EIGHTEENTH BIENNIAL REPORT

OF THE

STATE ENGINEER

TO THE

GOVERNOR OF NORTH DAKOTA

1937-1938

E. J. THOMAS
State Engineer

LETTER OF TRANSMITTAL

The Honorable John Moses,
Governor of North Dakota.

Sir:

In compliance with the provisions of State statutes, I have the honor to transmit herewith the Eighteenth Biennial Report of the State Engineer.

Respectfully submitted,

E. J. THOMAS,
State Engineer.

Bismarck, North Dakota,
January 15, 1939.

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INTRODUCTION

The purpose of this report is to acquaint the governor, legislators, and interested citizens with the activities of the State Engineer's office. The duties of this office are prescribed by law as follows:

> "Custodian of Government plats; examine State lands for presence of coal; general supervision of the waters of the state and the supervision of the measurement and appropriation thereof. Also, to make hydrographic surveys and investigations of stream basins; adjudicating water rights, and making surveys of state lands.
>
> "The State Engineer represents the state on matters pertaining to interstate and international water problems, he encourages and gives assistance in the matter of construction of dams and other control devices by individuals, Federal Agencies and communities, such assistance including the furnishing of information and data concerning stream flow. The State Engineer prepares reports to the Governor with recommendations for Legislation, formulates rules and regulations for carrying into effect the duties of the office.
>
> "The State Engineer acts as Water Conservation Commissioner, under the 1935 Water Conservation District Law, Secretary of the Missouri River Commission and has control of lands within ordinary high water level on meandered bodies of water."

The State Engineer is also required to pass on the feasibility of irrigation works proposed by a contemplated irrigation district. It is his duty to examine the area, maps, and plans of proposed structures. If after such examination he deems the lands suitable and plans adequate, he issues a certificate of feasibility to a board of county commissioners. These commissioners then permit the completion of the organization.

During the legislative session of 1937, these duties were enlarged by the State Water Conservation Law. A portion of this law reads as follows:

> "In all matters pertaining to water resources, water supply, and construction of reclamation projects, and in all other matters relating to the duties of the state engineer as now provided by law, the state engineer shall be the chief technical adviser of the commission. The state engineer shall exercise such powers and perform such duties, in addition to his regular duties as state engineer, as the commission shall direct or prescribe, and he shall receive and be paid such additional salary for such additional services as may be fair and reasonable to be fixed by the commission."

In addition to the duties prescribed by law, the State Engineer is a member of various committees dealing with the construction of facilities for the utilization of the surface and ground waters in the State. Of particular importance is his co-operation with the National Resources Committee, National Rivers and Harbors Congress, National Reclamation Association, and other national and state agencies.

The various activities participated in during the past two years will be discussed in the order of their listing above.

EIGHTEENTH BIENNIAL REPORT

—by—

E. J. Thomas, State Engineer

CUSTODIAN OF GOVERNMENT PLATS

This particular activity does not require a great deal of time on the part of the State Engineer. The original government plats, consisting of the township maps prepared by the original surveyors, are on file in the large vault in the Highway Department. In addition to these other maps, graphs and the original field notes are on file in the State Engineer's office. All are available for inspection by interested persons. The State Engineer's responsibility is to see that records are not permanently removed from the files, and that they are kept in proper order. Prints of these plats and field notes can be obtained at cost from the State Engineer's office.

EXAMINATION OF STATE LANDS FOR PRESENCE OF COAL

The locations of lignite coal in North Dakota have been quite thoroughly investigated by the United States Geological Survey, State Geological Survey and School of Mines, University of North Dakota. The State Engineer's duties, therefore, have been to co-operate with these agencies. Persons directly interested in the amount of coal and location thereof can get specific information from the School of Mines at the University in Grand Forks.

GENERAL SUPERVISION OF THE WATERS OF THE STATE AND THE SUPERVISION OF THE MEASUREMENT AND APPROPRIATION THEREOF

This activity of the State Engineer has required more time than any other function. During the past two years greater emphasis has been placed on the utilization of the surface waters of the State than ever before.

Plate I shows the existing and desirable stream gaging stations for the State. This map also shows the various governmental agencies which are co-operating with the State Engineer's office in securing reliable data on stream flow.

The value of these data is usually under-estimated by the general public. An illustration to show the application of the data derived from these stream gaging stations is, therefore, deemed desirable.

A reservoir for regulating the flow in the Sheyenne River was proposed in the Red River Development Plan prepared by the U. S. Army Engineers. In determining the size of this proposed reservoir, they

used figures obtained on the run-off in the Red River Basin at Grand Forks. On this basis they proposed a reservoir of a capacity of 170,000 acre feet. Various other engineers contend that this capacity is greater than the tributary drainage basin warrants. The estimated cost of this project is $1,700,000. In this particular case it is desired to have a reservoir as large as the area will support; however, it is also apparent that the construction of a dam to provide storage in excess of the usable capacity is a wastage of public funds. If adequate stream flow data were available in this case, the determination of the proper size of this reservoir would be a simple matter, and if the present proposed reservoir capacity is greater than warranted, as contended by some engineers, it would result in the saving of hundreds of thousands of dollars.

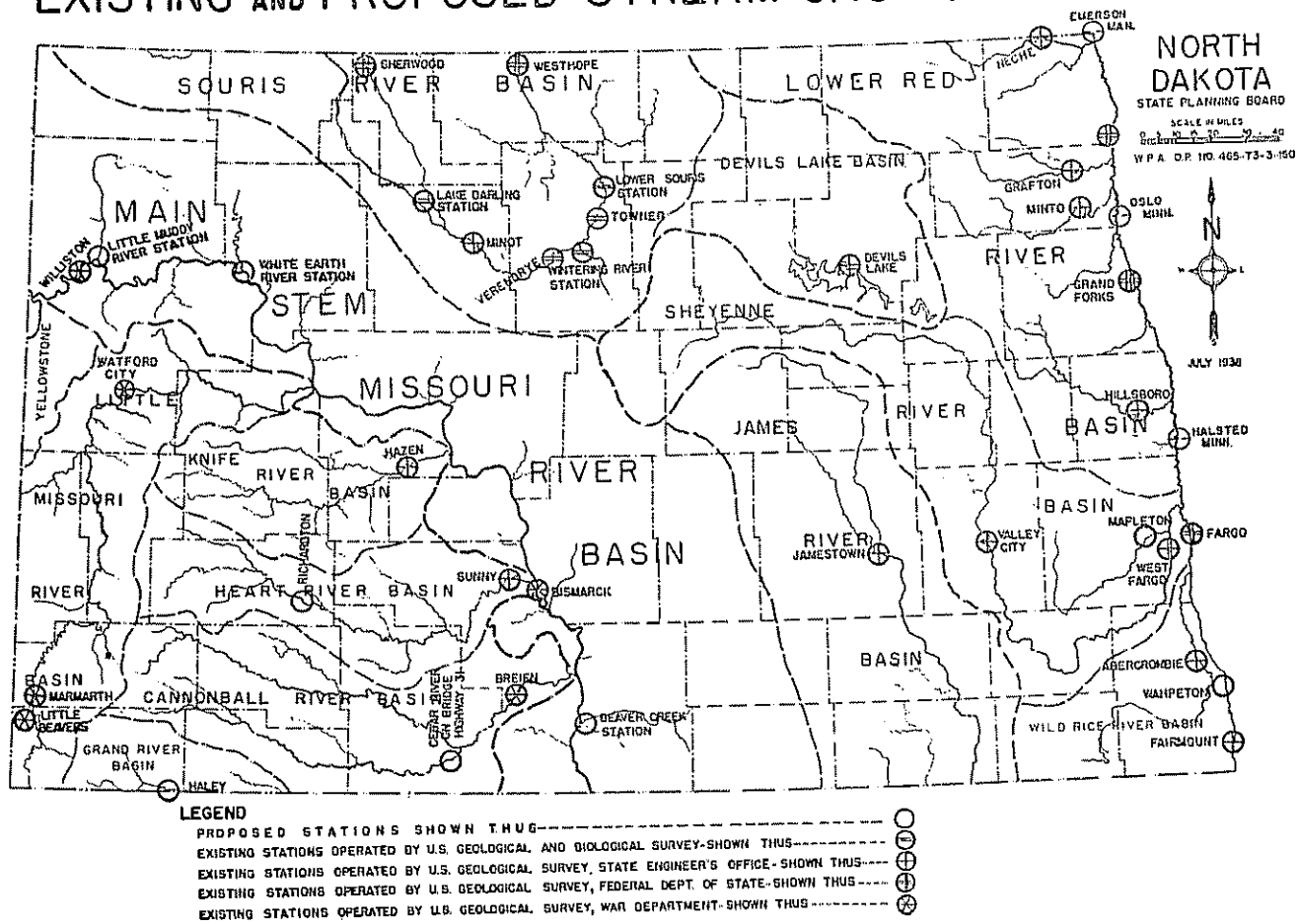
In May, 1937, a report, "Surface Waters in North Dakota," was published by the North Dakota State Planning Board, which includes all data available on the stream flow for streams in North Dakota to October 1, 1935. The State Engineer co-operated in the preparation of this report which has been made available to all interested State and Federal Agencies and also interested individuals.

The State Engineer's office has recently been notified of the allocation of $6,000 in PWA funds for the improvement of stream gaging stations under the supervision of the United States Geological Survey. This will be used in changing some of the present staff gaging stations to automatic recording stations which are more desirable, and provide a continuous record.

At the present time the assembling and compilation of run-off data for North Dakota is under supervision of the United States Geological Survey in co-operation with the State Engineer's office. This agency has three district offices which look after the work in this State. These are at St. Paul, Minnesota; Rolla, Missouri, and Helena, Montana.

Data on stream flow are compiled by climatic years which begin on Oct. 1st. The data compiled for North Dakota for the years 1936 and 1937 are shown in Tables 1 to 26.

