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GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GROUND-WATER DATA COLLECTED IN THE MISSOURI RIVER BASIN UNITS IN KANSAS DURING 1949

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

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OF PROPOSED REPORT
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GROUND-WATER DATA
COLLECTED IN THE MISSOURI RIVER BASIN UNITS IN KANSAS
DURING 1949

By Delmar W. Berry

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INTRODUCTION

Ground-water studies in the Missouri River Basin were begun by the United States Geological Survey during the fall of 1945 as a part of the program for development of the resources of the basin by the U~~nited~~ S~~tates~~ Bureau of Reclamation and other Federal Agencies. The studies of the ground-water resources in the part of Kansas that 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 State Geological Survey of Kansas 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, Rush, and Trego Counties; 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.)

Most of the ground-water data presented in this report were collected during 1949. Most of the data collected in these areas prior to the end of

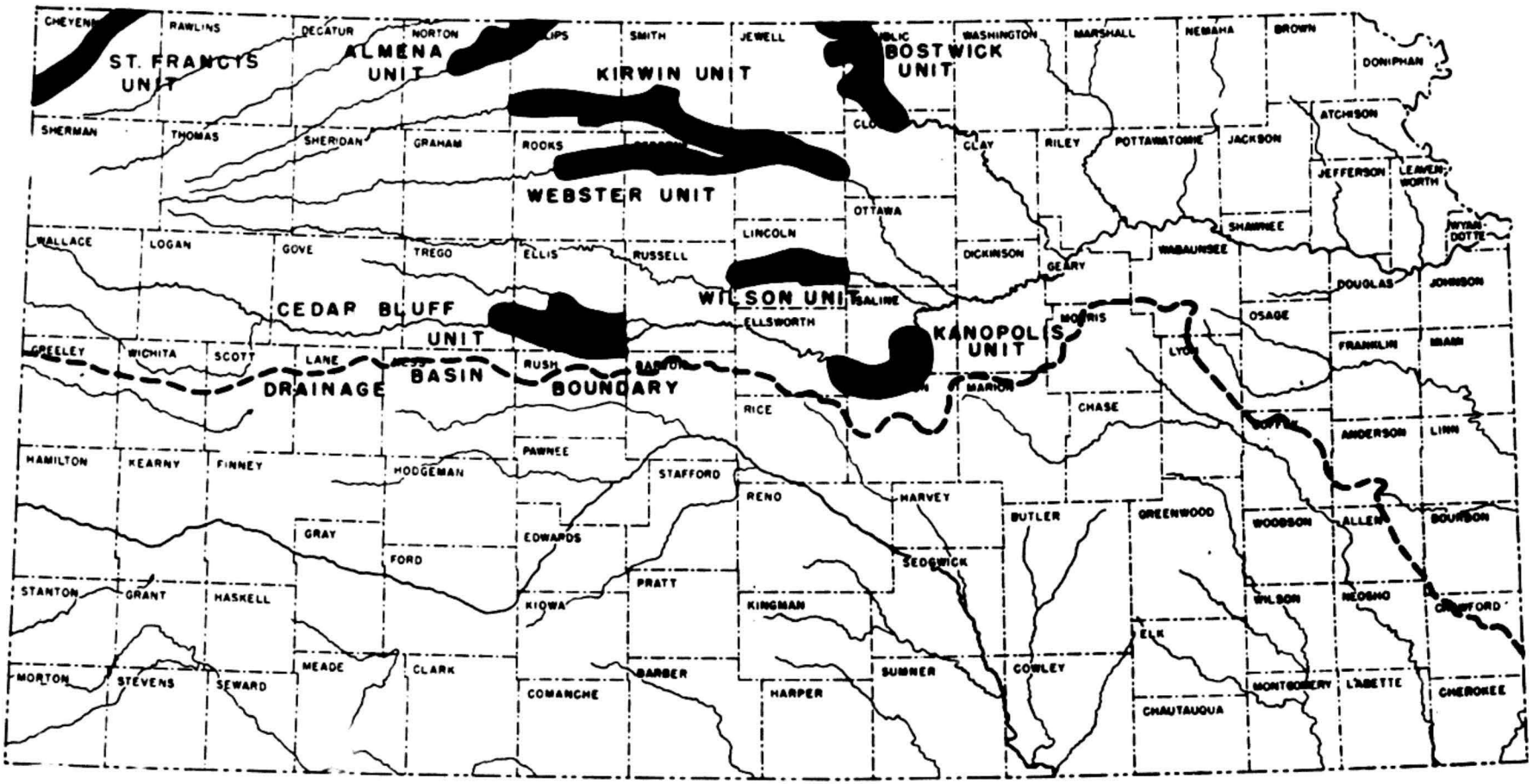

FIGURE 1.- UNITS OF THE MISSOURI BASIN IN KANSAS WITHIN WHICH GROUND-WATER DATA ARE BEING COLLECTED.

1947 were presented in a report which was mimeographed in September 1948 and most of the data collected during 1948 were presented in a report which was mimeographed in November 1949. This report is the third of a series of annual reports on ground-water data collected 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 that are included in the annual reports for a given area will be assembled later in a report on the geology and hydrology of that area. An index of the data collected and presented in the 1947, 1948, and 1949 reports is given in table 1.

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 published as bulletins 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 J. C. Frye and A. R. Leonard.[1] A report on the ground-water resources of Republic County and northern Cloud County, Kans., by V. C. Fishel,[2] 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 B. F. Latta.[3] The report on the ground-water conditions in the Smoky Hill Valley in Saline, Dickinson, and Geary Counties, Kans., by B. F. Latta,[4] and the report on the geology and ground-water resources of a part of

1 Kansas Geological Survey, Bulletin 81.
2 Kansas Geological Survey, Bulletin 73.
3 Kansas Geological Survey, Bulletin 76, Part 6.
4 Kansas Geological Survey, Bulletin 84.

Table 1.--Index to data collected within the Missouri Basin units of Kansas

	Page in reports		
	1947	1948	1949
Almena Unit			
Map showing locations of wells and test holes.....	18	..	..
Water-level measurements.....	7	8	9
Highest and lowest water levels.....	...	7	8
Difference between highest and lowest and net change in water levels.....	...	7	9 12
Hydrographs of five wells.....	...	10	..
Record of wells.....	10	..	..
Logs of test holes.....	19	..	..
Bostwick Unit			
Geology as related to ground water.....	46	..	..
Map showing locations of wells, test holes, and water-table contours during 1948.....	49	..	..
Water-level measurements.....	60	12	14
Highest and lowest water levels.....	...	11	13
Difference between highest and lowest and net change in water levels.....	...	11	13
Hydrographs of five wells.....	...	..	15
Record of wells.....	50	..	..
Logs of test holes.....	65	..	..
Cedar Bluff Unit			
Map showing locations of wells and test holes.....	108	..	23
Water-level measurements.....	112	14	17
Highest and lowest water levels.....	...	13	16
Difference between highest and lowest and net change in water levels.....	...	13	17
Hydrographs of five wells.....	...	15	24
Chemical analyses of water samples.....	110	..	20
Record of wells.....	114	..	51
Logs of test holes.....	117	..	25
Glen Elder Unit			
Map showing locations of wells and test holes.....	125	..	..
Water-level measurements.....	126	18	59
Highest and lowest water levels.....	...	17	58
Difference between highest and lowest and net change in water levels.....	...	17	58
Hydrographs of five wells.....	136	19	61
Record of wells.....	129	..	..
Logs of test holes.....	137	..	..
Kanopolis Unit			
Map showing locations of wells and test holes.....	149	..	..
Water-level measurements.....	148	22	63
Highest and lowest water levels.....	...	21	62
Difference between highest and lowest and net change in water levels.....	...	21	63

Table 1.--Index to data collected within the Missouri Basin units of Kansas Continued

	Page in reports		
	1947	1948	1949
Kanopolis Unit--Continued			
Hydrographs of five wells	153	24	66
Logs of test holes	154	..	...
Kirwin Unit			
Map showing locations of observation wells	...	26	...
Water-level measurements	...	27	68
Highest and lowest water levels	...	25	67
Difference between highest and lowest and net change in water levels	...	27	68
Hydrographs of five wells	...	36	107
Chemical analyses of water samples	...	..	72
Logs of test holes	...	..	74
St. Francis Unit			
Geology in relation to ground water	...	37	...
Map showing locations of wells	...	42	...
Water-level measurements	...	43	109
Highest and lowest water levels	...	41	108
Difference between highest and lowest and net change in water levels	...	43	109
Hydrographs of five wells	...	48	113
Record of wells	...	49	...
Webster Unit			
Map showing locations of wells	171	..	...
Water-level measurements	172	57	115
Highest and lowest water levels	...	56	114
Difference between highest and lowest and net change in water levels	...	56	114
Hydrographs of five wells	178	58	116
Records of wells	174	..	...
Wilson Unit			
Geology in relation to ground water	...	59	...
Map showing locations of wells	180	..	...
Map showing locations of wells and test holes	...	62	...
Water-level measurements	181	64	118
Highest and lowest water levels	...	63	117
Difference between highest and lowest and net change in water levels	...	64	118
Hydrographs of five wells	...	67	121
Chemical analyses of water samples	188	68	...
Record of wells	184	83	...
Logs of test holes	...	69	...

south-central Kansas with special reference to the Wichita municipal water supply, by C. C. Williams and S. W. Lohman,[5] 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, a map of the Cedar Bluff Unit showing locations of test holes and wells, chemical analyses of water samples taken from the Cedar Bluff Unit and Kirwin Unit; records of wells in the Cedar Bluff Unit, and logs of test holes in the Cedar Bluff and Kirwin Units.

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 G. H. Taylor, regional engineer in charge of ground-water investigations of the Missouri Basin units.

The stratigraphic nomenclature used in the well tables and logs is that of the Kansas Geological Survey. It does not accord in all respects with the usage of the U. S. Geological Survey.

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 the number indicates the township, the second the range, and the third the section in which the well is located. The lower-case letters (a, b, c, and d) after 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.

5 Kansas Geological Survey, Bulletin 79.

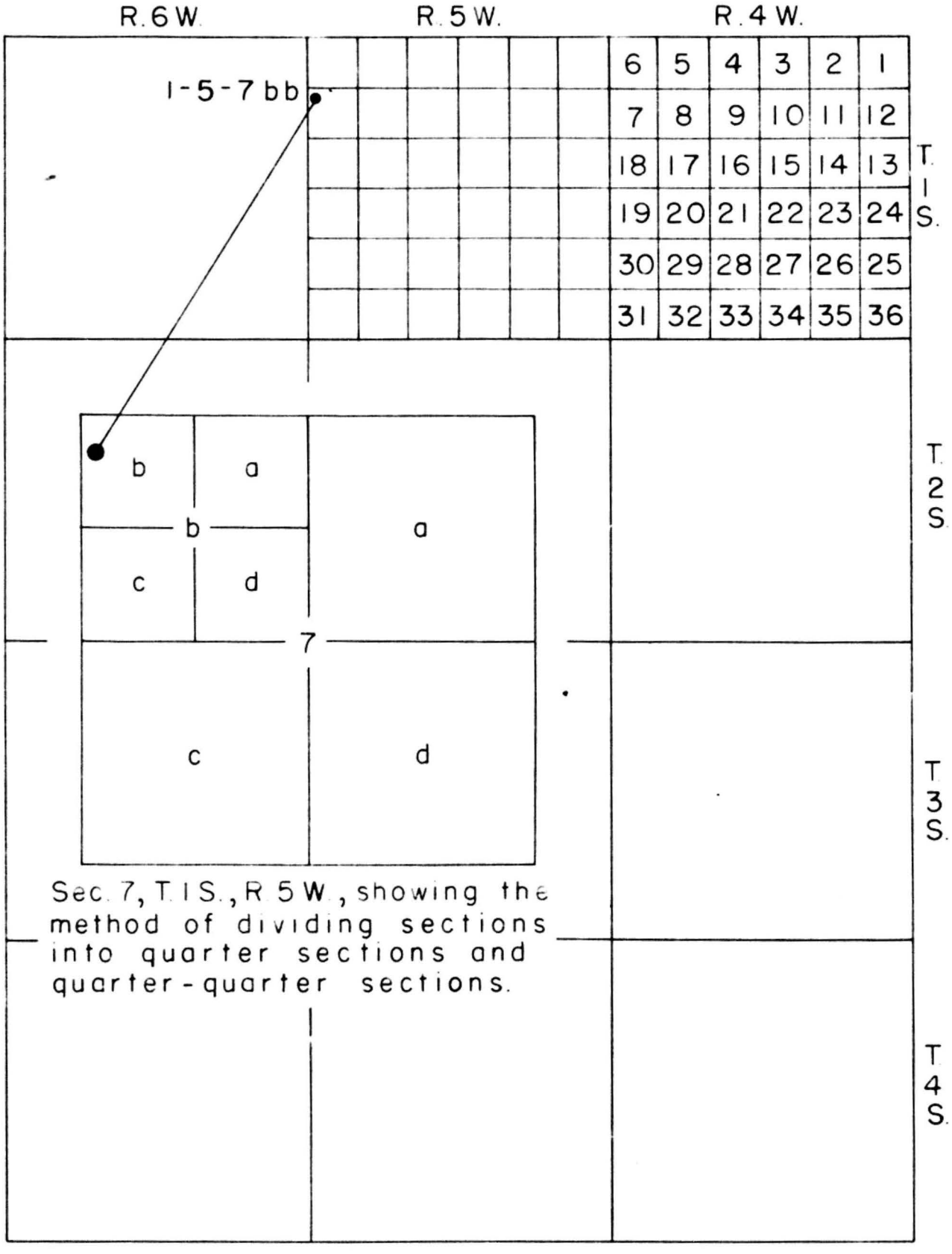

Figure 2.-Sketch illustrating well-numbering system.

Measurements of the water levels in 11 wells in Norton County and in four wells in Phillips County are being made periodically. The highest and lowest water levels for the period of record are given in table 2; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 3; and the water-level measurements made in 1949 are given in table 4. Hydrographs of five of the observation wells are shown in figure 3.

Table 2.--Highest and lowest water levels 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	2	14.95	July 7, 1949	20.18	Nov. 30, 1948
1-20-13ad	2.5	25.05	July 31, 1947	29.35	Oct. 8, 1948
-30cc	2	77.08	Dec. 30, 1949	78.43	Jan. 1, 1948
-34ba	2	26.58	July 7, 1949	30.50	Oct. 8, 1948
1-21-35dc	3.5	29.34	Dec. 30, 1949	33.74	Oct. 7, 1948
2-21-1bb	3.5	20.99	July 7, 1949	27.01	June 24, 1946
-2bd	3.5	22.14	July 7, 1949	26.19	Oct. 7, 1948
-11aa	4	28.66	Dec. 30, 1949	34.85	Oct. 7, 1948
-18aa	2.5	42.44	Aug. 29, 1947	43.22	Nov. 30, 1948
-19dd	3.5	63.12	Dec. 3, 1949	64.90	Oct. 7, 1947
2-22-11dc	3	65.65	Sept. 2, 1949	67.35	May 7, 1947
-26ac	3	27.21	July 31, 1947	29.80	Apr. 26, 1949
-28aa	2.5	47.30	July 31, 1947	49.70	Sept. 2, 1949
2-23-36cd	3.5	26.93	July 31, 1947	29.30	Oct. 7, 1948
3-23-8aa	2.5	37.35	July 7, 1949	38.80	Dec. 1, 1948

Table 3.--Difference between highest and lowest recorded water levels, net change in water level in 1949, 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 1949	Net rise (+) or net decline (-) for period of record
1-19-19cc	5.23	+3.49	+0.81
1-20-13ad	4.30	+1.60	+1.08
-30cc	1.35	+.27	+.79
-34ba	3.92	+2.80	+.97
1-21-35dc	4.40	+4.40	+3.90
2-21-1bb	6.02	+2.03	+2.41
-2bd	4.05	+1.77	+2.23
-11aa	6.19	+4.41	+2.78
-18aa	.78	+.63	+.45
-19dd	1.78	+.71	+.84
2-22-11dc	1.70	+1.02	+1.25
-26ac	2.59	+.92	+.86
-28aa	2.40	+.11	+.43
2-23-36cd	2.37	+1.33	+.62
3-23-8aa	1.45	+.80	-.15

Table 4.--Water-level measurements, in feet below land-surface datum, in the Almena Unit, 1949

1-19-19cc.

Date	Water level	Date	Water level	Date	Water level
Apr. 25	17.70	Sept. 1	15.60	Dec. 30	16.69
July 7	14.95	Oct. 27	16.18		

1-20-13ad.

Apr. 25	27.17	Sept. 1	27.99	Dec. 30	26.63
July 7	25.95	Oct. 27	26.89		

1-20-30cc.

Apr. 25	77.30	Sept. 1	77.18	Dec. 30	77.08
July 7	77.18	Oct. 27	77.20		

1-20-34ba.

Apr. 25	28.77	Sept. 1	27.22	Dec. 30	27.08
July 7	26.58	Oct. 27	27.34		

Table 4.--Water-level measurements, in feet below land-surface datum, in the Almena Unit, 1949--Continued

1-21-35dc.

Date	Water level	Date	Water level	Date	Water level
Apr. 25	31.62	Sept. 1	30.08	Dec. 30	29.34
July 7	30.74	Oct. 27	29.70		

2-21-1bb.

Apr. 25	24.40	Sept. 1	22.68	Dec. 30	23.43
July 7	20.99	Oct. 27	23.16		

2-21-2bd.

Apr. 25	24.25	Sept. 1	23.14	Dec. 30	23.53
July 7	22.14	Oct. 27	23.37		

2-21-11aa.

Apr. 25	31.55	Sept. 1	29.34	Dec. 30	28.66
July 7	28.67	Oct. 27	28.73		

2-21-18aa.

Apr. 26	43.04	Sept. 2	42.55	Dec. 30	42.59
July 7	42.49	Oct. 27	42.66		

2-21-19dd.

Apr. 25	63.92	Sept. 2	63.44	Dec. 30	63.12
July 7	64.23	Oct. 27	63.30		

2-22-11dc.

Apr. 26	66.86	Sept. 2	65.65	Dec. 30	65.92
July 7	65.88	Oct. 27	65.80		

2-22-26ac.

Apr. 26	29.80	Sept. 2	28.12	Dec. 30	28.45
July 7	27.28	Oct. 27	28.30		

Table 4.--Water-level measurements, in feet below land-surface datum, in the Almena Unit, 1949--Continued

2-22-28aa.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	49.10	Sept. 2	49.70	Dec. 30	48.74
July 7	48.95	Oct. 27	48.70		

2-23-36cd.

Apr. 26	28.39	Sept. 2	27.71	Oct. 27	27.83
July 7	27.38				

3-23-8aa.

Apr. 26	38.25	Sept. 2	37.75	Dec. 30	38.00
July 7	37.35	Oct. 27	38.05		

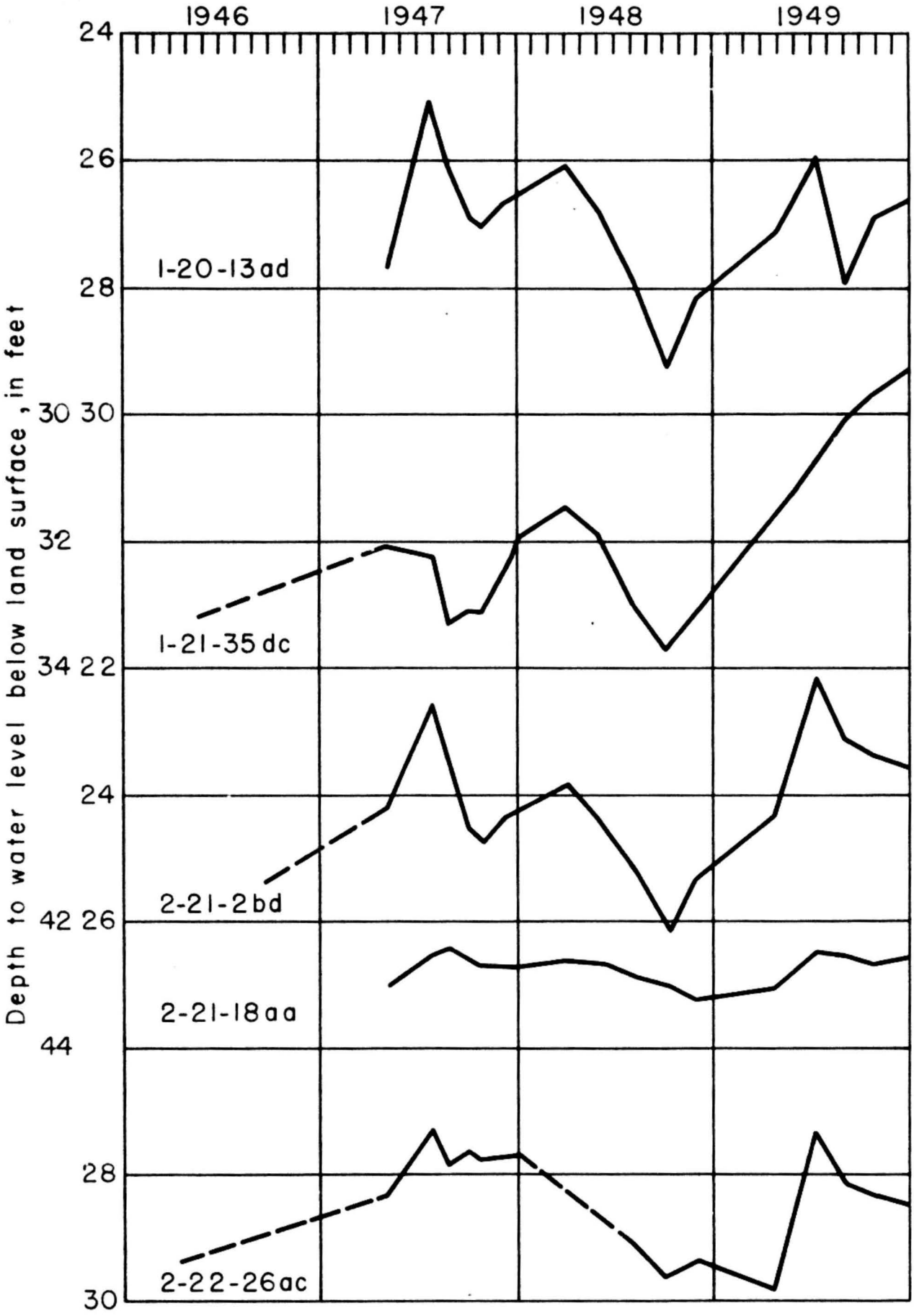

Figure 3.-Hydrographs of five wells, Almena Unit

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 in Republic County. Measurements of the water level in these wells have been made periodically. The highest and lowest water levels for the period of record are given in table 5; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 6; and the water levels for 1949 are given in table 7. Hydrographs of five observation wells are shown in figure 4.

