FOURTH BIENNIAL REPORT

PART I

STATE HIGHWAY COMMISSION

AND

PART II

STATE ENGINEER

MADE TO THE

GOVERNOR AND LEGISLATURE
OF NORTH DAKOTA

FOR PERIOD JULY 1, 1922
TO JUNE 30, 1924

FOURTH BIENNIAL REPORT

PART I

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MADE TO THE

GOVERNOR AND LEGISLATURE
OF NORTH DAKOTA

FOR PERIOD JULY 1, 1922
TO JUNE 30, 1924

Bismarck, North Dakota.

September 1, 1924.

Honorable R. A. Nestos, Governor,

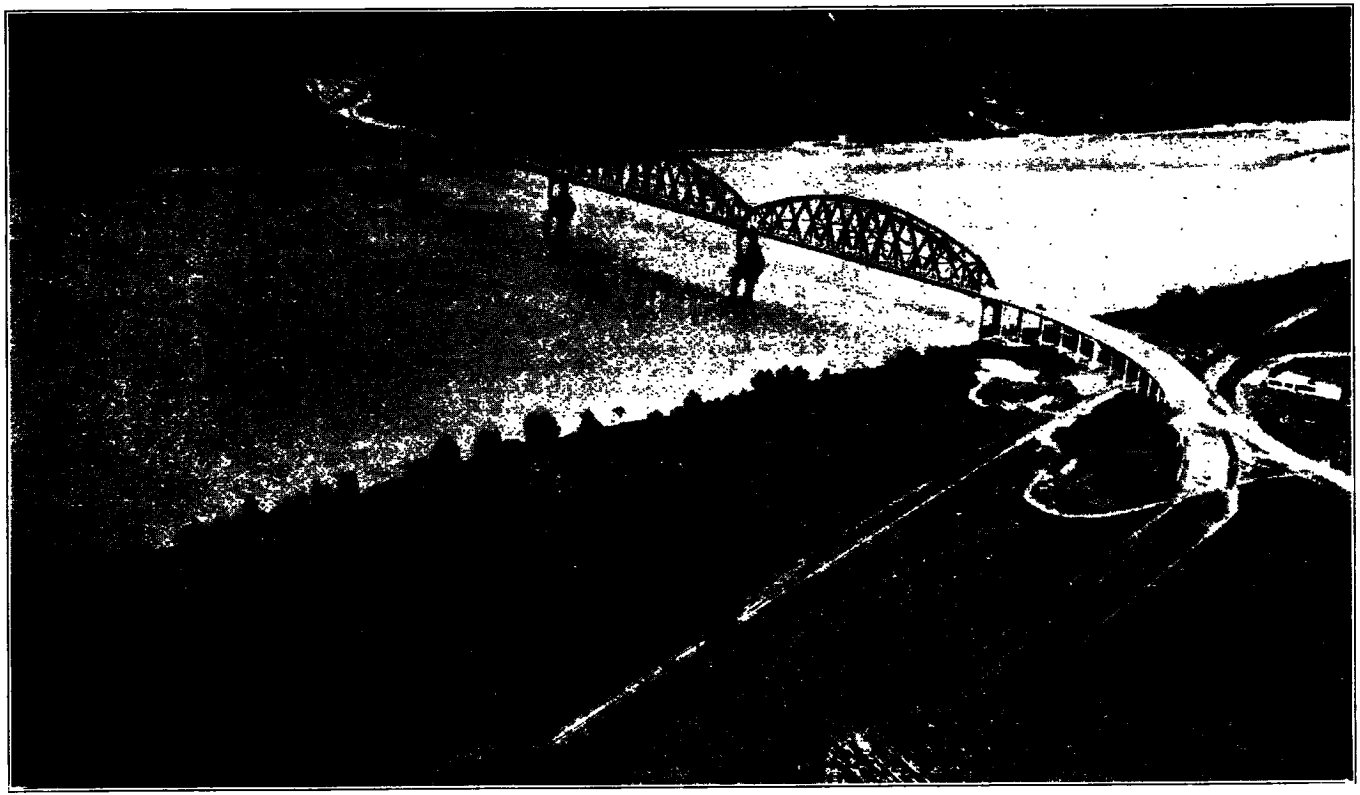
Dear Sir:

I have the honor of transmitting herewith a report of the activities of the Department of State Engineer and the Highway Commission for the biennial period, July 1, 1922 to June 30, 1924.

Respectfully submitted,

W. G. BLACK,

State Engineer



Airplane View Missouri River Bridge

F. A. P. No. 100-A—Between Bismarck and Mandan

State of North Dakota

STATE HIGHWAY COMMISSION

Governor R. A. Nestos, Minot	Chairman
Commr. of Agr. & Labor J. A. Kitchen	Sentinel Butte
Member, J. R. Poupore	Grand Forks
Member, Ormanzo A. Brown	Dickinson
State Engineer, W. G. Black	Chief Engr. & Sec'y.

HEADQUARTERS STAFF

Capitol Building, Bismarck

C. A. Myhre	Assistant Chief Engineer
J. E. O'Neil	Construction Engineer
A. D. McKinnon	Project Engineer
T. G. Plomasen	Maintenance Engineer
Clifford Johnson	Bridge Engineer
Frank Peters	Chief Draftsman
D. L. Lieberman	Chief Clerk
W. G. Gettelman	Supt. of Equipment

DIVISION ENGINEERS

Division		
I.	George E. Hanson	Bismarck
II.	H. C. Frahm	Minot
III.	Ralph McKeown	Devils Lake
IV.	M. P. Wynkoop (Acting)	Valley City
V.	A. D. La Due	Carson

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PART I.

FOURTH BIENNIAL REPORT

NORTH DAKOTA STATE HIGHWAY COMMISSION

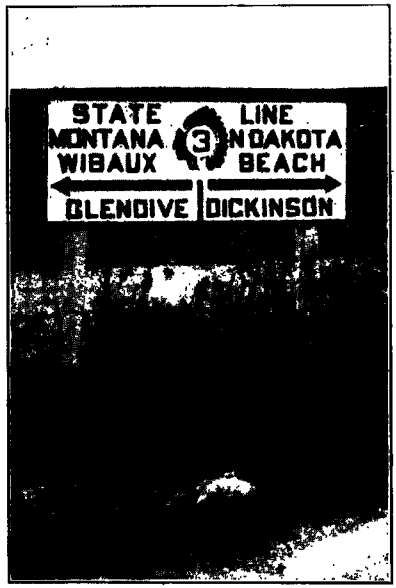
SECTION I

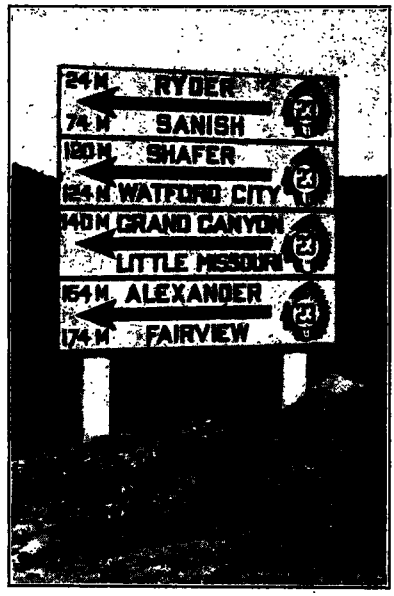
A Digest of Department Activities

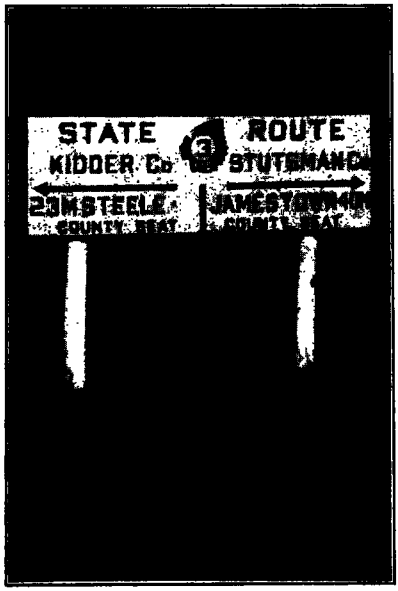
The Fourth Biennial Report of the State Highway Commission covers a period of two years from July 1, 1922 to June 30, 1924. During this period a virtual reorganization of the entire department occurred both in the personal and the policies to be pursued. On April 1, 1923, W. G. Black of Mandan succeeded W. H. Robinson whose term had expired, as Chief Engineer and Secretary of the Commission and on April 15th, 1923, O. A. Brown of Dickinson and J. R. Poupore of Grand Forks succeeded Benton Baker of Bismarck and Herman Hardt of Napoleon, whose terms had expired, as members of the State Highway Commission appointed from the state at large. At the time that Mr. Black assumed office a considerable change was made in the personal of the Department Heads and in several of the Division heads. A definite policy of economy and efficiency in administration was put in practice as well as the adoption of a policy to establish closer relations between the Commission, the County, Township, City and Village Officials and the public in general in the state.

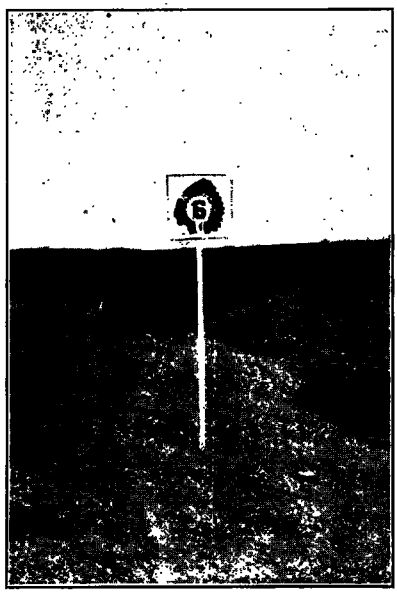
Salaries: With a nation wide road building program under way, the demand for men trained in construction work has increased greatly. Consequently the law of supply and demand in general has brought about increases in salaries in most states, however, this department, in spirit of economy due to the financial condition in the state, has to date not made any general increases in salary although a number of men in the employ of the Department for years have left for other fields, offering larger inducements in that line.

Seven Per Cent Federal Aid Highway System: Under the Federal Aid Road Act as amended in 1921, the expenditures of Federal Funds was limited to what was called a "Seven Per Cent System," that is, each state was permitted to construct, under Federal Aid, seven per cent of the estimated mileage of all roads in the state. The total estimated mileage of North Dakota which was submitted to the Bureau of Public Roads and approved by them as a basis for computing the allowable seven per cent system was 106,202 miles, seven per cent of which is 7,434.14 miles as constituting the seven per cent Federal Aid Highway System. On August 14th, 1923, there had been submitted to the Bureau of Public Roads and approved by them 4,855 miles of the above total of 7,434.14 miles and in addition to the above, at this writing there has been designated by the Commission and ready for submittal to the Bureau of Public Roads an additional 1,319 miles which will increase the present seven per cent system approved to 6,174 miles leaving only 1,260.14 miles to be designated in order to have the total allowable mileage of 7,434.14 miles absorbed. This system which will hereafter be referred to as the









Official Marker and a Few Types of Erected Distance and Direction Signs Used in the Marking of the State Highway System.

State Highway System of 6,174 miles as designated together with route numbers is shown on a map attached to this report.

Marking State Highway System: In the latter part of 1923 the State Highway Commission worked out route numbers for the State Highway System and after a great deal of study and deliberation adopted a standard marker to designate North Dakota Highways consisting of an Indian Head in black and white colors with a circle in the middle containing the number of the particular route on which the marker would be placed. Various designs were made and approved for warning and distance signs and a sign department organized for the actual work of making up and placing the warning and distance signs on the various approved routes. A few routes were covered in 1923 but principally efforts were concentrated on the actual manufacture and marking of the various signs during the winter of 1923 and 1924 and real progress was not made in the actual placing of the signs and markers until the spring and summer of 1924. A detail report of the activities and accomplishments of the Sign Department is given further along in this report. Much favorable comment has been expressed by the public in general on the excellence of the marking system completed to date and particularly of the great aid such a system is to the driving public, particularly at night as the markers and warning signs are easily discernible even at a distance of one thousand lineal feet, thereby making it as safe to drive by night as day on one of the marked routes of the Highway System.

State Highway Progress Map: As a natural sequence to the establishment of Route Numbers and a system of marking the State Highway System and in line with the general practice of adjoining States there was prepared during the winter of 1923-24 a State Highway Progress Map showing the entire state highway system as improved as of April 1st, 1924, together with the route numbers of all the Highways. Arrangements were made with the McGill-Warner Company of St. Paul for lithographing and printing 5,000 copies of this map in two colors for general free distribution to the public. The supply of 5,000 copies were very quickly absorbed and a requisition for 2,000 additional copies was made necessary in order to supply the public demand. It is proposed to improve this map considerably by making it more legible, also to somewhat reduce the size for the 1925 distribution. The new map will show the progress of construction up to April 1st, 1925, and will be in two colors as the previous map.

Highway Construction: During the period of this report there was let for construction a total of 737 miles of road of all classes, including bridges, gravel and paving for the approximate sum of $3,626,646.39. Also there were completed this period 1,098 miles at a cost of $5,400,000.00. Several tables giving detailed data on road construction are attached to this report and it is believed that everything of general interest has been included in these. Also further along in this report is given present method of financing road construction and results.

Highway Maintenance: During this period the amount of work undertaken by the Maintenance Department and the results achieved can

be most clearly appreciated by the number of miles of road maintained and the cost per mile. At the beginning of the period there were 1,029.5 miles while at the end 1,609 miles had been accepted which it was necessary to maintain. The total amount of money expended on Maintenance from July 1, 1922, to June 30, 1924, was $289,515.98. Further along in this report detailed data of the Maintenance Department is given which we believe includes everything of general interest.

Testing Laboratory: During this period it was necessary to add a testing Laboratory in addition to the other activities of the Department for the proper testing of all materials used in Highway Construction. Previous to this the Bureau of Tests at Washington had made all material tests for this Department but on account of the increased demands by the Bureau of Public Roads and certain State Departments not having Testing Laboratories of their own it was necessary for the Bureau of Tests to discontinue the further testing of materials for State Departments and confine their activities solely to Government work. This necessitated the creation of a testing laboratory by the Highway Department in order to properly fulfill requirements for the testing of all materials going into highway construction.

Railroad Grade Crossing Elimination: Recognizing the grave danger of all railroad crossings at grade this Department has put forth special efforts to safeguard the lives of highway users by eliminating as many of these crossings as possible, either by relocation of the highways themselves or the separation of grades by means of constructing overhead or underpass structures thereby allowing the Highway traffic to pass over or under the railroads. From June 30, 1917, to June 30, 1922, or the beginning of this report there were eliminated from our State Highway System 35 Railroad Grade Crossings of which 31 were eliminated by relocations of Highways, two by Underpass bridges and two by Overhead bridges. During the period of this report or from July 1, 1922, to June 30, 1924, there were eliminated 49 railroad grade crossings of which 43 were by relocation of the Highways and 6 by means of Underpass bridges. Proposed eliminations of Railroad Grade Crossings for 1925 construction amount to 21 such crossings of which 16 will be taken care of by relocation of Highways, two by means of Underpass bridges and three by overhead structures. Summarizing the accomplishment in Railroad Grade Crossing elimination we find that from July 1, 1917, to June 30, 1924, or during the entire existence of the Highway Commission, to date there have been eliminated 84 Railroad Grade Crossings of which 74 were by highway relocation, eight by means of Underpass bridges and two by means of Overhead bridges. Further along in this report data on the railroad grade crossing elimination accomplishments is set forth in greater detail.

It is believed to be fit and proper at this time to give due credit to the Northern Pacific and Soo Railway Companies for the splendid cooperation they have extended to this Department in the elimination of Railway Grade Crossings on their lines.

Information and Publicity: There is believed to be a great need for

some medium of Information and publicity which will give the public an idea of what the Highway Department is doing and what they hope to accomplish so with this idea in mind a modest start was made during the summer of 1924 by preparing mimeograph copies of interesting data concerning Highway accomplishments and releasing them to all daily and weekly papers in the State for publication. All of the various papers in the state to whom these news items were sent were very considerate and invariably printed such without cost to this Department. In addition to the news items present plans contemplate sometime in the future when funds are available, to issue a monthly bulletin as a medium for supplying the public with information of interest concerning the progress, activities, etc., of this Department in the construction, maintenance and marking of the State Highway System as such work progresses.

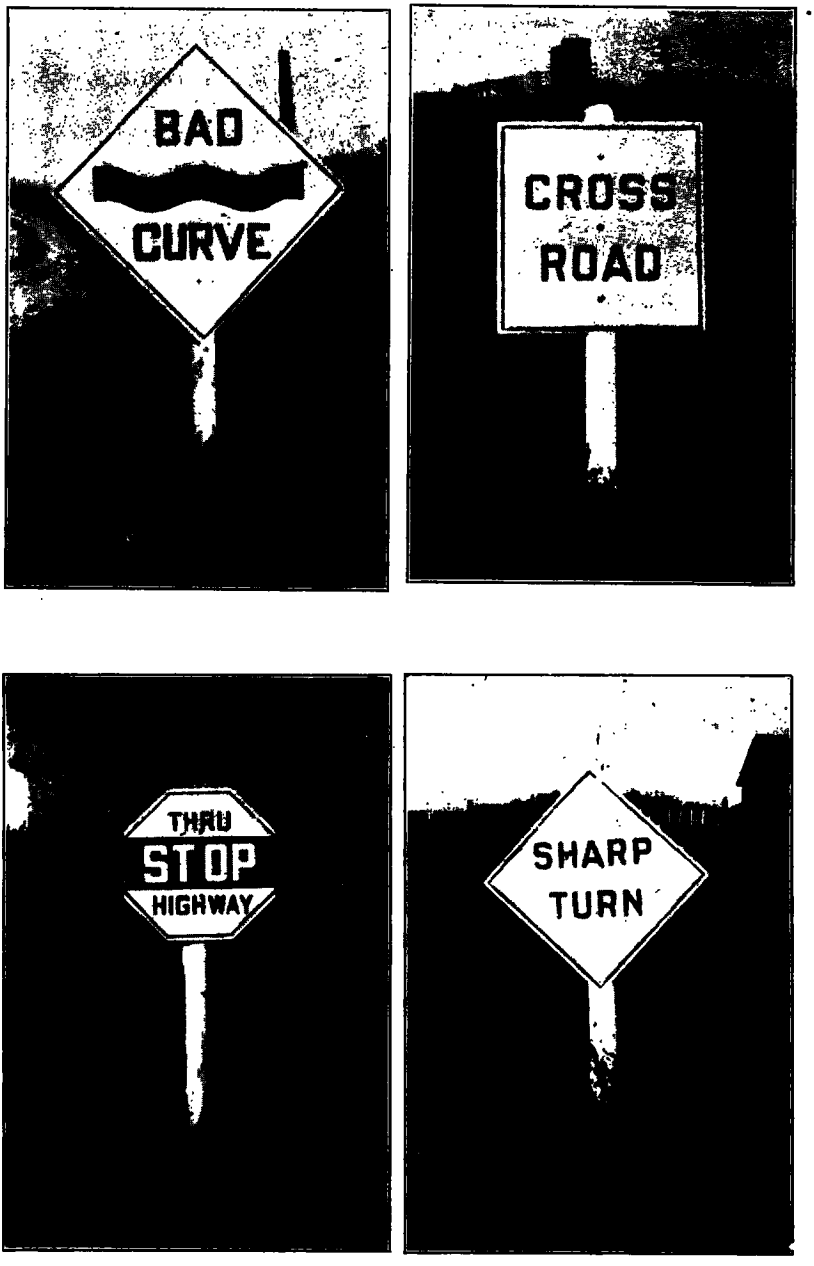
Federal Aid Allotments: During the period covered by this report there were two allotments made to North Dakota under the Federal Aid Road Act. The one in 1923 amounted to $776,476.28 while that made in 1924 totalled $1,021,269.47. The decrease in the first period is due to the fact that for the fiscal year ending June 30, 1923, only $50,000,000.00 was appropriated by Congress whereas for the Fiscal year ending June 30, 1922, $75,000,000.00 was appropriated and for the fiscal year ending June 30, 1924, $65,000,000.00 was appropriated. On June 30, 1924, all previous allotments of Federal Aid including that available for the fiscal year ending June 30, 1924, had been matched except $1,122,807.63. Of this amount $101,538.16 must be matched by June 30, 1925, and the balance or $1,021,269.47 must be matched by June 30, 1926. The Federal Aid Highway Act provided that the States must match Federal Aid Allotments by actual Project Agreements within two years after such allotment is available, i. e., the allotment for the fiscal year ending June 30, 1924, for example, must be matched by actual project agreement by June 30, 1926, and any balance remaining unmatched on that date will revert to a Federal Fund which is reapportioned to all of the states in the Union on the same basis as the original appropriation.

Maps: Two maps accompany this report, one giving an outline of the State Highway System with Route Numbers and the other indicates the progress of construction to June 30, 1924.

SECTION II

Methods of Financing State Highway Construction and Maintenance under present laws and needed remedial legislation.

Under the present existing laws on the basis of the 1923 Receipts from the Motor Vehicle Department there is available from State sources, same being Motor Vehicle License Fees, for construction of the State Highway System approximately $205,000.00 yearly and for Maintenance approximately $227,700.00 yearly. There is another State Fund set aside from the above mentioned sources under present laws of $130,000.00 yearly, however the expenditure of this fund is limited to the Construction of Bridges over navigable streams in the State and payment on any



Four of the Most Common Types of Erected Warning Signs Used in Marking the State Highway System

such bridge is not to exceed one-third (⅓) of the total cost of the structure on the part of the state out of such fund. Although such bridges are considered a part of the State Highway System so far as the general Highway Construction mileage of the State is concerned we may consider its funds limited to the $205,000.00 annually provided for such purposes as previously mentioned.

This $205,000.00 as set aside for construction of State Highways under the present laws is known as the State Aid Fund and remaining in the State Treasury, however, it is apportioned to the credit of the various counties of the State in the same ratio as this fund bears to the total receipts of Motor Vehicle License Fees as collected from these various counties. Although such Fund is under the control of and is expended by the State Highway Commission for the construction of State Highways, the present laws make such control and expenditure subject to certain conditions which in actual practice causes a considerable part of such funds to be unavailable for construction each year. These conditions are as follows:

1st. The proportionate amount of this fund must be expended in the County from which received.

2nd. The County must match this State Aid with a like amount of County money out of their own Road and Bridge Fund.

3rd. Requests must come from the various counties for State Aid money with an appropriation of a like amount of County money before such State Aid is available for construction purposes.

Due to these conditions the result has been that a considerable number of Counties, for economical and other reasons, have not seen fit to make requests for State Aid and to appropriate County money of like amount, thereby allowing their State Aid Credits to accumulate in the State Treasury. It is expected of course that at some future date such Counties will take advantage of their accumulated State Aid funds and utilize them on State Highway Construction projects, in fact, most of them have done so after an accumulation of three years credits. With the exception of the larger, more populous counties of the State, however, in general it may be said that the annual credits to the State Aid funds of the various Counties of the State from Motor Vehicle License Fee sources at the present time are so small that only a few miles could be constructed annually with State and Federal Aid, under present conditions. In those counties which are cooperating with us most extensively in the construction of State Highways, all of them with a few exceptions, are putting up Fifty Per Cent County Funds to meet the Federal Aid of fifty per cent on account of the small amount of State Aid now available. These conditions are naturally using up all of their available State Aid Funds as far as they will reach in addition to their county funds.

Consequently due to the small amount of State Aid Money now available for construction of our State Highways the greater part of the amount required to match the Federal Aid of approximately $1,100,000.00 allotted to North Dakota annually must come from County Road and

Bridge Funds as the only other available source under our present laws. Such a source of revenue for construction of our State Highways as the County Road and Bridge Funds are not entirely desirable as the source of this fund is from taxation of Real Property which is already carrying a heavy burden in the general taxation scheme of the State.

The present Highway Department was created under Chapter 131 of the Session Laws of 1917 so that this state would be in a position to take advantage of Federal Aid Provided for by the Act of Congress approved in July, 1916. Additional Federal Aid legislation was passed by Congress and approved by the President November 9th, 1921. which contained several important provisions.

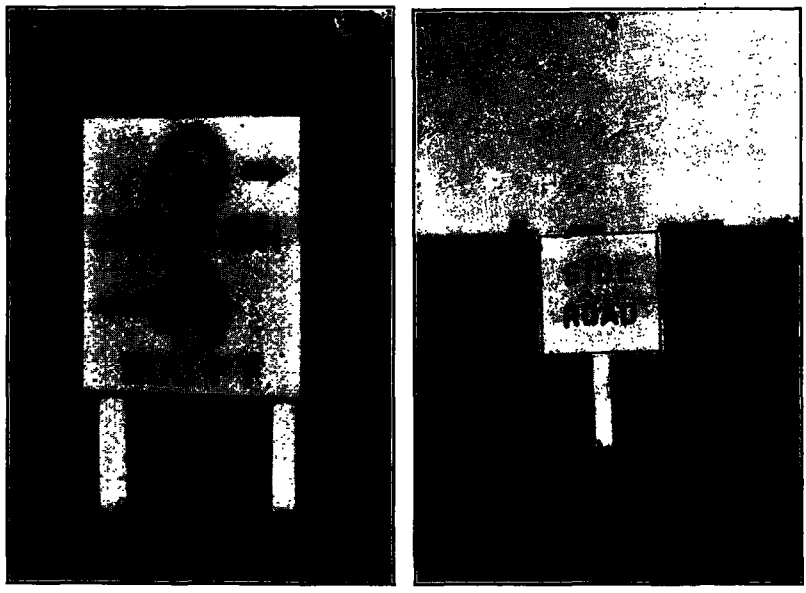
One of the provisions imposed by the above legislation is that after a certain date, November 9th, 1926, the state must match Federal Aid with funds wholly under the control of the State Highway Commission. Under our present state laws as previously mentioned, most of the funds necessary to meet Federal Aid are furnished from the road and bridge funds of the counties in which the improvements are to be made. Under this method it will be impossible to complete a state highway system for the reason that the poorer and more sparsely settled counties are unable to furnish the necessary funds with which to meet Federal Aid.

It is possible to create a state highway fund without making a direct tax levy. By proceeding on the theory that those who use our main highways should pay for their construction this state will be able to raise a fund large enough to meet the states allotment of Federal Aid funds each year. This can be done by 1st—Readjusting our motor vehicle registration fees. 2nd—By providing a tax on gasoline or other motor fuel consumed in automobiles, trucks and busses. Exempting gasoline or other motor fuel used in stationary engines, farm tractors or dry cleaning establishments and placing the money derived from such a tax where it belongs, in a highway fund.

That a readjustment of our motor vehicle registration fees is justifiable and necessary is very apparent. When one considers the fact that the amount charged as a registration fee also includes a personal property tax on the value of the automobile registered, it is readily seen that the amount of capital invested in automobiles is not taxed as heavily as the same amount of capital invested in any other form of property.

As a concrete example we might take a new Dodge Sedan costing $1,500.00. The registration fee including personal property tax under our present schedule is $15.50. If the same amount of capital were invested in a piece of farm land the taxes would be from $35.00 to $40.00 if not more.

The tax on gasoline or other motor fuel will give the users of our highways, whether they are residents of the State or tourists, an opportunity to contribute their share toward the cost of constucting and maintaining our highways. As to the equity of the tax, it is obvious. Assuming a tax of two cents per gallon on motor fuel used in automobiles, trucks and busses. A light car that travels twenty miles to a gallon would pay a tax of ten cents for every hundred miles it travels.



Common Types of Erected Warning Signs Used in Marking the State Highway System.

A heavier car that gets only ten miles to the gallon will pay twenty cents a hundred miles. A heavy bus or truck that gets only five miles to the gallon will pay forty cents a hundred miles. Take two cars which travel ten miles on a gallon, one care travelling three thousand miles in a season would pay six dollars, the other car travelling twenty thousand miles in a season would pay forty dollars. This will come as close as possible toward fixing the tax in proportion to the wear and tear on the roads.

The laws of this state have not kept pace with the rapid growth of the use of motor vehicles. Legislation dealing with license fees, loading of trucks and other laws of the road are urgently needed.

The annual "Special Road Maintenance Fund," created from Motor Vehicle License Fees of $227.700.00 annually as mentioned at the beginning of Section 11 of this report, under the present laws are apportioned to the various Counties of the State in the same ratio as the amount of total license fees received from these counties. However, instead of being placed in the State Treasury to the credit of the various counties as in the case of the State Aid Construction Fund, these monies are paid quarterly directly into the various County Treasurers and to be expended only for maintenance of the State Highway System under the direction of the State Highway Commission except if at the end of the year there remains a surplus in this fund unexpended, such surplus may be expended by the County Commissioners of any County for the maintenance of county highways with the consent and approval of the State Highway Commission.

It would seem logical that if any Department of State if empowered by law to direct the expenditure of any fund that such Department would also have control of such fund to the extent at least that the fund would remain in the hands of the State Treasurer rather than in the hands of the County Treasurers. Expenditure of such fund naturally to be made in the same manner as all other State Funds. It is therefore recommended that the present "Special Road Maintenance Fund" or any other Maintenance Fund created by the State Legislature for the purpose of Maintaining the State Highway System be deposited in the State Treasury and to be expended under the direction of the State Highway Commission in the same general manner as all other State Funds of a like nature are expended.

Legislation looking to a better regulation of the traffic on State roads than now exists should by all means be passed. Subject to only minor regulations, the overloaded motor truck, the tractor and threshing machinery with cleated wheels are now permitted to pass over our roads at will and are doing more damage to road surfaces than all other combined vehicular and motor traffic.

Laws unquestionably should be passed that will eliminate the use of sharp cleats on tractors and thresher engines. The damage that is done by the use of these cleats cannot be easily remedied and cannot be measured in dollars and cents. Such machines should be required by

statute to place blocks between the cleats when moving over road surfaces or to have removable cleats that can be taken off during such passage.

SECTION III

Department Organization

The present plan of Departmental Organization is contained in the Organization chart herewith shown which gives an idea of how the work of the Department is handled.

The paragraphs immediately following, give a terse description of the work handled by the various Divisions of the organization.

The Chief Engineer and Secretary as a member of the State Highway Commission acts as Secretary during deliberations of that body. In addition to which as directing head of the Highway Department he outlines the policies to be pursued, awards all contracts, approves all contract bonds and in general supervises all of the work of the Department. The Road Marking was inaugurated by the present Chief Engineer and Secretary and when systematized will be turned over to the Maintenance Department.

The Assistant Chief Engineer acting directly under the Chief Engineer supervises the details of the work of all Department Heads, especially with regard to transactions and dealings with the Bureau of Public Roads. In addition to above he arranges for advertisement and letting of contracts, preparation of contracts and surety bonds as well as estimate payments to Contractors.

The Project Engineer meets with County, Township, City and Village Officials initiating new projects, attends to preparation of Project Statements, location and survey of Roads, Right of Way Plats, as well as the preparation and circulation of publicity.

The Construction Engineer supervises the work of Design of all projects, preparation of plans, actual construction work, preparation of Estimates, Final Inspection and acceptance of projects.

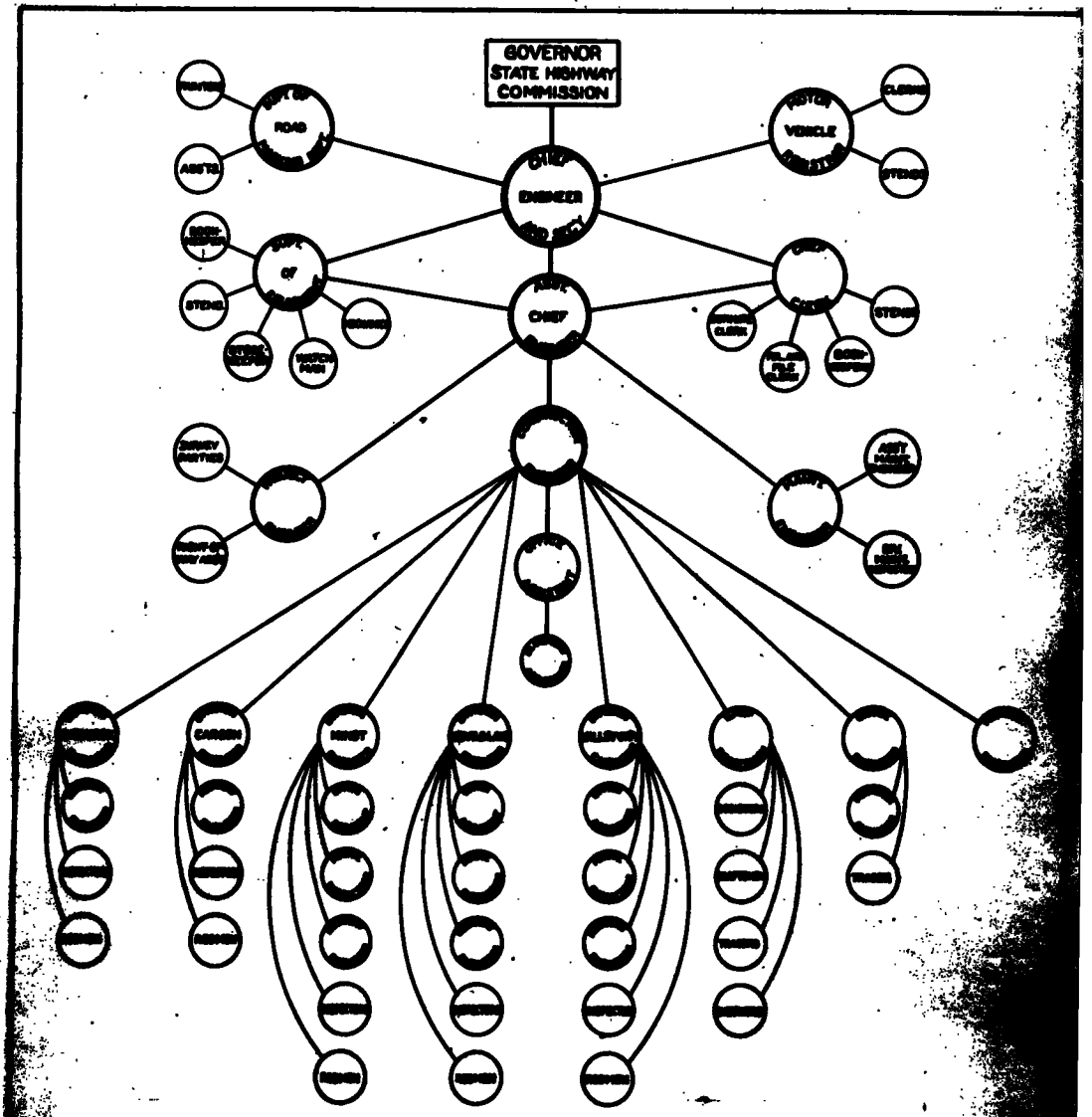
The Maintenance Engineer exercises supervision over all Maintenance, repair and reconstruction of all accepted projects. Makes periodical inspection of the work, employs all patrolmen, executing contracts with them and audits and records the accounts of patrolmen for Maintenance work performed.

Bridge Engineer: Supervision of location and surveys of all bridges over 20 foot span. Prepares plans, estimates, etc., for all bridges, concrete box culverts and headwalls for the Department.

Chief Draftsman: In responsible charge of the actual work, design, preparation of plans, maps, plats, etc., for all Departments.

Testing Engineer: In charge of the Testing Laboratory, being responsible for all material tests, such as cement, gravel, sand, metal pipe, reinforcing steel and in fact all materials going into Highway Construction.

The Chief Clerk purchases all office supply and equipment, transacts all Departmental business with State Auditor and Treasurer, supervises



ORGANIZATION CHART

OF

NORTH DAKOTA STATE HIGHWAY DEPARTMENT

and lays out the work of the Stenographic force and Bookkeeping Division, prepares all Federal Vouchers and audits all accounts expense vouchers, pay rolls and mails checks to all Departmental employees, Contractors and others. Supervises the filing of all letters, documents, etc., and attends to the receipt and distribution of all mail.

Supt. of Equipment: Receipts and disburses all surplus War Material, purchases all engineering and motor equipment, supervises state garage at Bismarck as well as having charge of all cars and trucks belonging to the Department, keeping them in repair and recording all reports in connection with the operation of the same.

Supt. Road Marking Department: Supervises the making and painting of all sign boards, etc., required for the marking of routes on the State Highway System, also attending to the erection of the same at the proper places on the Highways.

Division Engineers: These, the authorized field representatives of the Department are in responsible charge of all construction and maintenance work in their respective Divisions. They deal directly with County Authorities on all matters referring to construction and Maintenance. The Division Engineer is provided with an office at his headquarters which is designated by the State Highway Commission and during winter months supervises design, preparation of plans, etc., of such part of this work in his Division as he can accomplish with the help assigned to him before actual construction and Maintenance work commences in the spring.

Resident Engineers: In direct charge of several grading and gravel projects under supervision of Division Engineers with headquarters at some central town, contiguous to these projects during construction season. During winter months in Division Office or Bismarck Office working on design and preparation of plans for next season's work. During construction season Resident Engineers are responsible for the proper staking out and supervision of actual construction work and the preparation of reports and estimates for forwarding to Division Engineers.

Inspectors: Responsible for staking out and supervision of the actual work of Construction of Bridges, Box Culverts, Headwalls, Gravel Surfacing and paving, reporting directly to Resident or Division Engineers or Departmental Heads as the case may be, depending upon the importance of the work involved.

The above details of duties practically covers the work of the Entire Department.

SECTION IV

Co-operation with Federal Government

The Principle of co-operative construction of roads by the State and Federal Governments was originally laid down, in approximately its present form, by the Federal Aid Road Act, approved July 11, 1916. The Act provided an appropriation of $75,000,000 to be made available in five annual installments, beginning with $5,000,000 for the fiscal year 1917, and increasing by $5,000,000 each year, the last installment being $25,000,000 for the fiscal year 1921.

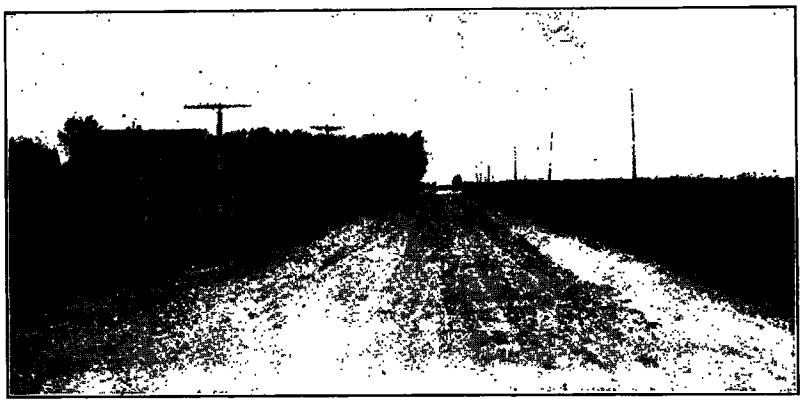
In order to participate in the benefits of the Federal appropriation, the States were required to create and maintain highway departments adequate, in the opinion of the Secretary of Agriculture, to supervise the construction of the roads. and when all States had complied with this provision the law specified that the Federal appropriation was to be apportioned fairly among them in accordance with a definite formula. Applying this formula the total appropriation was divided into three equal parts, one of which was apportioned among the States in proportion to their areas, one in proportion to their population, and the third part in the proportion that the area of rural post roads in each State bore to the total mileage of such roads in the United States.

Only roads which carried the U. S. mails could be improved under the Act as it was originally drawn. To such roads Federal aid might be granted to the extent of one-half of the cost of construction exclusive of the cost of bridges more than 20 feet in span, provided, however, that the maximum grant that could be made to any one road was $10,000 per mile.

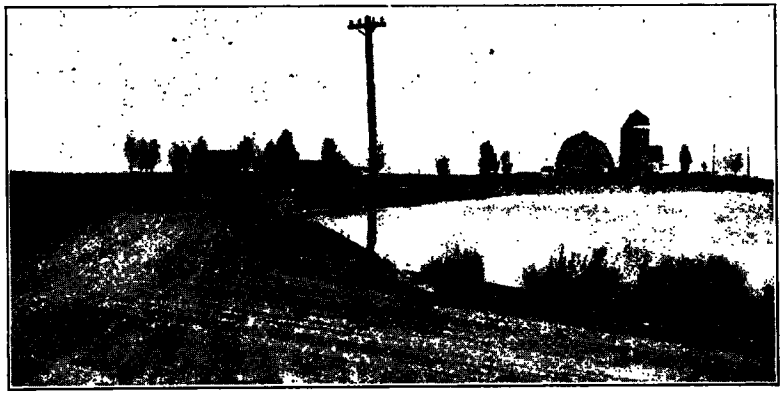
The State highway departments were required to prepare the plans, specifications and estimates and to supervise the construction subject to the approval of the Secretary of Agriculture, who designated the Bureau of Public Roads as his agent to carry out the details of administration.

The first project was completed by California within a year from the passage of the Act, and other States were equally prompt in taking advantage of the aid offered, but their activity was destined to be brought practically to a standstill by the increasing restraints upon road building necessitated by the exigencies of the World War.

After the close of the war attention was again turned to the work that had been started, and with a view to providing immediate employment for discharged soldiers Congress appropriated $200,000,000 more in February, 1919. The Act making the appropriation placed a more liberal interpretation upon the term "rural post roads" than had been possible under the earlier Act, so that it practically countenanced the granting of aid to the construction of any road necessary for the proper development of any section. The appropriation, which made available $50.000,000 for the fiscal year 1919 and $75,000,000 for each of the two succeeding years, was apportioned according to the formula prescribed by the original Act; and the same provision with regard to the division of the costs between the co-operating governments was retained, but the $10,000



F. A. P. No. 130—Towner County
Earth Grade South of Cando



F. A. P. No. 122—Ransom County
Earth Grade West of Lisbon

limitation upon Federal participation was increased to $20,000 per mile in view of the greatly diminished purchasing value of the dollar.

