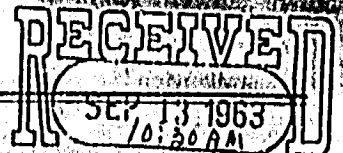


1062-3

1. Considered 11-6, 1963
2. Name of Applicant County of Scotland
3. Post Office Address _____
4. Amount of water claimed 2.0
5. Source of water supply Ground water
6. Water to be used for Future municipal use
Acres to be irrigated _____
7. Water to be diverted and used in Brown County about
2 E miles _____ of Scotland.
8. Proof of Publication Received YES V
Not Received _____
9. Application Approved _____ Subject to Deferred Approved
Not Approved _____ 1-15-64
Action deferred _____

10. Remarks:

*Now for 3 wells - 2 to be drilled
this coming year, and the 3rd
within 5 years.*

Water Division No. 3

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

No. 1062-3JAMES RIVERSTATE WATER RESOURCES COMM.
District 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 Scotland, Scotland, South Dakota
 Postoffice address Scotland, County Bon Homme, State So. Dakota

- I. If a corporation _____
 (a) Name of same _____
 (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)

- (b) Cash on hand, \$ _____ (c) Treasury stock, \$ _____
 (d) Bonds to be issued, \$ _____ (e) Other resources, \$ _____

2. Name of diversion work Wells #1, #2 & #3 - 11-20-63
 3. Amount of water claimed 1.5 cubic feet per second
 4. Source of water supply Underground Aquifer
 5. Location of point of diversion #1 N29°30'W 600 feet, #2 N29°34'W 112 feet, #3 N29°34'W 112 feet
57°40'N 600 feet from the SE corner of Section 10, T14N, R10E, SD 60
 on Reddick bank Reddick County.
 6. Annual period or periods during which water is to be used January 1 to Dec. 31
 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 on or attached to the application. Same must also be shown on accompanying map.)

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

II. Stockwatering, milking, 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 _____

MAP NO 701-3

8. Estimated cost of work:

(a) Head Gates, \$..... (b) Pump'ng plant, \$.....
 (c) Fluming, \$..... (d) Canal-earth, \$..... Rock, \$.....
 (e) Other structures \$..... Total, \$.....

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 bottomfeet; length at topfeet; thickness at bottomfeet; thickness at topfeet; slope at front water face; slope at back facematerial used in construction
 (b) Reservoir: Capacity when filledacre feet. Surface area at highwater mark.....acres.

DEPTH AT OUTLET-FEET	SURFACE AREA AT EACH DEPTH AT OUTLET--ACRES	FEET	ACRE-FOOT CAPACITY

(c)* Head gate: Width.....feet; heightfeet;
 Material
 (d) Canal: Total lengthmiles.

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 workyears.
 11. Time required for complete application of water to the proposed beneficial use years.
 12. Choice of newspaper for publication of notice of intention to appropriate

STATE OF SOUTH DAKOTA
 County of: Bon Homme } ss.

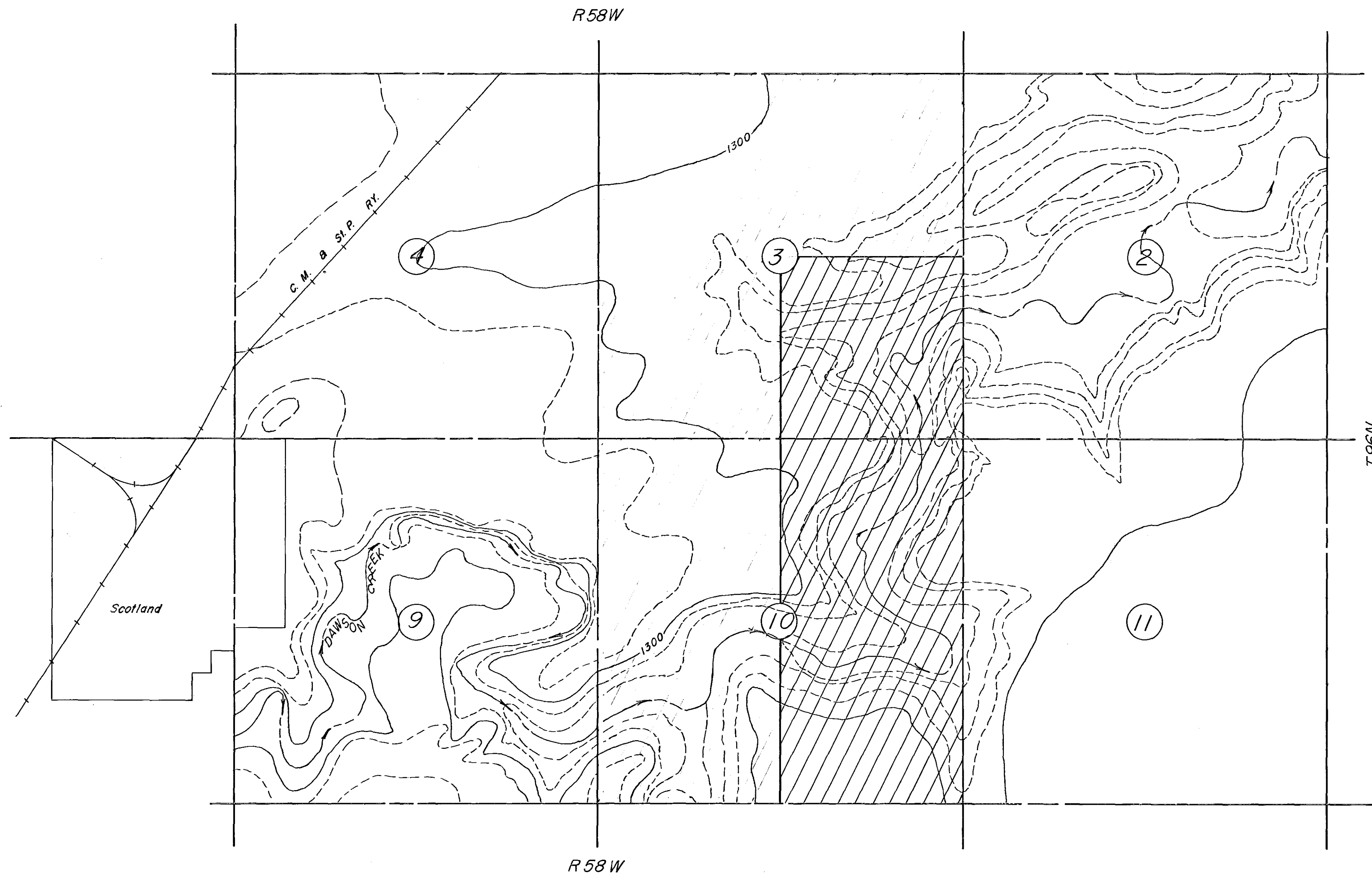
I, Walter J. Kleinlein, Mayor, City of Scotland, S.D., being first duly sworn on my oath depose and say: That my relation to the above described undertaking is that of owner, that I have read the above foregoing statement, examined the map accompanying the same, and that I know of my own personal knowledge that the matters therein stated and shown are true.

Signed Walter J. Kleinlein

Subscribed and sworn to before me this 11th day of September 19 63

Geo. J. M. M. M.
 Notary Public (or other qualified officer.)

BON HOMME COUNTY
SOUTH DAKOTA



R58W

LEGEND

//// Area of future water
rights application

SCALE

1" = 1000'

SURVEYOR'S CERTIFICATE

STATE OF SOUTH DAKOTA S.S.
COUNTY OF BROOKINGS

I, Calvin Vaudrey, a Registered Land Surveyor, in the State of South Dakota, do hereby certify that, at the request of the City of Scotland, South Dakota, I did prepare the plot on this sheet from existing information and that said plot is a true representative of the tract of land for which application for future water rights is made.

In witness whereof I have hereunto set my hand and seal this 7th day of Sept., A.D. 1963.

Calvin Vaudrey
Registered Land Surveyor

STATE OF SOUTH DAKOTA S.S.
COUNTY OF BROOKINGS

On this day, before me, the undersigned, a Notary Public within and for said State and County, personally appeared Calvin Vaudrey, known to me to be the person who executed the foregoing Surveyor's Certificate and acknowledged to me that he executed the same.

Witness My Hand and seal this 7th day of Sept., A.D. 1963.

