GROUND-WATER DATA COLLECTED IN THE MISSOURI RIVER BASIN UNITS IN KANSAS DURING 1948

By Delmar W. Berry

Copy no. 18

U. S. DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GROUND-WATER DATA COLLECTED IN THE MISSOURI RIVER BASIN UNITS IN KANSAS DURING 1948

By

Delmar W. Berry

Compiled in cooperation with the State Geological Survey of Kansas, the Division of Sanitation of the Kansas State Board of Health, and the Division of Water Resources of the Kansas State Board of Agriculture, as part of the program of the Interior Department for development of the Missouri River Basin.

PRELIMINARY DRAFT
OF PROPOSED REPORT
FOR OFFICIAL REVIEW ONLY
SUBJECT TO REVISION

November 1949

CONTENTS

ILLUSTRATIONS

TABLES

TABLES

GROUND-WATER DATA COLLECTED IN THE MISSOURI RIVER BASIN UNITS IN KANSAS DURING 1948

By Delmar W. Berry

INTRODUCTION

Ground-water studies in the Missouri River Basin were begun by the U. S. Geological Survey during the fall of 1945 as a part of the program for development of the resources of the basin by the U. S. Bureau of Reclamation and other federal agencies. The studies of the ground-water resources in the part of Kansas which lies within the Basin have been coordinated with the cooperative program of ground-water studies already being carried on in Kansas by the Federal Geological Survey and the Kansas State Geological Survey with the cooperation of the Division of Sanitation of the Kansas State Board of Health and the Division of Water Resources of the Kansas State Board of Agriculture.

Areas in which ground-water data have been collected under the Missouri Basin program include the Almena Unit in Norton and Phillips Counties; the Bostwick Unit in Jewell, Republic, and Cloud Counties; the Cedar Bluff Unit in Ellis County; the Glen Elder Unit in Mitchell County; the Kanopolis Unit in McPherson and Saline Counties; the Kirwin Unit in Phillips, Smith, and Osborne Counties; the St. Francis Unit in Cheyenne County; the Webster Unit in Osborne County; and the Wilson Unit in Lincoln County. (See fig. 1.)

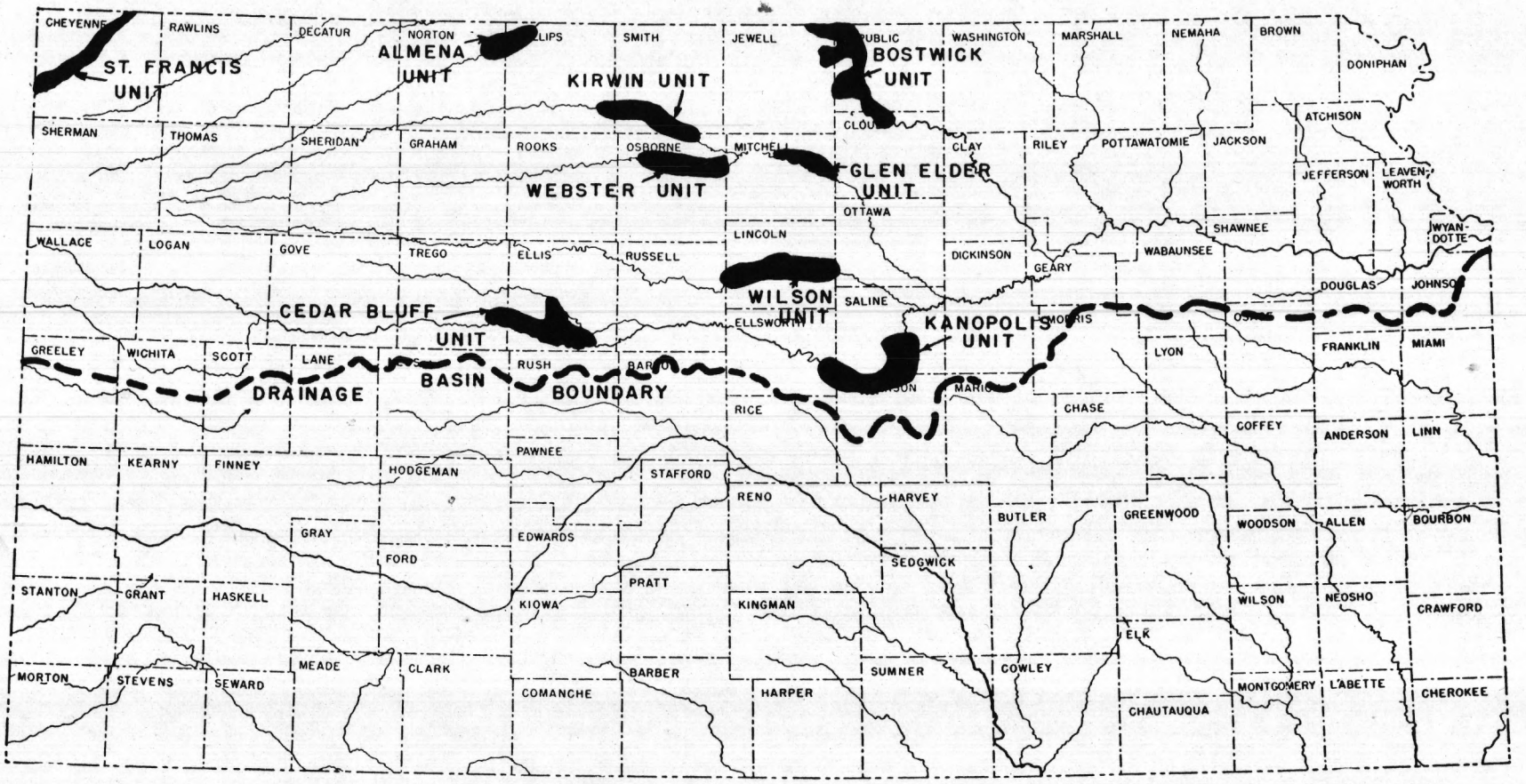


Figure 1.--Units of the Missouri Basin in Kansas on which ground-water data are being collected

Most of the ground-water data presented in this report were collected during 1948. Likewise, most of the ground-water data collected in these areas prior to the end of 1947 were presented in a report which was mimeographed in September 1948. This report and the previous report are the first two of a series of annual reports on ground-water studies in the Missouri Basin Units in Kansas. These annual reports are a means of more promptly releasing for administrative use the data collected each year. Data for a given area which are included in the annual reports will be assembled later in a report on the geology and hydrology of that area.

Geologic and ground-water investigations have already been made in the Almena, Bostwick, Cedar Bluff, and Kanopolis Units. The results of these investigations have been compiled and are now either in manuscript form, in press, or published as a bulletin of the State Geological Survey of Kansas. Ground-water data collected in the Almena unit are included in a report on the geology and ground-water resources of Norton and northwestern Phillips Counties, Kans., by John C. Frye and Alvin R. Leonard. This report is now in manuscript form. A report on the ground-water resources of Republic County and northern Cloud County, Kans., by V. C. Fishel,[1] contains ground-water data collected on the Bostwick Unit. Results of investigations in the Cedar Bluff Unit are presented in a report on the ground-water supplies at Hays, Victoria, Walker, Gorham, and Russell, Kans., by Bruce F. Latta.[2] The report on the ground-water conditions in

---

1 Kansas Geological Survey Bulletin 73.
2 Kansas Geological Survey Bulletin 76, Part 6.

the Smoky Hill Valley in Saline, Dickinson, and Geary Counties, Kans., by Bruce F. Latta,[3] and the report on the geology and ground-water resources of a part of south-central Kansas with special reference to the Wichita municipal water supply, by Charles C. Williams and Stanley W. Lohman,[4] contain ground-water data collected in the Kanopolis Unit.

Included in this report are data on fluctuations of the water level in each of the units; maps showing locations of test holes and wells in the Kirwin Unit, St. Francis Unit, and Wilson Unit; summaries of the geology in the St. Francis Unit and Wilson Units; and logs of test holes and chemical analyses of water samples in the Wilson Unit. Maps showing the locations of wells in the Almena Unit, Bostwick Unit, Cedar Bluff Unit, Glen Elder Unit, Kanopolis Unit, and Webster Unit were included in the previous report.

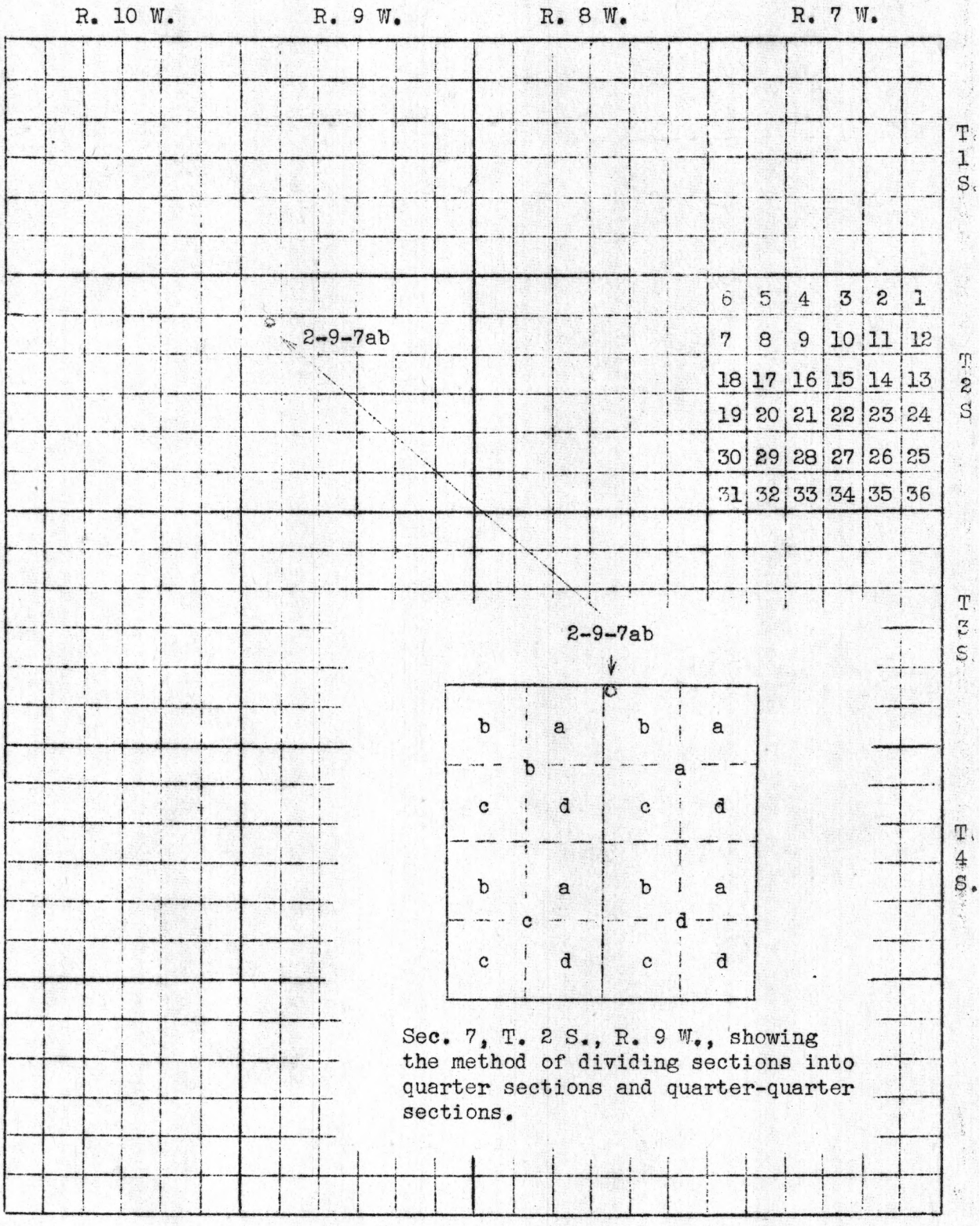
The ground-water studies in the Missouri Basin Units in Kansas are made under the general supervision of A. N. Sayre, chief of the Ground Water Branch of the Geological Survey and of Geo. H. Taylor, regional engineer in charge of ground-water investigations of the Missouri Basin Units.

WELL-NUMBERING SYSTEM

The well and test-hole numbers in this report are based on the location of the wells and test holes with respect to the General Land Office survey of the area. (See fig. 2.) The first numeral of a well number indicates the township, the second the range, and the third the section in which the well is located. The lower-case letters

3 In press; to be published as Kansas Geological Survey Bulletin 83.

4 In press; to be published as Kansas Geological Survey Bulletin 79.



Sec. 7, T. 2 S., R. 9 W., showing the method of dividing sections into quarter sections and quarter-quarter sections.

Fig. 2.--Sketch illustrating well-numbering system.

(a, b, c and d) following the section number indicate the location of the well within the section. The first letter denotes the quarter section and the second the quarter-quarter section. The letters are assigned in a counterclockwise direction, beginning in the northeast quarter of the section or quarter-quarter section. If two or more wells are located within the same quarter-quarter section, the wells are numbered serially according to the order in which they were inventoried.

ALMENA UNIT

Measurements of the water level in 11 wells in Norton County and in 4 wells in Phillips County are being made periodically. The highest and lowest water level for the period of record are given in table 1; the difference between the highest and lowest water levels, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 2; and the water-level measurements made in 1948 are given in table 3. Hydrographs of 5 of the observation wells are shown in figure 3.

Table 1.--Highest and lowest water level for the period of record, in feet below land-surface datum, in 15 wells in the Almena Unit

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
1-19-19cc	1	17.07	Dec. 5, 1947	20.18	Nov. 30, 1948
1-20-13ad	1.5	25.05	July 31, 1947	29.35	Oct. 8, 1948
30cc	1	77.30	Apr. 2, Aug. 4, 1948	78.43	Jan. 1, 1948
34ba	1	27.07	Oct. 28, 1947	30.50	Oct. 8, 1948
1-21-35dc	2.5	31.46	Apr. 2, 1948	33.74	Oct. 7, 1948
2-21- 1bb	2.5	23.22	Aug. 29, 1947	27.01	June 24, 1946
2bd	2.5	22.53	July 31, 1947	26.19	Oct. 7, 1948
11aa	3	29.03	July 31, 1947	34.85	Oct. 7, 1948
18aa	1.5	42.44	Aug. 29, 1947	43.22	Nov. 30, 1948
19dd	2.5	63.70	June 3, 1948	64.90	Oct. 7, 1947
2-22-11dc	2	65.95	Oct. 2, 1947	67.35	May 7, 1947
26ac	2	27.21	July 31, 1947	29.61	Oct. 7, 1948
28aa	1.5	47.30	July 31, 1947	49.17	May 7, 1947
2-23-36cd	2.5	26.93	July 31, 1947	29.30	Oct. 7, 1948
3-23- 8aa	1.5	37.37	Aug. 29, 1947	38.80	Dec. 1, 1948

Table 2.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 15 wells in the Almena Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
1-19-19cc	3.11	-3.11	-2.68
1-20-13ad	4.30	-1.55	- .52
30cc	1.13	+ .50	+ .52
34ba	3.43	-2.16	-1.83
1-21-35dc	2.28	-1.40	- .50
2-21- 1bb	3.79	-1.52	+1.55
2bd	3.66	- .98	+ .46
11aa	5.82	-2.17	-1.63
18aa	.78	- .47	- .18
19dd	1.20	+ .10	+ .13
2-22-11dc	1.40	- .82	+ .23
26ac	2.40	- .69	- .06
28aa	1.87	+ .25	+ .32
2-23-36cd	2.37	- .95	- .71
3-23- 8aa	1.43	- .39	- .95

Table 3.--Water-level measurements, in feet below land-surface datum, in observation wells in the Almena Unit, 1948

1-19-19cc

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Apr. 2	17.42	Aug. 4	18.52	Oct. 8	19.73	Nov. 30	20.18
June 3	18.40						

1-20-13ad.

Jan. 1	26.51	June 3	26.85	Oct. 8	29.35	Nov. 30	28.23
Apr. 2	26.04	Aug. 4	27.84				

1-20-30cc.

Jan. 1	78.43	June 3	77.32	Oct. 7	77.64	Nov. 30	77.35
Apr. 2	77.30	Aug. 4	77.30				

1-20-34ba.

Jan. 1	27.60	June 3	28.18	Oct. 8	30.50	Nov. 3	29.88
Apr. 2	27.40	Aug. 4	29.13				

1-21-35dc.

Jan. 1	31.98	June 3	31.91	Aug. 4	33.00	Oct. 7	33.74
Apr. 2	31.46						

2-21- 1bb.

Jan. 1	23.92	June 3	24.22	Oct. 7	25.43	Nov. 30	25.46
Apr. 2	23.72	Aug. 4	24.62				

2-21- 2bd.

Jan. 1	24.20	June 3	24.42	Oct. 7	26.19	Nov. 30	25.30
Apr. 2	23.84	Aug. 4	25.18				

2-21-11aa.

Apr. 2	30.16	June 3	30.42	Oct. 7	34.85	Nov. 30	33.07

Table 3.--Water-level measurements, in feet below land-surface datum, Almena Unit, 1948--Continued

2-21-18aa.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 1	42.70	June 3	42.66	Oct. 7	43.05	Nov. 30	43.22
Apr. 2	42.61	Aug. 4	42.86				

2-21-19dd.

Jan. 1	63.91	June 3	63.70	Oct. 7	63.85	Dec. 1	63.83
Apr. 2	63.80	Aug. 4	63.84				

2-22-11dc.

Jan. 1	66.20	June 3	66.60	Oct. 7	66.89	Dec. 1	66.94
Apr. 2	66.48	Aug. 4	66.72				

2-22-26ac.

Jan. 1	28.65	Aug. 4	29.05	Oct. 7	29.61	Dec. 1	29.37

2-22-28aa.

Jan. 1	49.10	June 3	49.08	Oct. 7	49.14	Dec. 1	48.85
Apr. 2	49.08	Aug. 4	49.10				

2-23-36cd.

Jan. 1	28.02	June 3	28.35	Oct. 7	29.30	Dec. 1	29.16
Apr. 2	27.79	Aug. 4	28.71				

3-23- 8aa.

Jan. 1	38.53	June 3	38.58	Oct. 7	37.98	Dec. 1	38.80
Apr. 2	38.61	Aug. 4	38.54				

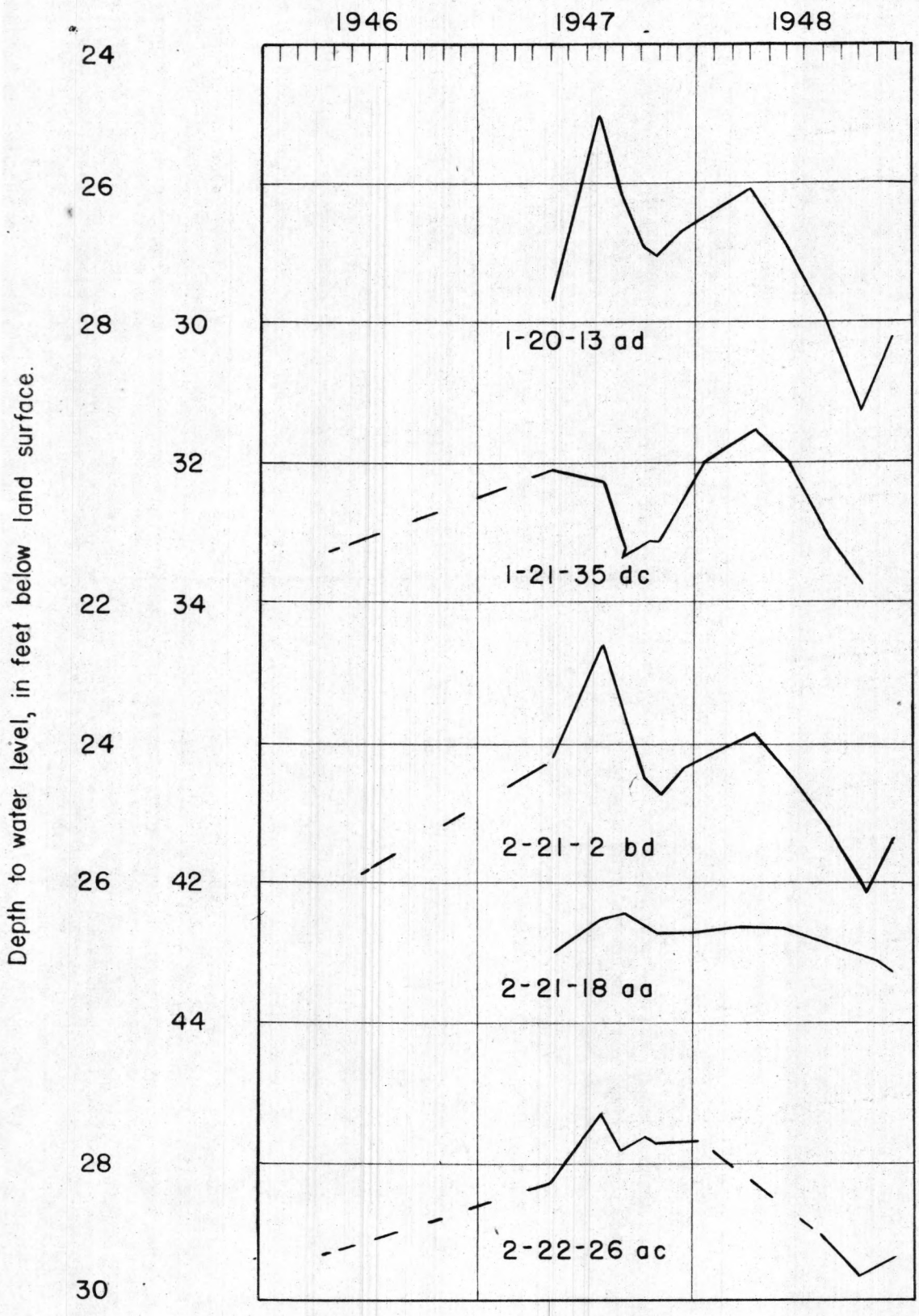


Fig. 3 - Hydrographs of five wells, Almena Unit.