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

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
1-5-7bb	2	4.79	June 20, 1949	8.83	Nov. 2, 1948
1-5-7cb	2	18.83	Oct. 28, 1949	22.04	Feb. 7, 1949
1-6-5da	2	3.80	June 20, 1949	9.80	Nov. 2, 1948
1-7-1bb	2	4.29	June 20, 1949	10.80	Nov. 2, 1948
1-7-2da	2	1.57	June 20, 1949	7.97	Nov. 2, 1948

Table 6.--Difference between highest and lowest recorded water levels, net change in water level in 1949, and net change in water level for period of record, in feet, in five wells in the Bostwick Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
1-5-7bb	4.04	+2.09	+1.42
1-5-7cb	3.21	+2.39	+.83
1-6-5da	6.00	+1.47	+.66
1-7-1bb	6.51	+.12	-.31
1-7-2da	6.40	+1.09	+.09

Table 7.--Water-level measurements, in feet below land-surface datum, in the Bostwick Unit, 1949

1-5-7bb.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Feb. 7	8.68	May 26	5.50	Aug. 17	6.60	Nov. 12	5.95
Mar. 24	7.74	June 20	4.79	Sept.22	6.54	Dec. 5	6.36
Apr. 27	7.23	July 29	5.95	Oct. 28	5.50	28	6.70

1-5-7cb.

Feb. 7	22.04	May 26	20.75	Aug. 17	19.40	Nov. 12	19.02
Mar. 24	21.85	June 20	19.93	Sept.22	19.35	Dec. 5	19.30
Apr. 27	21.35	July 29	19.16	Oct. 28	18.83	28	19.59

1-6-5da.

Feb. 7	9.67	May 26	5.65	Aug. 17	7.73	Nov. 12	7.62
Mar. 24	8.58	June 20	3.80	Sept.23	7.58	Dec. 5	8.09
Apr. 27	8.55	July 29	6.94	Oct. 28	6.98	28	8.43

1-7-1bb.

Feb. 7	10.25	May 26	7.50	Aug. 17	9.02	Nov. 12	10.15
Mar. 24	8.78	June 20	4.29	Sept.22	9.47	Dec. 5	10.40
Apr. 27	8.70	July 29	7.99	Oct. 28	9.97	28	10.44

1-7-2da.

Feb. 7	7.89	May 26	5.10	Aug. 17	5.27	Nov. 12	6.10
Mar. 24	7.06	June 20	1.57	Sept.23	6.16	Dec. 5	6.51
Apr. 27	6.62	July 29	4.42	Oct. 28	5.57	28	6.91

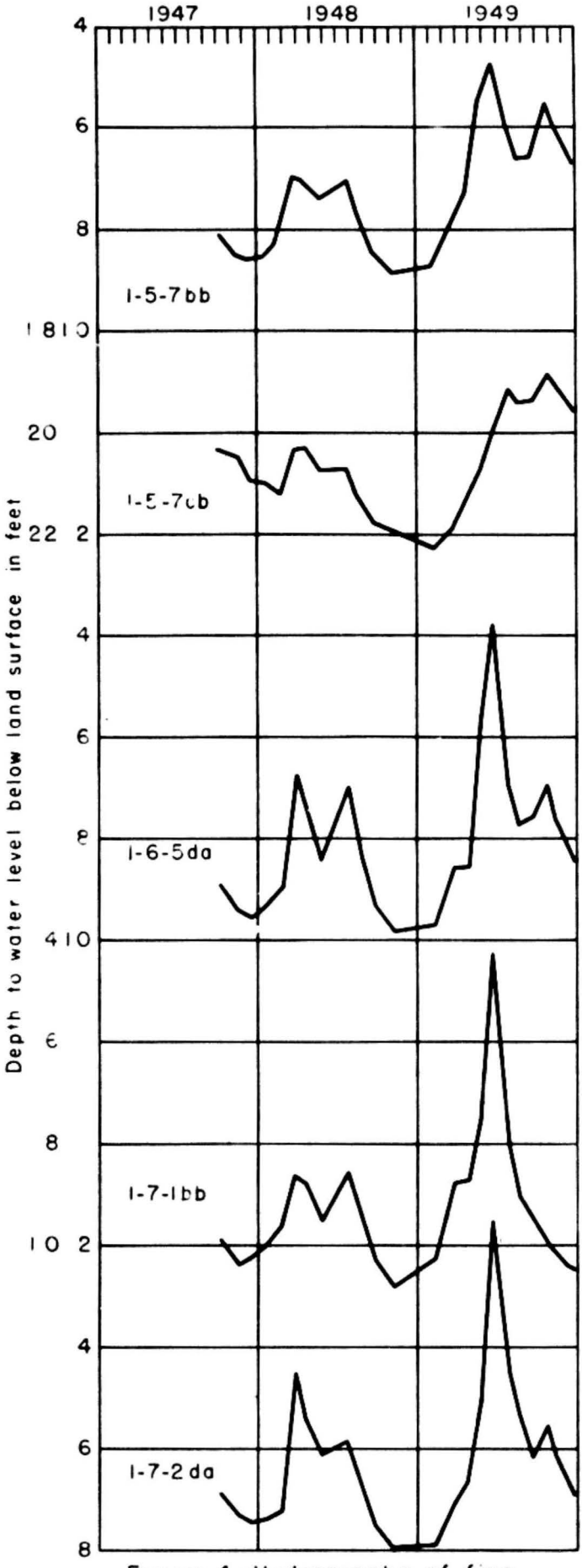

Figure 4 -Hydrographs of five wells, Bostwick Unit

Measurements of the water level in 14 observation wells in the Cedar Bluff Unit have been made periodically. The locations of the observation wells are shown in figure 5. The highest and lowest water levels for the period of record are given in table 8; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 9; and the water-level measurements for 1949 are given in table 10. Chemical analyses of 48 water samples are given in table 11; the logs of test holes are given in table 12; and records of wells are given in table 13. Hydrographs of five observation wells are shown in figure 6.

Table 8.--Highest and lowest water levels 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	3	17.67	July 6, 1949	19.62	Oct. 9, 1948
-36bc	3	19.32	Dec. 30, 1949	21.74	May 10, 1947
14-18-12bb	3	23.34	Dec. 30, 1949	27.15	July 30, 1946
-36aa	3	17.90	July 7, 1949	20.85	Jan. 8, 1948
14-20-35dc	3	13.95	July 7, 1949	16.29	Aug. 8, 1946
15-16-6dd	3	22.00	Oct. 22, 1949	24.33	Aug. 9, 1946
-13bb	3	13.87	June 4, 1948	14.85	July 17, 1946
15-17-19ab	3	132.40	July 7, 1949	140.50	July 22, 1946
-25cb	3	11.52	July 23, 1947	12.44	Apr. 26, 1949
15-18-1bb	3	17.27	Aug. 22, 1949	28.22	July 24, 1946
-16bb	3	5.62	July 23, 1947	9.55	July 12, 1946
15-19-6aa	3	51.65	Dec. 30, 1949	53.12	Aug. 22, 1949
-13ab	3	6.08	July 23, 1947	9.30	Oct. 8, 1947
-35aa	3	59.45	Jan. 8, 1948	70.70	Apr. 8, 1948

Table 9.--Difference between highest and lowest measured water levels, net change in water level in 1949, 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 water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
14-16-17cb	1.95	+1.09	+1.07
-36bb	2.42	+.60	+.45
14-18-12bb	3.81	+.62	+3.81
-26aa	2.95	+.11	+.62
14-20-35dc	2.34	+.78	+1.41
15-16-6dd	2.33	+.61	+2.33
-13bb	.98	-.13	+.50
15-17-19ab	8.10	+.52	+.98
-25cb	.92	+.06	+.09
15-18-1bb	10.95	+1.20	+10.12
-16bb	3.93	.00	+.85
15-19-6aa	1.47	+.41	+.94
-13ab	3.22	+1.55	+1.57
-35aa	11.25	+1.24	+.38

Table 10.--Water-level measurements, in feet below land-surface datum, in the Cedar Bluff Unit, 1949

14-16-17cb.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	18.67	Aug. 22	18.81	Dec. 30	18.53
July 6	17.67	Oct. 22	18.38		

14-16-36bb.

Apr. 26	20.05	Oct. 22	19.70	Dec. 30	19.32
July 6	19.48				

14-18-12bb.

Apr. 26	23.50	Aug. 22	24.33	Dec. 30	23.34
July 6	23.54	Oct. 22	24.07		

14-18-26aa.

July 7	17.90	Oct. 22	20.35	Dec. 30	20.14
Aug. 22	19.17				

Table 10.--Water-level measurements, in feet below land-surface datum, in the Cedar Bluff Unit, 1949--Continued

14-20-35dc.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	16.08	Aug. 22	14.27	Dec. 30	14.88
July 7	13.95	Oct. 22	14.57		

15-16-6dd.

Apr. 26	22.34	Aug. 22	23.20	Oct. 22	22.00
July 6	22.17				

15-16-13bb.

Apr. 26	14.13	Aug. 22	14.07	Dec. 30	14.35
July 6	13.92	Oct. 22	14.39		

15-17-19ab.

Apr. 26	139.70	Aug. 22	139.66	Dec. 30	139.52
July 7	132.40	Oct. 22	139.52		

15-17-25cb.

Apr. 26	12.44	Aug. 22	11.90	Dec. 30	12.01
July 6	12.39	Oct. 22	12.46		

15-18-1bb.

Apr. 26	17.98	Aug. 22	17.27	Dec. 30	18.10
July 7	17.35	Oct. 22	17.98		

15-18-16bb.

Apr. 26	6.64	Aug. 22	8.18	Dec. 30	8.70
July 7	5.79	Oct. 22	8.71		

15-19-6aa.

Apr. 26	52.06	Aug. 22	53.12	Dec. 30	51.65
July 7	51.95	Oct. 22	51.97		

Table 10.--Water-level measurements, in feet below land-surface datum, in the Cedar Bluff Unit, 1949--Continued

15-19-13ab.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	6.56	Aug. 22	7.25	Oct. 22	7.50

15-19-35aa.

Apr. 26	60.02	Aug. 22	63.69	Dec. 30	59.78
July 7	62.09	Oct. 22	61.77		

Table 11.--Mineral constituents, in parts per million, and related physical measurements of ground waters, Cedar Bluff Unit

Location of well	Date of collection	Depth of well (feet)	Temperature (°F.)	pH	Specific conductance (micromhos @ 25° C.)	Silica (SiO_2)	Total iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Noncarbonate	Percent sodium
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
									Alluvium											
14-16-10dd	3-24-47	17.5	51	7.8	599	..	a 0.10	90	9.8	18	272	24	21	0.6	30	0.05	361	265	42	13
14-20-28ad	10-29-49	22.8	57	7.5	691	32	.31	109	17	10	308	32	29	.1	46	....	430	342	89	6
-35dc	3-21-47	19.5	62	8.0	649	..	a .00	108	9.2	1.0	296	26	18	.4	10	....	427	307	64	1
14-21-30ca	10-29-49	29	59	7.4	1,040	32	4.70	156	29	39	284	262	29	.7	55	.05	772	508	275	14
-31cd	10-29-49	13.2	62	7.6	1,210	39	.10	174	43	43	268	416	23	.6	22	.20	938	611	391	13
-34ba	10-29-49	20.9	58	7.3	1,980	36	.26	342	48	20	194	496	97	.4	348	....	1,480	1,050	891	4
14-22-26ad	10-29-49	92	..	7.3	510	35	.19	76	11	20	248	53	9.0	.4	9.0	.10	368	235	32	16
15-16-21bd	10-29-49	18.3	59	7.9	1,120	28	.19	88	15	147	340	140	91	1.0	55	.50	730	281	2	53
15-17-33dc	10-29-49	16.7	57	7.5	1,590	34	.24	258	38	9.4	326	632	55	.2	2.4	.20	1,190	800	533	20
15-18-12aa	10-21-49	16.2	59	7.6	785	40	.10	86	22	61	356	80	21	.4	41	.30	520	305	13	30
-13ab	3-24-47	27.4	54	7.6	2,760	..	a .10	662	19	13	298	1,260	101	1.3	70	.17	2,280	1,730	1,486	2
-16bb	3-21-47	13.9	51	7.8	2,080	..	a .00	403	30	88	282	844	137	.5	20	....	1,660	1,128	897	14
-20ab	10-31-49	28	59	6.8	6,090	32	14	479	49	767	412	84	1,870	.1	.8	.40	3,500	1,400	1,060	54
-22bb	10-31-49	47.2	56	7.0	2,710	42	20	624	54	41	364	1,460	33	1.0	1.6	.36	2,440	1,780	1,480	5
-29dd	10-31-49	18.8	59	7.4	886	37	.04	139	21	30	196	296	19	.6	2.8	.20	654	434	273	13
15-19-2aa	10-21-49	17.3	60	7.5	1,320	37	.50	117	32	110	304	164	97	.5	130	....	904	424	175	36
-10ad	10-29-49	28.6	57	7.3	617	30	.04	104	13	8.3	296	29	16	.1	44	....	384	313	70	5

a Iron in solution at time of analysis.

Table 11.--Mineral constituents, in parts per million, and related physical measurements of ground waters, Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
							Terrace deposits													
14-16-17cb	3-24-47	23.1	53	8.0	631	..	a 0.05	103	9.2	9.0	282	38	28	0.3	3.0	0.05	383	295	64	1
-20dd	3-24-47	48.9	58	7.8	584	..	a .10	97	8.7	4.0	296	21	13	.2	4.0	.04	342	278	35	3
14-17-17bb	3-21-47	35.8	60	8.2	535	..	a .00	92	11	1.5	236	53	16	.2	8.0	....	340	275	81	1
-25aa	3-24-47	24.0	56	7.4	3,160	..	a .10	478	48	72	219	51	930	.1	3.0	.08	1,690	1,390	1,210	10
14-18-12bb	3-21-47	30.7	60	8.6	2,810	..	a .00	10	.3	599	487	247	480	7.0	5.0	....	1,590	53	0	96
14-20-32aa	10-22-49	39.4	57	7.7	634	35	.14	86	14	29	264	40	30	.2	42	.24	422	272	56	19
-32dd	3-21-47	43.0	62	7.6	620	..	a .00	100	12	4.5	276	30	35	.1	2.0	....	391	299	110	3
14-21-35ca	10-22-49	19.1	59	7.3	1,600	27	.26	214	38	101	224	538	78	.5	69	.20	1,180	690	506	24
-35cd	10-22-49	19.8	59	7.4	1,670	45	.77	226	78	81	374	648	41	.3	26	.40	1,330	884	577	17
15-16-6cb	10-29-49	57	58	7.6	465	38	.39	86	4.8	4.8	268	7.2	8.0	.1	6.7	.16	298	234	14	4
-25bb	10-29-49	19.7	59	7.7	635	31	.04	96	6.8	17	268	16	28	.2	36	.20	416	268	48	12
15-17-25bc	3-24-47	15.2	50	7.8	501	..	a .05	90	5.5	5.2	232	29	6.5	.3	35	.05	332	247	57	4
15-18-30ab	10-29-49	13.6	61	7.4	1,430	41	.20	206	30	78	336	296	42	.4	204	....	1,060	638	362	21
15-19-7ab	10-22-49	30.3	58	7.4	498	47	.17	69	9.0	24	212	29	15	.3	45	.40	338	209	35	20
-28dd	10-22-49	26.5	57	7.5	1,350	36	.15	148	26	125	260	346	95	.4	51	.36	968	477	264	36
-32cb	10-22-49	32.3	58	7.9	1,210	43	.16	163	30	80	316	366	32	.7	20	.24	880	530	271	25
15-20-7aa	10-29-49	18.7	61	7.6	1,060	32	.64	156	25	46	294	250	38	.3	46	.30	732	492	251	17
-12ad	10-21-49	32.9	58	7.5	913	29	3.10	130	14	18	244	8.0	45	.1	184	....	628	382	182	9
15-21-5ab	10-29-49	11.1	63	7.4	1,050	36	.14	137	14	53	196	98	60	.1	208	....	780	400	239	22
							Carlile shale and Greenhorn limestone ?													
14-16-16ab	10-31-49	24.7	56	7.5	934	32	.34	150	8.0	37	288	132	62	.2	32	.24	610	408	172	16
15-18-1bb	10-31-49	32.8	56	7.0	3,100	29	9.50	627	68	148	396	1,570	144	1.0	1.7	.40	2,780	1,840	1,520	15

a Iron in solution at time of analysis.

Table 11.--Mineral constituents, in parts per million, and related physical measurements of ground waters, Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
										Dakota formation (sandstone?)										
14-19-29dd	10-28-49	350	59	7.7	3,840	20	3.90	17	9.6	845	540	268	836	6.0	3.9	0.50	2,270	82	0	96
15-16-9aa	3-24-47	132.6	57	7.8	8,440	..	a .05	56	50	1,763	190	523	2,460	2.4	3.5	.74	4,950	345	189	92
-14ab	3-24-47	203.8	55	8.0	929	..	a .10	121	14	47	311	106	44	.7	40	.12	571	359	104	22
-18bb	3-24-47	188.1	58	7.9	4,430	..	a .05	92	25	858	359	411	1,030	3.2	20	.53	2,610	332	38	85
15-17-5ba	3-24-47	149.9	58	7.7	6,800	..	a .10	43	26	1,460	382	461	1,830	4.0	5.0	.86	4,020	214	0	94
-14dd	3-24-47	170.6	57	9.0	5,590	..	a .00	87	35	1,119	460	556	1,298	.2	8.0	....	3,330	361	0	87
15-18-9bb	10-31-49	269.5	59	7.2	3,640	38	28	562	89	341	280	1,780	298	1.0	4.1	.44	3,250	1,770	1,540	30
-33ba	3-21-47	153.8	63	8.2	3,590	..	a .00	18	13	770	334	264	860	3.6	2.0	....	2,100	98	0	94
15-19-4ad	10-28-49	291	58	7.6	1,430	23	4.70	77	25	208	304	306	125	1.4	.6	.50	908	295	46	61
-27da	3-21-47	156.3	62	8.0	600	..	a .00	85	15	28	342	32	12	.4	4.0	....	388	274	0	18
16-18-10cb	10-29-49	168.2	59	7.9	3,830	18	3.20	21	12	792	344	268	886	5.0	.8	.50	2,170	102	0	94

a Iron in solution at time of analysis.

