Water Conservation and



Drop structure in drain near Colfax, North Dakota

Flood Control District. Action relative to such drains is initiated by the landowners concerned through a petition submitted to their appropriate governing body concerned with drainage matters. Before construction of the drain gets under way an adequate engineering study, investigation and cost estimate is prepared and submitted to the landowners for their consideration and approval. If the project is approved the local cost is financed through special assessment of all property benefitted by the drain.

The State Water Conservation Commission does not enter into the organization or establishment of drainage districts nor in the proposal to construct drains or make surveys thereof unless specifically requested to do so. After a drainage project has been approved by the local governing body and if state assistance is desired, the State Water Conservation Commission receives a request from the local governing body. This request and the design of the proposed drain must conform to the rules and regulations adopted by the Commission in administering this fund. A copy of these drainage rules and regulations is made a part of this section of the report. If the request for assistance and construction of a drainage project submitted to the State Water Commission and the design of that project is in conformance with the Commission's drainage rules and regulations, consideration is given to allocating funds from the Commission's appropriations to assist in the construction of the drain. The state's participation in the drainage cost is normally established as 40% of the construction costs. Before payment of the state's share is made, a final inspection of the completed work is made by the engineering department of the State Water Conservation Commission.

It has become increasingly apparent that conditions which require change, improvement and addition to existing drainage facilities are due to other factors than the original topography of the land. The change that continually occurs in land use including the construction of highways, and commercial and urban development all have a bearing on the need and design of drainage channels. The problems incident to changes that can occur because of road and highway construction that affect the drainage patterns in an area have required an increasing amount of attention in recent years. Roadway design specifications have called for progressively wider rights-of-way and correspondingly wider and more streamlined ditch sections. These changes along with the construction of many new and modern highways have a direct bearing on the design of and need for drainage construction. Because of this need, and to improve the administration of the Commission's drainage program, a full time drainage engineer was employed in December 1959. His duties are to act as liaison between the Highway Department, the State Water Conservation Commission, the County Drain Boards and Water Conservation and Flood Control Districts in matters pertaining to the drainage of waters; to assist in the investigation, study and planning of impoundment or diversion of water for any beneficial purpose involved in

highway construction both underway and planned for the future and to work out culvert capacities for installations on state or county roads as requested. The drainage engineer is employed cooperatively by the State Water Commission and the State Highway Department with each department sharing equally in the costs incurred with this activity.

During the past biennium the drainage program of the State Water Commission has included assistance in the form of payment or allocations made for approximately 50 drainage or flood control projects in all areas of the state. A listing of these payments by county and drain or project is given in the financial section of this report.

In April 1960 a meeting of representatives of water conservation and flood control districts and drainage boards was held in Grand Forks at which various legal questions pertaining to the authority vested by law in such districts relative to matters pertaining to drainage and flood control were discussed. The meeting was successful in providing clarification of some points of law and resulted in focusing the attention of those concerned on additional clarification that was needed in portions of the laws under which drains are built and assessments for them made. A study committee was appointed by the State Engineer to study these legal questions with the objective of presenting proposed legislation to the North Dakota Legislature as deemed necessary and advisable. This committee is presently making a study of these laws and it is expected that some recommendations will be presented to the next legislature. Appointed to the Committee are:

Paul Sand, Assistant Attorney General, Bismarck, North Dakota.

Emerson Murry, Director, Legislative Research Committee, Bismarck, North Dakota.

Manfred Ohnstad, Clerk and Attorney, Cass County Board of Drain Commissioners, West Fargo, North Dakota.

Norton Hatlie, Attorney, Richland County Water Conservation and Flood Control District, Wahpeton, North Dakota.

F. E. Foughty, Attorney, Sweetwater and Chain Lakes Water Conservation and Flood Control District, Devils Lake, North Dakota.

Richard Gallagher, Attorney, Lower Heart Water Conservation & Flood Control District, Mandan, North Dakota.

Glenn Swanson, Attorney at Law, Bottineau, North Dakota.

DRAINAGE RULES AND REGULATIONS

1. State Water Conservation Commission funds appropriated for construction and reconstruction of drainage or irrigation works will be available only for work done on legally established drainage ditches and in conformity with following rules and regulations.

2. For the purpose of these regulations relating to drainage work, the following definitions are applicable: Clean-outs are defined as the repair and restoration of existing drains to substantially the original depth, gradient and section; reconstruction is defined as practicably a new construction job to meet present requirements, or revision of existing drains on the basis of new designs and specifications; and construction is defined as new legally established and located drains, designed to meet local requirements. The Chief Engineer of the State Water Conservation Commission shall approve the classification for each drain in which the Commission participates.

3. Before any state funds will be available for a drain all engineering plans showing location, profile, cross section, control structures, etc., and specifications shall be approved by, and be on file in the office of the Chief Engineer of the State Water Conservation Commission.

REGULATIONS GOVERNING DRAINAGE PLANS AND SPECIFICATIONS TO BE FORWARDED TO THE STATE WATER CONSERVATION COMMISSION FOR APPROVAL.

A. Plan and profile must be submitted on any standard 24"x36" maximum plan and profile sheets suitable for the making of reproductions.

B. Cross sections must be plotted on standard 24"x36" maximum cross section sheets suitable for making reproductions.

C. Drafting may be done in either India Ink or a suitable tracing pencil.

D. A title block must be placed in the lower right hand corner of sheet No. 1 and must contain the following information:
   (1) Name of organization responsible for the survey and design of said drainage plans with address.
   (2) Name of drain.
   (3) County name where drain is located.
   (4) Name of person making design.
   (5) Date.

E. On the first sheet of plans must be shown a general location map showing the following information:
   (1) A double heavy dashed line (= = = =) showing location of drain in respect to the county or township in which it is located.

(2) Section lines and numbered sections must be shown to properly locate said drain along with township and range numbers, county name, north arrow, railroads, highways, rivers, towns, and other drains. (This location map may be drawn at a scale of preferably 1" = 1 mile.)

(3) A dashed line (----------) showing the boundary of the drainage area of said drain.

F. The plan must be drawn at a maximum scale of 1" = 400'.

G. The profile shall be drawn at a maximum horizontal scale of 1" = 400' and at a vertical scale not smaller than 1" = 4' (All elevations must be referred to USGS mean sea level datum.)

H. The plan must show the following information:

(1) Station numbers at all changes in alignment, PI, PC and PT stations, bridges, culverts, proposed structures, intersecting drains, railroads, highways and section lines.

(2) Location of bench marks with elevations.

(3) Equations showing the stationing of any intersecting drains. (i:e: 428 + 89 Drain 62 = 252 + 00 Drain 3.)

(4) Bridge and culvert data such as span, deck and invert elevations, type, number and size.

(5) Section, township and range nos. and location.

(6) Location of drain right-of-way with ditch right-of-way labeled in feet.

(7) Center line of drain. (~- ->- - ->- ->)

(8) North arrow.

(9) Name and location of river, stream, or drain into which said drain empties and also information relative to channel, bridge and culvert capacities downstream from mouth of drain.

(10) Number of cu. yds. excavation required.

I. The profile must show the following information:

(1) Station numbers every 1,000'. (Stationing can start at either the mouth or headwaters of said drain but in no case may minus stationing be used. Commence on no. 1 page of plan and profile.)

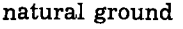
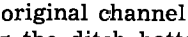
(2) Mean sea level elevations on vertical scale numbered every 10' in elevation.

(3) At station nos., label description of structures, section lines, intersecting drains, railroads and highways.

(4) At every change in design ditch cross section, list the drainage area, station numbers and hydraulic properties. (i:e:)

Drainage area — 10 sq. miles.
Side slopes — 3:1

B-6	N-.035
S-.0004	D-5
A-105	V-1.68
R-2.79	Q-176

J. The profile must consist of the following lines:
   (1) The natural ground line (). This line being the lowest ground elevation within area to be drained on either side of the proposed center line of the ditch.
   (2) The original channel bottom line (). This line being the ditch bottom elevation as existed at the time of the survey.
   (3) The proposed ditch grade with S labeled, such as (----S-.04%). This line being the proposed design grade of the said drain.
   (4) The proposed water surface line (— — — — —). This line being the position of the proposed water surface. This being D' above the proposed ditch grade.

K. The proposed ditch grade elevations must be drawn to the left of every 1,000' station line below the four profile lines.

L. The plan, profile and cross sections must contain information for a minimum of 1,000' of the stream, drain or river into which said drain empties. (The only exception in this case is the Red River of the North.)

M. The cross section sheets will contain actual cross sections at a minimum of every 500' and also cross sections at all significant breaks in topography and at structures, highways, railroads and section lines.

N. Cross sections will all be plotted on a scale of 1" = 10' horizontal and vertical and will contain the following information:
   (1) The station number below the cross section.
   (2) The datum elevation below the cross section:
   i.e. $\frac{850.0}{|}$
   (3) The survey cross section with the proposed ditch construction cross section superimposed upon it.
   i.e. 
   (4) The cut area will be entered adjacent to the cross section. i.e. Cut 95.

O. Any additional information relative to any adverse effects that said drain will have on downstream land and structures must be enclosed with said plans. The Chief Engineer reserves the right to require additional survey information relative to any problem that may arise due to the construction of said drain.

P. The Board of County Commissioners, the Board of Drain Commissioners or the Township Board of Supervisors or any other legally constituted board, as the case may be, upon awarding of a contract shall file a copy of such contract with the State Water Conservation Commission before any state funds will be available for such drain.

Q. Where the problems of determining capacities of state, county or township culverts and bridges to provide sufficient size to permit maximum quantity of water to flow freely through or under such structures, the Chief Engineer will be available upon request to determine as nearly as practicable the maximum size of structure to install.

R. When a Drainage District is unable to obtain engineering for surveying, design and supervision of the works, the State Water Conservation Commission may provide such engineering assistance as is required, if available, charging the cost thereof against the drain on which such services are required.

DESIGN CRITERIA FOR ENGINEERS IN PREPARING PLANS FOR DRAIN CONSTRUCTION

1. Nomenclature:
   - s: slope of drain. ft./ft.
   - v: velocity. ft./sec.
   - n: coefficient of roughness
   - r: hydraulic radius, area/wetted perimeter, ft.
   - A: area, sq. ft.
   - b: bottom width, ft.
   - d: depth, ft.
   - Q: discharge. cu. ft./sec.

   DA = Drainage Area

2. Formulas: (open channels and pipes)
   A. Use either Kutter's:

$$v = \left\{ \frac{\frac{1.811}{n} + 41.6 + \frac{.00281}{s}}{1 + \left(41.6 + \frac{.00281}{s} \right) \frac{n}{\sqrt{r}}} \right\} \sqrt{rs}$$

   or Manning's $v = \frac{1.486}{n} r^{2/3} s^{1/2}$

   B. $Q = Av$

3. Rules and limitations governing design of drains:
   A. b shall not be less than 4 ft.
   B. Side slopes shall be a minimum of 3:1 where mowing and weed control is required. (In places where riprap may be installed the slope may be reduced to 2:1.)

C. In no case shall the design velocity exceed 3.00 ft./sec., at the design discharge unless previously approved by the Chief Engineer of the North Dakota State Water Conservation Commission.

D. The "n" value shall not be less than .025 for open channel earth canals. (An "n" value of .030 or .035 may be used where excessive growths of weeds and grass are encountered.)

E. At no time may the hydraulic gradient of the water surface of the drain at design discharge be above the natural ground line so as to cause flood damage of farm land.

The only exceptions are as follows:

1. Where drain is in a pot hole area where crop lands will not be affected.
2. Where the hydraulic gradient may be kept in the ditch by the construction of a dike fill and field inlet. Flood easements from land owner must then be obtained for surplus water that may impound in back of the dike while the drain is in operation.
3. If flood easements from land owners can be obtained for these situations where the hydraulic gradient is above the ground line, remedial construction measures will not be required.

F. If the hydraulic gradient exceeds the ground line and no remedial measures can be arrived at on a friendly basis with the landowner, either a drop structure will be required so as to locate the hydraulic gradient below the natural ground, or, as an alternative, the ditch may be widened sufficiently to lower the hydraulic gradient below the ground line. (The economics of the cost of a drop structure plotted against cost of ditch excavation will have to be studied in this latter case.)

G. If drop structures are contained in the plans for construction, the plan for the structure or structures must be included in the overall plans and specifications submitted to the Chief Engineer for approval.

H. The design discharge for drains will be arrived at by the following tabulations:

ESTIMATED RUNOFF PER SQUARE MILE FROM WATERSHEDS
(Prepared by J. T. Steward, 1907.)
"LIMITS OF" DEPENDING ON TOPOGRAPHY

Sq. Miles Drainage Area	Discharge C.F.S. Minimum (Flat Slopes and Small Drainage Development)	Maximum (Steep Slopes and Intensive Drainage)
1	20	20
2	17	18
3	15	17
4	13.4	16
6	11.8	15
8	11.2	14.5
10	10.0	13.5
15	8.4	13.0
20	7.7	12.5
25	6.7	12.1
30	6.6	11.8
40	6.4	11.2
50	6.2	10.7
75	5.9	9.8
100	5.8	9.3
150	5.3	8.8
200	5.1	8.2

Larger factors may be used in areas of steep topography and where interception of defined water courses occur.

I. Where constructed drains enter into natural drainage courses, the following regulations govern:

(1) Where drain enters into a river that has year around flows, bottom elevation of ditch must enter at the average yearly water surface elevation.

(2) Where drain enters into a natural drainage course or channel that has only intermittent flows, the invert ditch elevation must enter at the channel bottom elevation of the natural drainage course.

(3) Enough survey information of the natural drainage course which is expected to accommodate the flow from the proposed drain must be obtained so that the discharge capacity of this course may be determined. (Use a value of "n" appropriate for the drainage course involved and use open channel formulas.)

(4) On the submitted plans, label the hydraulic properties of the drainage course that the proposed drain enters. If this drain consists of an irregular drainage course, list n, s, A, v, r and Q.

(a) n must be assumed depending on condition of stream.

(b) s, A and r can be averaged by taking at least three representative cross sections of the stream in not less than a distance of 1,000 ft. downstream from mouth of proposed drain.

(c) v and Q can then be calculated by their appropriate formulas.

(5) All engineers should check at county drainage boards for plans of previously constructed drains for the information relative to design capacities and water levels. If the drain under study enters into another legal drain, stationing equations should be shown on plans and the engineer must also make sure that the discharge capacity of the outlet of the proposed drain is sufficient to accommodate the discharge capacity of the entering drain.

J. The following steps for designing of a drain are recommended as follows after survey information is obtained from the field:

(1) Check to see if any limitations exist below the mouth of this drain that will limit the design capacity of the drain to a definite Q.

(2) If there are no limitations and the natural water course has sufficient capacity, get the required Q for the drain from the previous tabulations listed under 3-H.

(3) Use either Kutter's or Manning's formulas for open channels, arrive at a profile and cross section for a ditch that will reach or exceed the required Q from the previous paragraph; always noting that v must not exceed 3.00 ft./sec. unless approved by the Chief Engineer, and a minimum bottom width used of four feet.

(4) The total length of the ditch must be separated into several segments each having a different drainage area and the cross section of the ditch calculated for each segment with its representative hydraulic properties. (It must be noted that the required Q for each segment must correspond to the tabulations listed under 3-H.)
Note: Choose these segments at locations where future laterals to this drain may be constructed.

(5) Draw the hydraulic gradient line d' above the s line on the plans and note whether the water surface stays below the natural ground line. Thence one can tell whether a drop structure is required or a change in ditch grade is necessary. (Refer to exceptions in item 3-E.)

(6) Calculate the cu. yds. of excavation required, the size of culverts and bridges needed, the size and quantity of field inlets, the right-of-way needed if not previously obtained, the plan and elevation of any drop structures.

(7) All design information is then placed on plan and profile sheets as shown on previous instructions relating to submission of plans.

(8) A preliminary estimate of cost is prepared. It is here noted that crossings under railroads, state and county roads will be designed by their respective engineering offices and the cost for these will not be included in the preliminary estimate. The required Q for these structures, however, will be noted on the plans.
Other items included in the estimate will be (1) Brushing and grubbing; (2) Spoil bank leveling; (3) Excavation; (4) Field inlets; (5) Right-of-way; (6) Riprap; (7) Concrete for drop structures; (8) Backfill; (9) Private crossings; (10) Engineering, where it is not a donated item.

(9) If construction is to be let on a per cu. yd. contract, specifications governing all aspects of construction and also owners' and contractors' liability and payment shall be prepared and submitted to the State Water Conservation Commission along with the plans. (Sample of specifications may be obtained at either any Soil Conservation Service office or at the State Water Conservation Commission.)

(10) Prior to consideration by the State Water Commission for fund participation, an investigation of the site of construction will be made by one of its engineers following receipt of plans and specifications.

(11) Upon completion of construction of drain, a final investigation shall be made by an engineer of the Water Commission preferably prior to the Contractor's moving off of said job. If job is completed satisfactorily according to plans and specifications, the drainage project will be eligible to receive up to 40% of cost for the approved practices.

(12) If State Water Commission does not approve plans and specifications for said drain, said plans and specifications will be returned to engineer or agency for revision along with reasons for making such revisions.

(13) Prior to Contractor's start of excavation, the drain must be properly staked and marked with appropriate cuts and fills at every 100 ft. station by the Engineer in charge.

(14) If drain is properly staked prior to excavation, payment to contractor can then be based on the cubic yards of excavation as shown on the plans.

K. State funds may be made available up to 40% of the cost on the following items:

1. Excavation
2. Drops, regulating and control structures, to prevent erosion in the drain.

3. Clearing and grubbing where it is not a normal maintenance item.
4. Leveling spoil banks.
5. Culvert inlets from field drains or natural water courses.
6. Field drain inlets.
7. Farmstead driveways or crossings.
8. Moving and reconstructing fence lines.

L. State funds shall not be available for:
1. Installation of bridges or culverts across section lines, unless funds are appropriated for this specific purpose.
2. Administrative or legal expenses in connection with any drain.
3. Paying any costs of drainage work involved in court action.
4. For ditch maintenance or repairs resulting from deferred maintenance.

M. State funds shall not be available for assistance for maintenance work on any drain after state assistance has been received for the construction, reconstruction or clean-out of such drain.

N. Before vouchers are submitted to the State Water Conservation Commission for payment they must be approved by the Chairman of the Board of County Commissioners, or the Chairman of the Board of Drain Commissioners, or Board of Township Supervisors and the District Conservationist of the Soil Conservation Service, or the Engineer in charge.

O. The Chief Engineer of the State Water Conservation Commission shall approve the job before final payment is made. Payment of the State Water Conservation Commission's share for such work or other expenses shall be made only upon vouchers properly certified, according to law and in compliance with the terms of these rules, and prepared in the form designated by the State Water Conservation Commission.

INTERNATIONAL AND INTERSTATE COMPACTS

The most practical method of determining the rights of states or nations to the use of water from interstate or international streams is through the negotiations of compacts among the governmental entities concerned. Through such compact negotiations a satisfactory solution to many perplexing problems dealing with water can be found. The division of water among states can also be accomplished by court litigation or direct congressional action but the results are never as satisfactory as if agreement among the states concerned is reached.

Before a compact can be negotiated on an interstate stream the United States Constitution requires that Congress authorize the states concerned to enter into such negotiations. Such auhority ordinarily provides that a Federal representative will be a member of the compact commission conducting the negotiations and that the negotiations will be completed within a specified time. The compact commission, in addition to the Federal representative, is composed of representatives of the states involved. The commission, upon reaching agreement, submits its recommendations to the various state legislatures for ratification and following the approval of all state legislatures the action is submitted to Congress for approval. Once the compact is approved it becomes the basis for the rights of the parties to use the water of the streams concerned and the provisions of the compact are administrated by a joint commission composed of representatives of the state concerned.

Streams that are international are governed by a commission established under treaty between the nations concerned. Each nation is represented on the commission established by such treaty. The administration and control of all international waters of concern to the nations involved is vested in this Commission. The International Joint Commission is such an example and has jurisdiction over two North Dakota rivers. Both of these rivers are of significant importance to North Dakota, consequently North Dakota has a direct interest in the activities of the International Joint Commission.

International stream systems of concern to North Dakota are the Souris River and one of its tributaries, Long Creek, which drains portions of Saskatchewan, North Dakota and Manitoba; and the Red River of the North which drains portions of North Dakota, South Dakota, Minnesota and Manitoba. These streams have been the subject of considerable review and study by the International Joint Commission through the years. The Red River is also an interstate stream.

There are five other rivers in which North Dakota has in interest that are interstate streams. They are the Yellowstone, the Little Missouri, the Grand, the James and the Missouri. A compact has

been negotiated between the states of Wyoming, Montana and North Dakota on the Yellowstone River, and governs the use of water from that river. Compact negotiations are underway on the Little Missouri River between the states of Wyoming, Montana, North Dakota, and South Dakota. Division of the waters of the Grand and James Rivers is of interest to North and South Dakota. The Missouri River is of great interest to ten states in the Missouri River Basin.

INTERSTATE COMPACTS APPROVED

Yellowstone River Compact

The states of North Dakota, Montana and Wyoming have negotiated a compact on the Yellowstone River which was approved by the representatives of those states and their State Legislatures, ratified by Congress in 1951 and signed into law by the President on October 30, 1951. This compact provides for the division of the waters of the Yellowstone River and its tributaries between these three states affected by the Yellowstone River. The compact has successfully operated during the seven years it has been in force. The provisions of the Yellowstone River Compact have been published in previous biennial reports of the State Water Conservation Commission.

In November 1957, the Commissioners of the Yellowstone River Compact approved an application presented through the Wyoming Commissioner by the Columbia Geneva Steel Company to divert 5.3 cubic feet per second of water from the Big Horn River, a tributary of the Yellowstone, out of the Yellowstone River Basin to be utilized in connection with an industrial development in Wyoming. The approval of the Yellowstone Compact Commission of this request was given insofar as that Commission's authority to approve such transbasin diversions extended. The State Water Conservation Commission approved this action on December 20, 1957.

Only a small portion of North Dakota is affected by the Yellowstone River, therefore the states of Montana and Wyoming are primarily interested in the division of the waters of this river. These states have the controlling voice over matters in which the Compact Commission is involved and also finance the entire costs of administering the Yellowstone River Compact.

INTERNATIONAL JOINT COMMISSION

Many complex problems occurred over the allocation of water of those streams that flowed across the boundary of the United States and Canada. In 1909, the International Joint Commission was established by treaty between Great Britain and the United States and given jurisdiction over the boundary waters of Canada and the United States. The International Joint Commission is composed of three members from each of these two nations. It has the authority to consider and determine the rights of the two nations or subdivisions thereof, to the use of water of rivers, streams and lakes in which both countries have an interest. Jurisdictional disputes and problems arising from the use of such common waters called refer-

ences, are referred to the International Joint Commission for consideration by the respective countries.

North Dakota has an interest in the Reference under consideration by the International Joint Commission pertaining to the Souris River, dated January 15, 1940, and the Souris - Red River Reference, dated January, 1948. Various sub-committees have been appointed to study specific questions involved in these References, particularly in respect to the Souris River Reference, in which the State Water Conservation Commission has been concerned. Several important recommendations from the Engineering Sub-Committee relative to the Souris River Reference are under consideration by the International Joint Commission.

Souris River Reference

The three determinations requested in the Souris River Reference are:

1. The apportionment of waters of the Souris River and its tributaries between the Provinces of Saskatchewan and Manitoba, Canada and North Dakota.
2. The methods of control and operation to regulate the flow of the Souris River and its tributaries.
3. Interim measures to be in effect until final determination of the first two points had been made.

In October, 1940, the International Joint Commission issued its interim report containing recommendations as to the use of water from the Souris River pending a determination of the questions contained in the initial Reference. This report was approved by the governments of the United States and Canada early in 1941. The 1941 interim report authorized the provinces of Saskatchewan and Manitoba and the State of North Dakota to use certain quantities of water from the Souris River. It also required that certain quantities of water be released from the State of North Dakota to the Province of Manitoba. This interim report permitted the construction of certain reservoirs by both the Province of Saskatchewan and the State of North Dakota. In 1942 the interim report was modified to increase the flow from 10 to 20 cubic feet per second to be released from North Dakota, and in 1943 the report was further modified to permit the State of North Dakota and the Province of Saskatchewan to make application to meet stock water requirements and similar works which would not remove a quantity of water exceeding 1,000 acre-feet from the stream flow. A number of applications for such projects have been approved by both governments. 603.7 acre-feet have been appropriated in Saskatchewan and 710.82 acre-feet in North Dakota.

In 1952 the International Joint Commission approved the application of the City of Minot to divert 6,700 acre-feet of water per year at a rate of 2.92 cubic-feet per second for a municipal water supply. This diversion was in addition to the 1,000 acre-feet storage permitted under the interim order of 1943. The International Joint Commission

presently has applications pending requesting permission by the Province of Saskatchewan to construct a dam on Long Creek for a capacity of 48,500 acre-feet and for a smaller reservoir for the town of Radville, Saskatchewan. Visual inspection of the Long Creek site indicates that this dam has been constructed. The North Dakota State Water Conservation Commission has filed with the International Joint Commission an application requesting the right for the City of Minot to divert an additional 6,700 acre-feet of water to provide for immediate needs. None of the above applications has been acted on by the International Joint Commission.

The International Joint Commission has given a great deal of attention to the Souris River Reference in the past biennium. Their decision as to this reference is expected in the next year. It appears that their recommendations will provide, among other things, that the provinces of Manitoba and Saskatchewan and the State of North Dakota will have the right to use waters originating within the provinces or state providing that certain minimum flows will be available at designated points. Undoubtedly the construction of reservoirs will be permitted, provided that in regulating the flow from these reservoirs consideration be given to the mimimum flows at certain points on the Souris River, and provisions will be made that the use of water for human and livestock consumption will have a prior claim over other uses. It is expected that a Board of Control consisting of representatives from each of the countries will determine matters relative to the Souris River and that, during periods of severe drouth, the state of North Dakota will be relieved of the responsibility of a maximum flow from the Souris River for the Province of Manitoba.

The Souris River Reference was initiated in January, 1949, by the governments of the United States and Canada. It is primarily concerned with the waters of the Souris and Red Rivers. This reference has an engineering subcommittee composed of members from the United States and Canada that have been appointed to review the problems involved and to determine the water requirements of the two countries for municipal, industrial, irrigation, hydroelectric and stream pollution abatement uses.

RECOMMENDATIONS

In order to provide for the needed control of the Souris River the International Joint Commission proposed to the Provinces of Saskatchewan and Manitoba and the State of North Dakota that a Joint Board of Engineers consisting of two members, one from the United States and one from Canada designated as the International Souris River Board of Control, be appointed. The Board is charged, during the intervening period prior to the adoption of permanent measures, with the responsibility of insuring compliance with the interim measures set out hereinafter and of submitting to the International Joint Commission such reports as might be required or as the Board

may desire to file. In addition to recommending that such a Board be appointed. The Commission recommended that the two governments approve the following interim measures in substitution for the interim measures which were recommended in the report dated October 2, 1940 and heretofore approved:

1. The Province of Saskatchewan shall have the right to divert, store and use waters which originate in the Saskatchewan portion of the Souris River Basin provided that such diversions, storage and use shall not diminish the annual flow of the river, at the Sherwood Crossing, more than 50% of that which would have occurred in the state of nature. For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall so far as practicable regulate its diversions, storage and uses in such manner that the flow in the Souris River Channel at Sherwood Crossing shall not be less than four cubic feet per second when that much flow would have occurred under conditions of water use development prevailing in the Saskatchewan portion of the Souris River Basin prior to the construction of the Long Creek Dam referred to in Paragraphs 12 and 14.
2. Except as otherwise provided herein with respect to delivery of water to the Province of Manitoba, the State of North Dakota shall have the right to divert, store, and use the waters which originate in the North Dakota portion of the Souris River Basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing under Recommendation (1) above; Provided, that any diversion, use, or storage of Long Creek water shall not diminish the annual flow at the eastern crossing of Long Creek into Saskatchewan below the annual flow of said Creek at the western crossing into North Dakota.
3. (a) In addition to the waters of the Souris River Basin which originate in the Province of Manitoba, that Province shall have the right, except during periods of severe drouth, to receive for its own use and the State of North Dakota shall deliver from any available source during the months of June, July, August, September, and October of each year, six thousand and sixty-nine (6,069) acre-feet of water at the Westhope Crossing regulated so far as practicable at the rate of twenty (20) cubic feet per second except as set forth hereinafter; Provided, that in delivering such water to Manitoba no account shall be taken of water crossing the boundary at a rate in excess of the said 20 cubic feet per second.

3. (b) In periods of severe drouth when it becomes impracticable for the state of North Dakota to provide the foregoing regulated flows, the responsibility of the State of North Dakota in this connection shall be limited to the provision of such

flows as may be practicable, in the opinion of the said Board of Control, in accordance with the objective of making water available for human and livestock consumption and for household use. It is understood that in the circumstances contemplated in this paragraph the State of North Dakota will give the earliest possible advice to the International Souris River Board of Control with respect to the onset of severe drouth conditions.

4. In event of disagreement between the two sections of the International Souris River Board of Control, the matters in controversy shall be referred to the Commission for decision.
5. The interim measures for which provision is herein made shall remain in effect until the adoption of permanent measures in accordance with the requirements of questions (1) and (2) of the References of January 15, 1940, unless before that time, these interim measures are qualified or modified by the Commission.

In a letter on behalf of the government of Canada, dated March 20, 1959, and a letter on behalf of the Government of the United States of America, dated April 3, 1959, the International Joint Commission was informed that the iterim measures recommended in this report of March 19, 1958 and the Souris River Reference, 1940, had been accepted by both Governments. At a meeting on May 31, 1959, the International Joint Commission approved and signed a directive creating the International Souris River Board of Control. Mr. Milo W. Hoisveen, State Engineer of North Dakota was appointed the member for the United States and Gordon L. McKenzie, Director, Prairie Farm Rehabilitation Administration, Canada, Department of Agriculture was appointed the member for Canada. Mr. R. D. May, District Engineer, Water Resources Branch, Canada Department of Northern Affairs and National Resources was appointed alternate member for Canada. Subsequently, Mr. Harlan Erskine, District Engineer, United States Geological Survey was appointed alternate member for the United States.

Meetings of the Board of Control

Since its appointment in May, 1959, the Board has held three meetings as follows:

Minot, North Dakota.....June 30, 1959
Regina, Saskatchewan.....September 11, 1959
Winnipeg, Manitoba.....February 2, 1960

At these meetings, the methods of control and operation of existing impoundments were studied. The location of existing gaging stations were studied as well as the need for additional stations; particularly those that would be international stations. Agreements were reached on what would be considered as non-contributory areas and steps were taken to establish a method of computing natural flows and computation of annual balance. It was agreed to attempt

a temporary balance of the spring runoff on June 1, with a final balance after December 31, each year.

Inspections of the Basin

During the year, frequent field inspections of the basin were carried out by members of the staff of each of the agencies represented on the Board.

Gaging Stations

The Board has reviewed existing stations. In order to fulfill the objectives of the order, three additional international stations will be required at the following points:

(a) Long Creek at the International Boundary (Western Crossing.)
(b) Long Creek at the International Boundary near Noonan (Eastern Crossing.)
(c) Short Creek below the International Boundary near Roche Perce.

These stations have been requested in a separate communication to the International Joint Commission. In order to compute the natural flow at Sherwood, it was found that six additional stations are required to properly evaluate the uses in Saskatchewan to meet other requirements of the order. The contents of this report were submitted to the International Joint Commission at their semi-annual meeting held in Washington D.C. in April, 1960. The report was accepted by the International Joint Commission and all recommendations made by the Souris River Board of Control were concurred in by the International Joint Commission.

Determination of Natural Flow

A tentative balance sheet has been agreed upon for the computation of the natural flow at Sherwood, taking into account diversions and losses above that point. An approximate method for estimating consumptive uses for small stock dams and irrigation projects was accepted for the 1959 computations. Further study will be given to improving the accuracy of these estimates for future computations.

In addition, **tentative** criteria were drawn up to define the drouth conditions in North Dakota which would justify reduction in Westhope flows as provided in recommendation.

Hydrologic Conditions in 1959

Above Sherwood, winter snowfall and spring runoff were extremely low except in the North Dakota portions of Long and Short Creeks where a moderate runoff occurred. In the North Dakota loop of the Souris, the spring runoff was extremely low. A moderate spring runoff was experienced between Westhope and Wawanesa.

Although it has been operated through two runoff seasons, Boundary Dam has accumulated only 9,540 acre-feet of storage; and Lake Darling, at 37,500 acre-feet in 1959, has reached its lowest level since 1942. Summer rains in June produced a light local runoff on Long Creek. September rains produced moderate runoff in the Turtle

Mountain area which increased the fall flows into the Lower Souris Refuge area, and the Manitoba portion of the river.

Summary of Flows and Diversions

The natural flow at Sherwood for the calendar year 1959 was 24,677 acre-feet. The recorded flow at Sherwood was 17,158 acre-feet after depletions of 7,329 acre-feet in Canada and 190 acre-feet in North Dakota. Depletions in Canada amounted to 30% of the natural flow at Sherwood as indicated by the following table:

Canadian depletions on Long Creek	6,372 Acre Feet
U. S. depletions on Long and Short Creek	190 Acre Feet
Canadian depletions on Souris River	905 Acre Feet
Canadian depletions on Moose Mountain Creek	52 Acre Feet
Total diversions	7,519 Acre Feet
Recorded Flow at Souris River at Sherwood	17,158 Acre Feet
Natural flow at Sherwood (17,158 acre-feet plus 7,519 acre-feet)	24,677 Acre Feet
50% of natural flow	12,338 Acre Feet
Total Canadian depletions	7,329 Acre Feet

No special releases were necessary from stored waters in Saskatchewan to comply with the 4 c.f.s. provision of Recommendation (1). The flow into North Dakota at the western crossing of Long Creek was 3,033 acre-feet and the flow into Saskatchewan at the eastern crossing was 6,177 acre-feet. Short Creek contributed 6,474 acre-feet. Releases and losses from Lake Darling depleted the storage from 54,500 acre-feet, to 41,500 acre-feet.

During the period from June 1 to October 31, 1959 the total discharge at Westhope was 6,408 acre-feet, regulated at 20 c.f.s. or better except for 20 days from September 19 to October 12 when the release averaged 15 c.f.s. Since river conditions were favorable in Manitoba and storage levels in North Dakota were low, the Board of Control, with concurrence of responsible officials in Manitoba, authorized a reduction in Westhope releases in an endeavor to make the most prudent use of the available water and to determine the magnitude of Westhope releases necessary to maintain a live stream in the fall period. Higher Westhope releases were resumed when unseasonal fall rains produced an abnormal runoff in the Lower Souris Basin. The Federal Fish and Wildlife Service expressed a desire to make releases from Lower Souris Refuge reservoirs for the purpose of maintaining their reservoirs at the optimum elevation that would prevent ice damage to vegetative cover.

Pembina River - International Negotiations

The Pembina River, one of the principal tributaries of the Red River of the North, is under the jurisdiction of the International Joint Commission. It is one of the rivers of concern in the Red River Reference of 1948. The Pembina River has a total drainage area of 3,690 square miles of which 1,882 square miles are in the United States and 1,808 in Canada. It enters the United States from Mani-

toba at a point approximately 19 miles northwest of the City of Walhalla in northeastern North Dakota. The stream has its confluence with the Red River of the North approximately two miles south of the Canadian border in the town of Pembina.

