1579-3

1. Considered 7-17, 1968
2. Name of Applicant CITY OF SIOUX FALLS
3. Post Office Address _____
4. Amount of water claimed 1.89
5. Source of water supply GROUND WATER
6. Water to be used for MUNICIPAL
   Acres to be irrigated _____
7. Water to be diverted and used in MINNEHAHA county about IN CITY LIMITS miles of _____.
8. Proof of Publication
   Received ✓
   Not received _____
9. Application
   Approved _____
   Subject to _____
   Not Approved _____
   Action deferred _____
10. Remarks:

Form 2--Application for Permit to Appropriate Water—Original

No. 1579-3

Water Division No. 3 BIG SIOUX RIVER District

(Blanks to be Filled by the Engineer for the W. R. C.)

RECEIVED
APR 25 1968
STATE WATER RESOURCES COMM.
PIERRE, SOUTH DAKOTA

APPLICATION FOR PERMIT

To Appropriate Water within the State of South Dakota

(NOTE—Draw a line through items not applicable.)

1. Name of applicant City of Sioux Falls

Postoffice address Sioux Falls, County Minnehaha, State So. Dak.

I. If a corporation Municipal Corporation

(a) Name of same City of Sioux Falls, South Dakota

(b) Date and place of incorporation

(c) Amount of capital stock

(d) Amount paid in

(e) Names and addresses of directors

(NOTE—A certified copy of articles of incorporation must accompany the application.)

II. Method of accomplishing the work and financial resources of the applicant:

(a) Method of accomplishing work (Whether by contract, employment of others, or by direct labor) Contract

(b) Cash on hand, $ 100,000.00 (c) Treasury stock, $

(d) Bonds to be issued, $ (e) Other resources, $

2. Name of diversion work Well No. 35

3. Amount of water claimed 1.89 cubic feet per second

4. Source of water supply Big Sioux Aquifer

5. Location of point of diversion North East Quarter (NE 1/4) of Sec. 8, Township 101 North Range 49 West on bank County.

950' N & 1100' E OF SW COR. SEC. 8, T101N, R49W

6. Annual period or periods during which water is to be used Continuous

7. To be used for:

I. Irrigation or domestic use. Gravity, overhead sprinkling or combination system?

(a) Number of acres to be irrigated acres.

(b) Legal subdivisions to be irrigated

(NOTE—A list of lands to be irrigated, giving each subdivision and fraction with acreage thereof, should be written here, or may be appended as a part of this application. Same must also be shown on accompanying map.)

(c) Statement as to domestic use (giving location, etc.)

II. Stockwatering, mining, milling, power, fish culture, fire protection and public recreation:

(a) Nature of use

Name any of the above uses claimed

(b) Amount of power to be generated horse power.

Amount claimed for engine cooling

(c) Location of plant

(d) Method of developing power

(e) Point where water will be returned to stream

SE NW 2

8. Estimated cost of work:

(a) Head Gates, $________ (b) Pumping plant, $________ 15,000.00

(c) Fluming, $________ (d) Canal-earth, $________ Rock, $________

(e) Other structures ________$________ Total, $ 15,000.00

9. Description of diversion works:

I. Nature of works: (Reservoir, dam, ditch, flume, pumping plant, etc.)

____

II. Dimensions of works:

(a) Dam: Height________feet; length at bottom ________ feet; length at top ________feet; thickness at bottom ________feet; thickness at top ________ feet; slope at front water face ________; slope at back face ________ material used in construction ________

(b) Reservoir: Capacity when filled ________acre feet. Surface area at highwater mark________acres.

DEPTH AT OUTLET-FEET	SURFACE AREA AT EACH______FEET DEPTH AT OUTLET—ACRES	ACRE-FEET CAPACITY

(c)* Head gate: Width________feet; height ________feet; Material ________

(d) Canal: Total length ________miles.

LOCATION BELOW HEADGATE	DEPTH	BOTTOM WIDTH	WIDTH AT WATER-LINE	GRADE PER MILE
At ______ Mile	______ feet	______ feet	______ feet	______ feet
At ______ Mile	______ feet	______ feet	______ feet	______ feet
At ______ Mile	______ feet	______ feet	______ feet	______ feet
At ______ Mile	______ feet	______ feet	______ feet	______ feet
At ______ Mile	______ feet	______ feet	______ feet	______ feet
At ______ Mile	______ feet	______ feet	______ feet	______ feet

(Give dimensions where reductions in size are made.)

10. Time required for completion of work 3 ~~years~~ Months

11. Time required for complete application of water to the proposed beneficial use 6 ~~years~~ Months

12. Choice of newspaper for publication of notice of intention to appropriate Sioux Falls Argus Leader

STATE OF SOUTH DAKOTA }
County of Minnehaha } ss.

I, Carl J. McCart, being first duly sworn on my oath depose and say: That my relation to the above described undertaking is that of owner that I have read the above foregoing statement, examined the map accompanying the same, and that I know of my own personal knowledge that the matters herein stated and shown are true.

Signed Carl J. McCart

Subscribed and sworn to before me this 23 day of April 1968

[signature]

Notary Public (or other qualified officer)

*Each diversion must have a headgate or measuring device.


BM CE PLUG 116.93
SE. ABUTMENT OF BRIDGE
PARK WELL NO.
T1 CASING
875'
280'
109.77'
ELMWOOD GOLF COURSE
WELL NO. 8
12" DECK 117.31 WELL NO. 27
THRESHOLD 116.60'
112.92'
WELL NO. 28 DECK 116.50'
SIOUX RIVER
FLOOD PLAIN
T102N R49W
T101N R49W
T3 CASING
114.73'
WELL NO. 34
117.06' A5
115.95'
115.63'
WELL NO. 21 DECK 118.66'
TBM 5 USED. CONTROL BRONZE CAP SET IN LEAD AT THE N.W. CORNER OF PUMP HOUSE WELL NO. 20 0.5' WEST OF CORNER IN CONCRETE SLAB. 118.53'
119.22'
WELL NO. 20
DECK 118.47'
119.71
DECK 115.12 WELL NO. 10
12"
50' NE. 113.95'
112.37 WELL NO. 13
12.89 MH RING EAST SIDE
DECK
16"
N.E.C. MH. FRAME 116.42'
110.31
112.03'
WELL NO. 4
112.17'
NEC. MH. FRAME 113.54
WELL NO. 11
112.92'
112.89'
WELL NO. 12
NEC. FRAME 113.54
WELL NO. 23
S.F. MUNICIPAL AIRPORT
24" C.I.
16" C.I.
L. DECK 103.61
WELL NO. 3
111.30'
DECK 119.33'
WELL NO. 22
119.60'
WELL NO. 29
100' W. OF WELL 120.98'
DECK 120.14'
DAM
GNRR
TIEBACK LEVEE
B4
NE CURB BRIDGE
BM USC & G. 125.55'
121.45
WELL NO. 25
DECK 125.16'
123.70'
100' SO. WELL CASING
C4A
C4
WELL NO. 31
DECK 127.87'
CASING C7
WELL NO.
DECK 129.57
122.52'
40' NO. 32
123.27' 100' W
DECK 127.25'
10" C.I.
C4B
DITCH ROAD
DRAINAGE DITCH NO. 2
SILVER CREEK
107.24'
L. DECK
A3 117.32'
WELL NO. 18
114.87'
WELL NO. 17
L. DECK 106.76'
WELL NO. 16
113.79'
L. DECK 106.97'
WELL NO. 15
116.45'
L. DECK 106.55'
K1 115.10'
T4 CASING 118.62'
20" L.J. PIPE
10" C.I.
119.79'
WELL NO. 26
DECK 124.12'
BM B328-1949 63' NO. CTR. ENTR. 53' WEST CTR. MINN. AVE. DISK IN CONC. POST 110.50'
MINNESOTA AVE.
1100'
1579-3
STATE WELL 110.88'
FILTER PLANT
WELL NO. 19
WELL NO. 14
L. DECK 107.43'
24" L.J. PIPE
DECK 117.36'
A2
WELL NO. 24
119.20'
DRAINAGE DITCH NO. 1
DITCH ROAD
WELL NO. 30
T-5 CASING 119.48' DECK
250' NW. WELL 117.98'
WEIR
BM N341 121.48'
TOP OF SO. END OF EAST CONCRETE ABUTEMENT OF 101' BRIDGE.
C2
POWER PLANT
DIVERSION CHANNEL PUMPING UNIT NO. 2 (D.C. 2)
DIVERSION CHANNEL PUMPING UNIT NO. 1 (D.C. 1)
BM 1 3 RESET
113.90'
41-1/2 POLES NO. M. POST 73
90' SO. CTR. ROAD
46' E. OF EAST RAIL
DIVERSION CHANNEL
ALSO BM TOP OF EAST RAIL CTR. ROAD
115.5'
B2
CMSTP & PRR
BM. TOP OF EAST RAIL CTR. ROAD 119.5'
S.D. HIGHWAY NO. 38
TIE-BACK LEVEE
BMM 341 121.73'
2-2/3 POLES NO. OF MILEPOST 75
117' NO. OF CTR. OF ROAD
45.3' W. OF WEST RAIL
ALSO BM TOP OF EAST RAIL
122.4' CTR. OF E-W ROAD
S.D. PEN.
30" OVERFLOW
B.M. ADDED JAN. 1956
A1
FLOOD PLAIN
B1
SIOUX RIVER
SPILLWAY
CHUTE
C1
S.D. HIGHWAY NO. 77
7
6
31
30
19
8
5
32
29
20
9
4
33
28
21
See Map No 219-3
For original Filings
MAp No. 299-3
(Appl's No. 395-3
396-3
397-3
1305-3
1306-3
1347-3
1579-3)
SHEET NO. 1
WELLS & FEEDER LINES
S.F. WATERWORKS
8-1-56
OFFICE OF CITY ENGINEER
1" = 660'
REVISED 8/21/60 R.E.J. JR.
Map # 219-3
Appl see listing inside

Remarks by State Water Resources Commission:

THE PRIORITY FOR THIS PERMIT WAS ESTABLISHED UNDER FUTURE USE WITHDRAWAL 449-3, AND DEVELOPMENT OF THIS WELL REDUCES 449-3 BY 1.89 CFS., LEAVING 14.71 CFS. REMAINING FOR FUTURE DEVELOPMENT.

NOT IN FUTURE USE AREA BJJ 4/16/73

STATE OF SOUTH DAKOTA
County of HUGHES } ss.

Pierre, South Dakota, JULY 22, 1968

This is to certify that the foregoing application was received by the Commission at 8:00 o'clock A.m. upon the 25TH day of APRIL, 1968

State Water Resources Commission

By: Burton L. Jones
for Chief Engineer, Executive Officer

Number of permit 1579-3

Date of first receipt of application APRIL 25, 1968

Date of return to applicant for correction, amendments or changes required as follows: —, 19

Date of receipt of corrected application —, 19

Date from which applicant may claim right APRIL 8, 1957

Approved JULY 17, 1968 Recorded in Book 10 Page 227

This is to certify that we have examined the foregoing application for a permit to appropriate water of the State of South Dakota, and we hereby grant the same as stated herein, subject, however, to the following limitations and conditions:

1st. The equivalent of at least one-fifth of the work above specified is to be completed on or before SEPTEMBER 3, 1968

2nd. The whole of said work is to be completed on or before OCTOBER 17, 1968

3rd. The limit of time for proof of beneficial use of water appropriated in accordance herewith is APRIL 17, 1969

4th. The water appropriated shall be used for the purpose of MUNICIPAL

5th. The prior right of all persons who, by compliance with the laws of the State of South Dakota, have acquired a right to the use of water must not be injuriously affected by this appropriation.

6th. The amount of the appropriation herein granted shall not exceed 1.89 cubic feet per second; neither shall it exceed the capacity of the above described system of diversion works, nor the least amount of water that experience may hereafter indicate as necessary for ~~the production of crops in the exercise of good husbandry; and further, said appropriation must be limited to not more than one acre-foot of water per second of time for each acre of land to~~ USED FOR MUNICIPAL PURPOSES which water is actually and beneficially ~~applied for irrigation~~ on or before APRIL 17, 1969; said water to be used during the following described annual period:

CONTINUOUSLY

Witness my hand this 22ND day of JULY, 1968.

State Water Resources Commission

By: [signature]

Chief Engineer, Executive Officer

Certificate of Construction Issued JANUARY 5, 1971

Water License Issued JANUARY 5, 1971

Form 2A — Wells (Supplement to Form 2)

9. (Continued)

III. Well Specifications

(a) Hole and casing

Size of drill hole or excavation 36 inches . Depth 45 ft.

Type of casing Concrete (wood, concrete, steel, etc.)

Size of casing 24" , Thickness of casing 1"

Length of casing 35 ft. If collection gallery, length, size and depth of gallery

(b) Screens

Type of perforated screen Johnson Concrete Screen

Size of perforated screen 24" (diameter) , 35 ft. (length)

Thickness of gravel pack 6" , length of gravel pack 35 ft.

(c) Water Bearing Materials

Distance to water 12 ft. . Character of water bearing materials Medium to Coarse Sand and Gravel

Thickness of water bearing material 35 ft.

(d) Pump and Motor

Type of pump Turbine (centrifugal, propeller, mixed flow etc.)

Name of pump Fairbank Morse , size 8"

Kind of motor Electric (gasoline, electric, diesel, etc.)

Horsepower 25 . Name of Motor Fairbanks Morse

(e) Complete well

Capacity 850 gpm at drawdown of 15 ft. . Estimated cost $ 15,000.00

(f) Owner of land upon which well is located City of Sioux Falls Name ,

Sioux Falls, South Dakota Address

(g) Distance to nearest existing wells

On same owner's property 1000 ft. On property owned by others rods

Form 15.

Permit No. 1579-3

Water Diversion No. 3 BIG SIOUX RIVER Water District

CERTIFICATE OF CONSTRUCTION

This is to Certify, That the City of Sioux Falls

the holder of Permit No. 1579-3, issued upon Application No. 1579-3, bearing date of priority of April 8, 1957 authorizing the diversion of 1.39 cu. ft. per second of the waters of ground water County of Minnehaha, State of South Dakota at a point 995 ft. North and 1025' West of the SE Corner, Section 29, T102N, R49W (2.4 miles North of Permit 1579-3 location), for municipal purposes, has complied with the provisions of the laws of the State of South Dakota relating to proof of completion of the works of diversion set out and described in said Permit; that said works are found in satisfactory condition for diverting and conveying to the place of intended use .72 cu. ft. per second of water.

Date January 5, 1971

WATER RESOURCES COMMISSION

By:

J.W. GRIMES, Executive Officer

Form 16.

STATE OF SOUTH DAKOTA

WATER LICENSE NO. 1579-3

(1) WHEREAS, On the 25th day of April A. D. 19 68
the City of Sioux Falls

made Water Right Application No. 1579-3 for a permit to use 1.89 cubic feet per second of the waters of ground water

County of Minnehaha, State of South Dakota, for municipal purposes; and

(2) WHEREAS, On the 22nd day of July A. D. 19 68

Permit No. 1579-3, with a date of priority of April 8, 1957

was issued to said applicant _____ for the diversion of said water, and provided for the completion of construction of the water supply system therein described on or before the 17th day of October A. D. 19 68 and for the application to beneficial use of said water on or before the 17th day of April A. D. 19 69

and:

(3) WHEREAS, It is hereby certified that the applicant has complied with the provisions of the laws of the State of South Dakota relating to completion of the construction of the water supply system and is entitled to divert .72 cubic feet per second of water for beneficial use and,

(4) WHEREAS, It is hereby certified that the applicant has complied with the provisions of the laws of the State of South Dakota relating to the application of water to beneficial use of the following extent,

water is used for municipal purposes by the City of Sioux Falls

(5) NOW, THEREFORE, By the virtue of the authority vested in us by the laws of the State of South Dakota, We hereby grant and confirm to The City of Sioux Falls

xxx

the holder ____ and owner ____ of said permit No. 1579-3 a water right, dating from April 8, 1957 ____ to use of .72 cubic feet per second of the waters of ground water

in the County of Minnehaha and State of South Dakota, or so much thereof as may be necessary for the purposes hereinbelow mentioned to be diverted at a point 995 ft. North and 1035 ft. West of the S¼ Corner, Section 29, T102N, R49W (2.4 miles North of Permit 1579-3 location)

and xxxxxxxxxxxxxxxx conducted through the City water distribution system

for the purpose of municipal use

Subject to any limitations listed in Water Right Permit No. 1579-3 and subject to the laws of the State of South Dakota.

WITNESS My hand and seal of our office at Pierre, South Dakota this 5th day of January A. D. Nineteen Hundred and Seventy-one

WATER RESOURCES COMMISSION

By: _____

Chief Engineer, Executive Officer, J.W. GRIMES

Form 8—Notice of Intention to Appropriate Water

No. 1579-3

on or before
(First Publication June 20 1968)

APPROPRIATION OF WATER

Office of State Water Resources Commission,

Pierre, S. Dak., June 11, 1968

Notice is hereby given that the City of Sioux Falls whose post office address is S. Dak., has made an application in accordance with the provisions of the water laws of South Dakota for a permit to appropriate for beneficial use 1.89 cubic feet of water per second of time from the ground water through the City Well #35, the point of diversion of which is to be located on the in the NE ¼ of the NE ¼ of Section 8 Twp. 101N Range 49W. Said water to be used for the purpose of providing irrigation on the following described land:

municipal supplies for the City of Sioux Falls.

and for purposes.