At this time a number of the States began to feel the need of an additional Federal appropriation to carry on the work—not because the earlier appropriations had been spent, but because their apportionment had been entirely obligated for projects in course of survey or construction so that there remained no balance sufficient to enable them to plan for necessary future work.

The Federal Highway Act

A new Federal law had been under consideration in Congress for some time and the need for further appropriation hastened its enactment. It was finally approved by the President, and became a law on November 9, 1921. This was the Federal Highway Act, which is destined to be one of the most far-reaching pieces of Federal road legislation ever enacted.

In addition to providing $75,000,000 with which to carry on the cooperative work this law laid down some entirely new provisions with regard to the character of the roads to which Federal aid could be granted and the extent of participation by the Federal Government.

Instead of permitting the Federal-aid funds to be used on any road which carried, or which might at some future time carry, the mails, as had been the provision of the previous Act, the new Act prescribed that all Federal money subsequently appropriated was to be applied only to a limited system of main interstate and inter-county roads which it directed the Secretary of Agriculture and the State highway departments to select in co-operation. The system, which has come to be known as the Federal-aid Highway System, is to consist of not more than 7 per cent of the total mileage of road existing in each State on the date of the passage of the Act.

"Upon this system all Federal Aid apportionments shall be expended. Highways which may receive Federal Aid shall be divided into two classes, one of which shall be known as primary or interstate highways, and shall not exceed three-sevenths of the total mileage which may receive Federal Aid, and the other which shall connect or correlate therewith and be known as secondary or inter-county highways, and shall consist of the remainder of the mileage which may receive Federal Aid.

"The Secretary of Agriculture shall have authority to approve in whole or in part the systems as designated or to require modifications or revisions thereof; Provided, that the States shall submit to the Secretary of Agriculture for his approval any proposed revisions of the designated systems of highways above provided for.

"Not more than 60 per centum of all Federal Aid allotted to any State shall be expended upon the primary or interstate highways until provisions have been made for the improvement of the entire system of such highways; Provided, that with the approval of any State highway Department the Secretary of Agriculture may approve the expenditure

of more than 60 per centum of the Federal Aid apportioned to such State upon the primary or interstate highways in such State.

"Whenever provision has been made by any State for the completion and maintenance of a system of primary or interstate and secondary or intercounty highways equal to 7 per centum of the total mileage of such State, as required by this Act, said State, through its State highway department, by and with the approval of the Secretary of Agriculture, is hereby authorized to add to the mileage of primary or interstate and secondary or intercounty systems as funds become available for the construction and maintenance of such additional mileage."

The amendment further provides that the funds for construction, reconstruction and maintenance of all Federal Aid highways within the state shall be under the direct control of the State highway department. In a later amendment approved by the President on June 19, 1922, it is provided: "That in any state where the existing constitution or laws will not permit the State to provide revenue for construction, reconstruction or maintenance of highways the Secretary of Agriculture shall continue to approve projects for said State until five years after November 9, 1921, if he shall find that said State has complied with the provisions of this Act in so far as its existing constitutions and laws will permit. This later amendment also authorized the appropriation of the following funds:

The sum of $50,000,000 for the fiscal year ending June 30, 1923.
The sum of $65,000,000 for the fiscal year ending June 30, 1924.
The sum of $75,000,000 for the fiscal year ending June 30, 1925.

The Federal funds that may be obligated and expended in the construction of a highway, exclusive of the cost of bridges having a clear span of more than 20 feet, was limited by the original act of $10,000 per mile. This sum was too small to participate in the construction of a highway on a 50-50 basis and it was therefore raised to $20,000 per mile as stated above. The Post Office appropriation bill approved June 19, 1922, reduces the payments that the Secretary of Agriculture may make for the fiscal year ending June 30, 1923, to $16,250 per mile exclusive of the cost of bridges of more than 20 feet of clear span and reduces the payments that the Secretary of Agriculture may make from any sums appropriated under this act or any act amendatory thereof after the fiscal year ending June 30, 1923, to an amount not to exceed $15,000 per mile exclusive of the cost of bridges of more than 20 feet of clear span. The limitation applies to public land states, except that it is increased in proportion to the increased percentage of Federal Aid authorized by the amendment approved November 9, 1921.

FEDERAL AID APPROPRIATIONS TO THE STATES

Fiscal Year Ending	Act approved July 11, 1916	Act amended Feb. 28, 1919	Act amended Nov. 9, 1921	Act amended June 19, 1922	Total
June 30, 1917	$5,000,000	.....	.....	.....	5,000,000
June 30, 1918	10,000,000	.....	.....	.....	10.000,000
June 30, 1919	15,000,000	50,000,000	.....	.....	65,000,000
June 30, 1920	20,000,000	75,000,000	.....	.....	95,000.000
June 30, 1921	25,000,000	75,000,000	.....	.....	100,000,000
June 30, 1922	Avail. Nov. 9, 1921		25,000.000	.....	25,000,000
June 30, 1922	Avail. Jan. 1, 1922		50,000,000	.....	50,000,000
June 30, 1923	.....	.....	.....	50,000,000	50,000,000
June 30, 1924	.....	.....	.....	65,000,000	65,000,000
June 30, 1925	.....	.....	.....	75,000,000	75,000,000
Totals	75.000,000	200,000,000	75,000,000	190,000,000	540,000,000

FEDERAL AID FUNDS

Allotments of Federal Aid to North Dakota by Acts and Years

Fiscal Year Ending	Act of 1916	Act of 1919	Act of 1921	Act of 1922	Total
June 30, 1917	76,143.06	.....	.....	.....	76,143.06
June 30, 1918	152,286.12	.....	.....	.....	152,286.12
June 30, 1919	229,585.91	768,368.28	.....	.....	997,954.19
June 30. 1920	307,344.11	1,152,540.42	.....	.....	1,459,884.53
June 30, 1921	384,056.95	1,152,170.85	.....	.....	1,536,227.80
June 30, 1922	.....	.....	1,164,714.42	.....	1,164,714.42
June 30, 1923	.....	.....	.....	776,476.28	776,476.28
June 30, 1924	.....	.....	.....	1,021,269.47	1.021,269.47
June 30, 1925	.....	.....	.....	1,178,708.13	1,178,708.13
Totals	1,149,416.15	3,073,079.55	1,164,714.42	2,976,453.88	8,363.664.00

Under the seven per cent provision of the amended Federal Aid act, a proposed scheme of Federal Aid roads was outlined by the State Highway Department and submitted to the Bureau of Public Roads at Washington. With a few minor changes, the suggested scheme was accepted by the Federal authorities. A map showing an outline of the Federal Highway System as accepted, is included with this report.

STATUS OF FEDERAL FUNDS

June 30, 1924

Table No. 3

1. Federal Aid appropriations and Apportionments as made, up to and including fiscal year ending June 30, 1925....		$8,349,662.29
2. Federal Aid Actually Paid.....	$4,418,505.42	
3. Federal Aid Under Agreement and Actual Contract	1,643,634.82	
Balance to be placed under Agreement and Contract	2,287,522.05	
Totals	$8,349,662.29	$8,349,662.29
Amount of old funds available for contracts and necessary to be placed under agreement by June 30, 1925		$ 101.538.16
Amount of funds available for new contracts and necessary to be placed under agreement by June 30, 1926.....		$1,122,807.63

To convey an idea of the process of handling Federal Aid Projects between the Bureau of Public Roads and the State Highway Commission there is herein set forth the Rules and Regulations of the Secretary of Agriculture for carrying out the Federal Highway Act:

RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE FOR CARRYING OUT THE FEDERAL HIGHWAY ACT

Regulation 1.—Definitions

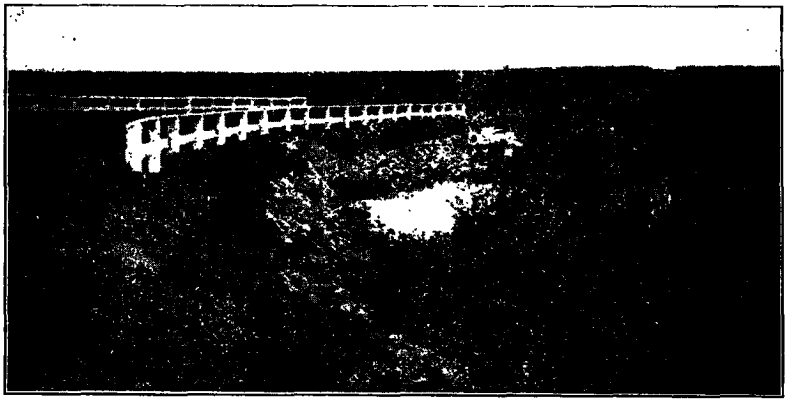
Section 1. For the purposes of these regulations, the following terms shall be construed, respectively, to mean:

ACT. The Act of Congress approved July 11, 1916, entitled "An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes" (30 Stat., 355), as amended by the Act of Congress approved February 28, 1919, entitled "An Act making appropriations for the service of the Post Office Department for the fiscal year ending June 30, 1920, and for other purposes" (40 Stat., 1200, 1201), and as amended by the Act of Congress approved November 9, 1921, entitled "An Act to amend the Act entitled 'An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes', approved July 11, 1916, as amended and supplemented, and for other purposes" (Public, No. 87, 67th Congress).

SECRETARY. The Secretary of Agriculture of the United States.

BUREAU OF PUBLIC ROADS. The Bureau of Public Roads of the United States Department of Agriculture.

F. A. P. No. 159—Divide County
Earth Grade—East of Crosby



F. A. P. No. 141—McIntosh County
Earth Grade West of Ashley

AUTHORIZED REPRESENTATIVES OF THE SECRETARY. The Chief of the Bureau of Public Roads and such other officials and employees thereof as he may designate from time to time.

FEDERAL AID HIGHWAY SYSTEM. The system of Federal Aid highways, established by actual agreement and joint action of the States and the Secretary of Agriculture, and upon which all Federal aid funds shall be spent.

PRIMARY HIGHWAYS. The primary or interstate portion of the Federal Aid highway system composed of not to exceed 3/7 thereof.

SECONDARY HIGHWAYS. The secondary or intercounty portion of the Federal Aid highway system consisting of at least 4/7 thereof.

TEN PER CENT FUND. Items for engineering, inspection, and unforseen contingencies, not exceeding 10 per cent of the total estimated cost of the construction.

Regulation 2—Application of Regulations.

Section 1. These regulations apply to all provisions of the Act, except the provisions thereof relative to forest roads and trails, unless hereafter so made applicable by order of the Secretary.

Section 2. These regulations shall apply as fully where the extent to which the State may engage in road construction and maintenance work, or raise state revenues therefor, is limited by its existing constitution and laws as in any other case.

Regulation 3—Information for the Secretary.

Section 1. Before any agreement is made upon any road or roads to be constructed in a State, or as to the character and method of construction, there shall be furnished to the Secretary upon his request, by or on behalf of the State, general information as to its laws affecting roads and the authority of the State and local officials in reference to the construction and maintenance of roads; as to the State Highway Department, how equipped and organized; as to the existing provisions of its constitution or laws relative to state revenues for the construction, reconstruction, or maintenance of roads; as to funds that will be available to meet the State's share of the cost of the construction work to be performed and the general source of such funds; and as to provisions made, or to be made, for maintaining roads upon which Federal Aid funds will be expended.

Section 2. Information requested by the Secretary or his authorized representatives relating to the maintenance of roads constructed under the provisions of the act shall be furnished, from time to time, by the State highway departments, on forms supplied by the Bureau of Public Roads.

Section 3. Data furnished by or on behalf of a State shall be supplemented by such reports of the Bureau of Public Roads as the Secretary may from time to time require.

Regulation 4—Federal Aid Highway System Map.

Section 1. Each State highway department shall file with the Secretary of Agriculture a state map showing the proposed Federal Aid Highway system and indicating the primary and the secondary portions thereof, in such form and with such information as he may require.

Section 2. The Secretary, through his authorized representatives, will make an examination of the proposed system and will from time to time notify the state highway department of the acceptability of the parts of the system examined.

Section 3. When Agreement has been reached between the state highway department and the Secretary as to the whole (or if the State so desires, of a material portion) of the Federal Aid highway system, the state shall make formal request for the approval of the Secretary of Agriculture. This request will be accompanied by a state map showing the full proposed Federal Aid highway system with the primary and secondary highways upon which formal approval is requested, in such form and with such information as may be prescribed by the Secretary or his authorized representatives.

Sec. 4. Pending the formal approval of the State highway system in whole or in part by the Secretary of Agriculture, only such projects will be approved as are on routes indicated on the proposed Federal Aid highway system as submitted under Section 1 and tentatively accepted by the Secretary under Section 2 of this Regulation; Provided, That the Secretary of Agriculture may approve project statements submitted by the State highway departments prior to the selection, designation, and approval of the system of Federal aid highways herein provided for if he may reasonably anticipate that the projects will become a part of such system.

Regulation 5—Project Statements.

Sec. 1. A project statement may be submitted for the whole or any part of a continuous route or routes embraced in the Federal aid highway system selected or designated in accordance with the provisions of the act, preference being given to such projects as will expedite the completion of a system of highways interstate in character.

Sec. 2. Prior to the selection, designation, and approval of the Federal Aid highway system, project statements may be submitted for any route or part of a route if the Secretary may reasonably anticipate that such route will become a part of such system. After the Federal Aid highway system shall have been selected, designated and approved no project statements shall be submitted for any route or part of a route not embraced in the system so selected, designated and approved.

Sec. 3. A project statement shall contain such information as the Secretary may require to be submitted on a form supplied by the Bureau of Public Roads and shall be accompanied by a sketch map in sufficient detail and covering such length of road as may be necessary to determine the fitness of the location as a part of the Federal Aid Highway system and with the termini of the proposed improvement indicated thereon.

Regulation 6.—Surveys, Plans, Specifications and Estimates.

Sec. 1. The surveys, plans, specifications and estimates shall show in convenient form and detail the work to be performed, and the probable cost thereof, all in conformity with the standards governing form and arrangement prescribed by the Secretary.

Sec. 2. Copies of the specifications shall be submitted with the plans and estimates, except that where standard specifications have been approved by the Chief of the Bureau of Public Roads a statement to the effect that approved standard specifications govern may be submitted in lieu of the printed documents.

Sec. 3. Until plans, specifications, and estimates for a project or part thereof have been submitted and found satisfactory for recommendation, and the State has been so notified by the District Engineer of the Bureau of Public Roads, no project or part thereof shall be let to contract.

Sec. 4. The estimate for each project shall show the estimated quantity and the estimated cost of each item of construction in detail and, separately, the 10 per cent fund, and shall not include any expense for advertising.

Sec. 5. Unless State standard contract and bond forms have been approved there shall be submitted with each set of plans for the approval of the Secretary copies of the form of contract together with all documents referred to therein or made a part thereof, and of the contractor's bond which it is proposed to use on the project. No alternation of either of these forms, when once approved, shall be made until it is approved by the Secretary.

Sec. 6. Where any part of the cost of a project is to be furnished by a county or other local subdivision or subdivisions of a State, the plans, specifications, and estimates shall be accompanied by certified copy of each resolution or order, if any, of the appropriate local officials, or such other showing as the Secretary may require respecting the funds which are made available, or respecting the supervision of the construction of the road and of the control of the money provided for paying such cost.

Sec. 7. Right-of-way ample for any project shall be provided and no incidental damages to adjoining property, due to construction work paid for by or on behalf of the state, shall be included in the estimate or be paid in any part, directly or indirectly, by the Federal Government.

Regulation 6.

Sec. 8. Grade crossings occurring on the Federal Aid Highway System shall be classified for priority of improvement by agreement between the State Highway Department and the Bureau of Public Roads.

Sec. 9. No part of the expense of making surveys, plans, specifications, or estimates, by or on behalf of the State prior to the beginning of construction work, shall be included in the estimate or paid by the Federal Government.

Sec. 10. Subsequent to the execution of the agreement no change which will increase the cost of a project to the Federal Government shall be made, except upon approval by the Secretary of Agriculture, and no changes shall be made in the termini or type, except upon approval of the Chief of the Bureau of Public Roads, but minor alterations which do not affect the general nature of the improvement or increase the total cost to the Federal Government may be authorized by the Chief of the Bureau of Public Roads or his authorized representative.

Regulation 7—Project Agreements.

Sec. 1. A project agreement between the state highway department and the Secretary shall be executed in triplicate on a form furnished by the Secretary. No payment shall be made by the United States unless or until such agreement has been executed, nor on account of work done prior to recommendation by the District Engineer of the Bureau of Public Roads that the plans, specifications and estimates be approved.

Regulation 8—Contracts.

Sec. 1. No part of the Federal money set aside on account of any project shall be paid until it has been shown to the satisfaction of the Secretary that adequate methods, either advertising or other devices appropriate for the purpose, were employed, prior to the beginning of construction, to insure economy and efficiency in the expenditure of such money.

Sec. 2. Upon publication of advertisements copies thereof shall be furnished to the Bureau of Public Roads.

Sec. 3. Bids shall conform to the standard proposal form, and the items shall be the same as those contained in the estimate provided for in Regulation 6, Section 4.

Sec. 4. Copy of the tabulated bid prices, showing the unit prices and the totals of each bid for every project, shall be furnished promptly to the Bureau of Public Roads.

Sec. 5. In advance of the acceptance of any bid sufficient notice of the time and place the contract is to be awarded shall be given to the Bureau of Public Roads to enable it, if it so desires, to have a representative present. When a bid has been accepted prompt notice thereof shall be given to the Bureau of Public Roads.

Sec. 6. If the contract be awarded to any other than the lowest responsible bidder the Federal Government shall not pay more than its pro rata share of the lowest responsible bid, unless it be satisfactorily shown that it was advantageous to the work to accept the higher bid.

Sec. 7. The specifications and plans shall be made a part of the contract.

Sec. 8. A copy of each contract, as executed, shall be promptly certified by the State Highway Department and furnished to the Secretary and no alteration in the contract shall be subsequently made without the approval of the Secretary.

Regulation 9—Construction

Sec. 1. Suitable samples of materials to be used in construction work shall be submitted, by or on behalf of the State Highway Department, to the Bureau of Public Roads whenever requested.

Sec. 2. Unless otherwise stipulated in writing by the Secretary or his authorized representative, materials for the construction of any project shall be tested, prior to use, for conformity with specifications, according to methods prescribed or approved by the Bureau of Public Roads.

Sec. 3. No part of the money apportioned under the act shall be used, directly or indirectly, to pay or to reimburse a State, county or local subdivision for the payment of any premium or royalty on any patented or proprietary material, specification, process, or type of construction unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods, if any, equally suitable for the same purpose.

Sec. 4. The supervision of each project by the State Highway Department shall include adequate and continuous engineering inspection throughout the course of construction.

Sec. 5. Written notice of commencement and completion of work on any project shall be given promptly by the State Highway Department to the Bureau of Public Roads.

Sec. 6. Reports of the progress of construction, showing force employed and work done, shall be furnished as requested by the Secretary or his authorized representatives.

Regulation 10—Records and Cost Keeping.

Sec. 1. Such records of the cost of construction, of inspection, of tests, and of maintenance, done by or on behalf of the state, shall be kept, by or under the direction of the State Highway Department, as will enable the State to report, upon the request of the Secretary or his authorized representatives, the amount and nature of the expenditure for these purposes.

Sec. 2. The accounts and records, together with all supporting documents, shall be open at all times to the inspection of the Secretary or his authorized representatives, and copies thereof shall be furnished when requested.

Regulation 11—Payments.

Sec. 1. Vouchers, in the form provided by the Secretary and certified as therein prescribed, showing amounts expended on any project and the amount claimed to be due from the Federal Government on account thereof, shall be submitted by the State Highway Department to the Bureau of Public Roads, either after completion of construction of the project, or. if the Secretary has determined to make payments as the construction progresses, at intervals of not less than one month.

Regulation 12—Submission of Documents.

Sec. 1. Papers and documents required by the act or these regulations to be submitted to the Secretary may be delivered to the Chief of the Bureau of Public Roads or his authorized representatives and, from the date of such delivery, shall be deemed submitted.

SECTION V

Project Department

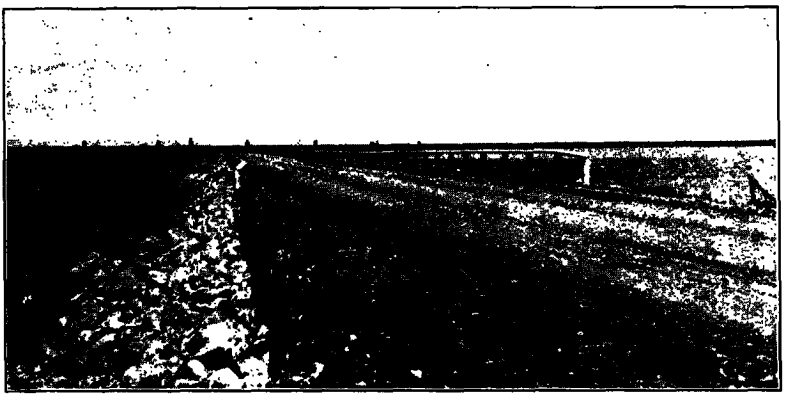
The Project Engineer meets with the various County, Township and Village Boards and City Commissions to consider and initiate proposed Federal Aid Projects, prepares project statements for submittal to the Federal Bureau of Public Roads, has charge of location and surveys of all projects and handles right of way matters and department publicity.

During the biennial period covered by this report a total of 113 Federal Aid Projects were initiated in 44 counties and project statements submitted to and approved by the Bureau of Public Roads. The 113 projects comprised 980.838 miles of earth roads for which surveys have been made.

Grade Crossing Elimination

In the location and survey of all proposed projects great attention has been given to the elimination of railroad grade crossings. Wherever possible grade crossings have been eliminated by relocation of the proposed highway this method being the most economical to the counties, railway companies and to the Federal Government. However, in several projects it was impossible to eliminate grade crossings by relocating the highway, therefore, a separation of the grades of the highway and railroad was secured by the construction of underpasses.

The accompanying tabulation shows that a total of 43 railroad grade crossings were eliminated by relocation and 6 by the construction of underpasses during the period covered by this report.



F. A. P. No. 155—Ramsey County
Earth Grade with Gravel Surface near Devils Lake

F. A. P. No. 100-C—Morton County
Concrete Underpass and Paved Highway Just East of Mandan

GRADE CROSSING ELIMINATION

Actual & Proposed **June 30, 1924**

F.A.P. No.	County	Number Eliminated					
		Over-head	R.R.	Under-pass	R.R.	Reloca-tion	R.R.
3	Williams	....	....	....	....	....	....
12	Barnes	....	....	1	Soo	....	....
15	Sargent	....	....	....	....	2	Soo
19	Ramsey	....	....	....	....	2	G. N.
36	Barnes	....	....	....	....	....	....
39	Grant	....	....	....	....	4	N. P.
56	Stutsman	....	....	....	....	5	N. P.
58	Sargent	....	....	....	....	2	Soo
61	Traill	....	....	....	....	2	G. N.
63	McLean	1	Soo	....	....	....	
73	Williams	....	....	....	....	2	G. N.
83	Ward	....	....	....	....	....	
84	Ward	....	....	....	....	2	Soo
96	Ramsey	....	....	....	....	2	G. N.
97	McIntosh	....	....	....	....	1	Soo
98	Benson	....	....	....	....	2	N. P.
100	Morton	....	....	1	N. P.	1	N. P.
118	Mountrail	....	....	....	....	2	G. N.
135	Barnes	1	....	....	....	2	N. P.
	TOTALS: June 30, 1917 to June 30, 1922	2	....	2	....	31	
80	Williams	....	....	....	....	2	G. N.
109	Griggs	....	....	....	....	2	N. P.
123	Logan	....	....	....	....	3	Soo
124	Barnes	....	....	1	N. P.	....	
126	Barnes	....	....	....	....	2	N. P.
133	Mountrail	....	....	....	....	2	G. N.
136	Burleigh	....	....	1	N. P.	....	
144	Cass	....	....	....	....	2	N. P.
149	Ramsey	....	....	....	....	2	G. N.
150	Dickey	....	....	....	....	1	C.M.& S.P.
151	Foster	....	....	....	....	2	N. P.
165	Walsh	....	....	....	....	2	Soo
166	Walsh	....	....	....	....	2	N. P.
182	Ward	....	....	....	....	2	G. N.
183	McIntosh	....	....	....	....	2	Soo
203	Benson	....	....	....	....	2	G. N.
210	Wells	....	....	....	....	2	N. P.
212	Dickey	....	....	....	....	1	C.M.& S.P.
213	Cass	....	....	1	N. P.	....	

218	Sheridan	....	....	....	....	2	N. P.
235	Mercer	....	....	1	N. P.	....	
242	Rolette	....	....	....	....	2	Soo
244	Burleigh	....	....	....	....	3	N. P.
245	Walsh	....	....	....	....	1	N. P.
247	Barnes	....	....	1	N. P.	....	
250	Williams	....	....	....	....	....	....
253	Cass	....	....	1	N. P.	2	N. P.
260	Morton & Stark	....	....	....	....	....	....
263	Towner	....	....	....	....	2	Soo
TOTALS: June 30, 1922 to June 30, 1924		....		6		43	
GRAND TOTALS		2		8		74	

NUMBER PROPOSED ELIMINATED

F.A.P. No.	County	Overhead	R.R.	Underpass	R.R.	Relocation	R.R.
3	Williams	1	G. N.	....	....	1	G. N.
36	Barnes	....	....	1	Soo	2	Soo
36	Barnes	....	....	....	....	4	N. P.
73	Williams	....	....	....	....	2	G. N.
83	Ward	....	....	1	G. N.	....	....
250	Williams	1	G. N.	....	....	....	....
260	Morton & Stark	1	N. P.	....	....	7	N. P.
TOTAL		3		2		16	

RECAPITULATION

Total Eliminated June 30, 1917 to June 30, 1924 by:
Overhead 2, Underpass 8, Relocation 74.
Total proposed eliminated as per project statements:
Overhead 3, Underpass 2, Relocation 16.

TOTAL ELIMINATION

Railroad	Overhead	Underpass	Relocation
Northern Pacific	1	7	34
Great Northern	..	..	20
Milwaukee	..	..	2
Soo Line	1	1	18
	2	8	74

SECTION VI

Construction Department

This section of the Biennial Report is devoted to tabulated data concerning the important features of the work performed by the Department during the period of this report and is presented in the form of tables with a short explanation of each table as follows:

Status Federal and State Aid Projects

Table No. 1—Lists all Federal and State Aid Projects in the State by Project Number, Counties and detail location showing the number of miles in each project and the status of same as of June 30, 1924.

Contract Awards

Table No. 2—Lists in detail contracts awarded during six month periods from July 1, 1917, to June 30, 1924, giving project numbers, County, mileage, and contractors name and address for each project with an average cost per mile for each itemized division of work.

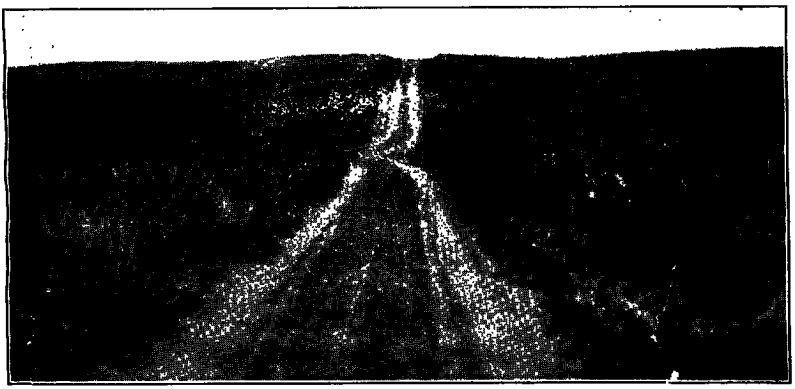
General Summary Contract Awards

Table No. 3 is a grand summary of Table No. 2, the top half of the sheet, giving total contracts awarded during six month periods from July 1, 1917, to June 30, 1924. for the various divisions of work and the lower half of the sheet giving average costs per mile for each six month period and a general average for the total period of this report.

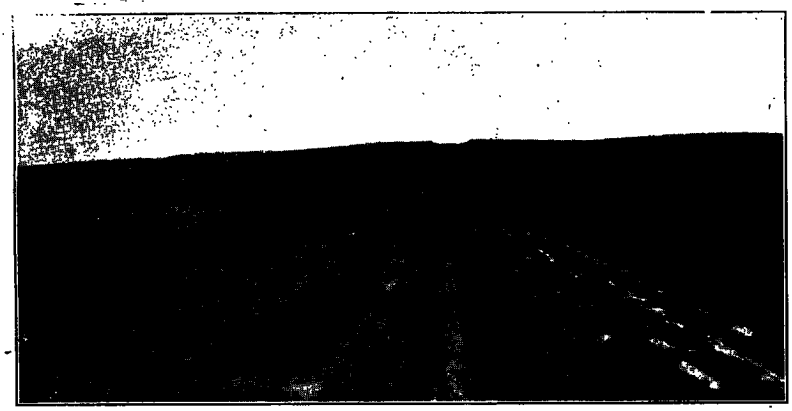
Distribution by Counties of Work Done
Table No. 4

There is presented in the accompanying table interesting detail data concerning First: The total mileage of approved State Highway in each County; Second: The total mileage of constructed State Highway, Earth, Gravel and Paving in each County; Third: The total mileage of State Highway remaining unimproved in each County on June 30, 1924; Fourth: The total cost of all constructed State Highways in each County; Fifth: That portion of the total cost above mentioned of State Highway constructed in each County paid by the Federal Government; Sixth: That portion of the total cost, above mentioned, of State Highway constructed in each County paid from the State Aid Fund and Seventh: That portion of the total cost, above mentioned, of State Highway constructed in each County paid out of **County Road and Bridge Funds.** Some interesting conclusions to be drawn from the figures compiled in this table show, That Stutsman County has the greatest Highway mileage in the State. That Barnes County has the greatest mileage of constructed earth and gravel highways in the State. That Griggs County is the first County in the State to complete the earth grading of their entire State Highway mileage and that by the end of 1925 the same will be all gravel surfaced. Grand Forks County leads in having the greatest mileage of paved Highways in the State.

It will be noted from this table that most of the Counties in the State have cooperated to some extent with this Department in the construction of State Highways and that with very few exceptions those who have once commenced such work have continued to do so.



F. A. P. No. 187—Divide County
Before Construction



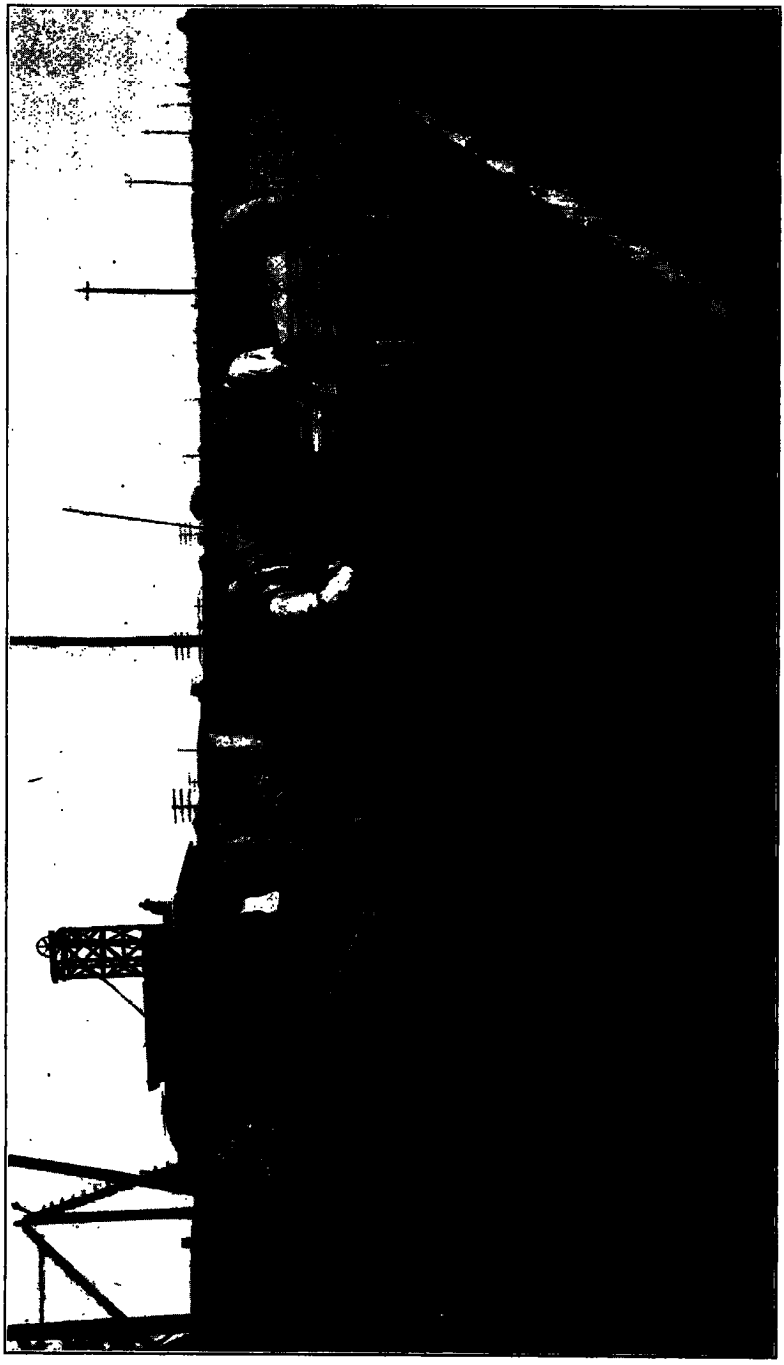
F. A. P. No. 187—Divide County
Same Road After Construction—Earth Grade

STATE HIGHWAY SYSTEM BY COUNTIES AND COSTS

County	Total S. H. Improved & Unimp.	Highways Completed and Under Construction with Federal Aid				Total S. H. Unimproved	Total Cost Incl. Engineering	Fed. Aid Pd. & Under Agree. to be Paid Incl. Construction Eng.	State Aid Pd. & Under Agree. to be Paid. Incl. Total Engineering	Co. Road & Bridge Funds Paid & Under Agree. to be Paid	Misc. Fund Payments Made & Under Agree to be Paid
		Earth Graded	Gravel	Hard Surface	Total Improved						
Adams	86	9	....	....	9	77					
Barnes	162	85	48	0.5	133.5	28.5	$ 659,957.28	$ 311,374.98	$ 38,667.42	$ 297,438.26	a$ 12,476.62
Benson	143	12	44	....	56	87	331,173.24	160,000.89	20,429.77	150,742.58	....
Billings	84	....	....	....	....	84					
Bottineau	109	39	25	....	64	45	307,608.01	149,059.73	23,772.35	134,775.93	....
Bowman	82	18	....	....	18	64	32,390.08	14,751.19	6,885.61	10,753.28	....
Burke	84	30	15	....	45	39	258,463.77	128,018.52	19,381.73	111,063.52	....
											b 11,214.29
Burleigh	132	....	....	1.0	1.0	131	754,462.60	358,908.22	23,292.14	134,047.84	227,000.00
Cass	182	16	39	....	55	127	352,750.99	164,653.44	79,300.23	108,797.32	....
Cavalier	81	20	....	....	20	61	55,629.16	23,955.60	24,666.37	7,007.19	....
Dickey	95	47	7	....	54	41	175,783.14	83,821.02	16,425.39	75,536.33	....
Divide	83	41	11	....	52	31	234,704.57	114,019.72	15,709.68	104,975.17	....
Dunn	126	....	....	....	....	126					
Eddy	79	10	19	....	29	50	158,476.28	76,882.56	18,894.96	62,698.76	....
Emmons	101	53	....	....	53	48	271,702.71	131,772.48	17,910.66	122,019.57	....
Foster	81	15	41	....	56	25	317,320.08	147,317.50	20,617.07	149,385.51	....
Grand Forks	187	50	10	2.0	62	125	371,963.52	157,632.47	20,596.46	192,734.59	....
Grant	82	10	....	....	10	72	72,819.58	35,273.92	9,789.82	27,755.84	....
Golden Valley	82	22	....	....	22	60	76,574.38	37,221.45	6,066.86	33,286.07	....
Griggs	59	11	47	....	58	1	292,877.79	150,334.10	18,336.61	124,207.08	....
Hettinger	109	32	....	....	32	77	197,645.51	96,483.18	12,413.37	88,748.96	....
Kidder	113	10	....	....	10	103	47,870.55	23,188.74	9,344.66	15,337.15	....
LaMoure	128	70	5	....	75	53	289,729.21	140,420.22	22,350.18	126,958.81	....
Logan	111	86	....	....	86	25	358,960.67	170,944.17	20,493.08	167,523.42	....
McHenry	160	12	....	....	12	148	44,139.07	21,107.53	8,866.71	14,164.83	....
McIntosh	117	71	1	....	72	45	239,193.49	117,805.22	12,348.00	109,040.27	....
McKenzie	217	....	....	....	....	217					....
McLean	237	30	....	....	30	207	217,617.00	106,031.10	22,753.28	87,832.61	....
Mercer	46	....	....	....	....	46					c 17,634.85
Morton	150	....	2	0.6	2.6	147.4	903,585.24	424,690.04	49,161.02	121,645.62	17,634.85
											d 227,000.00
											e 45,818.85
Mountrail	140	70	....	....	70	70	357,926.92	173,771.12	20,604.58	163,551.22	....
Nelson	128	48	5	....	53	75	246,901.71	119,714.19	27,008.18	100,179.34	....
Oliver	22	....	....	....	....	22					

											f 75,000.00
Pembina	82	16	....	....	16	66	278,616.48	99,708.45	12,208.02	56,700.01	35,000.00
Pierce	120	....	34	....	34	86	151,808.50	74,162.64	11,805.93	65,839.93	.....
Ramsey	155	28	66	....	94	61	447,098.32	220,826.86	21,932.79	204,338.67	.....
Ransom	66	54	1	....	55	11	240,893.35	115,228.45	19,667.61	105,998.28	.....
Renville	32	5	....	....	5	27	23,402.22	11,182.15	12,278.97	0.00	.....
Richland	150	42	8	....	50	100	279,068.99	135,613.02	44,750.90	98,705.07	.....
Rolette	81	18	7	....	25	56	101,955.12	36,326.43	13,228.79	52,399.90	.....
Sargent	96	79	2	....	81	15	397,943.68	193,933.99	19,406.54	184,603.15	.....
Sheridan	98	....	....	....	....	98					
Sioux	103	....	....	....	....	103					
Slope	104	....	....	....	....	104					
Stark	115	14	5	....	19	96	57,046.67	28,074.91	6,406.21	22,555.55	.....
Steele	77	8	....	....	8	69	25,983.39	12,286.33	.....	.....	.....
Stutsman	275	83	6	....	89	186	411,443.83	200,982.20	29,228.85	181,232.76	.....
Towner	114	22	30	....	52	62	279,287.65	137,609.95	18,629.46	123,048.24	.....
Traill	85	37	7	0.7	44.7	40.3	185,728.85	72,832.40	16,279.66	96,616.79	.....
Walsh	122	62	....	....	62	60	211,308.98	101,208.83	32,018.10	78,082.05	.....
Ward	245	48	64	....	112	133	574,658.93	306,677.94	54,290.32	213,690.67	.....
Wells	146	40	17	....	57	89	286,238.09	139,301.05	21,668.33	125,268.71	.....
Williams	110	71	2	....	73	37	268,269.36	131,017.13	26,499.39	109,752.84	.....
Total	6,174	1,544	568	4.8	2,116.8	4,057.2	$11,848,978.95	$5,656,126.03	$946,386.07	$4,561,039.69	$668,779.46

a N. P. R. R.
b N. P. Bridge Fund
c War Dept.
d N. P. Bridge Fund.
e N. P.
f State of Minn. Bridge Fund



