IOWA GEOLOGICAL SURVEY
In Cooperation with U. S. Geological Survey

W-0487

RECORD OF WELL



Location:

Town: Boyden (N E) (S W); County Sioux. E.

SE/c SW¼ sec. 26 T. 97 N., R. 44 W. Sheridan Twp.

Well name and number Boyden Town Well No. 1

Owner Town of Boyden Address Well at west edge of Boyden

Tenant _____ Address _____

Contractor Rasmussen Well Co. Address Leeds, Iowa

Drillers _____

Drilling dates December 1936 - Feb. 1937

Well data:

Elevations: Drilling curb 1416 feet; Land surface _____ feet

Determined by H. G. Hershey

Topographic position Upland

Total depth: Reported 500 feet; Measured _____ feet

Drilling method Cable tools

Hole and casing data 367'8" of 8" pipe from 0' to 367'8", 100'5" of 6" pipe from 340' to 440'5", 66'3" of 4¼" pipe from 433"9" to 500'. There is a lead seal at top of 6" pipe between 6" pipe and 8" pipe. The lower 59'7" of 4½" pipe is perforated with ½" holes on 4" centers

(Give amount, size, kind, and depth of all casing; type and position of seals and packers; cementing; how finished--perforated pipe, screen, gravel pack, open hole, etc.)

Original depth to water 234 ft. above below _____ Date _____

Original elevation of water level 1179 ft.; Source of data _____

Sources of water: Principal Cre. ss (Dakota) 440' 500'; Others In course of drilling, water was encountered in gray sand (Pleistocene) from 305'-335'

Production data: Date Fall-1937

Static depth to water 234'; Measuring point Drilling Curb at 1413-1416

Pumping level 250' at 125 g.p.m.

Specific capacity 7.8 g.p.m. per ft. drawdown; Temperature 52½ °F.

Pump data: Type pump Turbine: Column Dia. _____ Length _____

Cylinder or bowls: Dia. _____ Length 265; Suction pipe 25

Power Gasoline Motor; Airline _____

Estimated rate of production: _____ g.p.m. for _____ hrs. a day

Use of water Town Supply

WATER ANALYSES (in parts per million)

Date sampled	Jan. 21, 1937	Dec. 21, 1936		
Sampled by	H.G. Hershey	H. Rasmussen		
Total solids	2385	779		
Insoluble matter	80.0	28.0		
Alkalinity (Meo)	304.0	250		
Alkalinity (Phn)	0.0			
pH	6.9	3.0		
$Fe_2O_3+Mn_2O_3+Al_2O_3$	6.0			
Alkali as sodium	186.4			
Calcium	285.8	94.3		
Magnesium	91.8	31.7		
Iron (unfiltered)	2.0	(filtered) 2.0		
Manganese	0.08			
Nitrate	0.0			
Fluoride	1.0			
Chloride	50.0			
Sulphate	1171.6			
Bicarbonate	370.9	305.0		
Hardness (ppm)	1095.0			
Hardness (gpg)	64			
Remarks	Note high SO_4	Sample collected from screen at 305-345'		

Laboratory data: Sample storage location _____

Sample range 0-500 No. spls. 81 No. dupls & cond. 57 fair

Spls. prepared by _____ Washed range 0-500 by Gulf

Driller's log and cond. _____

Insoluble residues: Prepared by yes Studied by _____ Strip log _____

Microscopic study 0-500 MME & Gulf strip log 4-20-40 MME Elias Gulf

Gen. log ✓ Correl. by Gulf-Carnlody

Sheet No. ..... Name of Well Bayden City Well- ..... Survey No. W-0487

Location ..... Date Drilled Dec-Jany 1937 Analyst A.C. Tester

400 S/s, gry, clayey, thin bd; micac; much comminuted carbonized plant mater. with thin ~~plant~~ lignitic zones + dissem. carb—; some pyrite; non-calc.

405 S/s, gry - like 400-405; pyrite noduks: non-calc; more gry-brn clay

10 S/s, gry - like 400-405, very micac; pyritic + much comminuted carb. wood

S/s to very fine Ss: gray, micac similar to above, much carb-plant mater.

20 S/s, very fine; like 405-410; carb. plant mat; micac -: non-calc.

S/s to very fine Ss; like 415-420; few grains sd ½mm: non-calc.

30 Ss very fine grnd; gry; micac.; very angular sharp; some qtzte grns; thin streaks s/s.; few 1-½-¼ mm curd-subrd sd grns. mixed with clay, dirty.

Ss, very fine grnd to s/s, prob thin streaks s/s in fine Ss-like 430-425.

40 Ss, fine grnd, clean (prob. washed sample); sharp, angular, few curv.-subrd frosted grns. many access, including qtzte grns, pyrite, few rd ls frags; micac; few frags. carb. wood. Maj. gr. ⅛-1/16 prin. sub ¼-⅛

Ss, fine grnd, clean - about same as 440-445

50 Ss, fine grnd, clean like 445-450, very micac; slightly finer grd

Ss, fine, lt gry to wh, clean like above; some carb. wood frags.

60 Ss, fine, wh, clean, sharp, angl, very micac, in large flakes, access. mins, pyritic carb. wood common. like samples above

Ss, fine, wh, clean, like 460'-465'

70 Ss, med to fine grnd, maj gr ¼-⅛ mm prin. subs. ½-¼ + max. siz. 2-1 mm - Large pieces carb. wood; pyritic; ls. grns.

Ss, med to fine, wh, clean about same as 470-475; carb. wood shows impress. of qtz grns.; qtzte grns (pnk) prominent.

80 Ss: wh, clean, mixture of med + fine grnd apparently grading downward to clay + fine s/s, or streaks of s/s; otherwise similar to 475-480 (Large piece of gry silty clay looks like caved frag.)

Ss: gry, slightly dirty, fine + coarse mixed; maj. grade fine, some grns (10%±) over 1mm - some (2%) over 2mm; some clay mixed.; pyritic -

90

00

Preliminary

Generalized Log

Boyden City Well

Sioux County

W-0487

T.D. 500' Curb Elev. 1413' Static Level _____

Drilled by Rasmussen Bros. Sioux City, Dec.- 1936

No.	Description	Thick	From	To
	PLEISTOCENE SYSTEM			
1.	Drift, buff, oxidized, unleached, silty textured, with coarse sand and granules	30'	0'	30'
2.	Drift, buff, oxidized, unleached, marly	10'	30'	40'
3.	Drift, buff, oxidized, unleached, pebbly, coarse sandy	55'	40'	95'
4.	Drift, gray, pebbly, unoxidized	5'	95'	100'
5.	Drift, buff, oxidized, pebbly, unleached	10'	100'	110'
6.	Drift, pinkish buff, pebbly, reworked shale	85'	110'	195'
7.	Drift, gray, pebbly, calcareous, no igneous material	29'	195'	224'
8.	Sand, very fine, angular, micaceous, well sorted	8'	224'	232'
9.	Drift, light gray, calcareous, with limestone pebbles	8'	232'	240'
10.	Drift, medium to dark gray, non-calcareous, with bands of light gray drift	10'	240'	250'
11.	Drift, gray-buff, calcareous	15'	250'	265'
12.	Shale, dark gray, non-calcareous, with light buff limestone pebbles	5'	265'	270'
13.	Drift, medium gray, slightly calcareous, with thin fine sandy band between 285' and 295'	34'	270'	304'
14.	Sand, gray, medium grained, poorly sorted, angular to rounded, with much dark (igneous?) material	11'	304'	315'
15.	Sand, medium to coarse, angular to rounded, fairly well sorted, with considerable igneous material	20'	315'	335'
16.	Sand, very coarse to gravel, poorly sorted, with much igneous material	15'	335'	350'
17.	Drift, gray, silty textured, micaceous, non-calcareous	5'	350'	355'
18.	Sand, light buff, fine grained, angular, well sorted, no igneous material	5'	355'	360'
19.	Sand, medium to coarse, subangular to curvilinear, poorly sorted, much igneous material	5'	360'	365'
	CRETACEOUS SYSTEM			
20.	Shale, pinkish gray, silty textured, micaceous, non-calcareous	10'	365'	375'
21.	Sandstone, light gray, very fine grained, angular, well sorted, micaceous	10'	375'	385'
22.	Siltstone, to shale, light pinkish gray, non-calcareous, soft, micaceous	32'	385'	417'
23.	Sandstone, pinkish gray, very fine grained, micaceous, well sorted	3'	417'	420'
24.	Siltstone to shale, light pinkish gray, soft, micaceous	5'	420'	425'
25.	Sandstone, pinkish gray, to siltstone, very fine grained, shaly	15'	425'	440'

cont.

BOYDEN CITY WELL

DRILLER'S LOG
1937

	Thick	From	To
Yellow clay	196'	0'	196'
Blue clay	109'	196'	305'
Gray sand and water	50'	305'	355'
Sandstone	5'	355'	360'
Shale	5'	360'	365'
Sandstone	3'	365'	368'
Shale	12'	368'	380'
Sandstone	4'	380'	384'
Shale	51'	384'	435'
Dakota sandstone	65'	435'	500'

IOWA GEOLOGICAL SURVEY
Generalized Log Based on Detailed
Description of Drill Cuttings

PRELIMINARY

Name of Well: Boyden City Well Survey No. W-_____

Drilled by: Rasmussen Bros. Sioux City Date Dec., 1936

Total Depth: 500 ft; Curb Elevation: 1413 ft; Static Level: _____ ft.

Casing Data: _____

Pump and Screen Data: _____

Pumping Test: ____ Hours ____ Min; Gal. Per Min. _____; Drawdown ____ ft. in _____ min.

Description of Formations

No.	Rock Unit	Thick.	From (Feet)	To
	PLEISTOCENE SYSTEM			
1.	Glacial clay--yellow and light to dark gray, calcareous, with sand and small gravel pebbles	305	0	305
2.	Sand--gray, medium grained, angular	32	305	337
3.	Gravel and sand	13	337	350
	CRETACEOUS SYSTEM			
	Upper Dakota Formation			
4.	Shale - gray, fine textured, non-calcareous	5	350	355
5.	Sandstone - fine to medium grained, angular, well sorted, micaceous	10	355	365
6.	Siltstone - medium gray, coarse textured, non-calcareous	15	365	380
7.	Sandstone - medium gray, very fine grained, angular, well sorted, micaceous, silty	5	380	385
8.	Siltstone - medium gray, coarse textured	10	385	395
9.	Shale - medium gray, honogeneous, non-calcareous	15	395	410
10.	Siltstone - medium gray, coarse textured	30	410	440
11.	Sandstone - light gray, fine grained, well sorted, angular, micaceous	30	440	470
12.	Sandstone - buff, medium grained, angular, well sorted	10	470	480
13.	Sandstone - buff, fine grained, well sorted, angular, slightly micaceous	20	480	500 T.D.

Notes:

Drillers Log
Boyden City Well
1937

	Thick	From To
Yellow clay	196'	0' 196'
Blue clay	109'	196' - 305'
Gray sand and water	50'	305' - 355'
Sandstone	5'	355' - 360'
Shale	5'	360' - 365'
Sandstone	3'	365' - 368'
Shale	12'	368' - 380'
Sandstone	4'	380' - 384'
Shale	51'	384' - 435'
Dakota ss	65'	435 - 500'

1 Copy to E.C. Reimon, Councilman, Hull, Ia 2/15/39

Dr. Hinman reported this analysis this morning. 1/28/37

IOWA GEOLOGICAL SURVEY
PRELIMINARY
Water Analysis Report

County Sioux Date Sampled January 21, 1937

Town Boyden: Sampled by H. G. Hershey

Location of Well: ~~SE SW~~ SE ¼, SW ¼, Sec. 26, T. 97 N., R. 44 W.

West side of Boyden, South of tracks.

Owner City of Boyden Well No. ____; ~~T. D.~~ Drlg. 500 ft.

Type of Well Drilled Curb Elevation 1416 ft.

Producing Formation(s) Upper Dakota Ss Depth range 435-500 ft.

Remarks on Condition of Well, Casing or Formations 8" casing 0' to 367'; 6" casing 0' to 443'; 4½" pipe, 443' 7" to 500' perforated in Ss.

Constituents	Parts Per Million	Constituents	Parts Per Million
Total Solids	2329.0	Magnesium (Mg)	91.8
Dissolved Solids	---	Iron(Fe)(unfiltered)	2.0
Insoluble Matter	80.0	Iron(Fe)(filtered)	---
pH	6.9	Manganese (Mn)	---
Alkalinity (Me6)	304.0	Aluminum (Al)	---
Alkalinity (phn)	0.0	Fluorine (F)	1.0
R_2O_3	6.0	Chlorine (Cl)	50.0
Nitrogen as Ammonia(NH_4)	---	Sulphate (SO_4)	1171.6
Nitrogen as Nitrite(NO_2)	0.0	Bicarbonate (HCO_3)	370.9
Nitrogen as Nitrate(NO_3)	0.0	Phosphate (PO_4)	---
Alkalies as Sodium(Na)	178.6	Borate (BO_3)	---
Calcium (Ca)	285.8	Calculated Hardness	1095.0 = 64 grains

Temperature: Water 52.5 °F, Air -11 °F, Measured ~~at~~ in 3" pipe, 8 ft. from well.