During the fall of 1947 five drive-point observation wells were constructed along the Republican River in Kansas; three of these wells are in Jewell County and two are situated in Republic County. Periodic measurements have been made of the water level in these wells. The highest and lowest water levels for the period of record are given in table 4; the difference between the highest and lowest water level, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 5; and the water levels for 1948 are given in table 6.

Table 4.--Highest and lowest water level for the period of record, in feet below land-surface datum, in 5 wells in the Bostwick Unit.

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
1-5-7bb	1	6.95	Mar. 24, 1948	8.83	Nov. 2, 1948
7cb	1	20.30	Mar. 24, 1948	21.89	Nov. 2, 1948
1-6-5da	1	6.70	Mar. 25, 1948	9.80	Nov. 2, 1948
1-7-1bb	1	8.58	July 26, 1948	10.80	Nov. 2, 1948
2da	1	4.51	Mar. 25, 1948	7.97	Nov. 2, 1948

Table 5.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 5 wells in the Bostwick Unit.

Well	Difference between highest and lowest water levels	Net decline in 1948
1-5-7bb	1.88	0.33
7cb	1.59	1.89
1-6-5da	3.10	.44
1-7-1bb	2.22	.75
2da	3.46	.58

Table 6.--Water-level measurements, in feet below land-surface datum, in the Bostwick Unit, 1948

1-5-7bb.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 15	8.50	Apr. 16	7.04	July 26	7.05	Sept. 23	8.40
Feb. 19	8.25	May 20	7.38	Aug. 19	7.64	Nov. 2	8.85
Mar. 24	6.95						

1-5-7cb.

Jan. 15	21.00	Apr. 16	20.30	July 26	20.75	Sept. 23	21.76
Feb. 19	21.24	May 20	20.77	Aug. 19	21.21	Nov. 2	21.89
Mar. 24	20.30						

1-6-5da.

Jan. 15	9.36	Apr. 16	7.77	July 26	6.96	Sept. 23	9.29
Feb. 20	8.98	May 20	8.45	Aug. 19	8.31	Nov. 2	9.80
Mar. 25	6.70						

1-7-1bb.

Jan. 15	10.05	Apr. 16	8.77	July 26	8.58	Sept. 23	10.27
Feb. 19	9.67	May 20	9.54	Aug. 19	9.34	Nov. 2	10.80
Mar. 25	8.63						

1-7-2da.

Jan. 15	7.39	Apr. 16	5.42	July 22	5.80	Sept. 23	7.50
Feb. 19	7.22	May 20	6.10	Aug. 19	6.67	Nov. 2	7.97
Mar. 25	4.51						

CEDAR BLUFF UNIT

Periodic measurements were made of the water level in 14 observation wells in the Cedar Bluff Unit. The highest and lowest water levels for the period of record are given in table 7; the difference between the highest and lowest water levels, the net rise or decline in

1948, and the net rise or decline for the period of record are given in table 8; and the water levels for 1948 are given in table 9. Hydrographs of 5 wells are shown in figure 4.

Table 7.--Highest and lowest water level for the period of record, in feet below land-surface datum, in 14 wells in the Cedar Bluff Unit.

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
14-16-17cb	2	18.05	July 23, 1947	19.62	Oct. 9, 1948
36bb	2	19.69	July 23, 1947	21.74	May 10, 1947
14-18-12bb	2	23.96	Dec. 1, 1948	27.15	July 30, 1946
26aa	2	18.03	July 23, 1947	20.85	Jan. 8, 1948
14-20-35dd	2	14.93	July 23, 1947	16.29	Aug. 8, 1946
15-16- 6dd	2	22.17	May 10, 1947	24.33	Aug. 9, 1946
13bb	2	13.87	June 4, 1948	14.85	July 17, 1946
15-17-19ab	2	139.67	Apr. 8, 1948	140.50	July 22, 1946
25cb	2	11.52	July 23, 1947	12.10	July 12, 1946
15-18- 1bb	2	18.12	Oct. 9, 1948	28.22	July 24, 1946
16bb	2	5.62	July 23, 1947	9.55	July 12, 1946
15-19- 6aa	2	52.06	Dec. 1, 1948	52.59	Aug. 8, 1946
13ab	2	6.08	July 23, 1947	9.30	Oct. 8, 1947
35aa	2	59.45	Jan. 8, 1948	70.70	Apr. 8, 1948

Table 8.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 14 wells in the Cedar Bluff Unit.

Well number	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
14-16-17cb	1.57	-0.23	-0.02
36bb	2.05	- .15	- .15
14-18-12bb	3.19	+1.04	+3.19
26aa	2.82	+ .35	+ .51
14-20-35dd	1.36	- .05	+ .63
15-16- 6dd	2.16	+ .45	+1.72
13bb	.98	+ .18	+ .63
15-17-19ab	.83	- .08	+ .46
25cb	.58	- .31	+ .03
15-18- 1bb	10.10	+ .98	+8.92
16bb	3.93	+ .47	+ .85
15-19- 6aa	.53	+ .12	+ .53
13ab	3.22	+ .25	+ .02
35aa	11.25	-1.35	- .86

Table 9.--Water level measurements, in feet below land-surface datum, in the Cedar Bluff Unit, 1948

14-16-17cb

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Apr. 8	18.87	June 4	19.16	Aug. 5	18.59	Oct. 9	19.62

14-16-36bb.

Jan. 8	19.78	June 4	20.16	Aug. 5	19.83	Oct. 9	19.92
Apr. 8	19.82						

14-18-12bb.

Jan. 8	24.83	June 4	25.05	Oct. 9	25.65	Dec. 1	23.96
Apr. 8	24.72	Aug. 5	24.60				

14-18-26aa.

Jan. 8	20.85	June 4	19.95	Oct. 9	20.45	Dec. 1	20.25
Apr. 8	20.18	Aug. 5	19.38				

14-20-35dd.

Jan. 8	15.58	June 4	15.79	Aug. 5	15.42	Oct. 9	15.66
Apr. 8	15.71						

15-16- 6dd.

Jan. 8	22.80	June 4	23.17	Oct. 9	23.79	Dec. 1	22.61
Apr. 8	22.58	Aug. 5	22.85				

15-16-13bb.

Jan. 8	14.42	June 4	13.87	Aug. 5	13.94	Oct. 9	14.22
Apr. 8	14.14						

15-17-19ab.

Jan. 8	139.70	June 4	139.90	Oct. 9	140.11	Dec. 1	140.04
Apr. 8	139.67	Aug. 5	139.83				

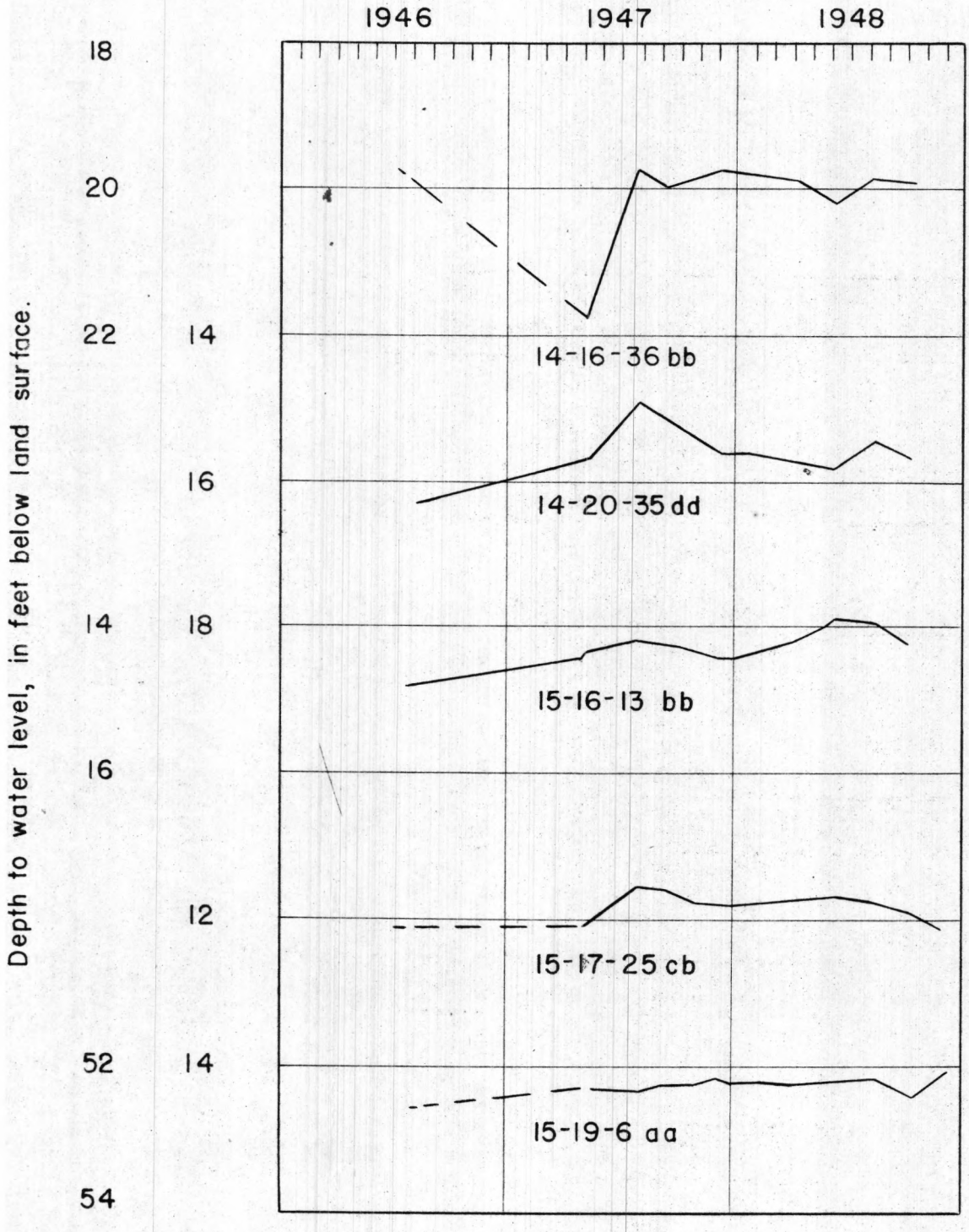


Fig. 4 - Hydrographs of five wells, Cedar Bluff Unit.

Table 9.--Water-level measurements, in feet below land-surface datum, in the Cedar Bluff Unit, 1948--Continued

15-17-25cb.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 8	11.80	June 4	11.67	Oct. 9	11.84	Dec. 1	12.07
Apr. 8	11.72	Aug. 5	11.72				

15-18-1bb.

Jan. 8	19.70	June 4	18.60	Oct. 9	18.12	Dec. 1	19.30
Apr. 8	19.38	Aug. 5	18.40				

15-18-16bb.

Jan. 8	9.23	June 4	7.89	Oct. 9	8.58	Dec. 1	8.70
Apr. 8	6.72	Aug. 5	6.65				

15-19-6aa.

Jan. 8	52.20	June 4	52.19	Oct. 9	52.35	Dec. 1	52.06
Apr. 8	52.23	Aug. 5	52.13				

15-19-13ab.

Apr. 8	6.19	June 4	7.30	Aug. 5	5.75	Oct. 9	9.05

15-19-35aa.

Jan. 8	59.45	June 4	61.04	Oct. 9	64.25	Dec. 1	61.02
Apr. 8	70.70	Aug. 5	61.90				

GLEN ELDER UNIT

Periodic measurements of the water level in 11 wells have been made as a continuation of the observation-well program set up in the Glen Elder Unit in cooperation with the Bureau of Reclamation. The highest and lowest water levels for the period of record are given in

table 10; the difference between the highest and lowest water levels, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 11; and the water levels for 1948 are given in table 12. Hydrographs of 5 wells are shown in figure 5.

Table 10.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 11 wells in the Glen Elder Unit

Well number	Length of record (years)	Highest level	Date	Lowest level	Date
6- 8-34cc	1	a 16.65	July 29, 1947	a 18.30	Sept. 29, 1947
6- 9-27ab	13	22.36	June 24, 1947	31.10	May 11, 1935
30da	2	26.70	Nov. 20, 1946	29.30	Nov. 29, 1948
7- 6-30bc	2	20.60	Dec. 10, 1946	30.32	July 28, 1948
34cb	2	22.93	July 28, 1948	32.19	Nov. 29, 1948
7- 7- 7aa	2	28.16	July 29, 1947	29.70	May 27, 1948
15dc	2	19.47	July 28, 1948	22.90	May 27, 1948
7- 8- 5cb	2	25.04	Nov. 8, 1946	29.18	Nov. 29, 1948
7- 9- 2bc	2	27.60	July 29, 1947	32.54	Nov. 29, 1948
7-10-10cc	2	25.25	July 29, 1948	26.84	Oct. 14, 1946
8- 6-12dd	2	31.76	Mar. 30, 1948	34.13	Sept. 29, 1947

a Well pumping.

Table 11.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 11 wells in the Glen Elder Unit

Well number	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
6- 8-34cc	1.65	+0.16	-0.48
6- 9-27ab	8.74	+ .01	+3.40
30da	2.60	- .75	-2.14
7- 6-30bc	9.72	+2.38	+1.39
34cb	9.26	-3.60	-7.84
7- 7- 7aa	1.54	- .22	- .18
15dc	3.43	+ .37	- .92
7- 8- 5cb	4.14	- .58	-4.14
7- 9- 2bc	4.94	-1.45	-4.19
7-10-10cc	1.59	+ .20	+ .90
8- 6-12dd	2.37	- .04	+ .05

Table 12.--Water-level measurements, in feet below land-surface datum, in the Glen Elder Unit, 1948

6-8-34cc.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Feb. 2	18.13	May 27	17.83	Sept. 28	17.85	Nov. 29	a 18.00
Mar. 30	17.66	July 29	17.14				

a Well pumping.

6-9-27ab.

Feb. 2	26.61	May 27	26.48	Sept. 28	26.63	Nov. 29	26.57
Mar. 30	26.18	July 29	25.55				

6-9-30da.

Feb. 2	28.85	May 27	28.69	Sept. 28	28.98	Nov. 29	29.30
Mar. 30	28.60	July 29	28.93				

7-6-30bc.

Feb. 2	29.32	May 27	27.65	July 28	a 30.32	Sept. 28	27.16
Mar. 30	27.85						

a Well pumping.

7-6-34cb.

Feb. 2	28.80	May 27	28.77	Sept. 28	26.18	Nov. 29	32.19
Mar. 30	28.37	July 28	22.93				

7-7-7aa.

May 27	29.70	July 29	29.28	Sept. 28	28.84	Nov. 29	29.28

7-7-15dc.

Feb. 2	22.77	May 27	22.90	Sept. 28	21.77	Nov. 29	22.28
Mar. 30	22.59	July 28	19.47				

7-8-5cb.

Feb. 2	28.98	May 27	29.03	Sept. 28	28.82	Nov. 29	29.18
Mar. 30	28.40	July 29	27.83				

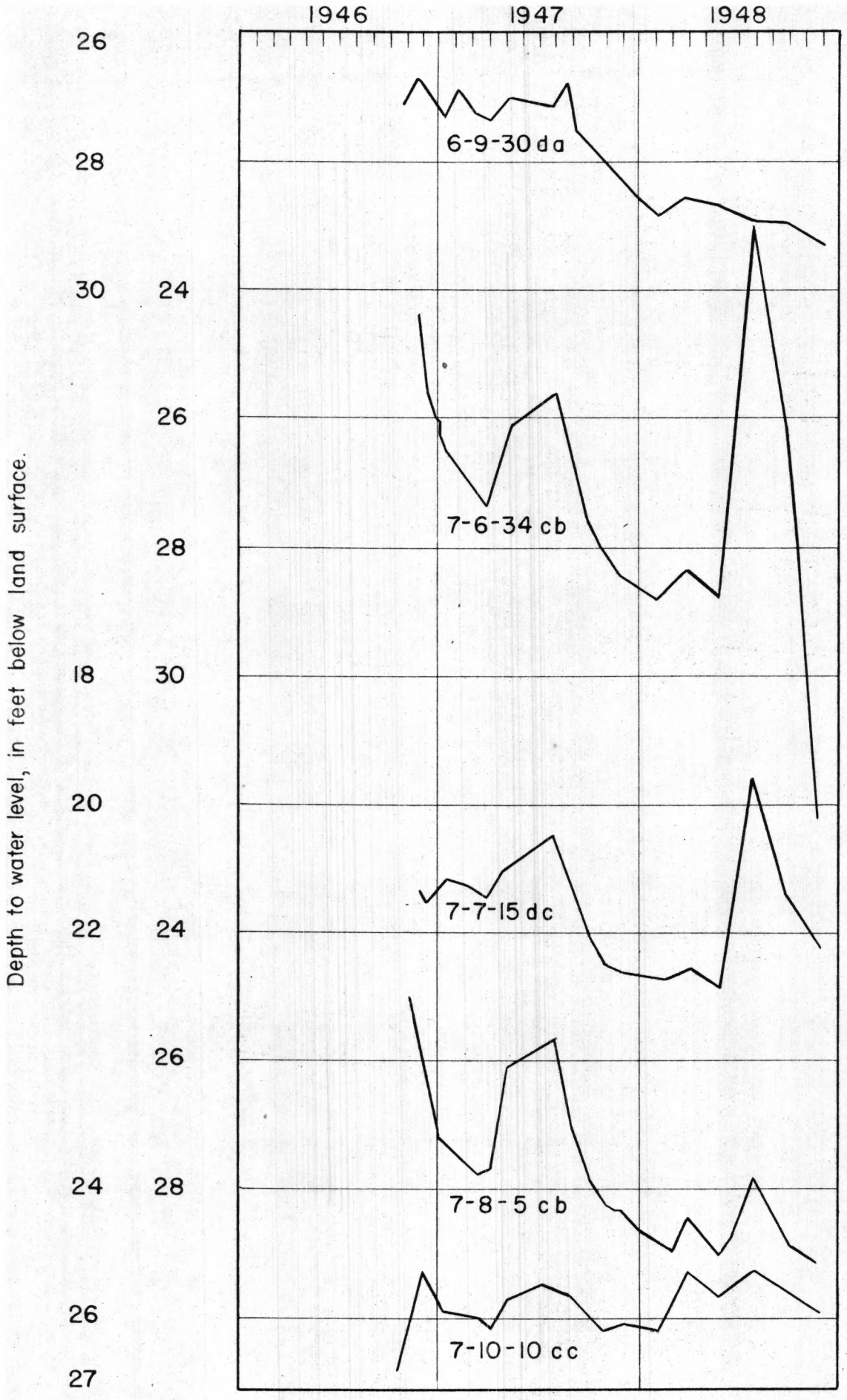


Fig. 5 - Hydrographs of five wells, Glen Elder Unit.

Table 12.--Water-level measurements, in feet below land-surface datum, in the Glen Elder Unit, 1948--Continued

7-9-2bc.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Feb. 2	31.52	May 27	31.78	Sept. 28	32.13	Nov. 29	32.54
Mar. 30	31.40	July 29	31.38				

7-10-10cc.

Feb. 2	26.20	May 27	a 25.66	July 29	25.25	Nov. 29	25.94
Mar. 30	25.34						

a Well pumping.

8-6-12dd.

Feb. 2	31.85	May 27	31.86	Sept. 28	31.87	Nov. 29	31.89
Mar. 30	31.76	July 28	31.88				

KANOPOLIS UNIT

A water-level observation program was begun in the Kanopolis Unit in the spring of 1946. Periodic measurement of the water level in the 15 drive-point observation wells was continued through 1948. The highest and lowest water levels for the period of record are given in table 13; the difference between the highest and lowest water levels, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 14; and the water levels for 1948 are given in table 15. Hydrographs of 5 wells are shown in figure 6.

Table 13.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 15 wells in the Kanopolis Unit

Well number	Length of record (years)	Highest level	Date	Lowest level	Date
15-2-17cd	3	22.33	Aug. 6, 1948	25.44	Jan. 6, 1948
18cd	3	22.90	Nov. 4, 1946	25.50	Jan. 6, 1948
30dc	3	19.58	Aug. 6, 1948	22.42	Sept. 5, 1946
15-3-24dd	3	17.49	Aug. 6, 1948	20.64	Jan. 6, 1948
36ab	3	23.54	Aug. 6, 1948	27.35	Jan. 6, 1948
16-2- 7bb	3	18.30	Aug. 6, 1948	22.08	Aug. 1, 1946
18cc	3	23.39	Nov. 4, 1946	26.52	Dec. 1, 1947; Jan. 6, 1948
19ab	3	21.00	Nov. 4, 1946	24.67	Dec. 1, 1947
16-3-13cd	3	20.70	Apr. 1, 1946	24.38	Jan. 6, 1948
26dc	3	19.00	Dec. 2, 1946	21.60	Jan. 6, 1948
34dd	3	20.92	Dec. 2, 1946	23.15	Jan. 6, 1948
17-3-17dd	2.5	26.24	Nov. 4, 1946	28.18	Dec. 1, 1947
18dd	2.5	26.42	July 21, 1947	28.40	Jan. 6, 1948
30dd	2.5	29.40	Dec. 2, 1946	31.36	Jan. 6, 1948
17-4-25dd	2.5	24.30	Apr. 23, 1946	25.80	Jan. 6, 1948

Table 14.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in 15 wells in the Kanopolis Unit

Well number	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
15-2-17cd	3.11	+1.29	-0.25
18cd	2.60	+ .72	- .55
30dc	2.84	+1.24	+ .30
15-3-24dd	3.15	+1.29	- .28
36ab	3.81	+1.90	- .10
16-2- 7bb	3.78	+1.23	+ .48
18cc	3.13	+ .74	+ .02
19ab	3.67	+..73	- .04
16-3-13cd	3.68	+1.14	-2.36
26dc	2.60	+ .80	- .14
34dd	2.23	+ .98	+ .47
17-3-17dd	1.94	+ .70	- .52
18dd	1.98	+ .91	+ .04
30dd	1.96	+ .41	- .39
17-4-25dd	1.50	- .67	+ .67

Table 15.--Water-level measurements, in feet below land-surface datum, in the Kanopolis Unit, 1948

15-2-17cd.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 6	25.44	May 28	24.87	Sept. 30	23.32	Dec. 3	23.98
Apr. 7	24.43	Aug. 6	22.33				

15-2-18cd.