The Pembina River has a long history of flooding dating back to the Selkirk Expedition in 1798. Most of the flooding occurs in the lower reaches of the stream in North Dakota. Little or no damage occurs in Canada where the Pembina courses its way in a moderately deep valley, which attains canyon proportions in the escarpment near Walhalla. The Pembina River Channel becomes relatively shallow when it reaches the flat lake bed of Old Agassiz east of Walhalla. Possibly the third worst flood since settlement by white men occurred in 1950. At that time a flow of 20,400 cubic feet per second was recorded at Walhalla on April 18, 1950. On April 20, 1950 when the flood crested at Neche, 20 miles east of Walhalla, a flow of 10,700 cubic feet per second was recorded. Approximately 50% of the flood water had left the banks of the Pembina River and spread devastation through almost 100,000 acres of fertile farm land.

The Corps of Engineers have studied the possibility of constructing a dam and reservoir near the Pembina - Cavalier County line capable of impounding a flood of proportions equal to the 1950 flood. The structure would be multi-purpose and would be designed to store water for municipal and industrial uses and irrigation, as well as providing flood control. A conservation pool would be provided in the reservoir to provide recreational facilities for the area. Studies have been made by the Bureau of Reclamation relative to the irrigation potential that exists below the proposed Pembilier Dam. Approximately 80,000 acres of land are ideally suited for irrigation. Much interest has been manifested by Canadians over the irrigation potential that exists in the Winkler and Carman areas.

In the fall of 1959, a joint survey was undertaken by Canada and the United States in an effort to explore the possibility of diverting water from the proposed Pembilier Dam into those areas best adapted to irrigation in Manitoba. Through this survey, it was determined that areas approximating 140,000 acres could be reached through a canal system originating from a diversion dam below the proposed Pembilier Dam and running northward into Canada.

As a result of this survey, it was suggested at the April, 1960, meeting of the International Joint Commission that this group visit the Pembina River Basin and proposed Pembilier Dam site in view of undertaking the construction of Pembilier Dam as a joint venture. Assurances have been received from the combined sections of the International Joint Commission that an inspection of the area will be made on August 24, 1960. The International Joint Commission has also, through its engineering board, established a committee to report on the feasibility of such a project. It is anticipated that this Committee will be in the position to make a report to the International Joint Commission on this matter at their semi-annual meeting, which will be held in Ottawa in October, 1960.

COMPACTS UNDER NEGOTIATION

Little Missouri River Compact

The Little Missouri River has its source in Wyoming and then flows northward through the southeastern corner of Montana and the northwestern corner of South Dakota into North Dakota in the extreme southwestern corner of the state. From here it flows northward through the North Dakota Badlands to a point south of Watford City and then flows eastward north of the Killdeer Mountains and empties into the Missouri River near Elbowoods. Approximately 5,200 square miles of the 9,500 square mile drainage basin of the Little Missouri is in North Dakota, 3,100 square miles in Montana, 600 in South Dakota and 600 in Wyoming.

In 1954 the North Dakota State Water Conservation Commission received numerous complaints from ranchers along the Little Missouri in North Dakota that the flow of the Little Missouri was being depleted through pumping from the river in lower states to an extent that their irrigation systems were being jeopardized. Because the Little Missouri is an interstate stream and the use of water from the river is a matter of jurisdiction of each of the states concerned it was apparent that the solution to the problem could best be provided by a compact. Consequently, at the instigation of the Congressional delegation from North Dakota at the request of the North Dakota State Water Conservation Commission, Congress authorized compact negotiations among the states of North Dakota, South Dakota, Montana and Wyoming in 1957. The provisions of this authorization were given in the Eleventh Biennial Report of the Commission.

Major General John S. Seybold, retired, was designated as Federal Representative of the Compact Commission and has been designated as Chairman by the Commission. Members of the Engineering Board for the Compact Commission are:

North Dakota — Milo W. Hoisveen, State Engineer
South Dakota — Joe W. Grimes, Chief Engineer
South Dakota Water Resources Board
Montana — Fred E. Buck, State Engineer
Wyoming — Earl Lloyd, State Engineer

Harlan Erskine, District Engineer, U. S. Geological Survey is an advisor for the Engineering Board.

The first meeting of the Little Missouri Compact Commission was held in Bismarck, North Dakota on April 24, 1958. One other meeting was held in Bismarck on December 10, 1950 and a third is scheduled for Pierre, South Dakota in the fall of 1960. The authority of Congress for these compact negotiations expires August 28, 1961.

In the first meetings of the Compact Commission it was apparent that several difficult problems had to be solved that were complicated by the procedure followed in each state in allocations for and administration of water rights. Consideration has been given to curtailing the issuance of water rights on the Little Missouri until compact

negotiations were completed but the legal differences in the administration of water rights among the states made such action impossible. Under consideration at the present is a proposal to base the allocation of water on a time period whereby during a certain period of the year — proposed to be November to May — water could be stored and that during the period May to July 1 the use for irrigation in the upstream states would be from stored waters and an allocated portion of the natural flow. During the period July 1 to November use of the natural flow for irrigation purposes in the upstream states would not be permitted. The upstream states would be Wyoming, Montana and South Dakota.

This matter will be considered further by the Compact Commission and it is expected that final determination as to the allocation of waters of the Little Missouri will be made in the near future.

COMPACTS PROPOSED FOR FUTURE CONSIDERATION

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 near Yankton, South Dakota. The James River is one of the principal rivers involved in the developments proposed under the Missouri River Basin Projects in North Dakota and South Dakota. It will be used as a major channel in connection with the Garrison Diversion project in North Dakota and flows through the irrigable land in the proposed Oahe Diversion Project in South Dakota. Because of the future developments contemplated in the James River Basin it appears that a compact would be primarily concerned with the division of normal flows of the James River and not be concerned with the imported waters from the Missouri River through the Garrison and Oahe Diversion projects. The James River Development Association, a private organization, composed of representatives from the two states was organized and at one time has indicated an interest in arranging for a compact on the James River. No definite action has been taken by Congress authorizing such a compact to date nor is any such action contemplated in the near future.

Red River of the North

The Red River of the North is an interstate and international stream. It has its source near Breckenridge, Minnesota, where the Bois De Sioux, and Ottertail River join and flows north to form the boundary between North Dakota and Minnesota and then into Canada where it empties into Lake Winnipeg. The Red River drains portions of South Dakota, North Dakota and Minnesota as well as Manitoba in Canada. North Dakota for many years has been interested in providing for the division of the waters of the Red River among the interested states and provinces so as to assure the maximum development in this area. In 1937 the Congress of the United States authorized the states of North Dakota, South Dakota and Minnesota to

establish the Tri-State Water Commission to administer and supervise the drainage area for the Red River of the North with the exception of the Ottertail and its tributaries. This Commission was active for a few years after its organization but because of the requirements in the authorizing legislation that commission representatives from all states be present at meetings of the Commission it could not function effectively. South Dakota had only a small interest in the Red River of the North and was not concerned in the affairs of the Commission. The Tri-State Water Commission is still in existence and can be activated as soon as members from the three states are designated and assume responsibility for the Commission's operations.

The division of the waters of the Red River is primarily of interest to the States of North Dakota and Minnesota. Several cities along the Red River in North Dakota depend extensively on the Red River for their municipal water supply. North Dakota also has a definite interest in the Sheyenne River which is the major tributary of the Red River in North Dakota. Several attempts have been made by officials in North Dakota to undertake compact negotiations with Minnesota for a division of the waters of the Red River. These attempts have failed. Minnesota has not indicated any particular interest in negotiating a compact on the Red River.

Fargo Levee

LEGAL WATER USER ORGANIZATIONS

IRRIGATION DISTRICTS

Irrigation development can be accomplished under two general methods — on an individual basis or on a group basis. In the early development of irrigation in this country and particularly in the Western states irrigation was most commonly accomplished by individual farmers and in some instances small groups of farmers. As the size of projects insofar as acreage covered, number of farmers, and construction costs increased, it became evident that definite organization was necessary to facilitate the financing and management of the irrigation facilities.

There are three principal types of irrigation organizations aside from the individual enterprises and Federal reclamation organizations. They are: cooperative irrigation companies, commercial irrigation companies, and irrigation districts. Many of the early irrigation developments in the West went through an evolutionary process from a beginning as a small individual effort to a partnership and then to a cooperative enterprise. North Dakota law provides for each of these three principal types of irrigation enterprise organization. There are no commercial irrigation companies operating in the state. During the 1930's there were several cooperative irrigation organizations established which were called mutual aid corporations. These organizations were established primarily to provide for the irrigation of small tracts of land which would permit a large number of people to have irrigated gardens to serve their needs and provide them an opportunity to obtain a supplemental source of income during this drouth period. Presently there are two mutual aid corporations functioning in North Dakota that are concerned with irrigation operations. They are the Dickinson Mutual Aid Corporation and the Lewis and Clark Mutual Aid Corporation.

The type of organization that is most used in connection with irrigation development is that of irrigation districts. An irrigation district is a public corporation established in accordance with specific procedures set forth in the laws of the State of North Dakota. It is a legal entity and as such has the power to levy special assessments for irrigation costs and perform other specific functions that are set forth in law. Irrigation districts in North Dakota are organized by the State Engineer upon petition from the landowners concerned. As political subdivisions of the state they have defined geographical boundaries that are set forth in the order establishing the irrigation district.

The organization of an irrigation district is initiated by petition of the owners of land proposed to be included in the district. This petition and the land to be included is based on the irrigable land that

can be served by the irrigation system that is proposed for the district. Upon receipt of a petition from owners of at least 51% of the irrigable land proposed to be included in the district, the State Engineer is required by law to hold a hearing at which time he will receive evidence as to the feasibility of establishing the irrigation district. Following the hearing, if he determines that the establishment of the district is feasible and desirable, he is required by law to call an election at which time the owners of the irrigable land in the district are given the opportunity to vote on the question of whether or not the district should be established. If the district establishment is approved by a majority of the votes cast at the election the State Engineer issues his order declaring the district established. At this election the landowners also elect a board of directors consisting of three, five or seven electors of the district who will govern the affairs of the irrigation district in accordance with state law. Depending on the size of an irrigation district it is often divided into divisions with one director being elected from each division, thereby insuring that all portions of the geographic area involved are represented.

Irrigation districts are organized primarily for the purpose of providing the landowners who own irrigable land in an area an opportunity to develop irrigation facilities to serve that land which individually would be impossible. Through its board of directors an irrigation district provides for the operation of the common irrigation system so that all irrigable lands in the district are given a water supply. To meet its financial obligations the district's board of directors is authorized under law to levy an assessment on the benefitted lands to the extent of the benefits received by that land in proportion to the total amount of revenue needed to meet the district's obligations.

The irrigation district generally arranges for the construction of facilities to serve their irrigable lands through either the Federal or state governmental agencies. In so doing the district must negotiate contracts whereby they agree to repay to the branch of government that agency represents a designated amount for such irrigation facilities. The Board of Directors is charged with the responsibility of negotiating such a contract with the appropriate governmental agency, but before such contract can become effective the board must submit it to a vote of the electors in the district for approval. Practically all contractual negotiations relative to the establishment of irrigation facilities for irrigation districts in North Dakota in recent years have been between the Bureau of Reclamation and the irrigation district concerned. In conjunction with the vast Garrison Diversion Unit in North Dakota, contractual relationships will exist, not only between the irrigation districts and the Bureau of Reclamation, but also between the irrigation districts and the Garrison Diversion Conservancy District.

There are eighteen organized irrigation districts in North Dakota. Several of these districts were organized during the late 1930's and

although irrigation facilities to serve the lands located therein have not as yet been developed the irrigation district organization still exists and can be utilized when the development of these facilities takes place. Seven of the organized irrigation districts are located in the Garrison Diversion Unit area and when that project is developed will obtain their water supplies through this diversion system. Of these seven, two were organized during the period of this report. In addition to the already existing districts it is expected that several more will be organized in the near future, both in the Garrison Diversion Unit area and in other areas of the state as water resources development projects are established.

Lower Yellowstone Irrigation District

The oldest irrigation district in North Dakota is the Lower Yellowstone District located in northwestern McKenzie County. Irrigable lands in this district are a part of the Lower Yellowstone Project, one of the first irrigation projects established by the Bureau of Reclamation. This district was organized in 1909 and includes over 20,000 acres of irrigable land in North Dakota which, combined with some 35,000 acres of irrigable land in Montana, forms the Lower Yellowstone Project. The irrigable lands in the district are served by means of a relatively simple diversion dam located in the Yellowstone River near Intake, Montana, which diverts water from the river into a 72-mile long canal to the irrigable lands. Construction of the project facilities was started in 1905 and completed in 1909. The first water was delivered to irrigable lands on the project on April 30, 1909. In view of the fact that the irrigable land on this project is located in both North Dakota and Montana two irrigation districts have been established, one for the land in each of the individual states. These irrigation districts in turn have designated a board of control consisting of representatives from each which serves as the operating agency for the project.

The construction costs chargeable to this project amounted to $66 per acre. These costs are repaid under a contract which the districts have negotiated with the Bureau of Reclamation that provides for an annual repayment charge based on the value of crops produced each year and ranges from $4 per acre for Class I land to $1.20 per acre for Class IV land. In addition the annual operation and maintenance charge for the district approximates $2.25 per acre.

Principal crops raised on the Lower Yellowstone Project include alfalfa, corn, wheat, barley, beans and sugar beets. An extensive livestock feeding operation is one of the major activities of project farmers in which grain and forage crops are utilized. Dairying is also an important operation.

The Lower Yellowstone Project celebrated its Golden Anniversary on July 23 and 24, 1959, at which time the Missouri River Basin Water Users' Irrigation Conference was held in Sidney, Montana, the major city in the project area. In connection with this anniversary various

studies were conducted to determine the affect of the project on the economy of the Lower Yellowstone valley. These studies indicate that the cumulative gross value of crops grown on the project since its construction is about fourteen times the Federal investment in the project. Project irrigated land outproduces adjacent nonirrigated land by about six times and irrigated land values are twelve times the value of grazing land and four times the value of dry crop land. The project has resulted in much more extensive community development through expanded hotel and motel facilities for the convenience of travelers, construction of good hospitals, schools and other public facilities to serve not only the townspeople, but the farmers from the valley as well and a greatly increased amount of business and trade activity in the area. Retail sales are four times as great in the Lower Yellowstone Valley communities as they are in nonirrigated comparison areas of equal size. The project has increased local employment in business and professions over twenty times, personal income in the irrigated area is three times greater than in the comparison area and residents in the area enjoy a higher level of living than in a comparison area and yet they pay one-third less non-federal taxes per capita. Approximately 60% of the total Federal investment in the project has been repaid to the Federal treasury. In addition, Federal tax revenues from the project area since 1940 equal nearly twice the Federal cost of the project construction. The Lower Yellowstone Project has often been cited as an example of what can happen in other areas in North Dakota through the development of the Garrison Diversion Unit.

On the Board of Directors for the North Dakota District are: David C. Brooks, Sidney, secretary-treasurer; Oscar Helm, Fairview; Alfred Norby, Fairview; Leonard R. Berry, director, Fairview, Montana.

Sioux Irrigation District

The Sioux Irrigation District is located on the right bank of the Yellowstone River in McKenzie County four miles northwest of Cartwright, North Dakota, and includes approximately 800 acres of irrigable land of which 634 are being assessed for irrigation costs. The irrigation facilities for this district were constructed by the North Dakota State Water Conservation Commission in 1938 and 1939 through an arrangement with the Rural Rehabilitation Corporation and the irrigation district. The original project proposed the irrigation of approximately 1,400 acres of bench land along the Yellowstone River. Irrigation water for the project is pumped from the Yellowstone River through the use of a pump powered by a 110 horsepower natural gas motor. There are six individuals who own the irrigable land in this project and their farming operations are devoted principally to the production of feed, forage crops and small grains.

Construction of the facilities for the project was financed with funds obtained from the Rural Rehabilitation Corporation which were later consolidated in a bond issue that the district made to the State

Water Conservation Commission. Settlement between the Rural Rehabilitation Corporation and the Commission was accomplished in a consolidation of several outstanding bond issues of the State Water Commission. The principal amount of the original issue was $25,000 and the balance of this issue at the present time is $18,500. These bonds are being retired over a period of 30 years and bear interest at a rate of 2¼%. The district obtains the money they use to retire this bond issue through an assessment on the irrigable lands each year.

Because of the wide fluctuations in the level of the Yellowstone River and because of the fact that during the critical irrigation season the Yellowstone River is the lowest, the district has experienced problems in conjunction with operating their pump. In some years it has been impossible for the district to obtain a water supply from the river and therefore the full benefits from the irrigation system for which the district is paying are not available to the irrigation farmers. The State Water Conservation Commission investigated the possibility of obtaining a water supply from a well located in the vicinity of the project. These investigations were successful in locating a good well site and the district is presently in the process of installing a pump at this site to augment their water supply. A temporary rental agreement has been negotiated between the district and the State Water Conservation Commission for the rental of a pump and motor for this installation. The district plans to make a second bond issue to pay for the entire cost of this installation and also has under consideration the possibility of installing an additional one or two wells to provide a full water supply for the district. It is expected that with the assurance of a full water supply the irrigation of more land will be accomplished.

The district's board of directors is composed of the following: M. E. Sandy, Cartwright; Richard Croy, Cartwright, and Lawrence Croy, Cartwright; Alfred Gullickson of Cartwright is secretary; and Emil Hartl of Cartwright assessor.

Buford-Trenton Irrigation District

The Buford-Trenton Irrigation District was developed under the Case-Wheeler Act by the Department of Agriculture and the Bureau of Reclamation during the 1930s. This project is located along the left bank of the Missouri River in Williams County between the towns of Buford and Trenton and contains approximately 14,000 acres of irrigable land that is served by pumping water from the Missouri River. The project was operated for several years by the Buford-Trenton Mutual Aid Corporation and in 1950 after the Department of Agriculture had turned over the project to the Bureau of Reclamation, the Buford-Trenton Irrigation District was organized.

The project facilities consist of three pumps which pump water from the Missouri River into a 14½-mile canal that carries the water to the irrigable lands. In the original development of the project the irrigation facilities were constructed, land cleared and leveled, and

farm dwellings and buildings constructed on each of the units of the project. These units in turn were sold to the project operators.

The Buford-Trenton Irrigation District was faced with a critical problem of erosion along the Missouri River that threatened to cut off a large portion of the project lands and destroy a considerable amount of the main canal. Appropriations were made by Congress to investigate and provide the necessary protective measures that would protect the project lands. This work has been substantially completed.

In addition to feed, forage and small grain crops a certain amount of sugar beets are grown in the Buford-Trenton Irrigation Project lands.

The directors of the Buford-Trenton Irrigation District are: Henry A. Bowen, president; Raymond Hoffman, vice president; Warren Gatham, secretary-treasurer; Thomas J. Kelly, general manager; B. W. Rossmiller, chairman, Williston, North Dakota.

Fort Clark Irrigation District

The first irrigation project developed in North Dakota under the Missouri River Basin Project authorized by Congress in 1944 is the Fort Clark Project located in Mercer and Oliver Counties along the Missouri River between the towns of Stanton and Fort Clark, North Dakota. The Fort Clark Irrigation District contains 2,089 acres of irrigable land in the Missouri River bottoms that can be served by pumping from the Missouri River. The district was organized in 1948 and in 1950 approved a repayment contract that was negotiated with the Bureau of Reclamation for the construction of facilities to serve the irrigable lands in the project. The first water was delivered to the project lands in 1953. During the past year approximately 1,100 acres of the project's 2,089 acres were irrigated. The district is presently in the fifth year of its 10-year development period and the assessment for irrigation costs for the past year was $4.25 per acre. It is expected that the remaining irrigable land in the district will be developed for irrigation during the balance of the development period and that the project will be in full production in the near future.

The board of directors of the Fort Clark Irrigation District are: Einer Alderin, chairman; Leonard Olander, director; Joe Gustafson, director; Henry Klindworth, appointive secretary-treasurer, Stanton, North Dakota.

Western Heart River Irrigation District

Included in the Western Heart River Irrigation District are 2,463 acres of irrigable land lying along the Heart River in Grant County below the Heart Butte Dam. Water to serve this district is pumped from the Heart River from releases made from the Heart Butte Reservoir. The irrigation facilities include 25 separate pumping plants and canals to convey the water to the irrigable land. The Western Heart District was organized in December, 1953, and the repayment contract between the district and the Bureau of Reclamation was

negotiated in 1955. Construction of irrigation facilities for the project was substantially completed on June 30, 1956, with irrigation water made available to some of the lands in the district the fall of that year. The first year of the 7-year development period was in 1958. During the past year approximately 1,600 acres of land in the Western Heart District had been leveled and developed for irrigation. The water cost for the district averaged $3.25. Under the repayment contract that has been negotiated the district has agreed to perform their own operation and maintenance functions and pay the full amount of costs associated with such operation and maintenance. The district has also agreed to repay to the Federal government a portion of the construction costs of the project including a portion of the costs of Heart Butte Dam and Reservoir over a period of 40 years.

The Western Heart River Irrigation District was originally a part of the Heart River District which contained some 13,000 acres of irrigable land along the Heart River between Heart Butte Dam and the confluence of the Heart and Missouri Rivers below Mandan. Because of difficulties encountered in negotiating the repayment contract between the landowners of this district and the Bureau of Reclamation, the Heart River District was dissolved in 1953 and the Western Heart River Irrigation District was organized in December of that year. A considerable amount of interest has been noted in the past year among the owners of other irrigable land, that was originally a part of the Heart River Irrigation District, to develop irrigation facilities. The Bureau of Reclamation is presently selling water to some of these irrigators on a year to year basis.

The directors of the Western Heart River Irrigation District are: Andrew Willman, Almont, president; A. A. Stegmeier, director; Harold Hager, director; and John Heinz, secretary-treasurer, Carson, North Dakota.

Typical irrigation pump installation, located on Ransom County Development Farm.

Cartwright Irrigation District

The Cartwright Irrigation District is located in McKenzie County along the Yellowstone River near Cartwright, North Dakota. The district was organized in 1939 and contains about 800 acres of irrigable land that was originally proposed to be irrigated by pumping from the Yellowstone River. This project was one authorized under the Missouri River Basin Project. It has been extensively investigated by the Bureau of Reclamation and found too costly for development under their plans and standards in relation to the benefits that could be expected.

In spite of this adverse report there still existed a great deal of interest in developing irrigation in this area among the farmers concerned. One of the principal reasons for the unfavorable findings of the Bureau was the costly pump site that would be required if the Yellowstone River was to be used as the water supply source. As a result of this situation the State Water Commission investigated the possibility of installing a well along the river that could serve a portion of the lands and developed this well on an experimental basis. This effort proved successful and the district has purchased a pump and motor which can serve about 200 acres of the project lands. The depth of the well being utilized is 45 feet. The water level of the well fluctuates with the river because of the proximity of the well to the river. The district financed the purchase of the pump, motor and discharge pipe through a private loan. Because of the success of this installation the district has indicated that they plan to install additional wells to serve all the lands that can be irrigated. It is expected that arrangements for such installations will be completed before the spring of 1961.

Directors of the Cartwright Irrigation District are: William Lassey, Berry Elletson and Henry Iszley, all of Cartwright.

Yellowstone Pumping Irrigation District

The Yellowstone Pumping Irrigation District is located in McKenzie County along the Yellowstone River immediately above and adjacent to the Cartwright Irrigation District. This District was organized in 1938 at which time it was contemplated that the 2,000 acres of irrigable land in the district would be developed for irrigation in conjunction with the development of the Sidney Pumping Project in Montana. At that time the district arranged for a loan through the State Water Commission for sufficient funds to enlarge the intake for the Sidney Project to a sufficient size to serve the district lands. Although this enlargement was accomplished the canals and other facilities to serve the Yellowstone Pumping District lands were not constructed because of the curtailment of such construction activities during World War II. The obligation of the District to the Commission for $3,500 for the enlargement of the intake for the Sidney Project remained and a levy on the project lands to repay this loan has been made each year. A total of $3,072.32 has been paid by the district on principal and interest of this loan.

When the development of the water source from a well in the Cartwright District was accomplished the landowners in the Yellowstone Pumping District indicated a definite interest in developing a similar well to serve their lands. The two districts indicated an interest in amalgamating in order to develop such a system and an effort was made to arrange for the districts to be joined. Under North Dakota law the only procedure that can be followed in such an action would be for one district to dissolve and then the landowners of the dissolved district petition the other to have their lands included. Before the Yellowstone District could dissolve state law requires that all outstanding obligations be provided for or paid, therefore; because of the balance due to the State Water Commission on the $3,500 loan the district could not dissolve. Further action in respect to developing the Yellowstone Pumping District lands has been delayed for this reason. There is some delinquency among the landowners of the Yellowstone district in paying their assessments for the $3,500 obligation. When the delinquencies are paid it appears that the full amount of the obligation can be satisfied and further action relative to the development of irrigation facilities taken.

Directors of the district are: Roy Olson, Cartwright; Gerald Melland, Cartwright; Bjarne Walla, Cartwright, and R. S. Nutt, Sidney, Montana, Secretary.

Oakes Groundwater District

The Oakes Groundwater District is a small district located in Dickey County immediately east of the City of Oakes. It contains 640 acres of land and was organized in 1957. The irrigable lands in the district are served from wells that the individual landowners have installed. There are five landowners in the district and two of them have developed irrigation wells. The lands are served by both gravity and sprinkler methods.

The Board of Directors of the Oakes Groundwater Irrigation District is composed of Paul Roney, Ivan Rodine and C. E. Roney, all of Oakes, North Dakota.

Eaton Flood Irrigation District

The Eaton Flood Irrigation District is located along the Souris River in McHenry County. It contains about 8,000 acres of hay land adjacent to the river that is served by flooding from the river during the spring of the year. The district was organized in 1935 under a special law enacted by the North Dakota Legislature providing for Flood Irrigation Districts. The project facilities were constructed in 1936 under the direction of the North Dakota State Engineer and financed by the PWA. (Public Works Administration)

Included in the project works is a 12 foot high dam on the Souris River with control gates that regulate the flow of the river so that during the spring water can be diverted from the channel reservoir into and through a series of ponds. These ponds are the hay meadows and the amount of water and the duration it is kept in a pond can be

regulated by control works included in the project. There are seven ponds that can be flooded in this system. Because of the flood irrigation available very excellent and abundant hay crops are raised each year from the lands served.

Due to ordinary wear and deterioration repairs have been required on the Eaton Dam and some of the control structures. The State Water Conservation Commission and the district have cooperated in this work during the past biennium and the nature and extent of repairs are reported under the construction section of this report.

Members of the Board of Directors of the Eaton District are: Richard Oium, chairman; L. U. Cook, Adam C. Haman, C. E. Dallmas, Joseph McIntee, secretary, all of Towner, North Dakota.

Painted Woods Irrigation District

The Painted Woods Irrigation District which was established in 1937 is located along the Missouri River in McLean County. It was established to provide the landowners in the District the entity needed to bring about the development of irrigation of their lands under a plan then being studied by the North Dakota State Water Conservation Commission. When Congress authorized the Missouri River Basin Project in the Flood Control Act of 1944 they included the Painted Woods Project as one of the five pumping projects on the Missouri River in North Dakota. The Bureau of Reclamation took over the investigations of the project and has prepared a preliminary plan of development.

The Bureau of Reclamation deferred further investigations and effort in developing the Painted Woods Project because of an apparent lack of interest on the part of the landowners. In 1959 an increasing interest in irrigation among the landowners of the Painted Woods District was noted. Several landowners in the area indicated that they desired to develop their own irrigation system and investigated the possibility of dissolving the Painted Woods Irrigation District to facilitate the operations of their individual irrigation systems. Other landowners in the district who would be unable to develop irrigation systems on an individual basis opposed the dissolution of the district. It was their contention that if the district were dissolved the only land that would be developed for irrigation would be the land most easily served from the river. They contended that the development of the entire project was dependent on all lands in the district. As a result, no action was taken to dissolve the Painted Woods Irrigation District. The renewed interest in irrigation in the Painted Woods area has prompted the old Board of Directors to determine the desires of all landowners in the district concerning further project development. The State Water Conservation Commission is working with the Board of Directors in an effort to provide ownership and other details relative to irrigation development in the Painted Woods Irrigation District.

Members of the Board of Directors are: Oscar Oberg, Lambert Chesworth and Robert Bickert, all of Washburn.

IRRIGATION DISTRICTS IN THE GARRISON DIVERSION UNIT AREA

Since the fall of 1957 seven irrigation districts have been organized in the Garrison Diversion Unit area in order to provide the local landowners the needed organizations through which irrigation facilities to serve their lands can be built when construction of the project gets underway. It will be these districts, along with others in the area that are yet to be organized, and the Garrison Diversion Conservancy District, that will contract with the Bureau of Reclamation for the repayment of the construction costs and the operation and maintenance responsibilities for the vast million acre Garrison Diversion Unit.

The seven irrigation districts that have been established contain approximately 320,000 acres of irrigable land that can be served under the project. It is expected that several other areas will request the establishment of irrigation district organizations in the near future. The Bureau of Reclamation has adopted the policy in respect to making detail surveys of the irrigable land in the overall project that their efforts will be concentrated only in the areas in which irrigation districts have been organized. These detail surveys are essential in the preparation of definite plan reports that set forth the exact irrigable acres that will be served and the method of serving such lands. Definite plan reports are required and prepared before the actual construction of irrigation facilities in an area is undertaken.

Each of the districts that have been organized have indicated to the Bureau of Reclamation and the Garrison Diversion Conservancy District that they are ready and anxious to proceed with the detail surveys and contract negotiations for the project. The contract discussions have been underway between the Bureau of Reclamation and the Conservancy District since 1957 and the irrigation districts have actively participated in and become familiar with the obligations they will be required to meet under the contracts. It is expected that during the fall and winter of 1960-61 an extensive program of detail discussions on the various terms of the contracts will be conducted.

New irrigation districts that have been organized during the period of this report include the Middle Souris District, containing approximately 87,000 acres of land located in McHenry, Ward, Renville and Bottineau counties and the Lincoln Valley District located in Sheridan County, containing approximately 9,000 acres of land. These districts, as in the case with all other districts in the Garrison Diversion Unit area that have been established, have followed the procedure of including only that irrigable land that the landowners do not object to having included. In all cases from 75% to 98% of the potential irrigable land is in the district. It is expected that this procedure will greatly enhance the operating activities of the districts when irrigation has been established. Each of the districts is discussed below.

James River Irrigation District

The James River District is located along the James River in Stutsman, LaMoure and Dickey Counties and contains approximately 13,700 acres of irrigable land. It was the first district organized in the Garrison Diversion Unit area and was established by the order of the State Engineer on September 20, 1957. This district will be served through the Garrison Diversion Unit through provisions in that over-all project plan which provides for the diversion of Missouri River water into the James River from the Lonetree Reservoir which will be regulated by Jamestown Dam and released for use on the irrigable lands in the James River District as needed. Water will be pumped from the James River to serve the irrigable lands. The Bureau of Reclamation has completed its detailed investigations of the James River area and has determined that there are 13,690 acres of irrigable land that can be served, of which 13,127 acres are in the district. The members of the board of directors of the James River Irrigation District are: John Earle Chappell, Dickey, chairman; J. H. Winslow, LaMoure; Earl Amundson, Jamestown; and James Stine, LaMoure, secretary.

Dickey-Sargent Irrigation District

The Dickey-Sargent Irrigation District contains approximately 48,000 acres of irrigable land located in Dickey and Sargent Counties in southeastern North Dakota. The district was established on September 27, 1957. Water to serve the irrigable lands in the Dickey-Sargent Irrigation District will be pumped from the James River and stored and regulated in Lonetree Reservoir and re-regulated by Jamestown Dam. The water will be conveyed through the 11-mile long Oakes Canal and will be designed to serve approximately 58,000 acres of land in North Dakota and an equal amount in South Dakota. There are 45,960 irrigable acres in the area in North Dakota that can be served of which 34,136 are in the irrigation district.

During the past year the board of directors of the Dickey-Sargent Irrigation District has received requests from some landowners requesting that certain lands be excluded from the irrigation district. The board has acted under North Dakota law and reviewed these requests and has honored the exclusion of those lands listed therein that are nonirrigable and cannot be served by the facilities which will be built for the district. The board has also received indications from several other landowners who own irrigable land that is not in the district that they desire to have their lands included.

The board of directors of the Dickey-Sargent Irrigation District is composed of the following directors: William Bosse, Cogswell, chairman; Emil Banderet, Straubville; Norval A. Dietz, Cogswell; Carl Daniels, Oakes; Louis Rehovsky, Oakes; and James Kenward, Forman, secretary.

Warwick-McVille Irrigation District

The Warwick-McVille Irrigation District, located in Nelson, Benson, Eddy and Ramsey Counties contains approximately 47,000 acres of irrigable land which will be served under the Garrison Diversion Unit with water diverted from the Lonetree Reservoir into the New Rockford and Warwick-McVille Canals. This district was organized in November, 1957. Detail investigations of the Bureau of Reclamation indicate that there are 41,380 acres of irrigable land in the service area that can be served by this canal of which 31,280 acres are in the Warwick-McVille Irrigation District. The district's board, as is the case in each of the other organized irrigation districts in the Garrison Diversion Unit area, has been working closely with the Garrison Diversion Conservancy District in contract negotiations which are under way with the Bureau of Reclamation. It is expected that some of the land that was left out of the Warwick-McVille Irrigation District when the district was originally organized will be included in the near future upon petition from the landowners concerned.

The members of the board of directors of the Warwick-McVille Irrigation District are: Earl Burns, Tolna, chairman; Robert R. Lofthus, McVille; Fyllis Burthold, Pekin; Howard Pare, Tolna, secretary; and Edward Reeves, Warwick.

Tri County Irrigation District

The Tri County Irrigation District is the largest irrigation district that has been organized in the Garrison Diversion Unit area. It is located in Cass, Ransom, and Richland Counties in southeastern North Dakota and contains approximately 88,000 acres of irrigable land along the western rim of the Red River Valley which will be served by pumping Missouri River water that has been diverted into the Sheyenne River from that river to the irrigable lands. The irrigable lands in this district are not included in that proposed to be developed in the original one million acre Garrison Diversion Project as set forth by the Bureau of Reclamation. Farmers in the area desired to organize an irrigation district so that they would be in a position to utilize the Missouri River waters that would be available to them in the Sheyenne River as soon as possible. Actually lands in the Tri County Irrigation District can be more easily served than some of the other project lands because the Sheyenne River, which has its source at the Lonetree Reservoir, courses its way through the irrigable lands in this district. It is expected that irrigable lands in the Tri County District will be developed as substitute acres for those lands in the original one million acre project for which development of irrigation is not desired by local landowners. The Tri County District was established by order of the North Dakota State Engineer on April 18, 1958. Members of the board of directors of the district are: Robert Radcliffe, Leonard, chairman; Ervin Bartholomay, Sheldon; Walter Geyer, Sheldon; Leon Beadles, Leonard; Lawrence Baarstad, Leonard; Hugo Hoffman, Wheatland, and Lorry I. Madsen, Wheatland.

Karlsruhe Irrigation District

The Karlsruhe Irrigation District was organized June 19, 1958, and contains approximately 25,000 acres of irrigable land, located in south central McHenry County immediately south of the Souris River, that will be served through a canal leading from the Velva Canal. Detailed surveys of the Bureau of Reclamation indicate there are about 16,000 acres of irrigable land in the area that can be irrigated, of which 11,490 acres are in the Karlsruhe Irrigation District.

In conducting their detailed surveys of this area the Bureau of Reclamation discovered that much of the land originally contemplated for irrigation was too sandy to be suitable for irrigation development; therefore, it was eliminated in the definite plan report. Because of the sandy nature of the soil in this area irrigation will be of great benefit to the farmers in assuring them an adequate moisture supply for their crops.