This application will be taken up by the State Water Resources Commission at their office at Pierre for consideration upon the 17th day of July, 1968 at 2:00 P.M. All interested persons may appear and be heard.

Appropriate action will be taken by the Water Resources Commission after suitable time has elapsed for the consideration of any or all information presented.

State Water Resources Commission

By:

(Chief Engineer, Executive Officer)

BURTON E. JONES
Water Rights Specialist

cc: Earl J.McCart, Sioux Falls, S.D.

25.41

Form 11—Proof of Publication—Appropriation of Water. No. 1577-3

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA }
County Minnehaha } ss.

M. T. HAGAR being duly sworn, deposes and says the annexed printed copy of Notice of Intention to Appripriate Water was taken from the Sioux Falls Argus Leader a newspaper which during the whole itme of publication of said notice herein after stated, has been and is printed and published in the City of Sioux Falls County of Minnehaha and State of South Dakota; that the said notice was published in said newspaper on the following dates:

Thursday, June 13, 1968

Thursday, June 20, 1968

Thursday, June 27, 1968

Thursday, July 4, 1968

in each and every issue of the full number thereof, the first publication being made on the 13th day of June 1968 and the last publication on the 4th day of July 1968, upon which days or times of publication aforesaid the newspaper was regularly published, and that during the whole time of said publication he was Comptroller the printer and publisher of the said newspaper.

Subscribed and sworn to before me this 4th day of July A. D. 1968

Notary Public Minnehaha County, S. D.

Eleanor Tague
My Commission Expires
June 30, 1974

Pierre, S. Dak.
June 11, 1968

Notice is hereby given that the City of Sioux Falls, S.Dak., has made an application in accordance with the provisions of the water laws of South Dakota for a permit to appropriate for beneficial use 1.89 cubic feet of water per second of time from ground water through City Well No. 35, the point of diversion of which is to be located in the NE¼ of the NE¼ of Section 8 Twp. 101N Range 49W. Said water to be used for the purpose of providing municipal supplies for the City of Sioux Falls.

This application will be taken up by the State Water Resources Commission at their office at Pierre for consideration upon the 17th day of July, 1968, at 2:00 P.M. All interested persons may appear and be heard.

Appropriate action will be taken by the Water Resources Commission after suitable time has elapsed for the consideration of any or all information presented.

State Water Resources Commission
By BURTON F. JONES
Water Rights Specialist

cc: Earl J. McCart,
Sioux Falls, S.D.

June 13, 20, 27, July 4, 1968

CITY OF SIOUX FALLS, SOUTH DAKOTA

M. E. SCHIRMER, MAYOR
HEALTH AND PUBLIC SAFETY

EARL McCART, COMMISSIONER
UTILITIES • LIBRARY • PARKS • RECREATION

DAVE WITTE, COMMISSIONER
STREET • ENGINEERING • WASTE WATER • COLISEUM • ARENA

August 23, 1968

Mr. J. W. Grimes
Chief Engineer and
Executive Officer
South Dakota Water Resources Commission
State Office Building
Pierre, South Dakota 57501

RECEIVED
AUG 2.) 1968
STATE WATER RESOURCES COMM.
PIERRE, SOUTH DAKOTA

Dear Mr. Grimes:

The location of Well #35 has been changed to Tract 10 of the Southeast Quarter (SE 1/4) of the Southeast Quarter (SE 1/4) of Section 29, Township 102 North, Range 49 West.

The Horse Power of the pump motor will be changed to 40 H.P.

This well will be 800 feet from a domestic well.

Sincerely,

EARL McCART
City Commissioner

EMc/em

Form 12.

Permit No. 1579-3

Water Division 3 BIG SIOUX RIVER Water District

REPORT OF EXAMINATION OF WORKS AND/OR APPLICATION OF WATER TO BENEFICIAL USE

TO: Water Resources Commission, State Office Building No. 2, Pierre, South Dakota 57501

I have this day made a thorough examination of the water use system constructed by the City of Sioux Falls of Sioux Falls, S.D. holder of Permit No. 1579-3, bearing date of priority of April 8, 1957 authorizing the diversion of 1.89 cu. ft. per second of the waters of ground water for municipal purposes, in Minnehaha County.

I have to report on the condition of the same as follows:

The Water Use System consists of,

A. Works used to divert the water:

Well No. 35. Forty feet deep, 24 inch standard steel pipe casing with 18 feet of stainless steel screen at bottom of well.
Western Land Roller pump, 8 inch, Mod. 8M
U.S. Electric Motor, 20 HP, Type RU

B. Works used to transport water to place of use,

City distribution system

C. Works used to apply water to beneficial use.

Service connections

The system is in the following condition: good

The point of diversion is located 995 feet north and 1035 feet west of the SE Corner of Section 20, T102N, R49W (Located 24 miles north of Permit 1579-3 location)

The works are capable of diverting and conveying to the place of use 0.72 cu. ft. per second of water which is to be used for municipal purposes

Water has been put to beneficial use to the maximum extent as follows: as shown

Date December 1, 1970

Donald Driscoll
(Signature)

DONALD DRISCOLL, Deputy Chief Engineer, W.R.C.

City of Sioux Falls
SOUTH DAKOTA
DEPARTMENT OF WATER

EARL McCART
COMMISSIONER IN CHARGE
LES HASH
GENERAL SUPERINTENDENT
JAMES COX
SUPERINTENDENT OF SUPPLY AND TREATMENT
HARVEY HUPP
SUPERINTENDENT OF DISTRIBUTION
HERMAN MULLER
SUPERINTENDENT OF SERVICE
BRUCE KNUDSON
SANITARY ENGINEER
DON GOHL
SENIOR ACCOUNTANT

June23, 1966

South Dakota Water Resources Comm.
Pierre, South Dakota

Att'n: Mr. Joe Grimes

Dear Sir:

Enclosed is a copy of the Greeley & Hansen 1961 Report on Sources of Supply to be filed with the Water Resources Commission as part of our record.

Sincerely,

Kenneth D. Vaughan
Civil Engineer
Research & Development

CC:
McCart
Hash
File

WR-K78-3

SIOUX FALLS, SOUTH DAKOTA

Report on Source of Supply

May, 1962

[illegible]
[illegible]
[illegible]

SIOUX FALLS, SOUTH DAKOTA

WATER SUPPLY SYSTEM

Report on Source of Supply

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SIOUX FALLS, SOUTH DAKOTA

WATER SUPPLY SYSTEM

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LIST OF FIGURES

SIOUX FALLS, SOUTH DAKOTA

IMPROVEMENTS TO THE WATER SUPPLY SYSTEM

Report on Source of Supply

Greeley and Hansen, Engineers

May, 1961

1. Introduction

Several reports have been written on the development of the Big Sioux Aquifer for water supplies, among which are the following:

a. Rothrock and Otton. Ground Water Resources of the Sioux Falls Area. South Dakota 1947

b. Greeley and Hansen, Engineers. Report on Water Supply. Sioux Falls, S. D. 1950

c. Greeley and Hansen, Engineers. Report on Water Supply. Sioux Falls, S. D. 1956

Since the completion of the most recent of these reports, the U. S. Army Engineer District, Omaha, Nebraska, Corps of Engineers, has substantially completed flood control improvements which may have an effect upon the nature of the ground water recharge to the Big Sioux Aquifer in the vicinity of Sioux Falls.

The work of Rothrock, in Ground Water Resources of the Sioux Falls Area, South Dakota, outlined the fundamental geology of the Aquifer. Subsequent to that date, considerable well field development has occurred but little basic investigative work has been undertaken. In 1960, however, the U.S.G.S., in cooperation with the City of

Sioux Falls constructed test wells and conducted pumping tests to determine the hydrological characteristics of the Aquifer. The data collected by the U.S.G.S. have been made available to the City.

The municipal water consumption of the City of Sioux Falls continues to increase and coincident therewith the need for further exploitation of the ground water continues. To provide for adequate, economical and progressive development of the water supply system, the City of Sioux Falls authorized Greeley and Hansen to review the data collected by the U.S.G.S., to study the effects of the flood control system recently completed, and to determine the following:

1. The area which should be developed as a well field to provide for an adequate water supply as the City continues to grow.
2. The need for additional wells to provide a supply adequate for present and future water consumption and at the maximum rates of use.
3. The feasibility of artificial recharge and the methods to be employed to make artificial recharge effective.
4. Other feasible means of providing for economical water supply development.

This memorandum summarizes the studies made on the water supply development and the conclusions drawn therefrom for the economical, progressive development of the water supply.

2. Basic Data

The basic data pertinent to these studies are summarized as follows:

a. Population. The record of population growth and estimates of future population are shown on Figure 1.

b. Water Consumption. The record of annual average and maximum day water consumption is summarized in Table 1. Those data, and estimates of future water consumption are shown on Figure 2. The estimated present and future water consumption are as follows:

Date	Estimated Water Consumption MGD	
	Annual Av.	Maximum Day
1960	8.3	20.5
1970	12.5	30.0
1980	14.3	34.3
1990	15.7	37.7
2000	17.0	40.8

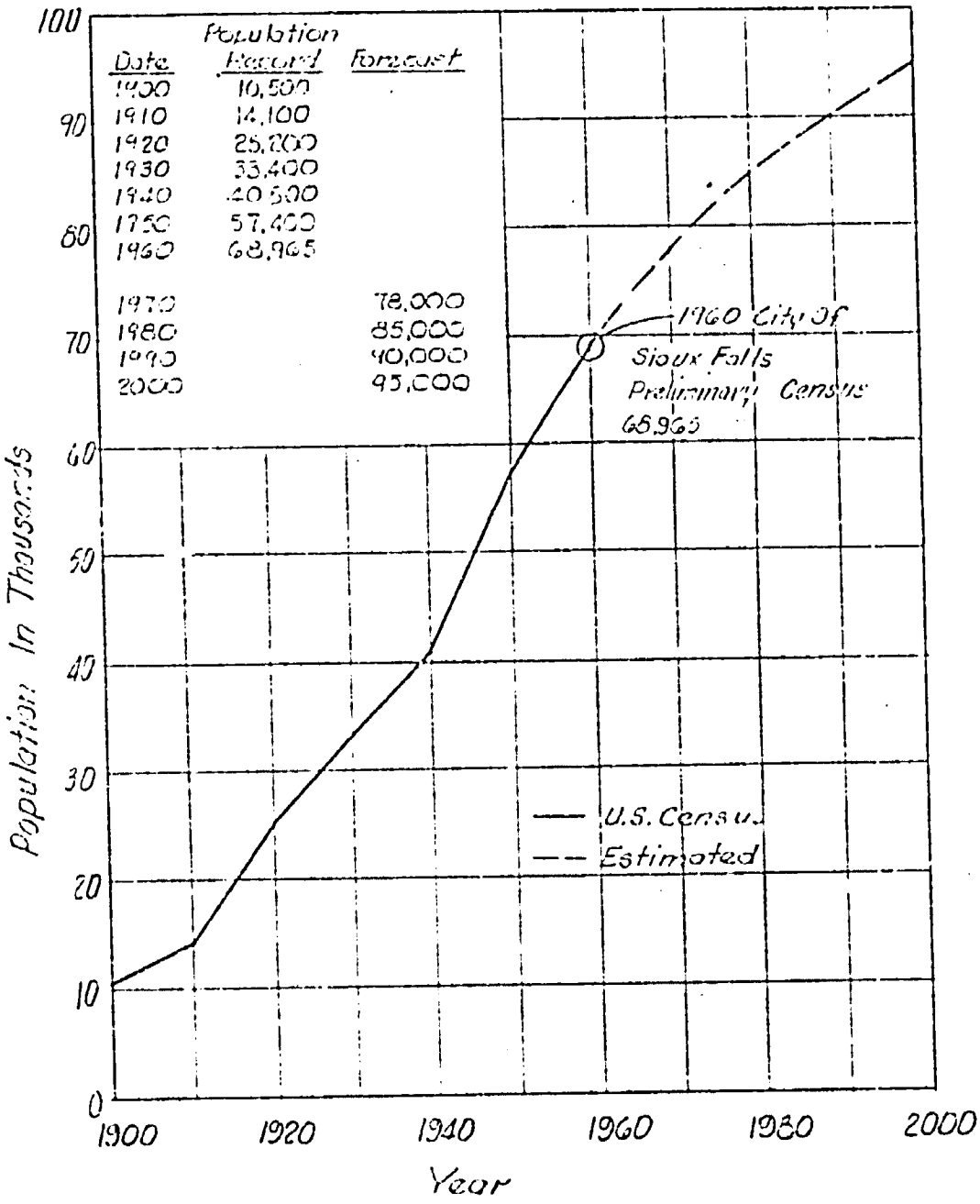
c. Rainfall. The annual average precipitation at Sioux Falls totals 25.62-inches per year. The annual precipitation for the period 1891 to 1960 is summarized in Table 2. The driest years of record are as follows:

Date	Total Annual Precipitation - Inches
1891	18.75
1894	10.44
1910	16.89
1917	19.45
1931	17.73
1952	18.86
1955	18.16
1958	15.33

The driest 2-year period of record occurred during the years 1894-1895 when the total 2-year rainfall aggregated 30.72 inches.

d. Stream flow. The flow in the Big Sioux River at Dell Rapids is summarized in Table 3 for the period of record of October 1948 to June 1959. The minimum monthly flows and the

FIGURE 1



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

POPULATION RECORD
& FORECAST

MAY, 1961

GREELEY AND HANSEN

TABLE 1

SIOUX FALLS, S. D.

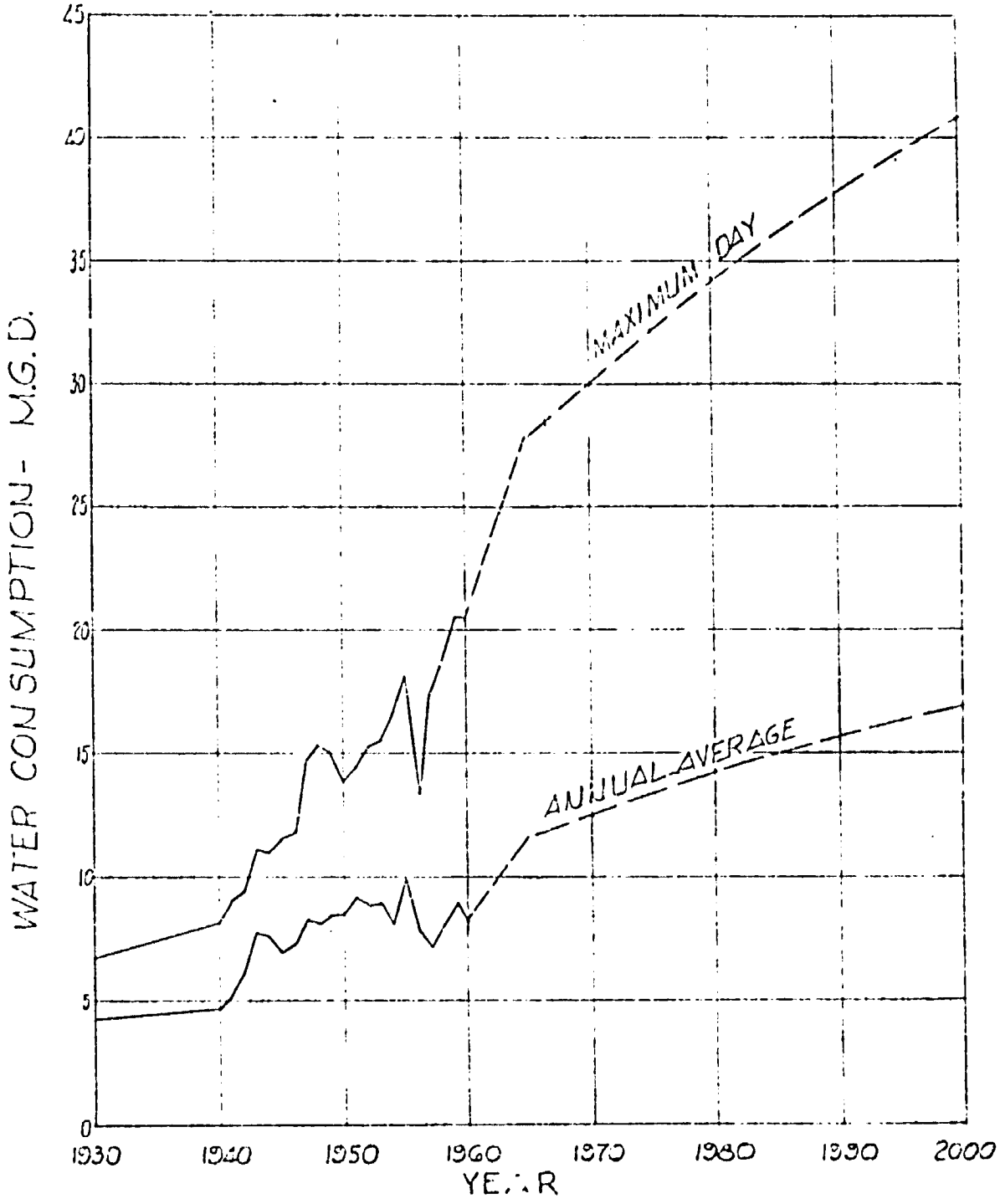
IMPROVEMENTS TO WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

