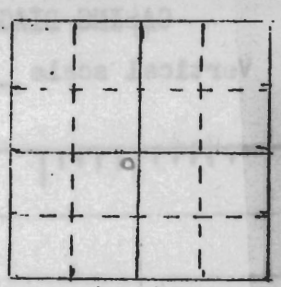
IOWA GEOLOGICAL SURVEY
In Cooperation with U. S. Geological Survey

W-0409

RECORD OF WELL


W of alley back of Tuthill Lumber Yard

Location:

Town: Larchwood (N E S W); County Lyon

NE/c SW¼ sec. 30 T. 100 N., R. 47 W. Larchwood Twp.

Well name and number Larchwood City Well No. 1

Owner Town of Larchwood Address

Tenant Address

Contractor Rasmussen Well Co. Address Leeds (Sioux City) Iowa

Drillers

Drilling dates started June 1, 1936 - Completed August 1, 1936

Well data:

Elevations: Drilling curb 1476 feet; Land surface feet

Determined by

Topographic position

Total depth: Reported 560 feet; Measured feet

Drilling method

Hole and casing data 353'8" of 8" casing from 0 to 353'8", 188'8" of 6" casing from 344'9" to 533'5", 39'7" of 4½" perforated casing from 520'5" to 560'. No record of any seals.

(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 187'6" ft. ~~above~~ below curb Date 7-31-36

Original elevation of water level ft.; Source of data A.C. Tester? by measurement

Sources of water: Principal Sandstone (Cre Dakota) 518-560; Others In course of drilling water was found in post-Cretaceous sand from 270-324

Production data: Date

Static depth to water 187.6'; Measuring point Curb

Pumping level 242' at 43 g.p.m.

254 54

Specific capacity .8 g.p.m. per ft. drawdown; Temperature 56 °F.

Pump data: Type pump ; Column: Dia. Length

Cylinder or bowls: Dia. Length; Suction pipe

Power ; Airline

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

Use of water

WATER ANALYSES (in parts per million)

pleist at dd 330'

Date sampled	July 5 1936	Aug 2, 1936	Sept. 30, 1936	
Sampled by	R.W. Wyant	A.C. Tester	W.R. Mark	
Total solids	1724	828.0	814.0	
Insoluble matter	35.0	43.2	36.0	
Alkalinity (Meo)	290.0	256.0	240.0	
Alkalinity (Phn)		0.0	0.0	
pH	7.4	7.1	7.1	
$Fe_2O_3+Mn_2O_3+Al_2O_3$	12.0	4.0	2.5	
Alkali as sodium	36.6	103.08	60.88	
Calcium	312.3	115.76	104.35	
Magnesium	97.6	29.16	36.00	
Iron (unfiltered)	5.50	0.9	-	
Manganese	3.50	0.00	0.00	
Nitrate	66.0	0.89	0.89	
Fluoride	0.9	0.5	0.0	
Chloride	20.0	64.0	59.0	
Sulphate	806.3	279.60	230.20	
Bicarbonate	353.8	312.32	292.80	
Hardness (ppm)	1197.67	411.0	410.0	
Hardness (gpg)	70			

Remarks

Laboratory data: Sample storage location

Sample range 0-555 No. spls. 95 No. dupls & cond. 37 p to f

Spls. prepared by Washed range by

Driller's log and cond. Yes

Insoluble residues: Prepared by Studied by Strip log

Microscopic study Gulf Elias strip log 1936 Carnody, Elias

Gen. log yes (also revised 1946) Correl. by Elias

W-0409

RASMUSSEN BROS. WELL CO.

Sioux City, Iowa

Larchwood City Well

Curb Elevation 1475 ft.

Well was started June 1 and completed August 1, 1936.
It is 560 ft. deep measured from top of 8" pipe to bottom of bore hole.
The well is cased with 8" standard black pipe 25 lbs. per ft. from 0 to 353'8". 6" standard black pipe extends from 344'9" to 533'5", making a lap of 9' between 8" and 6" pipe. A 6" hole was drilled through sandstone to a depth of 560', and 39'7" of 4½" black perforated pipe was installed, making a lap of 13' between 6" pipe and 4½" pipe.
Pumping test produced 43 g.p.m. for 20 hours with a drawdown of 55', and 54 g.p.m. for 6 hours with a drawdown of 67'.
Static water level - 187 ft.
Water temperature 56 degrees.

560
Jo
520'5"

Driller's Log of Well

0' to 15'	-	Yellow Clay
15' to 35'	-	Blued Yellow Joint Clay
35' to 40'	-	Yellow Clay
40' to 48'	-	Yellow Sandy Clay
48' to 52'	-	Bluish Yellow Joint Clay
52' to 52'6"	-	Yellow Gravel & Clay
52'6" to 85'	-	Yellow Sandy Clay
85' to 97'	-	Yellow Gravel & Clay
97' to 125'	-	Blue Clay
125' to 134'	-	Greyish Blue Clay
134' to 190'	-	Yellow Clay & Rocks
190' to 220'	-	Blue Clay
220' to 240'	-	Black Sticky Clay
240' to 280'	-	Fine Sandy Clay, Blue
280' to 291'6"	-	Fine Gray Sand
291'6" to 292'	-	Small Streak of Sand Clay
292' to 319'	-	Find Sand - Water Level 200' Below Surface
319' to 324'	-	Gravel & Rock
324' to 326'	-	Black Clay
326' to 528'	-	Hard Black Shale
528' to 560'	-	Sandstone, Dirty & Hard

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

IOWA GEOLOGICAL SURVEY
Generalized Log Based on Detailed
Description of Drill Cuttings
Revised, 1940

Name of Well: Larchwood No. 1 Survey No. W-0409

Drilled by: Rasmussen Bros. Well Co., Sioux City Date July-August, 193 8

Total Depth: 560 ft; Curb Elevation: 1275 ft; Static Level: 187.7 ft.

Casing Data: 8" to 353'8"; 6" 344'9" to 533'5"; perforated 4½" 520'5" to 560', overlapping 6" pipe 13'.

Pump and Screen Data:

Pumping Test: 8 Hours ___ Min; Gal. Per Min. 42.4; Drawdown 55.7 ft. in 20 min.

Temperature: Water 56°F., 5' from pump; Air 101° F., August 2, 1936, 1:30 p.m.

Description of Formations

No.	Rock Unit	Thick.	From (Feet)	To
	RECENT			
1.	Soil and loess--sandy and silty	8	0	8
	PLEISTOCENE			
2.	Sand and gravel with mixed silt	27	8	35
3.	Clay, yellow, with medium coarse sand and pebbles; gypsum fragments	5	35	40
4.	Sand and gravel, with some mixed clay	8	40	48
5.	Clay, yellow, with sandy and bouldery material and thin zones of sand and gravel at 52 ft. and 60-75 ft.	37	48	85
6.	Sand and gravel, coarse, some clay mixed	12	85	97
7.	Clay, gray, unoxidized and unleached with few pebbles and sand mixed	37	97	134
8.	Sand and fine gravel	11	134	145
9.	Clay, yellow, mixed with sand and gray clay	10	145	155
10.	Clay, gray, unleached and unoxidized, mixed with sand and gravel between 165-175 feet	35	155	190
11.	Silt and clay, light gray, thin streaks of sand and some pebbles mixed with clay	30	190	220
12.	Silt and fine sand, some glacial pebbles, thin streaks of clay. Some brown organic material 220-230	50	220	270

Notes: Producing formation: Upper Dakota sandstone. The sand was not screened or cased during pumping test.

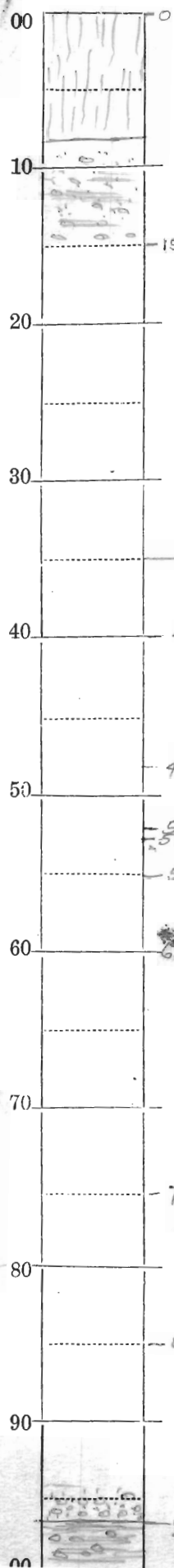
Date: February 4, 1937.

Description	Thick.	From	To
13. Sand, medium-fine grained, angular to curvilinear, water worn, wide variety of accessory minerals; contains snail shells. Becomes coarser below 310 ft. Contains water of high mineralization	47	270	317
14. Sand and gravel, water worn grains of quartz and accessory minerals	7	317	324
CRETACEOUS			
Carlile shale member			
15. Shale, light gray, calcareous, thin-bedded; contains small light buff calcareous pin-head globules, possibly foraminifera; fish remains 405-415 ft.	101	324	425
Greenhorn limestone and shale member			
16. Shale, light to dark gray, very calcareous and marly in zones; greenish zone 435-445; many fish remains and chalky material 440-445	20	425	445
17. Limestone, buff, medium to coarse crystalline; interbedded with light gray calcareous marly shaly. Many fossil fragments, oysters, foraminifera, and fish scales and teeth	10	445	455
18. Shale, like zone 16, very calcareous	10	455	465
Graneros shale member			
19. Shale, light to dark gray, calcareous, clay-like, siltstone zones, pyritic and with some black carbonaceous material	30	465	495
Dakota sandstone formation			
20. Shale, light to dark gray, very slightly to non-calcareous, clay-like, thin coal streaks 495-500 and 505-510; becomes siltstone 516-518	23	495	518
21. Sandstone, fine-grained, gray color, micaceous, glauconitic; thin interbedded with siltstone and shale 518-525 and below 555	37	518	555
22. No sample, reported by driller as fine sandstone mixed with siltstone and shale	5	555	560 T.D.
(Bottom of Dakota not reached.)			

Sheet No. 1 Name of Well Larchwood- City No. 1 Lyon Co. Survey No. W-0409

Location ..... Date Drilled Started June 1-'36 Completed Aug.-'36 Analyst Tester

Curb Elev 1475'



0-15' Loess and sand mixed; mixed ylw + gray loess; calc; Sand + gravel up to 16mm, maj. gr. 4-2mm; prim. subs. 8-4 + 2-1mm (Loess probably 8' thick; sd + grav-mixed silt to 15

15-35' Loess + sd mixed; ylw clay-loess; calc. Sand + grav. like 0-15' slightly coarser with maj grade 8-4mm Grains of qtz, felds. basic ign rx, chert, ls, qtzite, fresh qtz etc.

35'-40' Clay + silt mixed with med-coarse sd; ylw with brw iron oxide bands. Minute Calc. (Probably ylw clay interb. sd); gypsum fragments.

40'-48' Sd + fine gravel with ylw clay + silt mixed; max size grains 16-8mm. Maj. gr. 2-1mm- (Prob. Sd + grav bed with clay)

48'-50' Clay + silt, ylw, calc, micac. mixed with med-coarse sd like 40-48' few pebbles 16mm

50'-52' Sd + fine grav- maj. gr. 2-1 mm prim. subs. 4-2 mm; second. max - ½-¼ mm - some silt + clay mixed from above.; grains sub-ang to curr. qtz + mixed ign. + ls.

52'-55' Clay + silt, ylw to gray, mixed with sd + fine grav. Selenite frags; fine ign. rx. —

55'-60' Silt + sand, mixed with clay, few fine grav. frags; much Selenite up to 7mm Calc. ylw- Sd grns sub-curr-

60'-70' Sand + silt with clay mixed, similar to 55'-60' but slightly coarser; some selenite, less than above. - reg type glacial sand up to 8mm - maj gr. 2-1mm

70'-75' Clay, ylw, silty with sd + gravel mixed; coarser sd + gr, abund. Selenite; calc. (Prob. ylw oxidiz Kansan drift)

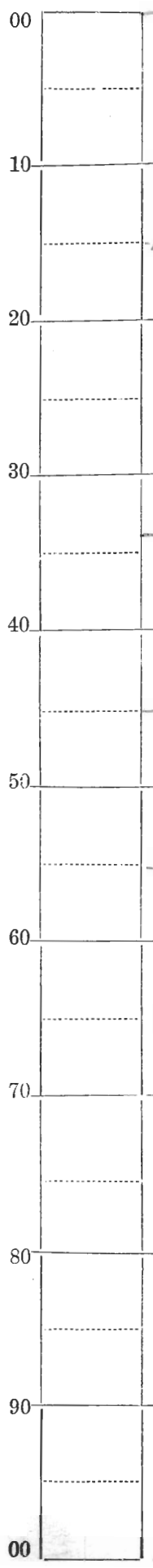
75'-85' Sand + gravel, mixed with yellow clay; coarse, grains up to 16mm - maj. gr. 8-4mm - typ. glac. coarse sd.