The members of the Board of Directors of the Karlsruhe Irrigation District are: Delbert Krumweide, Voltaire, chairman; George Lauinger, Balfour; Jack Keller, Bergen; and Alvin Kramer, Towner, secretary.

Middle-Souris Irrigation District

The Middle-Souris Irrigation District contains approximately 87,000 acres of irrigable land located in McHenry, Ward, Renville and Bottineau Counties that can be served under the Garrison Diversion Project with water from the Velva Canal. This district was established in September, 1958. The Velva Canal leading from the Lonetree Reservoir northward will convey water to serve the irrigable lands in this district as well as approximately 250,000 acres of additional land in the Souris Loop area. The Souris Loop contains the largest block of irrigable land in the one million acre Garrison Diversion Unit. It is expected that additional districts will be organized in this area in the near future and that some lands which were originally left out of this district when it was organized will petition for inclusion.

Members of the Board of Directors of the Middle-Souris Irrigation District are: Lester Anderson, Maxbass, chairman; Bill Long, Upham; William Sallee, Upham; E. P. Nicolaisen, Minot; Gehard Ronnie, Minot; E. James Boyd, Deering; Einar Christianson, Glenburn; and Alvin Kramer, Towner, secretary.

Lincoln Valley Irrigation District

The Lincoln Valley Irrigation District is located in Sheridan County south of the Lonetree Reservoir and will be served by water from the McClusky Canal before that canal empties into the Lonetree Reservoir. The district contains approximately 9,000 acres of irrigable land, as based on the Bureau of Reclamation's semi-detailed surveys, and was established by Order of the State Engineer on March 30, 1960. It is the seventh irrigation district that has been organized in the Garrison Diversion Project area.

The Lincoln Valley Irrigation District is located adjacent to the Lonetree Reservoir and because of its proximity to the main water supply that will serve all of the lands in the Garrison Diversion Unit its irrigable lands can be served rather easily. Approximately 80% of the potentially irrigable land in this area was included in the Lincoln Valley Irrigation District when it was organized. The balance was left out at the request of the landowners concerned. Bureau of Reclamation detailed surveys of the Lincoln Valley area are under way at the present time.

The members of the Board of Directors of the Lincoln Valley District are: Edwin Rau, Denhoff, chairman; Walter Essig, Lincoln Valley; Roy Filler, Goodrich; and Warren Tewksbury, McClusky, secretary.

Devils Lake Levees

IRRIGATION MUTUAL AID CORPORATIONS

There are two mutual aid corporations that have been established in North Dakota for the purpose of conducting irrigation operations. They are the Lewis & Clark Mutual Aid Corporation and the Dickinson Mutual Aid Corporation. Each are discussed below:

Lewis & Clark Mutual Aid Corporation

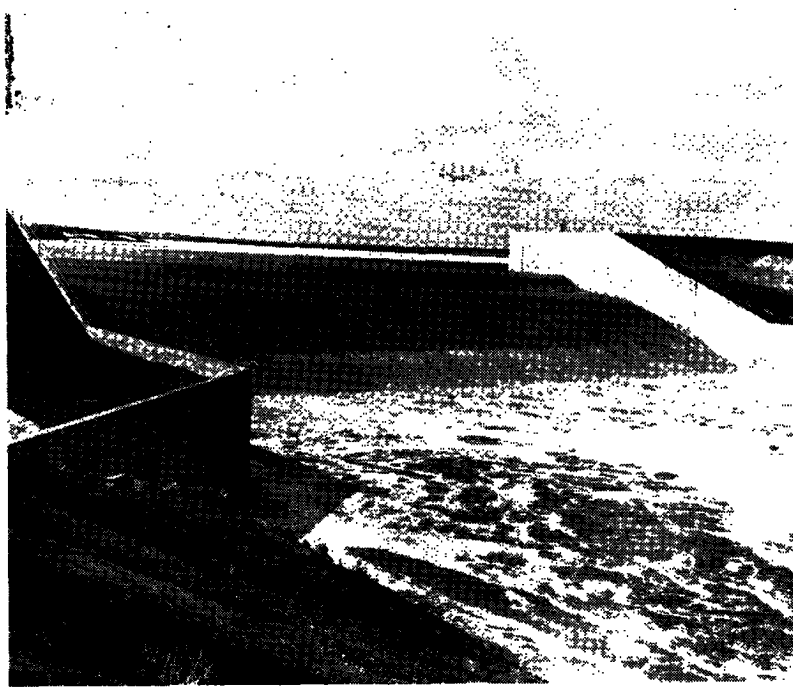
The Lewis & Clark Mutual Aid Corporation began functioning in 1957 when it took over the responsibilities for furnishing water to the irrigable lands in the former Lewis & Clark Irrigation District. This district was dissolved following the action of the district's landowners selling their lands to the Corps of Engineers for use in connection with the operation of Garrison Reservoir. The 5,000 acres of irrigable land served by this corporation are located about six miles southwest of Williston along the Missouri River and are served by pumping water from the Missouri River. There were 58 units in the original Lewis & Clark Project that were served by this irrigation system.

Following the acquisition of the land in the Lewis & Clark District by the Corps of Engineers many of the landowners involved leased the land back from the Corps for farming purposes on a year to year basis. Although this land will be affected by the Garrison Reservoir when that reservoir is near its full stage, it is expected that the lands in the project can be farmed most of the time. The Lewis & Clark Mutual Aid Corporation took over responsibility for the operation of the irrigation facilities that can serve the lands and through arrangements with the landowners provides water for the lands each year. The rental of the land and the irrigation system is arranged on an annual basis between the Corps of Engineers and the landowners and Lewis & Clark Mutual Aid Corporation. In 1958 the Corps of Engineers proposed a project to rebuild a portion of U. S. Highway No. 85 which would require that revisions be made to a siphon through this highway that was used in serving a portion of the lands. The State Water Conservation Commission provided technical assistance to the irrigation district on this problem and also agreed to finance the revision to this siphon that would be required to serve all of the irrigable lands in the project. Through this effort the Lewis and Clark Irrigation Project will be permitted to function as an irrigation project well into the distant future. The estimated cost of this construction work was $17,500 which would be advanced by the Commission and repaid by the Corporation at an interest rate of 4%. Construction of this siphon has been accomplished but the loan has not been completed. In 1960 at the request of the corporation the State Water Conservation Commission arranged for additional releases from the Fort Peck reservoir when the level of the Missouri was extremely low. Without these releases it estimated that crop losses would have been from $150,000 to $200,000.

Members of the Corporation Board are: Walter Burke, Edwin Dahl, Joseph Paulson, Lawrence Sowitz and Johnny Schmitz, all of Williston.

Dickinson Mutual Aid Corporation

The Dickinson Mutual Aid Corporation was established in 1959 and is composed of the owners of land below the Dickinson Reservoir who have arranged to purchase water from that reservoir from the Bureau of Reclamation to irrigate their lands. Approximately 400 acres of irrigable land below Dickinson Reservoir are suitable for irrigation development. The Dickinson Heart River Mutual Aid Corporation has contracted with the Bureau of Reclamation for a long term period for a water supply to serve their irrigable lands. This corporation makes a charge to the landowners concerned each year to cover the obligation of the corporation to the Bureau of Reclamation. In addition to serving the irrigable land below the reservoir the Dickinson Dam and Reservoir is used by the city of Dickinson for a municipal water supply. The city has a water service contract with the Bureau of Reclamation requiring the payment of $950,000 to the Federal government over a period of 40 years. Extensive recreational development has been accomplished around Dickinson Reservoir and the reservoir area is administered by the Dickinson City Park Board. It is estimated that approximately 90,000 visitors used these recreational facilities during the past year.



Dickinson Dam

GARRISON DIVERSION CONSERVANCY DISTRICT

In 1955 the North Dakota Legislature took a major step in bringing about the development of the Garrison Diversion Unit in North Dakota when it provided for the establishment of the Garrison Diversion Conservancy District. This 25-county legal entity, which represents all local interests that would be benefitted through the diversion of water from the Missouri River into eastern and central North Dakota, has been actively engaged in numerous activities relating to the Garrison Diversion Unit. The Conservancy District as it was originally established contained 22 counties in North Dakota and since has been expanded to include three other counties at the request of the Board of County Commissioners from those counties. A major function of the Conservancy District will be to contract with the United States for the construction and operation and maintenance of the Garrison Diversion Unit facilities.

The Conservancy District is governed by a Board of Directors composed of one director from each of the 25 counties included. Originally these directors were appointed by the Boards of County Commissioners from the respective counties, but in 1959 the Legislature changed the Conservancy District enabling legislation to provide for the election of the directors from each of the counties. The elected Board of Directors will take office on January 1, 1961, and each director will have a term of office of four years except that the Board elected in 1960 will determine the terms of office by lot with half of

Garrison Diversion Conservancy District—Board of Directors

the directors being given a two-year term and half a four-year term. The Board of Directors of the Garrison Diversion Conservancy District is presently composed of the following members:

Roy A. Holand, Chairman.....LaMoure, N. Dak.
Henry J. Steinberger, Vice Chairman.....Donnybrook, N. Dak.
E. G. Ranum.....Valley City, N. Dak.
Vernon Sturlaugson.....Minnewaukan, N. Dak.
Lester Wyman.....Westhope, N. Dak.
Mark Andrews.....Mapleton, N. Dak.
Forrest M. Gottschalk.....Oakes, N. Dak.
Russell L. Belquist.....New Rockford, N. Dak.
Ralph L. Harmon.....Carrington, N. Dak.
James H. Erickson.....Larimore, N. Dak.
Leon Sayer, Jr.....Cooperstown, N. Dak.
Walter J. Boye.....Willow City N. Dak.
Dave M. Robinson.....Coleharbor, N. Dak.
Earl Burns.....Tolna, N. Dak.
Peter L. Hoffart.....Rugby, N. Dak.
James B. Collinson.....Devils Lake, N. Dak.
Alf N. Larson.....Enderlin, N. Dak.
Kenneth L. Morgan.....Walcott, N. Dak.
Reese A. Bartlett.....Cogswell, N. Dak.
Ben F. Kludt.....McClusky, N. Dak.
Joseph E. Knudson.....Finley, N. Dak.
Francis Simmers.....Jamestown, N. Dak.
Gilman A. Strand.....Portland, N. Dak.
W. M. Harrington.....Minot, N. Dak.
Frank Bishop.....Harvey, N. Dak.
Vernon S. Cooper, Secretary-Treasurer.....Bismarck, N. Dak.

The terms of office of all of the directors presently serving on the Board will expire on December 31, 1960, at which time the newly elected Board of Directors will take office.

The Garrison Diversion Conservancy District has been involved in a multitude of activities relating to the Garrison Diversion Unit. These activities range from assisting in the establishment of irrigation districts throughout the Garrison Diversion Unit area, promoting the Garrison Diversion Unit through various information programs, publications, appearances and other methods both within the State of North Dakota and in other states of the Missouri River Basin, supporting legislation and appropriations concerning the Garrison Diversion Unit before appropriate Congressional committees, conducting contract negotiations with the Bureau of Reclamation for the project facilities, participating in activities in conjunction with the National Reclamation Association and Mississippi Valley Association in matters relating to the Garrison Diversion Unit and water resources and reclamation development in general, in spearheading various efforts to determine legal, operational and other technical problems associated with the development of the project.

Since the Conservancy District was established it has made a tax levy each year of one-tenth of one mill to cover its administrative operating expenses. This levy was authorized in the Conservancy District's enabling legislation. The one-tenth of a mill levy has raised approximately $38,000 per year. These funds have been used to pay the per diem and expenses of the directors, salaries of the Conservancy District employees, the employment of various consultants and technical help, various public relations and information programs and has provided assistance for irrigation districts in the Garrison Diversion Unit area in financing their administrative costs during the first years of their functioning. The Conservancy District is authorized to make an additional nine-tenths of a mill levy to finance its contract obligations. Several of the more significant activities of the Conservancy District are discussed in the following portion of this section.

Contract Arrangements and Negotiations

In July, 1958 the Board of Directors of the Garrison Diversion Conservancy District officially approved the proposed contractual arrangements outlined by the Bureau of Reclamation for the Garrison Diversion Unit and requested the Bureau to submit drafts of repayment contracts to the Conservancy District for consideration. These contractual arrangements provide for two contracts. One referred to as the Master Contract would be between the Conservancy District and the United States and would cover that portion of the facilities for the Garrison Diversion Unit referred to as the water supply system. The second contract referred to as the Three-Way Contract will be among the irrigation districts, the Conservancy District and the United States and will cover that portion of the facilities of the project referred to as the distribution system to serve a particular irrigation district.

Because of the large area and the many purposes that the Garrison Diversion Unit will serve the contractual arrangements for the project will necessarily be more complicated than they are in the case of other irrigation projects developed by the Bureau of Reclamation. Problems such as responsibility for operation and maintenance of the supply works and the distribution works, payments by the Conservancy District and the irrigation district for project construction and operation and maintenance costs, and the relationship between the Conservancy District and the irrigation districts in respect to financial assistance from the Conservancy District and the channeling of money for the operation and maintenance of the project works all must be included in the contractual arrangements. The task of reviewing the contracts with Bureau of Reclamation officials was assigned by the Conservancy District's Board of Directors to its Coordinating and Review Committee. This committee is composed of nine directors with James B. Collinson of Devil's Lake serving as committee chairman. The committee has met numerous times during the past two years to review and consider various matters relative to the contracts for the project.

Because of the procedure that has been followed in establishing irrigation districts in the Garrison Diversion Unit area and because the facilities that will be built by the Bureau of Reclamation to serve the irrigable lands in the project area will be built to full capacity, originally the Conservancy District and irrigation districts faced a question of what to do with acres that were left out of the irrigation districts at the owners' requests when those districts were organized. These acres, which are referred to as "missing acres", are irrigable and, if they were in the irrigation district, would be assessed their portion of the project costs. In view of the fact that they are not in the irrigation district it will be necessary for some other arrangement to be made to finance the costs, which they otherwise would assume, until they or substitute acres are irrigated. Studies have indicated that the Conservancy District, through its one-mill levy on all taxable property within its boundaries, will be able to assist irrigation districts to some extent in financing the costs associated with these "missing acres." The extent of Conservancy District revenue available for this purpose is limited because of the limitation on the extent of the Conservancy District revenue and other obligations that the Conservancy District will have in conjunction with the project.

Several studies were conducted by the Bureau of Reclamation and the Coordinating Committee to determine the extent to which the Conservancy District could provide this financial assistance to irrigation districts for missing acres. These studies have indicated that, depending on the rate of development and the extent of revenue that could be anticipated from fish and wildlife and municipal water users on the project, the Conservancy District could finance from 19% to 29% of the missing acres in any given irrigation district. The Conservancy District's Board of Directors has indicated a strong intent to limit its assistance from missing acres to a smaller percentage in order to be assured that there will be sufficient revenue available to assist all irrigation districts in the Garrison Diversion Unit. The District's Board set forth its policy in a resolution adopted whereby they stated that the Conservancy District would consider requests from irrigation districts for assistance in financing missing acres on an individual basis and the extent of the participation of the Conservancy District would depend on the availablity of revenue and the demand for this available revenue for other purposes.

During the course of its study and review of the contracts the Coordinating and Review Committee recognized the need for the employment of an outside consultant to assist them in arriving at their recommendations as to the contracts for the project. Subsequently Mr. H. A. Parker of Ephrata, Washington, was employed as a consultant to assist in this work and in November, 1959, he thoroughly studied the contracts and presented his report to the Coordinating Committee. This report was the basis for recommendations as to the contracts that were submitted to the Board of Directors for approval in January, 1960. Following the approval of the Board of Directors

these recommendations were submitted to the Bureau of Reclamation for consideration. The Bureau of Reclamation has reviewed these recommendations and accepted some of them, but others require further negotiation and clarification. These problems will be a matter of further review by Mr. Parker in the near future and it is expected that the Coordinating and Review Committee's approved recommendations as to the contracts will be submitted to the Board of Directors for consideration in October, 1960. If the Board approves of these recommendations, the contracts as approved by the Conservancy District will be submitted again to the Bureau of Reclamation.

The negotiation of contracts for the Garrison Diversion Unit becomes of prime importance in respect to the scheduled construction date for the project facilities. According to Bureau of Reclamation schedules the project construction is to get under way in fiscal year 1963. Negotiated repayment contracts, not only with the Conservancy District but also with a sufficient number of irrigation districts to justify the project construction, must be submitted to the Bureau of Reclamation before construction will be undertaken. The Coordinating and Review Committee of the Conservancy District plans to begin preliminary discussions with various irrigation districts in the Garrison Diversion Project area during the fall and winter of 1960-61.

Public Relations Activities

In July, 1957, the Board of Directors of the Conservancy District established a Public Relations Committee and charged them with the responsibility of conducting an information and education program relative to the Garrison Diversion Unit and irrigation in the project area, not only among the farmers and beneficiaries of the project in the area, but in other states of the Missouri River Basin also. The seven-man committee which was appointed has been active in various matters dealing with public relations activities. Mr. Leon Sayer, Jr., of Cooperstown, is chairman of this committee. One of the major functions of this committee was the preparation and distribution of a full color brochure on the Garrison Diversion Unit entitled "Water For Tomorrow". Fifty thousand copies of this brochure were printed and have been distributed throughout the state and the Missouri River Basin and to the members of Congress. The Public Relations Committee has also arranged for the printing of a pamphlet entitled "Basic Facts on Irrigation" which is scheduled to be released in the near future and is planning to conduct an extensive program of gathering expressions of local support for the Garrison Diversion Unit which will be submitted to Congress in conjunction with hearings being conducted by Congress relative to the authorization of the Garrison Diversion Unit. The Public Relations Committee has also sponsored an effort to have various speakers, familiar with the Garrison Diversion Unit, present a discussion of the project before meetings and conventions of the many organizations in the state which should have an interest in this development. Such presentations have been

made to the North Dakota Bankers' Association, North Dakota Grain Dealers' Association, North Dakota Association of Rural Electric Cooperatives, North Dakota Dairy Industries Association, and others.

Other Activities

The Garrison Diversion Conservancy District was a party to a legal action brought to determine the rights of the state and the Conservancy District to inundate certain lands around Devils Lake in connection with the restoration of that lake as is proposed under the Garrison Diversion Unit. This case — Rutten vs. the State of North Dakota and Garrison Diversion Conservancy District — was tried before District Court and the decision of the District Court appealed to the Supreme Court for decision. The Conservancy District also joined with the North Dakota Water Users Association, the State Water Conservation Commission and other groups in sponsoring a series of meetings with interests from Lower Missouri River Basin states to iron out evident differences that exist in conjunction with the development of the Missouri River Basin projects between the upper and lower states. A meeting was held in Kansas City in July of 1958 to bring about a better understanding of the problems and needs of both areas and as a result of this meeting an endorsement was secured from the representatives of these states, and consequently the Mississippi Valley Association, for the Garrison Diversion Unit. It is apparent that a continual need exists for discussions and conferences with interests from Lower Missouri River Basin states in order to present a united front of all Missouri River Basin states for the development of water resources in the basin.

One of the major concerns of the Garrison Diversion Conservancy District and other proponents of the Garrison Diversion Unit during the past two years has been that of securing Congressional action modifying the authorization of the project. In June, 1958, the Secretary of the Interior submitted a report on the Garrison Diversion Project to the Bureau of the Budget for review. During the period from June, 1958, until January, 1960, the Bureau of the Budget had this report under consideration. It became apparent to proponents of the Garrison Diversion Unit during the course of the Bureau of the Budget's review of the project report that the Bureau of the Budget did not intend to give a favorable endorsement to the Garrison Diversion Unit. Through the efforts of Governor Davis, Senator Milton R. Young, Congressman Don L. Short, officials of the Department of Interior and Bureau of Reclamation and other governmental leaders who supported the Garrison Diversion Project the Bureau of the Budget submitted its comments on the project to the Secretary of Interior in January, 1960; in which they stated that although they could not approve the project they had no objection to submitting it to Congress for consideration. These comments along with the Secretary of Interior's report were transmitted to Congress shortly thereafter.

The Bureau of the Budget's comments on the Garrison Diversion Unit were based on a 250,000 acre initial project. That agency was critical of the project, particularly insofar as the benefit-cost ratio for the project was concerned. The Secretary of Interior forwarded the project report to Congress along with the comments of the various states and agencies concerned and his report strongly endorsing the Garrison Diversion Unit. This report served as the basis for foundation hearings on the bills modifying the authorization of the Garrison Diversion Unit before the Subcommittee on Irrigation and Reclamation of the House Interior and Insular Affairs Committee on June 10, 1960. These hearings were arranged by Congressman Aspinall through the efforts of Senator Quentin N. Burdick of North Dakota, who was then a member of Congress and a member of the House Interior Committee. No final action was contemplated by Congress on the modifying legislation for the Garrison Diversion Unit during the current session of Congress.

Because of the Bureau of the Budget's criticism of the Garrison Diversion Unit insofar as the benefit-cost ratio of the project is concerned, the Conservancy District has arranged for an analysis of the economic justification of the project by an independent economist. The Bureau of the Budget's criticism was directed particularly to the secondary benefits that were claimed for the Garrison Diversion Unit. The secondary benefits constitute those that accrue to the trade and business economy of an area through the development of irrigation in that area. Proponents of the Garrison Diversion Unit contend that these benefits can equal or even exceed those direct irrigation benefits that will accrue to the farmers in the project area and should be given full consideration in determining the economic feasibility of the Garrison Diversion Unit. The Board of Directors of the Garrison Diversion Conservancy District authorized a study to be conducted by Dr. William E. Koenker, Director of the Bureau of Business and Economic Research at the University of North Dakota, directed primarily to the value and importance of the secondary benefits that will accrue from the Garrison Diversion Unit. It is expected that the results of this study will be available for presentation to the next session of Congress when appropriate Congressional committees will consider further the authorization of the Garrison Diversion Unit.

The Conservancy District has actively supported various legislation and appropriations that would enhance the development of irrigation in the Garrison Diversion Unit in North Dakota. It is expected that their efforts during the coming years will be directed primarily to the negotiation of contracts for the Garrison Diversion Unit and various other matters that will bring about the early construction of the project facilities.

WATER CONSERVATION AND FLOOD CONTROL DISTRICTS

Provision exists in North Dakota statutes for the organization and establishment of water conservation and flood control districts. These districts serve to provide the local people in a given area a legal entity that has authority over regulation, control and development of water resources in that area at a local level. The districts are established at the request of local landowners or their elected representatives, and are governed by a board composed of local people.

Water conservation and flood control districts have the power to investigate and construct or to arrange with the districts for the construction of projects that will serve to develop the water resources in certain areas. These projects can be of many types and serve many purposes. They can be dams constructed in watercourses within the district to provide conservation storage of water. They can be facilities used to maintain water levels in lakes or augment flows in streams. They can be facilities to regulate and control flood waters. They can be drainage projects that will provide for removing surplus waters from agricultural lands or they can be projects of a related nature that will provide benefits to the district through the conservation, control and regulation of the water resources of that district.

Water conservation and flood control districts have the authority to enter into contracts with the United States or agencies thereof, or with agencies of the state government, for the construction of projects that will be of benefit to the district.

In order to accomplish the purposes for which water conservation and flood control districts are organized, these districts have the power to levy special assessments or raise funds through a general levy to meet their costs of operation and to meet the costs of the projects in which the district becomes involved. The mill levy for the budget of a water conservation and flood control district is made by the Board of County Commissioners of the county in which the district is located. The district is also authorized to make special assessments on property specifically benefitted by a project.

The procedure provided in state law for the organization of water conservation and flood control districts is as follows: A petition is filed with the State Water Conservation Commission by the governing board of a municipality, county or other political sub-division or 51% of the landowners concerned requesting a water conservation and flood control district be organized encompassing a certain area. The proposed district can overlap county boundaries. The State Water Conservation Commission, upon receipt of this petition, determines whether or not it would be advisable to establish such a district and, if they believe it would be advantageous to do so, calls a hearing in the area concerned. Following the hearing, if it appears that it is desirable to proceed with the organization of the District, the State Water Conservation Commission will issue its Order declaring the water conservation and flood control district established. After the Order of the State Water Conservation Commission is issued, the

Board of County Commissioners of the county or counties in which the district is located is then required to appoint a board of commissioners for the water conservation and flood control district. This Board of Commissioners is responsible for governing the affairs of the water conservation and flood control district. The commissioners are appointed for a specific term in years by the county commissioners.

The Commission has cooperated extensively with many of the water conservation and flood control districts that have been organized in planning, constructing and developing various types of water projects, administering the law under which these districts operate and advising them in matters dealing with their tax structure and its relationship to the districts' activities.

Acting in this direction in March, 1959, the Commission circulated to all water conservation and flood control districts, in addition to all drain boards, clarified Commission policy and defined the circumstances under which State aid would be allowed for rehabilitation of existing drainage structures in order to prevent use of these funds for deferred maintenance. Again in April, 1959, the Commission sent information to all water conservation and flood control board members in order to clarify and emphasize their responsibilities to the district at large in the management of the district-wide tax funds, pointing the way toward the most equitable distribution of tax load as related to specific benefits.

Tongue River floodway east of Bathgate, North Dakota

Water conservation and flood control districts have proven very valuable in the State of North Dakota in bringing about the orderly development of needed water resource projects in various areas of the state. At the present time there are 20 water conservation and flood control districts that have been organized in the state. Many of these districts are organized as county wide districts, thereby permitting the benefits this type of organization can provide to all areas of a county. Other districts are organized on a drainage basis or for a specific area for which a specific project is proposed. Should a federal works program ever again be required, this type of entity would be an ideal one to sponsor projects and cooperate in their construction.

The water conservation and flood control districts that are in existence in North Dakota are discussed in the following sections of the report. Included in this discussion are the purposes for which each district was organized and the progress that these districts have made since their organization.

ADAMS COUNTY DISTRICT

The Adams County Water Conservation and Flood Control District was created in 1949 to provide the county a legal entity that would be responsible for maintaining and reconstructing dams that had been constructed in that county by federal agencies during the 1930's. Local authorities have not appointed a Board of Commissioners for the district; therefore, it has not been activated. Although the district is now inactive, it will be possible for the Board of County Commissioners to reactivate the district without public hearing, should they so desire.

BOWMAN COUNTY DISTRICT

The Bowman County Water Conservation and Flood Control District is a countywide district that was organized in 1949 at the request of the Board of County Commissioners of Bowman County to provide a local legal entity that could cooperate with state and federal agencies in the repair of dams, construction of flood protective facilities, the development of the Bowman-Haley Project and irrigation potential related thereto. The principal project with which this district is concerned is the Bowman-Haley Project which has been under investigation by various federal and state agencies for many years. Investigations by the Bureau of Reclamation indicated that it would be infeasible to develop irrigation in this area because of the limited water supply. The Corps of Engineers was also authorized to study the project in an effort to determine its feasibility for providing flood protection and other related benefits. In 1956 the Corps of Engineers requested the approval of the State Water Conservation Commission to a proposal that the Bowman-Haley Project investigation be dropped from the authorized list of projects the Corps had under consideration.

The Commission, through the Bowman County Water Conservation and Flood Control District, held a public hearing to determine the

local sentiments toward this proposed action. Strong support was indicated to retain the Bowman-Haley Project as a project authorized for investigation. As a result the Bowman County Water Conservation and Flood Control District and the State Water Commission requested the Corps of Engineers to continue its investigations of the project and give consideration to studies of the need for supplying water to cities and industries in the area. A possibility of the development of a uraniferous lignite industry in the area greatly increased the demand for municipal and industrial water. At the request of the district and the Commission adequate funds were appropriated by Congress to the Corps of Engineers to continue this investigation.

On December 3, 1958, the Corps of Engineers presented its preliminary proposal relative to the development of the Bowman-Haley Dam to the Bowman County Water Conservation and Flood Control District. The Corps proposed the construction of a dam on the Grand River 80 feet high and 560 feet long with a glory-hole type spillway. The reservoir would have a dead storage zone capable of impounding 4,000 acre-feet, and active conservation storage zone capable of impounding 16,000 acre-feet, a flood storage zone that could control floods of a 50-year frequency capable of impounding 14,500 acre-feet with provision for additional flood control above this zone to control an additional 97,000 acre-feet. The normal flood control pool would inundate an area of approximately 4,400 acres. The total estimated cost of the dam and reservoir is $2,860,500. Of this amount approximately $635,000 would be allocated to municipal and industrial water and would have to be repaid over a period of years by those water users. The balance of the project costs would be allocated to other uses.

Preliminary studies indicate that it is within the capabilities of the potential water users to repay these costs of the project. A firm water supply of 3,000 acre-feet annually is expected to be available for municipal and industrial uses. The municipalities and industries concerned would have to provide for the pipeline and distribution system to bring the water from the reservoir to the treatment plants. The Water Conservation and Flood Control District presently has under consideration the assurances that the Corps of Engineers require before proceeding further with the development of the Bowman-Haley Dam and reservoir project.

The Bowman County Water Conservation and Flood Control District has also sponsored the construction of the flood protective facilities for the village of Scranton by the Corps of Engineers. This project consists of about one mile of channel improvement on Buffalo Creek which flows through the village of Scranton and one mile of levee together with the necessary railroad improvement and pertinent works. The project was constructed by the Corps at a Federal cost of $103,000 and in addition the local interests, including the Water Conservation and Flood Control District, contributed $34,500 to provide lands and easements and other items of local cooperation. Con-

struction of the project facilities was completed in 1958 and the project has had a decided beneficial effect on the growth and development occurring in the village of Scranton. A new school and several new homes have been completed in the village and serious consideration is being given to the construction of a ten home project in the near future. The State Water Conservation Commission participated in the local costs of this project to the extent of 40%.

In connection with studies of the Bowman-Haley Dam and Reservoir project it was noted that runoff from the drainage area had decreased alarmingly in the last several years. Studies indicated that during recent years of favorable conditions, the runoff reaching the Grand River was actually less than during the dry years of the 1930s. This condition has been attributed to the construction of what appears to be an excessive number of stockwater dams and reservoirs in the area that restrict the amount of water reaching the river. A considerable amount of the water impounded in these reservoirs obviously is lost through evaporation as the evaporation in this area approximates 40 to 45 inches annually. In order to provide for the control of such impoundments and the most wise use of the available water resources of the area, the Bowman County Water Conservation and Flood Control District was authorized by the State Water Conservation Commission to regulate the number of dams that can be constructed in the drainage basin of the North Branch of the Grand River.

Commissioners of the Bowman County Water Conservation and Flood Control District are Ralph G. Keller, Scranton, Chairman; Chris Nester, Rhame; Howard White, Bowman; and Leinniece Werre, Secretary, Bowman.

BURKE COUNTY WATER CONSERVATION AND FLOOD CONTROL DISTRICT

The Burke County Water Conservation and Flood Control District is a countywide district which was created on December 27, 1957, by the State Water Conservation Commission upon petition from the Board of County Commissioners of Burke County. The district was organized to provide the citizens of Burke County the necessary legal entity through which the construction and maintenance of various small dams in the county could be accomplished. Since the district was organized it has cooperated in the construction of the Schmisek Lake Dam and has several other proposed dams under consideration. The State Water Conservation Commission is cooperating with the Water Conservation and Flood Control District in the planning and investigations of these projects. The Schmisek Lake Dam is discussed under the construction section of this report. Other dams which the district has under consideration include a dam on Short Creek which would replace a WPA dam that was built in 1939 and destroyed in 1940, which was investigated by the State Water Commission and submitted to the district for consideration; a dam on Stoney Creek that would be used in conjunction with the municipal

water supply of the City of Bowbells; and a dam located near Northgate in conjunction with the anticipated rebuilding of highway No. 8. The Stoney Creek dam proposal has been temporarily shelved in view of the construction costs.

Commissioners of the Burke County District are: Otto Fisher, Bowbells; Ted Gibson, Powers Lake; and Norbert Kihle, Columbus.

CHAIN LAKES DISTRICT

The Chain Lakes Water Conservation and Flood Control District is located in northwestern Ramsey County and was organized in May 1955 to provide the residents of the area a legal entity through which they could provide for the construction of facilities that would alleviate the flooding of land in the Lake Alice - Lake Irvine areas. Approximately 10,000 to 15,000 acres of highly fertile agricultural land have been lost to production due to excess water in 9 out of the last 12 years. The flooding is caused principally because channels between Lake Alice and Lake Irvine and the channel of Mauvais Coulee have become filled with an accumulation of soil drift and silt, greatly reducing the capacity of these channels to drain off surplus water. In 1954 during the flood peak it was estimated that 3,300 cubic feet per second of water was entering the Lake Alice - Lake Irvine area while only approximately 385 cubic feet per second was leaving the area. The State Water Conservation Commission assisted the local people in organizing the Chain Lakes Water Conservation and Flood Control District and has participated in making numerous investigations in the area to determine the most feasible and satisfactory solution to the flood problem. The Corps of Engineers was authorized to conduct an investigation of the problem by Congress and funds were appropriated to that agency for this purpose. In addition, the Soil Conservation Service has assisted in making certain surveys. During the past biennium the Commission arranged through its topographic mapping program with the U. S. Geological Survey for a series of quadrangle maps of the Upper Mauvais Coulee drainage area. The studies and investigations by these various agencies are continuing and it is expected that a definite plan for development of facilities to provide flood control for this area will be completed in the near future.

In order to provide a partial solution to the problem the Commission and the Board of County Commissioners of Ramsey County in 1957 cooperated in constructing a control structure at the outlet of Lake Irvine which was so located as to fit in with the future drainage channel position from those lakes to the Mauvais Coulee. The Commission also cooperated with the Fish and Wildlife Service in blasting a channel between the two lakes so as to increase the flow between these lakes and stabilize their levels, thereby reducing the flood damage in the area. Another segment of the project was proposed as a result of Commission surveys that would provide for

the construction of a drainage channel from Lake Irvine to the Six Mile Bay of Devils Lake. In 1960 the Commission conducted surveys in the area to install permanent triangulation points for future improvements and to eliminate costly resurveys of the area and also to make it possible to determine exactly the lands that would be involved in easements that would be required for the project.

The Chain Lakes District is presently working toward the construction of the outlet channel from Lake Irvine downstream to a railroad bridge. Plans and specifications for this work were provided by the State Water Commission. The financing of the local share of the cost of this portion of the channel has not as yet been arranged, mainly because of the relatively small tax base available to the District. The Commission has made an allocation of funds to participate in the cost of this project. It appears that by constructing this channel, relief will be provided to the Lake Alice - Lake Irvine area thereby permitting farming of a considerable portion of land now out of production or in serious jeopardy from floods.

Commissioners of the Chain Lakes Water Conservation and Flood Control District are: Almer Anderson, Maza; John Magnuson, Churchs Ferry; Roy Cowan, Churchs Ferry, and F. E. Foughty, Secretary, Devils Lake.

FREMONT DISTRICT

On petition from the Board of Township Supervisors of Fremont Township, Cavalier County, the Fremont Township Water Conservation and Flood Control District was established on June 15, 1956. The primary concern of the district has been the severe flood and resultant erosion damage to agricultural lands during the spring runoff.

The district lands are located in the Soil Conservation Service North Walhalla Watershed Project area and the district has worked with the Soil Conservation Service toward establishment of this project which would serve to reduce flood damages and soil erosion.

The Soil Conservation watershed planning for this project has been completed. It includes three retention dams, which are designed to reduce the maximum water flow to the principal drain during peak runoff, and three drop structures incorporated into the extensive channel improvements to provide protection from erosion, while allowing effective drainage. Construction of this project, which involved areas in both the Fremont District and the northwest portion of Pembina County, was possible in 1960, but postponed because of inability for arrangements to be completed for local financing.