Remarks:

Analysis by State Water Analysis Laboratory, Dr. J. J. Hinman Jr., Director, Iowa City, Iowa. Lab.No. 110.026, Date Jan. 28, 1937

Sent to:
Date:

097-44W-26 CDD
KDD

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Boyden Town 1937
W-0487

Water Quality
(ppm)

Card Q

State: Iowa (1 2) 16 County: Sioux (3 4) 84 Town: Boyden

Well No. Latitude 43 11 3 N (5–11) Longitude 096 00 37 (12–18) Seq. No. 1 (19) Date M 02 D 13 Y 37 (20–25)

Sampling Depth 500 (26–29) Type 1 (30) Kx10⁶ (31–35) pH 6.9 (36–38) Temp. °F 53 (39–41)

SiO_2 (42–44) Ca 286 (45–49) Mg 92 (50–53) Na 186 (54–58) K .6 (59–61)

HCO_3 371 (62–65) CO_3 0 (66–67) SO_4 1700 (68–72) Cl 50 (73–78) Source No. 3 (79) 9 (80)

Card R

Duplicate Columns 1-25 from Card Q

F 1.0 (26–28) NO_3 ~~.0~~ (29–32) PO_4 (33–35) B (36–38) Al (39–41) Fe 2.0 (42–45)

Mn ~~.0~~08 (46–49) Cu (50–52) Pb (53–54) Zn (55–57)

Solids Determined 2390 (58–63) Calc. (64–69) Hardness Ca,Mg 1100 (70–73) Non-Carb. 791 (74–77)

Color (78–79) No. R (80)

Card S

Duplicate Columns 1-25 from Card Q

Br (26–28) I (29–31) Alk. as $CaCO_3$ 304 (32–35) Free CO_2 (36–38) SAR (39–41)

RSC (42–44) ABS (45–47) (48–50)

Alpha (pc/l) (55–57) Beta (pc/l) (58–60) Ra (pc/l) (61–63) U (ug/l) (64–66)

No. S (80)

Verified PMJ

Recorded by: P.J. Horick

Punched by: Punched FCH Date:

Published:

097-44W-26CDD
KDD

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Boyden Town (1937)
W-0487

Water Quality
(ppm)

Card Q

State: Iowa [16] (1 2) County: Sioux [84] (3 4) Town: Boyden

Well No. Latitude [43 1 3 N] (5–11) Longitude [096 03 7] (12–18) Seq. No. [1] (19) Date M D Y [02 7 59] (20–25)

Sampling Depth [500] (26–29) Type [1] (30) Kx10^6 [2310] (31–35) pH [7.4] (36–38) Temp. °F [61] (39–41)

SiO_2 [10.] (42–44) Ca [324.] (45–49) Mg [99.] (50–53) Na [194.] (54–58) K [1.8] (59–61)

HCO_3 [393] (62–65) CO_3 [0] (66 67) SO_4 [1200.] (68–72) Cl [50.] (73–78) Source No. [3] [Q] (79 80)

Card R

Duplicate Columns 1-25 from Card Q

F [0.7] (26–28) NO_3 [22.] (29–32) PO_4 [.] (33–35) B [.] (36–38) Al [.] (39–41) Fe [1.4] (42–45)

Mn [0.45] (46–49) Cu [.] (50–52) Pb [.] (53 54) Zn [.] (55–57)

Solids Determined [2400] (58–63) Calc. [ ] (64–69) Hardness Ca,Mg [1220] (70–73) Non-Carb. [898] (74–77)

Color [ ] (78 79) No. [R] (80)

Card S

Duplicate Columns 1-25 from Card Q

Br [.] (26–28) I [.] (29–31) Alk. as $CaCO_3$ [322] (32–35) Free CO_2 [ ] (36–38) SAR [ ] (39–41)

RSC [ ] (42–44) ABS [.] (45–47) [.] (48–50) [ ]

Alpha (pc/l) [ ] (55–57) Beta (pc/l) [ ] (58–60) Ra (pc/l) [.] (61–63) U (ug/l) [.] (64–66)

No. [S] (80)

Verified PMJ

Recorded by: P.T. Horick

Punched by: Punched PCH Date:

Published:

Carl A. Moore,
Geology 209,
Jan. 14, 1937.

W-0487

Well in Sioux County, Iowa.
Boyden

Sample number	1	2	3	4
Depth of sample in feet	400-405′	405-410′	410-415′	415-420′
Ognl wt. sample	23.1g	25.6g	22.6g	27.5g
Wt. filter paper + residue (over 1/32)	8.6g	8.0g	10.4g	15.9g
Wt. filter paper (over 1/32)	2.5g	2.3g	2.3g	2.3g
* Wt. residue (over 1/32)	6.1g	5.7g	8.1g	13.6g
Wt. filter paper + residue (1/32-1/64)	6.4g	6.5g	5.8g	5.7g
Wt. filter paper (1/32-1/64)	2.3g	2.4g	2.5g	2.2g
* Wt. residue (1/32-1/64)	4.1g	4.1g	3.3g	3.5g
Wt. material at (1/64-under) by substraction	12.9g	15.8g	11.4g	10.4g
** Totals	23.1g	25.6g	22.6g	27.5g

No reaction with dilute HCl acid.

Size grade distribution

Sample number	1	2	3	4
over 2	2.00g	0.50g	0.62g	tr.
2 - 1	0.50g	0.93g	0.29g	0.10g
1 - 1/2	0.12g	0.37g	0.19g	0.19g
1/2 - 1/4	0.11g	0.11g	0.12g	0.35g
1/4 - 1/8	0.33g	0.17g	0.10g	0.31g
1/8 - 1/16	0.82g	0.98g	1.23g	4.82g
1/16 - 1/32	2.22g	2.64g	5.55g	7.83g
1/32 - 1/64	4.05g	4.10g	3.30g	3.50g
1/64 -under	12.90g	15.80g	11.40g	10.40g
Totals	23.10g	25.60g	22.60g	27.50g
over 2	8.1 %	1.9 %	2.6 %	
2 - 1	2.3	3.6	1.2	0.4 %
1 - 1/2	0.5	1.5	0.7	0.7
1/2 - 1/4	0.5	0.4	0.5	1.3
1/4 - 1/8	1.4	0.7	0.4	1.1
1/8 - 1/16	3.6	3.8	5.2	17.5
1/16 - 1/32	9.7	10.5	24.5	28.5
1/32 - 1/64	17.5 27.2	15.9 26.4	14.5 39.0	12.7 41.2
1/64 -under	56.4	61.7	50.4	37.8
Totals	100.0 %	100.0 %	100.0 %	100.0 %

SPECIFICATIONS FOR DRILLING, CASING, DEVELOPING AND TESTING WELL at BOYDEN, IOWA

Sioux Co

1. GENERAL

1. PARTIES.
Where the words "Well Contractor" or "Contractor" are used, they shall mean the party, firm or corporation who has agreed to furnish material and equipment, and to perform the skilled and common labor as contemplated by these specifications. Where the word "Owner" is used, it refers to the City of Boyden for whom the work contemplated is to be done. Wherever the word "Supervisor" is used in these specifications, it shall mean the person designated as the duly authorized representative of the City of Boyden and who is authorized to act for the Owner and is responsible to the Council of the City of Boyden.

2. THE CONTRACT.
The specifications, including the detailed statement of pre-drilling log, casing, sealing, cementing recommendations, and pumping tests, and proposal shall constitute a part of the contract and shall govern the construction and completion of the well. A complete set of this material will be furnished each bidder.

3. TERMS OF PAYMENT.
Payments will be made by the Owner on the basis of fifty (50) per cent of the contract cost of the actual number of feet drilled, or contract cost of cementing or pumping, or other contracted work as determined at the end of the 25th day of each calendar month. The balance of fifty (50) per cent will be paid upon completion and acceptance of the well and after the statutory period of thirty (30) days provided by law. All payments will be made by issue of check or warrant upon the filing and approval of proper vouchers and receipts therefor.

4. INSURANCE.
The Contractor shall provide ample and adequate Public Liability and Workmen's Compensation Insurance, which will protect the Owner against any claims or damages.

5. STANDARDS OF EQUIPMENT AND MATERIALS.
(a) The materials herein specified shall be furnished in accordance with the standards of the American Petroleum Institute (A.P.I.) unless otherwise specified herein or in writing upon agreement between the Owner and Contractor.

(b) The Contractor shall submit as a part of his bid, a statement of type, physical condition and age of drilling rig, and all equipment, and kind and capacity of power to be used on the job, and where and when the articles can be inspected if desired by the Owner before the letting of the contract.

(c) The Contractor shall describe as a part of his bid, the method to be used for making water shut-off, cementing water zones, and casing and for making lead seals.

6. LABOR.
(a) The Contractor shall state in his bid the amount and kind of labor included in determining the price for each item. The Contractor agrees that this labor will be experienced in the type of work to be done.

(b) The Contractor shall protect the Owner by bond against claims, liens or suits for wages or other contracted labor costs.

7. PATENTS.
The Contractor shall be responsible and liable for all infringements of patent right by the use of patented or proprietory materials, devices, processes or equipment necessary for the requirements of this contract, and is to indemnify and save harmless the Owner from all claims, damages or expenses by the use thereof and all fees and royalties are included in the price bid by the Contractor for the work done under these specifications.

8. TIME FACTORS.
The Contractor shall commence operations on the drilling site not later than the fifteenth (15) day after receiving notice of the award of contract. Construction work shall proceed daily, except Sunday or legal holidays, from the start to completion without interruption or delay, except as ordered by the Owner, or due to causes beyond the control of Contractor with the exercise of reasonable care and proficiency of workmanship.

9. SURETY BOND.
The Contractor on acceptance of his bid shall provide and pay cost of a bond in the sum of one hundred (100) per cent of the estimated cost of the well, based on the unit prices set forth in the contract.

10. ACCEPTANCE OR REJECTION OF BIDS.
The Owner reserves the right to reject any or all bids or to accept any bid which may be deemed most advantageous from all points of consideration. Bids shall be submitted on forms provided therefor, and are to be filed without alteration or in a different manner than called for by the specifications.

II. SCOPE OF CONTRACT

11. WORK AND MATERIALS INCLUDED.
(a) The work under this contract shall include furnishing and transporting all equipment, tools, materials, temporary and permanent casing, coupling, shoes, drive heads, pumping equipment, etc., required for the drilling, casing, testing and proper finishing of a well of the dimensions in accordance with the drawings and specifications, except as hereinafter specified.

(b) The actual setting up, drilling, sealing, casing, cementing, and making pumping tests and other work in the construction of a well as specified.

(c) The Contractor shall have an experienced foreman or driller at the well site in charge at all times and every effort shall be made to complete the well in as short a time as possible, but without sacrificing good workmanship. Instructions given by the Owner to the Contractor's foreman or driller shall be considered as having been given to the Contractor.

(d) The Contractor shall provide for and pay for all installation and transportation of fuel, electricity, steam, compressed air or other forms of power and light for all parts of the construction, testing, and equipping of the well as required in the contract.

(e) Water will be furnished by the Owner, but storage tanks, pipe lines and fittings will be furnished and installed by the Contractor. (See II-12(a)).

(f) The Owner shall provide for the clearing of the site and making it accessible for drilling equipment and for storage of casing and tools. (See II-12(c)).

(g) The Contractor shall maintain a sluice box with high sides and approximately six feet long to direct the bailings to pit or ditch. A pit shall be constructed by the Contractor to catch water and bailings if surface drainage is not adequate.

(h) Samples and Records. At least one week before starting to drill the well, the Contractor shall send a written request to A. C. Tester, Assistant State Geologist, Iowa City, Iowa, for sample sacks, driller's record book and instructions for the collecting and handling of drill cuttings. The Contractor shall save a sample of cuttings from every five (5) feet and place same in sacks properly labelled. These cuttings shall be taken from the bailer and not from the sluice box or pit. The Contractor shall note in the drill record book the amount and depth of any openings or soft or broken ground encountered, and the depth at which water is encountered, the static water level and any changes in water level during the drilling operation.

(i) The sacks containing the cuttings shall be sent to the Iowa Geological Survey at Iowa City ~~each day~~ until all the casing has been set, and during the drilling of the Dakota sandstone or other water producing beds. These cuttings shall be examined by the Assistant State Geologist or his assistants. On the completion of the well the Contractor shall forward to the Iowa Geological Survey all samples not previously submitted and the driller's record book.

(j) The Contractor shall install pumping equipment with acceptable measuring devices and operate a pump for the time desired of not less than the gallons per minute capacity specified in the requisition, when requested by the Owner.

(k) The Contractor shall provide under-reaming equipment and perform the work when required by the circumstances of the formations or for cementing purposes. When permanent casing is in the hole, the contractor shall pull the casing so that the bottom of the casing will be at least ten (10) feet above the top of the under-reaming tools.

(l) The Contractor shall provide and operate a steel measuring line marked in feet, of sufficient length to measure the total depth to be drilled. The line shall be equipped with sinker weights and mounted on a reel to permit proper measurements. Measurements of depth shall be made at the beginning and end of each day, at the position of each water producing zone, at the bottom of each size of hole, at the total depth of the hole, and as requested by the owner. All depth measurements shall be related to the existing ground surface.

(m) The Contractor shall provide a steel tape for the measurement of casing. All casing shall be measured and marked for the verification by the Supervisor.

(n) The Contractor shall install all necessary permanent tubes, screens, or other devices needed to make the well ready for installation of permanent pump machinery. (See II-12(e)).

(o) The Contractor shall perforate the casing to permit entrance of water at zones shown on diagrammatic log or as directed by Geologist.

(p) The Contractor shall provide shelter as needed for workmen, machinery, equipment, and tools.

(q) The Contractor shall report in writing to the Supervisor at the end of each day the nature of the work done, the depth and size of hole, the water level, the kind of formation, and the depth of casing. Notice of water shut-off tests or pumping tests shall be given the Owner in sufficient time to arrange for supervision and observation of such tests.

12. WORK AND MATERIALS NOT INCLUDED.

(a) Water will be furnished by the Owner. (See II-11(e)).

(b) Elevation of well curb, water analyses, and geological information determination will be furnished by the Owner and will be available for the records of the Contractor.