Jerald V. Hether
Notary Public

My Commission Expires

SEPTEMBER 15, 1964

CITY OF SCOTLAND, SOUTH DAKOTA
WATER RIGHTS MAP

SHOWING LOCATION FOR
FUTURE WATER RIGHTS

J. T. BANNER & ASSOCIATES, INC., ENGINEERS, BROOKINGS, SOUTH DAKOTA

APPROVED FOR

DATE

APPROVED FOR J. T. BANNER & ASSOCIATES

DATE

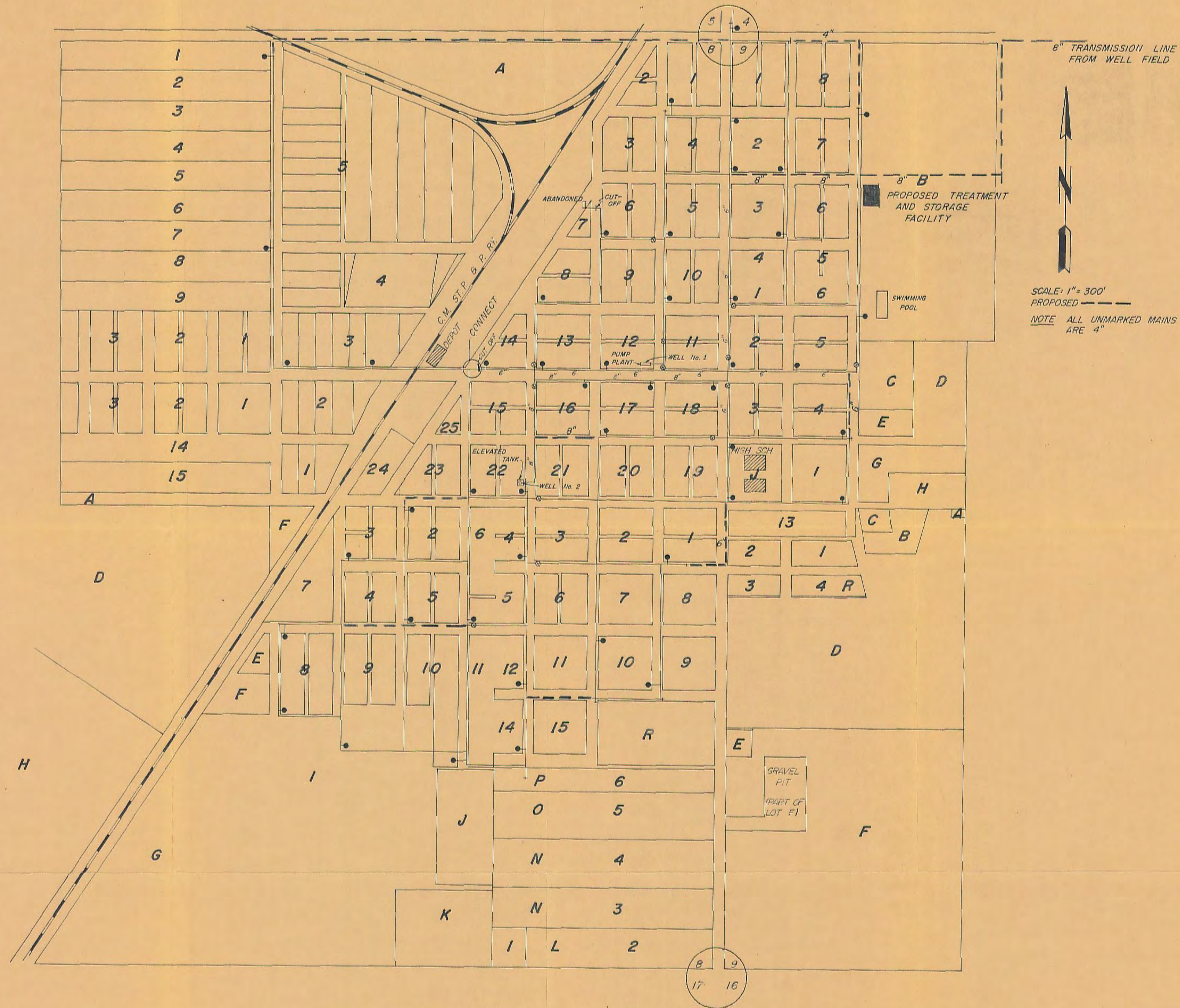
CHECKED BY

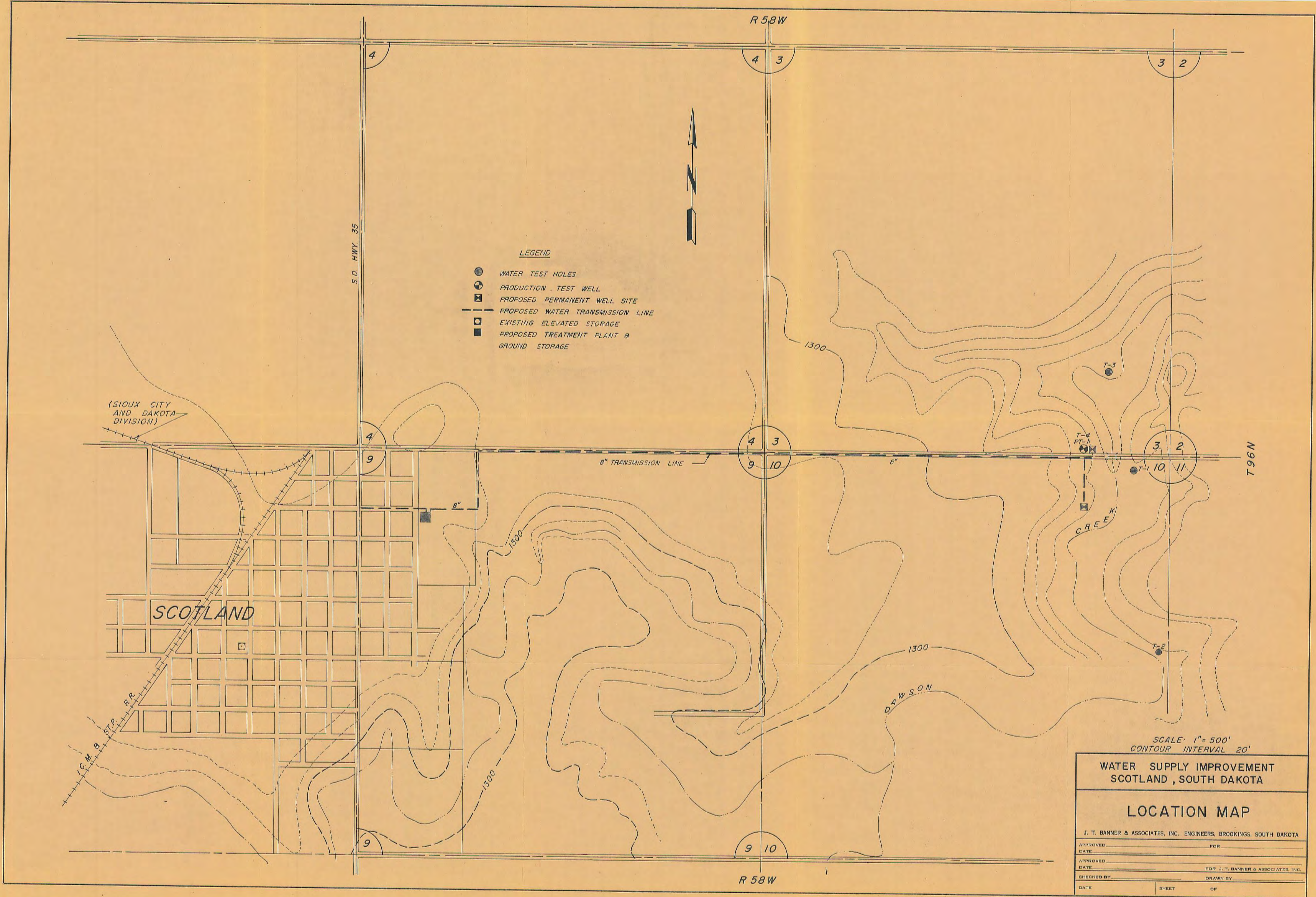
DATE

SHEET

OF

MAP N^o 701-3 (APPL N^o 1062-3)





LEGEND

- WATER TEST HOLES
- ⊕ PRODUCTION TEST WELL
- ⊠ PROPOSED PERMANENT WELL SITE
- PROPOSED WATER TRANSMISSION LINE
- EXISTING ELEVATED STORAGE
- PROPOSED TREATMENT PLANT & GROUND STORAGE

SCALE: 1" = 500'
CONTOUR INTERVAL 20'

WATER SUPPLY IMPROVEMENT
SCOTLAND, SOUTH DAKOTA

LOCATION MAP

J. T. BANNER & ASSOCIATES, INC., ENGINEERS, BROOKINGS, SOUTH DAKOTA

APPROVED	FOR
DATE	
APPROVED	FOR J. T. BANNER & ASSOCIATES, INC.
DATE	
CHECKED BY	DRAWN BY
DATE	SHEET OF

Map # 701-3 (W/R 1062-3)

Remarks by State Water Resources Commission:

This permit is approved contingent upon the applicant making necessary arrangements with the landowners.

STATE OF SOUTH DAKOTA
County of Hughes ss.

Pierre, South Dakota, January 16, 1964

This is to certify that the foregoing application was received by the Commission at 10:30 o'clock a.m. upon the 13th day of September, 1963

State Water Resources Commission

By:

Durston Jones
Chief Engineer, Executive Officer

Number of permit 1062-3

Date of first receipt of application September 13, 1963

Date of return to applicant for correction, amendments or changes required as follows: November, 1963

Date of receipt of corrected application January 2, 1964

Date from which applicant may claim right September 13, 1963

Approved January 15, 1964, Recorded in Book 8 Page 149

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

July 15, 1966

2nd. The whole of said work is to be completed on or before January 15, 1969

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

January 15, 1969

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

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 1.5 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 the best husbandry, and further, said appropriation must be limited to not more than one-seventieth (1/70) of one cubic foot of water per second of time for each acre of land to which water is actually

used for municipal purposes

and beneficially applied ~~for irrigation~~ on or before January 15, 1969; said water to be used during the following described annual period:

Continuously

Witness my hand this 16th day of January, 1964

State Water Resources Commission

By:

Robert L. Jones
Chief Engineer, Executive Officer

Certificate of Construction Issued NOVEMBER 6, 1969

Water License Issued NOVEMBER 6, 1969

Obt. Commission approval to
change diversion point authorized
in water permit 1062-3 from

" N. $80^{\circ}30'$ W. 609 feet, N. $26^{\circ}37'$ W. 112 feet
and S. $7^{\circ}40'$ E. 600 feet from the
SE corner of section 3, T.96N., R.
58 W. to " in N $1/2$ Lot 16
Block 16, Town of Scottville, in
section 8, T.96N., R. 58 W. "

Relocation of Diversion Point

Approved 11-4-69

9. (Continued)

III. Well Specifications

(a) Hole and casing

Size of drill hole or excavation 10", Depth 165
Type of casing Steel
(wood, concrete, steel, etc.)
Size of casing 6", Thickness of casing 3/8"
Length of casing 160 If collection gallery, length, size and depth of
gallery

(b) Screens

Type of perforated screen Stainless Steel
Size of perforated screen 2" (diameter), 3' (length)
Thickness of gravel pack None, length of gravel pack None

(c) Water Bearing Materials

Distance to water 84' Character of water bearing materials
Chalk Rock
Thickness of water bearing material 58'

(d) Pump and Motor

Type of pump Turbine
(centrifugal, propeller, mixed flow, etc.)
Name of pump Pontona, size 5"
Kind of motor Fairbanks Morse Electric
(gasoline, electric, diesel, etc.)
Horsepower 7 1/2, Name of Motor Fairbanks Morse

(e) Complete well

Capacity 145 GPM at drawdown of Estimated cost 6,500

(f) Owner of land upon which well is located City of Scotland
Name
Scotland So. Dak
Address

(g) Distance to nearest existing wells

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

Water Tank No 2

Form 2A — Wells (Supplement to Form 2)

9. (Continued)

III. Well Specifications

(a) Hole and casing

Size of drill hole or excavation 10", Depth 162'
 Type of casing Steel
 (wood, concrete, steel, etc.)
 Size of casing 6", Thickness of casing 3/8"
 Length of casing 125' If collection gallery, length, size and depth of
 gallery

(b) Screens

Type of perforated screen Stainless Steel
 Size of perforated screen 1/2" (diameter), 3' (length)
 Thickness of gravel pack None, length of gravel pack None

(c) Water Bearing Materials

Distance to water 86' Character of water bearing materials
Chalk Rock
 Thickness of water bearing material

(d) Pump and Motor

Type of pump Turbine
 (centrifugal, propeller, mixed flow, etc.)
 Name of pump Pomona, size 2"
 Kind of motor Electric Fairbanks Morse
 (gasoline, electric, diesel, etc.)
 Horsepower 7 1/2, Name of Motor Fairbanks Morse

(e) Complete well

Capacity 165 GPM drawdown of Estimated cost 6,200

(f) Owner of land upon which well is located City of Scotland
 Name
Scotland So. Dak.
 Address

(g) Distance to nearest existing wells

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

#1

1951

9. (Continued)

III. Well Specifications

(a) Hole and casing

Size of drill hole or excavation 12, Depth 160'Type of casing STEEL
(wood, concrete, steel, etc.)Size of casing 6", Thickness of casing STANDARDLength of casing 150 If collection gallery, length, size and depth of gallery

(b) Screens

Type of perforated screen

Size of perforated screen 6", 10'
(diameter) (length)Thickness of gravel pack 3, length of gravel pack 160

(c) Water Bearing Materials

Distance to water 38' 6" Character of water bearing materialsSAND & GRAVEL

Thickness of water bearing material

(d) Pump and Motor

Type of pump TURBINE
(centrifugal, propeller, mixed flow, etc.)Name of pump FAIRBANKS MORSE, size 4"Kind of motor ELEC.
(gasoline, electric, diesel, etc.)Horsepower 15, Name of Motor PANOL

(e) Complete well

Capacity 200 GPM at drawdown of 20', Estimated cost(f) Owner of land upon which well is located CITY
Name

Address

(g) Distance to nearest existing wells

On same owner's property 4 Blocks rods. On property owned by others 1000 rods

#2 1955

9. (Continued)