Commissioners of the Fremont Township Water Conservation and Flood Control District are John Ermer, Walhalla; Joe Bodensteiner, Jr., Walhalla; Albert Gapp, Walhalla, and Leo A. Verville, Walhalla.

LOWER HEART DISTRICT

The Lower Heart Water Conservation and Flood Control District was organized in 1953 and embraces the area along the Heart River, including the City of Mandan from the confluence of the Missouri and Heart Rivers to a point about seven miles west of Mandan. The district was created for the purpose of providing a legal entity to cooperate with the Corps of Engineers in the construction, operation and maintenance of additional facilities needed for flood protection in Mandan and for agricultural and commercial property along the Heart River above and below the city.

The required protection, which was planned as extension and addition to the levee system constructed by the Corps of Engineers in 1950 and 1951 included the raising of Highway No. 10 west of Mandan and the highway bridge across the Heart about 5½ feet which made it possible to adequately protect the area south of Highway No. 10 and west of Mandan. Further increase of channel capacities through Mandan were provided to permit a 50,000 c.f.s. flood to pass without overtopping the levees. In addition, a channel improvement and system of levees extending from the original dyked area to the confluence of the Heart River and the Missouri provides protection to the industrial, commercial and farm properties north of the levee and below Mandan. This phase of the project should eliminate the annual interruption of highway traffic which almost invariably was caused by the Heart overtopping the roadway near the Mandan underpass.

Heart River Channel change and Levee near Mandan

The Corps of Engineers has provided the planning, supervision and actual project construction. The Lower Heart District, the State Highway Department, the Board of Administration and the State Water Conservation Commission have all participated in the local costs which included the raising of the Heart River Highway bridge at the west edge of Mandan.

As of June 30, 1960, the construction in the western portion of the improvement was largely completed, with work progressing on the southeastern dike and channel system. The State Water Conservation Commission has participated in the cost of levy construction in the vicinity of the State Training School making possible internal drainage which would have otherwise been impounded behind the levee system.

Commissioners of the district are: L. C. Hulett, Chairman, Mandan; R. E. Sylvester, Mandan, and Carl Keidel, Mandan.

MAPLE RIVER DISTRICT

The Maple River District was formed in August 1956 upon petition by the Board of County Commissioners of Cass County. This district absorbed the then existing Swan Creek District and extended the area included to cover the Swan - Buffalo River Watershed within Cass County.

Surveys were immediately undertaken by the Soil Conservation Service and a watershed improvement proposal was submitted and approved by the district and by Congress, which included the construction of various features for the project.

Construction of channel improvements and retention dams, as proposed in the project plan, which are aimed at providing adequate control and drainage of excess runoff, and reducing the peak flow during flood periods, is under way and has proceeded at a rate governed by the ability of the district to finance their share of the costs of the project.

Commissioners of the district are: H. H. Wheeler, Wheatland, Chairman; William Martin, Chaffee; Francis Archbold, Sheldon; and F. J. Woell, Casselton, Secretary.

MARMARTH DISTRICT

The Marmarth Water Conservation and Flood Control District was organized in 1956 at the request of the City Commissioners of Marmarth. The district includes the City of Marmarth and adjacent land which was affected by the flood control measures contemplated.

Flooding in Marmarth occurred during peak runoff from the Little Missouri River and Little Beaver Creek, which join the river just upstream, and has caused extensive damage. The city requested assistance to provide for a means to alleviate the condition and in 1954 Congress authorized a local flood protection project. The Corps of Engineers investigated this project and determined that it was feasible. Before construction and actual funds could be made

available to the Corps of Engineers for the project, local assurances of furnishing right-of-way, moving utilities and in general taking responsibility for the local phases of the project had to be furnished. The Water Conservation and Flood Control District provided the legal entity to provide for the local sponsorship of the project, and to provide a responsible organization for future maintenance. Appropriations were made available to the Corps of Engineers in July 1956 to construct the project. The State Water Conservation Commission agreed to participate with the District in meeting the local costs.

The project has been completed and benefits which have accrued extend beyond those that can be measured in terms of specific flood damage reduction. Local people now can locate buildings and facilities within the protected area with confidence and it is expected that further commercial and residential buildings will be constructed.

Commissioners of the district are: R. C. Rushford, Earl D. Corneil, Ben Dohling, A. J. Spire, Secretary, all of Marmarth.

OAK CREEK DISTRICT

The Oak Creek Water Conservation and Flood Control District was established in January 1956. The District includes the major portion of the Oak Creek watershed which is contained in eastern Bottineau County. It has been instrumental in the construction of projects which have been in abeyance for more than 30 years for lack of a sponsoring agency.

Of principal concern to the district has been the improvement and stabilization of the level of Lake Metigoshe which is used extensively for recreational purposes. The project has also made a significant reduction in the flooding that frequently occurs below the Turtle Mountains adjacent to Oak Creek. Approximately 500 cottages are located around the lake. This objective has been accomplished by the impoundment of additional water in Sharpe Lake located in Canada just north of Metigoshe and slightly above its level which can be released to Lake Metigoshe as needed. This improvement project consists of a dam at the outlet of Sharpe Lake and a canal from Sharpe Lake to Lake Metigoshe. Availability of water from the Sharpe Lake impoundment has exceeded expectations in view of the excellent runoff which occurred in the spring of 1960.

Arrangements were made with Canadian landowners and officials to permit the operation of the Sharpe Lake release gate to manage the water level in Lake Metigoshe. The controlled flow of water from Sharpe Lake to Lake Metigoshe provides adequate water to sustain fish during the winter when the lake ordinarily is low, and retards the excess runoff to the lower watershed area during the peak spring flow. The State Water Conservation Commission and the State Game and Fish Department will act as technicians in determining the proper release of water from Sharpe Lake to Lake Metigoshe.

Additional stabilization measures and the need for more complete management of water flow in the upper watershed area are presently under study by the State Water Conservation Commission and the district. Included in these studies are proposals to control water flowing into and out of Rost Lake which is east of Metigoshe.

The improvement of the lower reaches of the watershed area has been given study. Action toward improvement of Willow Creek, the main drainage channel into the Souris River through which Oak Creek drains, has not yet been determined feasible. The development of a program of improvement of drainage and flood control within the middle and lower reaches is contingent upon the provision of adequate outlet into the Souris. Most of the area involved in this proposal is not within the Oak Creek District or in Bottineau County. This project is further complicated by the fact that Oak Creek is only one of several streams that join to form the common Willow Creek Outlet.

It is expected that eventually means may be provided whereby the entire area to the outlet into the Souris can be included in a water conservation and flood control district and a watershed improvement project established. The Oak Creek District is cooperating with the State Water Conservation Commission and the Soil Conservation Service in developing and improving the basin as much as possible with the aim of reducing flood damage in the lower watershed area.

Commissioners of the district are: Carl Bullinger, Gardena; Fred Brandt, Bottineau; and Charles Neff, Bottineau.

PEMBINA COUNTY DISTRICT

The Pembina County Water Conservation and Flood Control District, a county-wide district, was formed in July 1950. The county-wide organization was aimed at providing the most effective legal entity possible to deal with drainage and flood control problems which are county-wide both in the effect of their damages and in the need for local support of the major proposed projects. Since its organization this district has been actively engaged in a program to alleviate flood damages in the county including improvement of river channels by bridge construction, channel straightening and other projects.

It has actively cooperated with the United States Soil Conservation Service in connection with the planning and construction of the Tongue River Watershed Project, one of the pilot projects under the Soil Conservation Service watershed program. This project provides for the protection of the entire 415,000 acres of the watershed through construction of detention dams and channel improvements. As of June 30th eight dams have been constructed with two more under contract, and channel improvement completed on the three reaches of the Tongue River within the district.

The district is also actively engaged in providing for flood control facilities for the lower Pembina River area and is actively supporting

the construction of the Pembilier Dam which is proposed at a location just below the confluence of the Pembina and the Little Pembina Rivers. This project was authorized originally by Congress in the Flood Control Act of 1944, and is presently being investigated by the Corps of Engineers.

Thorough study of the benefits which would result from the construction of the Pembilier Dam shows that the resultant control of water possible with the deep and long reservoir in which the river would be impounded would provide adequate flood control, including prevention of overflow into the Tongue River Watershed, decrease the threat of extensive erosion damage, and make it possible to manage diversions of water into the reservoir from the Souris River in Canada through the Garrison Diversion Project. In conjunction with these diversions, which would provide the reservoir with a firm supply during periods when it would otherwise be expected to be lower, power generation to 10,000 kilowatts, and irrigation development of approximately 80,000 acres in Pembina County are considered feasible.

The Pembilier Dam has received endorsement of the Mississippi Valley Association and the National Rivers and Harbors Congress. The proponents of the project are confident that it will be built and will emphatically prove its worth.

Commissioners: C. R. Howell, Walhalla, Chairman; Otto Pudil, Pembina; Ed A. Thomson, Cavalier; and William J. Sturlaugson, Cavalier, Secretary.

RICHLAND COUNTY DISTRICT

The Richland County Water Conservation and Flood Control District was formed in August, 1958, by the State Water Commission upon petition from the County Commissioners. The district includes the entire county. The district board has taken over the duties of and replaced the drain board.

Since its formation the Richland County District has been active in improving drainage and flood control within the county, and has directed its efforts toward forestalling potential drainage problems prior to road bridge and culvert construction.

In addition to continuing and intensifying the county-wide drainage program the district has worked closely with the Soil Conservation Service in providing the necessary local assurances for several watershed projects. As of June 30, 1960, the watershed improvement known as "West Tributary, Bois de Sioux" has been planned and made ready for final approval. Preliminary investigation of the watershed designated as "Wild Rice B" has been instigated and is expected to be completed in the near future.

Commissioners: Ernest Israelson, Christine; Jens Lovdokken, Wyndmere; Holger Bertelsen, Fairmount; and Odin J. Wold, Wahpeton, Secretary.

RUSH RIVER DISTRICT

The Rush River Water Conservation and Flood Control District was established in 1949 by the State Water Conservation Commission at the request of the Board of County Commissioners of Cass County to provide the needed legal entity that could arrange for the construction of drainage facilities to alleviate flood conditions affecting approximately 197,000 acres of rich agricultural land located in the east and central portion of Cass County. Rush River, for which the project is named, possessed many channel irregularities which, along with restriction of this channel caused by soil drift, greatly retarded the flow of runoff waters in the river. The condition was so severe that it resulted in normally low flows leaving the banks of the river and flooding adjacent agricultural lands.

Through the efforts of the Rush River Water Conservation and Flood Control District, and the State Water Conservation Commission, the Corps of Engineers initiated construction of a project in 1954 to improve the channel of Rush River. The construction of this project was completed in the fall of 1956 at a cost of approximately $250,000.

In April 1959 the State Water Conservation Commission was requested to modify and extend the boundaries of the Rush River District so as to include additional land in the upper reaches of the Rush River in order to allow channel improvement work in this area.

Following a hearing held in Amenia, North Dakota, on August 8, 1957, at which no opposition was voiced toward the boundary modification, the State Water Conservation Commission modified the district boundaries to include an additional 107 square miles, thereby increasing its size to 304 square miles.

Since that time the district has been cooperating with the Soil Conservation Service in improvement of the drainage of the enlarged district and are using the improved Rush River channel to advantage.

Commissioners: Kenneth McIntyre, Harwood; L. F. Chaffee, Amenia, and Robert Lewis, Jr., Fargo, North Dakota.

SARGENT COUNTY DISTRICT

In November 1956 a petition and a resolution were received from the Sargent County Board of Commissioners requesting that a water conservation and flood control district be established embracing that entire county. A hearing was held by the State Water Conservation Commission on December 20, 1956, at which unanimous support for establishing this district was indicated. The district was established January 14, 1957, and the objectives of the district are to cooperate with the Commission in the repair and maintenance of certain dams in that county and to cooperate with the Soil Conservation Service in establishing a watershed project for the Wild Rice Basin located in the eastern portion of Sargent County. The County Commissioners appointed the following members to the Board at a regular meeting held on February 15, 1957. Chairman Milton Bergsjoe, DeLamere; Ole Breum, Rutland, and William Bosse, Cogswell.

SIOUX COUNTY DISTRICT

The Sioux County Water Conservation and Flood Control District was established by Order of the State Water Conservation Commission on October 24, 1938. It was created to cooperate with state and federal agencies in maintaining and repairing dams that were constructed in that county. To date the district has been inactive.

SOUTHEAST CASS DISTRICT

The Southeast Cass County Water Conservation and Flood Control District was established by the Commission upon petition of the Board of County Commissioners of Cass County in June 1960. The district comprises the southeast portion of Cass County, extending to Richland County on the south, the boundary of the existing Maple River District on the east, the north edge of Township 139 on the north, and the Red River on the east, excluding the corporate area of the City of Fargo.

The area of Southeast Cass included in the district covers the lower portion of the Wild Rice watershed and is nearly centered on the course of the Sheyenne. The commercial and industrial development with concurrent improvement in roads and highways has emphasized the need for the kind of water management available through a locally appointed and legally responsible board.

The principal initial aims of the district are to make provisions for channel improvements in the Sheyenne, adequate control of water impounded in upstream areas, flood protective works for municipalities within the district, and flood control and drainage of agricultural land.

Commissioners: Howard Emerson, West Fargo; Robert Meyer, Fargo; and Albert Pyle, West Fargo, North Dakota.

SWEETWATER - DRY LAKE DISTRICT

The Sweetwater - Dry Lake District located in the northeast portion of Ramsey County was established by the State Water Conservation Commission on June 10, 1955. It includes an area of approximately 720 square miles.

The district was created for the purpose of cooperating with the Commission, the Corps of Engineers and the Soil Conservation Service in an effort to provide a means to alleviate flood conditions which have occurred repeatedly in that area. Approximately 72,000 acres of valuable agricultural land within the boundaries of the district are subjected to floods. The State Water Conservation Commission in cooperation with the Soil Conservation Service has made surveys in the area to be used in conjunction with flood control projects.

One proposal for this project provides for excavating a canal from the south end of Sweetwater Lake into Devils Lake. The proposed canal would be 9.6 miles in length with a capacity of 700 cubic feet per second and is estimated to cost $390,000. This plan also provides for the storage of some of the flood waters in Sweetwater

Lake and for diversion of a portion of such flood waters into Dry Lake where it could be utilized for the propagation of wildlife. The proposal was designed for a maximum flood contribution approximating 47,000 acre-feet in one year. Allowances were made for an additional 16,000 acre-feet which would result from drainage practices initiated in the upper Sweetwater Lake watershed area. The anticipated frequency of a flood peaking at 63,000 acre-feet per year would occur on the basis of once every five years. The district is making a levy to be able to initiate this project. The State Water Conservation Commission has included topographic mapping of this area in its cooperative mapping program with the U. S. Geological Survey. The Soil Conservation Service is cooperating in the planning for this project.

Commissioners: Thelmer Ivesdal, Edmore; Henry Anderson, Webster, and Gordon Perry, Webster, North Dakota.

TRAILL COUNTY DISTRICT

The Traill County Water Conservation and Flood Control District was established by the State Water Conservation Commission in April, 1956, upon petition of the Board of County Commissioners. The district includes the entire county, since it was reasoned that a county-wide district could best benefit the landowners, with all of the Buffalo Creek watershed and major portions of the Elm and Goose River watersheds needing improvements within the Traill County Boundaries.

The Soil Conservation Service was requested by the district to proceed with the planning of the Elm River Watershed Project immediately after the district was established. The study was made, plans completed and approved. To date one main drainage channel has been completed and four other drains are under contract within the principal flood damage areas.

In addition to sponsoring the watershed project this district has aided the City of Portland in the construction of a dam on the Goose River in the Portland City park which is used in conjunction with the Portland municipal water system.

Commissioners: Theo. A. Peterson, Buxton; Theo. Wheeler, Buxton; Iver Smith, Galesburg; Gerhard D. Olson, Hillsboro, and John S. Flaa, Hillsboro, North Dakota.

UPPER WEST SOURIS DISTRICT

The State Water Conservation Commission creater the Upper West Souris Water Conservation and Flood Control District on June 10, 1955, upon petitions and resolutions submitted by the County Commissioners of Renville and Ward Counties. The district comprises an area west of the Souris River containing 163,000 acres in Renville County and 60,000 acres in Ward County, making a combined total of 223,000 acres in the two counties.

The history of the flood conditions within the area of the district as organized antedates the establishment of the district by many years. The elongated basin which lies between the DesLacs and Souris Rivers known as the Tolley Flats has no definable outlet to either stream. Spring runoff and heavy rainfall has gathered in the basin on a number of occasions flooding approximately 3,000 acres to such a degree that the crops are totally destroyed. There are approximately 20,000 acres of other land within the district that are periodically flooded. These areas have suffered severe crop losses due to flooding nine out of the past 12 years, with an average annual damage of $240,000.

The fundamental reason for district organization was to work toward improvement of the drainage from this basin. In 1956 a three mill tax was levied on the district but the levy was discontinued after one year since the immediate demand for funds did not arise. This money is not yet spent, and no further levy is anticipated until a plan for management of the water within the watershed has been developed satisfactory to the property owners.

A meeting of the district board, at which the Corps of Engineers, Soil Conservation Service and State Water Conservation Commission were represented, was held December 28, 1959. The Corps of Engineers informed the board that funds were available and a directive from Congress had been received to investigate the flood problem in Tolley Flats and they were required to hold a public hearing before beginning the investigation of the drainage problem in the area being studied. The hearing was held in Kenmare on February 16, 1960. Opposition to the proposed investigation was very strong, and was based on the argument that with over 260,000 acres in the district, only 3,000 acres would be benefitted, and that drainage practices would cause detriment to the balance of the area.

Commissioners of the district are: Henry J. Steinberger, Donnybrook; H. A. Bodmer, Kenmare; Claude James, Kenmare; Harry E. Stanley, Tolley, and E. William Jensen, Kenmare.

WALSH COUNTY DISTRICT

The Walsh County Water Conservation and Flood Control District was established December 19, 1956, upon petition by the Walsh County Commissioners to create a county-wide district. The State Water Conservation Commission arranged three hearings to determine the sentiments of the Walsh County residents toward the formation of such a district. The favorable reception given the proposal at hearings held in Grafton, Adams and Park River resulted in the Commission's order establishing the district.

The need for a responsible local entity to take concerted action within the area of Walsh County toward flood control is illustrated by topography of the county. Because of the topography a rapid runoff from the western slopes onto the sluggishly drained central and eastern flats occurs. Frequently discharges within the Forest

and Park River channels are so great that the vast area lying between the two rivers is one huge lake. The cities of Minto, Forest River and Grafton are frequently devastated by these floods. Roads and bridges have suffered extensive damages.

Since the formation of the district, the Walsh County board has promoted the development of watershed improvement projects and has requested the Soil Conservation Service to study certain watersheds under their watershed protection program.

To date the plans by the Soil Conservation Service for the Lower Forest River, Middle and South Branch Forest River, and North Branch Park River watershed projects, are progressing rapidly toward completion.

In addition to the watershed programs, the district has investigated existing dams and has taken action to have them repaired or rebuilt, and has investigated means of clearing the Park River Channel below the City of Grafton.

PROPOSED WATER CONSERVATION AND FLOOD CONTROL DISTRICTS

BOUNDARY CREEK DISTRICT

On April 15, 1960, upon petition containing the names of 58 landholders within the Boundary Creek watershed areas in northern Bottineau County, the Bottineau County Commissioners passed a resolution requesting the State Water Conservation Commission to hold a hearing on the establishment of a Boundary Creek Water Conservation and Flood Control District.

The Commission agreed to the request, the description of the district's boundaries was developed in the State Engineer's office and notice was given of the hearing scheduled for the 1st of June at Landa, North Dakota.

The Order establishing the Boundary Creek District has been issued, but the directors for the district have not been appointed. The legal requirements for establishing the district have been met and the district can be activated when desired by the local interests.

STONE CREEK DISTRICT

A resolution of the Bottineau County Commissioners requesting a hearing on the formation of a water conservation and flood control district comprising the Stone Creek watershed and backed by a petition containing the names of 54 landholders in the Stone Creek watershed area was received by the State Water Conservation Commission in April 1960.

The State Water Commission, after publishing and posting the required notice, held a hearing at Kramer, North Dakota, on June 1. Opposition to the formation of the district was strong at the hearing and, after discussion of all phases of the district operation, a standing vote was requested at which all who voted were against the formation of the district.

The formation of the district was therefore not approved. Future organization of the watershed area, for which the original request was made, will require a duplication of the action taken for the first hearing and a more favorable acceptance.

TOWNER COUNTY DISTRICT

On February 3, 1960, the Board of County Commissioners of Towner County passed a resolution requesting the State Water Conservation Commission to hold a hearing on the possibilities of a water conservation and flood control district in Towner County.

The State Water Commission conformed to this request and, after providing the notice required, held hearings at Rock Lake and Cando on April 25, 1960. The combined vote of the landholders at the two meetings was 74% for and 26% against the formation of a county-wide district.

As a result of the vote, the State Water Conservation Commission established a county-wide conservation and flood control district in Towner County. The district has not been activated by the appointment of directors by the Towner County Commissioners, and its future status is not completely resolved as of June 30, 1960.

Mandan Levee

WATER RIGHTS

North Dakota has already entered into an era where both industrial and agricultural developments are limited by inadequate water supplies. In the more nearly arid southwestern part of the state, this situation is most pronounced. Even in the Red River Valley, where rainfall is more abundant and water supplies are generally considered adequate, certain localities are experiencing water shortages. As the demands for water for beneficial purposes from the limited supply in North Dakota grow the importance of water rights becomes more apparent. In recent years there has been a noticeable increase in the water right filings made with the State Engineer. The water users making these filings request water for irrigation, municipal, industrial and other beneficial purposes. The water rights that they request, although they do not guarantee the user a water supply of a certain quantity, give him protection as to his priority of use.

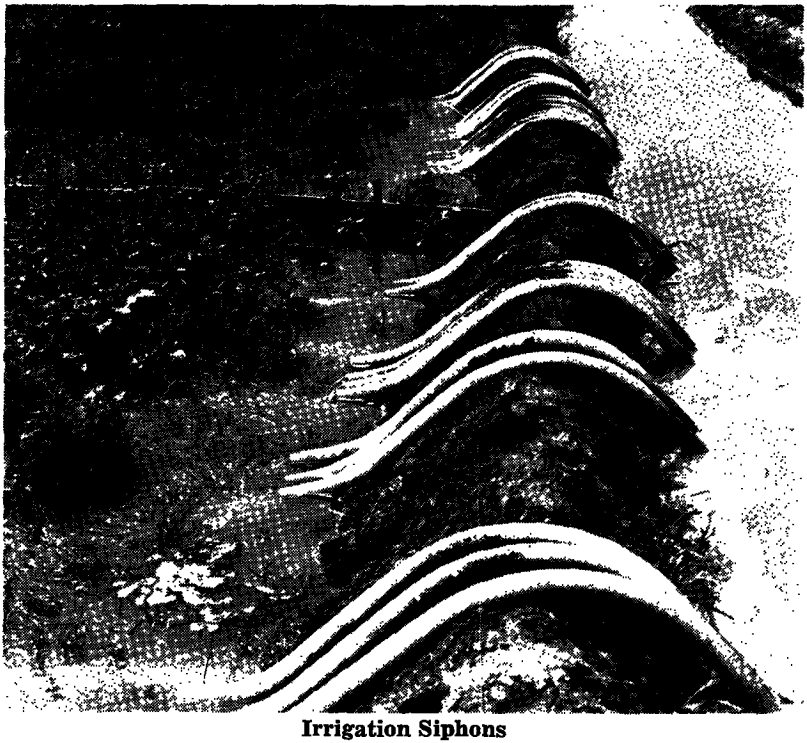
A water right which attaches to a water course is a right to the use of the flow of that water course and is not a private ownership in the water itself. This is the case whether the water right is based on ownership of riparian land or upon the statutory right of appropriation. The right of use is a property right and is entitled to protection to the same extent as other forms of property.

There are two doctrines used in the western states dealing with water rights — the riparian doctrine and the appropriation doctrine. 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 ownership. Under the appropriation doctrine, the first user of water acquires a priority to continue the use and the contiguity of land to the water course is not a factor. The appropriation doctrine requires the filing of a water right with a designated state agency in order to establish a priority of use. North Dakota recognizes both of these doctrines and operates under them. This practice is followed in several of the western states while in others the riparian doctrine has been abondoned entirely through court decisions and legislation and these states operate entirely under the appropriation doctrine. In North Dakota a riparian landowner has the right to the use of a limited amount of water from a stream or other water course because of his ownership in the land, but if he intends to use water for beneficial purposes, such as irrigation, he is required to file for a water right.

Section 61-0402 of the North Dakota Revised Code provides that "Any person, asociation 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 procedures to be followed in obtaining a water right. These procedures were outlined in the Ninth Biennial Report of the State Water Conservation Commission, and are available in instructions which are issued by the State Water Commission to prospective water right applicants.

There are very few court decisions in North Dakota dealing with the right to use water and many of the procedures followed in administering the laws dealing with water rights are based on practices and court interpretations in other of the 17 Western states. Involved in the interpretation of laws relating to water rights are many legal and technical questions that are difficult to determine. Questions as to what is riparian land, what constitutes beneficial use, and the conflict between the appropriation and riparian doctrines are but a few of such points. A recent District Court decision in North Dakota, if it is upheld as the interpretation of our water laws, would pose a serious question as to the validity of any water right obtained in the state under our appropriation doctrine. It is expected that this decision will be appealed to the Supreme Court of the State of North Dakota for final determination.



Irrigation Siphons

Waters which are of concern in the issuance of water rights in North Dakota come from two sources — surface waters and underground waters. Until 1957 there was no provision in the North Dakota law for the issuance of water rights under the appropriation doctrine for underground water sources. The 1957 Legislature enacted legislation requiring that a water right application be filed with the State Engineer for the beneficial use of waters from underground water sources. Water right filings have been required for surface water in North Dakota since 1905. Again, because of the lack of court decisions dealing with underground waters and an apparent conflict in certain of our laws, the rights of appropriators from underground water sources, whether these appropriations be under the riparian doctrine or the appropriation doctrine, undoubtedly will cause problems in the future.

Workable and practical water right laws are essential if full utilization of our limited water resources is to be accomplished and the development of our state both agriculturally and industrially is to go forward. Without the protection that a water right affords there would be few individuals or industries who would be willing to make the investment in their agricultural or industrial plant facilities that they would like to make. To assure an equitable distribution and full utilization of our state's water resources for all beneficial purposes, it has become necessary to allocate waters very carefully. In administering the state's water right laws the State Water Commission thoroughly reviews and investigates every water right application because the quantities allowed must be in proportion to the water available and must not be in excess of the water required. Even an apparently abundant water supply in a river or stream can rapidly become depleted or over-appropriated if unwise usage is authorized. If excess allowances of water were made because of inadequate investigation on the part of the issuing authority, a stream could be over-appropriated according to their records but actually a water supply would still exist that would otherwise be available to other water users anxious to develop such a supply. This situation has existed in the case of some North Dakota streams and provision should be made in the North Dakota Code for a procedure providing for the cancellation of water rights which have not been developed and are not being utilized. Such action would greatly enhance the efforts of the State Water Conservation Commission in controlling and providing for the full beneficial use of the limited water resources in the state.

In an attempt to determine the status of existing water rights in North Dakota the North Dakota Legislature in 1955 made an appropriation to the Commission to conduct a water right study. Much valuable information was gained from this study which has been beneficial to the Commission and the State of North Dakota in the administration of the state's water laws. This report was published in 1957 and was printed in the Eleventh Biennial Report of the Com-

mission. The 1959 Legislature recognized the problem involved in the administration of water rights and provided a small appropriation to the Commission to continue its work in this field.

In an attempt to determine ways to alleviate the problems involved in the administration of water rights in North Dakota the Commission has begun a study of water rights and the availability of water in several of the streams in the state. By using the data obtained from stream flow records of the U. S. Geological Survey and correlating it with water usage and proposed water usage, Commission Engineers are attempting to find a means for conserving the maximum amount of water and providing for its beneficial use. In many cases this valuable resource is now allowed to go to waste because of underdevelopment. This study appears to have great merit and will provide much valuable and important data to the state of North Dakota that could greatly enhance the development of the state's naural resources for agricultural and industrial purposes. A definite need exists to expand this study to enable the Commission to gather the essential data as soon as possible if the state is to continue its growth and expansion.

In addition to the valuable information that will be obtained from this study in determining the future development that is possible on many of our streams this study will provide basic and essential information of the extent of unappropriated water in these streams that can be safely used without damaging others. Already the Commission has found it neccessary to discontinue or drastically curtail the allotments of water for water right applicants in a large portion of the state until some provision is made for the storage of surplus waters during the spring of the year that can be released as needed for use in downstream areas. Specific streams which fall in this category include the Souris, Green, Cannonball, Cedar and Grand Rivers and Apple Creek. If water right applications continue at their high rate a similar action will undoubtedly be necessary in connection with the appropriation of water from other streams.

Although most of the water right applications received by the Commission are from individuals requesting water for irrigation purposes there has been an increasing number from municipalities for water supplies for their purposes. These municipalities have found it necessary to develop new water supplies to meet the demands created by increased population and industrial expansion. Presently the average per capita use of water in North Dakota is 101 gallons a day, but each year this per capita use increases. Because of availability of an excellent water supply in the Missouri River, Bismarck has a per capita usage of 179 gallons a day. Many of our municipalities depend on ground water aquifers for their water supplies which, in many cases, are limited in the quantity and quality of water that they produce. Several municipalities in the state must look to new sources for water as their needs increase. Of primary concern to industry in locating new plants is the water supply that is available. If

such a needed supply is not available, that industry must look elsewhere for its plant location. Although much information is available on the surface waters of the state much remains to be obtained relative to our ground water aquifers. Undoubtedly there are many of these aquifers located in the state that can support sizeable industrial and agricultural development. This information can be supplied only through thorough investigation and study. During the past biennium and, in view of the legislation enacted in 1957 providing for the issuance of water rights on ground water sources, many applications have been filed with the Commission for water rights from these sources to provide cities their water supplies. Municipal or domestic use of this type should have and is given the highest priority in the granting of water rights.

Certain legislation is needed relating to our water right laws that would enhance their administration and insure the full beneficial use for the most important purpose of our limited water resources. Consideration and study should be given to a procedure that would be provided under law for a priority use in the appropriation of the public waters of North Dakota. As the demand for waters from our rivers and streams and ground water aquifers increases with the growth and development of our state, and as the available water supply dwindles in quantity, it is apparent that some priority as to the use of the remaining water must be established. While the priority of use procedure is not advocated as a part of our water law it can be used in evaluating the granting of a water right.

In establishing such a priority of use system there are certain inherent problems that conflict with the priority of time that is followed under our appropriation doctrine.

Much of North Dakota's precious water is lost each year through evaporation from reservoir storage. The amount of this loss increases as the surface area or number of reservoirs, ponds or lakes increases. The loss of water from evaporation from stock water ponds through the excessive construction of such ponds and reservoirs has been very noticeable in the case of several of our river basins. Compatibility problems are occurring between identical uses resulting from those that desire to store stock water in the upper basins through the use of small impoundments and those who prefer to see the water flow in the principal streams for use by the riparian owner who desire to have a flowing stream as a stock water supply. This problem is occasionally further aggravated by irrigators who have water requirements during the low flow periods.

Officials from the State Water Conservation Commission and the Soil Conservation Service have spent considerable time in attempts to arrive at a policy that would better meet the needs of all three classes of users. A policy statement will soon be released which will be helpful in solving this problem.

The advisability of legislation requiring a water right for any use of water should be thoroughly explored and studied. A very urgent need, insofar as legislation dealing with our water right laws is concerned, is provision for a procedure for the cancellation of water rights that are not being used. On practically every stream in the State of North Dakota there are water right applications on record which have never been developed, nor has there been any effort made on the part of the owner to use the waters for which the application has been approved. Although our water right laws require the applicant to develop to beneficial use the water provided in his application within a specified time limit, there is no specific procedure outlined for the State Engineer or State Water Commission to follow in cancelling out such approved applications if this time limit is not complied with. Cancellation of water right applications for unneeded waters would, in effect, make them available in many cases to other potential water users who are anxious to develop irrigation systems or obtain water for other purposes.

Provisions should also be made in connection with our water right laws for the appropriation of water from the Missouri River for the vast Garrison Diversion Unit. The Garrison Diversion Unit is a project that will be developed over a 50-60 year period. If our present water right laws were to be followed in connection with the development of this project it is apparent that the requirement of our laws that a water right be developed with a five-year period and water placed to beneficial use could not be complied with. In effect this might adversely affect the claim of North Dakota to water from the Missouri River for the Garrison Diversion Unit in respect to the claims from lower basin states for water from the Missouri for beneficial purposes in their states. Specific legislation for the appropriation of water from the Missouri River for the entire Garrison Diversion Unit will be proposed to the next session of the legislature.