Record of Water Consumption

May, 1961

Year	Annual Average Pumpage M.G.D.	Maximum Daily Pumpage M.G.D.	Max. Day as % of Ave. Day
1930	4.3	6.8	158
1940	4.7	8.1	172
1941	5.2	9.0	173
1942	6.1	9.4	154
1943	7.7	11.0	143
1944	7.6	11.0	145
1945	7.0	11.5	164
1946	7.3	11.8	162
1947	8.2	14.7	180
1948	8.1	15.3	189
1949	8.5	15.0	176
1950	8.5	13.9	164
1951	9.2	14.5	158
1952	8.9	15.3	172
1953	8.9	15.6	175
1954	8.2	16.7	204
1955	9.9	18.2	184
1956	7.8	13.4	172
1957	7.2	17.4	242
1958	8.1	18.7	231
1959	8.9	20.5	231
1960	8.3	20.5	247

FIGURE 2



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY
WATER CONSUMPTION
ANNUAL AVERAGE & MAX. DAY
RECORD AND FORECAST
MAY, 1961

GREELEY AND HANSEN

TABLE 2

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

Annual Precipitation

May, 1961

	Precipitation Inches		Precipitation Inches
1891	18.75	1930	23.76
1892	23.68	1931	17.73
1893	22.33	1932	27.65
1894	10.44	1933	20.73
1895	20.28	1934	24.61
1896	30.07	1935	32.25
1897	25.54	1936	25.28
1898	26.89	1937	27.65
1899	29.00	1938	29.43
1900	29.06	1939	25.33
1901	22.53	1940	26.64
1902	25.92	1941	20.68
1903	30.90	1942	27.94
1904	20.07	1943	23.45
1905	35.53	1944	32.21
1906	32.88	1945	25.37
1907	29.68	1946	26.26
1908	33.04	1947	25.61
1909	36.02	1948	27.58
1910	16.89	1949	20.76
1911	34.57	1950	21.24
1912	24.63	1951	30.79
1913	26.96	1952	18.86
1914	26.58	1953	30.05
1915	29.41	1954	24.69
1916	22.26	1955	18.16
1917	19.45	1956	22.74
1918	25.62	1957	28.19
1919	27.88	1958	15.33
1920	32.89	1959	29.81
1921	21.18	1960	27.51
1922	23.10		
1923	29.23	Total	1,793.98
1924	20.28		
1925	20.04		
1926	24.64	Annual Average	25.63
1927	23.95		25.628
1928	26.23		
1929	34.09		

TABLE 3

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

Stream Flow, Big Sioux River At Dell Rapids, South Dakota

From Oct. 1948 to Sept. 1959

May, 1961

Year	Flow in c.f.s.											
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
1948	74.3	86.7	56.0	20.2	312.0	2126.0	1360.0	796.0	428.0	858.0	499.0	293.0
1949	169.0	128.0	56.3	25.0	45.0	571.0	872.0	289.0	209.0	90.5	52.1	35.7
1950	34.5	38.5	31.3	6.4	6.2	289.0	861.0	635.0	251.0	78.7	42.2	64.0
1951	139.0	46.3	20.4	12.2	50.8	302.0	3090.0	592.0	523.0	531.0	499.0	494.0
1952	200.0	132.0	93.7	50.8	83.8	319.0	5701.0	1173.0	880.0	740.0	242.0	118.0
1953	62.3	43.6	23.4	15.9	10.7	668.0	511.0	968.0	493.0	371.0	617.0	207.0
1954	86.5	64.1	42.1	16.5	156.0	995.0	529.0	449.0	476.0	214.0	137.0	9.0
1955	51.5	47.6	32.3	19.3	11.4	354.0	197.0	86.6	44.1	23.8	8.9	4.07
1956	5.5	12.8	4.6	3.2	3.2	19.6	117.0	59.3	55.3	75.2	164.0	43.6
1957	23.4	26.7	10.6	4.4	4.2	312.0	166.0	254.0	1825.0	367.0	81.1	52.7
1958	43.7	51.9	36.9	21.5	25.2	96.6	209.0	136.0	90.9	35.1	11.5	4.8
1959	4.6	9.7	6.3	2.5	1.8	113.0	45.3	51.4	27.4	6.2	3.9	2.5
Ave.	75.5	58.2	35.0	16.8	59.3	520.4	1141.1	458.2	442.7	282.5	196.3	117.7

minimum daily flows over the period of record are summarized in Table 4. These data show that during the summer months the stream flow is low, and that the bulk of the stream flow occurs during the months of March, April and May during which time floods are apt to occur.

e. Flood Control. The flood control structures constructed by the Corps of Engineers U. S. Army Engineers District, Omaha, Nebraska, are shown in Figure 3. The spillway south of the City's Water Treatment Plant has a crest elevation of 1407.5 and ponds water in the by-pass channel to about the location of a weir located 2600 feet East of the new Diversion Headworks. The weir has a crest elevation of 1421.0 and can, by closing the gates on the dam of the Big Sioux River, pond water to the dam and in the tributary stream some distance upstream.

f. Geology. The Big Sioux Valley was initially formed by stream action on the indurated quartzite of the Sioux formation. During the subsequent ice age, glacial movements covered the valley with a thick blue black sandy clay which ultimately formed the impervious base for the present aquifer. The natural quartzite barriers at Dell Rapids and Sioux Falls which cross the valley and form the north, south limits of the aquifer are believed to be horsts resulting from faulting during crustural stabilization. The Wisconsin ice sheet, at the end of the glacial period, scoured a spillway in the stream bed which set the site for the present aquifer. As the ice sheet retreated, sorting action of the melt waters deposited layers of sand and gravel in the stream bottom, filling the valley to the top of the natural quartzite barriers. With the termination of the glacial period, slower moving waters deposited an additional 10 feet of fine sands, silts and clays on top of the sand and gravel base forming the aquifer as it presently exists.

The water bearing material which is approximately 27 feet in thickness is heterogeneous in nature. The predominate matrix is composed of coarse sand and gravel which has been lensed by stream deposition with fine sand, clay, and silt. As the lensing does not extend over the entire length or width of the aquifer, ground water flow is possible both vertically and horizontally throughout the entire aquifer.

TABLE 4

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

Minimum Flows, Big Sioux River At
Dell Rapids, South Dakota

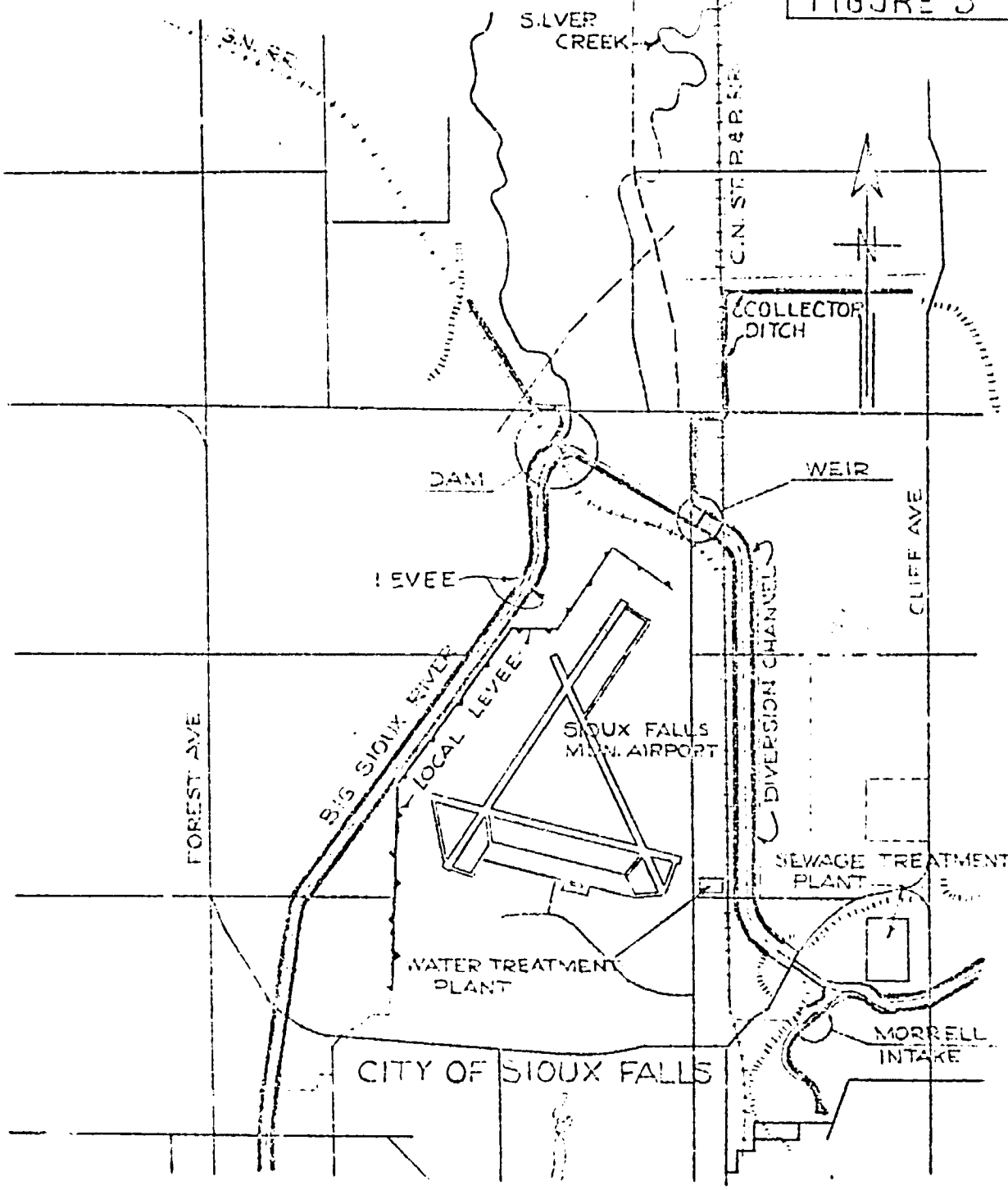
May, 1961

Minimum Month	Year	Flow in c.f.s. Minimum Month (1)	Minimum Day (2)
January	1959	2.5	2.0
February	1959	1.8	1.0
March	1956	19.6	5.0
April	1959	45.3	29.0
May	1959	52.4	30.0
June	1959	27.4	12.0
July	1959	6.2	0.5
August	1959	3.9	0.8
September	1959	2.5	1.0
October	1959	4.6	2.1
November	1959	9.7	2.4
December	1956	4.6	3.7

(1) Average flow in Minimum Month of period of record 1948-1959.

(2) Minimum day during minimum month.

FIGURE 3



SIOUX FALLS, S.D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

FLOOD CONTROL WORKS ON BIG SIOUX BASIN AT SIOUX FALLS

MAY, 1961

GREELEY AND HANSEN

The water contained in the Big Sioux Aquifer is maintained by direct infiltration of natural precipitation on exposed sands and gravels, by infiltration of the Big Sioux River, its tributaries and drainage ditches, and natural percolation throughout the entire aquifer. The aquifer has a natural slope of three feet per mile, permitting ground water flow toward Sioux Falls and the natural entrapment area formed by the Sioux Falls barrier. A picturization of the aquifer is shown in Figure 4.

g. Well Field. The location of the several wells and the collecting mains are shown on Figure 5. The capacities and types of the several wells are summarized in Table 5. The present capacity of all wells is estimated at 27.6 MGD.

h. Water Quality. The chemical quality of the water varies between the several wells and from season to season. The water from the wells in the airport area is generally more highly mineralized than the water from the more remote wells. The average hardness, plotted as contours, is shown on Figure 6. The water quality in June 1959 and January 1960 is as follows:

CHEMICAL COMPOSITION - PPM

	June 1959 (1)	January 1961 (2)
pH	7	7
Ca	404	368
Hardness	495	554
Mg	200	187
MO (3)	273	295
CO_2	40	44
CO_2 as $CaCO_3$	91	100
Alk+CO_2 as $CaCO_3$	371	395

(1) For 27 wells with The Big Sioux River Flowing

(2) For 26 wells with the Big Sioux River Frozen

(3) Methyl Orange Alkalinity

BLOCK DIAGRAM
OF THE
BIG SIOUX VALLEY
SIOUX FALLS SOUTH DAKOTA

COMPILED FROM DATA REVEALED BY TEST DRILLING.
PORTIONS OF DIAGRAM REMOVED TO SHOW VIEW
ALONG LETTERED CROSS-SECTIONS.

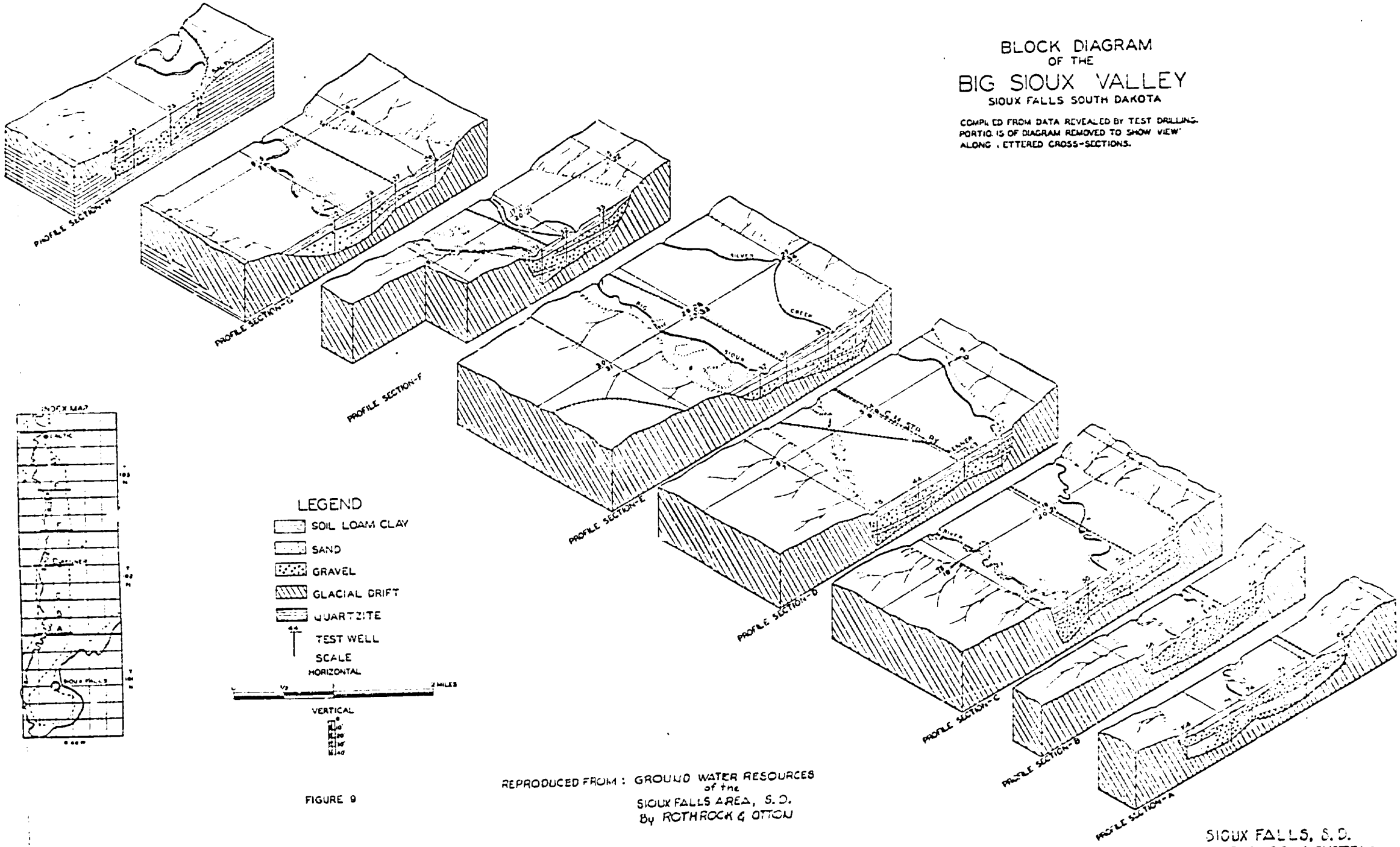
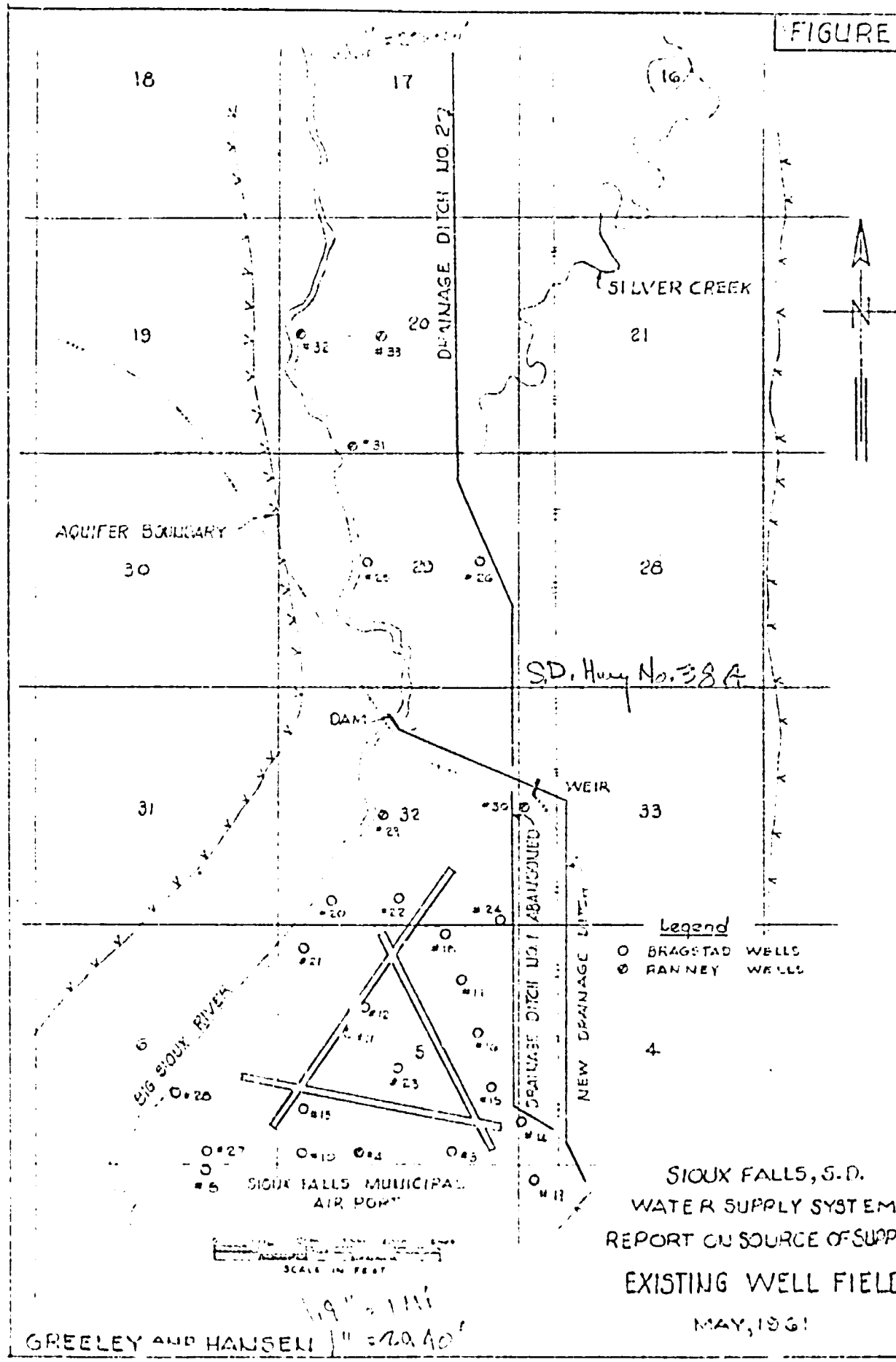