III. Well Specifications

(a) Hole and casing

Size of drill hole or excavation 12', Depth 165'Type of casing Steel
(wood, concrete, steel, etc.)Size of casing 6', Thickness of casing 1/2"Length of casing 160 If collection gallery, length, size and depth of gallery

(b) Screens

Type of perforated screen

Size of perforated screen 6" (diameter), 10' (length)Thickness of gravel pack 3', length of gravel pack 165'

(c) Water Bearing Materials

Distance to water 38' Character of water bearing materialssand & gravel

Thickness of water bearing material

(d) Pump and Motor

Type of pump Vertical
(centrifugal, propeller, mixed flow, etc.)Name of pump Wagner, size 4"Kind of motor Electric
(gasoline, electric, diesel, etc.)Horsepower 15, Name of Motor Wagner

(e) Complete well

Capacity 200' at drawdown of 20' Estimated cost

(f) Owner of land upon which well is located Name

Address

(g) Distance to nearest existing wells

On same owner's property 1/2 mile rods. On property owned by others 1/2 mile rods

STATE OF SOUTH DAKOTA

WATER LICENSE NO. 1062-3

(1) WHEREAS, On the 13th day of September A. D. 19 63
the City of Scotland

made Water Right Application No. 1062-3 for a permit to use 1.5 cubic feet per second of the waters
 of ground water

County of Be Horne, State of South Dakota, for municipal

_____ purposes; and

(2) WHEREAS, On the 16th day of January A. D. 19 64

Permit No. 1062-3, with a date of priority of September 13, 1963

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 15th day of January A. D. 19 64 and for the
 application to beneficial use of said water on or before the 15th day of January 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 .58 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.

used for municipal purposes by the City of Scotland

(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 Scotland

~~xxxx~~

the holder _____ and owner _____ of said permit No. 1062-3 a water right, dating from September 13, 1963

_____ to use of .58 cubic feet per second of the waters

of ground water

in the County of Bon Homme and State of South Dakota, or so much thereof as may be necessary for the

purposes hereinbelow mentioned, to be diverted at points in the NE 1/4, Lot 16, Block 16, City of Scotland,

in Section 8, T96N, R56W

and conduct ~~to and from~~ through the City water distribution system

for the purpose of municipal use

Subject to any limitations listed in Water Right Permit No. 1062-3 and subject to the laws of the State of South Dakota.

WITNESS, My hand and seal of our office at Pierre, South Dakota
this 6th day of November A. D.
Nineteen Hundred and Sixty-nine

WATER RESOURCES COMMISSION

By:

Chief Engineer, Executive Officer, J.W. GRIMES

Form 15.

Permit No. 1062-3

Water Diversion No. 3 JAMES RIVER Water District

CERTIFICATE OF CONSTRUCTION

This is to Certify, That the City of Scotland

_____ the holder _____ of
Permit No. 1062-3, issued upon Application No. 1062-3, bearing date of priority of September 13,
1963 authorizing the diversion of 1.5 cu. ft. per second of the waters of _____
ground water County of Ben Homme, State of South Dakota at _____
#1-N.80°30' W., 609 feet; #2-W.26°34' N., 112 feet and #3-S.7°40' W., 600 feet from
the SE Corner, Section 3, T96N, R58W *

_____, for Municipal

purposes, has been 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 .58 cu. ft. per second of water.

Date November 8, 1969

WATER RESOURCES COMMISSION

By:

J.W. GRIMES, Executive Officer

* At its September 4, 1969 meeting, the Commission approved relocation of
the Diversion points to "in E½ Lot 16, Block 16, City of Scotland, in
Section 8, T96N, R50W."

(First Publication on or before October 10, 1963)

APPROPRIATION OF WATER

Office of State Water Resources Commission,

Pierre, S. Dak., September 17, 1963

Notice is hereby given that the City of Scotland

S. Dak., has made an application in accordance with future

the provisions of the water laws of South Dakota for a permit to appropriate for/beneficial use 2.0

cubic feet of water per second of time from ~~the~~ ground water through the

area, the point of diversion of which is to be located

in the E $\frac{1}{2}$ Sec. 10 & SE $\frac{1}{4}$ of Section 3

Twp. 96N Range 58W. Said water to be used for the purpose of providing irrigation on the

following described

future municipal supplies for the City of Scotland.

and for

This application will be taken up by the State Water Resources Commission at their office at Pierre for consideration upon the 6th day of November, 1963, at 2 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 Right Specialist

CC: B. L. Farus, Publisher
Scotland Journal
Scotland, South Dakota

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA }
 County Bon Homme } ss.

B. L. Farus

_____ being duly sworn, deposes and says the annexed printed copy of Notice of Intention to Appropriate Water was taken from the _____ Scotland Journal

_____ 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 _____ Scotland _____ County of

Bon Homme

_____ and State of South Dakota; that the said notice was published in said newspaper on the following dates:

September 26, 1963	September 26, 1963
September 27, 1963	October 3, 1963
October 3, 1963	October 10, 1963
October 7, 1963	October 17, 1963

in each and every issue of the full number thereof, the first publication being made on the 26 day of September 63 and the last publication on the 17 day of October 1963, upon which days or times of publication aforesaid the newspaper was regularly published, and that during the whole time of said publication he was _____ the printer and publisher of the said newspaper.

B. L. Farus

Subscribed and sworn to before me this 4th day of JANUARY A. D. 1964

Leo J. Moore, Jr.

Notary Public Bon Homme County, S. D.

APPROPRIATION OF WATER.

Office of State Water
 Resources Commission,
 Pierre, S. Dak.
 September 17, 1963

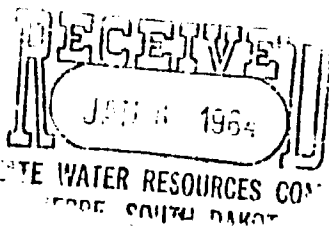
Notice is hereby given that the City of Scotland, S. Dak., has made an application in accordance with the provisions of the water laws of South Dakota for a permit to appropriate for future beneficial use 2.0 cubic feet of water per second of time from ground water, the area of diversion of which is to be located in the E $\frac{1}{2}$ Sec. 10 & SE $\frac{1}{4}$ of Section 3 Twp. 96N Range 58W. Said water to be used for the purpose of providing future municipal supplies for the City of Scotland.

This application will be taken up by the State Water Resources Commission at their office at Pierre for consideration upon the 6th day of November, 1963, at 2 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 Right Specialist
 (Sept. 26 - 40)



Preliminary Report
ON
Water Supply Facilities
FOR
City of Scotland, South Dakota

PREPARED FOR
City Council

Frank Kopplinger	Walter J. Kleinlein, Mayor	Randy Haslerman
William Gemar		Harry Nelson
Lawrence Diede		Ray Mehrer
	Leo Moore, City Auditor-Attorney	

September - 1963

Prepared By
J. T. Banner & Associates, Inc.
Consulting Engineers
Brookings, South Dakota



CONSULTING ENGINEERS

BANNER & ASSOCIATES, Inc.

ENGINEERS:
J. T. BANNER
CALVIN VAUDREY
J. O. EDWARDS
G. C. HAROKOPIS
A. J. HULL, JR.
HARRY M. JOHN
T. R. PFISTERER
J. A. SHELDON

PHONE 692-6343
1024 SIXTH STREET
P. O. BOX 44
BROOKINGS, SOUTH DAKOTA

September 9, 1963

Honorable Mayor and Council
City of Scotland
Scotland, South Dakota

Gentlemen:

We are submitting herewith our report of investigation of water supply facilities for the City of Scotland in accordance with our contract dated January 7, 1963.

This investigation and report of water supply facilities for the City includes: engineering and economic study and evaluation of the existing water supply facilities; recommendations for improvements and modernization of the system; detailed cost estimates for each proposed improvement along with a recommended rate structure for amortization of capital improvements and operation and maintenance of the various facilities. The recommendations and estimated costs are based on data contained within the appendixes of the report and the layouts attached thereto.

The summary of our findings and recommendations are outlined in Part VII of the report.

Respectfully submitted,

Calvin Vaudrey, Vice President
J. T. BANNER & ASSOCIATES, INC.

CV/dv

I. INTRODUCTION

A. AUTHORITY

This preliminary study and report on water supply facilities for the City of Scotland, South Dakota was prepared at the request of the City Council under Contract dated January 7, 1963.

B. SCOPE OF WORK

This preliminary study and report includes: (1) the investigation analysis and evaluation of the present water supply system, (2) the investigation, testing and survey of requirements, sources of supply and recommendations for modernization, extensions, replacements and other necessary improvements required to provide adequate water supply facilities and (3) detailed cost estimates for the proposed improvements and recommended rate structures for financing the various improvements.

C. DESCRIPTION OF THE AREA

The City of Scotland, South Dakota is located in Bon Homme County about 25 miles northwest of Yankton and 55 miles southwest of Sioux Falls. Dawson Creek borders the City on the south and east and discharges into the James River about 4.5 miles north and east of Scotland. The topography in the area is rolling.

The transportation requirements of the community are served by the Chicago, Milwaukee and St. Paul railroad and South Dakota State Highway No. 35 with access to U. S. Highway No. 18 six miles north of the City.

D. POPULATION

The City of Scotland is an incorporated city under the laws of the State of South Dakota.

The population of Scotland at the time of each regular United States census beginning in 1900 together with average fluctuations for the various periods is shown in Table No. 1.

TABLE NO. 1 -- POPULATION -- Scotland, South Dakota

Year	Population	Average Increase or Decrease	Percentage Change
1900	964		
1910	1102	+138	14
1920	1234	+132	12
1930	1163	- 71	-6
1940	1204	+ 41	3.5
1950	1188	- 16	-1.3
1960	1077	-111	-9.4

The above table shows that the City of Scotland has lost population since 1940. It does not appear that appreciable growth can be expected during the next ten years unless the establishment of industry or other businesses which provide steady employment can be encouraged to locate in Scotland.

The water supply requirements for Scotland are based on a population of 1100 persons which provides for a small amount of growth or allowance for some industrial development.