85'-97' Clay, gray, unoxid + unleach - mixed with pebbles + sand; some selenite

Sheet No. 2 Name of Well Larchwood City Well No. 1 Survey No. W-0400

Started 6/1/36

Location ..... Date Drilled ..... Analyst Tester



100 Clay, gray, like 97-100, fewer pebbles; selenite present. (Unoxid, unleach glac. drift)

110 Clay, gray, like 100-110, fewer pebbles larger than 100-110, (Unoxid, unleach, glac. drift)

115 Clay, gray, like 110-115', sandy & pebbly: (Unoxid, unleach glac. drift)

125 Clay, light gray, similar to 115-125; pebbles & sand & increase in silt content. (Unoxid, unleach silty glac. drift with thin irreg sd & fine gran lenses)

134 Sand & fine gravel, with ylw clay & silty mixed; sd maj. gr. 2-1mm; max size 16-8mm.

145 Clay & sand mixed; ylw-gry; fine gravel: (red brick frags - prob. to aid drilling).
(Oxid & unleach - ylw drift with sdy grav. zones -

155 Clay & sd with gravel mixed; gray color, unoxid & unleached drift Like 165-175

165 Sand & fine grav mixed with clay; gry-brn color - Maj. grade 4-2mm, much 8-4mm, max 8mm+

175 Clay & sd & gravel; glacial drift, unleach & unoxid - like 185-190 Moderate abrad sd & grav. up to 16mm-. Med to dark gray color.

185 Clay & gravel, sand coarse sd; typical glacial gray clay & sdy grav. zone (unleach & unoxid) Gravel up to 16mm. + Med to dark gray color.

190 Silt & clay; light gray; non-calc (few grams effer & some mud)

200

Sheet No. 3 Name of Well. LARCHWOOD CITY No. 1 Survey No. W-0409

Location ..... Date Drilled July 1936 Analyst Tester

00 — 200 Silt, light gray, clayey; few pebbles, some sand; calc;

10 — 210 Silt ▼ clay with sand ▼ pebbles mixed; probably glacial drift with prin. const. of siltstone ▼ sh of underlying samples. Numerous pebbles of gray ▼ pinkish ls.

Pleistocene

20 — 220 Sls: gray; calc; clayey; with glacial sd ▼ pebbles prob. cave; like 230-240! slight gry-brw organic color

30 — 230 Sls ▼ very fine sd, light gry to gry-brw color; clayey; calc: mixed with 5-10% coarse sd and pebbles (glacial) prob. cave.

(Coring Scale abund.)

40 — 240 Sand very fine grnd to Sls. light gray; angl; clayey; very slightly calc; micac ▼ (glauconitic?) like 250-260.

PLEISTOCENE (?) TERTIARY (?) Def. probably not CRETACEOUS

50 — 250 Sand; very fine to Sls; light gray much clay admix; calc; access min. like zones below; (?) micac ▼ (glauconitic)?

60 — 260 Sand; very fine grd to silty; gry; ang. to subang; rich in access. mineral; micac; (glauconitic) few curv to subrd coarse qtz grns.

? Detrital?

70 — 270 Sand; gry, slightly calc; med-fine grnd; ang-sub-ang few curvl; rich access minerals; ? (glauconitic); felds; ferro-mag; chert grns; micac; pyritic (second)

Mixed zones of very fine sd ▼ silt like above deser in second sample exact position undeterm.

Washed sample shows loss of silt ▼ general coarser portions — much clear xline qtz in abraded grains.

All samples sh. water abns.

80 — 280 Sand; gry, clean, med-fine grd; like 285-290

285 Sand; clean, fine grd ang to sub ang; rich in access min; micac; (glauconitic); ? 1 grain like 290-292 except much finer; poorly consolid; non-calc.

290 — Ss: light, clean, uncemented; med-fine grnd; sub-ang to curv to subrd; mineral, basic felds, qtzite grns ▼ some wh. chert; rich in access. min. much grn-ign.

90 — 291'6¼" Sand — very fine grnd to silty; gry; non-calc (some ls ▼ calc frags): Many ign. min. micac ▼ (glauconitic)? Much plag. felds (290-292) in large frags. — also qtzite frags.

292'1

297 Sand fine gray, sub.rd to curve, maj. gr. ½ - ¼ mm. chiefly clear qtz with dark and light igneous rx, qtzite, ls, (Glauconite abundant)?? Abund. access. mins. Pearly frags. of shells, very delicate, possibly snails (?) — numerous frags.

00

Sheet No. 4 Name of Well Larchwood City No. 1 Survey No. W-0409

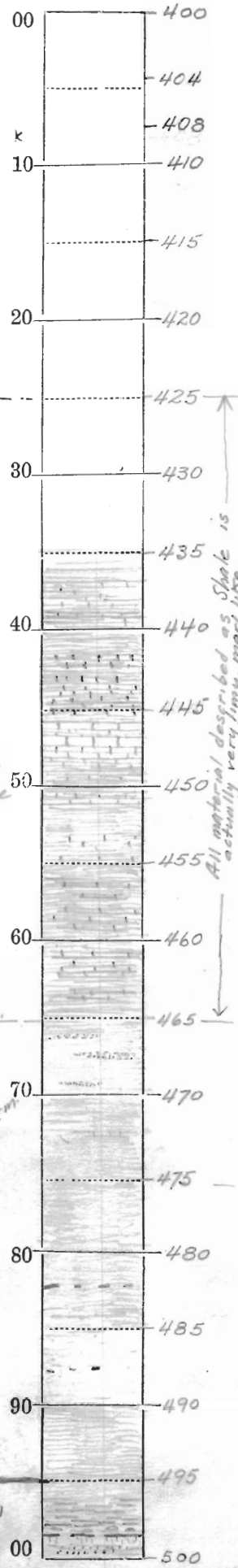
Location .... Date Drilled July 1936 Analyst Hershey

Scale	Depth	Description
	297	
00	297–302	Sand - light gray, sub-rd to curv., maj. gr. 1-½ mm. Chiefly clear qtz, mica, chert dark & light ig. rx., ls, feld., - Red pipestone slate, qtzte, plag. felds, diabase detrit. etc.
	302–307	Sand - light gray, - like 297-302: Contains Snail frags - one spire top well preserved -
10	307–312	Sand - light gray, maj. gr. ½-¼ mm, princ sub 1-½ mm., max. gr. 16-8 mm. Rd. to ang Clear qtz. chiefly, with light and dark ig. mat, qtzite., ls., (glauconite ?) shell fragments, Same sand as above
	312–317	Sand - similar to 307-312. Max. gr. 8-4 mm. - (Slightly coarser than above)
20	317–322	Congl. Sand and gravel - sand similar to 307-312, but with numerous usually rd., brown coated dolo. ls grains with red + black inclus. 2-1 mm to 4-2 mm. Gravel qtz, Chert, qtzite. ch. up to 26 mm. Gravel up to 27 mm. qtz, qtzite, dark igneous mat. chiefly. (Red qtzte + slate)
	322–324	Large brw-rd growths of glauc?? Sand and angular igneous material - sand similar to 307-312. Igneous material dark fine grained. (Boulder).
	324–326	Shale ~~lt. gray~~ (clay) calc. ~~A few~~ Much sand grains (perms. lam?) and chips of igneous material also present from above.
30	326–330	Shale: light gray; calc. [Less sand than 324-326, from above] (clay)
	330–335	Shale - ~~dark~~ light gray, calc., [slightly sandy, trace of mica and little pyrite (clay)
40	335–340	~~Shale - similar to 330-335~~ Shale - ~~light~~ med. gray, calc., free of silt and sand; slightly micaceous.
	340–345	Shale - similar to 335-340. Possibly darker colored. - some ? fossil fragments and chalky ls.
50	345–350	Shale - ~~dark~~ gray, calc., with a few sand grains and chips of dark ig. material probably contamination from above. Shale appears to be free of silt and sand.
	350–355	Shale - ~~dark~~ gray, calc, accompanied by a few angular grains of ls. dark gray, and fine grained.
60	355–360	Shale - ~~dark~~ gray, calc. accompanied by considerable sd. (cave) Shale contains small light colored calc. inclusions.
	360–365	Shale - ~~dark~~ gray, calc., with small light colored calc. inclusions. (bands) Sample contains very little sand Shale apparently free of sand or silt.
70	365–370	Shale - similar to 360-365
	370–375	Shale - (~~dark~~) light gray, calc., with less calc. inclusions than above.
80	375–380	Shale - med. gray, calc., with a few calc. inclusions. - Fossil pelecy. + ceph. + fish teeth?
	380–385	Shale - med. gray, calc. with very few light calc. inclusions.
90	385–390	Shale - med. gray, calc., with more light calc. incl. than above (chalk materials + fish remains etc.
	390–393	Shale - similar to 385-390
	393–395	~~Shale - similar to 385-390~~
	395–397	Shale - med. dark gray, calc., with small no. of soft, light colored calc. inclusions.
00	397–400	Shale - similar to 395-397.

Margin notes (left): CRETACEOUS (boundary marked at 324); K? (330–335); K (340–345); K (360–365); Definitely Cret. (375–380); √K (385–390); K (395–397).

Sheet No. 5 Name of Well: Larchwood City No. 1 Survey No. W-0409

Location ..... Date Drilled July 1936 Analyst Hershey



Shale - dark gray, calc., free of silt and sand with inclusions of light colored, soft, calc. material.

Shale - similar to 400 - 404.

Shale - med. gray, calc., very slightly gritty, pyritic, with inclusions of soft white calc. material. (probably foram shells) also fish remains etc.

Shale - similar to 408 - 410

Shale - dark gray, calc.; no pyrite seen; free of silt and sand. Less white inclusions than 408-410

Shale - similar to 415 - 420, but with more light colored inclusions.

Shale - dark gray. calc., slightly gritty; and high in light colored inclusions One small white nodule (½ mm. ±) was found to have a calcite center. Slightly pyritic.

Shale - dark gray, calc., similar to 425 - 430.

Shale - dark gray, calc, slightly gritty, contains much light colored calc. material. Few fragments of pale bluish green gray non-calc., soft, unctuous material. Pyrite

Shale, light gray to grnh-gray; very calc to marly; light buff chalky inclusions - Very flfs, fish scales, teeth, spines etc.

Limestone, gray, thin bd. very calc, slightly gritty; containing slightly less light colored material than 435 - 440. In part free of silt.; Much shark scale fossils.

Limestone 45%; buff, med. coarse x-line. Small amt. of pale bluish green gray material. Trace of very fine, sub rd clear qtz, f.s. in part columnar suggesting Inoceramus Shells.

Shale - light gray, calc., almost entirely free of grit, including a small amount of light colored material Small amt. of limestone present.

Limy shale - very calc - thin streaks marly clay -

Shale - light gray very calc., very slightly gritty, with white material in flat planar bodies ∥ to bedding of shale, and calc. Fish remains Few grains of limestone as above. Little pyrite.

Shale - Similar to 455 - 460

Shale - dark to med gray, calc., slightly gritty, with slightly less white carbonate than above. Much more pyrite (or Marcasite) than above. One small fragment of qtz seen.

Shale - dark gray, calc., containing little white carbonate, Slightly gritty, with somewhat less pyrite than 465 - 470

Shale - dark gray, calc, silty in part, highly pyritic 5 - 10 % Trace of very fine sand.

Shale - similar to 475 - 480, but with a very small amt. of black carbonaceous material, in part shiny, in part brn-blk ("lignitic coal")

Shale - (dark) gray, very silty, calc. but less so than above; small amount of carbonaceous material. Much less pyrite than above Micaceous.

Shale - similar to 485 - 490, with numerous hard, black, slightly calc material 2 mm and less in dia.; and opaque. Shale less calc.

Shale - (dark) gray, very silty, non-calc except for small calc. inclusions. High in pyrite, micaceous and with small amt. of black carbonaceous material. (impure coal) Pyrite nodules etc typical of coal streaks Few hard, black, very slightly calc. material.

Sheet No. 6 Name of Well Larchwood City Well No 2 Survey No. W-409

Location ..... Date Drilled Aug. June 1, 1936 1936 Analyst Hershey

495

DAKOTA FORMATION

Upper Shale member

Upper Sandstone Mbr

00 — 500'

No Sample - driller describes "Like zone above - muck sticky clay

505

Shale - med. to dark gray, very silty, non-calc., with 2% coal and black carbonaceous material. Pyritic and micaceous.; Some fragments are pure clay - apparently underclay(?)

10 — 510

light gray (dark gry-blk when wet)

Shale - similar to 505-510, but with less carbonaceous material. Possibly slightly less silty than above(?)
Micac; pyritic (nodular + euhedral)

515

65

Sh.

Sandstone 75% - fine: gray, maj. gr. 1/4 - 1/8 mm. prin. sub 1/2 - 1/4, 1/8 - 1/16 mm max. gr. 1 - 1/2 mm., ang to curv. qtz chiefly clear. Few calc. grains 15% pyrite. 10% dark gray shale similar to 510-515.: Sl's 10-15%. Sh - 15-20%

516+

Sl's.

518

Ss.