EXISTING AND PROPOSED STREAM GAGING STATIONS



LEGEND

PROPOSED STATIONS SHOWN THUS ○

EXISTING STATIONS OPERATED BY U.S. GEOLOGICAL AND BIOLOGICAL SURVEY-SHOWN THUS ⊖

EXISTING STATIONS OPERATED BY U.S. GEOLOGICAL SURVEY, STATE ENGINEER'S OFFICE-SHOWN THUS ⊕

EXISTING STATIONS OPERATED BY U.S. GEOLOGICAL SURVEY, FEDERAL DEPT. OF STATE-SHOWN THUS ⊕

EXISTING STATIONS OPERATED BY U.S. GEOLOGICAL SURVEY, WAR DEPARTMENT-SHOWN THUS ⊗

TABLE No. 1 MONTHLY DISCHARGE OF BOIS DES SIOUX RIVER AT FAIRMOUNT, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October					.....	.....	.....	0
November					.....	.....	.....	0
December					.....	.....	.....	0
January	NO FLOW FROM LAKE TRAVERSE				.....	.....	.....	0
February	DURING THIS YEAR MAXIMUM				.....	.....	.....	0
March	FLOW OBSERVED WAS 1 6 SECOND				.....	.....	.....	0
April	FEET ON APRIL 12				14	0	4 3	258
May					20	0	4 9	301
June					.....	.....	.....	0
July					.....	.....	.....	0
August					.....	.....	.....	0
September					.....	.....	.....	0

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

Maximum Stage 3 15 May 1, Discharge 20 Cfs
Minimum Stage 0 Discharge 0 Cfs

TABLE No. 2 MONTHLY DISCHARGE OF RED RIVER AT FARGO, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	11 0	0 2	4 9	300	.....	.....	0	0
November	7 8	0 0	1 9	114	.....	.....	0	0
December	8 9	0 0	0 6	36	14	0	4 2	260
January	18.0	7 8	13 9	856	24	0	4 4	270
February	8 9	2 5	5 8	334	12	0	1 0	54
March	695 0	8 9	161 0	9,920	59	0	26 8	1,650
April	1,050 0	125	428 0	25,470	1,300	63	445	26,450
May	165 0	1 5	86 7	5,330	836	53	253	15,540
June	9 0	0 0	2 9	171	299	33	183	10,910
July	0 0	0 0	0 0	00	212	51	107	6,610
August	0 0	0 0	0 0	00	117	30	55 7	3,430
September	0.0	0.0	0.0	00	222	59	139	8,290

Maximum Stage 9 90 April 14 Discharge 1,050 Cfs.
Minimum Stage 3.94 September 23 Discharge 00 Cfs
Drainage Area 6,420 Sq. Miles.

Maximum Stage, 10.17, Apr 12, Discharge 1,390 Cfs.
Minimum Stage, 4 41, Discharge 0 Cfs.

TABLE No. 3 **MONTHLY DISCHARGE OF RED RIVER AT HALSTAD, MINN.**

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October					36	5.4	10.5	646
November					43	17	22.6	942
December	NO RECORD OCT TO MAR. 15							
January					NO RECORD			
February								
March	1,860	39	479	16,140				
April	7,580	800	2,899	172,500	2,660	160	1,156	68,760
May	1,460	437	803	49,350	1,920	359	883	54,270
June	411	97	194	11,550	667	385	517	30,740
July	153	16	58.3	3,590				
August	15	5.8	8.7	533	NO RECORD			
September	32	6.6	11.8	702				

Maximum Stage 16.33, Apr. 15. Discharge 7,670 Cfs.
Minimum Stage Aug. 25 Discharge 5.8 Cfs
Drainage Area .....Sq. Miles.

Maximum Stage 9.39, Apr. 15 Discharge 2,660 Cfs.
Minimum Stage 1.90 observed. Discharge 5.4 Cfs.

TABLE No. 4 **MONTHLY DISCHARGE OF RED RIVER AT GRAND FORKS, N. DAK.**

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	122	86	103	6,340	13	10	12.1	744
November	100	74	83.3	4,950	91	12	30.5	1,810
December	80	64	70.6	4,340	52	3.6	17.8	1,090
January	66	50	58.5	3,600	36	2.6	18.8	1,160
February	62	50	54.3	3,130	4	2.4	2.9	159
March	76	52	63.7	3,920	121	4.0	42.1	2,590
April	14,500	336	4,829	287,300	3,700	155	1,485	88,360
May	2,960	654	1,482	91,150	4,120	670	1,636	100,600
June	606	142	274	16,320	1,570	374	922	54,860
July	148	44	88.8	5,460	1,810	223	767	47,160
August	46	26	32.1	1,970	2,660	704	1,333	81,960
September	34	13	20.3	1,210	1,010	456	794	47,230

Maximum Stage 25.00, Apr. 18. Discharge 14,500 Cfs
Minimum Stage 1.16, Sept. 29. Discharge 12 Cfs
Drainage Area 25,500 Sq. Miles.

Maximum Stage 11.57, May 4. Discharge 4,180 Cfs.
Minimum Stage 0.79. Discharge 2.4 Cfs.

TABLE No. 5 **MONTHLY DISCHARGE OF RED RIVER AT OSLO, MINN.**

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October					18	10	13.8	849
November								
December								
January	NO RECORD				NO RECORD			
February								
March								
April	14,500	75	5,111	304,100	3,770	80	1,488	88,520
May	3,370	720	1,634	100,400	4,070	605	1,715	105,500
June	640	140	286	17,040	1,560	392	935	55,650
July	167	37	92.9	5,710				
August	44	26	36.2	1,920	NO RECORD			
September	30	14	18.9	1,120				

Maximum Stage 18.18 April 19. Discharge 14,500 Cfs.
Minimum Stage..... September 18, Discharge 14 Cfs
Drainage Area ..... Sq. Miles.

Maximum Stage 6.47 May 4. Discharge 4,070 Cfs.
Minimum Stage 3.07 observed. Discharge 10 Cfs.

TABLE No. 6 **MONTHLY DISCHARGE OF RED RIVER AT DRAYTON, N. DAK.**

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October					18	7.7	13.8	846
November					17	15	16.1	478
December								(1 to 15 only)
January	NO RECORD							
February					NO RECORD			
March								
April	16,600	78	5,768	343,200	3,920	72	1,729	102,900
May	4,000	920	1,826	112,300	4,500	678	1,952	120,000
June	770	177	399	23,740	1,520	534	968	57,620
July	183	60	118	7,250				
August	65	36	50.1	3,080	NO RECORD			
September	38	14	27.4	1,630				

Maximum Stage 24.26 April 20. Discharge 16,600 Cfs
Minimum Stage 1.75 September 30. Discharge 14 Cfs
Drainage Area ..... Sq. Miles.

Maximum Stage 10.26 May 5. Discharge 4,530 Cfs
Minimum Stage 1.48. Discharge 7.7 Cfs.

TABLE No. 7 MONTHLY DISCHARGE OF RED RIVER AT EMERSON, MAN.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	142	102	117	7,180	36.4	23.5	28.6	1,760
November	110	57	78	4,630	31.0	19.0	23.7	1,410
December	64	55	59	3,640	70.0	17.0	33.5	2,060
January	64	48	57	3,490	42.2	1.2	7.1	436
February	64	45	54	3,100	1.6	0.9	1.2	67
March	72	48	58	3,580	11.0	1.1	2.3	139
April	18,000	63	6,740	401,000	4,320.	15.0	2,030.0	120,500
May	5,590	1,310	2,600	160,000	5,840.	896.	2,900	178,500
June	1,180	200	583	34,710	1,680	560	1,060	63,020
July	180	81	121	7,410	1,910	355	830	51,060
August	97	70	79	4,870	2,620	822	1,570	96,230
September	114	29	67	3,980	941	617	818	48,690

1935-1936: Maximum Stage 767.68 April 21. Discharge 18,000 Cfs.[1] Minimum Stage 743.87 September 30. Discharge 29.2 Cfs. Drainage Area 34,600 Sq. Miles.

1936-1937: Maximum Stage 15.98 May 7. Discharge 5,840 Cfs. Minimum Stage 3.42 February 19. Discharge 0.9 Cfs.

TABLE No. 8 MONTHLY DISCHARGE OF WILD RICE RIVER AT ABERCROMBIE, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	.....	.....	0	.....	.....	.....	0	.....
November	.....	.....	0	.....	.....	.....	0	.....
December	.....	.....	0	.....	.....	.....	0	.....
January	.....	.....	0	.....	.....	.....	0	.....
February	.....	.....	0	.....	.....	.....	0	.....
March	389.0	0.0	80.4	4,940	.....	.....	0	.....
April	132.0	14.0	55.6	3,310	540	0	117	6,990
May	38.0	1.4	13.0	801	310	17	85.1	5,230
June	1.9	0.0	0.4	21	37	3.6	20.9	1,240
July	.....	.....	0	0	94	3.0	18.0	1,110
August	.....	.....	0	0	30	1.0	3.9	239
September	.....	.....	0	0	.....	.....	2.0	119

1935-1936: Maximum Stage 8.00 March 22. Discharge 415 Cfs. Minimum Stage 0. Discharge 0 Cfs. Drainage Area ..... Sq. Miles.

1936-1937: Maximum Stage 8.71 April 9. Discharge 540 Cfs. Minimum Stage 0. Discharge 0 Cfs.

[1] Gage height based on sea level datum

TABLE No. 9 MONTHLY DISCHARGE OF SHEYENNE RIVER AT WEST FARGO, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	40	21	26.5	1,630	16	4.8	9.9	607
November	22	15	18.1	1,080	17	4.8	12.4	736
December	21	18	19.5	1,200	30	2.2	7.5	460
January	18	14	16.1	992	12	4.0	7.8	478
February	15	14	14.7	843	8.2	3.0	5.5	304
March	241	14	53.1	3,260	124	4.4	36.6	2,250
April	718	74	309.0	18,360	443	63	195	11,620
May	552	77	200.0	12,300	191	52	102	6,260
June	111	25	55.0	3,270	187	55	103	6,140
July	77	8.5	22.7	1,400	67	24	36.7	2,260
August	12	5.0	7.5	459	49	7.6	22.2	1,360
September	14	5.4	8.4	498	49	10	21.3	1,270

1935-1936: Maximum Stage 9.74 April 21. Discharge 718 Cfs. Minimum Stage 2.13 August 9. Discharge 4.6 Cfs. Drainage Area ..... Sq. Miles.

1936-1937: Maximum Stage 7.40 April 18. Discharge 485 Cfs. Minimum Stage 1.90 December 14. Discharge 2.0 Cfs.

TABLE No. 10 MONTHLY DISCHARGE OF GOOSE RIVER AT HILLSBORO, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	.....	.....	0	.....	.....	.....	.....	.....
November	.....	.....	0	.....	.....	.....	.....	.....
December	.....	.....	0	.....	.....	.....	.....	.....
January	.....	.....	0	.....	.....	.....	.....	.....
February	.....	.....	0	.....	.....	.....	.....	.....
March	5.0	0.0	1.5	50	.....	.....	.....	.....
April	951.0	0.0	151	8,970	45	0.6	15.4	915
May	36.0	5.0	14.1	866	22	1.1	7.5	460
June	6.2	0.6	2.8	165	20	0.1	9.7	574
July	1.8	0.1	0.6	36	13	0.2	2.4	149
August	.....	.....	0.1	6.1	12	0.9	3.7	229
September	.....	.....	0.1	6.0	.....	.....	.....	.....

1935-1936: Maximum Stage 13.06 April 16. Discharge 1,060 Cfs. Minimum Stage 0. Discharge 0 Cfs. Drainage Area ..... Sq. Miles.

1936-1937: Maximum Stage 3.57 April 15. Discharge 46 Cfs. Minimum Stage 2.03 observed. Discharge 0.1 Cfs.

TABLE No. 11 MONTHLY DISCHARGE OF FOREST RIVER AT MINTO, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	.....	.....	0	.....	.....	.....	0	.....
November	.....	.....	0	.....	.....	.....	0	.....
December	.....	.....	0	.....	.....	.....	0	.....
January	.....	.....	0	.....	.....	.....	0	.....
February	.....	.....	0	.....	.....	.....	0	.....
March	.....	.....	0	.....	.....	.....	0	.....
April	552	0 0	107	6,350	72	0	14 2	847
May	34	8 6	17 9	1,100	17	5 1	10 2	625
June	14	5 0	8 3	495	12	0 6	6 4	383
July	7 8	0 0	1 4	86	1 7	0 0	0 5	31
August	0	.....	0 0	0 0	0 5	0 0	0 1	7
September	0	.....	0.0	0.0	.....	.....	0.0	0

Maximum Stage 11.88 April 15. Discharge 576 Cfs.
Minimum Stage 0 Discharge 0 Cfs.
Drainage Area ..... Sq. Miles.