E. THE REPORT

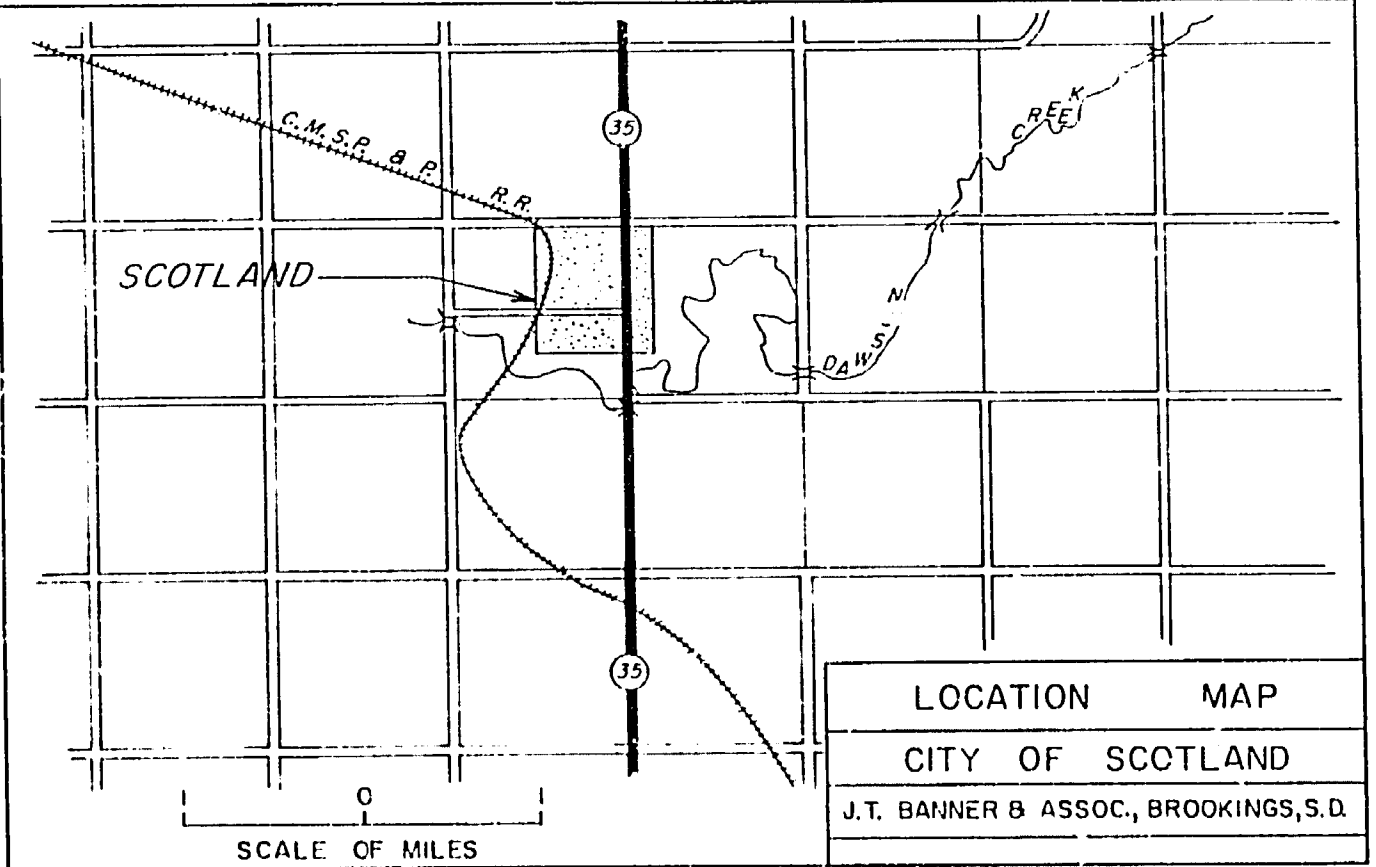
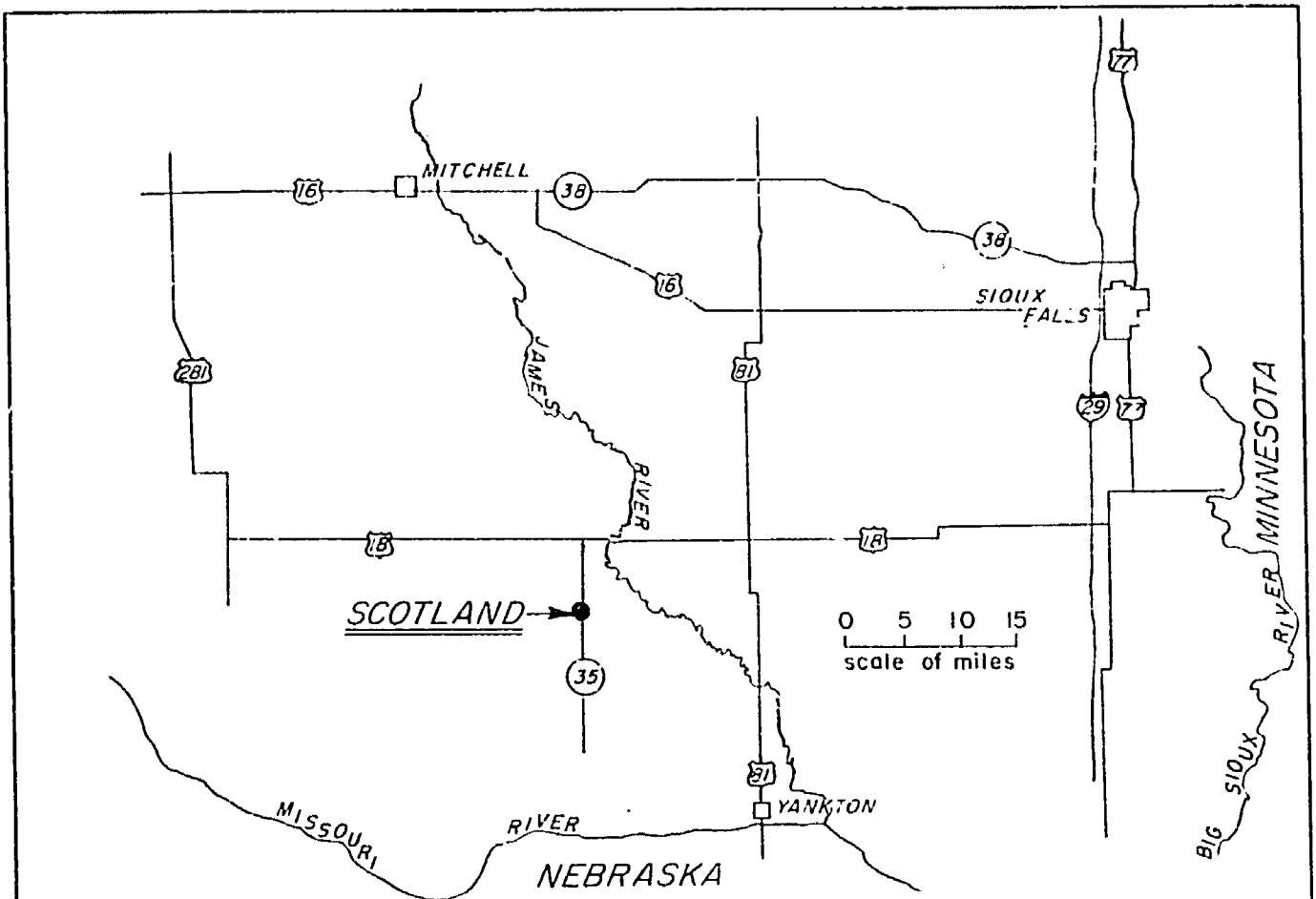
This report is divided into several sections, each dealing with a specific area of the problem.

Part II is a review of the existing facilities available to the City of Scotland and its evaluation. Part III deals with the water requirements of the City. The proposed improvements are outlined and discussed in Part IV. Part V consists of the estimated costs involved to construct the proposed facilities. Part VI deals with proposed rates required to finance the costs of proposed facilities and Part VII is our conclusions and recommendations derived from our study and analysis.

Appendixes to the report include supporting data for the findings contained within the report. Plates showing layouts of the various facilities are attached.

F. ACKNOWLEDGEMENTS

We wish to express our appreciation and thanks for the fine cooperation and assistance received from the City officials, the State Geological Survey, South Dakota Department of Health and Thorpe Well Company during the investigation and preparation of this report.



II. EXISTING WATER SUPPLY FACILITIES

A. GENERAL

The City of Scotland is served by a municipal water supply system. The system consists of two 8" wells, which produce about 150 gallons per minute each; about 34,000 feet of distribution main; a 65,000 gallon elevated storage tank for maintaining distribution pressure and for fire protection.

B. QUANTITY

The present water supply is obtained from two 8" wells. Well No. 1 is 165 feet deep and Well No. 2 is 160 feet deep. The pumps in both wells are designed for 150 g.p.m. against a TDH of about 180 feet.

C. WATER QUALITY

The results of an analysis of samples from existing wells are presented in Table No. 2. These data were taken by the South Dakota Department of Health laboratory and are compared here with recommended limits established by the U. S. Public Health Service.

TABLE NO. 2 --Chemical Analysis of Existing Water Supply - Scotland, S. Dak.

Determination	Well No. 1 Mg/L	Well No. 2 Mg/L	Drinking Water Standards **
pH - Units	7.5	7.2	
Alkalinity CaCO ₃	390	382	
Total Hardness CaCO ₃	1294	1310	
Calcium Ca	348	350	
Magnesium Mg	102	103	
Bicarbonate HCO ₃	476	466	
Sulfate SO ₄	1160	1035	250
Iron FE	2.4	6.2	0.3
Manganese MN	0.0	0.2	0.05
Sodium Na	142	98	
Potassium K	20.5		
Chloride Cl	45	27	250
Fluoride F	0.8	0.7	0.6 - 1.7
Nitrate NO ₃	0.0	0.0	45
Total Solids	2274	2063	500 - 1000

** Recommended maximum concentrations based on Public Health Service Drinking Water Standards, 1962.

It is noted from the above tabulation that these waters are highly mineralized. Without treatment these waters are considered unsatisfactory for domestic and municipal purposes, from the standpoint of total iron, sulphates content, hardness and total solids.

Although a limitation for permissible hardness is not included in the Public Health Service Drinking Water Standards, the acceptable limit ranges from 50 to 150 Mg/L. The total hardness in the existing supply is about 1300 Mg/L, much in excess of the acceptable limits. Hardness is of special concern where sanitation standards are a prime consideration. Hard water requires the use of much soap before lather is formed while washing for personal cleanliness or laundry. Plumbing fixtures and cooking vessels are subject to staining incrustations as a result of hard water and especially when in combination with excessive concentrations of iron and/or manganese.

The natural fluoride concentration of the existing supply is within the range generally considered desirable.

C. TREATMENT

The water is pumped directly from the wells into the distribution system. The only treatment is chlorination. It is recommended that chlorination of the existing supply be maintained without interruption.

D. DISTRIBUTION SYSTEM

The existing distribution system serves the City and is available to all users. The lengths of the various sizes of water mains which make up the existing distribution system are given in Table No. 3.

TABLE NO. 3 -- Inventory of Water Distribution System - Scotland, S.Dak.

<u>MAIN</u>	<u>QUANTITY</u>	<u>Percent of Total</u>	<u>Fire Hydrants</u>
8" C.I.	1750 feet	5	4
6" C.I.	3550 feet	10	6
4" C.I.	28700 feet	85	36
TOTAL	34,700 feet	100	46

Water mains less than 6 inches in diameter are considered inadequate for proper fire protection. At present 36 fire hydrants are connected to 4-inch diameter pipe. In addition one 4" line, 3,500 feet in length terminates in a dead end. There are 4 hydrants attached to this line.

The present distributed water is metered to each of the 432 users. The meters are read once each year and billings made once each year.

E. DISTRIBUTION STORAGE

The present storage facilities consist of a 65,000 gallon elevated storage tank. The tank appears to be in relatively good condition and is maintained and painted under contract.

III. WATER REQUIREMENTS

A. GENERAL

Each well is metered and records of water production and consumption are maintained. The average winter usage is about 110,000 gallons per day. The summer average is 210,000 gallons per day and the maximum day usage is about 360,000 gallons per day.

Major factors affecting water demand include population, quality of water, distribution pressure, sewer facilities, climate, use of meters and cost. An evaluation of these factors considering the type of community and the degree of commercial or industrial water use allows the assignment of water consumption rates.