F. A. P. No. 100-B—Morton County, Concrete Paving Construction in Operation Between Mandan and Bismarck

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
ADAMS			
115	Lemmon, S. D.	3.0	Surveyed—Proj. indef. postponed
243	Haynes W	8.98	Under construction
BARNES			
12 A, B, C, D	Valley City, etc.	23.5	Construction complete
12 E grav.	Valley City E	0.6	Construction complete
12 A, B, C grav.	Valley City, etc.	11.7	Construction complete
12 D grav.	Valley City W	11.8	Surveyed. Plans to be made 1924 letting.
36	Wimbledon-Fingal	49.8	Construction complete
36 A grav.	Rogers S	8.37	Under construction
36 D grav.	Rogers N	1.72	Under construction
47 grav.	Valley City E	7.0	Construction complete
124 grav.	Sanborn W	11.0	Under construction
126	Rogers N	10.0	Construction complete
135 grav.	Sanborn E	7.3	Construction complete
171	Hastings N & S	9.0	Construction complete
221 A, B	Nome N & S	12.02	Under construction
232	Rogers E & S	4.75	Plans to be made 1925 letting
265	Oriska N & S	23.0	Plans to be made 1925 letting
156 grav.	Valley City E	0.5	Construction complete
171 grav.	Hastings N & S	9.0	Plans to be made 1924 letting
247 A grav.	Valley City W	0.795	Under construction
247 B paving	Valley City	0.4922	Under construction
BENSON			
26 grav.	Obern	5.0	Construction complete
27 grav.	Minnewaukan	24.0	Construction complete
98 grav.	Minnewaukan S	10.8	Construction complete
157	Niles W	5.0	Construction complete
189	Minnewaukan W	7.07	Under construction
208	York E	7.51	Under construction
205	Minnewaukan W	6.02	Under construction
223	N of Churchs Ferry	3.0	Under construction
255 A grav.	Minnewaukan	0.28	Under construction
1003 grav.	Minnewaukan	0.47	Under construction
249 A	Ft. Totten N E	8.00	Plans complete, 1924 letting
BILLINGS			
0402	Medora	Br.	Construction complete
1001	Medora S	0.34	Under construction
BOTTINEAU			
40	E of Mohall	8.0	Construction complete
43	Bottineau E	10.1	Construction complete
44 grav.	W of Bottineau	4.5	Construction complete
87 grav.	Bottineau W	14.7	Construction complete
111	Willow City	0.2	Plans complete indef. postponed
145	W of Bottineau	11.7	Construction complete
170	Bottineau-Dunseith	3.0	Construction complete
172	Bottineau-Mohall	11.0	Construction complete
198	Bottineau-Mohall	1.0	Plans complete indef. postponed
BOWMAN			
21	Bowman	17.7	Construction complete
BURKE			
76	Bowbells N & S	22.9	Construction complete
77 grav.	Columbus E & W	14.94	Construction complete
127	Portland S	7.5	Construction complete
258 A	Bowbells S	6.0	Survey made. Plans to be provided 1924 letting

TABLE NO. 1
STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924
(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete, *Surveyed. Plans to be prepared for 1925 letting.
BURLEIGH			
100 A	Bismarck	Br.	Construction complete
136 A paving	Bismarck	1.0	Construction complete
136 B	Bismarck	Br.	Construction complete
174	McKenzie W	2.1	Plans made, indef. postponed
244	Bismarck E	1.24	Plans made, indef. postponed
CASS			
0982	Hickson	0.4	Construction complete
0984	S County Line	0.4	Construction complete
1	Fargo S	16.3	Construction complete
32	S of Fargo	Br.	Construction complete
0916	Mapleton E	7.9	Construction complete
137 A grav.	Mapleton E	7.9	Construction complete
137 B	Haggart	Br.	Construction complete
144 grav.	Mapleton W	17.0	Construction complete
154	Mapleton W	Br.	Construction complete
202	W of Fargo	Br.	Under construction
213	Tower City E	13.2	Under construction
253	Fargo W	12 0	To be surveyed for 1925 constr.
CAVALIER			
11	Clyde E & W	7.6	Construction complete
162	Langdon S	12.0	Construction complete
262	Nekoma S	4.0	To be surveyed for 1925 constr.
DICKEY			
112 A	Ellendale E	10.0	Construction complete
112 B	E of Ellendale	10.0	Construction complete
112 C	E of Ellendale	10.984	Construction complete
112 C gravl.	E of Ellendale	10.984	Plans complete 1924 letting
150	Ellendale N	13.0	Construction complete
143 grav.	Ellendale S	5.0	Under construction
206	Ellendale W	9.55	Under construction
211 A	Oakes N	7.5	Under construction
211 B	N of Oakes	12.0	Plans complete 1925 letting
212	N of Ellendale	8.0	Under construction
261	W of Ellendale	15.5	To be surveyed for 1925 constr.
DIVIDE			
30	Crosby S	10.5	Construction complete
30 A gravel	Crosby S	5 0	Construction complete
78 A B	Noonan E & W	10.0	Construction complete
78 B grav.	Noonan E & W	5.98	Construction complete
79	Fortuna E & W	11.0	Construction complete
79 grav.	Fortuna E & W	9.0	Plans complete, 1924 letting
257 A	S of Crosby	10.0	Survey made, 1925 letting
159	Crosby E & W	9.0	Construction complete
187	W of Crosby	12.0	Construction complete
DUNN			
266	Manning to Killdeer	4.0	Survey to be made for 1925 letting
EDDY			
6 grav.	Cheyenne N & S	5.5	Construction complete
8 grav.	New Rockford W & S	9.3	Construction complete
103 grav.	S of New Rockford	4.0	Construction complete
178	E of New Rockford	15.0	Under construction
177	E of New Rockford	15.0	Survey made, indef. postponed

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924

(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
EMMONS			
34	Hazleton N & S	14.4	Construction complete
91	N of Hazleton	8.2	Construction complete
119	Linton N	4.7	Construction complete
139	Linton S	10.5	Construction complete
161	Strassburg-Hull	10.0	Construction complete
197	Hull-Hague	5.2	Under construction
FOSTER			
1672	W of Glenfield	4.9	Construction complete
2 grav.	Carrington N & E	15.2	Construction complete
45 A	E of Carrington	11.1	Construction complete
45 A grav.	E of Carrington	11.1	Under construction
45 B	W of Glenfield	Br.	Construction complete
92 grav.	N of Carrington	4.0	Construction complete
101	Carrington W	6.0	Construction complete
101 grav.	Carrington W	6.0	Plans to be made 1925 letting
102	Glenfield E	3.5	Construction complete
102 grav.	Glenfield E	3.5	Under construction
151	Carrington SE	11.0	Construction complete
252 grav.	E of Carrington	4.9	Under construction
151 grav.	Carrington	2.623	Construction complete
151 grav.	Carrington	8.377	Plans to be made for 1925 construction
GOLDEN VALLEY			
49	Beach	22.1	Construction complete
GRAND FORKS			
1872	Thompson S	3.0	Construction complete
1874	Manvel NW	10.7	Construction complete
9	Reynolds	3.6	Construction complete
9 grav.	Reynolds	3.6	Under construction
16 grav.	Emerado E & W	6.7	Construction complete
41 A, B, C	Thompson-Northwood	14.0	Construction complete
51 Paving	Grand Forks	1.0	Construction complete
52 Paving	Grand Forks	0.9	Construction complete
107	Manvel NW	6.0	Plans complete, 1925 constr'n
110	Levant NW	4.7	Plans complete, 1925 constr'n
117	Larimore N	11.0	Construction complete
125	Grand Forks NW	9.4	Surveyed. 1925 construction
131	N of Larimore	11.0	Under construction
199	W of Grand Forks	Br.	Under construction
215	Grand Forks-Thompson	16.14	Under construction
217 A, B	E of Petersburg	13.89	Under construction
241	W of Grand Forks	10.0	Survey made. Plans for 1925 letting
246	Larimore E	9.5	Survey made. Plans for 1925 letting
18119 Paving	Grand Forks	0.8	Surveyed. Indef. postponed
230B	Northwood W	9.0	Under construction
230A	Northwood W	7.0	Plans complete, 1925 letting
GRANT			
39 A	Carson W	6.0	Plans made. Indef. postponed
39 B, C	Carson E	11.0	Construction complete
68	Lark E	6.0	Under construction
256 A	New Leipzig W & N	5.92	Under construction
GRIGGS			
17 A, B grav.	Cooperstown E & W	17.7	Construction complete
50 grav.	W of Cooperstown	4.0	Construction complete
99 grav.	W of Cooperstown	2.5	Construction complete

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924
(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
108 B, C	Binford S	11.0	Construction complete
108 B, C	Binford S	11.0	Under construction
108 A	Binford N	6.0	Construction complete
108 A grav.	Binford N	6.0	Plans to be made 1925 letting
109 A, B, C	Hannaford N & S	16.0	Construction complete
109 A, B grav.	Hannaford N & S	9.0	Under construction
109 C grav.	Hannaford S	7.0	Plans to be made 1925 letting
HETTINGER			
37 A, B, C, D	Mott E & W	18.8	Construction complete
38	New England N	8.9	Construction complete
105	Mott	Br.	Construction complete
220	New England	4.04	Under construction
KIDDER			
2282	Dawson S	11.0	Construction complete
64	Crystal Springs E&W	4.2	Construction complete
167	N of Tuttle	6.0	Construction complete
LA MOURE			
23	Edgeley	10.0	Construction complete
31 grav.	LaMoure E & W	4.8	Construction complete
31 B grav.	LaMoure	1.18	Plans complete, 1924 letting
93	Varona W	8.0	Construction complete
23 grav.	Edgeley	10.0	Plans to be prepared 1925 letting
94	W of LaMoure	15.0	Construction complete
94 grav.	W of LaMoure	15.0	Plans prepared, 1924 letting
113	Verona N	8.1	Construction complete
140	Verona S	5.0	Construction complete
148	N of Verona	12.00	Construction complete
148 grav.	N of Verona	12.00	Plans to be prepared, 1925 letting
176	Kulm E & W	8.0	Under construction
LOGAN			
35	Napoleon E & W	22.1	Construction complete
64	Burnstad	Br.	Construction complete
123	Napoleon S	21.0	Under construction
142	E of Napoleon	16.0	Construction complete
185 A, B	N of Fredonia	14.04	Construction complete
185 C	Fredonia N & E	4.99	Under construction
188	Gackle S	6.71	Under construction
207	Napoleon N	7.0	Plans complete, 1925 letting
McHENRY			
163	Towner W	10.0	Indef. postponed
164	Velva W	5.0	Construction complete
164 grav.	Velva W	5.0	Under contract
201	Granville	7.9	Under contract
McINTOSH			
33	Ashley E	18.1	Construction complete
97	Ashley N	11.5	Construction complete
141	Ashley W	13.0	Construction complete
183	Danzig-Wishek	18.0	Construction complete
216	W of Ashley	14.0	Under construction
McKENZIE			
236	W of Sanish	6.31	Under contract
237	Sanish W	11.8	Under contract

TABLE NO. 1
STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924
(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
McLEAN			
57	Garrison W	10.5	Construction complete
62	Turtle Lake W	10.0	Construction complete
63	Washburn S	10.0	Construction complete
63 A grav.	Washburn S	5.0	Under contract
MERCER			
235	Stanton S & W	7.32	Plans complete, 1924 letting
MORTON			
100 A	Mandan-Bismarck	Br.	Construction complete
100 B, C grav.	Mandan-Bismarck	3.434	Construction complete
100 B, C, paving	Mandan-Bismarck	3.434	Under contract
100 D	Mandan-Bismarck	Br.	Construction complete
251	Mandan S	12.0	Plans complete, 1925 letting
260	Glen Ullen W	18.0	To be surveyed, 1925 letting
MOUNTRAIL			
74	Stanley E	7.9	Construction complete
75	Palermo E & W	15.5	Construction complete
118	Stanley W	11.0	Construction complete
132	White Earth W	6.0	Withdrawn
133	White Earth E	14.0	Construction complete
250 B	White Earth W	3.32	Under construction
190	Belden S	15.0	Construction complete
248	Belden N	6.0	Under construction
258 B	Lostwood N	6.0	Surveyed. Plans to be made 1924 letting
NELSON			
70 grav.	Michigan E	5.5	Construction complete
121	Lakota E	10.9	Construction complete
121 grav.	Lakota E	10.9	Under construction
138	Lakota W	4.0	Construction complete
138 grav.	Lakota W	4.0	Under construction
146	Petersburg E	6.3	Under construction
152	Pekin S	8.0	Under construction
169	Mapes-Pekin	16.0	Under construction
OLIVER			
PEMBINA			
42	Cavalier W	5.2	Construction complete
114	Hamilton E	11.0	Construction complete
128	Pembina	1.0	Surveyed
3402	Drayton	Br	Construction complete
300	Pembina	Br.	Under construction
PIERCE			
10 grav.	Balta S	5.0	Construction complete
48 A, B, C grav.	S of Balta	21.3	Construction complete
106	Rugby E	7.4	Construction complete
106 grav.	Rugby E	7.4	Under construction
204	Rugby S	15.80	Plans complete, 1924 letting
219	Rugby NW	16.0	Surveyed. Indef. postponed
RAMSEY			
18 grav.	Churchs Ferry E	4.5	Construction complete
18 B	E of Churchs Ferry	Br.	Construction complete

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924

(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
19 grav.	Devils Lake E & W	19.9	Construction complete
95 grav.	Grand Harbor	12.4	Construction complete
149 grav.	E of Doyon	3.5	Construction complete
155 grav.	Devils Lake S	6.3	Construction complete
168	Starkweather-Edmore	16.0	Construction complete
168 grav.	Starkweather-Edmore	16.0	Plans complete, 1924 letting
153	Starkweather E & S	7.0	Construction complete
224	Devils Lake N	21.0	Survey made, 1924 letting
225	S of Nekoma	12.0	Under construction
222	N of Churchs Ferry	3.0	Under construction
RANSOM			
28	Lisbon N & S	27.0	Construction complete
28 A grav.	N of Lisbon	6.0	Plans complete, 1924 letting
122	W of Lisbon	10.0	Construction complete
129	Lisbon E	11.0	Construction complete
192 grav.	Lisbon W	0.66	Construction complete
214	W of Lisbon	6.0	Plans complete, 1924 letting
221 C	NW of Enderlin	3.0	Plans complete, 1924 letting
RENVILLE			
180	SE of Donnybrook	6.0	Construction complete
RICHLAND			
3972	S of Wahpeton	3.0	Construction complete
4	S of Wahpeton	20.0	Construction complete
59	Fairmont W	14.4	Construction complete
60	Wahpeton N	34.0	Indef. postponed
69	Wyndmere W & E	18.5	Indef. postponed
71	Wahpeton W	15.9	Construction complete
71 grav.	Wahpeton W	15.9	Under construction
72	Hankinson W	18.0	Indef. postponed
ROLETTE			
160 grav.	Dunseith W	7.0	Construction complete
194 A, B	Dunseith E	11.0	Under construction
196	W of Rolla	8.67	Under construction
238	Rolla E & W	7.0	Under construction
242	Fonda	7.09	Plans complete, 1924 letting
SARGENT			
15	Forman W & N	31.4	Construction complete
15 A grav.	Forman W & N	2.0	Construction complete
58	Forman E	19.0	Construction complete
66	Perry N	6.3	Construction complete
89	Forman S	12.0	Construction complete
147	Milnor S & E	16.0	Construction complete
191	W of Milnor	7.0	Indef. postponed
229	Forman	2.5	Plans complete. Indef. postponed
231	Cogswell	0.76	Plans complete. Indef. postponed
SHERIDAN			
209	Denhoff	12.5	Under construction
218 A	W of McClusky	6.3	Under construction
SIOUX			
SLOPE			

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924

(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
STARK			
14	N & S of Dickinson	18.9	Construction complete
14 gravel	N of Dickinson	5.1	Under construction
65	W of Dickinson	Br.	Construction complete
260 B	Dickinson E & W	6.0	Survey made. Indef. postponed
STEELE			
29	Sherbrooke E	8.5	Plans complete. Indef. postponed
158	Pickert W	10.0	Construction complete
265 A	Finley S	5.0	To be surveyed 1925 construction
STUTSMAN			
7	Newhome S	9.2	Construction complete
13	Pingree W	7.9	Construction complete
24	Cleveland N & S	25.9	Construction complete
55 gravel	Spiritwood E & W	6.0	Construction complete
56	Jamestown N & S	39.6	Construction complete
239 grav.	Jamestown E	8.0	Under construction
TOWNER			
22 grav.	Rock Lake N & S	17.5	Construction complete
120 grav.	Cando N	11.6	Construction complete
130	Cando S	9 0	Construction complete
130 grav.	Cando S	9.0	Plans complete, 1924 letting
179	Ellsberry-Rolla	14.0	Under construction
TRAILL			
4972	E of Mayville	7.0	Construction complete
5	Hillsboro	24.9	Construction complete
5G grav.	Mayville-Portland	3.14	Under construction
5D	S of Taft	2.0	Plans complete, 1925 letting
46	Buxton S	4.0	Construction complete
61 A, B	Hillsboro S	13.0	Under construction
61 C	Hillsboro-Kelso	Br.	Construction complete
61 D paving	Hillsboro	0.736	Construction complete
61E	Kelso	Br.	Plans complete, 1924 letting
67	Buxton N	7.1	Plans complete. Indef. postponed
WALSH			
116 A, B, C	E of Park River	14.9	Construction complete
165	Park River-Adams	15.5	Under construction
166	Minto-Ardock	9.2	Under construction
245	Grafton-Minto	9.0	Under construction
184	Adams W	12.0	Under construction
WARD			
25 grav.	Minot W	6.0	Construction complete
81 grav.	Minot E	13 0	Construction complete
82	Minot N	15.0	Under construction
83 grav.	Des Lacs N & E	8.7	Construction complete
84 grav.	Burlington NW	22.8	Construction complete
85 grav.	Minot S	14.0	Construction complete
86	N of Minot	12.0	Under construction
181	Kenmare SE	18.44	Construction complete
182	Berthold SE	8.5	Under construction
226	N of Minot	6.0	Plans complete, 1925 constr'n
227	W of Berthold	8.0	Plans complete, 1925 constr'n
228	Kenmare N	8.0	Plans complete, 1925 constr'n
	Minot-Velva	20.0	To be surveyed, 1925 constr'n
	Max-Ryder	14.0	To be surveyed, 1925 constr'n

TABLE NO. 1

STATUS OF PROJECTS AND PROGRAM OF CONSTRUCTION IN NORTH DAKOTA BY COUNTIES AS OF JUNE 30, 1924

(Continued)

COUNTY Proj. No.	LOCATION	Length	STATUS **Plans complete. *Surveyed. Plans to be prepared for 1925 letting.
WELLS			
20 grav.	Harvey N & S	16.8	Construction complete
88 grav.	Hurdsfield N	11.3	Construction complete
90	Hurdsfield W & S	10.0	Construction complete
175	Bowden E	18.0	Under construction
210	Bowden E & W	17.01	Plans complete, 1924 constr'n
WILLIAMS			
3	Williston NE	30 5	Construction complete
73	Ray-Tioga	17.0	Construction complete
80	Williston W	19.0	Construction complete
80 grav.	Williston W	2.2	Construction complete
250 A	Tioga S & E	6.7	Under construction

F. A. P. No. 247-B—Barnes County, Finished Pavement at Valley City. Concrete Base and Warrenite Bithulithic Top, Asphalt Plant to the Right in the Foreground

TABLE NO. 2

NORTH DAKOTA STATE HIGHWAY COMMISSION

TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JULY 1, 1922 TO DECEMBER 31, 1922

Proj. No.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading etc.	Furnish'g Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
12E	Barnes	....	567	Barnes County—force account	.....	.....	.....	$ 837.60	$ 837.60
22	Towner	....	*(a)	Cramer Construc. Co., St. Paul, Minn.	.....	.....	.....	9,747.91	9,747.91
37CD	Hettinger	10.87	....	Lindsay & Gilden, Mott, N. D.	$ 20,055.79	.....	$ 4,651.13	.....	.....
				Western Steel Prod. Co., Duluth, Minn.	.....	$ 1,455.60	.....	.....	26,162.52
61B	Traill	5.961	....	J. E. Johnson, Buxton, N. D.	6,442.26	.....	.....	.....	.....
				W. H. Noel, Jamestown, N. D.	.....	562.80	.....	.....	.....
				Carl E. Winberg	.....	.....	1,703.32	.....	8,708.38
70	Nelson	*(b)	....	W. H. Noel, Jamestown, N. D.	10,866.50	.....	.....	.....	10,866.50
120	Towner	....	*(a)	Cramer Construc. Co., St. Paul, Minn.	.....	.....	.....	7,784.94	7,784.94
122	Ransom	9.997	....	Midwest Construc. Co., Fargo, N. D.	21,085.27	.....	745.08	.....	23,797.63
				N. D. Metal Culv. Co., Fargo, N. D.	.....	1,967.28	.....	.....	.....
136	Burleigh	....	1.052 *(c)	Haggart Construc. Co., Fargo, N. D.	.....	.....	*(c)	42,055.00	42,055.00
137B	Cass	Bridge		J. A. Jardine, Fargo, N. D.	.....	.....	17,500.67	.....	17,500.67
144	Cass	18.593	6.631	W. H. Noel, Jamestown, N. D.	27,374.26	.....	.....	15,196.25	.....
				Concr. Sec. Culv. Co., Fargo, N. D.	.....	4,462.58	.....	.....	.....
				J. A. Jardine, Fargo, N. D.	.....	.....	1,513.46	.....	48,546.55
				Nels Brolander, Lidgerwood, N. D.	19,746.80	.....	.....	.....	.....
147BC	Sargent	9.912	....	N. D. Metal Culv. Co., Fargo, N. D.	.....	1,882.42	.....	.....	.....
				Prendergast Bridge Co., Milbank, S. D.	.....	.....	3,929.89	.....	25,559.11
151	Foster	11.689	....	N. D. Construc. Co., Linton, N. D.	29,777.79	3,046.56	1.526.20	.....	34,350.55
162A	Cavalier	6.136	....	Wm. Collins, Lakota, N. D.	10,390.10	.....	.....	.....	.....
				N. D. Metal Culv. Co., Fargo, N. D.	.....	2,070.14	.....	.....	.....
				Fargo Bridge & Iron Co., Fargo, N. D.	.....	.....	2,494.26	.....	14,954.50
TOTALS		73.158	7.198		$145,738.77	$15,447.38	$34,064.01	$33,566.70	.....
Concrete			1,052				Concrete	$42,055.00	$270,871.86

*(a) Second (1-3) course gravel
*(b) Riprap on grading project
*(c) Concrete surfacing

SUMMARY FOR CALENDAR YEAR 1922

Total grading, culverts and bridges	$1,006,515.39	— 362.758 mi.	— average	$ 2,774.61
Total gravel surfacing	278,897.19	— 140,012 mi.	— average	1,991.95
Total concrete surfacing	42,055.00	— 1.052 mi.	— average	39,976.37
GRAND TOTAL FOR 1922	$1,327,467.58			

TABLE NO. 2

NORTH DAKOTA STATE HIGHWAY COMMISSION

TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1923 to JUNE 30th, 1923

Proj. No.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv. etc.	Reinf. Concrete	Gravel Surfacing	Total
2A	Foster	5.008	5.008	W. H. Noel, Jamestown, N. D.	$5,798.15	.....	$14,442.29	.....
				Foster County—Gravel	.....	.....	1,714.55	$21,954.99
15	Sargent ..	....	2.222	Stevens Bros., Garrison, N. D.	.....	.....	6,579.65	.....
				Sargent County—Gravel	.....	.....	411.15	6,990.80
17B	Griggs	....	4.000	W. H. Noel, Jamestown, N. D.	.....	.....	9,583.45	.....
				Griggs County—Gravel	.....	.....	548.50	10,131.95
20	Wells	16.787	....	The Padgett Co., Leeds, N. D.	12,342.40	.....	.....	12,342.40
22	Towner ..	.610	....	Dunbar & McCoy, Cando, N. D.	4,446.98	.....	.....	4,446.98
26	Benson ..	....	5.020	Rhyne & Sigurdson, Minneota, Minn.	.....	.....	5,007.64	.....
				Benson County—Gravel	.....	.....	1,719.75	6,727.39
27CD	Benson ..	....	11.018	Rhyne & Sigurdson, Minneota, Minn.	.....	.....	14,207.31	.....
				Benson County—Gravel	.....	.....	3,523.00	17,730.31
30	Divide	....	4.5	Stevens Bros., St. Paul, Minn.	.....	.....	7,566.87	.....
				Divide County—Gravel	.....	.....	1,367.40	8,934.27
41C	Gr. Forks	6.98	....	W. H. Noel, Jamestown, N. D.	13,024.76	.....	.....	13,024.76
44	Bottineau	....	4.501	Bottineau Co., Force Account	.....	.....	6,690.31	.....
				Bottineau County—Gravel	.....	.....	1,233.00	7,923.31
47	Barnes	....	6.881	Ed Wyttenbach, Valley City, N. D.	.....	.....	17,378.64	.....
				Barnes County—Gravel	.....	.....	1,131.12	18,509.76
50	Griggs	....	3.990	W. H. Noel, Jamestown, N. D.	.....	.....	8,307.33	.....
				Griggs County—Gravel	.....	.....	546.70	8,854.03
61C	Traill	Bridge		Carl Winberg, Hillsboro, N. D.	.....	6,695.16	.....	6,695.16

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1923 to JUNE 30th, 1923

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
77	Burke	-----	14.94	J. L. Manley, Milbank, S. D.	----------	----------	$ 34,140.44	----------
				Burke County—Gravel	----------	----------	2,047.40	$ 36,187.84
78	Divide	-----	6.0	J. J. Gits, Noonan, N. D.	----------	----------	6,852.02	----------
				Divide County—Gravel	----------	----------	1,229.10	8,081.12
86A	Ward	6.015	-----	Druhl & Kemper, Minot, N. D.	$ 31,774.06	----------	----------	----------
86B	Ward	6.130	-----	Druhl & Kemper, Minot, N. D.	28,492.44	----------	----------	60,266.50
92	Foster	-----	4.002	W. H. Noel, Jamestown, N. D.	----------	----------	6,416.26	----------
				Foster County—Gravel	----------	----------	1,096.40	7,512.66
96	Ramsey	-----	6.530	Stevens Bros., Garrison, N. D.	----------	----------	8,600.10	----------
				Ramsey County—Gravel	----------	----------	2,236.75	10,836.85
98	Benson	-----	14.718	The Padgett Co., Leeds, N. D.	----------	----------	17,761.18	----------
				Benson County—Gravel	----------	----------	5,040.00	22,801.18
99	Griggs	-----	2.490	W. H. Noel, Jamestown, N. D.	----------	----------	7,672.50	----------
				Griggs County—Gravel	----------	----------	341.50	8,014.00
109C	Griggs	5.050	-----	Stanley Bros., St. Cloud, Minn.	14,852.37	----------	450.45	----------
				Griggs County—Gravel	----------	----------	69.30	15,372.12
112C	Dickey	10.757	-----	Nels Brolander, Lidgerwood, N. D.	21,690.04	$ 2,459.97	----------	24,150.01
124BC	Barnes	-----	2.020	Webster Contract g Co., Bismarck, N. D.	----------	----------	1,733.04	----------
				Barnes County—Gravel	----------	----------	332.16	2,065.20
126	Barnes	10.360	-----	Midwest Const. Co., Fargo, N. D.	28,739.36	----------	----------	----------
				N. M. Nielson, Valley City, N. D.	----------	1,828.41	----------	30,567.77
127	Burke	6.773	-----	Schultz Bros., Bowbells, N. D.	19,955.44	----------	----------	19,955.44
127	Burke	-----	-----	Stanley & Moyer, Williston, N. D.	----------	3,165.21	----------	3,165.21
129	Ransom	11.018	0.568	Stevens Brs., Garrison, N. D.	38,186.17	----------	900.88	----------
				Ransom County—Gravel	----------	----------	116.70	39.203.75
131	Grand Forks	11.024	-----	Wm. Schultz, Fergus Falls, Minn.	23,815.95	----------	----------	23,815 95
135	Barnes	-----	7.310	W. H. Noel, Jamestown, N. D.	----------	----------	13,211.18	----------
				Barnes County—Gravel	----------	----------	1,205.16	14,416.34
143	Dickey	6.335	6.335	J. W. Tracey, Ellendale, N. D.	10,052.52	----------	----------	----------
				Stevens Bros., Garrison, N. D.	----------	----------	10,480.43	----------
				Dickey County—Gravel	----------	----------	1,041.48	21,574.43
146	Nelson	6.156	-----	W. H. Noel, Jamestown, N. D.	14,352.98	----------	----------	14,352.98
149	Ramsey	-----	3.390	Stevens Bros., Garrison, N. D.	----------	----------	3,907.10	----------
				Ramsey County—Gravel	----------	----------	1,163.75	5,070.85
152	Nelson	9.147	-----	Hohman, Webster & Son, Turtle Lake, N. D.	46,662.01	----------	----------	----------
				T. M. Swingen, Cooperstown, N. D.	----------	17,254.45	----------	63,916.46
158	Steele	7.960	-----	Stevens Bros., Garrison, N. D.	22,395.39	----------	----------	----------
				Fargo Bridge & Iron Co., Fargo, N. D.	----------	1,763.40	----------	24,158.79
161	Emmons	9.741	-----	N. Dak. Const. Co., Linton, N. D.	29,740.55	4,610.93	----------	34,351.48
162B	Cavalier	6.010	-----	Wm. Collins, Lakota, N. D.	13,005.60	----------	----------	----------
				N. D. Metal Culv. Co., Fargo, N. D.	1,318.20	----------	----------	----------

TABLE NO. 2

NORTH DAKOTA STATE HIGHWAY COMMISSION

TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1923 to JUNE 30th, 1923

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
				Fargo Bridge & Iron Co., Fargo, N. D.	.....	3,049.84	.....	17,373.64
164	McHenry	4.397	.....	Stevens Bros., Garrison, N. D.	15,503.80	9,634.62	.....	25,138.42
165	Walsh	15.383	.....	Wm. Schultz, Fergus Falls, Minn.	33,679.99	.....	.....	.....
				J. J. Rue & Sons, Baldwan, N. Dak.	.....	8,672.25	.....	42,352.24
167	Kidder	5.936	.....	Steig & Olson, Edmond, N. D.	23,744.69	.....	.....	23,744.69
168	Ramsey	16.001	.....	Stevens Bros., Garrison, N. D.	52,462.84	12,213.88	.....	64,676.72
169A	Nelson	9.105	.....	W. H. Noel, Jamestown, N. D.	27,319.24	.....	.....	.....
				T. M. Swingen, Cooperstown, N. D.	.....	895.54	.....	28,214.78
169B	Nelson	8.364	.....	Hohman, Webster & Son, Turtle Lake, N. D.	28,911.34	.....	.....	.....
				T. M. Swingen, Cooperstown, N. D.	.....	4,090.59	.....	33,001.93
170	Bottineau	2.888	.....	John Coghlan, St. John, N. D.	15,005.86	.....	.....	15,005.86
171	Barnes	9.233	.....	Stanley Bros., St. Cloud, Minn.	27,262.23	.....	.....	.....
				N. M. Nielson, Valley City, N. D.	.....	5,121.68	.....	32,383.91
172	Bottineau	10.987	.....	The Padgett Co., Leeds, N. D.	32,518.73	.....	.....	32,518.73
175A	Wells	9.076	.....	The Padgett Co., Leeds, N. D.	26,167.24	.....	.....	.....
				C. V. Anderson, Baldwin, N. D.	.....	4,570.26	.....	30,737.50
175B	Wells	8.991	.....	The Padgett Co., Leeds, N. D.	28,003.19	.....	.....	.....
				C. V. Anderson, Baldwin, N. D.	.....	10,058.50	.....	38,061.69
178	Eddy	10.334	.....	Steig and Olson, Esmond, N. D.	45,735.24	.....	.....	.....
				N. M. Neilson, Valley City, N. D.	.....	2,937.24	.....	48,672.48
180	Renville	5.234	.....	Stanley Bros., St. Cloud, Minn.	15,895.00	.....	.....	.....
				F. M. Haas, Minot, N. D.	.....	6,075.29	.....	21,970.29
181A	Ward	9.015	.....	Schultz Bros., Bowbells, N. D.	49,486.55	.....	.....	.....
				J. J. Rue & Sons, Baldwin, N. D.	.....	14,929.88	.....	64,416.43
181B	Ward	9.426	.....	Schultz Bros., Bowbells, N. D.	30,076.96	.....	.....	.....
				J. J. Rue & Sons, Baldwin, N. D.	.....	12,649.43	.....	42,726.39
183A	McIntosh	8.418	.....	R. S. Burnstad, Burnstad, N. D.	23,941.80	.....	.....	.....
183B	McIntosh	8.984	.....	R. S. Burnstad, Burnstad, N. D.	22,037.23	.....	.....	.....
183AB	McIntosh	.....	.....	V. D. Marshall, Forbes, N. D.	.....	11,729.16	.....	57,708.19
185A	Logan	6.989	.....	Stevens Bros., Garrison, N. D.	23,548.42	.....	.....	.....
185B	Logan	7.044	.....	Stevens Bros., Garrison, N. D.	20,083.93	.....	.....	.....
185AB	Logan	.....	.....	Nels Brolander, Lidgerwood, N. D.	.....	1,452.19	.....	45,084.54
187A	Divide	6,107	.....	Stanley Bros., St. Cloud, Minn.	21,162.49	.....	.....	21,162.49
187B	Divide	6.003	.....	Stanley Bros., St. Cloud, Minn.	32,692.15	.....	.....	32,692.15
189	Benson	7.070	.....	The Padgett Co., Leeds, N. D.	21,136.01	.....	.....	21,136.01
190A	Mountrail	7.080	.....	Hall & Booth, Stanley, N. D.	34,672.85	4,263.86	.....	38,936.71
190B	Mountrail	7.592	.....	Hall & Booth, Stanley, N. D.	27,474.22	2,291.30	.....	29,765.52
192	Ransom	0.662	0.662	Midwest Const. Co., Fargo, N. D.	3,743.73	.....	1,123.77	.....

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1923 to JUNE 30th, 1923

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
192	Ransom	.....	.....	Ransom County—Gravel	.....	.....	160.65	5,028.15
194A	Rolette	6.139	.....	Ellis M. Nelson, Bottineau, N. D.	15,544.92	.....	.....	15,544.92
Totals		348.589	116.105		$1,078,456.02	$152,413.04	$231,288.36	$1,462,157.42
				Total Grading and Concrete	$1,230,869.06			
				Average per mile—Grading & Pipe Culverts			$ 3,093.77	
				Average per mile—Reinf. Concrete Structures			437.23	
				Total Average per mile			$ 3,531.00	
				Average per mile—Gravel Surfacing			$ 1,992.06	

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JULY 1, 1923 TO DECEMBER 31, 1923

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
14	Stark	.....	5.129	Stark County—furnish gravel	.....	.....	1,405.40	.....
				Wm. Gillen, Mott, N. D.	.....	.....	11,403.20	12,808.60
55	Stutsman	.....	5.980	Stutsman County—furnish gravel	.....	.....	1,228.65	.....
				Chas. Jackson, Jamestown, N. D.	.....	.....	6,508.38	7,737.03
61D	Traill	.....	.736	Northern Construction Co.				
		Conc. Paving		Grand Forks, N. D.	.....	.....	.....	57,438.27
71	Richland	.....	7.960	Cudd & Hidlebaugh, Foxhome, Minn.	.....	.....	39,236.55	39,236.55
84AB	Ward	.....	11.910	Ward County—furnish gravel	.....	.....	3,307.16	.....
				J. L. Manley, Milbank, S. D.	.....	.....	20,734.77	24,041.93
85	Ward	.....	14.736	Ward County—furnish gravel	.....	.....	4,037.80	.....
				The Padgett Co., Leeds, N. D.	.....	.....	34,234.59	38,272.39
100D	Morton	Underpass	.....	Force Account	.....	83,307.00	.....	83,307.00
100E	Morton	Revetment	.....	Force Account	.....	.....	.....	775,000.00
106	Pierce	.....	7.430	Pierce County—furnish gravel	.....	.....	2,035.40	.....
				Pierce county—force account	.....	.....	11,543.85	13,579.25
124G	Barnes	.....	2.020	C. O. Lindgren—breakwater	.....	.....	1,650.00	.....
				Barnes County—furnish gravel	.....	.....	332.16	.....
				Webster Cont. Co., Bismarck, N. D.	.....	.....	1,733.04	3,715.20

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JULY 1, 1923 TO DECEMBER 31, 1923

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
144BC	.....	.....	11.950	Cass County—furnish gravel	.....	.....	13,488.70	.....
				W. H. Noel, Jamestown, N. D.	.....	.....	51,336.52	64,825.22
151	Foster	.....	2.623	Foster County—furnish gravel	.....	.....	2,648.45	.....
				Chas. C. Jackson, Jamestown, N. D.	.....	.....	6,261.06	8,909.51
155	Ramsey	.....	5.800	Ramsey County—furnish gravel	.....	.....	1,682.20	.....
				E. T. Young, Devils Lake, N. D.	.....	.....	7,828.45	9,510.65
160	Rolette	.....	6.960	Rolette County—furnish gravel	.....	.....	2,421.80	.....
				C. M. Padgett, Leeds, N. D.	.....	.....	7,124.67	9,546.47
167	Kidder	5.936	.....	Steig & Olson, Esmond, N. D.	23,744.69	.....	.....	23,744.69
176	LaMoure	11.883	.....	R. S. Burnstad, Burnstad, N. D.	45,024.40	.....	.....	45,024.40
184	Walsh	12.020	.....	Hohman, Webster & Son,				
				Turtle Lake, N. D.	28,741.36	.....	.....	28,741.36
185C	Logan	4.989	.....	Linton Br. Constr. Co., Linton, N. D.....	14,027.49	.....	.....	14,027.49
188	Logan	6.707	.....	H. Knudson, Adrian, N. D.	29,517.32	.....	.....	29,517.32
194B	Rolette	4.874	.....	John Coghlan, St. John, N. D.	14,959.40	.....	.....	14,959.40
197	Emmons	5.260	.....	W. L. Chapin & Son, McIntosh, S. D.	18,152.24	.....	.....	18,152.24
20C	Dickey	9.553	0.707	Dickey County—furnish gravel	.....	.....	737.20	.....
				Louis Wohlwend & Son,				
				Lidgerwood, N. D.	35,310.32	.....	3,686.00	39,733.52
30C	Pembina	Steel & Conc.						
	Kittson	bridge		Linton Br. Constr. Co., Linton, N. D.	.....	175,484.32	.....	175,484.32
Totals		61.222	83.205	.736 Concrete	$ 209,477.22	$258,791.32	$236,606.00	$ 837,312.81

SUMMARY FOR CALENDAR YEAR 1923

Total grading, culverts & small bridges	1,440,346.28	409.811 Mi.	Average	3,514.66 per mile
Total gravel surfacing	467,894.36	199.310 Mi.	Average	2,347.57 per mile
Total concrete surfacing City of Hillsboro	57,438.27	0.736 Mi.	Average	78,041.13 per mile
Pembina Bridge, Mandan Underpass and Missouri River Revetment	333,791.32			
Grand Total for 1923	2,299,470.23			

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1924 TO JUNE 30, 1924

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
5	Traill	3.176	.....	W. H. Noel, Jamestown, N. D.	12,186.78	.....	.....	.....
		.....	3.176	W. H. Noel, Jamestown, N. D.	.....	.....	13,913.48	.....
				Traill County—gravel material	.....	.....	1,209.75	27,310.01
36AD	Barnes	.....	11.257	C. C. Jackson, Jamestown, N. D.	.....	.....	15,237.49	.....
				Barnes County—gravel material	.....	.....	3,084.80	18,322.29
45	Foster	.....	11.1	Stevens Bros., St. Paul, Minn.	.....	.....	18,947.88	.....
				Foster County—gravel material	.....	.....	3,801.00	22,748 88
61A	Traill	6.171	.....	W. H. Noel, Jamestown, N. D.	12,440.37	.....	.....	12,440.37
63A	McLean	.....	5.	C. M. Padgett, Leeds, N. D.	.....	.....	3,204.53	.....
				McLean County—gravel material	.....	.....	1,365.60	4,570.13
82	Ward	9.111	.....	Schultz Bros., Bowbells, N. D.	31,930.67	.....	.....	.....
				F. M. Haas, Minot, N. D.	.....	1,903.67	.....	33,834.34
100C	Morton	.....	* .58 *Concrete	Woodrich Construc. Co., Minneapolis	.....	.....	.....	24,359.42
102	Foster	.....	3.48	Stevens Bros., St. Paul, Minn.	.....	.....	7,252.74	.....
				Foster County—gravel material	.....	.....	1,192.00	8,444.74
108BC	Griggs	.....	11.304	Stevens Bros., St. Paul, Minn.	.....	.....	14,706.79	.....
				Griggs County—gravel material	.....	.....	3,097.40	17,804.19
109AB	Griggs	.....	10.16	Griggs County—force account	.....	.....	14,308.98	14,308.98
123	Logan	21.595	.....	N. D. Construction Co., Linton, N. D.	68,485.23	.....	.....	.....
				E. A. Moline, Bottineau, N. D.	.....	18,109.07	.....	86,594.30
124AB	Barnes	.....	10.057	C. C. Jackson, Jamestown, N. D.	.....	.....	10,990.93	.....
				Barnes County gravel material	.....	.....	3,117.20	14,108.13
152	Ramsey	.....	12.997	Ramsey County—force account	.....	.....	19,489.66	19,489.66
166	Walsh	8.801	.....	W. H. Noel, Jamestown, N. D.	28,841.97	.....	.....	.....
				J. J. Rue & Sons, Bismarck, N. D.	.....	22,714.59	.....	51,556.56
179A	Towner	7.071	.....	H. F. McCoy, Cando, N. D.	20,052.32	.....	.....	.....
179B	Towner	6.283	.....	C. M. Padgett, Leeds, N. D.	21,169.07	.....	.....	.....
179B	Towner	.....	.....	John J. Curran, Minot, N. D.	.....	4,358.35	.....	45,579.74
182	Ward	8.196	.....	Schultz Bros., Bowbells, N. D.	26,553.02	1,426.68	.....	27,979.70
196	Rolette	8.669	.....	M. C. Lilleby, Dunseith, N. D.	24,310.16	986.73	.....	25,296.89
201	McHenry	7,937	.....	Makens Bros., Carpio, N. D.	17,557.32	.....	.....	17,557.32
202	Cass	0.233	.....	J. A. Jardine Bridge Co., Fargo, N. D.	.....	17,346.82	.....	17,346.82
209	Sheridan	13.005	.....	F. O. Smith, Steele, N. D.	32,360.56	.....	.....	32,360 56
211A	Dickey	6.525	.....	Nels Brolander, Lidgerwood, N. D.	22,538.95	.....	.....	22,538.95
212	Dickey	7.889	.....	Nels Brolander, Lidgerwood, N. D.	24,966.86	.....	.....	.....
				N. M. Nielson, Valley City, N. D.	.....	5,000.58	.....	29,967.44
213	Cass	12.819	12.819	W. H. Noel, Jamestown, N. D.	33,256.82	1,144.40	25,114.28	.....
				Cass County—gravel	.....	.....	4,255.20	63,770.70
216	McIntosh	12.39	.....	Jacob Herr, Jr., Ashley, N. D.	32,856.97	.....	.....	.....
				J. J. Rue & Sons, Bismarck, N. D.	.....	5,536.92	.....	38,393.89
217A	Grand Forks	6.0	.....	Steig & Olson, Esmond, N. D.	18,102.22	.....	.....	.....
				J. A. Jardine, Fargo, N. D.	.....	2.296.91	.....	20,399.13