(c) The Owner shall clear the site, maintain entrance roads and provide storage space for tools. (See II-11(f)).

(d) The Owner or others will provide permanent pumping equipment, tubes and screen to be specified later. (See II-11(n)).

III. LOCATION

13. The location of the well shall be at the site near the present standpipe in the north part of the town of Boyden, Sioux County, Iowa.

14. The Contractor shall familiarize himself with the location of the well and the conditions affecting the proposed work. No additional allowance will be granted because of lack of knowledge of such conditions.

15. DEPTH.
The information furnished by A. C. Tester, of the Iowa Geological Survey, indicates that the well will be finished in the formation and at an approximate depth as described elsewhere, although the work may be stopped at a shallower depth or continued to a greater depth upon written order of the Owner.

16. WELL CASING.
All casing used in the well shall be as shown in detailed specifications with a suitable steel shoe to prevent damage to the casing. The weights and sizes of casing are shown elsewhere.

17. REDUCTIONS IN CASING DIAMETERS.
Based on the information at hand, it is anticipated that the casing diameter will be reduced as described elsewhere. (Division IV.) In each case, it is desired that the diameter size shall be reduced as little as possible. In any event it is desired to finish the well in the Dakota formation at an approximate depth and with a hole not smaller than described in details of well. The Contractor may start the well at the surface with any diameter of pipe he may desire to use in order to assure sinking the well to the anticipated depth with the desired specified diameter, if approved by the Owner.

18. SEALING CASINGS.
Each line of casing shall be seated securely into the formation into which it is stopped with sufficient tightness to provide an effective seal against the infiltration of water, sand, silt or other similar materials from overlying formations; and a suitable, durable, effective seal shall be provided between each reduced size of pipe or casing and the next larger size. When such larger diameter casing or casings are not removed the smaller casing inserted inside of the larger casing may be cut off at a point which will provide an overlap of not less than 18 feet. When such larger temporary size or sizes of pipe or casing are removed the space between the wall of the hole and the permanent pipe or casing shall be sealed effectually with cement. The approved method of cementing requires that the cement be forced under pressure up and behind the casing at least fifteen (15) feet. The approved method for sealing between two sizes of casing is a lead packer of not less than three (3) feet long tightly swedged in place. After the cement is hard or lead seal is set a

water shut-off test shall be made by bailing the hole dry and allowing to set for twenty-four (24) hours to be followed by a bailing test and measure of water level. If water is in the hole the process of bailing dry and standing by for twenty-four hours and testings shall be repeated. If water is present after the second test, then the casing must be pulled and recemented or resealed, and again tested.

18. ALINEMENT.

It is intended that a pump with a casing as large as is practicable shall be admitted in that part of the borehole which is above the low water level, which pump may be lowered to any point below the low water level down to the bottom of the size of the hole at that point and before the well shall be accepted, the Contractor shall demonstrate that the alinement and bore of this hole is sufficiently straight and concentric to accomodate said pump.

The well shall be drilled straight and plumb and the Contractor shall be required to give a written guarantee that he does not deviate from a straight and plumb line by an amount sufficient to interfere with the successful operation of a commercial type centrifugal or turbine deep-well pump of the largest size designed for the size of casing in which said pump may be installed.

In order that this fact may be demonstrated, the Contractor shall at his own expense make the following tests:

A dummy shall be constructed, 40 feet in length, with three rings each ring 12 inches wide and five-eighths (5/8) inch smaller than the I.D. size of the casing. The rings shall be truly cylindrical and shall be spaced one at each end of the dummy and one ring in the center thereof. The spokes of the rings shall be at right angles to the vertical axis of the dummy. This dummy shall be lowered into the well and shall move freely without binding, to a sufficient depth required for pumping equipment. Should the dummy fail to move freely throughout this entire length, the alinement of the well shall be corrected by the Contractor at his own expense or should he fail to correct the alinement a new well shall be constructed by the Contractor at his own expense at a point to be designated by the Owner.

20. PUMPING TESTS.

At the completion of the well, the Contractor shall pump the well until a stabilized head shall be reached and thereafter for at least eighteen (18) hours. At least eight (8) hours shall be continuous pumping. Equipment used in such test shall meet the approval of the Owner and be of such nature as to determine the drawdown at various pumping rates or discharges. A pressure guage or electric circuit shall be used to determine the drawdown and rate of recovery. Pumping for development and during the construction of the well is not to be considered a part of the test.

21. INTERMEDIATE OR ADDITIONAL TESTS.

At any time required by the Owner, the Contractor shall suspend drilling operations to permit a test to be made of the well, should there be indications of a satisfactory water supply, provided that such test or tests can be made without endangering further drilling

operations or incur the expense of a permanent screen. Such test or tests shall be made by the Contractor under the same conditions as specified in Division II, Section 11 - (j), and as recommended by the Owner. The Contractor shall be remunerated for making such tests on a basis of the definite sum stipulated in the proposal or bidding form for all equipment and labor.

22. GUARANTY.

The Contractor shall guarantee to furnish the materials and equipment and to perform the work in a skilled workmanlike manner using first class standard methods required for the drilling, casing and finishing of the well in strict accordance with these specifications. The Contractor further guarantees to obtain the available water from the vein or veins which are expected to furnish the supply. Such supply shall be free from all contamination by other waters and safe from pollution from surface drainage, unless such contamination or pollution results unavoidably from causes entirely apart from the Contractor's materials or workmanship.

23. SANITARY REQUIREMENTS.

Without additional charge, the Contractor shall sterilize the water after all construction is completed and just before the pump is set in its permanent place, ordinary chlorinated lime may be used, which contains about 25% available chlorine. For each 150 feet of water in well one pound of lime compound shall be used. Enough water should be added to contents of the can to make a thick paste, being careful to break up all lumps in the material. This paste should then be added to three to five gallons of water and thoroughly mixed for ten or fifteen minutes, after which the solution should be allowed to settle. The clear supernatant liquid should then be decanted and poured directly into the well. This solution should remain in the well for a period of several hours, after which it may be pumped out. The dosage of chlorine is heavy, and as a result, the well should be thoroughly pumped before an attempt is made to use the water. There is practically no danger from the use of this solution, because long before the concentration of chlorine becomes heavy enough to cause injury, the taste will be so obnoxious that persons or animals will not drink the water. Even after pumping the well, a chlorinous taste might persist a few days, but will gradually disappear. Samples of water for bacteriological analysis should not be submitted for three (3) or four (4) days after the well has been chlorinated, giving the residual chlorine an opportunity to dissipate before sampling.

24. PENALTIES.

The Contractor shall be paid a fixed hourly rate for delays caused by the Owner or not within the control of the Contractor. The Owner shall deduct from the final payment a similar penalty based on the same hourly rate for delays caused by the Contractor, such as lack of proper tools, to continue the work or to carry it forward with practical efficiency and speed, delay in making repairs or getting new tools on the job or not having pumping equipment available when needed, or unwarranted shut-down of work.

IV

DETAILS OF WELL

25. DEPTH.

Starting from a surface elevation of approximately 1430 feet above sea level, the Dakota sandstone should be reached at a depth of about 500 feet. The second Dakota sandstone may be expected at a depth of approximately 120 feet lower and should have a thickness of approximately 30 feet, making the total depth 650 feet. If the first or upper Dakota sandstone has a sufficient quantity of good quality of water, the well should be stopped with a total depth of approximately 550 feet.

26. SIZE OF HOLE.

The hole should be started at least 10 inches diameter to permit the setting of temporary casing to shut off surface water. Below the temporary pipe the hole should be drilled to accommodate the 8-inch casing as hereinafter specified, and such drilling should be continued so that the 8-inch pipe can be set in the shale formation at approximately 375 to 400 feet. The shale zone will contain some limestone bands at about 380 to 390 feet depth which should serve as a good seat for the 8-inch casing. The size of hole should be reduced after the setting of the 8-inch casing to a size sufficient to accommodate a 6-inch casing of the dimensions hereinafter specified which will be set at the top of the producing sandstone formation. Below the base of the 6-inch casing and extending to at least 1 foot below the base of the producing sandstone a 4½-inch perforated casing shall be set and sealed. The 4½-inch casing shall overlap inside of the 6-inch casing at least 6 feet and sealed with lead seal properly swedged. The 6-inch casing shall overlap inside of the 8-inch casing at least 18 feet and sealed as hereinafter specified.

27. FORMATIONS.

The upper formations of the locality will consist of the top soil and sandy clay material for a few feet and then encounter the normal glacial deposit, consisting of yellow clay, intervening beds of sand and gravel of variable thickness and composition, blue clay, some silt and clay mixed, and a bed of sand and gravel at the base of the glacial drift, all having a total thickness of approximately 275-300 feet. Below the glacial drift the formations will be dominantly a gray and chalky mixed shale with streaks of limestone at about 380 feet. At about 500 feet depth a fine sandstone may be expected. In the shale member between the base of the glacial drift and the top of the Dakota sandstone there may be numerous beds of fine sandstone, some of which may be moderately hard and others sufficiently porous to yield some water. Such sandstone water beds and the water of the glacial sands and gravel must be completely shut off as they are known to contain water of poor quality, and in no case should such water be permitted to enter the completed well.

28. CASING.

For the 8-inch casing mentioned above the following specifications shall prevail:

(a) Extra strong black ~~galvanized~~ pipe, 8-inch nominal size, 8 5/8 inch external diameter, 7 5/8 inch internal diameter, weight per foot plain end 43.388 pounds, thickness .50 inches, 8 threads per inch, 3/4 inch taper per foot, or

(b) Seamless steel A.P.I. 8 5/8 inch casing, internal diameter 7.651 inches, weight per foot threaded and coupled 43 pounds, thickness .487 inches, 8 threads per inch, 3/4 inch taper per foot, grade C.

For the 6-inch casing or pipe mentioned above, it shall be:

(a) External diameter 6 5/8 inches (coupling 7.48 inches), internal diameter 5.761 inches, thickness .432 inches, 8 threads per inch, 3/4 inch taper per foot, weight 28.573 pounds per foot plain end, or

(b) Seamless steel A.P.I. standard 6.5/8 inch external diameter, 5.791 internal diameter, coupling 7.39 inches, weight per foot threaded and coupled 28 pounds, 10 threads per inch, 3/8 inch taper per foot.

For the pefforated 4½inch nominal pipe, a standard heavy weight pipe may be used.

SHOES

The 8 and 6-inch nominal size casing shall be provided with a shoe or proper protection against damage to the bottom of the pipe during drilling or driving through bouldery and limestone formations. The standard shoes for this purpose should be used.

29. SCREEN OR PERFORATION.

The standard pipe of proper length of 4½-inch nominal external diameter shall be set in the producing zone of the Dakota sandstone. This pipe shall be perforated with 1/4 inch holes set 2 inches center to center in the vertical and approximately 1½ inch center to center in the horizontal.

30. SEALS.

The 8-inch casing or pipe shall be set and tested for proper water shut-off. If the pipe is set tightly in shale and shows a satisfactory test, it will not be necessary to cement. However, if the pipe is loose and there is leakage of water or rock material then a neat mixture of high grade quick setting cement shall be pumped into and forced behind the casing as hereinbefore specified. For such a concrete seal the cement must form a tight ring for a distance at least 15 feet above the base of the casing. After the cement has been set and the pipe tapped in place, the operations in the well shall be suspended for not less than 60 hours to permit a solid setting of the cement, before testing water shut-off.

The 6-inch pipe shall be set tightly in the shale overlying the producing sandstone in such a manner to produce a tight seal without the necessity of cementing. This can be done by tapering the hole just above the producing formation.

An overlap of at least 18 feet shall be allowed between the 8 and 6-inch casing and this interval sealed with 2 lead packers of at least 3 feet length properly swedged in place so as to make a complete water shut-off between the 2 pipes.

The overlap between the 4½-inch perforated pipe and the 6-inch casing shall be sealed with a lead seal properly swedged at least 3 feet long.

31. PRODUCTION.

It is expected that the static water level will be approximately 225 feet below the ground level, and at a production of 100 gallons per minute the drawdown will be 100 feet to approximately 325 feet below ground level. The test pump shall have a setting to permit pumping from a level at least 325 feet below the surface and shall be of sufficient capacity to produce 100 gallons per minute at the maximum drawdown.

The equipment shall include an air gauge or electrical circuit for measuring drawdown or pumping water level at any and all times during the operation. Proper meters or gauges or storage tanks of sufficient size shall be provided to measure the output of the pump.

The pump shall be operated for a minimum of 18 hours during the final testing period of which the eight hours at the end of the period shall be continuous pumping. During the early stages of the test, the well should be pumped 4 to 5 hours continuously and then for several short intervals with periods of shut-down during which the recovery of water levels will be carefully measured.

32. FINISH AT TOP.

The top of the well shall be finished in a manner to seal out all surface water and to exclude any movement of water on the outside of the 8-inch casing. If a temporary 10 inch or larger pipe is used in the upper beds, then the annular space between the outside of the 8 inch and the temporary pipe and the annular space between the outside of the 8-inch casing and the drilled hole shall be filled with cement grouting. The grouting shall consist of high grade, quick setting cement mixed in proportions of not more than 1 part of medium fine, sharp plaster sand to 1 part of quick setting cement. This mixture shall be introduced into the space outside of the 8-inch casing by pressure pumps, so that it will be directed into and fill the space along which water can seep. This grouting shall come to the base of the frost line approximately 5 feet below the normal ground surface or 5 feet below the proposed floor of the permanent pump house. The cement and sand will be furnished by the city separate from this contract, but the work will be done by the Contractor under this contract.