B. WATER CONSUMPTION

The City of Scotland is primarily a residential area, serving a farm community with small commercial business and light industry not requiring any abnormal use of water. Considering this, along with other factors affecting water use in a community of this nature, the water consumption rates as shown in Table No. 4 can be expected to be adequate after proposed water supply improvements are completed and an improved quality of water is offered to the users.

TABLE NO. 4 -- Unit Water Consumption Rates -- Scotland, South Dakota

Annual Average	150 gallons per capita per day
Winter Average	100 gallons per capita per day
Summer Average	200 gallons per capita per day
Maximum Month	230 gallons per capita per day
Maximum Week	300 gallons per capita per day
Maximum Day	350 gallons per capita per day

For a city the size of Scotland, the comparative rate of water consumption during a fire is very high, being much greater than other demands. Thus fire flow requirements generally are the determining factor in designing a water system for small communities when fire flow is weighted in the design as recommended by the National Board of Fire Underwriters.

On the basis of the design population and the estimated water consumption rates outlined above, the water requirements in gallons per minute and the total gallons per day for the City of Scotland for various critical periods during the year is tabulated in Table No. 5.

TABLE NO. 5 -- Estimated Water Requirements -- City of Scotland

PERIOD	Based on 1100 design population	REQUIREMENT	
		gpd	gpm
Maximum Day	385,000		267
Maximum Week	330,000		236
Maximum Month	253,000		176
Summer Average	220,000		153
Winter Average	110,000		80
Annual Average	165,000		115
Fire Demand (1)	240,000		1000

gpm = gallons per minute

gpd = gallons per day

(1) = National Board of Fire Underwriters grading schedule,
4 hour fire @ 1000 gpm

C. PRODUCTION REQUIREMENTS

The water requirements outlined in the above table shows the critical flows averaged over a 24-hour period. However the demands are concentrated during the daylight hours except in emergencies. This is most noticeable during the summer periods while businesses, air conditioners and lawn sprinkling is carried on. It is estimated that 70 to 80 percent of the daily water consumption occurs between 8:00 A.M. and 8:00 P.M. These heavy demand peaks must be absorbed either through additional pumping and processing facilities or adequate storage facilities.

Sufficient water should be provided from the well field to allow for proper maintenance of the wells and/or emergencies which may occur. Water production facilities along with storage should be sufficient to prevent curtailment of water to consumers or jeopardize fire protection.

Adequate storage is dependent upon the available direct supply. Storage may be provided through ground or elevated storage.

Appendix A shows the water use requirements which would occur during critical periods without and with full fire demand.

In order to insure adequate supply for fire fighting purposes as well as maintaining full supply to the users, additional water supply development is required.

Table No. 6 is a summary of Appendix A showing required amounts of additional supply to insure against shortage during critical periods.

TABLE NO. 6 -- Additional Water Supply Requirement - Scotland, S. Dak.

CONDITION	Additional Requirement during 4-hour Fire (gallons)	Additional Requirement during critical 12-hour Daily Use Period (gallons)
Maximum Day	204,000	29,000
Maximum Week	190,000	Adequate
Maximum Month	180,000	Adequate
Summer Average	161,000	Adequate
Winter Average	132,000	Adequate
Annual Average	147,000	Adequate

The above requirements are based on water wells which will maintain a safe yield of 300 gallons per minute. It is apparent that the critical water shortage will occur during a fire. The above requirements for additional water supply are necessary to provide maximum fire protection with a continued supply to other users during the fire. It is possible to provide this additional water requirement through production facilities and storage. It is recommended, however, that at least one half of the total requirement during such a critical period be provided through storage.

On the basis of past water use records for the City of Scotland and that an additional 100,000 gallon storage tank will be provided, the rates of production required from wells to insure no shortage of supply for the various critical conditions are shown in Table No. 7.

TABLE NO. 7 - Required Water Production Rates (assumed 100,000 gallons storage provided)

Condition	Production Capability		Minimum number wells*	
	fire demand gpm	no fire demand gpm	fire demand	no fire demand
Maximum Day	730	210	4	2
Maximum Week	675	137	4	2
Maximum Month	590	adequate	3	2
Summer Average	550	adequate	3	2
Winter Average	430	adequate	3	2
Annual Average	495		3	2

* Assumed 200 gpm wells

If 100,000 gallons additional storage is not provided, an additional 410 gallons per minute is required in production facilities to meet demand during a maximum fire condition. An additional production of 140 gallons per minute would be required to meet critical demand without fire demand.

D. WATER SUPPLY SOURCES

The existing municipal water supply wells for Scotland produce water from the Niobrara formation or Codeil sandstone. The existing water supply as shown in Table No. 2 is highly mineralized and does not meet public health standards for municipal water supply. Therefore the State Geological Survey was requested by the City to explore potential locations for a new water supply of better quality as well as sufficient quantity for the municipality's future needs. The Survey's investigation indicated that a source of water of better quality was available along the Dawson Creek watershed about 2 miles east of the City. Four test holes were drilled at locations shown on Plate No. 2 attached to this report. The logs of the test holes are shown in Appendix B.

The production test well was constructed at the sight of test hole No. 4. This well was constructed 90 feet deep. A gravel packed 10-inch screen, twenty feet in length was installed for the pumping test. The log of this well and a record of the pumping test is shown in Appendix B.

The pumping test demonstrated that production wells of good capacity can be constructed in the area with capabilities of producing water at 10 gallons per minute or more per foot of drawdown.

Water analysis were performed on samples collected from test holes 1, 2 and 3 and the production well. The results of these analyses compared with the average analysis from the existing city supply and the public health standard recommended limits are shown in Table No. 8.

TABLE NO. 8 - Results of Water Analysis from Tests and Existing Supply

Determination	Test No. 1	Test No. 2	Test No. 3	Prod. test C # 4	Present City Supply	USPHS Sds.
pH	7.9	7.5	7.7	6.95	7.3	
Alkalinity CaCO_3	435	350	391	368	386	
Total hardness CaCO_3	685	735	1100	992	1300	
Calcium Ca	164	211	239	258	349	
Magnesium Mg	70	33	33	34	102	
Bicarbonate HCO_3				449	471	
Sulphate SO_4	625	505	1038	1000	1097	250
Iron Fe	0.03	0.5	1.1	1.0	4.3	0.3
Manganese Mn	0.75	0.24	2.4	3.0	0.1	0.05
Sodium Na	182	56	154	180	120	
Potassium K					20.5	
Chloride Cl	9	9	14	12	36	250
Fluoride F	0.8	0	0.6		0.8	0.6-1.7
Nitrate NO_3	2	0.6	0.3		0	45
Total Solids	1500	1150	2064	1821	2168	500-1000

The comparison of these various analyses clearly indicates an improved quality water is available from the area which was tested. It also indicates that the tests farther up stream are of better quality. Test hole number 1 was stopped at the 63 foot level because of boulders. The formation directly above the boulder layer is excellent water producing formation. Test hole number 2 bottomed at 80 feet. The material above the bottom clay was slightly cemented and not as desirable for well construction as the material in test hole number 1. The material in test hole number 3 was not as deep nor as thick as upstream tests. Test hole number 4 was drilled through the boulder area and bottomed at 95 feet in a hard shale. The formation directly above the shale is an excellent water producer. The production well was developed at the site of test number 4 because of the additional depth of formation.

The quality of the water from test hole number 2 was better than samples taken from other tests. Test number 1 was only slightly inferior to test number 2. The quality of water from test number 3 was inferior to other samples. This factor along with the poorer formation in test hole number 3 eliminated further consideration for downstream development. The samples taken from the production test well indicate that quality of the water from the bottom of the formation is poorer.

The tests indicate that the City of Scotland can obtain an adequate water supply with improved quality from the area between test number 2 and test number 1 and 4. The tests show that a well developed at or near the site of the production well and eliminating the bottom 10 to 15 feet of formation over the shale would improve the quality without much sacrifice for quantity. It certainly justifies testing and sampling of the upper strata.

A well field developed in this area would provide the City with a water supply with much better quality, thus a water which is much simpler to treat. One great advantage of water supply from the area tested is the large reduction of sulphates content in the water. Sulphates cannot be removed economically with common treatment methods.

E. WATER TREATMENT REQUIREMENTS

The chemical analysis of the existing water supply for the City of Scotland and the new source of water supply tested indicates that the methods of treatment of the supplies are essentially the same. However equipment for special purposes may vary. All sources of water supply investigated require iron and manganese removal. The hardness is far in excess of acceptable limits.

Iron and Manganese - The presence of over 0.3 parts per million of iron and over 0.05 parts per million of manganese in a water supply for municipal purposes is considered objectionable. It is considered good practice to remove iron and manganese when in excess of these amounts. The presence of these minerals stain many things with which they come in contact. This is particularly noticeable in plumbing fixtures, laundry operation

and in crustations in the water lines. They may cause discoloration of vegetables which are cooked in the water. Compounds containing these minerals stimulate the growth of crenothrix, a biological organism, in water mains which upon death impart disagreeable tastes and odors to the water. These crenothrix growths are stringy and gelatinous and may become so voluminous as to interfere with the flow of water through the pipes.

The total hardness of the water from the wells is extremely high. The hardness of these waters is decidedly above the maximum which would be desirable for a satisfactory domestic and municipal water supply. The extreme hardness results in relatively large increases in costs to the water users. These increased costs are readily noticed from increased soap use and the damage to clothing, plumbing fixtures, heating system, etc.

It is not desirable or economically feasible to provide treatment to obtain zero softening for a municipal water supply. The practical limit for softening is dependent upon the economic feasibility of reaching it. The basic treatment facilities are the same for varying degrees of softening. The variation occurs in the amounts of chemicals introduced to reduce the hardness to the desired level.

The total sulphates and total solids content of all sources of water tested are also in excess of recommended limits.

IV. PROPOSED IMPROVEMENTS

A. WATER PRODUCTION FACILITIES

The adequacy of a municipal water system is dependent upon the source of supply and the production facilities to provide water at the rates for the period of time required.

It is not always practicable or economically feasible to provide facilities to meet all anticipated or possible disasters. However, provision should be made to meet most critical demand periods with plans for continued improvement with the eventual goal of complete service in the future.

It is proposed that two new wells be developed at locations shown on Plate II attached with future plan for development of the third well. Sufficient water supply wells should be provided to allow for proper maintenance and/or emergencies which may remove a portion of the production facilities from service.

Each well should be equipped with pump motor, controls, meter and housing.

B. TRANSMISSION AND DISTRIBUTION PIPING

A new transmission line is required to carry the water from the two wells to the central point of treatment and to the distribution system. A 8-inch transmission line is recommended to carry the anticipated water production requirement to meet all demands.

C. DISTRIBUTION SYSTEM

Analysis of the city's distribution system shows that the system is very high in percentage of 4-inch mains. Plans should be made to strengthen the system in various locations indicated on Plate I. Other replacement or additional strengthening may be required to maintain desired distribution pressure during higher usage and to improve fire protection. A program for cleaning mains should be given serious consideration, if pressures have been dropping as a result of incrustation over the years of use of poor quality water.

D. STORAGE FACILITIES

The existing 65,000 gallons elevated storage tank is not considered adequate to provide carry-over for peak usages or for adequate fire protection. Additional storage is essential to insure greater safety during an emergency and carry-over of peak usage. A minimum additional storage of 100,000 gallons is recommended. This may be incorporated as a part of the treatment facility and provide booster pumping from a clear well into the distribution system. Additional elevated storage naturally is most desirable for meeting an emergency condition; however, economy is a determining factor.