Maximum Stage 4.08 April 13. Discharge 112 Cfs
Minimum Stage..... Discharge 0 Cfs

TABLE No. 12 MONTHLY DISCHARGE OF PARK RIVER AT GRAFTON, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	.....	.....	.....	.....	.....	.....	0	.....
November	.....	.....	.....	.....	.....	.....	0	.....
December	.....	.....	.....	.....	.....	.....	0	.....
January	.....	.....	.....	.....	.....	.....	0	.....
February	.....	.....	.....	.....	.....	.....	0	.....
March	.....	.....	.....	.....	.....	.....	0	.....
April	1,140	0 0	227	13,510	306	0 0	90 2	5,370
May	38	1 4	12 0	740	67	2 8	21 1	1,300
June	148	0 0	13 0	772	11	0 0	3 7	220
July	0 7	0 0	.....	2	32	0 0	4 7	292
August	0	0	0	0	5	0 0	1 2	72
September	0	0	0	0	0	0	0	.....

Maximum Stage 13 68 April 14. Discharge 1,140 Cfs
Minimum Stage 0. Discharge 0 Cfs.
Drainage Area ..... Sq. Miles.

Maximum Stage 7 34 April 13 Discharge 306 Cfs.
Minimum Stage 0. Discharge 0 Cfs.

TABLE No. 13 MONTHLY DISCHARGE OF PEMBINA RIVER AT NECHE, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	17 0	9 9	14 0	861	19	8 2	14 1	870
November	8 6	3 0	5 0	298	9 4	5 2	7 1	421
December	3 8	1 0	2 2	135	5 8	1 8	3 5	217
January	1 0	0 1	0 6	36	1 6	0 0	0 6	34
February	0 2	0 0	0 1	2 0	.....	.....	0 0	0
March	0 0	0 0	0 0	0 0	.....	.....	0 0	0
April	2,530	0 0	681	40,540	213	0 0	112 0	6,670
May	516	328 0	428	26,340	181	44	74 8	4,600
June	315	95	197	11,690	213	23	65 5	3,900
July	93	33	57 0	3,500	21	7 8	14 3	878
August	31	16	20 7	1,270	52	0 6	12 5	767
September	58	16	25 3	1,510	1 7	0 1	0 4	24

Maximum Stage 17 34 April 15. Discharge 2,530 Cfs
Minimum Stage 0. Discharge 0 Cfs.
Drainage Area 2,960 Sq. Miles.

Maximum Stage 5 60 April 11. Discharge 237 Cfs
Minimum Stage 0. Discharge 0 Cfs

TABLE No. 14 WATER LEVEL ELEVATION—DEVILS LAKE

Month	1935-1936 Elevation	Month	1936-1937 Elevation
October 19th	1,406 70	October 24th	1,405 08
November	.....	November	.....
December	.....	December	.....
January	.....	January	.....
February	.....	February	.....
March	.....	March	.....
April	.....	April	.....
May 2nd	1,407 22	May 29th	1,404 89
June	.....	June	.....
July 22nd	1,405 99	July	.....
August	.....	August 18th	1,404 23
September 24th	1,405.29	September	.....

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

TABLE No. 15 MONTHLY DISCHARGE OF SOURIS RIVER AT SHERWOOD, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	0 5	0 0	0 1	8 5	.....	.....	0	.....
November	0 4	0 0	0 2	9 7	.....	.....	0	.....
December	.....	.....	0 0	0 0	.....	.....	0	.....
January	.....	.....	0 0	0 0	.....	.....	0	.....
February	.....	.....	0 0	0 0	.....	.....	0	.....
March	.....	.....	0 0	0 0	.....	.....	0	.....
April	1 270 0	0 0	602 0	35,810 0	.....	.....	0	.....
May	419	59 0	176 0	10,800 0	118	0 0	14 7	872
June	54	5 4	22 6	1,340 0	10	1 4	3 6	223
July	5 4	0 0	1 7	102.0	1 6	0 0	0 6	34
August	0 0	0 0	0 0	0 0	0	0	0	0
September	0.0	0.0	0.0	0.0	0	0	0	0

Maximum Stage 10 32 April 25. Discharge 1,270 Cfs
Minimum Stage 0 Discharge 0 Cfs
Drainage Area ..... Sq. Miles.

Maximum Stage 2 6 April 14. Discharge 125 Cfs
Minimum Stage 0 Discharge 0 Cfs

TABLE No. 16 MONTHLY DISCHARGE OF SOURIS RIVER AT FOXHOLM, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	STATION ESTABLISHED IN APRIL, 1937				.....	.....	.....	.....
November					.....	.....	.....	.....
December					STATION ESTABLISHED IN APRIL, 1937			
January					.....	.....	.....	.....
February					.....	.....	.....	.....
March					.....	.....	.....	.....
April					0.3	0	0 2	10
May					201	0	14 8	908
June					4 7	2 1	3 6	217
July					4 0	0 0	1 2	75
August					0	0	0	0
September					0	0	0	0

Maximum Stage ..... Discharge ..... Cfs
Minimum Stage ..... Discharge ..... Cfs.
Drainage Area ..... Sq. Miles.

Maximum Stage 4 51 May 19. Discharge 202 Cfs.
Minimum Stage 0 Discharge 0 Cfs

TABLE No. 17 MONTHLY DISCHARGE OF SOURIS RIVER AT MINOT, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	0	0	0	0	.....	.....	0	.....
November	0	0	0	0	.....	.....	0	.....
December	0	0	0	0	.....	.....	0	.....
January	0	0	0	0	.....	.....	0	.....
February	0	0	0	0	.....	.....	0	.....
March	0	0	0	0	0 1	0	0	0
April	326	0 0	60 3	3,590	5 2	0.1	1 3	76
May	208	0 7	26 1	1,610	184	0 0	13 8	850
June	120	35 0	81 7	4,860	3 0	0	0 2	13
July	99	10	49 6	3,050	.....	.....	0	.....
August	84	40	69 5	4,270	.....	.....	0	.....
September	32	0	5.5	325	.....	.....	0	.....

Maximum Stage 6 45, Apr, 13. Discharge 356 Cfs
Minimum Stage 0 0 Discharge 00 Cfs
Drainage Area 10,270 Sq. Miles.

Maximum Stage 5 22, May 19. Discharge 197 Cfs
Minimum Stage 0 Discharge 0 Cfs

TABLE No. 18 MONTHLY DISCHARGE OF SOURIS RIVER AT VERENDRYE, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	STATION ESTABLISHED IN APRIL, 1937				.....	.....	.....	.....
November					.....	.....	.....	.....
December					STATION ESTABLISHED IN APRIL, 1937			
January					.....	.....	.....	.....
February					.....	.....	.....	.....
March					.....	.....	.....	.....
April					19	4	11.7	698
May					93	3 2	12 9	792
June					118	1 6	18 6	1,110
July					1 6	0 4	0 7	41
August					0 6	0,3	0.4	26
September						NO RECORD		

Maximum Stage ..... Discharge ..... Cfs
Minimum Stage ..... Discharge ..... Cfs
Drainage Area ..... Sq. Miles

Maximum Stage 2 20, May 23. Discharge 118 Cfs
Minimum Stage 0 Discharge 0 Cfs

TABLE No. 19 MONTHLY DISCHARGE OF SOURIS RIVER AT TOWNER, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	4.0	1.9	3.1	109	22	0.5	6.3	387
November					7.6	4.4	5.9	129-11 days
December								
January	NO RECORD OCT. 19th to APRIL 9th					NO RECORD		
February								
March					.....	.....	0.3	21
April	903.0	12	348	15,180	4.5	0.1	1.2	69
May	64.0	15	29.9	1,840	0.7	0.2	0.4	26
June	119.0	54	79.5	4,730	132	0.2	17.6	1,040
July	98.0	18	48.0	2,950	140	0.5	19.0	1,170
August	61.0	29	51.9	3,190	0.9	0.0	0.3	21
September	48.0	0.4	21.3	1,270	0.6	0.0	0.2	10

1935-1936: Maximum Stage 9.53 Apr. 15. Discharge 905. Cfs. Minimum Stage 1.81 Sept. 29. Discharge 0.1 Cfs. Drainage Area.....Sq. Miles

1936-1937: Maximum Stage 4.30 June 25. Discharge 226 Cfs. Minimum Stage 0 Discharge 0 Cfs.

TABLE No. 20 MONTHLY DISCHARGE OF SOURIS RIVER AT BANTRY, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October								
November								
December					STATION ESTABLISHED IN APRIL, 1937			
January								
February								
March	STATION ESTABLISHED IN APRIL, 1937				1.0	0.0	0.4	27
April					26.0	2.0	11.0	653
May					5.0	1.7	3.0	187
June					86.0	2.8	15.2	907
July					118.0	2.0	34.8	2,140
August					5.9	0.0	1.1	66
September						NO RECORD		

1935-1936: Maximum Stage..... Discharge.....Cfs. Minimum Stage..... Discharge.....Cfs. Drainage Area.....Sq. Miles

1936-1937: Maximum Stage 2.86 June 6. Discharge 118 Cfs. Minimum Stage 0 Discharge 0 Cfs.

TABLE No. 21 MONTHLY DISCHARGE OF SOURIS RIVER AT WESTHOPE, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October	1.6	0.0	0.31	19				
November	.....	.....	0.0	.....				
December	.....	.....	0.0	.....	NO FLOW OCTOBER 1st TO APRIL 6th			
January	.....	.....	0.0	.....	AND MAY 1st TO SEPTEMBER 30th			
February	.....	.....	0.0	.....				
March	.....	.....	0.0	.....				
April	139.0	0.0	32.1	1,909	9.0	0	1.8	110
May	0.2	0.0	0.0+	0.8	.....	.....	0	.....
June	42.0	0.0	7.7	458	.....	.....	0	.....
July	16	0.1	3.7	226	.....	.....	0	.....
August	.....	.....	0.0	.....	.....	.....	0	.....
September	.....	.....	0.0	.....	.....	.....	0	.....

1935-1936: Maximum Stage 4.94 Apr. 14. Discharge 139 Cfs. Minimum Stage..... Discharge.....Cfs. Drainage Area.....Sq. Miles

1936-1937: Maximum Stage 1.90 Apr. 11. Discharge 9.0 Cfs. Minimum Stage 0 Discharge 0 Cfs.

TABLE No. 22 MONTHLY DISCHARGE OF WINTERING RIVER (Souris Tributary) AT KARLSRUHE, N. DAK.