Ss + Sl's = micac + glauconitic + cal

20 — 520

Sandstone 85% - fine: light gray maj. gr. 1/2 - 1/4 mm. prin. subs. 1/8 - 1/4, 1 - 1/2 mm, pyritized material. SS. clear qtz ang. to curv. 15-10% pyrite; 5% black carbonaceous Detr. musc. mica; Little dark shale probably from above. Few calc. grains Much adcess. mins. Glauconite; Detrit. qtzite, feldspars.

525

No sample. Driller reports "Fine, gray Ss - like below."

30 — 530

Sandstone - fine: gray, maj. gr. 1/4 - 1/8 mm; prin. subs. 1/2 - 1/4, 1/8 - 1/16 mm.; ang. to curv., clear qtz. chiefly; frosted in part. Non-calc. Highly micaceous. Slightly pyritic.; much detrital qtzite:

535

Sandstone - similar to 530-535, but slightly darker in color.

40 — 540

Sandstone - fine; gray, maj. gr. 1/4 - 1/8 mm., prin subs. 1/2 - 1/4, 1/8 - 1/16 mm. clear, ang to curv. qtz. chiefly. Few calc. grains; Glauconite. ~~little~~ pyrite, some mica. Few fragments of black shale (A second sample marked for this depth is slightly coarser).

545

Sandstone - fine; gray, maj. gr. 1/4 - 1/8 mm., prin. subs. 1/2 - 1/4, 1/8 - 1/16 mm and less. clear ang. to curv. qtz chiefly, Some pink (qtzite) Few calc. grains. Few qtz crystals. <1% pyrite. Some mica. Glauconite in SS intergrown - common. Access. mins present.

50 — 550

Sandstone; fine; gray; maj. gr. 1/4 - 1/8 mm prin. subs 1/2 - 1/4, 1/8 - 1/16 mm.; finer than 545-50 clear, ang. to curv. qtz chiefly. Few calc. grains Pyrite; detrital feldspars qtzite (pink), mica, and access. mins: pox marked with FeO and FeS_2; 10-15% of qtz grns. Curv. subrd from previous generation.

555

No. Sample - reported to be fine Ss mixed with silty sh

60 — 562 T.

70

80

90

00

See later copy

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

Name of Well: Larchwood No. 1 Survey No. W-0409

Drilled by: Rasmussen Bros. Well Co., Sioux City Date July-August, 1936

Total Depth: 560 ft; Curb Elevation: 1475. ft; Static Level: 187.7 ft.

Casing Data: Temporary setting: 8" to 353'8"; 6" 344'9" to 533'5"; perforated 4½" 520'5" to 560', overlapping 6" pipe 13'.

Pump and Screen Data:

Pumping Test: 8 Hours ___ Min; Gal. Per Min. 42.4; Drawdown 55.7 ft. in 20 min.

Description of Formations

No.	Rock Unit	Thick.	From (Feet)	To
	Recent			
1.	Soil and loess--sandy and silty	8	0	8
	Pleistocene			
2.	Sand and gravel with mixed silt	27	8	35
3.	Clay, yellow, with medium coarse sand and pebbles; gypsum fragments	5	35	40
4.	Sand and gravel, with some mixed clay	8	40	48
5.	Clay, yellow, with sandy and bouldery material and thin zones of sand and gravel at 52 ft. and 60-75 ft.	37	48	85
6.	Sand and gravel, coarse, some clay mixed	12	85	97
7.	Clay, gray, unoxidized and unleached with few pebbles and sand mixed	37	97	134
8.	Sand and fine gravel	11	134	145
9.	Clay, yellow, mixed with sand and gray clay	10	145	155
10.	Clay, gray, unleached and unoxidized, mixed with sand and gravel between 165-175 ft.	35	155	190
11.	Silt and clay, light gray, thin streaks of sand and some pebbles mixed with clay	30	190	220
12.	Silt and fine sand, some glacial pebbles, thin streaks of clay. Some brown organic material 220-230	50	220	270
13.	Sand, medium-fine grained, angular to curvilinear, water worn, wide variety of accessory minerals; contains snail shells. Becomes coarser below 310 ft. Contains water of high mineralisation	47	270	317
14.	Sand and gravel, water worn grains of quartz and accessory minerals.	7	317	324
	Cretaceous			
	Carlile shale member			
15.	Shale, light gray, calcareous, thin bedded; contains small light buff calcareous pin-head globules, possibly foraminifera; fish remains 405-415 ft.	101	324	425

Notes: Producing formation: Upper Dakota sandstone. The sand was not screened or cased during pumping test. Accurate measurements of 8 and 6-inch casings not available at this time.

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

Date: October 13, 1936.

Description of Formations

No.	Rock Unit	Thick.	From (Feet)	To	
	Greenhorn limestone and shale member				
16.	Shale, light to dark gray, very calcareous and marly in zones; greenish zone 435-445; many fish remains and chalky material 440-445	20	425	445	
17.	Limestone, buff, medium to coarse crystalline; interbedded with light gray calcareous marly shale. Many fossil fragments, oysters, foraminifera, and fish scales and teeth	10	445	455	
18.	Shale, like zone 16, very calcareous	10	455	465	
	Graneros shale member				
19.	Shale, light to dark gray, calcareous to 495 below which becomes darker, pyritic, siltstone zones and thin streaks of coal and carbonaceous material; coal very prominent at 495-500 and 505-510; becomes siltstone with thin streaks shale 516-518 ft.	53	465	518	
	Dakota Sandstone formation				
20.	Sandstone, fine grained, gray color, micaceous, glauconitic; thin interbedded with siltstone and shale 518-525 and below 555	37	518	555	
21.	No sample, reported by driller as fine sandstone mixed with siltstone and shale	5	555	560	T.D.

IOWA GEOLOGICAL SURVEY
Generalized Log Based on Detailed
Description of Drill Cuttings
Revised, 1940

Name of Well: Larchwood No. 1 Survey No. W-0409

Drilled by: Rasmussen Bros. Well Co., Sioux City Date July-August, 193 8

Total Depth: 560 ft; Curb Elevation: 1475 ft; Static Level: 187.7 ft.

Casing Data: 8" to 353'8"; 6" 344'9" to 535'5"; perforated 4" 520'5" to 560', overlapping 6" pipe 13'.

Pump and Screen Data:

Pumping Test: 8 Hours ___ Min; Gal. Per Min. 42.4; Drawdown 55.7 ft. in 20 min.
Temperature: Water 56°F. 5' from pump; Air 101° F., August 2, 1936, 1:30 p.m.

Description of Formations

No.	Rock Unit	Thick.	From (Feet)	To
RECENT				
1.	Soil and loess--sandy and silty	8	0	8
PLEISTOCENE				
2.	Sand and gravel with mixed silt	27	8	35
3.	Clay, yellow, with medium coarse sand and pebbles; gypsum fragments	5	35	40
4.	Sand and gravel, with some mixed clay	8	40	48
5.	Clay, yellow, with sandy and bouldery material and thin zones of sand and gravel at 52 ft. and 60-75 ft.	37	48	85
6.	Sand and gravel, coarse, some clay mixed	12	85	97
7.	Clay, gray, unoxidized and unleached with few pebbles and sand mixed	37	97	134
8.	Sand and fine gravel	11	134	145
9.	Clay, yellow, mixed with sand and gray clay	10	145	155
10.	Clay, gray, unleached and unoxidized, mixed with sand and gravel between 165-175 feet	35	155	190
11.	Silt and clay, light gray, thin streaks of sand and some pebbles mixed with clay	30	190	220
12.	Silt and fine sand, some glacial pebbles, thin streaks of clay. Some brown organic material 220-230	50	220	270

Notes: Producing formation: Upper Dakota sandstone. The sand was not screened or cased during pumping test.

Date: February 4, 1937.

Description	Thick.	From	To
13. Sand, medium-fine grained, angular to curvilinear, water worn, wide variety of accessory minerals; contains snail shells. Becomes coarser below 310 ft. Contains water of high mineralization	47	270	317
14. Sand and gravel, water worn grains of quartz and accessory minerals	7	317	324
CRETACEOUS			
Carlile shale member			
15. Shale, light gray, calcareous, thin-bedded; contains small light buff calcareous pin-head globules, possibly foraminifera; fish remains 405-415 ft.	101	324	425
Greenhorn limestone and shale member			
16. Shale, light to dark gray, very calcareous and marly in zones; greenish zone 435-445; many fish remains and chalky material 440-445	20	425	445
17. Limestone, buff, medium to coarse crystalline; interbedded with light gray calcareous marly shaly. Many fossil fragments, oysters, foraminifera, and fish scales and teeth	10	445	455
18. Shale, like zone 16, very calcareous	10	455	465
Graneros shale member			
19. Shale, light to dark gray, calcareous, clay-like, siltstone zones, pyritic and with some black carbonaceous material	30	465	495
Dakota sandstone formation			
20. Shale, light to dark gray, very slightly to non-calcareous, clay-like, thin coal streaks 495-500 and 505-510; becomes siltstone 516-518	23	495	518
21. Sandstone, fine-grained, gray color, micaceous, glauconitic; thin interbedded with siltstone and shale 518-525 and below 555	37	518	555
22. No sample, reported by driller as fine sandstone mixed with siltstone and shale	5	555	560 T.D.

(Bottom of Dakota not reached.)

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Water Quality
(ppm)

Local Well No. 100-47W-30CAAA
Aquifer Code(s) KIDI
Owner's Name LARCHWOOD, IA.
W Number 0409

Card Q

State: IOWA (19) County: LYON (60) Town: LARCHWOOD, IA.

Well No. Latitude 43271 5 N (5–11) Longitude 096262 1 (12–18) Seq. No. 1 (19) Date M D Y 09 30 36 (20–25)

Sampling Depth 562 (26–29) Type 1 (30) Kx10^6 (31–35) pH 7.1 (36–38) Temp. °F 56 (39–41)

SiO_2 (42–44) Ca 104. (45–49) Mg 36. (50–53) Na +K 61. (54–58) K .C (59–61)

HCO_3 293 (62–65) CO_3 (66–67) SO_4 230. (68–72) Cl 59. (73–78) Source No. 3 (79) Q (80)

Card R

Duplicate Columns 1-25 from Card Q

F 0. (26–28) NO_3 .2 (29–32) PO_4 .08 (33–35) B (36–38) Al (39–41) Fe .6 (42–45)

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

Solids Determined (58–63) Calc. (64–69) Ca,Mg 410 (70–73) Hardness Non-Carb. 170 (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 $CaCO_3$ 240 (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)

Recorded by: D. AARONSON

Punched by: T Date:

Published:

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Water Quality
(ppm)

Local Well No. 100-47W-30CAAA
Aquifer Code(s) KIDI
Owner's Name LARCHWOOD, IA.
W Number 0409

Card Q

State: IOWA (19) (1 2) County: LYON (60) (3 4) Town: LARCHWOOD, IA.

Well No. Latitude 43 27 15 N (5–11) Longitude 096 26 21 (12–18) Seq. No. 1 (19) Date M D Y 04 02 53 (20–25)

Sampling Depth 562 (26–29) Type 1 (30) Kx10⁶ 1090 (31–35) pH 7.5 (36–38) Temp. °F (39–41)

SiO_2 (42–44) Ca 121 (45–49) Mg 43 (50–53) Na 96 (54–58) K 2.1 (59–61)

HCO_3 305 (62–65) CO_3 0 (66 67) SO_4 354 (68–72) Cl 65 (73–78) Source No. 3 (79) Q (80)

Card R

Duplicate Columns 1-25 from Card Q

F 1.0 (26–28) NO_3 57 (29–32) PO_4 (33–35) B (36–38) Al (39–41) Fe .44 (42–45)

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

Solids Determined 917 (58–63) Calc. (64–69) Ca,Mg 479 (70–73) Hardness Non-Carb. 229 (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 $CaCO_3$ 250 (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)

Recorded by: D. AARONSON

Punched by: T Date:

Published:

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Local Well No. 100-47W-30CAAA
Aquifer Code(s) KIDI
Owner's Name LARCHWOOD, IA.
W Number 0409

Water Quality
(ppm)

Card Q

State: IOWA (19) (1 2) County: LYON (60) (3 4) Town: LARCHWOOD, IA.

Well No. Latitude 43271 5N (5–11) Longitude 096262 1 (12–18) Seq. No. 1 (19) Date M D Y 08 02 36 (20–25)

Sampling Depth 562 (26–29) Type 1 (30) Kx10^{e} (31–35) pH 7.1 (36–38) Temp. °F 56 (39–41)

SiO_2 (42–44) Ca 116 (45–49) Mg 29 (50–53) Na +K 103 (54–58) K .C (59–61)

Source No. 3 Q (79–80)

HCO_3 312 (62–65) CO_3 0 (66–67) SO_4 280 (68–72) Cl 64 (73–78)

Card R

Duplicate Columns 1-25 from Card Q

F .5 (26–28) NO_3 .2 (29–32) PO_4 0 (33–35) B (36–38) Al (39–41) Fe .9 (42–45)

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

Solids Determined 828 (58–63) Calc. (64–69) Hardness Ca,Mg 411 (70–73) Non-Carb. 155 (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 $CaCO_3$ 256 (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)

Recorded by: D. AARONSON

Punched by: T Date:

Published:

IOWA GEOLOGICAL SURVEY
Water Analysis Comparison

Town: _____ County: Sioux Location: _____ Sec. ____ T. ____ N., R. ____ E. W.