FIGURE 9

REPRODUCED FROM : GROUND WATER RESOURCES of the SIOUX FALLS AREA, S. D. By ROTHROCK & OTTON

SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

FIGURE 5



SIOUX FALLS, S.D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY
EXISTING WELL FIELD
MAY, 1961

GREELEY AND HANSEN

TABLE 5

SIOUX FALLS, SOUTH DAKOTA

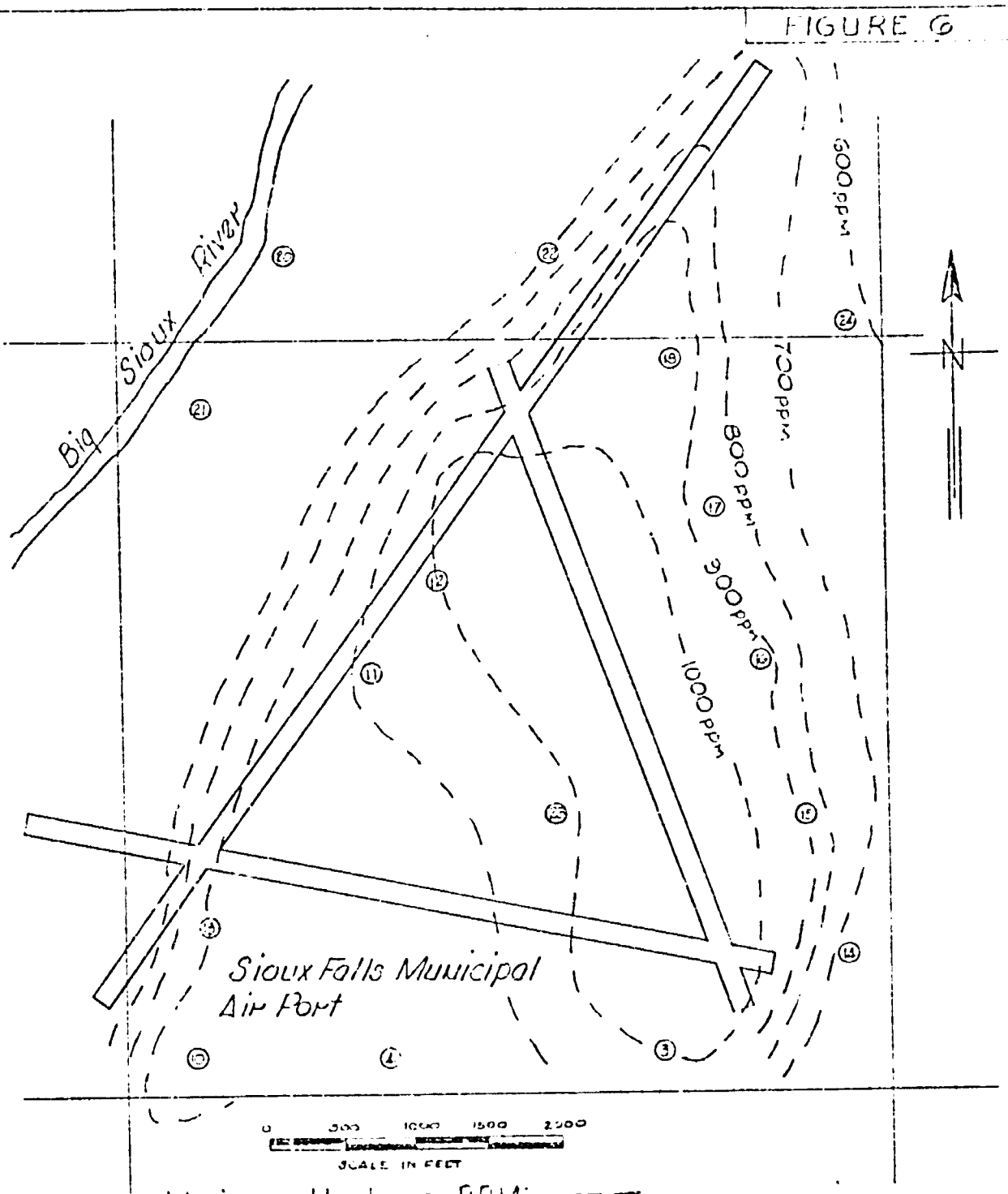
Improvements to Water Supply System
Report on Sources of Supply

Capacities of Existing Wells

May, 1961

Well No.	Type Well	Pump Capacity GPM	Pump Capacity TDH	Well Capacity Information Month & Yr. Well Tested	Drawdown In Caisson	Ave. Cap. GPM	Specific Capacity
3	Caisson	1100	75	4/60	7.69	455	59.3
4	Ranney	1200	70	7/60	5.84	1,176	201.8
8	Dragstad	500	70	----		150	---
10	"	700	70	7/60	4.90	440	89.7
11	"	700	70	6/60	6.30	507	74.5
12	"	700	70	6/60	6.24	265	42.4
13	"	1200	70	7/60	5.37	540	92.0
14	"	1200	70	7/60	7.91	424	53.6
15	"	1200	70	9/60	5.36	591	110.2
16	"	1200	60	7/60	6.75	542	80.3
17	"	1200	60	2/60	6.70	575	85.8
18	"	1200	60	4/60	5.71	812	142.1
19	"	700	70	----		265	---
20	"	1200	60	5/60	10.55	763	72.3
21	"	1200	67.5	10/60	5.89	676	114.8
22	"	1200	70	10/60	5.78	374	64.8
23	"	1200	70	6/60	5.81	449	77.4
24	"	1100	75	6/60	8.42	567	67.3
25	"	1000	137	6/60	8.06	456	56.5
26	"	1000	137	6/60	4.51	523	116.0
27	"	1000	75	6/60	8.46	654	77.2
28	"	1000	75	6/60	5.28	735	138.2
29	Ranney	1500	75	5/60	7.98	1,509	189.1
30	"	1500	65	5/60	14.92	1,435	96.2
30	"	1500	100	5/60	9.29		---
31	"	1500	150	4/60	8.96	1,507	167.8
32	"	1500	150	4/60	8.63	1,371	157.9
33	"	1500	150	4/60	13.18	1,355	102.8
					Total	19,116	

FIGURE 6



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY
WELL WATER QUALITY

MAY, 1961

GREELEY AND HANSEN

3. Bases for Well Field Development

The criteria for the development of the municipal water supply from the Big Sioux Aquifer are as follows:

(1) During the periods of drought, when stream flow is low or absent, water for recharge of the aquifer may not be available. The entire water supply, therefore, must be derived from the water stored in the aquifer.

(2) The development of the aquifer should be such that water can be produced at rates sufficient to supply the maximum day water consumption.

The water consumption for which the well field should be developed, therefore, is as follows:

	WATER CONSUMPTION, MGD		WELL FIELD PRODUCTION MGD(1)	
Date	Annual Av.	Max. Day	Annual Av.	Max. Day
1960	8.3	20.5	8.7	21.5
1970	12.5	30.0	13.1	31.5
1980	14.3	34.3	15.0	36.0
1990	15.7	37.7	16.4	39.6
2000	17.0	40.8	17.8	42.8

(1) Water Consumption plus 5% for Wash Water and other losses.

4. Hydrological Studies

Several testing programs have been undertaken in connection with the Big Sioux Aquifer, as follows:

a. In 1947, Rothrock and Otton conducted tests in the Municipal Well Field to determine the ability of the aquifer to yield water. These tests are summarized in the report, Ground Water Resources of the Sioux Falls Area, South Dakota.

b. In 1956-1957, the Ranney Company conducted tests to determine locations for wells and to estimate the well capacity which could be developed by the use of Ranney type wells.

c. Over a considerable period of time the City of Sioux Falls has conducted annual tests on each producing well. These tests are used primarily to estimate the water production capacity available and to determine any variations in such capacity from the preceding years. These tests are useful, also in connection with the determination of the pressure drop through the caisson or collectors. A summary of the results of the 1960 testing program is given in Table 6.

d. A test was conducted by the U.S.G.S. in 1960 at Ronner, in connection with the ground water investigation programs of the U.S.G.S. The test data are summarized in Table 7.

TABLE 6

SIOUX FALLS, SOUTH DAKOTA

IMPROVEMENTS TO WATER SUPPLY SYSTEM

REPORT ON SOURCE OF SUPPLY

Well Pumping Tests - 1960

May, 1961

Well No.	Month Tested	Av. Capacity GPM	Drawdown In Caisson	Specific Capacity
3	April	455	7.69	59.2
4	July	1178	5.84	201.8
8	-	-	-	-
10	July	440	4.90	89.7
11	June	507	6.80	74.5
12	June	265	6.24	42.4
13	July	540	5.87	92.0
14	July	424	7.91	53.6
15	Sept.	591	5.36	110.2
16	July	542	6.75	80.3
17	Feb.	575	6.70	85.8
18	April	812	5.71	142.1
19	-	-	-	-
20	May	763	10.55	72.3
21	Oct.	676	5.89	114.8
22	Oct.	374	5.78	64.8
23	June	449	5.81	77.2
24	June	567	8.42	67.3
25	June	456	8.06	56.5
26	June	523	4.51	116.0
27	June	654	8.46	77.2
28	June	733	5.28	138.8
29	May	1509	7.98	189.1
30	May	1435	14.92	96.2
31	April	1507	8.98	167.8
32	April	1371	8.68	157.9
33	April	1355	13.18	102.8
	Total	18,701		

TABLE 7

SIOUX FALLS, SOUTH DAKOTA

Improvements to Water Supply System
Report on Source of Supply

Selected Data - U.S.G.S. Test Well at Renner, South Dakota

Time from Start of Pumping. Minutes	Draw down - Feet					Obs.Well No. 4 r = 2/3
	Pumped Well	Obs.Well #1 (r = 154')	Obs.Well #2 (r = 344')	Obs.Well #3 (r = 57')	Obs.Well #4 (r = 3051')	
0	0.00	0.00	0.00	0.00	0.00	
1		2.27	1.67	1.09	0.[illegible]	1.60×10^{7}
2		2.69	1.[illegible]	[illegible]	0.02	8.02×10^{6}
3		2.76	1.9[illegible]	1.32	0.[illegible]	5.33
4		2.85	2.0[illegible]	1.[illegible]	0.9[illegible]	4.0[illegible]
5		2.89	2.06	1.[illegible]	1.07	3.22
6		2.9[illegible]	2.1[illegible]	1.[illegible]	1.1[illegible]	2.67
7		2.9[illegible]	2.1[illegible]	1.66	1.17	2.29
8		5.96	2.17	1.6[illegible]	1.2[illegible]	2.0[illegible]
9		2.97	2.17	1.70	1.25	1.78
10		2.99	2.1[illegible]	1.7[illegible]	1.2[illegible]	1.60
11		3.00	2.22	1.7[illegible]	1.2[illegible]	1.46
12		3.02	2.22	1.75	1.26	1.33
13		3.03	2.2[illegible]	1.7[illegible]	1.27	1.23
14		3.05	2.2[illegible]	1.77	1.2[illegible]	1.14
15		3.07	2.2[illegible]	1.77	1.2[illegible]	1.07
16		3.06	2.2[illegible]	1.7[illegible]	1.3[illegible]	1.00
17		3.07	2.2[illegible]	1.79	1.32	9.43×10^{5}
18		3.07	2.2[illegible]	1.[illegible]	1.3[illegible]	8.90
19		3.08	2.3[illegible]	1.8[illegible]	1.3[illegible]	8.43
20		3.10	2.2[illegible]	1.82	1.34	8.02
21		3.10	2.3[illegible]	1.[illegible]	1.3[illegible]	7.63
22		3.12	2.3[illegible]	1.[illegible]	1.3[illegible]	7.28
23		3.1[illegible]	2.3[illegible]	1.[illegible]	1.3[illegible]	6.97
24		3.1[illegible]	2.3[illegible]	1.[illegible]	1.37	6.6[illegible]
25		3.1[illegible]	2.3[illegible]	1.[illegible]	1.37	6.4[illegible]
26		3.15	2.3[illegible]	1.87	1.3[illegible]	6.17
27		3.1[illegible]	2.3[illegible]	1.[illegible]	1.3[illegible]	5.93
28		3.16	2.3[illegible]	1.[illegible]	1.40	5.73
29		3.17	2.3[illegible]	1.89	1.4[illegible]	5.53
30	8.95(37[illegible])	3.17	2.3[illegible]	1.[illegible]	1.4[illegible]	5.34
60	9.12	3.[illegible]	2.[illegible]	2.09	1.56	2.67
120		3.[illegible]	1.72	2.22	1.72	1.33
180		3.[illegible]	2.[illegible]	2.32	1.81	8.90×10^{4}
300	9.05	3.91	3.05	2.55	2.01	4.22
720	10.22	4.11	3.47	2.75	2.21	2.17
1040	10.22	4.10	3.33	2.81	2.27	1.54
1400	10.22	4.18	3.[illegible]	2.[illegible]	2.30	1.14
1500		4.19	3.36	2.83	2.32	1.05

Pumping Rate - 364 GPM.

e. A test was conducted by the City, in cooperation with Greeley and Hansen, on the existing well field, in 1960 to determine the area of influence of Well No. 4. The test data are summarized in Table 8, and plotted on Figure 7.

In addition to the testing, considerable geological exploration has been undertaken in the Big Sioux Valley to determine areal extent of the aquifer. Test borings have been made throughout the area; nine east-west test well lines across the valley by the U.S.G.S. and scattered borings by the City of Sioux Falls, and others. In addition to test borings a small section of the north end of the well field was mapped by an electrical sounding technique. The limits of the aquifer appear, therefore, to have been well defined. These investigations show also that the aquifer is of near-uniform thickness and is comprised of several layers, and lenses of diverse materials.