During the period July 1, 1958, to June 30, 1960, 103 water right applications were received by the State Engineer. A summary of these applications and a listing of the applications received during this period and those approved are as follows:

WATER RIGHTS

For Period July 1, 1958 to June 30, 1960

Number Filed			104
Number for Irrigation		84	
Acres Requested	15,559.49		
Acre Feet Requested	30,428.82		
Number Filed for Industrial Use		6	
Acre Feet	5,363		
Number Filed for Municipal & Industrial Use		10	
Acre Feet	55,731		
Number Filed for Recreation		4	
Acre Feet	1,630		
Number Approved			91
Number for Irrigation		73	
Acres	11,954.84		
Acre Feet	21,373.16		
Number Approved with Reduced Area		44	
Number for Industrial Use Only		5	
Acre Feet	5,343		
Number for Municipal and Industrial Use		10	
Acre Feet	45,979		
Number for Recreation		3	
Acre Feet	1,350		
Number Pending Approval, June 30, 1960			17

WATER RIGHT APPLICATIONS

July 1, 1958 to June 30, 1960

No.	NAME AND ADDRESS	County	Source	Acre Feet	Acres	Date of Claim	Status
766	Zontelli Bros., Ironton, Minn.	Stutsman	Groundwater	1,000		7-24-58	Approved
767	Williston Country Club, Inc., Williston	Williams	Little Muddy Creek	180	80	7-31-58	Deferred
768	F. J. Artz, Antler	Bottineau	Antler Creek	105	70	7-21-58	Approved
769	Harley Kissner, Antler	Bottineau	Antler Creek	97	65	7-21-58	Approved
771	Engleman & Engleman, Hazelton	Emmons	Long Lake	112	75.2	9- 3-58	Approved
772	N. D. Game & Fish, Bismarck	Slope	Cedar Creek	800		10- 7-58	Approved
773	Gotthilf Siewert, Richardton	Stark	Heart River	62	41.2	10-28-58	Approved
774	City of Devils Lake	Benson	Wells	6,720		10-31-58	Approved
775	Sheyenne Sand & Gravel, Sheyenne	Eddy	Sheyenne River	2,534		11-21-58	Approved
776	Peter Kronbauer, Jr., Mott	Hettinger	Cannonball River	18	12	11-25-58	Approved
777	James E. Roberts, Maxbass	Bottineau	Cut Bank Creek	120	80	12- 2-58	Approved
778	P. B. Madsen, Sidney, Mont.	McKenzie	Gooseberry Creek	120	96	12-11-58	Approved
779	Wm. F. Freymiller, Hettinger	Hettinger	Cannonball River	37	25.1	12-26-58	Approved
780	Albert Steffenson, Price	Oliver	Missouri River	844.8	422.4	12-29-58	Approved
781	Arthur A. Anderson, Arnegard	McKenzie	Red Wing Creek	470	235.3	1-14-59	Approved
782	Thomas Price, Price	Oliver	Missouri River	1,475.2	737.6	1-14-59	Approved
783	City of Minot	Ward	Wells	11,200		1-21-59	Pending
784	Warren, Howard & G. B. Long, Kramer	Bottineau	Stone Creek	192.5	192.5	2-13-59	Approved
785	Warren, Howard & G. B. Long, Kramer	Bottineau	Stone Creek	254	254	2-13-59	Approved
786	Northern Improvement Co., Bismarck	Burleigh	Groundwater	714		2-14-59	Approved
787	N. D. Agricultural Experiment Station	Foster	Wells	1,185	592.5	3- 2-59	Approved
788	Loren & Grace Oliver, Fargo	Cass	Red River	1	6.5	10-21-58	Approved
789	Ben T. Nordell, Williston	Williams	Missouri River	366.8	183.4	3-11-59	Approved
790	Manfred Cain, Bottineau	Bottineau	Unnamed Lake	96	64	3-18-59	Approved
791	Elvin Njos, Williston	Williams	Blacktail Creek	160	160	3-19-59	Deferred
792	Lloyd Njos, Williston	Williams	Blacktail Creek	400	240	3-19-59	Deferred
793	Thelma Houston, Wheaton, Minn.	Griggs	Sheyenne River	33	22.5	3-18-59	Approved
794	Maurice O'Connell, New England	Slope	Cannonball River	33	22	3-18-59	Approved
795	Fred M. Roberts, Jr., Bismarck	Burleigh	Burnt Creek	28.2	26.5	4-23-59	Pending
796	Fargo Country Club, Fargo	Cass	Red River	100	100.9	5- 5-59	Approved
797	Dan Panko, McIntosh, S. D.	Sioux	Cedar River	3	1.5	5- 7-59	Approved

798	C. J. Reff, H. T. Frederickson, Bismarck	Burleigh	Apple Creek	11	11.2	5-11-59	Approved
799	Patterson Land Co., Bismarck	Kidder	Ranch Lake	331	221.24	5-22-59	Approved
800	Patterson Land Co., Bismarck	Burleigh	Apple Creek	253.8	126.9	5-22-59	Refused
801	Bennie Larson, Valley City	Williams	Missouri River	640	320	6-16-59	Pending
802	Bernard Bourrett, Zahl	Williams	Little Muddy River	262	262.2	6-24-59	Approved
803	Vincent J. Magrum, Braddock	Emmons	Long Lake	80	53.6	7-21-59	Approved
804	John N. Gunderson, Ross	Mountrail	Missouri River	193	96.5	7-29-59	Approved
805	Village of Burlington	Ward	Wells	548		8- 1-59	Approved
806	Jack Padilla, Beulah	Mercer	Knife River	39	26	8- 6-59	Approved
807P	Alvin O. Foss, Tolley	Renville	Souris River	2	85	1914	Approved
808	Burns & Wretling, Stanton	Mercer	Missouri River	1,950.6	975.3	8-10-59	Approved
809	Art A. Eslinger, Elgin	Grant	Cannonball River	22.5	15	8-20-59	Approved
810	John Rouzie, Bowman	Slope	Little Missouri River	200	127.1	8-25-59	Approved
811	Midway Special School District 128, Gilby	Grand Forks	Wells	50		8-10-59	Approved
812	Alden Henderson, Breien	Morton	Wells	193.4	96.7	8-26-59	Approved
813	Charles Bublitz, Ambrose	Divide	Unnamed Creek	1.2	47	9- 8-59	Deferred
814	N. D. Game & Fish, Bismarck	Williams	Blacktail Creek	500		9 17-59	Approved
815	Carl M. & Fred C. Eidmann, Towner	McHenry	Wells	150	100	9-23-59	Approved
816	City of Lignite	Burke	Wells	480		10-13-59	Approved
817	Ervin Bourgois, Bismarck	Burleigh	Missouri River	421	210.8	12-30-59	Approved
818	Byron W. Snippen, Bismarck	Burleigh	Missouri River	422	211	12-30-59	Approved
819	Robert J. Jiran, Bismarck	Burleigh	Missouri River	499	249.6	12-30-59	Approved
820	George E. Shipp, Bismarck	Burleigh	Missouri River	275	137.4	1- 4-60	Approved
821	Arnold Schmidt, Mandan	Morton	Missouri River	726.8	363.4	1- 7-60	Approved
822	Warren Reid, Bismarck	Burleigh	Missouri River	571.6	285.8	1-14-60	Approved
823	City of Cavalier	Pembina	Tongue River	1,100		1-15-60	Approved
824	Edmund Dubs, New Leipzig	Grant	Cannonball River	22.5	15	1-19-60	Approved
825	J. W. Tyler, Bismarck	Burleigh	Missouri River	320	160	1-20-60	Approved
826	Ell Torrance, Bismarck	Morton	Cannonball River	22.5	15	1-25-60	Approved
827	Joe Kralicek, Jr., Dickinson	Stark	Green River	63.6	31.8	1-27-60	Approved
828	R. A. & E. F. Hehn, Leith	Grant	Cannonball River	22.5	15	1-23-60	Approved
829	Arthur Mutschelknaus, Elgin	Grant	Cannonball River	22.5	15	1-25-60	Approved
830	Edwin E. Rivinius, Elgin	Grant	Cannonball River	22.5	15	1-25-60	Approved
831	Ray K. Swindler, New Leipzig	Grant	Cannonball River	22.5	15	1-25-60	Approved
832	Miles & Lyle Michelson, New Leipzig	Grant	Cannonball River	22.5	15	1-23-60	Approved
833	Chester J. Hamers, Epping	Williams	Unnamed Creek	60	29.9	2- 1-60	Deferred
834	Dan J. McDonald, Bismarck	Burleigh	Well	636	318	2- 2-60	Approved

WATER RIGHT APPLICATIONS
July 1, 1958 to June 30, 1960

No.	NAME AND ADDRESS	County	Source	Acre Feet	Acres	Date of Claim	Status
835	City of Grand Forks	Grand Forks	Red River	53,623		1-23-60	Approved
836	Pan American Petroleum Corporation, Casper, Wyoming	Burke	Underground	1,085		2- 3-60	Approved
837	Frank Weisgarber, Hensler	Oliver	Missouri River	1,404	702	2- 4-60	Approved
838	Milton Roth, New Leipzig	Grant	Cannonball River	22.5	15	1-23-60	Approved
839	Chrisan Company, Fargo	Cass	Red River	20	20.6	12-29-59	Approved
840	James F. Manny, Center	Oliver	Square Butte Creek	45	30	2- 9-60	Approved
841	Ben Roth, Elgin	Grant	Cannonball River	22.5	15	2-10-60	Approved
842	Ben Roth, Elgin	Grant	Unnamed Creek	30	20	2-10-60	Approved
843	Melvin Hagen, Williston	Williams	Unnamed Creek	56	28	2-13-60	Approved
844	Jacob Wutzke, Elgin	Grant	Sheep Creek	22.5	15	2-16-60	Approved
845	Coca Cola Bottling Co., Jamestown	Stutsman	Underground	15		2-17-60	Approved
846	Cullen Bros., Hensler	Oliver	Missouri River	1,816	908	2-23-60	Approved
847	Edwin Hummel, Mott	Hettinger	Cannonball River	22.5	15	2-27-60	Approved
848	City of Cooperstown	Griggs	Wells	548		6-12-59	Approved
849	Ed Ulmer, Elgin	Grant	Antelope Creek	28	28	2-17-60	Approved
850	Robert Levis, Sanger	Oliver	Missouri River	3,856.2	1,928.1	3- 7-60	Approved
851	Raymond Schnell, Dickinson	Dunn	Knife River	80	245.8	3-17-60	Pending
852	Ardell Liudahl, Williston	Williams	Groundwater	50	50	3-22-60	Approved
853	Stanley Ripley, Medora	Billings	Little Missouri River	22.5	15	3-24-60	Approved
854	Ernest Tietz, Elgin	Grant	Cannonball River	22.5	15	4- 4-60	Approved
855	Max Borner, Stanton	Mercer	Knife River	176.4	88.2	4- 8-60	Approved
856	Leo Anderson, Fargo	Cass	Red River	180	180	4- 9-60	Approved
857	City of Kenmare	Ward	Des Lacs Lake	1,460		4-13-60	Approved
858	City of Fortuna	Divide	Underground	25		4-21-60	Approved
859	Lyle V. Witham, Towner	McHenry	Wells	662	331	4-28-60	Pending
860P	Dick Musch, Burlington	Ward	Souris River	112.1	56.2	1914	Approved
861P	Pritschet Bros., Foxholm	Ward	Souris River	140	70	1914	Approved
862	Casper B. Nervig, Williston	Williams	Little Muddy River	24	24	5- 6-60	Approved
863	W. C. Chaseley, Marmarth	Slope	Little Missouri River	22.5	15	5-10-60	Approved
864	Christensen-Thompson Ranch, Minot	McHenry	Well	200	160	5-18-60	Pending
865	Leo or Laverne Grewe, Washburn	McLean	Missouri River	894	447	5-27-60	Pending
866	Maurice Wick, Valley City	Barnes	Sheyenne River	15		5-31-60	Pending
867	Arnold J. Gunlikson, Zahl	Williams	Scoria Creek	246	123	6-11-60	Pending
868	Henry Hoadley, Towner	McHenry	Well	500	400	6-17-60	Pending
869	Edward S. Krieger, White Earth	Mountrail	White Earth River	112.6	56.3	6-30-60	Pending
870	Earl E. Bucklin, Mandan	Morton	Heart River	2	6.39	6-30-60	Pending

QUALITY OF WATER INVESTIGATIONS

As the unappropriated supply of fresh water dwindles in many portions of the state, an increased emphasis on the use of waters of poorer quality is becoming noticeable. It has also become evident that as the natural flows of streams are reduced the salinity increases. In a few streams in the western part of the state it has been noted that, during the periods of low flow, the percent of dissolved salts appears to be approaching the point where the water will be unsuitable for irrigation and other uses.

The U. S. Geological Survey has been making a limited number of studies of the quality of surface waters in North Dakota during the past fourteen years. In order to increase the amount of information obtained each year, the North Dakota State Water Conservation Commission has signed a contract, subject to approval, to share in the cost of the work of cataloging all available water quality data in the state. This program is scheduled to begin on July 1, 1961. Members of the Commission's staff have facilitated this study through the collection of water samples. Water samples are taken from various streams as business trips are required for other purposes. The samples are analyzed by the State Laboratory.

SALINE WATERS

In recent years the extraction of fresh water from saline and salt waters has become a major method of obtaining potable water in many parts of the world. To assist in research for improved and cheaper methods of extraction of fresh water and to inform the American public of methods of conversion, the office of Saline Water has been set up as a branch of the U. S. Department of the Interior.

The North Dakota State Water Conservation Commission has assisted this agency in its efforts to select a location for a demonstration plant for water conversion in the Northern Great Plains area. The Commission has furnished data on saline water supplies and information on cities and towns in North Dakota which appear to be in need of additional supplies of fresh water and which have supplies of saline water available for a demonstration plant. Assistance in inspecting possible locations for a 250,000 gallon a day conversion plant was also given by the Commission. Although the first demonstration plant in the Northern Great Plains will not be in North Dakota, it is anticipated that other demonstration plants of a size needed in North Dakota will be authorized at a later date.

HYDROLOGY STUDIES

Drouth which prevailed in most areas in northwest and southwest North Dakota was responsible for an increasing interest in maintaining the greatest possible stream flow in these areas during the past two seasons. Many of the streams, such as the Cedar, the Cannonball, the Green, Apple Creek and the Souris, were at times without flow.

The riparian owner who was dependent upon streams of this nature for stock water was greatly concerned over these low flow conditions. Bitter complaints were registered with the State Water Conservation Commission against irrigators who showed a tendency to pump from the streams during the critical flow periods. It was necessary for the State Water Conservation Commission to apply restrictions on the water use from some of these streams in order that the riparian owner could have water for stock. Also affecting the flow in the stream is the fact that many stock water impoundments have been constructed in the upper reaches of these streams thereby eliminating flow that might normally flow to the major streams. It also became apparent that restrictions would be necessary on the number of dams to be constructed in the upper reaches. Meetings were held with water users, Commission staff members and the Soil Conservation Service relative to methods of improving the problem. Studies were made by the State Water Commission in cooperation with the Soil Conservation Service as to the proper spacing of stock water impoundments. It was recommended that the dugout type of impoundment be given priority over the impoundments that result from construction of a dam. It was believed that through such a practice evaporation could be minimized. The State Water Conservation Commission has also advocated the use of hexadecanol or other evaporation suppressents on these reservoirs which in turn might curtail evaporation and extend the available water to greater use.

The increasing demand for water in impoundments and streams indicates the need for a hydrology study of all our streams and tributaries of importance. The staff of the Commission has embarked on such a study. Watershed maps covering the drainage areas of the various streams and tributaries are being prepared. The present water uses are being cataloged on the maps. It is hoped that through a continuing study the Commission will be in a position to ascertain the number of active water rights, the number of stock water impoundments, both of a surface and dugout type, and any other major water use that may occur on the stream being evaluated. This will afford the Commission a better opportunity to determine the granting of future water rights regardless of their use. A study of this type will also permit the opportunity to install gaging stations at proper locations for better stream evaluations.

Several water disputes occurred during the 1959 and 1960 growing season. They were generally the results of irrigators using water during extreme drouth periods and when the stream flow was at a minimum. Such disputes occurred on the Cedar River, the Cannonball River, Apple Creek and the Souris River. Considerable time, on the part of the Water Commission staff members, was required in order to alleviate the resulting tense conditions and to make proposals whereby the situations might be rectified.

Some farmers contend that the flow in some of the streams in question result from improved farming practices. They contend that since strip farming has been widely practiced a greater amount of runoff water is impounded in the soil where it falls. This practice of strip farming is to be recommended, as the water stored in the ground and made available for crop production creates an improved economy for the farmer.

The Commission will also consider a zoning system which could be used in the issuance of water rights. The system, when properly evaluated, would provide for the construction of stock water ponds on a much more liberal basis in those areas that are designated as non-contributing in nature. The present definition of a non-contributing area is one where the water does not flow into a definite water course more than once every three years on the average. This liberalization would also be extended to predetermined areas adjacent to the Missouri, Yellowstone and the Little Missouri Rivers. This study will get underway during fiscal 1961.

INFORMATION PROGRAM

In conjunction with its other activities the State Water Conservation Commission conducts an extensive information program relating to the water resources of North Dakota. In this program an effort is made to bring factual information and data relating to specific water resources projects and the water resources program in general to the public. This program involves the preparation and display of exhibits, appearances before numerous organizations, and the assembly and distribution of maps and printed material relating to the water resources program in the state.

The Commission has had prepared a large six-color map which depicts existing and potential water resources projects located throughout the state. This map has been reproduced in quantity and has been distributed free of charge to all the schools in the state and other individuals and organizations requesting a copy. It is used in many displays and has been effective in bringing information about the water resources developments in North Dakota to all the people of the state. A limited number of copies is available at the office of the State Water Conservation Commission for distribution to other individuals and organizations upon request.

Throughout the year the Commission displays an exhibit on the water resources program at many fairs, conventions, and other func-

tions in various cities of North Dakota. This exhibit consists of maps, pictures, charts, graphs and other data pertaining to water resources in general and specific projects which are existing or are proposed for development in the state. The exhibit requires a space of approximately 24 feet and is available for display at appropriate functions upon request. One employee of the Commission devotes a portion of his time to this work.

During the course of a biennial period the Commission receives approximately 1,500 requests for general information relative to the state's water resources development program. Insofar as funds have been available the Commission has prepared various printed booklets and pamphlets dealing with the water resources program which have been used to fill these requests. By having such material available for distribution the information requested can be provided much more readily than would be the case if a specific answer were required for each request. Presently the Commission's supply of printed material available is becoming depleted or out dated and should be augmented by new publications. The extent of such publications will be dependent upon funds available for this purpose.

Much of the progress that has been made in conjunction with the water resources program in North Dakota can be attributed to th continuing effort of the Commission to bring information relative to this program to the public. This activity is an important function of the Commission and it is recommended that it be maintained at a high level of efficiency.

Part of State Water Commission Exhibit

FINANCIAL

STATUS OF 1957 - 1959 APPROPRIATIONS

June 30, 1960

	AVAILABLE FUNDS				FUND BALANCES		
	FUND	Appropriation	Receipts	Disbursements To Date	Unexpended	Encumbered	Unencumbered
1.	Commissioners Per Diem and Exp.	$ 6,000.00	$	$ 6,000.00	$	$	$
2.	Administration	47,000.00	2,797.33	49,579.27	218.06		218.06
3.	Maintenance of Dams	105,000.00	101,910.58	206,910.58			
4.	International and Interstate Expenses	8,000.00	14.85	7,997.33	17.52		17.52
5.	Topographic Surveys, USGS	30,000.00		30,000.00			
6.	Hydrographic Surveys, USGS	27,500.00		27,500.00			
7.	Engr. and Geol. Surveys, USGS	37,500.00	5,306.81	42,806.81			
8.	Coop. with U. S. Dept., etc.	50,000.00	10.00	50,004.93	5.07		5.07
9.	Small Projects, etc.	118,000.00	2,374.98	120,374.98			
10.	Admin. of Water Laws	6,000.00		6,000.00			
11.	OASIS Contributions	3,800.00	4,541.24	8,341.24			
		$438,800.00	$116,955.79	$555,515.14	$240.65	$	$240.65

STATUS OF 1959 - 1961 APPROPRIATIONS

June 30, 1960

	AVAILABLE FUNDS				FUND BALANCES		
	FUND	Appropriation	Receipts	Disbursements To Date	Unexpended	Encumbered	Unencumbered
1.	Commissioners Per Diem and Exp.	$ 6,000.00	$	$ 2,320.78	$ 3,679.22	$ 892.21	$ 2,787.01
2.	Administration	49,200.00	294.73	23,374.17	26,120.56	564.64	25,555.92
3.	Maintenance of Dams	115,000.00	67,094.55	157,864.55	24,230.00	8,314.79	15,915.21
4.	International and Interstate Expenses	10,000.00		2,890.64	7,109.36	576.42	6,532.94
5.	Topographic Surveys, USGS	30,000.00		12,727.13	17,272.87	17,272.87	
6.	Hydrographic Surveys, USGS	27,500.00	900.00	12,098.57	16,301.43	4,800.80	11,500.63
7.	Engr. & Geol. Surveys, USGS	57,500.00		19,524.56	37,975.44	12,975.44	25,000.00
8.	Coop. with U. S. Dept., etc.	57,000.00		21,026.71	35,973.29	3,371.16	32,602.13
9.	Engineering Investigations	138,000.00		63,419.29	74,580.71	3,553.28	71,027.43
10.	Administration of Water Laws	6,000.00		823.50	5,176.50		5,176.50
11.	OASIS Contributions	6,500.00		3,211.12	3,288.88	1,307.16	1,981.72
		$502,700.00	$68,289.28	$319,281.02	$251,708.26	$53,628.77	$198,079.49

STATUS OF CONTINUING APPROPRIATIONS

June 30, 1960

20.	Multiple Purpose	$200,000.00					
	(Carried Forward)	178,751.98	$ 4,981.28	$100,625.15	$283,108.11	$251,551.43	$ 31,556.68
21.	Construction Bond Guarantee						
	(Carried Forward)	$ 77,056.64	$ 3,236.60	$	$ 80,293.24	$	$ 80,293.24

STATUS OF BONDS RECEIVABLE
June 30, 1960

TYPE	Due Date	Interest Rate	Principal Balance
U. S. Series G Bonds	3-62	2½%	$ 5,000.00
U. S. Treasury Bonds	12-15-68	2½%	3,000.00
U. S. Series K Bonds	5-65	2.76%	1,500.00
U. S. Series K Bonds	4-67	2.76%	2,000.00
Sioux Irrigation Dist. Bonds	1984 Serial	2¼%	18,500.00
			$30,000.00

Interest received on these bonds and receipts from retirement are deposited to the credit of the "Construction Bond Guarantee Fund", a continuing appropriation, until such time as the fund is restored to its original level of $90,000.00. This level will be attained in 1964 at which time Legislative action will be required to determine the disposition of the funds received in excess of the original appropriation. It is recommended that the excess funds at that time be left to accumulate in a separate fund for future water resource projects. The moneys appropriated to the "Construction Bond Guarantee Fund" are used to guarantee or insure, or agree to pay, the interest on and principal of revenue bonds issued by the State Water Conservation Commission and Irrigation Districts to the extent of not to exceed 20% of the bond issue.

STATEMENT OF COLLECTIONS
July 1, 1958 — June 30, 1960

FUND CREDITED	Source	Amount
Administration	Sales of Maps and Field Notes	$ 759.87
Maintenance of Dams	Participant's share of projects	133,961.61
Hydrographic Surveys	Participant's share of gaging station	900.00
Multiple Purpose	Participant's share of projects	25,839.42
Construction Bond Guarantee	Bond Retirement and interest	4,617.65
General Fund	Water right filing and land rental	2,882.00
	Groundwater Survey payments – FY '60	7,500.00
	Yellowstone Pumping ID Warrant – FY '60	151.49
*Bank of N. Dak. Account	Groundwater Survey payments – FY '60	16,600.00
*Bank of N. Dak. Account	Yellowstone Pumping ID Warrant – FY '59	469.61

*Balance of these accounts transferred to the General Fund on July 1, 1959 as per House Bill 543.

EXPLANATION OF INDIVIDUAL FUNDS

Commissioners' Per Diem and Expenses Fund —

The appropriation for this item is used to pay the per diem allowance of $7.00 per day and expenses of the members of the Commission while attending meetings, hearings, and performing other work for the Commission.

Administration Fund —

The appropriation for this item is used for the general office and administrative operating expenses of the Commission. The salaries of the Assistant Secretary, chief steno, file clerk, accountant, clerk-typist, and part-time clerical help are paid from this item along with the cost of supplies, equipment, travel expenses, communications, printing and other general office expenses.

Maintenance of Dams Fund —

The appropriation for this item is used to finance the construction and repair of small dams in the State in cooperation with the State Game and Fish Department and local entities. A summary of the projects which the Commission has constructed or repaired during the period of this report are shown in the chapter on "Construction".

In conducting its program of repair of small dams, the Commission has adopted a policy whereby the repair work must be requested by a local organization and the local interests must contribute toward the cost of the work. It has been the experience of the Commission that the amount of participation by local interests and the State Game and Fish Department more than equals the funds appropriated to the Commission by the Legislature for this work.

The salaries of the Assistant State Engineer, Construction Engineer, two construction foremen, and hourly construction employees are paid from this item along with travel expenses, equipment, supplies and materials, equipment operation and maintenance, contract payments, and other expenses relating to the dam maintenance program.

International and Interstate Commissioners and Conference Expenses Fund —

This item of the appropriation is used to pay the expenses of the Commissioners and employees while engaged in work for the Commission on problems of an international or interstate nature. This includes participation in meetings of the National Reclamation Association, Mississippi Valley Association, National Rivers and Harbors Congress, Association of Western States Engineers, Missouri Basin Inter-Agency Committee, Missouri River States Committee, International Joint Commission, meetings with neighboring States on various Water Compacts, hearings of the Senate Select Committee on National Water Resources and the Corps of Engineers.

Topographic Surveys, Cooperation with U. S. Geological Survey Fund —

Appropriations for this item are used to pay the Commission's 50% share of the costs of the topographic mapping program conducted cooperatively with the U. S. Geological Survey, Topographic Branch. The maps produced through this program are essential in planning and developing the water resources of the State along with industrial, highway, and urban development. The details of this program are given under the chapter "Cooperating Agencies-Federal".

Hydrographic Surveys, Cooperation with U. S. Geological Survey Fund —

Appropriations for this item are used to carry on the stream gaging program in cooperation with the U. S. Geological Survey, Hydrographic Branch. The funds provided for this item are matched in full by the Federal government. Under this cooperative program, basic data as to the discharge of the rivers and streams in the State is gathered and compiled for use in planning water resource projects, highway, industrial, and drainage projects. The information derived from this program is also essential in considering water right applications and determining right to water flowing through the State into Canada and neighboring States. Details of this program are shown under the chapter "Cooperating Agencies — Federal".

Engineering and Geological Surveys, Cooperation with U. S. Geological Survey Fund —

This item of the appropriation is used to finance the Commission's share of the cooperative ground water survey program conducted with the U. S. Geological Survey, Groundwater Branch. The Commission furnishes the drilling equipment, drillers, and supplies necessary to perform the test drilling work and receives credit from the U. S. Geological Survey on a footage basis for the drilling performed under the direction of the U. S. Geological Survey geologist. The Commission also contributes funds to match the U. S. Geological Survey expenditures for other phases of the cooperative prgram. The work involved in this program includes field investigations, test drilling, compilation and analysis of the information gathered and publication of a report of the survey. The county, city, or town for which the survey is conducted contributes a share of the cost. These receipts are deposited to the credit of the General Fund. Details of this program are shown under the chapter "Cooperating Agencies — Federal".

Cooperation with U. S. Departments and for Organizing Conservation and Irrigation Districts Fund —

Appropriations for this item are used to finance various cooperative programs with the Bureau of Reclamation, Corps of Engineers, and other Federal Agencies as well as to provide for the organization of various types of districts required in connection with the development of water resource projects.

Salaries, travel expenses, and related costs of employees engaged in these projects along with equipment operation, printing, and equipment costs are paid from this item. Dues to the National Reclamation Association, Mississippi Valley Association, National Rivers and Harbors Congress, Association of Western State Engineers, and the North Dakota Water Users Association are also paid from this item. During the 1961-1963 biennium it is proposed that the drainage engineer's salary and expenses be paid from this item. He is employed in cooperation with the State Highway Department to alleviate drainage problems which exist in many areas of the State.

Engineering Investigations, Surveys, and Design of Water Resource Projects Fund —

Funds appropriated to the Commission for this item are used to maintain the majority of the engineering and surveying staff including the State Engineer and Chief Engineer, Office Engineer, Investigation Engineer, a survey crew, a drilling crew, and two draftsmen. In addition, funds for this item are used to pay for the travel expenses, equipment, supplies, equipment operation and maintenance, and other related costs in connection with the investigations, surveys, and design of water resource projects performed by the Commission. Details of surveys and investigations are reported under the chapter "Investigations" in this report.

Administration of Water Rights Fund —

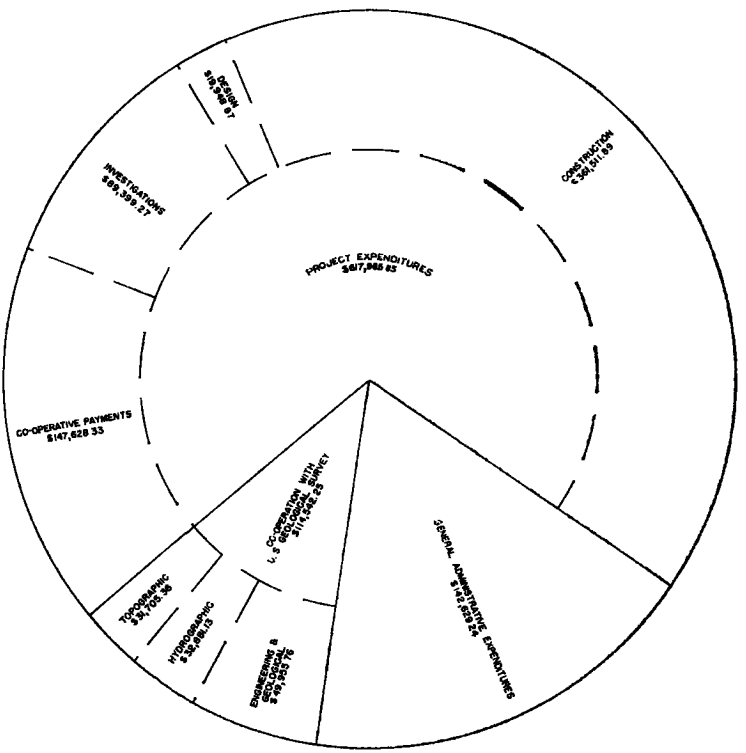
Appropriation for this item are used to pay part of the salaries, travel expenses, and related costs of personnel assigned to this phase of the Commission's program. It is proposed that a full-time hydraulic engineer be employed to handle the ever-increasing administrative work involved in the administration of water rights. Details on this phase of the Commission's activities are shown under the chapter "Water Rights" in this report.

Multiple Purpose Fund —

The Multiple Purpose Fund was established in 1955 by the North Dakota Legislature as a continuing appropriation to replace the appropriation that had been made to the State Water Conservation Commission since 1943 titled: "Construction and Reconstruction of Drains and Irrigation". There was a definite need to establish this fund as a continuing appropriation because many of the projects for which expenditures from this fund were made usually required more than a biennial period to complete from the beginning of planning, when the allocation from the fund is made, to the completion of construction when payment is remitted. The Legislature recognized the problems that were involved in administering this fund on a biennial appropriation basis and in 1955 made this appropriation available until expended.

The State Water Conservation Commission, through the Multiple Purpose Fund, aids the various counties, cities, towns, drainage districts, irrigation districts, and water conservation and flood control districts in the State in drainage, flood control, irrigation, snagging and clearing of streams, and other types of water resource projects. A large portion of the expenditures are in the form of payments to sponsoring districts for a share of the project costs, although in some cases the Commission uses its own crews to accomplish the actual construction.

The budget request to the Legislature for this fund is based on the amount of money required to restore the fund to a sufficient level to take care of the anticipated demands during the next two-year period.



NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
EXPENDITURES
JULY 1, 1958-JUNE 30, 1960

STATEMENT OF MULTIPLE PURPOSE FUND

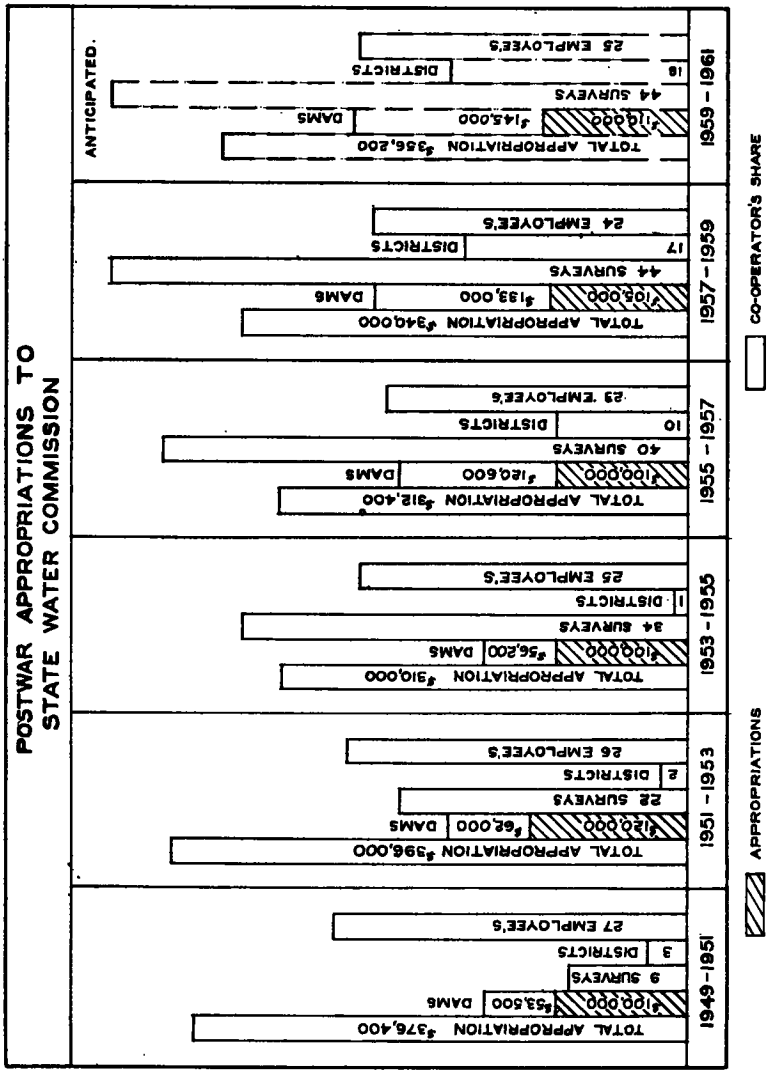
(a)

Appropriation by Legislature, July 1, 1957		$200,000.00
Refunds, 1957 - 1959		27,802.65
Brought Forward from 1955 - 1957 Continuing Appropriation		184,892.93
		$412,695.58
Expenditures for Drainage, Flood Control, Irrigation, and other Water Resource Projects: July 1, 1957-June 30, 1959:		
Benson and Ramsey Co. — Ziebaugh Pass	$ 2,543.20	
Bottineau County — Drain No. 2	720.30	
Bottineau County — Kane-Tacoma Drain	15,365.18	
Cass County — Drains No. 3 and 10	224.00	
Cass County — Drain No. 10	16,434.95	
Cass County — Drain No. 19	3,702.50	
Cass County — Drain No. 39	6,753.03	
Grand Forks County — Drain No. 9	5,441.53	
Grand Forks County — Drain No. 11	12,370.13	
Grand Forks County — Drain No. 28	9,354.74	
Eaton Flood Irrigation District	6,174.69	
Cartwright Irrigation Dist. Investigation	2,267.95	
Lower Heart River Flood Control Dist.	40,000.00	
Pembina County — Drain No. 10	8,935.66	
Pembina County — Drain No. 13	8,080.55	
Pembina County — Rhinelander Drain	2,617.12	
Ramsey County — Lake Irvine	5,607.14	
Richland County — Drain No. 1	1,147.80	
Richland County — Drain No. 2	969.13	
Richland County — Drain No. 7	4,414.39	
Richland County — Drain No. 55	1,718.75	
Traill County — Drain No. 18	1,262.70	
Williams County — Twin Lakes Cleanout	923.08	
Ancient Channel Surveys, Investigations, Equipment and Miscellaneous	49,112.43	
Participants share of Projects (Refunds)	27,802.65	$233,943.60
Allocations made for projects in progress or to be under construction in the biennium; Balance available in the Multiple Purpose Fund until expended and used in making allocations in 1959-1961 biennium		$178,751.98

(b)

Appropriation by Legislature, July 1, 1959		$200,000.00
Refunds — 1st Year of Present Biennium		4,981.28
Brought forward from 1957-59 Continuing Appropriation		178,751.98
		$383,733.26
Expenditures for Drainage, Flood Control, Irrigation, and other Water Resource Projects; July 1, 1959-June 30, 1960:		
Bottineau County — Ovregaard Lateral	$ 11,137.09	
Cass County — Drain No. 22	9,525.38	
Divide County — Long Creek	201.47	
Grand Forks County — Drains No. 1 and No. 2	14,807.45	
Pembina County — Rhinelander Drain	1,945.86	
Pembina County — Drain No. 11	4,025.46	
Pembina County — Drain No. 43	4,426.41	
Pembina County — Park River Channel Change	551.26	
Richland County — Drain No. 2	8,294.96	
Steele County — Golden Lake	3,016.85	
Richland County — Drain No. 5	5,774.34	
Richland County — Drain No. 17	2,433.50	
Traill County — Drains No. 4 and 14	10,430.95	
Eaton Flood Irrigation District	11,680.13	
Sioux Irrigation District	2,392.76	
Investigations, Equipment, and Misc.	5,000.00	
Sponsors share of Projects (Refunds)	4,981.28	$100,625.15
Unexpended Balance as of June 30, 1960		$283,108.11
Estimated Refunds, Sponsors share of projects constructed by Commission — July 1, 1960 to June 30, 1961		35,018.72
		$318,126.83