In the space above the top of the cement grouting which shall be approximately 5 feet below the ground surface or the permanent pump house floor, the annular space outside of the 8-inch casing shall be filled with plastic asphaltum similar to that used for foundation grouting. This material will not crack or break under frost conditions but will seal the open spaces against percolation of water. This material shall be set by the Contractor to the level prescribed by the Owner as the base of the permanent pump house floor. The asphaltum will be furnished by the city separate from this contract, but the work will be done by the Contractor under this contract.

The 8-inch pipe shall extend above the normal ground level, the necessary heighth to provide grading and fill as prescribed by the State Board of Health in the plans for the permanent pump house. In order that there be sufficient pipe available for such construction, not less than 42 inches of the original pipe without joints shall be left by the Contractor.

33. PERMANENT PUMP.

Permanent pump, drop pipe, air gauge, and other necessary equipment will be purchased by the Owner on separate contract.

17) 338 (19
17
168
153
150

~~Following are phone conversation~~ late ~~last night I went to the Postoffice~~ postmarked Friday this

Your letter of February second, came to my attention this morning. Regardless of ~~why~~ what you made the decision ~~why you~~ to finish the well at 500 feet and ignoring all of the contributing factors and human elements I want to make one more plea that you abandon your present plan and return to the original idea to drill the well to the lower Dakota sandstone at approximately 650 feet. I believe your present plan is ~~not the best~~ a very costly and unfortunate one.

1. The chemical quality of the water is poor.
   a) The hardness of approximately 64 grains per U.S. gallon is over three times the hardness of your present supply.
   b) The iron content of 2.0 ppm will cause pronounced red-brown staining of bathroom fixtures and coloring of enamel, porcelain or glassware. Also as the water mains and supply pipes become coated with the iron oxide precipitate after a year or two the water drawn from such pipes will have an orange to reddish-brown color. Boyden will become another red water town.
   c) The calcium sulphate or gypsum precipitate will become a hazard to boilers, hot water storage tanks, and hot water pipes or heating systems.
   d) The high magnesium and sulphate content indicates the prominence of the compound of magnesium sulphate or Epsom salts. An excessive amount of such salts is objectionable in a city water supply

2. The construction of the well should carry the six inch casing to the top of the lower sandstone. That is a full size six inch hole should be drilled through the producing sand. A hole of 4½ inch diameter is too small for the capacity you require. This should be done even though it might require reaming.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

January 16, 1937.

Dr. A. C. Tester, Asst. State Geologist
Iowa City, Iowa.

Dear Mr. Tester:

Upon receipt of your letter of January 13th we showed same to Howard Rasmussen and instead of completing the cutting of the six inch casing, a test of the well will be made and water sample submitted for analysis.

I am sorry that you did not call us when you received our letter of the 11th and 12th wherein I mentioned cutting of pipe. Probably Howard was a bit hasty about cutting but he felt that this was the sandstone we were looking for and has been trying to get the pipe cut during the past week. He broke two or three cutters and when we received your letter of the 13th he was about two-thirds thro the casing. He felt he could make a better test of the well with a pump in the 8-inch casing than with a smaller pump. After talking it over with council members, we will make a test of the well before cutting the six inch casing. Howard reported today that he had the cutters out of the well and that he would bring a pump with him Monday and that they should be ready to test about Tuesday noon.

After you receive the sample of water, how long will it be before you will know the quality of the water. I presume the drillers will have to wait until we receive such report before continuing work on the well.

2-3 days ±

Yours very truly,

Clerk.

January 13, 1937

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Thank you for your letters of January 11 and 12. I am sorry to learn that Rasmussen Brothers have had some difficulty in setting the pipe in the new well, but am glad that there has not been any delay occasioned by my inability to be in Boyden in the middle of the week. After giving further consideration to your problem, I have decided that I will withhold making a trip to Boyden until the results of the pumping test and water analysis are known. In other words, I will ask you and the Council to forward me the complete information on the capacity test and static water level, drawdown and recovery of the well, and a proper sample of the water. I outlined the method for obtaining the water sample in my letter to you of January 5. I hope that you will find it possible to see to it personally that the water sample is taken and shipped according to my instructions.

The work which Rasmussens are doing mentioned in your letter of the 11th relating to the cutting of pipe is not clear. I hope that they are not proceeding with the operations in the well on the basis that the well is to be completed at its present depth. In other words, the sandstone formation at the bottom of the well at the present time is not that which I forecasted in my general report and specifications for the project. This sand represents the Upper Dakota member and may carry mineralized water. Therefore, you should be cautious in doing any work that might constitute a final setting of pipe, as I now contemplate that deeper drilling

PAUL T. McCRUM
Mayor

S. G. VANDEN BRINK
Town Clerk

A. B. VANDEN BRINK
Town Treasurer

TOWN OF BOYDEN
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JOHN VANDER HAAR

January 12, 1937

Dr. A. C. Tester
103 Geology Building,
Iowa City, Iowa.

Dear Mr. Tester:

Howard Rasmussen was in this afternoon and stated they broke another cutter so testing would be delayed, and if they had good luck they might be able to test by Thursday afternoon or Friday morning. It begins to look as tho the testing will be delayed until the end of the week without special arrangements.

Yours very truly,

Town Clerk.

January 8, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Your letter of January 7 came in the afternoon mail following the telegram which I sent earlier in the morning. Since the letter answers the questions raised in the telegram, I will not be surprised if you do not make reply.

I would like very much to be present at the time of the pumping test and since the weather gives every indication of making conditions unfavorable for work for several days, I wonder if it would be possible to delay the pumping test to the last of the week of January 15 or 16. You mention that it would possibly be as late as the 13th before the work could be done even if it goes forward on the rapid schedule.

I will appreciate your letting me know by Tuesday, the 12th, concerning these plans.

Yours very truly,

A. C. Tester

ACT:A

PAUL T. McCRUM
Mayor

S. G. VANDEN BRINK
Town Clerk

A. B. VANDEN BRINK
Town Treasurer

TOWN OF BOYDEN
IOWA

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PAUL SCHREUDER
JOHN VANDER HAAR

January 7, 1937.
~~December~~

Dr. A. C. Tester,
103 Geology Building,
Iowa City, Iowa.

Dear Mr. Tester:

The bottles for submitting samples of water received this morning. Had a talk with Russel Rasmussen this morning and showed him your letter of January 5th. He stated that on account of the weather they have not been able to do much about testing here and does not expect to get ready for the test until next week Tuesday or Wednesday. If you are not able to be here at the time of testing, we will try to take care of water samples as per your instructions.

Yours very truly,

[signature]
Clerk.

January 5, 1937

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Two crates containing our regular one gallon bottles used for water samples for mineral analysis were sent to you by express collect this afternoon. One bottle can be used for a sample to be taken at the end of the pumping period developing the water from the zone below 450 feet depth. The second bottle will be available for a later pumping test for the lower sandstone formation, or I may pick it up prior to that time.

In taking the sample of water, please caution the man in charge to be extremely careful to rinse out the bottle with water taken from the stream of water to be sampled. The bottle has been cleaned, but should be thoroughly rinsed at least two times before catching the full bottle for the final sample. Be sure that the mouth of the bottle is clean, so that no dirt or mineral matter is introduced from the outside and that once the cork is placed it is not removed before the shipment is made by express. In other words, I am placing confidence in you that the water sample taken from the well will be exactly representative of that which is developed from the well and will be taken exactly as I would take it if it were possible for me to be there.

Please see that the sample is taken near the end of the pumping period. If the well is tested continuously for ten hours, then the sample should be taken near the end of that period and after the longest possible consecutive uninterrupted pumping. In other words, if the well is pumped for awhile one

day and then shut down and allowed to recover for a few hours and pumped again the following day, wait until the last day before the sample is taken. Take the sample from an outlet close to the pump or top of the well. In other words, eliminate any possible chance for the gathering of mineral matter from sources other than that actually contained in the producing formation. Please record the full information concerning the static water level before the pumping test is started, the exact amount of drawdown and the exact rate of pumping at the time the sample is taken. Also, please give a complete and exact statement concerning the setting of the pump and the casing. Rasmussen has a certified thermometer which he obtained from us. Please read the water temperature and air temperature at the time the water sample is taken.

I would like very much to be present at the time of this pumping test, and if it is possible to delay it until the 9th or 10th of January I can be there. Please let me know by wire exactly when the pumping test will be run.

Enclosed find a form which will include all of the information requested above. Please fill this in completely and return with the water sample.

Yours very truly,

A. C. Tester

ACT:A
Enc. 1

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

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December 31, 1936.

Dr. A. C. Tester,
Asst. State Geologist,
Iowa City, Iowa.

Dear Mr. Tester:

We are sending you several samples of cuttings and Howard Rasmussen states the following:

Well is now 490 feet deep. Struck the sandstone at 435. Last sample shows a bit of clay. He is preparing to pump test and expects to be ready about the middle of next week. Water is 235 feet from top.

We hope the well will now prove satisfactory and that water will show up very favorable. I presume that we should send in another sample of water after the well has been pumped some.

Yours very truly,

Clerk.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

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IOWA

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December 22, 1936

Rec'd Wednesday 12/23

Dr. A. C. Tester
Iowa City, Iowa.

Dear Mr. Tester:

Under sepaprate cover we are sending you samples of cuttings, numbers 50 to 54.

Mr. Rasmussen reports they are now down to 365 feet and the water level is now the same as in the upper strata from which we took samples as sent to you yesterday. He also reports that they are thro the sanstone as per samples 53 or 54 and are now in shale. It seems there was only about 4 or 5 feet of sandstone.

Mr. Pitstick just reported that the boys were down as far as they could get with the eight inch pipe and that they were going to drop to the six inch size.

Yours very truly,

S. G. Vanden Brink

Clerk.

S. G. Vanden Brink
Boyden — Samples to ~~fifty four~~ three sixty five feet in glacial sand stop Make every effort to get eight inch casing at least twenty feet in shale for purpose of absolute mineralized water shut off.

A. C. Tester

Charge 7.10
Phoned 12 5x dwl
12/24/36

December 22, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

The samples of well cuttings to 340 feet arrived this afternoon. The box which you sent last Friday did not arrive until Monday afternoon.

There is no question but that the sand the fine gravel is basal Nebraskan in age, which means that it is the lower part of the glacial drift. I feel confident that the water sample will show the same type of mineralization found in the water from the Wassink well 285 feet deep and the Doktor well, both southwest of Boyden and producing from the same formation. The Rensink well just north of town produces from a shallower sand of lower Kansan glacial drift, and likewise has a high degree of mineralization.

To make our record complete on the water samples which you sent, please determine from Mr. Rasmussen the exact depth of the 8-inch casing at the time of the sampling at 338 feet and the exact level of the water below the curb and the amount of lowering of the water level, if any, by the bailing process. I note your letter states that the bailer was run several times to the bottom of the well, and hence should establish a fresh flow of water which would not be diluted by the present city supply used for drilling purposes.

I will send you a preliminary analysis as soon as it is available, but I feel sure that you can proceed with the drilling and if necessary drive the

pipe through the sand and into the underlying shale formation. The presence of such a thick body of sand may make it difficult to carry the 8-inch casing very far below the base of the sand, but every attempt should be made to continue the 8-inch casing downward so there will be ample opportunity for a tight seal in the underlying shale beds.

I am very much pleased at your promptness in sending in the samples and certainly appreciate the way that Mr. Rasmussen and you people are cooperating on this project.

With best wishes for a Merry Christmas and prosperous New Year, I remain,

Yours very truly,

A. C. Tester

ACT:A

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

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H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

December 21, 1936.

Mr. A. C. Tester,
Iowa City, Iowa.

Dear Mr. Tester:

We are sending you today by prepaid express two samples of water together with a few cuttings.

Mr. Rasmussen states that water sample No. 1 was taken at a depth of 338 feet. Sample No. 2 taken after the slush bucket was run several times at same depth. This sample was caught in a pail, let stand a short time and then poured into jar.

Yours very truly,

Clerk

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

December 18, 1936.

Dr. A. C. Tester

Iowa Geological Survey,

Iowa City, Iowa.

Dear Mr. Tester:

Under separate cover we are sending you today, a few more samples of drill cuttings. Mr. Rasmussen stated when they got into the snad as per samples 43 and 44 the water raised 80 feet in the pipe. They are not thro this sand at this writing. They also stated that above two samples look the same as the cuttings from the Granville well. We are wondering if this is formation you mention in your specifications as the formation that will be found below the 300 foot level. If not and you feel that the water might be satisfactory and that you suggest a test of the well at this time, will you please call the Mayor or myself on the phone and reverse the charges. If it is the formation you refer to in your specifications (see #27) we presume it is the water you suggest being shut out.

We will be glad to hear from you,

Yours very truly,

Clerk.

20 samples 200'
24 x 5 = 120 120' ?
320'?

It is obvious from the few constituents noted above that the sample No. 2 taken from the drilling well shows a very good quality of water which is, however, radically different from other water of the territory from the same sand and gravel zone. After checking the facts and getting additional information from Mr. Howard Rasmussen, there is absolutely no question in my mind but that the water analyzed represents the water poured into the hole for drilling purposes with a very small mixture of water from the sand and gravel zone. In other words, while the clay was being drilled it was necessary to keep the hole full of water, and soon after the top of the sand zone at 305 feet was reached the water lowered to a level 80 feet below the curb. Thus, a water column from curb to 305 feet depth lowered to a water column from 80 feet below curb to 305 feet depth, and that water was taken up by the sand zone forcing the natural water away from the hole. If additional water was added at the surface at any time (and it probably was not), such water would also have been lost in the sand. However, as water was bailed out due to cleaning of the hole during the drilling of the sand, some water came in from the sand zone, but since there was slightly over 200 gallons of water in the sand from the surface supply this would be the first to run back into the hole.