These several investigations indicate the following:

a. Aquifer Limits. The Big Sioux Aquifer varies in width from 1.5 to 3.0 miles with an average width of about 2.0 miles and is about 18.0 miles in length. The thickness of the glacial sands and gravels varies from 18 feet to 40 feet with an average thickness of 27 feet. The aquifer has an average slope from Baltic to Sioux Falls of about 3.0 feet per mile.

b. Permeability and Transmissability. The several

TABLE 8

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM

REPORT ON SOURCE OF SUPPLY

Selected Data - City of Sioux Falls - Tests on Well No. 4

May, 1961

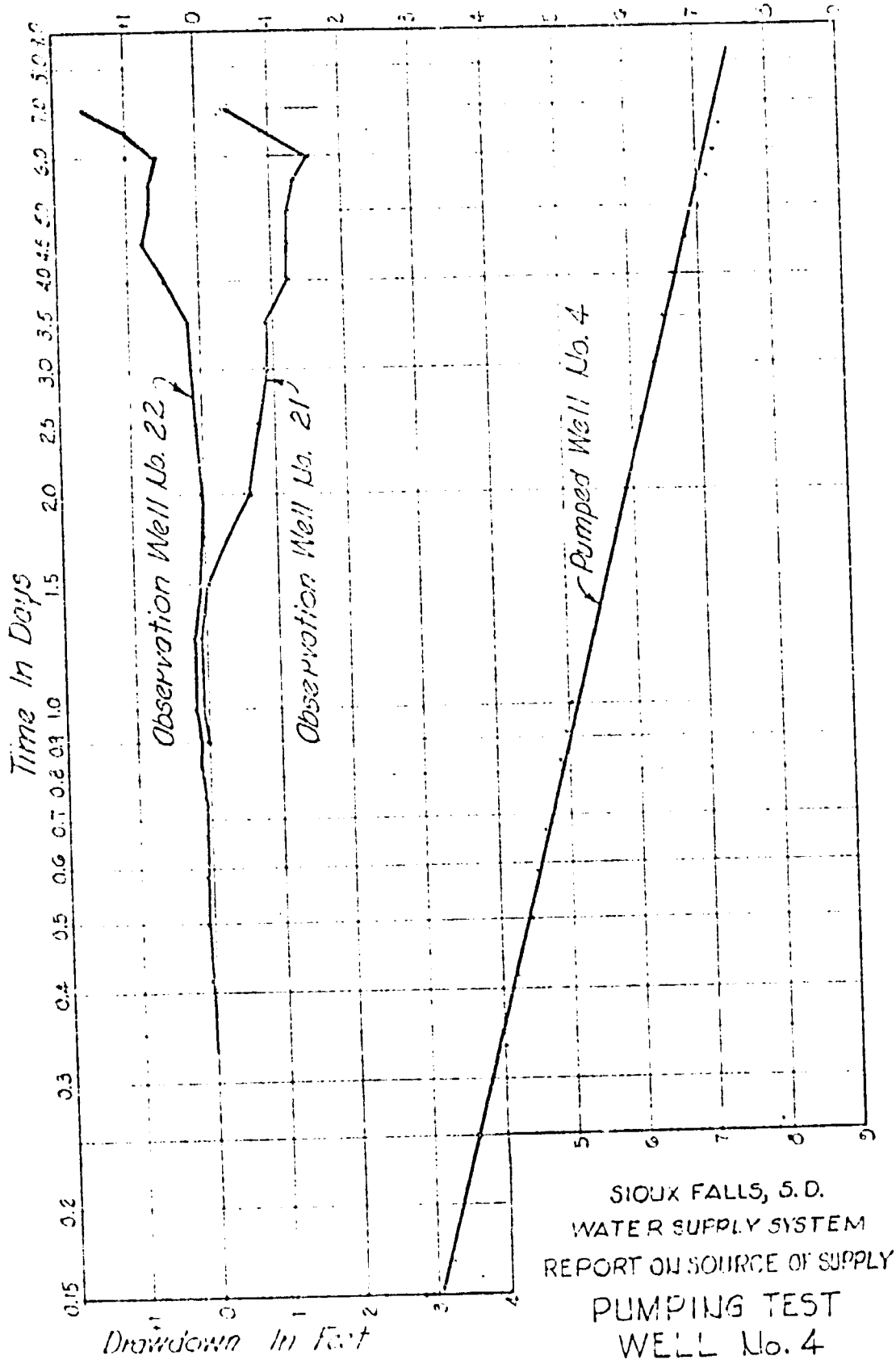
	Time in Days	Pumped Well Well No. 4 Drawdown in ft.(1)		Pumping Tests Well No. 4 Observation Wells Well No. 22 Dwn. in ft.(2)		Well No. 23 Dwn. in ft.(3)
Static level Elev. in ft.	0	99.95'		102.62'		98.24'
Pumps On	0.083	2.70		0		0
	.167	3.22		0		0
	.250	3.60		0		0
	.333	4.00		0		0
	.417	4.23	+	0.05		0
	.500	4.40	+	0.10		0
	.584	4.53	+	.10		0
	.667	4.67	+	.10		0
	.750	4.80	+	.10		0
	.834	4.89	+	.15		0
	.917	4.98	+	.15		0
	1.000	5.06	+	.20	+	0.10
	1.250	5.38	+	.20	+	0.10
	1.500	5.57	+	.10		0.00
	1.750	5.74	+	.05		0.30
	2.000	5.88	+	0.00		0.60
	2.500	6.14	+	.05		0.75
	3.000	6.33	+	.10		0.90
	3.500	6.49	+	.15		0.90
	4.000	6.66	+	.20		1.20
	4.500	6.82	+	.50		1.20
	5.000	7.00	+	.80		1.20
	5.500	7.16	+	.70		1.30
	6.000	7.24	+	.60		1.50
	6.500	7.32	+	1.00		0.90
	7.000	7.29	+	1.60		0.40

(1) Well No. 4 was pumped at 1250.0 GPM for 171.04 Hrs.

(2) Well No. 22 is located approximately 5,800 feet North of Well No. 4.

(3) Well No. 23 is located approximately 2,140 feet Northeast of Well No. 4.

FIGURE 7



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

PUMPING TEST
WELL No. 4

MAY, 1941

GREELEY AND HANSEN

tests show a range in permeability of from 2540 gallons per day (per mile of width, per foot of thickness under a hydraulic gradient of 1 foot per mile) to 8000 gallons per day with an average of 3770 gallons per day. The tests also show a transmissability of from 83,000 gallons per day (for 27 foot of saturated aquifer, per mile of width, under a hydraulic gradient of 1 foot per mile) to 180,000 gallons per day, with an average of 105,650 gallons per day.

c. Storage Coefficient. The storage coefficient is defined as the volume of water that an aquifer releases from storage per unit surface area of aquifer per unit change in the component of head normal to that surface.

The several tests show a field coefficient of storage of from 2.8% to 17.0%. The laboratory coefficient of storage was determined by Rothrock and Otton as 30%. An average storage coefficient of about 12.3% is considered reasonable for use in estimated yields from storage.

The summary of the results of these several tests is given in Table 9.

5. Development of Well Field

During periods of drought, when stream flow for recharge of the aquifer may be virtually absent, it is necessary to develop the entire water supply from aquifer storage. It is necessary under these conditions that sufficient water be in storage during the summer months so that water may be removed from the aquifer at the maximum day rates. The stream flow records, summarized in Table 3, indicate that some flow exists in the Big Sioux River each Spring, but that on occasion very little stream flow exists

TABLE 9

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM

REPORT ON SOURCE OF SUPPLY

Summary of Aquifer Characteristics

May, 1961

Test Conducted by	Date	Location	Ave. Permeability gal/day	Ave. Transmissability gal/day/ft.	Average Storage Coefficient
Ranney	10-56	Well 29	3,246	104,570	10.72
Ranney	10-56	Well 30	3,060	108,250	-----
Ranney	5-56	Well 4	6,500	144,830	24.35
Ranney	3-57	Well 31	2,650	93,900	13.95
Ranney	3-57	Well 33	3,305	93,450	10.30
U.S.G.S.	11-60	Renner(1)	3,410	88,600	2.08
		Average	3,695	105,650	12.28
Ground Water Resources Report(2)	47	Well 10	6,700	180,000	
	47	Well 16	5,500	83,000	
	47	Well 18	8,000	120,000	
	47	Well 19	3,700	76,000	
	47	Well 20	------	155,000	
	47	Well 50	4,200	135,000	

LABORATORY MEASUREMENTS

1 Ground Water Resources Rept.	47	31 Samples	4,080	30.0

(1) Tests performed by U.S.G.S. at Renner, South Dakota

(2) From Ground Water Resources of the Sioux Falls Area, South Dakota 1947 by Rothrock and Otton

during the Summer months. For example, during the year 1959, practically no stream flow occurred except during the month of April.

The development of the water supply for years during which stream flow is virtually absent has been predicated on the following bases:

a. During a 12-month period, no recharge to the aquifer will occur.

b. The water available in the aquifer has been estimated on the following bases:

   1. The average storage coefficient is 12.3%
   2. The average thickness of the aquifer is 27-feet.
   3. The lower 4-feet of the aquifer is not available for draw-down. Water levels in the wells less than 4-feet would probably result in pumping difficulties.

c. Sufficient water must be in storage during the summer season to insure that sufficient draw-down is available to permit pumping from the wells at the maximum day rate. For this purpose it is assumed that one-third of the annual water consumption has been withdrawn from storage before the maximum day rates of water consumption occur.

On these bases the total annual yield per square mile is estimated at 590 million gallons or about 1.7 MGD per square mile. If one-third of the annual requirements are used prior to the maximum day rates of water consumption occur, the available draw-down for pumping has decreased from 27-feet to 18-feet. The maximum rate of pumping on a maximum day would be about 4.1 MGD per square mile. This may be achieved by two - Ranney type wells or four - Fragstad type wells per section, as follows:

Max. rate of pumping per sq. mile	4.1 MGD
Max. draw-down available	18.0 feet
Fragstad Wells:	
No. per section	4
Cap. per well	1.02 MGD
Estimated draw-down	8.25 feet
Ranney Wells:	
No. per section	2
Cap. per well	2.04 MGD
Estimated draw-down	9.3 feet

This analysis indicates that the well field designed to produce the total water supply for a 12-month period from water stored in the aquifer should be adequate

to supply water at the maximum day rates required during the summer months.

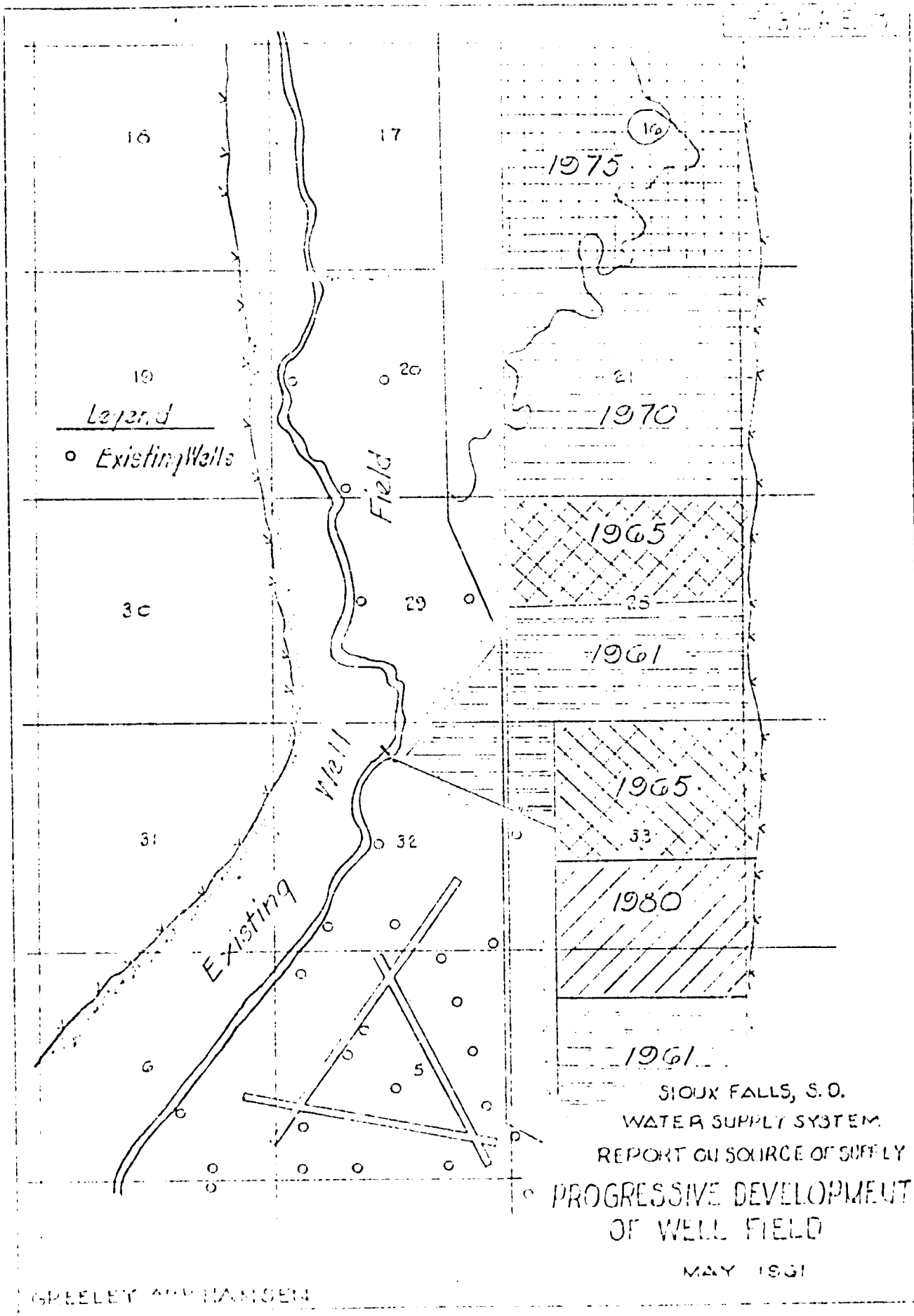
The present city well field has an effective area of about 4.15 square miles. It therefore has an estimated annual average capacity from aquifer storage at 7.05 MGD. In addition to water available from storage the migratory supply available from the upper reaches of the aquifer is estimated at 0.63 MGD. The total estimated water supply available from the present well field during drought conditions is 7.68 MGD. The present and future quantities required are estimated as follows:

Year	Est. An. Av. Water Consumption MGD	Estimated Additional Well Field Cap. Req'd. MGD (1)	Additional Well Field Area Req'd. Sq. Miles (2)
1960	8.3	0.6	0.35
1970	12.5	4.8	2.82
1980	14.3	6.6	3.88

(1) Estimated Annual Av. Water Consumption minus 7.68 MGD, present well field capacity.

(2) Estimated Well Field Cap. @ 1.7 MGD/sq. mile.

The additional area which should be developed for progressive expansion of the well field is shown on Figure 8.



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

PROGRESSIVE DEVELOPMENT OF WELL FIELD

MAY 1951

GREELEY AND HANSEN

6. Recharge

The aquifer is recharged naturally by rainfall on the Big Sioux Basin, and by stream flow in the Big Sioux River. Prior to the construction of the new flood control work by the U. S. Engineer Corps, the run-off from precipitation was quickly lost to areas downstream of the Sioux Falls aquifer. The construction of the flood control works, outlined on Figure 3, makes possible the ponding of water in the new by-pass canal. It is understood that the U. S. Engineer Corps will permit the construction of low dams in the Big Sioux River, downstream of the diversion dam, which could be used for the impounding of stream flow.

The availability of the new flood control structures makes possible the establishment of ponds to induce recharge to the aquifer in the vicinity of the wells, and thereby make possible the maintenance of high water levels in the aquifer.

Several feasible methods of promoting recharge are as follows:

a. A pool exists in the drainage canal from the spillway to the weir, and a second pool exists behind the weir at the drainage canal which pool extends along the Big Sioux River and in Silver

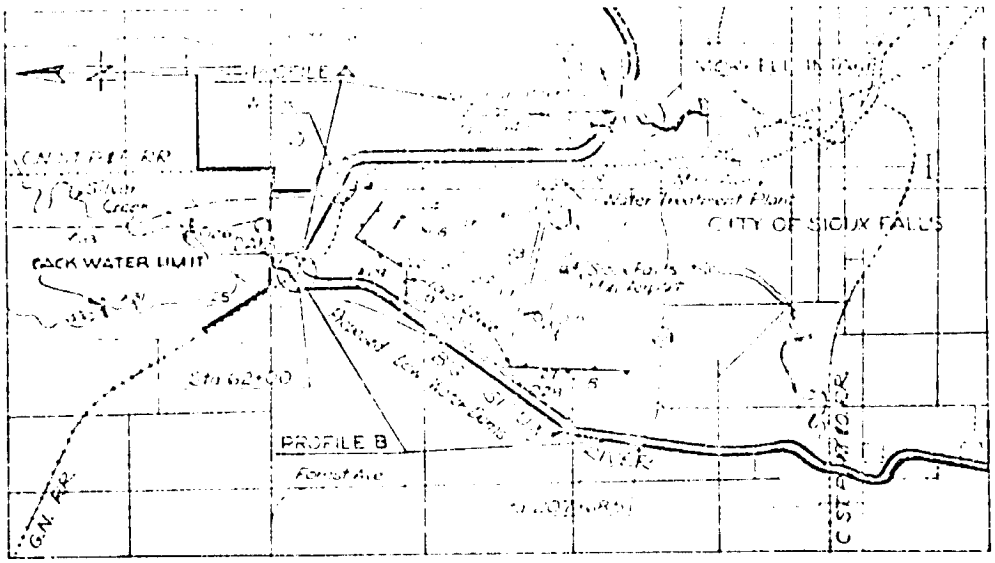
Creek, a distance of about one mile. The development of high capacity wells in the vicinity of these pools may induce large recharge to the aquifer.

b. The construction of low dams as shown on Figure 9 and the use of existing drainage gates will permit the flooding of areas in the vicinity of wells Nos. 20, 21, 22, 27, 28 and 29, and thereby induce recharge to the aquifer in these areas.