Allocations made for projects in progress or to be constructed in near future:		
Bowman County — Scranton Flood Control	$ 15,000.00	
Cass County — Drain No. 12	1,116.59	
Cass County — Drain No. 13	4,294.00	
Cass County — Drain No. 19	1,746.78	
Cass County — Drain No. 21	28,000.00	
Cass County — Drain No. 29	2,000.00	
Cass County — Drain No. 30	2,197.21	
Cass County — Drain No. 45	1,515.07	
Cass County — Drain No. 49	4,000.00	
McHenry County — Oak Willow Creek Clearing	3,000.00	
Sioux Irrigation District	3,000.00	
Lewis and Clark Irrigation District	17,500.00	
Pembina County — Drains No. 4 and 18	18,169.60	
Pembina County — Drain No. 6	14,615.84	
Pembina County — Drain No. 7	11,200.00	
Pembina County — Drain No. 64	3,444.29	
Richland County — Drain No. 2	6,013.20	
Richland County — Drain No. 63	5,274.68	
Richland County — Drain No. 64	3,905.01	
Slope County — Marmarth Flood Control	8,577.16	
Stutsman County — Pipestem Project	6,000.00	
Stutsman County — Jamestown Flood Control	8,800.00	
Traill County — Drain No. 35	8,632.00	
Eaton Irrigation District	3,500.00	
Ramsey County — Lake Irvine	6,400.00	
Cass County — Fargo Flood Control	28,000.00	
Ancient Missouri River Channel Surveys	13,900.00	
Pembina County — Walhalla Park Cutoff	12,000.00	
Walsh County — Park River Snagging and Clear.	5,000.00	
General Investigations	3,500.00	
Minot Ground Water Survey	1,250.00	$251,551.43
Estimated amount available for Allocation for Drainage, Flood Control, Irrigation, and other Water Resource Projects through June 30, 1961		$ 66,575.40


POSTWAR APPROPRIATIONS TO STATE WATER COMMISSION
ANTICIPATED.
1949 - 1951
TOTAL APPROPRIATION $376,400
$100,000 $53,500 DAMS
9 SURVEYS
3 DISTRICTS
27 EMPLOYEES
1951 - 1953
TOTAL APPROPRIATION $396,000
$120,000 $66,000 DAMS
22 SURVEYS
2 DISTRICTS
26 EMPLOYEES
1953 - 1955
TOTAL APPROPRIATION $310,000
$100,000 $56,200 DAMS
34 SURVEYS
1 DISTRICTS
25 EMPLOYEES
1955 - 1957
TOTAL APPROPRIATION $312,400
$100,000 $120,600 DAMS
40 SURVEYS
10 DISTRICTS
23 EMPLOYEES
1957 - 1959
TOTAL APPROPRIATION $344,000
$105,000 $133,000 DAMS
44 SURVEYS
17 DISTRICTS
24 EMPLOYEES
1959 - 1961
TOTAL APPROPRIATION $356,200
$120,000 $145,000 DAMS
44 SURVEYS
18 DISTRICTS
25 EMPLOYEES
APPROPRIATIONS
CO-OPERATOR'S SHARE

SUMMARY OF DRAINAGE, FLOOD CONTROL, IRRIGATION, AND OTHER WATER RESOURCE PROJECTS

Construction and Reconstruction of Drains and Irrigation Fund Expenditures: 1943-1955

Multiple Purpose Fund Expenditures: 1955-1960

July 1, 1943 to June 30, 1960

COUNTY AND/OR PROJECT	1943-1955	1955-1957	1957-1959	1959-1960	TOTAL
(Brought Forward)	$	$	($184,892.93)	($178,751.98)	($ 363,644.91)
Barnes County	3,838.72	.....	.....	.....	3,838.72
Benson-Ramsey County	.....	.....	2,543.20	.....	2,543.20
Bottineau County	9,268.00	.....	16,085.48	11,137.09	36,490.57
Cass County	194,903.38	.....	27,114.48	9,525.38	231,543.24
Cavalier County	6,452.78	.....	.....	.....	6,452.78
Dickey County	3,798.55	.....	.....	.....	3,798.55
Divide County	.....	.....	.....	201.47	201.47
Grand Forks County	23,509.76	.....	27,166.40	14,807.45	65,483.61
Morton County	2,995.00	.....	.....	.....	2,995.00
Pembina County	109,061.72	.....	19,633.33	10,948.99	139,644.04
Ramsey County	1,056.25	9,105.01	5,607.14	.....	15,768.40
Richland County	135,047.84	.....	8,250.07	16,502.80	159,800.71
Sargent County	5,877.69	.....	.....	.....	5,877.69
Steele County	.....	.....	.....	3,016.85	3,016.85
Traill County	132,145.83	.....	1,262.70	10,430.95	143,839.48
Walsh County	9,403.32	.....	.....	.....	9,403.32
Walsh-Pembina County	43,289.78	.....	.....	.....	43,289.78
Williams County	.....	.....	923.08	.....	923.08
Burlington Irrigation Project	2,144.80	.....	.....	.....	2,144.80
Cartwright Irrigation District	.....	.....	2,267.95	.....	2,267.95
Eaton Fl. Irrigation District	2,891.19	.....	6,174.69	11,680.13	20,746.01

Lewis and Clark Irrigation District	8,456.35				8,456.35
Oakes GW Irrigation District		4,959.05			4,959.05
Sioux Irrigation District	6,910.60			2,392.76	9,303.36
Lower Heart Flood Control			40,000.00		40,000.00
Snagging and Clearing	28,086.48				28,086.48
GW Surveys, Equipment, etc.	37,081.22	1,043.01	49,112.43	5,000.00	92,236.66
Returned to General Fund	103,780.74				103,780.74
Multiple Purpose Fund:					
Encumb. Bal. (6-30-60)				251,551.43	251,551.43
Unencumb. Bal. (6-30-60)				31,556.68	31,556.68
Carried Forward		184,892.93	178,751.98		363,644.91
APPROPRIATIONS	$870,000.00	$200,000.00	$200,000.00	$200,000.00	$1,470,000.00

SUMMARY OF PROPOSED BUDGET
MULTIPLE PURPOSE FUND

Fund	Expend. Past. Bi.	Expend. 1st Year Pres. Bi.	Est. Expend. 2nd Year Pres. Bi.	Present Budget	Proposed Budget	Increase
Multiple Purpose	$233,943.60(a)	$100,625.15	$318,126.83(b)	$200,000.00	$300,000.00	$100,000.00

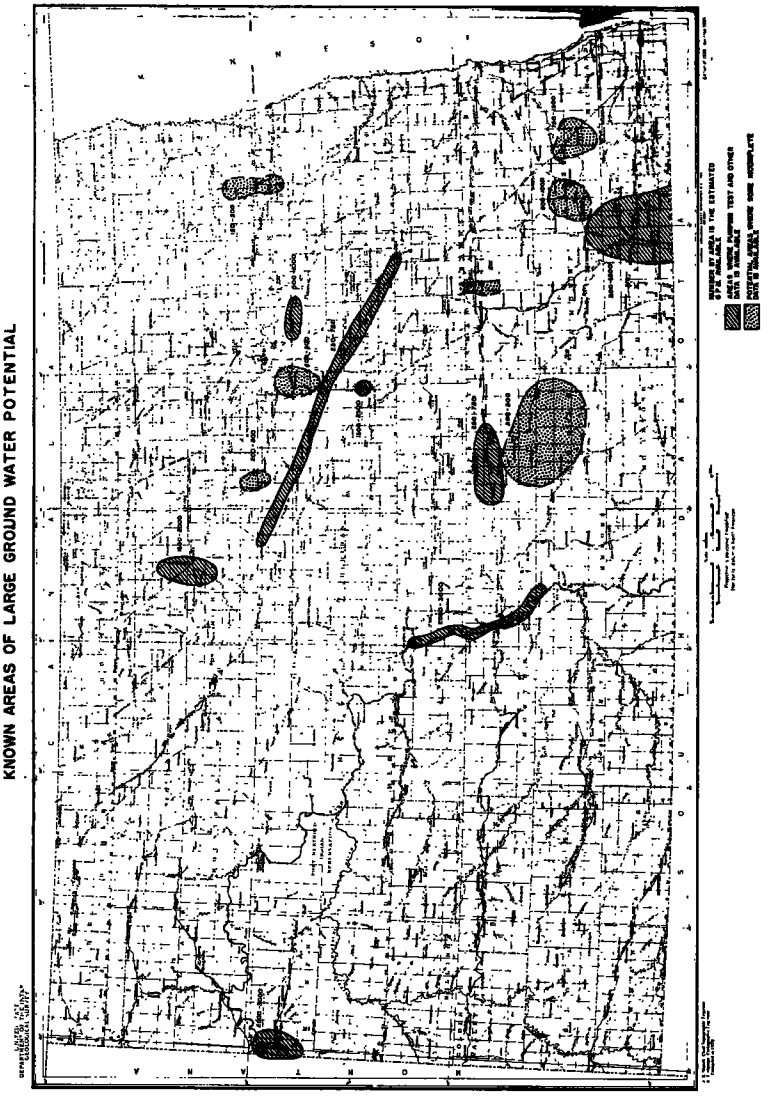
Note: Footnotes (a) and (b) follow "Explanation of Individual Funds — Multiple Purpose Fund".

SUMMARY OF PROPOSED BUDGET

1961-1963 Biennium

Fund	Expend. Past Bi.	Expend. 1st Year Pres. Bi.	Est. Expend. 2nd Year Pres. Bi.	Present Budget	Proposed Budget	Increase (Decrease)
1. Commissioners' Per Diem & Exp.	$ 5,476.38	$ 2,320.78	$ 3,700.00	$ 6,000.00	$ 6,000.00	$ .....
2. Administration	49,579.27(a)	23,374.17(a1)	26,350.00(a2)	49,200.00	55,000.00	5,800.00
3. Maintenance of Dams	206,910.58(b)	157,864.55(b1)	137,100.00(b2)	115,000.00	150,000.00	35,000.00
4. Int'l. and Interstate Expenses	7,997.33	2,890.64	7,100.00	10,000.00	10,000.00	.....
5. Topographic Surveys, USGS	30,000.00	12,727.13	17,272.87	30,000.00	30,000.00	.....
6. Hydrographic Surveys, USGS	27,500.00	12,098.57	16,301.43(c)	27,500.00	30,000.00	2,500.00
7. Engr. and Geol. Surveys, USGS	42,806.81	19,524.56	37,975.00	57,500.00(d)	57,500.00	.....
8. Coop. with U. S. Dept., etc.	50,004.93	21,026.71	36,000.00	57,000.00	70,000.00	13,000.00
9. Engineering Investigations, etc.	120,277.41(e)	63,419.29	74,600.00	138,000.00	155,000.00	17,000.00
10. Admin. of Water Rights (f)	6,000.00	823.50	5,300.00	6,000.00	17,500.00	11,500.00
11. OASIS Contributions	8,341.24(g)	3,211.12	3,288.88	6,500.00	10,000.00	3,500.00
12. Irrig. Project Development, etc. New Item	.....	.....	.....	.....	85,000.00	85,000.00
	$554,893.95	$319,281.02	$364,988.18	$502,700.00	$676,000.00	$173,300.00

(a) Includes Transfer from No. 1 - $523.62; No. 3 - $1,344.33; No. 9 - $97.57; Refunds - $613.75 — Total $2,579.27.
(a1) Includes refunds of $294.73.
(a2) Includes anticipated refunds of $229.44.
(b) Includes refunds of $103,254.91.
(b1) Includes refunds of $67,094.52.
(b2) Includes estimated refunds of $112,870.00.
(c) Includes refund of $900.00.
(d) Includes transfer from Emergency Commission of $20,000.00; change in State Law pertaining to deposit of funds from Cooperators in Groundwater Surveys necessitated an increase in this item; the Legislature adjourned before an Appropriation could be made.
(e) Includes refunds of $2,374.98.
(f) Previous Title of this item was: Administration of Water Laws.
(g) Includes transfer from Emergency Commission - $4,541.24.


KNOWN AREAS OF LARGE GROUND WATER POTENTIAL

EXPLANATION OF PROPOSED BUDGET

All items shown in the Summary of the Proposed Budget for the 1961-1963 Biennium and the Summary of the Proposed Budget—Multiple Purpose Fund will be utilized for the purposes outlined in the Explanation of Individual Funds; the same as for the funds appropriated for the 1959-1961 Biennium. The Irrigation Project Development Qualifying under Federal Small Projects Acts Fund is a new item in the budget for which an explanation follows:

Irrigation Project Development Qualifying Under Federal Small Projects Act Fund

This fund was included at the request of many proponents of irrigation development in North Dakota, primarily for the purpose of providing needed assistance to various small irrigation districts in the State to permit them to take advantage of the Small Projects Act passed by Congress in 1958. It would permit the Commission to investigate, study, develop plans, cost estimates and other data needed to prepare and present the application for the project to the Bureau of Reclamation under this Act. The Act provides:

1. That should the project be a feasible one according to the Bureau of Reclamation standards and a deposit of $1,000 made upon presentation of a plan through the Bureau of Reclamation, that that agency would make an interest free loan for a period of not to exceed 50 years for 80% of the total cost of the project.
2. That the remaining 20% would be available through the local interests which could be an irrigation district, a county or a state agency.

In order to provide the needed assistance to the various districts who might be interested and can qualify under this Act, it will be necessary to increase the Commission's staff. This item of the budget proposes the addition of the following employees for this function: one Irrigation Engineer, one instrument man, two rodmen, and one part-time draftsman. Other items in the budget for this item include travel, equipment, tools, and operating expenses and an estimated amount to cover the costs of irrigation soil surveys that would be accomplished cooperatively with another agency. Also included is an allowance for the $1,000 deposit required under the Small Projects Act.

At one time the North Dakota State Water Conservation Commission retained a large staff for the purpose of construction of small irrigation projects. The Lewis and Clark and the Sioux Irrigation Projects were developed through this staff. Both projects have been successful and are making sizable contributions toward stabilizing the economy in the areas in which they are located. They have been a source of hay and other much needed crops during drought periods.

It is estimated the $85,000.00 will be required to finance this program for the biennium.

PROJECT AND CONGRESSIONAL HEARINGS

Senate Select Committee on National Water Resources

In March 1959 the United States Senate established the Senate Select Committee on National Water Resources by Senate Resolution 48 to analyze information and make recommendations relative to the water supplies and requirements of the nation between the present time and 1980. This action became apparent because of the increasing demands for water and water resources projects development throughout the country to serve the needs of our expanding population and economy and growing industrial development. The Committee was headed by Senator Robert S. Kerr of Oklahoma with Senator Thomas H. Kuchel of California as Vice Chairman. Other Committee members were: Dennis Chavez, New Mexico; Allen J. Ellender, Louisiana; Warren G. Magnuson, Washington; Clinton P. Anderson, New Mexico; Henry M. Jackson, Washington; Clair Engle, California; Philip A. Hart, Michigan; Gale W. Moss, Utah; James E. Murray, Montana, ex-officio; Milton R. Young, North Dakota; Andrew F. Schoeppel, Kansas; Francis Case, South Dakota; Thos. E. Martin, Iowa, and Hugh Scott, Pennsylvania.

The Committee set forth as their objective the answers to several specific questions which are: 1. How much water development is needed? 2. When is it needed? 3. Where is it needed? 4. What should be the pattern of water development? 5. What levels of cost and expenditures are justified for future water development? 6. What amounts of water will be required in relation to various levels of population and economic activity, stated by time-periods and geographic areas? 7. What are economic limits for water development in terms of cost per acre-foot that are economically justified for water for various uses? What have been the costs in the past for water for various uses; what are the present costs of water for various uses, and what is expected to be the future limit, if any, in the cost of developing water for various purposes? 8. How much expediture of public and private funds can be economically justified for water programs?

The program the Committee followed was divided into three phases, as follows: accumulation of information, staff analysis, and preparation of a draft report for the Committee. The first of these phases involved a series of field hearings throughout the country at which testimony and data from states, private individuals, organizations and representatives of business and industry was heard. The first of these field hearings the Committee scheduled was held in Bismarck, North Dakota on October 7, 1959. This hearing set the pattern for others that followed and provided North Dakotans an opportunity to present concise and detailed factual data concerning the water resources of the state and the need for water resource

development. At that hearing a total of 33 witnesses, headed by Governor John E. Davis presented testimony relating to North Dakota's water needs. The witnesses came from all sections of the state and represented all groups, interests and organizations concerned with the use and development of the water resources of the state for agricultural, industrial, municipal, recreation, fish and wildlife and other purposes.

North Dakota's opportunity and need for water resources development was summarized in a statement by Milo W. Hoisveen to the Senate Committee. He estimated that $902,392,000 were needed for the development of water resources in the State between now and 1980. He also pointed out that these expenditures would provide for the irrigation of an ultimate 1,659,000 acres of irrigable land by year 2025 that would help in providing the needed food and fiber for a greatly expanded population expected in this country by that time. The water projects proposed would include the projects not only for irrigation development but for municipal and industrial water, power, flood control and pollution control as well as related benefits from recreation, fish and wildlife conservation and propagation and lake restoration and other uses.

Committee Chairman Senator Robert S. Kerr, at the conclusion of the hearing said, "It was a most impressive demonstration of the awareness and interest in a problem of great significance. We hope that the evidence accumulated in other hearings to follow will be of the same kind and quality we received here. Your problem is typical of the growing pains being felt everywhere in the country and the testimony was of great benefit to us."

Copies of the testimony presented at the Bismarck hearing can be obtained from the office of the State Water Conservation Commission in Bismarck.

Garrison Diversion Unit Hearings

The largest and most significant project in the North Dakota water resources program is the Garrison Diversion Unit. This project was authorized by Congress as a part of the Missouri River Basin Program in the Flood Control Act of 1944. It has been in the planning stage under the direction of the Bureau of Reclamation since that time. The original Missouri River Diversion Project in North Dakota proposed that the diversion of water be accomplished from a point below Fort Peck in Montana and that large sections of northwestern and central North Dakota be irrigated. Because much of the land in northwestern North Dakota was found unsuitable for irrigation because of poor drainage characteristics of the soil the Bureau shifted the point of diversion on the Missouri River to the Garrison Reservoir and found additional large tracts of land in the Souris River loop area and central and south central North Dakota that could be served more easily and more economically than those proposed in the original project. Their planning was shifted to this proposal and the Garrison Diversion Unit has evolved as a sound and

feasible plan. This project plan was submitted by the Bureau of Reclamation to the Department of Interior in 1957 and to the Bureau of the Budget in 1958, which agency submitted their comments thereon in 1959 and the project report was forwarded to Congress for consideration. Although the project was originally authorized in the Flood Control Act of 1944, it is necessary to obtain a further congressional approval of the project so as to make the authorization conform to the point of diversion and the lands to be served as well as to make certain other specific provisions insofar as the development of the project is concerned. Legislation had been introduced in Congress by the members of the North Dakota congressional delegation that, if approved, would make these necessary provisions. This proposed legislation had been referred to the Interior and Insular Affairs Committee of the United States Senate and the House of Representatives respectively.

Through the efforts of Senator Quentin Burdick, then a member of the House of Representatives and a member of the House Interior and Insular Affairs Committee, foundation hearings were scheduled for June 10, 1960, on the legislation affecting the Garrison Diversion Unit authorization. These hearings were to provide a basis for congressional consideration of the project at coming sessions of Congress. It was recognized by all proponents of the Garrison Diversion Unit and officials of the Department of Interior Bureau of Reclamation that, because of the size and nature of the Garrison Diversion Unit, extensive hearings before congressional committees would undoubtedly be required before congressional approval would be given to the project. The arrangements for the hearings and testimony to be presented was prepared by a coordinating committee established by Governor John E. Davis for the Garrison Diversion Unit. This committee designated 19 North Dakota witnesses to present the case for the Garrison Diversion Unit at the congressional hearings.

The basic points presented by the witnesses in support of the Garrison Diversion Unit are as follows:

1. That the state has made a sacrifice of more than one half million acres of rich bottom lands to provide for main stem reservoirs, with the firm pledge that North Dakota would share in the benefits of the over-all Missouri River Basin program through the development of approximately a million acres of irrigation as set forth under the Garrison Diversion Unit.
2. That the Missouri River Diversion in North Dakota as provided in the Garrison Diversion Unit was authorized in the Flood Control Act of 1944 which was a part of the over-all program and it remains as a part of the program today.
3. That by the stabilization of North Dakota's agriculture and the diversification of its economic base the project will benefit not only farmers and citizens of North Dakota but also those of the region and nation.

4. That North Dakota, a major supplier of food for the Nation, must be ready to meet the continuing population growth. Only by anticipating this growth and preparing for it now can the demands that will face the Nation be met. Tied closely to this argument is the fact that irrigation will tend to cut down on the crops that are currently in surplus and provide for the production of forage and feed crops which can be utilized through livestock to fill the demand of the Nation.
5. North Dakota can become one of the vast new areas of opportunity for the Nation's increasing population through the development of the Garrison Diversion Unit. In order to do this its shrinking farm opportunities must be reversed and new industrial and business horizons opened. The Garrison Diversion Unit would provide these opportunities.

At the June 10th hearing, all testimony presented came from North Dakota witnesses. It is expected that at future hearings on the project, which will be scheduled during the next session of Congress, testimony from the Bureau of Reclamation and the Department of Interior witnesses will be heard. The foundation hearing in 1959 on the Garrison Diversion Unit will permit a swifter action by Congress on the project during the next session. The Garrison Diversion Unit is scheduled to get under construction in fiscal year 1963 by the Bureau of Reclamation.

Missouri River Bank Stabilization Hearing

The Corps of Engineers held a hearing in Bismarck on February 26, 1960 relative to the need for a bank stabilization project along the Missouri River below Garrison Dam and Bismarck. The erosion of good agricultural Missouri River bottom land, since Garrison Dam has been in operation, has increased greatly. This is due to the fact that the clear water now being released from Garrison Dam has a tremendous natural ability to pick up silt along the river banks. Before Garrison was in operation, this situation was not nearly as serious because the silt ladened waters had a tendency then to deposit as much silt as it picked up elsewhere along the river's course. This condition was recognized by the Corps of Engineers in its consideration of a proposed low head dam across the Missouri River at Bismarck to serve as a highway crossing and also to provide a reservoir that could be used for recreation and irrigation purposes. The Corps determined that such a dam was infeasible because it would fill with silt in from three to five years, with most of the silt coming from the erosion of Missouri River banks.

At the instigation of the State Water Conservation Commission, the Corps of Engineers was appropriated funds by Congress to investigate this problem. The hearing held in Bismarck on February 26, 1960 was the initial phase of the Corps' activity in conducting this investigation.

At this hearing approximately 50 witnesses testified to the Corps as to their loss of land. These witnesses were, for the most part, owners of Missouri River bottom lands adjacent to the river and representatives of irrigation districts and other groups and the State Water Conservation Commission. Testimonies presented at the hearing indicated that nearly 500 acres of bottom lands are being lost to erosion each year which amount could be increased to 1,000 acres a year, depending on the releases made from Garrison Reservoir. The need for prompt action to provide protection to the river bottom lands was stressed at the hearing. This protection could be provided either through the installation of bank protective facilities or through the construction of a series of low head dams on the Missouri between Garrison Dam and Bismarck. It is contended by the Commission that the erosion is another of the negative benefits from Garrison Dam that North Dakota is experiencing, and the cost of providing the protection of this land should be charged to Garrison Dam itself or the over-all Missouri River Basin program and should not be considered a local responsibility.

The Corps of Engineers presently is studying the problem and is expected to present its recommendations to its higher headquarters in the near future.

Missouri River Slack Water Navigation Hearing

An apparent controversy exists over the use of water from the Missouri River mainstem reservoirs. Lower basin interests favor using the majority of the available waters for navigation purposes; however, Upper Basin interests propose that the water be used for production of hydro-electric power and other beneficial purposes such as irrigation. Navigation was designated as one of the primary purposes of the Missouri River Basin project in the Flood Control Act of 1944 and it has been greatly benefited through the installation and operation of the main stem dams and reservoirs. The tremendous amounts of stored water that are required to maintain the free flowing navigation channel in the lower river basin areas has been of concern to those who contend that the water is more valuable for the protection of hydro-power during the peak demand periods in the winter months. Demands for water for navigation during the winter months are at their lowest, therefore the demands for these uses are not synchronous. Because of this controversy, and at the instigation of the Governors of Iowa and South Dakota, Congress authorized a study of slack water navigation on the Missouri River. To provide for this type of navigation a series of low dams with locks would have to be installed on the Missouri and the reservoirs created by these dams would be utilized for navigation purposes and other uses. These installations would greatly reduce the amount of water required for navigation purposes and would also permit more beneficial and full utilization of the waters of the Missouri River.

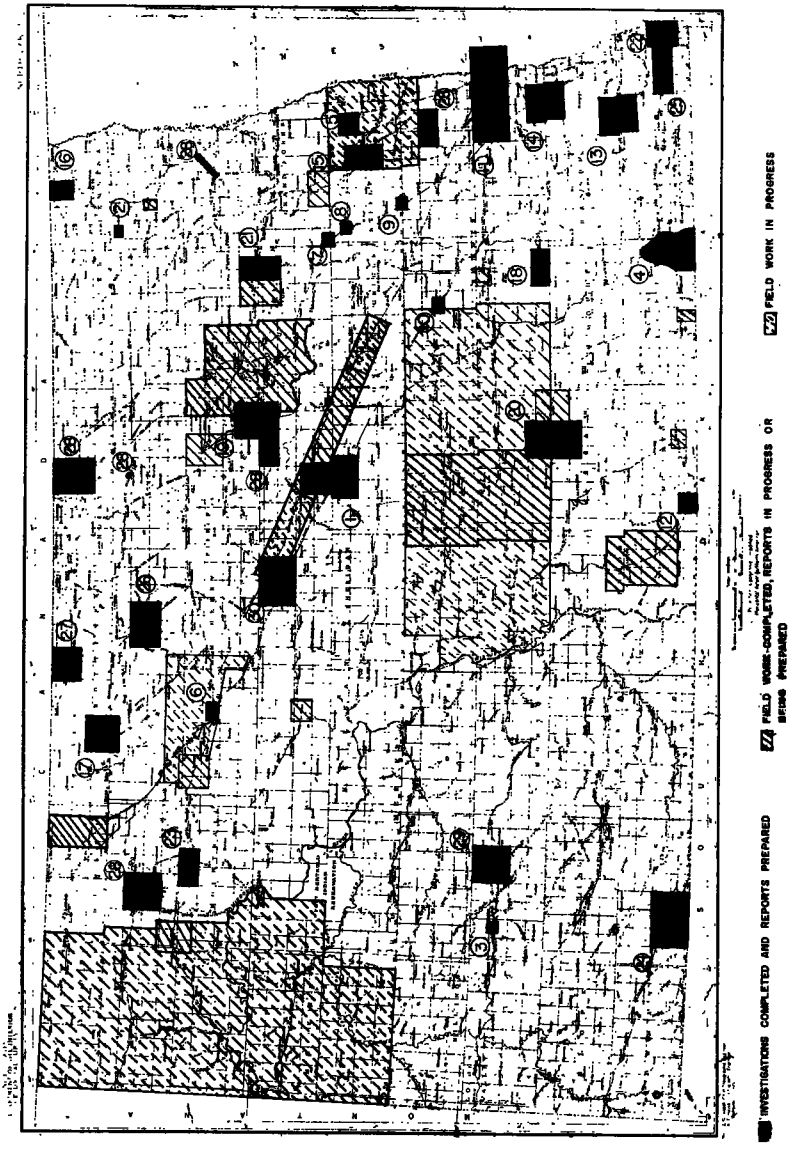
A hearing was scheduled by the Corps of Engineers on this proposal at Bismarck, North Dakota on April 26, 1960. At the hearing witnesses from North Dakota, South Dakota and Montana presented testimony relating to slack water navigation. Most of the witnesses were representatives of REA Cooperatives and individuals and organizations concerned with the hydro-power production in the basin. The State of North Dakota and the State Water Conservation Commission took the position that a study of the slack water possibilities should be made in order to determine its feasibility but the development of slack water navigation on the Missouri should in no way be given a higher priority than the Garrison Diversion project. The Corps of Engineers estimated that approximately $300,000 would be needed to complete the study. Corps of Engineer officials have indicated that there are very grave technical problems involved in the slack water navigation proposal and that it is doubtful if it would be feasible to build such a channel for many years. General Barney, Missouri River Division Engineer, of the Corps of Engineers has indicated that more than 100 dams would have to be built from Yankton, South Dakota to the River mouth and the cost of such an undertaking could run into the billions of dollars. When considering a $75,000 appropriation request to continue this study, the House Appropriations Committee determined that the study was not warranted and refused to approve the appropriation of any funds for this work.

Other Congressional Hearings

The State Water Conservation Commission has taken an active part in supporting the enactment of Federal legislation to accomplish certain things insofar as the water resources development program is concerned. They have, through resolutions directed to appropriate congressional committees, supported the enactment of legislation that would recognize the states' right to control all the waters within their boundaries. The Commission has also supported legislation that would provide that costs allocated to recreation in connection with the redevelopment of a water resources project be non-reimbursable. The Commission and the Garrison Diversion Conservancy District have been instrumental in attempting to obtain legislation that would spell out the criteria that is to be used by Federal agencies in determining the economic justification for water resources projects. It is contended that the present criteria used by various Federal agencies is not consistent nor does it recognize all benefits that accrue from these water resources projects. This situation was particularly noted in the comments of the Bureau of the Budget on the benefit-cost ratio for the Garrison Diversion Unit.

CHAPTER III

COOPERATIVE ACTIVITIES


INVESTIGATIONS COMPLETED AND REPORTS PREPARED
FIELD WORK COMPLETED, REPORTS IN PROGRESS OR SOON PREPARED
FIELD WORK IN PROGRESS

NORTH DAKOTA STATE AGENCIES

State Health Department

North Dakota state laws give the State Water Conservation Commission the control over all waters of the state including certain responsibilities as to the control of pollution of such public waters. In this connection the Commission and the State Health Department cooperate in various administrative functions to prevent or alleviate pollution problems and also review and approve plans for all municipal water supply and sewage facilities. The two agencies have also adopted certain rules and regulations relative to the control of pollution of the streams and rivers of the state. During the past biennium the State Health Department and the State Water Conservation Commission have reviewed and approved 129 plans for municipal water supply and sewage projects. The Health Department also cooperates with the Commission in representing the state before the International Joint Commission and other organizations that are interested in the waters of North Dakota.

State Game and Fish Department

The State Game and Fish Department and the State Water Conservation Commission have cooperated extensively for many years in the development of various water resources projects that are utilized as recreational areas because they afford opportunities for fish and wildlife conservation and propagation. The Commission works very closely with the State Game and Fish Department in the investigation and construction of facilities for projects that are utilized for this purpose. The greater amount of work accomplished in cooperation with the Game and Fish Department is in the construction and repair of small dams throughout the state. This program is discussed more fully in another section of this report. In addition the Commission has provided engineering services to the Game and Fish Department to investigate various projects that serve specifically to develop fish and wildlife conservation and propagation areas.

State Highway Department

The State Highway Department cooperates with the State Water Conservation Commission in matters pertaining to the construction of highways throughout the state insofar as they affect the natural drainage pattern and create drainage problems. The State Legislature designated the State Water Conservation Commission as the agency responsible for determining the size of culverts or bridges required on various watercourses crossed by highways so that the normal drainage would be restricted by such highway construction.

The State Water Conservation Commission and the State Highway Department, recognize the problem that is involved in the construction of highways insofar as their effect on the drainage pattern of an area is concerned, and have jointly arranged for the employment of a

drainage engineer to work under the direction of the State Water Commission to assist in matters relating to drainage. The costs associated with this activity are divided equally between the Highway Department and the Commission.

The Highway Department and the State Water Commission have cooperated extensively in other problems associated with water development and highway construction in the state.

Junction North and South Forks, Pembina River

OTHER ORGANIZATIONS

National Reclamation Association

The National Reclamation Association is a voluntary organization composed of citizens, organizations and governmental agencies in the 17 Western Reclamation States and has as its primary objective the development of sound reclamation projects in these states. The Association maintains an office in Washington, D. C., and has a Board of Directors consisting of one director elected from each of the 17 Western Reclamation States. Mr. Milo W. Hoisveen, Secretary-Chief Engineer of the State Water Conservation Commission and State Engineer, is the North Dakota director.

The National Reclamation Association is very influential in all matters pertaining to reclamation development and serves to unite the interests of all proponents of reclamation development in the West. It has been principally concerned with the enactment of Federal legislation to provide protection to the states' water rights and the authority of the states to control the waters within their boundaries. The Association proposed and sponsored the Small Projects Act which was passed by Congress in 1958 and has recently promoted Congressional action to gain full recognition of all benefits that accrue from reclamation projects and determine the economic justification of reclamation projects.

Mississippi Valley Association

The Mississippi Valley Association is a voluntary organization composed of various individuals, organizations and agencies concerned with all phases of water resources development in the 23 state watershed area of the Mississippi River and its tributaries. This Association is one of the most influential water resource organizations in the country and actively promotes the development of specific projects and water resources in the country. Although the Association has primarily directed its efforts in the promotion and development of flood control and navigation, an increasing emphasis is now being placed on the development of water projects for irrigation and other purposes. The Directors of the Mississippi Valley Association from North Dakota are James Moore of Bismarck and Henry J. Steinberger of Donnybrook, North Dakota. The State Water Conservation Commission and several other legal entities, organizations and individuals are members of the Mississippi Valley Association.

The Association endorses specific water resources projects throughout the area and supports these projects before appropriate Congressional Committees. North Dakota projects endorsed by the Mississippi Valley Association include the Garrison Diversion Unit, the Pembilier Dam and the Bowman-Haley Project.

National Rivers and Harbors Congress

The National Rivers and Harbors Congress is a nation-wide organization composed of federal, state and local leaders interested in the sound development of the water resources of the country. It was organized in 1901 and has become one of the most influential groups in the country working in the water resources field. All members of Congress are Ex-Officio members of the organization. Close liaison is maintained with various agencies of the federal government concerned with water resources development.

The National Rivers and Harbors Congress has endorsed several North Dakota projects and has given its highest endorsement to the Garrison Diversion Unit. The State Water Conservation Commission and several other organizations, agencies and individuals from North Dakota are members of this organization. Other projects in North Dakota endorsed by this organization include the Bowman-Haley Project and the Pembilier Dam.

Association of Western State Engineers

The Association of Western State Engineers is composed of the State Engineers or the state officials responsible for the control of the waters of the states which make up the 17 Western Reclamation States. The Association provides the state officials of these states an opportunity to present united support for various phases of water resources development and has been active in obtaining Congressional approval of various policy matters dealing with water resources. It has strongly supported full recognition of the states' rights to control and allocate water within their boundaries.

The Association also provides the state officials an opportunity to meet and discuss problems of mutual interest and gain from the experiences of other states who have faced similar problems. Mr. Milo W. Hoisveen, State Engineer of North Dakota, has been designated as President of the organization for 1961. The 1961 meeting of the Association will be held in North Dakota.