Jan. 6	25.50	May 28	25.18	Sept. 30	24.16	Dec. 3	24.67
Apr. 7	24.83	Aug. 6	23.70				

15-2-30dc.

Jan. 6	22.41	May 28	21.38	Sept. 30	20.60	Dec. 3	21.08
Apr. 7	20.85	Aug. 6	19.58				

15-3-24dd.

Jan. 6	20.64	May 28	19.44	Sept. 30	18.75	Dec. 3	19.18
Apr. 7	18.93	Aug. 6	17.49				

15-3-36ab.

Jan. 6	27.35	May 28	25.74	Sept. 30	24.98	Dec. 3	25.40
Apr. 7	25.48	Aug. 6	23.54				

16-2-7bb.

Jan. 6	21.14	May 28	20.13	Sept. 30	19.05	Dec. 3	19.72
Apr. 7	19.75	Aug. 6	18.30				

16-2-18cc.

Jan. 6	26.52	May 28	26.18	Sept. 30	25.47	Dec. 2	25.78
Apr. 7	25.54	Aug. 6	24.83				

16-2-19ab.

Jan. 6	24.66	May 28	24.41	Sept. 30	23.70	Dec. 2	23.94
Apr. 7	23.62	Aug. 6	22.98				

Table 15.--Water-level measurements, in feet below land-surface datum, in the Kanopolis Unit 1948--Continued

16-3-13cd.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 6	24.38	May 28	23.56	Sept. 30	22.44	Dec. 2	23.06
Apr. 7	23.32	Aug. 6	21.78				

16-3-26dc.

Jan. 6	21.60	May 28	20.75	Sept. 30	20.28	Dec. 2	20.74
Apr. 7	20.17	Aug. 6	19.50				

16-3-34dd.

Jan. 6	23.15	May 28	22.36	Sept. 30	21.90	Dec. 2	22.09
Apr. 7	21.84	Aug. 6	21.57				

17-3-17dd.

Jan. 6	28.16	May 28	27.77	Sept. 30	27.54	Dec. 2	27.48
Apr. 7	27.35	Aug. 6	27.10				

17-3-18dd.

Jan. 6	28.40	May 28	27.80	Sept. 30	27.14	Dec. 2	27.40
Apr. 7	27.49	Aug. 6	26.52				

17-3-30dd.

Jan. 6	31.36	May 28	31.02	Sept. 30	30.77	Dec. 2	30.92
Apr. 7	30.72	Aug. 6	30.46				

17-4-25dd.

Jan. 6	25.80	May 28	25.23	Sept. 30	24.86	Dec. 2	24.97
Apr. 7	25.05	Aug. 6	24.40				

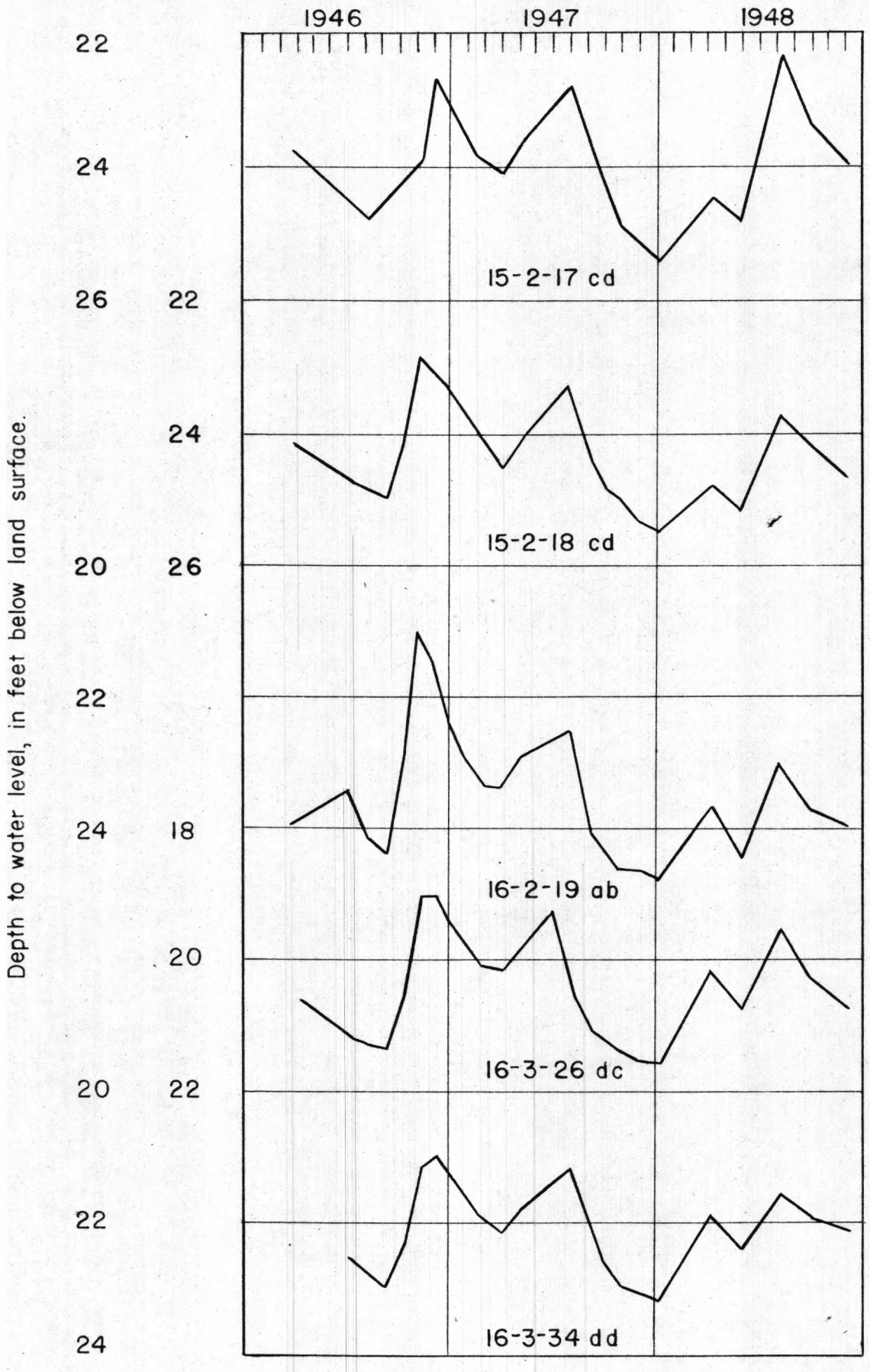


Fig. 6 - Hydrographs of five wells, Kanopolis Unit.

KIRWIN UNIT

The depth to water has been measured periodically since 1945 in 24 wells in the Kirwin Unit. Eight of the wells are located in Smith County, ten in Phillips County, and six in Osborne County. The locations of these wells are shown on figure 7. The highest and lowest water levels for the period of record are given in table 16; the difference between the highest and lowest water levels, the net rise or decline in the water level in 1948, and the net rise or decline for the period of record are given in table 17; and the water levels for the period of record are given in table 18. Hydrographs of five wells are shown in figure 8.

Table 16.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 24 wells in the Kirwin Unit

Well number	Length of record (years)	Highest level	Date	Lowest level	Date
4-14-34bc	3	42.15	Nov. 21, 1945	43.05	Sept. 25, 1946
4-15-31bb	3	34.92	July 30, 1947	36.26	Nov. 30, 1948
35bc	3	34.10	July 30, 1947	37.99	June 12, 1946
4-17-25cd	3	83.10	Jan. 2, 1948	86.27	Sept. 25, 1946
31bc	3	50.59	July 30, 1947	52.72	Oct. 6, 1948
4-18-30ab	3	15.20	July 30, 1947	20.29	Sept. 25, 1946
4-19-21dd	3	10.10	June 2, 1948	15.10	Sept. 25, 1946
35ab	3	12.17	Aug. 29, 1947	14.17	Nov. 30, 1948
4-20-21cc	3	48.46	Mar. 31, 1948	48.92	Feb. 6, 1946
5-13- 4dc	3	24.18	Mar. 31, 1948	35.28	Dec. 17, 1945
25cc	3	43.78	Jan. 2, 1948	46.53	Jan. 28, 1946
33ba	3	25.64	July 30, 1947	30.46	Jan. 2, 1948
5-14- 3bc	3	34.80	Mar. 26, 1947	40.50	Oct. 27, 1947
5-15- 2dc	3	31.85	Aug. 28, 1947	33.84	Nov. 30, 1948
5-16- 3aa	3	42.43	July 30, 1947	44.76	Dec. 17, 1945
5-17- 1aa	3	.73	Mar. 31, 1948	7.60	Nov. 21, 1945
3cd	3	1.18	May 6, 1947	27.00	June 12, 1946
12aa	3	51.93	Mar. 31, 1948	54.20	Sept. 30, 1947
6-11-34aa	3	34.67	Aug. 18, 1947	37.07	June 11, 1946
36aa	3	30.65	July 30, 1947	33.05	Apr. 26, 1946
6-12-20bb	3	36.30	Nov. 26, 1945	43.06	Jan. 28, 1946
23cd	3	25.23	Jan. 2, 1948	27.17	Apr. 26, 1946
24aa	3	32.21	July 30, 1947	37.00	Nov. 23, 1945
6-13-12ba	3	37.85	Mar. 31, 1948	40.95	Dec. 15, 1947

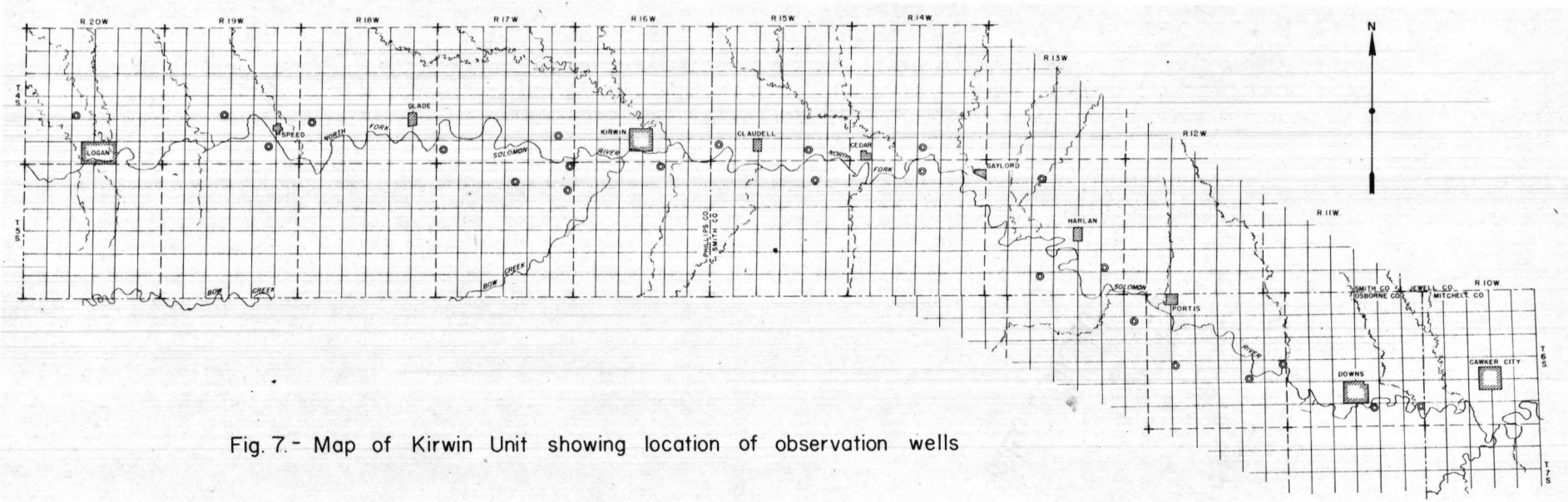


Fig. 7.- Map of Kirwin Unit showing location of observation wells

Table 17.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 24 wells in the Kirwin Unit

Well number	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
4-14-34bc	0.90	-0.35	-0.65
4-15-31bb	1.34	- .84	- .36
35bc	3.89	-1.83	-2.38
4-17-25cd	3.17	- .73	+2.09
31bc	2.13	- .85	- .53
4-18-30ab	5.09	-1.78	+1.83
4-19-21dd	5.00	- .88	-1.23
35ab	2.00	-1.49	-1.51
4-20-21cc	.46	+ .04	+ .35
5-13- 4dc	11.10	- .29	+8.05
25cc	2.75	- .26	+1.18
33ba	4.82	-3.32	-2.90
5-14- 3bc	5.70	+2.46	-2.43
5-15- 2dc	1.99	-1.84	- .69
5-16- 3aa	2.33	- .94	- .56
5-17- 1aa	6.87	- .56	+ .20
3cd	25.82	-5.45	- .35
12aa	2.27	- .07	+ .69
6-11-34aa	2.40	-1.03	- .41
36aa	2.40	- .80	- .02
6-12-20bb	6.76	- .13	-4.25
23cd	1.94	- .19	+1.01
24aa	4.79	- .18	+2.49
6-13-12ba	3.10	+1.31	+ .86

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48

4-14-34bc.

Date	Water level	Date	Water level	Date	Water level
Nov. 21, 1945	42.15	June 12, 1946	42.88	Aug. 28, 1947	42.49
Dec. 17	42.25	Sept.25	43.05	Sept. 30	42.39
Jan. 4, 1946	42.22	Oct. 31	42.78	Oct. 27	42.37
16	42.40	Nov. 25	42.72	Dec. 15	42.43
28	42.47	Jan. 3, 1947	42.67	Jan. 2, 1948	42.44
Feb. 11	42.52	28	42.60	Mar. 31	42.61
25	42.48	Feb. 26	42.68	June 2	42.69
Mar. 11	42.56	Mar. 26	42.80	Aug. 3	42.75
25	42.58	May 6	42.76	Oct. 6	42.75
Apr. 6	42.66	July 30	42.65	Nov. 30	42.80
26	42.96				

4-15-31bb.

Nov. 21, 1945	35.90	June 12, 1946	35.90	Aug. 28, 1947	34.94
Dec. 17	35.92	Sept.25	35.87	Sept. 30	35.10
Jan. 4, 1946	35.89	Oct. 31	35.65	Oct. 28	35.10
16	35.96	Nov. 25	35.61	Dec. 15	35.42
28	36.00	Jan. 3, 1947	35.62	Jan. 2, 1948	35.46
Feb. 11	36.00	29	35.52	Mar. 31	35.53
25	35.94	Feb. 26	35.66	June 2	35.59
Mar. 11	35.96	Mar. 26	35.69	Aug. 3	35.87
25	35.97	May 6	35.60	Oct. 6	36.04
Apr. 6	36.01	July 30	34.90	Nov. 30	36.26
27	36.04				

4-15-35bc.

Nov. 21, 1945	35.60	June 12, 1946	37.99	Aug. 28, 1947	34.34
Dec. 17	36.33	Sept.25	37.93	Sept. 30	35.20
Jan. 4, 1946	36.43	Oct. 31	36.54	Oct. 27	35.76
16	36.37	Nov. 25	36.33	Dec. 15	36.15
28	36.57	Jan. 3, 1947	36.47	Jan. 2, 1948	36.24
Feb. 11	36.57	29	36.43	Mar. 31	36.50
25	36.77	Feb. 26	36.63	June 2	36.79
Mar. 11	36.63	Mar. 26	36.63	Aug. 3	36.43
25	36.71	May 6	36.52	Oct. 6	37.70
Apr. 6	36.72	July 30	34.10	Nov. 30	37.98
27	36.81				

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

4-17-25cd.

Date	Water level	Date	Water level	Date	Water level
Feb. 8, 1946	86.12	Dec. 31, 1946	85.32	Dec. 5, 1947	83.30
Apr. 6	85.94	Feb. 26, 1947	85.42	Jan. 2, 1948	83.10
27	85.89	Mar. 26	84.80	Mar. 31	83.22
June 12	85.63	May 6	85.04	June 2	83.20
Sept.25	86.27	July 30	84.40	Aug. 3	83.60
Oct. 31	85.98	Aug. 28	84.04	Oct. 6	83.60
Nov. 25	85.99	Oct. 28	83.40	Nov. 30	84.03

4-17-31bc.

Feb. 4, 1946	51.39	Nov. 25, 1946	51.18	Sept. 30, 1947	51.60
Mar. 25	51.39	Dec. 31	51.30	Oct. 28	51.87
Apr. 6	51.36	Feb. 26, 1947	51.09	Jan. 2, 1948	51.34
27	51.52	Mar. 26	51.07	Mar. 31	51.43
June 12	51.56	May 6	51.10	Aug. 3	52.10
Sept.25	52.06	July 30	a 50.59	Oct. 6	52.72
Oct. 31	51.32	Aug. 29	a 51.15		

a Well pumping.

4-18-30ab.

Dec. 4, 1945	19.30	Apr. 27, 1946	19.56	July 30, 1947	15.20
17	19.33	June 12	19.60	Aug. 29	15.28
Jan. 4, 1946	19.35	Sept. 25	20.29	Sept. 30	15.43
16	19.49	Oct. 31	18.39	Oct. 28	15.64
28	19.48	Nov. 25	17.95	Jan. 2, 1948	15.91
Feb. 11	19.54	Dec. 31	18.63	Mar. 31	15.49
25	19.61	Jan. 29, 1947	18.62	June 2	15.82
Mar. 11	19.62	Feb. 26	18.67	Aug. 3	16.52
25	19.54	Mar. 26	17.76	Oct. 6	17.06
Apr. 6	19.62	May 6	16.57	Nov. 30	17.42

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

4-19-21dd.

Date	Water level	Date	Water level	Date	Water level
Dec. 4, 1945	10.88	Apr. 27, 1946	11.69	July 30, 1947	a10.15
17	11.40	June 12	11.86	Aug. 29	10.63
Jan. 4, 1946	11.37	Sept. 25	15.10	Sept. 30	11.10
16	11.45	Oct. 31	12.73	Oct. 29	11.23
28	11.50	Nov. 25	12.24	Jan. 2, 1948	10.80
Feb. 11	11.45	Dec. 31	12.39	Mar. 31	10.16
25	11.50	Jan. 29, 1947	12.33	June 2	10.10
Mar. 11	11.52	Feb. 26	12.03	Aug. 3	a 10.73
25	11.60	Mar. 26	10.96	Oct. 6	a 11.81
Apr. 6	11.39	May 6	10.60	Nov. 30	a 12.11

a Well pumping.

4-19-35ab.

Feb. 21, 1946	12.66	Dec. 31, 1946	12.73	Oct. 28, 1947	12.68
Mar. 25	12.57	Jan. 29, 1947	12.75	Jan. 2, 1948	13.02
Apr. 6	12.63	Feb. 26	12.94	Mar. 31	13.31
27	12.54	Mar. 26	13.19	June 2	13.92
June 12	12.77	May 6	12.92	Aug. 3	13.65
Sept.25	13.44	July 30 a	12.71	Oct. 6	13.92
Oct. 31	12.78	Aug. 29	12.17	Nov. 30	14.17
Nov. 25	12.67	Sept. 30	13.00		

4-20-21cc.

Feb. 6, 1946	48.92	Nov. 25, 1946	48.75	Sept. 30, 1947	48.56
25	48.78	Dec. 31	48.73	Oct. 28	48.61
Mar. 11	48.79	Jan. 29, 1947	48.56	Jan. 2, 1948	48.49
25	48.75	Feb. 26	48.71	Mar. 31	48.46
Apr. 6	48.76	Mar. 26	48.64	June 2	48.52
27	48.79	May 6	48.63	Aug. 3	48.60
June 12	48.78	July 30	48.62	Oct. 6	48.56
Sept.25	48.80	Aug. 29	48.61	Nov. 30	48.57
Oct. 31	48.75				

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

5-13-4dc.

Date	Water level	Date	Water level	Date	Water level
Nov. 20, 1945	35.10	June 12, 1946	34.23	Aug. 28, 1947	a27.30
Dec. 17	35.28	Sept. 25	33.05	Sept. 30	27.33
Jan. 4, 1946	33.30	Oct. 31	32.58	Oct. 27	28.06
16	33.40	Nov. 25	32.14	Dec. 15	26.76
28	33.66	Jan. 3, 1947	31.57	Jan. 2, 1948	25.90
Feb. 11	33.27	28	30.10	Mar. 31	24.18
25	32.78	Feb. 26	31.32	June 2	a 27.07
Mar. 11	33.54	Mar. 26	28.30	Aug. 3	25.80
25	32.82	May 6	26.72	Oct. 6	27.68
Apr. 6	32.94	July 30	25.15	Nov. 30	27.05
26	33.70				

a Well pumping.