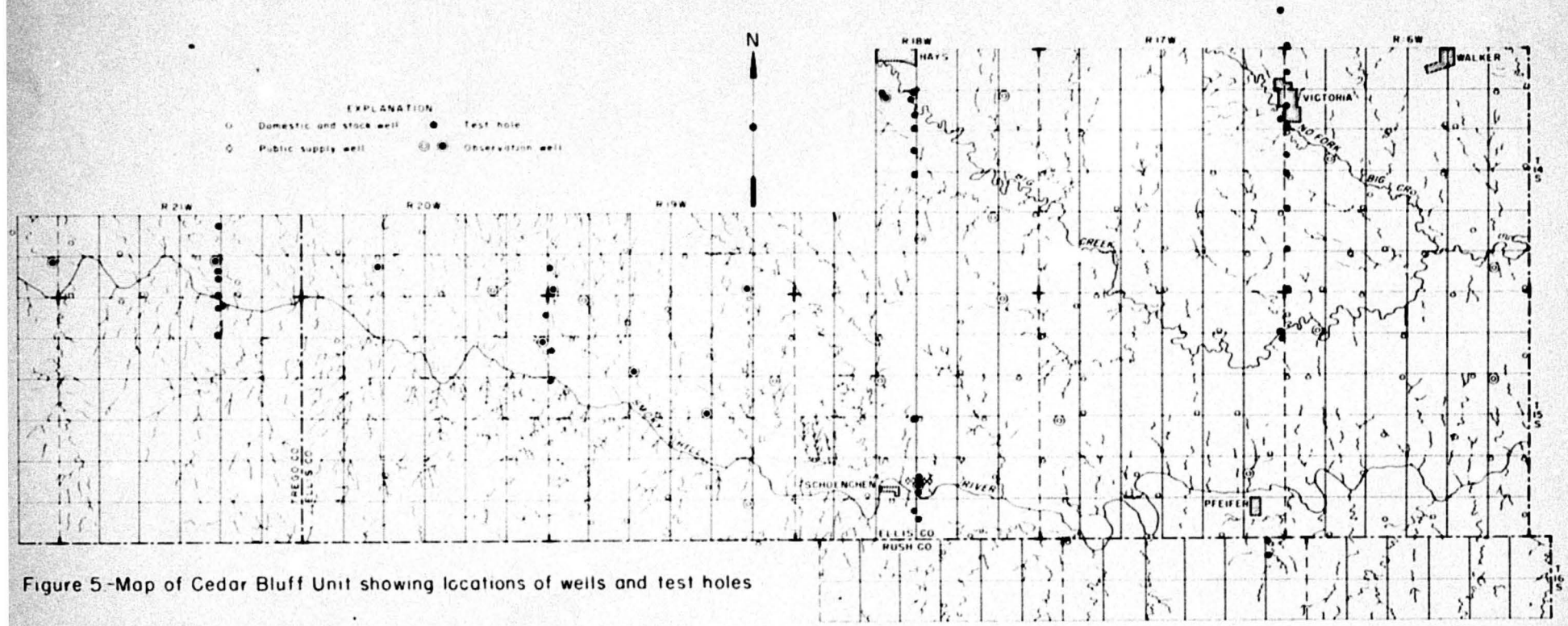

Figure 5-Map of Cedar Bluff Unit showing locations of wells and test holes

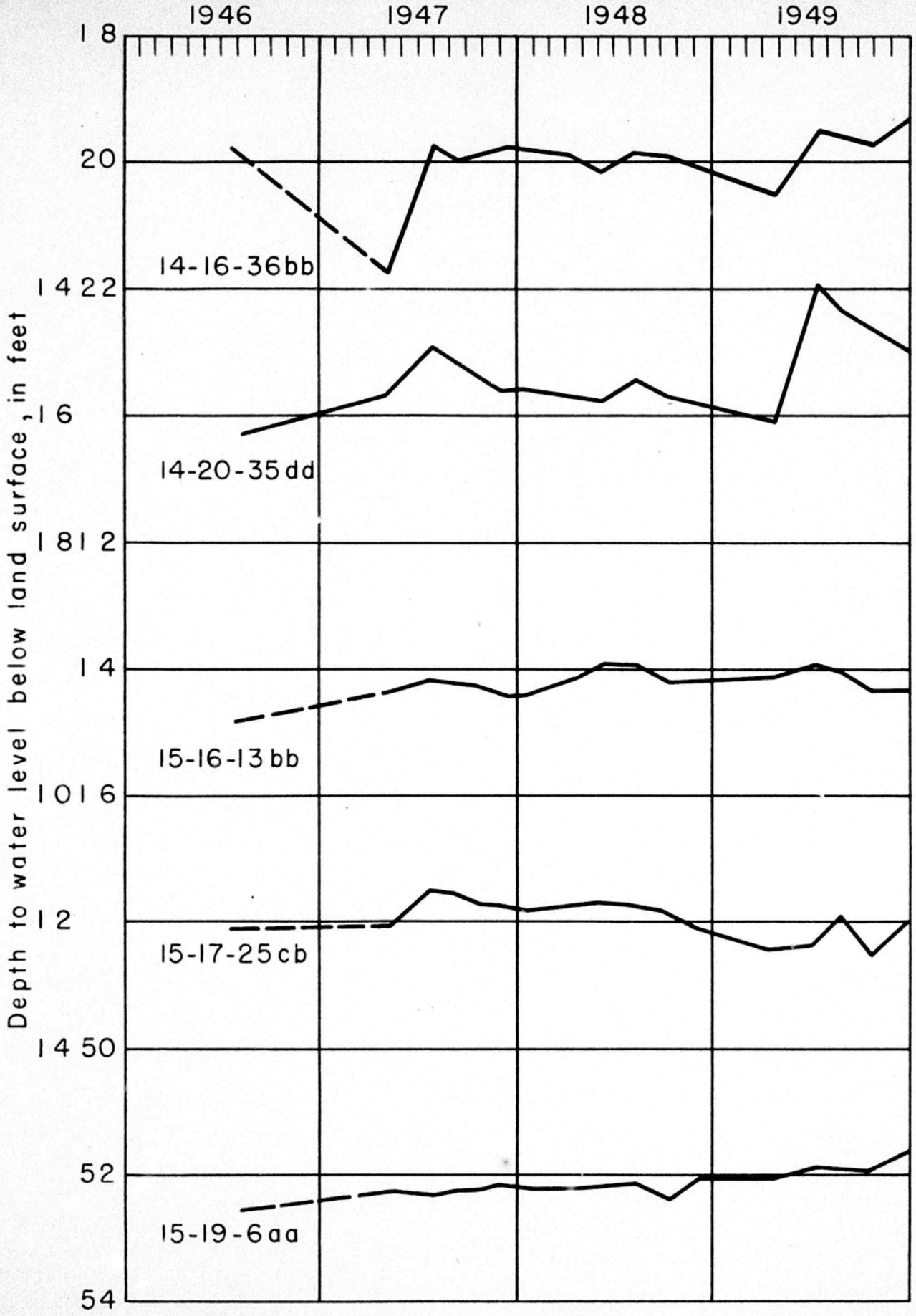

Figure 6.-Hydrographs of five wells, Cedar Bluff Unit

Logs of Test Holes

In order to gain a more thorough knowledge of the character, thickness, and extent of the water-bearing formations in the Cedar Bluff Unit, an additional 48 test holes were drilled by the State Geological Survey of Kansas during the summer of 1949. The locations of the holes are shown on figure 5 and the logs of the test holes are given in table 12.

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949

Ellis County

13-16-31cc. Surface altitude, 1,973.3 feet; water level, 15.65 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Undifferentiated		
Silt, compact, brown	3	3
Silt, compact, light-gray	3	6
Silt, slightly calcareous, buff	3	9
Silt, medium compact, slightly sandy, brown	2	11
Silt, tan; contains medium to coarse sand and gravel	3	14
Silt, sandy, light-gray	2	16
Sand and gravel, medium to coarse; cemented layer from 18.5 to 19 feet	4	20
Sand and gravel, fine to coarse	6	26
CRETACEOUS--Gulfian		
Carlile shale		
Clay and shale, compact, calcareous, yellow to gray	2	28

13-17-36aa. Surface altitude, 1,991.85 feet; water level, 11.50 feet.

Silt, dark brown; contains sand and gravel (road fill)	2	2
QUATERNARY--Pleistocene		
Undifferentiated		
Silt, medium compact, sandy, brown	2	4
Silt, medium compact, sandy, tan	3	7
Silt, slightly sandy	3	10
Silt, buff to white; contains a little caliche	3	13

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

13-17-36aa--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Undifferentiated--Continued		
Silt, lime-cemented, tan, white to cream; contains some caliche.....	4	17
Silt, cemented, sandy and clayey, cream to white.....	4	21
Clay and gravel, medium to coarse, quartz and calcareous clay.....	2	23
CRETACEOUS--Gulfian		
Carlile shale		
Shale and clay, compact, calcareous, yellow to gray.....	3	26

14-16-6cb. Surface altitude, 1,948.96 feet; water level, 19.38 feet.

Silt, gray, dark-gray, brown (road fill)....	3	3
QUATERNARY--Pleistocene		
Undifferentiated		
Silt, sandy, calcareous, dark-brown.....	4	7
Silt, medium compact, sandy, calcareous, buff.....	1	8
Silt, tan; contains sand, gravel and caliche	2	10
Silt, sandy, tan; contains caliche.....	4	14
Gravel, coarse, quartz; contains limestone and shale fragments and some cream to tan silt.....	6	20
Gravel and silt, tan silt, and coarse quartz gravel, lime-cemented, calcareous.....	3	23
CRETACEOUS--Gulfian		
Carlile shale		
Clay and shale, yellow to gray.....	7	30

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-16-7bc. Surface altitude, 1,909.56 feet; water level, 24.57 feet.

	Thickness (feet)	Depth (feet)
Silt, compact, dark-gray, contains some sand and gravel (road fill).....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, sandy, tan.....	4	7
Silt, compact, slightly sandy, brown.....	3	10
Silt, medium compact, sandy, tan.....	7	17
Silt, sandy, buff; contains some coarse sand, and caliche.....	5	22
Silt and gravel, sandy silt, buff; contains small amount of sand and gravel.....	2	24
CRETACEOUS--Gulfian		
Carlile shale		
Clay, sandy, calcareous, buff, yellow.....	2.5	26.5
Shale, compact, sandy, calcareous, dark-gray...	1.5	28

14-16-7cc. Surface altitude, 1,902.32 feet; water level, 18.80 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, brown.....	4	4
Silt, sandy, light-brown.....	3	7
Silt, medium compact, sandy, brown.....	3	10
Silt, sandy, tan to brown.....	4	14
Silt, slightly sandy, gray-brown; contains a little gravel.....	6	20
Silt, sandy, dark-gray to gray; contains fragments of shells.....	5	25
Gravel, coarse, quartz; contains many locally derived pebbles and quartz sand.....	5	30
Gravel, very coarse; contains many locally derived pebbles.....	3	33
CRETACEOUS--Gulfian		
Carlile shale or Greenhorn limestone		
Shale, very compact, calcareous, dark-gray.....	2	35

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-16-18cb. Surface altitude, 1,941.75 feet.

	Thickness (feet)	Depth (feet)
Silt, compact, dark-brown.....	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, slightly sandy, brown....	5	9
Silt, calcareous, sandy, rust to buff; contains caliche.....	8	17
Silt, compact, calcareous, buff; contains caliche.....	6	23
Silt, very sandy, calcareous, tan to buff.....	7	30
Silt, medium compact, sandy, buff.....	3	33
Silt and gravel; contains some pebbles.....	1.5	34.5
CRETACEOUS--Gulfian		
Carlile shale		
Clay and shale, compact, chalky, white to cream; contains limestone.....	5.5	40

14-16-19bb. Surface altitude, 1,929.22 feet; water level, 38.50 feet.

Silt, dark-brown; contains sand and gravel (road fill).....	2.5	2.5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, sandy, slightly calcareous, gray	3.5	6
Silt, slightly calcareous, dark rusty-brown; contains sand.....	4	10
Silt, sandy, calcareous, rusty-brown; contains caliche.....	4	14
Silt, calcareous, slightly sandy, tan; contains caliche.....	4	18
Sand and tan silt; contains gravel.....	2	20
Gravel and tan silt; contains pebbles, and shell fragments.....	5	25
Silt, medium compact, sandy, calcareous.....	2	27
Gravel, medium to coarse, quartz, black stained; contains some coarse sand.....	2	29
Silt, compact, brown.....	3	32
CRETACEOUS--Gulfian		
Carlile shale		
Clay, silty, limey, soft, calcareous, buff.....	4	36
Chalk and shale, calcareous, cream to light-gray and white.....	4	40

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-16-19cc. Surface altitude, 1,944.02 feet; water level, 28.45 feet.

	Thickness (feet)	Depth (feet)
Silt, dark-brown; contains sand and gravel (road fill).....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, calcareous, sandy, gray.....	2	4
Silt, compact, sandy, brown.....	3	7
Silt, compact, sandy, dark-brown.....	2	9
Silt, calcareous, sandy, rusty-brown.....	8	17
Silt, calcareous, buff to cream; contains caliche and a little gravel and sand.....	3	20
Silt, buff, and sand; contains fine to medium gravel.....	4	24
Sand, coarse, quartz; contains fine to coarse gravel.....	3	27
Gravel, coarse, and chalk pebbles; contains a layer of white silty caliche, 6" thick at 27 feet.....	5	32
CRETACEOUS--Gulfian		
Carlile shale		
Limestone, compact, chalky, calcareous.....	8	40

14-16-30cc. Surface altitude, 1,938.14 feet; water level, 55.10 feet.

Silt, compact, sandy, brown (road fill).....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, calcareous, sandy, tan.....	2	4
Silt, sandy, calcareous, brown.....	2	6
Silt, calcareous, sandy, rusty-brown.....	2	8
Silt, compact, calcareous, sandy, tan; contains caliche.....	7	15
Silt, compact, calcareous, slightly sandy, tan to buff.....	5	20
Silt, calcareous, sandy, buff.....	6	26
Clay, cream to white; contains some caliche and sand.....	2	28
Silt, calcareous, slightly sandy, buff.....	4	32
Silt, calcareous, buff; contains a little caliche.....	4	36
Silt, calcareous, slightly sandy, buff.....	6	42
Silt, compact, calcareous, gray-buff; contains some sand.....	4	46

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-16-30cc--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Silt, sandy, calcareous, buff; contains some gravel and sand	4	50
Silt, calcareous, sandy, tan; contains medium to fine gravel	4	54
Silt, calcareous, sandy, tan	3	57
Gravel and silt, sandy; contains some pebbles and shell fragments	7	64
CRETACEOUS--Gulfian		
Greenhorn limestone		
Clay and shale, calcareous, slightly sandy, gray to yellow	2	66
Shale, sandy, calcareous, dark-gray	2	68

14-16-31cc. Surface altitude, 1,928.90 feet; water level, 43.50 feet.

Silt, compact, dark-brown (road fill)	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, slightly sandy, dark-brown	3	5
Silt, sandy, brown	3	8
Silt, sandy, light rusty-brown; contains caliche at 9 feet	6	14
Silt, calcareous, sandy, buff; contains caliche	6	20
Silt, compact, calcareous, sandy, buff	5	25
Silt, calcareous, buff to cream	5	30
Silt, compact, calcareous, sandy, cream to white	10	40
Silt, calcareous, buff, and fine to coarse gravel and sand	8	48
Gravel, coarse, and interbedded silt; contains some coarse sand and pebbles	12	60
Gravel, fine to coarse; contains pebbles and shell fragments	3	63
CRETACEOUS--Gulfian		
Greenhorn limestone		
Clay, compact, light-gray to white	1	64
Limestone and shale, very solid and medium-solid layers interbedded, gray to dark-gray.	1	65

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-17-12da. Surface altitude, 1,904.75 feet.

	Thickness (feet)	Depth (feet)
Silt, dark-brown; contains gravel (road fill)..	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, calcareous, brown.....	4	8
Silt, compact, slightly sandy, calcareous.....	4	12
Silt, calcareous, tan; contains some calcium carbonate particles.....	5	17
Silt, compact, calcareous, iron-stained, tan to gray.....	5	22
Silt, sandy, iron streaks, tan; contains some shell fragments.....	3	25
Gravel, coarse to very coarse; contains some coarse sand.....	3.5	28.5
CRETACEOUS--Gulfian		
Carlile shale or Greenhorn limestone		
Shale, compact, sandy, dark-gray.....	1.5	30

14-18-9aa. Surface altitude, 1,981.53 feet; water level, 31.57 feet.

Soil, friable, silty, brown.....	2.5	2.5
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, plastic, dark-gray to brown; contains clay layer at 5 feet.....	4.5	7.0
Sand, fine to coarse; contains fine gravel and brown silt.....	3	10
Sand, very fine and fine; contains small amount of coarse sand and gravel and caliche	10	20
Sand, fine to coarse, and fine to coarse gravel; contains quartz and granite pebbles up to ½ inch, and shale and limestone pebbles.....	8	28
Clay, plastic, blue-gray, and brown silt.....	2	30
Gravel, fine to coarse, pebbles up to ½ inch; contains coarse sand.....	10	40
Gravel, medium to coarse, pebbles up to 1 inch of chert, limestone, and granitic material...	3.5	43.5
CRETACEOUS--Gulfian		
Carlile shale		
Limestone, hard, and black, and calcareous shale.....	1.5	45

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-18-9ad. Surface altitude, 1,979.65 feet; water level, 18.79 feet.

	Thickness (feet)	Depth (feet)
Soil, friable, silty, dark-brown.....	2	2
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, black, and fine sand.....	1	3
Clay, compact, stiff, gray; contains some gravel and sand and caliche from 7 to 10.5 feet.....	7.5	10.5
Clay, friable, gray; contains caliche nodules up to ½ inch.....	6.5	17
Clay, silty, gray; contains some caliche.....	3	20
Gravel, and sand, fine to coarse; contains much limestone and shale pebbles up to 3/4 inch.....	5	25
CRETACEOUS--Gulfian		
Carlile shale		
Shale, hard, calcareous, black.....	5	30

14-18-9bbl. Surface altitude, 2,011.47 feet; water level, 46.85 feet.

Soil, friable, dark-gray.....	1.5	1.5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, calcareous, tan; contains some sand and gravel.....	2.5	4
Silt and clay, calcareous, buff; contains some sand and gravel.....	5	9
Clay, plastic, tough, calcareous, gray to cream.....	5	14
Silt, buff, interbedded with sand and gravel.	6	20
Sand, very fine, and silt, tan; contains some caliche.....	6	26
Sand, fine to coarse; contains gravel and clay	11	37
Sand and gravel, fine to coarse; contains caliche, shell fragments, and chalk pebbles	7	44
Gravel, fine to coarse, and chalk pebbles up to 3/4 inch; contains small amount of blue, plastic clay and fine sand.....	6.5	50.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, hard, calcareous, black.....	2.5	53

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-18-9bb2. Surface altitude, 2,017.63 feet; water level, 51.72 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, brown; contains some sand and gravel....	4	4
Clay, plastic, gritty, calcareous, buff.....	8	12
Clay, hard, stiff, buff; contains scattered gravel and caliche fragments.....	10	22
Silt, compact, buff; contains sand, caliche, and limestone fragments.....	11	33
Silt, calcareous, buff; contains caliche and sand.....	6	39
Sand, fine to medium, and clay; contains coarse sand and gravel.....	8	47
Gravel and sand, coarse to $\frac{1}{4}$-inch pebbles; contains many limestone pebbles.....	11.5	58.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, hard, calcareous, blue-black.....	6.5	65

14-18-9da. Surface altitude, 2,011.59 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, friable, slightly sandy, brown.....	1	1
Silt, compact, sandy, buff.....	1.5	2.5
Silt, sandy, rusty-brown; contains caliche....	2.5	5
Silt, compact, sandy, tan.....	5	10
Silt, medium compact, sandy, buff.....	4	14
Silt, sandy, buff; contains caliche.....	6	23
Silt, sandy, buff; contains caliche and some sand.....	8	31
Silt; contains some caliche and gravel.....	4	35
Gravel, coarse; contains some sand and some pebbles up to $\frac{1}{4}$ inch.....	8	43
Gravel, medium, buff; contains silt layer from 45 feet to 48 feet.....	7	50
Gravel, medium to coarse, well sorted, quartz and limestone.....	5.5	55.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, compact, black, blue-black.....	4.5	60

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-18-9dd. Surface altitude, 2,007.40 feet.

	Thickness (feet)	Depth (feet)
Soil, silty, gray-buff; contains few gravels..	2.5	2.5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, friable, reddish-brown; contains few gravels.....	5.5	8
Silt, sandy, brown; contains caliche.....	3.5	11.5
Sand, very fine to fine.....	5.5	17
Clay, plastic, buff to tan; contains caliche..	1	18
Sand, very fine to fine, some medium to coarse and fine gravel.....	.5	18.5
Silt, plastic, buff, reddish; contains some sand and some caliche nodules up to ½ inch..	18.5	37
Silt, plastic, gray to dark-brown.....	3	40
Silt, tough, plastic, tan to buff.....	12	52
Gravel and sand, fine to coarse; contains pebbles 3/8-inch in diameter.....	6.5	58.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, calcareous, hard, black.....	1.5	60

14-18-16da. Surface altitude, 1,993.61 feet; water level, 32.4 feet.

Silt, compact, gray; contains limestone (road fill).....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, sandy, rusty-brown.....	4	7
Silt, very sandy, loose; contains fine sand at 9 feet.....	6	13
Sand and silt, tan silt; contains medium to coarse sand.....	4	17
Silt, compact, buff.....	5	22
Silt, sandy, iron-stained, buff; contains a little gravel.....	4.5	26.5
Sand, medium to coarse; contains a little coarse gravel.....	6.5	33
Gravel, coarse, quartz and limestone; contains a small amount of pebbles.....	7	40
Gravel, medium to coarse, quartz and limestone; contains a little coarse sand.....	5	45
Gravel, coarse, quartz and limestone.....	5	50
Gravel, coarse, quartz and limestone; contains pebbles.....	4.5	54.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, chalky and lignitic in texture, black..	3.5	58

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-18-21aa. Surface altitude, 2,005.52 feet; water level, 22.85 feet.

	Thickness (feet)	Depth (feet)
Silt, gray; contains gravel (road fill).....	2.5	2.5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, slightly sandy, gray-brown.....	2.5	5
Silt, sandy, rusty-brown.....	3	8
Silt, fairly loose, buff.....	2	10
Silt, iron-stained, slightly sandy, gray-buff.	4	14
Gravel, coarse; contains pebbles.....	2	16
Clay, sandy, calcareous, gray-yellow.....	5	21
Gravel, coarse, quartz; contains pebbles.....	1.5	22.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale and clay, calcareous, weathered, gray-yellow.....	7.5	30
Shale, platey, yellow to blue-gray; contains selenite crystals.....	3	33

14-19-31bc. Surface altitude, 2,085.04 feet.