Mr. Rasmussen informs me that he bailed about fifteen times before taking the first sample, and then bailed several times more before taking the second sample. Using a six-inch diameter bailer about 12 feet long, 17.5 gallons would be taken out each bailer or 262 gallons for the fifteen times and the additional amount for each bailer following that first sample. I doubt if more than 350 gallons were bailed from the well before the sample was taken. At the beginning of the bailing operation there was 260 feet of water in the 8-inch hole or the equivalent of 676 gallons plus approximately 200 gallons in the adjacent sand minus the amount that had been removed by bailing during the drilling of 40 feet of sand. I would estimate that in round figures there would be left in the hole between 550 and 600 gallons of surface water which would be mixed with approximately 300 gallons of water from the sand and gravel zone.

I know the above explanation is rather complicated, but in summary it is obvious that the only sample that could be taken that would really represent the true composition of water coming from the sand zone would be that taken from the lower part of the hole after all the water that had been

introduced during drilling had been removed, and unfortunately this does not seem to have been accomplished at this time. I am very sorry that I cannot give you a conclusive and dependable analysis on the water, but I do not believe that you need to have any fear about passing up a potable water supply.

Yours very truly,

A. C. Tester

ACT:A
CC: Rasmussen Brothers Well Co.

December 28, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

A preliminary report on the chemical analysis of the water sample taken on December 21 was available the 24th, but because of the unusual character of the water I did not make report to you at that time. I have corresponded with Rasmussen Brothers and learned more of the details concerning the method of sampling and have reached the conclusion that the No. 2 water sample did not represent the water actually produced from the sand formation at 338 feet and lower. In other words, sufficient bailing was not accomplished before the sample was taken and instead the water represents a mixture dominated by the supply introduced for drilling purposes.

Sample No. 2 which you submitted shows the constituents listed below, and for comparative purposes I am listing the same constituents from the present city water supply.

	New Well Sample No. 2	Present City Well
Dissolved Solids	684.0	477.0
Insoluble	28.0	31.2
Alkalinity (MeO)	250.0	268.0
Calcium	94.3	87.6
Magnesium	31.7	28.9
Fluorine	Tr.	Tr.
HCO_3	305.0	326.9
Calculated Hardness (Approximate)	369.0	338.0

RASMUSSEN BROS. WELL CO.

RUSSELL PHONE 5-7595

3604 5110 FOURTH AVENUE
SIOUX CITY, IOWA

HOWARD PHONE 6-6219

Dec. 26, 1936

Dr. A. C. Tester.

Dear Sir:

In reply to your letter to Russell about the well at Boyden, Ia.; We have the 8 in. pipe set at 367 ft. + got thru the sand into shale and drilled to the depth of 410 ft. The water raised about 80 ft. + we used a 6 in. bailer about 12 ft. long + we bailed about 15 times before the first sample was taken. Then we bailed several times more and took the second sample.

Bored & gravel'd @ 345'

This sand is not what it seems in the sample. We can drill several feet below the pipe before it caves in. I would say it is a sandy clay as the clay washes up + leaves the sand.

I would not recommend a well in this sand for more than 15 gal. per min. with an 8" pipe.

The water was at its natural level before we started to bail out.

Yours truly,

Howard Rasmussen

H. B. R.

SPECIAL DELIVERY

December 24, 1936

Mr. Russell Rasmussen
1211 Nineteenth Street
Sioux City, Iowa

Dear Russell:

Last Monday Howard took a sample of water from the Boyden well. This followed a phone conversation which I had with Mr. Vanden Brink Saturday afternoon, the 19th, in which I explained that we should have a sample to check the quality of water contained in the glacial sand formation between 305 and 365 feet. The preliminary report is now available on this sample, and the quality of the water is so unexpected that I doubt that it is representative of the glacial sand water.

It is my understanding that it was necessary to add water at all times during the drilling through the upper clay beds and before the sand was reached. I understand that the present Boyden city supply was used for this purpose. Having that thought in mind, I explained to Mr. Vanden Brink that it would be necessary to bail the well the equivalent of the water in the hole. In other words, to remove all water that had been introduced and thus allow the water from the lower bed to replace the water introduced from the top. Unless the water removed is nearly equivalent to the water in the hole, the water from below will not mix thoroughly or replace completely the introduced water, even though the static level will remain that of the lower formation. Before the sand was reached the water level was probably kept close to the surface and just as soon as the sand was drilled in that level dropped to the static level or pressure of the water in the glacial sand, which means that the fresh surface water actually ran into the sand. Therefore, theoretically it would be necessary to remove a quantity of water equivalent to that contained in the 8-inch casing from the surface to the top of the sand. That is, for 305 feet the

quantity of water contained in the 8-inch casing is 2.6 gallons per linear foot or a total of 793 gallons. If the static level was at 80 feet, then the 225 feet of water would contain 585 gallons. If a bailer of 5-inch inside diameter was used it would contain approximately 1 gallon per linear foot, so if the bailer had a clear length of 12 feet, each bailer would hold 12 gallons of water; and it would require 48 to 50 trips of the bailer to remove the water from the static level to the top of the sand, which would mean approximately one hour of continuous, hard-running, fast bailing.

I wish you would talk this over with Howard, so as to get an exact picture of what was done before the sample was taken, so as to know approximately how many bails full of water and how many gallons were extracted before the sample was taken. I understand that the sample was taken with the bailer at a depth of 338 feet. I will appreciate your writing me by return mail so that I can clear this question.

The analysis of the water is very close to the analysis of the Boyden city supply. For instance, the shallow wells now in use contain 87.6 p.p.m. of lime and 28.9 p.p.m. of magnesium, and 326.9 p.p.m. of bicarbonate. In the sample taken from the new well the lime is 94.3 p.p.m., magnesium 31.7 p.p.m., and bicarbonate 305 p.p.m., all of which is within the limits used for close comparison.

It is obvious that if the quality of water actually produced from the glacial sand is that shown by our analysis that this water zone should be developed, as it is practically the same as the present supply in mineral content and calculated hardness of approximately 21 grains per U. S. gallon.

I hope you can make an immediate reply giving me all of the details concerning water level, the depth of casing, and the amount of bailing in order that I can understand more accurately the meaning of the water analysis.

I hope this letter does not disturb your Christmas dinner, although I am very anxious to have a reply. Merry Christmas!

Yours very truly,

A. C. Tester

ACT:A

December 1, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Thank you for your telegram received at noon. A letter from Rasmussen which arrived yesterday advised me of this plan, which I acknowledged and sent a copy to you.

I will be in Boyden some time Saturday, December 12, and I hope by that time sufficient progress will be made to give an indication of what can be expected in the formations.

Yours very truly,

A. C. Tester

ACT:A

November 30, 1936

Mr. Russell Rasmussen
Rasmussen Brothers Well Company
Sioux City, Iowa

Dear Russell:

Thank you for your letter of November 27 advising me that you plan to move your equipment to Boyden and start drilling early this week. You state that you have sufficient bags and record books for the job and will keep samples as requested. I appreciate this assistance and trust you will inform us in case you need additional material.

Yours very truly,

A. C. Tester

ACT:A
CC: Mr. S. G. Vanden Brink

RASMUSSEN BROS. WELL CO.

RUSSELL
PHONE
8-4181

3604 FOURTH AVENUE
SIOUX CITY, IOWA

HOWARD
PHONE
6-6219

November 27, 1936

11-29-36
AM

Mr. A. C. Tester,
Ass't State Geologist,
103 Geology Building,
Iowa City, Iowa.

Dear Doctor:

With reference to your letter of the 25th, We are pleased to advise we are moving our equipment to Boyden the first of the week and expect to start drilling immediately.

At this time we have sufficient bags and record books and will keep samples for you.

Yours very truly,

Russell R Rasmussen
Rasmussen Bros. Well Co.

R/r

P.S. We recently have been awarded contracts for the drilling of one 8" well for the O'Brien County Poor farm east of Primghar, Iowa which I am sure you will be interested in having samples kept for you. We also have been awarded contracts for two 12" wells, approximately 300 ft. deep for the T. S. Martin Co. store here in Sioux City. Work to start on these after the first of the year.

R.R.R.

November 25, 1936

Mr. Russell Rasmussen
Rasmussen Brothers Well Company
Sioux City, Iowa

Dear Russell:

Mr. Vanden Brink, the City Clerk at Boyden, wrote to me stating that you had been awarded the contract for the new well at Boyden. I will appreciate receiving information from you indicating your plans for starting the well, stating about the date that you plan to move your drilling equipment to the site. As you know, I am very much interested in this project and wish to follow it closely and to obtain cuttings during the drilling. If you do not have bags or record books for this job, please let me know.

Yours very truly,

A. C. Tester

ACT:A

November 25, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Thank you for your letter of November 24 in which you informed me that the Rasmussen Brothers Well Company of Sioux City had received the contract for the drilling of your new well. As you know, I am very much interested in the project and wish to keep in close contact throughout the operation. I will appreciate your informing me when the rig arrives at Boyden, so that I can make plans to visit the place early during the operations.

Yours very truly,

A. C. Tester

ACT:A

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

November 24, 1936.

Dr. A. C. Tester,
Assistant State Geologist
103 Geology Building,
Iowa City, Iowa.

Dear Mr. Tester:

Thought you would be interested in knowing that Rasmussen Bros. Well Company of Sioux City were awarded the contract for the proposed well here. Contracts are being sent them today.

Instead of the location of the well being near the water tower, it will be located just south of the road leading to the pump house, along the railroad track. This location has the approval of the Department of Health.

Yours very truly,

S. G. Vanden Brink

Town Clerk.

November 12, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

By this time no doubt your Council has let a contract for the drilling of a deep well at Boyden. I will be interested to learn the outcome of the project.

I was very much surprised to receive your reply to my inquiry of October 22, in which you told me that you had used the specifications exactly as I had submitted them, as I had thought that my material would simply serve as a suggestion of the type of specifications to be drawn up by your engineer. You will recognize that the specifications contain many items in which there should be complete supervision and periodic checking. It is obvious that this should be done by some one thoroughly familiar with proper methods used in construction of deep wells and conversant with checking materials, alignment of hole, method of setting casing, and testing the well. In other words, in order that you receive a job in line with the accepted specifications or contract with the drilling firm, you should employ competent engineering services as maintained by licensed engineers.

You may rest assured that I will be glad to serve at any time in connection with the interpretation of the geological circumstances during the construction of the well, correlation of formations, interpretations of water producing zones, and will for purposes of record of the Geological Survey have samples taken of the major water types.

Yours very truly,

A. C. Tester

ACT:A
CC: Buell & Winter Engineering Co.

November 12, 1936

Mr. W. E. Buell
Buell & Winter Engineering Company
Insurance Exchange Building
Sioux City, Iowa

Dear Mr. Buell:

Your letter of November 11 came to my attention this afternoon. I heartily agree with the point in principle which you make and must admit that it has been one of the very difficult problems before me. There is some likelihood that I should have handled the Boyden proposition in a different manner.

In the conversation with the Council at Boyden and in my correspondence I pointed out that the specifications which I provided were to be used as suggestions and a guide in the preparation of their own specifications. I was admittedly quite surprised when, some two weeks after the specifications were sent to them, I was informed that they were used just as I had submitted them.

The specifications that I suggested are such that I do not see how any town could expect to follow the construction of the well and have the job completed as specified without competent engineering advice and supervision. In other words, I believe that there would be a greater demand for your services than had the town proceeded without specifications. It appeared quite certain to me that the town would proceed without specifications and without the services of competent supervisors unless I gave them something to work on. It is not the policy or intent of the Geological Survey to displace or compete with established business such as yours. The more that we can avoid such contacts, the happier we will be, as there are responsibilities involved which are not in our line, training, or endeavor.

As you mentioned in your letter, our relationships in connection with the Larchwood project were very cordial and happy from all points of view, and such marks the type of cooperation that we should have. It is unfortunate, however, that some engineering firms of the state have drawn specifications for wells or have supervised construction of wells in which little or no attention was paid to the character of the rock formations and to the development of the best quality of water possible in the area. This could have been avoided by making contact with the Survey Office and by establishing cooperation which, I feel sure, would have been to the benefit of the town, the engineering firm, and the Geological Survey. Also, some engineering firms do not provide for proper sampling of the formations, recording of water levels, pumping tests, casing records, and other essential information. In other words, our serving towns in developing specifications for wells has been in part a matter of self-defense, either to guarantee proper information from a well in which the town had refused to hire engineering services or to prove to the town that the preservation of information was valuable for their uses as well as for ours.

I expect to be in Sioux City some time in the near future, and hope that I will have the opportunity to meet you and answer more thoroughly to your satisfaction any points in connection with this problem. I do not want any misunderstanding to exist, but wish to continue working with you on the same friendly basis.

Enclosed find a copy of a letter I am sending to the clerk at Boyden.

Yours very truly,

A. C. Tester

ACT:A
Enc. 1

BUELL & WINTER ENGINEERING CO.

PLANS REPORTS ESTIMATES SUPERVISION APPRAISALS

MUNICIPAL ENGINEERS

INSURANCE EXCHANGE BUILDING
SIOUX CITY, IOWA

SEWERAGE PAVEMENTS WATERWORKS SEWAGE DISPOSAL POWER PLANTS

November 11, 1936.

Mr. A. C. Tester,
Iowa City, Iowa.

Dear Mr. Tester:

A few months ago we received a letter from the Town of Boyden, Iowa asking what our engineering fee would be for plans and specifications and supervision of the letting for the drilling of a new well. We quoted them a price by mail.

Buhs rec'd 11/9/36

Noting in the Press Reports that a bond election had carried for a new well the writer called the Mayor this morning and was informed that they did not contemplate the employing of any engineer on the work. We pointed our to him the necessity of having a specification where all bidders would bid upon the same conditions. He advised us that the specification had been furnished, free of charge, by someone at Iowa City.