5-13-25cc.

Nov. 19, 1945	45.30	Apr. 26, 1946	46.48	July 30, 1947	44.12
Dec. 17	45.24	June 12	45.14	Aug. 28	44.48
Jan. 4, 1946	45.55	Sept. 25	45.05	Sept. 30	43.86
16	46.11	Oct. 31	44.93	Jan. 2, 1948	43.78
28	46.53	Nov. 25	44.85	Mar. 31	43.84
Feb. 11	45.23	Jan. 3, 1947	44.67	June 2	43.96
25	45.12	28	44.51	Aug. 3	43.96
Mar. 11	45.12	Feb. 26	44.49	Oct. 6	44.00
25	45.11	Mar. 26	44.48	Nov. 30	44.12
Apr. 6	45.15	May 6	44.44		

5-13-33ba.

Nov. 27, 1945	26.80	June 12, 1946	27.66	Aug. 28, 1947	25.96
Dec. 17	26.98	Sept. 25	26.19	Sept. 30	26.24
Jan. 16, 1946	27.11	Oct. 31	26.49	Oct. 27	26.38
28	27.15	Nov. 25	26.68	Jan. 2, 1948	a30.46
Feb. 11	27.27	Jan. 3, 1947	27.10	Mar. 31	28.80
25	27.27	28	28.31	June 2	27.63
Mar. 11	27.34	Feb. 26	a 28.11	Aug. 3	27.80
25	27.39	Mar. 26	28.38	Oct. 6	28.82
Apr. 6	27.46	May 6	27.39	Nov. 30	29.70
26	27.42	July 30	25.64		

a Well pumping.

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

5-14-3bc.

Mar. 29, 1946	35.61	Jan. 29, 1947	32.91	Oct. 27, 1947	32.00
Apr. 6	35.67	Feb. 26	33.07	Jan. 2, 1948	37.12
26	35.69	Mar. 26	33.27	Mar. 31	36.15
June 12, 1946	36.56	May 6, 1947	33.17	June 2, 1948	36.29
Sept. 25	37.76	July 30	32.10	Aug. 3	37.80
Oct. 31	37.51	Aug. 28	31.85	Oct. 6	38.75
Nov. 25	37.26	Sept. 30	31.90	Nov. 30	38.04
Jan. 3, 1947	33.00				

5-15-2dc.

Nov. 20, 1945	33.15	Apr. 27, 1946	33.68	July 30, 1947	32.10
Dec. 17	33.22	June 12	33.80	Aug. 28	31.85
Jan. 4, 1946	33.27	Sept. 25	33.72	Sept. 30	31.90
16	33.31	Oct. 31	33.22	Oct. 27	32.00
28	33.37	Nov. 25	33.09	Jan. 2, 1948	32.34
Feb. 11	33.43	Jan. 3, 1947	33.00	Mar. 31	32.90
25	33.39	29	32.91	June 2	32.97
Mar. 11	33.49	Feb. 26	33.07	Aug. 3	33.42
25	33.51	Mar. 26	33.27	Oct. 6	33.55
Apr. 6	33.36	May 6	33.17	Nov. 30	33.84

5-16-3aa.

Nov. 20, 1945	44.04	Apr. 27, 1946	44.47	July 30, 1947	42.43
Dec. 17	44.76	June 12	44.57	Aug. 28	42.84
Jan. 4, 1946	44.58	Sept. 25	44.61	Sept. 30	43.93
16	44.64	Oct. 31	44.40	Oct. 28	43.66
28	44.75	Nov. 25	44.37	Jan. 2, 1948	43.65
Feb. 11	44.65	Dec. 31	44.19	Mar. 31	43.52
25	44.45	Jan. 29, 1947	44.04	June 2	43.39
Mar. 11	44.48	Feb. 26	44.16	Aug. 3	44.04
25	44.49	Mar. 26	43.95	Oct. 6	44.60
Apr. 6	44.50	May 6	43.69		

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

5-17-1aa.

Date	Water level	Date	Water level	Date	Water level
Nov. 21, 1945	7.60	Apr. 27, 1946	6.98	May 6, 1947	1.91
Dec. 17	6.80	June 12	5.39	July 30	3.16
Jan. 4, 1946	5.62	Sept. 25	2.26	Aug. 29	5.15
16	5.59	Oct. 31	1.94	Sept. 30	6.47
28	5.54	Nov. 25	1.45	Oct. 28	6.84
Feb. 11	5.57	Dec. 31	3.19	Mar. 31, 1948	.73
25	5.67	Jan. 29, 1947	1.37	June 2	4.27
Mar. 11	5.76	Feb. 26	.94	Aug. 3	5.46
25	5.91	Mar. 26	1.23	Oct. 6	7.40
Apr. 6	6.28				

5-17-3cd.

Nov. 23, 1945	11.74	Apr. 27, 1946	26.52	May 6, 1947	1.18
Dec. 17	14.09	June 12	27.00	July 30	3.75
Jan. 4, 1946	15.88	Sept. 25	6.47	Aug. 29	5.68
16	17.28	Oct. 31	4.40	Sept. 30	6.30
28	18.78	Nov. 25	4.05	Oct. 28	6.64
Feb. 11	20.76	Dec. 31	3.67	Mar. 31, 1948	6.67
25	22.16	Jan. 29, 1947	3.64	June 2	6.82
Mar. 11	23.35	Feb. 26	3.72	Aug. 3	8.63
25	24.37	Mar. 26	1.62	Oct. 6	12.09
Apr. 6	25.21				

5-17-12aa.

Feb. 13, 1946	52.89	Dec. 31, 1946	52.32	Sept. 30, 1947	a 54.20
Mar. 25	52.32	Jan. 29, 1947	52.18	Oct. 28	52.13
Apr. 6	52.21	Feb. 26	52.19	Jan. 2, 1948	52.10
27	52.34	Mar. 26	52.08	Mar. 31	51.93
June 12	52.25	May 6	a 53.36	June 2	51.95
Sept. 25	52.26	July 30	52.00	Aug. 3	52.16
Oct. 31	52.64	Aug. 29	a 52.02	Oct. 6	52.20
Nov. 25	52.27				

a Well pumping.

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

5-20-10aa.

Date	Water level	Date	Water level	Date	Water level
Jan. 25, 1946	17.42	June 12, 1946	14.30	Jan. 29, 1947	15.34
Feb. 25	17.60	Sept. 25	18.78	Feb. 26	14.20
Mar. 11	15.50	Oct. 31	17.55	Mar. 26	a 13.75
25	15.89	Nov. 25	17.00	May 6	14.05
Apr. 6	14.60	Dec. 31	15.73	Measurements discontinued.	
27	15.53				

a Well pumping.

6-11-34aa. Water-stage recorder installed October 1946.

Nov. 26, 1945	35.98	Mar. 22, 1947	35.53	Dec. 1, 1947	35.26
Dec. 17	36.02	27	35.60	7	35.38
Jan. 4, 1946	36.02	31	35.57	15	35.38
16	35.99	Apr. 7	35.78	23	35.34
28	36.63	14	35.65	30	35.36
Feb. 11	36.69	21	35.63	Jan. 5, 1948	35.38
25	36.65	28	35.60	12	35.43
Mar. 11	36.70	May 5	35.65	19	35.52
25	36.76	12	35.57	27	35.58
Apr. 7	36.82	19	35.57	Feb. 23	35.86
26	36.92	26	35.62	Mar. 1	35.65
June 11	37.07	June 2	35.65	8	35.71
Sept. 25	36.20	9	35.64	19	35.64
Oct. 13	36.18	16	35.52	Apr. 12	35.60
20	36.07	23	35.46	16	35.65
27	36.06	30	35.30	23	35.57
31	36.04	July 7	35.19	May 1	35.63
Nov. 3	36.06	14	35.08	8	35.62
11	35.99	22	34.90	15	35.72
17	35.92	28	34.88	22	35.70
24	35.78	Aug. 5	34.71	29	35.75
Dec. 2	35.66	11	34.72	June 5	35.70
9	35.62	18	34.67	12	35.75
16	35.58	26	34.80	19	35.73
23	35.57	Sept. 3	34.69	29	35.62
Jan. 5, 1947	35.59	11	34.87	July 3	35.91
12	35.50	18	34.95	10	35.90
21	35.53	25	34.97	25	35.95
27	35.44	Oct. 3	35.00	Aug. 1	35.93
Feb. 3	35.53	11	35.00	7	36.01
10	35.46	19	35.10	14	35.95
17	35.46	27	35.15	Dec. 5	36.34
26	35.55	Nov. 2	35.19	12	36.34
Mar. 3	35.49	9	35.21	19	36.35
10	35.51	17	35.22	26	36.39
16	35.56	24	35.22		

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

6-11-36aa.

Date	Water level	Date	Water level	Date	Water level
Nov. 15, 1945	32.80	Apr. 26, 1946	33.05	July 30, 1947	30.65
Dec. 17	32.98	June 11	32.82	Aug. 28	31.24
Jan. 4, 1946	32.91	Sept. 25	31.44	Sept. 30	31.74
16	32.85	Oct. 31	30.98	Oct. 27	32.02
28	32.90	Nov. 25	31.11	Jan. 2, 1948	31.80
Feb. 11	32.92	Jan. 3, 1947	31.63	Mar. 31	32.10
25	32.93	28	31.78	June 2	32.38
Mar. 11	32.98	Feb. 26	31.93	Aug. 3	32.28
25	32.97	Mar. 26	31.95	Oct. 6	32.66
Apr. 7	32.93	May 5	31.49	Nov. 30	32.82

6-12-20bb.

Nov. 26, 1945	36.30	Oct. 31, 1946	41.57	Sept. 30, 1947	40.45
Jan. 28, 1946	43.06	Nov. 25	41.38	Oct. 27	40.37
Feb. 11	43.02	Jan. 3, 1947	41.85	Dec. 15	40.42
25	42.89	28	41.45	Jan. 2, 1948	40.45
Mar. 11	42.90	Feb. 26	41.56	Mar. 31	40.35
25	42.90	Mar. 26	41.32	June 2	40.40
Apr. 7	42.84	May 5	41.26	Aug. 3	40.31
26	42.85	July 30	40.36	Oct. 6	40.39
June 12	42.76	Aug. 28	40.46	Nov. 30	40.55
Sept.25	41.68				

6-12-23cd.

Nov. 26, 1945	26.84	Apr. 26, 1946	27.17	July 30, 1947	25.27
Dec. 17	26.70	June 12	26.95	Aug. 28	25.28
Jan. 4, 1946	26.67	Sept. 25	25.77	Sept. 30	25.45
16	26.75	Oct. 31	25.69	Oct. 27	25.57
28	26.94	Nov. 25	25.83	Dec. 15	25.64
Feb. 11	26.94	Jan. 3, 1947	26.12	Jan. 2, 1948	25.23
25	26.74	28	25.98	Mar. 31	25.52
Mar. 11	26.77	Feb. 26	26.15	June 2	a 25.77
25	26.86	Mar. 26	26.19	Aug. 3	25.50
Apr. 7	26.84	May 5	25.85	Nov. 30	25.83

a Well pumping.

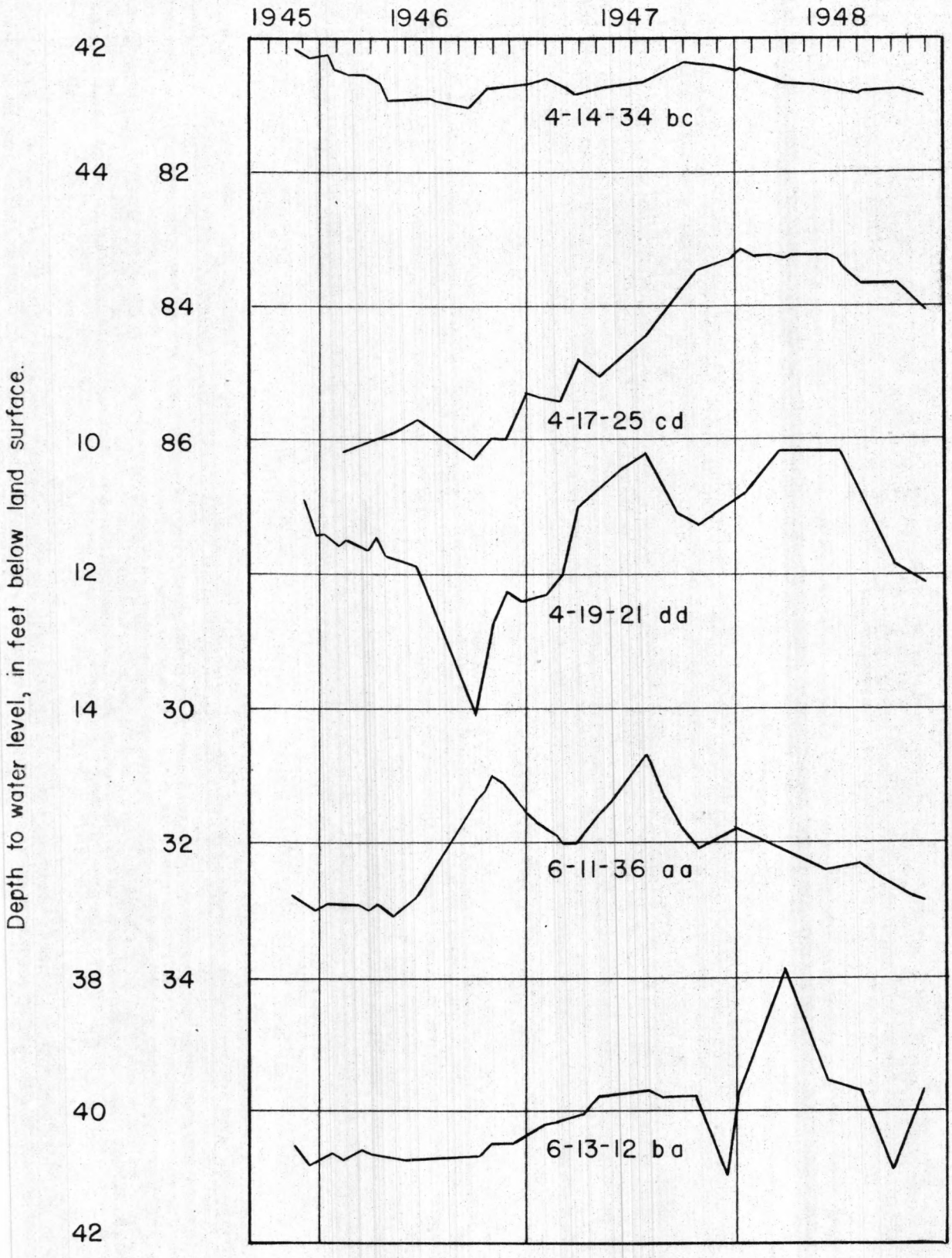


Fig. 8 - Hydrographs of five wells, Kirwin Unit.

Table 18.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1945-48--Continued

6-12-24aa.

Date	Water level	Date	Water level	Date	Water level
Nov. 23, 1945	37.00	June 12, 1946	34.98	Aug. 28, 1947	32.79
Dec. 17	35.36	Sept.25	34.09	Sept.30	33.90
Jan. 4, 1946	35.33	Oct. 31	33.76	Oct. 27	34.33
16	36.78	Nov. 25	33.68	Jan. 2, 1948	a 32.75
28	36.78	Jan. 3, 1947	33.54	Mar. 31	32.70
Feb. 11	36.15	28	33.18	June 2	32.68
25	35.10	Feb. 26	33.21	Aug. 3	33.56
Mar. 11	35.07	Mar. 26	33.86	Oct. 6	34.51
25	34.76	May 5	32.70	Measurements	
Apr. 7	34.72	July 30	32.21	discontinued	
26	34.93				

a Well pumping.

6-13-12ba.

Nov. 19, 1945	40.50	June 12, 1946	40.75	Aug. 28, 1947	39.76
Dec. 17	40.80	Sept.25	40.72	Sept.30	39.78
Jan. 16, 1946	39.70	Oct. 31	40.47	Oct. 27	39.75
28	40.64	Nov. 25	40.51	Dec. 15	a 40.95
Feb. 11	40.67	Jan. 3, 1947	40.30	Jan. 2, 1948	39.60
25	40.63	28	40.15	Mar. 31	37.85
Mar. 11	40.59	Feb. 26	40.13	June 2	39.52
25	40.62	Mar. 26	40.07	Aug. 3	39.63
Apr. 6	40.64	May 5	39.73	Oct. 6	a 40.82
26	40.69	July 30	39.66	Nov. 30	39.64

a Well pumping.

ST. FRANCIS UNIT

GEOLOGY IN RELATION TO GROUND WATER

Summary of Stratigraphy

Exposed rocks in the St. Francis Unit are of Upper Cretaceous (Gulfian[5]), Tertiary (Pliocene), and Quaternary (Pleistocene and Recent) age.

5 Gulfian is the term used by the Kansas Geological Survey for the Upper Cretaceous.

The Pierre shale of the Cretaceous system, which underlies the valley of the South Fork of the Republican River, consists of thin-bedded black to gray or dark-gray shale which weathers to a coffee brown. It is widely marked by concretions, selenite crystals, and thin bentonite beds; chalky beds are present locally. The Ogallala formation of the Tertiary system overlies the Pierre shale. It consists predominantly of sand, gravel, and clay, and is locally cemented into "mortar beds" The Sanborn formation of the Quaternary system overlies the Ogallala in much of the area adjacent to the valley. It consists mainly of loess; but sand and, locally, gravel occur at its base; it is generally well sorted and is tan to gray buff. Adjoining the valley are dissected terraces underlain by sand and gravel. Pleistocene and Recent alluvium, deposited by the action of the present flowing stream, underlies the channel and flood plain.

Cretaceous System

Upper Cretaceous (Gulfian Series)

Pierre shale.--The Pierre shale has been subdivided into six members.[6] The uppermost, the Beecher Island shale member, is approximately 100 feet thick. It is gray, contains an upper and a lower concretionary zone, and contains thin bentonite streaks in the lower part. Below it is an unnamed black to gray shale member. The Salt Grass shale member lies 500 to 600 feet lower than the Beecher Island member. It is approximately 60 feet thick, is clayey, and contains numerous thin bentonite beds, limestone concretions, and limonite concretionary zones. The next lower member, the Lake Creek shale member, is approximately 200 feet thick. It is thin-bedded,

6 The members of the Pierre shale (except Sharon Springs) are terms used by the Kansas Geological Survey.

flaky, dark gray to black, and contains many limonite concretionary streaks and small limestone concretions. The Weskan shale member, which underlies the Lake Creek shale member, is approximately 170 feet thick. It consists of gray clayey shale with large limestone concretions and thin streaks of limonite; bentonite streaks are common in the lower part. The lowermost member of the Pierre shale is the Sharon Springs member. It is approximately 155 feet thick and consists of flaky, somewhat bituminous black shale and a few light-gray shale beds, both with abundant fish scales. The upper part contains gigantic septarian and smaller limestone concretions. The total thickness of the Pierre shale is approximately 1,400 feet at the west side of Cheyenne County.

The Pierre shale is so impervious that practically no water can be obtained from it.

Tertiary System

Pliocene Series

Ogallala formation.--The Ogallala formation consists predominantly of gravel, sand, silt, and caliche. It is generally massive and cross-bedded and contains pebbles of igneous rocks, limestone, and sandstone. Locally the gravel and sand are cemented to form "mortar beds" and in much of the area the Ogallala is capped by a stratum commonly referred to as "algal limestone." Much of the water for domestic and stock supply is obtained from the Ogallala formation. Great quantities of water are stored in this formation but its permeability is such that wells drawing from it do not have very large yields.

Quaternary System

Pleistocene Series

Sanborn formation and terrace deposits.--The Sanborn formation, which consists mostly of loess, mantles much of the upland area and some parts of the terraces. Sand and gravel occur at the base of the Sanborn formation in local areas. A few wells on the slope north of the valley obtain an adequate supply for domestic and stock use from the Sanborn; however, this supply is generally limited.

The higher terraces throughout the valley have been dissected in much of the area, but the deposits contain enough water to supply domestic and stock wells. The lower terrace sands and gravels contain larger supplies of water. Yields as great as 1,300 gallons a minute are obtained by irrigation wells.

Pleistocene and Recent Series

Alluvium.--Stream deposits consisting of silt, loam, sand, and gravel range in thickness from a few feet up to 50 feet in the valley of the South Fork of the Republican River. This alluvium is the chief source of the water supply throughout the valley. A few irrigation wells have been reported to yield 800 gallons a minute; only small yields are obtained in some places because of the presence of fine sand in these deposits.

WELL RECORDS

A total of 109 wells have been inventoried in the St. Francis Unit since 1946. Records of these wells are given in table 22 and the locations of the wells are shown in figure 9. Periodic measurements of the water level in 22 observation wells have been made since 1946. The highest and lowest water levels for the period of record are given in table 19; the difference between the highest and lowest water levels, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 20, and the water levels for the period of record are given in table 21. Hydrographs of five wells are shown in figure 10.