TABLE NO. 2
NORTH DAKOTA STATE HIGHWAY COMMISSION
TABULATION OF CONTRACT AWARDS FOR THE PERIOD FROM JANUARY 1, 1924 TO JUNE 30, 1924

Proj.	County	Earth Miles	Gravel Miles	Contractor's Name and Address	Grading Pipe Culv.	Reinf. Concrete	Gravel Surfacing	Total
217B	Grand Forks	7.89	.....	Wm. Schultz, Fergus Falls, Minn.	17,343.06	.....	.....	.....
				F. W. Rasmussen, LaMoure, N. D.	.....	1,059.20	.....	18,402.26
218A	Sheridan	6.256*	.....	F. O. Smith, Steele, N. D.	23,239.67	878.40	.....	24,118.07
220A	Hettinger	4.039	.....	Stanley Bros. & Moyer, Bismarck, N. D.	12,594.78	18,229.22	.....	30,824.00
221	Barnes	12.017	.....	W. H. Noel, Jamestown, N. Dak.	32,946.32	1,607.15	.....	34,553.47
225	Ramsey	12.085	.....	Wm. Collins, Lakota, N. D.	31,529.51	.....	.....	.....
				J. J. Rue & Sons, Bismarck, N. D.	.....	6,693.18	.....	38,222.69
230B	Grand Forks	9.	.....	Steig & Olson, Esmond, N. D.	28,417.35	.....	.....	.....
				J. A. Jardine, Fargo, N. D.	.....	5,994.72	.....	34,412.07
238	Rolette	6.917	.287	Ellis M. Nelson, Bottineau, N. D.	21,167.75	3,387.22	.....	24,554.97
239	Stutsman	7.975	.....	Hohman, Webster & Sons, Turtle Lake, N. D.	16,486.66	.....	.....	.....
		.....	7.975	W. H. Noel, Jamestown, N. D.	.....	.....	9,088.18	.....
				Stutsman County—gravel material	.....	.....	2,731.50	28,306.34
243	Adams	8.979	.....	Bellman & Lindsay, Bentley, N. D.	19,622.64	.....	.....	.....
				Carl V. Anderson, Baldwin, N. D.	.....	4,973.42	.....	24,596.06
245	Walsh	9.174	.....	W. H. Noel, Jamestown, N. D.	21,382.80	.....	.....	.....
				J. J. Rue & Sons, Bismarck, N. D.	.....	5,519.79	.....	26,902.59
*247A	Barnes	0.802	0.802	A. J. Jackson, Jamestown, N. D.	7,425.52	1,524.26	2,392.10	11,341.88
248A	Mountrail	6.01	.....	Hall & Booth, Stanley, N. D.	20,262.86	.....	.....	20,262.86
250A	Williams	6.701	.....	Schultz Bros., Bowbells, N. D.	15,034.23	.....	.....	.....
				John J. Curran, Minot, N. D.	.....	6,306.96	.....	21,341.19
250B	Mountrail	3.319	.....	Schultz Bros., Bowbells, N. D.	9,066.75	.....	.....	9,066.75
252	Foster	4.875	.....	Hohman, Webster & Sons, Turtle Lake, N. D.	5,678.94	.....	.....	.....
		.....	4.875	Stevens Bros., St. Paul, Minn.	.....	.....	4,967.52	.....
				Foster County—gravel material	.....	.....	1,669.50	12,315.96
Totals		251.910	105.289		$ 707,997.13	$136,998.24	$186,949.51	$1,056,304.30
				Total Grading & Concrete	844,995.37			

Average per mile—Grading, Pipe Culverts, etc.	$ 2,810.51
Average per mile—Reinf. Concrete Structures	543.84
Total average per mile—Earth Road Projects	$ 3,354.35
Average per mile—Gravel surfacing	1,775.58
Average per mile—Concrete surfacing	41.999.00

TABLE NO. 3
RECAPITULATION
STATE HIGHWAY WORK PLACED UNDER CONTRACT OR FORCE ACCOUNT CONSTRUCTION YEARS OF 1917, 1918, 1919, 1920, 1921, 1922, 1923 and 1924 to June 30
GRADING & DRAINAGE STRUCTURES

Period Ending	Miles	Grading, etc. Amount	Furnishing & Delivering Pipe Culverts	Reinf. Conc. Struct.	Total Grading & Drainage Structures
Dec. 31 — 1917	7.0	$ 7,000.00	.....	.....	$ 7,000.00
Dec. 31 — 1918	244.0	274,753.86	$17,896.89	$34,342.08	326,992.83
Dec. 31 — 1919	249.8	517,327.21	74,119.20	99,141.62	690,588.03
Dec. 31 — 1920	311.3	1,117,316.39	67,159.04	395,695.18	1,580,170.61
	.....	.....	.....	1,074,263.00*	1,074,263.00*
Dec. 31 — 1921	408.55	1,259,552.79	69,347.19	316,846.65	1,645,746.63
Dec. 31 — 1922	362.758	745,049.06	71,190.73	190,275.60	1,006,515.39
Dec. 31 — 1923	409.811	1,287,933.24**	.....	152,413.04	1,699,137.60
				175,484.32*—	
				83,807.00*+	
June 30 — 1924	251.910	707,997.13**	.....	136,998.24	844,995.37
Totals	2245.129	$5,916,929.68	$299,713.05	$2,658,766.73	$8,875,409.46

	GRAVEL		CONCRETE			
	Miles	Amount	Miles	Amount	Missouri River Revetment	Total Contracts and Force Accounts
Dec. 31 — 1917	.....	.....	.....	.....	.....	$ 7,000.00
Dec. 31 — 1918	25.6	$ 56,452.30	.....	.....	.....	383,445.13
Dec. 31 — 1919	15.4	41,333.90	.....	.....	.....	731,921.93
Dec. 31 — 1920	41.8	168,785.70	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2,818,219.31
Dec. 31 — 1921	87.422	250,390.07	1.9	$121,827.90	.....	2,017,964.60
Dec. 31 — 1922	140.012	278,897.19	1,052	42,055.00	.....	1,327,467.58
Dec. 31 — 1923	199.310	467,894.36	0.736	57,488.27	$75,114.51	2,299,584.74
					.....	.....
					.....	.....
June 30 — 1924	105.289	186,949.51	0.58	24,359.42	.....	1,056,304.30
Totals	614.833	$1,445,703.03	4.268	$245,680.59	$ 75,114.51	$10,641,907.59

*Missouri River Bridge F. A. P. No. 100A
**Furnishing & Delivering Pipe Culverts & Reinforced Concrete Headwalls Included in Grading Items
*—Pembina River Bridge F. A. P. No. 300
*+Mandan Underpass

TABLE NO. 3
AVERAGE CONTRACT AND FORCE ACCOUNT PRICES PER MILE

Period Ending	Grading	Furnishing Pipe Culverts	Reinforced Conc. Structures	Total Grading & Structures	Gravel Surfacing	Concrete Surfacing
Dec. 31 — 1917	$1,000.00	.....	.....	$1,000.00	.....	.....
Dec. 31 — 1918	1,126.04	$ 73.34	140.74	1,340.13	$2,205.16	.....
Dec. 31 — 1919	2,070.96	296.71	396.88	2,764.56	2,684.01	.....
Dec. 31 — 1920	3,589.19	215.73	1,271.10	5,076.03	3,918.31	.....
Dec. 31 — 1921	3,082.98	169.73	775.54	4,028.25	2,864.15	64,119.94
Dec. 31 — 1922	2,053.84	196.25	524.52	2,774.61	1,991.95	39,976.37
Dec. 31 — 1923	3,142.75	.....	371.91	3,514.66	2,347.57	78,041.13
June 30 — 1924	2,810.51	.....	543.84	3,354.35	1,775.58	41,999.00
General Average	$2,476.30* 3,016.27**	$189.28	$ 654.47 437.36	$3,998.51 3,453.63	$2,549.23 2,149.86	$55,515.85 62,156.30

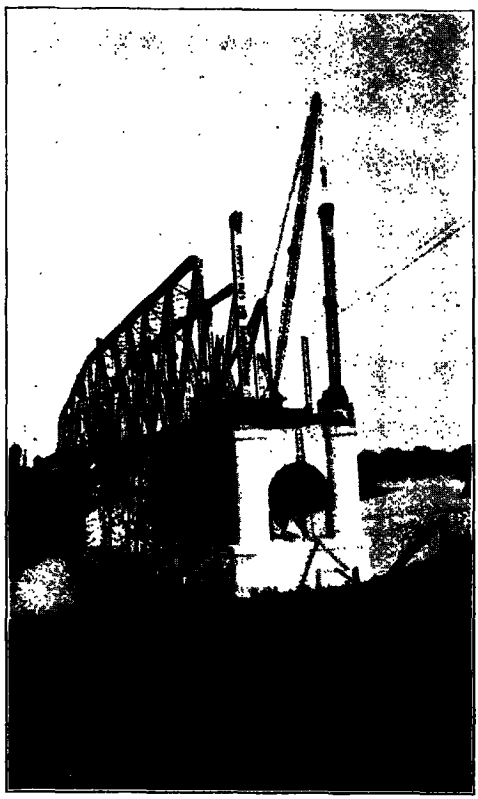
* General Average Grading to Dec. 31, 1922
**General Average Grading Jan. 1, 1923 to June 30, 1924

PEMBINA BRIDGE

F. A. P. No. 300

The greatest single construction project undertaken during the period of this report is without exception what is commonly known as the Pembina Bridge, Federal Aid Project Number 300, located over the Red River of the North and connecting the villages of Pembina, No. Dak., and St. Vincent, Minnesota. Some preliminary engineering work had been done on this project prior to July 1, 1922, such as a survey of the site, borings for determination of depth of footings and preparation of various sketches in order to determine the type of structure which would most satisfactorily meet all conditions expected to be encountered.

In order to meet requirements of the War Department due to the Red River of the North being considered a navigable stream it was necessary for the structure to be a certain height above high water if a fixed span was used otherwise a lift span would have to be constructed.



F. A. P. No. 300—Pembina Bridge
In Process of Construction, Oct. 7, 1924

Another requirement of the War Department was that the stream channel should not be obstructed any more than necessary during low water which virtually prevented any plan being considered with a pier in the center of the stream.

The most troublesome feature encountered effecting design and type of structure on the Red River of the North is the lateral movement of the banks towards the center of the stream. A thorough study was made of this feature including an inspection of most of the bridges now in place over the stream. It was found in one instance that the pier of a bridge near Drayton on the west bank of the river had moved nearly 12 lineal feet from its original position. This was an extreme case, however, it was found that all piers located in the banks of the stream in general were subject to this lateral movement to a greater or less degree. It was also discovered that piers located at the edges of the stream or in the water apparently were not subject to this movement, or at least not to any appreciable extent as there was no record or knowledge of any pier so located having moved due to this condition. Therefore, after a thorough study of various designs, both on the part of the Bureau of Public Roads and this Department, it was decided to use what is known as the cantilever type, with two fixed piers in the water, one at each edge of the stream. From these piers two cantilever arms reach out to each bank supported by the main fixed span and as these cantilever arms do not require piers on the bank for support, the main piers being in the water, it was believed that the problem created by the sliding banks would be satisfactorily solved with this type of structure. In addition to the main structure there are two short reinforced concrete approaches on bents one on each side which are independent of the main structure. These approaches were designed with the idea in mind of a probable movement due to the sliding banks, however, such movement cannot effect the main structure and any damage caused to these approaches from this condition can be easily and cheaply repaired.

The entire Bridge proper as designed is 768 lineal feet in length consisting of a main span of 252 lineal feet and two cantilever arms of 180 lineal feet each as composing the main structure with 66 lineal feet of concrete approach on the west side and 90 lineal feet on the east side.

The plans and specifications were then prepared by this Department on the basis of the type selected, and submitted to the Bureau of Public Roads for their approval.

Advertisement for letting was then published calling for bids to be submitted at a joint meeting of the County Commissioners of Pembina County, North Dakota, Kittson County, Minnesota, and representatives from the Minnesota Highway Department, Bureau of Public Roads and this Department to be held at the City Hall at Pembina on November 30, 1923, at 2:00 P. M. The meeting was held on the date above mentioned and seven bids in all were received, the lowest bid received being

that of the Linton Bridge Construction Company of Linton, North Dakota, in the sum of $175,484.32 and the second low bid, that of Foley Brothers of St. Paul, Minnesota, in the sum of $194,231.92. Contract was officially awarded to the low bidder in the amount above mentioned and actual work was commenced on the structure on January 28th, 1924, and at the present writing it is about fifty per cent complete. It is expected that the structure will be completed and opened for traffic by the latter part of November, 1924.

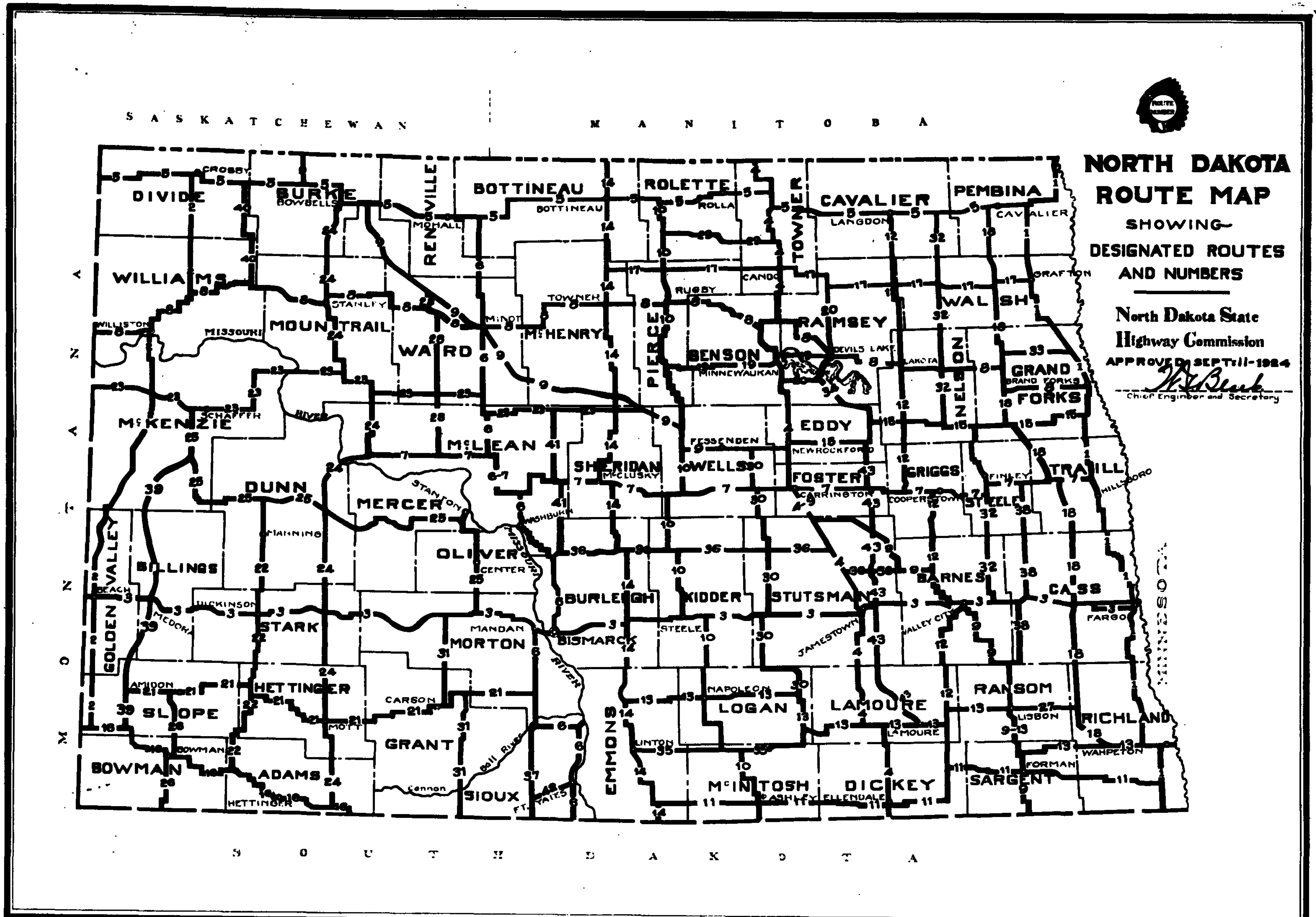
The financing of the cost of constructing this bridge was made possible first by the 1923 North Dakota Legislature appropriating $35,000.00 from the Bridge Fund toward its cost supplemented by later appropriations from the Minnesota Highway Department, Kittson County, Minnesota, and Pembina County, North Dakota, and the Bureau of Public Roads.

In order to convey some idea of the size of the Bridge a few of the total quantities of various items entering into its construction are set forth approximately as follows:

1.	1600	Cu. Yds. of Concrete.
2.	800	Tons of Structural Steel.
3.	1650	Sq. Yds. of Paving.
4.	5000	Lin. Ft. of Timber Piles.

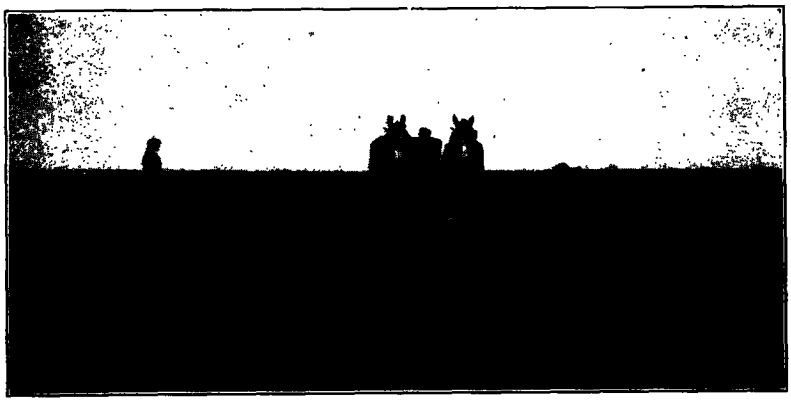
There are other lesser items such as Earth Excavation, Structural Excavation, Guard Rail, etc., entering into the total quantities necessary to complete the contract.

The Bridge when completed will cost the state of North Dakota and Pembina County approximately $60,000.00 as their share.



NORTH DAKOTA
ROUTE MAP
SHOWING
DESIGNATED ROUTES
AND NUMBERS
North Dakota State
Highway Commission
APPROVED SEPT. 11-1924
Chief Engineer and Secretary
ROUTE NUMBER
SASKATCHEWAN
MANITOBA
MONTANA
MINNESOTA
SOUTH DAKOTA
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
WARD
McHENRY
PIERCE
BENSON
RAMSEY
WALSH
NELSON
GRAND FORKS
McKENZIE
McLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
DUNN
MERCER
OLIVER
BILLINGS
GOLDEN VALLEY
STARK
MORTON
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
HETTINGER
SLOPE
BOWMAN
ADAMS
GRANT
SIOUX
EMMONS
LOGAN
McINTOSH
LAMOURE
DICKEY
RANSOM
SARGENT
RICHLAND
CROSBY
BOWBELLS
MOHALL
BOTTINEAU
ROLLA
LANGDON
CAVALIER
GRAFTON
CANDO
STANLEY
MINOT
TOWNER
RUGBY
DEVILS LAKE
LAKOTA
MINNEWAUKAN
WILLISTON
SCHAFFER
FESSENDEN
NEW ROCKFORD
McCLUSKY
CARRINGTON
COOPERSTOWN
FINLEY
HILLSBORO
MANNING
STANTON
WASHBURN
CENTER
BEACH
DICKINSON
MEDORA
MANDAN
BISMARCK
STEELE
JAMESTOWN
VALLEY CITY
FARGO
AMIDON
CARSON
MOTT
NAPOLEON
LISBON
LAMOURE
BOWMAN
LINTON
FORMAN
WAHPETON
HETTINGER
ASHLEY
ELLENDALE
FT. YATES
MISSOURI
RIVER
Cannon
Ball River

A Common and Satisfactory Type of Equipment Used in Maintaining the State Highway System



A Part of the State Highway System in Process of Maintenance Using the Above Type of Equipment

SECTION VII

MAINTENANCE DEPARTMENT

On June 30, 1924, there were 1,717.4 miles of the State Highway System under maintenance and directly supervised by the State Highway Commission. This mileage does not include such highways as were placed under contract for maintenance, prior to this date, but no expenditures made thereon up to July 1, 1924, for such maintenance. This mileage consists of 1.608.8 miles of completed Federal Aid highways, 17.9 miles of State Aid highways, and 90.7 miles of county improved highways. With the exception of Cass and Traill Counties, this mileage is divided into patrol sections and a patrolman assigned to and made responsible for the maintenance of a definite number of miles of highway. The length of patrol sections vary from 3 to 24 miles depending upon the equipment used. For a horse patrol, 3 to 12 miles are assigned, for a truck from 10 to 24 miles, and for an engine from 10 to 20 miles. The equipment used in the maintenance of the above mileage includes 102 horse patrols using blade graders, 34 horse patrols using drags, 19 trucks using drags, and 11 engines varying from ten ton caterpillars to Fordson's with blades or drags, or 136 horse patrols and 30 motor power patrols. For general maintenance work, the tendency seems to be from power machinery to horse patrol. The selection of equipmnt is left to the Board of County Commissioners.

There was a complete turn over in the personnel of this Department on April 1, 1923, since which time a broad policy of co-operation between the highway commission and the boards of County Commissioners has been practised. It is the contention of the Department that not alone can the highway department be of valuable assistance to the counties in the planning and carrying out of maintenance of the state highway system, but the County Commissioners with their closer contact in local affairs and their personal knowledge of local conditions can render valuable assistance to the Commission in the execution of an efficient maintenance policy. It is our experience, that where there has been a close co-operation between the County Board and the Highway Commission a very efficient and economic maintenance has been secured. It is relatively an easy matter to keep highways in good condition when you have at your disposal sufficient funds and ample equipment, but when, as is the situation in this state, you have limited equipment and very little funds, it becomes a perplexing and difficult problem. The Special Road Maintenance Fund derived from the automobile registration fee amounted to $227,722.22, for the year of 1923. The state highway system contains in round numbers 6,000 miles of highways. This would give us a little less than $38.00 per mile for maintenance or enough to drag the highways about ten or twelve times. If the construction of a road is necessary, then it naturally follows that the proper maintenance of that road is an economical necessity. No community can afford to build highways and then let them deteriorate for the want of proper maintenance.

We are submitting a detail report of maintenance activities from January 1, 1922, to June 30, 1924.

Table No. 1 gives the report for the calendar year of 1922. During this period the department supervised the maintenance of 1,029.4 miles of Federal Aid highways, 61.4 miles of State Aid highways, and 635.6 miles of other state highways, making a total of 1,726.4 miles at an average cost per mile of $65.45.

Table No. 2 gives the report for the calendar year of 1923. During this period the department supervised the maintenance of 1,289.15 miles of Federal Aid highways, 28.9 miles of State Aid highways, and 530.6 miles of other state highways, making a total of 1,848.65 miles at an average cost of $70.08 per mile.

Table No. 3 gives the report from January 1st to June 30, 1924, or for the first six months of 1924. During this period the department supervised the maintenance of 1,608.8 miles of Federal Aid highways, 17.9 miles of State Aid highways, and 90.7 miles of other state highways, making a total of 1,717.4 miles at an average cost for the six months of $37.42 per mile.

Table No. 4 gives the classification of the equipment used in the maintenance of the mileage shown in table Number 3.

We are submitting a drawing representing a dollar paid out for maintenance as supervised by the department for the calendar year of 1923. This shows the percentage of the total expenditure paid out for each class of work. We wish to call to your attention the fact that 40 cents out of each dollar went for work necessitating the employment of a man and team. If a man and team are necessary forty per cent of the time, and if by the addition of an extra horse or two, the other sixty percent of the work can be done, we will have the most efficient unit for maintenance in the horse patrol. Our experience has clearly demonstrated that the cheapest and best equipment for the maintenance of earth and gravel roads, is the horse patrol, consisting of a man and team weighing around three thousand pounds, equipped with an eight foot maintenance blade grader. Where smaller horses are used, it is necessary to use three or four when the roads become badly rutted.

The proper large equipment has its sphere of usefullness in maintenance, the same as in construction, and if a system of horse patrol can be supplemented by large equipment as often as becomes necessary, we believe very good results can be secured.

TABLE NO. 1

CLASSIFICATION OF MILEAGE					MAINTENANCE EXPENDITURES FOR 1922											
Counties	Federal Aid Miles	State Aid Miles	Other State Highways Miles	Total Miles	Dragging	Blade Grader	Surface Repair	Drainage Culverts Bridges	Weeds and Brush	Guardrail Snow-Fence	Gasoline Oil Repair	Snow Removal	Maintenance Equipment Purchased	Additions and Betterments	Totals	Average Cost per Mile
Adams	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barnes	92.0	....	19.0	111.0	$2,621.37	$ 506.51	$1,273.66	$ 51.05	$ 551.28	$117.00	$2,493.25	$240.81	$1,726.16	$ 497.10	$10,078.19	$90.79
Benson	43.5	....	43.5	43.5	428.24	147.16	474.38	43.80	370.87	11.63	578.91	.....	29.95	.....	2,084.94	47.93
Billings	.....	....	23.0	23.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	244.00	244.00	.....
Bottineau	38.8	....	....	38.8	177.26	943.48	541.30	159.00	605.52	1.00	2.50	.....	12.95	14.15	2,457.16	63.33
Bowman	17.7	....	52.0	69.7	533.29	3.90	263.25	10.45	92.16	.....	556.25	.....	21.15	42.90	1,523.35	21.86
Burke	38.1	....	....	38.1	948.73	341.25	283.94	106.16	315.99	.....	1,681.93	.....	762.21	37.02	4,477.23	117.51
Burleigh	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cass	24.6	0.8	69.4	94.8	9,613.81	7,235.40	.....	54.45	38.50	.....	.....	.....	.....	.....	16,942.16	178.71
Cavalier	7.6	....	47.0	54.6	383.00	74.04	18.37	47.00	68.72	.....	.....	.....	.....	48.00	639.13	11.70
Dickey	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Divide	20.5	....	....	20.5	825.02	105.10	129.90	30.50	329.55	8.00	650.86	.....	15.13	903.84	2,997.90	146.28
Dunn	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eddy	19.0	....	6.0	25.0	578.21	36.50	397.97	9.80	64.00	.....	899.83	.....	50.74	110.50	2,147.55	85.90
Emmons	27.3	....	....	27.3	574.15	16.75	38.30	.....	581.55	.....	438.37	.....	10.15	47.25	1,706.52	62.51
Foster	39.7	4.9	....	44.6	1,241.91	332.20	316.23	39.12	152.99	.....	890.69	14.00	50.92	300.00	3,338.06	74.84
Grand Forks	11.5	13.7	....	25.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grant	11.0	....	54.0	65.0	910.20	100.40	94.00	121.60	142.80	.....	221.65	.....	199.50	33.00	1,823.15	28.08
Golden Valley	22.1	....	12.5	34.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Griggs	24.2	....	....	24.2	176.30	62.00	64.80	.....	94.27	.....	18.00	.....	.....	208.95	624.32	25.80
Hettinger	17.0	....	77.0	94.0	618.35	165.75	625.30	99.80	122.25	5.00	84.53	132.90	5.00	64.50	1,923.38	20.47
Kidder	3.8	12.0	....	15.8	178.80	.....	57.00	3.20	9.00	.....	.....	.....	.....	208.80	456.80	28.91
LaMoure	45.9	....	....	45.9	1,566.35	227.35	833.06	145.00	242.33	26.77	.....	8.00	47.63	40.00	3,136.49	68.33
Logan	22.2	....	....	22.2	707.72	45.60	214.55	139.00	355.60	7.66	.....	.....	.....	.....	1,470.13	66.22
McHenry	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
McIntosh	29.6	....	....	29.6	702.04	.....	392.40	20.04	155.92	.....	.....	.....	.....	218.87	1,489.27	50.31
McKenzie	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
McLean	25.5	....	....	25.5	431.55	.....	55.10	94.10	115.45	3.00	.....	.....	.....	.....	699.28	27.42
Mercer	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Morton	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mountrail	23.4	....	....	23.4	249.64	666.48	188.68	101.46	45.80	.....	146.43	.....	1,636.09	.....	3,034.58	129.68
Nelson	16.2	....	16.0	32.2	798.42	265.17	352.15	48.90	297.90	.....	.....	.....	25.41	110.70	1,898.65	58.96
Oliver	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Pembina	5.2	....	15.0	20.2	135.58	77.68	172.32	13.84	350.09	.....	.....	.....	12.00	6.26	767.77	38.00
Pierce	26.3	....	....	26.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ramsey	46.8	....	34.0	80.8	450.22	227.90	212.75	6.80	343.26	.....	.....	.....	16.45	127.75	1,385.13	17.14
Ransom	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Renville	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Richland	26.0	3.0	6.0	35.0	1,214.90	179.95	26.70	1.00	79.18	.....	.....	.....	4.00	.....	1,505.73	43.02
Rolette	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sargent	49.7	....	....	49.7	3,171.68	1.544.06	158.91	112.56	672.15	.....	955.40	.....	380.23	1,603.20	8,598.19	173.00
Sheridan	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sioux	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Slope	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stark	19.1	....	77.0	96.1	105.60	309.50	135.80	.....	127.80	.....	.....	.....	.....	.....	678.70	7.06
Steele	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stutsman	87.7	20.0	14.7	122.4	2,433.31	267.85	441.40	53.70	243.73	.....	93.40	.....	5.00	6,165.04	9,703.43	79.27
Towner	23.0	....	34.0	57.0	439.84	630.64	603.79	37.13	376.46	.....	385.70	.....	.....	38.64	2,512.20	44.07
Traill	28.9	7.0	28.0	63.9	3,324.94	1,665.50	272.20	17.00	238.90	10.00	475.58	285.81	227.71	572.56	7.090.20	110.96
Walsh	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ward	18.6	....	2.0	20.6	518.02	.....	144.57	51.45	118.98	3.92	687.62	.....	59.76	.....	1,584.32	76.91
Wells	29.3	....	49.0	78.3	387.21	38.35	194.45	7.20	204.54	.50	916.88	.....	46.96	.....	1,795.59	22.93
Williams	47.6	....	....	47.6	727.79	769.88	158.33	76.71	267.13	.....	1,141.35	.....	499.29	.....	3,640.48	76.48
TOTAL	1029.4	61.4	635.6	1726.4	37,173.45	16,986.35	9,135.56	1,701.90	7,774.67	194.48	18,318.63	681.52	5,844.39	11,643.03	104,453.98	65.45

TABLE NO. 2

Counties	CLASSIFICATION OF MILEAGE				MAINTENANCE EXPENDITURES FOR 1928											
	Federal Aid Miles	State Aid Miles	Other State Highway Mi.	Total Miles	Blade Grader	Dragging	Surface Repair	Drainage Culverts Bridges	Weeds & Brush	Guard-rail Snow Fence	Gasoline Oil Repairs	Snow Removal	Maintenance Equipment Purchased	Additions and Betterments	Total Cost	Average Cost Per Mile
Adams	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barnes	89.6	....	2.0	91.6	$2,689.01	$1,908.98	$1,818.38	$ 59.71	$1,388.08	$ 397.08	$1,007.23	$ 509.73	$ 103.59	$ 560.00	$ 9,941.77	$ 108.53
Benson	44.5	....	26.0	70.5	79.84	1,160.22	656.91	140.45	446.44	186.53	274.98	184.27	.....	.....	3,129.64	44.40
Billings	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bottineau	38 9	....	....	38.9	701.18	285.36	198.15	103.70	661.77	116.37	123.76	40.00	.....	.....	2,230.29	57.41
Bowman	17.7	....	....	17.7	18.20	150.15	118.61	145.70	64.55	58.91	224.00	.....	.....	.....	780.12	44.07
Burke	38.0	....	6.0	44.0	97.60	1,417.55	229.10	5.20	257.48	23.80	247.01	56.30	1,729.25	90.60	4,153.89	53.05
Burleigh	1.05	....	....	1.05	4.20	.....	346.10	74.60	41.00	.....	.....	.....	.....	187.02	652.92	439.52
Cass	24.1	....	74.0	98.1	15,171.50	213.00	912.00	.....	.....	.....	.....	.....	.....	.....	16,296.50	166.13
Cavalier	7.6	....	45.5	53.1	97.50	1,331.78	411.00	31.35	357.11	204.70	16.20	144.55	.....	.....	2,534.19	35.69
Dickey	10.0	....	....	10.0	117.96	.....	17.56	.....	201.18	9.20	1.30	.....	.....	.....	347.20	3.47
Divide	40.2	....	....	40.2	86.50	645.75	92.00	133.80	341.50	128.80	1,063.32	.....	.....	.....	2,491.67	62.06
Dunn	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eddy	18.8	....	6.7	25.5	104.79	629.13	285.75	16.14	396.62	140.24	32.16	31.80	.....	36.68	1,673.31	65.62
Emmons	38.3	....	....	38.3	30.00	877.61	528.89	449.00	593.87	120.49	774.06	.....	.....	.....	3,382.92	88.32
Foster	39.7	4.9	....	44.6	111.15	1,182.34	266.26	48.25	113.75	14.70	1,008.04	5.40	.....	.....	2,749.89	61.66
Grand Forks	23.4	3.0	....	26.4	295.40	352.23	30.55	....	71.77	90.45	10.30	.....	.....	.....	850.70	53.59
Grant	10.2	....	49.3	59.5	68.00	1,070.30	626.00	206.00	186.00	.....	49.58	94.55	.....	.....	2,295.43	32.22
Golden Valley	22.1	....	12.5	34.6	130.10	1,197.70	279.92	30.75	184.55	22.00	.....	10.50	.....	.....	1,855.52	46.56
Griggs	35.5	....	....	35.5	88.70	714.13	92.75	2.76	226.97	98.60	14.00	39.80	.....	.....	1,277.71	35.97
Hettinger	17.5	....	11.0	28.5	724.28	497.58	455.22	99.00	212.29	29.89	11.34	.....	.....	.....	2,029.60	71.22
Kidder	3.8	11.0	....	14.8	27.60	235.18	152.60	.....	32.60	6.80	9.00	.....	.....	1,015.15	1,478.93	31.64
LaMoure	57.9	....	1.1	59.0	1,074.15	1,878.62	596.55	23.60	610.48	124.99	149.69	65.30	.....	99.00	4,622.38	77.82
Logan	51.7	....	....	51.7	78.90	1,354.39	623.27	40.90	568.40	86.00	9.15	36.40	.....	2,365.85	5,163.26	54.11
McHenry	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
McIntosh	43.0	....	....	43.0	578.05	661.70	784.35	74.10	594.47	48.50	.....	.....	.....	.....	2,741.17	63.75
McKenzie	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
McLean	30.5	....	....	30.5	53.75	818.60	345.85	211.80	240.75	16.20	36.60	.....	.....	.....	1,723.55	56.50
Mercer	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Morton	3.0	....	....	3.0	470.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	470.00	15.66
Mountrail	34.5	....	....	34.5	.....	423.50	771.55	262.05	308.75	65.40	485.15	.....	.....	218.50	2,534.90	73.48
Nelson	20.0	....	8.0	28.0	545.48	965.23	877.15	61.45	364.05	30.40	39.39	.....	.....	.....	2,883.15	102.97
Oliver	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pembina	5.0	....	42.0	47.0	194.20	1,311.30	364.89	19.50	385.76	158.50	79.46	.....	.....	.....	2,513.61	53.48

Pierce	18.1	....	....	18.1	26.90	193.23	123.96	18.60	226.40	1.65	.....	.....	.....	.....	590.74	32.67
Ramsey	56.5	....	35.5	92.0	370.18	2,231.74	1,491.25	231.41	847.91	395.76	32.05	.....	.....	.....	5,600.30	60.87
Ransom	38.6	....	....	38.6	532.58	96.10	328.95	41.93	253.22	164.53	38.54	.....	.....	85.54	1,541.39	39.93
Renville	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Richland	36.0	3.0	....	39.0	244.10	2,167.00	72.10	99.35	326.75	55.90	18.49	.....	.....	.....	2,983.69	76.50
Rolette	7.0	....	....	7.0	108.02	25.70	180.00	18.15	70.10	22.10	17.80	.....	.....	.....	441.87	63.49
Sargent	57.3	....	....	57.3	2,164.88	816.09	628.77	212.48	721.09	209.53	78.82	14.20	.....	.....	4,845.86	84.51
Sheridan	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sioux	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Slope	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stark	18.9	....	61.1	80.0	43.65	400.00	18.00	26.20	157.00	.....	19.57	79.15	.....	.....	743.57	39.34
Steele	8.0	....	2.0	10.0	29.74	.....	3.68	.....	8.40	.....	3.55	.....	203.06	.....	248.43	24.84
Stutsman	82.0	....	47.8	129.8	971.83	4,474.92	946.32	138.71	596.26	338.90	151.80	.....	.....	.....	7,618.74	58.70
Towner	29.6	....	38.5	68.1	695.35	763.70	461.10	52.66	468.63	311.61	587.26	.....	420.00	.....	3,760.31	79.32
Traill	26.9	7.0	31.1	65.0	2,978.50	2,303.38	30.40	.....	257.70	39.20	.....	.....	.....	.....	5,609.18	87.43
Walsh	16.0	....	30.5	46.5	41.18	1,656.84	244.57	6.80	371.52	225.39	11.57	.....	.....	.....	2,557.87	26.98
Ward	41 7	....	....	41.7	624.65	721.65	248.20	84.85	503.05	130.40	1,584.77	15.00	113.46	.....	4.026.03	96.55
Wells	38.5	....	....	38.5	288.30	609.47	187.46	121.03	271.78	239.61	683.73	.....	.....	.....	2,401.38	62.42
Williams	47.5	....	....	47.5	747.65	782.95	598.02	54.50	351.01	170.15	1,058.70	.....	.....	13.00	3,775.98	79.49
TOTAL	1289.15	28.90	580.6	1848.65	33,449.55	38,525.10	16,944.14	3,346.48	14,280.99	4,483.28	9,952.37	1,326.95	2,569.36	4,671.34	129,549.56	70.08

TABLE NO. 8

CLASSIFICATION OF MILEAGE					MAINTENANCE EXPENDITURES January 1st to June 30th, 1924											
Counties	Federal Aid Miles	State Aid Miles	Other State Highways Mi.	Total Miles	Blade Grader	Dragging	Surface Repair	Drainage Culverts Bridges	Weeds and Brush	Guard-rail Snow Fence	Gasoline Oil Repairs	Snow Removal	Maintenance Equipment Purchased	Additions and Betterments	Total Cost	Average Cost Per Mile (6-months)
Adams	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barnes	119.8	....	....	119.8	1,909.71	637.84	1,258.90	161.31	$ 100.18	$ 80.58	$ 60.15	$ 162.83	$ 95.00	.....	$ 4,466.50	$37.28
Benson	48.5	....	7.1	55.6	57.75	852.16	259.72	131.60	96.45	93.80	2.00	.....	.....	.....	1,493.48	26.86
Billings	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bottineau	53.0	....	....	53.0	501.17	72.41	207.06	99.30	72.13	52.67	385.85	.....	.....	.....	1,390.59	26.23
Bowman	17.7	....	....	17.7	1.80	74.50	154.70	24.75	16.25	5.20	77.25	.....	.....	.....	353.95	20.00
Burke	44.9	....	....	44.9	130.42	462.12	53.80	.....	17.20	.....	9.95	.....	.....	.....	673.49	15.00
Burleigh	1.1	....	....	1.1	24.50	104.00	49.50	120.00	.....	.....	5.10	.....	.....	.....	303.10	275.50
Cass	42.7	....	4.3	47.0	1,395.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,395.00	29.68
Cavalier	7.6	....	....	7.6	.....	70.87	.....	6.00	.....	.....	.....	.....	.....	.....	76.87	10.10
Dickey	10.0	....	....	10.0	216.40	.....	229.80	.....	5.50	.....	14.60	.....	.....	.....	466.30	46.63
Divide	52.3	....	....	52.3	490.50	342.25	399.70	42.55	.....	81.90	689.47	.....	.....	$ 500.15	2,546.52	48.70
Dunn	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eddy	29.1	....	6.1	35.2	.....	951.51	.....	.....	.....	.....	.....	.....	.....	.....	951.51	27.03
Emmons	38.1	....	....	38.1	71.30	628.75	333.55	170.25	56.30	207.15	219.67	.....	.....	.....	1,686.97	44.27
Foster	51.3	4.9	....	56.2	174.00	1,501.95	165.95	.....	7.00	.....	62.06	.....	.....	.....	1,910.96	34.00
Grand Forks	36.4	3.0	....	39.4	.....	659.11	85.52	.....	39.75	5.50	.....	.....	.....	.....	789.88	20.05
Grant	10.2	....	....	10.2	15.60	316.20	389.90	64.30	40.25	16.15	43.68	.....	.....	.....	886.08	86.87
Golden Valley	22.2	....	....	22.2	4.20	302.96	40.65	36.88	28.10	6.50	1.75	.....	.....	.....	421.14	19.00
Griggs	57.1	....	....	57.1	98.47	1,261.08	235.68	.....	2.40	44.32	349.50	.....	.....	.....	1,991.40	34.87
Hettinger	27.8	....	....	27.8	373.00	150.00	23.50	47.00	.....	.....	.....	.....	.....	.....	593.50	21.34
Kidder	3.9	....	....	3.9	353.00	71.00	36.60	2.00	.....	.....	.....	.....	.....	.....	462.60	11.86
LaMoure	62.9	....	....	62.9	1,425.11	84.23	376.72	120.76	106.79	17.30	96.85	.....	.....	.....	2,227.76	35.41
Logan	52.2	....	....	52.2	257.40	853.40	327.50	33.00	84.70	32.75	1.25	.....	.....	.....	1,590.00	30.46
McHenry	4.7	....	....	4.7	96.00	24.00	5.00	.....	13.20	30.80	2.40	.....	.....	.....	171.40	36.47
McIntosh	42.5	....	....	42.5	414.45	217.18	187.32	40.91	16.26	3.20	.....	.....	.....	.....	879.32	20.70
McKenzie	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
McLean	30.5	....	....	30.5	26.85	390.05	68.00	33.00	54.20	.....	21.15	.....	.....	.....	593.25	19.45
Mercer	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Morton	3.0	....	....	3.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mountrail	45.7	....	....	45.7	12.95	211.00	346.55	77.55	38.50	.....	345.63	.....	.....	.....	1,032.18	22.58
Nelson	26.4	....	23.0	49.4	33.60	974.60	295.10	59.33	.....	.....	20.00	.....	.....	.....	1,382.63	28.00
Oliver	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pembina	17.4	....	4.0	21.4	.....	410.70	111.05	40.70	22.00	.....	16.00	.....	.....	.....	600.45	28.06
Pierce	26.8	....	....	26.8	95.62	394.88	.....	.....	33.00	.....	.....	.....	.....	.....	523.50	29.90