E. TREATMENT FACILITIES

The improved water quality as shown in Table 8 for Wells 1 and 2 of the proposed new water supply assumes a much greater significance when the possible alternatives of treatment are considered. The considered alternatives of treatment include:

1. Forced draft aeration of the water prior to storage thus utilizing the storage facilities for a settling basin accomplishing some iron and manganese removal. Additional iron and manganese or softening facilities may be added at a later date.

2. Iron and manganese removal, utilizing a pressure unit containing manganese greensand to selectively remove the iron and manganese. This type of unit requires the addition of potassium permanganate to the water for maintaining the removal efficiency as well as use backwash facilities.

3. Softening all water to a hardness of about 100 mg/l. during which the iron and manganese would also be removed to acceptable concentrations. Softening can be accomplished by two methods:

- A. Utilizing sodium zeolite to exchange sodium for the calcium magnesium, iron and manganese causing hardness. Sodium chloride is used to regenerate the zeolite.

- B. Precipitation of the calcium and magnesium from the water by the addition of lime and soda ash.

In general these alternatives might be expected to: (1) increase in complexity of operation, (2) increase in cost, and (3) provide improved quality of treated water as the alternatives are considered in sequence from 1 to 3B. Alternate 1 is essentially no treatment at all and the water quality would be about that of the improved raw water source. The cost estimates for these alternatives are included in Section V.

On the basis of the above considerations, it is recommended that the City install only iron and manganese removal facilities (Alternate 2) at this time. This method of treatment was selected over Alternative 1 because it insures efficient removal of iron and manganese and this improved quality should eliminate the major complaints of plumbing fixtures and laundry staining which are prevalent with the existing supply. The addition of softening facilities at a future date may be contemplated, however, it is felt that the problems associated with hard water can be handled most satisfactorily on an individual basis at this time.

V. ESTIMATED COSTS

A. SCOPE

This section summarizes the costs of the various improvements and new facilities required to provide an adequate water supply facility for the City of Scotland.

B. PROPOSED WATER SUPPLY FACILITIES

The proposed water supply facilities includes two new wells, a transmission line to transport the water to the proposed treatment facility and ground storage, treatment to remove iron and manganese from the raw water, provide ground storage facility, booster pumps to pump into the existing distribution system.

The estimated cost of the projects required to provide the above proposed facilities for the community is summarized in Table 9. See detailed Appendix D.

TABLE NO. 9 - Total Estimated Cost - Water Supply Facilities Proposed -
Scotland, South Dakota

Project No.	Description	Total Cost
1*	2 water supply wells (Alt. 1A)	\$29,040.00
2	Transmission lines	47,625.00
3**	Treatment & storage facilities (iron & manganese removal)	<u>66,000.00</u>
TOTAL ESTIMATED FACILITIES COST		\$142,665.00

* If Alternate 1B is used, deduct \$3,020.00 from estimate

** If zeolite softening included, add \$21,300.00 to estimate

In addition to the above costs certain distribution system strengthening should be given consideration in the future which would result in an estimated cost of \$17,110.00.

Water main cleaning may also be necessary to remove certain amounts of incrustation which has developed over the years. This probably would not involve all lines, however the estimated cost of cleaning all mains is \$10,200.00.

The estimated unit cost of capital improvements for projects 1, 2 and 3 as shown in the above table would be:

Unit cost Projects 1, 2 and 3 / capita = \$132.50.

The average annual cost to amortize the proposed facilities summarized in Table No. 9 based on a uniform annual interest rate of 4 percent and a 20 year repayment period is \$10,497.29.

Unit Costs -- Capital Facilities:

Unit cost per capita = \$9.50/year
 (based on population of 1100)
 Unit cost per service = \$24.30/year
 (based on 432 services)
 Unit cost per 1000 gallons
 water = \$0.174/1000 gal.
 (based on 60,225,000 gal/year)

C. OPERATION AND MAINTENANCE COSTS

The estimated annual costs for operation and maintenance of the water supply facilities system with partial treatment are itemized below in Table No. 10.

TABLE NO. 10 - Estimated Operation and Maintenance Costs - Water Supply Facilities System - Scotland, South Dakota

EXPENSE	Total Estimated Cost
Labor, O & M, Billing, etc.	\$3,000.00
Chemicals	1,100.00
Power (based on 2¢/kw hour)	2,000.00
Materials, Repairs, etc.	600.00
Extensions	900.00
TOTAL ESTIMATED ANNUAL O & M COSTS	\$7,600.00
UNIT COST -- O & M	
Unit Cost per Capita (based on population 1100)	= \$6.91/year
Unit Cost per Service (based on 432 services)	= \$17.60/year
Unit Cost per 1000 gal. water (based on 60,225,000 gal/year)	= \$0.126/1000 gal.

Softening of the water with zeolite softeners would increase the chemical costs about \$10,000 per year.

The detailed breakdown of requirements and costs for chemical for various methods of treatment is given in Appendix C.

Summary of unit costs for capital improvements and operation and maintenance are itemized below in Table 11.

TABLE NO. 11 - Summary - Estimated Unit Costs

Description of Expense	AVERAGE UNIT COST		
	Per Capita Annual	Per Service Annual	Water Production per 1000 gal.
Capital Improvements	\$9.75	\$24.30	\$0.174
Operation & Maintenance	<u>7.06</u>	<u>17.60</u>	<u>0.126</u>
TOTAL UNIT COST	\$16.81	\$41.90	\$0.300

VI. PROPOSED RATES

A. SCOPE

This section includes a recommended rate schedule necessary to provide sufficient revenue to finance capital improvements, including all interest charges, administration, operation and maintenance of the facilities in an adequate manner.

B. RATE STRUCTURE

In order to develop a sound rate structure, it is essential that good bookkeeping principals be practiced, including complete cost accounting of operations and property records. It is equally important that service meters be read and billed at regular intervals as often as is economically feasible, but not exceeding once every three months. While bi-monthly is preferable for proper maintenance, each three months is more practicable in smaller communities. It is important that billings be maintained on a current basis and not allowed to accrue in order to maintain smaller payments.

Rates for water service must be realistic and adequate. In establishing a rate schedule there are many methods and an infinite number of rates which can be established which are adequate and satisfactory.

It is recommended that a minimum water charge be established either with some water or no water furnished. The necessity of this charge, which is commonly referred to as the "readiness to serve charge", is to cover a definite service and must be adequate to cover all fixed costs, including principal and interest on indebtedness, depreciation, etc. which are of considerable cost to the City whether any water is used or not. This charge generally is based upon the size of service meter. The next charge in addition to the readiness to serve charge is based upon the water used by a customer over a period of time. These charges generally cover all operational and maintenance charges which are involved in water production, treatment and distribution, plus a small margin for emergencies and repairs.

1. Minimum Charge - The quarterly minimum charge, based on residential size meter (3/4" or less) of \$6.00/quarter is required to approximately defray the estimated annual fixed capital costs of \$10,497.29.

If an amount of water is allowed the customer under this minimum charge of \$6.00 per quarter, it should be nominal.

2. Water Consumption Rates - It is also known that the most efficiency of the water system is at design capacity. Therefore usage at less than design capacity requires some higher costs per unit of production to operate and maintain the system under such conditions.

Unit Cost of O & M = \$0.126/1000 gallons produced
(based on 60,225,000 gal/year)

Proposed Rates --

First 10,000 gal/quarter @ \$.30/1000 gal.
Next 10,000 gal/quarter @ \$.20/1000 gal.
All over 20,000 gal/quarter @ \$.15/1000 gal.

Table No. 12 shows the comparison of the proposed rate with the existing rate.

TABLE NO. 12 -- RATE COMPARISON - Scotland, South Dakota		
Description	Existing Rate	Proposed Rate
Minimum	\$12.00/year	\$6.00/quarter
First 10,000 gallons	included in min.	0.35/1000
Next 5,000 gallons	0.20/1000	0.25/1000
Next 5,000 gallons	0.18/1000	0.25/1000
Over 20,000 gallons	0.15/1000	0.15/1000

These proposed rates are presented as a guide for financing the system. There are an infinite number of rate schedules which can be developed. It is recommended that the lowest rate charged be higher than the cost of production.

VII. SUMMARY OF FINDINGS AND RECOMMENDATIONS

The following summary of findings and recommendations has been developed from the survey and study of water supply facilities for the City of Scotland, South Dakota.

1. The design population equivalent used in this study was 1100.
2. The City presently is served by a water supply system and water is available in all areas of the City which are developed.
3. The system consists of two wells which feed directly into the distribution system and an elevated storage tank with a capacity of 65,000 gallons for maintaining distribution pressure and fire protection. The only treatment is chlorination of the water at the wells.
4. The water supply from the existing wells is highly mineralized with excessive iron, hardness, sulphates and total solids. The fluoride concentration is in the desirable range.
5. A new water supply located along Dawson Creek about 2 miles east of Scotland was tested and found to contain adequate supply for the City and of an improved quality compared with the existing supply.
6. Tests of the formation two miles east of Scotland show that several wells can be developed in this area, each with a production of about 200 gpm.
7. The mineral analysis of the water from the tests made indicate that treatment for the removal of iron and manganese is required to produce a quality water.
8. The average annual water production requirement for the City of Scotland is estimated to be 165,000 gallons per day.
9. It is recommended that 2 new wells be developed along Dawson Creek about 2 miles east of Scotland, and 8-inch transmission line to be constructed to the City. Iron and manganese removal facilities should be installed, consisting of a manganese greensand filter, complete with permanganate feed and appropriate controls. This unit will insure the removal of iron and manganese below the suggested limitation of about 0.3 mg/L as recommended by the U. S. Public Health Service Drinking Water Standards. Chlorination of the treated water by the addition of a hypochlorite solution also is recommended. The improvements would include a 100,000 gallon ground storage facility and booster pumps to feed the distribution system. It is also recommended that the new facilities be operated under an automatic control system.

10. The total estimated cost of the capital improvements recommended is \$142,665.00. The annual cost, based on an average interest rate of 4 percent and a 20-year amortization period, is \$10,497.29 per year.

11. The operational and maintenance cost of the water supply system for the City is estimated to be \$7,600.00.

12. The unit cost of water produced are:

Capital Improvements	= \$0.174/1000 gallons
Operation and Maintenance	= \$0.126/1000 gallons

13. The water rate which would be required to defray capital costs and provide adequate operation and maintenance for the system would require an increase of present rates by 300 percent at near minimum usage with a gradual decrease in percent as consumer usage goes up.

14. It is recommended that the City establish an annual plan for strengthening the distribution system by additional looping and possible cleaning of certain mains to remove incrustations.

APPENDIX A

ADDITIONAL WATER SUPPLY REQUIREMENTS FOR CITY OF SCOTLAND, SOUTH DAKOTA

The following table shows the amounts of additional water supply required in order to insure a full supply during critical periods.

Additional Water Supply Requirement to Meet Demand During Critical
Period of 12 hours - Without Fire -- Scotland, South Dakota

	(12 hour) City Demand (gallons)	Max. Safe Yield (gallons)	Existing Storage (gallons)	Additional Supply Re'd to meet demand (gallons)
Maximum Day	310,000	216,000	65,000	29,000
Maximum Week	264,000	216,000	65,000	None
Maximum Month	202,000	216,000	65,000	None
Summer Average	176,000	216,000	65,000	None
Winter Average	88,000	216,000	65,000	None
Annual Average	132,000	216,000	65,000	None

ASSUMPTIONS: (1) That the daily city demand is critical during the 12-hour period, 8:00 A.M. to 8:00 P.M. During this period 80% of daily water requirements will occur.