Owner: _____ Contractor: _____ Date Started: _____

Well Number or Location	1 Alton	2 Boyden	3 Granville	4 Hawarden	5 Hospers	6 Hull
Depth of Sample	T. D. 30'	T.D. 21'	T.D. 416'	Shallow (Dug)	T.D. 32'	T.D. ~~1263'~~ 1300'
Formation Source	(Pleist.) Alluv.	Alluv.-in valley Loess?	Pleist. (Nebr?)	(Pleistoc.) + Alluv. (Mix)	Pleist. (Riv. alluv.)	Pleis. + Dak. + Algonk.
Water Level Below Curb						
~~How Sampled~~ Curb Elevation	1296'	1400'±	1451'±	1180'±	1347'±	1430'±
Sampled by	Mr. Mark	Mr. Mark	Mr. Mark	Mr. Fiala	Mr. Mark	Mr. Mark
Date Sampled	June 23,1934	Sept.13,1935	Sept.13,1934	Aug.24,1934	Sept.13,1934	Sept.13,1935
Total Solids	747.0	477.0	2509.0	526.0	1047.0	2667.0
Dissolved Solids	747.0	477.0	2509.0	526.0	1047.0	2667.0
Insoluble Matter	16.3	31.2	51.4	22.6	19.0	29.4
Alkalinity (MeO)	286.0	268.0	358.0	248.0	312.0	344.0
Nitrite (NO_2)	Tr.	0.001	Tr.	Tr.	0.02	Tr.
Nitrate (NO_3)	8.0	4.0	0.0	4.0	12.0	0.0
Sodium(Na) & Potassium(K)*	49.6	22.1	236.2	17.8	43.6	253.7
Calcium (Ca)	142.0	87.6	278.9	107.6	175.4	264.1
Magnesium (Mg)	42.0	28.9	135.8	29.7	50.4	171.0
Iron (Fe)	---	---	---	---	---	---
Iron (Unfiltered)**	0.3	0.1	5.0	0.1	0.2	2.0
Manganese (Mn)	1.2	0.08	0.3	0.06	Tr.	0.1
Aluminum (Al)	1.2	0.4	0.5	1.2	0.3	2.2
Fluorine (F)	1.0	Tr.	1.0	0.0	Tr.	Tr.
Chlorine (Cl)	27.0	7.0	25.0	11.0	70.0	24.0
Sulphates (SO_4)	231.1	107.3	1333.0	159.1	246.0	1446.0
Bicarbonates (HCO_3)	349.2	326.9	436.8	302.6	380.6	419.7
Phosphates (PO_4)	0.04	0.02	0.14	0.06	0.2	0.07
Borates (BO_3)	0.5	1.0	5.0	0.8	1.5	8.0
Calculated Hardness***	531.0	338.0	1262.0	391.0	645.0	1368.0
Water Lab. Number	84812	88436	88438	87443	88439	88437

*Na & K not separated, calculated as Sodium(Na): **Includes iron precipitated or flocculated after sample collected: ***Calculated as $CaCO_3$.

Completed Depth _____ ft.; Final Static Water Level _____ ft.; Production _____ GPM; Draw-down _____ ft., at _____ GPM; Gallons per foot draw-down _____. Date Completed _____ 193_.

Remarks: _____

IOWA GEOLOGICAL SURVEY
Water Analysis Comparison

Town: _____ County: Sioux Location: _____ Sec. ____ T. ____ N., R. ____ E. W.

Owner: _____ Contractor: _____ Date Started: _____

Well Number or Location	1 Ireton	2 Maurice	3 Oak Grove SP	4 Orange City	5 Rock Valley	6 Sioux Center
Depth of Sample	T.D. 168'	T.D. 30' (Dug)	T.D. 467'	T.D. 560'	T. D. 32'	T.D. 31'
Formation Source	Pleistocene (Kansan?)	River Alluv.	"Dakota and Granites"	Dakota (Upper low?)	Pleis. - Alluv.	Pleist - Alluv.
Water Level Below Curb						
~~How Sampled~~ Curb Elev.	1368' ±	1290' ±	1375' ±	1412' ±	1757'	1421' ±
Sampled by	Mr. Mark	Mr. Fiala	Mr. Mark	Mr. Mark	Mr. Mark	Mr. Mark
Date Sampled	Sept. 14 1934	Aug. 24, 1934	Aug. 14, 1934	June 23, 1934	Sept. 13, 1934	Nov. 22, 1934
Total Solids	2588.0	741.0	1310.0	2443.0	806.0	745.0
Dissolved Solids	2211.0	741.0	1310.0	2443.0	806.0	745.0
Insoluble Matter	346.8	32.4	11.2	24.5	26.2	27.4
Alkalinity (MeO)	422.0	308.0	274.0	292.0	252.0	286.0
Nitrite (NO_2)	0.025	0.0	0.0	0.04	0.001	Tr.
Nitrate (NO_3)	0.0	4.0	0.0	0.2	12.0	0.0
Sodium(Na) & Potassium(K)*	118.5	18.9	148.8	830.0	23.0	24.8
Calcium (Ca)	280.3	140.5	175.1	324.0	148.5	148.2
Magnesium (Mg)	169.0	47.1	43.0	122.0	37.6	47.9
Iron (Fe)	---	---	---	---	---	---
Iron (Unfiltered)**	2.0	0.0	3.5	4.0	Tr.	7.0
Manganese (Mn)	0.6	0.25	0.0	0.05	0.0	0.55
Aluminum (Al)	0.0	1.3	5.0	3.3	1.0	1.3
Fluorine (F)	Tr.	0.0	2.0	1.0	Tr.	1.5
Chlorine (Cl)	7.0	9.0	82.5	26.0	19.5	4.0
Sulphates (SO_4)	1123.0	293.8	597.0	1376.0	231.9	311.2
Bicarbonates (HCO_3)	514.8	375.8	334.3	356.2	307.4	348.9
Phosphates (PO_4)	0.25	0.08	0.0	Tr.	0.08	0.12
Borates (BO_3)	8.0	3.0	1.0		2.0	1.0
Calculated Hardness***	1402.0	544.0	620.0	1319.0	511.0	580.0
Water Lab. Number	88493	87448	97847	84813	88441	90567

*Na & K not separated, calculated as Sodium(Na): **Includes iron precipitated or flocculated after sample collected: ***Calculated as $CaCO_3$.

Completed Depth _____ ft.; Final Static Water Level _____ ft.; Production _____ GPM; Draw-down _____ ft., at _____ GPM; Gallons per foot draw-down _____. Date Completed _____ 193_.

Remarks: _____

1375 / 967 / 408' 1375 / 967 + Top SS / 93'

IOWA GEOLOGICAL SURVEY
Water Analysis Comparison

Town: _____ County: Sioux Location: _____ Sec. ____ T. ____ N., R. ____ E. W.

Owner: _____ Contractor: _____ Date Started: _____

	1	2	3	4	5	6
Well Number or Location	Sioux Center					
Depth of Sample	T.D. 435'					
Formation Source	Pleist. Nebr(?) or Upp. Cret.					
Water Level Below Curb						
~~How Sampled~~ Curb Elev.	1451'					
Sampled by	Mr. Mark					
Date Sampled	Sept. 14, 1934					
Total Solids	2248.0					
Dissolved Solids	2248.0					
Insoluble Matter	223.0					
Alkalinity (MeO)	378.0					
Nitrite (NO_2)	0.0					
Nitrate (NO_3)	0.0					
Sodium(Na) & Potassium(K)*	144.2					
Calcium (Ca)	242.6					
Magnesium (Mg)	130.3					
Iron (Fe)	---					
Iron (Unfiltered)**	3.0					
Manganese (Mn)	0.3					
Aluminum (Al)	0.3					
Fluorine (F)	1.0					
Chlorine (Cl)	7.0					
Sulphates (SO_4)	1031.0					
Bicarbonates (HCO_3)	461.2					
Phosphates (PO_4)	0.4					
Borates (BO_3)	4.0					
Calculated Hardness***	1148.0					
Water Lab. Number	88494					

*Na & K not separated, calculated as Sodium(Na): **Includes iron precipitated or flocculated after sample collected: ***Calculated as $CaCO_3$.

Completed Depth _____ ft.; Final Static Water Level _____ ft.; Production _____ GPM; Draw-down _____ ft., at _____ GPM; Gallons per foot draw-down _____. Date Completed _____ 193_.

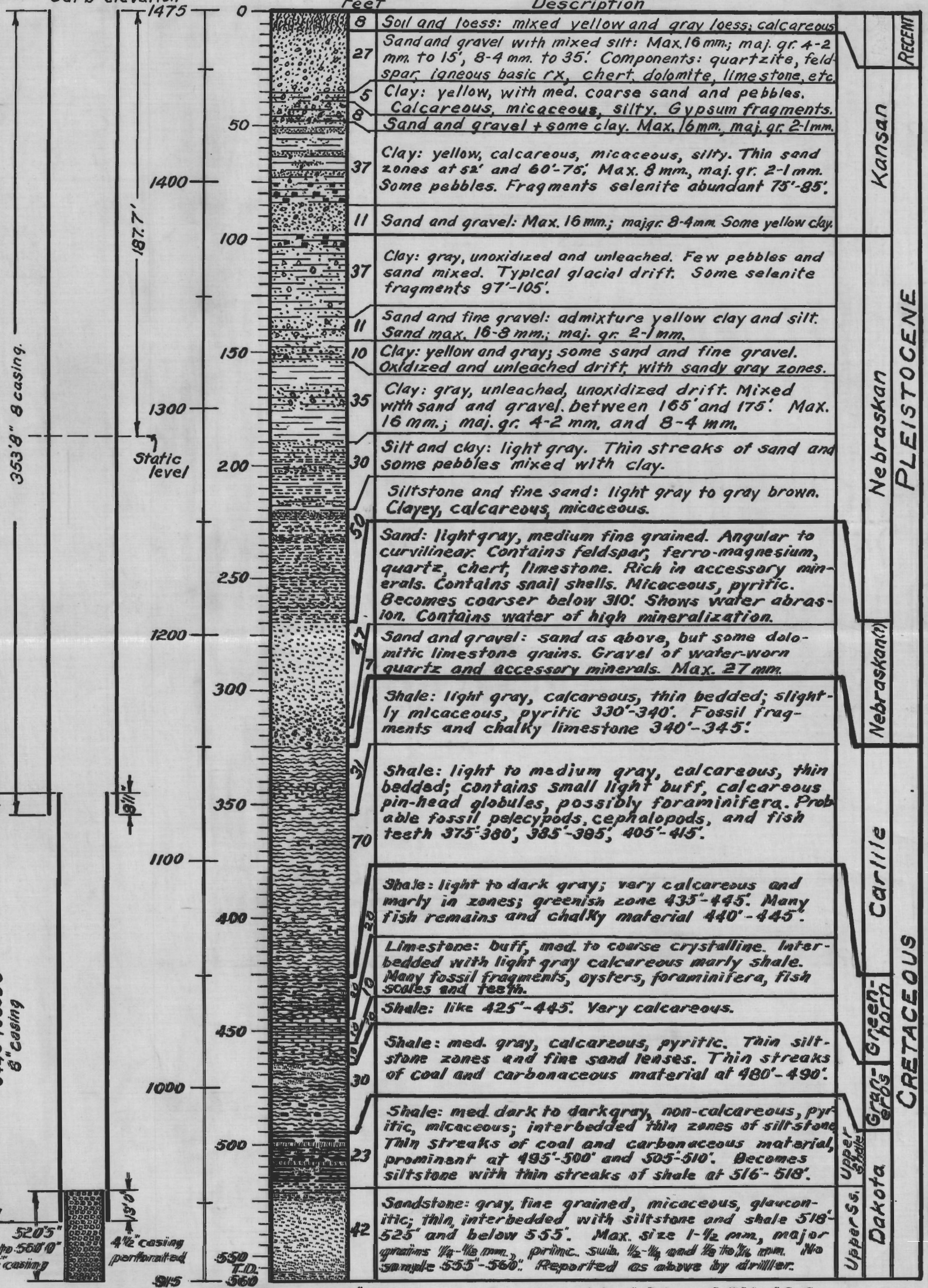
Remarks: _____

LARCHWOOD WELL No 1

LARCHWOOD, IOWA

Drilled July-August, 1936 SURVEY No. W-0409 Vertical Scale 1"= 50'

Elevations, in feet, referred to sea level.
Depth, in feet, below surface.