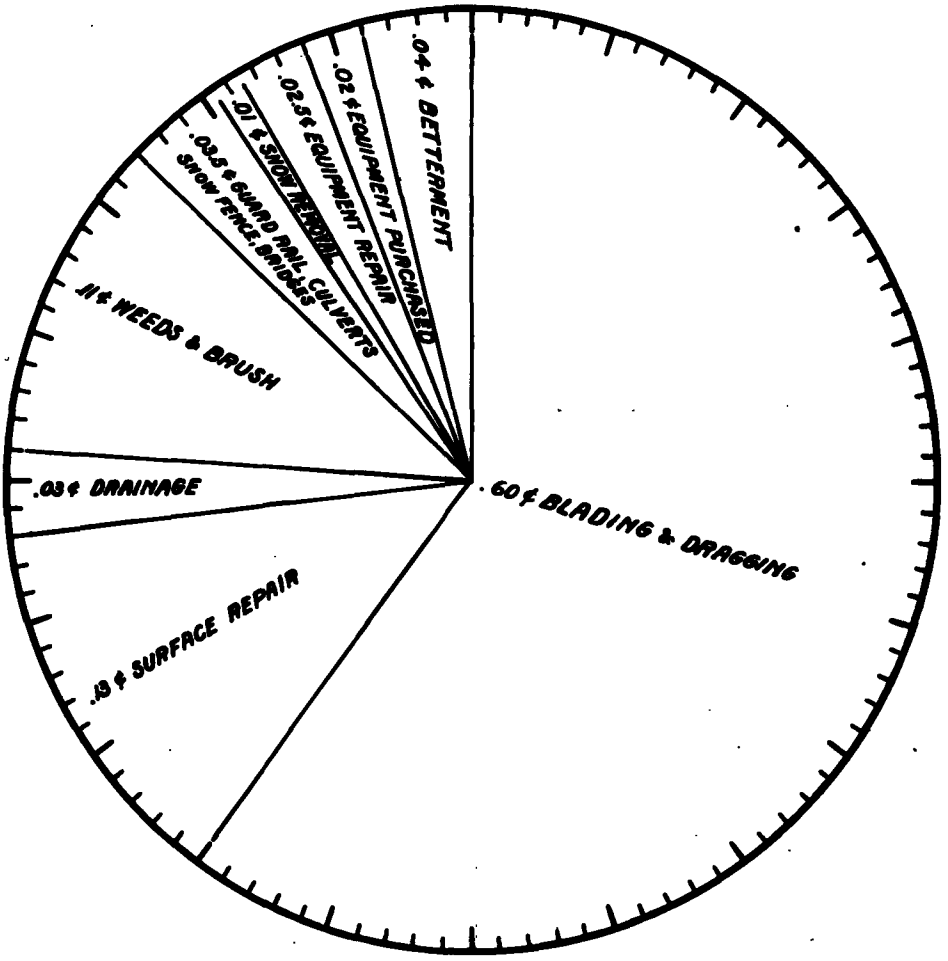
Ramsey	81.2	....	....	81.2	4.75	1,356.47	736.24	420.99	.....	38.75	6.50	.....	.....	.....	2,563.70	31.57
Ransom	48.8	....	....	48.8	1,313.85	133.63	531.25	27.90	7.60	63.28	18.89	.....	.....	.....	2,096.40	42.95
Renville	5.2	....	....	5.2	99.12	14.24	37.53	1.20	17.31	.....	4.59	.....	.....	.....	173.99	33.46
Richland	42.4	3.0	....	45.4	426.25	890.35	90.35	13.40	19.60	4.85	.....	.....	.....	.....	1,444.80	31.82
Rolette	7.0	....	....	7.0	2.60	.....	.....	2.60	.....	3.25	.....	.....	.....	.....	8.45	.....
Sargent	86.9	....	....	86.9	2,452.96	79.68	475.63	55.94	166.15	52.46	45.65	.....	.....	$ 542.00	3,870.47	44.53
Sheridan	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sioux	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Slope	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stark	18.9	....	6.1	25.0	93.40	118.26	122.75	23 60	.....	.....	84.45	.....	.....	.....	442.46	17.70
Steele	8.0	....	5.0	13.0	262.60	28.85	77.44	31.76	8.43	2.40	.....	15.00	.....	.....	426.48	32.80
Stutsman	90.4	....	....	90.4	459.92	1,475.45	408.36	1.75	7.00	.....	21.23	.....	.....	.....	2,373.71	26.26
Towner	29.8	....	5.0	34.8	44.00	386.33	205.55	16.00	34.62	103.91	227.14	.....	.....	.....	1,017.55	29.24
Traill	26.9	7.0	30.1	64.0	.....	2,772.50	92.70	.....	.....	53.40	.....	.....	.....	.....	2,918.60	45.60
Walsh	16.3	....	....	16.3	114.25	332.95	73.20	.....	.....	21.75	6.10	.....	465.00	.....	1,013.25	62.16
Ward	56.2	....	....	56.2	1,221.43	25.13	994.84	55.30	77.24	37.06	66.01	.....	9.50	.....	2,486.51	44.24
Wells	38.5	....	....	38.5	47.55	226.12	132.10	29.75	20.60	21.30	328.35	.....	.....	.....	805.77	20.93
Williams	67.0	....	....	67.0	404.66	630.21	328.75	70.60	2.89	66.25	506.61	.....	.....	.....	2,009.97	29.13
TOTAL	1608.8	17.9	90.7	1717.4	15,125.64	20,488.87	9,948.46	2,061.98	1,211.60	1,146.58	3,739.83	177.83	569.50	1,042.15	55,512.44	37.42

TABLE NO. 4
CLASSIFICATION OF MAINTENANCE EQUIPMENT

	Horse Patrol		Power Machinery	
	Blades	Drags	Trucks	Engines
Adams	..	..	..	..
Barnes	11	..	..	..
Benson	4	..	..	..
Billings	..	..	..	..
Bottineau	1	2	..	2
Bowman	..	..	1	..
Burke	3	3	..	..
Burleigh	1	..	..	..
Cass	..	..	..	2
Cavalier	..	1	..	..
Dickey	1	..	..	..
Divide	4	1	2	..
Dunn	..	..	..	..
Eddy	3	..	1	..
Emmons	4	..	1	..
Foster	1	1	2	..
Grand Forks	4	..	..	..
Grant	1	..	..	..
Golden Valley	1	4	..	..
Griggs	1	..	2	..
Hettinger	..	..	..	2
Kidder	1	..	..	..
LaMoure	5	..	..	1
Logan	2	3	..	..
McHenry	1	..	..	..
McIntosh	2	2	..	..
McKenzie	..	..	..	..
McLean	3	..	2	..
Mercer	..	..	..	..
Morton	..	..	1	..
Mountrail	..	..	2	..
Nelson	3	3	..	..
Oliver	..	..	..	..
Pembina	2	..	..	..
Pierce	..	..	..	1
Ramsey	8	..	..	..
Ransom	5	..	..	..
Renville	1	..	..	..
Richland	3	5	..	..
Rolette	1	..	..	..
Sargent	8	..	..	..
Sheridan	..	..	..	..
Sioux	..	..	..	..
Slope	..	..	..	..
Stark	..	..	..	1
Steele	1	..	..	..
Stutsman	4	8	..	..
Towner	2	1	..	..
Traill	..	..	1	2
Walsh	2	..	..	..
Ward	6	..	..	..
Wells	..	..	2	..
Williams	2	..	2	..
TOTAL	102	34	19	11

Total Horse Patrol = 136. Total Power = 30.

NORTH DAKOTA HIGHWAY COMMISSION
1923
MAINTENANCE DOLLAR
BY CLASS OF WORK



STATE HIGHWAY MAINTENANCE

SECTION VIII

Motor Vehicle Registration Department

Bismarck, North Dakota

August 25, 1924

Hon. W. G. Black,
Chief Engineer & Secretary,
State Highway Commission,
Bismarck, North Dakota.
Dear Sir:

Pursuant to request I take pleasure in transmitting for your approval the enclosed financial report of the Motor Vehicle Registration Department.

Inasmuch as our registration period coincides with the calendar year. the report covers Collections and Disbursements for the periods, January 1, 1923—December 31, 1923, January 1, 1924—June 30, 1924, while expenditures for the Department are given for the fiscal year, July 1, 1923—June 30, 1924.

At this time I beg leave to make the following suggestions and recommendations and sincerely trust that they will be given due consideration at the next Legislative Session:

(1) Believing that a Gasoline tax is a just and equitable tax I recommend that a tax of two (2) cents per gallon be placed on same. From this tax a revenue of approximately $800,000.00 would be derived. Tractors and stationary engines using gasoline to be exempted from such tax.

(2) As the present system of determining fees necessitates a great deal of unnecessary work and expense I would, at this time, recommend a revision of that part of the Motor Vehicle Laws pertaining to fees, also that the present basic fee be increased to one (1) mill per dollar of selling price, forty (40) cents per 100 pounds or major portion thereof of the net weight of the vehicle and twenty (20) cents per horsepower, provided that the fee shall at no time be less than ten (10) dollars. By increasing the basic fee as above the State would realize an increase in revenue of approximately $850,000.00.

(3) As a great many of the auto owners are inclined to be a little lax in procuring licenses I would recommend that a time limit be set, similar to the law now in effect in the State of Minnesota, in which a specified date is set. All licenses to be procured on or before such date and providing for a penalty for non compliance, said penalty to take effect the day following the date so set.

(4) Under the present law no provision is made for Certificates of Registration or Ownership. I would recommend that a fee of not less than $1.00 be charged for this service and also that a fee of 25c be charged for completing applications in this Department.

(5) The Motor Vehicle Law should be more specific as to the length of time that cars bearing license plates from other states would be allowed to operate under such plates in this state. I would recommend

30 days and that such cars would be required to register and procure a visitor's permit. A small fee to be charged for such permit.

(6) The subject of Headlights and Signals should be given careful consideration as many accidents are caused by improper lights and incorrect signals. Signalling devices and Hand signals should be standardized.

(7) A specific provision in the law should be made whereby a motor vehicle could be held for back taxes or fees no matter how many times the ownership of such motor vehicle changed.

(8) Owing to the increase of Motor Vehicles being registered annually in the state a substantial increase in the appropriation for Clerk Hire should be made.

Respectfully submitted,

JOHN P. TUCKER,
Registrar.

JPT/J

FINANCIAL REPORT
OF THE
MOTOR VEHICLE REGISTRATION DEPARTMENT
FOR THE PERIOD
JANUARY 1, 1923 — DECEMBER 31, 1923

RECEIPTS

Automobile Licenses, Passenger Cars and Trucks	$743,625.45	
Transfer of Ownership	14,507.00	
Duplicate Tags	368.50	
Motorcycle Licenses	1,943.50	
Total		$760,444.45

DISBURSEMENTS

*State Highway Commission, Appropriation	$131,925.00	
Motor Vehicle Department, Appropriation	43,075.00	
State Bridge Fund, Appropriation	130,000.00	
Apportionment to Counties	227,722.22	
APPORTIONMENT to State Highway Commission	227,722.23	
Total		$760,444.45

***$25,000.00 of this amount should have been deducted from the 1922 receipts.**

I, John P. Tucker, Registrar of the Motor Vehicle Registration Department, do hereby certify that the above is a true financial report of the Motor Vehicle Registration Department for the period, January 1, 1923, to December 31, 1923, to the best of my knowledge and belief.

JOHN P. TUCKER,
Registrar.

Subscribed and sworn to before me this 21st day of August, 1924.

CELIA A. HAGEN,
Notary Public.

(SEAL)

My Commission expires Feb. 5, 1929.

RECEIPTS AND DISTRIBUTIONS BY COUNTIES
1923

County	Total Amount Collected	Amount retained for Motor Vehicle Department, State Highway Com. and Bridge Fund.	Special Road Maintenance Fund distributed to Counties for expenditure under direction of State Highway Com. for maintenance of St. High. Sys.	State Aid Fund to be expended by State High. Com. Co-operatively with individual counties for construction on State Highway System.
Adams	$ 5,876.30	$ 1,906.80	$ 1,984.74	$ 1,984.76
Barnes	25,559.35	10,629.63	7,464.86	7,464.86
Benson	13,602.40	6,207.41	3,697.49	3,967.50
Billings	1,748.15	475.62	636.27	636.26
Bottineau	15,917.25	5,449.98	5,233.63	5,233.64
Bowman	5,485.40	1,707.30	1,889.06	1,889.04
Burke	10,804.00	3,733.07	3,535.45	3,535.48
Burleigh	25,013.65	9,480.20	7,766.73	7,766.72
Cass	70,876.10	30,315.16	20,280.48	20,280.46
Cavalier	17,318.15	7,984.60	4,691.77	4,691.78
Dickey	12,740.55	5,655.62	3,542.46	3,542.47
Divide	9,796.35	3,423.43	3,186.46	3,186.46
Dunn	5,989.90	2,330.14	1,829.88	1,829.88
Eddy	7,170.10	3,280.90	1,969.61	1,969.59
Emmons	10,928.15	4,336.15	3,295.99	3,296.01
Foster	7,794.30	3,429.09	2,182.61	2,182.60
Golden Valley	4,669.80	1,633.80	1,518.00	1,518.00
Grand Forks	44,799.95	18,438.55	13,180.69	13,180.71
Grant	6,602.00	2,245.29	2,178.36	2,178.35
Griggs	8,834.70	4,023.00	2,405.85	2,405.85
Hettinger	7,776.95	2,459.06	2,658.94	2,658.95
Kidder	6,591.05	2,591.78	1,999.65	1,999.62
LaMoure	14,150.80	6,159.01	3,995.88	3,995.91
Logan	5,728.30	2,337.51	1,695.39	1,695.40
McHenry	16,636.95	6,089.84	5,273.56	5,273.55
McIntosh	8,203.85	3,223.56	2,490.15	2,490.14
McKenzie	6,806.40	1,941.34	2,182.53	2,182.53
McLean	18,846.75	7,371.09	5,737.83	5,737.83
Mercer	7,505.20	2,778.57	2,363.31	2,363.32
Morton	19,028.15	6,384.35	6,321.90	6,321.90
Mountrail	13,457.95	4,785.43	4,336.26	4,336.26
Nelson	12,872.75	6,029.08	3,421.84	3,421.83
Oliver	2,870.35	1,050.19	910.08	910.08
Pembina	17,050.55	7,844.72	4,602.92	4,602.91
Pierce	7,779.95	2,950.74	2,414.60	2,414.61
Ramsey	23,093.90	9,967.07	6,563.42	6,563.41
Ransom	13,181.40	5,783.31	3,699.04	3,699.05
Renville	8,424.15	3,252.47	2,585.84	2,585.84
Richland	26,679.15	11,800.76	7,439.20	7,439.19
Rolette	7,158.35	2,840.64	2,158.86	2,158.85
Sargent	12,302.65	5,583.82	3,359.41	3,359.42
Sheridan	4,920.75	1,955.15	1,482.80	1,482.80
Sioux	2,188.10	672.64	757.73	757.73
Slope	3,827.80	1,425.29	1,201.25	1,201.26
Stark	15,839.75	4,665.37	5,587.20	5,587.18
Steele	9,260.80	4,194.10	2,533.35	2,533.35
Stutsman	26,810.90	10,565.87	8,122.52	8,122.51
Towner	9,806.50	4,146.53	2,829.98	2,829.99
Traill	16,880.60	7,177.20	4,851.69	4.851.71
Walsh	27,809.25	12,082.15	7,613.55	7,613.55
Ward	40,387.80	15,491.84	12,447.98	12,447.98
Wells	15,102.10	6,183.16	4,459.47	4,459.47
Williams	20,988.00	6,630.62	7,153.70	7,153.68
TOTAL	$760,444.45	$305,000.00	$227,722.22	$227,722.23

FINANCIAL REPORT
OF THE
MOTOR VEHICLE REGISTRATION DEPARTMENT
FOR THE PERIOD
JANUARY 1, 1924 — JUNE 30, 1924

RECEIPTS

Automobile Licenses, Passenger Cars and Trucks	$698,206.35	
Transfers of Ownership	6,955.00	
Duplicate Tags	167.50	
Motorcycle Licenses	1,246.00	
Total		$706,628.85

DISBURSEMENTS

State Highway Commission, Appropriation	$106,925.00	
Motor Vehicle Department, Appropriation	43,075.00	
State Bridge Fund, Appropriation	130,000.00	
Apportionment to Counties	213,314.42	
Apportionment to State Highway Commission	213,314.43	
Total		$706,628.85

I, John P. Tucker, Registrar of the Motor Vehicle Registration Department, do hereby certify that the above is a true financial report of the Motor Vehicle Registration Department for the period, January 1, 1924, to June 30, 1924, to the best of my knowledge and belief.

JOHN P. TUCKER,
Registrar.

Subscribed and sworn to before me this 22nd day of August, 1924.

CELIA A. HAGEN,
Notary Public.

(SEAL)

My Commission expires Feb. 5, 1929.

RECEIPTS AND DISTRIBUTIONS BY COUNTIES
PERIOD JANUARY 1, 1924 — JUNE 30, 1924

County	Total Amount Collected	Amount retained for Motor Vehicle Department, State Highway Com. and Bridge Fund.	Special Road Maintenance Fund distributed to Counties under direction of State Highway Com. for maintenance of St. High. Sys.	State Aid Fund to be expended by State High. Com. Co-operatively with individual counties for construction on State Highway System.
Adams	$ 5,557.40	$ 2,163.56	$ 1,696.91	$ 1,696.93
Barnes	23,843.65	9,411.08	7,216.29	7,216.28
Benson	11,961.55	5,008.36	3,476.60	3,476.59
Billings	1,589.55	643.44	473.05	473.06
Bottineau	14,505.90	5,861.52	4,322.19	4,322.19
Bowman	4,945.20	2,019.92	1,462.64	1,462.64
Burke	10,864.80	3,977.96	3,443.42	3,443.42
Burleigh	21,258.75	9,210.04	6,024.36	6,024.35
Cass	67,325.75	26,096.84	20,614.45	20,614.46
Cavalier	14,655.55	6,377.00	4,139.28	4,139.27
Dickey	12,634.55	4,691.12	3,971.71	3,971.72
Divide	9,977.30	3,606.96	3,185.17	3,185.17
Dunn	5,593.80	2,205.28	1,694.26	1,694.26
Eddy	6,617.45	2,640.12	1,988.66	1,988.67
Emmons	10,297.40	4,023.60	3,136.91	3,136.89
Foster	6,989.75	2,870.00	2,059.87	2,059.88
Golden Valley	4,137.40	1,719.48	1,208.96	1,208.96
Grand Forks	40,360.60	16,495.64	11,932.48	11,932.48
Grant	6,019.55	2,430.96	1,794.30	1,794.29
Griggs	8,322.15	3,253.32	2,534.41	2,534.42
Hettinger	7,444.85	2,863.56	2,290.64	2,290.65
Kidder	6,186.05	2,426.76	1,879.65	1,879.64
LaMoure	13,726.85	5,210.52	4,258.16	4,258.17
Logan	5,645.40	2,109.24	1,768.08	1,768.08
McHenry	15,158.00	6,125.84	4,516.09	4,516.07
McIntosh	8,275.35	3,020.64	2,627.35	2,627.36
McKenzie	5,625.45	2,322.04	1,651.71	1,651.70
McLean	15,797.65	6,939.80	4,428.92	4,428.93
Mercer	6,917.00	2,763.32	2,076.84	2,076.84
Morton	20,020.75	7,006.16	6,507.29	6,507.30
Mountrail	11,706.10	4,955.16	3,375.47	3,375.47
Nelson	11,618.30	4,739.84	3,439.23	3,439.23
Oliver	2,613.55	1,057.00	778.28	778.27
Pembina	15,029.75	6,277.32	4,376.21	4,376.22
Pierce	7,514.75	2,864.68	2,325.04	2,325.03
Ramsey	21,118.10	8,503.32	6,307.39	6,307.39
Ransom	13,202.15	4,853.52	4,174.31	4,174.32
Renville	7,735.80	3,101.84	2,316.98	2,316.98
Richland	26,274.40	9,823.52	8,225.44	8,225.44
Rolette	6,911.45	2,635.64	2,137.91	2,137.90
Sargent	11,782.20	4,529.94	3,626.18	3,626.18
Sheridan	4,740.50	1,811.88	1,464.31	1,464.31
Sioux	2,073.15	805.56	633.79	633.80
Slope	3,721.85	1,409.62	1,156.17	1,156.16
Stark	14,757.30	5,832.40	4,462.45	4,462.45
Steele	8,984.55	3,409.84	2,787.36	2,787.35
Stutsman	26,449.10	9,871.96	8,288.57	8,288.57
Towner	8,319.20	3,610.88	2,354.15	2,354.17
Traill	16,504.40	6,215.44	5,144.49	5,144.47
Walsh	23,311.80	10,055.36	6,628.21	6,628.23
Ward	37,342.50	14,871.08	11,235.71	11,235.71
Wells	13,690.25	5,560.80	4,064.73	4,064.72
Williams	18,972.30	7,709.52	5,631.39	5,631.39
TOTAL	$706,628.85	$280,000.00	$213,314.42	$213,314.42

MOTOR VEHICLE OPERATING DEPARTMENT
DEPARTMENTAL DISBURSEMENTS
JULY 1, 1923 TO JUNE 30, 1924

Month	$2,400.00 Salary	$10,000.00 Clerk-hire	$10,000.00 Postage	$200.00 Supplies	$600.00 Furniture Fixtures	$500.00 Printing	$425.00 Pre. Misc. Bonds	$750.00 Travel	$1,000.00 Special Agents	$15,000.00 Tags	$200.00 Contingent	$43,075.00 Total
July	$ 166.66	$ 1,103.87	.....	$ 49.07	$ 78.36	$ 30.77	$ 84.27	$382.74	$173.96	$ 624.78	$	$ 2,694.48
August	166.66	1,133.00	.....	1.00	314.57	63.46	31.55	159.87	280.00	601.87	.....	2,751.98
September	166.66	845.33	.....	20.00	59.72	538.45	22.07	197.62	280.00	.....	.....	2,129.85
October	166.66	764.60	$ 4,000.00	44.21	4.42	202.29	35.18	.....	140.00	.....	.....	5,357.36
November	166.66	814.10	1,869.21	18.00	10.55	.....	8.39	.....	.....	.....	.....	2,886.91
December	166.66	865.00	.....	11.32	26.82	46.22	7.35	.....	.....	.....	16.50	1,139.87
January	166.66	865.00	.....	5.00	14.94	269.26	14.40	.....	.....	6,756.50	75.59	8,167.35
February	166.66	908.25	.....	27.89	69.63	43.37	11,93	.....	.....	5,949.64	11.50	7,188.87
March	166.66	957.00	230.20	10.75	11.22	203.24	13.55	.....	.....	.....	13.00	1,605.62
April	166.66	1,040.55	2,854.99	.....	3.26	130.78	6.15	.....	.....	.....	36.40	4,238.79
May	166.66	*See Foot Note	1,045.60	11.63	.70	.....	12.06	.....	75.00	.....	16.00	1,327.65
June	166.66	*See Foot Note	.....	.....	5.02	74.32	8.30	.....	48.00	.....	21.75	324.05
TOTAL	$1,999.92	$ 9,296.70	$10,000.00	$198.87	$599.21	$1,602.16	$ 255.20	$ 740.23	$ 996.96	$13,932.79	$ 190.74	$39,812.78
BALANCE	$ 400.08	$ 703.30	.....	$ 1.13	$ .79	$ 897.84	$ 169.80	$ 9.77	$ 3.04	$ 1,067.21	$ 9.26	$ 3.262.22

*Payment Clerk Hire—May $1,056.00 and June $1,116.50 out of Highway Commission Operating Fund.

SECTION IX

Chief Clerk and Accounting Department

The total amount of cash receipts for the biennial period was $3,055,077.70, and the total amount of disbursements $2,926,681.45. Detailed financial statements for each fiscal year appear elsewhere in this report.

The number of vouchers handled was 10,306, of which 4,738 covered the fiscal year ending June 30, 1923, and 5,578 the fiscal year ending June 30, 1924.

The large increase in the cash transactions during the fiscal year ending June 30. 1924, as compared with previous years is due principally to a change in the method of handling Federal Aid payments. On all construction contracts awarded prior to January 1, 1922, the counties were required to pay the contractors the full amount of each estimate of work done, being reimbursed directly by the Federal government for the United States' pro rata share of the cost of the project, which is usually fifty per cent. Therefore, the Federal Aid paid on such contracts has not appeared either as a receipt or as a disbursement of State funds. Subsequent to January 1, 1922, all contracts were awarded with a provision that the counties would pay on each estimate only their ultimate proportion of the cost, the Federal Aid to be paid by the United States to the State Treasurer, and by him disbursed to the various contractors in accordance with vouchers drawn by the State Highway Commission. Due, however, to the large number of contracts current during the year 1922 which remained uncompleted from the awards of previous years, the full force of this new procedure was not felt until the second year covered by this report.

An audit of the books of the department for the period to February 28, 1923, was made by the State Examiner's office during the winter of 1923. Another audit covering the period from March 1, 1923, to October 30, 1923, was made pursuant to Chapter 143 of the Session Laws of 1923, by an examiner employed by the State Board of Auditors.

STATEMENT OF RECEIPTS AND DISBURSEMENTS OF THE NORTH DAKOTA STATE HIGHWAY COMMISSION

July 1, 1922 to June 30, 1923

Balance, July 1, 1922		$ 206,562.39
RECEIPTS		
Appropriation Senate Bill No. 5, Special Session 1919	$100,000.00	
Transfer from State Bridge Fund to Missouri River Bridge Fund	60,000.00	
Transfer from State Bridge Fund to Missouri River Bridge Fund	54,000.00	
Motor Vehicle Fees Allotted as State Aid (Less deduction for 10% Fund)	199,769.28	
Federal Aid received on Missouri River Br.	82,976.07	
Payments received from Burleigh and Morton Counties on Missouri River Bridge	73,382.14	
Federal Aid recd on Construction $373,353.74		
Federal Aid recd. on Engineering 44,576.34	417,930.08	
Miscellaneous Collections	2,778.42	
Ten Per Cent Fund Collections	108,973.02	
Total Receipts		1,099,809.01
		$1,306,371.40
DISBURSEMENTS		
Office Salaries (Secretary, Commissioners per diem and expense Staff Engineers) $51,246.84		
Clerical 18,146.16		
Travel Expense 9,718.17		
Office Expense (Supplies, etc.) 9,786.39		
Printing 1,459.85		
Telephone 499.88		
Field Equipment 3,492.36		
Freight and Express 685.29		
Office Rent 4,615.00		
Geological Survey 769.80		
Miscellaneous 1,955.58		
Total Operating Expenses	$102,375.32	
Missouri River Bridge	270,283.38	
Federal Aid Paid to Counties and Contractors	348,112.18	
State Aid Paid to Counties and Contractors	132,704.38	
Construction Engineering	124,760.95	
Ten Per Cent Fund Disbursements	104,168.66	
Total Disbursements		$1,082,404.87
Balance, June 30, 1923		223,966.53
		$1,306,371.40

NORTH DAKOTA STATE HIGHWAY COMMISSION
COMBINED STATEMENT OF RECEIPTS AND DISBURSEMENTS IN ALL FUNDS July 1, 1923, to June 30, 1924

RECEIPTS

Highway Operating Fund, Appropriation	$106,925.00	
Highway Operating Misc. Collections	192.74	$ 107,117.74
Motor Vehicle Fees Allotted as State Aid		309,271.79
Federal Aid Received on Construction		1,207,874.39
Federal Aid Received on Engineering		75,167.52
Miscellaneous Refunds and Collections (Construction)		5,208.15
Ten Per Cent Fund, Motor Vehicle Fee Cr.	$ 34,363.54	
Ten Per Cent Fund, Misc. Collections & Refunds	60,151.68	
Ten Per Cent Fund, Transferred from State Aid —Mileage, etc.	27,755.03	122,270.25
Transferred to Construction (State Aid) from 10% Fund (F. A. on Engineering)		13,358.85
Pembina County Bridge, Appropriation		35,000.00
Refund to Construction from State Bridge Fund (Account Missouri River Bridge)		80,000.00
Total Receipts		$1,955,268.69
Balance July 1, 1923		223,966.53
		$2,179,235.22

DISBURSEMENTS

Highway Operating—Administration:		
Office Salaries (Secretary, Commissioners, Staff Engineers, etc.)	$43,116.91	
Clerical	20,827.44	
Travel Expense	10,228.63	
Office Expense (Supplies, etc.)	8,722.93	
Printing	1,568.66	
Telephone, Toll & Telegrams	1,565.04	
Field Equipment	2,100.82	
Freight, Express, Postage	297.92	
Miscellaneous	6,016.26	
Furniture and Fixtures	114.40	
Payments drawn against Prior State Highway Fund	10,998.76	
Total Highway Operating Expense		$ 105,557.77
Federal Aid Paid to Counties and Contractors		1,249,459.64
State Aid Paid to Counties and Contractors		167,581.21
Construction Engineering		188,733.80
Ten Per Cent Fund Disbursements (Equipment and Road Marking)		89,315.70
Missouri River Bridge		9,772.95
Pembina County Bridge		10,825.32
Bridge Approach Fund		8,084.84
Transfer from State Aid to 10% Fund (Acct. Proj. No. 8)		1,586.50
Transfer from 10% fund to State Aid (Acct. Fed. Aid on Engineering)		13,358.85
Total Disbursements		$1,844,276.58
Balance June 30, 1924		334,958.64
		$2,179,235.22

SECTION X

ROAD MATERIALS TESTING LABORATORY

The testing of all road materials entering into the construction of Federal Aid Projects prior to October, 1923, was made by the Division of Tests, Bureau of Public Roads at Washington without cost for all states not having Testing Laboratories of their own equipped to perform such work. On account of the increased demands upon this Department at Washington due to the vast amount of work involved the Bureau of Public Roads advised all State Departments in the year 1923 that no more material tests could be undertaken for the various states and that such states would have to equip laboratories of their own in order to make all material tests required. Accordingly a Testing Department was formed in October, 1923, and a Laboratory partly equipped at that time to take care of at least some of the testing work required. Mr. Clifford Johnson was placed in charge of the Department and served until May, 1924, at which time his services were more urgently needed in the Bridge Department and Mr. P. M. Hegdol was appointed to take his place and is occupying that position at this date.

The facilities of the laboratory are not complete at this writing but are being improved gradually by the addition of required equipment as funds permit. A large compression machine has been received from the Surplus War Equipment Department of the United States and is now being installed. This machine tests the compression strength of concrete by crushing prepared cubes of this material and the pressure per square inch noted at the time of failure of the cube. This is one of the most important tests in connection with concrete work as it discloses the compression strength of the concrete going into the various structures under construction.

This Department tests samples of such construction material as cement, sand and gravel for concrete, gravel and scoria for surfacing, corrugated metal pipe and numerous other materials going into road construction. In the future it is expected to provide facilities for testing reinforcing steel, paints, asphalt and cast concrete and vitrified clay pipe culverts which it is impossible to do at this time and tests of these materials as required are now being made in other laboratories. During the latter part of the 1923 construction season there were tested by this Department 30 samples of cement, sand and gravel and 39 samples of corrugated metal culvert pipe. To date in 1924, there have been tested 174 samples of cement, sand and gravel and 126 samples of corrugated metal pipe culverts.

Tests on sand and gravel for owners of such property in the state as may request it are being made free of charge.

SECTION XI

EQUIPMENT DEPARTMENT

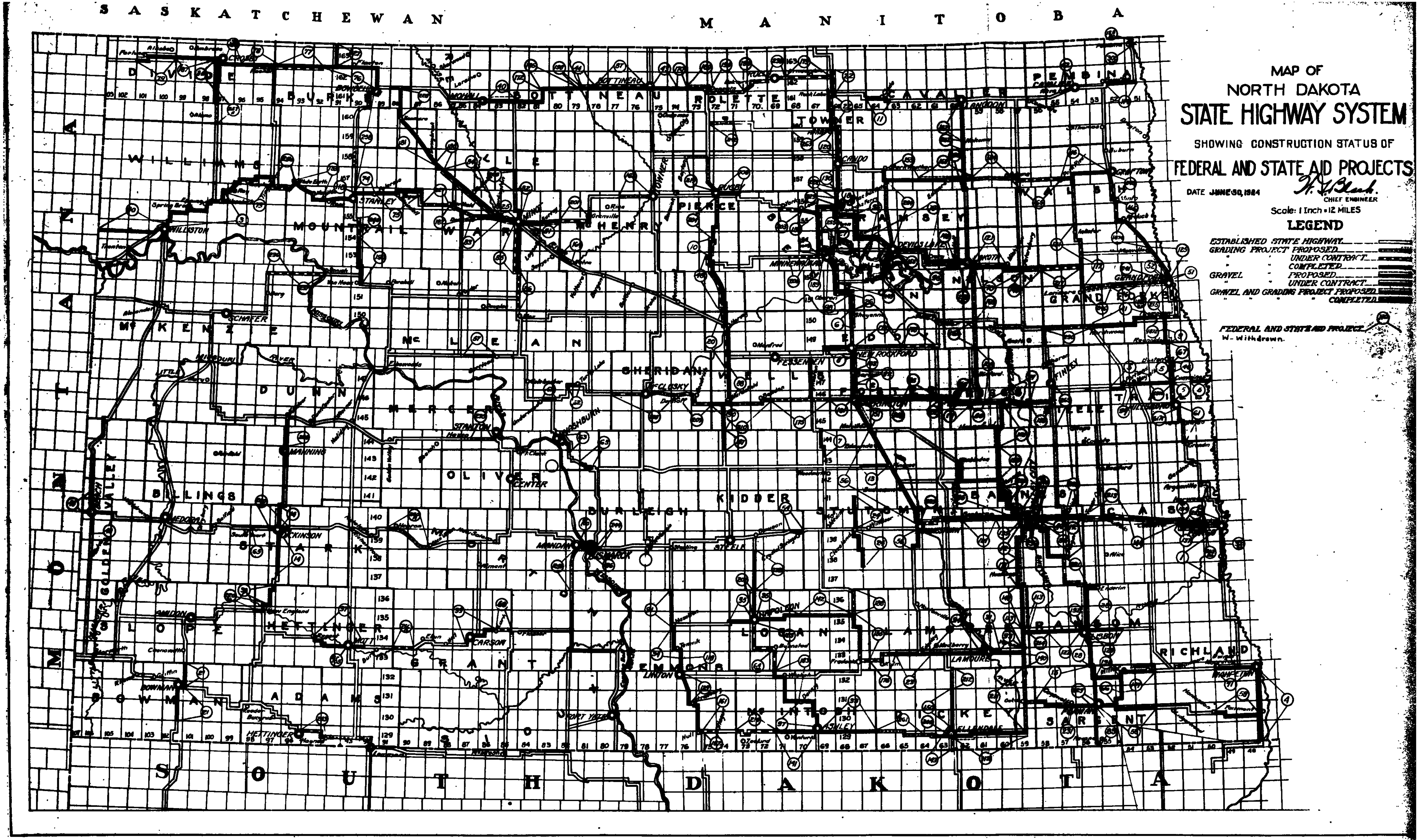
At the close of the recent war, laws were passed by the National Government providing for the distribution by the Department of Agriculture to the various States of large quantities of surplus war materials, these materials to be used by the States in the construction and maintenance of public roads.

The first shipments were made in some cases direct to various counties late in 1918 and consisted mostly of tractors and trucks. From then on more shipments were received, mostly at Bismarck and in addition to trucks and tractors, included repair parts for the same and large stores of construction and engineer supplies. As the quantities of material on hand increased the need of department to handle the same was realized. An engineer was put in charge and the equipment department was gradually formed in 1918 and 1920.

The original function of the equipment department was to distribute these surplus war materials to the counties, townships, cities and other road-building agencies within the State as well as to other State institutions and departments at an assignment charge covering the cost of freight, handling and accrued government charges. In the case of trucks and tractors, the counties, etc., were able to obtain these at a charge, representing in most cases, a tenth of the real value of the article. In the case of the miscellaneous equipment the amount charged represented from 20% to 50% of the actual value. The miscellaneous equipment consisted of trailers, tents and canvas, and all manner of carpenter and construction tools and supplies. Of the 60 tractors and 341 trucks received by this department, practically all have been transferred to counties, etc., or otherwise disposed of in accordance with government and department regulations. More of these will be available for distribution after the coming session of Congress.

Included in the shipments of materials received were 52 passenger cars of various makes, 19 motorcycles, transits, levels, drafting room and engineer field supplies. These were put into use by the field and office forces of the State Highway Commission and the equipment department thus took over the function of supplying and maintaining the equipment used by the Highway Commission proper. The cars received as above stated were kept in repair by a force of expert mechanics and when their period of usefulness passed were replaced by new machines in the interests of economical operation. Approximately twenty of the original cars are still in use, but the motorcycles have all been disposed of as not being suited to this type of work. The Highway Commission at present has about fifty vehicles in use including several of the lighter, pneumatic-tired trucks, the number varying as unserviceable machines are sold and new ones acquired, in accordance with the needs of the department.

During the period covered by this report, from July 1, 1922, to June 30, 1924, the passenger cars supplied to the Highway Commission by this department had a total mileage of 718,940 miles, covering all cars reporting mileage. The total charge for this mileage for the same



MAP OF
NORTH DAKOTA
STATE HIGHWAY SYSTEM
SHOWING CONSTRUCTION STATUS OF
FEDERAL AND STATE AID PROJECTS
DATE JUNE 30, 1924
CHIEF ENGINEER
Scale: 1 Inch = 12 MILES
LEGEND
ESTABLISHED STATE HIGHWAY
GRADING PROJECT PROPOSED
UNDER CONTRACT
COMPLETED
GRAVEL PROPOSED
UNDER CONTRACT
GRAVEL AND GRADING PROJECT PROPOSED
COMPLETED
FEDERAL AND STATE AID PROJECT
W - Withdrawn.
SASKATCHEWAN
MANITOBA
MONTANA
SOUTH DAKOTA
DIVIDE
BURKE
WILLIAMS
MOUNTRAIL
McKENZIE
DUNN
MERCER
McLEAN
SHERIDAN
WELLS
FOSTER
GRIGGS
STEELE
TRAILL
GRAND FORKS
NELSON
RAMSEY
TOWNER
CAVALIER
PEMBINA
WALSH
BOTTINEAU
ROLETTE
PIERCE
McHENRY
WARD
BILLINGS
STARK
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
RANSOM
RICHLAND
SARGENT
DICKEY
LAMOURE
LOGAN
McINTOSH
EMMONS
GRANT
HETTINGER
ADAMS
SLOPE
BOWMAN
GOLDEN VALLEY
CROSBY
WILLISTON
STANLEY
MINOT
RUGBY
CANDO
DEVILS LAKE
MINNEWAUKAN
LANGDON
CAVALIER
GRAFTON
GRAND FORKS
HILLSBORO
FINLEY
COOPERSTOWN
NEW ROCKFORD
FESSENDEN
CARRINGTON
McCLUSKY
WASHBURN
STANTON
CENTER
MANDAN
BISMARCK
STEELE
NAPOLEON
LINTON
ASHLEY
ELLENDALE
LAMOURE
LISBON
WAHPETON
FORMAN
VALLEY CITY
JAMESTOWN
FARGO
MANNING
DICKINSON
MEDORA
AMIDON
BOWMAN
HETTINGER
MOTT
CARSON
SCHAFER
BEACH
BOWBELLS
MOHALL
FORT YATES

period was $70,768.18. The charge per mile has varied from the original twelve cents per mile to the present charge of ten cents. In this case everything was furnished by this department. Under the present arrangement where most of the cars have the gas, oil, storage and emergency repairs paid for in the field by the operator, this department has made a charge of from seven to eight cents per mile for the use of cars, tires, overhauling and other items as listed below. The Highway Commission has been reimbursed in part by the Federal Government for the mileage charged—to the extent of $11,692.57 for the biennial period.