Silt, friable, sandy, dark-brown (road fill)..	1.5	1.5
QUATERNARY--Pleistocene		
Silt, calcareous, buff.....	1.5	3
Clay, chalky, calcareous, cream-white; contains caliche and sand grains.....	3	6
CRETACEOUS--Gulfian		
Carlile shale		
Shale, weathered, calcareous, gray to tan....	1	7
Shale, plastic, calcareous, gray, light blue-gray.....	3	10

14-19-31cc. Surface altitude, 2,062.50 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, sandy, dark-brown and black....	2	2
Clay, compact, gray.....	2	4
Clay, compact, light-gray.....	3	7
Silt, iron-stained, gray-brown; contains some gravel particles.....	5	12
Silt, compact, sandy, rusty-brown.....	13	25

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-19-31cc--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Silt, less compact, iron-stained at base, sandy, buff	5	30
Sand, medium to coarse, and fine gravel	6	36
Gravel, coarse, quartz; contains some coarse sand	1	37
CRETACEOUS--Gulfian		
Carlile shale		
Clay and shale, calcareous, weathered, yellow to light-gray	1.5	38.5
Shale, plastic, calcareous, blue-gray	1.5	40

14-19-35dd. Surface altitude, 2,108.41 feet.

TERTIARY--Pliocene ?		
Ogallala		
Silt, plastic, sandy, brown	4	4
Silt, tan, and coarse quartz sand, and gravel cemented by calcium carbonate; contains caliche	3	7
Gravel, coarse to 1-inch pebbles and fine to coarse sand; contains small amount of intermixed clay	8.5	15.5
Clay, compact, sandy, noncalcareous, gray; contains coarse gravel	10.5	26.0
CRETACEOUS--Gulfian		
Carlile shale		
Clay, very stiff and weathered shale, noncalcareous, blue-gray; contains selenite crystals	4	30

14-20-32aa2. Surface altitude, 2,089.35 feet.

Silt, sandy, brown; contains some gray silt (road fill)	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, sandy, gray to brown; contains some clay particles	1.5	3.5
Silt, sandy, gray to brown	2	5.5

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

14-20-32aa2--Continued

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Silt, sandy, rusty-brown; contains some gravel	4.5	10
Silt, clayey, sandy, brown to buff.....	5	15
Silt, clayey, sandy, brown.....	3	18
Gravel, limestone and quartz, fine to coarse; contains clayey, sandy silt.....	7	25
Gravel, fine to coarse, quartz and feldspar; contains some $\frac{1}{4}$-inch limestone pebbles and shell fragments; contains silty clay 1 foot thick from 26 to 27 feet.....	5	30
Gravel and sand, fine to medium; contains pebbles.....	3	33
Gravel, fine to coarse, and gray clay.....	5	38
Gravel, coarse, predominantly limestone; contains some quartz and feldspar and a little clay.....	6	44
CRETACEOUS--Gulfian		
Carlile shale		
Shale, non-calcareous, blue-gray to black; contains fragments of limestone and satin spar.....	4	48

15-17-1dd. Surface altitude, 1,881.08 feet.

Silt, dark-brown; contains sand and gravel (road fill).....	3	3
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, compact, sandy brown to tan.....	3	6
Silt, compact, sandy, brown.....	2	8
Silt, medium compact, gray-brown.....	2	10
Silt, compact, dark-brown.....	5	15
Silt, compact, calcareous, sandy, gray.....	2	17
Silt, very sandy, gray.....	1	18
Gravel, medium to coarse; contains a little sand.....	5	23
Gravel, coarse to medium.....	4	27
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale and limestone, interbedded, gray.....	2	29

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-17-12aa. Surface altitude, 1,884.55 feet; water level, 22.67 feet.

	Thickness (feet)	Depth (feet)
Silt, friable, sandy, brown (road fill).....	3	3
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, sandy, calcareous, tan.....	3	6
Silt, clayey, slightly calcareous, tan.....	4	10
Silt, sandy, brown; contains gravel particles.	7	17
Clay, sandy, gray.....	3	20
Gravel, fine to coarse, quartz, feldspar, and limestone.....	5	25
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, brittle, calcareous, blue-gray.....	2	27

15-18-21aa. Surface altitude, 2,036.54 feet; water level, 10.50 feet.

Soil, medium compact, sandy, brown.....	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, sandy, rusty-brown.....	.5	1.5
Silt, calcium carbonate, cemented, compact, sandy, buff; contains sand and gravel.....	2	3.5
Gravel, fine to medium; contains caliche and silt.....	2.5	6
Clay, calcareous, gray to yellow; contains gravel and satin spar.....	4	10
CRETACEOUS--Gulfian		
Carlile shale		
Clay and shale, gray and yellow; contains weathered bentonite.....	2	12
Shale and clay, compact, calcareous, gray and yellow.....	8	20
Shale and clay, gray, yellow; contains chalky limestone.....	3	23
Shale, gray-yellow; contains streaks of bentonite.....	3	26

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-18-27cb1. Surface altitude, 1,919.42 feet; water level, 22.40 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, tan, and fine to medium sand.....	2	2
Silt, medium compact, sandy, buff.....	8	10
Silt, calcareous, gray-buff.....	7	17
Silt, plastic, calcareous, gray-buff; contains some gravel at 17 feet.....	5	22
Silt, sandy, gray, and coarse gravel, limestone and quartz.....	8	30
Gravel, coarse, quartz, and gray, compact silt	10	40
Gravel, coarse; contains blue-gray silt to 44 feet.....	10	50
Gravel, coarse; contains some layers of gray silt.....	9	59
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, blue to blue-gray and limestone.....	4	63

15-18-27cb3. Surface altitude, 1,907.89 feet; water level, 9.32 feet.

QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, sandy, tan; contains medium sand.....	3	3
Sand, medium to coarse; contains coarse gravel	7	10
Sand, coarse, quartz and medium to coarse gravel.....	5	15
Gravel, fine to coarse, quartz; contains a small amount of limestone pebbles. Blue-gray silt at 18 feet.....	5	20
Sand, coarse, quartz and fine gravel.....	5	25
Gravel, medium to fine, quartz and coarse sand; contains limestone pebbles.....	5	30
Sand, medium to coarse, quartz; contains blue-gray clay.....	5	35
Sand, coarse, and fine to medium quartz and limestone gravel.....	5	40
Sand, medium to coarse, quartz.....	5	45
Sand, medium to coarse, quartz.....	4	49
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, calcareous, blue-gray to black.....	1	50

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-18-27cc. Surface altitude, 1,911.31 feet; water level, 15.00 feet.

	Thickness (feet)	Depth (feet)
Silt, sandy, brown (road fill).....	3	3
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, compact, sandy, tan.....	4	7
Sand, medium to coarse, quartz.....	3	10
Sand, medium to coarse, quartz and medium to coarse gravel.....	5	15
Sand, coarse, quartz, limestone, and shale, and medium to coarse gravel.....	5	20
Gravel, fine to coarse, quartz, feldspar, and limestone; contains shell fragments.....	6.5	26.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, very solid, calcareous, gray; contains much lag.....	3.5	30

15-18-33ad. Surface altitude, 1,954.40 feet; water level, 32.40 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, friable, brown.....	4	4
Silt, slightly sandy, buff.....	4	8
Silt, rusty-brown; contains coarse sand at 8 feet.....	2	10
Gravel, fine to medium; contains coarse sand..	5	15
Gravel, fine to medium, and coarse sand; contains a very little silt.....	5	20
Sand, coarse, quartz, and fine gravel.....	6	26
Gravel, fine to medium; contains a very little yellow silt.....	4	30
Gravel, fine to medium, quartz.....	6	36
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, calcareous, gray to gray-black.....	3	39

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-18-34cb.

	Thickness (feet)	Depth (feet)
Silt, brown.....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, tan.....	4	7
Silt, brown; contains fine to medium sand and medium gravel.....	5	12
Sand, medium to coarse; contains medium to coarse gravel and silt.....	8	20
Gravel, medium to coarse, quartz.....	5	25
Gravel, coarse, quartz; contains shale and limestone fragments.....	4	29
Gravel, coarse; contains some yellow clay...	5	34
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, calcareous, gray to black.....	3	37

15-19-7bc. Surface altitude, 2,030.09 feet.

Silt, sandy, dark-brown (road fill).....	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, loose, sandy, buff.....	2	3
Sand, coarse, quartz, and brown silt.....	4	7
Sand, coarse; contains gravel, fine quartz and shell fragments.....	8	15
Sand, medium to coarse, quartz; contains some fine gravel.....	5	20
Sand, coarse, limestone and granite.....	5	25
Gravel, fine to coarse, granitic, limestone; contains clay at 28.5 feet.....	4	29
Gravel, fine to coarse, granitic, limestone.	4	32
CRETACEOUS--Gulfian		
Carlile shale		
Shale, calcareous, sandy, dark-gray.....	4	36

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-19-9cc. Surface altitude, 2,017.49 feet; water level, 35.91 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium-compact, dark-brown.....	2.5	2.5
Silt, fairly-compact, sandy, calcareous, buff	2.5	5
Silt, medium-compact, sandy, buff.....	2	7.5
Silt, calcareous, rusty-brown to brown.....	3.5	11
Silt, buff and medium to coarse sand.....	5	16
Sand, medium to coarse, igneous.....	4	20
Sand, coarse, igneous.....	5	25
Gravel, medium coarse, igneous, and coarse sand.....	5	30
Gravel, fine, igneous, and coarse sand.....	5	35
Gravel, medium to coarse, igneous.....	2	37
Clay, gray-tan to buff and coarse quartz gravel.....	6	43
Gravel, coarse to medium and gray, buff, and white clay interbedded.....	7	50
Gravel, fine to medium, igneous.....	4	54
Clay and limestone, weathered, white and gray; contains medium to fine gravel.....	3.5	57.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, sandy, calcareous, dark-gray to gray	2.5	60

15-19-15dd. Surface altitude, 1,992.99 feet.

Soil, friable, brown.....	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, tan; contains gravel.....	5	6
Sand, and fine gravel.....	4	10
Gravel, fine to coarse, granitic; contains sand and thin clay layers at 18 feet.....	10	20
Gravel and sand, as above.....	6.5	26.5
Clay, iron-stained, yellow and gray.....	.5	27
Sand, coarse, and fine gravel.....	3.5	30.5
Clay, plastic, sandy, yellow to light gray..	4.5	35
Clay, plastic, calcareous, gray.....	2	37
Sand, coarse to medium; contains a small amount of gravel.....	1	38
Clay, fine, plastic, sandy, blue-gray and light-gray.....	2	40
Sand, coarse, with thin clay layers.....	4	44
Sand, coarse, and fine to very coarse gravel	7	51
CRETACEOUS--Gulfian		
Greenhorn limestone		
Limestone, hard, and blue-gray shale.....	.5	51.5

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-19-18bb. Surface altitude, 1,972.77 feet; water level, 20.10 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Sand, medium to coarse, igneous.....	2	2
Gravel, fine to medium, quartz and coarse sand.....	3	5
Silt, sandy, gray-brown and coarse sand.....	7	12
Silt, loose, clayey, sandy, brown.....	3	15
Gravel, quartz and limestone, and brown silt	8	23
Gravel, medium to coarse, quartz and limestone	7	30
Gravel, fine to coarse, quartz and limestone; contains gray silt.....	7	37
Gravel, fine to coarse, quartz and limestone, gray interbedded silt.....	5	42
Gravel, coarse, igneous and limestone, contains blue-gray silt layers.....	8	50
Gravel, coarse to medium, quartz and limestone, some silt.....	10	60
Gravel, coarse, igneous and limestone, and pebbles.....	6.5	66.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Limestone and shale, interbedded, gray to white.....	2	68.5

15-20-1da. Surface altitude, 2,042.99 feet; water level, 36.05 feet.

Silt, compact, dark-brown (road fill).....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, brown.....	3	5
Silt, slightly sandy, tan; contains caliche fragments.....	2	7
Silt, medium compact, buff.....	8	15
Silt, fairly loose, sandy, gray-brown.....	4	19
Silt, sticky, clayey texture, dark-gray.....	4	23
Silt, same as above, more sandy; contains sand and gravel.....	3	26
Gravel, fine to medium, quartz; contains some coarse gravel.....	4	30
Gravel, fine to medium, quartz; contains limestone fragments.....	5	35
Gravel, fine, quartz, and limestone; contains some light-brown clay at 37 feet.....	5	40
Gravel, medium to fine, igneous, and limestone.....	3.5	43.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, very compact, calcareous, blue-gray..	2.5	46

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Ellis County--Continued

15-20-12aa. Surface altitude, 2,038.35 feet; water level, 41.23 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, slightly sandy, dark-brown.....	2	2
Clay, sandy, dark-gray to tan; contains caliche.....	3	5
Silt, loose, sandy, brown to tan.....	2	7
Silt, sandy, rusty-brown.....	1	8
Silt, friable, sandy, tan.....	2	10
Sand, coarse, quartz, and rusty, brown silt..	5	15
Gravel, medium to coarse quartz and fine to medium sand. Clay layer for 0.5 foot at 18 feet.....	5	20
Gravel, coarse to fine, quartz.....	5	25
Gravel, fine to coarse, quartz and limestone; contains some coarse sand.....	5	30
Gravel, medium to coarse, quartz and limestone	5	35
Gravel, coarse, quartz, and limestone; contains clay layer at 37 feet.....	5	40
Sand, medium to coarse, quartz; contains some limestone pebbles.....	5	45
Gravel, fine to medium, quartz and limestone, clay layer 8 inches thick at 48 feet.....	6	51
Clay, compact, plastic, gray; contains lag...	4	55
Sand, medium to very coarse, quartz; contains some medium gravel.....	3	58
CRETACEOUS--Gulfian		
Carlile shale		
Shale, compact, calcareous, blue-black to blue	2	60

Rush County

16-17-1bb. Surface altitude, 1,887.70 feet; water level, 19.90 feet.

Soil, compact, brown (road fill).....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, slightly sandy, calcareous, tan.....	4	7
Sand, medium to coarse, and fine to medium gravel.....	3	10
Gravel, fine to medium, igneous, and coarse sand.....	5	15
Gravel, medium to fine, quartz.....	5	20
Gravel, coarse to medium.....	5	25
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, calcareous, gray, blue-gray, and yellow clay.....	2	27

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Rush County--Continued

16-17-1bc. Surface altitude, 1,896.92 feet; water level, 24.80 feet.

	Thickness (feet)	Depth (feet)
Silt, solid, brown (road fill).....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, tan.....	4	7
Sand, medium to coarse, uniform; contains silt from 7 to 8 feet.....	6	13
Gravel, fine to medium, and medium to coarse sand; contains silt.....	7	20
Gravel, fine to medium, igneous, limestone, and shale.....	6	26
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, clayey to compact shale, gray, blue-gray.....	2	28

Trego County

14-21-27ad. Surface altitude, 2,108.35 feet; water level, 76.70 feet.

Silt, black, dark-brown (road fill).....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, brown, and angular limestone gravel....	2	4
Silt, plastic, tan to brown.....	6	10
Silt, sandy, rusty-brown.....	3	13
Silt, plastic, buff.....	8	21
Gravel, limestone, and brown silt.....	4	25
Silt, plastic, clayey, gray.....	3	28
Gravel, medium to fine; contains some coarse granitic sand.....	2	30
Gravel, medium to fine; contains some coarse granitic sand.....	5	35
Gravel, medium to coarse.....	2	37
Gravel, medium to coarse, granitic.....	2	39
Silt, calcareous, gray-white.....	6	45
Silt, calcareous, gray-white to buff.....	5	50
Silt, calcareous, gray-white to cream.....	5	55
Silt, calcareous, white.....	8	63
Gravel, limestone; contains some gray silt...	4	67
Clay, gray and silt; contains limestone gravel	3	70
Gravel, fine to medium, limestone and quartz.	4	74
Gravel, medium to coarse, limestone and quartz, and gray silt.....	4	78
Gravel, fine to coarse, limestone and quartz.	6	84

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Trego County--Continued

14-21-27ad--Continued

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Gravel, coarse, limestone and quartz.....	5	89
Gravel, medium to fine, igneous.....	2	91
Gravel, coarse to fine, igneous and limestone.....	4	93
CRETACEOUS--Gulfian		
Carlile shale		
Shale, pliable, plastic, calcareous, blue...	2	95

14-21-34aa. Surface altitude, 2,095.41 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, friable, slightly sandy, brown.....	1	1
Silt, clayey, slightly sandy, brown to gray-buff.....	1.5	2.5
Silt, clayey texture, sandy, buff.....	2.5	5
Silt, sandy, rusty-brown; contains buff silt	2	7
Sand, coarse, and fine quartz and feldspar gravel; contains some clay.....	3	10
Sand, fine to coarse; contains some fine gravel.....	5	15
Sand, medium to coarse; contains some fine to medium gravel.....	2	17
Gravel, fine to coarse, quartz and feldspar.	8	25
Gravel, medium to coarse, limestone.....	7	32
CRETACEOUS--Gulfian		
Carlile shale		
Shale, plastic, weathered, yellow to gray...	2	34
Shale, noncalcareous, blue-black.....	3	37

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Trego County--Continued

14-21-34ad. Surface altitude, 2,087.33 feet.

	Thickness (feet)	Depth (feet)
Silt, gray to brown (road fill).....	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, plastic, clayey, calcareous, buff.....	1	2
Silt, calcareous, sandy, tan.....	3	5
Gravel, fine to coarse, igneous and limestone; contains silt.....	4	9
Gravel, fine to medium, quartz, and coarse sand	5	14
Gravel, coarse to fine, quartz, clay stone and iron stone.....	2	16
Sand, coarse to medium, quartz and feldspar..	2	18
Sand, coarse, and fine to medium quartz.....	3	21
Gravel, fine to medium.....	2	23
CRETACEOUS--Gulfian		
Carlile shale		
Shale, pliable, plastic, noncalcareous, blue-gray, black.....	3	26

14-21-34da. Surface altitude, 2,041.39 feet; water level, 16.90 feet.

QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Sand, fine to coarse; contains silt.....	3	3
Silt, fine texture, sandy, buff.....	6	9
Silt, buff, gray-buff; contains fine to coarse gravel.....	6	15
Silt, buff to brown; contains medium to coarse sand.....	3	18
Clay, plastic, gray; contains fine to coarse sand and gravel.....	7	25
Clay, plastic, gray; contains some gravel and sand.....	5	30
Clay, plastic, gray; contains fine and coarse sand.....	5	35
Clay, gray; contains fine to coarse gravel...	5	40
Clay, sandy, gray; contains some coarse sand.	4	44
Clay, pliable, plastic, slightly sandy, gray.	6	50
Gravel, fine to medium, and coarse sand.....	6	56
Gravel, fine to coarse, igneous, limestone and shale.....	7	63
CRETACEOUS--Gulfian		
Carlile shale		
Shale, calcareous, gray-black.....	5	68

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Trego County--Continued

14-21-34da. Surface altitude, 2,041.39 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Sand, fine to coarse, quartz and feldspar; contains some silt	3	3
Sand, fine to coarse; contains some silt	2	5
Sand, medium to coarse, and fine gravel	5	10
Gravel, medium to coarse	2	12
Gravel, medium to coarse; contains some shale fragments	1	13
CRETACEOUS--Gulfian		
Carlile shale		
Shale, fissile, calcareous, black	5	18

14-22-36aa. Surface altitude, 2,116.22 feet; water level, 44.15 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, dark-brown; contains fine to coarse gravel and some coarse sand	1	1
Gravel, fine to coarse, quartz, rusty-brown	1	2
Gravel, fine, quartz and feldspar	3	5
Gravel, fine to coarse, quartz, feldspar and limestone	2	7
Gravel, fine to medium, quartz; contains some coarse sand	3	10
Gravel, fine to coarse, quartz	4.5	14.5
Silt, soft, plastic, gray-white	5.5	20
Silt, clayey, calcareous, gray-white	6	26
Silt, sandy, tan to cream	6	32
Gravel, fine to medium, and medium to coarse sand; contains some limestone fragments	6	38
Silt, clayey, calcareous, gray-white	7	45
Silt, calcareous, gray to gray-white	5	50
Silt, gray to gray-white	8	58
Gravel, fine to medium, igneous	7	65
Gravel, fine, and coarse quartz sand	3	68
CRETACEOUS--Gulfian		
Carlile shale		
Shale, calcareous, blue-black; contains limey-cemented material at 68 feet	6.5	74.5

Table 12.--Logs of test holes drilled by the State Geological Survey of Kansas in the Cedar Bluff Unit in 1949--Continued

Trego County--Continued

15-21-2bb. Surface altitude, 2,031.36 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene and Recent		
Terrace deposits		
Silt, brown.....	1	1
Sand, fine to coarse; contains some brown silt	4	5
Gravel and sand, fine to coarse.....	3	8
Gravel, fine to coarse, and medium sand.....	3	11
CRETACEOUS--Gulfian		
Carlile shale		
Shale, black, blue-black to dark-gray.....	3	14

15-21-3ad. Surface altitude, 2,100.66 feet.

Silt, brown to gray (road fill).....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, slightly sandy, reddish-brown.....	9	12
Silt, sandy, tan, and medium sand.....	3	15
Sand, medium to coarse, and fine gravel.....	5	20
Sand, fine to coarse; contains silt at 25.5'..	5.5	25.5
Gravel, fine and coarse sand.....	2.5	28
Gravel, medium to coarse.....	2	30
CRETACEOUS--Gulfian		
Carlile shale		
Shale, gray, blue-black and black.....	4	34

15-21-3dd. Surface altitude, 2,148.78 feet.