North Dakota Conservation Education Council

The North Dakota Conservation Education Council was proposed at a meeting of various agencies and organizations concerned in all types of conservation programs. It was apparent that such a council could be effective in promoting the teaching of conservation subjects in the schools of our state so as to conform with the action taken by the North Dakota Legislature. This council was proposed as a means whereby all agencies concerned with conservation could work as a body in promoting the wise use of our natural resources by:

a. Maintaining teachers' courses of study in conservation education at all state colleges and at Ritchie Memorial Conservation Camp on Lake Ashtabula.

b. To establish a working program through which state education departments, institutions of higher learning, natural resources agencies and other interested groups may cooperate effectively in stimulating interest in conservation needs.

c. To review and recommend conservation education books, films, and other materials to be used in conservation education programs.

d. To serve as a clearing house through which successful conservation education programs can be circulated so that the state as a whole may benefit.

e. To review, clarify and make known the kinds of help that cooperating resource agencies and public groups may make available for the conservation education program at the state and local levels.

The proposed North Dakota Conservation Education Council is expected to be formally organized at a meeting scheduled at the Conservation Training Center on Lake Ashtabula on July 8 and 9, 1960.

THE NORTH DAKOTA WATER USERS ASSOCIATION

In February, 1959, the North Dakota Reclamation Association and the Missouri-Souris Projects Association amalgamated to form the North Dakota Water Users Association. This Association is composed of individuals and organizations interested in furthering the water resources development program in North Dakota. Each of the two organizations which were amalgamated to form the Water Users Association had been concerned with water resources development in the state. The North Dakota Reclamation Association was composed of members from all areas of the state and was concerned with the state's water resources program in general. The Missouri-Souris Projects Association was specifically concerned with the development of the Garrison Diversion Unit and devoted its efforts to this end. The overlapping and duplication of efforts in connection with the water resources program that resulted from the efforts of these organizations was eliminated with the amalgamation into one organization. The Water Users Association maintains an office in Minot and employs a full time Executive Secretary who directs the activities of the Association. The Board of Directors of the Association is composed of 20 directors — four from each of the northeast, southeast, northwest and southwest districts and four who are selected at large. President of the Association is L. C. Mueller of Oakes, North Dakota; First Vice President R. L. Dushinske, Devils Lake; Second Vice President Walter R. Hjelle, Garrison; Treasurer Murray Baldwin, Fargo; and Executive Secretary Oscar N. Berg, Minot.

Since its organization the North Dakota Water Users Association has built up a membership of approximately 2,800 individuals and organizations from North Dakota and other neighboring states. The Association has actively participated in several major events concern-

ing the North Dakota water resources development programs since its organization. It has been active in Congressional hearings on appropriation matters dealing with water resources projects in the state and in organizing the hearings on the project authorization of the Garrison Diversion Unit. It has assisted in arranging for the hearings of the Senate Select Committee on National Water Resources which was held in Bismarck in October, 1959. It has sponsored a testimonial dinner for Bruce Johnson, former Project Manager of the Bureau of Reclamation's office in Bismarck, when he was promoted to Regional Director of the Bureau of Reclamation — Region VI — Billings, Montana. It has participated in the arrangements for the meeting of the International Joint Commission that was held in North Dakota in the fall of 1960. The Association publishes a monthly newsletter covering various phases of the water resources program and has cooperated in furthering the public relations and education program dealing with water resources development in the state.

The North Dakota Water Users Association has been an effective organization in furthering interest in the water resources program in North Dakota. This interest is indicated by the growing membership of the Association and the interest of individuals from all sections of the state in our water resources development.

FEDERAL AGENCIES

Hydrographic Surveys — Cooperation with U. S. Geological Survey

The State of North Dakota has had a cooperative program under way with the Hydrographic Branch of the U. S. Geological Survey for conducting stream gaging activities in North Dakota since the early 1930's. Shortly after the State Water Conservation Commission was established by the North Dakota Legislature it was designated as the agency of the state through which this cooperative stream gaging program was to be conducted. The stream gaging data that has been compiled through the years under this cooperative program is of great value in the planning and development of water resources projects.

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

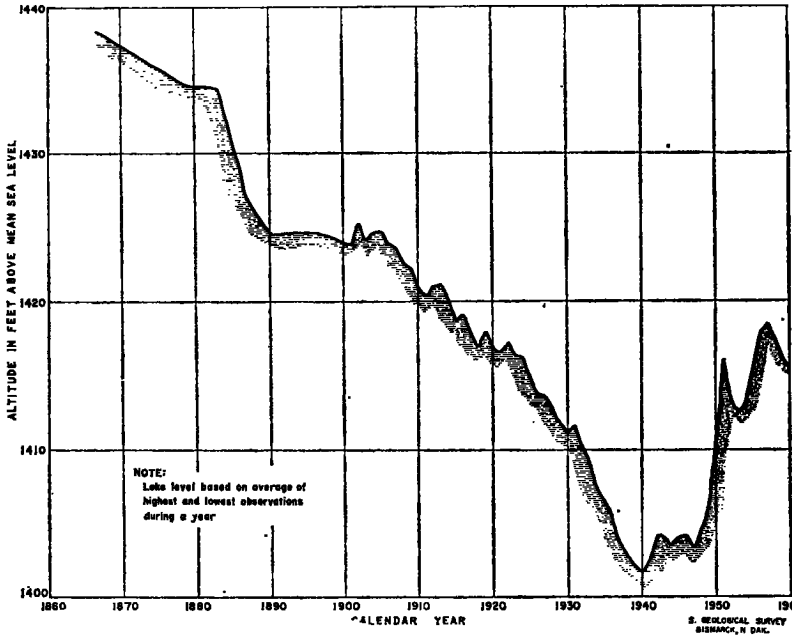
The only means we have of determining our water supplies and the probable future behavior of our streams is on the basis of their past performance. This requires the collection of continuous records of stream flow at strategic points over long periods of time. The cooperative stream gaging program that the State Water Commission conducts with the U. S. Geological Survey is directed toward this end.

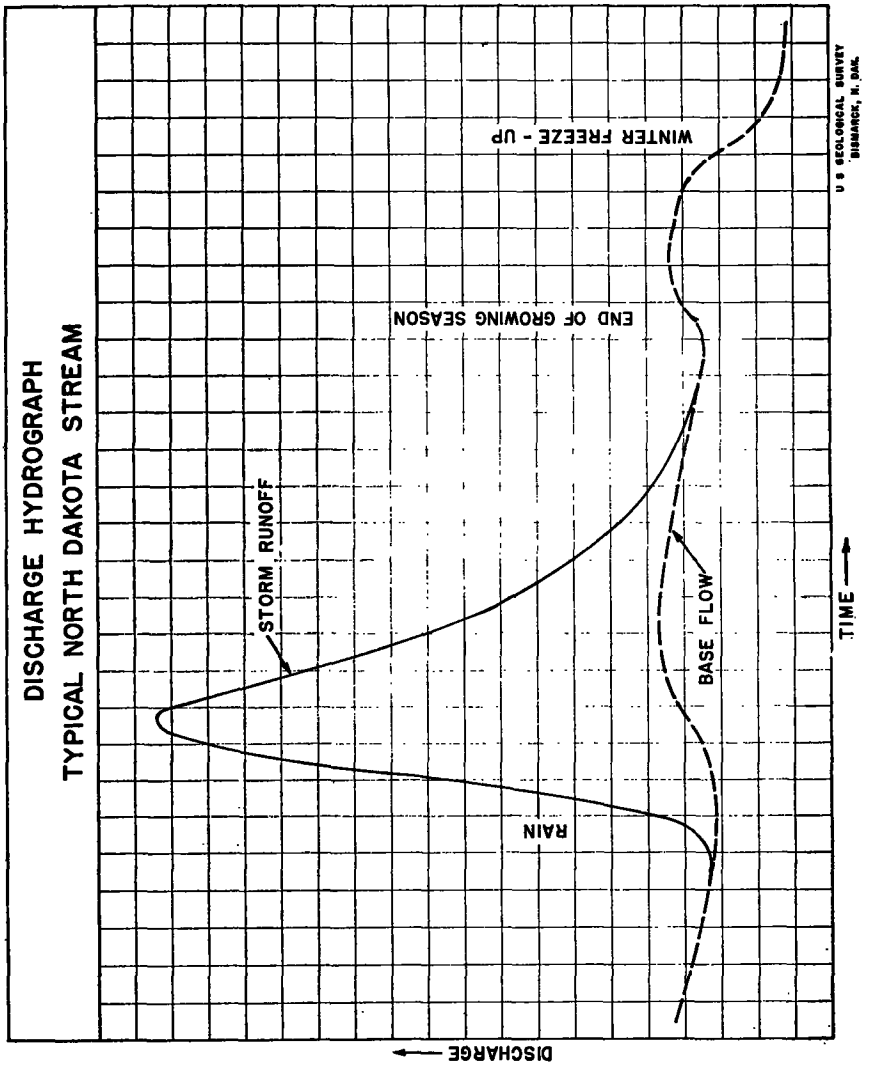
At the present time there are 97 gaging stations in operation on streams in North Dakota and on its boundaries. Thirty-one of these are operated wholly through the cooperative program with the State Water Commission and 13 are partially supported by this program and partially by cooperation of other Federal agencies. The remainder of the stations are maintained in a cooperative program between the U. S. Geological Survey and other Federal agencies including the Corps of Engineers, the State Department, the Fish and Wildlife Service, the Bureau of Reclamation, and the Soil Conservation Service.

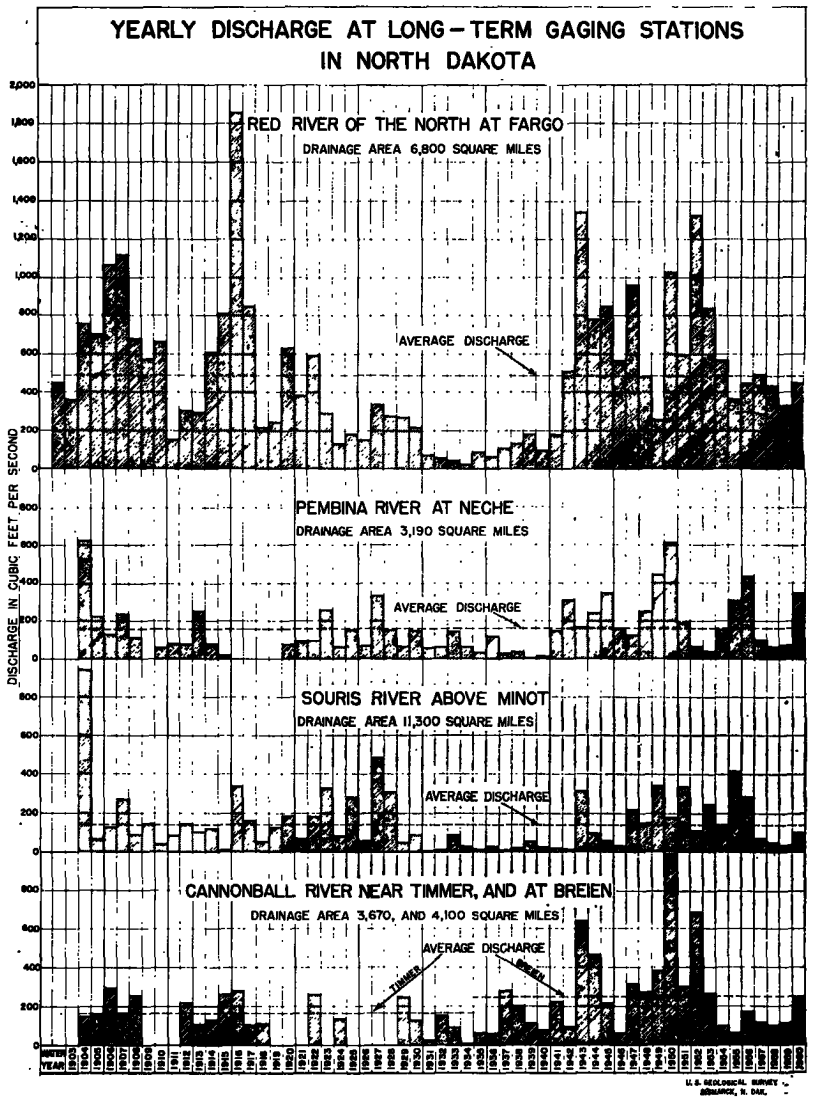
There has been little change in the over-all stream gaging program in North Dakota during the past biennium. Noteworthy additions to the program include the inauguration of a systematic series of base flow measurements at the state line crossings of the Little Missouri River and its principal tributaries in connection with studies for the proposed Little Missouri River Compact, the installation of a recording gaging station on Cedar Creek near North Lemmon and the establishment of a gaging station on Long Creek near Noonan which is necessary in connection with the division of Souris River Basin water between North Dakota and Saskatchewan. It is expected that this latter station will be financed by the U. S. State Department; however, some support will undoubtedly be required from the cooperative program for other work that will be needed in the Souris River Basin studies in connection with the division of the water of this basin.

The Commission's cooperative stream gaging program may be divided into two general types of work: the operation of what is considered the long-term basic network of gaging stations; and the several other gaging stations and special investigations usually of an urgent nature because of their association with small projects and special problems in which this type of basic data is essential. A strong effort has been made to accomplish the special tasks as expeditiously and as thoroughly as circumstances will permit. Work in this category includes gaging work such as that associated with the Lake Metigoshe

FLUCTUATION IN LEVEL OF DEVILS LAKE




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


YEARLY DISCHARGE AT LONG-TERM GAGING STATIONS IN NORTH DAKOTA
RED RIVER OF THE NORTH AT FARGO
DRAINAGE AREA 6,800 SQUARE MILES
AVERAGE DISCHARGE
PEMBINA RIVER AT NECHE
DRAINAGE AREA 3,190 SQUARE MILES
AVERAGE DISCHARGE
SOURIS RIVER ABOVE MINOT
DRAINAGE AREA 11,300 SQUARE MILES
AVERAGE DISCHARGE
CANNONBALL RIVER NEAR TIMMER, AND AT BREIEN
DRAINAGE AREA 3,670, AND 4,100 SQUARE MILES
AVERAGE DISCHARGE
TIMMER
BREIEN
DISCHARGE IN CUBIC FEET PER SECOND
WATER YEAR
U.S. GEOLOGICAL SURVEY
BISMARCK, N. DAK.

Improvement Project, the construction of the dam on Blacktail Creek in Williams County, the Mauvais Coulee drainage problem in the Devils Lake area, and others.

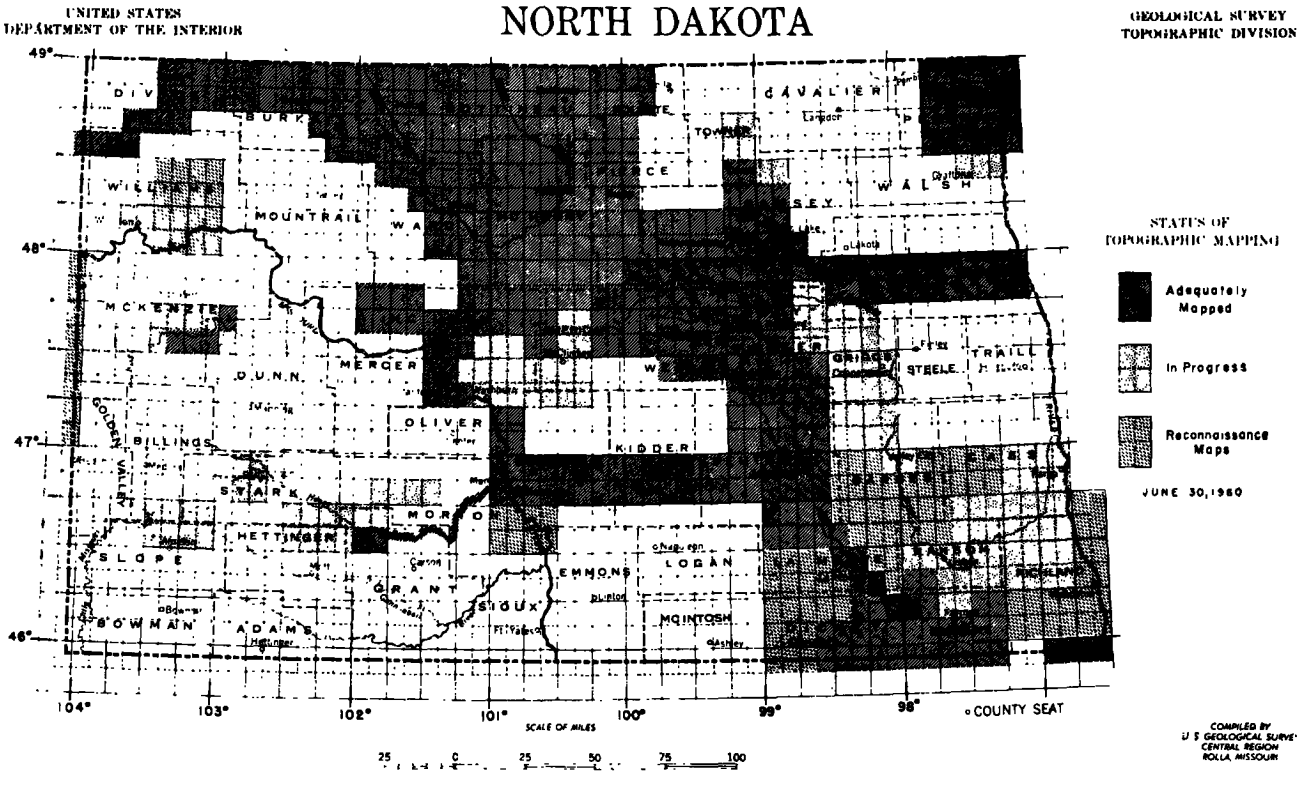
The Commission's cooperative program is conducted at a rate of $33,000 a year with half of this amount furnished by the State Water Commission and half by the U. S. Geological Survey. The Commission's share of this program is provided from legislative appropriations and by furnishing direct expenditures in the form of services of Water Commission employees assigned to assist the U. S. Geological Survey in carrying out its stream gaging activities and compilation of data on stream flows in the state.

The cooperative program during the coming year is expected to be maintained at its present status with the addition of special work required in the Souris River Basin including the partial support of the station on Long Creek near Crosby and to provide for the operation of a small area runoff station at Ray Dam near Ray in Williams County.

The importance of the basic data that is compiled through this cooperative stream gaging program cannot be over emphasized. Although the results from this program are not as spectacular or as evident as is the case in the construction of various water facility projects, the data is absolutely essential to the sound development of any type of water resources project. It is important in highway construction activities to determine capacities of bridges and culverts, for industrial plant locations to determine the quantities of water available and for a multitude of other uses in connection with the control and use of the available water resources. The Commission proposes that the appropriations for the hydrographic activities for the coming biennium be increased $2,500 to $30,000. Such an increase, although it will not permit the expansion of the program to gather data from other streams where it would be desirable, will help in offsetting the ever increasing costs of operations and permit a continuation of the program at its present rate.

Topographic Surveys — Cooperation with U. S. Geological Survey

Under the topographic mapping program conducted cooperatively between the State Water Conservation Commission and the Topographic Branch of the U. S. Geological Survey, topographic quadrangle maps are made of various sections of the state as designated by the Commission. In addition to the cooperative program with the Commission, the U. S. Geological Survey cooperates with various other branches of the Federal government in making topographic maps in North Dakota in conjunction with the Missouri River Basin program at no cost to the state. The Missouri River Basin topographic maps are confined to areas that are included for proposed development under the Missouri River Basin Project. The state's cooperative program with the U. S. Geological Survey is directed to making


UNITED STATES
DEPARTMENT OF THE INTERIOR
NORTH DAKOTA
GEOLOGICAL SURVEY
TOPOGRAPHIC DIVISION
STATUS OF
TOPOGRAPHIC MAPPING
Adequately Mapped
In Progress
Reconnaissance Maps
JUNE 30, 1960
49°
48°
47°
46°
104°
103°
102°
101°
100°
99°
98°
BURKE
DIVIDE
TOWNER
CAVALIER
PEMBINA
WALSH
MOUNTRAIL
WILLIAMS
MCKENZIE
DUNN
MERCER
OLIVER
KIDDER
GRIGGS
STEELE
TRAILL
BILLINGS
GOLDEN VALLEY
STARK
MORTON
HETTINGER
SLOPE
BOWMAN
ADAMS
GRANT
SIOUX
EMMONS
LOGAN
MCINTOSH
SARGENT
SCALE OF MILES
25 0 25 50 75 100
COUNTY SEAT
COMPILED BY
U S GEOLOGICAL SURVEY
CENTRAL REGION
ROLLA, MISSOURI

topographic maps of other areas as determined necessary and desirable. Maps prepared under either of these programs are made and published by the U. S. Geological Survey in accordance with their standards.

The modern topographic quadrangle map 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 in relation to the scale of the map. The topographic quadrangle map, however, is unique in that it shows the elevations, slope and configuration of all the ground surfaces. In short, it contains the same information as would be represented by a true scale model of the terrain.

There is a definite need for the basic data that can be obtained from 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. These maps are valuable for road and highway locations, power line locations and in proposed industrial development. In fact, topographic maps of an area may well be called "blueprints for progress". Modern up-to-date topographic maps are invaluable in the development of any area.

The State Water Conservation Commission's cooperative program with the U. S. Geological Survey provides for the preparation of maps of designated areas in the state. These maps, commonly called quadrangle maps, are bounded by parallels of latitude and meridians of longitude and usually cover either 7½ minutes or 15 minutes in latitude and longitude. The 7½ minute quadrangle maps are prepared at a scale of 1 to 24,000 (1″ = 2,000′) and cover an area of approximately 49 square miles and the 15 minute quadrangles have a scale of 1 to 62,500 (1′ = 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 present status of this mapping program is shown on a map accompanying this section of this report. During the period covered by this report six 7½ minute quadrangle maps under the state's cooperative program and thirty-nine 7½ minute maps under the Missouri River Basin program have been completed and published. In addition, 19 other quadrangle maps for other Federal projects have been completed and published making a total of 64 maps that have been published during this period. There are an additional 131 7½

minute quadrangle maps on which mapping was in progress on June 30, 1960, of which 12 are included in the Commission's cooperative program, 103 under the Missouri River Basin program, and 16 are being sponsored by the Federal Government. The State Water Conservation Commission appropriation to support this cooperative mapping program was $30,000 for the 1959-61 biennium. It is proposed that a similar amount be appropriated for this purpose for the 1961-63 biennium.

The status of topographic mapping is indicated on pages 191-194 of this report.

Water Commission Survey Crew

Maps in North Dakota Completed During the Period July 1, 1958 to June 30, 1960

Name	Size	Cooperator*	Name	Size	Cooperator*
Anamoose	7½	MRB	Goldwin SE	7½	MRB
Baker	7½	MRB	Goldwin SW	7½	MRB
Balfour	15	SIR	Grahams Island	15	SIR
Balfour	7½	SIR	Hamlin	7½	MRB
Balfour NW	7½	SIR	Harlow	7½	MRB
Balta	7½	MRB	Harlow SE	7½	MRB
Balta NW	7½	MRB	Harlow SW	7½	MRB
Balta SE	7½	MRB	Karlsruhe	7½	MRB
Bergen	7½	MRB	Kief	7½	SIR
Brinsmade	7½	MRB	Kongsberg NE	7½	SIR
Brinsmade SW	7½	MRB	Lone Butte	7½	MRB
Butte	7½	SIR	Lone Butte SE	7½	MRB
Cando	7½	COOP	Long X Divide	7½	MRB
Cando NE	7½	COOP	Marlow	7½	MRB
Cando SE	7½	COOP	Minnewaukan West	7½	MRB
Cayuga	7½	MRB	North Killdeer Mountain	7½	MRB
Cayuga NW	7½	MRB	Oberon	15	SIR
Churchs Ferry	7½	COOP	Orrin	7½	MRB
Clifton	7½	SIR	Pekin	15	SIR
Comstock	7½	MRB	Petrified Lake	7½	MRB
Devils Lake	15	SIR	Rangeley	7½	MRB
Drake	15	SIR	Rangeley SE	7½	MRB
Drake	7½	SIR	Rutland	7½	MRB
Drake NW	7½	SIR	Sawyer	15	SIR
Drake SE	7½	SIR	Silva	7½	MRB
Drake SW	7½	SIR	Starkweather SE	7½	COOP
Elliott SE	7½	MRB	Stirum	7½	MRB
Esmond	7½	MRB	Tokio	15	SIR
Fillmore	7½	MRB	Vashti	7½	MRB
Flora	15	SIR	Veblen NE	7½	MRB
Forman	7½	MRB	Webster	7½	COOP
Geneseo	7½	MRB			
Goldwin	7½	MRB			

*COOP—State Cooperative Project
MRB—Missouri River Basin
SIR—Surveys, Investigations, and Research (Regular G. S. appropriation)

Progress of U.S.G.S. Quadrangle Maps in North Dakota
Maps in Progress June 30, 1960

Quadrangle	Size	Cooperator	Status of Mapping, June 30, 1960
Antwine NW	7½	COOP	In field contouring
Arnegard 3 NE	7½	MRB	In final review (Tepee Buttes)
Arnegard 3 NW	7½	MRB	In final review (Stocke Butte)
Arnegard 3 SW	7½	MRB	In final review (Sperati Point)
Arnegard 4 NE	7½	MRB	In final review (Lone Butte (NE)
Arnegard 4 NW	7½	MRB	In final review (Lone Butte (NW)
Binford NE	7½	MRB	In supplemental control planning
Binford NW	7½	MRB	In supplemental control planning
Binford SE	7½	MRB	In supplemental control planning
Binford SW	7½	MRB	In supplemental control planning
Blue Butte 3 NW	7½	MRB	In final review (Croff)
Casselton 1 NE	7½	SIR	Ready for field contouring
Casselton 1 NW	7½	SIR	Ready for field contouring
Casselton 1 SE	7½	SIR	In field contouring
Casselton 1 SW	7½	SIR	Ready for field contouring
Casselton 3 NE	7½	MRB	Ready for field contouring
Casselton 3 NW	7½	MRB	Ready for field contouring
Casselton 3 SE	7½	MRB	Ready for field contouring
Casselton 3 SW	7½	MRB	Ready for field contouring
Casselton 4 NE	7½	MRB	In cartography
Casselton 4 NW	7½	MRB	In cartography
Casselton 4 SE	7½	MRB	Ready for field completion
Casselton 4 SW	7½	MRB	Ready for field completion
Cole Harbor SE	7½	MRB	Supplemental control completed
Dazey 1 NE	7½	MRB	Ready for supplemental control
Dazey 1 NW	7½	MRB	Ready for supplemental control
Dazey 1 SE	7½	MRB	Ready for supplemental control
Dazey 1 SW	7½	MRB	Ready for supplemental control
Dazey 2 NE	7½	MRB	In supplemental control planning
Dazey 2 NW	7½	MRB	In supplemental control planning
Dazey 2 SE	7½	MRB	In supplemental control planning
Dazey 2 SW	7½	MRB	In supplemental control planning
Dazey 3 NE	7½	MRB	In supplemental control planning
Dazey 3 NW	7½	MRB	In supplemental control planning
Dazey 3 SE	7½	MRB	In supplemental control planning
Dazey 4 NE	7½	MRB	Ready for supplemental control
Dazey 4 NW	7½	MRB	Ready for supplemental control
Dazey 4 SE	7½	MRB	Ready for supplemental control
Dazey 4 SW	7½	MRB	Ready for supplemental control
Dickinson 1 NW	7½	COOP	Ready for supplemental control
Dickinson 1 SW	7½	COOP	In final review (Lehigh)
Dickinson 2 NE	7½	COOP	In cartography (Dickinson)
Dickinson 2 SE	7½	COOP	In cartography (SE Dickinson)
Eckelson 1 NE	7½	COOP	Basic control completed
Egeland NE	7½	MRB	In field contouring

Progress of U.S.G.S. Quadrangle Maps in North Dakota
Maps in Progress June 30, 1960

Quadrangle	Size	Cooperator	Status of Mapping, June 30, 1960
Egeland NW	7½	MRB	Ready for field contouring
Egeland SE	7½	MRB	Ready for field contouring
Egeland SW	7½	MRB	Ready for field contouring
Fargo 2 NE	7½	SIR	In cartography (Fargo North)
Fargo 2 NW	7½	SIR	In cartography (West Fargo)
Fargo 2 SE	7½	SIR	In cartography (Fargo South)
Fargo 2 SW	7½	SIR	In final review (Southwest Fargo)
Fargo 3 NE	7½	SIR	In cartography (Hickson)
Fargo 3 NW	7½	SIR	In final review (Norman)
Fargo 3 SE	7½	SIR	In cartography (Christine)
Fargo 3 SW	7½	MRB	In cartography
Glen Ullin 1 SE	7½	MRB	Ready for field completion
Glen Ullin 1 SW	7½	MRB	Ready for field completion
Glen Ullin 2 SE	7½	MRB	Ready for field completion
Grafton NE	7½	COOP	In field contouring
Grafton NW	7½	COOP	Ready for field contouring
Hamar SE	7½	MRB	In supplemental control planning
Hamar SW	7½	MRB	In supplemental control planning
Heart Butte NE	7½	MRB	Photogrammetry completed
Heart Butte NW	7½	MRB	Photogrammetry completed
Kloten NW	7½	MRB	Ready for supplemental control
Kloten SW	7½	MRB	Ready for supplemental control
Lincoln Valley NE	7½	MRB	In photogrammetry
Lincoln Valley NW	7½	MRB	In photogrammetry
Lincoln Valley SE	7½	MRB	In photogrammetry
Lincoln Valley SW	7½	MRB	In photogrammetry
Lisbon 1 NE	7½	MRB	In photogrammetry
Lisbon 1 NW	7½	MRB	Ready for field contouring
Lisbon 1 SE	7½	MRB	Ready for field contouring
Lisbon 1 SW	7½	SIR	Ready for field contouring
Lisbon 2 NE	7½	SIR	In field contouring
Lisbon 2 NW	7½	SIR	In field contouring
Lisbon 4 NE	7½	SIR	Ready for field contouring
Lisbon 4 NW	7½	SIR	In field contouring
McClusky NE	7½	MRB	Ready for field completion
McClusky NW	7½	MRB	In cartography
McClusky SE	7½	MRB	Field completion completed
McClusky SW	7½	MRB	Field completion completed
McHenry NE	7½	MRB	In supplemental control planning
McHenry NW	7½	MRB	In supplemental control planning
McHenry SE	7½	MRB	In supplemental control planning
McHenry SW	7½	MRB	In supplemental control planning
McVille SW	7½	MRB	Ready for supplemental control
New Salem 2 SW	7½	MRB	Ready for field completion
Pelican Lake SW	7½	MRB	Ready for supplemental control

Progress of U.S.G.S. Quadrangle Maps in North Dakota
Maps in Progress June 30, 1960

Quadrangle	Size	Cooperator	Status of Mapping, June 30, 1960
Pickardville NE	7½	MRB	In cartography
Pickardville NW	7½	MRB	In cartography
Pickardville SE	7½	MRB	In cartography
Pickardville SW	7½	MRB	In cartography
Richardton 3 NE	7½	MRB	Ready for field completion
Richardton 3 NW	7½	MRB	Ready for field completion
Richardton 3 SE	7½	MRB	Ready for field completion
Richardton 3 SW	7½	MRB	Ready for field completion
Richardton 4 NE	7½	MRB	Ready for field completion
Richardton 4 NW	7½	MRB	In photogrammetry
Richardton 4 SE	7½	MRB	Ready for field completion
Richardton 4 SW	7½	MRB	Ready for field completion
Starkweather NE	7½	MRB	Ready for field contouring
Starkweather NW	7½	MRB	Ready for field contouring
Tower 2 NW	7½	COOP	Basic control completed
Tower 4 NE	7½	MRB	Ready for field contouring
Tower 4 SE	7½	MRB	Ready for field contouring
Turtle Creek NE	7½	MRB	Ready for supplemental control
Turtle Creek NW	7½	MRB	Ready for supplemental control
Turtle Creek SE	7½	MRB	Ready for supplemental control
Turtle Creek SW	7½	MRB	Ready for supplemental control
Turtle Lake SE	7½	MRB	Ready for supplemental control
Turtle Lake SW	7½	MRB	Ready for supplemental control
Wahpeton 2 NE	7½	MRB	In field contouring
Wahpeton 2 NW	7½	MRB	In cartography
Wahpeton 2 SE	7½	MRB	In field contouring
Wahpeton 2 SW	7½	MRB	In field contouring
Washburn NE	7½	MRB	Supplemental control completed
Washburn NW	7½	MRB	Supplemental control completed
Washburn SE	7½	MRB	Ready for supplemental control
Williston 1 SE	7½	COOP	In cartography
Williston 4 NE	7½	COOP	In cartography
Williston 4 NW	7½	COOP	In cartography
Wyndmere 1 NE	7½	MRB	In cartography
Wyndmere 1 NW	7½	MRB	In field contouring
Wyndmere 1 SE	7½	MRB	In field contouring
Wyndmere 1 SW	7½	MRB	In field contouring
Wyndmere 2 NE	7½	MRB	Ready for field contouring
Wyndmere 2 NW	7½	MRB	Ready for field contouring
Wyndmere 2 SE	7½	MRB	Ready for field contouring
Wyndmere 2 SW	7½	MRB	Ready for field contouring

*COOP — State Cooperative Project
MRB — Missouri River Basin
SIR — Surveys, Investigations, and Research — (Regular U.S.G.S. Appropriations)

Underground Water Surveys — Cooperation U. S. Geological Survey

The State Water Conservation Commission and the Ground Water Branch of the U. S. Geological Survey have had a cooperative ground water survey program underway in North Dakota for the past 15 years. This program has been financed on a fifty-fifty basis, with the State Water Commission and the U. S. Geological Survey contributing to the cost of the program. The State Geologist acts as the technical adviser for the State Water Conservation Commission in matters pertaining to ground water resources and assists in this program.

The ultimate aim of the ground water survey program is to obtain an over-all knowledge of the ground water resources in the entire State of North Dakota that would provide a sound basis for effectively directing development of this resource for domestic, municipal, industrial and irrigation purposes. The ground water investigation program also serves as a basis for determining administrative measures which are necessary or desirable in connection with the development and use of ground water resources of the State. Because of the critical problems that many municipalities in the State face in obtaining an adequate and suitable ground water supply to meet their municipal needs, a greater portion of this program has been directed to studying the ground water resources in those areas from which various municipalities could economically develop a municipal water supply. In recent years the scope of the ground water investigation program has been broadened to include area studies, with greater emphasis being placed on county wide or area wide studies. It is expected that this trend will continue in the future in a manner that will provide basic information on ground water resources throughout the area but will also provide this information for specific cities and communities in that area.

At the present time investigations have been completed or underway in 45 areas in the State. Reports have been completed on 35 of these area studies, of which 27 have been released and eight are in the process of final review. New studies that were inaugurated during the past biennium include the Stutsman County study, a study of the ancient channel of the Missouri River in Divide, Williams and McKenzie Counties, including the glacial and pre-glacial valleys in those counties, and the Souris River Valley in the vicinity of Minot in Ward County. Work was also continued on the Kidder County wide and Traill County wide survey. Special ground water studies were conducted by the State Water Conservation Commission in the Leeds, Berthold, Max, Beulah, Northwood, Sanborn and Hoople areas.

To date, over 12,400 square miles of the state's 72,000 square miles have been covered by ground water surveys or are under investigation. Up to June 30, 1960 more than 1,761 test holes had been drilled with the state owned drilling rig in connection with this

investigational work, which represents more than 232,823 feet of drilling.

The reports on the investigations that have been completed and published are available free of charge, unless the supply has been exhausted, from the office of the State Water Commission at Bismarck, the North Dakota Geological Survey at Grand Forks, and the U. S. Geological Survey, University Station, Grand Forks.