Month	1935-1936 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet	1936-1937 Discharge in Second Feet Maximum	Minimum	Mean	Run-off in Acre Feet
October								
November								
December					STATION ESTABLISHED IN APRIL, 1937			
January								
February								
March	STATION ESTABLISHED IN APRIL, 1937				15.0	0	2.6	161
April					13.0	3.0	6.0	355
May					3.6	1.4	2.1	132
June					36	1.4	12.8	763
July					2.6	0.7	1.1	69
August					1.2	0.2	0.6	37
September					1.0	0.4	0.7	41

1935-1936: Maximum Stage..... Discharge.....Cfs. Minimum Stage..... Discharge.....Cfs. Drainage Area.....Sq. Miles

1936-1937: Maximum Stage 3.82 June 13. Discharge 37 Cfs. Minimum Stage 0. Discharge 0 Cfs.

TABLE No. 23 MONTHLY DISCHARGE OF MISSOURI RIVER AT WILLISTON, N. DAK.

1935-1936

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	9,130	6,940	8,170	502,300
November	9,850	4,100	7,155	425,800
December	9,850	4,200	6,977	429,000
January	6,940	4,200	5,630	346,200
February	6,940	3,800	5,094	293,000
March	50,500	6,640	22,740	1,398,000
April	46,500	8,420	21,930	1,305,000
May	51,700	19,500	31,950	1,965,000
June	62,500	25,000	41,960	2,497,000
July	24,800	8,650	15,210	935,200
August	13,700	7,260	9,706	596,800
September	7,920	6,470	7,185	427,500

Maximum Stage 18.10 (Ice) March 9, Discharge 62,500 Cfs
Minimum Stage 1.21 February. Discharge 3,800 Cfs
Drainage Area ..... Sq. Miles.

1936-1937

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	8,850	7,400	8,465	520,500
November	14,600	5,810	9,586	570,400
December	9,850	2,490	6,205	381,500
January	7,420	3,420	4,817	296,200
February	6,080	5,000	5,564	309,000
March	17,100	5,940	12,140	746,500
April	27,200	11,300	16,210	964,400
May	30,700	10,600	18,050	1,110,000
June	88,300	27,000	48,330	2,876,000
July	52,900	11,800	29,850	1,836,000
August	14,300	4,570	7,724	474,900
September	8,880	4,570	6,252	372,000

Maximum Stage 10.27 June 16. Discharge 88,300 Cfs.
Minimum Stage 2.72 December 10 Discharge 2,490 Cfs

TABLE No. 24 MONTHLY DISCHARGE OF MISSOURI RIVER AT BISMARCK, N. DAK.

1935-1936

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	8,730	7,410	7,938	488,100
November	9,800	4,100	6,380	379,600
December	10,300	5,800	8,329	512,100
January	7,000	4,800	5,681	349,300
February	7,900	5,200	6,276	361,000
March	68,500	7,100	21,940	1,349,000
April	95,200	8,500	23,530	1,400,000
May	55,000	18,100	30,430	1,871,000
June	61,400	30,100	40,480	2,409,000
July	28,900	10,300	17,030	1,047,000
August	12,300	8,280	9,806	603,000
September	9,130	6,920	7,564	450,100

Maximum Stage 16.50 March 20. Discharge 117,000 Cfs.
Minimum Stage 2.55 October. Discharge 4,100 Cfs
Drainage Area 186,400 Sq. Miles.

1936-1937

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	9,400	7,250	8,304	510,600
November	13,000	8,200	10,220	607,900
December	9,700	3,100	5,258	323,300
January	10,500	4,100	6,027	370,600
February	5,700	5,200	5,418	300,900
March	21,700	5,400	12,210	750,500
April	42,000	14,200	19,120	1,138,000
May	29,700	11,700	16,730	1,028,000
June	94,500	23,400	48,220	2,869,000
July	72,200	16,200	33,260	2,045,000
August	15,200	5,080	9,545	586,900
September	7,810	4,750	6,227	370,500

Maximum Stage 12.65 June 18. Discharge 98,900 Cfs.
Minimum Stage 1.90 December Discharge 3,100 Cfs

TABLE No. 25 MONTHLY DISCHARGE OF LITTLE MISSOURI RIVER NEAR WATFORD CITY, N. DAK.

1935-1936

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	8.2	3.1	6.5	400
November	3.1	1.3	2.2	129
December	4.8	0.1	2.6	161
January	.....	.....	0.1	6
February	.....	.....	0.0	0
March	8,620	24	2,362	145,200
April	2,660	230	1,011	60,150
May	220	20	98.8	6,080
June	54	3.8	18.6	1,100
July	548	0	60	3,690
August	276	0	25.3	1,560
September	4.3	0	1.4	82.0

Maximum Stage 8.0 March 10. Discharge 2,800 Cfs.
Minimum Stage 0 Discharge ..... Cfs
Drainage Area ..... Sq. Miles

1936-1937

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	3.8	0.0	1.2	77
November	3.6	0.6	1.8	106
December	0.1	0.0	.....	0.8
January	.....	.....	0.0	0.0
February	.....	.....	0.0	0.0
March	2,070.0	0.0	667.0	41,020
April	2,940.0	62.0	871.0	51,810
May	950.0	30.0	132.0	8,110
June	8,470.0	122.0	2,497.0	148,500
July	3,800.0	131.0	1,175.0	72,240
August	5,360.0	6.1	1,405.0	86,410
September	1,380.0	9.4	226.0	13,430

Maximum Stage 7.85 June 15. Discharge 8,990 Cfs.
Minimum Stage 0 Discharge 0 Cfs.

TABLE No. 26 MONTHLY DISCHARGE OF CANNONBALL RIVER AT BREIEN, N. DAK.

1935-1936

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	1.4	0.5	1.0	61
November	1.2	0.9	1.1	63
December	1.2	0.5	0.9	53
January	0.8	0.2	0.4	21
February	56.0	0.2	7.1	410
March	2,040.0	69.0	576	35,420
April	388.0	36.0	118	7,020
May	73.0	5.0	22.5	1,380
June	9.0	0.5	3.1	184
July	0.4	0.0	0.2	10
August	5.0	0.1	0.5	30
September	4.9	0.2	0.6	34

Maximum Stage 6.50 March 9. Discharge 2,710 Cfs.
Minimum Stage 0.10 Discharge 0 Cfs
Drainage Area 4,066 Sq. Miles

1936-1937

Month	Discharge in Second Feet			Run-off in Acre Feet
	Maximum	Minimum	Mean	
October	0.7	0.2	0.5	29
November	1.3	0.5	0.7	43
December	0.9	0.3	0.5	31
January	1.5	0.1	0.4	24
February	0.1	0.0	0.+	3
March	1,510	0.0	313.0	19,260
April	860	62	315.0	18,740
May	71	4.2	23.5	1,450
June	10,400	22	2,384.0	141,900
July	984	56	246	15,150
August	254	9	34.7	2,130
September	472	8	86.0	5,120

Maximum Stage 14.28 June 14 Discharge 12,700 Cfs.
Minimum Stage 0.19 January Discharge 0 Cfs.

In addition to the data shown for the stream gaging stations in the preceding tables, three stations, which had been discontinued for some time were re-established during the latter part of August, 1937. These are as follows: Mandan (near) on the Heart River, Hazen (near) on the Knife River, and Jamestown on the James River. The records for these stations have not been completed. They do show, however, that such flow as prevailed for the remainder of August and the month of September, 1937, was the ordinary dry weather flow for those streams, varying from 0 flow to 10 cubic feet per second.

In March, 1938, a stream gaging station of major importance in Eastern North Dakota was established on the Sheyenne River at Valley City. There has been some controversy regarding the proper size of the Baldhill Dam and the regulated flow that may be realized as a result of its construction. This station will provide needed factual data for determining the proper size and probable benefits from this project. The results this year are valuable. The record shows that the total run-off at the station was approximately 12,000 acre feet with a maximum flow of 244 Cfs., and minimum flow of zero.

On March 27, 1938, two stations of importance in Western North Dakota were established near Marmarth. One of these was on the Little Beaver Creek, and the other on the Little Missouri River. These stations were put in operation by the U. S. Army Engineers to obtain factual data for their study of the Little Missouri River and its tributaries.

WATER RIGHTS

In North Dakota, as in all other western states, persons desiring to use a portion of the water flowing in the streams were required to make a water right filing with the State Engineer. The law creating the North Dakota Water Conservation Commission, which was approved March 6, 1937, made certain changes in the required procedure. Section 13 and a portion of Section 16 of this law describes present authority over surface waters and method of securing water rights. These are quoted for convenience as follows:

> "Section 13. Duties of State Agencies Concerned with Intrastate Use or Disposition of Waters. It shall be the duty of every state officer, department, board, and commission heretofore or hereafter authorized by any law of this state, to take any action, perform any duties, or make any contract which concerns the use or disposition of waters, or water rights, within this state to first submit to the commission any plans, purposes and contemplated action with respect to the use or disposition of such waters, and thereupon first receive the consent and approval of the commission before making any agreement, contract, purchase, sale, or lease to carry into execution any works or projects authorized under this Act."
>
> "Section 16. It is hereby declared that the commission shall have full control over all public water of the state now unappropriated, whether above or under the ground, to the extent necessary to fulfill the purposes of this Act.
>
> "In acquiring the rights and administering the terms of this Act herein prescribed and established, the commission shall not be limited to the terms of the statutes of the State of North Dakota relating to water rights heretofore enacted; but, in addition thereto, may initiate a right to the waters of this state by executing a declaration in writing of the intention to store, divert, or control the unappropriated waters of a particular body, stream, or source, designating and describing in general terms such waters claimed, means of appropriation and location of use, and cause said notice to be filed in the office of the state engineer, which right shall vest in such commission on the date of the filing of such declaration. The commission shall also file in the office of the state engineer copies of its plans and specifications involved in completing all appropriations of water. * * * * *"

In recent years there has been increased activity in the filing of water rights for irrigation and other purposes. This becomes evident from the data in the following tables which list the water rights filed with the State Engineer up to December 1, 1938. These data are grouped by drainage basins as outlined in Plate I. By comparing these data with Tables 1 to 26, the proportionate amount of the average annual flow now filed on can be determined.

MAIN STEM MISSOURI RIVER

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Thomas E. McGregor	26	149	100	3.64	131	Tobacco Gardens Creek
Haivor Rolfsrud*	32	152	96	0.10	8	Tobacco Gardens Creek
Mina Stenehjem	6	154	100	1.00	80	Little Muddy Creek
T. Rolfstad	30	155	100	0.50	25	Little Muddy Creek
Roy Lindvig	19	155	100	1.00	80	Little Muddy Creek
Lucius S. Albright	13	156	102	0.50		Cow Creek
Nels Lundell	10	155	101	0.36	28.70	Little Muddy Creek
Richard E. Ike*	18	154	101	0.44	35	Little Muddy Creek
Henry A. Martin, Fred J. Wilkinson and Wayne S. Martin	15	153	102	3.44		Painted Woods Creek near Williston
Oscar S. Oberg	34	144	81	0.49	39.03	Painted Woods Creek near Washburn
M. G. Ward	12	139	81	2.00	155	Burnt Creek
A. W. Gussner	2	139	81	1.50	120	Burnt Creek
Logan Ward	13	139	81	1.43	114.63	Burnt Creek
Oscar H. Will & Co.	34	138	80	0.31	25	Apple Creek
I. J. Reid	36	139	79	1.25	100	Apple Creek
Clara G. Tatley	9	139	79	0.50	40	Apple Creek
Harry Tatley*	9	138	79	0.19	15	Apple Creek
V. M. Craven*	14	139	78	0.38	30	Apple Creek
J. R. Burns	1	147	85	9.50	762	Garrison Creek
Carl Barteison	35	154	94	10.00	685	White Earth River
Frank I. J. Kiebert	35	141	82	0.50	25	Square Butte Creek
Bruno Upmeyer*	22	154	101	0.38	30	Sand Creek
T. B. Meinhover*	6	133	76	0.10	9	Beaver Creek

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

In addition to the filings shown above, Federal Agencies have filed on extensive water rights for the creation of water fowl refuges and water use projects on Indian Reservations. The following is a list of these filings.