Silt, brown (soil and roadfill).....	1	1
QUATERNARY--Pleistocene		
Silt, clayey, tan.....	1	2
Silt, sandy, buff.....	2	4
Clay, pliable, plastic, tan, light-gray.....	2.5	6.5
CRETACEOUS--Gulfian		
Carlile shale		
Shale, plastic, gray, blue-gray; contains bentonite.....	3.5	10

Well Records

During the summer of 1949 a total of 146 wells were visited and data relative to depth, water level, aquifer, and type of well were obtained. The locations of the wells are shown on figure 5 and the data relative to these wells are given in table 13.

Table 13.--Record of wells in the Cedar Bluff Unit

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
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
					Ellis County							
14-16-10dd	.....	Du	18.3	30	R	L,G	Cy,W	N	Tpl	0.7	14.75	9-26-49
-11cc	H. H. Robben.....	Du	13.9	54	R	S,P	Cy,W	S	Tpl	.8	13.15	9-26-49
-12bb	F. H. Schulte.....	Du	17.3	28	R	S,P	Cy,H	D	Tca	.3	14.78	9-26-49
-13dd	J. M. Rome.....	B	30.4	6	GI	S,P	Cy,H	N	Bpl	.0	25.60	9-26-49
-16ab	Wm. H. Bevens.....	Du	24.7	42	R	L,G	Cy,W	D,S	Tpl	.0	21.46	9-27-49
-17cb	.....	Du	24.0	60	R	S,Gr,A,T	Cy,W	O	Tpl	.9	20.06	9-26-49
-18bb	A. G. Wagner.....	Du	30.7	42	R	S,T	Cy,W	D	Tpl	.0	25.38	9-26-49
-19bb	.....	Du	40.9	34	R	S,Gr,P	Cy,W	S	Tpl	1.4	36.92	9-27-49
-20dd	D. Smithberger.....	Dr	49.9	10	I	S,Gr,T	Cy,W	S	Tca	1.0	42.74	9-26-49
-21cb	P. A. Dreiling.....	Du	37.8	36	R	S,Gr,T	J,E	D	Tpl	.8	33.30	9-26-49
-22aa	U. G. Tholen.....	Du	28.1	36	R	S,Gr,A	Cy,W	S	Tpl	...	21.92	9-26-49
-22cb	.....	Du	20.2	36	R	S,Gr,A	Cy,W	S	Tpl	1.8	16.65	9-27-49
-26ac	B. J. Wagner.....	Du	29.9	42	R	Gr,T	Cy,W	D,S,I	Tpl	.4	26.02	9-26-49

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
			Ellis County--Continued									
14-16-28cd	Dan J. Braun.....	Du	53.3	42	R	L,G	Cy,W	D,S,P	Tpl	0.6	51.47	9-27-49
-31dd	M. Dinkle.....	Du	37.2	48	R	S,Gr,P	Cy,W	S	Tpl	1.0	35.31	9-27-49
-32ab	.....	Du	52.3	27	R	S,P	Cy,W	N	Tpl	1.4	50.42	9-27-49
-34ba	.....	B	15.8	6	GI	S,Gr,T	Cy,H	D	Tca	.2	14.77	9-28-49
-36bc	.....	Du	22.7	30	R	S,P	Cy,W	S,O	Tpl	1.5	20.95	8-22-49
-36dd	.....	Du	14.3	36	R	Gr,P	N	N	Tcu	1.1	10.70	9-27-49
14-17-16ad	.....	Du	20.1	42	R	S,P	Cy,W	S	Tpl	1.0	16.80	9-26-49
-17bb	Leo Dellva.....	Du	36.3	36	R	S,P	Cy,W	D,S	Tpl	.5	29.90	9-27-49
-19bb	Hilarius Gabel.....	B	41.5	6	GI	S,Gr,P	J,E	D	Tpl	1.5	35.73	9-27-49
-20dd	Mrs. Steeklein.....	Dr	50.3	6	GI	S,P	Cy,W	N	Tca	1.2	26.15	9-27-49
-23ba	.....	Du	31.4	36	R	S,P	Cy,W	N	Tpl	.5	29.65	9-27-49
-25aa	Robt. Goetz.....	Du	26.0	36	R	S,P	Cy,W	S	Tpl	-2.0	22.80	9-27-49
-27aa	.....	Dr	30.5	6	GI	S,P	Cy,W	S	Tca	.5	25.50	7-16-46
-27cc	.....	Dr	66.3	5	GI	S,P	N	N	Tca	.8	47.09	9-23-49
-31aa	John Ruder.....	Dn,B	26.1	6	GI	S,Gr,T	Cy,W	D,S	Tpl	.9	20.01	8- 9-46
-32bb	A. N. Pfannenstiel..	Du	24.8	42	R	Gr,T	Cy,W	D,S	Tpl	.3	20.60	9-27-49
-34cc	.....	B	38.2	5	GI	S,P	Cy,W	S	Tca	.8	34.91	9-28-49
-36bb	Frank Dinkel.....	B	50	5½	GI	S,C,P	J,E	D	Tpl	.0	35.95	9-27-49
14-18-9bb2	Hays Experimental Station	Dr	65.0	5	GI	S,Gr,T	N	O	Ls	.0	51.72	10-28-49
-12bb	J. Brull.....	Du	31.1	48	R	S,P	Cy,W	D,S,O	Tpl	.4	24.73	8-22-49
-25aa	Al Rohr.....	B	28.2	6	GI	S,T	J,E	D	Tpl	.6	23.20	9-27-49
-26aa	F. J. Befort.....	Du	24.1	43	R	S,T	Cy,W	D,S,O	Tpl	1.2	20.17	8-22-49
-27cb	A. A. Dechant.....	Dr	345	7	GI	Ss,D	N	O	Tca	.9	159.77	10- 3-49
-29bb	.....	Du	27.5	48	R	S,Gr,P	Cy,W	S	Tpl	1.2	22.65	7-26-46

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
						Ellis County--Continued						
14-19-29dd	Jacob M. Haas.....	Dr	350	6	GI	Ss,D	Cy,W	S	Tpl	2.0	181.08	8-23-49
-31cc	U. S. Geological Survey	Dr	.....	1¼	GP	S,Gr,T	N	O	Tca	2.2	33.99	10-22-49
-34ba	Joe Feitz.....	Dr	217	6	GI	Ss,D	N	N	Tpl	-.5	197.41	8-15-49
-35dd	U. S. Geological Survey	Dr	.....	1¼	GP	Gr,P	N	O	Tca	...	.....	.....
14-20-28ad	Florence Solomon....	Du	23.6	26	RC	S,Gr,Co	Cy,W	D,S	Tpl	.8	15.92	8-15-49
-30dd	Kutina Estate.....	B,Dn	31.4	5	GI	Gr,T	Cy,W	D,S	Tpl	.6	31.15	10-10-49
-32aa1	Clarence Groff.....	Du	39.9	42	R	Gr,T	Cy,W	D,S	Tpl	.5	28.25	10- 4-49
-32aa2	.....do.....	Dr	.....	1¼	GP	Gr,T	N	O	Tca	.3	35.73	10-21-49
-32dd	School District.....	Dr	43.2	8	I	S,Gr,T	Cy,W	D	Tca	.2	35.78	8-15-49
-34cd	.....	Du	45.8	30	C	S,Gr,T	Cy,H	S	Tpl	.4	40.51	8-22-49
-35dc	F. A. Pfannehstiel..	Du	20.1	72	R	S,A	Cy,H	D,O	Tpl	.6	14.87	8-22-49
15-16-2bb	C. D. Wagner.....	Du	35.5	46	R	G,T	Cy,W	D,S	Tpl	.4	34.63	9-27-49
-5aa	Leo Rajewski.....	Dr	21.9	7	GI	S,T	Cy,W	...	Tca	.6	15.62	9-28-49
-6cb	Louis Leiker.....	B	57.7	6	GI	S,Gr,T	Cy,W	D,S	Tpl	.8	54.86	9-27-49
15-16-6dd	Tea Tholen.....	Du	29.5	48	R	S,Gr,T	Cy,W	D,S,O	Tpl	.4	23.44	9-27-49
-9aa	H. Huser.....	Dr	133.2	6	GI	Ss,D	Cy,W	S	Tpl	.6	92.38	9-27-49
-12da	M. L. Goram Co.....	Du	13.7	48	R	S,A	Cy,H	D	Tpl	.3	10.83	9-27-49
-13bb	I. S. Hammersmith...	Du	16.8	48	R	S,P	Cy,W	D,S,O	Tpl	.8	14.80	9-27-49
-14ab	.....	Dr	204.6	6	GI	Ss,D	Cy,W	S	Tca	.8	112.90	7-17-46
-16aa	Alfred Dreiling.....	Du	20.5	45	R	S,Gr,A	Cy,W	S	Tpl	1.6	13.45	9-30-49
-18ab	Ed F. Schulte.....	Dr	178.0	6	GI	Ss,D	Cy,W	S	Tca	1.0	110.49	9-30-49
-18bb	D. Vonfeldt.	Dr	189.4	6	GI	Ss,D	Cy,W	D,S	Tpl	1.3	108.58	9-28-49
-21bd	John Kruger.....	Du	19.3	8	R	Gr,P	Cy,H	D	Tpl	1.0	16.44	9-28-49
-23cb	.....	Dr	108.2	5	GI	Ss,D	Cy,H	D	Tca	.3	53.40	9-28-49

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
						Ellis County--Continued						
15-16-25aa	.....	B	26.5	10	GI	S,Gr,T	Cy,W	S	Bp	0.3	14.34	9-29-49
-25bb	Loren Truan.....	Du	19.9	72±	R	G,T	Cy,W	S	Tpl	...	17.48	9-29-49
-29ad	G. E. Scurlock.....	B	23.0	6	GI	G,T	Cy,W	D,S	Tpl	.8	21.53	9-28-49
-32cc	John J. Dome.....	Du	16.6	30	R	Gr,T	Cy,W	D,S	Tpl	.5	15.40	9-28-49
-33ca	D. G. Meier.....	Dr	80.3	6	GI	L,Gr,G	Cy,W	D,S	Bp	.3	58.32	9-29-49
-34db	.....	Du	10.3	44	R	S,Gr,A	N	N	Tpl	1.2	5.86	9-29-49
-36ad	J. Edward Boxberger.	Dr	180.2	6	GI	Ss,D	Cy,W	S	Tca	.3	137.89	9-29-49
15-17-2cd	.....	Du	38.5	36	R	S,Gr,T	Cy,W	S	Tpl	1.4	36.89	8- 7-49
-5ba	Alois Gross.....	Dr	150.9	6	GI	Ss,D	Cy,W	S	Tpl	1.0	89.70	8- 7-49
-6ad	.....	Dr	94.2	5	GI	S,P	Cy,W	N	Tca	.5	36.56	9-29-49
-7bb	.....	Du	29.0	24	R	S,P	Cy,W	D,S	Tpb	.4	22.92	9-29-49
-14dd	Christina Roth.....	Dr	170.9	6	GI	Ss,D	Cy,W	S	Tca	.3	121.70	7-20-46
-15dd	Degmhardt.....	Dr	191.2	6	GI	Ss,D	Cy,W	S	Tca	.4	179.08	9-29-49
-17bb	S. Leiket.....	Dr	182.0	6	GI	Ss,D	Cy,W	S	Tpl	.5	90.6	8- 7-49
-17cc	.....	Dr	222	6	GI	Ss,D	Cy,W	S	Tpl	.6	140.05	8-14-49
-19ab	Liker.....	Dr	246.8	6	GI	Ss,D	N	O	Tca	.5	140.16	8-22-49
-24dc	Geo. Meder.....	Dr	152.0	6	GI	Ss,D	Cy,W	D,S	Tpl	.8	102.74	9-30-49
-25bc	.....do.....	Du	15.2	36	R	Gr,P	Cy,W	D,S,O	Tpl	.0	11.90	8-22-49
-28bd	Fr. Rejewk.....	Dr	132.4	6	GI	Ss,D	Cy,W	N	Tpl	.7	110.90	10- 3-49
-28dd	.....	Du	41.3	33	R	Gr,T	Cy,W	N	Tpl	1.7	37.03	9-30-49
-30bb	.....	Dr	196.5	5	GI	Ss,D	Cy,W	S	Tpl	1.3	124.89	9-30-49
-31ab	E. P. Steckline.....	B	32.7	5.5	GI	S,Gr,P	Cy,W	D,S	Tca	.8	30.18	9-30-49
-33dc	Anthony Jacobs.....	Du	19.4	36	R	S,Gr,A	B,H	D	Tpl	2.7	17.05	9-30-49
-35cd	.....	Du	20.7	24	R	Gr,T	N	N	Trw	.2	18.41	9-30-49
15-18-1bb	Joe J. Gerstner.....	Du	33.3	24	R	S,Gr,P	Cy,W	S,O	Bp	.5	23.58	10- 3-49

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
			Ellis County--Continued									
15-18-2cb	Alex B. Leiker.....	Dr	234.2	6	GI	Ss,D	Cy,W	D,S	Tpl	1.4	25.29	10- 3-49
-9bb	Mermis Trust.....	Dr	270.0	5	OW	Ss,D	Cy,W	S	Tca	.5	137.70	10- 3-49
-11cc	.....	Du	17.0	36	R	S,A	Cy,H	S	Tpl	1.0	9.47	10- 3-49
-13ab	S. S. Leiker.....	Du	27.4	..	..	S,A	Cy,W	S	Tpl	.7	16	7-16-46
-16bb	T. W. Wolf.....	Du	16.4	40	R	S,A	B,H	D,S,O	Tpl	2.5	10.68	8-22-49
-20ab	Geo. Klaus.....	....	24.2	6	GI	S,A	Cy,W	N	Tpl	.7	22.10	10-31-49
-22bb	Joe B. Zimmerman....	Dr	47.8	6	GI	Gr,P	Cy,H	D	Tpl	.6	34.53	10- 3-49
-23ab	.....	Dr	257.2	6	GI	Ss,D	Cy,W	S	Tps	1.0	89.80	9-29-49
-26bb	E. F. Madden.....	Dr	127.3	8	I	Ss,D	Cy,G	I	Tca	.5	115.94	8-19-49
-26da	Henry S. Leiker.....	Du	17.7	34	R	S,Gr,A	Cy,W	D,S	Tpl	.9	15.01	10- 3-49
-27ca	City of Hays.....	Dr	50	17	C	S,Gr,A	T,E	P	Ls	.0	11	.....
-27cb1	.....do.....	Dr	50	17	C	S,Gr,A	T,E	P	Ls	.0	11	.....
-27cb2	.....do.....	Dr	51.0	17	C	S,Gr,T	T,E	P	Ls	.0	11	.....
-27cb3	U. S. Geol. Survey..	Dr	50.0	1¼	GP	S,Gr,T	N	O	Ls	.0	9.32	11- 1-49
-28da1	City of Hays.....	Dr	50	17	C	S,Gr,A	T,E	P	Ls	.0	11	.....
-28da2	.....do.....	Dr	50	17	C	S,Gr,A	T,E	P	Ls	.0	11	.....
-29dd	N. R. Werth.....	Dn,B	20.2	6	GI	Gr,A	C,G	S	Tpl	1.4	12.47	8-17-49
-30ab	Roy Thomas.....	B	13.6	5	GI	S,Gr,T	Cy,W	S	Tca	.0	9.85	10- 5-49
-33ba	Frank Werth.....	Dr	154.2	6	GI	Ss,D	Cy,E	D,S	Tca	.4	36.38	8-17-49
-35cd	.....	B	14.0	5	GI	S,Gr,T	Cy,W	S	Tpl	.6	12.87	10- 4-49
15-19-2aa	Alfred Haas.....	Du	17.9	24	R	S,Gr,P	Cy,W	D,S	Tpl	.6	14.74	8-24-49
-4ad	Carl Pfannenstiel...	Dr	291	6	GI	Ss,D	Cy,W	D,S	Tpl	.8	137.78	8-23-49
-5da	"Shorty" Breden.....	Dr	64.7	6	GI	Gr,T	N	N	Tpl	.0	47.23	8-17-49
-6aa	Aug. Leiker.....	Dr	55.4	6	GI	Gr,T	Cy,H	D,O	Tpl	.7	53.82	8-22-49
-7ab	Peter M. Younger....	B	30.7	6	GI	S,T	Cy,W	D,S	Tca	.4	27.57	8-15-49

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
						Ellis County--Continued						
15-19-9cc	U. S. Geol. Survey..	Dr	.....	1¼	GI	Gr,T	N	O	Tca	2.9	35.91	10-24-49
-10ad	Alec Gross.....	Du	29.1	24	R	S,Gr,A	Cy,W	S	Tpl	.5	20.88	8-24-49
-12aa	Walter Urban.....	B	17.0	6	GI	S,Gr,Co	Cy,W	S	Tpl	.8	14.30	8-17-49
-13ab	Pete Wolfe.....	Du	13.0	48	R	S,A	Cy,G	S,O	Tpl	1.0	13.0	8-22-49
-15dd	U. S. Geol. Survey..	Dr	52.0	1¼	GP	S,Gr,T	N	O	Tca	2.6	28.07	10-29-49
-16dc	Mike Unrein.....	B	12.5	6	GI	G,T	N	N	Tca	.0	9.87	8-15-49
-18bd	.....	B	18.8	5	GI	S,Gr,A	Cy,H	S	Tpl	.1	17.06	10- 5-49
-20ab	Tom Bieler.....	B	16.2	6	I	S,Gr,A	N	N	Tpi	.0	8.30	10- 6-49
-27aa	Andrew Gross.....	B	20.7	6	GI	S,Gr,T	Cy,W	S	Tpl	.8	14.94	8-17-49
-27da	Martin Drener.....	Dr	158.0	6	GI	Ss,D	Cy,W	D,S	Tca	1.7	77.04	8- 5-46
-28dd	Fred F. Werth.....	Du	27.1	36	R	S,Gr,T	Cy,W	D,S	Tpl	.6	23.13	10- 6-49
-32cb	Alfred J. Werth.....	Du	33.1	30	R	S,Gr,T	Cy,W	D,S	Tpl	.8	23.21	8-18-49
-32da	J. K. Zimmerman.....	Du	32	...	R	Gr,T	Cy,W	D,S	Tpl	.2	27.79	8-18-49
-35aa	J. Zimmerman.....	Dr	152.5	6	GI	Ss,D	Cy,G	S,O	Tca	.3	63.99	8-22-49
15-20-7aa	Ernest J. King.....	Du	19.5	45	GI	S,Gr,T	Cy,W	D,S	Tpl	.8	17.65	10-29-49
-8ab	Chester Meserve.....	Du	18.3	60	R	S,Gr,A	Cy,W	N	Tpl	.2	11.25	10-10-49
-12aa	U. S. Geol. Survey..	Dr	.....	...	..	S,Gr,T	N	O	Tca	2.0	41.23	10-22-49
-12ad	Alphonse Dechant....	Dn,B	32.9	6	GI	S,Gr,T	Cy,W	D,S	Tpl	.4	31.90	8-23-49
-28bc	.....	Du	7.7	54	R	S,Gr,A	Cy,H	S	Trw	.0	3.78	8-23-49
						Rush County						
16-17-1bb	.....	Du	22.1	36	T	S,Gr,T	Cy,W	D,S	Tpl	.5	20.27	9-28-49
-6bb	.....	Du	23.6	60	R	S,Gr,A	Cy,W	S	Tpl	1.4	19.80	9-30-49
16-18-3bc	.....	B	34.6	6	OW	S,Gr,T	Cy,W	S	Tca	.8	29.94	10- 4-49
-10cb	Wm Legleiter.....	Dr	168.5	5	GI	Ss,D	Cy,W	D,S	Tca	.3	69.62	10- 4-49

See footnotes at end of table.

Table 13.--Record of wells in the Cedar Bluff Unit--Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
				Rush County--Continued								
16-19-2ba	.....	Du	33.3	30	R	S,Gr,T	Cy,W	N	Tpl	1.0	28.15	8-17-49
				Trego County								
14-21-29dc	Geo. Snyder.....	B	28.7	5½	GI	S,Gr,A	Cy,W	S	Tpl	.6	17.36	10-29-49
-30ca	Tony Aschenburner...	Du	30.4	42	C	S,Gr,A	Cy,W	D,S	Tpl	1.2	19.68	10-29-49
-31cd	Dave Yanda.....	Du	13.7	36	R	S,Gr,A	Cy,W	D	Tpl	.5	10.38	10-29-49
-33cc	Jake Augustine.....	Du	11.8	33	C	S,Gr,A	Cy,W	D,S	Tcu	.6	8.48	10-18-49
-34aa	U. S. Geol. Survey..	Dr	.....	1¼	GP	Gr,T	N	O	Tca	4.0	.....	10-22-49
-34ba	J. F. Wanamaker.....	Du	21.8	33	R	S,Gr,A	Cy,W	D,S	Tpl	.9	13.71	10-12-49
-35ca	C. S. Holtzinger....	Du	19.1	60	C	S,Gr,T	Cy,W	D,S	Tpl	.0	17.35	8-15-49
-35cd	.....do.....	B	20.2	6	GI	S,Gr,T	Cy,W	D,S	Tpl	.4	15.44	8-15-49
14-22-26ad	U. S. Bur. Recl.....	Dr	91.7	6	GI	S,Gr,T	J,E	D	Tca	1.0	72.86	10-29-49
36aa	U. S. Geol. Survey..	Dr	.....	1¼	GP	Gr,P	N	O	Tca	1.5	44.15	10-19-49
15-21-5ab	A. B. Engel.....	Du	11.9	18±	C	S,Gr,T	Cy,W	D,S	Tpl	.8	9.80	10-18-49

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

2 B, bored; Dn, driven; Dr, drilled; Du, dug.

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

4 C, concrete; GI, galvanized iron; GP, galvanized pipe; I, Iron; OW, oil well; R, rock; RC, rock, concrete; T, tile.

5 C, clay; Gr, gravel; L, limestone; S, sand; Ss, sandstone.

A, alluvium; Co, colluvium; D, Dakota formation; G, Greenhorn limestone; P, Pleistocene; T, terrace deposits.