The ever-increasing demands for more water in many of our communities and areas of the State has pointed up the need for the continuation and expansion of the ground water investigation program. It is expected that the basic data that is made available through this investigational work will be extremely valuable in the economic development of the State of North Dakota.

U.S. Army Engineer District, Omaha

General

Effective 1 April 1960 the U. S. Army Engineer District, Omaha, was delegated the responsibility for Corps of Engineers activities in all areas of North Dakota tributary to the Missouri River.

Completed Projects

Mandan — The project is located on both banks of the Heart River at Mandan, North Dakota. The Mandan project consists of a levee on the left bank of the Heart River from U. S. Highway 10 west of Mandan to the Northern Pacific Railway south branch line; a levee on the right bank from the Northern Pacific Railway to high ground; a west closure levee between U. S. Highway 10 and the Northern Pacific Railway; two bridge raises; a stoplog structure on U. S. Highway 10; highway raises; railroad blanketing; drainage culverts; bank protection; flood wall; and interior drainage.

The project, which was authorized by the Flood Control Act of 1946 and modified by the Flood Control Act of 1950, was completed in July 1959 and turned over to local interests for operation and maintenance. Total Federal cost of the improvement was $677,000. In addition it is estimated that local interests expended $155,600 for lands and relocation.

Marmarth — The project is located on the left banks of the Little Missouri River and Little Beaver Creek at Marmarth, North Dakota. Existing levees at Marmarth were inadequate for flood protection. The project consisted of raising the existing levees around Marmarth and extending the protection to include the Browning Addition north of the railroad.

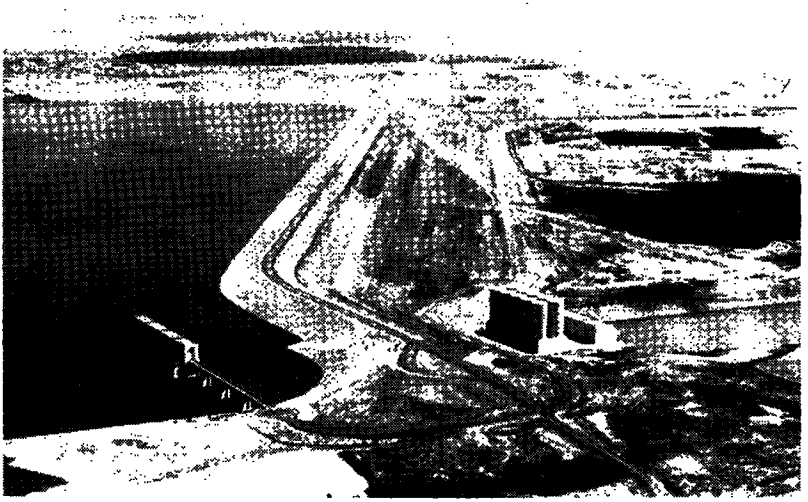
The project, which was authorized by the Flood Control Act of 1954, was completed in December of 1959 and turned over to local interests for operation and maintenance. Total Federal cost of the improvement was $169,500. In addition it is estimated local interests spent $12,000 for lands and relocation.

Scranton — The project, which is located on Buffalo Creek, a tributary of the North Fork of the Grand River adjacent to Scranton, consists of about one mile of channel improvement and one mile of levee together with necessary railroad improvement and appurtenant works.

The project was constructed under authority of Public Law 685 at a Federal cost of $103,000. In addition it is estimated that local interests spent $34,500 to provide lands and other items of local cooperation.

Projects Under Construction

Garrison Dam and Reservoir — Garrison Dam is located on the Missouri River in McLean and Mercer Counties, North Dakota, about 11 miles south of Garrison, North Dakota. It is 1,455 miles above the mouth of the river and 77 miles above Bismarck. The existing project was authorized by the Flood Control Act of 22 December 1944 as part of the general comprehensive plan for the Missouri River basin. The project plan provided for the construction of a dam and reservoir for flood control, irrigation, navigation, hydroelectric power, and other purposes. The dam, built of rolled earthfill, extends more than two miles across the valley and has a maximum height of 210 feet above the stream bed. The spillway, located in the east abutment, is of the concrete-chute type and is controlled by 28 Tainter gates, each 40 feet wide by 29 feet high. The outlet works, located on the west side of the river, consist of an intake tower, eight tunnels, a



Garrison Dam

stilling basin, and a tailrace. Three tunnels are for reservoir regulation and flood control, and the other five are for power generation. A hydroelectric power generating plant is located on the downstream toe of the dam below the outlet works. The reservoir storage capacity of 24.5 million acre-feet is divided into zones. The bottom 4,900,000 acre-feet is for inactive storage and is ample to accumulate the river's silt for at least 100 years. The operating zone, which is the multiple-purpose storage capacity, will store 13,600,000 acre-feet of water assigned to power development, irrigation releases, and improvement of river flow for navigation, municipal water supply and stream sanitation. The top zone of approximately 6,000,000 acre-feet is set aside for flood control and will be used to impound excess flows during flood seasons. The reservoir, with a shoreline of approximately 1,500 miles, affords almost unlimited public recreational opportunities. The estimated cost for the project, which includes a power installation of five 80,000 kilowatt units and initial protection in the vicinity of Williston, North Dakota, is $294,000,000.

As of 30 June 1960 the overall project was 97 percent complete with project completion scheduled for 1963.

Oahe Dam and Reservoir — Oahe Dam is located on the Missouri River in Hughes and Stanley Counties, South Dakota, about six miles northeast of Pierre, South Dakota, and 1,123 miles above the mouth of the river.

The existing project was authorized by the Flood Control Act of 22 December 1944 as part of the general comprehensive plan for the Missouri River basin. The dam has been under construction by the Corps of Engineers since September 1948. It is 9,300 feet long, 242 feet in height above the river bed, and contained over 90 million cubic yards of earth fill.

The gated spillway, about a mile from the right or west abutment, has an overall crest length of 456 feet. Six tunnels, each nearly 20 feet in diameter, have been built in the right abutment to handle flood control discharges, and initially to divert flow during the closure. Seven additional tunnels, 24 feet in diameter, are under construction in the left abutment to serve the power installation.

The powerhouse, under construction on the downstream toe of the dam on the east side, will house generators with total installed capacity of 595,000 kilowatts. Other power facilities will include surge tanks, transformers and the switchyards.

The reservoir will have a shore line of 2,350 miles. It will extend approximately 250 miles upstream, almost to Bismarck, North Dakota. The lake will be over 200 feet in maximum depth, and at full operating level will cover 376,000 acres.

Full capacity of the reservoir is 23,600,000 acre-feet in which 4,300,000 acre-feet will be set aside for exclusive and seasonal flood control. During periods of water shortage, water for irrigation, power, navigation and other beneficial uses will be drawn from the 13,800,000

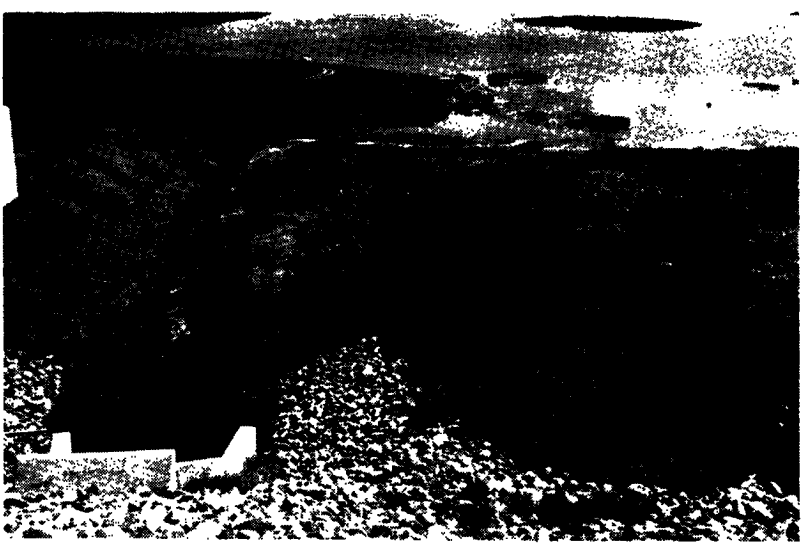
acre-feet of joint use storage, and the remaining 5,500,000 acre-feet will provide a pool for power head and sediment reserve. Impoundment was begun with the dam closure in August 1958.

In years of normal runoff, the pool levels will vary only about seven feet. Should drought conditions such as those of the 1930's recur, the reservoir could be drawn down about 70 feet. The reservoir will be so regulated that the maximum pool elevation will be reached in late spring and the lowest elevation during the winter months.

As of 30 June 1960 the project was 50 percent complete with project completion scheduled for 1965.

Lower Heart River — The project is located on both banks of the Heart River in the 14 mile reach upstream from the mouth of the river. It is in the vicinity of Mandan, North Dakota. The plan of improvement provides for three units — (1) the Sunny unit which would include a closure levee between U. S. Highway 10 and high ground, (2) the Mandan unit which would consist of raising existing levees, floodwall, and bridges, and (3) the unit below Mandan which would consist of channel relocation, cleared floodway, and an additional levee from the south branch bridge to the Missouri River.

The project, which was authorized by the Flood Control Act of 1954, is scheduled for completion in 1961. The estimated cost of the project is $2,510,000 of which $2,200,000 is Federal and $310,000 is local costs. Construction is in progress and about 58 percent complete on 30 June 1960.



Flow at Snake Creek

Authorized Projects

Mott — This project which would be located along both banks of the Cannonball River at Mott, North Dakota, was authorized by the Flood Control Act of 1958. There is no flood protection project in existence at the present time. The plan of improvement provides for levees on the left bank to protect "Mott original," levees on the right bank to protect "west Mott," replacement of a concrete arch bridge, channel improvement, and a pumping station. The estimated cost of the improvement is $825,000 of which $540,000 is Federal cost of construction and $285,000 is local cost.

Authorized Investigations

Grand River — Authority for study of the Grand River is contained in the Flood Control Acts of 1944 and 1958. The investigation has formulated a plan for a dam and reservoir at the Bowman-Haley site for municipal water supply, fish and wildlife conservation, recreational opportunities and impoundment for flood control. The study is scheduled for completion early in 1961.

Green River — Resolutions by the United States Senate and the House of Representatives have requested a review report on the Green River with a view to provision of storage for flood control, irrigation and related water resources development. Funds have not as let been allocated for initiation of the study.

James River — Resolutions by the United States Senate and the House of Representatives have requested a review report on the James River with a view to provision of flood control and other water resources development. The review report is in preparation with completion scheduled for July 1962.

Missouri River, Garrison Dam to Oahe Dam — In response to a Senate resolution a review report on the erosion problem in the reach from Garrison Dam to Oahe Dam is under preparation. The report is scheduled for completion in 1961.

Missouri River, North Dakota, South Dakota and Nebraska — In response to numerous Senate and House resolutions a review report on the need and justification for extending navigation from Sioux City, Iowa, to the North Dakota - Montana state line is under preparation. Completion of the report is scheduled for 1962.

U. S. Army Engineer District, St. Paul

The St. Paul District has the responsibility for the planning, construction and, where appropriate, maintenance and operation of Federal improvements for flood control and allied purposes in that portion of North Dakota drained by the Red River of the North and Souris River. The projects are described briefly in the following paragraphs under headings designating their stage of progress.

Projects Completed

Baldhill Dam and Lake Ashtabula

The 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 nine miles above Fargo so as to provide the city of Fargo with a supplemental city water supply from water stored in Lake Ashtabula. This work, to be done by the city of Fargo, has not been accomplished. Construction of the basic project was completed in 1956. During the biennium just completed recreation facilities consisting of access roads, wells, restrooms, and other works have been constructed. Federal cost of the project to date is $2,683,000.

Homme Reservoir and Dam

The project is located on the South Branch of the Park River about four miles upstream from Park River, North Dakota. The 3,650 acre-foot reservoir created by the dam affords partial flood protection to areas below the dam and provides a minimum flow of about five second-foot in the river to meet the water supply and pollution abatements needs from the dam to Grafton, N. Dak. In addition, a 16-inch cast iron pipe water-supply outlet through the dam has been provided at the request of local interests. In June 1960 a contract was awarded in conjunction with the Park Board to improve an access road for recreational purposes. Federal cost of this project to date is $1,322,000.

Lake Traverse and Bois de Sioux Project

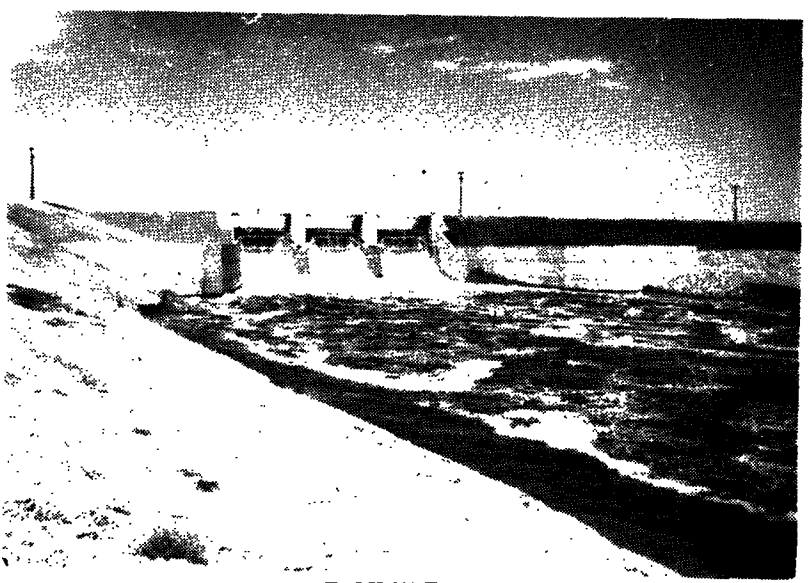
Lake Traverse located on the boundary between the States of Minnesota and South Dakota and the north end of an extension to the lake reaches within one mile of the North Dakota border. The Bois de Sioux River is the outlet stream from Lake Traverse. It flows from the lower end of Lake Traverse between the State of Minnesota and the States of South Dakota and North Dakota to Wahpeton,

North Dakota, and Breckenridge, Minnesota, where is joins the Ottertail River to form the Red River of the North.

The main features of this project are: (1) the Bois de Sioux channel improvement (2) the White Rock Dam (3) the Reservation Highway Dam (4) the Brown's Valley Dike. The main purpose of the project is to provide flood protection for some 50,000 acres of agricultural land located in this area. Other benefits to be achieved are the creation of a lake that is ideal for boating, swimming, fishing and wildlife conservation. Construction of this project was completed in 1941 at a Federal cost of $1,333,800.

Grand Forks Protection System

This unit of work is a part of the comprehensive flood control project in the Red River of the North Basin authorized in 1948 and 1950. Improvements completed in 1959, consist of a 5,163-foot levee and a 771.5-foot flood wall with the necessary interceptor lines, sewers and a pumping plant to provide for interior drainage. Due to foundation difficulties requiring a realignment of levees and resulting in construction of the flood wall, certain lands were acquired by the Government. Federal cost to date of construction and special land acquisition is $969,300. Local interests have acquired all land except that required for construction of flood wall and realignment of levees which was acquired by the Government as mentioned above. The project was transferred to the city for maintenance on May 1, 1959.



Baldhill Dam

Rush River Improvements

This unit of work, a part of the comprehensive flood control project in the Red River of the North Basin authorized in 1948 and 1950, consisted of clearing and snagging along approximately 14 miles of the river and excavation deepening, widening, and straightening the channel in an additional 14-mile reach. The improvement extends for a distance of 28 miles above the river mouth. The Federal cost of the completed work is $246,300. The project was transferred to local interests for maintenance 4 December 1956.

Snagging and Clearing Operations

Snagging and clearing projects, consisting of the removal of snags, debris, brush and timber within channel banks to eliminate obstructions, have been completed in the localities noted in the following tabulation and the projects which have been transferred to local interests for maintenance during the current biennium, are:

STREAM	Miles	FY Year Clearing Completed	Total Cost
North Branch Park River above Hoople	9	1958	$25,114

Projects Under Construction

Fargo Protection System

This unit of work is a part of the comprehensive flood control project in the Red River of the North Basin authorized in 1948 and 1950. A plan of improvement for the protection of Fargo has been developed and a contract for construction was awarded May 13, 1959. The plan provides for construction of about 3,550 feet of levee, with pumping station, sewers and ditches for interior drainage; a channel cutoff in the vicinity of Island Park; and three short cutoffs downstream from Fargo. 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 the construction and maintenance of the works; (c) maintain and operate all of the channel and levee improvement works after completion in accordance with regulations prescribed by the Secretary of the Army; (d) make all necessary changes to utilities, highways, and bridges, including approaches, except that construction of the new city dam and extension of the Northern States Power Company's water lines will be accomplished by the Federal Government with the costs therefor to be reimbursed by local interests; and (e) obtain appropriate legal control over a pondage area and prevent encroachment in such area until a substitute area or equivalent additional pump or outlet capacity has been provided without cost to the United States. The assurances of local cooperation have been approved and the city of Fargo has obtained the necessary rights-of-way.

Inactive Projects

Improvements authorized under the comprehensive Red River of the North Basin flood control project include channel improvements on the Bois de Sioux River and Red River of the North in the vicinity of Wahpeton, N. Dak., and similar improvements on the lower Sheyenne and Maple Rivers in the vicinity of West Fargo, N. Dak. No work is being done on these units.

Projects Under Investigation

Red River of the North Drainage Basin Studies

Based upon the recommendations contained in a preliminary examination completed in December 1956, a survey of the flood problems remaining at a number of points in the basin has been authorized. A separate interim survey report covering the flood and major drainage problems in the vicinity of Devils Lake is under way. Funds for the survey of the other problem areas have not been made available to date.

Souris River Study

In accordance with a recommendation contained in a preliminary examination completed in July, 1956, a survey has been authorized for flood control and allied purposes at and in the vicinity of Minot, N. Dak., and for flood control and major drainage in an upland area near Tolley, N. Dak. The study is in progress.

Pembina and Tongue River 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 in progress. Current Corps of Engineers activities are confined largely to consideration of the feasibility of a multiple-purpose dam and reservoir on the Pembina River near Walhalla. The study will be coordinated with Canadian interests through the International Joint Commission.

BUREAU OF RECLAMATION
Missouri River Basin Project
Garrison Division
Garrison Diversion Unit

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

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

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

Major features of the principal supply works are:

1. Snake Creek Pumping Plant. This structure is to be designed and constructed by the Bureau of Reclamation. It will pump water from Garrison Reservoir into the adjacent Snake Creek Reservoir behind the existing Snake Creek embankment. The pumping plant will have a capacity of about 8,850 cubic feet per second (6 units, 1475 C.F.S. each) for a 1,007,000 acre irrigation development and, will pump about 2,627,000 acre-feet a year for irrigation and other uses.

2. McClusky Canal. This canal, to be built by the Bureau of Reclamation, will carry water from Snake Creek Reservoir, through low country south of Turtle Lake and Mercer, and thence northeasterly into Lonetree Reservoir. It will be about 73 miles long and have a beginning capacity of about 8,200 second-feet.

3. Lonetree Reservoir. This reservoir is located in the uppermost reaches of the Sheyenne River southwest of Harvey. It is so

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

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

1. Velva Canal. This canal, which will run in a northwesterly direction from Lonetree Reservoir, will deliver water to 333,000 irrigable acres in the Souris River Basin. It will have an initial capacity of about 5,270 c.f.s. and be about 128 miles long, terminating near the Canadian boundary northwest of Westhope.

2. East Souris Canal. This canal will irrigate 152,000 acres lying east of the Souris River and deliver excess Souris River flows to the Sheyenne River. The canal, with an initial capacity of about 3,000 c.f.s., will begin near the Canadian boundary and run in a southeasterly direction for 122 miles, emptying into the North Fork of the Sheyenne. The water supply, consisting mainly of return flows from irrigation west of the river, will be pumped from the Souris River at a point northeast of Westhope.

3. Devils Lake Canal. This canal will lead from Lonetree Reservoir in a northeasterly and easterly direction to serve 86,000 irrigable acres in the Harvey-Maddock area. It will have an initial capacity of 1,620 c.f.s. and be 81 miles long, terminating near Oberon, North Dakota. A relatively short feeder canal through Round, Stoney and Long Lakes south of Minnewaukan will lead from the Devils Lake Canal into Devils Lake. A feeder canal connecting Devils Lake with Stump Lake, and an outlet canal from Stump Lake to the Sheyenne River will permit continuous flow through the system.

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

5. New Rockford Canal. For the first 30 miles this canal will utilize the channel of the James River which flows in an easterly direction from Lonetree Reservoir. The canal capacity, at its beginning point, will be 4,380 c.f.s. It will supply water to 67,000 irrigable acres in the Baldhill area. It will also supply water to supplement return and natural flows in the James River for the irrigation of

about 12,000 acres in the LaMoure section and 108,000 acres in the Oakes section.

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

The Warwick Canal can be extended to the east to serve irrigable lands in Steele, Grand Forks, Traill and Cass Counties.

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

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

9. Oakes Canal. This canal, together with the Oakes Pumping Plant, will deliver water from the James River near Oakes to the 108,000-acre Oakes section in North and South Dakota. (About 52,000 acres of this section is in North Dakota.) The canal will have an initial capacity of 1,420 c.f.s. and will extend 11 miles eastward to be regulated at Taayer Reservoir. For the western portion of Oakes section, water will be taken directly from the Oakes Canal; for the eastern section, it will be supplied both from the Oakes Canal and storage in Taayer Reservoir. This reservoir will have active storage of 40,500 acre feet and will be used to help meet peak demands in the east portion of the Oakes section.

10. Coleharbor Canal. This feature will supply water to the 40,000-acre Coleharbor section which lies between Snake Creek Reservoir and the town of Washburn. It will begin at a point three miles east of the town of Coleharbor, where water will be pumped 105 feet from Snake Creek Reservoir. The canal will be about 50 miles long and have a capacity at its heading of 748 c.f.s.

Besides Snake Creek, Lonetree, Jamestown and Taayer Reservoirs, there are five regulating impoundments of minor size. These are located in the Souris Section and have a combined storage capacity of 107,000 acre-feet. There will be a considerable number of pumping plants, other than those already mentioned. Six of them will have capacities over 500 c.f.s., 39 will range in size from 50 to 500 c.f.s., and about 600 will be smaller than 50 c.f.s. The water use system also will include a network of smaller laterals sufficient to make delivery to every quarter section of the project area. The entire canal and lateral system will include:

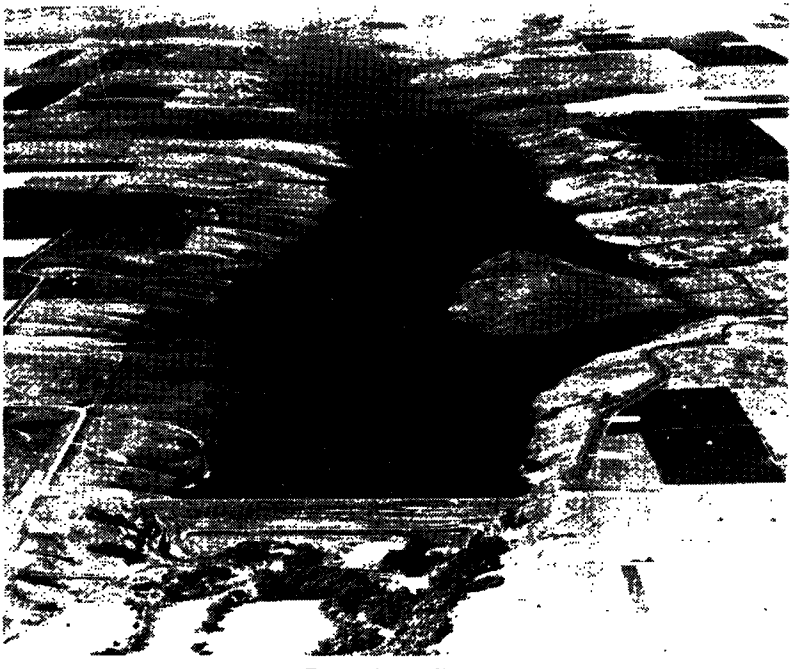
Canals and laterals	Length in miles
Over 500 c.f.s.	764
51 to 500 c.f.s.	980
50 c.f.s. and under	5,029
Total	6,773

Over 35,000 canal structures will be included in the canal and lateral system. Project works for the unit also will include 980 miles of main drains, 2,020 miles of shallow surface drains, 6,300 miles of subsurface drains, and about 20,000 drainage structures.

Electric power for pumping will be supplied from the Missouri River Basin System, either by direct connection to existing or proposed Transmission Division facilities, or by wheeling over electric cooperative or utility company lines.

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

The plan of development for the unit includes 62 areas for fish and wildlife purposes. Two of these areas will replace the Sheyenne Lake National Wildlife Refuge and the downstream pool of the Lower Souris National Wildlife Refuge, which are to be flooded by regu-



Jamestown Dam

lating reservoirs. The remaining areas are for mitigation of damages to waterfowl habitat resulting primarily from agricultural drainage, and for general enhancement of fish and wildlife values over the project area.

To provide improved recreation opportunities in the project area, the National Park Service recommends development of recreation facilities at major reservoirs.

A feasibility-type report on the unit, together with supporting appendixes, was completed in January 1957. The report includes definite plan coverage for the principal diversion works. In June 1957 the report was transmitted to other federal agencies and the states concerned for review and comment. On June 21, 1958, the report was approved by the Secretary of the Interior and transmitted to the President of the United States through the Bureau of the Budget. This report, with letters of comment, has been printed as House Document No. 325, 86th Congress, 2d Session (1960). Work is presently under way on preparation of definite plans for the Oakes area (North Dakota), the LaMoure section, the Warwick-McVille area, and the Lincoln Valley area. A report on 250,000 acres of the Garrison Diversion Unit, of which about 100,000 acres will be completed on definite plan standards, is scheduled for completion in November 1961.

Irrigation Farm, Sheyenne, North Dakota

Red River Valley Areas

In the Red River Valley there are about 1,000,000 acres along the shoreline of ancient Lake Aggassiz that are generally suitable for irrigation. These lands are in Richland, Ransom, Cass, Steele, Traill, Grand Forks, Walsh and Pembina Counties. They are not included in the first-stage development plan but can be considered as an additional or substitute market for water. By extending the operating season for the principal supply works and providing additional storage on the Sheyenne River, these lands can be served without increasing the size of any important features of the Garrison Diversion Unit. Interest in water development on the delta lands is clearly evident, five counties in the Red River Valley having joined the Garrison Diversion Conservancy District to reinforce their claim for a share in the unit water supply.

Jamestown Unit

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

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

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

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

Irrigation Development Farms

Three development farms have been established by the Bureau of Reclamation in cooperation with the North Dakota Agricultural College and the United States Department of Agriculture. They have been developed to demonstrate the influence of irrigation on crops and livestock production, and the reaction of soils to irrigation water. The benefits and operation methods of irrigation under soil

and climatic conditions in the Garrison Diversion Unit are being observed on these farms.

The Deep River Farm is located in McHenry County about three miles west of Upham. It includes 215 acres, 133 of which are presently being irrigated. This farm has been in operation since the spring of 1953.

The Sheyenne Farm is located in Eddy County immediately west of and adjacent to Sheyenne, North Dakota. This farm includes 394 acres, with 118 acres irrigated in 1958. Operation of the Sheyenne Farm was started in the spring of 1956.

The Ransom Farm is located in Ransom County about six miles south of Sheldon. The farm unit includes 365 acres, of which 132 are irrigated, 61 are dry farmed and the remainder is pasture, farmstead, roads, and timbered river bottom. Twenty-three irrigated acres have been set aside for research purposes. The water supply is pumped from the Sheyenne River. Construction and land development work were started in the fall of 1957 and the farm was first irrigated in the summer of 1958.

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

Dickinson Unit

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

The principal feature of the unit is a rolled earth-fill dam with a combined concrete spillway and outlet works structure and a 6,800 acre-foot reservoir. Construction of the dam was started in March of 1949, and substantially completed in August 1950. Subsequent work has included extension of the outlet works farther into the reservoir, repair of the spillway damaged by flood in the spring of 1954, and development of public-use areas adjacent to the reservoir.

The City of Dickinson has obtained most of its municipal water supply from Dickinson Reservoir beginning in 1951, with the water requirement rapidly increasing since then. A water service contract with the city provides for payment of $950,000 to the federal government in 40 years. Water is available for irrigation of about 400 acres, and the irrigation facilities to serve the individual tracts have been developed by the landowners. The Dickinson-Heart River Mutual Aid Corporation was organized in 1956 and has contracted with the Bureau of Reclamation for the irrigation water supply.

The reservoir area, including the recreational facilities is administered by the Dickinson City Park Board. Use of the reservoir by the public has steadily increased.

Heart Butte Unit

Heart Butte Unit is located on the Heart River in Grant and Morton Counties in southwestern North Dakota. State Highway No. 49 crosses Heart Butte Dam about 15 miles south of Glen Ullin and the irrigable areas extend eastward from there for about 60 miles along the Heart River to the City of Mandan. The unit is a multiple-purpose development designed to provide controlled conservation storage for irrigation of 13,100 acres, flood control for downstream areas, sedimentation control, fish and wildlife conservation, and recreational benefits.

The principal features of the unit included a rolled earth-fill dam with a combined glory-hole spillway and gated outlet works, a 225,500 acre-foot reservoir, wildlife habitat areas to replace those inundated by the reservoir, and the necessary pumping plants, laterals and drains to serve the irrigable lands. Construction of the dam was substantially completed in December 1949, and it has since played a major role in providing flood protection, particularly to the City of Mandan. Wildlife habitat replacement areas and minimum recreational facilities have been developed. Construction of pumping plants, laterals and drains to serve the 2,463 irrigable acres of the Western Heart River Irrigation District was substantially complete by June 30, 1956. By June 30, 1960, more than 1,300 acres in the district had been developed for gravity irrigation. Construction of facilities to serve the rest of the 13,100 irrigable acres will not be started until appropriate repayment arrangements have been made. Farmers not in the irrigation district were purchasing water on a temporary basis to irrigate 250 acres in 1960.

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

The 70-acre Mandan Development farm which is in the area included in the Heart Butte unit, is operated by the State Training School.

North Dakota Pumping Division

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

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

Fort Clark Unit

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

The Soil Conservation Service is assisting the farmers with farm irrigation layouts and land leveling. By June 30, 1960, approximately 1,400 acres had been prepared for irrigation.

Transmission Division

Under the Flood Control Act of 1944, the responsibility for marketing the power generated by Missouri River Basin project power plants, was assigned to the Secretary of the Interior. The Bureau of Reclamation has been designated as the agency responsible for prosecution of the power marketing program. In North Dakota the major source of Missouri River Basin power is 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 has an installed capacity of 400,000 kilowatts and an average annual energy production in excess of one billion kilowatt-hours.

To market this power, an adequate and efficient power transmission system is necessary. A backbone grid of 230-kilovolt transmission lines interconnects the Missouri River power plants and provides power at the major load centers. A network of 115-kilovolt and 69-kilovolt lines supplies power to smaller load centers and irrigation pumping developments throughout the state.

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

As of June 30, 1960, the following lines and substations were complete and in service:

LINES	Length Miles	Substations	Capacity Kva
Garrison - Bismarck 230-kv[1]	62.70	Bismarck	32,000
Bismarck - Mobridge 230-kv	94.97	Washburn	15,000
Bismarck - Jamestown 230-kv	98.32	Jamestown	117,000
Jamestown - Fargo 230-kv	83.03	Fargo	293,334
Fargo - Morris 230-kv	104.73	Devils Lake	22,500
Williston - Garrison 115-kv	170.21	Grand Forks	50,000
Garrison - Voltaire 115-kv	57.17	Valley City	15,000
Voltaire - Rugby 115-kv	55.95	Lakota	15,000
Rugby - Devils Lake 115-kv	58.85	Leeds	16,500
Devils Lake - Lakota 115-kv	26.09	Rugby	15,000
Devils Lake - Carrington 115-kv	52.49	Bisbee	1,500
Carrington - Jamestown 115-kv	48.35	Rolla	4,500
Jamestown - Valley City 115-kv	35.31	Carrington	11,500
Jamestown - Edgeley 115-kv	37.36	Edgeley	21,500
Edgeley - Groton 115-kv	80.49	Ellendale	15,000
Fargo - Grand Forks 115-kv	83.01	Forman	12,000
Leeds - Rolla 69-kv	42.55	Watford City	5,000
Edgeley - Forman 69-kv	66.42	Beulah	9,375
Bismarck - DeVaul 69-kv	45.03	Custer Trail	1,500
		DeVaul	2,500
		Fort Clark	750
TOTALS	1,303.03		676,459

[1]Double Circuit.

U. S. SOIL CONSERVATION SERVICE

The Soil Conservation Service cooperates with the State Water Conservation Commission on activities involving the conservation, utilization and disposal of water. The three programs of the Soil Conservation Service that require closest coordination of functions are: the watershed protection and flood prevention program, drainage in the Red River Valley, and irrigation and stock water developments throughout the state.

Watershed Protection and Flood Prevention

Good progress has been made in the watershed protection and flood prevention program in North Dakota. The first watershed in the state was the Tongue River Watershed in Pembina and Cavalier Counties. This watershed was authorized for construction in 1955. Nine of the ten dams planned for this project have been completed, the one floodway which was 13 miles long is in operation and all of the 48 miles of channel improvement planned has been installed. The project will be completed during 1961.

Six other watersheds have been approved for construction. They are the Elm River Watershed in Traill County; the Swan-Buffalo Creeks Watershed in Cass County; the Wild Rice Creek Watershed in Sargent County and extending into Marshall County, South Dakota; the Tewaukon Watershed in Sargent County; the North Branch of the Forest River Watershed in Walsh County; and the West Tributary Bois-de-Sioux River Watershed in Richland County and extending into Roberts County, South Dakota. The other plans will be presented to Congress in 1961, both being branches of the Forest River. Before these plans are completed, planning will be started on two or three new watersheds.

Under the watershed protection program, land treatment practices that increase the amount of water the soil can absorb are given first consideration. These practices include increased plantings of grass and legumes in the crop rotation, stubble mulching, tree planting to reduce erosion and help keep floodways and channels free from snow and dirt, the proper use of grass land so that more mulch is left on the ground, and many others.

At least 50% of the people living within the watershed must be cooperators with soil conservation districts before dams or floodways can be constructed. Waters which cannot be absorbed by the land after improved farming practices have been applied is retarded behind dams or carried safely to the outlets in floodways and through improved channels if existing channels are inadequate.

The State Water Conservation Commission is responsible for organizing the local water conservation and flood control districts, the local governmental entities through which the watershed projects are developed. A discussion of these districts can be found on pages 121 to 138 of this report. The Commission also cooperates in this program by reviewing plans for the proposed project, (and, in some cases, providing financial assistance.)

Red River Valley Drainage

Under the legal drainage program which is carried out primarily in the Red River Valley area, the Soil Conservation Service in most instances provides the engineering which includes field surveys, design and supervision of construction. The State Water Conservation Commission approves the plans and designs, inspects the project, and cost shares construction with the local people.

Irrigation and Stock Water

The Soil Conservation Service has assisted farmers in a number of cases in the survey, design and installation of irrigation facilities for their individual projects. Water rights for these projects are granted by the State Water Conservation Commission based on application from the farmers to the Commission. Almost 50,000 acres have been developed for irrigation in North Dakota by the individual farmers during the past 12 years.

The Soil Conservation Service also provides the technical assistance to farmers in the planning, design and installation of stock water ponds throughout the state. Over 14,000 of these ponds have been developed in the State since 1948.

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