Table 19.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 22 wells in the St. Francis Unit

Well	Length of record (years)	Highest level	Date	Lowest level	Date
1-38- 1cd	1	22.46	June 8, 1948	23.09	Oct. 5, 1948
8dd	3	11.24	Feb. 25, 1947	13.32	Sept. 7, 1947
10cc	3	19.99	Aug. 3, 1948	21.67	Oct. 22, 1946
17cd	3	11.32	June 8, 1947	12.57	Oct. 5, 1948
2-39- 2cb	3	14.59	July 29, 1947	19.03	Mar. 28, 1946
10bb	2	25.27	July 29, 1947	27.10	Aug. 3, 1948
17ba	2	10.38	June 8, 1947	12.56	Sept. 7, 1947
27bb	3	17.08	July 29, 1947	19.50	Mar. 27, 1946
2-40-25db	1	15.69	Dec. 8, 1948	16.45	Oct. 5, 1948
26cc	2	78.67	Feb. 25, 1947	79.07	Mar. 29, 1946
3-39- 6aa	3	5.49	June 8, 1947	8.73	Dec. 5, 1947
3-40- 9ba	3	11.69	Feb. 25, 1947	13.10	Sept. 7, 1947
16da	3	9.70	June 8, 1947	11.90	Sept. 7, 1947
22ab	3	10.02	July 29, 1947	15.18	Mar. 9, 1946
28bd	3	10.02	Mar. 20, 1946	12.75	Aug. 16, 1946
30dc	2	11.81	Mar. 1, 1946	12.79	Oct. 22, 1946
33dd	3	11.90	July 29, 1947	14.50	Mar. 4, 1946
3-41-13cc	3	10.78	July 29, 1947	15.78	Aug. 16, 1946
4-41- 2aa	3	23.67	Mar. 1, 1946	26.20	Sept. 7, 1947
4-42-24ca	3	24.85	Feb. 25, 1947; Apr. 10, 1948	25.89	Sept. 7, 1947
34db	3	8.92	Feb. 25, 1947	10.31	Sept. 7, 1947
5-42- 4aa	3	21.83	Dec. 5, 1947; June 8, 1948	23.11	Aug. 16, 1946

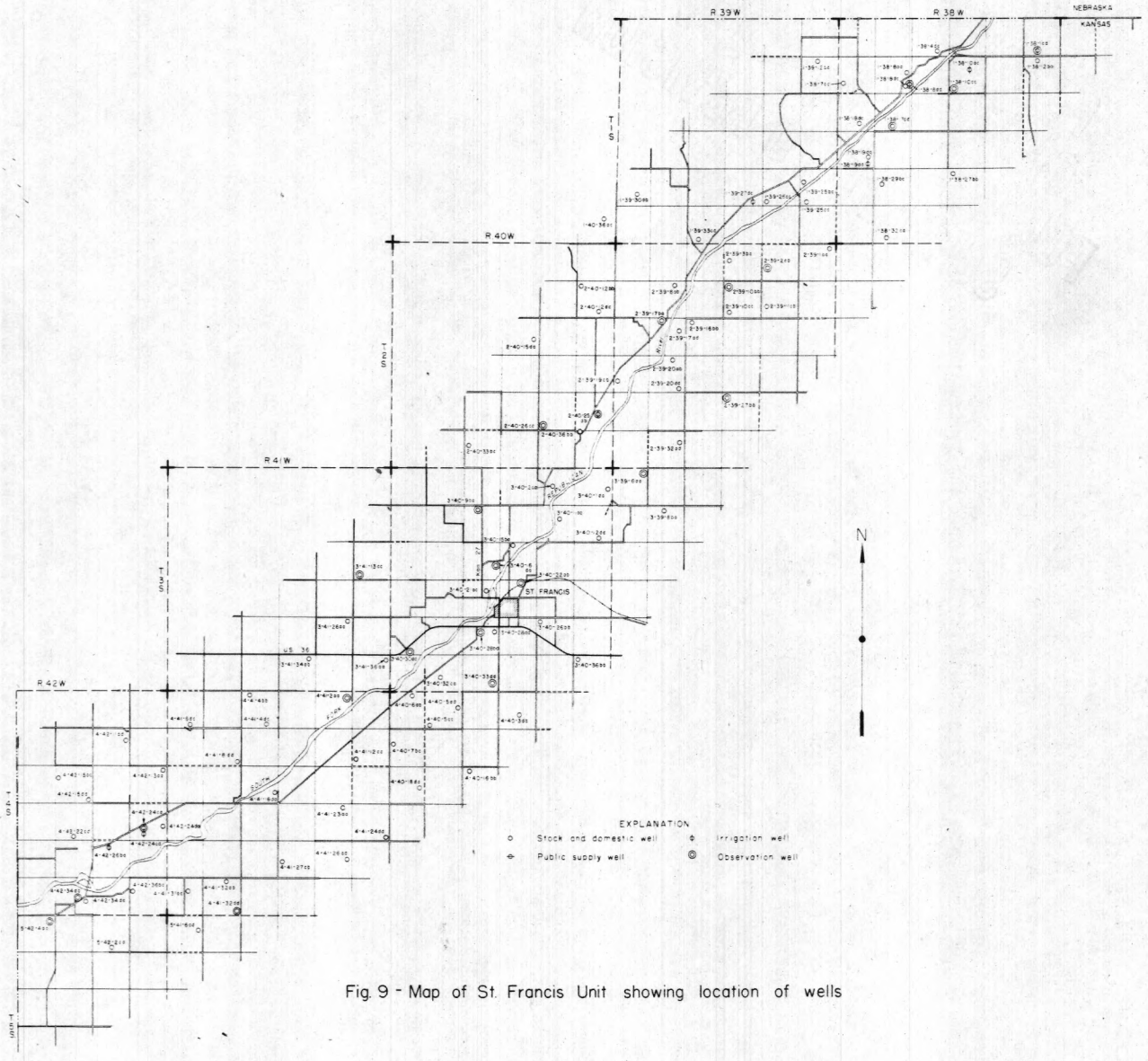


Fig. 9 - Map of St. Francis Unit showing location of wells

Table 20.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 22 wells in the St. Francis Unit

Well	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
1-38- 1cd	0.63	-0.31	-0.31
8dd	2.08	- .48	- .23
10cc	1.68	+ .06	+ .99
17cd	1.25	- .32	- .54
2-39- 2cb	4.44	+ .58	+3.71
10bb	1.83	- .07	- .44
17ba	2.18	-	-1.24
27bb	2.42	+ .82	+ .51
2-40-25db	.76	+ .08	+ .08
26cc	.40	-	+ .14
3-39- 6aa	3.24	- .84	-1.90
3-40- 9ba	1.41	- .48	- .50
16da	2.20	- .44	-1.37
22ab	5.16	- .12	+1.12
28bd	2.73	- .27	-2.11
30dc	.98	-	- .42
33dd	2.60	+ .86	+1.61
3-41-13cc	5.00	+1.84	+2.70
4-41- 2aa	2.53	- .36	-2.31
4-42-24ca	1.04	- .03	+ .61
34db	1.39	- .18	- .31
5-42- 4aa	1.28	- .70	+ .20

Table 21.--Water-level measurements, in feet below land-surface datum in the St. Francis Unit, 1946-48

1-38- 1cd.

Date	Water level	Date	Water level	Date	Water level
Apr. 10, 1948	22.49	Aug. 3, 1948	23.02	Dec. 8, 1948	22.80
June 8	22.46	Oct. 5	23.09		

Table 21.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit 1946-48--Continued

1-38- 8dd.

Date	Water level	Date	Water level	Date	Water level
Aug. 19, 1946	12.52	Sept. 7, 1947	13.32	June 8, 1948	12.08
Oct. 22	12.30	Dec. 5	12.53	Aug. 3	12.94
Dec. 13	11.81	Feb. 3, 1948	12.27	Oct. 5	13.27
Feb. 25, 1947	11.24	Apr. 10	12.02	Nov. 5	12.75
June 8	11.50				

1-38-10cc.

June 14, 1946	21.62	June 8, 1947	20.16	Apr. 10, 1948	20.55
Aug. 17	21.47	July 29	20.10	June 8	20.45
Oct. 22	21.67	Sept. 7	20.86	Aug. 3	19.99
Dec. 13	21.34	Dec. 4	20.69	Oct. 5	20.72
Feb. 25, 1947	20.42	Feb. 3, 1948	20.73	Dec. 8	20.67

1-38-17cd.

June 13, 1946	11.74	June 8, 1947	11.32	Apr. 10, 1948	11.77
Aug. 17	12.42	July 29	11.62	June 8	11.62
Oct. 22	11.99	Sept. 7	12.47	Aug. 3	11.40
Dec. 13	11.67	Dec. 5	12.31	Oct. 5	12.57
Feb. 25, 1947	11.61	Feb. 3, 1948	11.96	Dec. 8	12.28

2-39- 2cb.

Mar. 28, 1946	19.03	June 8, 1947	16.14	Apr. 10, 1948	15.87
Aug. 17	16.93	July 29	14.59	June 8	15.96
Dec. 13	16.41	Sept. 7	16.04	Aug. 3	15.74
Feb. 25, 1947	16.34	Feb. 3, 1948	15.90	Oct. 5	15.32

2-39-10bb.

June 8, 1947	25.75	Feb. 3, 1948	26.12	Aug. 3, 1948	27.10
July 29	25.27	Apr. 10	26.24	Oct. 5	26.39
Sept. 7	26.02	June 8	26.94	Dec. 8	26.19
Dec. 5	25.69				

2-39-17ba.

Apr. 16, 1946	11.03	June 8, 1947	10.38	Dec. 5, 1947	12.27
Aug. 17	11.60	Sept. 7	12.56		

Table 21.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit 1946-48--Continued

2-39-27bb.

Date	Water level	Date	Water level	Date	Water level
Mar. 27, 1946	19.50	June 8, 1947	17.67	Apr. 10, 1948	18.99
Aug. 17	18.63	July 29	17.08	June 8	19.05
Oct. 22	17.95	Sept. 7	18.06	Aug. 3	19.14
Dec. 13	17.99	Dec. 5	17.94	Oct. 5	18.22
Feb. 25, 1947	18.12	Feb. 3, 1948	19.01	Dec. 8	18.19

2-40-25db.

June 8	15.77	Oct. 5	16.45	Dec. 8	15.69

2-40-26cc.

Mar. 29, 1946	79.07	Feb. 25, 1947	78.67	Measurements discon-	
Dec. 13	79.01	Sept. 7	78.93	tinued.	

3-39- 6aa.

Mar. 26, 1946	6.48	June 8, 1947	5.49	Apr. 10, 1948	6.46
Aug. 17	7.86	July 29	6.94	June 8	7.05
Oct. 22	7.23	Sept. 7	8.64	Aug. 3	6.85
Dec. 13	5.89	Dec. 5	8.73	Oct. 4	8.38
Feb. 25, 1947	6.19	Feb. 3, 1948	7.54		

3-40- 9ba.

Mar. 19, 1946	12.30	June 8, 1947	12.21	Apr. 10, 1948	12.36
Aug. 16	12.43	July 29	12.59	June 8	12.40
Oct. 22	12.88	Sept. 7	13.10	Aug. 3	12.62
Dec. 13	12.45	Dec. 5	13.02	Oct. 5	12.80
Feb. 25, 1947	11.69	Feb. 3, 1948	12.32		

3-40-16da.

Mar. 13, 1946	9.74	June 8, 1947	9.70	Apr. 10, 1948	10.40
Aug. 16	10.81	July 29	10.02	June 8	10.28
Oct. 22	10.23	Sept. 7	11.90	Aug. 3	10.30
Dec. 13	10.12	Dec. 6	11.52	Oct. 5	11.49
Feb. 25, 1947	10.09	Feb. 3, 1948	10.67	Dec. 8	11.11

Table 21.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit 1946-48--Continued

3-40-22ab.

Date	Water level	Date	Water level	Date	Water level
Mar. 9, 1946	15.18	June 8, 1947	11.06	Apr. 10, 1948	14.72
Aug. 16	15.08	July 29	10.02	June 8	14.35
Oct. 22	13.68	Sept. 7	13.37	Aug. 3	12.60
Dec. 13	11.95	Dec. 5	12.61	Oct. 5	14.55
Feb. 25, 1947	12.47	Feb. 3, 1948	13.94	Dec. 8	14.06

3-40-28bd.

Mar. 20, 1946	10.02	June 8, 1947	11.23	Apr. 10, 1948	11.59
Aug. 16	12.75	July 29	10.90	June 8	12.10
Oct. 22	11.79	Sept. 9	12.53	Aug. 3	12.03
Dec. 13	11.54	Dec. 5	11.91	Oct. 5	12.65
Feb. 25, 1947	11.33	Feb. 3, 1948	11.86	Dec. 8	12.13

3-40-30dc.

Mar. 1, 1946	11.81	Feb. 25, 1947	12.20	June 8, 1947	12.23
Oct. 22	12.79				

3-40-33dd.

Mar. 4, 1946	14.50	June 8, 1947	14.08	Apr. 10, 1948	13.71
Aug. 16	14.29	July 29	11.90	June 8	13.75
Oct. 22	13.30	Sept. 7	13.50	Aug. 3	12.88
Dec. 13	13.68	Dec. 6	12.28	Oct. 5	13.45
Feb. 25, 1947	14.10	Feb. 3, 1948	13.75	Dec. 8	12.89

3-41-13cc.

June 12, 1946	14.70	June 8, 1947	15.31	Apr. 10, 1948	13.59
Aug. 16	15.78	July 29	10.78	June 8	13.50
Oct. 22	15.51	Sept. 7	11.14	Aug. 3	13.37
Dec. 13	15.32	Feb. 3, 1948	13.84	Oct. 5	12.00
Feb. 25, 1947	15.28				

Table 21.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit 1946-48--Continued

4-41- 2aa.

Date	Water level	Date	Water level	Date	Water level
Mar. 1, 1946	23.67	June 8, 1947	24.81	Apr. 10, 1948	24.79
Aug. 16	25.57	July 29	24.97	June 8	24.73
Oct. 22	25.02	Sept. 7	26.20	Aug. 3	25.25
Dec. 13	24.89	Feb. 3, 1948	25.62	Oct. 4	25.98
Feb. 25, 1947	24.76				

4-42-24ca.

Aug. 17, 1946	25.78	July 29, 1947	25.50	June 8, 1948	25.20
Oct. 22	25.50	Sept. 7	25.89	Aug. 3	25.38
Dec. 13	25.09	Dec. 5	24.97	Oct. 4	25.83
Feb. 25, 1947	24.85	Feb. 3, 1948	25.14	Dec. 8	25.17
June 8	24.90	Apr. 10	24.85		

4-42-34db.

Mar. 22, 1946	9.42	Sept. 7, 1947	10.31	June 8, 1948	9.43
Feb. 25, 1947	8.92	Dec. 5	9.43	Aug. 3	9.60
June 8	9.57	Feb. 3, 1948	9.86	Oct. 4	10.04
July 29	9.25	Apr. 10	9.27	Dec. 8	9.73

5-42- 4aa.

Mar. 19, 1946	22.88	Feb. 25, 1947	22.66	Feb. 3, 1948	21.98
Aug. 16	23.11	July 29	23.10	June 8	21.83
Oct. 22	22.81	Dec. 5	21.83	Dec. 8	22.68

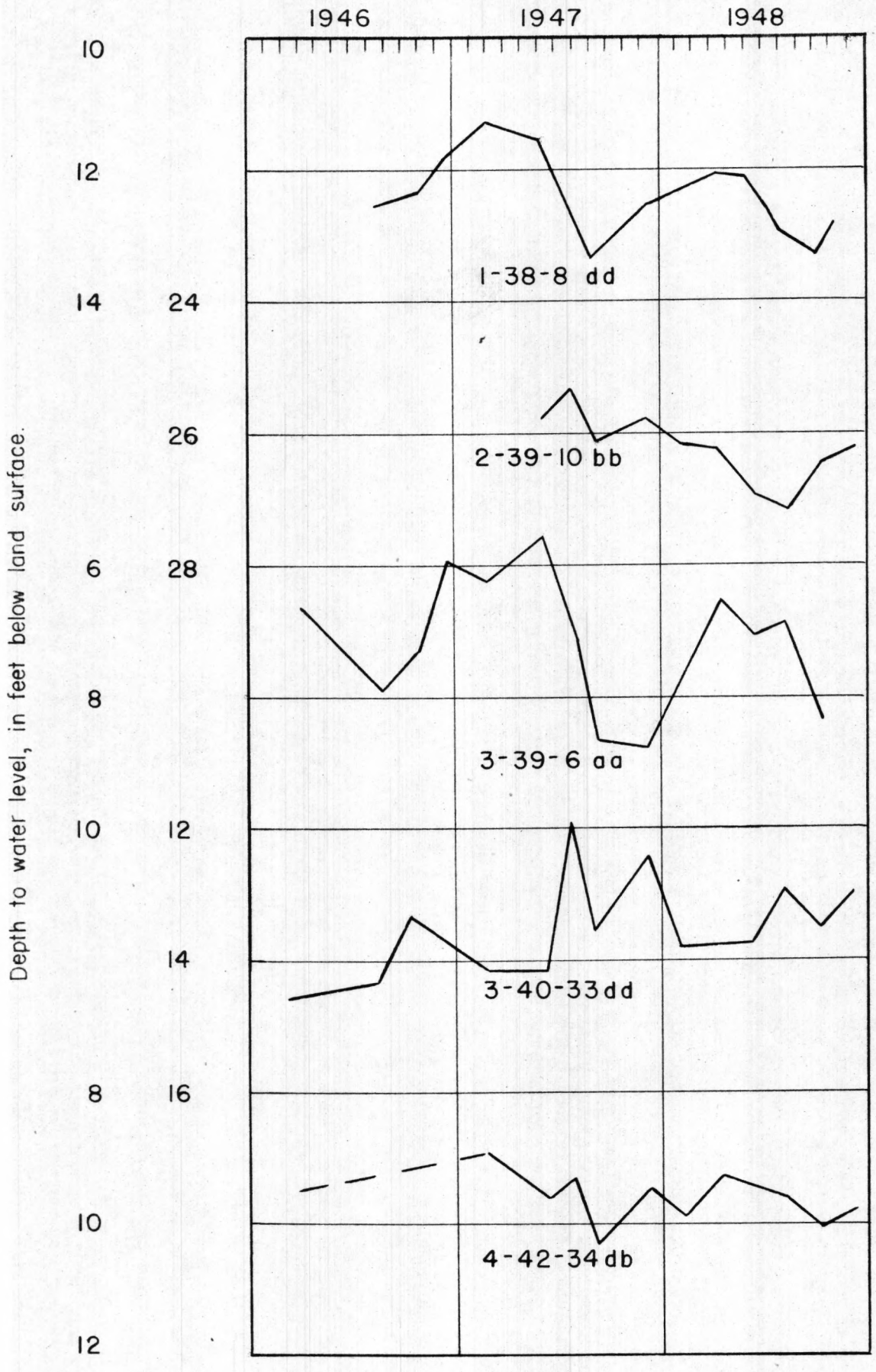


Fig. 10 - Hydrographs of five wells, St. Francis Unit.

Table 22.--Record of wells in the St. Francis Unit, Cheyenne County, Kans.

Well number[1]	Owner or tenant	Type of well[2]	Depth of well (feet)[3]	Diameter of well (in.)	Type of casing[4]	Character and geologic source of principal water-bearing material[5]	Method of lift[6]	Use of water[7]	Measuring point			Depth to water level below measuring point (feet)[9]	Date of measurement
									Description[8]	Distance above land surface (feet)	Height above mean sea level (feet)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1-38- 1cd	Paul O'Brien	Dr	42	18	GI	S,Gr;A	Tu,T	I,O	Bp	1.0	-	23.49	4-10-48
4dc	D. L. Ough	B	10.8	5	GI	S,A	Cy,W	S	Ls	.0	3,038.95	7.90	6-14-46
7cc	-	Du	34.6	36	C,So	S,A	Cy,W	S	Tpl	1.0	3,157.70	32.25	4-17-46
8cc	-	B	23.1	5	GI	S,A	Cy,W	D,S	Tpl	1.3	3,059.11	20.88	4-17-46
8dc	Ralph Kephart	Dr	34.3	24	GI	S,A	Tu,T	I	Ls	.0	3,058.15	13.33	6-14-46
8dd	-	Dr	34	18	GI	S,A	Tu,T	I,O	Bp	1.0	-	13.52	8-19-46
10ac	P. E. O'Brien, Sr.	DD	37.5	16	GI	S,A	Vc,G	I	Tca	1.5	3,042.65	21.60	6-13-46
10cc	School District	B	36.5	5	GI	S,A	N	O	Tcu	.3	3,051.25	21.87	6-13-46
12ba	Clyde Retler	B	37.0	3	GI	S,A	Cy,W	S	Ls	.0	3,040.66	26.60	6-13-46
17cd	F. J. Ostick	B	22.2	5	GI	S,A	Cy,H	D,O	Tcu	.3	3,067.71	12.07	6-13-46
18dc	-	B	29.5	5	GI	S,A	Cy,W	D,S	Tpl	.7	3,093.11	25.80	4-22-46
19da	L. A. Merklin	B	30.3	5	GI	S,A	Cy,W	D,S	Tcu	1.5	3,196.77	27.44	6-13-46
19dd	do.	Dr	40.5	-	GI	Gr	Tu,G	I	-	-	-	22	-
27bb	Edwin O'Leary	Dr	96.5	6	GI	S,Gr;Og	Cy,W	S	Tca	1.2	3,225.60	81.70	6-13-46

See footnotes at end of table.