6 B, bucket; C, centrifugal; Cy, cylinder; J, jet; N, none; T, turbine.

E, electricity; G, gasoline; H, hand; W, wind.

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

8 Bp, base of pump; Bpl, bottom of platform; Ls, land surface; Tca, top of casing; Tcu, top of curb; Tpb, top of pump base; Tpi, top of pit; Tpl, top of platform; Tps, top of pump supports; Trw, top of rock wall.

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 14; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 15; and the water-level measurements made in 1949 are given in table 16. Hydrographs of five wells are shown in figure 7.

Table 14.--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 water level	Date	Lowest water level	Date
6-8-34cc	2	a 16.65	July 29, 1947	a 18.30	Sept.29, 1947
6-9-27ab	14	22.36	June 24, 1947	31.10	May 11, 1935
-30da	3	26.35	June 29, 1949	29.30	Nov. 29, 1948
7-6-30bc	3	25.70	June 29, 1949	30.32	July 28, 1948
-34cb	3	22.18	June 29, 1949	32.19	Nov. 29, 1948
7-7-7aa	3	28.16	July 29, 1947	30.35	Apr. 21, 1949
-15dc	3	19.47	July 28, 1948	22.90	May 27, 1948
7-8-5cb	3	23.53	June 29, 1949	29.18	Nov. 29, 1948
7-9-2bc	3	27.06	June 29, 1949	32.54	Nov. 29, 1948
7-10-10cc	3	25.25	July 29, 1948	26.84	Oct. 14, 1946
8-6-12dd	3	31.76	Mar. 30, 1948	34.13	Sept.29, 1947

a Well pumping.

Table 15.--Difference between highest and lowest recorded water levels, net change in water level in 1949, 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 water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
6-8-34cc	1.65	+0.20	-0.28
2-9-27ab	8.74	-.18	+3.07
-30da	2.95	+2.03	-.11
7-6-30bc	4.62	-.44	+.95
-34cb	10.01	+4.55	-3.29
7-7-7aa	2.19	+.36	+.18
-15dc	3.43	+.81	-.11
7-8-5cb	5.65	+1.68	-2.46
7-9-2bc	5.48	+2.46	+.22
7-10-10cc	1.59	+.06	+.96
8-6-12dd	2.37	+.02	+.03

Table 16.--Water-level measurements, in feet below land-surface datum, in the Glen Elder Unit, 1949

6-8-34cc.

Date	Water level	Date	Water level	Date	Water level
Apr. 21	17.62	July 30	17.85	Dec. 28	17.80
June 29	17.62	Oct. 26	17.50		

6-9-27ab.

Apr. 21	25.68	July 30	25.28	Dec. 28	26.39
June 29	24.00	Oct. 26	25.25		

6-9-30da.

Apr. 21	28.83	July 30	26.60	Dec. 28	27.27
June 29	26.35	Oct. 26	26.75		

7-6-30bc.

Apr. 21	29.19	July 30	26.48	Dec. 28	27.60
June 29	25.70	Oct. 26	28.76		

7-6-34cb.

June 29	22.18	Oct. 26	27.20	Dec. 28	27.64
Aug. 30	26.50				

7-7-7aa.

Apr. 21	30.35	July 30	28.69	Dec. 28	28.92
June 29	28.63	Oct. 26	28.28		

7-7-15dc.

Apr. 21	21.50	July 30	21.18	Dec. 28	21.47
June 29	20.04	Oct. 26	21.26		

7-8-5cb.

Apr. 21	28.48	July 30	26.55	Dec. 28	27.50
June 29	23.53	Oct. 26	26.63		

Table 16.--Water-level measurements, in feet below land-surface datum, in the Glen Elder Unit, 1949--Continued

7-9-2bc.

Date	Water level	Date	Water level	Date	Water level
Apr. 21	31.22	July 30	28.82	Oct. 26	28.13
June 29	27.06				

7-10-10cc.

Apr. 21	25.57	July 30	25.90	Dec. 28	25.88
June 29	25.28	Oct. 26	25.60		

8-6-12dd.

Apr. 21	31.88	Aug. 30	31.85	Dec. 28	31.87
June 29	31.87	Oct. 26	31.85		

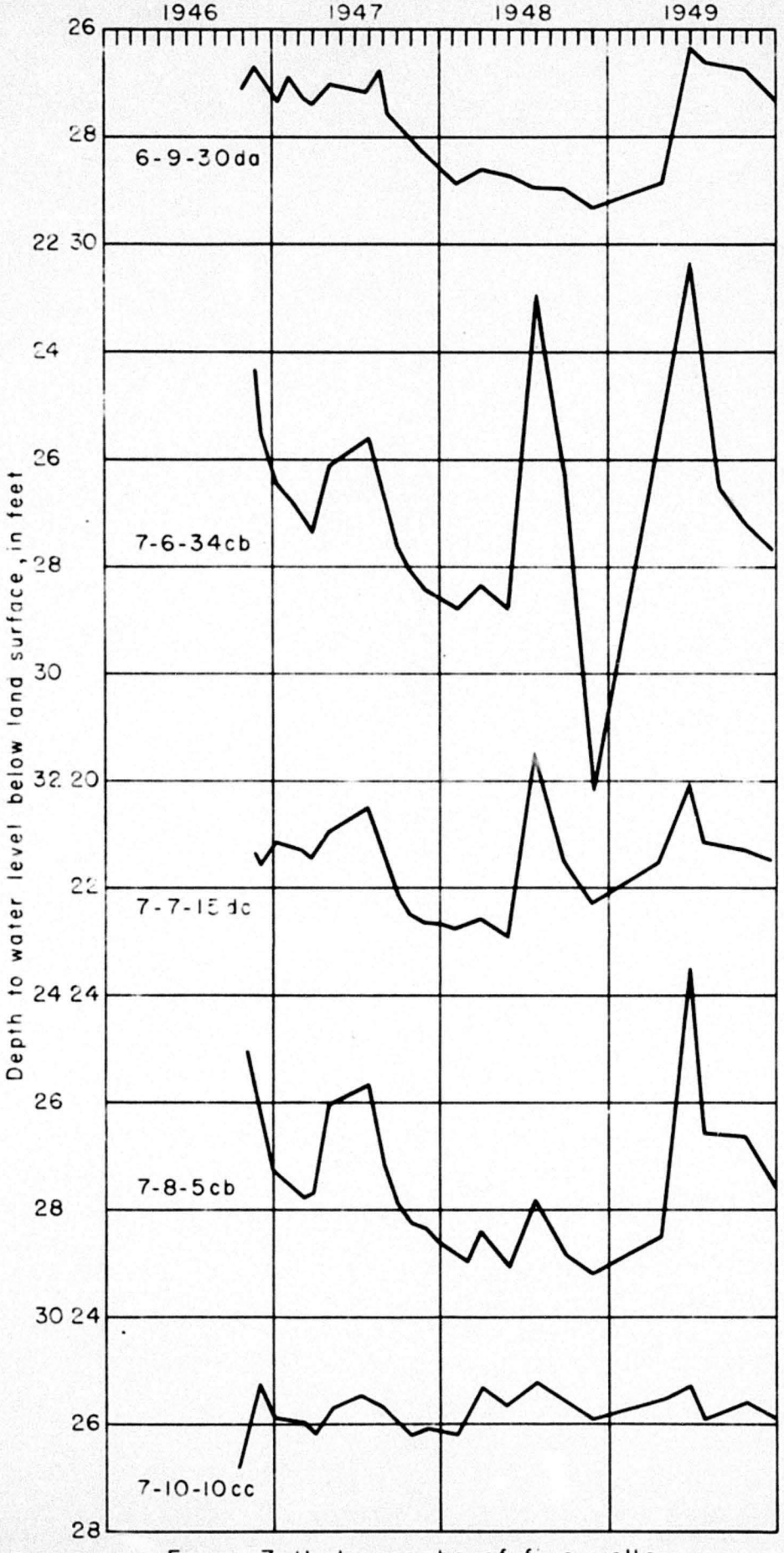

Figure 7.-Hydrographs of five wells, Glen Elder Unit

An observation-well program was begun in the Kanopolis Unit in the spring of 1946. Periodic measurements of the water levels in the 15 drive-point observation wells were continued through 1949. The highest and lowest water levels for the period of record are given in table 17; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 18; and the water-level measurements made in 1949 are given in table 19. Hydrographs of five wells are shown in figure 8.

Table 17.--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 water level	Date	Lowest water level	Date
15-2-17cd	4	21.41	July 1, 1949	25.44	Jan. 6, 1948
-18cd	4	22.12	July 1, 1949	25.50	Jan. 6, 1948
-30dc	4	19.06	July 1, 1949	22.42	Sept. 5, 1946
15-3-24dd	4	17.49	Aug. 6, 1948	20.64	Jan. 6, 1948
-36ab	4	23.54	Aug. 6, 1948	27.35	Jan. 6, 1948
16-2-7bb	4	18.30	Aug. 6, 1948	22.08	Aug. 1, 1946
-18cc	4	22.28	July 1, 1949	26.52	Dec. 1, 1947; Jan. 6, 1948
-19ab	4	19.94	July 1, 1949	24.67	Dec. 1, 1947
16-3-13cd	4	20.70	Apr. 1, 1946	24.38	Jan. 6, 1948
-26dc	4	18.04	July 1, 1949	21.60	Jan. 6, 1948
-34dd	4	19.76	July 1, 1949	23.15	Jan. 6, 1948
17-3-17dd	3.5	24.98	July 1, 1949	28.18	Dec. 1, 1947
-18dd	3.5	25.08	July 1, 1949	28.40	Jan. 6, 1948
-30dd	3.5	28.49	July 1, 1949	31.36	Jan. 6, 1948
17-4-25dd	3.5	23.43	Aug. 22, 1949	25.80	Jan. 6, 1948

Table 18.--Difference between highest and lowest recorded water levels, net change in water levels in 1949, and net change in water levels for period of record, in feet, in 15 wells in the Kanopolis Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline for period of record
15-2-17cd	4.03	+0.49	-0.22
-18cd	3.38	+.66	+.11
-30dc	3.36	+.03	+.33
15-3-24dd	3.15	-.78	-.99
-36ab	3.81	-.97	-1.07
16-2-7bb	3.78	.00	+.58
-18cc	4.24	+.38	+1.40
-19ab	4.73	+1.73	+1.69
16-3-13cd	3.68	+.07	-2.29
-26dc	3.56	+.80	+.66
-34dd	3.39	+.62	+1.09
17-3-17dd	3.20	+1.31	+.79
-18dd	3.32	+.95	+.99
-30dd	2.87	+1.34	+.95
17-4-25dd	2.37	+.88	+.21

Table 19.--Water-level measurements, in feet below land-surface datum, in the Kanopolis Unit, 1949

15-2-17cd.

Date	Water level	Date	Water level	Date	Water level
Apr. 27	22.15	Aug. 22	22.42	Dec. 22	23.49
July 1	21.41	Oct. 24	23.12		

15-2-18cd.

Apr. 27	23.20	Aug. 22	24.29	Dec. 22	24.01
July 1	22.12	Oct. 24	23.98		

15-2-30dc.

Apr. 27	19.72	Aug. 22	20.11	Dec. 22	21.05
July 1	19.06	Oct. 24	20.95		

15-3-24dd.

Apr. 27	17.72	Aug. 22	18.88	Dec. 22	19.89
July 1	18.22	Oct. 24	19.63		

Table 19.--Water-level measurements, in feet below land-surface datum, in the Kanopolis Unit, 1949--Continued

15-3-36ab.

Date	Water level	Date	Water level	Date	Water level
Apr. 27	24.22	Aug. 22	25.49	Dec. 22	26.37
July 1	24.58	Oct. 24	26.07		

16-2-7bb.

Apr. 27	18.60	Aug. 22	18.96	Dec. 22	19.72
July 1	18.38	Oct. 24	19.60		

16-2-18cc.

Apr. 27	24.27	Aug. 22	24.55	Dec. 22	24.40
July 1	22.28	Oct. 24	24.63		

16-2-19ab.

Apr. 27	22.24	Aug. 22	22.48	Dec. 22	22.21
July 1	19.94	Oct. 24	22.54		

16-3-13cd.

Apr. 27	21.84	Aug. 22	21.92	Dec. 22	22.99
July 1	21.67	Oct. 24	22.63		

16-3-26dc.

Apr. 27	19.06	Aug. 22	19.11	Dec. 22	19.94
July 1	18.04	Oct. 24	19.74		

16-3-34dd.

Apr. 27	20.40	Aug. 22	20.31	Dec. 22	21.47
July 1	19.76	Oct. 24	21.22		

17-3-17dd.

Apr. 27	25.88	Aug. 22	26.10	Dec. 22	26.17
July 1	24.98	Oct. 24	26.33		

Table 19.--Water-level measurements, in feet below land-surface datum, in the Kanopolis Unit, 1949--Continued

17-3-18dd.

Date	Water level	Date	Water level	Date	Water level
Apr. 27	26.02	Aug. 22	25.93	Dec. 22	26.45
July 1	25.08	Oct. 24	26.34		

17-3-30dd.

Apr. 27	29.39	Aug. 22	29.08	Dec. 22	29.58
July 1	28.49	Oct. 24	29.54		

17-4-25dd.

Apr. 27	24.02	Aug. 22	23.43	Dec. 22	24.09
July 1	23.46	Oct. 24	23.84		

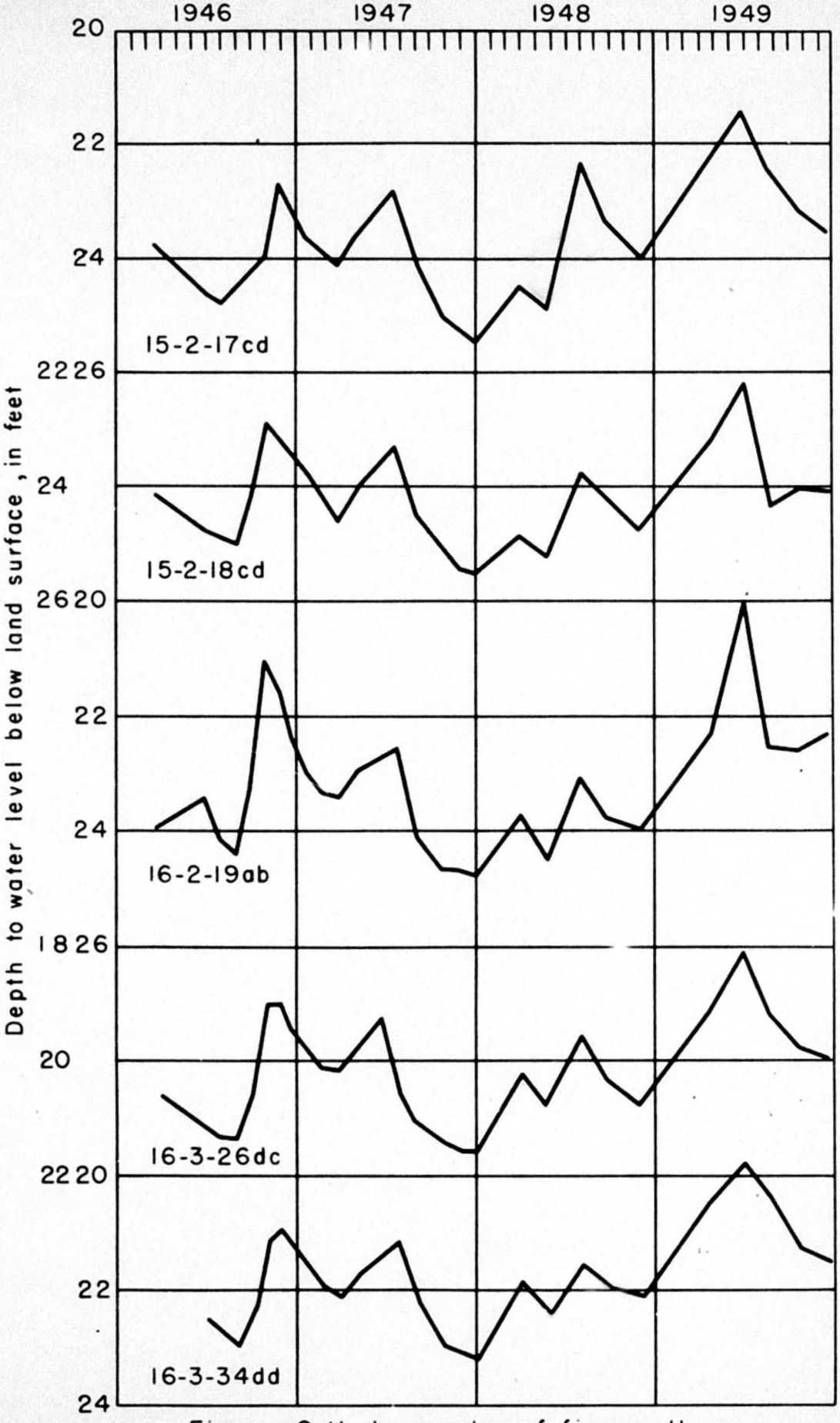

Figure 8.-Hydrographs of five wells, Kanopolis Unit

The depth to water has been measured periodically since 1945 in 21 wells in the Kirwin Unit. The highest and lowest water levels for the period of record are given in table 20; the difference between the highest and lowest water levels, the net rise or decline in the water level in 1949, and the net rise or decline for the period of record are given in table 21; and the water-level measurements made in 1949 are given in table 22. The chemical composition of 18 water samples are given in table 23 and the logs of test holes are given in table 24. Hydrographs of five wells are shown in figure 9.

Table 20.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 21 wells in the Kirwin Unit[1]

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
4-14-34bc	4	42.15	Nov. 21, 1945	43.05	Sept.25, 1946
4-15-31bb	4	34.92	July 30, 1947	36.26	Nov. 30, 1948
-35bc	4	33.18	Sept. 1, 1949	37.99	June 12, 1946
4-17-31bc	4	50.40	July 8, 1949	52.72	Oct. 6, 1948
4-18-30ab	4	9.43	July 8, 1949	20.29	Sept.25, 1946
4-19-21dd	4	8.80	July 8, 1949	15.10	Sept.25, 1946
-35ab	4	12.17	Aug. 29, 1947	14.17	Nov. 30, 1948
4-20-21cc	4	48.46	Mar. 31, 1948	48.92	Feb. 6, 1946
5-13-4dc	4	19.68	Dec. 29, 1949	35.28	Dec. 17, 1945
-25cc	4	43.05	Oct. 27, 1949	46.53	Jan. 28, 1946
-33ba	4	23.25	July 8, 1949	30.46	Jan. 2, 1948
5-14-3bc	4	34.80	Mar. 26, 1947	40.50	Oct. 27, 1947
5-15-2dc	4	31.55	Sept. 1, 1949	33.84	Aug. 28, 1947
5-16-3aa	4	37.75	July 8, 1949	44.76	Dec. 17, 1945
5-17-1aa	4	.73	Mar. 31, 1948	7.60	Nov. 21, 1945
-3cd	4	1.18	May 6, 1947	27.00	June 12, 1946
-12aa	4	51.49	Dec. 29, 1949	54.20	Sept.30, 1947
6-11-34aa	4	34.67	Aug. 18, 1947	37.07	June 11, 1946
6-12-20bb	4	36.30	Nov. 26, 1945	43.06	Jan. 28, 1946
-23cd	4	24.37	July 8, 1949	27.17	Apr. 26, 1946
6-13-12ba	4	37.85	Mar. 31, 1948	40.95	Dec. 15, 1947

1 Measurement of water level in wells 6-11-36aa and 6-12-24aa discontinued; no measurement of water level in well 4-17-25cd made in 1949.

Table 21.--Difference between highest and lowest recorded water levels, net change in water levels in 1949, and net change in water levels for period of record, in feet, in 21 wells in the Kirwin Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
4-14-34bc	0.90	+0.46	-0.19
4-15-31bb	1.34	+.84	+.48
-35bc	4.81	+2.75	+.37
4-17-31bc	2.32	+1.44	+.11
4-18-30ab	10.86	+5.72	+7.60
4-19-21dd	6.30	+2.72	+1.49
-35ab	2.00	+.83	-.68
4-20-21cc	.46	+.04	+.39
5-13-4dc	15.60	+7.37	+15.42
-25cc	3.48	+1.05	+2.23
-33ba	7.21	+1.98	-.92
5-14-3bc	5.70	+3.04	+.61
5-15-2dc	2.29	+1.84	+1.15
5-16-3aa	7.01	+3.85	+3.29
5-17-1aa	6.87	+3.37	+3.57
-3cd	25.82	+5.98	+5.56
-12aa	2.71	+.71	+1.40
6-11-34aa	2.40	+.31	+.71
6-12-20bb	6.76	+2.25	-2.00
-23cd	2.80	+.91	+1.92
6-13-12ba	3.10	+1.54	+2.40

Table 22.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1949

4-14-34bc.