(2) That the safe yield of wells is 300 gpm.

Additional Water Supply Requirements to Meet Demand During a Critical
Period of 4 hours with Full Fire Demand - Scotland, South Dakota

Condition	Full Fire* Demand 4-hr. fire	Normal city demand	Max. Safe Yield Wells	Existing Storage	Additional Supply Req'd to meet demand	
					1/2 storage	production
Maximum Day	240,000	101,000	72,000	65,000	104,000	100,000
Maximum Week	240,000	87,000	72,000	65,000	98,000	92,000
Maximum Month	240,000	67,000	72,000	65,000	88,000	82,000
Summer Average	240,000	58,000	72,000	65,000	84,000	77,000
Winter Average	240,000	29,000	72,000	65,000	69,000	63,000
Annual Average	240,000	44,000	72,000	65,000	77,000	70,000

* National Board of Fire Underwriters Rate Scale

The following assumptions were made above:

- (1) Full fire demand would occur during a peak consumer period.
- (2) That daily city demand will be critical during the 12-hour period of 8:00 A.M. to 8:00 P.M. During this period 80% of daily requirement will occur.
- (3) The safe yield of water supply wells is 400 gpm.

APPENDIX B

WATER SUPPLY INVESTIGATION DATA

TEST HOLES

1. Test Hole No. 1

LOCATION: NE 1/4, S 10, T 96N, R 58W

About 2 miles east of Scotland, 275 feet east and
300 feet south of bridge over Dawson Creek.

HOLE: Rotary 2 x 4 ft. x 2 x 4 ft. mud pits

Static Water Level: 8-1/2 feet from ground level

FORMATION:

<u>Thickness</u>	<u>Description of Formation</u>	<u>Total Depth</u>	<u>Remarks</u>
3	Black top soil	3	
7	Brown clay (sandy)	10	
1	Coarse sand & gravel	11	
3	Gray clay	14	fine sand in formation
4	Coarse sand and gravel	18	
1	Gray clay	19	
9	Coarse sand and gravel	28	30" mud loss
16	Soft gray clay	44	
19	Medium to coarse sand & gravel	63	big boulders, could not go through

2. Test Hole No. 2

LOCATION: NE 1/4, S 10, T 96N, R 58W

About 2 miles east of Scotland, 300' west and
2300' south of bridge over Dawson Creek

HOLE: Rotary 2 x 4 ft x 2 x 4 ft. mud pit

Static Water Level: 8 feet from ground level

FORMATION:

<u>Thickness</u>	<u>Description of Formation</u>	<u>Total Depth</u>	<u>Remarks</u>
3	Black top soil	3	
12	Brown clay (gravel streaks)	15	
8	Coarse sand and gravel	23	
13	Gray Clay	36	
14	Fine medium sand & gravel	50	
15	Medium sand	65	25" mud loss
10	Medium sand and gravel	75	
5	Gray Clay	80	
		Bottom	

3. Test Hole No. 3

LOCATION: SE 1/4, S 3, T 96N, R 58W/
About 2 miles east of Scotland, 1110' north
of bridge over Dawson Creek

HOLE: Rotary 2 x 4 ft. x 2 x 4 ft. mud pits

Static Water Level:

FORMATION:

<u>Thickness</u>	<u>Description of Formation</u>	<u>Total Depth</u>	<u>Remarks</u>
2	Black top soil	2	
2	Sandy brown clay	4	
12	Medium to coarse sand & gravel	16	
3	Gray clay	19	
16	Medium to coarse sand & gravel	35	boulders - 15" mud loss
23	Gray Clay	58	
5	Shale	63	

4. Test Hole No. 4

LOCATION: SE 1/4, S 3, T 96N, R 58W
About 2 miles east of Scotland, 300' west
and 60' north of bridge over Dawson Creek

HOLE: Rotary 2 x 4 ft. x 2 x 4 ft. mud pits

Static Water Level: 11.0 feet

FORMATION:

<u>Thickness</u>	<u>Description of Formation</u>	<u>Total Depth</u>	<u>Remarks</u>
2	Black top soil	2	
5	Sandy brown clay	7	
1	Coarse sand and gravel	8	
10	Brown clay	18	
12	Gray clay	30	
5	Coarse sand and gravel	35	boulders-streak of coal
11	Gray clay	46	
2	Boulders	48	
3	Gray clay (boulders)	51	
13	Coarse sand and gravel	64	boulders
2	Gray clay (boulders)	2	
17	Medium coarse sand & gravel	83	36" mud loss
12	Fine to medium sand & gravel	95	
5	Shale	100	
		Bottom	

5. Production Test Well

LOCATION: SE 1/4, S 3, T 96N, R 58W
About 2 miles east of Scotland, 300' west
and 60' north of bridge over Dawson Creek

HOLE: Rotary 15"

SCREEN: 20' x 10", gravel packed

Static Level: 11 feet Drawdown: 31'-4"

FORMATION:

<u>Thickness</u>	<u>Description of Formation</u>	<u>Total Depth</u>	<u>Remarks</u>
2	Black top soil	2	
5	Sandy brown clay	7	
1	Coarse sand and gravel	8	
10	Brown clay	18	
12	Gray clay	30	
5	Coarse sand & coal streaks & gravel	35	
11	Gray clay	46	
2	Boulders	48	
3	Gray clay (boulders)	51	
13	Coarse sand & gravel (boulders)	64	
2	Gray clay streaks (boulders)	66	
17	Medium to coarse sand & gravel	83	
12	Fine to medium sand & gravel	95	
5	Shale	100	
	Hard shale at 100'		

APPENDIX C
DESIGN COMPUTATIONS AND DATA

1. WELLS

Tests indicate wells can be developed to produce 200 gpm.

Number required --	1963	2 wells
Minimum number		2 wells
Total dynamic head		182 feet
Type pump	vertical turbine	
Setting	60 feet	
TRY	8" LC 6970 - FB	
Efficiency	= 75% impeller A	
Head	= 27 ft./stage	Use 7 stage
HP	= 1.7 ft./stage	
Use	= 7 stage	
HP required	= 12	
TRY	7" MC 6970 - FB	
Efficiency	= 75%	
Head	= 23.7/stage	Use 8 stage
HP	= 1.5/stage	
HP required	= 12	

Use 6" discharge head to 8" main
Transmission line to treatment plant

Flow to be metered at treatment plant and pumps controlled at treatment plant.

2. BOOSTER PUMPS

Total Dynamic Head	= 150 feet
Discharge:	
Pump No. 1	= 250 gpm
Pump No. 2	= 250 gpm
TRY	8" LC
Efficiency	= 81% Impeller A
Head	= 21ft/stage
HP	= 1.8/stage
Total	= 12.6

SUMMARY OF CHEMICAL REQUIREMENTS and RELATIVE COSTS for ALTERNATIVES

Alternative & Chemicals	Annual Requirement	Unit Cost	Annual Cost	Approx. Chemical Cost per 1000 gal.
1. Forced Draft Aeration Only Chlorine as hypochlorite 70%cl	1800 lbs.	\$0.37/lb	\$665.00	1.1¢
2. Iron & manganese removal only Chlorine (see Alternate 1) Permanganate	800 lbs.	\$0.50/lb	\$655.00 400.00	1.8¢
3A. Softening with Zeolite Chlorine (see Alternate 1) Sodium Chloride	480 tons	20.00/T	\$665.00 \$9600.00	17¢
3B. Softening with lime & soda ash Chlorine (see Alternate 1) Lime Soda Ash Alum	157 tons 40.5 tons 4.3 tons	40.00/T 80.00/T 100.00/T	\$665.00 \$6280.00 \$3980.00 430.00	19.2¢

APPENDIX D

DETAILED PROJECT ESTIMATES

A. PROJECT 1A (Alternate to 1B) WATER SUPPLY WELLS

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1.	6" Pilot Hole	80	LF	3.00	240.00
2.	Reaming to 30" diam.	80	LF	30.00	2,400.00
3.	18" S.S. Screen-304	20	LF	210.00	2,400.00
4.	18" O.D. Casing	65	LF	20.00	1,300.00
5.	Gravel Pack	14	Ton	50.00	700.00
6.	Test Pumping	20	Hour	20.00	400.00
7.	Concrete curb & base	2	C.Y.	40.00	80.00
8.	Pump	1		L.S.	2,000.00
9.	Pump House	1		L.S.	2,200.00
10.	Pump House Piping			L.S.	600.00

TOTAL ESTIMATED CONST. COST	1 well	\$12,320.00
Engineering Services		1,250.00
Contingencies		1,000.00

TOTAL ESTIMATED COST, Project 1A 1 well \$14,570.00

2 wells \$29,040.00

B. PROJECT 1B (Alternate to 1A) WATER SUPPLY WELLS

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1.	6" Pilot Hole	80	LF	3.00	240.00
2.	Reaming to 30" diam.	80	LF	30.00	2,400.00
3.	16" SS Screen 304	20	LF	110.00	2,200.00
4.	16" Casing	65	LF	18.00	1,170.00
5.	Gravel Pack	20	Ton	50.00	1,000.00
6.	Test Pumping	20	Hour	20.00	400.00
7.	Concrete curb & base	4	C.Y.	40.00	160.00
8.	Pump	1		L.S.	2,000.00
9.	Underground discharge head	1		L.S.	1,200.00
10.	Control Housing			L.S.	200.00

Total Estimated Construction Cost	1 well	\$10,910.00
Engineering Services		1,100.00
Contingencies		1,000.00

TOTAL ESTIMATED COST Project 1B 1 well \$13,010.00

2 wells \$26,020.00

C. PROJECT 2 - TRANSMISSION LINE AND DISTRIBUTION FEEDER

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1.	8" Pipe	11,500	LF	\$3.25	\$37,375.00
2.	Vacuum & air relief valves	4	ea.	350.00	1,400.00
3.	Gate valves	5	ea.	150.00	750.00
4.	Blow-off valves	2	ea.	200.00	400.00
5.	Fittings	1,500	lb.	0.40	600.00
Total Estimated Construction Cost					\$40,525.00
Engineering Services					4,100.00
Contingencies					3,000.00
TOTAL ESTIMATED COST, Project 2					\$47,625.00

D. PROJECT 3 - TREATMENT AND STORAGE FACILITIES Iron and Manganese Removal

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1.	100,000 gal. clearwell storage	1		L.S.	\$18,000.00
2.	Pumps	2	ea.	\$2,000.00	4,000.00
3.	Treat Equip for Iron & manganese			L.S.	13,000.00
4.	Meters			L.S.	1,500.00
5.	Piping & Connections			L.S.	2,500.00
6.	Automatic Controls			L.S.	4,500.00
7.	Treatment Building			L.S.	12,000.00
Total Estimated Construction Cost (Iron & Manganese Removal)					\$55,500.00
Engineering Services					5,500.00
Contingencies					5,000.00
TOTAL ESTIMATED COST, Project 3 with iron & manganese removal					\$66,000.00
ADDITION OF SOFTENING					
8.	Softening Equipment			L.S.	\$13,000.00
9.	Salt Storage Room			L.S.	5,000.00
Total Estimated Cost to Add Softening					\$18,000.00
Engineering Services					1,800.00
Contingencies					1,500.00
Total Estimated Cost--Softening					\$21,300.00
TOTAL ESTIMATED COST, Project 3, with softening					\$87,300.00

SUMMARY OF ESTIMATED PROJECT COSTS

Project	Alternate 1A	Alternate 1B
Project 1	\$29,040.00	\$26,020.00
Project 2	47,625.00	47,625.00
Project 3	<u>66,000.00</u>	<u>66,000.00</u>
TOTAL	\$142,665.00	\$139,645.00

PROJECT 4 - DISTRIBUTION SYSTEM IMPROVEMENTS

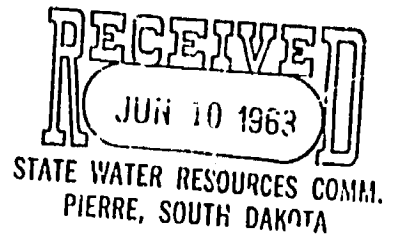
Item	Description	Quantity	Unit	Unit Cost	Total Cost
1.	8" Pipe	360	LF	\$3.50	\$1,260.00
2.	6" Pipe	950	LF	3.00	2,850.00
3.	4" Pipe	5,200	LF	2.50	<u>13,000.00</u>
Total Estimated Costs - Distribution System Improvements					\$17,110.00

PROJECT 5 - WATER MAIN CLEANING

34,000 LF @ \$0.30/LF \$10,200.00

Location No.