We acknowledge with a great deal of pleasure the services which you have rendered us in the past, particularly at Larchwood, Iowa. We do feel, however, that the policy of your Department should be that any town who avail themselves of the information from the State Geology Office should be required to employ some engineer on the well in the event that such a well is drilled.

The consulting engineers of Iowa are maintaining offices at their own expense and the only way that these offices can be maintained is by doing sufficient business at a fair price. It is quite evident that if the State of Iowa is to furnish specifications on work free of charge that a portion of our income is going to be curtailed..

We would be glad to have your reaction as to our attitude in this regard.

With the best of personal regards to you, I am

Very truly yours,
W. E. Buell
W. E. BUELL.

WEB:ER

ARTHUR C. TROWBRIDGE
DIRECTOR AND STATE GEOLOGIST
ALLEN C. TESTER
ASSISTANT STATE GEOLOGIST

STATE OF IOWA
IOWA GEOLOGICAL SURVEY
103 GEOLOGY BUILDING
IOWA CITY

GEOLOGICAL BOARD
CLYDE L. HERRING
GOVERNOR OF IOWA
EUGENE A. GILMORE
PRESIDENT STATE UNIVERSITY OF IOWA
CHARLES E. FRILEY
PRESIDENT IOWA STATE COLLEGE
LEO P. SHERMAN
PRESIDENT IOWA ACADEMY OF SCIENCE
CHARLES W. STORMS
AUDITOR OF STATE

October 22, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Not having heard from you since sending by special delivery the suggested specifications for a well at Boyden on October 10, I am writing to learn if any action was taken and what plans are being made. I will appreciate hearing if the specifications reached you in proper time and if any decision was reached.

Yours very truly,

A. C. Tester

ACT:A

We are using your specifications just as you submitted them. Enclosed find the notice we are running, calling for bids.

Special Delivery

October 10, 1936

Mr. S. G. Van den Brink
Town Clerk
Boyden, Iowa

Dear Mr. Van den Brink:

Enclosed you will find four copies of specifications and bidding form designed to meet your approval. There will be some modifications no doubt which you will wish to make, but many things were included which are safeguards for the construction of a good well. Many wells are constructed without a complete set of specifications, and in some cases the job is just as satisfactory. However, I believe that you will be better protected to keep most of the clauses in the specification. In part this will make it easier to obtain a responsible, high-grade contractor, as a firm of such type will not find the specifications burdensome.

The bidding form is not complete in its full legal outline, but the various items are designed to give a complete coverage of your needs.

I will be pleased to learn the outcome of your Council meeting and the bidding.

Yours very truly,

A. C. Tester

ACT:A
Enc.

November 14, 1936

Mr. S. G. Vanden Brink
Town Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

In reply to your letter of November 13, I am interested to learn that you received bids but are holding up the matter of awarding the contract.

With regard to the point on the casing, will say that I have discussed this point with several people since you sent out the specifications for bidding. I believe that the principal objection to the casing, as suggested in my specifications, is the difficulty in obtaining the material in that extra strong black pipe or seamless steel A.P.I. casing is not carried in stock by all dealers. In order to provide the material, it would be necessary to have it shipped from the mill which might take a little extra time. One contractor said that the penalty for delay might be imposed because of delays beyond his control, due to ordering the pipe from the manufacturer in the East. Of course, this point would be easily handled, as the penalties do not apply to circumstances beyond the normal control of the town or contractor.

At the time I drew up the suggested specifications, I referred to standard tables and stock sizes made by several of the large casing and pipe manufacturers. Item 28 (a) calls for extra strong black pipe of nominal 8 inch diameter. The standard for this pipe is 8 5/8 inch external diameter and 7 5/8 inch internal diameter, with a wall thickness of ½ inch with a weight of 43.388 pounds per foot of plain end pipe. This is the closest dimension to an inside diameter of 8 inches until the nominal 10 inch pipe which is 9 3/4 inch internal diameter. The alternative for this part of the well would be to use a black standard, weight pipe, 8 inch nominal diameter which is 8 5/8 inch

outside diameter and 8.071 inch inside diameter with a wall thickness of 0.277 inch (almost one-half of that specified) and a weight of 25 pounds per foot, including coupling and threads. It is obvious from the above comparison that in order to get an inside diameter of at least 8 inches, you are forced to use a thin pipe and of low weight. This is, of course, the standard well construction and is the type of pipe commonly used for most jobs. However, I suggested the seamless steel casing which gives you practically the same specifications (see item 28 (b)) and may be more readily obtained, as some of this equipment has been used in Iowa.

The same conditions pertain to the 6 inch casing or black pipe, except that the actual dimensions are different and the pipe is lighter in weight.

The reason for suggesting the type of pipe indicated above is to increase the life of the well and to protect against the corrosive action of the waters to be cased out above the producing formations. It is now a recognized fact that a part of the difficulty of the poor quality of deep well supplies of northwestern Iowa is related to the incomplete water shut-off of the highly mineralized water zones of the glacial drift and the upper part of the Cretaceous formations. The leakage of these upper waters is due in part to improper construction, imperfect seals between casing, broken joints, and to perforation of the pipe by chemical corrosion. In other words, the thicker the pipe the longer it will take the sulphate bearing waters to eat holes in the pipe and allow the water to mix with the good water. The use of thicker pipe reduces the hazard of threads being cut through the pipe and thus developing an imperfect joint. Experience in oil field work has demonstrated that the A.P.I. standard specifications for the type of steel used in the seamless casing will withstand to a better degree the corrosive action of ground waters.

I realize that my suggested specifications are more rigid and severe than considered necessary by many of the contractors and engineers of the state. At the same time I realize that there are many unsatisfactory wells in the state. I believe that the thick, heavy casing will add six to eight years of life to the well, which may be 25% to 35% longer than if the lighter weight pipe is used.

So far as the objection by pump men is concerned, this does not seem to be a matter of concern. A turbine pump designed for a 6 inch casing with a 6 inch drop column as a maximum should produce more water than the

well will be capable of yielding, and this will be contained within the 7 5/8 inch inside diameter casing. In other words, it is doubtful if you would want to use an 8 inch pump in this well which, of course, would not be possible with the casing as specified.

The matter of using extra heavy casing reduces itself entirely to original costs and expected life of the well. If you feel that you cannot afford the additional cost of the pipe and will be satisfied with a well that may develop poor water, due to infiltration of the glacial drift waters within eight to twelve years, then the lighter pipe should be used. If you reach this decision, you will be in line with general practice of well construction.

I hope that this has answered your questions and that you will not hesitate to call on me if there are other points that are not clear or have caused some discussion.

Yours very truly,

A. C. Tester

ACT:A

P.S. Note that item 28 (a) contains the word "galvanized" which should be cut out. This should read: "Extra strong black pipe."

A.C.T.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

November 13, 1936.

Mr. A. C. Tester,
Assistant State Geologist,
Iowa City, Iowa.

Dear Mr. Tester:

Bids for the drilling of proposed well here were opened November 9th but contract as yet has not been awarded.

There has been considerable discussion on the part of a pump man, as well as a well man, regarding the casing mentioned in the specifications. The well man stated we should be sure to get a casing with inside measurement of eight inch and six inch. There is some talk of using standard casing instead of casing as specified. While we realize that the standard casing will cost considerable less, we feel that we should take this matter up with you, before making any changes.

We realize that the casing mentioned in the specifications is the kind that you approve of. Will you please advise the advantages over the standard casing? What are the advantages of the inside size of the casing shown in specifications over the casing with inside diameter of eight inches and six inches.

We assure you this information will be appreciated.

Yours very truly,

Town Clerk.

October 2, 1936

Mr. S. G. Van den Brink
Town Clerk
Boyden, Iowa

Dear Mr. Van den Brink:

Thank you for your letter of October 1 advising me that the election carried. I presume this means that you will proceed with the development of a deep well. I have the specifications completed in part and will finish the work and send it to you the first of next week.

Yours very truly,

A. C. Tester

ACT:A

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

October 1, 1936.

Mr. A. C. Tester, Asst.,

Iowa Geological Survey,

Iowa City, Iowa.

Dear Mr. Tester:

Result of election yesterday: 156 ballots cast, of which 108 were cast yes and 47 were no and 1 defective. There was 162 ballots cast at the election last March, so our election yesterday carried by 14 votes. Rather close.

Yours very truly,

Clerk.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

September 9, 1936.

Mr. A. C. Tester, Asst.,
Iowa Geological Survey,
Iowa City, Iowa.

Dear Mr. Tester:

We are calling an election to vote on the bond issue and water extensions, for September 30, 1936.

We are getting mighty curious as to what your report will contain. Do you suppose you will have it ready for us by the end of the week. Our council will meet again Monday night regarding some matters.

Yours very truly,

Clerk.

Hear from Co Bluffs to be in Boyden Monday night with report.

Meet with council Monday night 9/14/36

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

August 20, 1936.

Mr. A. C. Tester,
Burk Hotel,
Carroll, Iowa.

Dear Mr. Tester:

Regarding the legal matter in connection with the proposed well, we find that the amount involved will mean a bond election, which must be acted on at a regular meeting and published for three weeks. We have written to some of the bond houses asking for particluars as to legal proceeding and procedure, in the hopes that we can find some way by which we can start work on the well right away instead of waiting until after the election.

I have not yet written to any of the well companies. We will wait until we receive your report and specifications and then if we can find some way to proceed with well digging before the election, we can get bids on the job at once.

Yours very truly,

Town Clerk.

Bayden, Iowa,
Jan. 20, 1937.

Rec'd 1/21/37 9 am

Dear Dr. Tester:

I arrived here safely shortly after noon to find that the tractor with which they had planned to pump the well was not powerful enough to lift the water from the hole. Mr. Rasmussen went to Sioux City yesterday to get adequate equipment and he expected to return this morning. He has not arrived and is probably held up by the snow which fell last night and which has drifted badly in places.

I am going to Alton and then spend the night in Sheldon and return to Bayden early tomorrow morning.

A report on the situation at Sac City will be sent in tonight.

Very truly yours,
H.G. Hershey.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

January 13, 1937.

Dr. A. C. Tester, Asst. State Geologist
103 Geology Building,
Iowa City, Iowa.

Dear Dr. Tester:

We sent you telegram this afternoon that the boys will not be able to test the well this week. It seems they are having trouble with their cutter and find out today that they will not be ready for testing until possibly Saturday sometime and if it happens to be late Saturday morning they doubt if they will start testing them until the first of the week. Sorry this has to happen as it looked as tho things were going to work out nicely for you for the end of this week.

Will keep you posted .

Yours very truly,

Town Clerk.

% Mrs. Peter Lindgren,
Albert City, Iowa,
January 25, 1937.

Dear Mr. Foster:—

Your letter of January 24 reached me today. Thank you for the additional information on the Thorpe wells. I was especially glad to have your remarks on the Springhar well.

Regarding the depth of the Bayden well, I understand that additional drilling was done to a depth of 500 feet and the samples obtained were to be sent directly to you. I did not take the samples because I thought that you would want to see them before my return to Iowa City. I also left one empty sample jug and crate there in case further sampling is necessary.

Two water jugs now on hand —

Very truly yours,
A.G. Hershey.

Arlington Hotel,
Sheldon, Ia.,
Jan. 21, 1937.

Dear Dr. Foster:

Attached is the water sample data sheet for the sample collected at 8:30 tonight from the Bayden well.

It was impossible to get an airline into the well with the pumping equipment used, but Mr. Rasmussen will measure the drawdown and recovery and send us the results when the final pumping test is run, after the well is completed. From the data sheet you will see that the drawdown is less than 55 feet when the well is being pumped at 96 g.p.m.

I am not sure when I can ship the sample. I could not locate the express agent at his office or home tonight, but from all information I could get there will not be another train east before tomorrow at about 6 p.m. It may be possible to get a better train out of Spencer or Cherokee.

The trip so far has been quite eventful. The snow which fell Tuesday night and Wednesday morning drifted badly under a high wind yesterday afternoon and night. I was forced to turn back after going seven miles from Sheldon

January 28, 1937

Mr. S. G. Vanden Brink
City Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Enclosed find a copy of the preliminary report showing the chemical composition of water developed from the new well drilling at 500 feet depth. This sample was taken by Dr. Hershey on January 21, and, of course, is only preliminary and does not include all of the substances. However, the variation in final analysis is usually very small, so I believe that you can be justified in assuming that the quality of water shown by this analysis is practically the same as will be shown by the final report.

You will note that the calcium and magnesium are moderately high, and in addition the sulphate content is more than is desirable. The calculated hardness of 1095 parts per million is equivalent to approximately 64 grains per U. S. gallon. The chlorine content of 50 parts per million indicates that the sodium content will be moderate.

The composition of the water is not surprising, as we had expected the Upper Dakota sandstone to contain mineralized water. Therefore, I suggest that drilling be continued to the Lower Dakota sandstone with the anticipation of a better quality of water.

According to the record submitted by Dr. Hershey the total depth of the well at the present time is 500 feet. Our samples stop at 490 feet. I would like to have the additional 10 feet of material at the earliest possible date, as I do not want to lose a full record of this particular interval. I will appreciate your sending these by mail, even though the new drilling has not yet been continued.

If there are any questions concerning this analysis or the condition of the well, do not hesitate to write me.

I am very anxious to learn if the water from the glacial sand and gravel at about 350 feet was completely shut off at the time of the pumping test and when the sample was taken.

Yours very truly,

A. C. Tester

ACT:A

P.S. It will be necessary to close the perforated pipe that was set in this sand. In other words, this water will have to be shut off in order to protect the lower water from contamination. I suggest that the perforated pipe be pulled and that the 6-inch casing be carried downward and drilling continued with as large a hole as possible.