Feet	Description		
8	Soil and loess: mixed yellow and gray loess; calcareous		RECENT
27	Sand and gravel with mixed silt: Max. 16 mm.; maj. gr. 4-2 mm. to 15', 8-4 mm. to 35'. Components: quartzite, feldspar, igneous basic rx, chert, dolomite, limestone, etc.		
5	Clay: yellow, with med. coarse sand and pebbles. Calcareous, micaceous, silty. Gypsum fragments.		
8	Sand and gravel + some clay. Max. 16 mm., maj. gr. 2-1 mm.		
37	Clay: yellow, calcareous, micaceous, silty. Thin sand zones at 52' and 60'-75'. Max. 8 mm., maj. gr. 2-1 mm. Some pebbles. Fragments selenite abundant 75'-85'.	Kansan	
11	Sand and gravel: Max. 16 mm.; majgr. 8-4 mm. Some yellow clay.		
37	Clay: gray, unoxidized and unleached. Few pebbles and sand mixed. Typical glacial drift. Some selenite fragments 97'-105'.		
11	Sand and fine gravel: admixture yellow clay and silt. Sand max. 16-8 mm.; maj. gr. 2-1 mm.		
10	Clay: yellow and gray; some sand and fine gravel. Oxidized and unleached drift, with sandy gray zones.		
35	Clay: gray, unleached, unoxidized drift. Mixed with sand and gravel between 165' and 175'. Max. 16 mm.; maj. gr. 4-2 mm. and 8-4 mm.	Nebraskan	PLEISTOCENE
30	Silt and clay: light gray. Thin streaks of sand and some pebbles mixed with clay.		
	Siltstone and fine sand: light gray to gray brown. Clayey, calcareous, micaceous.		
50	Sand: light gray, medium fine grained. Angular to curvilinear. Contains feldspar, ferro-magnesium, quartz, chert, limestone. Rich in accessory minerals. Contains snail shells. Micaceous, pyritic. Becomes coarser below 310'. Shows water abrasion. Contains water of high mineralization.		
42	Sand and gravel: sand as above, but some dolomitic limestone grains. Gravel of water-worn quartz and accessory minerals. Max. 27 mm.	Nebraskan(?)	
7	Shale: light gray, calcareous, thin bedded; slightly micaceous, pyritic 330'-340'. Fossil fragments and chalky limestone 340'-345'.		
31	Shale: light to medium gray, calcareous, thin bedded; contains small light buff, calcareous pin-head globules, possibly foraminifera. Probable fossil pelecypods, cephalopods, and fish teeth 375'-380', 385'-395', 405'-415'.	Carlile	CRETACEOUS
70			
20	Shale: light to dark gray; very calcareous and marly in zones; greenish zone 435'-445'. Many fish remains and chalky material 440'-445'.		
10	Limestone: buff, med. to coarse crystalline. Interbedded with light gray calcareous marly shale. Many fossil fragments, oysters, foraminifera, fish scales and teeth.	Greenhorn	
10	Shale: like 425'-445'. Very calcareous.		
30	Shale: med. gray, calcareous, pyritic. Thin siltstone zones and fine sand lenses. Thin streaks of coal and carbonaceous material at 480'-490'.		
23	Shale: med. dark to dark gray, non-calcareous, pyritic, micaceous; interbedded thin zones of siltstone. Thin streaks of coal and carbonaceous material, prominent at 495'-500' and 505'-510'. Becomes siltstone with thin streaks of shale at 516'-518'.	Upper Shale / Graneros	
42	Sandstone: gray, fine grained, micaceous, glauconitic; thin interbedded with siltstone and shale 518'-525' and below 555'. Max. size 1-½ mm., major grains ¼-⅛ mm., princ. subs. ½-¼ and ⅛ to 1/16 mm. "No sample 555'-560'." Reported as above by driller.	Upper Ss.	Dakota

Pump test data: Static level 187.7' below curb. Duration of test 3 hrs. G.P.M. 42.4. Drawdown 55.7' in 20 min. Producing formation: Upper Dakota Sandstone.

Contractor: Samples interpreted & log prepared by:

Office Copy
Dec. 5, 1935

A REPORT ON THE WATER RESOURCES OF LARCHWOOD, LYON COUNTY, IOWA.

Introduction

The town of Larchwood is located in the center of section 30, T. 100 N., R. 47 W. (Larchwood township), Lyon County, and is the extreme northwestern incorporated town of the state. This location is 3½ miles south of Minnesota and 8 miles east of the South Dakota boundary made by the Big Sioux River.

The census figures for 1930 list a population of 382, but Larchwood officials state that the present population is about 420 people.

The Estherville-Sioux Falls branch of the C.R.I. & P. R.R. provides railroad service for the town. Iowa State Highway No. 9 connects with South Dakota Highway No. 38 to give a direct connection to Sioux Falls, South Dakota, 21 miles from Larchwood. Rock Rapids, the county seat, is 15 miles east of Larchwood on Iowa Highway No. 9. State Highway No. 26 connects with U. S. Highway No. 18 about 10 miles south of Larchwood.

At the present time the water needs of the town are served by numerous private wells at homes and stores and by several wells bored at city expense. Two wells have been developed by the city in the park at the west side of town, and these wells are drawn on constantly and water hauled to the place of consumption. A test well bored about two years ago south of the C.R.I. & P. station has been fitted with a pump and is now used by a few people.

cc R.W. Wyant, city clerk 12/5/35
H. Rasmussen March 13, 1936

Topography

The major portion of Lyon County is composed of an upland prairie with gentle slopes to the relatively shallow valleys. The most pronounced relief of the area is found along the bluffs of the Big Sioux River on the west and adjacent to the Rock River in the central part of the county.

The uplands west of Little Rock attain an elevation of 1505 feet; the Big Sioux River level at Beloit is about 1220 feet. The upland at Larchwood has an elevation between 1460 and 1480 feet. The elevation of the station at Larchwood is 1465 feet.

No strongly emphasized drainage pattern has been developed at Larchwood. The major portion of the town is on a very gentle, almost imperceptible slope to the southwest and west. A very shallow drainage course crosses from east to west along the railroad right-of-way. Another drainage, the major one of the area, flows from the northeast to southwest on the west side of town. The total relief made by these drainage courses is less than 25 feet in the area of Larchwood.

Loess

The material at the surface is wind-deposited loess and is known to be at least 25 feet thick in several of the wells drilled or bored on the upland divides. It is believed that a careful check of well cuttings would show a greater thickness. On the slopes and along a drainage course the thickness of loess diminishes to practically nothing if the stream has made any deposits of sand and silt.

During seasons of abundant penetrating precipitation the loess will yield a small amount of excellent water. The loess material is very fine grained, almost like a rock flour, and the pore spaces are so small that water travels very slowly. The water which enters the loess is that which soaks into the soil during a rain or the melting of a snow. Recharging the loess water reservoir is a process which fluctuates very closely with the opportunity for water to soak in at the surface. It is apparent that such water will be soft and more nearly like rain water than any other ground-water. Unfortunately, because of the close relation to precipitation the wells developed in loess are among the first to fail during a dry season, and should not be developed for a town supply.

Geologic Formations and Their Relations to Water Supply

Glacial Drift

Underlying the loess is a thick layer of glacial drift composed of clay, sand, gravel, and boulders. In parts of the drift the material is sorted and free of clay, but in other parts the materials of all kinds are in a heterogeneous mixture. A zone called gumbotil is of a blue or gray clay which is very sticky and gummy and practically free of sand or gravel. Other zones are yellow or dark gray to black clay with pebbles, boulders, and sand.

Within the glacial drift the sorted sands and gravels are the principal water producers, and in some places several of such water-bearing zones may occur. If the bed is of considerable thickness and underlies a large area, the amount of water may be very large and a supply sufficient for a town of several

thousand people is available. Such a bed may be recognized by its association with the yellow or black clay containing pebbles and boulders or by the variety of types of rocks found in the pebbles. That is, the pebbles of a coarse sand or gravel water-bearing bed are of white, gray, red, green, black, or a mixture of colors and were derived from different varieties of limestone, granite, quartzite, basalt, slate or sandstone. In numerous cases there is a large amount of iron or lime cementing the gravel bed, and the zone may drill slowly like a bed of sandstone or limestone.

According to the records of the wells studied by the writer, there are several of the glacial sand and gravel beds underlying the area adjacent to Larchwood. One zone which is encountered between 120 feet and 160 feet below the upland level of 1475 feet produces water in many places. The depth is greater or less depending on the surface elevation. This zone is interpreted as occurring at the base of the Kansan age of glacial drift.

A second gravel zone occurs about 100 feet to 140 feet lower or a depth between 220 feet and 300 feet and usually rests on a gray to black shale. The gravel bed is believed to be at the base of the Nebraskan age of glacial drift and to be underlain by shale of upper Cretaceous age (probably Graneros formation).

The wells of Hohman, west of town, Groth, northeast of town, Bontje Bros., and Hookendorn, southeast of town, all produce water from one or the other of the glacial gravel beds. Also, the town wells of Inwood (335 feet and 96 feet), Lyon

County, and Granville, Ireton (168 feet, old well), and Sioux Center of Sioux County all produce from the glacial gravels.

The analysis of the principal constituents of the water from the various wells mentioned above, as shown on Table I, gives a very clear idea of the type of water to be expected from the glacial gravel sources. The character of the water is such that it cannot be recommended for public use of even a domestic type. Inspection of column 10 which is an average of the 9 analyses shows that the hardness, sulphate, iron, lime, and magnesium content is beyond a reasonable limit. Such a water would cause corrosion of pipes and staining of fixtures, besides being unpleasant to drink.

Valley Deposits

Closely associated with the glacial drift deposits are the materials washed down the valley slopes and spread on the valley flats. The origin of this material is varied, but in all cases bearing on the situation at Larchwood and towns in Lyon and Sioux counties the deposits are the latest in the geological history of the area. Along the principal streams of Lyon County a thickness of 40 feet to 50 feet of material has filled parts of the valley, and a recognizable valley flat has been formed. These deposits are composed largely of medium and fine sand, but layers of silt and clay are present. In a few locations a fine gravel has been found. At Little Rock the material is coarse gravel interbedded with sand and silt.

TABLE I

Principal Constituents of Water From Glacial Drift
Lyon and Sioux Counties
(Shown in parts per million)

	1 Hohman	2 Groth	3 Bontje Bros.	4 330' Well	5 Inwood	6 Inwood	7 Granville	8 Ireton	9 Sioux Center	10 Average
Dissolved Solids	2434.0	2556.0	1982.0	4009.0	2805.0	2993.0	2509.0	2211.0	2248.0	2638.5
Sodium & Potassium	49.4	239.6	83.4	---	121.5	48.2	236.2	118.5	144.0	130.1
Calcium	543.4	337.5	307.1	489.9	466.9	243.9	278.9	280.9	242.6	354.56
Magnesium	80.8	132.8	117.6	175.2	156.9	316.2	135.8	169.0	130.3	157.16
Iron (unfiltered)	1.4	10.0	6.25	6.0	2.5	Tr.	5.0	2.0	3.0	4.02
Fluorine	0.0	1.0	0.50	0.5	0.0	0.0	1.0	Tr.	1.0	0.44
Chlorine	8.5	17.0	6.0	56.0	10.0	10.0	25.0	7.0	7.0	16.26
Sulphates	1392.5	1414.5	1042.5	2293.9	1653.0	1654.0	1333.0	1123.0	1031.0	1437.36
Bicarbonates	347.7	441.0	395.3	----	380.6	356.2	436.8	514.8	461.2	416.7
Hardness(Calculated)	1695.5	1407.0	1264.0	----	1810.0	1914.0	1262.0	1402.0	1148.0	1487.8

1. Hohman well, west of Larchwood, depth 80 ft. Curb elevation 1460 ft.±. Sample No. 100020.
2. Groth well, northeast of Larchwood, depth 410 ft. Curb elevation 1475 ft.±. Sample No. 100018.
3. Bontje Bros. well, southeast of Larchwood, depth 275 ft. Curb elevation 1460 ft.±. Sample No. 100017.
4. (Well 1 mile south of Bontje Bros.) T.D. 330 feet. Sample No. 100402 (Collected by R.W. Wyant) W. G. Warner Owner Se-ne-Sec. 9-T 99N-R 47W
5. Inwood well, depth 335 ft. Curb elevation 1464 ft.±. Sample No. 90868.
6. Inwood well, depth 96 ft. Curb elevation 1464 ft.±. Sample No. 88315.
7. Granville well, depth 416 ft. Curb elevation 1451 ft.±. Sample No. 88438.
8. Ireton, old well, depth 168 ft. Curb elevation 1368 ft.±. Sample No. 88493.
9. Sioux Center well, depth 435 ft. Curb elevation 1451 ft. Sample No. 88494.
10. Average of nine samples.

The shallow valley at the west and northwest of Larchwood is of the type described, but unfortunately is of a very shallow depth and does not contain a great thickness of sand or large quantity of water. In case this type of water is considered for development, very careful prospecting should be done at sites properly selected north of the business district. No test drilling should be done without a location approved by the writer. Table II gives the analyses showing only the principal constituents of water derived from the valley flat source.

Cretaceous Sands

Below the 300 to 400 feet of surficial material and glacial drift occurs the shales, marls, and sandstones of the Cretaceous system. The shales are characteristically dark gray to black in color and are thinly bedded and compact. Because of the smoothness of the shale and its tough character during drilling, it is frequently described as 'soapstone'. The shale contains a relatively large amount of iron pyrite (FeS_2) and selenite (a gypsum mineral) which usually imparts to water associated with the sands in the shale a high content of lime, iron, and sulphates. Table III lists two analyses (Columns 1 and 2) of water of this type. This is not a satisfactory water for a municipal supply.