Two sites appear suitable for the development of large capacity collectors. These are in the vicinity of the weir, north of the drainage canal, to induce recharge from the pool behind the weir, and the second in the vicinity of the water treatment plant to induce recharge from the pool behind the spillway crest. Both sites should be investigated by test drilling and detailed hydrological studies, but only that site which appears most productive should be developed.

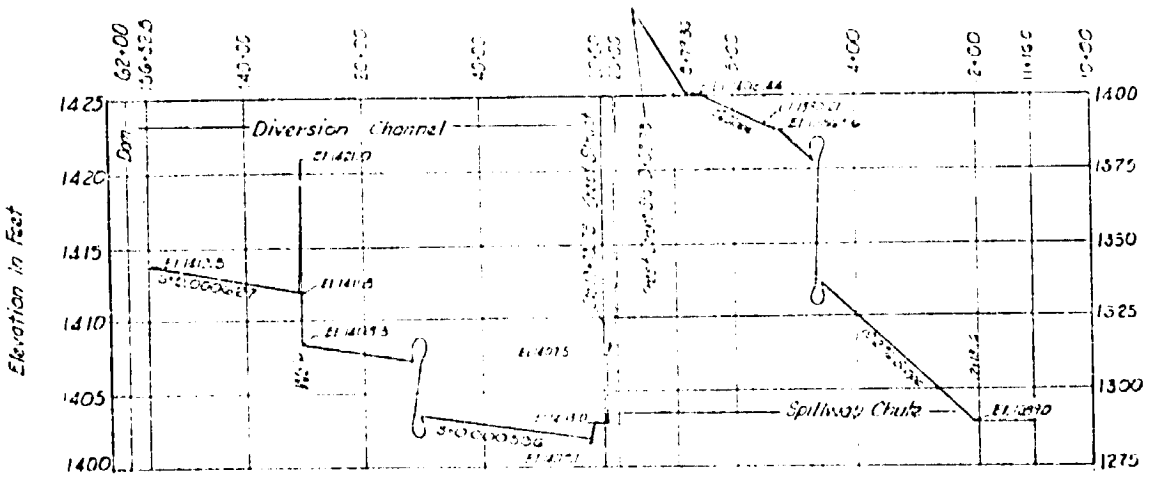
The construction of facilities to promote recharge of the well field during periods of stream flow is desirable for the following reasons:

1. High water levels will be maintained in the aquifer.

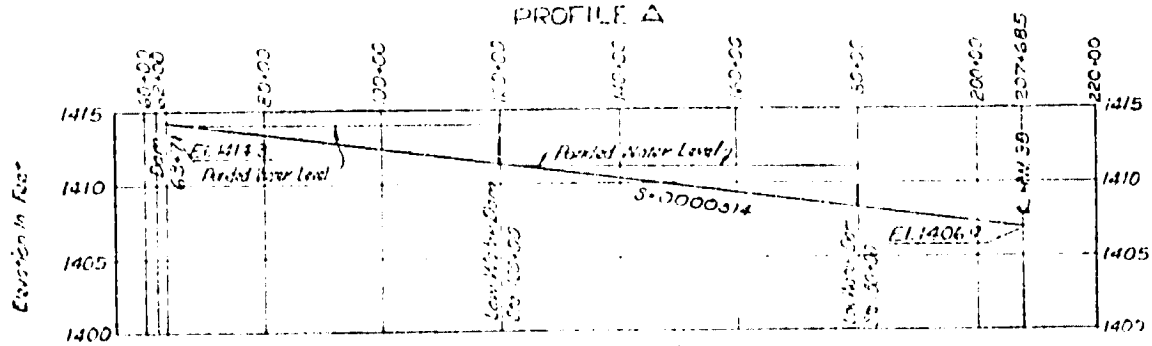


PROJECT PLAN

SCALE IN MILES



PROFILE A



PROFILE B
BIG SIOUX RIVER

SIOUX FALLS, S.D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

RECHARGE BY PONDING
IN THE BIG SIOUX RIVER

MAY, 1961

GREELEY AND HANSEN

2. The mineral content of surface water induced into the aquifer in the vicinity of the wells will be lower than that which has had greater underground travel. Savings in chemical costs for treatment will therefore be realized.
3. Power costs for pumping will be lower if pumping can be maintained from wells close to the treatment plant than would result if pumping were accomplished from remote areas.

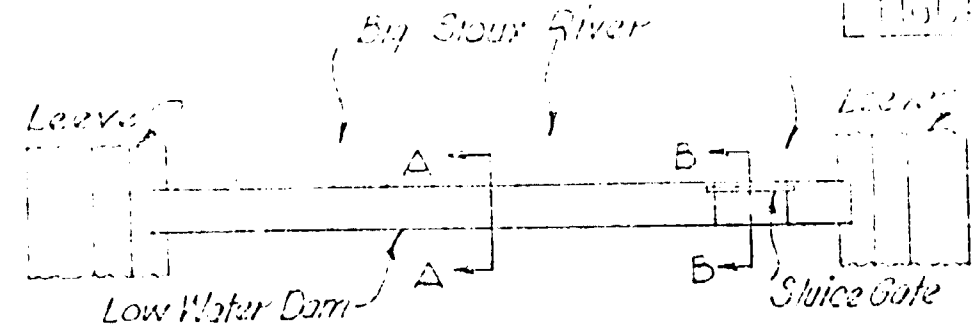
Preliminary details of the low dams on the Big Sioux River are shown on Figure 10.

7. Types of Wells

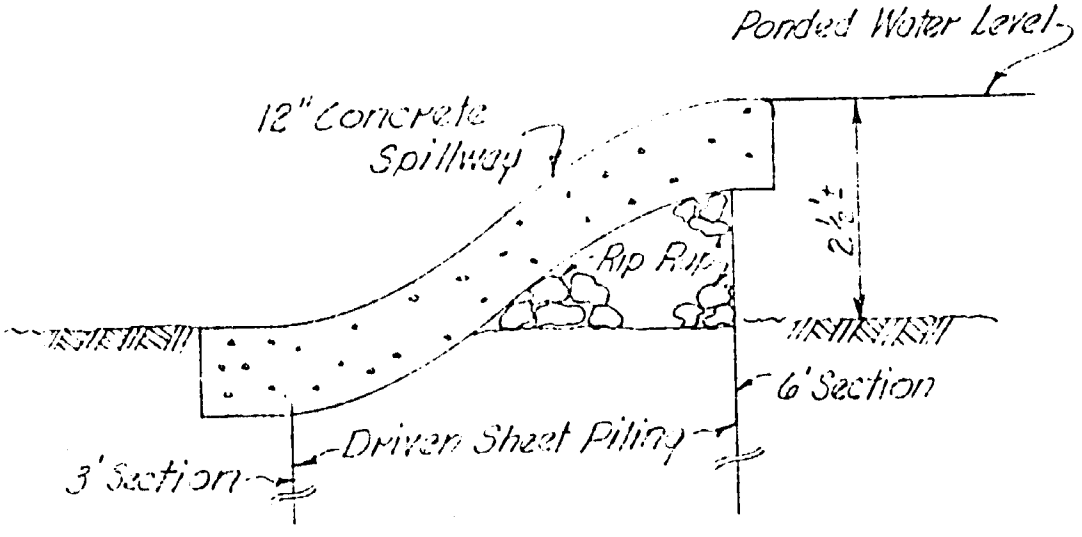
Two types of wells have been used successfully by the City for the development of the Big Sioux Aquifer. These are as follows:

a. The Bragstad Well, developed by the Sioux Falls City Engineer, comprises a slotted inner caisson, a secondary caisson around the collector extending partway into the aquifer, and the annular space between the caissons filled with coarse sand and gravel. The outer caisson makes possible the maintenance of well efficiency by periodically replacing the sand and gravel envelop between the inner and outer caissons.

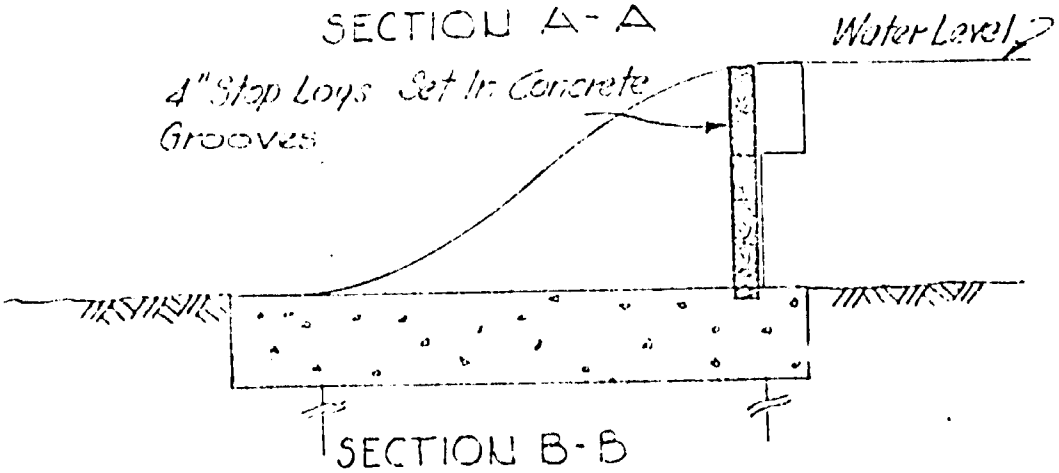
b. The Ranney Well consists of a caisson with slotted laterals extending horizontally near



PLAN
No Scale



SECTION A-A



SECTION B-B
Scale 1"=2'0"

SIOUX FALLS, S.D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY

PRELIMINARY DETAILS
DIVERSION DAMS ON
BIG SIOUX RIVER

MAY, 1940

GREELEY AND HANSEN

the bottom of the caisson into the water bearing stratum. The laterals may extend a considerable distance from the caisson with the result that the effective radius of the well is large and the entrance velocity and head loss are low. Draw-down differential between the caisson and aquifer is small.

The Bragstad wells appear to decline in specific capacity with use. This loss is probably a result of chemical and physical clogging of the aquifer in the immediate vicinity of the well.

Reduction in piezometric pressure and unwatering of the aquifer may cause the oxidation of dissolved minerals which would tend to clog the aquifer. The clogging appears to be of quite small areal extent, inasmuch as the replacement of the gravel envelope around the Bragstad wells appears to restore the specific capacity of the wells to their original condition.

Head loss into the well is important because of the limited thickness of the aquifer. The head loss should be kept to a practicable minimum so that the available draw-down can be used to induce flow to the area around the well and not be consumed in causing the water to enter the well. The loss of head on entrance to the wells, or well efficiency, has been investigated for all of the wells.

To estimate the efficiency of the wells, uniform permeability of 4,570 gpd/sq. ft., and an average thickness

of aquifer of 27 feet have been assumed. Test data collected in 1960 have been used for the estimates of well efficiency.

The theoretical efficiencies for the Bragstad wells vary from 42.5% to 95.5% with an average of 66.6%. The theoretical efficiency for the Ranney wells vary from 87.0% to 107.3% with an average of 98.0%. The individual theoretical well efficiencies are summarized in Table 10. Efficiencies in excess of 100% probably result from permeability and thickness of the aquifer around the individual wells different from the average.

The investigation of efficiency indicates that both the Bragstad and the Ranney type wells are efficient, but that higher sustained efficiencies appear to be possible with Ranney wells than with Bragstad wells.

Because of the ability of the Ranney collectors to maintain higher well efficiencies, and because it is possible to develop higher capacities in those wells, it is recommended that new wells to be provided be of the Ranney type.

8. Project for Development of Water Supply

The further development of the water supply is amenable for progressive construction. Water supply facilities may

TABLE 10

SIOUX FALLS, S. D.

IMPROVEMENTS TO WATER SUPPLY SYSTEM

REPORT ON SOURCE OF SUPPLY

Summary of Well Efficiency

May, 1961

Bragstad Well No.	Efficiency %	Ranney Well No.	Efficiency %
3	42.9	4	104.2
8	--	29	96.4
10	50.8	30	95.2
11	66.3	31	87.0
12	42.5	32	--
13	80.5	33	107.3
14	55.7		
15	71.4	Avg.	98.0%
16	79.3		
17	95.5		
18	84.2		
19	--		
20	53.6		
21	89.8		
22	69.2		
23	70.9		
24	54.6		
25	44.3		
26	75.5		
27	--		
28	--		
Avg.	66.6%		

Based on test data collected in 1960 and uniform permeability of 4570 gal/day/sq. ft.

be added periodically as the need for such additional facilities is demonstrated. A program, arranged for construction in approximately 5-year intervals, is as follows:

Estimated Date for Construction	Description of Improvements
1961	a. Construct a large Ranney collector along the new by-pass drainage canal either in the vicinity of the water treatment plant or the weir.
	b. Construct one additional Ranney collector.
	c. Construct low dams in the Big Sioux River to promote recharge.
1965	Provide two additional Ranney collectors.
1970	Provide two additional Ranney collectors.
1975	Provide two additional Ranney collectors.
1980	Provide two additional Ranney collectors.

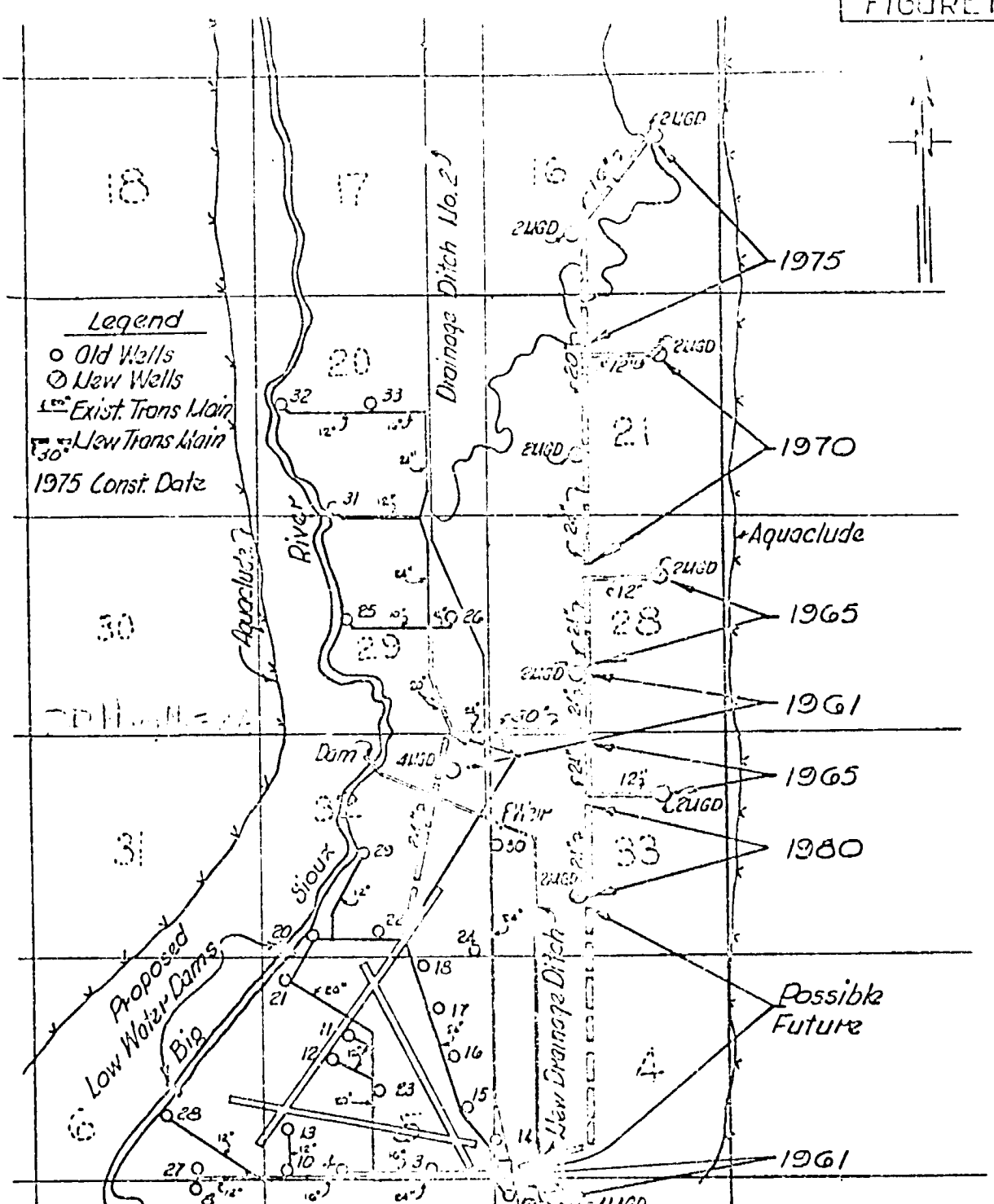
The extension of the water system farther to the north will require additions and extensions to the well collecting system. During periods of maximum water consumption, many of the wells in the existing well field will interfere with each other and therefore may not be used to the extent possible if several of the wells are allowed to remain idle. The well collecting system, therefore, has been analyzed on the basis of maximum day water consumption from the areas required to supply water from the aquifer when water

is being withdrawn from storage. On this basis, the 24-inch main from approximately Section 29 will receive the water production from about 6 sections of land by the year 1980, while the 24" - 20" well field ring in the airport will receive the water production from about 1.5 sections of land. It is considered advisable, therefore, to effectively utilize the capacity of the existing system to connect the "ring collector" in the airfield area with the system which now serves the area north of the south boundary of Section 29. Other extensions may be limited to those necessary to connect new wells to the well collection system. The piping should be arranged, however, so that an additional main may be extended to the site of the water treatment plant in the future. The proposed extensions to the well field are shown on Figure 11.