Table 22.--Record of wells in the St. Francis Unit, Cheyenne County, Kans.--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1-38-29bc	J. O. Bash	B	44.3	5	GI	S,A	Cy,W	N	Tpl	.8	3,126.18	40.09	6-13-46
32cd	San Brunswig	Du	19.7	5	GI	S,A	Cy,W	D,S	Tpl	.2	3,170.07	14.83	6-13-46
1-39-12ba	-	Dr	92.0	4	GI	S,Gr;Og	Cy,H	N	Tcu	.0	3,260.61	87.96	6-14-46
25bc	School District	B	28.1	5	GI	S,A	Cy,H	D	Tcu	.8	3,106.74	14.95	4- 5-46
25cc	-	B	36.3	5	GI	S,A	Cy;W,G	S	Tpl	1.1	3,119.47	25.43	4-11-46
26cc	R. L. Harrison	B	17.8	5	GI	S,A	Cy,W	S	Tcu	1.0	3,115.28	13.72	4- 4-46
27dc	do.	DD	18	-	-	S,A	C,G	I	-	-	-	13	-
30db	W. Eckenberg	Du	26.3	34	C	S,A	Cy,W	D,S	Tpl	.8	3,241.98	21.77	6- 6-46
33cd	-	B	23.1	5	GI	S,A	Cy,H	S	Tcu	2.0	3,163.11	14.90	4- 5-46
1-40-36ac	Fred Kamla	Dr	79.3	8	GI	S,Gr;Og	Cy,W	D,S	Tpl	.0	3,283.58	78.35	6- 5-46
2-39- 1aa	Arnold Munyon	B	31	5	GI	S,A	Cy,W	D,S	Tcu	1.3	3,161.40	20.39	6-13-46
2cb	-	B	26.6	5	GI	S,A	Cy,H	O	Tpl	.8	3,160.21	19.78	3-28-46
3bc	-	B	23.5	5	GI	S,A	Cy,W	S	Tpl	2.0	3,145.36	15.19	3-28-46
8ab	-	Dr	59.4	5	GI	S,Gr;Og	Cy;W,G	D,S	Ls	.0	3,204.04	56.48	4- 2-46
10bb	-	Dr	39.0	5	GI	S,A	Cy,H	O	Tca	.5	-	26.25	6- 8-47
10cc	-	B	45.8	5	GI	S,A	Cy,W	D,S	Tcu	.42	3,273.24	24.40	4-11-46
11cb	School District	Dr	70.5	5	GI	S,Gr;Og	Cy,H	D	Tcu	.0	3,262.93	39.38	4-11-46
16bb	-	B	22.8	5	GI	S,A	Cy,H	S	Tca	1.0	3,165.28	9.70	3-28-46
17ba	-	Du	13.5	36	So	S,A	Cy,W	S	Tpl	.5	3,168.69	11.63	4-16-46
17ad	-	B	15.1	6	GI	S,A	Cy,H	D,S	Tcu	.3	3,167.42	7.20	3-28-46
19cb	Keller	B	22.9	4.5	GI	S,A	Cy,W	N	Tcu	.0	3,208.99	15.42	4- 1-46
20ab	-	B	16.6	6	GI	S,A	Cy,H	S	Tcu	1.5	3,180.43	13.62	3-27-46
20dd	School District	Dr	68.0	5	GI	Gr	Cy,H	D	Tcu	.5	-	52.79	3-27-46
27bb	-	B	29.3	8	GI	S,A	N	O	Tpl	1.3	3,236.46	20.83	3-27-46
32ad	-	Dr	50.0	6	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.0	3,299.91	39.03	3-27-46
2-40-12bb	F. R. Douthit	Dr	130.6	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.3	3,420.19	123.21	6- 5-46

See footnotes at end of table.

Table 22.--Record of wells in the St. Francis Unit, Cheyenne County, Kans.--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
2-40-12dc	Herbert Bandel	Dr	115.5	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.5	3,394.36	83.71[10]	6- 4-46
15da1	Ansel Miller	Dr	52.3	5	GI	S,Gr;Og	Cy,W	D	Tcu	.2	3,360.35	47.01	6- 4-46
15da2	-	Dr	23.0	4	GI	S,A	Cy,H	N	Tca	.0	-	15.77	6- 8-48
25db	Keller	DD	33	-	GI	S,A	C,G	I,O	-	-	-	14	-
26cc	-	Dr	88.6	5	GI	S,Og	Cy,W	D,S,O	Tpl	.3	3,387.61	79.40	3-29-46
33bc	William Gienger	Dr	116.5	5	GI	S,Og	Cy,W	D,S	Tcu	1.0	3,456.91	109.23	5-13-46
36bb	-	B	21.6	5	GI	S,A	Cy,H	D	Ls	.0	-	16.35	3-29-46
3-39- 6aa	-	B	14.8	5	GI	S,A	Cy,H	D,O	Tcu	.6	3,251.26	7.14	3- 3-46
8ba	-	B	32.5	5	GI	S,A	Cy,W	S	Tpl	1.5	3,309.61	26.18	3-26-46
3-40- 1da	-	B	16.8	5	GI	S,A	Cy,H	D	Ls	.0	3,263.40	9.33	3-26-46
2ca	-	B	32.0	5	GI	S,A	Cy,H	S	Tcu	.5	3,254.02	19.20	3-29-46
9ba	-	B	16.2	5	GI	S,A	Cy,H	S,O	Ls	.0	3,344.36	12.30	3-19-46
11ac	-	Du	17	6	GI	S,A	Cy,W	N	Tcu	.4	3,252.97	8.80	3-14-46
12dc	-	Dr	88.9	5	GI	S,Gr;Og	Cy,H	S	Tcu	.6	3,373.38	76.58	3-26-46
15ba	-	Du,Dn	14.2	22	Ob	S,A	Cy,H	S	Tpl	.4	3,269.67	9.28	3-14-46
16da	-	B	14.34	6	GI	S,A	N	O	Tcu	1.0	3,278.14	10.74	3-13-46
21ac	-	B	18.3	6	GI	S,A	Cy,H	D	Tcu	.3	3,301.85	10.98	3- 4-46
21dd1	City of St. Francis	Dr	24	-	GI	S,A	Tu,E	P	Tcu	-	-	11	3- 4-46
21dd2	do.	Dr	24	-	GI	S,A	Tu,E	P	Tcu	-	-	11	3- 4-46
21dd3	do.	Dr	24	-	GI	S,A	Tu,E	P	Tcu	-	-	11	3- 4-46
21dd4	do.	Dr	24	-	GI	S,A	Tu,E	P	Tcu	-	-	11	3- 4-46
22ab	-	B	19.2	5	GI	S,A	N	O	Tcu	.2	3,286.32	15.43	3- 9-46
26bb	-	B	36.8	5	GI	S,A	Cy,W	D,S	Tcu	.5	3,361.12	30.93	3- 9-46
28ad	-	B	25.3	8	GI	S,Gr,Og	Cy,H	D	Tcu	.5	3,353.83	21.89	3- 1-46
28bd	-	B	25.5	5	GI	S,A	N	N	Ls	.0	3,307.57	10.02	3-20-46
30dc	-	B	19.5	8	GI	S,A	Cy,W	S,O	Tpl	.1	3,330.01	11.97	3- 1-46

See footnotes at end of table.

Table 22.--Record of well in the St. Francis Unit, Cheyenne County, Kans.--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3-40-32ca	Sturm estate	DD	20.4	12	GI	S,A	C,G	I	Ls	.0	3,341.53	8.32	6- 8-46
33dd	-	Dr	27.4	6	GI	S,A	Cy,H	O	Tcu	.0	3,370.26	14.50	3- 4-46
36bb	W. R. Wilber	Dr	109.0	5	GI	S,Gr;Og	Cy,W	S	Tcu	1.0	3,433.77	87.96	6- 8-46
3-41-13cc	-	B	15.1	5	GI	S,A	Cy,H	N	Tca	.0	3,388.18	14.70	6-12-46
26aa	-	Dr	143.0	5	GI	S,Gr;Og	Cy,W	S	Tcu	.5	3,536.26	131.73	6-12-46
34ab	Andrew Byerly	Dr	104.5	6	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.0	3,548.76	101.72	6-12-46
36aa	-	B	29.8	8	GI	S,A	Cy,W	S	Tcu	.8	3,381.31	26.90	3- 4-46
4-40- 3db	Elmer M. Moberly	Dr	101.2	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.5	3,446.72	81.19	6- 8-46
5ad	-	B	17.5	6	GI	S,A	Cy,W	D	Tca	.3	3,371.42	12.77	3- 2-46
5cc	School District	Dr	65.7	6	GI	S,Gr;Og	Cy,H	D	Tcu	.5	3,429.06	55.06	3-14-46
6ab	-	B	24.1	6	GI	S,A	Cy,W	S	Tcu	.3	3,348.82	16.72	3- 8-46
7bc	-	Dr	58.8	5	GI	S,Gr,Og	Cy,W	D,S	Tcu	.3	3,431.52	53.94	3-20-46
16bb	-	B	29.8	5	GI	S,A	Cy,W	S	Tpl	.6	3,410.19	24.88	6- 7-46
18da	J. L. Evins	Dr	82.0	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.6	3,454.15	60.00	6-10-46
4-41- 2aa	-	B	29.9	6	GI	S,A	Cy,H	D,S	Tcu	.6	3,370.79	24.33	3- 1-46
4bb	Fred Zweygardt	Dr	131.5	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.11	3,568.46	119.72	6-12-46
4dc	do.	Dr	96	5	GI	S,Gr;Og	Cy,W	N	Tpl	1.0	3,518.82	69.73	6-12-46
6dc	A. E. Zimbelman	Dr	126	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.6	3,574.09	113.50	6-12-46
8dd	School District	Dr	90.5	5	GI	S,Gr;Og	Cy,H	D	Tcu	.0	3,505.10	88.64	3-11-46
12cc	-	Dr	57.4	5	GI	S Gr;Og	Cy,W	D,S	Tcu	.5	3,435.28	47.60	3- 8-46
16da	Thad Douthit	B	26.3	5	GI	S,A	Cy,W	S	Tcu	1.0	3,408.83	15.54	3- 8-46
23aa	William Krien	Dr	128.5	5	GI	S,Gr;Og	Cy,W	S	Tca	.0	3,525.89	120.42	6-11-46
24dd	A. J. Williams	Dr	192.0	6	GI	S,Gr;Og	Cy,W	D,S	Tcu	.5	3,588.76	173.36	6-10-46
26ad	D. E. Warner	Dr	167.5	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.3	3,570.91	141.50	6-10-46
27cb	-	Dr	118.3	4	GI	S,Gr;Og	Cy,W	S	Tcu	.5	3,552.17	111.50	6-10-46

See footnotes at end of table.

Table 22.--Record of wells in the St. Francis Unit, Cheyenne County, Kans.--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
4-41-31ac	-	Dr	117.6	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	.8	3,553.13	96.30	3-22-46
32ab	-	Dr	64.3	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.6	3,509.88	61.95	3-18-46
32dd	-	Dr	121.2	6	GI	S,Gr;Og	N	N	Tca	.3	3,576.44	114.70	6-10-46
4-42-11ad	Wilmer Lampey	Dr	186.5	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.1	3,658.56	174.53	6-11-46
13aa	-	Dr	145.5	6	GI	S,Gr:Og	Cy,W	S	Tcu	1.0	3,593.37	139.89	6-11-46
15bc	Wilmer Lampey	Dr	153.4	5	GI	S,Gr;Og	Cy,W	S	Tcu	.5	3,641.99	136.93	6-11-46
15dd	School District	Dr	149	5	GI	S,Gr;Og	Cy,W	D	Tpl	.5	3,618.42	137.65	6-11-46
22cd	-	B	38.5	5	GI	S,A	Cy,G	D,S	Tcu	1.0	3,512.30	26.68	3-13-46
24ca	Jake Waltz	Dr	72.0	24	GI	S,Gr;Og	Tu,T	I,O	Bp	-	-	-	3-12-46
24cd	Waltz	Dr	51.3	24	GI	Gr	Tu,T	I	Ls	.0	3,473.34	25.00	3-12-46
24da	-	B	24.3	6	GI	S,A	N	N	Ls	.0	3,449.20	14.75	3-12-46
26ba	P. E. O'Brien, Jr.	Dr	51.5	24	GI	Gr	Tu,T	I	Ls	.0	3,485.80	21.03	3-12-46
34da	-	B	41.3	5	GI	S,Gr;Og	Cy,H	D	Ls	.0	3,512.40	29.70	3-12-46
4-42-34db	School District	B	14.8	5	GI	S,A	N	O	Tcu	.08	3,494.14	9.50	3-22-46
36bc	-	Dr	71.7	5	GI	S,Gr;Og	Cy,W	D,S	Tcu	1.0	3,538.15	70.25	3-21-46
5-41- 6ad	School District	Dr	47.5	5	GI	S,Gr;Og	Cy,H	D	Tcu	.3	3,502.63	25.23	6-10-46
5-42- 2cd	-	Dr	87.8	5	GI	S,Gr;Og	Cy,W	S	Tcu	.3	3,582.59	79.00	3-22-46
4aa	-	B	37.2	6	GI	S,A	Cy,W	S,O	Tcu	1.0	3,526.30	23.88	3-19-46

See footnotes on following page.

Table 22.--Record of wells in the St. Francis Unit, Cheyenne County, Kans.--Continued

Footnotes:

1 Description of well-numbering system is given in text.

2 B, bored; DD, dug and drilled; Dr, drilled; Du, dug.

3 Measured depths are given in feet and tenths below measuring points; reported depths below the land surface are given in feet.

4 C, cement; GI, galvanized sheet iron; Ob, oil barrels; So, soil.

5 A, alluvium; Gr, gravel; Og, Ogallala formation; S, sand.

6 Method of lift: C, horizontal centrifugal; Cy, cylinder; N, none; Tu, turbine; Vc, vertical centrifugal.

Type of power: E, electric; G, gas engine; H, hand; T, tractor; W, windmill.

7 D, domestic; I, irrigation; N, none; O, observation; P, public supply; S, stock.

8 Bp, base of pump; Ls, land surface; Tca, top of casing; Tcu, top of curb; Tpl, top of platform.

9 Measured depths to water level are given in feet, tenths, and hundredths; reported depths to water level are given in feet.

10 Possible surface flow into well.

Replacement page, May 1950

WEBSTER UNIT

Periodic measurements of the water level have been made since 1946 in 9 observation wells in the valley of the South Fork of the Solomon River in Osborne County. The highest and lowest water levels for the period of record are given in table 23; the difference between the highest and lowest water levels, the net rise or decline in 1948, and the net rise or decline for the period of record are given in table 24; and the water-level measurements for 1948 are given in table 25. Hydrographs of five wells are shown in figure 11.

Table 23.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 9 wells in the Webster Unit

Well	Length of record (years)	Highest level	Date	Lowest level	Date
7-11-18cc	2	30.67	Mar. 30, 1948	33.32	Mar. 3, 1947
21da	2	32.24	July 29, 1947	33.86	Nov. 29, 1948
23dd	2	18.79	Nov. 20, 1946	25.67	Aug. 27, 1947
7-12-28ab	2	32.45	July 29, 1947	34.60	Jan. 7, 1947
7-13-15da	2	36.20	Nov. 7, 1946	a 38.94	Sept.30, 1947
7-14- 6cb	2	23.65	Dec. 9, 1946	24.19	Nov. 29, 1948
10dd	2	31.93	July 29, 1947	32.22	Feb. 4, 1947
7-15- 8cc	2	22.95	Aug. 27, 1947	23.64	Feb. 16, 1948
12dc	2	10.83	July 29, 1947	b 20.85	Dec. 2, 1948

a Well pumped recently.
b Well pumping.

Table 24.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 9 wells in the Webster Unit

Well	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
7-11-18cc	2.65	+1.72	+1.23
21da	1.62	- .20	- .43
23dd	6.88	-4.23	-4.93
7-12-28ab	2.15	- .97	- .04
7-13-15da	2.74	- .02	-1.67
7-14- 6cb	.54	- .27	- .49
10dd	.29	- .02	+ .24
7-15- 8cc	.69	+ .20	.00
12dc	10.02	+3.02	-3.91

Table 25.--Water-level measurements, in feet below land-surface datum, in the Webster Unit, 1948

7-11-18cc.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Feb. 16	32.58	May 28	31.73	July 30	30.70	Measurements discontinued.	
Mar. 30	30.67						

7-11-21da.

Feb. 16	33.67	May 28	33.65	Sept.28	33.50	Nov. 29	33.86
Mar. 30	33.59	July 30	33.00				

7-11-23dd.

Feb. 16	21.06	May 28	19.74	Sept.28	20.44	Nov. 29	a 24.73
Mar. 30	20.18	July 30	19.58				

a Well pumping.

7-12-28ab.

Mar. 30	33.03	July 30	33.24	Sept.28	33.34	Nov. 29	33.88

7-13-15da.

Feb. 16	38.45	May 28	37.45	Sept.28	38.42	Nov. 29	38.47
Mar. 30	38.10	July 30	37.36				

7-14-6cb.

Feb. 16	24.09	May 28	24.08	Sept.28	24.13	Nov. 29	24.19
Mar. 30	24.02	July 30	24.12				

7-14-10dd.

Mar. 30	32.15	July 30	32.00	Sept.28	32.00	Nov. 29	32.17
May 28	32.15						

7-15-8cc.

Feb. 16	23.64	May 28	23.20	Sept.28	23.00	Nov. 29	23.10
Mar. 30	23.33	July 30	23.03				

7-15-12dc.

May 28	14.66	July 30	11.65	Sept.28	11.74	Nov. 29	a 16.25

a Well pumped recently.

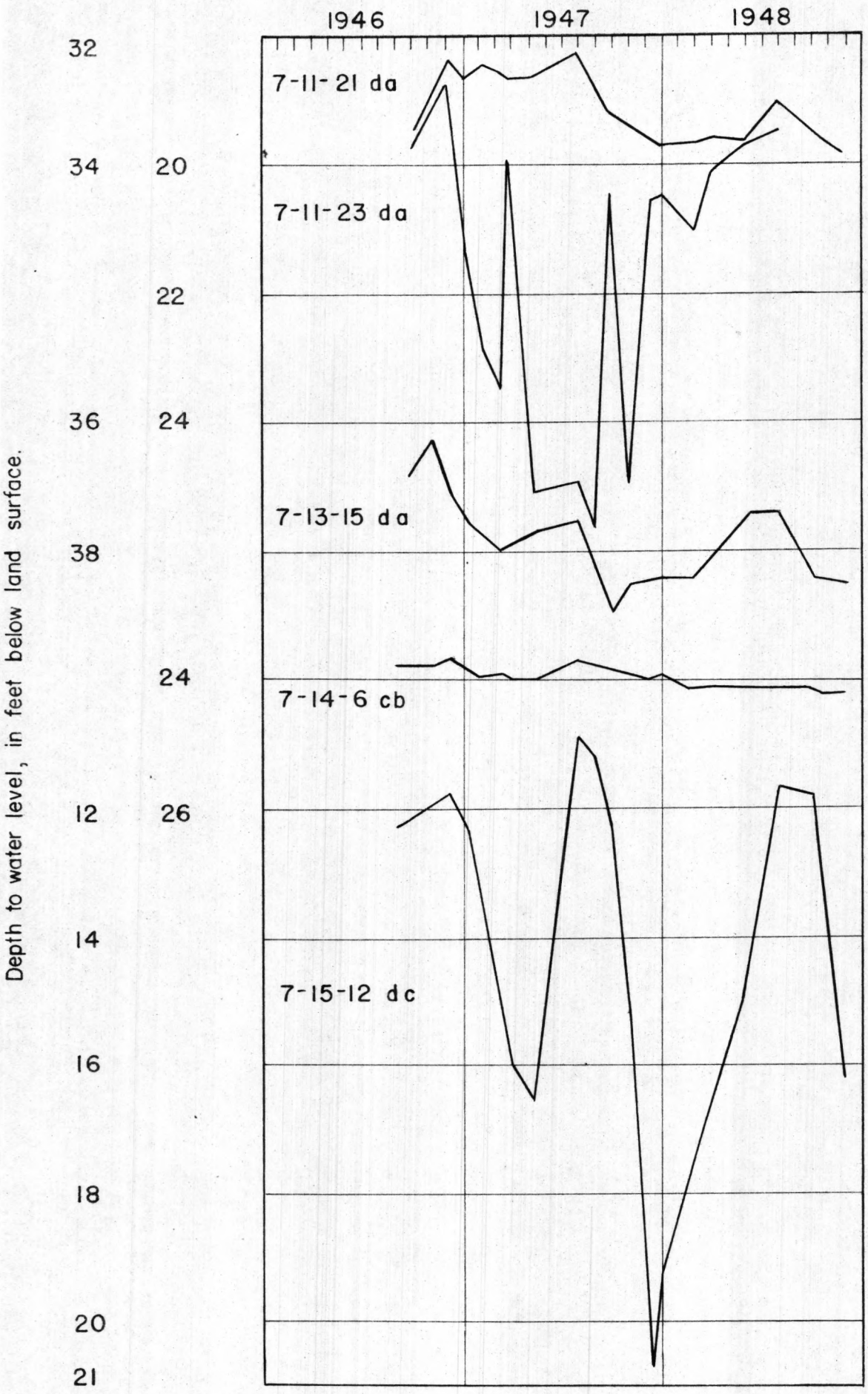


Fig. 11 - Hydrographs of five wells, Webster Unit.

GEOLOGY IN RELATION TO GROUND WATER

Summary of Stratigraphy

Exposed rocks in the Wilson Unit are of Cretaceous (Upper or Gulfian) and Quaternary (Pleistocene and Recent) age.