Water Division No. Water District



Proof of Application of Water to Beneficial Use

PETITION OF HOLDER

Ques. 1. State your name, residence, occupation and postoffice address.

Ans. Walter J. Kleinlein, Mayor, Scotland, South Dakota

Ques. 2. If acting in behalf of a corporation, state its name, principal place of business (if a foreign corporation, give name and postoffice of statutory agent,) your position with reference to same, and your authority for appearing in its behalf.

Ans. City of Scotland, Scotland, South Dakota, as Mayor of said City.

Ques. 3. State date of posting and date of recording notice of appropriation.

Ans. No PRIOR POSTING

Ques. 4. State source of water supply and give exact location of point of diversion.

Ans. WELL #1 (143' DEEP - 8") WELL #2 (160' DEEP - 8") WELL #1 LOT 15 BLK 12, TOWN OF SCOTLAND. WELL #2 - LOT 4 BLOCK 22, LAWLERS ADDITION

Ques. 5. Describe your works of diversion giving length and height of each dam and state amount of water they are capable of conveying from point of diversion to place of use, and give name of canal or ditch or other works by which water is conducted to such place of use, and date of completion of same.

Ans.

Ques. 6. State for what purpose water is used and describe place of use. (If for irrigation, name each subdivision in which used, and number of acres in each subdivision that have ACTUALLY been irrigated with said water.)

Ans. City water works

Ques. 7. If for other than irrigation purpose, state how applied, amount of horse power generated, etc.

Ans.

Ques. 8. What is the minimum amount of water required for the use specified above?

Ans. WELL #1 - 100 G.P.M. WELL #2 - 100 G.P.M.

Ques. 9. If you are not the person or representative of the corporation to whom above mentioned permit was originally issued, please state how ownership was acquired by present holder.

Ans.

Ques. 10. State when, how, in what amount and to what extent, the water diverted under above mentioned permit has been used.

Ans. WELL #1 COMPLETED IN 1941 AND WELL #2
COMPLETED IN 1954

(Sign) _____

I hereby certify that the foregoing testimony was read to the above subscriber before its signing, that I believe him to be the person he represents himself to be, and that said testimony was subscribed and sworn to before me, at my office in Scotland, County of Bon Homme, State of South Dakota, on this 7th day of June, A. D. 1953.

Walter J. Hamilton Mayor
Attest: _____ Auditor

I, the undersigned, do hereby certify that I am a duly qualified elector residing in the immediate vicinity of the diversion works designated in the foregoing testimony, that I have no interest in the works, water or land above described, that I have read the foregoing testimony and that I know of my own personal knowledge that the matters therein stated are true.

Oscar T. Lee

Location No. _____	
PROOF OF APPLICATION OF WATER TO BENEFICIAL USE	
PETITION OF HOLDER	
Amount of Water _____ c. f. s.	
Source _____	
County _____	
Purpose _____	
Place of Use _____	

Date of recording _____	

Received and filed _____	



CONSULTING ENGINEERS

BANNER & ASSOCIATES, Inc.

ENGINEERS:

J. T. BANNER
CALVIN VAUDREY
G. C. HAROKOPIS
A. J. HULL, JR.
HARRY M. JOHN
T. R. PFISTERER
J. A. SHELDON

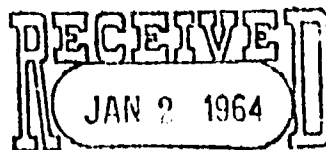
6343

PHONE 692-2845

P. O. BOX 44

BROOKINGS, SOUTH DAKOTA

December 30, 1963



STATE WATER RESOURCES COMMISSION

PIERRE, SOUTH DAKOTA

Water Resources Commission
State of South Dakota
Pierre, South Dakota

Re: Water Rights Application
No. 1062-3
Scotland, South Dakota

Gentlemen:

In behalf of the City of Scotland, South Dakota as their consulting engineers for proposed water supply facilities and development, we request modification in water right application number 1062-3 for the City of Scotland, South Dakota to include the following changes provided such modifications can be made without sacrifice of priority.

1. That the application be changed from future water right to current water right.
2. The quantity requested is 1.5 cubic feet per second.
3. The present development during 1964 shall consist of 2 wells, 30-inch diameter with 18" casing and screen, gravel packed, designed to obtain water about 60 to 80 feet below ground surface at well sites. The pumping rate is anticipated to be about 200 to 250 gpm. The pumps shall be vertical turbine-type. The water will be transported to the City through 2 plus or minus miles of 8" or 10" supply line which will terminate at a treatment facility. Treatment will include removal of iron and manganese and chlorination of the water supply. Metering of the water supply, storage of treated water and automatic controls shall be incorporated in the facility. From the treatment facility water shall be fed into the distribution system with booster pumps.

On additional well is recommended to be developed within a period of five years.

Water Resources Commission
Scotland Water Rights

-2-

December 30, 1963

4. The location of the wells proposed for current development are shown on the attached sketch.

5. The City presently is negotiating with the owner of the land on which the first two wells are located for the purchase of well sites as well as easements for right-of-way for the transmission line to the City.

Water rights for development of this water supply which is of improved quality to the city's present supply is vital to the City of Scotland. Your favorable consideration of this request is of utmost importance to the City of Scotland, South Dakota.

If it is required that additional information is desired, we will be pleased to assist in obtaining it for the Commission.

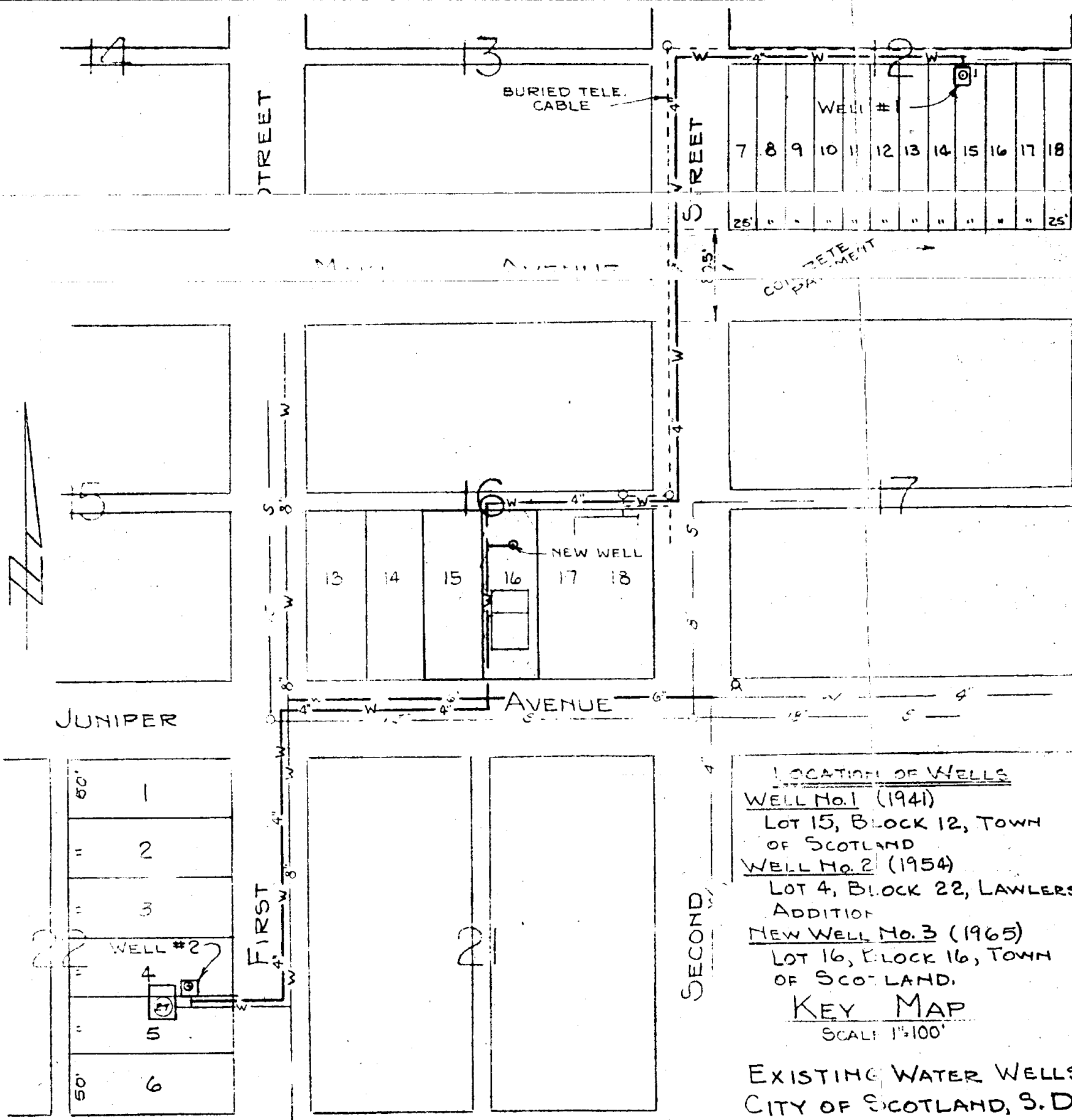
Respectfully submitted,



Calvin Vaudrey
J. T. BANNER & ASSOCIATES, INC.

CV/dv

Enc.



LOCATION OF WELLS
 WELL No. 1 (1941)
 LOT 15, BLOCK 12, TOWN
 OF SCOTLAND
 WELL No. 2 (1954)
 LOT 4, BLOCK 22, LAWLERS
 ADDITION
 NEW WELL No. 3 (1965)
 LOT 16, BLOCK 16, TOWN
 OF SCOTLAND.
 KEY MAP
 SCALE 1"=100'

EXISTING WATER WELLS
 CITY OF SCOTLAND, S.D.
 JULY 1969
 S.K.B.A.

1062-3