Date	Water level	Date	Water level	Date	Water level
Feb. 21	42.95	July 8	42.69	Oct. 27	42.16
Apr. 25	42.83	Sept. 1	42.61	Dec. 29	42.34

4-15-31bb.

Feb. 21	36.18	July 8	35.30	Oct. 27	35.30
Apr. 25	35.96	Sept. 1	35.26	Dec. 29	35.42

4-15-35bc.

Feb. 21	37.69	July 8	34.28	Oct. 27	34.92
Apr. 25	35.57	Sept. 1	33.18	Dec. 29	35.23

Table 22.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1949--Continued

4-17-31bc.

Date	Water level	Date	Water level	Date	Water level
Apr. 25	51.40	Sept. 1	51.40	Dec. 29	51.28
July 8	50.40	Oct. 27	51.43		

4-18-30ab.

Apr. 25	14.54	Sept. 1	10.38	Dec. 29	11.70
July 8	9.43	Oct. 27	10.94		

4-19-21dd.

Apr. 25	13.55	Sept. 1	9.45	Dec. 29	9.39
July 8	8.80	Oct. 27	9.63		

4-19-35ab.

July 8	13.63	Oct. 27	13.09	Dec. 29	13.34
Sept. 1	13.15				

4-20-21cc.

Apr. 25	48.53	Sept. 1	48.60	Dec. 29	48.53
July 8	48.60	Oct. 27	48.60		

5-13-4dc.

Feb. 21	27.15	July 8	20.18	Oct. 27	21.10
Apr. 25	22.69	Sept. 1	21.03	Dec. 29	19.68

5-13-25cc.

Feb. 21	44.15	July 8	43.43	Oct. 27	43.05
Apr. 25	43.80	Sept. 1	43.17	Dec. 29	43.07

5-13-33ba.

Apr. 25	28.00	Sept. 1	24.39	Dec. 29	27.72
July 8	23.25	Oct. 27	24.57		

Table 22.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1949--Continued

5-14-3bc.

Date	Water level	Date	Water level	Date	Water level
Feb. 21	37.17	July 8	35.80	Oct. 27	37.22
Apr. 25	36.71	Sept. 1	36.95	Dec. 29	35.00

5-15-2dc.

Apr. 25	33.78	Sept. 1	31.55	Dec. 29	32.00
July 8	32.16	Oct. 27	31.63		

5-16-3aa.

Apr. 25	41.59	Sept. 1	39.68	Dec. 29	40.75
July 8	37.75	Oct. 27	40.42		

5-17-1aa.

Apr. 25	4.57	Sept. 1	1.57	Dec. 29	4.03
July 8	1.94	Oct. 27	2.88		

5-17-3cd.

Apr. 25	5.08	Sept. 1	5.95	Dec. 29	6.18
July 8	1.94	Oct. 27	5.94		

5-17-12aa.

Apr. 25	51.83	Sept. 1	51.79	Dec. 29	51.49
July 8	52.09	Oct. 27	51.55		

Table 22.--Water-level measurements, in feet below land-surface datum, in the Kirwin Unit, 1949--Continued

6-11-34aa.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Jan. 2	36.43	Apr. 7	36.40	July 2	35.86	Oct. 2	35.21
10	36.58	14	36.43	10	35.71	11	35.24
17	36.55	22	36.42	17	35.57	18	35.17
25	36.62	28	36.46	25	35.49	26	35.15
Feb. 2	36.58	May 5	36.45	Aug. 2	35.37	Nov. 3	35.12
10	36.64	13	36.48	9	35.31	10	35.09
18	36.59	20	36.50	18	35.26	17	35.15
25	36.60	27	36.45	27	35.23	25	35.16
Mar. 8	36.51	June 3	36.49	Sept. 5	35.20	Dec. 2	35.16
16	36.46	11	36.32	12	35.19	9	35.12
24	36.39	17	36.16	19	35.19	16	35.16
Apr. 1	36.45	25	36.00	26	35.17	23	35.27

6-12-20bb.

Date	Water level	Date	Water level	Date	Water level
Feb. 21	40.15	July 8	37.60	Oct. 27	38.05
Apr. 25	40.17	Sept. 1	38.15	Dec. 29	38.30

6-12-23cd.

Feb. 21	25.71	July 8	24.37	Oct. 27	24.65
Apr. 25	25.67	Sept. 1	24.82	Dec. 29	24.92

6-13-12ba.

Apr. 25	39.07	Sept. 1	38.64	Dec. 27	38.10
July 8	38.49	Oct. 27	38.38		

Table 23.--Mineral constituents, in parts per million, and related physical measurements of ground waters, Kirwin Unit

[Analyses by U. S. Geological Survey, Lincoln, Nebr.]

Location of well	Date of collection March 1947	Depth from land surface (in feet): Well	Depth from land surface (in feet): To water surface	Temperature (°F.)	pH	Specific conductance (micromhos @ 25°C.)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) + Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$: Total	Hardness as $CaCO_3$: Noncarbonate	Percent sodium
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Alluvium																				
4-19-35ab	17	33.5	12.66	60	7.5	1,010	0.05	144	20	35	313	198	38	0.4	0.6	0.00	653	442	185	15
5-15-2bc	18	22.8	15.96	58	8.7	766	.00	121	16	35	325	131	16	.2	25	.06	553	368	101	15
Terrace deposits																				
4-20-32db	17	38.5	30.22	58	7.5	833	.05	100	21	43	332	134	7.0	.2	8.0	.10	530	336	64	22
4-18-30cc	17	33.6	24.46	57	7.6	1,240	.05	212	24	33	362	359	18	.2	5.0	.02	906	628	331	10
4-18-25ab	17	42.0	26.27	58	7.4	620	.05	83	13	31	332	42	7.5	.4	.0	.02	385	261	0	20
4-16-20da	17	55.7	46.88	59	7.6	1,050	.05	104	31	76	422	166	22	.4	4.0	.08	671	387	41	30
4-14-29cc	18	37.1	29.77	60	7.5	1,210	.00	201	29	43	597	107	37	.1	75	.09	895	621	131	13
4-14-34bc	18	46.2	42.15	57	7.9	1,470	.00	213	21	83	311	50	119	.3	400	.00	1,040	618	363	23
4-14-36bd	18	30.3	26.39	58	8.1	787	.00	106	18	52	a 333	132	25	.2	6.5	.06	551	338	65	25
5-13-4dc	18	42.6	35.10	60	7.5	1,490	.00	235	28	91	520	233	78	.2	150	.00	1,080	702	276	22
6-13-12ba	18	47.7	40.50	59	7.6	787	.00	112	14	52	373	86	34	.9	5.0	.11	526	337	31	25
6-12-23aa	18	43.9	32.75	60	7.7	988	b 25	139	23	66	571	33	57	.0	2.0	.00	621	441	0	24

a Includes equivalent of 8 parts per million of carbonate (CO_3)

b Total iron--other analyses are for iron in solution at time of analyses.

Table 23.--Mineral constituents, in parts per million, and related physical measurements of ground waters, Kirwin Unit--Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
							Sanborn formation, Crete member													
4-20-26cc	17	51.4	47.32	58	7.8	581	0.05	94	12	5.0	310	20	1.5	0.3	10	0.02	351	284	30	4
4-16-30cc	17	80.9	71.54	60	7.4	791	.05	113	10	21	329	67	14	.3	10	.02	460	323	53	12
5-13-23dd	18	77.1	65.03	61	7.6	988	.00	166	19	34	379	144	17	.3	100	.10	706	492	181	13
6-11-24ad	18	38.3	35.35	60	7.6	1,370	.00	184	24	89	378	173	113	.2	125	.00	917	558	248	26
6-10-20aa	18	36.1	32.80	59	7.7	702	.00	122	10	12	313	19	41	.1	45	.06	485	346	89	7
							Niobrara formation													
5-16-3bc	17	110.7	64.96	59	7.7	1,210	.05	63	29	154	464	140	57	1.4	.3	.44	697	276	0	55

Logs of Test Holes

Logs of 55 test holes drilled in the North Solomon Valley by the State Geological Survey during May 1946 are given in table 24. The logs were prepared by James B. Cooper from field studies of the well cuttings. Also included are logs of 11 test holes drilled by the Bureau of Reclamation along the axis of the proposed dam at Kirwin; these logs were prepared by geologists of the Bureau of Reclamation from studies of drive samples and cores. A large number of additional test holes were drilled in the same locality by the Bureau of Reclamation and the Corps of Engineers, United States Army.

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit[1]

Mitchell County

6-10-5cd. Drilled 6 feet north of center of road and 0.3 mile east of road intersection. Surface altitude, 1,541.1 feet.

	Thickness (feet)	Depth (feet)
Soil, dark-gray loose silt.....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, brown.....	9	12
Silt, compact, light gray-tan; contains small amount sand and limestone gravel, fine to pebble size.....	25	37
Sand, very fine to coarse sand, fine to very coarse gravel, with limestone pebbles up to 1 inch.....	12	49
Silt, medium compact, gray.....	7	56
Sand, very fine to coarse, and much fine to very coarse gravel, with limestone pebbles up to 1 inch.....	3	59
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, medium hard, silty, black.....	1	60

1 All test holes drilled by State Geological Survey of Kansas unless otherwise indicated.

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Cont.

Mitchell County--Continued

6-10-8cc. Drilled 10 feet east of center of road and 0.21 mile north of road intersection. Surface altitude, 1,508.1 feet.

	Thickness (feet)	Depth (feet)
Soil, dark-brown, loose silt.....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, light-gray.....	2	4
Silt, fairly compact, brown.....	13	17
Silt, compact, yellow-tan to gray.....	4	21
Silt, soft, light-tan; contains small amount of very fine to fine sand.....	6	27
Silt, light-tan, and much very fine to fine sand, with small amount medium to coarse...	3	30
Sand, very fine to coarse and much fine to coarse gravel; contains many limestone and shale pebbles up to ½ inch, and a little gray silt.....	7.5	37.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, medium hard, calcareous, black.....	2.5	40

6-10-17bc. Drilled 7 feet east of center of road and 36 feet north of ½-mile line fence. Surface altitude, 1,473.9 feet.

Soil, black and gray loose silt.....	5	5
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, gray to tan.....	13	18
Silt, soft, light green-gray and dark-gray; contains very fine to fine sand.....	12	30
Sand, very fine to coarse, and fine to very coarse limestone gravel, with shale pebbles up to ½ inch; contains small amount gray-green silt.....	6.5	36.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, fairly hard, calcareous, black and gray.....	3.5	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Cont.

Mitchell County--Continued

6-10-20bb. Drilled 10 feet east of center of road and 0.15 mile south of road intersection. Surface altitude, 1,469.9 feet.

	Thickness (feet)	Depth (feet)
Soil, dark gray-black silt.....	2	2
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium soft, tan and light-gray.....	3	5
Silt, compact, plastic, dark-gray.....	4	9
Silt, soft, light gray-tan.....	9	18
Silt, gray, and much very fine to fine sand, with small amount fine limestone gravel.....	11	29
Silt, soft, dark gray-blue.....	7.5	36.5
Sand, fine to coarse and fine to coarse limestone gravel.....	2.5	39
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, medium hard, calcareous, black.....	1	40

6-10-20cc. Drilled 10 feet east of center of road and 0.21 mile north of intersection of road with U. S. Highway 24. Surface altitude, 1,464.7 feet.

Soil, silt, dark-gray to black.....	3	3
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, brown and gray.....	16	19
Silt, soft, tan, and very fine to fine sand....	8	27
Sand, very fine to medium, with small amount coarse; contains very small amount fine limestone gravel.....	6	33
Sand, very fine to coarse sand, and a little fine to very coarse gravel, mostly limestone pebbles up to $\frac{1}{2}$ inch.....	6	39
CRETACEOUS--Gulfian		
Greenhorn limestone		
Limestone, very hard, light-gray.....	.3	39.3
Shale, hard, fissile, calcareous, black.....	.7	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con't.

Mitchell County--Continued

6-10-29ba. Drilled 12 feet west of center of ½-mile road and 0.09 mile south of intersection of road with U. S. Highway 24. Surface altitude, 1,464.2 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, silty to plastic, gray...	6	6
Silt, light-gray to tan; contains small amount of very fine sand.....	9	15
Silt, dark-tan to tan; contains very fine sand.	3	18
Sand, very fine to fine and tan silt.....	5	23
Sand, very fine to coarse, and fine gravel, with few limestone pebbles up to ½ inch.....	9	32
Sand, very fine to coarse, and much fine to very coarse gravel, with many limestone pebbles up to 1 inch, and small amount white to yellow clay.....	22	54
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, fissile, medium hard, silty, gray, and gray-blue, soft silty shale; contains many fragments of light-blue, soft bentonite.....	4	58

6-10-29ca. Drilled 11 feet west of center of ½-mile road on south side of ½-mile fence. Surface altitude, 1,462.8 feet.

Soil, black and dark-gray compact silt.....	3	3
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, gray to brown, with occasional coarse sand grain.....	8	11
Silt, tan; contains very small amount of fine to coarse sand.....	7	18
Silt, dark-brown, blocky.....	7	25
Silt, light-gray with a little yellow iron-stain; contains some sand, very fine, and few small snail shells.....	2	27
Sand, very fine to fine, with very small amount of medium and coarse; and small amount of fine to medium limestone gravel.....	3	30
Sand, very fine to coarse and fine to coarse gravel, with pebbles of limestone up to 1 inch	6	36
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, fissile, hard, dark gray-black, and soft calcareous shale.....	4	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Mitchell County--Continued

6-10-29cc. Drilled 12 feet north of center of road and 0.2 mile east of road intersection. Surface altitude, 1,467.1 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, brown and tan; contains a few small snail shells	10	10
Silt, soft, gray to brown; contains very fine sand	21	31
Silt, gray, with small amount of sand, gray	9	40
Silt, soft, light-gray; contains small amount of very fine to fine sand and few small snail shells	3	43
Sand, very fine to fine, with small amount medium to coarse	7	50
Sand, very fine to coarse; contains a small amount of fine to medium gravel, and limestone pebbles up to ½ inch; contains shale fragments	2.5	52.5
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, hard fissile, gray-black; contains hard gypsum (?)	2.5	55

6-10-31ad. Drilled 10 feet west of center of road and 200 feet south of approach to Solomon River bridge. Surface altitude, 1,450.4 feet.

QUATERNARY--Recent		
Alluvium		
Silt, soft, dark-brown; contains very fine sand	5	5
Silt, soft, gray and brown; contains small amount very fine sand, and small snail shells	11	16
Sand, very fine to fine, with very small amount of medium to coarse sand and fine gravel; contains a little gray silt	5	21
Sand and gravel, fine to coarse, poorly sorted; contains limestone and shale pebbles up to 1 inch, and a small amount of gray clay	8	29
Silt, soft, gray-blue; contains very fine to fine sand, and many small snail and clam shells	3	32
Sand, very fine to medium; contains small amount coarse sand, fine to medium gravel, and a few limestone pebbles	7	39
CRETACEOUS--Gulfian		
Greenhorn limestone		
Shale, hard, dark gray-black, some soft and silty	1	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Mitchell County--Continued

6-10-31dd. Drilled 11 feet west of center of road and 0.2 mile north of road intersection. Surface altitude, 1,485.1 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Recent		
Soil and slope deposits		
Silt, dark-brown; contains small amount of very fine sand.....	2	2
Silt, medium compact, tan and brown.....	3	5
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, clay-shale, gray-yellow, with few fragments of weathered Ostrea shells.....	2	7
Shale, clay-shale, light-gray to tan; contains fragments of gray, medium-soft limestone.....	1	8
Shale, clay-shale, light-gray; contains few shell and chalk fragments.....	2	10

7-10-6aa. Drilled 10 feet west of center of road and 0.15 mile south of road intersection. Surface altitude, 1,499.5 feet.

QUATERNARY--Recent		
Soil and slope deposits		
Silt, soft, dark-brown to black.....	3	3
Silt, medium compact, plastic, gray and tan....	2	5
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, light-gray, tan and reddish soft plastic; contains a few fragments of Ostrea shells....	5	10

7-10-6da. Drilled 13 feet west of center of road and 0.35 mile north of road intersection. Surface altitude, 1,493.2 feet.

QUATERNARY--Recent		
Soil and slope deposits		
Silt, soft, dark-brown.....	1	1
Silt, medium compact, tan and gray.....	4	5
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Clay-shale, soft, silty, tan; contains weathered shell fragments.....	1	6
Clay-shale, tan and light-gray; contains many shell fragments.....	1	7
Clay-shale, soft, chalky, light-gray; many fragments of red consolidated shale.....	3	10

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Osborne County

6-12-12cc. Drilled 12 feet north of center of road and 0.25 mile east of road intersection. Surface altitude, 1,552.3 feet.

	Thickness (feet)	Depth (feet)
Soil, compact, silt, dark-gray.....	3	3
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, light-gray; contains small amount of limestone gravel.....	5	8
Silt and gravel, tan silt, and chalk gravel, fine to ½-inch pebbles, yellow-white.....	7	15
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, light to dark-gray, some tan to yellow, much iron-stain.....	5	20

6-12-13bc. Drilled 7 feet east of center of road and 0.5 mile north of road intersection. Surface altitude, 1,512.9 feet.

Soil, loose dark silt.....	4	4
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, compact, plastic, dark-gray.....	4	8
Silt, medium compact, light gray to tan.....	4	12
Silt, very loose, tan and gray.....	6	18
Silt, medium compact, light-gray.....	11	29
Sand, very fine to coarse; contains small amount fine quartz gravel and few limestone gravels and pebbles.....	11	40
Sand and gravel, very fine to medium sand, and gravel, fine to medium, with a little coarse; contains much silt and clay, yellow to red and brown, and few limestone pebbles up to ½ inch.....	8	48
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, dark gray-black.....	2	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Osborne County--Continued

6-12-24bb. Drilled 20 feet east of center of trail road and 0.1 mile south of road intersection. Surface altitude, 1,505.0 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, loose, brown	13	13
Silt, dark-gray, compact	5	18
Silt, tan and gray; contains much loose sand very fine to fine	12	30
Sand, very fine to fine, with small amount coarse; contains small amount fine gravel, fine to very coarse limestone gravel, and very small amount of clay, green and gray	14	44
Silt, soft, dark-gray; contains much very fine to fine sand, and small amount fine to coarse limestone gravel	6	50
Sand, very fine to medium, greenish, with small amount coarse sand to fine gravel; contains small amount dark gray-green clay and silt	9	59
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, dark gray-black, silty to plastic, calcareous	11	70

6-12-24bc. Drilled 42 feet east of center of trail road and 0.4 mile south of road intersection. Surface altitude, 1,505.5 feet.

QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, brown to gray; contains small snail shells	14	14
Silt, medium compact, gray; contains very small amount of coarse sand	6	20
Silt, interbedded, soft, brown and gray; contains small snail shells	17	37
Sand, very fine to medium, very well-sorted, greenish	13	50
Sand, very fine to medium, greenish; small amount coarse sand and fine gravel; very small amount gray shale	10	60
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, calcareous, dark gray-black	5	65

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Cont.

Osborne County--Continued

6-12-24cc. Drilled 5 feet east of center of road and 0.2 mile north of intersection of road with U. S. Highway 24. Surface altitude, 1,504.0 feet.

	Thickness (feet)	Depth (feet)
Soil, soft gray-brown silt.....	3	3
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, compact, interbedded, brown and gray.....	10	13
Silt, fairly soft, grayish-tan; contains a few small snail shells.....	12	25
Silt, soft, grayish-tan; contains very fine sand and small snail shells.....	9	34
Silt, soft, gray; contains small amount of very fine sand.....	7	41
Silt, compact, plastic, dark-gray, and green soft silt; contains very fine sand and few small snail shells.....	12	53
Sand, very fine to coarse, greenish, and small amount of fine gravel; contains very small amount of fine to coarse limestone gravel and green silt, with gray shale fragments.....	7	60
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, plastic to silty, calcareous, black.....	5	65

6-12-26aa. Drilled 8 feet west of center of road 0.05 mile south of intersection of road with U. S. Highway 24. Surface altitude, 1,501.8 feet.

Soil, dark-brown soft silt.....	4	4
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, gray.....	5	9
Silt, medium compact, tan.....	5	14
Silt, medium compact, yellow-tan; contains very fine sand.....	12	26
Sand, very fine to coarse sand and silt with small amount of gravel, and tan, mixed silt..	4	30
Sand, very fine to medium, with a little coarse sand; contains very small amount fine to medium gravel, and few fine to coarse limestone gravels.....	10	40
Sand, very fine to coarse; contains fine to coarse gravels, limestone gravels, and shale fragments.....	5	45
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, plastic to silty, calcareous, black.....	5	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con't

Osborne County--Continued

6-12-26ad. Drilled 8 feet west of center of road, 180 feet north of ½-mile fence. Surface altitude, 1,509.2 feet.