The Dakota formation of the Cretaceous system underlies the valley of the Saline River and all its tributary valleys. It consists predominantly of channel sandstone, clay, and shale. The Graneros shale, which overlies the Dakota formation in the areas adjacent to the valley, is predominantly a fissile noncalcareous blue-black shale. Pleistocene terrace deposits along the Saline River Valley and its tributaries are composed of locally derived gravel, sand, and silt. Pleistocene and Recent alluvium underlies the stream channels and flood plains. The Meade formation of Pleistocene age underlies the Wilson Valley, which extends south from a location approximately 1 mile north of the Lincoln-Ellsworth County line and 3 miles east of the Lincoln-Russell County line and which is approximately 4 miles wide at the Lincoln-Ellsworth County line. The Meade formation is composed of gravel, sand, and silt.

Cretaceous System

Upper Cretaceous (Gulfian) Series

Dakota formation.--The Dakota formation of the Cretaceous system is subdivided into two members, the Janssen clay and the Terra Cotta clay members. The lower or Terra Cotta clay member consists of varicolored interbedded clay, shale, sandstone, and quartzitic sandstone. The

quartzitic sandstone appears at the top of this member. The upper or Janssen clay member consists of clay, silt, fissile shale with lenticular sandstone, and lignitic clay. Although yields of wells tapping the Dakota formation generally are adequate for domestic purposes, there is a considerable range in the quality of the water; the chloride content of water samples collected in the Wilson Unit from the Dakota formation ranges from less than 50 up to 1,060 parts per million. The water in the Dakota formation is under artesian head in many places. Well 12-7-28db is estimated to flow at the rate of 10 gallons a minute.

Quaternary System

Pleistocene Series

Meade formation.--The Meade formation, which floors the Wilson Valley is divided into two members, the Grand Island and the Sappa. The Grand Island member is predominantly quartz sand and gravel, and the overlying Sappa member contains silty clay, sandy silt, and local deposits of the Pearlette volcanic ash.[1] The Meade formation ranges in thickness from 20 to 55 feet in the Wilson Valley. As it is generally above the water table, it yields water to wells only in local areas.

Terrace deposits.--Two terraces are recognized within the Wilson Unit. The upper terrace deposit is generally dissected and ranges in thickness from a thin veneer to approximately 20 feet. It is developed on materials composed of locally derived sand and gravel, some quartz sand and gravel,

1 Term used by the Kansas Geological Survey

and silt. Locally, the sands and gravels are cemented. The upper terrace deposits are above the water table and hence are not a source of water supply in this area. The lower terrace is developed on materials composed of silt, clay, locally derived sand and gravel, and some quartzitic sand and gravel. These deposits range in thickness from 10 to 20 feet and are the chief aquifer in the Saline River Valley. Wells on this terrace have been reported to yield as much as 1,000 gallons a minute. The surface of the lower terrace is mantled in some places by Recent alluvial silt and clay deposited by flood waters of the river. Precipitation is not readily transmitted down to the zone of saturation by these finer materials, and as a result some of the crop lands need to be drained.

Pleistocene and Recent Series

Alluvium.--The alluvium of the Saline River and its tributaries was derived almost entirely from local outcrops of limestone and sandstone formations. It consists of sand and gravel, very fine sand, and silt and ranges in thickness from less than a foot to 30 feet. Water supplies for domestic and stock use can be developed from the alluvium in many places.

WELL RECORDS

Data obtained from an inventory of 37 wells are presented in table 31. Inasmuch as many of the wells are located outside the limits of the Wilson Unit, only the locations of the wells inside the unit are shown on figure 12.

Replacement page, May 1950

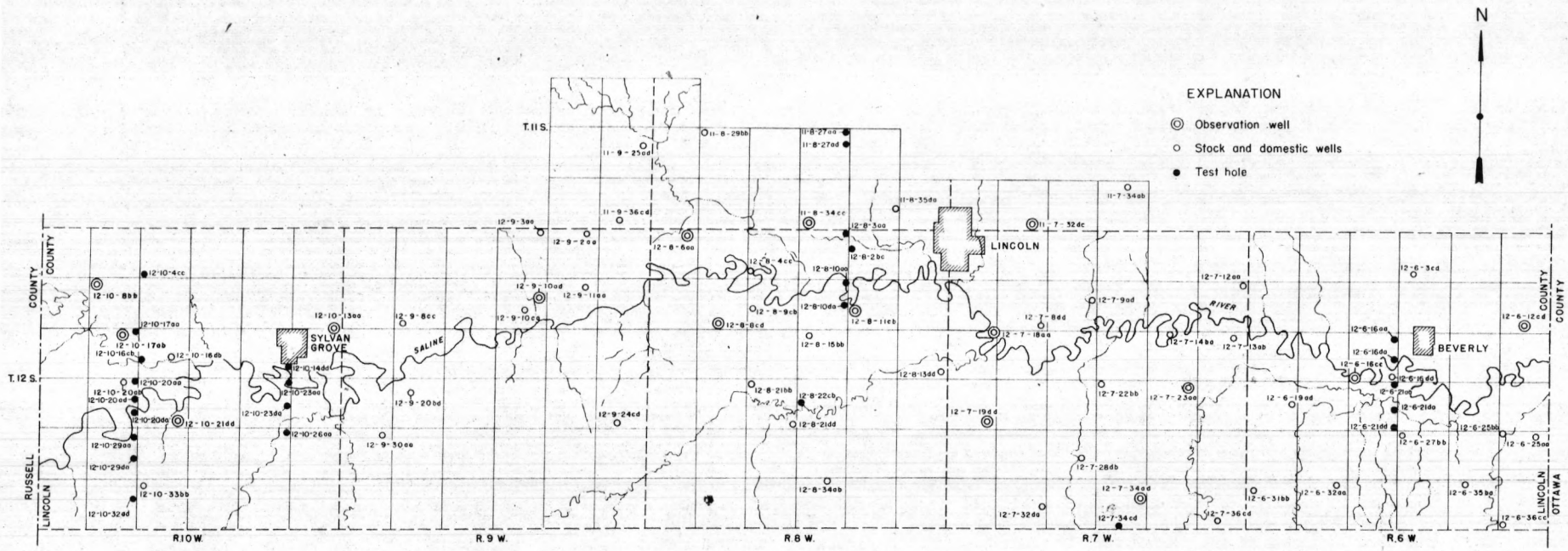


Figure 12.- Map of Wilson Unit showing location of wells

Measurements of the water level in 16 wells have been made periodically since 1947. The highest and lowest water levels for the period of record are given in table 26; the difference between the highest and lowest recorded water levels, the net rise or decline of the water level in 1948, and the net rise or decline of the water level for the period of record are given in table 27; and the water-level measurements made in 1948 are given in table 28. Hydrographs of five wells are shown in figure 13.

Table 26.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 16 wells in the Wilson Unit

Well	Length of record (years)	Highest level	Date	Lowest level	Date
11- 7-32dc	2	73.74	Apr. 6, 1948	74.67	Sept. 8, 1947
11- 8-34cc	2	4.17	Apr. 6, 1948	7.45	Nov. 28, 1947
12- 6-12cd	2	11.64	Aug. 9, 1948	15.52	Jan. 12, 1948
16cc	2	21.09	Apr. 28, 1947	24.87	Nov. 28, 1947
12- 7-18aa	2	20.15	July 24, 1947	23.43	Nov. 28, 1947; Jan. 12, 1948
19dd	2	10.58	Aug. 9, 1948	13.18	Jan. 12, 1948
23aa	2	10.56	Aug. 9, 1948	13.43	Jan. 12, 1948
34ad	2	49.90	Aug. 9, 1948	50.84	Feb. 21, 1947
12- 8- 6aa	2	5.92	Apr. 28, 1947	10.53	Sept. 8, 1947
8cd	2	12.53	Apr. 6, 1948	14.30	Jan. 12, 1948
11cb	2	15.85	Aug. 9, 1948	19.35	Jan. 12, 1948
12- 9-10ad	2	18.52	Sept.29, 1948	20.26	Jan. 12, Apr.6, 1948
12-10- 8bb	2	14.65	Aug. 9, 1948	16.58	Jan. 12, 1948
13aa	2	19.36	Aug. 9, 1948	24.48	Jan. 12, 1948
17ab	2	25.61	July 24, 1947	28.49	Dec. 7, 1948
21dd	2	25.98	July 24, 1947	27.38	Jan. 12, 1948

Table 27.--Difference between highest and lowest recorded water levels, net change in water level in 1948, and net change in water level for period of record, in feet, in 16 wells in the Wilson Unit

Well	Difference between highest and lowest levels	Net rise (+) or net decline (-) in 1948	Net rise (+) or net decline (-) for period of record
11- 7-32dc	0.93	+0.33	+0.04
11- 8-34cc	3.28	+1.01	-1.10
12- 6-12cd	3.88	+1.03	- .18
16cc	3.78	+ .38	-3.31
12- 7-18aa	3.28	+ .64	-2.17
19dd	2.60	+ .39	+1.04
23aa	2.87	+1.94	+2.06
34ad	.94	+ .67	+ .80
12- 8- 6aa	4.61	+1.12	-1.39
8cd	1.77	+ .10	- .33
11cb	4.50	+ .76	- .07
12- 9-10ad	1.74	+1.39	+1.03
12-10- 8bb	1.93	+ .12	- .23
13aa	5.12	+3.70	+3.66
17ab	2.88	-1.71	-2.33
21dd	1.40	- .32	- .45

Table 28.--Water-level measurements, in feet below land-surface datum, in the Wilson Unit, 1948

11-7-32dc.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 12	74.55	May 20	74.23	Aug. 9	73.80	Sept.29	74.30
Apr. 6	73.74						

11-8-34cc.

Jan. 12	7.32	May 20	6.83	Sept.29	6.44	Measurements dis-	
Apr. 6	4.17	Aug. 9	5.24			continued.	

12-6-12cd.

Jan. 12	15.52	May 20	13.82	Sept.29	13.27	Dec. 6	13.77
Apr. 6	13.36	Aug. 9	11.64				

Table 28.--Water-level measurements, in feet below land-surface datum in the Wilson Unit, 1948--Continued

12-6-16cc

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 12	24.70	May 20	24.12	Sept.29	24.00	Dec. 6	24.49
Apr. 6	23.80	Aug. 9	22.35				

12-7-18aa.

Jan. 12	23.43	Apr. 6	22.89	May 20	23.07	Sept.29	22.79

12-7-19dd.

Jan. 12	13.18	May 20	11.38	Sept.29	11.10	Dec. 6	11.56
Apr. 6	11.57	Aug. 9	10.58				

12-7-23aa.

Jan. 12	13.43	May 20	11.99	Aug. 9	10.56	Sept.29	11.34
Apr. 6	12.17						

12-7-34ad.

Jan. 12	50.60	May 20	50.03	Aug. 9	49.90	Sept.29	50.04
Apr. 6	50.30						

12-8-6aa.

Jan. 12	8.70	May 20	8.15	Sept.29	9.07	Dec. 7	7.73
Apr. 6	6.63	Aug. 9	8.00				

12-8-8cd.

Jan. 12	14.30	May 20	13.16	Sept.29	13.90	Dec. 7	14.00
Apr. 6	12.53	Aug. 9	12.55				

12-8-11cb.

Jan. 12	19.35	May 20	18.60	Aug. 9	15.85	Sept.29	18.44
Apr. 6	18.30						

Table 28.--Water-level measurements, in feet below land-surface datum in the Wilson Unit 1948--Continued

12-9-10ad.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 12	20.26	May 20	20.18	Sept.29	18.52	Dec. 7	18.58
Apr. 6	20.26	Aug. 9	18.63				

12-10-8bb.

Jan. 12	16.58	May 20	a18.90	Sept.29	15.40	Dec. 7	a16.43
Apr. 6	15.96	Aug. 9	14.65				

a Well pumping.

12-10-13aa.

Jan. 12	24.48	May 20	22.94	Sept.29	19.73	Dec. 7	20.42
Apr. 6	23.64	Aug. 9	19.36				

12-10-17ab.

Jan. 12	26.80	May 20	26.86	Sept.29	26.42	Dec. 12	28.49
Apr. 6	26.65	Aug. 9	25.98				

12-10-21dd.

Jan. 12	27.38	May 20	27.26	Sept.29	27.13	Dec. 7	27.32
Apr. 6	27.13	Aug. 9	26.88				

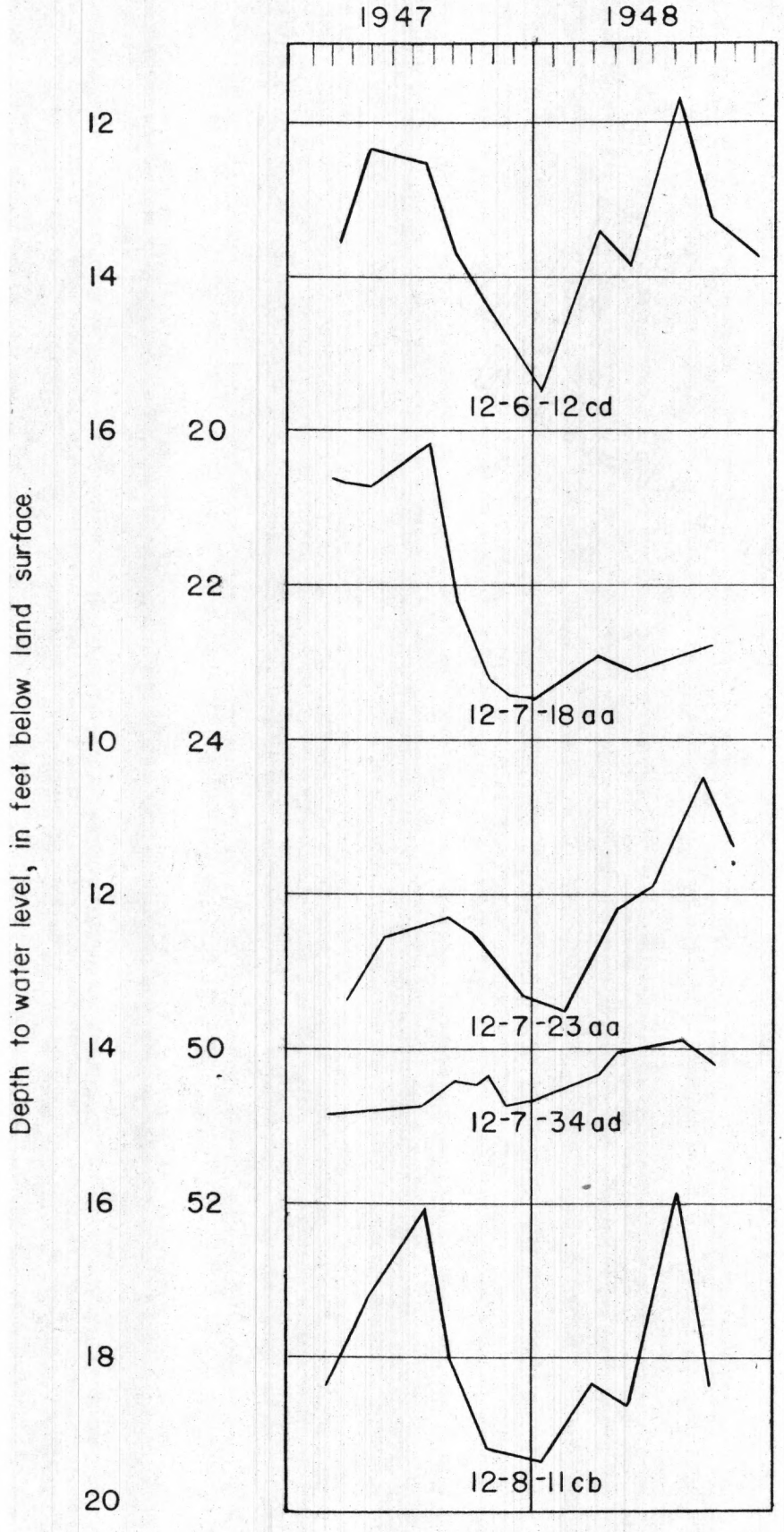


Fig. 13 - Hydrographs of five wells, Wilson Unit.

QUALITY OF THE WATER

During October and November 1948 a total of 26 water samples were collected in the Wilson Unit and in the area adjacent to it. The chloride and nitrate contents of the water were determined by Howard Stoltenberg of the Kansas State Board of Health. (See table 29.)

Table 29.--Chemical analyses of 26 water samples collected in the Wilson Unit and adjacent area. /Concentration in parts per million/

Well number	Chloride	Nitrate (NO_3)	Nitrate nitrogen (N)
11-8-26aa	24	49	11
11-9-16db	955	8.8	2
25ad	22	1.9	.42
12-6-16dd	305	.88	.20
31bb	12	2.2	.50
35ba	156	1.3	.30
36cc	32	3.4	.78
12-7-8dd	20	88	20
19dd	29	80	18
22bb	19	1.3	.30
28db	310	.44	.10
12-8-15bb	127	30	6.8
21dd	20	28	6.3
34ab	83	137	31
12-9-3aa	27	2.4	.55
24cd	34	22	4.9
13-6-7ab	45	.97	.22
10bb	223	1.5	.35
26ba	91	1.3	.30
29ca	17	1.3	.30
13-7-7bb	17	1.1	.25
15dc	21	5.8	1.3
17aa	334	168	38
26ac	15	1.3	.30
28ba	12	1.5	.35
13-8-13cc	44	3.4	.78

LOGS OF TEST HOLES

The character, thickness, and extent of the water-bearing formations in the Wilson Unit were determined by the drilling of 38 test holes by the State Geological Survey of Kansas in August 1948. The locations of the holes drilled inside the boundary of the Wilson Unit are shown on figure 12, and the logs of all test holes are given in table 30.

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948.

10-6-21bb

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	3	3
Clay and silt, sandy, tan to brown	14	17
Clay, sandy, greenish gray	19	36
Gravel, limestone and sandstone, fine to medium, rounded	2	38
CRETACEOUS--Gulfian		
Dakota formation		
Clay, sandy, tan and gray	2	40
Clay, sandy, light tan	10	50

10-6-21cb.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black, and clay	5	5
Clay, sandy, tan	10	15
Clay, slightly sandy, brownish tan	8	23
Clay, bluish black	22	45
Clay, very sandy, fossiliferous, greenish	11	56
Sand, quartz, fine to medium, fossiliferous, greenish	5	61
Gravel, fine to medium; contains rounded limestone	2	63
CRETACEOUS--Gulfian		
Dakota formation		
Clay, tan, gray, and red. Lignite from 68 to 70 feet	7	70

Table 3.0.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

10-6-28bc.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	4	4
Clay, very sandy, light tan	4	8
Clay, very sandy, fossiliferous, light tan	3	11
Gravel, limestone, fine to coarse, angular, rounded; contains clay	4	15
Gravel, limestone, fine to medium, and thin clay beds	8	23
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray and red	4	27

10-6-28cb.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, brown to black; contains road fill	8.5	8.5
Clay, sandy, light gray, tan, and buff	9.5	18
Clay, light tan and red; contains fossil resembling crinoid columnal	7	25
Clay, red; contains a trace of gravel	7	32
Sand, quartz, fine to medium	1	33
CRETACEOUS--Gulfian		
Dakota formation		
Sandstone, yellowish brown	7	40

10-10-35ad.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, tannish brown; contains fine sand	5	5
Silt, sandy, tannish brown	4.5	9.5
Clay, sandy, light brown	8.5	18
Clay and very fine sand, light brown	6.5	24.5
Clay, dark gray	6.5	31
Gravel, fine to medium, and fine sand, reddish; contains "ironstone," and limestone pebbles	6	37
Gravel, fine to medium, reddish; contains "ironstone" and limestone pebbles	7	44
Gravel, coarse, and clay	3	47
Silt and clay, black; contains coarse gravel	7.5	54.5
Silt, soft, gray	3	57.5
Silt, sandy, gray	1.5	59
Gravel, fine to coarse, and limestone pebbles	4	63
CRETACEOUS--Gulfian		
Dakota formation		
Shale, very sandy, noncalcareous, gray	10	73

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September 1948--Continued

11-8-27aa. Surface altitude 1,437 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, sandy, tan	5	5
Silt and clay, brown	2	7
Clay, sandy, reddish-tan; contains fine limestone gravel	3	10
Clay, light-tan, and fine limestone gravel	8	18
Gravel, limestone, and clay	2	20
CRETACEOUS--Gulfian		
Dakota formation		
Clay, reddish-tan; contains light-gray clay	19	39
Clay, light-gray; contains reddish-tan clay which is probably lag[8/]	11	50

11-8-27ad. Surface altitude 1,420.6 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black to dark-brown	3.5	3.5
Clay, sandy, tan	3	6.5
Clay, silty, sandy, tan and brown	10.5	17
Gravel, limestone, fine to medium, angular; contains clay	7	24
CRETACEOUS--Gulfian		
Dakota formation		
Clay, tan and gray	6	30

12-6-16aa. Surface altitude 1,322.2 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	4	4
Clay, blocky, tan	9	13
Clay, light-tan	9	22
Clay, compact, light-tan	5	27
Clay, very sandy, tan	3	30
Sand, quartz, very fine; contains clay	17	47
Gravel, fine to medium, rounded; contains medium sand	3.5	50.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, very compact, light-gray	3.5	54

8/ Rock cuttings recovered at the surface in the drilling of holes by the rotary method often contain a considerable proportion of material derived from beds which were passed through higher in the hole.