Analysis column No. 3 of Table III is from a new well recently drilled for the Oak Grove State Park north of Hawarden. This water is a mixture from zones of sand in the shale and a sandstone zone in the lower part of the well and below the shale. Inspection will prove that the quality of this water

TABLE II

Principal Constituents of Water From Shallow Valley Sands Lyon and Sioux Counties

	1 Larch-wood	2 Larch-wood	3 Lester	4 Alvord	5 George	6 Doon	7 Rock Rapids	8 Rock Valley	9 Sioux Center	10 Alton	11 Little Rock	12 Average
Dissolved Solids	998.0	553.0	1372.0	805.0	738.0	849.0	499.0	806.0	745.0	747.0	1398.0	864.5
Sodium & Potassium	47.7	---	47.2	30.8	28.5	25.6	18.1	23.0	24.8	49.6	48.2	34.3
Calcium	188.4	111.2	197.3	143.2	115.7	134.0	106.8	142.5	148.2	142.0	234.5	151.2
Magnesium	55.4	38.0	86.4	45.4	43.2	36.6	36.2	37.6	47.9	42.0	76.1	49.5
Iron (unfiltered)	2.5	0.5	0.2	0.5	0.1	0.1	Tr.	Tr.	7.0	0.3	2.2	1.2
Fluorine	0.5	1.0	1.0	0.0	1.0	1.0	1.0	Tr.	1.5	1.0	1.5	0.9
Chlorine	6.0	15.0	96.0	23.0	34.0	36.0	11.0	19.0	4.0	27.0	16.0	26.9
Sulphates	430.4	83.3	350.0	263.6	132.2	116.3	81.2	231.9	311.2	231.1	633.7	260.4
Bicarbonates	396.5	----	409.9	361.1	336.7	300.1	436.8	307.4	348.9	349.2	409.9	365.6
Hardness	703.0	----	848.0	546.0	466.0	485.0	415.0	511.0	580.0	531.0	902.0	598.7

1. Larchwood City Park; dug and bored, T.D. 60-65 ft. Curb elevation 1465±. Sample No. 100019.
2. Bored well, two blocks north of west end of Larchwood City Park, T.D. 38 feet. Sample No. 100401
3. Lester, T.D. 23 feet. Curb elevation 1370 ft. ±. Sample No. 88312.
4. Alvord, T.D. 40 feet. Curb elevation 1315 ft. ±. Sample No. 88316.
5. George, T.D. 33 feet. Curb elevation 1365 ft. ±. Sample No. 88311.
6. Doon, T.D. 29 feet. Curb elevation 1275 ft. ±. Sample No. 88313.
7. Rock Rapids, T.D. 32 feet. Curb elevation 1365.2 ft. Sample No. 88440.
8. Rock Valley, T.D. 32 ft. Curb elevation 1257 ft. Sample No. 88441.
9. Sioux Center, T. D. 31 feet. Curb elevation 1421 ft. ±. Sample No. 90867.
10. Alton, T.D. 32 feet. Curb elevation 1296 ft. Sample No. 84812.
11. Little Rock, T.D. 30 feet. Curb elevation 1470 ft. ±. Sample No. 88314.
12. Average of 11 samples.

TABLE III

Principal Constituents of Water From Cretaceous Rocks
Lyon and Sioux Counties
and
Canton, South Dakota

	1 Hull	2 Orange City	Average (of 1&2)	3 Oak Grove State Park	4 Kennedy	5 Newton Hill	6 Canton No.1	7 Canton Asylum	Average (of 4,5,6,7)
Dissolved Solids	2667.0	2443.0	2555.0	1310.0	448.0	776.0	666.0	824.0	678.75
Sodium & Potassium	253.7	230.0	241.85	149.8	97.0	211.0	194.0	185.0	171.75
Calcium	264.1	324.0	294.05	175.1	45.0	42.0	30.0	62.0	44.75
Magnesium	171.0	122.0	146.5	43.0	18.0	17.0	13.0	27.0	18.75
Iron (unfiltered)	2.0	4.0	3.0	3.5	0.6	0.4	0.5	4.1	1.4
Fluorine	Tr.	1.0	0.5	2.0	---	---	---	---	---
Chlorine	24.0	26.0	25.0	22.5	5.5	22.0	15.0	32.0	18.63
Sulphates	1446.0	1376.0	1411.0	597.0	81.0	263.0	164.0	306.0	203.5
Bicarbonates	419.7	356.2	387.85	334.3	361.0	405.0	432.0	361.0	389.75
Hardness	1368.0	1319.0	1343.5	620.0	186.0	175.0	128.0	266.0	188.75

1. Hull, T.D. 1263 ft. Curb elevation 1430 ft.±. Sample No. 88437.
2. Orange City, T.D. 560 ft. Curb elevation 1412 ft.±. Sample No. 84813.
3. Oake Grove State Park, T.D. 467 ft. Curb elevation 1375 ft.±. Sample No.97847.
4. Kennedy Farm well, NW¼ Sec. 27, T. 99 N., R. 49 W., Lincoln Co. S.D. T.D. 362 ft. Curb elev. 1385 ft.
5. Newton Hill farm well, SE¼ Sec. 13, T.97N.,R.49W., Lincoln Co.,S.D. T.D. 502 ft. Curb elev. 1500 ft.
6. Canton,S.D., City Well No. 1, SW corner Dakota and 9th Sts. T.D. 306 ft. Curb elevation 1260 ft.
7. U.S. Asylum Insane Indians, east of Canton, SE¼ Sec. 18, T.98N.,R.48W., Lincoln Co., S.D. T.D. 322 ft. Curb elevation 1270 ft.

Well data and analyses 4-7 incl., from U.S.G.S. Water Supply Paper 597, 1929.

is much better than that from the higher sand formations due to the freshening affect of the lower sandstone water.

Table III shows in addition to the analyses mentioned above four analyses from the Canton, South Dakota, district. The water from the Canton wells is produced from the Dakota sandstone below the heavy, black, carbonaceous, pyritic, sulphurous shales. The water is commonly known as coming from the "soft water zone." Even a casual inspection will show that this water is of the best quality reported in any analysis group in this report, with the possible exception of the water from the shallow domestic well at the northwest part of Larchwood.

The soft water Cretaceous sandstone zone should be encountered at a depth of between 515 and 560 feet below the surface of the upland at Larchwood. Inasmuch as the Canton area is approximately 12 miles in a straight line from Larchwood and Ellsworth, Minnesota, and other southern Minnesota points which likewise produce soft water are within 20 miles in a straight line, it is believed that the soft water zone underlies Larchwood.

The drilling of a well to develop the Dakota sandstone "soft water zone" should receive very special attention. Some of the hazards are as follows:

1. The acceptance of a water zone without critical examination and analysis of water in place of the real soft water zone.

2. The drilling past the soft water zone without testing it and developing a lower water of poor quality.

3. The failure to properly develop the true soft water zone and to recover the desired amount of water.

4. Improper screening of the true soft water zone with the resultant short life of the well.

All of the above hazards can be eliminated by the proper supervision of the drilling with a careful preservation and examination of samples so that the exact geologic formation can be identified. The proper testing and construction of the well can be assured by careful selection of drilling contractor.

Recommendations

The preliminary analysis of water sampled by Mr. Wyant on December 2 and included in this report on Table II shows that of the water analyses available for the territory immediately adjacent to Larchwood that the highest quality of water can be obtained from a shallow well in the thin deposits of the small valley to the northwest of town. A very careful prospecting should be done in this area, as the analyses of the water from the city park well and from the Hohman well show that there is a pronounced variation in the quality of water from relatively shallow depths. It is obvious that only the best water, as shown by the well northwest of town, is desired, and under no circumstance should a well deeper than 35-40 feet be attempted. The writer prefers to make a specific location in the field for testing, provided this type of water supply is used.

If the shallow water is developed after proper testing, including analysis of water and pumping tests of 48 to 60 hours duration, then the well of the best type would be of a stabilized screened variety or of a gravel pack variety. Unless an especially desirable location and character of materials, including impervious clays, is established by the test drilling, the writer does not recommend this type of final well for the Larchwood city water supply.

A second type of well for Larchwood is one drilled to the "soft water sandstone zone" of the Dakota formation. As mentioned previously, the depth below the upland surface at Larchwood would be approximately 515 to 560 feet. This well should be drilled and cased, properly developed and screened by a competent contractor with equipment sufficient to drill to the depth indicated a well of a minimum of eight inches diameter at the surface. Cast iron pipe should be set to ~~the bottom of the well~~ the top of the soft water producing zone. Ordinary steel casing, even though of heavy weight, would not withstand the corrosive affects of the high content sulphate waters. The contractor should have sufficient proper equipment to cement the casing at the bottom and to complete the well in a straight and plumb position, in order that a guarantee can be given by pump manufacturers for a satisfactory operation for turbine pumping equipment.

A. C. Tester
Assistant State Geologist

December 5, 1935

November 30, 1935

Mr. R. W. Wyant
Security Savings Bank
Larchwood, Iowa

Dear Mr. Wyant:

The analyses of the water samples which I took at Larchwood last Saturday are now available. The results are not encouraging, but after giving the subject considerable thought I desire to obtain additional samples.

By ~~separate cover~~ express collect I am sending to you today two empty, one-gallon bottles. I will appreciate your assistance in obtaining a sample of water from each of the wells described below. Possibly Doctor Sawyer can assist you, as he will have in mind the locations that we discussed.

VCL:V

There is a well about a mile south of the Bontje Brothers' farm which was described to me as being about 515 feet deep. I would like to have a sample of this water. Please check with the owner the depth of the well, the size and depth of casing, and the level of the water in the well before pumping.

The second sample I desire from the private well in the northwest part of town which you consider of the best quality. Doctor Sawyer described several wells in this location that are believed to be the best water in town. I wish to compare this with the water from the city park well and from the Hohman well.

It is necessary that I ask the town of Larchwood to pay the transportation charges for the containers and the return of the samples. I trust you will not object to taking care of this relatively small cost.

December 3, 1935

Mr. R. W. Wyant
Security Savings Bank
Larchwood, Iowa

Dear Mr. Wyant:

The two bottles of water arrived today and are now being analyzed. I will have the report available on these Thursday afternoon, the fifth, and will forward my report to you that evening.

I note that the well about one mile south of the Bontje Brothers farm is only 330 feet deep. It may be that Mr. Gallup was mistaken, but he informed me of a well in that locality of 515 feet deep. Do you know of any well in the locality south of the Bontje farm and southwest of the Hookendorn farm that is over five hundred feet deep? Of course, it will be too late to get in a water sample before I send my report, but I would still like to get this point clear; and if we can find a well between 500 and 600 feet deep, get a sample from it for future study.

I wish to thank you for your cooperation.

Yours very truly,

A. C. Tester

ACT:A

SECURITY SAVINGS BANK

C. T. SWANSON, PRESIDENT
AUG. SWANSON, V. PRESIDENT
R. W. WYANT, CASHIER

LARCHWOOD, IOWA

January 24th, 1936.

Mr A.C.Tasker

Iowa City, Iowa.

Dear Sir;

I wish to thank you kindly for your letter of January 21st, showing your interest in our prospecting for water.

I am sorry to say that as yet we have not secured sufficient water for a town well. The first test well was drilled on the Hecht property, the drillers have in their possession a complete log of well, they struck sand at 46' and then went thru about 14' feet of sand, even though the sand was fine there seemed to be some prospects of the making of a good well, however upon pumping it it did not hold up, it was pumped for about five hours producing about 20 galons a minute, during the first two hours of pumping the Hecht well went dry, also during the pumping sand was pumped all of the time, they had about 8' foot of screen in the well but not fine enough to hold out the sand and of course if they had had a finer screen the water would not of come in as fast either. At the end of the five hours pumping it seemed that there was but very little water left, however the sand was bothering so much that it was hard to tell. They then went down to about 90' however they did not strik any more sand or gravel and it seemed that they were running into the blue clay. Upon the pulling of the casing and filling up of the well the Hecht well came back in about four days time, so it does appear that there is plenty of water it that hill if we could strik a bed of gravel, this test hole was drilled about 50' directly east of the Hecth well.

On the second test hole they are now drilling about 500' west and 200' north of the Hecht well, the weather has been so bad since they started on this that as yet we do not know how it will work out, it appears to be a good spot and the prospects might be a coarser gravel. Again thanking you for the interest you have taken in this matter and assuring you that we will keep you posted regarding our progress, We remain,

Yours Very Truly

Clerk.

TOWN OF LARCHWOOD
LARCHWOOD IOWA

Larchwood, Iowa,
March 18, 1936

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

Dear Mr. Tester:

It has been a long time since we have taken up the well proposition, however, wish to acknowledge receipt of your letter of January 29, regarding the change of location for test well No. 1.