The following figures show how the cost per mile for the use of the car and the relative value of various items amounts to:

Repair parts	$ .0157 per mile
Repair labor	.0130 " "
Accessories, miscellaneous	.0044 " "
Storage	.0039 " "
Gas	.0158 " "
Oil	.0034 " "
Tires and tubes	.0093 " "
Dept. administration	.0193 " "
Interest on plant	.0028 " "
Depreciation on cars	.0124 " "
	$ .1000 " "

In 1923 the sign department was organized for the purpose of marking the roads and trails of the State Highway system. The equipment department furnishes the quarters for this department in one of several assembled buildings received from the government and also furnishes a passenger car and three light trucks for use in transporting the signs.

The equipment department has always given all aid possible to state institutions and other departments in order that the work of these departments and institutions might be expedited, and in some cases made possible where otherwise lack of funds would not have otherwise permitted. In many instances this aid has been without remuneration to the equipment department. It has consisted of the loan of tractors, trucks, supplies and labor.

The policy of this department has been to make it possible for the various road-building agencies within the State to obtain equipment to use in road-building at as low a cost as possible, in order that the greatest good may be accomplished for the entire State. The financial status has not been the criterion in deciding where the equipment should go, but where it would be of the most use. As a result the department has suffered to a certain extent from accounts still unpaid by some of the counties. Every effort is being made to collect these old accounts. This money is needed for the acquiring of more tractors and trucks from the government and the distribution of the same.

In the Fall of 1923 an audit was made of this department by Mr. O. B. Lund, accountant, as provided by law. This audit shows all the activities of this department in so far as they can be shown in figures, particularly as to the various kinds of equipment received and the distribution of the same. For additional information refer to this audit.

PART II.

BIENNIAL REPORT

OF THE

STATE ENGINEER

TO THE

GOVERNOR OF NORTH DAKOTA

PART II.

FOR

PERIOD JULY 1ST, 1922

TO

JUNE 30TH, 1924

Bismarck, North Dakota,

September 1, 1924.

Honorable R. A. Nestos, Governor.

Sir:

As provided by our statutes I have the honor to transmit herewith the transactions of the Department of State Engineer for the period of time commencing July 1, 1922, and ending June 30, 1924, with recommendations for such legislation as will increase the efficiency of the department and encourage the development of irrigation in North Dakota.

Yours very respectfully,

W. G. BLACK,

State Engineer.

OFFICERS AND EMPLOYEES FOR BIENNIAL PERIOD

W. H. ROBINSON	State Engineer
W. G. BLACK	State Engineer
GEO. H. McMAHON	Assistant State Engineer
CLARA CHRISTENSEN	Stenographer
MAURICE DIEHL	Instrumentman
HAROLD A. MURPHY	Instrumentman
CARL BARNECK	Rodman
MERRILL KITCHEN	Rodman
KENNETH CRAWFORD	Rodman

FINANCIAL STATEMENT

July 1st, 1922 to June 30th, 1923

Balance in fund June 30, 1922	$12,222.15	
Transfer to Travel Fund	150.00	
Transfer to Hydrographic Fund	100.00	$12,472.15
Less Expenditures	$10,268.96	
Less 1921 Prior Balance Reverted to General Fund	640.63	10,909.59
Balance in fund June 30, 1923		$ 1,562.56

July 1st, 1923 to June 30th, 1924

Balance in fund June 30, 1923	$ 1,562.56	
Credit by Appropriation	18,200.00	
Misc. Collections (Credit to travel and supplies)	33.90	$19,796.46
Less Expenditures		9,347.29
Balance in State Engineer's Fund June 30, 1924		$10,449.17

Fees of State Engineer's Office July 1, 1922 to June 30, 1924

For field notes	$166.18
For water rights	77.75
Credited to General Fund	$243.93
Misc. Collections Credited to Travel and Supply Fund	$ 33.90

FINANCIAL STATEMENT IN ACCORDANCE WITH THE SUBDIVISIONS OF THE APPROPRIATION FOR THE STATE ENGINEER'S OFFICE UNDER THE BUDGET BILL S. B. NO. 25

July 1st, 1922 to June 30th, 1923

SALARY STATE ENGINEER

Balance July 1, 1922	$2,500.04
Less expenditures	2,500.04
Balance	

CLERK HIRE

Balance July 1, 1922	$5,761.18
Less expenditures	5,336.56
Balance	$ 424.62

POSTAGE

Balance July 1, 1922	$ 300.00
Less expenditures	268.01
Balance	$ 31.99

SUPPLIES

Balance July 1, 1922	$ 166.29
Less expenditures	19.38
Balance	$ 146.91

FURNITURE & FIXTURES

Balance July 1, 1922	$ 462.88
Less expenditures	254.50
Balance	$ 208.38

PRINTING

Balance July 1, 1922	$ 685.20
Less expenditures	267.26
Balance	$ 417.94

MISCELLANEOUS

Balance July 1, 1922	$ 72.20
Less expenditures	61.85
Balance	$ 10.35

TRAVEL

Balance July 1, 1922	$ 943.33
Less expenditures	768.81
Balance	$ 174.52

HYDROGRAPHIC

Balance July 1, 1922	$ 940.40
Less expenditures	792.55
Balance	$ 147.85

July 1st, 1923 to June 30th, 1924

SALARY STATE ENGINEER

Balance July 1, 1923	$5,000.00
Less expenditures	2,499.96
Balance	$2,500.04

CLERK HIRE

Balance July 1, 1923	$8,000.00
Less expenditures	3,999.96
Balance	$4,000.04

POSTAGE

Balance July 1, 1923	$ 300.00
Less expenditures	115.10
Balance	$ 184.90

SUPPLIES

Balance July 1, 1923	$ 420.00
Less expenditures	268.76
Balance	$ 151.24

FURNITURE & FIXTURES

Balance July 1, 1923	$ 600.00
Less expenditures	10.68
Balance	$ 589.32

PRINTING

Balance July 1, 1923	$ 700.00
Less expenditures	5.49
Balance	$ 694.51

MISCELLANEOUS

Balance July 1, 1923	$ 200.00
Less expenditures	24.08
Balance	$ 175.92

TRAVEL

Balance July 1, 1923	$2,013.90
Less expenditures	1,188.58
Balance	$ 825.32

HYDROGRAPHIC

Balance July 1, 1923	$1,000.00
Less expenditures	600.33
Balance	$ 399.67

PRIOR

Balance July 1, 1923	$1,562.56
Less expenditures	634.35
Balance	$ 928.21

INTRODUCTION

The development of individual irrigation projects in the state during the past biennial period has been somewhat handicapped through the low prices received for farm products and through the shortage of available funds for new construction. However, several small projects have been developed, particularly spring flooding projects where the water is stored in the soil in the early spring to be made available when moisture is needed later in the season. Such methods, where tried in North Dakota and elsewhere, invariably cause an increased crop yield, sometimes giving more than double the yield obtained through dry land farming methods.

Sec. 14 of the North Dakota irrigation code of 1905 provides that; "The state engineer shall make hydrographic surveys and investigations of each stream system and source of water supply in the state, beginning with those most used for irrigation, obtaining and recording all available data for the determination, development and adjudication of the water supply of the state."

It has been the aim of this office, insofar as the limited funds would permit, to comply with this provision of the irrigation code.

Data for the determination of the water supply of the state has been obtained during the past twenty years through cooperation with the U. S. Geological Survey and the records of the last biennial period are given elsewhere in this report.

Data concerning the development of the water supply has been obtained to some extent in the past, and the reports and maps showing the results of such surveys made during the last biennial period are also published in this report.

RECOMMENDATIONS

In the past the department has been handicapped through a lack of available funds for field assistants in making surveys for reservoir sites, irrigable areas, etc. It is recommended that the coming session of the legislature revise the budget in such a way that an adequate fund for field assistants may be made available.

The salaries of the State Engineer and the Assistant State Engineer were established by the Irrigation Code on March 1, 1905 at a time when engineers' salaries, as well as living costs, were much lower than they are now. At present these salaries are less than those paid in neighboring states and less than is paid by private corporations for the same class of work.

In a number of reservoir sites surveyed by this office a considerable acreage of state land is included in the submerged area. It is important that proper action be taken by the legislature to reserve this land for reservoir sites.

It is also recommended that a fund be provided for cooperation with the departments of the federal government in making surveys and investigations as provided in Sec. 14 of the irrigation code, such money

to be expended whenever any department of the federal government will make a like sum available.

Also, it is recommended that attention be given to the development and colonization of the irrigation projects already in operation in this state. Particularly is this true of the Williston and the Lower Yellowstone Projects. It is only through the intensive farming of crops that yield a high return per acre that an irrigation project will give the greatest return on the investment. North Dakota has splendid opportunities to offer new settlers on these projects. Much has already been done through private initiative. However, State help through an ample immigration fund made available for this purpose is advisable.

During the last session of the legislature Senate Bill No. 258 providing for the appointment of an interstate Missouri River Commission was passed. This bill provides a method for avoiding future litigation with the states of South Dakota and Montana on matters concerning the Missouri River and its tributaries. Litigation with the state of Minnesota concerning flood control of the Red River, after pending for several years, has been brought to an end.

Attention is called to the need of legislation providing for an interstate commission to consider flood control problems of the Red River, which is the common boundary of the states of Minnesota and North and South Dakota. Through such a commission the proper plans for flood control could be formulated and a joint demand should be made by the three states interested that the federal government stand its just share of the cost of such works as are needed to safeguard this rich farming district from the disastrous results that would accompany another serious flood in the Red River Valley.

THE MISSOURI RIVER COMMISSION

Senate Bill No. 258 passed at the last session of the Legislative Assembly of North Dakota provides for the appointment of a Missouri River Commission. This commission will consist of two members each appointed from the states of North Dakota, South Dakota and Montana, together with a member appointed by the federal government. The commission will make a study of the further utilization and distribution of the waters of the Missouri River and streams tributary thereto.

A point of common interest to the three states is in establishing the priority of the various interests involved. These interests are concerned with the use of the stream for irrigation, navigation and power development.

It is generally considered that an excessive bridge clearance is demanded on the Missouri River for navigation purposes. This requirement at present for North Dakota is 38 feet clearance above extreme high water. If this requirement could be reduced even slightly a very large saving would be made in the construction of bridges now being considered.

Before the construction of railroads in the state the Missouri River was the only means of transportation for both the Dakotas and Montana. At the present time the river traffic has practically ceased. The Missouri River falls 306 feet in 405 miles through North Dakota, or about nine inches per mile. There are no rapids and the fall is very uniform. The strong current, a shifting channel due to the deposition of silt, and the shallow depth of water, all contribute to make navigation very expensive.

Slack water navigation through the construction of dams of movable crest, as on the Ohio River and its tributaries, would be impracticable owing to the great cost and the fact that there is no satisfactory foundation. As an instance of this fact, the piers for the Bismarck-Mandan highway bridge across the Missouri River were driven to a depth of over seventy feet to secure a satisfactory foundation.

No type of fixed dam would be of any permanent benefit to navigation, as the channel above the dam would silt up within a very few years.

Navigation of the Missouri River in North Dakota could be revived to a limited extent for the carrying of freight by means of small motor craft if the stages of the river could be regulated by the construction of impounding reservoirs at the headwaters of the Missouri River and its tributaries in Montana and Wyoming and on the tributaries of the Missouri River in North Dakota and South Dakota. These reservoirs would afford flood protection to the bottom lands and would save thousands of acres of good farm land annually. This land is washed away by the Missouri River floods and carried on down the Mississippi River to silt up the channel and add to the difficulties of navigation on that stream.

Reports of the pumping plant of the City of New Orleans show that the maximum of turbidity does not occur at the flood stage of the Mississippi but at some time later in the season. A considerable amount of the silt carried comes from the floods of the upper Missouri River reaching the lower Mississippi after its floods have passed.

The construction of the reservoirs mentioned would have only a slight effect on the floods of the lower Mississippi, as the flood peaks of the two streams do not coincide. The maximum floods on the Missouri River in North Dakota do not exceed 200,000 second feet, or only about ten percent of the maximum discharge of the Mississippi River at New Orleans.

The construction of impounding reservoirs at the headwaters of the Missouri River and its tributaries in Montana, Wyoming, North and South Dakota, would improve navigation, add to the irrigation possibilities of these states, would make various water power schemes more practical, would provide flood control and avoid the losses incident to floods of the Missouri River, one of the chief losses being the cutting away of rich North Dakota soil to add to the silt problems of the lower Mississippi.

These are the various problems to be studied and their consideration at the present time will do much to hasten the development of one of North Dakota's greatest natural resources, the Missouri River.

SENATE BILL NO. 258

Passed by the Eighteenth Session of the Legislative Assembly of North Dakota

Introduced by Mr. Baird and Mr. Garberg

A BILL

For an Act Providing for the Appointment of Representatives on Behalf of the State of North Dakota to Negotiate a Compact and Agreement Between the States of North Dakota, South Dakota and Montana, and Between said States and the United States of America, Respecting the Use and Distribution of the Waters of the Missouri River and the Rights of said States and the United States Thereto.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF THE STATE OF NORTH DAKOTA.

Section 1 The Governor of the State of North Dakota shall appoint the State Engineer, or the Assistant to the State Engineer, who is in charge of matters relating to irrigation and water rights, and one other elector and taxpayer of the state, both of whom shall serve without compensation as representatives of the State of North Dakota, and who shall be duly authorized to represent the State of North Dakota on a joint commission to be composed of representatives of North Dakota, South Dakota, and Montana, and a duly authorized representative of the United States of America, such commission to be constituted for the purpose of negotiating and entering into a compact or agreement between the said states, and between said states and the United States, with the consent of Congress, respecting the further utilization and disposition of the waters of the Missouri River and streams tributary thereto and fixing and determining the rights of the said states and the rights of the United States in and to the use and disposition of the waters of said stream and the benefits to be derived therefrom; provided, however, that any compact or agreement so entered into by said states and the United States, shall not be binding or obligatory upon any of the high contracting parties thereto, unless and until the same shall have been ratified and approved by the Legislatures of the said states and by the Congress of the United States.

Section 2. The Governor of North Dakota shall notify the respective Governors of the States of South Dakota and Montana of the appointment of the representatives of North Dakota, as soon as said representatives shall have been appointed and qualified, but said representatives shall not enter upon the performance of their duties until a representative or representatives to serve upon said joint commission shall have been

named and qualified for each of the said states named in Section 1 hereof, provided, however, that said representative shall proceed immediately after the passage of this act and its approval by the Governor, in carrying out the provisions of Section 3 hereof as pertains to the Missouri River and its tributaries within the boundaries of the State of North Dakota, and the securing of the necessary data and information called for by this Act shall not be contingent upon appointment and qualification of the representatives of the other states concerned or of the representative of the United States of America.

Section 3. Said representatives of the State of North Dakota shall have full authority to make or cause to be made any and all investigations of the Missouri River and the drainage area thereof, which may become necessary in order to sufficiently advise said representatives of the physical conditions obtaining upon said streams and the drainage area thereof, and of the present and future needs of the State of North Dakota and its citizens in the use and benefit of the waters of the said stream and the streams tributary thereto. To that end said representatives shall have authority to administer oaths, examine and require the attendance of witnesses, and to perform such other duties and gather such data as may be necessary to sufficiently apprise said representatives of the facts and furnish him or them with adequate information in order that they may properly perform their duties as representatives of the State of North Dakota upon said joint commission.

Section 4. No appropriation is made for the purposes of carrying out this act; but the State Engineer shall be permitted to utilize his office force and staff, where this can be done without detriment to the other work required to be performed under existing laws; and the representatives appointed under the provisions of this act may receive financial or other assistance from such associations or individuals as are interested in and willing to give such aid in performance of the services required to be performed under the provisions of this act.

LOWER YELLOWSTONE PROJECT

The Lower Yellowstone Project is located on the boundary line between North Dakota and Montana. It comprises 59,529 acres, of which 20,303 acres are in McKenzie County, North Dakota. Of the North Dakota division of the project 19,500 acres were irrigable in 1923. Construction was started in 1905. During the summer of 1923 the ditches were completed on the North Dakota division and the project as a whole was 99% completed.

About one-third of the project is in North Dakota. However, when the quality of the soil, the slope of the land, and other favorable features are considered, North Dakota's interest in the project is much greater than would appear at first glance. The water supply is ample. Water is diverted from the Yellowstone River by means of a low dam. The capacity of the main canal is 850 second feet and the minimum recorded discharge of the river is 2,270 second feet.

The irrigation season extends from May 1 to October 10th. Some seasons the precipitation is sufficient in the spring for seed germination and the first irrigation is not necessary until the last of May. The average quantity of water required for best results is about 1.5 feet per acre.

The general character of the soil is deep sandy loam. Alkali is scarce and as the valley is long and somewhat narrow the percentage of seeped lands has been very low. The principal crops are alfalfa, wheat, corn, potatoes, and sugar beets.

Truck gardening pays well. Returns of $500 per acre from onions and cabbages are not unusual. Berries yield well, and hardy varieties of apples can be raised.

Dairying, together with hogs, sheep, and chickens on the place, means successful farming on the irrigated homes of the Lower Yellowstone Project.

The last frost in the spring is about May 15th and the first in the fall about the 20th of September. The average elevation is 1900 feet above sea level and the valley is free from humidity and not too high for frosts early in the fall or late in the spring. The average annual rainfall over a period of sixteen years is a little less than 15 inches. The average of the highest temperature since 1906 is 103° F. and the average of the lowest is 35° F.

The construction cost of the project is $63 per acre, payable over a twenty year period without interest. The present value of this indebtedness compounded on a basis of 6% interest is less than $25 per acre. It is seldom that a dependable private irrigation project can be built at this figure. The type of construction is permanent throughout, making for a low maintenance cost and obviating the danger of failure of structures and thus causing a shortage of water at a critical time.

The large size of the project means a low overhead cost as well as a sufficient area to support such industries as sugar beet mills, canning factories, creameries and cheese making establishments.

Low cost power through generating plants located at nearby coal mines will also be a factor in the industrial development of the district.

The operating cost averages $1.00 per acre per year, which is a very reasonable price for irrigation water.

A branch of the Great Northern Railway extends from the main line at Snowden through Nohly, Dore, and Fairview and connects with the Northern Pacific Railway at Sidney, Montana. No point on the project is over three miles from the railroad. This is important when the hauling of sugar beets and other crops yielding a large tonnage per acre is considered.

Fairview on the boundary line between North Dakota and Montana is the principal town on the project. It has a population of 750 and good schools and churches.

There are several coal mines on the project where a good quality of lignite coal may be had at the cost of mining. Also, an ample supply

of cottonwood for firewood is available on the many islands of the Yellowstone River.

The early history of the project indicates a one crop system of farming, viz., grain. This was followed by a period of grain and alfalfa. During the past two or three years a very gratifying movement toward crop rotation is evident. This is to a large extent brought about by the advent of sugar beet culture and the development of corn.

The following shows the growth of beet acreage on the Lower Yellowstone Project during the past seven years:

Year	Acres of Sugar Beets
1917	307
1918	500
1919	380
1920	658
1921	1533
1922	1107
1923	3110
1924	6800

One of the most favorable aspects of the project is the opportunity of extending the dairy industry. A certain supply of winter feed is available at a reasonable cost. The growth of the dairy industry on the project is as follows:

	Dairy cattle by years
1914	744
1915	860
1916	890
1917	894
1918	1312
1919	1370
1920	1300
1921	1823
1922	1961
1923	1980

In 1909 when water was first available for irrigation the Lower Yellowstone valley was largely owned by stock men. At first these settlers thought a section of land, more or less, was necessary to make a comfortable living and set aside a few dollars for their older days. Now the land owners have invariably decided to cut their holdings to smaller tracts, thus saving the heavy expense of hired labor, upkeep of machinery, etc. This change of conditions is placing on the market considerable acreage of land at prices inviting, in most cases, to prospective home seekers. Never in the history of the valley was there a better time for

one to pick out a desirable tract for a home. These lands may be had on easy payments at prices ranging from $35 to $100 per acre, depending on the quality of the soil, improvements and distance from the railroad. There are good roads throughout the project but no Federal Aid roads have been constructed to date.

An irrigation district was formed on the North Dakota division of the project in 1920.

The outstanding need of this project at the present time is more settlers. Five times the present population would make it a greater success. People with farming experience and a small capital can find no better place for obtaining a farm home. Those without capital but willing to work in sugar beets and milk cows will also find an opportunity to make good.

The following table shows the growth in population of the Lower Yellowstone Project during the past ten years:

	1913	1918	1923
(a) Towns	800	3500	4240
(b) Farms	600	1120	1420

The nationality of the settlers on the project is estimated to be as follows:

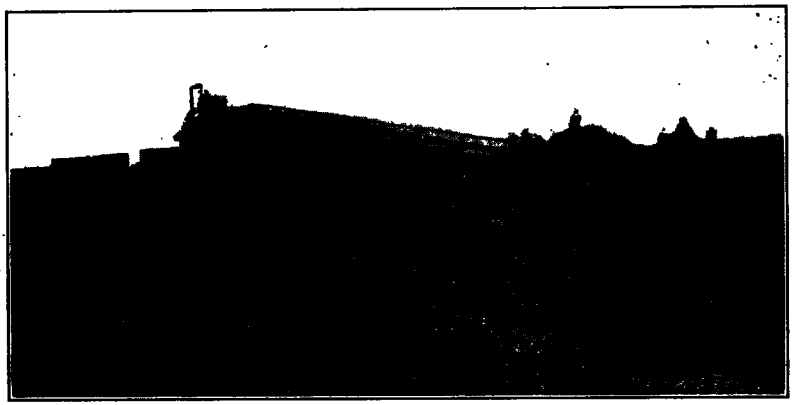
Americans 65%
Scandinavians 30%
Miscellaneous 5%

The duty of water for various crops on the project is shown on the following table:

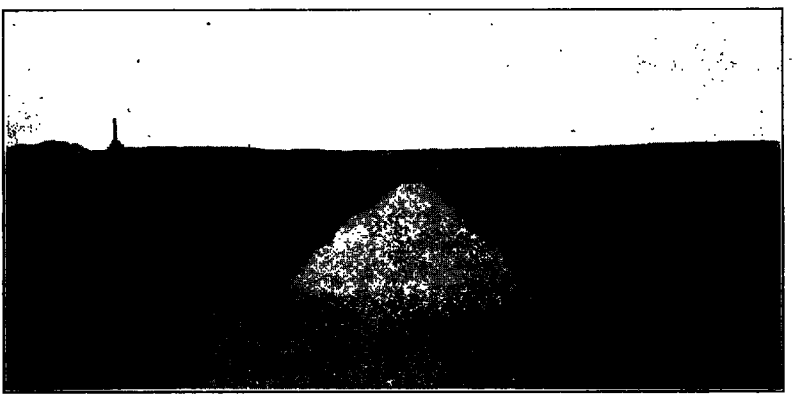
Crop	Average Depth of Water per Year in Feet	Average Length of Irrigation Season in Days
Grain	1.0	45
Alfalfa	1.5	90
Sugar Beets	1.5	75
Corn	0.5	30

The average cost of crop production at the present time is as follows:

Crop	Cost per Acre
Grain	$16.00
Alfalfa	11.00
Sugar Beets	45.00
Corn	18.00



Loading Sugar Beets—Lower Yellowstone Project



Main Canal Lower Yellowstone Project

DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

Lower Yellowstone Project — **Total Irrigated Crop Year of 1928**

Crop	Area acres	Unit of Yield	Yields: Total	Yields: Per acre Average	Yields: Per acre Max.	Values: Per unit of yield	Values: Total	Values: Per acre
Alfalfa	6,356	Ton	11,569	1.9	3.5	$ 8.00	$ 92,552	14.55
Alfalfa, New	73		None	.....	....	....	.....	.....
Alfalfa Seed	99	Bu.	92	0.9	2.0	12 00	1,104	11.15
Barley	400	Bu.	7,148	17.9	29.0	.60	4,288	10.72
Beans	320	Bu.	3,988	12.5	30.0	2.50	9,970	31.15
Beets, Sugar	3,110	Ton	32,638	10.5	16.0	8.00	261,240	89.00
Beets, Tops		Acre				5.00	15,550	
Cane	48	Ton	120	2.5	4.0	5.00	600	12.50
Clover Hay, Sweet	142	Ton	174	1.2	3.5	5.00	870	6.00
Corn, Indian	1,196	Bu.	30,573	25.6	60.0	.60	18,343	15.34
Corn, Fodder	357	Ton	1,272	3.6	4.0	7.00	8,904	24.94
Corn, Ensilage	24	Ton	120	5.0	5.0	5.00	600	25.00
Flax	101	Bu.	707	7.0	14.0	2.10	1,484	14.70
Garden	140	Acre	.....	.....	.....	.....	10,655	76.10
Hay	453	Ton	618	1.4	3.5	5.00	3,090	6,82
Oats	1,253	Bu.	31,358	25.0	70.0	.40	12,543	10.00
Pasture	442	Acre	.....	.....	.....	.....	2,669	6.00
Potatoes	371	Bu.	47,221	127.	300.	.60	28,332	76.36
Wheat	2,986	Bu.	27,967	9.4	23.	.95	26,568	8.89
*Misc.	36	Acre	.....	.....	.....	.....	7,200	200.00
Less duplicated areas	50	(New Alfalfa)						
Total cropped	17,857	Total and average					$506,562	28.37

		Areas	Acres	Farms	Per cent of project
Grand Total Irrigated	17,857	Total irrigable area farms reported	35,956	373	60
		Irrigated under water right applications (Irrig. Dist.)	17,857	373	30
		Total cropped area farms reported	32,648	.....	55

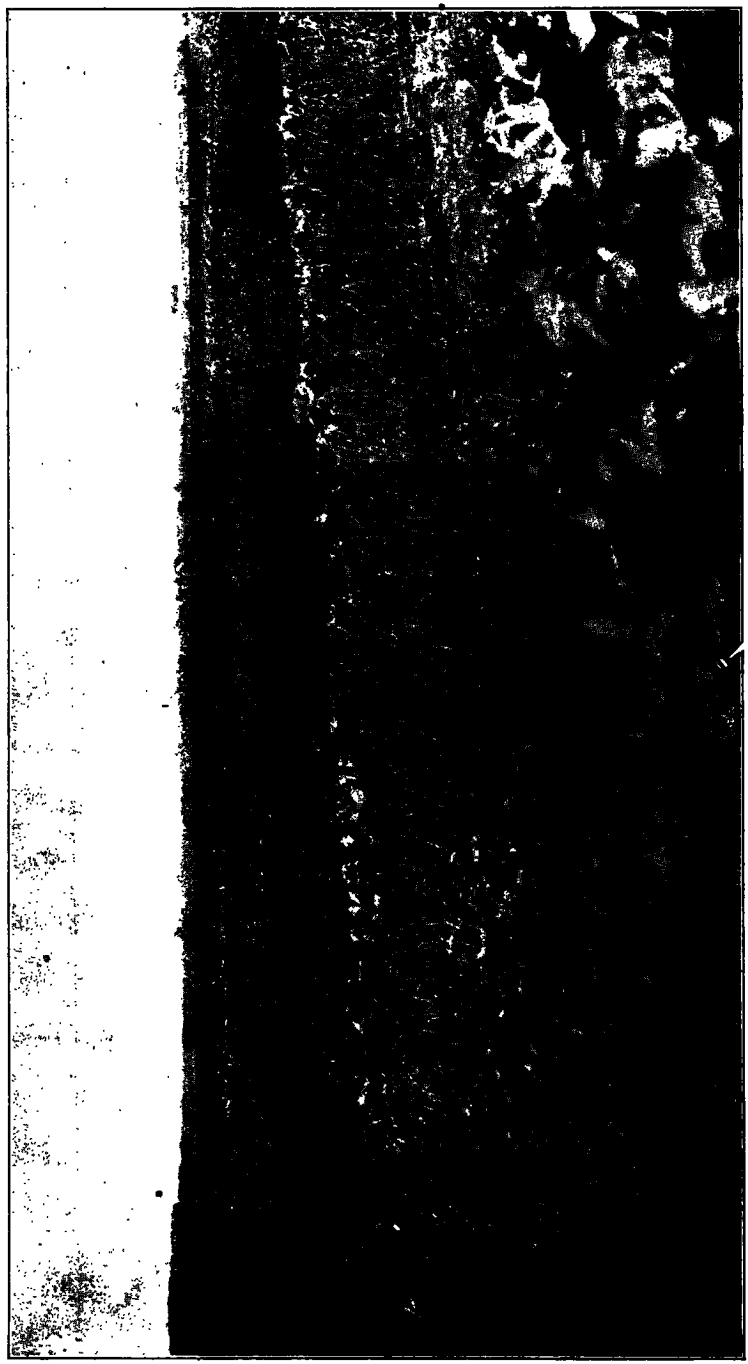
*Onions, Melons, Sweet Corn, Small Fruit, and Cabbage.

DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

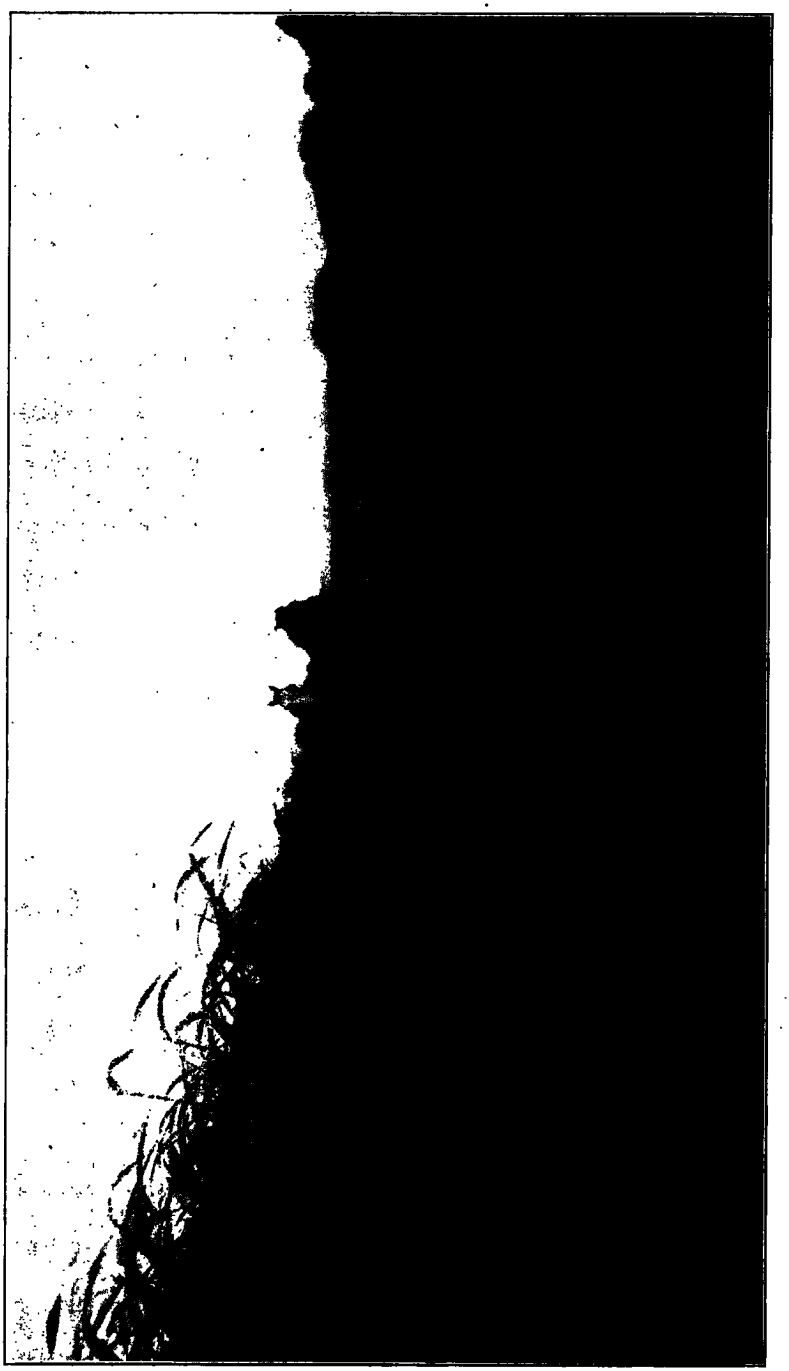
Lower Yellowstone Project — Total Dry Crop Year of 1923

Crop	Area acres	Unit of Yield	Yields		Values		
			Total	Per acre Average	Per unit of yield	Total	Per acre
Alfalfa Hay	2,837	Ton	3,585	1.2	$ 8.00	$ 28,680	$10.11
Alfalfa Seed	136	Bu.	40	.3	12.00	480	3.53
Barley	500	Bu.	6,604	13.2	.60	3,962	7.92
Beans	124	Bu.	820	6.6	2 50	2,050	16.50
Beets, Sugar	105	Ton	233	2.2	8.00	1.864	17.75
Cane	16	Ton	22	1.4	5.00	110	6.88
Corn, Indian	1.566	Bu.	35,474	22.6	.50	17,737	11.32
Corn, Ensilage	40	Ton	200	5.0	5.00	1,000	25.00
Corn, Fodder	285	Ton	800	2.8	7.00	5,600	19.63
Clover Hay, Sweet	122	Ton	125	1.0	5.00	625	5.12
Clover Seed, Sweet	54	Bu.	68	1.2	4.20	286	5.30
Flax	612	Bu.	3,344	5.5	2.10	7,022	11.47
Garden	31	Acre	.....	....	.....	1,202	38.78
Hay	1,177	Ton	917	.8	5.00	4,585	3.90
Oats	1,306	Bu.	26,982	20.6	.40	10,793	8.26
Pasture	1.294	Acre	.....	....	.....	4,442	3.43
Potatoes	211	Bu.	11.787	55 9	.60	7,072	33.51
Rye	32	Bu.	460	14.4	.42	193	6.04
Speltz	106	Bu.	1,963	18.5	.60	1,178	11.10
Wheat	4,237	Bu.	32,329	7.6	.94	30,389	7.18
Total cropped	14,791	Total and Average				$129,270	$ 8.74

		Areas	Acres	Farms	Per cent of project
Grand Total Dry Farmed	14,791	Total Dry area farms reported	14.791	.....	.....



Irrigated Lands—Lower Yellowstone Project



Irrigated Farm Near Fairview, N. D.

THE WILLISTON PROJECT

In 1906 the U. S. Reclamation Service started construction of a steam power plant at Williston, using lignite coal as fuel. The purpose of this plant was to supply power for pumping for irrigation for the Williston Project, as well as the Buford-Trenton Project, also on the Missouri River and twenty-five miles above Williston.

As this was a new departure in the field of reclamation several new and untried problems presented themselves. Among these were the operation of a government owned coal mine, the use of barges anchored in the Missouri River for mounting the pumps used on the first lift, and the operation of both steam plant and coal mine during only three months of the year.

It is thus seen that many problems were involved that do not ordinarily enter into the operation of an irrigation project. These problems tended to keep the overhead costs much higher than under a gravity project of similar size. As the entire acreage could not be developed at once the initial operating costs were also high.

Added to these difficulties, the land ownership was held in large acreage and an intensive system of farming could not be developed. The first lands to be developed were on the higher or eighty foot lift, also contributing towards a high operating cost.

In order to avoid closing down the power plant and coal mine when the irrigation season was completed a contract was entered into with the City of Williston to supply power to the city. Due to the passage of the Reclamation Extension Act which required that the charges of one year should be repaid in the following year the farmers were unable to meet the charges and the irrigation feature of the project was closed down in 1915. The power contract with the City of Williston was continued, however, and the coal mine and power plant continued to operate. Due to government restrictions the coal mine has never been allowed to operate on a commercial basis; not even in war time when there was a serious coal shortage.

In 1917 the North Dakota irrigation district law was passed. An irrigation district was formed and irrigation resumed under a new contract in 1919.

The Williston Project has been successfully operated to the extent of 2,810 acres, although ditches have been constructed to irrigate over 8,000 acres.

The manifest need of the project was more settlers and a cash crop that would yield a high return per acre. Through negotiations with the Great Northern Railroad a rate on sugar beets of $2.55 a ton from Williston to the Great Western Sugar Beet Mill at Billings was secured, the sugar beet company agreeing to pay $1.20 of this rate and the balance being paid by the shipper. This agreement was secured late in the spring of 1923 and only a small acreage of sugar beets could be raised. The results, however, were very encouraging and a great interest in sugar beets was developed.

During the coming season the problem is one of securing labor to perform the hand work in beet growing. Permanent settlers, either land owners or desirable tenants, are needed.

Most of the difficulties encountered in the early stages of development have been overcome. A shore pumping plant is being built to replace the floating barge and the growth of Williston to a city of 4,000 people has created an outlet for the surplus power from the steam plant.

Through the closing down of the project during the war years the inflation of land values was avoided. Lands are now at rock bottom prices and conditions on the project are gradually improving. A definite assurance has been given by the U. S. Reclamation Service that the project would be continued and an attempt made to put it on a solid basis.

It is the general belief that this project was started somewhat early and that an attempt was made to develop too large an acreage. However, these conditions could not be foreseen at the time of construction and the knowledge gained through the development at Williston will be invaluable as a guide for future construction along similar lines.

SUGAR BEET CULTURE IN WESTERN NORTH DAKOTA

The best paying crop on the Lower Yellowstone and Williston Irrigation Projects at the present time is sugar beets. A market is available at a fair price for all the sugar beets that can be raised on those projects.

However, a change from small grains where one man can care for a large acreage to sugar beets where one man can care for, at most, ten to twelve acres, means a very great increase in population or a corresponding increase in hired labor. At present this labor demand is largely met by the importation of Mexican labor from Texas and old Mexico. The Mexicans are good laborers and are paid $25.00 per acre for the season for doing the hand work only. This work consists of blocking and thinning and hoeing the beets, also topping and loading after the beets are lifted. The hand work is needed for a period of seven months but only sixty-five days of actual labor is required during this period. The laborer must find other work during the season to supplement the contract work on sugar beets. In all, the return to the laborer is about $3.00 per day for the actual time worked.

Over 400 Mexicans were used in the Lower Yellowstone district last season. As it is the intention of the farmers to double their last year's crop, which amounted to 3,110 acres, it will be readily seen that a supply of labor is the most serious problem to be met in any extension of irrigated crops in western North Dakota and eastern Montana. As the Mexican is entirely unskilled in American farming methods and is in the majority of cases illiterate, and generally speaking, is not the best human material available for citizenship, it would appear that any expenditure by the state to secure permanent settlers for farming a small

acreage of sugar beets, together with milking cows and practicing diversified farming generally, would be well repaid in the increased tax returns.

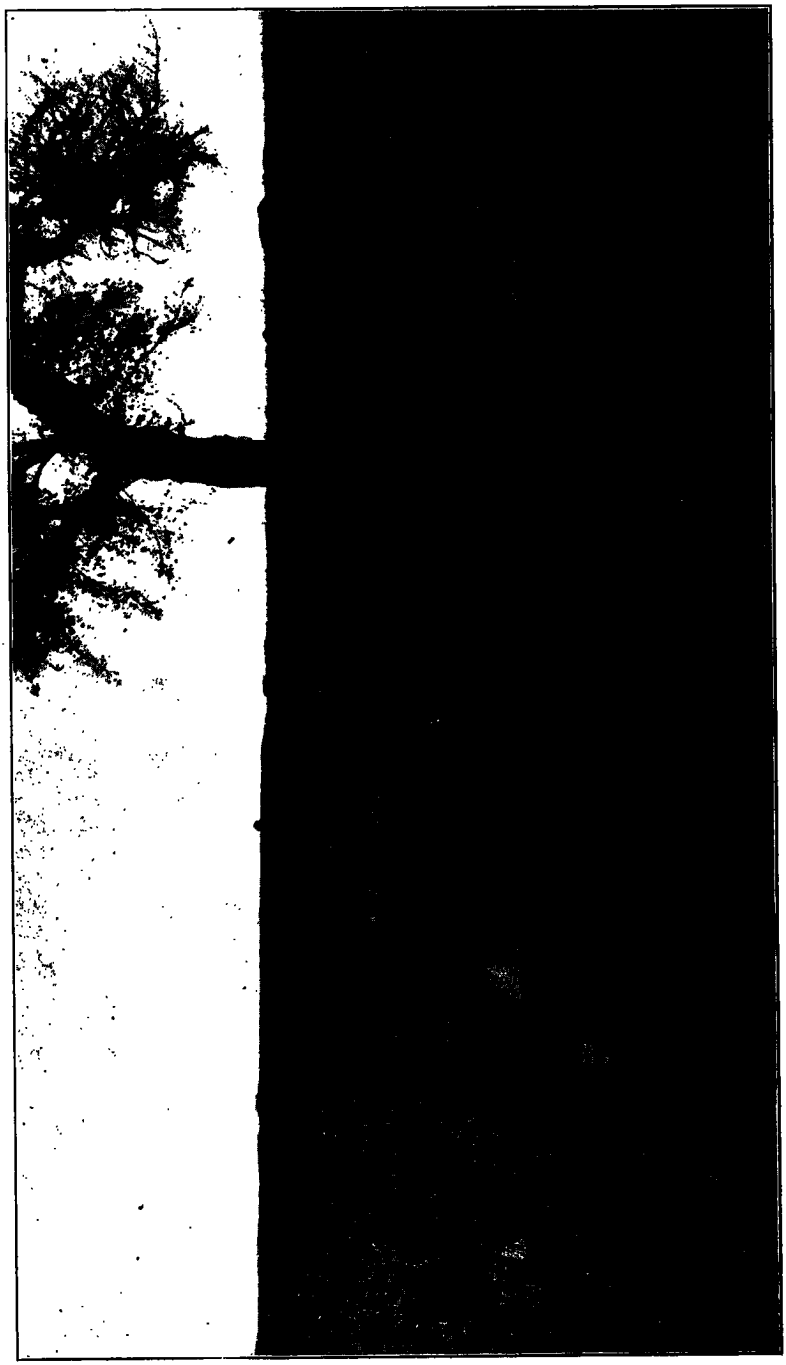
Sugar beet tops make excellent feed for dairy cattle. In experiments conducted at Williston during the past year it was shown that by adding beet tops to the dairy ration the output of milk was increased 16%.