A. C. T.

CC: Rasmussen Well Company
Sioux City, Iowa.

February 2, 1937

Mr. S. G. Vanden Brink
City Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Enclosed find a copy of the telegram which I sent to you Sunday noon, as promised in our telephone conversation Saturday night. As I did not receive a reply, I asked the telegraph company to confirm delivery, which they stated had been accomplished Sunday afternoon by phone to Mr. McCrum from Sheldon.

I will be interested to learn your decision on this matter. I am sorry that it was not possible to have a more satisfactory conversation than that by phone, but feel that you would be making a mistake to stop the well at 500 feet.

It was necessary to ask that you pay travelling expenses, as the Survey has already been to considerable expense on this project, all of which we are very glad to do wherever the trip provides new information or serves a purpose otherwise insufficiently provided. In this particular case I felt that the trip would be primarily to emphasize that material which had been thoroughly explained at previous meetings and properly provided in the specifications.

Yours very truly,

A. C. Tester

ACT:A

Called Vanden Brink Thursday night 9:45 pm -

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

February 2, 1937.

Dr. A. C. Tester, Asst. State Geologist,
103 Geology Building,
Iowa City, Iowa.

Dear Mr. Tester:

Under separate cover we are sending you the last two samples of cutting taken from the drilled well.

At the council meeting held last Saturday evening, your letter of January 28 was presented and read. At the meeting held last night your telegram was presented and read. At both of these meetings there was considerable discussion regarding the new well and it was finally decided to complete the well at present depth of approximately 500 feet and if after using the water for several months, the people raised enough objection to the water, it could be drilled to a lower depth, sinking a 4½ inch casing.

I realize that this decision on the part of the council will be a disappointment to you but we want you to know that your help and your suggestions in connection with the drilling of this well, are very much appreciated.

Yours very truly,

Town Clerk.

PAUL T. McCRUM
MAYOR
S. G. VANDEN BRINK
TOWN CLERK
A. B. VANDEN BRINK
TOWN TREASURER

TOWN OF BOYDEN
IOWA

COUNCILMEN:
JOHN H. DYKSTRA
H. MARIS
H. W. PITSTICK
PAUL SCHREUDER
JOHN VANDER HAAR

February 5, 1937.

Dr. A. C. Tester, Asst. State Geologist
103 Geology Building,
Iowa City, Iowa.

Dear Mr. Tester:

Just received your letter the 2nd this morning. I presume we should have wired you Sunday P.M. as to whether or not you were to come to Boyden, but as I stated over telephone Saturday evening we would wire you if we wanted you to come, I felt that so long as you did not receive a telegram, you would not come. As to your traveling expenses we anticipated that same would have to be taken care of by us so long as we were asking you to come. The reason your message was phoned to Mr. McCrum was because I was out of town Sunday afternoon and asked our telephone operator to call Mr. McCrum when and if a message came from Iowa City.

In view of the Council's decision to complete the well at 500 feet, I don't suppose there is much more that you can help us with, unless of course, they decide to drill deeper sometime in the future.

Mr. Rasmussen expects to pump this afternoon and will continue the pumping test tomorrow morning. We have one of the bottles you sent us and we will send you another sample of the water just before they stop pumping tomorrow.

Sometime when you are in this vicinity, I hope that you will find time to stop in and see us again.

Yours very truly,

S. G. Vanden Brink
Clerk.

P.S. Am enclosing a copy of the front page of our local paper.

February 6, 1937

Mr. S. G. Vanden Brink
City Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Your letter of February 5 enclosing the clipping from the newspaper came to my attention this morning. I appreciate your sending this information to me.

I sincerely hope that your decision concerning the completion of the well at 500 feet will not prove unnecessarily expensive. I doubt, however, if this was a good business transaction, as you will find it very expensive to change the well after it is once completed. In other words, it will be necessary to bring in sufficient equipment to move the pump, pull casing, do new drilling, set casing, and replace the pump.

There is one very important item which apparently did not give you very much concern in the matter of a possible reconstruction of the well at a later date. According to the newspaper article and the letter which you sent me you would extend the hole to a greater depth by casing with a 4½ inch pipe. Let us suppose you do decide to drill the well 650 feet deep after a period of trial of the present water quality. You have two alternatives representing extremes of cost and results.

The first alternative would be to leave the 6 inch casing at its present depth; continue drilling inside of the 6 inch casing with a bit of that size down to the top of the lower sandstone at approximately 600 to 615 feet. At that depth the casing should be set and as the hole is not over 6 inches in diameter, the largest size pipe that would be possible would be an odd size 5 inch, light weight pipe or a standard 4½ inch pipe plus the thickness of the coupling. Below the

base of this pipe the hole would be drilled to take the perforated pipe through the producing formation. This would mean that the largest possible hole in the producing sandstone could not be over 4 inches diameter. This is considerably different from a hole 6 inches in diameter to take a 4½ to 5 inch perforated pipe as contemplated by the specifications. In other words, your effective percolation surface in contact with the 3 to 3½ inch diameter pipe would be a marked reduction from that as originally planned. I doubt if such a construction would produce enough water to be worth the additional cost.

The second alternative would be to pull the 6 inch pipe now in the hole and resume drilling with a 7½ inch diameter bit and carry the full size hole down to the top of the lower sandstone; or by the use of an underreamer extend the 7½ hole below the bottom of the 6 inch casing and thus make room to carry the 6 inch casing to the proper depth. Either type of work will be expensive, but it will provide a 6 inch hole through the producing sandstone zone which will be large enough to take a minimum 4½ inch diameter perforated pipe or a maximum welded joint 5 inch perforated pipe. As you know, your original specification and contract provided for this work; and if you postpone it to a later date, you will be paying for it a second time. Not only will you be required to pay for this work a second time, but the second rate will be much higher than the first rate.

I understand that Dr. Hershey left a second crate with bottle, so that you now have two crates on hand. When you send in the new sample, I will appreciate your shipping the second, unfilled sample container. This shipment should be made to the Iowa Geological Survey, Iowa City. So far as our work is concerned, I do not believe that it will be necessary to take a sample for your second pumping test, as the first sample taken by Dr. Hershey should suffice for the formations at the 435-500 foot interval.

Yours very truly,

A. C. Tester

ACT:A

February 10, 1937

Mr. A. H. Wieters, Director
Division of Engineering
State Board of Health
Des Moines, Iowa

Dear Mr. Wieters:

Enclosed find a report on the final analysis of the water developed from the new well at Boyden, Sioux County. The information on the casing, depth, static level, temperature, etc. is shown, which I thought might be of interest to you in addition to the analysis which, of course, you receive direct from Dr. Hinman.

My particular reason for calling this analysis to your attention is the fact that I had a great deal to do with the project and was responsible for the recommendation of the deep well at Boyden. This, however, followed testing with the hope to develop a shallow water supply which would be of low mineral quality. However, my recommendation and detailed statement after a rather exhaustive study of the underground conditions of the area provided for the casing out of all water above 550 feet, with the water to be developed occurring between 600 and 650 feet. In other words, the presence of an apparently adequate water supply between 435 and 500 feet so excited the people at Boyden that they minimized the poor quality of water and apparently were afraid to follow my recommendation that a better quality of water could be obtained at a lower depth. I am confident that water of less than half the hardness and sulphate content can be obtained at Boyden at a depth between 600 and 650 feet.

I am very much disappointed in the outcome at Boyden, as we were fully acquainted with the mineralized water in the lower part of the Nebraskan glacial drift and in the upper part of the Dakota and warned the town accordingly before recommending a deep well and before they considered voting for a bond issue.

Yours very truly,

ACT:A

A. C. Tester

February 10, 1937

Rasmussen Bros. Well Company
Sioux City, Iowa

Attention: Russell Rasmussen

Dear Russell:

The enclosed report with a copy of the final analysis on the water at Boyden is self-explanatory.

I was a little surprised that you would encourage the town of Boyden to complete the well at the level containing the poor quality of water, especially in view of the fact that the well had been originally planned to 650 feet in depth.

You will recall our conversation after the completion of the well at Larchwood. I believe that it will be to your material advantage from the standpoint of increasing your business in well drilling to make every attempt to develop the best possible quality of water, and I felt after the success at Larchwood that you saw the advantage of drilling wells to the soft water zone rather than finishing in a hard water zone.

I hope you are making plans to be in Cedar Rapids for the Well Driller's Association Convention, March 17, 18, and 19.

With best regards, I remain,

Yours very truly,

A. C. Tester

ACT:A
Encs.

February 10, 1937

Mr. S. G. Vanden Brink
City Clerk
Boyden, Iowa

Dear Mr. Vanden Brink:

Enclosed find a final report on the chemical analysis of water taken from your new well at the time of the first pumping test on January 21.

You will note that the composition of this water is practically the same as reported on the preliminary analysis. The calcium, magnesium, iron, and sulphates in particular are high. The sodium and chlorine are not abnormal or particularly hazardous. The calcium and magnesium sulphates which will produce gypsum and epsom salts, respectively, will be quite undesirable for a domestic water supply. In addition, the 2 parts per million of iron is so high that you will have a characteristic rust brown stain on lavatories and bathroom fixtures and any porcelain or enamel ware in which the water is used. The calculated hardness of 1095 parts per million is equivalent to approximately 64 grains per U. S. gallon, as reported at the time of the preliminary analysis. The fluorine content of 1 part per million is below that considered as being the source of mottling of teeth of growing children, but the content should be watched as it is known to vary in waters in the upper formations of northwestern Iowa.

Yours very truly,

A. C. Tester

ACT:A
CC: Rasmussen Bros. Well Company

COMMUNICABLE DISEASES—EPIDEMIOLOGY
CARL F. JORDAN, M. D., C. H. P.
DIRECTOR

CHILD HEALTH AND HEALTH EDUCATION
J. H. KINNAMAN, M. D.
DIRECTOR

PUBLIC HEALTH ENGINEERING
A. H. WIETERS, M. S.
DIRECTOR

STATE HYGIENIC LABORATORIES
UNIVERSITY OF IOWA, IOWA CITY
M. E. BARNES, M. D., DR. P. H.
DIRECTOR

"A Healthy State and a Happier People"

Iowa

State Department of Health

WALTER L. BIERRING, M. D., COMMISSIONER

Des Moines

PUBLIC HEALTH NURSING
EDITH S. COUNTRYMAN, R. N.
DIRECTOR

VITAL STATISTICS
ROBERT L. McLAREN
DIRECTOR

LICENSURE AND REGISTRATION
H. W. GREFE
DIRECTOR

LAW ENFORCEMENT
HERMAN B. CARLSON, ATTY.
DIRECTOR

EXECUTIVE CLERK
ALBERT F. VOGT

February 11, 1937.

Dr. A. C. Tester,
Iowa Geological Survey,
University of Iowa,
Iowa City, Iowa.

Dear Dr. Tester:

This will acknowledge, with thanks, receipt of your letter of February 10th with reference to the Boyden well.

I am glad to get this information and don't know whether or not we can do anything about the matter now, but will try.

Very truly yours,

A. H. Wieters, Director,
Division of Engineering.

AHW/MM

Punched FCH

WRD Exp. (GW)
Aug. 1964

Verified PMJ

U. S. DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

Water Resources Division Well Schedule Form

MASTER CARD

Record by P. J. Horick Source of data Files Date 6/2/65 Map H. & T.

State Iowa (16) County (or town) Sioux (814)

Latitude: 43 11 13 N Longitude: 096 00 37 Sequential number: 1

Lat-long accuracy: 2 T. 97 N, R. 44 W Sec. 26, SE ¼, SE ¼, SW ¼ 5PM

Local well number: 097 44W 26 C d d Other number: W-0487 B & M

Local use: 004 87 CITY Owner or name: BOYDEN

Owner or name: BOYDEN Address: Boyden, Iowa

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — M

Use of water: (A) Air cond, (C) Comm, (D) Dewatering, (F) Fire, (H) Dom, (I) Irr, (N) Ind, (P) P S, (S) Stock, (T) Instit, (U) Unused — P

Use of well: (A) Anode, (D) Drain, (G) Seismic, (O) Obs, (P) Oil-gas, (R) Recharge, (S) Spring, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — W

DATA AVAILABLE: Well data 1 Freq. W/L meas.: INVENTORY Ø Field aquifer char.

Hyd. lab. data:

Qual. water data; type: COMPLETE C

Freq. sampling: INTERMITTENT I Pumpage inventory: yes / no, period:

Aperture cards: yes

Log data: GEOLOGIST LOG G

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 500 ft 500 Meas. (est.) 6

Depth cased; (first perf.) 440 ft 440 Casing type: STEEL ; Diam. 8 in accuracy 8

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., screen, sd. pt., (S) shored, (W) open hole, (Z) other

Method drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other

Date drilled: FEB. 1937 9 3 7 Pump intake setting: ft

Driller: Rasmussen Well Co. (name) Sioux City Iowa (address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other; Deep / Shallow

Power (type): diesel, elec, gas, gasoline, hand, gas, wind; nat, LPG, H.P. Trans. or meter no.

Descrip. MP LSD ft above / below lsd, Alt. MP 1916

Alt. LSD: 1916 1 4 1 6 Accuracy: (source) ALTIMETER 7

Water level 234 ft above / below MP; Ft above / below lsd 2 3 4 Accuracy: DRILLER'S LOG

Date meas: FEB. 1937 2 3 7 Yield: 125 GPM 1 2 5 Method determined

Drawdown: 16 ft 1 6 Accuracy: 3 Pumping period hrs

QUALITY OF WATER DATA: Iron 1.44 ppm Sulfate 1200 ppm 9 Chloride 50 ppm 2 Hard. 1220 ppm

Spec. Conduct 2310 K x 10^6 6 Temp. 61 °F 6 1 Date sampled FEB 1939 2 5 9

Air, color, etc.