The estimated costs of the improvements, as outlined above, are as follows:

	Estimated Cost
Stage 1 - Construction in 1961.	
a. Construct a large Ranney collector along the by-pass drainage canal, either between the weir and dam, or near the water treatment plant	$113,700
b. Construct one additional Ranney well to develop further areas of the aquifer	$102,600

FIGURE II



SIOUX FALLS, S. D.
WATER SUPPLY SYSTEM
REPORT ON SOURCE OF SUPPLY
PRELIMINARY PLAN
PROGRESSIVE WELL FIELD
DEVELOPMENT
MAY, 1961

GREELEY AND HANSEN

		Estimated Cost
c.	Construct extensions to the well collecting lines to provide for increased capacity in the well field.	$272,000
d.	Construct low dams in the Big Sioux River to promote recharge.	$ 29,700
	Total 1961	$518,000

Stage 2 - Construction in 1965.

a.	Construct two Ranney wells.	$205,000
b.	Extend collecting mains.	$144,000
	Total 1965	$349,000

Stage 3 - Construction in 1970.

a.	Construct two Ranney wells.	$205,000
b.	Extend collecting mains.	$161,000
	Total 1970	$366,000

Stage 4 - Construction in 1975.

a.	Construct two Ranney wells.	$205,000
b.	Extend collecting mains.	$122,000
	Total 1975	$327,000

Stage 5 - Construction in 1980

a.	Construct one Ranney well	$103,000
b.	Extend collecting mains	$ 60,000
	Total 1980	$163,000
	Total 1962 - 1980	$1,723,000

The details of these estimated costs are given in Table 11. The preliminary location of wells and the collecting mains are shown on Figure 11.

The large collectors proposed for construction near the by-pass drainage canal should be designed to produce the greatest feasible quantity of water. Detailed hydrological studies will be required for the determination of the capacities of these collectors. It is recommended, therefore, that test drilling be undertaken in the selected sites to determine the capacity which could be developed with Ranney type collectors at these sites.

9. Additional Improvements

The capacities and required pumping heads of many of the older wells are less than originally estimated, with the result that the pump and motors of many of the wells are larger than required. To avoid overpumping of these wells with the equipment installed therein, the discharge valves on the pumps are throttled. This procedure probably will be required always to some extent, but when the throttling is constant and the reduction in flow by throttling is large, the operation is wasteful of power and promotes rapid deterioration of the discharge valves. The capacities of the wells and of the pumping equipment installed therein are summarized in Table 12.

TABLE 11

SIOUX FALLS, SOUTH DAKOTA

REPORT ON SOURCE OF SUPPLY

Construction Program
Estimated Cost of Projects for Further Development
of Big Sioux Aquifer

1961 Construction Program	Project Cost	Total Cost
1 Large Collector		
Exploratory Work	$ 12,400	
1 Ranney Well @ $69,000	69,000	
1 Well House @ 1,800	1,800	
Pumping Equipment	6,400	
Electrical Controls	1,600	
Construction Cost	$ 91,200	
1 Ranney Collector		
Test Holes	$ 4,500	
1 Ranney Well @ $69,000	69,000	
1 Well House @ 1,800	1,800	
Pumping Equipment	5,200	
Electrical Controls	1,600	
Construction Cost	$ 82,100	
Extension to Well Collecting Lines		
1,850 ft. 30" concrete pipe @ $25.00/lin.ft.	$ 46,300	
6,450 ft. 24" concrete pipe @ $21.00/lin.ft.	135,500	
1,000 ft. 18" cast iron pipe @ $18.00/lin.ft.	18,000	
Valves and Fittings	17,800	
Construction Cost	$ 217,600	

(Continued)

1961 Construction Program	Project Cost	Total Cost
2 Low Water Dams		
3,690 sq. ft. Sheet Piling @ $4.00/ft.	$ 15,800	
92 cu. yd. Concrete @ $50.00/cu. yd.	4,600	
100 cu. yd. Rip Rap @ $4.00/cu. yd.	400	
Sluice Gates	3,000	
Construction Cost	$ 23,800	
Total Construction Costs	$ 414,700	
Engineering and Contingencies @ 25%	$ 103,300	
TOTAL PROJECT COST	$ 518,000	$ 518,000

1965 Construction Program	Project Cost	Total Cost
2 Ranney Collectors		
Test Holes	$ 9,000	
2 Ranney Wells @ $69,000 ea.	138,000	
2 Well Houses @ $1,800 ea.	3,600	
Pumping Equipment	10,400	
Electrical Controls	2,200	
Construction Cost	$ 161,200	
Extensions to Well Collecting Lines		
3,800 ft. 24" Concrete Pipe @ $21.00/lin. ft.	$ 79,800	
3,900 ft. 12" Cast Iron Pipe @ $6.00/lin. ft.	23,500	
Valves and Fittings	11,400	
Construction Cost	$ 114,700	
Total Construction	$ 275,900	
Engineering and Contingencies @ 25%	$ 70,100	
TOTAL PROJECT COST	$ 349,000	$ 349,000

1970 Construction Program	Project Cost	Total Cost
2 Ranney Collectors		
Test Holes	$ 9,000	
2 Ranney Wells @ $69,000 ea.	138,000	
2 Well Houses @ $1,800 ea.	3,600	
Pumping Equipment	10,400	
Electrical Controls	3,200	
Construction Cost	$ 164,200	
Extensions to Well Collecting Lines		
3,200 ft. 24" Concrete Pipe @ $21.00/lin.ft.	$ 67,200	
2,200 ft. 20" Concrete Pipe @ $18.00/lin.ft.	39,600	
1,960 ft. 12" Cast Iron Pipe @ $6.00/lin.ft.	11,800	
Valves and Fittings	10,100	
Construction Cost	$ 128,700	
Total Construction Cost	$ 292,900	
Engineering and Contingencies @ 25%	$ 73,100	
TOTAL PROJECT COST	$ 366,000	$ 366,000

1975 Construction Program	Project Cost	Total Cost
2 Ranney Collectors		
Test Holes	$ 9,000	
2 Ranney Wells @ $69,000 ea.	138,000	
2 Well Houses @ $1,800 ea.	3,600	
Pumping Equipment	10,400	
Electrical Controls	3,200	
Construction Cost	$ 164,200	
Extensions to Well Collecting Lines		
3,200 ft. 20" Concrete Pipe @ $18.00/lin.ft.	$ 57,600	
3,000 ft. 16" Concrete Pipe @ $11.00/lin.ft.	33,000	
Valves and Fittings	7,000	
Construction Cost	$ 97,600	

(Continued)

1975 Construction Program	Project Cost	Total Cost
Total Construction Cost	$ 261,800	
Engineering and Contingencies @ 25%	65,200	
TOTAL PROJECT COST	$ 327,000	$ 327,000

1980 Construction Program	Project Cost	Total Cost
1 Ranney Collector		
Test Holes	$ 4,500	
1 Ranney Well @ $69,000	69,000	
1 Well House @ $1,800	1,800	
Pumping Equipment	5,200	
Electrical Controls	1,600	
Construction Cost	$ 82,100	
Extensions to Well Collecting Lines		
2,000 ft. 24" Concrete Pipe @ $21.00/lin.ft.	$ 42,000	
Valves and Fittings	6.000	
Construction Cost	$ 48,000	
Total Construction Cost	$ 130,100	
Engineering and Contingencies @ 25%	$ 32,900	
TOTAL PROJECT COST	$ 163,000	$ 163,000
TOTAL COST OF PROJECT THROUGH 1980		$ 1,723,000

TABLE 12

SIOUX FALLS, S. D.

WATER SUPPLY SYSTEM

Report on Source of Supply
Well Capacities & Pump Capacities

Well No.	Pumping Equipment: Pump Cap. G.P.M.	T.D.H. ft.	R.P.M.	Motor HP	Well Capacity: G.P.M.	Req. T.D.H. Exist. Syst.	Req. T.D.H. New Syst.	Required HP Exist. Syst.	Required HP New Syst.	
3	1100	75		25	455	56	62	8	9	57
4	1200	70		25	1178	61	69	23	25	61
8	500	70		15	150	66	81	3	4	50
10	700	70		15	440	63	77	9	11	50
11	700	70		15	507	57	67	9	11	56
12	700	70		15	265	56	67	5	6	52
13	1200	70		25	540	67	80	11	14	50
14	1200	70		25	424	55	59	7	8	60
15	1200	70		25	591	62	70	12	13	50
16	1200	60		25	562	59	70	10	12	54
17	1200	60		25	575	58	73	10	13	57
18	1200	60		25	812	58	78	15	20	54
19	700	70		15	265	53	55	4	4	65
20	1200	60		25	763	56	72	14	17	54
21	1200	67.5		25	676	52	67	11	14	61
22	1200	70		25	374	43	67	6	9	62
23	1200	70		25	449	56	67	8	10	56
24	1100	75		25	567	67	80	12	14	47
25	1100	137		40	456	78	102	11	15	41
26	1100	137		40	523	74	99	12	16	44
27	1000	75		25	654	61	76	13	16	50
28	1000	75		30	733	64	78	15	18	50
29	1500	75		40	1509	76	94	36	45	42
30	1500	65		40-50	1435	87	107	39	48	34
31	1500	150		75	1507	110	135	52	64	30
32	1500	150		75	1371	107	132	46	57	20
33	1500	150		75	1355	89	114	38	49	26
			Proposed Wells							
34	1460	110		60	1460		110		51	
35	1460	120		60	1460		120		55	
36	1460	116		60	1460		116		54	
37	1460	134		75	1460		134		62	
38	1460	131		75	1460		131		61	
39	1460	148		75	1460		148		68	
40	1460	143		75	1460		143		66	

The data summarized in Table 12 indicate that the pumping equipment on a large number of wells is considerably greater than required and should be modified. General changes which appear feasible are as follows:

a. Where possible, relocate the existing pumping equipment so that pump capacities match well capacities.

b. Reduce pump speed, or remove pump stages as required to adjust pump capacity to well capacity.

c. Provide new pumps and motors where relocation and alterations to existing equipment are not possible.

For purposes of illustration, the following example is cited:

> Well No. 23 has a 1,200 gpm capacity with a 70' TDH pump, but the well has a capacity of 449 GPM at 67' TDH. It is equipped with a 25 HP motor, but would require only 10 HP. Well No. 8 has a 500 GPM at 70' TDH with a 15 HP motor. Well No. 8 has a capacity of only 150 GPM. The pump on Well No. 8 could be moved to Well No. 23 and the pump on Well No. 23 used elsewhere.

Wells requiring modification are shown as follows:

Well No.	GPM Pump Cap.	Well Cap. G.P.M.	Existing Motor HP	Required HP
3	1100	455	25	9
8	1200	150	15	4
12	700	265	15	6
14	1200	424	25	8
15	1200	592	25	13
16	1200	542	25	12
17	1200	575	25	13
19	700	265	15	4
21	1200	676	25	14
22	1200	374	25	8
23	1200	449	25	10
24	1100	567	25	14
25	1100	456	40	15
26	1100	523	40	16
32	1500	1372	75	57
33	1500	1355	75	49

The pump characteristic curves for all of the well pumps should be investigated to determine the best use of present equipment.

10. Summary and Conclusions

The total estimated water supply available from the Sioux Falls Well Field during drought conditions is 7.68 MGD. This supply is obtained from a well field, the effective area extent of which is estimated at 4.15 square miles and an average annual yield of 1.7 MGD per square mile. An additional yield of 0.63 MGD results from the migration of water from the upper reaches of the aquifer. The present

annual average day water consumption is greater than the estimated quantities of water available from aquifer storage. Further development of the aquifer is, therefore, considered necessary as follows:

Year	Est. An. Av. Well Field Production MGD	Estimated Additional Well Field Cap. Req'd. MGD	Additional Well Field Area Req'd. Sq. Miles
1960	8.7	1.02	0.60
1970	13.1	5.42	3.19
1980	15.0	7.32	4.13

To meet the increased water consumption the following improvements are proposed:

a. The progressive development of approximately four square miles of aquifer by the construction of nine new Ranney Type collectors, one of which should be a large capacity collector, one located adjacent to the new diversion channels in order to utilize the water ponded by the new Army Engineer flood control structures.

b. The construction of two low water dams in the Big Sioux River, capable of ponding water from Maple Street to the new Dam north of the municipal airport. Existing drainage gates in the vicinity of these dams will permit the flooding of the areas west of the airport and promote recharge to the aquifer in the vicinity of Wells 8, 20, 21, 22, 27, 38, and 29.

c. Construction of extensions to the well collecting lines to provide for increased capacity in the well field.

d. Modifications to the present well pumping facilities to meet the well capacities by relocating or modifying existing equipment and the installation of new equipment where modifications are not possible.

The construction programs may be programmed for progressive construction.

The construction cost of these improvements is estimated at $1,723,000.

The initial construction program comprising two new Ranney Collectors, additions to the transmission mains, two low water dams on the Big Sioux River, and modifications to the well pumping equipment should be begun immediately in order to meet this summer's maximum water demands.

NAME OF PERSON OR FILE: City of Sioux Falls - Water Right No. 1579-3

NAME OF CONTACT: Glen Dostal, HDR consulting

DATE: December 21, 1990

SUBJECT: Water Right No. 1579-3

Glen Dostal called regarding the placing of water to beneficial use by Water Right No. 1579-3 from Future Use Permit No. 448-3. Mr. Dostal questioned why this was done when the application did not request withdrawal from future use reservations and the well is not located within the future use area. After review of Water Right No. 1579-3 and Future Use Permit Nos. 448-3 and 449-3, I found the following:

1) The permit for No. 1579-3 states that the priority for No. 1579-3 is established by Future Use Permit No. 449-3 and that No. 449-3 has been reduced by 1.89 cfs. A note written by Burt Jones dated November 16, 1973, indicates that No. 1579-3 is not located within the future use area.

2) No. 1579-3 is licensed for 0.72 cfs and this amount has been subtracted from Future Use Permit No. 448-3.

3) The well for No. 1579-3 is located approximately 2.4 miles north of the location specified on the permit.

4) The legal description of the well site specified on the original permit for No. 1579-3 and the actual licensed well site (2.4 miles North of permitted site) are NOT located within the future use areas of either Permit No. 448-3 or No. 449-3.

5) The license for No. 1579-3 was issued January 5, 1971, and is legalized by SDCL 46-5-4.1 even though the well is not located at the permitted site. Reducing Future Use Permit No. 448-3 by 0.72 cfs is apparently an error.

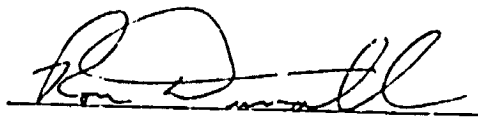
6) The November 6, 1990, draft report submitted by HDR Engineering indicates that No. 1579-3 has been abandoned.

RECOMMENDED ACTION:

1) If No. 1579-3 has not been forfeited or abandoned, then the license for No. 1579-3 needs to be reissued with the priority date being when the original application was filed (April 25, 1968). The license should note the diversion point has been legalized pursuant to SDCL 46-5-4.1. The pump rate may also be revised depending on the present well capacity.

2) If No. 1579-3 has been forfeited or abandoned, the water right can be scheduled for cancellation consideration by the Board.

3) The 0.72 cfs reduction from Future Use Permit No. 448-3 should be deleted to correct the error of reducing the future use permit. The amount to be reinstated is 60% of the annual volume based on either 0.72 cfs or the current pump rate of the well, whichever is less.

NAME:  , Natural Resources Engineer

1579-3

HDR

December 28, 1990

City of Sioux Falls
Water Purification
224 West 9th Street
Sioux Falls, South Dakota 57102

Attn: Lyle Johnson, P.E.

Re: Aquifer Study
Sioux Falls, South Dakota
HDR No. 01450-071-135

Dear Mr. Johnson:

Enclosed please find a copy of the revised Water Rights section for the Big Sioux Aquifer Study. Several quantities have been revised to reflect the actual licensed amount. A copy of this information is being sent to DWNR for their review. As discussed with Ron DuVall (DWNR) a meeting in Sioux Falls may be appropriate in January to review the probable license accounts for the most recent permits.