U. S. Biological Survey Filings

1. From Appert Lake Creek, a tributary of Long Creek—Missouri River—a storage right of 365 acre feet and an additional seasonal use of not to exceed 309 acre feet. (Emmons County).

2. From Camp Lake, Strawberry Lake, Turtle Creek, a tributary of the Missouri River, a storage of 706 acre feet and an additional seasonal use of not to exceed 648 acre feet. (McLean County).

3. From Canfield Lake, a tributary of the Missouri River in Burleigh County, a storage of 872 acre feet and an additional seasonal use of not to exceed 654 acre feet.

4. From Beaver Creek for Flickertail project in Emmons County, a storage of 141 acre feet and seasonal use of 183 acre feet.

5. From Florence Lake, a tributary of the Missouri River in Burleigh County, a storage of 300 acre feet and seasonal use of 300 acre feet.

6. From Lake George, a tributary of the Missouri River in Kidder County, a storage of 773 acre feet and seasonal use of 468 acre feet.

7. Half Way Project with drainage to the Missouri River in Stutsman County, a storage of 90 acre feet and a seasonal use of 90 acre feet.

8. Hiddenwood Project, Hiddenwood Lake, with drainage to the Missouri River, a storage of 240 acre feet and a seasonal use of 336 acre feet. (McLean-Ward).

9. Hutchinson Project, in Kidder County, with drainage to the Missouri River, a storage of 90 acre feet and seasonal use of 90 acre feet.

10. Legion Lake Project on Shell Creek, in Mountrail County, a storage of 865 acre feet and seasonal use of 1,230 acre feet.

11. Little Lake Project, on Long Lake and Long Lake Creek, with drainage to the Missouri River in Emmons County, a storage of 43 acre feet and a seasonal use of 39 acre feet.

12. Lost Lake Project, on Painted Woods Creek, in McLean County, a storage of 61 acre feet and seasonal use of 183 acre feet.

13. Lake Moraine Project, on west branch of Apple Creek in Burleigh County, a storage of 40 acre feet and a seasonal use of 30 acre feet.

14. Lake Nettie, Turtle Creek Drainage into the Missouri River, a storage of 2,268 acre feet and seasonal use of 1,260 acre feet.

15. Lake Oliver on Square Butte Creek in Oliver County a storage of 190 acre feet and seasonal use of 219 acre feet.

16. Shell Creek Project on Shell Creek in Mountrail County a storage of 1500 acre feet and seasonal use of 1596 acre feet.

17. Spring Water Project on Clear Creek, a tributary of Beaver Creek Missouri River drainage in Emmons County, storage of 64 acre feet and seasonal use of 48 acre feet.

18. From Sunburst Lake and Sunburst Lake Creek in Emmons County, storage of 119 acre feet and seasonal use of 99 acre feet.

19. Lake Susie project on Deep Water Creek in McLean County, storage of 148 acre feet and seasonal use of 210 acre feet.

20. From Wildfang Project and west Branch of Apple Creek in Burleigh County, a storage of 251 acre feet and seasonal use of 207 acre feet.

21. From Yanktonia Creek for Yanktonia Project in McLean County a storage of 181 acre feet and seasonal use of 129 acre feet.

22. Lake Zahl Project on Little Muddy Creek in Williams County a storage of 3003 acre feet and seasonal use of 3,900 acre feet.

23. Clear Water Lake Project, Little Knife River, Mountrail County, a storage of 403 acre feet and seasonal use 432 acre feet.

February 13, 1936[1]

Long Lake Creek and its tributaries, together with such other watersheds as are also tributary to and empty into Long Lake, Burleigh and Kidder Counties, North Dakota.

Indian Reservation Filings[1]

W. O. Beyer—Fort Berthold Indian Reservation—Elbowoods, N. Dak.
Beaver Creek—1,980 ft. from Public Survey Corner
Center Sec. 5; Twp. 146 N; Range 88 W.
Six Mile Creek—3,800 ft. from Public Survey Corner.
Center Sec. 17; Twp. 147 N; Range 88 W.

YELLOWSTONE RIVER BASIN

Name of Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Sioux Mutual Aid Corp.	14	151	104	12.10	920	Yellowstone River
Frank Lassey*	31	151	103	0.50	40	Charbonneau Creek

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

LITTLE MISSOURI RIVER BASIN

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Gus A. Johnson*	30	149	98	0.50	40	Little Missouri River
H. P. Lundin*	11	150	98	0.68	55	Cherry Creek
John Wen Dike*	4	150	98	0.38	30	Cherry Creek
Osmund Hamre*	10	149	99	0.38	30	Cherry Creek
Joseph Seibold*	19	150	98	0.25	20	Cherry Creek
Geo. Gerbig*	32	137	101	0.38	30	Little Missouri River
Louis Signalness*	6	148	96	0.88	70	Little Missouri River

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

In this basin the Federal Government has entered into an extensive land buying program. Mr. M. B. Johnson of Dickinson, North Dakota, is manager of this project and has made the following blanket water right filing for this area:

> "All creeks, intermittent streams and other water sheds and their tributaries which drain any part of the project area and which empty or may empty into the Missouri, Yellowstone and Little Missouri and all their tributaries within the boundary lines of the project area, also all springs and underground waters which have been or may be brought to the surface through wells within the project area."

The United States Biological Survey has three filings in this basin for water fowl refuges. These are as follows:

1. Cherry Creek Project on Cherry Creek in McKenzie County, storage 82 acre feet—seasonal use 60 acre feet.

2. Tobacco Gardens—Cherry Creek Project on Cherry Creek and Tobacco Gardens Creeks a storage of 190 acre feet and seasonal use of 219 acre feet. (McKenzie County).

3. Stewart Lake Project, Slope County, storage 802 acre feet, seasonal use 591 acre feet.

[1] Incomplete—Water-needs to be determined upon completion of plans.

KNIFE RIVER BASIN

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Northern Pac. Ry.	8	139	96	1.00	Ry. Supply	Knife River
Northern Pac. Ry.	33	140	90	2.00	Ry. Supply	Knife River
Northern Pac. Ry.	23	144	89	2.00	Ry. Supply	Knife River
Northern Pac. Ry.	24	145	92	2.00	Ry. Supply	Knife River
Campbell Scott	6	143	95	0.70	53	Knife River
Dan Brew	12	143	96	0.30	24	Knife River
R. E. O'Neil	30	144	87	0.54	43	Knife River
Isabel S. Little	26	144	97	0.19	15	Knife River
E. A. Karges	26	144	87	0.51	41	Knife River
N. D. Power & Light Company	25	144	88	0.25	Power Plant	Knife River
Mattie Belle Stephens	6	144	85	0.30	21	Knife River
Richards, Wilcox & Co.	20	145	95	10.62	850	Knife River
John Bang	26	145	94	1.00	40	Knife River
Alf Olafson*	12	145	92	0.25	20	Knife River
Joseph Brew	6	143	95	0.50	37	Knife River
Paul O. Dahlke	35	141	94	2.00	160	Knife River
Fred Senerius*	20	144	88	0.50	40	Spring Creek
Emma L. Sampson*	34	144	96	0.32	25	Knife River
Mary B. Materna*	15	143	95	0.25	20	Knife River
Lewis Dinehart*	14	143	95	0.63	50	Knife River

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

In this basin the United States Biological Survey has created the largest artificial lake in North Dakota. This was named Lake Ilo, and is located on Spring Creek, the largest tributary of Knife River near the town of Dunn Center. The following is the water right for this lake:

1. Lake Ilo Project on Spring Creek in Dunn County, a storage of 7130 acre feet and seasonal use of 3720 acre feet.

HEART RIVER BASIN

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Northern Pac. Ry.	8	139	96	2.00	Ry. Supply	Heart River
Northern Pac. Ry.	7	139	94	0.50	Ry. Supply	Heart River
Northern Pac. Ry.	31	139	88	2.00	Ry. Supply	Heart River
Northern Pac. Ry.	11	138	86	0.50	Ry. Supply	Heart River
Emma F. McBride	13	139	97	.25	20	Heart River
Fred Finger	12	139	98	4.00	248	Heart River
Albert Weigum	15	139	97	2.00	105	Heart River
A. J. Sylvester	1	138	81	2.19	175	Heart River
Karl Kilian	28	139	81	0.12	10	Heart River
G. A. Renden	36	139	81	2.00	170	Heart River
C. T. Langley	2	137	92	1.00	90	Heart River
Thomas, John, Robert & Joseph Fisher	4, 5, &9	140	96	4.00	320	Green River
R. W. Gilliam	27	140	95	1.25	100	Green River
Kirsch & Helbling	34	139	94	1.00	63	Heart River
E. L. Thorkelson*	15	139	97	0.63	50	Heart River
Adolph Sprenger*	27	135	89	0.32	25	Antelope Creek
Ed Nuss*	20	135	89	0.25	20	Antelope Creek
Theo. L. Semerad*	26	141	97	0.32	25	Green River

*Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

It will be noted that there are no filings in this basin by the United States Biological Survey.

CANNONBALL RIVER BASIN

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Western Dakota Ry. Co.	36	134	82	2.00	Ry. Supply	Cannonball River
Western Dakota Ry. Co.	2	133	93	2.00	Ry. Supply	Cannonball River
Western Dakota Ry. Co.	5	133	90	2.00	Ry. Supply	Cannonball River
Western Dakota Ry. Co.	14	134	86	2.00	Ry. Supply	Cannonball River
Wm. H. Brown Co.	2	133	93	1.00	80	Cannonball River
Anton Bolte*	10	134	95	1.00	80	Cannonball River
Matt Meissner	3	133	93	1.00	40	Cannonball River
W. T. Krebsbach*	35	133	98	1.50	129.2	Cannonball River
Mrs. Wilhelmine Hagen	35	133	98	1.50	114	Cannonball River
B. Byron Bobb	1	129	94	2.00	128	Duck Creek
Harry W. Long*	26	134	81	0.38	30	Cannonball River
Odessa Mutual Aid*	8	133	90	0.45	36	Cannonball River
Hoerauf Mutual Aid	2	133	89	0.25	20	Cannonball River

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

The following water right was filed on behalf of the Indians on the Standing Rock Reservation.

L. C. Lippert—Standing Rock Indian Reservation—Fort Yates, N. D.[2] Cannonball River—1,960 ft. from Public Survey Corner N. E. Corner Sec. 31; Twp. 132 N., Range 83 E. 4th P. M.