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-6-16da. Surface altitude 1,324.8 feet

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay; black	3	3
Clay, dark greenish gray	4.5	7.5
Clay, light gray	6	13.5
Clay, very sandy, tan	10.5	24
Gravel, fine to medium, and coarse quartz sand	6	30
Sand and fine gravel, mostly quartz	10	40
Sand, coarse, and fine gravel, quartz (Six-inch bed of black clay at 48 feet)	10	50
Gravel and gray clay	4.5	54.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, greenish black; contains pyrite and lignite	4.5	59

12-6-21aa. Surface altitude 1,317.9 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, brown to black	4.5	4.5
Clay, silty, tan	9.5	14
Clay, sandy, tan	9	23
Clay and sand; tan	12	35
Gravel, fine to coarse; contains sand	10	45
CRETACEOUS--Gulfian		
Dakota formation		
Clay, bluish gray and yellow	2	47
Clay, slightly sandy, light gray	2	49
Sandstone and quartzite, light gray; contains lignite	5.5	54.5
Clay, very sandy, light bluish gray, and gray sandstone	15.5	70
Clay, light bluish gray	14.5	84.5
Clay, gray and greenish gray; contains lignite and pyrite; contains thin zone of sandy clay	5.5	90
Clay, sandy, gray to bluish gray	28	118
Clay, light green and reddish brown	8	126
Sandstone, fine, light tan to gray	34.5	160.5
Shale, very fissile, noncalcareous, bluish black; contains lignite and sandstone	19.5	180
CRETACEOUS--Comanchean		
Kiowa shale		
Sandstone, medium coarse, calcite cemented; contains some calcite-cemented thin hard zones	17	197
Shale, noncalcareous, black and blue green; contains shell fragments and hard beds	13	210
Shale, noncalcareous, black, and tan limestone	14	224
Shale, noncalcareous, black, and tan limestone; contains white crystal fragments	23	247
Shale, black, greenish gray, and red	12	259
PERMIAN--Guadalupian		
Shale, red; contains black and greenish-gray shale which is probably lag	21	280

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-6-21da. Surface altitude 1,317.8 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, dark gray to black; contains sand and gravel	4	4
Clay, sandy, tan; contains limestone gravel	2.5	6.5
Clay, sandy, tan; contains silt and gravel	3.5	10
Silt and clay, sandy, reddish brown	10	20
Clay, sandy, tan; contains limestone gravel	3	23
Gravel, fine to medium, limestone; contains medium quartz sand	14	37
Gravel, medium, and rounded limestone; contains quartz sand	12	49
CRETACEOUS--Gulfian		
Dakota formation		
Clay, blue black and yellow; contains quartzitic sandstone	5	54

12-6-21dd. Surface altitude 1,328.2 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Road fill, gravel and silt, dark brown and gray	2.5	2.5
Silt, sticky, compact, gray	3.5	6
Silt, slightly sandy, fairly compact, tan	1.5	7.5
Silt, sandy, medium compact, rusty brown	1	8.5
Gravel, sandstone	5	13.5
Silt, very sandy, compact, buff to rusty brown	6.5	20
Sand, fine to coarse, tan to buff	11	31
Gravel, fine to coarse; contains coarse sand and silt which are probably lag	9	40
Gravel, fine to coarse, sandstone and limestone	5.5	45.5
CRETACEOUS--Gulfian		
Dakota formation		
Shale and clay; sandy, blue gray	1	46.5
Sandstone, very solid, blue gray	1	47.5

12-7-34cd.

QUATERNARY--Pleistocene		
Sanborn formation		
Road fill, brown, medium compact silt	2	2
Silt, slightly sandy, buff to brown	3	5
Silt, fairly loose, slightly sandy, rusty brown	5	10
Silt, sandy, light tan to buff; contains caliche	6	16
Terrace deposits		
Gravel, fine to coarse, limestone, and sandstone	8.5	24.5
CRETACEOUS--Gulfian		
Dakota formation		
Sandstone, compact, yellow brown	2.5	27
Sandstone, compact, tan	1.5	28.5
Sandstone and sandy clay, fairly compact, white	1.5	30

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-8-2bc. Surface altitude 1,372.5 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black; contains clay	4	4
Clay, light tan to gray	2	6
Clay, light tan	6	12
Clay, tan	8	20
Sand, quartz, medium	10	30
Sand and fine gravel	20	50
Sand and rounded medium limestone gravel; contains a trace of clay at 53½ feet	10	60
Sand, fine, and rounded medium limestone gravel; contains a trace of lignite at 63½ feet	4.5	64.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, light gray	5.5	70

12-8-3aa. Surface altitude 1,371.6 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay; black	5	5
Clay, gray and tan mottled	7	12
Clay, sandy, dark gray to brown	3.5	15.5
Clay, sandy, light tan and gray	1.5	17
Sand, very fine, tan	20	37
Sandstone, soft, reddish tan	7	44
CRETACEOUS--Gulfian		
Dakota formation		
Sandstone, "ironstone," reddish brown	5.5	49.5

12-8-10aa. Surface altitude 1,373.4 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, slightly sandy, black	8.5	8.5
Clay, slightly sandy, tan	8	16.5
Sand, very fine, silty	9	25.5
Sand, quartz, medium to fine	4.5	30
Sand, gravel, and thin beds of clay	14	44
Gravel and sand, fine	3	47
Gravel, limestone, medium to coarse, rounded, stained brown; contains sand	6.5	53.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, light gray	6.5	60

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-8-10da. Surface altitude 1,374.6 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black; contains clay	4	4
Clay, tan to brown	11	15
Clay and silt, black	5	20
Clay, greenish gray	11	31
Gravel, fine to coarse; contains coarse sand	8	39
Gravel and sand, medium to coarse	4	43
CRETACEOUS--Gulfian		
Dakota formation		
Clay, light gray	4	47

12-8-22cb.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	4	4
Clay, buff tan; contains fine gravel	10	14
Clay, sandy, buff tan	6	20
Clay, sandy, tan to buff	6	26
Silt, sandy, fossiliferous, black	3	29
Clay, greenish gray	5	34
Gravel, coarse to medium, rounded, and limestone pebbles	5	39
Gravel, fine to medium, sandy; contains black silty clay	2.5	41.5
CRETACEOUS--Gulfian		
Dakota formation		
Gravel and clay; gray	1.5	43
Clay, light gray; contains gray sandstone	2	45

12-10-4cc. Surface altitude 1,422.0 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, dark brown; contains road fill	3.5	3.5
Clay, sandy, tan	3.5	7
Clay, silty; contains gravel	7	14
Clay, sandy, gray; contains coarse gravel	3.5	17.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, buff, tan, gray, and some red; contains "ironstone" gravel	2.5	20

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in Augsut and September, 1948--Continued

12-10-14dd. Surface altitude 1,429.7 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	3	3
Clay, tannish brown; contains coarse sand	5.5	8.5
Sand, fine, and coarse limestone gravel	3	11.5
Clay, silty, light brown	8	19.5
Clay and some very fine sand	1.5	21
Clay, sandy, tan	8	29
Clay, reddish tan; contains red coarse sand	6	35
Sand, quartz, medium to coarse, rounded	6	41
Gravel, fine to medium, limestone, and quartz	1	42
CRETACEOUS--Gulfian		
Dakota formation		
Clay shale, gray, buff, and reddish brown	2	44

12-10-16cb. Surface altitude, 1,439.0 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, black	4	4
Silt, brown	4	8
Clay, silty, tan	8	16
Clay, sandy, light tan	9	25
Clay, slightly sandy, grayish tan	5	30
Clay, dark gray	10	40
Clay, dark bluish gray	4	44
Clay, greenish gray	3	47
Gravel and rounded, fine to medium limestone	3	50
Sandstone, fine	4	54
Sand, fine to medium, and rounded quartz	2	56
CRETACEOUS--Gulfian		
Dakota formation		
Clay, soapy, light gray	4	60

12-10-17aa. Surface altitude, 1,448.8 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Clay, silty, buff to brown	6.5	6.5
Clay, silty, tan	6.5	13
Gravel, fine to medium; contains sand and clay	7	20
Gravel, iron-stained limestone, fine to medium	10	30
Gravel, limestone, medium to coarse	6	36
CRETACEOUS--Gulfian		
Dakota formation		
Clay, slightly sandy, gray	4	40

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in Augst and Sepetmber, 1948--Continued

12-10-20aa. Surface altitude, 1,445.9 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, very sandy, brown	6	6
Sand, quartz and feldspar, medium fine	2	8
Clay, tan, mottled with buff and black	8	16
Clay, sandy, tan, and fine limestone gravel	7	23
Gravel, limestone and "ironstone;" contains clay	2	25
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray, buff, tan; contains red sand	4.5	29.5

12-10-20ad. Surface altitude, 1,446.2 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, fine, sandy, black to dark brown	8	8
Clay, sandy, tan	8	16
Clay and silt, sandy, brown	4	20
Sand, quartz and feldspar, medium to coarse	8	28
CRETACEOUS--Gulfian		
Dakota formation		
Clay, red and light tan	2	30

12-10-20da. Surface altitude, 1,437.2 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, very sandy, light tan	6	6
Sand, fine, limestone and quartz	2	8
Clay, gray	4	12
Gravel, limestone, fine to medium, and dark-gray clay and sand	8	20
Sand, quartz, fine to coarse, and fine gravel	8	28
Clay, dark gray, and sand	7	35
Gravel, fine to medium; contains quartz sand	15	50
Gravel, fine to coarse; contains quartz sand	13.5	63.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, red and gray	6.5	70

Table 3.0.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-10-23aa. Surface altitude, 1,429.4 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt and clay, grayish brown	10	10
Clay and very fine sand	5	15
Clay, tan	7	22
Sand, quartz, medium, rounded	7	29
Gravel, medium, and rounded limestone	4	33
Gravel, quartz, fine, rounded	3.5	36.5
Shale, clay, sandy, dark gray	3.5	40
CRETACEOUS--Gulfian		
Dakota formation		
Shale, clay, sandy, bluish gray streaked with red	4.5	44.5

12-10-23da. Surface altitude 1,434.0 feet.

QUATERNARY--Pleistocene and Recent		
Alluvium		
Silt, brown to black	4	4
Silt and clay, light brown	6	10
Clay, sandy, light brown	4	14
Gravel and clay; contains limestone and quartz gravel	4.5	18.5
Clay, very sandy, tan to buff	2.5	21
Sand, fine to medium, and rounded quartz	4	25
Sand, medium to coarse, and rounded quartz	9	34
Gravel, fine to medium, and limestone pebbles	2	36
Gravel, limestone, medium to coarse, and gray and red clay shale	1	37
CRETACEOUS--Gulfian		
Dakota formation		
Clay shale, noncalcareous, sandy, gray	.5	37.5

12-10-26aa. Surface altitude, 1,472.4 feet.

QUATERNARY--Pleistocene		
Sanborn (?) formation		
Silt, black	4	4
Silt and clay, tan	1.5	5.5
Clay, reddish brown, contains silt	5.5	11
Clay, light tan grading to light gray; sandy in lower part	4.5	15.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, sandy, buff, gray, and red	3.5	19
Clay, light gray; red at 21 feet	4	23
Clay, buff	1	24

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

12-10-29aa. Surface altitude, 1,449.6 feet.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene and Recent		
Alluvium		
Clay, silty, tan	4	4
Silt and clay, buff to tan	6	10
Clay, silty, tan; contains fine gravel	8	18
Sand, quartz, medium to coarse, and fine to medium limestone gravel	10	28
CRETACEOUS--Gulfian		
Dakota formation		
Clay, red and gray	2	30

12-10-29da. Surface altitude, 1,496.9 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Clay, tan; contains sand, limestone, and caliche	5	5
Clay, tan; contains sand, limestone gravel, and caliche	3.5	8.5
Sand, quartz, fine to medium	10.5	19
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray, tan, yellow, and red	3	22

12-10-32ad. Surface altitude, 1,492.0 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Clay, tan; contains much caliche	3	3
Gravel, limestone, rounded, and caliche	4	7
Gravel, limestone, fine, and fine sand	10	17
Gravel, limestone, fine to coarse, and coarse sand	9	26
Gravel, medium, angular limestone and "ironstone;" contains gray clay	5	31
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray	6	37

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

13-9-31cc.

	Thickness, feet	Depth, feet
QUATERNARY--Recent and Pleistocene		
Soil		
Silt, sandy, light brown	4.5	4.5
Meade formation		
Silt and clay, tan to brown	10	14.5
Clay, silty, buff to tan; contains caliche pebbles	15.5	30
Clay, light tan; contains very fine sand	27	57
Sand, quartz, medium to coarse; contains fine quartz gravel	6.5	63.5
CRETACEOUS--Gulfian		
Dakota formation		
Clay, yellow, and fine sandy sandstone, noncalcareous	9.5	73

13-10-33dd.

QUATERNARY--Pleistocene		
Meade formation		
Clay and silt, sandy, and gravel, tan	3	3
Clay and coarse sand, tan; contains fine gravel	5	8
Clay, tan, and caliche; contains coarse sand and fine gravel	3	11
Clay, light tan	6	17
Clay and silt, tan; contains loose sand	3	20
Clay, tan	5	25
Clay, compact, sandy, light tan	5	30
Clay, sandy, light tan	5	35
Sand, quartz and feldspar, medium to coarse, rounded	9	44
Sand and gravel, quartz and feldspar, rounded	5	49
CRETACEOUS--Gulfian		
Dakota formation		
Sandstone, fine, light gray	11	60

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

13-10-34cc.

	Thickness, feet	Depth, feet
QUATERNARY--Pleistocene		
Sanborn formation		
Clay and silt, tan	10	10
Clay, light tan	10	20
Clay, reddish tan, and caliche	6.5	26.5
Meade formation		
Clay, sandy, tan	3.5	30.5
Clay, sandy, light tan to gray	7	37
Sand, quartz, medium, rounded	10	47
Gravel, fine to medium, and coarse sand	10	57
Gravel, sandstone, reddish brown	2	59
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray and yellow	1	60

13-10-34dd.

QUATERNARY--Pleistocene		
Sanborn formation		
Silt and clay, sandy, brown	10	10
Clay and silt, tan; contains caliche	10	20
Clay and silt, sandy, light tan; contains caliche	12	32
Meade formation		
Clay, greenish tan	8	40
Clay, compact, greenish tan	7	47
Sand, quartz, medium to coarse, and fine gravel	3	50
Sand, medium to coarse, and fine gravel (slightly coarser than above sample)	12	62
Gravel, sandstone, and reddish-brown sand	4	66
CRETACEOUS--Gulfian		
Dakota formation		
Clay, light gray and yellow	3	69

Table 30.--Logs of test holes drilled by the Kansas State Geological Survey in the Wilson Unit in August and September, 1948--Continued

14-9-4bb.

	Thickness, feet	Depth, feet
QUATERNARY--Recent		
Soil		
Silt, brown	2.5	2.5
TERTIARY--Pliocene		
Ogallala formation		
Limestone, white, algal	1	3.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Clay shale, sandy, calcareous, red	4	7.5
Clay shale, sandy, calcareous, tan and red	5	12.5
Limestone, soft, white to tan	1.5	14
Clay shale, sandy, calcareous, tan and buff	6	20
Clay shale and limestone in alternating thin layers	10	30
Limestone, light gray; contains calcareous shale	10	40
Clay and shale, calcareous, tan and buff	1.5	41.5
Shale, calcareous, black	5.5	47

14-9-5bb.

QUATERNARY--Pleistocene		
Sanborn formation		
Silt, sandy, brown	3	3
Silt and clay, tan to gray; contains sand	6	9
Clay, sandy, reddish brown	10	19
Meade formation		
Clay, sandy, compact, greenish gray	4	23
Gravel, rounded quartz, and yellow clay	6	29
CRETACEOUS--Gulfian		
Greenhorn limestone		
Clay shale, yellow	1	30

14-10-2aa.

QUATERNARY--Pleistocene		
Sanborn formation		
Silt, sandy, tan; contains clay	5	5
Clay and silt, tan	4	9
Clay, sandy, reddish tan	8	17
Clay, sandy, compact, reddish tan	7.5	24.5
Clay, compact, tan	10.5	35
Meade formation		
Clay and caliche, sandy	8	43
Clay, very plastic, light greenish gray	5	48
Sand and gravel, quartz, fine to medium	10	58
Gravel, quartz, fine to medium, and fine to medium quartz sand	3	61
CRETACEOUS--Gulfian		
Dakota formation		
Clay, gray and red	8	69

Table 31.--Record of wells in the Wilson Unit, Lincoln County, Kans.

Well number[1]	Owner or tenant	Type of well[2]	Depth of well (feet)[3]	Diameter of well (in.)	Type of casing[4]	Character and geologic source of principal water-bearing material[5]	Method of lift[6]	Use of water[7]	Measuring point: Description[8]	Measuring point: Distance above land surface (feet)	Depth to water level below measuring point (feet)[9]	Date of measurement 1948
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
11-7-20ab	James Larsen	Dr	65.0	6	GI	G	N	N	Tbd	0.0	63.15	Apr. 15
34ab	C. T. Brown	Du	18.5	24	R	S,Gr;A	Cy,W	N	Bp	.5	13.23	June 11
11-8-22bb	B. J. and H. Strange	Dr	114.0	6	GI	Ss,D	Cy,W	S	Tca	.5	100.35	Apr. 15
35da	Emil Gabelman	B	25.2	6	GI	S,Gr;T	N	N	Tca	.0	5.75	Apr. 15
12-6-25bb	School District	B	20.5	6	GI	S,Gr;T	Cy,H	D	Tca	.2	8.46	Apr. 28
12-7- 9ab	E. L. Wiebke	Du	38	-	R	Ss,D	Cy,W	D,S	Tpl	.8	34	Apr. 23
12aa	R. G. Kerr	Dr	130	5	GI	Ss,D	Cy,W	S	Ls	.0	51	Apr. 28
22bb	H. A. Walter	Dr	67.0	6	GI	S,Gr;T	Cy,W	D	Tcu	.3	21.48	Apr. 23
23aa2	-	Du	17.9	36	R	S,Gr;T	N	N	Tcu	1.0	13.56	Sept. 8
28db	Paul Suelter	Dr	96	6	GI	Ss,D	A	S	Ls	.0	+ 9(10)	Apr. 23
32da	W. C. Weseloh	Du	30.5	30	R	S,A Ss,D	N	N	Tbd	3.5	28.10	Apr. 21
12-8-13dd	B. J. Tarning	Dr	70	-	-	Ss,D	Cy,W	D,S	Ls	.0	30	Apr. 15
21bb	F. E. Lewick, et. al.	Du	25.0	36	R	S,Gr;T	Cy,W	N	Ls	.0	20.72	Apr. 19
21dd	Pleasant Valley School District No. 5	Dr	57.8	5	GI	Ss,D	Cy,H	N	Tca	.0	50.07	Apr. 15
34ab	Herman Zier	Du	30.0	48	R	Ss,D	Cy,W	D,S	Ls	.0	23.00	Nov. 9

See footnotes at end of table.

Table 31.--Record of wells in the Wilson Unit, Lincoln County, Kans.--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
12-9- 3aa	J. E. Cheney	Dr	100	6	GI	Ss,D	Cy,W	D,S	Ls	.0	90	Nov. 10
24cd	Louis Felcamp	Dr	64	-	GI	Ss,D	Cy;W,H	D,S	Ls	.0	40	Apr. 19
13-6- 7ab	W. A. Trapp	Dr	96.6	6	GI	Ss,D	Cy,W	S	Tca	1.0	47.32	Apr. 27
10bb	Perry Adamson	Dr	92.0	5	S	Ss,D	Cy,W	D,S	Ls	.0	30.00	Apr. 28
12cc	Edward Holman	Dr	30.3	6	GI	S,Gr;T	N	N	Tca	.8	14.69	Apr. 28
16cc	S. W. Stone	Du	15.1	24	R	Ss,D	N	N	Tib	.0	12.46	Apr. 30
26ba	School District	Dr	36	-	GI	Ss,D	Cy,H	D	Tcp	.9	29.68	May 5
29ca	School District	Dr	100.5	5	GI	Ss,D	Cy,H	N	Tca	.5	85.71	May 5
34dc	George W. Woodworth	Dr	60.3	6	GI	S,Gr;T Ss,D(?)	N	N	Tpl	.0	13.25	May 5
13-7- 7bb	Loyal Achterberg	Dr	45.0	6	GI	Ss,D	Cy,W	D	Bp	.5	26.45	Apr. 21
10ba	W. J. Meier	Dr	73.0	6	GI	Ss,D	N	N	Tca	.3	45.63	Apr. 27
12cb	M. W. Webb	Du	37.3	24	R	Ss,D	N	N	Tpl	.8	32.32	Apr. 30
15dc	Emma Michael	Dr	71.5	5	GI	Ss,D	Cy,W	S	Tca	1.0	52.55	Apr. 28
17aa	Mary M. Soldner	Dr	69.0	6	GI	Ss,D	Cy,W	D,S	Bp	.8	43.83	Apr. 27
19ab	Wm. Garrity	Du	12.2	-	R	Ss,D	Cy,H	N	Tpl	.7	10.50	Apr. 28
24cd	E. Dodge	Dr	39.1	6	GI	Ss,D	N	N	Tca	.8	12.60	Apr. 30
26ac	School District	B	36.0	4.5	I	Ss,D(?) S,Gr;T	Cy,H	N	Tca	.3	12.40	May 5
28ba	School District	Dr	60.8	5	GI	Ss,D	Cy,H	D	Tca	.3	14.27	Apr. 28
33dc	John Shoemaker	Dr	52.3	5.5	GI	S,Gr;T Ss,D(?)	J,E	D,S	Tca	1.0	18.10	May 5
13-8-13cc	Edwin Reinert	Du	28	36	R	S,Gr,A	C,E	D	Ls	.0	20	Nov. 8
25dd	C. J. Panzer	Dr	58.5	5	GI	Ss,D	Cy,W	S	Bp	1.0	47.90	Apr. 29
13-9-33bc	Everett Weinhold	Dr	260	6	GI	Ss,D	Cy,W	D,S	Ls	.0	248	Nov. 10

See footnotes on following page.