Replying to this wish to advise that we had no intention of going against your instructions. However, the proposition was put up to the well men to test the Hecht well. They came back at us stating that they would much rather drill and test a new hole than to bother with the old bored well and would make us a price on such work, therefore I think the Council then moved close to this particular well so that they could get a test of the Hecht well, which test I set forth in my letter as of January 24. As explained to you in my letter of January 24, we then went west and a little north of test well No. 1 and went down 67 feet without any results whatsoever. The weather then became so severe that no more work was done until just this last week, where we then put down a test hole as located by you, and No. 1 being east and north of the Hecht well. We went down here some odd 87 feet with no results, not even running into the same sand as when we drilled near the Hecht well. We are now contemplating putting down one more test hole, being on the location picked by you and No. 2. This location would be south of the west end of our Park.

It does not appear that we are going to have very good results on our shallow test wells, and of course this testing is running into a lot of money, and unless we do get results from this last test hole we would like very much to have a meeting in Larchwood with our engineers, yourself, some reliable well men and an official of the PWA, at which time we would then decide on what course to pursue regarding the securing of an adequate water supply for Larchwood.

We assure you that we appreciate very much the time and troubleyou have taken in trying to help our situation and trust that I have explained the reason why we did not follow your original instructions regarding the first test hole.

Will keep you advised as to our last test well and in the mean time will appreciate hearing from you regarding this matter.

Yours very truly, V. A. Schaut Clerk

RASMUSSEN BROS. WELL CO.

RUSSELL
PHONE
5-7595

~~5000~~ 3604 FOURTH AVENUE
SIOUX CITY, IOWA

HOWARD
PHONE
6-6219

March 26, 1936

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

Dear Doctor:

We are pleased to acknowledge receipt of your letters of the 13th, also the sample bags, drillers' log books, the blue print of the Orange City Creamery well and copy of the report which you submitted to the Town of Larchwood, for which we wish to thank you. I certainly enjoyed reading the report which you sent to the Town of Larchwood.

At this time we have completed five test holes for the Town of Larchwood. The last three were drilled in the locations which you suggested.

Test Hole No. 3 was located at the exact spot where you suggested drilling test hole No. 1, and was drilled to a depth of 83 feet, but no water was encountered.

Test Hole No. 4 was located directly south of town close to the highway and was drilled to a depth of 100 feet, but no water was encountered.

Test Hole No. 5 was located South-west of town, down by the railroad track and was drilled to a depth of 65 feet, with only a little surface water found.

I was in Larchwood yesterday and talked to the Clerk and two of the Councilmen and they seem to be very much in favor of drilling a deep well. I talked with Mr. Winters, of the Buell and Winters Engineering Company, and he said he would write Mr. P. F. Hopkins, P. W. A. Engineer, for permission to start drilling a ten inch well to a depth of 100 feet, which is in accordance with our contract, advising Mr. Hopkins that we no doubt would have to drill to a depth of 500 feet before securing a sufficient supply of water. After we have drilled the 100 feet it will be necessary for us to get a change order to continue with the work. I do not know whether or not he can get this approved by Mr. Hopkins, but if he can it will save us considerable time. I suggested to Mr. Winters that we would agree on the price per foot for the drilling of the balance of the well before ever starting to drill.

With kind personal regards, I am

Yours very truly,

Russell R Rasmussen

RASMUSSEN BROS. WELL CO.

R/R

TOWN OF LARCHWOOD
LARCHWOOD IOWA

March 28, 1936.

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

Dear Mr. Tester:

I wish to thank you kindly for your letter of March 24, regarding the well situation at Larchwood, and wish to say that the results of the test well located south of the west end of our Park did not prove satisfactory.

We have taken this matter up with our Engineers, Buel and Winter, of Sioux City, Iowa, and Mr. Winter advises us that he has written Mr. Hopkins, Acting State Director PWA regarding our situation, and as soon as we hear from Mr. Hopkins and Mr Winter we will advise you as to what course we intend to pursue.

Yours very truly,

TOWN CLERK

TOWN OF LARCHWOOD

LARCHWOOD IOWA

A. C. Tester, Ass't State Geologist,
Geology Bldg.,
Iowa City, Iowa.

Dear Mr. Tester:

Under separate cover we are this date forwarding to your office earth samples and also a water sample of the town well, Larchwood.

The earth samples speak for themselves with the exception of a possible explanation regarding the last solid sample of sand and earth, which I will try to explain. For the last forty feet the drillers had been in this real fine sand then they hit about two inches of solid sand and earth, which you have an unmixed sample of, and immediately after that they run into a coarser sand and immediately stopped, with the tought in mind that they would run down inside the eight inch casing a five inch casing to find out just how deep this coarser sand might be.

The sample of water that I am sending you was taken out of their slush bucket into a larger container and left to settle for about an hour, the clear water being sent to you.

The well drillers will be back on the job Monday with the smaller casing and would suggest that you wire me at our expense as to what day you could be here so they would know about how to proceed with their work. I imagine they would be able to know considerable more about this lower layer of sand by Tuesday and if you could arrange to be here Tuesday it might not hold them up with their work.

Will appreciate it very much as long as you are coming to Larchwood if you will bring along with you a couple of glass jugs to be used in sending in samples of water.

Yours very truly,

Town Clerk

Drilling Starts for Larchwood's Well

Rasmussen Bros. of Sioux City are Down More than 100 Feet Already

Thursday of last week drilling started on the new city well that is expected to furnish water for the Larchwood waterworks system to be installed this summer. Rasmussen Bros. of Sioux City, who have the contract for the well, brought their big rig to town recently and "spudded in" Thursday. By Monday noon the well was down sixty-five feet to seventy feet and by this time it will be past the hundred foot mark.

The drill used weighs better than 1,300 pounds and it is powered by a big truck engine. The well is located in the rear of the Tuthill lumber yard, on the property already owned by the city. The standpipe will be built directly north of the well, in the event there is plenty of water available, as is confidently expected. When the water supply is assured, the contract for the building of the water mains will be started.

TOWN OF LARCHWOOD

LARCHWOOD IOWA

Tester, Ass't State Geologist,
y Bldg.,
ity, Iowa.

r. Tester:

In reply to your letter of June 24, o advise that drilling was started on our own well about the first of June. However, ave not progressed so very rapidly due to the that they had considerable trouble with rocks epth of about eighty to ninety feet, which them up considerable, and at the present time are down to a depth of approximately 150 feet, I understand the matter they have been going gh blue clay from the depth of about ninety feet and are still in blue clay.

The samples that you request will be forwarded to you immediately, and we assure you that we appreciate your interest very kindly and if there is any information that you desire other than what we have given you kindly advise and same will have our immediate attention.

Yours very truly,

W. W. Wyant.

Town Clerk

Note: 6/21/31

The driller just went in and stated that he was down to a little over 200' and in a little soft blue clay.

Wyant.

August 6, 1936

Mr. P. F. Hopkins
State Director, PWA
407 Federal Court Building
Des Moines, Iowa

Dear Sir:

Re: Docket Iowa-1126-R, Larchwood
Water Works.

A copy of your letter of August 5 addressed to Buell and Winter came to my attention this morning. For your information, will say that the sample of water was taken at the time of the pumping test of the Larchwood well and this sample will be run for chemical composition. However, no sample in a sterile container was taken for bacteriological analysis. The matter was discussed at the time, but it was concluded that a sample taken under the existing conditions would very likely show a bacterial contamination.

The mayor and council of Larchwood raised the point concerning a bacteriological analysis, as they did not know whether your office would authorize the starting of water main work, storage tower, and other phases of the project until the well had been accepted on the basis of chemical and bacteriological analysis and quantity. There is additional work to be completed in the well, such as setting the 6-inch pipe, setting a 5-inch perforated and sealed pipe in the producing formation, in addition to the setting of the permanent pump. All of these operations provide an opportunity for the introduction of bacterial contamination which will be counteracted by a complete treatment and sterilization when such work is completed. Until such sterilization is done, we could hardly expect a satisfactory bacterial analysis.

For my own information, I would like to know if the balance of the work will be delayed until the bacteriological analysis shows a satisfactory condition of the water. The type of construction used in this well is such that once the contamination introduced by construction operation has been counteracted and the proper surface seal has been made, there is no chance for further contamination of the water.

It will be approximately a week before the chemical analysis of the water is ready, and at that time a copy will be sent to your office.

Yours very truly,

A. C. Tester

ACT:A
CC: Buell & Winter Engineering Co.
R. W. Wyant

August 7, 1936

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

Dear Mr. Buell:

Your letter of August 6 reached me this morning, evidently crossing in the mail my letter addressed to Mr. Hopkins and copies sent to you and Mr. Wyant at Larchwood.

In order that there be no misunderstanding, I will repeat that the sample of water which I collected at the time of the pumping test will be given a full chemical analysis in the State Water Analysis Laboratory as a part of our general Survey and Planning Board work, and there will be no charge for this. A preliminary analysis should be available within the next two or three days.

I do not know just how they will get a sample of water for bacterial analysis unless it is taken from a bailer, as it will be some time before the pump is put in. It seems ridiculous to me that any one should expect to pass approval of a water supply on a bacterial analysis derived from a sample taken when the well is in process of construction. If a well fails to show satisfactory condition after completion and proper sterilization, then I would be the first one to refuse it; but under the circumstances it seems a needless procedure.

Yours very truly,

A. C. Tester

ACT:A

BUELL & WINTER ENGINEERING CO.

PLANS REPORTS
ESTIMATES SUPERVISION
APPRAISALS

MUNICIPAL ENGINEERS
INSURANCE EXCHANGE BUILDING
SIOUX CITY, IOWA

SEWERAGE PAVEMENTS
WATERWORKS SEWAGE DISPOSAL
POWER PLANTS

August 6, 1935.

Dr. Tester,
State University of Iowa,
Iowa City, Iowa.

Dear Doctor:

Youhhave a letter from Mr. Hopkins, dated August 5th in regard to the Larchwood well requesting bacteriological and chemical analyses of the water.

We have written Jack Hinman to send a container to the Town to have the bacteriological analyses made.

We do not know whether anyone at Iowa City makes the chemical analyses or not. We have written Mr. Howard Maffitt of DesMoines to quote Mr. R. W. Wyant, Town Clerk of Larchwood a price for making a chemical analyses.

If anyone at Iowa City makes these chemical analyses we would request that they get in touch with Mr. Wyant at once by wire, quoting him a price on the same.

Thanking you for your assistance in the past on the Larchwood job, we remain

Very truly yours,

BUELL & WINTER ENGINEERING CO.

WEB:ER

By W E Buell

FEDERAL EMERGENCY ADMINISTRATION OF PUBLIC WORKS

STATE DIRECTOR

407 Federal Court Bldg.,
Des Moines, Iowa
August 8, 1936

IN REPLY PLEASE REFER TO

Dr. A. C. Tester,
Assistant to State Geologist,
Iowa City, Iowa.

Re: Docket Iowa 1126-R
Larchwood Water Works

Dear Dr. Tester:

Thanks for your letter of August 6th relative to the Larchwood water supply.

Our Washington office reserves the final decision on the water supplies for P. W. A. projects. I do not in any way question but what this supply will be satisfactory. They have in the past insisted upon copies of the bacteriological and chemical analyses before making final decision. That was the reason I wrote Buell & Winter upon receipt of the record of the pump test.

I enclose a copy of letter I have just written to Buell & Winter for your information.

I will appreciate having the copy of the chemical test when complete.

Yours very truly,

P. F. HOPKINS
State Director PWA (Iowa)
For the Administrator

PFH-NEF

August 10, 1936

Mr. P. F. Hopkins
State Director P.W.A.
407 Federal Court Building
Des Moines, Iowa

Dear Mr. Hopkins:

With further reference to our correspondence Re: Docket Iowa 1126-R, will say that I hope that the Larchwood Water Works can proceed without final verification of sanitation analysis. Of course, before the well is finally accepted there must be a final verification.

Enclosed find a copy of a preliminary report of chemical composition of the water from the Larchwood well at the time of pumping test Although this is stated as a preliminary, the final analysis will be within very small limits the same for the constituents shown and will carry a few additional compounds. The final analysis should be ready within a week or ten days.

The chemical quality of the Larchwood water is excellent for the northwestern part of the state and, in fact, is better than the water supply of most of the towns of that region.

Yours very truly,

A. C. Tester.

ACT:F

Encl. 1

August 10, 1936

Mr. R. W. Wyant
City Clerk
Larchwood, Iowa

Dear Mr. Wyant:

Enclosed find a preliminary report on the chemical composition of the water I collected at the time of the pumping test of the new Larchwood well. The final analysis will be practically the same as most of these constituents have been determined and double-checked. The final report will show a few additional compounds not included here.

You will note several features of the analysis which should be compared with the water as sampled at the 300' level. Namely, the lime, magnesium, iron and sulphate content is markedly lower. I know you will be interested to compare this analysis with all of the others shown on Tables I and II of my original report of December 5, 1935. The water is markedly better than anything on Table I and compares very favorably with the water developed from the shallow valley sands at Rock Rapids, Sioux Center and other adjacent towns. The water is also much better than that at Hull, Orange City, and the Oak Grove State Park, but not quite as soft as the water developed in the Canton, South Dakota area. It is the nearest approach to the Canton water of any water supply in northwestern Iowa. You will also note that the fluorine content of 0.5 PPM. is considerably below the limit of safety of 1.5 PPM.

Are you sorry you drilled the deep well?