In this basin the United States Biological Survey has four waterfowl refuges. The water rights for these are as follows:

1. Charles Lake Project on Charles Lake Creek, a storage of 185 acre feet and seasonal use of 111 acre feet.

2. Lake Patricia Project on Lake Patricia Creek, a storage of 906 acre feet and seasonal use of 834 acre feet.

3. Pretty Rock Project on Pretty Rock Creek, a storage of 989 acre feet and seasonal use of 603 acre feet.

4. White Lake Project on tributary of Cannonball River, a storage of 760 acre feet and seasonal use of 555 acre feet.

GRAND RIVER BASIN

Only one water right has been filed within the area in North Dakota drained by the Grand River. This is as follows:

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Levi Dodge	34	129	98	2.00	83.7	Grand River

There are no projects of United States Biological Survey in this drainage basin.

[1] Incomplete—Water-needs to be determined upon completion of plans.

SOURIS RIVER BASIN[1]

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
Minot Sand & Gravel Co.	21	155	83	1.50	Washing Sand & Gravel	Souris River
L. S. Foot	....	156	84	10.00	803	Souris River
Graham Bros.	9	156	84	3.00	241	Souris River
J. B. Eaton	1	155	77	4.10	332	Souris River
Carl J. Johnson[2]	31	161	85	2.00	149	Souris River
W. R. Carter[1]	31	161	85	2.00	155	Souris River
	25	161	86			
Frank Swenson[2]	25	161	86	1.00	70	Souris River
Andrew Olson[2]	20	162	86	1.00	80	Souris River
N. P. Lindelauf[1] 14 &	11	161	86	2.00	110	Souris River
J. C. Eaton	14	155	77	8.00	530	Souris River
John Swenson[2]	3	161	86	1.00	90	Souris River
St. Teach. College	14	155	83	1.00	30	Souris River
Herman Hanson Oil Syndicate	29	156	82	1.00	Gold Washing Plant	Souris River
Rural Rehabilitation Corporation	34	156	84	4.00	274.1	Des Lacs River
Vern A. Soderquist*	26	163	94	0.06	5	Short Creek
T. S. Stuart*	32	164	97	0.38	30	Long Creek
Eaton Flood Irrig. Project	....	156	76	10,000 A. Ft.[3]	7,000	Souris River

In this basin the United States Biological Survey has created one of the most prolific breeding grounds for waterfowl in the United States. For this reason they have extensive water right filings which are enumerated in the following:

1. From the Des Lacs River and its tributaries north of the town of Baden, not to exceed 65,000 acre feet per annum for use on the Des Lacs Migratory Waterfowl Refuge.

2. From the Souris River and its tributaries for use on the Upper Souris Migratory Waterfowl Refuge and the Lower Souris Migratory Waterfowl Refuge, an annual use from April 1st to November 1st, of 61,000 acre feet and an additional storage right from January 1st to December 1st, of 120,000 acre feet.

3. From Cottonwood Lake Creek, a tributary of the Wintering-Souris River, a storage right of 750 acre feet and additional seasonal use of 600 acre feet to maintain water levels on the Cottonwood Lake Creek Project in McHenry County.

4. From Lord's Lake, a tributary of Willow Creek-Souris River, a storage right of 5252 acre feet and additional seasonal use of 2334 acre feet to maintain water levels on Lord's Lake Project in Bottineau-Rolette Counties.

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual shown.

[1] See also blanket water right filing by U. S. Biological Survey on Page 24.

[2] These are prior rights and were purchased with the land by the United States Biological Survey.

[3] This provides for 10,000 acre feet to flood 7,000 acres in the spring of the year, and has priority over the U. S. Biological Survey.

5. From Oen Creek, a tributary of the Souris River, a storage right of 31 acre feet and an additional seasonal use of 75 acre feet to maintain water level on Oen Project in Ward County.

6. From Rabb Lake, a tributary of Willow Creek-Souris River, a storage of 251 acre feet and an additional seasonal use of 291 acre feet to maintain water level on Rabb Lake Project in Rolette County.

7. From School Section Lake and Creek, a tributary of Willow Creek- Souris River, a storage right of 2,098 acre feet and an additional use of 915 acre feet to maintain water level in School Section Lake in Rolette County.

8. From Willow Lake and Branch Creek, a tributary of the Willow Creek-Souris River, a storage of 7,200 acre feet and an additional seasonal use of 3,600 acre feet to maintain water level on the Willow Lake Project in Rolette County.

9. From Wintering River, a tributary of the Souris River, a storage right of 103 acre feet and an additional seasonal use of 258 acre feet to maintain water level on the Wintering River Project in McHenry County.

JAMES RIVER BASIN[1]

Name or Corporation	Location S	T	R	Water Right CFS	Use or Acres to be Irrigated	Name of Tributary, Creek, or River
N. P. Railway Co. ..	26	140	64	2.00	Ry. Supply	James River
N. P. Railway Co. ..	13	146	69	0.50	Ry. Supply	James River
E. R. Anderson	11	136	63	1.00	90	James River
State Hospital*	6	139	63	2.00	157	James River
T. H. Lynch*	11	133	61	1.00	80	James River

The United States Biological Survey has several waterfowl refuges in this area, the water rights for which consist of the following:

1. From the James River and its tributaries, a storage right of 16,000 acre feet and an additional seasonal use of not to exceed 10,000 acre feet to maintain water levels on the Arrowwood and Jim Lakes Migratory Waterfowl Refuge in Stutsman County.

2. From the James River and its tributaries, a storage right of 3,200 acre feet and an additional seasonal use of not to exceed 4,800 acre feet to maintain water level on the Dakota Lake Migratory Waterfowl Refuge in Dickey County.

3. From Bone Hill Creek, a tributary of the James River, a storage right of 114 acre feet and an additional seasonal use of not to exceed 114 acre feet to maintain water level on the Bone Hill Creek Migratory Waterfowl Refuge in LaMoure County.

[1] See also blanket water right filing by U. S. Biological Survey on Page .....

* Filing made by the State Water Conservation Commission for an irrigation project operated by the individual or institution shown.

4. From Maple River, a tributary of the James River, a storage right of 310 acre feet and an additional seasonal use of not to exceed 390 acre feet to maintain water level on the Maple River Migratory Waterfowl Refuge in Dickey County.

WILD RICE RIVER BASIN

The only filings for water rights in this basin consist of those made by the United States Biological Survey for waterfowl refuges. These are as follows:

1. Clouds Lake Project in Sargent County, a storage of 397 acre feet and seasonal use of 312 acre feet.

2. Lake Elsie Project on Wild Rice River in Richland County, a storage of 522 acre feet and additional for seasonal use of 900 acre feet.

3. Lake Tewaukan on Wild Rice River in Sargent County, a storage of 7,198 acre feet and seasonal use of 4,251 acre feet.

4. Storm Lake Project in Sargent County, a storage of 729 acre feet and seasonal use of 516 acre feet.

5. Wild Rice Project in Sargent County, a storage of 80 acre feet and seasonal use of 120 acre feet.

LOWER RED RIVER BASIN

Filings for water rights in this basin also consist only of those made by the United States Biological Survey. These are listed as follows:

1. Kelley's Slough Project in Grand Forks County on Turtle Creek, a storage of 195 acre feet and seasonal use of 390 acre feet.

Goose River Sub-basin:

1. Lambs Lake Project on Goose River in Nelson County, a storage of 269 acre feet and additional for seasonal use of 333 acre feet.

2. Little Goose River Project in Grand Forks County, a storage of 138 acre feet and seasonal use of 132 acre feet.

3. Prairie Lake Project in Nelson County, a storage of 43 acre feet and seasonal use of 129 acre feet.

Forrest River Sub-basin:

1. Ardoch Lake Project in Walsh County on Forrest River, a storage of 2,875 acre feet and seasonal use of 3,450 acre feet.

2. Pioneer Lake Project on Forrest River in Walsh County, a storage of 50 acre feet and seasonal use of 63 acre feet.

Park River Sub-basin:

1. Billings Lake Project, on headwaters of Park River in Cavalier County, a storage of 216 acre feet and seasonal use of 216 acre feet.

SHEYENNE RIVER BASIN

There are no filings in this basin by individuals for irrigation purposes. Much of the Sheyenne River Basin is in the more humid regions of North Dakota where irrigation is not so essential. Furthermore, surface run-off is very limited, and a water supply for irrigation during drouth periods is unreliable. The United States Biological Survey, however, has extensive water right filings for waterfowl refuges, which are listed as follows:

1. Buffalo Lake Project on Sheyenne drainage, Pierce County, storage of 3,135 and additional for seasonal use of 1,986 acre feet.

2. Hobart Lake Project on creek in Barnes County, a storage of 778 acre feet and additional for seasonal use of 834 acre feet.

3. Johnson Lake Project on Creek tributary to Sheyenne River in Eddy-Nelson-Foster Counties, a storage of 2,590 acre feet and seasonal use of 2,220 acre feet.

4. Pleasant Lake Project on Pleasant Lake Creek in Benson County, a storage of 1,166 acre feet and seasonal use of 1,440 acre feet.

5. Rose Lake Project on Sheyenne Drainage in Nelson County, a storage of 225 acre feet and additional for seasonal use of 255 acre feet.

6. Sheyenne Lake Project on Sheyenne River in Sheridan County, a storage of 628 acre feet and seasonal use of 534 acre feet.

7. Sibley Lake Project on Baldhill Creek in Griggs County, a storage of 1,300 acre feet and seasonal use of 1,461 acre feet.

8. Stoney Slough Project on Stoney Creek in Barnes County, a storage of 1,911 acre feet and seasonal use of 1,365 acre feet.

9. Tomahawk Project on Tomahawk Creek in Barnes County, a storage of 303 acre feet and additional for seasonal use of 189 acre feet.

The following was filed by the Soil Conservation Service in behalf of a 65,000 acre tract purchased by the U. S. Government lying south of the Sheyenne River in Ransom and Richland Counties.

Sheyenne River Project LD-No. 6. All Creeks, intermittent streams and other watersheds and their tributaries which drain any part of the project area and empty or may empty into the Sheyenne River within the boundary lines of the project area, also springs and other underground waters brought to the surface through wells within the boundary lines of the project area.

DEVILS LAKE BASIN

Water supplies for any purpose are rather limited in this basin. There is only one water right filing, and it was placed on record by the

United States Biological Survey under date of February 21, 1935, and reads as follows:

All creeks, intermittent streams, and other watersheds and their trihutaries, which empty or may empty into North or South Rock Lake, in Towner County, North Dakota, and Mauvais Coulee, otherwise known as the Big Coulee, and all its tributaries.

From the preceding list of water rights, it will be noted that various Federal Agencies, particularly the United States Biological Survey, have filed claims to much of the surface waters of the State. This is particularly true of the Souris River Basin where facilities of the United States Biological Survey have a sufficient capacity to utilize and regulate the average annual run-off. This has resulted in the creation of one of the most prolific waterfowl propagation areas of the nation and, incidentally, has had a very beneficial effect in providing water for sewage dilution at Minot and water for the farmers along the Souris River during times when the river would otherwise have no flow.