The cost of producing an acre of sugar beets under present conditions as given by several farmers on these projects is about $50.00 per acre. The entire output of the Lower Yellowstone Project last year was 33,000 tons of sugar beets, or a yield of about 11 tons per acre. In individual cases the yield was over 19 tons per acre, the larger yield being due to a better prepared seed bed and better care being given the beets; also, early planting is a large factor in increased yields.

The contract price offered by the Great Western Sugar Company at Billings is $9.90 per ton for the 1924 crop. The freight rate to Billings from Dore, the most distant station, is $2.30, of which the purchaser pays $1.10 and the grower the remainder. The freight rate from Williston to Billings is $2.55 per ton.

In the opinion of the officials of the sugar beet company the prospects of securing a sugar beet mill on the Lower Yellowstone Project are excellent as soon as the territory is proven and a large enough acreage is produced, namely about six thousand acres.

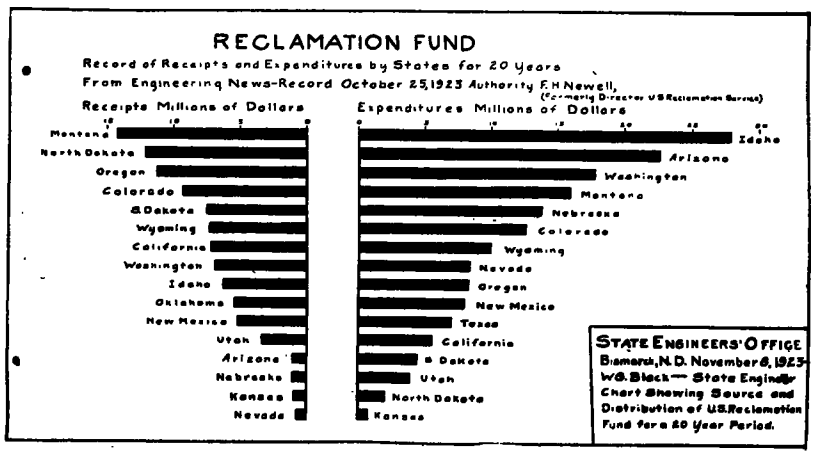
Reports from the Billings, Montana territory state that sixty per cent of the farmers that are at present producing sugar beets came to the district as contract laborers and gradually worked up as renters and finally as land owners.



Sugar Beets—Lower Yellowstone Project

SETTLEMENT OF IRRIGATION PROJECTS

The settlement of lands is perhaps the most difficult problem faced by the U. S. Reclamation Service on the projects already developed in North Dakota. As the greater part of this land was already under private ownership proper control of settlement thereon could not be exercised. Men accustomed to dry land farming invariably attempt to farm too large an irrigated area with crops giving a low return per acre. This has sometimes led to disastrous results. On the other hand settlers who have come to these projects taking up small tracts of land and working them under intensive farming methods have invariably made good. This has been the history of all irrigation projects. Forty acres is enough and in many cases ten to twenty acres in small fruits and vegetables located near a market have brought their owners better returns than larger areas planted to small grains and other crops bringing a low return per acre.



Securing funds from the federal government for further irrigation development in our state is largely contingent on the success of projects already developed. It should therefore be to the interest of the state to encourage the settlement of these lands in as small tracts as possible. It is recommended that land settlement schemes such as are now being applied on irrigation projects in several western states be studied. The settlement plan of the state of California in particular is recommended.

The encouragement of the sugar beet industry is another important factor for the success of these projects.

Another vital need is the establishment of irrigation experimental farms on the projects already constructed. Irrigation in North Dakota should be considered as a new industry that will serve to supplement

the type of farming heretofore practiced by supplying food products not obtainable by any other means.

This industry is in its infancy and it merits whatever help the state may be able to supply.

REPORT OF THE KNIFE RIVER PROJECT

The Knife River Project contemplates the development of the flats of the Knife River between Beulah and Stanton, as well as various other units along the Knife River and its principle tributary, Spring Creek, which enters the Knife River a short distance above Beulah. This project was first suggested by Professor E. F. Chandler, State Engineer, in 1904, and was also recommended by Mr. A. L. Fellows, State Engineer in 1906.

In 1909 the U. S. Reclamation Service mapped the area between Beulah and Stanton and surveyed a reservoir site at a point about midway between Beulah and Hazen, and also made a reconnaissance for reservoir sites on the Knife River from its mouth to Manning, and on Spring Creek from its mouth to Dunn Center. The report of these surveys under the title of the Little Missouri Project showed that at a reasonable cost a canal 27 miles long could be built on the north side of the Knife River from the reservoir site above Hazen to the Missouri River. No cut banks were encountered and no expensive structures would be required to care for cross drainage. The total area to be irrigated under the proposed canal was 5000 acres. Another 2000 acres on the south side of the river could be reached by a canal 26 miles long. The soil on the north side is a sandy loam with some few small patches of gumbo. On the south side it is more sandy and would doubtless require a larger water supply.

No other work was done on this project until the past summer. The State Engineer's Office had a party in the field during May, June and July. It was found that by the construction of the North Branch of the Northern Pacific Railway through this project, the storage capacity of the reservoir above Hazen would be reduced and an attempt was made to find additional storage elsewhere. All of the sites on Spring Creek noted in the U. S. Reclamation Service reconnaissance of 1909 were examined and it was found that all but one of the sites mentioned on Spring Creek were no longer available due to the construction of the railroad in 1912.

The best site still available is on the county line between Mercer and Dunn Counties and it was found that a dam 40 feet high and 1600 feet long at this point, containing 91,300 cubic yards, would store 5,700 acre feet of water. The area flooded would be approximately 620 acres.

Continuing the search up Spring Creek, a reservoir site was found about one and a half miles above Dunn Center, or a short distance above the last reservoir site mentioned in the reconnaissance of 1909. A survey of this reservoir was made and it was found that a dam 30 feet high

and 1500 feet long, containing 130,000 cubic yards, would store 10,000 acre feet. With slight excavation an emergency spillway could be provided about one mile north and west of the dam site. This reservoir would have a larger capacity and could be more economically constructed than any other site yet located.

There are a number of small tracts of irrigable land along Spring Creek between Dunn Center and Beulah that could be irrigated from the Dunn Center reservoir. The largest area, amounting to approximately 2000 acres, is located at the forks of Spring Creek and Knife River. This area known as the Beulah Project could be irrigated by gravity by means of a low diversion dam about two miles below Zap and a ditch about five miles long that would be located through comparatively easy country.

On the Knife River above the mouth of Spring Creek a search was made for reservoir sites. No satisfactory storage was noted on the main stream below the mouth of Crooked Creek. A line of levels was run up Knife River from Beulah to Emerson to determine the fall of the stream and to locate, if possible, any considerable areas that might be irrigated by gravity from Knife River or its tributaries.

A dam site was surveyed in Section 22, Twp. 143 N., Rg. 94 W. just below the mouth of Crooked Creek. A dam 40 feet high and 2200 feet long, containing 329,000 cubic yards of earthwork, will store. 24,000 acre feet. The upper end of the proposed reservoir is just below Emerson postoffice. The drainage area is 400 square miles and the mean annual discharge is 21,330 acre feet.

A survey was made of the Fayette reservoir site noted by A. L. Fellows in 1906. A 35 foot dam, 800 feet long, containing 84,000 cubic yards, will store 4,300 acre feet. Between this reservoir site and Manning several hundred acres of good land could be irrigated by gravity, the largest area being located at the forks of the Little Knife River.

Little Knife Reservoir

A survey was made of a reservoir site on Little Knife River about six miles above its mouth. The dam site is situated on the north line of Section 9, Twp. 141 N., Rg. 91 W. A dam 25 feet high and 1200 feet long at this point, containing 101,000 cubic yards, will store 7,030 acre feet. There are several hundred acres of good land between the dam site and the mouth of Little Knife River that could be irrigated by gravity at a very low cost. There is also a considerable area on the north side of Knife River below the mouth of the Little Knife that could be reached by gravity by constructing a flume across Knife River.

Broncho Project

This project contemplates the diversion of Knife River in Sec. 25, Twp. 143 N., Rg. 90 W. by means of an earthen dam that would raise the water about ten feet above the flats at that point. A ditch could

be constructed on the north side of the river with only a slight difficulty from cut banks from this point to the Beulah flats. About five thousand acres of land could be irrigated from this ditch. The land is of good quality and lies well for irrigation.

A request was made of Prof. E. F. Chandler, District Engineer of the U. S. Geological Survey, for a report on the water supply at the various reservoir sites surveyed during the past summer. Prof. Chandler reports as follows:

Above dam for Dunn Center Reservoir Site on Spring Creek in SW¼ of Sec. 27, Twp. 145 N, R. 94 W.

Drainage Area .....130 sq. miles
Average Annual Run-off .....1 inch
Average Annual Discharge .....6,900 acre feet

* * * * * *

Above dam for "Fayette Reservoir" site on the Knife River in SE¼ of Sec. 26, Twp. 144 N, R. 97 W.

Drainage Area .....86 sq. miles
Average Annual Run-off .....1 inch
Average Annual Discharge .....4,600 acre feet

* * * * * *

Above dam for "Spring Lake Reservoir" on Spring Creek at Dunn-Mercer County Line, E. side Sec. 24, Twp. 144 N, R. 91 W.

Drainage Area .....135 sq. miles
Average Annual Run-off .....1 inch
Average Annual Discharge .....20,500 acre feet

* * * * * *

Above dam for "Hazen Project" on the Knife River in the SW¼ of Sec. 23, Twp. 144 N, R. 87 W.

Drainage Area .....2,210 sq. miles
Average Annual Run-off .....1 inch
Average Annual Discharge .....117,900 acre feet

Need of Irrigation

The lands that it is proposed to irrigate are mostly in grain or used for grazing purposes. The soil yields a fair grain crop in good years but as the district is rapidly developing as a dairy center a certain supply of winter feed for dairy cows is imperative. In dry years a considerable amount of hay and feed is shipped into this territory from Minnesota and Montana.

The mining of lignite coal is a growing industry in this district and there has been a considerable growth of the towns as the result of the mining industry affording a home market for poultry and dairy products, as well as for other farm produce.

Attitude of the Landholders

The surveys made during the past season were the result of requests made by a number of land owners on the proposed project. The people generally, seem to favor the development but as irrigation in general

is a new subject to many of them, they are seeking any information available as to cost of development, the details of organization, etc.

Conclusions

It would seem that as the Knife River Project is made up of a number of units of various sizes, it would be wise to develop one of the smaller units first. Possibly the development of Spring Creek storage and the irrigation of a portion of the flats in the vicinity of Beulah and Hazen would be sufficient to care for local needs, and the entire project could be completed at a later date whenever market conditions would warrant the expenditure of the capital required.

The State Legislature during the last session passed a concurrent resolution urging the return to North Dakota of the funds obtained from the sale of public lands in this state, which funds have been used for the development of reclamation projects in other states. As the Knife River Project is small in comparison with the other projects constructed by the Reclamation Service, the water supply is ample, and the construction cost comparatively low, it would seem no more than common justice to request that a part of these funds be restored through the construction of this project.

HEART RIVER RESERVOIR

During the present season a survey was made of the Heart River reservoir site situated in Section 13, Township 136 N, Range 89 W. The purpose of this survey was to determine the capacity of the reservoir at the greatest practical depth and also to determine whether or not an excavated spillway at some point remote from the dam site was practicable.

It was found that a dam 80 feet in height and 800 feet long will contain 267,600 cubic yards of earthwork. Allowing a ten foot freeboard, a 70-foot depth of water at the proposed dam will form a lake ten miles long and one and one-half miles wide at the point of greatest width.

The storage capacity of this reservoir will be 88,000 acre-feet. The average annual discharge over a sixteen year period is 60,000 acre-feet. A satisfactory site for an excavated spillway was found on the south side of the reservoir and about one and one-half miles west from the dam site.

The lands to be irrigated are in the Heart River valley between the reservoir site and Mandan, and also the Missouri River bottoms below Mandan. It might also be practicable to divert the Heart River over a divide north of Flasher into Louse Creek valley, a tributary of tht Cannon Ball.

The following elevations will indicate the fall of the river below the reservoir site:

Elevation of spillway of proposed reservoir	2090
Low water level at proposed dam site	2019.5
Low water level of Heart River at bend north of Flasher	1781.0
Low point in divide between Heart River and Louse Creek	1905
Low water level of Missouri River near Mandan	1617.0

Irrigation Pumping Plant
Little Missouri River

Reservoir, Sentinel Butte, N. D.

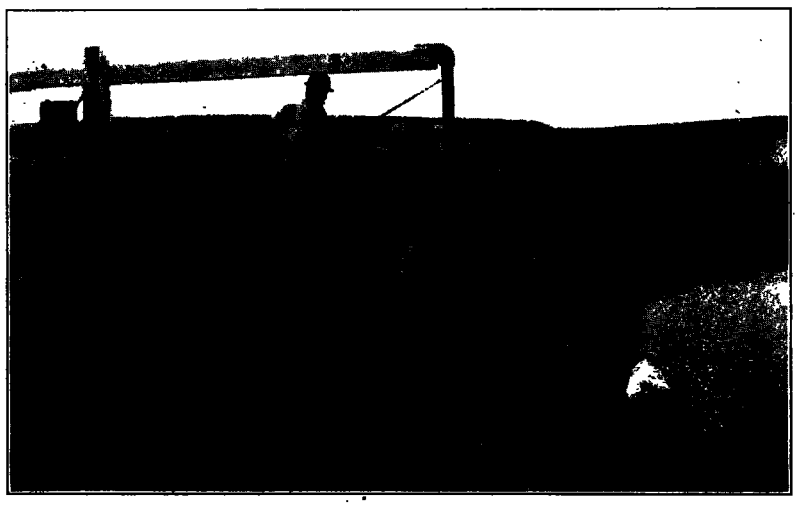
POSSIBILITIES OF IRRIGATION THROUGH PUMPING IN NORTH DAKOTA

It is commonly believed that irrigation through pumping in North Dakota has not proven a success. This has been true in some instances where power costs were high and where the cost of preparing the land for irrigation was excessive, or where the projects were somewhat remote from markets. However, where conditions are favorable, particularly in the vicinity of cities where local markets are available, such projects should be successful.

It has been proven that large steam plants built especially for irrigation pumping with no other market for power through the remainder of the year are not advisable and have been economic failures where they have been tried. Wherever power may be obtained at reasonable cost from commercial plants already in existence, and other conditions being satisfactory, such projects would be advisable. Many power companies could to advantage give offpeak pumping rates for irrigation and thereby secure a more even load on their plants.

Where long transmission lines are not needed the installation of motor driven pumps with proper housing and the necessary ditches for carrying the water can be accomplished at a very reasonable cost per acre. Operating costs will be much higher than where gravity irrigation can be had. However, by not oversizing the project and by proper care in selecting the lands to be irrigated the operating cost will not prove to be too great a burden on the irrigation farmer.

A low pumping lift is also very important from the standpoint of operating costs, as the power cost of pumping varies in almost a direct ratio with the height to which the water must be lifted.



Pumping Plant—Sweetbriar Creek

The estimated cost of the shore plant at Williston now under construction is approximately $30,000.00. This plant is motor driven, maintaining two 30 second foot pump units driven by 120 horse power motors direct connected and provision made for a third unit to be installed later. The pumping lift is thirty feet and the plant will supply sufficient water to irrigate 4,800 acres, or 7,200 acres when a third unit is installed. A duplicate of this plant could be erected under similar conditions at other points on the Missouri River wherever the banks are protected against scour.

In many cases small gas or oil driven pumping plants could be installed by individuals for pumping irrigation water for gardens or for irrigating small areas where the crop returns per acre are relatively high. However, such plants for general irrigation farming are not advisable, particularly under present market conditions.

A number of large pumping projects supplying water for irrigating the bottom lands of the Missouri River have been surveyed by the U. S. Reclamation Service. When the prices for farm products are on a more equitable basis with the prices of other commodities some of these projects will no doubt be constructed. Under present market conditions, however, the projects at Bismarck and Buford are the only ones that appear to be justifiable from an economic standpoint.

LITTLE MISSOURI RIVER

During the fall of 1922 a reconnaissance of the Little Missouri Valley was made from Camp Crook, South Dakota to the Fort Berthold Indian Reservation. The object of this reconnaissance was to locate reservoir sites suitable for storing the flood waters of the Little Missouri River and to determine, if possible, whether there was a small gravity project that could be developed at a reasonable cost per acre.

Several possible reservoir sites were found along this stream between Marmarth and the South Dakota State Line. However, the scarcity of rock suitable for riprap and the outlet structures required would make for a high construction cost. More favorable sites for storage reservoirs are available on the headwaters of this stream in Montana and South Dakota.

Development of storage on the Little Missouri River could be accomplished more economically through cooperation with the states of Montana and South Dakota. A bill was passed by the last session of the legislature making provision for a cooperative agreement between the states of Montana, North Dakota and South Dakota. This bill is given in full on another page of this report.

It was found that a great many opportunities existed for using the flood waters of the tributary streams for spring flooding and storing the moisture in the soil, and in a number of cases where the conditions are favorable reservoirs could be built and the water made available when needed. There was no place found where a large area might be irrigated

from the Little Missouri River by gravity, although undoubtedly such opportunities exist for a small acreage but at a rather high cost per acre.

There appears to be a good opportunity for developing irrigation by pumping with power supplied from central plants both at Medora and Marmarth. On another page of this report the outline of such a project at Marmarth using natural gas as fuel has been given by Prof. L. P. Dove, Assistant State Geologist. The success of a central power plant supplying power to individual pumping stations is largely contingent on the possibility of finding a market for the power generated outside of the irrigation season. With the growth of neighboring cities and the use of power in mining lignite coal this problem will find a satisfactory solution.

The development of several steam pumping plants supplying individual projects indicates the feasibility of irrigation even at the high cost of operation occasioned by the use of a small steam plant.

A survey of the lands of the Little Missouri Valley suitable for irrigation has been prepared by the U. S. Geological Survey. Maps to accompany this report have been prepared by this office and may be obtained on request. Land values in this section are very low, considering the quailty of the soil and the amount of water available. It offers an ideal location for those who are seeking lands suitable for irrigation.

SQUARE BUTTE CREEK

Square Butte Creek which flows through the southeastern part of Oliver County has several promising possibilities for the development of small gravity projects. This stream has a fall that varies from eight to twelve feet per mile. It has a drainage area of 290 square miles and an average annual discharge equal to about 15,000 acre feet, or sufficient to irrigate over six thousand acres if the entire run-off could be conserved. There are several favorable reservoir sites along the stream where the spring floods could be stored at a reasonable cost.

Owing to its heavy fall this stream is particularly suitable for small gravity projects. At the mouth of Square Butte Creek and nine miles north of Mandan there is a flat lying along the Missouri River embracing 3500 acres in area that could be irrigated by gravity from the waters of Square Butte Creek. The flat mentioned is sometimes subject to overflow from the Missouri River and has produced heavy yields of grain following the inundation from the river.

The soil of these flats is very fertile and the land lies well for irrigation.

During the past season a survey was made with the object of diverting Square Butte Creek about one mile above Center and irrigating the lands in the vicinity of Center. It was found that a small project could be developed here at a reasonable cost. The project contemplated the construction of an earthen dam on the north line of Sec. 16, Twp. 142 N, R. 84 W. The dam would be 20 feet high and 1150 feet long

and would store about 1500 acre feet, or sufficient to irrigate over 700 acres. A local market is available for the output of this project and its development would be of benefit to the entire county.

RAINY BUTTES PROJECT

On the Cannon Ball River above New England, in Sec. 20, Twp. 136 N, R. 98 W., there is a reservoir site where a dam 1300 feet long and 16 feet high will store 1,980 acre feet. A natural spillway is available about one-quarter of a mile south of this dam site. From this reservoir about 1,080 acres of land situated in Secs. 21, 22, 27, 28 and 34 can be irrigated by gravity. A ditch about three-quarters of a mile long through easy country will reach the lands to be irrigated. The land has uniform slopes and lies well for irrigation. The lands to be irrigated are now in cultivation. The soil is good and the construction cost of the project would be comparatively low.

All things considered, this project appears to be very favorable.

RED LAKE PROJECT

On September 21st and 22nd, 1923 a reconnaissance was made at the headwaters of Beaver Creek in Logan County. The purpose of this reconnaissance was to determine the feasibility of using Red Lake near Burnstad as a storage reservoir and to locate lands below Red Lake that could be irrigated by gravity.

It was found that the drainage area of Beaver Creek above Red Lake is approximately 100 sq. miles. The drainage area is in broken country with steep slopes. The minimum run-off from this area may be estimated at 0.66 inch which is the average run-off from the drainage area of neighboring streams that have been measured by this office for the past eighteen years. This run-off should equal an average of 3,500 acre feet annually. The area of Red Lake at the time of the original survey in 1884 was 893 acres. This area has not decreased since that time.

The average loss through evaporation from this area is approximately 24 inches annually, which is equal to 1,786 acre feet. This leaves an average of 1714 acre feet, annually, sufficient to irrigate about 1200 acres of land to a depth of eighteen inches.

Red Lake appears to be a very favorable reservoir site. By constructing a dam at the outlet 400 feet long and raising the water in the lake four feet, a storage of 3,572 acre feet may be obtained or an amount equal to the average annual flow. There are plenty of large boulders near the site of the proposed dam which could be constructed as a rock fill dam with the upper slope of earth. The banks of Red Lake are quite steep, which will mean that by raising the lake very little damage will be done to abutting property.

A county road passes around the south end of the lake. This road will have to be relocated with the consent of the County Commissioners of Logan County before the construction of the reservoir is feasible.

By the testimony of the people in this vicinity and considering the size of the drainage structures below the outlet of Red Lake, it would appear that the above estimate as to water supply is a conservative one.

The fall of Beaver Creek for the first five miles below Red Lake is very light, not sufficient for a gravity ditch.

There are a number of good bottoms in this area comprising forty acres or more that could be irrigated by pumping with a very low lift, not to exceed fifteen to twenty feet. About twelve miles below Red Lake in Twp. 133 N, R. 73 W. near St. Anthony's Church are a number of extensive flats, possibly two or three sections in all. These flats slope towards Beaver Creek and lie within about twenty-five feet above the stream. The soil is a black loam and is all in cultivation, producing a dry land grain crop with heavy yields in favorable seasons.

Levels were run upstream for some distance above these flats and it was found that Beaver Creek at this point has a fall in places of eight to ten feet per mile. It would seem that a gravity ditch from three to five miles long would reach all of this land. The ditch location would be through easy country with no cut banks or rock cuts and practically no cross drainage.

It appears that a favorable gravity project could be constructed in this vicinity if the entire project could be developed as a unit.

NATURAL GAS NEAR MARMARTH, NORTH DAKOTA, AND THE POSSIBILITY OF ITS USE FOR PUMPING WATER FOR IRRIGATION

L. P. DOVE, Geological Engineer Assistant State Geologist

In November 1923, at the request of the State Engineer, I began a study of the natural gas resources of the Marmarth district to see if a dependable source of natural gas might be developed and to make a preliminary investigation as to its use for developing electric power for use in irrigating the flats bordering the Little Missouri River. Previous investigation has shown that these flats are extensive and rich. The lift of water is not excessive. The successful irrigation of these flats awaits cheap power for pumping. Natural gas is one of the most efficient fuels for power and if its cost is not too high offers attractive possibilities for cheap power.

The Little Beaver Dome Gas Field

Extending south, south-eastward from the vicinity of Glendive, Montana, across the extreme southwestern corner of the State of North Dakota, is a large well defined anticline or upfold in the rocks known as the Cedar Creek anticline. This anticline has been studied and mapped both by Federal and State Geological surveys, as well as several oil companies. At intervals along this anticline are high spots in the rocks known as domes.

In order of development the domes that have shown commercial quantities of gas are; Gas City, Montana 1913; Baker, Montana 1915; Cabin Creek, Montana 1917; and finally the Little Beaver Dome, a large part of which lies in western Bowman County, North Dakota, in 1923.

A well located test well is now being completed by the Absoraka Oil Development Company and the Florence Oil Gas Company on Section 24, Twp. 4 N, Rg. 60 W., a mile and a half west of the state line. This pioneer well now drilling at a depth of about 3700 feet has been watched with unusual interest, since it is going far to prove or disprove the presence or absence of oil and gas in the corners of three states. So far encouraging quantities of gas have been found and it is with this gas the present report is concerned.

Gas Sands

At Baker, Montana, natural gas has been produced for several years and used in the city of Baker. This supply comes largely from the shallow or Baker sand (probably Judith River). This sand thins southward, and while small quantities of gas are found in the sand in the Little Beaver Dome, the prospects seems better of an adequate supply being developed from the Niobrara formation about 700 feet deeper. The deep test on Sec. 24 mentioned before developed a good flow of high grade gas at about 1400 feet. About June 15, 1923, this well showed a closed pressure of 246 lbs. This gas was led to the surface. Since then it has supplied fuel for camp and drilling and by December 1st, without special attempt to develop the gas, still was producing at the rate of about 300,000 cu. ft. per day. This well is about 15 miles air-line from Marmarth, North Dakota.

There is some possibility of the Judith River sand being gas bearing in the vicinity of the Hidden Water Dome about 13 miles southwest of Marmarth. If not, the Niobrara may be reached probably within 1800 feet. Possibly a commercial supply might be developed closer to the city of Marmarth but this would involve more uncertainty. The gas form both the Judith and Niobrara is high grade.

Cost of Gas

No definite estimate can be given at this time as to what gas might be sold for at Marmarth. It is reported that a project is now under way to bring gas to Marmarth, a franchise having been granted for a price of 75 cents per thousand cubic feet, graded downward for large consumers.

The Use of Gas for Power

Natural gas is a highly efficient fuel for power. Electric power can be generated very cheaply by the use of gas engines. Due, however, to the possibility of delay and expense in changing over from gas engines to steam in the event of failure of the gas, I recommend that steam boilers burning gas be used to drive steam turbine generators.

Location of Power Plant

The power plant should be located near the Little Missouri River at Marmarth, in order to have water for condensing purposes and to be on the railroad. The plant should not be less than 1000 kilowatt capacity, with 500 kilowatt in reserve. This location favors the development of a market for power. Lines would be run out to electrically driven pumps situated along the river, each pump serving one or more water users.

The Cost of Irrigating

The cost that a water user can pay is limited. It is found in practice that rarely over four cents per kilowatt hour can be paid for power by the farmer and make irrigating pay. If power may be retailed for 2½ cents or less per kilowatt it is thought that the project would become inviting.

One thousand cubic feet of this gas is roughly the equivalent of 200 pounds of good lignite when burned efficiently under the conditions above outlined. Thus lignite at $1.50 per ton is the equivalent of gas at 15 cents per thousand cubic feet. With lignite at $2.40 per ton as at the Williston Project, the cost range is three to four cents per kilowatt. A plant of 1000 kilowatt with reserve capacity uses about 2000 boiler horse power. Taking fuel, labor, supplies, etc. into account but not plant investment, the saving of gas over lignite with lignite at $2.40 per ton and gas at 24 cents per M. in labor alone is about 6%. If such a plant could produce electricity at three to four cents per kilowatt, a reduction of the price of gas to ten cents per M. cu. ft. would reduce the cost to 1.6 to 2.1 cents per kilowatt. It is thus seen that the reduction of the cost of fuel is much more important than the saving in labor by the substitution of gas for lignite. Such a plant operating on full load would require nearly one and three quarters million cubic feet of gas daily. Should it be possible to deliver the gas to such a plant at a cost of two cents per M., as is being done at the Carbon Black plant at Baker, Montana, it is safe to assume that power might be developed at a cost of about one half cent per kilowatt.

Assuming again that the cost of power for irrigating is about four dollars per acre per year, with power at three to four cents per kilowatt, the lift 50 feet with an 18 inch depth of water, with gas at two cents per M. this cost might be reduced to 50 cents to 80 cents per acre.

No Details Furnished in This Report

It is not the scope of this report to give details of construction either of gas lines, plant nor power lines. The above assumptions are also based on a year round market for enough power to take care of overhead during the season when no irrigating is done. The figures given are approximations of what might be expected under reasonably favorable conditions.

Outstanding Points

It seems then that there are several outstanding points that merit further consideration.

1. Tributary to Marmarth, North Dakota, within fifteen miles is a large potential natural gas supply for power and domestic purposes.

2. Near Marmarth are flats bordering the Little Missouri River that are favorably situated for irrigation by pumping.

3. Gas may be burned to produce power at a cost of from half a cent upward per kilowatt hour, which cost favors its use for irrigation. The project appears feasible, should it be possible to deliver large quantities of gas at 20 cents per M. cubic feet or less.

Recommendations

My recommendations are therefore that:

1. An attempt be made to develop an ample supply of gas by drilling sufficient wells as near Marmarth as investigations shows to be the best location.

2. That careful estimates be prepared of the cost of delivering gas to Marmarth.

3. That more detailed and accurate estimates be prepared for a power plant and power lines embracing the features outlined above.

4. That surveys of irrigable lands be made available as a basis of plans for equipment necessary for irrigating the lands.

Recommendations 1 and 2 should be carried out first and 3 and 4 made contingent on the findings of 1 and 2.

BISMARCK PROJECT

(Apple Creek Surveys)

During the summer of 1923 surveys were made by the State Engineer's Office to determine the possibilities of storage on Apple Creek and also the feasibility of utilizing Apple Creek in the development of the proposed Bismarck Project.

A satisfactory reservoir site was found requiring the construction of an earthen dam just below the northwest corner of Sec. 19, Twp. 139 N., Rg. 78 W. A dam averaging 25 feet in height and 800 feet long, containing 42,400 cubic yards, will form a reservoir with a capacity of 6,400 acre feet, sufficient to irrigate 3,200 acres or an area equal to that of the lower flat at Bismarck.

The drainage area of Apple Creek above the dam site mentioned is approximately 600 sq. miles. Considering an average anual run-off of one half inch, which is the estimate made by Professor Chandler of the U. S. Geological Survey, this area will yield an average annual discharge of 16,000 acre feet. The loss through evaporation will be approximately 1500 acre feet, leaving 14,500 acre feet or sufficient to fill the reservoir more than twice.

It is known that in certain seasons Apple Creek has a very light flow. To guard against such a contingency it might be advisable to build a higher dam than the one proposed or to seek additional storage at some other point on the stream. Several hundred acres of land in the Apple Creek bottoms below the dam could be irrigated by gravity from that source.

The water may also be brought to the Forth Lincoln bench of the Bismarck flats by means of a ditch about ten miles in length, or it may be brought to the lower flat at Bismarck by returning the water into the creek below the reservoir and by constructing a low dike across Apple Creek on the South line of Section 13, Twp. 138 N., Rg. 80 W. and by excavating a ditch across the Forth Lincoln bench to the lower Bismarck flats. One of the advantages of this plan is that it would afford an opportunity to store the surplus water in the soil during the spring flood season. This ditch would reach the lower Bismarck flat at the point most distant from the proposed pumping plant and might serve to supplement the proposed pumping project or it might be used as an alternative scheme of development.

It was the belief of competent engineers at the time that the Bismarck Pumping Project was originally proposed in 1904 that the possibilities of utilizing Apple Creek as a part of the project had not been given sufficient consideration.

FORT LINCOLN RESERVOIR SITE

During June of 1924, at the request of a number of citizens of Bismarck, the State Engineer's Office made a survey of a dam site on Apple Creek situated in the southeast quarter of Sec. 27, Township 138 North, Range 80 West. The purpose of the survey was to determine the advisability of creating an artificial lake near the City of Bismarck for boating and fishing, and is a possible addition to the Bismarck parking system.

The result of the survey showed that by the construction of a dam 1500 feet in length and 25 feet high, containing 106,000 cubic yards of earth, a reservoir approximately two miles long and one mile wide at its greatest width could be formed.

The banks of the proposed reservoir are for the most part steep and the shore line well defined, so that there will be no unsightly mud flats visible due to fluctuations in the water level of the reservoir.

It is proposed to excavate a spillway from the north end of the dam site to the lower end of the Bismarck flats. The excess water when available may thus be utilized for flood irrigation on the lower Bismarck flats. It is proposed to utilize the material excavated from the spillway, amounting to 35,000 cubic yards of earth, in the construction of the dam. The project as outlined is therefore simply earth excavation with a minor concrete structure to control the outlet, this structure to be located at the upper end of the spillway.

The height of the proposed dam will be five feet above the extreme flood height of the Missouri River at the flood stage of 1881, or approximately ten feet above the 1917 flood, backwater in the Missouri River being the governing feature.

A lake 815 acres in extent will be formed between the proposed dam and the section line road running east from Forth Lincoln. Approximately 320 acres more in Section 13 north of this road will be either flooded or rendered useless by the construction of the reservoir.

The lower Bismarck flats comprising about 3,500 acres could be irrigated by gravity from this reservoir. However, the fluctuation in the lake level due to the use of the water for irrigation would be detrimental to the primary purpose for which the project was designed. Irrigation will have to be considered as a secondary feature only, unless the upper Apple Creek reservoir mentioned in another part of this report be constructed.

The water supply available has been estimated by a comparison with the runoff data from neighboring streams that have been measured for the past twenty years. This estimate has been approved by Professor E. F. Chandler, District Engineer of the United States Geological Survey. The water supply estimate follows:

Drainage area above proposed dam .....698 sq. miles
Average annual run-off .....0.50 inch
Average annual discharge of Apple Creek above proposed dam .....18,600 acre feet
Average annual loss due to evaporation .....24 inches, or 2500 acre feet over an area of 1250 acres.
Net water supply available .....16,100 acre feet
Capacity of proposed reservoir ..... 8,000 acre feet

Under average conditions the loss sustained through evaporation over a reservoir area of 1250 acres is about 14% of the normal flow of the stream.

From the above data the water supply is not only ample, but under average conditions a considerable surplus will be available for flood irrigation.

On the whole the project appears favorable if the land can be purchased at a reasonable figure.

APPLE CREEK STORAGE

By E. F. Chandler

The advisability of the construction of a reservoir for storage of Apple Creek and the creation of a permanent lake in the lower valley near Bismarck, southeast of Fort Lincoln, as now is suggested, necessarily depends in part on the amount of the total annual flow of the creek and its seasonal distribution. Unfortunately, no continuous records of the flow of Apple Creek have ever been kept. But fair estimates may be based upon the records of the nearest adjoining streams, some of which are of twenty years duration.

The nearest recorded streams west of the Missouri River have average figures for annual run-off between 0.6 and 1.0 inch for the different streams; but they flow through regions thoroughly drained, without any extensive sloughs and pools to hold the water for evaporation and loss before reaching the main stream. The topography of these is essentially different from that along Apple Creek, which more closely resembles that of the upper Mouse River, the average annual run-off from which (if absolutely complete measurements be made so as to include every possible square mile within the drainage) is only 0.25 inch.

If complete inclusive measurements of drainage area be made so as to put every quarter-section of the state into one river basin or another, the total belonging to Apple Creek is 3,020 square miles. From this greatly extended area it may fairly be expected that the average annual run-off is at least 0.15 inch, probably considerably more; this would amount to an average flow of 33 cubic feet per second. On the other hand, in the computations all the surplus acreage may be excluded, the flat lands and sloughs which rarely deliver any water into the main stream, in fact never except in remarkably wet seasons; the limits of these are merely a matter of judgment which cannot be definitely determined, and the area may thus be reduced to a total of betwen 500 square miles and 900 square miles. With such limitation of the area to the land which in ordinary years does actually flow into the stream, the average annual run-off must be put at least as high as 0.5 inch, but probably not above 1.1 inch. If the total average flow be computed on this basis, the most generous figures of area and of run-off will give as result 73 cubic feet per second, and the most conservative 18 feet per second. In the lack of records of this particular stream or of any other nearby stream of identically the same character, no authoritative statement may be ventured on the question of just where between these figures the real fact is to be found.

In such case, however, it seems to be fairly safe to consider that the long period average outflow of Apple Creek will be at least 30 cubic feet per second, and that it is probably much greater. But it must always be remembered that the flow is irregular, varying from week to week and from year to year. In a majority of the years, half of the total annual flow will come within a period of two, three, or four weeks in early spring; in some years the total for the year will be several times the average total, and in other years will be less than a quarter of the average total, or perhaps even, in an unusually dry year, less than a twentieth of the average. The "average year" is merely a convenient mathematical fiction, which rarely occurs; most years are either wet or dry.

If a reservoir should be established by the construction of a dam near the mouth of Apple Creek, and if, for example, the lake thus formed should have an area of one square mile, an average depth of ten feet, and a total capacity of 6,400 acre-feet, and if the average inflow were assumed to be 30 cubic feet per second, the reservoir

capacity would be slightly less than one-third of the total flow of one average year. In other words, if the reservoir were completely empty, and if its outlet gates should be closed at the beginning of the spring flood season, in an average year the reservoir would be filled to overflowing within a month, in the wet years within a week or less, and except in an extremely dry year it would be entirely filled in less than a year.

After the reservoir or lake has been raised to its intended permanent level another pertinent question concerns the possible lowering of the water surface from crest-level by evaporation during the summer and fall.

The records of gross monthly evaporation from water surfaces in this region are, in round numbers, these. March, 2 inches; April, 3 inches; May, 4 inches; June, 5 inches; July, 6 inches; August, 5 inches; September, 3 inches; October, 2 inches; November, 1 inch; December to February, less than one inch per month; total for year, about 33 inches. If there were no rainfall whatsoever on the lake surface and absolutely no inflow, and if on the other hand there were no losses from leakage or seepage but only from evaporation, the water surface level would fall about 33 inches per year. If there were average rainfall on the surface, but no inflow or outflow, the net lowering by evaporation would be about 16 inches per year; in this case, an average inflow of about one and one-quarter cubic feet per second would be sufficient to replace the evaporation. After the reservoir had been filled, if there were no leakage or losses except by evaporation, the amount necessary to keep the reservoir approximately filled would be less than one-twentieth of the estimated average flow of Apple Creek. Therefore, even in the driest years the spring inflow would always be ample to replace all evaporation losses. Usually, during the spring flow the first two or three days or few days would suffice for replacing the evaporation loss of the previous summer, and thereafter almost the whole flow would be a surplus, to be wasted unless some good use should develop, such as flooding the meadows or bottom lands below or other local irrigation projects.

However, after midsummer the lake usually would fall some inches from its crest level. During July and August, if the rainfall were normal, an inflow of about three cubic feet per second would be needed to replace the evaporation from a lake of one square mile area; if there were no rainfall, an inflow of about five cubic feet per second. Undoubtedly the summer flow of Apple Creek is often much less than this, and in such case the lake level would necessarily fall slightly, but ordinarily only a very few inches; and in the driest years on record, when the inflow was presumably correspondingly small, the total net lowering by evaporation between the end of April and the beginning of winter could not have exceeded a foot or sixteen inches.

If the height of dam finally adopted be such as to make the lake area more or less than one square mile, these figures will have slight

change in proportion. But the general conclusions on the feasibility and desirability of this project will not be materially modified.

THE DRAINAGE PROBLEM OF THE RED RIVER VALLEY

By E. F. Chandler

The development and improvement of the lands in the Red River valley has been progressing rapidly in recent years by the construction of systems of drainage ditches to carry away the surplus water and to make spring cultivation possible even in wet years. This has been carried especially far on the Minnesota side of the valley, where some regions are almost completely gridironed by systems of huge ditches.

A chief purpose of these is of course to carry off the melting snow and spring floods more promtly than could have been effected by the inadequate natural channels. Records have not yet been maintained long enough to prove conclusively whether or not this change in conditions will have any appreciable effect on the total amount of the annual run-off, though many, or most hydraulic engineers doubt that it will change the total to the slightest degree. But it seems indisputable that this ditch construction may affect or greatly modify the distribution through the season of the total run-off, and it seems very possible that in some regions it will intensify the extremes, increase the flow during flood season, and leave for the low-stage season of flow a remainder more meager even than formerly.

Whether or not it be the opinion that this wide-spread drainage development will seriously intensify former flood possibilities, there can be no reason to doubt that there may in the future be low stages and floods at least as extreme as in former years before any improvements had been added to natural conditions.

Unprecedented low stages have already appeared several times in recent years along the Red River; for example, at Grand Forks, although the rainfall of the year 1924 had been approximately normal, the Red River fell through the first third of September until it had diminished to the lowest open season flow ever noted since records began forty-three years ago, and was several inches below even the low water marks of 1910 and 1911 which were consequent upon a year of only half the normal rainfall.