If you have any questions, please contact us.

Sincerely,

HDR ENGINEERING, INC.

Glenn H. Dostal, P.E.
Project Manager

GH/dm

Enclosure

cc: Ron DuVall
LGI
Stockwell Engineers

HDR Engineering, Inc.

8404 Indian Hills Drive
Omaha, Nebraska
68114-4049

Telephone
402 399-1000

6.3 City of Sioux Falls Water Rights

The permits and legal descriptions were compared to the well number for the various wells. Table 6.3.1 summarizes this information. In addition, those permits and wells which were issued from Future Use Permit No. 448-3 are separately identified in Table 6.3.2.

Table 6.3.1
Water Rights
City of Sioux Falls

Permit No.	cfs	GPM	Well No.
254-3 (2)	1.55	700	ST-1 - Abandoned
255-3 (2)	1.55	700	ST-2 - Abandoned
256-3 (2)	1.11	500	3
257-3 (2)	2.67	1200	4
258-3 (2)	0.44	200	8 - Abandoned
259-3 (2)	1.33	600	10
260-3 (2)	1.33	600	11
261-3 (2)	1.33	600	12
262-3 (2)	1.55	700	13
263-3 (2)	1.55	700	14
264-3 (2)	1.55	700	15
265-3 (2)	1.55	700	16 - Abandoned
266-3 (2)	1.55	700	17
267-3 (2)	1.55	700	18
268-3 (2)	1.00	450	19
269-3 (2)	1.78	800	22 - Abandoned
270-3 (2)	1.67	750	21
271-3 (2)	1.67	750	20
272-3 (2)	1.44	650	23
273-3 (2)	1.67	750	24
274-3 (2)	2.00	900	25
275-3 (2)	1.78	800	26
276-3 (2)	1.78	800	27
298-3 (2)	1.78	800	28
299-3 (2)	3.12	1400	29
300-3 (2)	3.21	1440	30
395-3 (2)	3.12	1400	31
396-3 (2)	3.12	1400	32
397-3 (2)	3.12	1400	33
1305-3	1.57	703	34
1306-3	6.20	2775	DC-1
1347-3	7.75	3475	DC-2
1579-3 (2)	0.72	325	35 - Abandoned
2018-3	3.10	1390	36
2019-3 (2)	3.10	1390	37
2747-3 (2)	3.10	1390	38
2886-3 (2)	3.10	1390	39
4098-3 (2)	1.00	450	42
4099-3 (2)	1.00	450	43

1579-3

DEPARTMENT OF WATER & NATURAL RESOURCES
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

February 7, 1991

Lyle D Johnson, Water/Wastewater Manager
Utilities Department
224 W 9th Street
Sioux Falls SD 57102

Dear Mr. Johnson:

This letter is in response to my inspection of the City's water permits/rights completed on January 16, 1991.

Several of the city's permits can be licensed after receipt of the following information:

1) Permit Nos. 5127-3 and 5127A-3 (Well Nos. 53 thru 58),.
Permit No. 5115-3 (Well Nos. 48 thru 52).
Permit No. 5235-3 (Well Nos. 60 thru 65).

- Sustained pump rate for each well under optimal operating conditions,
- Type and horsepower of the submersible units in each of the wells, and
- Brief description of the distribution system.

I have located a well completion report (copy enclosed) for a well that appears to be north of well No. 58. A copy of the well completion report for well No. 58 is also enclosed. No well was noted north of No. 58 during my inspection. Please explain if the well exists as described on the enclosed report and if the well is being used by the city.

2) Permit No. 5202-3 for water impounded in Silver Creek by the Big Sioux diversion dam. Two units are used with a capacity of 700 gpm each.

- Type and model no. of the motor and pump with the horsepower.

3) Permit No. 5334-3 for the Big Sioux River pump facility.

- Brief description of the operation of the facility at peak operating capacity.

An application (forms enclosed) needs to be approved to increase the permitted pumping rate to 46.4 cfs and to increase the annual volume of water if you plan to exceed the current 10,000 acre-feet. If approved, No. 5334-3 and the new permit would be issued one water license.

(continued)

The following changes are needed to correct errors on the current licenses:

1) The following licenses need to have R50W deleted and be reissued for R49W:

254-3, 255-3, 256-3, 257-3, 258-3 cancel RO 5/13/91, 259-3, 260-3, 261-3, 262-3, 264-3, 266-3, 267-3, 269-3, 270-3, 272-3, 273-3, 275-3, 276-3, and 274-3 needs the same range correction plus should be T102N instead of T103N.

License No. 300-3 needs to have section 32 deleted and be reissued for section 33. The original notice of hearing and application are correct.

License No. 4101-3 needs to have T101N deleted and be reissued for T102N and 2,030 feet east rather than 2,030 feet west. The original notice of hearing is correct.

License Nos. 4098-3, 4099-3, 4100-3, and 4812-3 also need to be reissued to identify the correct location of the wells. The original notices of hearing are correct for each license.

2) The notice of hearing for 1306-3 needs to be readvertised to correct a diversion point error (should be NW1/4 NW1/4 instead of NE1/4 NE1/4).

The notice of hearing for 4811-3 needs to be readvertised to correct a diversion point error (should be T102N instead of T101N).

Each of these changes (Nos. 1 & 2) will be initiated by the Division of Water Rights. Item No. 2 will require publication of a notice of hearing. The city will be notified of the completion of the corrections.

Well Nos. 30, 31, 32, and 33 have been rehabilitated in the last two years. Revisions may also be needed to some of the water rights held by the city to reflect changes in the pumping capacity of the wells. If the sustained pump rate of these wells under optimal operating conditions is less than the permitted pump rate, then the licenses should be reissued for the reduced pump rate. If the sustained pump rate exceeds the permitted amount, then a new permit is needed for the increase in the pump rate. Please indicate what the sustained pump rates are for well Nos. 30, 31, 32, 33, and other wells as rehabilitation efforts and aquifer conditions allow.

Water Right Nos. 254-3, 255-3, 258-3 RO 5/13/91, 268-3, 271-3, and 1579-3 will be scheduled for a hearing to allow the Water Management Board to consider cancellation of the water rights due to abandonment and/or forfeiture. Notice will be given of the time and place of hearing. If the Parks and Recreation Department is using of the well authorized by No. 1579-3, please inform me.

In response to your questions during our meeting on January 17, 1991, the city can plug abandoned wells if the work is completed according to the Well Construction Standards. A copy of the standards and some plugging report forms are enclosed for the city's use.

Water Permit No. 1790-3 held by the Lincoln County Rural Water System is for supplying the rural water system from the city's well field. Enclosed is a copy of Permit No. 1790-3, including the affected city permits and a resolution signed by the mayor of Sioux Falls.

Thank you and your staff for the assistance we received concerning these inspections. I appreciate Mr. Holden taking the time to show us around. If you have any questions regarding any of this information, please contact me.

Sincerely,

Ron Duvall
Natural Resources Engineer
605 773-3352

enc.

cc: Glenn Dostal, HDR Engineering, Inc.

NAME OF PERSON: Lyle D Johnson, Water/Wastewater Manager
City of Sioux Falls, Utilities Department
224 W 9th Street
Sioux Falls SD 57102

DATE: May 14, 1991

SUBJECT: Cancellation of Water Right Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3.

On January 16, 1991, an inspection of water permits/rights held by the City of Sioux Falls was completed with Doug Holden representing the City of Sioux Falls. Based on the inspection results and documentation supplied by HDR Engineering, Inc. dated December 28, 1990, the following water rights are subject to cancellation due to abandonment and/or forfeiture: Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3.

A letter dated February 7, 1991, to Lyle Johnson with the City of Sioux Falls omitted Water Right No. 258-3 from the list of water rights subject to cancellation. The water right should have been included in the cancellation list.

Ron Duvall, Natural Resources Engineer
Water Rights Division

1579-3

RECOMMENDATION OF CHIEF ENGINEER

FOR WATER RIGHT NOS. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and (1579-3)

Pursuant to SDCL 46-2A-2 and 46-5-37.1, the following is the recommendation of the Chief Engineer, Water Rights Division, Department of Environment and Natural Resources concerning Water Right Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3 held by the City of Sioux Falls.

The Chief Engineer is recommending cancellation of the above Water Rights due to abandonment and/or forfeiture. An inspection completed by Ron Duvall, Natural Resources Engineer, on January 16, 1991, and documentation supplied by HDR Engineering, Inc. dated December 28, 1990, indicate that the above water rights are no longer used to supply water for municipal purposes.

RON DUVALL, Natural Resources Engineer IV
for JOHN HATCH, Chief Engineer
May 16, 1991

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DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

May 16, 1991

NOTICE OF CANCELLATION

1579-3

TO: Lyle D Johnson, Water/Wastewater Manager
Utilities Department
224 W 9th Street
Sioux Falls SD 57102

FROM: Ron Duvall, Natural Resources Engineer IV
for John Hatch, Chief Engineer
Water Rights Division

SUBJECT: Cancellation of Water Right Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3

The Water Management Board will consider cancellation of Water Right Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3 at 10:00 am, on July 24, 1991, at the Governor's Inn, Kneip Room, 700 West Sioux Avenue, Pierre SD.

The hearing(s) will be conducted pursuant to the provisions of SDCL 46-1-1 thru 46-1-10, 46-1-14 thru 46-1-15; 46-2-3.1, 46-2-9, 46-2-11, 46-2-17; 46-5-36, 46-5-37, 46-5-37.1; 46-2A-1 thru 46-2A-7; and Board Rules ARSD 74:02:01:36 thru 74:02:01:41. These are contested cases pursuant to procedures contained in SDCL 1-26.

The Chief Engineer of the Water Rights Division is recommending cancellation of the water rights due to abandonment and/or forfeiture of the water rights. The recommendation of the Chief Engineer is not final or binding upon the Board. The Board is authorized to 1) cancel, 2) cancel portions of, 3) delay action on, or 4) take no action on Water Right Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and 1579-3 based upon facts presented at the public hearing. Our records show the City of Sioux Falls to be the holder of the water rights. If you wish to oppose the cancellation and if you intend to participate in the hearing before the Board and present evidence or cross-examine witnesses according to SDCL 1-26, you must file a written petition with the Chief Engineer by July 12, 1991. The petition may be informal, but it must include a statement describing the reasons for your opposition to the cancellation, and your signature and mailing address or your legal counsel if legal counsel is obtained. The Board may consider any abandoned or forfeited water to be available for appropriation subject to the provisions of SDCL 46-1, 46-2, 46-2A and 46-5.

(continued)

These hearings are adversary proceedings. Any party has the right to be present or to be represented by a lawyer. These and other due process rights will be forfeited if they are not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law.

Further information on the proposed cancellation or to assure access to the hearing by the handicapped can be obtained by contacting the Water Rights Division, Joe Foss Building, 523 E Capitol, Pierre, SD (605-773-3352) for assistance prior to the hearing. The time of the hearing will be automatically extended for at least twenty days upon your written request to the Chief Engineer after a petition has been filed to oppose the cancellation. If an extension is requested, the hearing on the cancellation will be continued until the next regular Board Meeting held October 2-3, 1991, in Pierre, SD. Any request for extension must be filed with the Chief Engineer by July 12, 1991.

Please note: Cancellation of this permit does not prohibit you from making a new application for this project in the future.

1579-3

CERTIFICATION

I hereby certify that on May 16, 1991 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Cancellation of Water Right Nos. 254-3, 255-3, 253-3, 265-3, 268-3, 271-3, and 1579-3 addressed:

Lyle D. Johnson, Water/Wastewater Manager
Utilities Department
224 W. 9th St.
Sioux Falls, SD 57102

Cheryl F. Frost
Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 20th day of May, 1991.

John Hatch
Notary Public

Sioux Falls UTILITIES

WATER • (605) 339-7031
WASTEWATER • (605) 339-7088

LIGHTS • (605) 339-7150
STORM DRAINAGE • (605) 339-7023

July 10, 1991

Mr. Ron Duvall
Water Rights Division
DENR
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Re: Water Right Cancellations

This letter is our written request to have the Water Management Board consider cancellation of Water Right Permit Numbers 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and (1579-3) at the same meeting that our future use permits and water right applications in the Skunk Creek Aquifer and Big Sioux Aquifer are considered.

We feel that it would be appropriate to deal with all of these issues at one meeting. This would provide the board members with a better overall view of our water supply sources.

Please contact me if you have any questions about this request.

Sincerely,

Lyle D. Johnson, PhD, P.E.
Water/Wastewater Manager

cc Keith DeJong
Glenn Dostal

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DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

July 12, 1991

NOTICE

TO: Lyle D Johnson, Phd, P.E., Water/Wastewater Manager, Sioux Falls Utilities, 224 W 9th St, Sioux Falls, SD 57102

FROM: Ron Duvall, Natural Resources Engineer
for JOHN HATCH, Chief Engineer
Water Rights Divisior, DENR,
(605) 773-3352

SUBJECT: Automatic Continuance of Time of Hearing

Pursuant to SDCL 46-2A-5 and your July 10, 1991 request, the time of hearing for cancellation consideration of Vested Water Right Claim Nos. 254-3, 255-3, 258-3, 265-3 268-3, 271-3 and Water Right No. 1579-3 has been delayed. The hearing will be rescheduled to coincide with the Board hearing to consider the City's future use permits and water permit applications in the Skunk Creek and Big Sioux Aquifers. Notice of the time, date and place of the hearing will be given at a later date.

1579-3

CERTIFICATION

I hereby certify that on July 12, 1991 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Automatic Continuance of Time of Hearing addressed as stated below:

Lyle D. Johnson, Phd, P.E., Water/Wastewater Manager, Sioux Falls, Utilities, 224 W. 9th St., Sioux Falls, SD 57102.

Cheryl F. Frost

Cheryl F. Frost
Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 15th day of July, 1991.

John Hatch

Notary Public

JOHN HATCH
NOTARY PUBLIC SOUTH DAKOTA
SEAL SEAL
My Commission Expires Apr. 1, 1993

DEPARTMENT of ENVIRONMENT and NATURAL RESOURCES
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

September 3, 1991

NOTICE

TO: Lyle D Johnson, Phd, P.E., Water/Wastewater Manager
Sioux Falls Utilities
224 W 9th St
Sioux Falls, SD 57102

FROM: Ron Duvall, Natural Resource Engineer
for JOHN HATCH, Chief Engineer
Water Rights Division
605 773-3352

SUBJECT: Rescheduling of Cancellation of Vested Water Right Claim Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and Water Right No. 1579-3

The Water Management Board will consider cancellation of Vested Water Right Claim Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3 and Water Right No. 1579-3 on October 2, 1991 at 9:00 am in the Embassy Room 1 & 2, Holiday Inn City Centre, 100 West 8th Street, Sioux Falls SD. The agenda time is an estimate and may be delayed due to prior agenda items. These cancellations were continued from the July 24, 1991 Board meeting based on your request that the cancellations be considered at the same meeting the city's future use applications and water permit applications are considered.

Applicable provisions of the Notice of Cancellation dated May 16, 1991 will still apply at this hearing. If you have any questions regarding the upcoming hearing, please contact Eric Gronlund at 773-3352.

cc: Diane Best, Assistant Attorney General

CERTIFICATION

I hereby certify that on September 3, 1991 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Rescheduling of Cancellation of Vested Water Right Claim Nos. 254-3, 255-3, 258-3, 268-3, 271-3, and Water Right No. 1579-3 addressed as stated below:

Lyle D. Johnson, Phd, P.E., Water/Wastewater Manager, Sioux Falls Utilities, 224 W. 9th St., Sioux Falls, SD 57102.

Sent Inter-office To:

Diane Best, Assistant Attorney General, Capitol Building.

Cheryl F. Frost

Cheryl F. Frost
Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 5th day of September, 1991.

John Hatch
Notary Public

JOHN HATCH
SEAL NOTARY PUBLIC SOUTH DAKOTA SEAL
My Commission Expires Apr. 1, 1993

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DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

254-3
255-3
258-3
265-3
268-3
271-3
1579-3

October 8, 1991

NOTICE

Lyle D Johnson, Phd, P.E., Water/Wastewater Manager
Sioux Falls Utilities
224 W 9th St
Sioux Falls, SD 57102

Dear Mr. Johnson:

This will notify you that the Water Management Board cancelled your Vested Water Right Claim Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and Water Right No. 1579-3.

This action was taken under the conditions outlined in our notice to you dated September 3, 1991.

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Division
605 773-3352

CERTIFICATION

I hereby certify that on October 8, 1991, I have personally deposited with the U.S. Mail, postage prepaid envelopes containing a Notice dated October 8, 1991, regarding Cancellation of Vested Right Claim Nos. 254-3, 255-3, 258-3, 265-3, 268-3, 271-3, and Water Right No. 1579-3 addressed to:

Lyle D Johnson, Phd, P.E., Water/Wastewater Manager
Sioux Falls Utilities
224 W 9th St
Sioux Falls, SD 57102

JACI R. KONOP
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 10th day of October, 1991.

JOHN HATCH
SEAL NOTARY PUBLIC SOUTH DAKOTA SEAL
My Commission Expires Apr. 1, 1993

John Hatch
Notary Public

Appl. # 1579-3

-See also Appl. # 395-3