With increasing interest in irrigation throughout Western North Dakota, water rights become of increasing value, and the proper administration of this function requires very careful thought and consideration.

HYDROGRAPHIC SURVEYS AND INVESTIGATIONS OF STREAM BASINS

During the summer and fall of 1936, extensive investigations were made of the various drainage basins in the State. For the purposes of these studies the State was divided into five major drainage basins as follows: The Red River Basin, including all its tributaries in North Dakota; Souris and Devils Lake Basins combined; James River Basin; Main Steam of the Missouri, including its minor tributaries; and the Slope Area which includes the area in North Dakota drained by the following rivers: Yellowstone, Little Missouri, Knife, Heart, Cannonball, and Grand. The areas incorporated in these various basins are shown on Plate I.

A report on this activity is contained in the State Engineer's "Seventeenth Biennial Report," on pages 9, 10, 11, and 12. This work was undertaken by the State Planning Board in co-operation with the State Engineer under the direction of the National Resources Committee, which organization supplied technical consultants for this work. It was the wish of this committee that the reports prepared as a result of this study be revised periodically so they will represent prevailing conditions. Meetings have been held for this purpose with representatives of the various State and Federal agencies interested in this work. The State Engineer was either present or represented at these meetings which took place as follows: St. Paul, Minnesota, November, 1937, for discussion of the drainage basins of the Red River, Souris River and Devils Lake, and meetings at Aberdeen, South Dakota, and Bismarck, North Dakota, for the discussion of the area drained by the Missouri River and its tributaries in North Dakota. During the fall of 1938 meetings were again called for this purpose. At these meetings data were presented which are definitely bringing about a better understanding of our North Dakota water problems.

Red River Drainage Basin

The U. S. Army, Corps of Engineers, have also made some intensive studies of several drainage basins in the State. A WPA grant was made available in the fall of 1936 for a study of the Red River Basin, and a report outlining a plan for this area was published in 1937. Some revisions of the plans proposed in this report have been suggested by interested persons in the State, and the report is being reviewed at this time.

Irrigation Investigations—Army Engineers

An appropriation was also made to the U. S. Army Engineers in the fall of 1936 for a study of irrigation possibilities on the Missouri River bottom lands including the Heart-Butte Dam and irrigation project on the Heart River, and the Bowman County Dam and irrigation project on the Grand River. The data accumulated by this study has been referred to the U. S. Bureau of Reclamation for review. The Reclamation Bureau made their comments to the Army Engineers. A final report on this study will likely be made to the 1939 Congress, and be available to the public thereafter.

Missouri River Diversion

A detailed study of the Missouri River Diversion Project was also made at about the same time. Their report on this study showed an estimated cost of $54,106,299 for the diversion of 1,000 cubic feet per second, and $36,237,516 for diversion of 500 cubic feet per second. The capitalized benefits to be realized from this plan were given at $7,434,590. The State took exceptions to various items in this report, and presented evidence to a Board of Review in Washington, D. C., on September 27, 1937, to substantiate their claims. All the information gathered to date is now being reviewed by a special Board of Army Engineers headed by Lt. Col. Philip B. Fleming, District Engineer of the St. Paul Office, U. S. Corps of Engineers. Col. Fleming held a public hearing in Bismarck on December 15 and 16, 1938, to permit the presentation of additional evidence. Continued insufficient flow in the streams of central and eastern North Dakota has emphasized the need for this project.

Souris River

On February 17, 1937, the Army Engineers held a meeting at Minot for the purpose of studying flood control measures along the Souris River. No report on the findings of this study has been made public to date.

In recent years extensive development has taken place in the Souris River watershed in Canada. Several dams, creating large storage reservoirs and a flood irrigation project similar to that near Towner (Eaton Project), were constructed. This has materially reduced the quantity of water which may be expected in this State, and has also materially reduced the flood hazards in the Souris River Valley.

Little Missouri River

In December, 1937, the Army Engineers held a hearing at Medora, North Dakota, to give the public an opportunity to present evidence to substantiate the need of a re-study of the Little Missouri River watershed. As a result of this hearing the former surveys of the Army Engineers were reviewed in the light of more recent developments, and a new report on this drainage basin submitted to the War Department in Washington, D. C. This report will likely be submitted to Congress during the 1939 session and be made public thereafter.

At this hearing data were submitted to substantiate the need for two large reservoirs; one on Little Beaver Creek south and west of Marmarth, and one on the Little Missouri River approximately 20 miles south of the city of Marmarth. These reservoirs would provide flood protection for the city of Marmarth, and also make possible a regulated flow in both Little Beaver Creek and the Little Missouri River. This would assure a water supply for irrigating the river bottom lands in the respective valleys. Considerable interest in irrigation was manifested by the ranchers in this valley during the past summer. It was also shown that the irrigation of these bottom lands would do a great deal to stabilize the livestock industry. Much of the land is only fit for grazing and production of winter feed is a serious problem.

Pembina and Tongue Rivers

In October, 1938, the Army Engineers held a meeting in Cavalier to give the public an opportunity to present evidence to substantiate requests for flood control projects on the Tongue and Pembina Rivers. The State Engineer prepared a brief showing the flood damages which have been recorded in various reports filed in his office. The brief also gave other important hydrological and climatic data. The Army Engineers' report on this study will likely be made public during the spring of 1939.

General—Flood Control

Efforts are being made to secure approval for the construction of projects on streams studied by the Army Engineers in the Flood Control Bill to be considered by the 1939 Congress. Efforts are also being made to have this bill include authorization for investigations by the Army Engineers on the Park, Forest, Goose, and Knife Rivers. It is a tedious task to get a project under construction through the Flood Control Act. However, the material benefits to be realized justify the persistent efforts required.

National Rivers and Harbors Congress

The National Rivers and Harbors Congress is a national organization having considerable influence in Washington and is interested in the development of the water resources of the nation. This organization meets in Washington, D. C., once a year at which time proposed projects are considered, and if approved, recommended to the Congress and the President. The State Engineer attended the meetings of this Congress during the past two years, and during 1938 served on the resolutions committee.

In submitting projects to this organization, they must be accompanied by both technical and economic data. Considerable time and effort, therefore, is required in their preparation. The projects that have been submitted, with the recommendations received, are as follows:

No.	Name of Project:	Classification:
299-R	Red River of the North Basin, Water Program, North Dakota, South Dakota, and Minnesota	Meritorious [1]
208-R	North Dakota Pumping Project	"
210-R	Washburn Irrigation Project	"
209-R	Bismarck Pumping Project for Irrigation	"
214-R	Heart-Butte Pumping Project	"
217-R	Bowman Irrigation Project	"
294-R	Pipestem Creek, Reservoir Project	"
388	Fort Stevenson Flats Irrigation Project	"
389	Nesson Irrigation Project	"
390	Livona Flats Irrigation Project	"
212	Broncho and Hazen-Beulah, Reservoir Project	Expeditious [2]
295-R	Little Beaver Creek, Reservoir Project	Recommended for Survey [3]
297-R	Dickinson, Reservoir Project	" " "

In addition to the above projects which were submitted and considered in March, 1938, the following projects were formerly submitted, and are carried on the project listing of the Rivers and Harbors Congress.

No.	Name of Project:
211	Marmarth Flood Control Project (Little Missouri River)
213-R	Gladstone Reservoir Project (Heart River)
215	Cannonball River Project
216	Arrowwood Lake Reservoir (James River)
221	Cartwright Irrigation Project (Yellowstone River)

National Reclamation Association

This is another national agency interested in planning the use of the nation's water resources. As the name implies, this agency is primarily interested in the development of irrigation. It has co-operated with, and assisted State Agencies in advancing the status of irrigation projects in North Dakota.

As a member of this association, the State Engineer attended the annual conventions. The 1938 convention was held in Reno, Nevada, on October 11, 12, and 13. At this convention the State Engineer served on the Resolutions Committee. Mr. M. O. Ryan, Secretary of the

[1] Meritorious. This means that the Committee believes that although the project is not sufficiently advanced in status to warrant the present endorsement, it is meritorious and open for further consideration by the Committee.

[2] Expeditious Report on Authorized Survey Requested. This means that the Committee believes the Congress should request the engineering authority to expedite the report of its investigation and survey of the project to the end that appropriate further action may be had thereon in regard to classification by the Congress.

[3] Recommended for Survey. This means that the Committee believes that sufficient showing on behalf of the project has been made to warrant further examination in the form of an adequate survey by an appropriate agency of the Federal Government.

Greater North Dakota Association from Fargo, North Dakota, was another North Dakota representative, and is a member of the Board of Directors. Mr. J. Arthur Engen, a member of the State Water Conservation Commission, was another representative and served on the Legislative Committee.

With increasing interest in irrigation in Western North Dakota, the co-operation of this agency may be of material assistance in advancing our projects to the construction stage.

FLOODS

In a study of the hydrology of the streams of the State, floods are of major importance, not only because of the property damage resulting from these floods, but also because of the accompanying human suffering. In recent years, Congress has recognized the necessity of providing projects for flood protection.

During the past two years, floods in North Dakota have been confined to the Slope Area and the Missouri River. A record of these floods is essential so their devastating effect will not be overlooked in evaluating future flood control projects. A brief discussion of the more important areas affected during the past two years will be made a part of this report.

Missouri River

During the spring of 1938 the Missouri River reached a stage approaching that of March, 1928, which is the highest stage officially recorded. As a result, there was some loss of livestock and property damage. Its general affect, however, was considered beneficial to the valley as a whole. The extensive bottom lands along the river were flood irrigated, and sufficient moisture was stored in the ground to produce a hay or grain crop.

This flood was not due to excessive run-off; it was caused by intermittent ice jams along the stream. Following are the gauge heights at Bismarck for the days during which the flooding occurred: March 15, 9.75; March 16, 10.3; March 17, 11.30; March 18, 14.93 March 19, 20.05 at 4:30 P. M.; March 20, 19.52; March 31, 12.63. In the above it will be noted that the river reached its maximum stage at 4:30 P. M., March 19. At this time, the extensive river bottoms between Mandan and Bismarck were under water, lacking only 6 inches of going over the highway grade.

The Fort Peck Dam did not diminish the flow in the Missouri River at this time. Storage of water for flood control and navigation was commenced on March 27 which was after the flooding had occurred. Had the flow from the Missouri River above the Fort Peck Dam been retained, there would likely have been no flooding of the river valley.

Heart River

Rains of severe intensity in 1937 did some damage in the upper portions of this drainage basin. At Dickinson a small truss bridge used by the Dickinson Brick Plant, and several dams in the surrounding area were washed out. There is no record of other damage.

In the spring of 1938, the ice jams and flooding of the Missouri River bottoms also caused the ice in the Heart River to form jams at its confluence with the Missouri. This caused the flooding of portions of the City of Mandan. In common with the Missouri River, the Heart also reached its crest on March 19, and the water soon receded after the ice barrier in the Missouri River moved on down stream. No effort was made to determine the property damage as a result of this flooding, though more than 30 families temporarily had to leave their homes.

In July, 1938, however, a more serious flood occurred. This was a repetition of a similar flood in July, 1935. These floods have more serious consequences because they destroy growing crops. A more extensive investigation was made of the 1938 summer flood by the State Planning Board, which agency collected the data regarding the losses incurred.