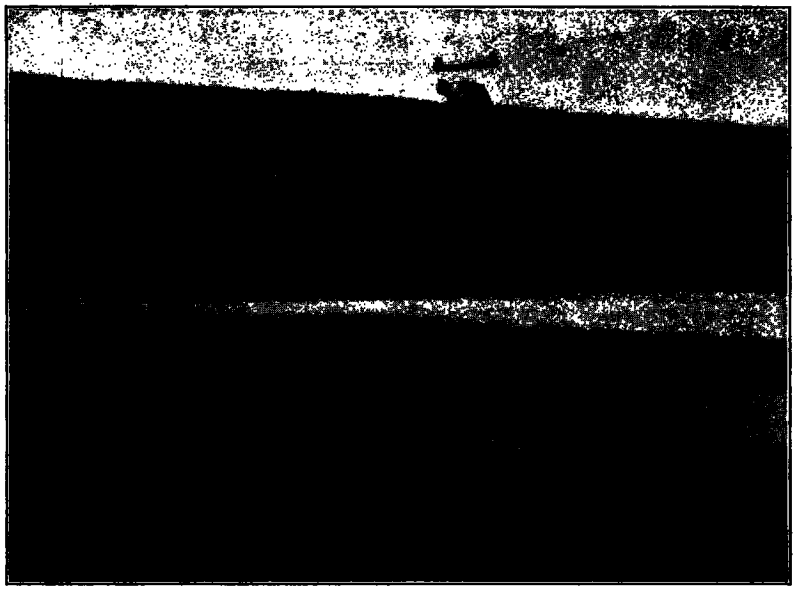
On the other hand, when there shall be an appropriate combination of frozen watersoaked soil, heavy snow, warm spring rains, and other conducing causes, it may fairly be expected that these will bring again at the appropriate (and inconvenient) time floods at least as great as any in the past.

The spring flood of 1897 is the greatest occurring since Dakota was settled and the damages along the whole length of the valley aggregated millions of dollars. But there were some settlers at Winnipeg many years earlier who have left fairly authentic reports of previous floods much higher even than that of 1897; the flood of the year 1776 was at Winnipeg about ten feet higher; 1790, ten feet higher; 1809, ten feet

higher; 1826, fifteen feet higher; 1852, thirteen feet higher; and the flood of 1861 was eleven feet higher at Winnipeg than the 1897 flood. It should not be assumed that in any selected year the excess flood height above the 1897 record happened to be exactly the same in the Dakota part of the valley as at Winnipeg, for the excess in any single year might be more or less. But from a study of these records and all the years of simultaneous records in the two sections of the valley it seems so very probable as to be almost certain that in several of these years, and perhaps in some others, the flood heights in Dakota were five and ten feet higher than in 1897. Also the traditions of Indians and old trappers confirm this conclusion.

The Red River valley above the Canadian boundary has an area of about 35,500 square miles, and is in three states; North Dakota and Minnesota have nearly equal area, and South Dakota a small but comparatively important portion. There is no longer any extensive navigation on the portion of the river between these states, so that federal control on that basis is merely nominal. It is an interstate stream, and any work, either drainage extension, construction of reservoirs, or other development in any one of the states affects the others favorably or unfavorably.

There is therefore no need for lengthy argument to show the desirability, and in fact the necessity, of the authorization and organization of a suitable interstate commission to recommend or negotiate any advantageous arrangements between these several states or with the federal government concerning the control or improvement of the Red River or any of its tributaries within or by any state, so that no mutual injuries may result therefrom, but benefits to the neighboring states also when possible. A method of procedure similar in its chief feature to that authorized by the Missouri River Interstate Commission Bill passed by the last legislature of North Dakota (Senate Bill No. 258, Eighteenth Session) ought to be inexpensive and efficient.



Stream Measurement—Cannon Ball River

RIVER RECORDS

By E. F. Chandler

Hydraulic Engineer, United States Geological Survey

By permission of the United States Geological Survey, with which the office of the State Engineer has been cooperating in this work, the following tables of flow of the more important or typical streams of North Dakota and the Red River valley have been selected and compiled from the records in the office of the Survey in advance of their regular publication by the Survey for use here. The expense of maintenance of these records, including payment of gage observers on the different streams, field work in installation and maintenance of gages and measurements of discharge by hydrographer or engineer, and the office work of computing and summarizing the results, has usually been carried in cooperation between the federal survey and the offices of the state engineers of the states concerned; these have each contributed approximately the same total, although the proportion has varied from year to year, according to the extent of available funds.

The methods followed in this work have been described in detail in previous reports of the State Engineer, but the following short statement will be a sufficient outline.

At each "river station" or "gaging station" a gage is established, marked with feet and tenths of a foot. It is intended to place the gage

so that its zero shall be below the lowest known low water, and at most of the stations the zero has been placed below the bottom of the river; but the height of floods is easily seen by a comparison between the maximum gage height of the flood and the minimum heights recorded during periods of small flow. At each station a local resident is engaged as observer, who makes regular observation and record of the height of the water; these records are usually made once each day during the open season; at most of the stations less frequent observations are made during the winter, and at some stations no winter records are kept.

At suitable intervals, an engineer or assistant (called in this work a "hydrographer") equipped with appropriate meter and other instruments makes measurements of the discharge (that is, of the actual number of gallons of water per day flowing by the gage) and records the gage height at which that discharge is found. It is thus known how much water will be flowing whenever the river happens to be at the same gage height again, provided the river channel does not suffer change in the meantime. In this region almost all channels change gradually; but if the changes are shown and checked by reasonably frequent measurements, the records can be corrected so as to eliminate all except small inaccuracies.

When enough such measurements have been secured at different heights of the river (low, medium and flood), it becomes possible to determine by interpolation how much water flowed by the gage at any foot and tenth of gage height between lowest and highest stages. Upon this basis, from the daily record of gage heights that has been made by the observer a computation is made of the actual daily quantities of water that have flowed by the gage, and these are tabulated in such form as needed for reference. In the following pages these results have been arranged as "Tables of Monthly Discharge" showing for each month the average flow (for twenty-four hours) of that day in the month when the total flow was the greatest or maximum, the flow for the minimum day, and the mean flow, or average for the entire month taken as a whole.

The column headed "accuracy" in the tables of monthly discharge applies to the mean flow for the month (but not necessarily to the maximum and minimum, which might have been affected by an accidental error applying only to a single day, such for example as the brief absence of observer.) The accuracy of the final figures depends on many factors, especially in the case of streams such as most North Dakota streams, which have gradually changing channels. But, stated in fewest words, it may be said that the accuracy of the monthly total depends on the character of the stream and its channel, the care and reliability of the observer in keeping the daily records, and the number and distribution through the season and through previous seasons of discharge measurements by engineer.

The mean for any month marked A in these tables may properly be assumed as correct within five per cent; of any month marked B, within ten per cent; C, within fifteen per cent; D, within twenty-five per cent; E indicates a rough estimate with so little definite basis that it could not permissibly be published unless the notation clearly showed it to be merely an estimate; but it is assumed that these figures marked E are uniformly within fifty per cent of the facts, unless sometimes in the case of some of the small figures estimated for winter. The flow of most Dakota streams is sometimes so extremely small during part of the winter, channel almost completely filled with ice and current obstructed, that instrumental measurement if actually made might have discovered the flow to be surprisingly less than any estimate made on the basis merely of the observed gage height and reported ice thickness.

All figures of discharge as here given are in "second-feet." One second-foot is a flow that carries by the observer one cubic foot of water each second; a rapid current in a small channel, or a slow current in a large channel can carry the same amount of water past the observer each second. For example, a stream five feet wide and one foot deep flowing with a velocity of six feet per second, or a stream twenty feet wide and three feet deep flowing with a velocity of one half foot per second, would each carry thirty second-feet of water. According to North Dakota law, fifty "miner's inches" of water is the same quantity as one second-foot. One second-foot amounts to 646,272 gallons per day, and will cover almost two acres one foot deep in twenty-four hours.

Included in the following pages are summaries of the records of these streams;

Red River at Grand Forks, N. D.
Red River at Fargo, N. D.
Red Lake River at Crookston, Minn.
Thief River near Thief River Falls, Minn.
Bois des Sioux River near Fairmount, N. D.
Mustinka River above Wheaton, Minn.
Pembina River at Neche, N. D.
Mouse River at Minot, N. D.
Cannon Ball River near Stevenson, N. D.
Heart River near Richardton, N. D.
Heart River at Sunny, N. D.
Knife River near Broncho, N. D.
Spring Creek at Zap, N. D.
Little Missouri River at Medora, N. D.

The tables run from the close of the tables published in the last biennial report of the State Engineer, (usually September 1, 1922) to August 31, 1924. The portions of the summaries for the year 1924 have been extracted from the official records in advance of the completion of the final computations of the season's work as made for regular publication by the U. S. Geological Survey, and are therefore to be considered merely as "preliminary computations" and as being still subject

to revision. But in no case is it to be expected that any later revisions will introduce large changes in the figures as here shown, and in most of these tables the later changes will be so small as to be inappreciable or the final publication will be without change.

Similar summaries have been published in each of the biennial reports of the State Engineer. More complete records are published from year to year in the Water Supply Papers series of the U. S. Geological Survey. Copies of all the essential records are on file in the office of the State Engineer at Bismarck; the original data are filed in the Washington Office of the U. S. Geological Survey; and complete copies of all data and computations have been kept in the office of the resident hydrographer for the Survey, E. F. Chandler (post office, University Station, N. D.) under whose supervision nearly all the field work and computations for this class of records in this entire region has been through the past twenty-one years. On request to any of these offices, full information can be obtained if desired by anyone who has reason for interest in any of these records or investigations

RED RIVER AT GRAND FORKS, N. D.

Gagings of the flow of the Red River at Grand Forks, N. D. were begun by the U. S. Geological Survey in 1901, but a gage height record had been kept under the direction of the Corps of Engineers (U. S. War Department) by whom the dredging fleet had been operated for the improvement of the river, for about twenty years previously, and a few discharge measurements were made by them; thus fairly good run-off summaries begin with the year 1882. The gaging station is located below the confluence of the Red and Red Lake Rivers. The total drainage area is 25,480 square miles, of which 670 is in South Dakota, 12,890 in Minnesota, and 11,920 in North Dakota.

The tables of discharge are based on gage observations twice daily through the open season and three times a week through the winter, and on the measurements in the list below and one hundred and forty measurements in the twenty-one preceding years, and are well-founded through the entire year.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
5-15-1922	Johnson and Black	22.96	11,260
5-31-1922	Black and Diehl	10.60	3,650
9-21-1922	Chandler and Tilly	4.28	671
12-22-1922	Tilly and Black	4.18*	372
1-20-1923	Tilly and Johnson	4.74*	454
2-10-1923	Johnson and Diehl	4.76*	334
3- 3-1923	Johnson and Black	4.48*	268
4-21-1923	Johnson and Black	26.39	15,700

4-28-1923	Black and Diehl	15.97	7,480
5-26-1923	Diehl and Black	7.51	2,140
6- 9-1923	M. Diehl	6.00	1,300
7- 6-1923	E. F. Chandler	9.49	3,230
8- 8-1923	Black and Chandler	4.08	620
10-31-1923	A. Johnson	3.34	397
12-15-1923	Johnson and Diehl	3.75*	358
1- 5-1924	Johnson and Levi	3.89*	297
1-26-1924	Johnson and Daily	3.60*	181
2-16-1924	Johnson and Meyers	3.72*	217
3- 8-1924	Johnson and Daily	4.35*	293
5- 3-1924	M. Diehl	8.19	2,540
6- 6-1924	M. Diehl	5.20	1,120
9- 6-1924	E. F. Chandler	2.34	210

*Frozen; mean thickness of ice from 0.5 foot to 1.5 feet at times of different measurements.

MONTHLY DISCHARGE OF RED RIVER AT GRAND FORKS, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	724	440	508	B
	October	590	450	509	B
	November	847	561	720	B
	December			508	C
1923	January			405	C
	February			304	C
	March			407	C
	April	15,900		5,450	C
	May	5,780	1,980	3,190	A
	June	4,160	920	1,570	A
	July	5,000	745	1,890	B
	August	883	424	589	B
	September	533	424	473	B
	October	533	450	478	A
	November	619	424	501	A
	December	615	300	434	C
1924	January	322	174	236	C
	February	286	189	213	C
	March	1,310	300	546	C
	April	2,200	1,400	1,780	A
	May	2,530	1,400	2,010	A
	June	1,350	853	1,050	A
	July	1,180	443	748	A
	August	498	345	423	A

Maximum gage heights; 26.5 feet April 21, 1923; 8.2 feet May 2, 1924; maximum ever recorded, 50.2 feet April 10, 1897.

Minimum gage heights; 3.5 feet September 10, 1922; 3.4 feet September 2, 1923; 3.5 feet February 9, 1924; 3.0 feet August 31, 1924; minimum ever recorded, 2.3 feet September 9, 1924.

RED RIVER AT FARGO, N. D.

The gaging station on the Red River at Fargo, N. D. was established May 27, 1901. The drainage area above this point is 6,420 square miles, of which 670 square miles is in South Dakota, 3,590 square miles in Minnesota, and 2,160 square miles in North Dakota.

In September 1914 the gage location for the Geological Survey was changed from the Front Street bridge (where there is a gage still used by the Weather Bureau) to a point immediately above the Island Park Dam. The zero of the gage at Island Park is about one foot below the crest of the dam (0.3 foot below the present lowest point of the crest at the middle of the dam) and is so related to the zero of the Front Street gage that at extreme flood stages, when the dam is drowned out and causes no irregularity in the surface slope of the river, readings on the Front Street gage are numerically about 10.2 feet greater than on the Island Park gage now used. Under present conditions at low stage a reading of 7.0 feet on the Front Street gage indicates nearly the same flow as a reading of 1.0 feet on the Island Park gage.

The tables of discharge, based on the measurements in the list below and on one hundred and twelve measurements made during the twenty-one preceding years, are unusually accurate except during parts of the winter when gage observations were made only weekly.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
11- 4-1922	E. F. Chandler	1.22	79
6-13-1923	E. F. Chandler	1.86	244
7- 2-1923	E. F. Chandler	4.53	1,840
9- 5-1923	E. F. Chandler	1.31	116
11-17-1923	R. B. Black	1.35	104
12-28-1923	E. F. Chandler	0.60*	12
2-23-1924	E. F. Chandler	0.88*	32
4-19-1924	R. V. Tilly	1.53	188
7-18-1924	E. F. Chandler	1.29	90
8-11-1924	E. F. Chandler	0.93	56

*Dam in process of rebuilding, and gage-height not the same as ordinarily accompanying that discharge.

MONTHLY DISCHARGE OF RED RIVER AT FARGO, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	57	9	37	C
	October	57	24	40	C
	November	144	39	96	C
	December	78	57	58	C
1923	January	78	39	46	C
	February	57	24	31	D

	March			57	D
	April	2,650	68	1,100	B
	May	725	365	544	A
	June	3,960	144	861	A
	July	2,660	144	528	A
	August	132	60	91	A
	September	102	30	68	B
	October	98	78	88	B
	November	109	69	93	B
	December			73	C
1924	January			52	D
	February			50	D
	March			72	D
	April	530	125	267	A
	May	490	235	303	A
	June	235	175	205	A
	July	235	100	164	A
	August	162	42	85	A

Maximum gage heights; 5.4 feet April 18, 1923; 7.9 feet June 29, 1923; 2.5 feet April 30, 1924; maximum ever recorded, 19.9 feet (30.1 feet on Front Street gage) April 6, 1916.

Minimum gage heights; 1.0 feet October 10, 1922; 0.9 feet September 12, 1923; 0.8 foot August 13, 1924; minimum ever recorded on Front Street gage, 5.7 feet November 1, 1910.

RED LAKE RIVER AT CROOKSTON, MINN.

The Red Lake River is the principal tributary of the Red River, and its average flow is approximately equal to that of the Red River above the confluence, although it is usually more regular than the Red and brings less than the Red when both are at flood stages, and more than the Red during low-stage periods; it is therefore an important factor in any problem concerning the lower Red River. The gaging station on the Red Lake River at Crookston, Minn. is located a quarter-mile below the lower dam and was established May 19, 1901. The drainage area above it is 5,320 square miles, all in Minnesota; there are no considerable tributaries between this station and the mouth of the river, so that almost the whole flow is shown.

The tables of discharge are based on the measurements in the list below and one hundred and forty-four measurements in the twenty-one preceding years. By the operation of the power plants above the station abrupt variations in flow are sometimes caused which occasionally result in minor discrepancies, but the figures of monthly discharge are in general accurate except during the winters, when there have been considerable interruptions in records.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
10- 9-1922	R. V. Tilly	4.03	366
10-28-1922	Tilly and Johnson	3.12	145
10-28-1922	Tilly and Johnson	3.22	177
12-29-1922	R. V. Tilly	3.28*	108
2- 5-1923	A. Johnson	4.78*	334
6-10-1923	R. V. Tilly	5.65	1,490
6-27-1923	E. F. Chandler	5.11	608
7-20-1923	Black and Chandler	5.20	521
8-17-1923	E. F. Chandler	3.59	139
9-29-1923	R. B. Black	3.16	87
4-22-1924	R. B. Black	4.75	944
6- 1-1924	M. Diehl	3.98	588
6-20-1924	E. F. Chandler	4.36	538
7-15-1924	E. F. Chandler	3.92	115
8- 7-1924	E. F. Chandler	3.61	96
9- 3-1924	E. F. Chandler	2.81	88
9- 5-1924	E. F. Chandler	2.81	90

*Frozen; mean thickness of ice 0.6 foot to 1.0 foot at different measurements.

MONTHLY DISCHARGE OF RED LAKE RIVER AT CROOKSTON, MINN.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	920	160	478	B
	October	700	95	328	B
	November	700	200	469	B
	December			240	D
1923	January			190	E
	February			170	E
	March			160	E
	April	5,820		2,140	C
	May	2,480	755	1,290	B
	June	975	550	693	B
	July	975	34	534	C
	August	550	22	236	C
	September	600	125	274	C
	October	550	90	341	B
	November			320	E
	December			280	E
1924	January			170	E
	February			170	E

March			250	E
April	1,090	360	690	A
May	1,090	395	677	A
June	590	360	478	C
July	460	190	237	C
August	215	90	161	C

Maximum gage heights; 13.4 feet April 19, 1923; 5.1 feet April 23, 1924; maximum ever recorded, 25.2 feet April 11, 1897.

Minimum gage heights; 3.0 feet October 21, 1922; 3.0 feet October 19, 1923; 2.8 feet September 5, 1924; minimum ever recorded, 2.2 feet October 9, 1911.

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

The gaging station on Thief River is located about five miles above the confluence with Red Lake River at Thief River Falls, Minn. and is in Section 3, Township 154, Range 43. This river is a typical example of many on the east side of the Red River valley which are occasionally the source of serious floods. The drainage area above the station is 1,010 square miles, all in Minnesota. The station was established July 1, 1909, but was temporarily discontinued because of lack of funds during the years 1918 and 1919.

The tables of discharge are based on the measurements in the list below and on fifty-eight measurements in the preceding years, and have fair accuracy except during the winter when the actual flow has not been accurately measured; but the winter flow is known to be extremely small, and perhaps zero occasionally.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
10- 7-1922	R. V. Tilly	4.27	7
11- 4-1922	A. Johnson	4.35	13
5- 3-1923	A. Johnson	6.49	544
6-27-1923	E. F. Chandler	4.29	10
7-19-1923	Black and Chandler	4.33	11
8-16-1923	E. F. Chandler	3.68	0.6
4-19-1924	R. B. Black	4.82	52
6-17-1924	E. F. Chandler	4.56	20
9- 3-1924	E. F. Chandler	3.58	0.1

MONTHLY DISCHARGE OF THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	81	0.7	17	D
	October	11	6	8.4	C
	November	15		5.8	C
	December			1.0	E

1923	January			0.8	E
	February			0.6	E
	March			0.7	E
	April	1,160		347	B
	May	810	23	221	B
	June	29	11	15.5	C
	July	11	8	10.0	C
	August	5.7	0.4	1.7	C
	September	2.6	0.2	1.1	C
	October	3	1	1.7	C
	November			2.8	C
	December			1.5	E
1924	January			1.0	E
	February			0.7	E
	March			2.0	E
	April	132	4	49	C
	May	42	13	25	B
	June	30	13	19	B
	July	30	6	15	B
	August	6	0.2	2.5	B

Maximum gage heights; 8.4 feet April 21, 1923; 5.3 feet April 21, 1924; maximum ever recorded, 14.5 feet April 23, 1916; but on or about July 12, 1919 the gage height was about 16.6 feet.

Minimum gage heights; 3.8 feet November 19, 1922; 3.5 feet September 10, 1923; 3.6 feet September 3, 1924.

BOIS DES SIOUX RIVER NEAR FAIRMOUNT, N. D.

The gaging station on the Bois des Sioux River was established April 5, 1919 at the highway bridge southeast of Fairmount; April 1, 1920 it was moved to the Soo Railway Bridge. The elevation of the zero of the gage at the highway bridge is 962.13 feet above sea level; at the Soo railway bridge the gage-zero is 961.08 feet above sea level. The drainage area above the station is 1,460 square miles, of which 360 square miles is in South Dakota, 980 square miles in Minnesota, and 120 square miles in North Dakota.

The tables of discharge are based on the measurements in the list below and twenty-three measurements in the four preceding years and are fairly accurate. Nine-tenths of the drainage area is above the outlet of Lake Traverse, into which most of the tributary streams discharge. It is evident that through most of this two years the inflow into the lake has been not more than sufficient to supply evaporation from the lake, so that there has been no overflow or outflow to pass down the Bois des Sioux River.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
6-15-1923	E. F. Chandler	2.22	4.4
8-30-1923	E. F. Chandler	1.11	0
4.18-1924	R. V. Tilly		0
8-12-1924	E. F. Chandler	0.80	0

MONTHLY DISCHARGE OF BOIS DES SIOUX RIVER NEAR FAIRMOUNT, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	0.3	0.0	0.1	C
	October			0	A
	November			0	A
	December			0	A
1923	January			0	A
	February			0	A
	March			0.7	A
	April	76	16	39	C
	May	28	16	22	C
	June	16	3	8.7	C
	July	5	0	2.2	B
	August to December			0	A
1924	January to August..			0	A

Maximum gage height; 4.7 feet April 2, 1923; maximum included in records of station, 5.7 feet April 22, 1922; during the highest flood of 1916 a stage of 9.0 feet was reached.

Minimum gage height ever recorded; 0.8 feet August 12, 1924.

MUSTINKA RIVER ABOVE WHEATON, MINN.

The gaging station on the Mustinka River was established June 7, 1916, about three miles below (southwest from) Wheaton, Minn., but it was found that at this point the stage might sometimes be affected by backwater from Lake Traverse if the lake should be high. Accordingly the station was transferred March 1, 1917 to its present location one mile above (northeast from) Wheaton. From October 1, 1917 to June 24, 1919 the station was discontinued because of lack of funds. The drainage area above the station is 776 square miles, all in Minnesota.

The tables of discharge, based on the measurements in the list below and thirty-one measurements in preceding years, are fairly accurate, except during the winters when observations were insufficient for complete determination; but it is certain that the winter flow was uniformly very small, and presumably less than a second-foot.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
6-14-1923	E. F. Chandler	1.31	0.3
8-31-1923	E. F. Chandler	1.18	0.2
4-17-1924	R. V. Tilly	1.75	5.6
8-12-1924	E. F. Chandler	1.31	0.1

MONTHLY DISCHARGE OF MUSTINKA RIVER ABOVE WHEATON, MINN.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	0.1	0.0	0.1	C
	October			0.8	B
	November			0.6	E
	December			0.5	E
1923	January			0.4	E
	February			0.3	E
	March			0.4	E
	April	746		198	B
	May	21	1.9	6.0	A
	June	24	0.1	4.0	B
	July	21	0.3	2.9	B
	August	1	0.0	0.1	B
	September	0.1	0.0	0.01	B
	October			0.1	C
	November			0.4	C
	December			0.2	E
1924	January			0.1	E
	February			0.1	E
	March			1	E
	April	45	1.9	13	B
	May	7.4	0.5	2.8	B
	June	5.1	0.4	2.0	B
	July	5.5	0.1	1.4	B
	August	0.7	0.1	0.2	B

Maximum gage heights; 10.1 feet April 14, 1923; 2.7 feet April 5, 1924; maximum included in records of station, 14.7 feet April 1, 1917; during the spring flood of 1916 a gage height of about 17 feet was reached.

Minimum gage heights; 1.1 feet September 30, 1922; 1.1 feet August 18, 1923; 1.3 feet August 15, 1924.

PEMBINA RIVER AT NECHE, N. D.

The gaging station on the Pembina River was established April 29, 1903 but was discontinued for lack of funds during the years of 1916, 1917 and 1918. It is located at Neche, N. D., sixteen miles above the mouth of the river at the Great Northern railway bridge. The drainage area above this point is 2,960 square miles, of which 1,950 square miles is in Manitoba and 1,010 square miles in North Dakota.

The tables of discharge, based on the measurements in the list below and sixty-six measurements in previous years, are fairly accurate through the open season, but are merely estimates in winter based on a very few observations.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
7-12-1923	E. F. Chandler	4.22	94
7-13-1923	E. F. Chandler	4.21	90
4-22-1924	M. Diehl	4.93	282
8- 1-1924	E. F. Chandler	3.57	27
8- 2-1924	E. F. Chandler	3.54	20

MONTHLY DISCHARGE OF PEMBINA RIVER AT NECHE, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	79	6	39	B
	October	79	46	68	C
	November	79		73	D
	December			33	D
1923	January			20	E
	February			10	E
	March			11	E
	April	3,120		1,150	B
	May	1,470	781	1,130	A
	June	711	121	315	A
	July	121	73	86	B
	August	104	73	89	B
	September	121	88	104	B
	October			114	C
	November			90	C
	December			23	D
1924	January			4	E
	February			3	E
	March			7	E
	April	674	30	220	B
	May	259	117	157	B
	June	117	84	98	B
	July	84	30	54	C
	August	30	8	14	C

Maximum gage-heights: 17.8 feet April 20, 1923; 6.7 feet April 20, 1924; maximum included in records, 20.9 feet May 2, 1904; height said to be 21.5 feet April 19, 1916.

Minimum gage-heights: 3.4 feet September 2, 1922; 4.1 feet July 28, 1923; 3.3 feet August 26, 1924.

MOUSE RIVER AT MINOT, N. D.

The gaging station on the Mouse River at Minot, N. D. was established May 5, 1903. The drainage area above this point is considered (on the basis of the latest complete maps) to be 10,270 square miles, of which 3,280 square miles is in North Dakota, 30 square miles in Montana, and 6,960 square miles in Canada. But much of this rarely drains into any stream and was not clearly shown on earlier maps, so that for many years the area was considered as 8,400. The gage was located directly north of the Great Northern roundhouse, at the Anne Street bridge; but on account of the construction of the Park Board dam below the city, which controls the height of water surface when its gate is closed, it became necessary in March 1924 to move the station to the bridge a few rods above the Park Board dam. The zero of the gage at Anne Street is 85.9 feet above the Minot city datum, and of the gage at the Park Board dam is 80.0 feet above the city datum; the crest of the dam is from 93.3 to 93.7 feet above the city datum.

The tables of discharge, based on the measurements in the list below and on seventy-four measurements in the preceding years, are fairly accurate for all seasons, except a short period when the gate in the dam was partially open and not kept in the same position, so that the relation between gage height and discharge was not constant.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
4-26-1923	R. B. Black	18.83 a	3,050
5- 1-1923	R. B. Black	19.60 a	3,420
6- 4-1923	R. B. Black	5.78 a	181
8-28-1923	E. F. Chandler	4.95 a	86
3- 8-1924	E. F. Chandler	5.03 b	52
6-25-1924	E. F. Chandler	7.38 b	241
7-26-1924	E. F. Chandler	13.91 c	62
8-30-1924	E. F. Chandler	12.38 c	6

a—gage height at Anne Street gage.
b—gage height at gage above dam, gate open.
c—gage height at gage above dam, gate closed.

MONTHLY DISCHARGE OF MOUSE RIVER AT MINOT, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	September	17	2	6	C
	October	1.8	0.9	1.6	C
	November	5	1.1	1.8	C
	December			1.0	D
1923	January			1.0	D
	February			0.7	D
	March	212	34	86	D
	April	3,460	121	1,410	B
	May	3,460	281	1,340	B
	June	862	97	230	B
	July	844		491	C
	August	424	91	256	B
	September	260	13	74	B
	October			22	D
	November	13	7	11	B
	December			10	C
1924	January			6	C
	February			1.4	C
	March	253	15	105	B
	April	472	108	257	B
	May			152	E
	June			142	C
	July	117	28	71	B
	August	41	14	29	B

Maximum gage heights; at gage at dam, 21.8 feet May 1, 1923; 14.7 feet June 28, 1924;

Maximum gage heights at Anne Street gage; 19.6 feet May 1, 1923; about 8.7 feet June 28, 1924; maximum ever recorded, 21.9 feet April 20, 1904.

Minimum gage height at gage at dam, gate open; 4.8 feet March 12, 1924; at Anne Street gage, 3.6 feet February 10, 1923; 3.9 feet February 9, 1924.

CANNON BALL RIVER NEAR STEVENSON, N. D.

The gaging station on the Cannon Ball River was established June 10, 1903 at the postoffice Stevenson, N. D., which was at that time located about thirty miles above the mouth of the river and four miles above the confluence with Dogtooth Creek, at a point four miles south of the present postoffice and railway station Timmer, N. D. Because of lack of available observer the station was discontinued in 1909 and

1910, and from August 9, 1911 to August 1915, was maintained about a mile upstream from the original location with a gage so placed that all readings would be approximately 10.0 feet greater numerically than at the original location. Records were temporarily discontinued because of lack of funds from October 1918 to October 1921.

The drainage area above this point is 3,650 square miles, of which 70 square miles is in South Dakota and 3,580 square miles in North Dakota. The tables of discharge, based on the measurements in the list below and seventy-nine measurements in previous years, are fairly accurate except during the winter and the first few days of spring break-up when the effect of the ice is merely estimated, and except during the season of 1923 when difficulties with a displaced gage make the records perhaps only approximate part of the season.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
5- 2-1923	G. H. McMahon	4.00	381
8-16-1923	McMahon and Diehl	3.65	108
9-15-1923	McMahon and Diehl	3.20	14
5- 2-1924	G. H. McMahon	3.78	178
5- 9-1924	G. H. McMahon	3.52	111
5-21-1924	G. H. McMahon	3.28	65
5-29-1924	G. H. McMahon	3.13	40
6- 6-1924	G. H. McMahon	3.08	35
6-24-1924	M. Diehl	3.32	62
7-20-1924	McMahon and Chandler	3.39	74

MONTHLY DISCHARGE OF CANNON BALL RIVER NEAR STEVENSON, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	August	184	10	64	C
	September	47	6	18	C
	October	10	6	7	C
	November			53	D
	December			26	E
1923	January			27	E
	February			26	E
	March	6,900		1,210	E
	May	285	62	127	D
	June	1,660	62	214	D
	July	1,310	126	513	D
	August	650	102	288	D
	September	900	9	180	D
	October	900	180	420	C
	November	180	56	119	C
	December			34	E

1924	January			23	E
	February			11	E
	March			13	E
	April	1,870	81	541	A
	May	210	41	88	A
	June	650	33	128	A
	July		15	41	A
	August	1,590	9	161	A

Maximum gage heights; 14.9 feet March 2, 1923; 7.8 feet April 3, 1924; Maximum recorded, 14.9 feet.

Minimum gage heights; 2.7 feet October 11; minimum recorded, 1.4 feet October 23, 1907.

HEART RIVER NEAR RICHARDTON, N. D.

The gaging station on the Heart River was established May 18, 1903 at the steel highway bridge ten miles south of Richardton, N. D. On September 4, 1911 it was transferred one mile downstream and the gage-datum so changed that all readings at the new location are approximately 20.0 feet greater numerically than at the original location. The station was discontinued April 1, 1924. The drainage area above this station is 1,250 square miles.

The tables of discharge, based on the measurements in the list below and fifty-nine measurements in the nineteen previous years, are only approximate through most of the season, because in recent years channel conditions there have become such as to cause occasional small changes in the relation between gage height and discharge, and the times and amounts of these changes cannot be closely determined except by more frequent discharge measurements than the available funds seemed to warrant.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
9-26-1922	McMahon and Diehl	24.23	2.5
4-11-1923	G. H. McMahon	27.80	299
9-27-1923	G. H. McMahon	24.70	39

MONTHLY DISCHARGE OF HEART RIVER NEAR RICHARDTON, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	August	1,380	2	74	D
	September	2.2	0.8	1.6	D
	October	8	1.2	3.1	C
	November			21	D
	December			3	E

1923	January			5	E
	February			8	E
	March			261	E
	April	1,380	124	501	D
	May	124	50	80	D
	June	862	60	158	D
	July	667	41	195	D
	August	332	60	114	D
	September	738	50	192	D
	October	1,020	23	174	C
	November	23	6	15	C
	December			5	D
1924	January			3	E
	February			4	E
	March			68	E

Maximum gage heights; 31.1 feet April 13, 1923; maximum recorded, about 45.9 feet June 10, 1906.

Minimum gage heights; 24.1 feet September 25, 1922; 24.3 feet November 10, 1923.

HEART RIVER AT SUNNY, N. D.

The gaging station on the Heart River at Sunny was established March 1, 1924 at the highway bridge near the railway bridge in the northeast quarter of Section 25, Township 139, Range 82. It is about seven miles above the mouth of the river and the drainage area above the station is 3,320 square miles. The zero of the gage is 1,630 feet above sea level.

The tables of discharge are based on the measurements in the list below and are fairly accurate.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
4- 7-1924	G. H. McMahon	12.40	3,120
4-11-1924	G. H. McMahon	9.31	533
4-22-1924	G. H. McMahon	8.25	163
4-28-1924	G. H. McMahon	8.17	147
5- 1-1924	G. H. McMahon	8.40	210
5-20-1924	G. H. McMahon	7.97	103
5-30-1924	G. H. McMahon	7.82	57
6- 6-1924	G. H. McMahon	7.60	45
6- 9-1924	M. Diehl	7.79	77
6-23-1924	M. Diehl	13.03	2,010
6-24-1924	M. Diehl	11.21	1,180
6-25-1924	G. H. McMahon	10.03	877
7-16-1924	M. Diehl	8.16	141
7-19-1924	McMahon and Chandler	8.01	110

MONTHLY DISCHARGE OF HEART RIVER AT SUNNY, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1924	April	2,060	139	473	C
	May	293	49	132	A
	June	2,530	36	592	B
	July	1,200	104	277	A
	August	83	5	35	B

Maximum gage height; 13.6 feet June 19, 1924.
Minimum gage height; 7.2 feet August 31, 1924.

KNIFE RIVER NEAR BRONCHO, N. D.

The gaging station on the Knife River is about twenty miles north of Hebron, N. D., in Section 4, Township 142, Range 90, at the ranch of C. D. Smith, the former location of Broncho Postoffice. The station on this river was first established May 29, 1903 at a point about four miles further downstream and was transferred to the present location March 23, 1905. The station was temporarily discontinued because of lack of funds from November 1919 until October 1921. The drainage area above this station is 1,200 square miles. The zero of the gage is 1848.35 feet above sea level.

The tables of discharge, based on the measurements in the list below and fifty measurements in preceding years, are close approximations except during the winter when they are merely estimates based on a few gage observations, and during the summer low-stage of 1923 when some minor uncertainties entered the records between visits of engineer to station.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
9-27-1922	McMahon and Diehl	3.75	7
9-26-1923	G. H. McMahon	3.85	14
4- 9-1924	G. H. McMahon	4.65	89
5-23-1924	G. H. McMahon	3.75	16
6-20-1924	McMahon and Diehl	8.20	720
6-20-1924	M. Diehl	9.00	829
6-20-1924	M. Diehl	11.50	1,420
6-21-1924	M. Diehl	11.95	1,370
7-22-1924	McMahon and Chandler	4.78	136

MONTHLY DISCHARGE OF KNIFE RIVER NEAR BRONCHO, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1922	August	3,920	4	300	C
	September	47	4	16	C
	October	12	7	9	C
	November	62	12	24	C
	December			9	E

1923	January			7	E
	February			6	E
	March			765	D
	April	4,730	3	770	C
	May	3	1	1.4	D
	June	3	1	1	D
	July	520	2	85	B
	August	72	2	26	B
	September	452	3	52	C
	October	81	18	38	C
	November	42	18	25	C
	December			12	D
1924	January			6	E
	February			7	E
	March	416		104	D
	April	1,580	51	210	C
	May	96	33	51	B
	June	1,520	33	252	B
	July	359	33	90	B
	August			25	C

Maximum gage heights; 17.4 feet April 14, 1923; 11.7 feet April 5, 1924; 11.9 feet June 21, 1924; maximum ever recorded, 24.0 feet June 26, 1914.

Minimum gage heights; 3.6 feet September 1, 1922; 2.7 feet June 21, 1923; 3.8 feet August 26, 1924.

SPRING CREEK AT ZAP, N. D.

The gaging station on Spring Creek at Zap, N. D. which was established March 4, 1924 is at the Northern Pacific Railway bridge at Zap, about eight miles above the confluence of Spring Creek with the Knife River. It is in the southwest quarter of Section 14, Township 144, Range 89. The drainage area above this station is 547 square miles.

The tables of discharge, based on the measurements in the list below, are fairly accurate for the low-stage flows, but are merely estimates for the flood and medium flow periods, because no discharge measurements happened to be obtained this season during those periods; therefore the monthly tables are subject to considerable revision later after high-stage discharge measurements shall have been obtained.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
5-11-1924	G. H. McMahon	9.16	11
5-15-1924	G. H. McMahon	9.30	14
5-23-1924	G. H. McMahon	9.19	11
6-20-1924	McMahon and Diehl	10.16	55
7-21-1924	McMahon and Chandler	9.15	16
7-22-1924	McMahon and Chandler	9.07	12

MONTHLY DISCHARGE OF SPRING CREEK AT ZAP, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1924	March	228		111	E
	April	622	35	134	D
	May	112	8	34	B
	June	878	8	70	D
	July	172	8	18	B
	August	8	2	5	D

Maximum gage heights; 14.0 feet March 7, 1924; 15.7 feet April 5, 1924; 16.3 feet June 27, 1924.

Minimum gage height; 8.7 feet August 31, 1924.

LITTLE MISSOURI RIVER AT MEDORA, N. D.

The gaging station on the Little Missouri River at Medora was established May 12, 1903 but was discontinued in November 1908. It was reestablished October 11, 1921, but it happened that records were interrupted from December 1 to March 12, 1922, and from June 18 to November 5, 1922, and from January 1 to May 2, 1923. Enough discharge measurements have been made to render the tables of discharge fairly accurate except for the winter periods when the effect of ice as applied to the computations is merely estimated.

On the reestablishment of the station in 1921 the gage was transferred to the new highway bridge and the effect of this change was the same as if the gage zero had been lifted 0.20 foot. It may be assumed, for example, that the discharge at a gage height of 6.0 feet on the present gage is the same as formerly, in the years 1903 to 1908, would normally have occurred at a gage reading of 6.2 feet.

The drainage area above this station is 6,190 square miles, of which 680 square miles is in Wyoming, 560 square miles in South Dakota, 3,040 square miles in Montana, and 1,910 square miles in North Dakota. The tables of discharge are based on the measurements in the list below and also on thirty-nine measurements in previous years.

MEASUREMENTS OF DISCHARGE

Date	Hydrographer	Gage-height	Discharge
10-11-1921	McMahon and Chandler	2.31	10
5-26-1922	G. H. McMahon	4.80	728
8-12-1922	Chandler and McMahon	4.64	647
9-15-1922	McMahon and Diehl	3.10	68
10-10-1922	G. H. McMahon	2.75	26
5- 4-1923	G. H. McMahon	3.20	151
7- 5-1923	M. Diehl	4.10	436
9-28-1923	G. H. McMahon	4.35	402
10-16-1923	G. H. McMahon	6.60	3,500
11- 2-1923	G. H. McMahon	3.65	192

3-11-1924	G. H. McMahon	4.40	632
4-15-1924	G. H. McMahon	6.65	3,940
4-23-1924	G. H. McMahon	4.95	1,210
5-13-1924	G. H. McMahon	3.65	344
6- 3-1924	G. H. McMahon	3.10	126
6-28-1924	M. Diehl	3.90	401
7-23-1924	E. F. Chandler	5.07	1,250
7-24-1924	E. F. Chandler	5.28	1,330

MONTHLY DISCHARGE OF LITTLE MISSOURI RIVER AT MEDORA, N. D.

	Month	Maximum	Minimum	Mean	Accuracy
1921	October			11	D
	November			11	C
1922	March 12-31			1,070	D
	April	2,200	395	1,180	B
	May			1,490	C
	June 1-17	7,840	605	2,660	B
	November 5-30	630	150	342	C
	December			86	E
1923	May	109	50	76	C
	June	1,040	41	381	B
	July	1,230	80	356	B
	August	4,200	330	1,430	C
	September	5,030	69	662	B
	October	10,660	240	2,050	B
	November	240	109	163	C
	December	240	59	115	C
1924	January			35	E
	February			437	E
	March			1,580	E
	April	18,520	650	5,640	B
	May	590	130	297	B
	June	4,100	105	642	B
	July	1,860	185	560	B
	August	650	105	244	B

Maximum gage heights; 9.1 feet March 23, 1922; 9.7 feet June 16, 1922; 7.4 feet August 9, 1923; 10.7 feet October 2, 1923; 13.8 feet April 4, 1924; maximum included in records, 16.0 feet June 24, 1907.

Minimum gage heights; 2.2 feet October 25, 1921; 2.9 feet December 22, 1922; 2.7 feet June 2, 1923; 3.0 feet January 4, 1924, June 8, 1924 and August 13, 1924.