Yours very truly,

A. C. Tester.

ACT:F

Encl. 1

c/c to Russell Rasmussen, Sioux City, Iowa.

407 Federal Court Bldg.,
Des Moines, Iowa
August 19, 1936

Mayor A. D. Moreland,
Larchwood, Iowa

Re: Docket Iowa-1126-R
Larchwood Waterworks

Dear Mayor Moreland:

This will constitute your authority, as far as P. W. A. is concerned, for permitting the contractors for the tank and tower and for the distribution system on the above project to proceed with the construction involved in their contracts. I have previously authorized the installation of the pump.

In order to satisfy the requirements of our Washington office inconnection with water supplies, will you please furnish me at the earliest moment they become available, the following:

2 Copies Drilling Log of the well
2 Copies hourly record of preliminary pump test
2 Copies final turbine pump test
2 Copies chemical analysis of the water
2 Copies Bacteriological analysis
2 Copies Certificate State Board of Health that water isupply is satisfactory.

Very truly yours,

P. F. HOPKINS
State Director PWA (Iowa)
For the Administrator

CC L. D. Gates, S.E.I.
Buell & Winter, Sioux City
Dr. A. C. Tester, Iowa City
A. H. Weiters, State House, Des Moines

GROUND-WATER CONDITIONS

NORTHWEST OF LARCHWOOD, IOWA

The contemplated drilling site is reported to occur 3½ miles north and 2 miles west of Larchwood or approximately in the NW¼ sec. 12, T. 100 N., R. 48 W., Lyon County. This location is adjacent to or near Blood Run, a small valley that traverses southward through the center of section 12. A generalized log of the strata anticipated to underlie this vicinity down to the top of the Sioux quartzite of Precambrian age is outlined below (all depths are referred to an assumed upland starting elevation of 1465 feet above sea level).

Formation	Thickness (ft)	Depth Range (ft)
Quaternary system		
Pleistocene series (glacial drift clay, probably contains some interbedded sand and gravel layers; thin mantle of loess at top)	180±	0-180±
Cretaceous System		
Undifferentiated silt and shale, may include some Dakota sandstone in lower part	195±	180±-375
Precambrian system		
Sioux quartzite		375-

This forecast may have to be adjusted slightly owing to local irregularities in the structure and thickness of the beds. A higher or lower starting elevation will also modify these depths to some extent.

All the geologic formations except the loess and the shales of Cretaceous age will yield some water to wells. The interbedded glacial sands and alluvial and outwash sand and gravel underlying the bottomlands and terrace levels of the main streams and their larger tributaries are the principal sources for most domestic and public supply wells. The Dakota sandstone which is the producing aquifer in the new Larchwood town well No. 2, yields moderate quantities of water to many wells in northwestern Iowa. The Sioux quartzite which underlies the Cretaceous rocks might yield small supplies of water from joints and less cemented portions of the

formation, but generally speaking, the chances of developing a satisfactory well in the quartzite are not promising owing to the tightly cemented character of this rock.

Sufficient water for an ordinary household or stock well might be obtained from a properly constructed well penetrating shallow alluvial sand and gravel beneath the bottomland of Bloody Run. This water is likely to be of better quality than the water from the deep drift sands. However, a well of this type might have certain objectionable features in that 1) a long pipeline construction might be required depending on the location of the property, 2) there is a possibility of contamination from surface drainage, and 3) there is a possibility of failure during an extended drought.

Sand and gravel layers scattered through the glacial drift generally furnish small amounts of water adequate for farm wells on the uplands. These glacial sands usually occur in the form of lens or pockets of limited distribution. Although one or two sand layers usually are encountered in the drift at most places, they may be totally absent or so thin in some localities as to have little value as water-yielding beds. Therefore, actual drilling and test pumping will provide the most reliable information on the potential of these deposits. The water from the lower part of the glacial drift frequently is highly mineralized and very hard.

If the Dakota sandstone underlies this vicinity it probably will yield small to moderate amounts of water. A well completed in the Dakota aquifer probably will be a more dependable source than either the alluvial or interglacial sands. However, as the Precambrian surface is believed to be considerably higher here than at Larchwood the Cretaceous rocks may be much thinner and the Dakota sandstone may be missing. In this case, little or no water probably will be obtained from the Cretaceous rocks.

It is not considered advisable to drill into the Sioux quartzite. The formation is extremely hard for drilling and the chances of developing an adequate supply are not very good.

In summary, alluvial and interbedded glacial sand and gravel above a depth of 180 feet seem to be the most promising sources for a satisfactory well in this vicinity. If the Dakota sandstone is present it should comprise an additional source of small to moderate water supplies.

Iowa-U.S. Geological Surveys
PJH 7/58

TOWN OF LARCHWOOD

LARCHWOOD IOWA

October 27, 1936.

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

Dear Mr. Tester:

I am in receipt of your letter of Oct. 21, enclosing chemical analysis of our water as taken by Mr. Mark. We wish to thank you kindly for the comments regarding this analysis.

I am this day writing the Fairbanks Morse people to give me the information regarding the setting of the new pump as to the depth of the bowls, amount of suction pipe below the bowls, the size of pipe, rated capacity of pump, and further information, which I will relay to you as soon as received from the Fairbanks Morse people.

Wish to advise that our system is just about being completed at this time. We have filled the water tank once and, as I understand the situation, the well has been sterilized and that upon filling the tank again and flushing it out the water then will be ready for bacterilogical analysis, at which time we will forward you sample for analysis.

At the time Mr. Mark was here there had been no sterilization made, so therefore his sample would be practically the same as the one taken by you. I will advise you at the time we send in a smaple of this water as I am sure you are interested and would like to have same to complete your files, together with the other information that I will secure from the Fairbanks Morse people.

Again assuring you of our appreciation of your efforts on our behalf, we remain

Yours very truly,

Town Clerk

TOWN OF LARCHWOOD

LARCHWOOD IOWA

September 3, 1936.

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

Dear Dr. Tester:

I wish to acknowledge receipt of complete chemical analysis of the new well and also log of formations enclosed in your letter of August 31.

As yet the new pump has not been set. However, a part of it has arrived and we expect within the very near future to be able to start the new pump and at this time work on the installation of the complete water works system will start in earnest.

I am sure that the people of Larchwood and community and the Town Council join in with me in thanking you heartily for the efforts you put forth for the good of the Larchwood well and I can truthfully say that we are very grateful to you and trust that whenever you are in or near Larchwood that you will drop in and see us, as we certainly will appreciate a call from you.

As soon as the pump is set and we can get a new test I will again write you as I know that you are very much interested in this well. We will also have to send in a smaple for a ~~for a~~ bacteriology test, which will be done at the proper time.

Again thanking you, I am

Yours very truly,

Clerk.

August 24, 1936

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

Dear Russell:

A final report of the Larchwood water sample taken at the time of the pumping test shows the same composition as indicated on the preliminary with the addition of a few minor constituents which are unimportant so far as the general idea of the quality of the water is concerned. The sodium is present in the amount of 103.1 p.p.m. This is such a small quantity that it will not add taste to the water or in any way be deleterious.

I hope that you have completed the setting of the perforated pipe in the Larchwood well and that you will save the complete statement indicating the length of pipe, size and number of perforation so that I can add it to my data for this well. I hope to be in Sioux City on my next trip west and will advise you later the date, as I wish to take up with you the matter of records on a number of wells in northwestern Iowa.

With best regards, I remain,

Yours very truly,

A. C. Tester

ACT:A

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 5/5/65 Map H. & T.

State Iowa 16 County (or town) Lyon 60

Latitude: 43 27 15 N S Longitude: 096 26 21 Sequential number: 1

Lat-long accuracy: T. 100 N S, R. 47 W E Sec. 30, NE ¼, NE ¼, SW ¼ 5 PM B & M

Local well number: 100 47W 30 C a a A Other number: W-0409

Local use: 0090 36 CITY 1 Owner or name: LAKEWOOD CITY #1

Owner or name: LAKEWOOD Address: LAKEWOOD, IA

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 0 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: 562 ft 562 Meas. kept 6

Depth cased; (first perf.) 533.4 ft 533 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, (T) open hole, (X) other, (Z) other P

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

Date Drilled: AUGUST 1936 9 3 6 Pump intake setting: 286 ft 280

Driller: Rasmussen Bros. name, Sioux City, Iowa address

Lift (type): (A) air, (B) bucker, cent, (C) cent, (J) jet, (L) multiple, (cent.), (M) multiple, (turb.), (N) none, (P) piston, (R) rot, submerg, (S) turb, (T) other, (Z) 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 1475

Alt. LSD: 1475 1475 Accuracy: (source) ALTIMETER

Water Level 187. ft above below MP; ft above below lsd 187 Accuracy: REPORTED

Date meas: AUG 1936 8 3 6 Yield: 42.4 gpm 12 Method determined

Drawdown: 55.7 ft 56 Accuracy: 5 Pumping period hrs

QUALITY OF WATER DATA: Iron 0.44 ppm 3 Sulfate 3543 ppm 7 Chloride 65.0 ppm 2 Hard. 477 ppm 7

Sp. Conduct 1050 K x 10⁶ 3 Temp. 56 °F 56 Date sampled 4/2/53 4 5 3

Taste, color, etc.

100-47W-30caa

Well Number 43, 27, 15 (N/S) 096, 26, 21.1
(d m s d m s)

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: CENTRAL LOWLAND [12] (20–21) Section: DISSECTED

TILL PLAIN [e] (22) Drainage Basin: BIG SIOUX [ ] (23–25) Subbasin: [ ] (26)

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

MAJOR AQUIFER: Cretaceous system, LOWER series [KI] (28–29) Dakota Sandstone aquifer, formation, group [DI] (30–31)

Lithology: [ ] [SV] (32–33) Origin: [ ] [6] (34) Aquifer Thickness: [ ] ft

[ ] (35–37) Length of well open to: 29 ft [29] (38–40) Depth to top of: 516 ft [516] (41–43)

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: 190 ft [190] (60–63) Source of data: WELL CUTTINGS [C] (64)

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

Surficial material: [ ] [ ] (70–71) Infiltration characteristics: POOR [4] (72)

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

Coefficient Perm: [ ] gpd/ft^2; Spec cap: 1 76 gpm/ft; Number of geologic cards: [ ] (79)

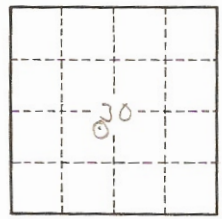
CASING

8" TO 353' 8"

6" 344'9" TO 533' 5"

4 1/2" PERF. 520' 5" TO 560'

(13' OVERLAP WITH 6" PIPE)



GPO 844-225

John C. Moore Corporation, Rochester, N.Y. Binder and holes in leaves, each Patented 1906. 390345

MOORE'S MODERN METHODS

7/31/36 Larchwood πr^2

53¾" dia
23⅞" deep

229.7 gals is capacity of stock watering tank.

2 | 53.75
26.87
26.87
18809
21496
16122
5374
721969

3.1416
722.
628 32
628 32
219912
2268235²

2268.
23.4
9072
6804
4536
53071.7

231 | 530700. (229.7
462
687
462
2250
2079
1710
1617

Depth to water below top of 6" pipe
95.1
2
190.2 ft
2.6 curb to top 6"
187.6 Static Level at 7pm 7/31/36 = Friday (JWR)
after 12 hrs ± pumping

July 30
5 hrs on Thurs afternoon -
7 " " Fri 31 morning + afternoon to 2pm +
showed up to 65gpm - but pumped steadily
@ 40 gpm

8/1/36 Air 96° Temp 56° @ 5³⁰ pm
Pumped started 4³⁵ pm.
Pumped 230gal in 8min 50sec. = 26gpm.
D.D. 25.6 ft. @ 5¹⁰ pm
+ 8.6 ft @ 5³⁰ pm @ 40.7 gpm
+ 6 ft. @ 7³⁰ pm @ 54.4 gpm
(below bottom of link)

25.6
23.
48.6

2484 Low Water

187.7 ft first mark - (S.L. @ 4pm 8/1/36
190.4 ft (SL @ 7pm 7/31/36
197.4 ft (SL @ 7⁴⁵ pm 8/1/36
216 ft - (rubber top) 15 min after Stop pump
226 " (2nd rubber top)
236 " (3rd " ")
238.9 " 4th " ")
243.4 " (5th " ")

8/2/36 S.L. @ 195 ft 47 min after shut down
5 min 25 sec for 230 gals.
D.D. to 243.4 in 20 min.

Larchwood

pumped 230 gals in 4 min 25 sec
@ fastest speed of Gas motor
D.D to below 249 ft.

Temp 56°F Air 101°F
Sample G-101

Bottom of suction pipe @ 286'
" 30'
Bowls → pipe 10'
Drop pipe 246"
286'

8/3/36 G-65 - Sample from Wissink well.
3¾ mi S. of Highway 18-
Sec. 17 SE¼-

Cylinder 1½" dia - T.D. 285 ft.
Curb Elev. 1427' (check - is 2 ft lower than Hull CMSTP)
Van der Vaate of Hull driller.
SO_4 gas above water sd-
Water temp 50°F Air temp 85°F