The secretary of the County Welfare Board estimated that this flood cost governmental agencies an additional $20,000 for increased relief needs. Other losses reported by individuals or government agencies follow: Livestock losses $150; crop losses $14,700; and Soil Conservation Service tree nursery $30,000. This amounts to a total of $64,850 and includes only the area near Mandan. A complete investigation for the entire river valley would likely disclose damages in excess of $100,000.

In 1935, no record was made of the damages caused by the flood, or the river discharge.

The stream gauging station re-established on the Heart River near Mandan in August, 1937, has provided factual data on the 1938 flood. Preliminary calculations, from the data obtained, show that the river reached a maximum stage on July 7 of 16.9 feet, at which it had a discharge of 12,200 Cfs. Low water with no flow registers approximately 4.9 feet on the gauge.

The storm causing this flood in the Heart River was centered around Richardton and Hebron. Precipitation data recorded by the various weather bureau stations in the Heart River Basin are shown in Table 27.

TABLE No. 27
PRECIPITATION
Heart River Basin — July 1 to 7

Recording Stations	Precipitation in Inches, July						
	1	2	3	4	5	6	7
Fryburg	.53	.33	.27	....	.57	....	....
Dickinson	.32	T	1.39	.12	.71	....	....
Richardton	.43	1.46	....	3.08	.61	....	....
Carson	.73	.07	....	.37	.53	....	.03
New Salem	.48	....	T	.35	.70	....	.02

The above table indicates that the storm covered a comparatively small area, yet produced a flood discharge of 12,000 Cfs. A discharge of greater volume can, therefore, be anticipated, and means should be provided to reduce the resulting damages.

A project has been studied by local, state, and federal authorities to provide protection for the Heart River Valley. This is the so-called Heart Butte Project located about 60 miles up the Heart River Valley from its confluence with the Missouri. This project is now proposed to create a storage capacity of approximately 90,000 acre feet and irrigation development for 12,000 acres of land. This project would eliminate flood damages such as were caused by the floods of 1935 and 1938.

Knife River

Floods with serious consequences occurred in the towns of Hazen and Beulah in the Knife River Valley. These were not caused by high water in the Knife River itself, but by exceedingly high run-off in small tributaries.

Hazen Flood

At Hazen the flood was caused by run-off in Antelope Creek. This creek flows east a short distance to the north of Hazen and enters the Knife River several miles east of the town. Approximately 1½ to 2 miles northwest from Hazen this creek has a sag in its south bank. Through this, a large volume of water sought its way to the river. In doing this it spread over an area approximately 1,000 to 1,500 feet in width. Natural obstructions to flow such as growing grain, buildings, fences, etc., offered considerable resistance to the advancing water causing it to pile up, and forming more or less of a wave. This wave proceeded towards the Knife River and encountered the City of Hazen in its path. Practically every basement was completely filled with water, doing much damage to merchandise and household commodities and equipment usually stored in basements. In addition to this, considerable structural damage was done by weakening or destroying foundations of buildings. It was estimated that it would take over $200,000 to replace the damages.

After the water had entered these various buildings, it moved on and encountered the railroad. Here culverts through the track embankment proved of insufficient size to carry off the excess water, and a portion of the railroad embankment was washed out. While the railroad track possibly delayed the release of the flood waters, it is very doubtful whether it was responsible for the general flood condition.

Antelope Creek at this point has a tributary drainage area of approximately 100 square miles with a comparatively high run-off. This creek has, on previous occasions, caused a somewhat similar flood. A survey should be made to determine the best means of preventing recurrence of this catastrophe. From superficial examination it appears that a long dyke at the point where the creek overflowed its banks may prevent a similar flood.

Beulah

The flood conditions in Beulah were caused by the excessive flow in two comparatively short creeks. These creeks, one to the east and one to the west of the city, approach the Knife River in narrow valleys. It is a characteristic of these streams that the land just outside of the stream channel slopes downward away from the creek. Because of this, the water after overflowing the creek, flowed into the town of Beulah, and here as in Hazen, flooded practically all the basements in town. In addition to this damage, several buildings were moved off their foundations and some totally destroyed. The flood damage was estimated as great or greater than that at Hazen.

Both of the streams referred to drain 4 or 5 square miles each. The flood, therefore, was of very short duration, but its effects were disastrous.

Here, too, floods of a similar nature have previously occurred. Projects which will retard excess run-off a sufficient period of time to reduce the crest of the flood to such proportion that the creek channels will accommodate it, are necessary. Surveys for this purpose are urgently needed.

Although the precipitation in the Knife River Valley was also of cloud-burst proportions in the various local areas, no general damage in the Knife River Valley occurred. The river stage at Hazen reached a maximum of approximately 19 feet above normal low water on July 5, 1938.

Surveys for Flood Protection

In the past funds have not been available for surveys of flood hazards. Such surveys would often develop the facts that a project can be constructed which will prevent or reduce flood damages at less cost than the flood damages caused by one flood. Such a project can usually be so designed that it will also serve other purposes as well as provide flood protection.

EFFECT OF FORT PECK DAM ON MISSOURI RIVER FLOW IN NORTH DAKOTA

People in North Dakota have heard much about the Fort Peck Dam, which is being constructed by the U. S. Army Engineers. This dam is on the Missouri River above the confluence of the Yellowstone, and controls approximately 40% of the flow of the Missouri River in North Dakota.

In this State, we are primarily interested in the affect this project will have on the flow in the Missouri River within our boundaries. The influence of this year's operation is given in the following quotation from a letter written by Colonel C. L. Sturdevant, Division Engineer, Corps of Engineers, U. S. Army:

> "Storage of water for navigation and flood-control purposes was commenced on March 27, 1938. During April and May all of the inflow except approximately 1,000 c.f.s was stored, and during June and July nearly one-half of the total inflow was stored. During August and September most of the water stored during June and July was released for the benefit of navigation. During October releases were limited to approximately the natural inflows. During November releases exceeded inflows by an average of approximately 6,000 c.f.s.
>
> "During April and May the releases were such as to decrease the natural flows below Fort Peck by an average of approximately 8,000 c.f.s. and to decrease stages by an average of approximately 1 foot. During the high-water period, June 1, to July 15, releases were such as to decrease the natural flows below Fort Peck by an average of approximately 17,000 c.f.s. and to decrease stages up to a maximum of approximately 1.5 feet. Following the high-water period, until about October 1, releases were such as to increase the natural flows below Fort Peck by an average of approximately 10,000 c.f.s. and to increase stages by an average of approximately 2 feet. The releases during October were such as to produce little change in the natural discharges and stages. From November 1 to date releases have been such as to increase the flows below Fort Peck by an average of approximately 6,000 c.f.s and to increase stages by an average of approximately 1 foot."

By reducing the range of variation in the stage of the river, a more stable channel will prevail. This will be of material benefit to the irrigation development along the river channel. It will also reduce the frequency of floods such as formerly prevailed during the spring.

Some farmers in the valley looked forward to these frequent floods as they assured sufficient moisture for a crop during the following year or two. These farmers will likely have to find other means to supplement the natural precipitation when the Fort Peck Dam functions properly.

STATE WATER CONSERVATION COMMISSION

After the establishment of the State Water Conservation Commission in March, 1937, this commission appointed the State Engineer as their chief technical advisor as provided in the law. During the past two years, therefore, the State Engineer has functioned in this capacity in addition to his other duties.

The State Water Conservation Commission made 32 water right filings for irrigation projects undertaken during its existence. Other projects were undertaken where the filings were not completed or old water rights were established. In other instances, projects were investigated and found infeasible. One major project—the Lewis and Clark—which provides for the irrigation of 5,000 acres of land, was sponsored by the commission as a WPA Project. Every one of these projects required engineering work which was done under the general direction of the State Engineer.

The Lewis and Clark Project is but a short distance from the Lower Yellowstone Irrigation Project. It consists of an extensive river bottom along the Missouri River southwest of Williston. The Lower Yellowstone Project proved of great economic value during the recent drought. This project, therefore, should be of material benefit to Northwestern North Dakota where the effects of drought have been particularly serious.

Nine irrigation projects were submitted to the PWA for grants and loans. Considerable engineering work was involved in their preparation. The following is a list of the projects submitted:

Projects for irrigation of river bottom lands by pumping from Yellowstone river:

- Cartwright Irrigation Project near Cartwright, North Dakota
- Yellowstone Pumping Project near Sidney, Montana

Projects for irrigation of river bottom lands by pumping from Missouri River:

- Seneschal Irrigation Project near Watford City, North Dakota
- Painted Woods Irrigation Project near Washburn, North Dakota
- Stout Irrigation Project near Bismarck, North Dakota
- Kyes Irrigation Project near Hazelton, North Dakota
- Bismarck Irrigation Project near Bismarck, North Dakota
- Lewis & Clark Irrigation Project (Intake and Pumping Station) near Williston, North Dakota

Projects to provide for a storage reservoir and facilities for irrigation by gravity method:

Grand River, Bowman Irrigation Project, near Haley, North Dakota.

At the present time, no word has been received that these projects have, or will be approved.

In promoting irrigation development in Western North Dakota, it is equally important to advise people to refrain from constructing irrigation works where construction and operating costs may be prohibitive, as to promote feasible projects. This is one of the most important functions of the State Engineer's office. Development of sound irrigation projects will have a material effect in rehabilitating our people in Western North Dakota, while failures will cause additional delays in our ultimate development.

FINANCIAL STATEMENT

Status of Budget at the end of the Biennium, June 30, 1937

	Present Budget	Total Expenditures		Balance
Salary, State Engineer	$ 3,840.00	$ 3,918.40	($84.56 transferred from Postage and Office Supplies)	$ 6.16
Clerkhire, Stenographic	500.00	482.00		18.00
Postage	100.00	65.44	($34.56 transferred to Salary)	.....
Office Supplies	400.00	347.39	($50.00 transferred to Salary)	2.61
Furniture & Fixtures	100.00	100.00		.....
Printing	300.00	300.00		.....
Miscellaneous	400.00	400.00		.....
Travel Expense	2,000.00	1,997.03		2.97
Field Assistants	1,200.00	1,200.00		.....
Missouri River Diversion	5,000.00	5,000.00		.....
Total	$ 13,840.00	$ 13,810.26		$29.74
Prior	1,073.56	1,073.56		.....

Status of Budget on June 30, 1938

	Present Budget	Total Expenditures	Balance
Salary, State Engineer	$ 4,400.00	$ 2,199.96	$ 2,200.04
Clerkhire, Stenographic	1,920.00	980.00	940.00
Postage	100.00	.....	100.00
Office Supplies	400.00	35.47	364.53
Furniture & Fixtures	200.00	63.14	136.86
Printing	300.00	14.01	285.99
Miscellaneous	400.00	180.15	219.85
Travel Expense	2,000.00	714.90	1,285.10
Field Assistants	1,200.00	226.00	974.00
Water Conservation, Irrigation, and Hydrographic Survey	3,000.00	1,279.53	1,720.47
Total	$ 13,920.00	$ 5,693.16	$ 8,226.84
Prior	29.74	29.74	.....