350-440

5 90

1 118

Boyden

350-375 Banks ×

375-400 Vonnelly?

400-420 Moore A-

420-440 Bates?

3 Brooks
1 Vernon
2 Frye
} Micro

Brooks - 440'-445'
450-455
460-465
470-475
480-485
485-490

Vernon - 320-350

Frye - 295-320

097-44W-26cdd

Well Number 43 11 13 N 096 00 37.1
d m s S d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: CENTRAL LOWLAND (20–21) 12 Section: DISSECTED TILL PLAIN (22) e Drainage Basin: FLOYD (23–25) 36B Subbasin: (26)

Topo of well site: local depression, (D) flat surface, (F) hilltop, (H) hillside, (S) terrace, (T) valley flat, (V) (27)

MAJOR AQUIFER: Cretaceous system, LOWER series (28–29) K1 Dakota Sandstone aquifer, formation, group (30–31) D1

Lithology: FINE SANDSTONE (32–33) ZV Origin: MARINE (34) 6 Aquifer Thickness: ft

(35–37) Length of well open to: 60 ft (38–40) 60 Depth to top of: 355 ft (41–43) 355

MINOR AQUIFER: system, series (44–45) aquifer, formation, group (46–47)

Lithology: (48–49) Origin: (50) Aquifer Thickness: ft

(51–53) Length of well open to: ft (54–56) Depth to top of: ft (57–59)

Intervals Screened:

Depth to consolidated rock: 350 ft (60–63) 350 Source of data: WELL CUTTINGS (64) C

Depth to basement: ft (65–68) Source of data: (69)

Surficial material: SANDY TILL (70–71) ST Infiltration characteristics: POOR (72) 4

Coefficient Trans: gpd/ft (73–75) Coefficient Storage: (76–78)

Coefficient Perm: gpd/ft²; Spec cap: 7.9 gpm/ft; Number of geologic cards: (79)

Casing:

367'8" of 8" pipe from 0-367'8"
100'5" of 6" pipe from 340-440'5"
66'3" of 4¼" pipe from 443'9" to 500', perforated through sandstone



Boyden

Banks-

350-355 = -1/16 90%

355-360 = -1/16 20% 1/4-1/8 28% >1/4 16%
1/8-1/16 36%

360-365 = -1/16 5.5% 1/2-1/4 43% 1-1/2 26%
>1=17%

365-368 > 1/16 = 5.5%, 1/16-1/64 14% < 1/64 76%

368-375 > 1/16-2% 1/16-1/64 7% < 1/64 91% -

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

1201-S

CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

(12)

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

SYMBOLS
DL = Day Letter
NM = Night Message
NL = Night Letter
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination.

Received at 110 East Washington St., Iowa City, Iowa. Dial 3141

1937 JAN 13 PM 4 13

4:20 p.m.

MRP66 10 XC=BOYDEN IOWA 13 345P

DR A C TESTER=

103 GEOLOGY BLDG=

UNABLE TO TEST WELL THIS WEEK STOP WAIT FOR TELEGRAM=

S G VANDENBRINK TOWN CLERK.

1206-A

CLASS OF SERVICE DESIRED			
DOMESTIC		CABLE	
TELEGRAM		FULL RATE	
DAY LETTER	X	DEFERRED	
NIGHT MESSAGE		NIGHT LETTER	
NIGHT LETTER		SHIP RADIOGRAM	

Patrons should check class of service desired; otherwise message will be transmitted as a full-rate communication.

WESTERN UNION

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK
ACCT'G INFMN.
TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

JANUARY 8 1937

S G VANDEN BRINK
TOWN CLERK
BOYDEN IOWA

ADVISE RESULT OF PUMPING TEST AND IF WATER SAMPLE TAKEN

A C TESTER

CHARGE: EXTENSION 710
Iowa Geological Survey

REPORT CHARGE TO EXTENSION 710.

WESTERN UNION GIFT ORDERS ARE APPROPRIATE GIFTS FOR ALL OCCASIONS

1206-A

CLASS OF SERVICE DESIRED

DOMESTIC		CABLE	
TELEGRAM		FULL RATE	
DAY LETTER		DEFERRED	
NIGHT MESSAGE		NIGHT LETTER	
NIGHT LETTER		SHIP RADIOGRAM	

Patrons should check class of service desired; otherwise message will be transmitted as a full-rate communication.

WESTERN UNION

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK

ACCT'G INFMN.

TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

DAY LETTER COLLECT

January 31, 1937

Delvd at office @ 12 1/2 pm

S. G. Vanden Brink,
City Clerk,
Boyden, Iowa.

Can arrange to leave tonight arrive Sheldon twelve forty noon return leave Sheldon four ten Monday afternoon via Sioux City stop Will recommend drilling to lower Dakota sandstone or six hundred fifty feet as stated page eight specifications stop Formations and water production normal as expected and see no reason to deviate from original plan and specifications if you want a good water supply stop Wire reply at once if you want me for conference you to pay travelling expenses.

A. C. Tester

WESTERN UNION GIFT ORDERS ARE APPROPRIATE GIFTS FOR ALL OCCASIONS

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

1201-S

CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

(36).

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

SYMBOLS

DL	Day Letter
NM	Night Message
NL	Night Letter
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NLT	Cable Night Letter
	Ship Radiogram

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination.

Received at 110 East Washington St., Iowa City, Iowa. Dial 3141

1937 JAN 19 AM 10 40

MRP13 7 = BOYDEN IOWA 19 1024A

DR A C TESTER=

103 GEOLOGY BLDG=

DRILLERS EXPECT TO START PUMPING THIS AFTERNOON=

S G VANDENBRINK CLERK.

1206-A

CLASS OF SERVICE DESIRED

DOMESTIC		CABLE	
TELEGRAM	X	FULL RATE	
DAY LETTER		DEFERRED	
NIGHT MESSAGE		NIGHT LETTER	
NIGHT LETTER		SHIP RADIOGRAM	

Patrons should check class of service desired; otherwise message will be transmitted as a full-rate communication.

WESTERN UNION

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

CHECK

ACCT'G INFMN.

TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

JANUARY 19 1937

10:58 a.m.

S G Vanden Brink
Town Clerk
Boyden Iowa

HERSHEY WILL BE IN BOYDEN BY NOON WEDNESDAY HOPE TO OBSERVE PUMPING TEST AND TAKE SAMPLES

A C TESTER

CHARGE: EXTENSION 710

69¢

Report charge to Extension 710.

WESTERN UNION GIFT ORDERS ARE APPROPRIATE GIFTS FOR ALL OCCASIONS

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

1201-S

CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

(26)

R. B. WHITE, PRESIDENT — NEWCOMB CARLTON, CHAIRMAN OF THE BOARD — J. C. WILLEVER, FIRST VICE-PRESIDENT

SYMBOLS

DL = Day Letter
NM = Night Message
NL = Night Letter
LC = Deferred Cable
NLT = Cable Night Letter
Ship Radiogram

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination.

Received at 110 East Washington St., Iowa City, Iowa. Dial 3141

1936 DEC 1 AM 11 29

MRP30 4=BOYDEN IOWA 1 1115A

DR A C TESTER=

103 GEOLOGY BLDG=

RASMUSSENS START DRILLING TODAY=

S G VANDENBRINK=

pd 11 55 a

NOTICE

Notice is hereby given that sealed bids will be received by the Town Council of Boyden, Iowa for the drilling, casing, developing and testing of a well for said town, said well to be approximately 500 feet to 650 feet deep, hole to be drilled to accomodate an 8 inch casing to be set in shale formation at approximately 375 to 400 feet, then reduced to size sufficient to accomodate a 6 inch casing which is to be set at the top of the producing sandstone formation. Below the base of the 6 inch casing and extending to at least one foot below the base producing sandstone a 4½ inch perforated casing shall be set and sealed and overlap inside of the 6 inch casing at least 6 feet and sealed with lead seal properly swedged.

Contractor to furnish necessary material, such as casing, shoes, screens, seals as further set out in specifications on file with town clerk.

The Contractor shall commence operations on the drilling site not later than the 15th day after receiving notice of the award of contract. Construction work shall proceed daily, except Sunday or legal holidays, from the start to completion without interuption or delay, except as ordered by the town, or due to causes beyond the control of contractor with the exercise of reasonable care and proficiency of workmanship.

Payments will be made by the Town on the basis of fifty per cent of the contract cost of the actual number of feet drilled, or contract cost of cementing or pumping, or other contracted work as determined at the end of the 25th day of each calendar month. The balance of fifty per cent will be paid upon completion and acceptance of the well and after the statutory period of thirty days provided by law. All payments will be made by issue of warrant upon the filing and approval of proper vouchers and receipts therefore.

For balance of specifications see copy on file with the Town Clerk.

Each bid must be accompanied by a certified check in an amount equal to 10% of the bid, drawn on and certified by a bank in Iowa, payable to the Town Treasurer of Boyden, Iowa, as security that bidder will enter into a contract for the doing of the work and will give bond as required.

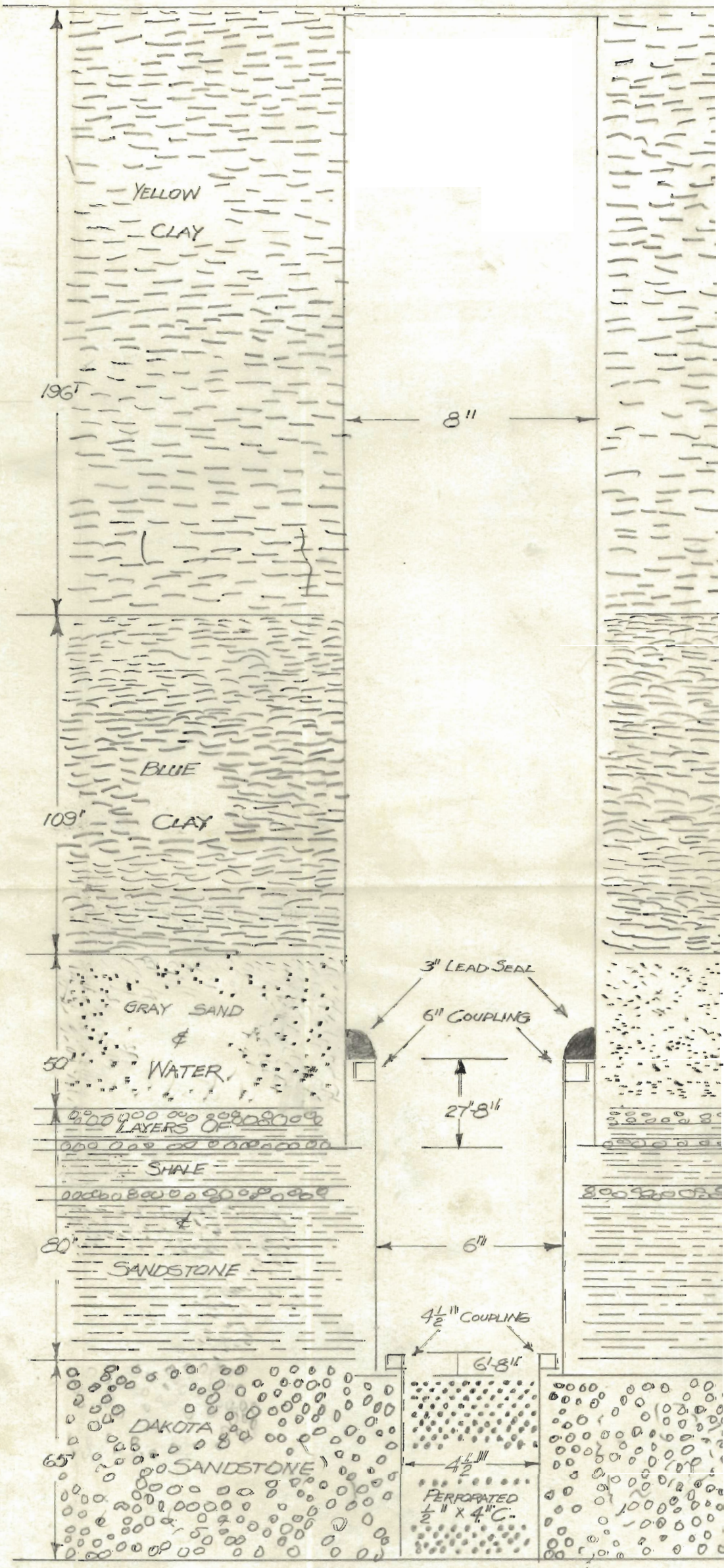
Bids to be filed with the Town Clerk prior to 7:30 o'clock P. M., November 9, 1936, at which time the Town Council will meet to consider and act on bids. Town Council reserves the right to reject any and all bids.

By order of Town Council,

STRATA

0-196'-	YELLOW CLAY
196'-305'-	BLUE CLAY
305'-355'-	GRAY SAND & WATER
355'-360' -	SANDSTONE
360'-365'-	SHALE
365'-368'-	SANDSTONE
368'-380'-	SHALE
380'-384' -	SANDSTONE
384'-435'-	SHALE
435'-500' -	DAKOTA SANDSTONE

TOTAL DEPTH- 500'
STATIC WATER LEVEL- 234'
TESTED AT 125 G.P.M.
DRAW DOWN 16'



VERTICAL SCALE:- ¼" = 10'-0"
HORIZONTAL SCALE: 3" = 1'-0"

LOG OF CITY WELL
BOYDEN, IOWA

DRILLED BY RASMUSSEN BROS. WELL CO.
SIOUX CITY, IOWA - FEBRUARY 16, 1937

Rec'd from Howard Rasmussen Fall 1937