	Thickness (feet)	Depth (feet)
Soil, brown soft silt.....	4	4
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, gray and tan.....	12	16
Silt, medium compact, light-gray; contains very fine sand and brown iron-stain.....	9	25
Silt, much iron-stain, gray and tan; contains some very fine to fine sand.....	3	28
Sand, very fine to medium, with small amount coarse; much iron-stain.....	2	30
Sand, very fine to fine, small amount medium to coarse.....	14	44
Sand, very fine to coarse, and fine gravel, with small amount medium gravel and fine to pebble-size limestone gravels.....	8	52
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, plastic to silty, calcareous, black.....	8	60

6-12-36bb. Drilled 6 feet south of center of road and 350 feet west of ¼-mile fence. Surface altitude, 1,545.7 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, brownish-tan; contains much gravel and limestone pebbles.....	8	8
Silt, compact, clayey, gray-tan; contains a few limestone pebbles.....	18	26
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, clayey, few iron-stains, light gray.....	6	32
Shale, clayey, dark-gray.....	8	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Osborne County--Continued

6-13-2cb. Drilled 10 feet east of center of section line road and 0.4 mile north of road intersection. Surface altitude, 1,565.0 feet.

	Thickness (feet)	Depth (feet)
Soil, dark-brown, loose silt.....	5	5
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, dark-gray.....	3	8
Silt, fairly soft, gray-tan.....	4	12
Silt, soft, light-tan; contains much very fine sand, and small snail shells.....	4	16
Silt, soft, tan; contains much sand, very fine to fine, and inclusions of rusty-brown sand and silt.....	4	20
Gravel, chalky, white; assorted, from fine sand to ½-inch pebbles (worn); also contains small amount of sandy silt, gray, and fine quartz sand.....	7	27
Silt, soft, gray-tan; contains fine sand and fine to coarse chalk gravel.....	3	30
Sand, quartz, very fine to fine; contains worn chalk pebbles.....	5	35
Silt, fairly soft, plastic, dark blue-gray, partly tan.....	4	39
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, dark blue-gray; contains fragments of red-brown, rotten (lignite?) wood...	6	45

6-13-3aa. Drilled at edge of field near east line of section and 0.3 mile north of intersection of ½-section road with section line road. Surface altitude, 1,555.1 feet.

QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, loose, brown; contains scattered small chalk pebbles.....	16	16
Silt, tan and light gray-white; contains fine sand.....	3	19
Sand, very fine to medium; contains small amount of coarse sand and few limestone gravels, fine to medium.....	11	30
Sand, very fine to coarse, with few pebbles of limestone up to ½ inch.....	6	36
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic to silty, blue-gray.....	4	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Osborne County--Continued

6-13-10aa. Drilled 20 feet south of center of road intersection. Surface altitude, 1,568.0 feet.

	Thickness (feet)	Depth (feet)
Soil, loose, dark-brown silt.....	3	3
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, gray-tan.....	8	11
Silt, soft, gray.....	5	16
Silt, soft, gray; contains many small snail shells, and small amount fine sand.....	5	21
Silt, soft, gray; contains much sand, very fine to fine, and fragments of shale and limestone	8	29
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, clay-shale, dark-gray.....	6	35

6-13-10dd. Drilled 9 feet west and 30 feet north of center of cross-roads. Surface altitude, 1,643.0 feet.

Soil, soft tan silt.....	5	5
QUATERNARY--Pleistocene		
Terrace (?) deposits		
Silt, loose soft, dark-tan.....	4	9
Silt, soft, tan; contains fragments and pebbles of limestone.....	12	21
Silt, soft, tan; probably contains small amount of limestone gravel.....	8	29
Silt, gray; contains much gravel and limestone pebbles.....	5	34
Gravel, limestone fragments and pebbles; contains small amount tan silt.....	4	38
Silt, tan; contains much gravel and pebbles of limestone.....	2	40
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, light blue-gray to dark-gray, small amount yellow-brown; contains much iron-stained shale and selenite.....	10	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Osborne County--Continued

6-13-11bc. Drilled 12 feet east of center of road and 0.5 mile north of road intersection. Surface altitude, 1,583.5 feet.

	Thickness (feet)	Depth (feet)
Soil, soft tan silt	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, black	3	5
Silt, medium compact, gray to gray-tan	7	12
Silt, fairly soft, brown	8	20
Silt, soft, dark-gray	4	24
Silt, light gray-green; contains very fine sand.	5	29
Gravel, limestone gravels, assorted sizes from fine sand to 1-inch pebbles; gravel is white and iron-stained; contains a small amount of silt	7.5	36.5
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, dark-gray	3.5	40

6-13-13cc. Drilled 5 feet east of center of road, 0.2 mile north of road intersection. Surface altitude, 1,507.1 feet.

Soil, dark compact silt	5	5
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, medium compact, light-gray to gray	11	16
Silt, fairly loose, light-tan	12	28
Sand, very fine to coarse; small amount gravel, fine	7	35
Sand, very fine to coarse, fine to very coarse gravel; contains pebbles of limestone up to $\frac{1}{4}$ inch, gray silt, and fragments of gray shale	4	39
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, dark-gray	1	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County

4-16-28cal. (U. S. Bureau of Reclamation core hole DH-105). Drilled 475 feet north and 970 feet west of center of street intersection near Kirwin water tower in February 1946. Surface altitude, 1,760.8 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, compact, brown.....	37	37
Sand, fine, silty, compact, gray.....	5.6	42.6
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, firm, hard, gray.....	11	53.6

4-16-28ca2. (U. S. Bureau of Reclamation core hole DH-104). Drilled 135 feet north and 600 feet west of center of street intersection near Kirwin water tower in February 1946. Surface altitude, 1,760.2 feet.

QUATERNARY--Pleistocene		
Sanborn formation		
Silty sand, fine, compact, gray.....	38.6	38.6
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, firm, gray.....	10	48.6

4-16-28dcl. (U. S. Bureau of Reclamation core hole DH-128). Drilled 10 feet from center of street and 560 feet south of center of street intersection near Kirwin water tower in March 1946. Surface altitude, 1,731.5 feet.

QUATERNARY--Pleistocene and Recent		
Sanborn formation (Pleistocene) and slope deposits (Recent)		
Loam, clay to silty, stiff to plastic, brown...	18.6	18.6
Sand, medium, compact, clean, gray; contains chalk fragments.....	13.4	32.0
Chalk, weathered, soft seams, gray.....	6	38
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, firm, few soft broken seams, gray.....	19.5	57.5
Carlile shale		
Shale, firm, noncalcareous, blue.....	10	67.5

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-16-28dc2. (U. S. Bureau of Reclamation test hole TH-9; drive sampled). Drilled 40 feet north of center Kansas Highway 9 and 365 feet east of intersection Highway 9 and half section line road in November 1945. Surface altitude, 1,695.3 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene		
Terrace deposits		
Clay, silty, moist, sticky, tight, brown.....	15.5	15.5
Sand, fine, damp and compact, silty, buff.....	14.5	30
Sand, medium, compact, clean, moist, gray.....	6	36
Sand, coarse, compact, damp, brown.....	3	39
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, tight, moist, slightly weathered, firm, noncalcareous, top brown, base, blue.....	3	42

4-16-33ab. (U. S. Bureau of Reclamation test hole TH-7; drive sampled). Drilled 820 feet south and 875 feet east of center of intersection of Kansas Highway 9 and half section road in November and December 1945. Surface altitude, 1,695.7 feet.

QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, compact, sandy, brown.....	5	5
Loam, compact, sandy, brown.....	4	9
Clay, compact, lean, brown.....	3	12
Silt, fine, compact, sandy, brown.....	6	18
Clay, lean, stiff, wet, brown.....	3	21
Sand, fine, silty, firm, moist, buff.....	5	26
Clay, lean, stiff, wet, buff.....	9	35
Silt, saturated, buff.....	3	38
Sand, fine, compact, silty, saturated, gray....	1	39
Sand, medium, gray; contains some sand.....	9	48
Sand, fine, compact, silty, gray.....	3	51
Silt, compact, stiff, dark-gray.....	3	54
Sand, compact, medium, gray.....	3	57
Sand, coarse, compact, clean, gravelly, gray; contains fragments of broken chalk.....	3	60
Sand, medium, clean, gray.....	3	63
Sand, coarse, compact, clean.....	3	66
Sand, coarse, gravelly, gray.....	2.5	68.5
Talus, chalk, gravel to $1\frac{1}{2}$ inches, broken chalk to $1\frac{1}{4}$ inches; colors uneven.....	5	73.5
Clay, lean, silty, stiff, brown.....	2.5	76

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-16-33ab--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene (?)--Continued		
Terrace deposits--Continued		
Silt, soft, brown	3	79
Sand, medium, compact, clean, gray; contains about 5 percent gravel	5.3	84.3
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, firm, blue	.7	85

4-16-33ad1. (U. S. Bureau of Reclamation test hole TH-105; drive sampled). Drilled 1,680 feet south and 1,260 feet west of intersection of Kansas Highway 9 and section line road at south edge of Kirwin in November 1945. Surface altitude, 1,696.7 feet.

QUATERNARY--Pleistocene		
Terrace deposits		
Sand, fine, silty, brown	2.5	2.5
Silt, firm, dry, brown	5.5	8
Silt, firm, damp, brown	9	17
Clay, lean, firm, brown	3	20
Silt, firm, light-brown	7.5	27.5
Clay, lean, firm, brown	12.5	40
Sand, fine, compact, brown	6	46
Silt, gray	9	55
Sand, very fine, gray	7	62
Silt, compact, dark-gray	9	71
Clay, lean, firm,dark-gray	3	74
Clay, medium, stiff, blue	5.5	79.5
Gravel, coarse, compact, gray; contains clay	3.5	83
Sand, coarse, compact	1	84
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, firm, blue	3	87

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-16-33ad2. (U. S. Bureau of Reclamation test hole TH-3; drive sampled). Drilled 460 feet north of north end of bridge over Solomon River and 820 feet west of section line road in December 1945. Surface altitude, 1,674.1 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Recent		
Alluvium		
Sand, fine, silty, compact, brown.....	7.5	7.5
Sand, fine, clean, compact, gray.....	4.5	12
Clay, lean, stiff, silty, brown.....	15.5	27.5
Clay, very stiff, blue.....	11.5	39
Clay, lean, stiff, compact, brown.....	3	42
Sand, fine, compact, silty, gray.....	3	45
Sand, fine, compact, clean, gray.....	3	48
Sand, medium compact, clean, gray; contains some broken chalk.....	6	54
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, firm, blue.....	1	55

4-16-33da. (U. S. Bureau of Reclamation test hole TH-2; drive sampled). Drilled 510 feet west of south end of bridge over Solomon River in December 1945. Surface altitude, 1,672.8 feet.

QUATERNARY--Recent		
Alluvium		
Sand, fine, compact, gray.....	3	3
Sand, medium, compact, clean, gray.....	7	10
Sand, coarse, compact, clean, gray; contains many fragments of chalk.....	9	19
Sand, fine, compact, silty, gray.....	3	22
Sand, medium, compact, gray; contains many fragments of broken chalk.....	9	31
Sand, coarse, compact, gravelly, clean, gray...	3	34
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, firm, upper 0.5 foot weathered, blue-gray	3	37

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-16-34cb. (U. S. Bureau of Reclamation core hole DH-127). Drilled 1,370 feet north and 60 feet east of road intersection 1 mile south of Kirwin in February and March 1946. Surface altitude, 1,698.4 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Clay loam to silty loam, stiff to plastic; upper 12 feet black, remainder brown.....	48.8	48.8
Sand, fine, compact, silty.....	5.2	54
Sand, medium, compact, clean.....	1	55
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, firm, blue.....	13	68

4-16-34cc. (U. S. Bureau of Reclamation core hole DH-108). Drilled 700 feet north and 480 feet east of road intersection in December 1945. Surface altitude, 1,723.5 feet.

QUATERNARY--Pleistocene		
Sanborn formation		
Loam, silty, brown.....	19	19
Sand, fine, clean, gray.....	5	24
Sand, fine, silty, brown; contains lumps of chalk rock.....	9	33
Chalk, soft, weathered and broken.....	1.5	34.5
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, firm, gray.....	23.5	57.5
Carlile shale		
Shale, firm, blue.....	9.1	66.6

4-18-23aa. Drilled 18 feet west of center of U. S. Highway 183 and 0.2 mile south of road intersection. Surface altitude, 1,866.9 feet.

Soil, silt, fairly loose, brown and tan.....	2	2
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, loose, tan; contains small amount sand and few small snail shells.....	9	11
Silt, medium compact, dark-brown; contains small amount quartz sand.....	3	14
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Chalk, fairly hard, white, large fragments limestone and white to buff shale or clay.....	2	16
Chalk, consolidated, gray-white, and white to gray soft shale or clay.....	4	20

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-18-24cb. Drilled in ditch 35 feet east of center of U. S. Highway 183 and 0.3 mile north of highway intersection at Glade. Surface altitude, 1,817.1 feet.

	Thickness (feet)	Depth (feet)
Soil, silt, fairly loose, brown and gray-brown..	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, soft, light buff-tan.....	14	18
Silt and sand, light cream-tan silt, with much fine to coarse sand.....	7	25
Sand, fine to coarse; contains much fine to coarse gravel, and few chalk pebbles; chalk pebbles and broken chalk at base.....	23	48
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, fairly hard, white, and some buff shale..	2	50

4-18-25bc. Drilled 20 feet east of center of U. S. Highway 183 and 0.35 mile south of highway intersection at Glade. Surface altitude, 1,800.1 feet.

Soil, silt, loose, dark-brown.....	5	5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, light-tan to gray-tan.....	13	18
Sand, very fine to medium and tan silt.....	6	24
Sand, fine to coarse; contains few fine to medium gravels and a few quartz pebbles.....	9	33
Sand, quartz, very fine to coarse; contains few gravels, some chalk pebbles and small amount gray silt.....	10	43
Sand, fine to coarse quartz sand; contains pebbles, partially cemented together.....	5	48
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, fairly hard, white, and soft light-blue shale or clay.....	2	50
Shale, soft, chalky, light-gray and light blue-gray.....	5	55
Carlile shale, Codell sandstone		
Shale, medium consolidated, gray and dark-gray, and fine sandy shale; contains small amount medium-hard dark gray-black sandstone.....	4	59
Carlile shale, Blue Hill member		
Shale, plastic, noncalcareous, clay-shale, dark bluish-gray.....	6	65

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-18-25cc. Drilled 36 feet east of center of U. S. Highway 183 and about 0.1 mile south of bridge over North Solomon River. Surface altitude, 1,777.8 feet.

	Thickness (feet)	Depth (feet)
Soil, sand and silt, very fine to fine, loose, brown	1	1
QUATERNARY--Recent		
Alluvium		
Sand, very fine to medium; contains small amount of coarse sand, few fine gravels, and chalk pebbles	24	25
Sand, very fine to coarse, and fine to medium gravel; contains few chalk pebbles and shale fragments	15	40
Sand and gravel, fine to coarse	11	51
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, clay-shale, compact, plastic, noncalcareous, dark-gray	4	55

4-18-26aa. Drilled 60 feet west of center of U. S. Highway 183 and 0.1 mile south of highway intersection at Glade. Surface altitude, 1,812.5 feet.

Soil, silt, loose, dark-brown	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, loose, tan; contains some very fine sand, and few small snail shells	15	16
Sand, very fine to fine; contains very little coarse sand and fine gravel	12	28
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Shale, clayey, soft, buff and cream	3	31
Shale, chalky, fissile, dark-gray, soft; contains some bentonite	9	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-18-36bb. Drilled 15 feet east center of U. S. Highway 183 and 0.15 mile south of north line of section. Surface altitude, 1,805.1 feet.

	Thickness (feet)	Depth (feet)
Road fill	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, soft, tan; contains chalk pebbles, quartz sand	21	25
Gravel and silt, chalk pebbles and silt, tan	18	43
Silt, soft, tan; contains fine sand, and small amount of chalk pebbles and gravel	10	53
Silt, soft, gray; contains small amount chalk gravel and very fine sand	9	62
Silt, medium soft, slightly plastic, dark blue-gray	8	70
Silt, soft, plastic, dark blue-gray; contains fine quartz sand and few fine chalk gravels	5	75
Sand, very fine to medium; contains some coarse sand and fine to coarse, greenish gravel	5	80
Sand and gravel, fine to coarse; contains broken shale fragments	8	88
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, clay-shale, noncalcareous, dark-gray	2	90

4-19-30cc. Drilled 20 feet north and 50 feet east of center of road intersection. Surface altitude, 1,931.5 feet.

Soil and road fill	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, slightly sandy, dark-gray	3	7
Silt, medium compact, gray-tan; contains small amount of sand and few snail shells	10	17
Sand and silt, sand, fine to coarse and silt, brown	11	28
Sand, fine to coarse; contains gravel and chalk pebbles	10	38
Sand and gravel; fine to coarse sand, with gravel, chalk pebbles, and broken chalky shale	1	39
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, chalky, light blue-gray	11	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-20-25da. Drilled 10 feet west of center of road and 0.35 mile north of road intersection. Surface altitude, 1,965.7 feet.

	Thickness (feet)	Depth (feet)
Soil, silt, loose, dark-brown.....	0.5	0.5
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, soft, tan to brown; contains small snail shells.....	10.5	11
Silt, soft, dark-brown.....	3	14
Silt, medium compact, slightly plastic, buff and tan.....	5	19
Terrace (?) deposits		
Sand, very fine to fine; contains some buff silt	5	24
Sand, very fine to fine; contains little coarse sand and some silt, with occasional chalk gravels.....	16	40
Sand, very fine to coarse; contains chalk gravel and broken chalky shale.....	7	47
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, hard, chalky, light blue-gray.....	1	50

4-20-36ad. Drilled 12 feet west of center of road and 0.35 mile south of road intersection. Surface altitude, 1,922.6 feet.

Soil, silt, loose, gray-brown.....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, tan and brown; contains small amount fine sand and a few small snail shells.....	14	16
Silt and sand; silt, soft, medium brown, and fine to coarse sand; contains few pebbles.....	4	20
Sand and gravel, fine to coarse, with small amount silt and chalk pebbles.....	13	33
Sand and gravel, fine to coarse; contains small amount white to gray broken chalky shale.....	5	38
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, fissile and chalky, light blue-gray.....	2	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

4-20-36da. Drilled 13 feet west of center of road, 135 feet north of Solomon River bridge, and 0.37 mile north of road intersection. Surface altitude, 1,897.6 feet.

	Thickness (feet)	Depth (feet)
Soil, sand and silt, loose, brown, with shale fragments	4	4
QUATERNARY--Recent		
Alluvium		
Sand, fine to coarse; contains some fine gravel and scattered pebbles of chalk and chalky shale	11	15
Sand, very fine to medium, grayish, with small amount of coarse sand	11	26
Sand, fine to coarse, gray-green	21	47
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, fissile, very chalky, light- to dark-gray	3	50

5-16-3bb. (U. S. Bureau of Reclamation core hole DH-110). Drilled 50 feet south and 950 feet east of center of road intersection in January 1946. Surface altitude, 1,745.5 feet.

QUATERNARY--Pleistocene		
Sanborn formation		
Sandy loam, brown	7	7
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalk, weathered, soft, gray	3	10
Chalk, weathered, soft, yellow	2	12
Chalk, weathered, firm, gray	3	15
Chalk, weathered, soft, yellow	6	21
Chalk, firm, gray	11.2	32.2

5-19-6bb. Drilled 9 feet south and 50 feet east of center of crossroads. Surface altitude, 1,931.6 feet.

Soil, sand and silt, loose, brown	5	5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, gray-tan	5	10
Silt, fairly soft, dark gray-black; contains small amount of fine sand and gravel	5	15
Silt, brown; contains fine sand and few chalk pebbles and gravels	5	20

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

5-19-6bb--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Silt, brown, with sand and gravel and broken shale fragments; contains snail shells near base.....	15	35
Sand, fine to medium tan, very little coarse sand and few broken shale pebbles.....	15	50
Sand, fine to coarse; contains fine gravel, with small amount coarse gravel and broken shale...	12	62
Sand, gravel, and broken chalky shale.....	18	80
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, soft, fissile and chalky, light- to dark-gray.....	10	90

5-19-6cc. Drilled 12 feet north of center of road and 0.05 mile east of road intersection. Surface altitude, 1,996.5 feet.

Soil, loose, brown, silt.....	2	2
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, fairly loose, tan and gray-brown.....	8	10
Silt, soft, gray-brown; contains snail shells...	8	18
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, medium compact, chalky, gray, creamy.....	2	20
Shale, fissile, light-gray to buff, and light-gray, soft chalk; few shell fragments.....	4	24
Shale, soft, medium plastic, chalky, light-gray with small amount of buff.....	3.5	27.5
Shale, soft, plastic, chalky; contains fragments of shells and selenite crystals.....	.5	28
Shale, fissile, soft, dark gray-black; contains few selenite crystals and shells.....	2	30

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

5-20-1aa. Drilled 12 feet west of center of road and 0.05 mile south of road intersection. Surface altitude, 1,931.6 feet.

	Thickness (feet)	Depth (feet)
Soil, silt and fine sand, brown.....	4	4
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, medium compact, gray-tan.....	2	6
Silt, soft, dark-brown; contains sand and chalk fragments.....	3	9
Silt, fairly compact, tan- and dark-brown.....	8	17
Sand, fine to medium; contains some coarse sand, fine gravel and few coarse gravels and chalk fragments.....	12	29
Silt and sand, silt, soft, dark-brown and tan; sand, fine to coarse, with few gravels and chalk pebbles.....	11	40
Sand, fine to coarse; contains small amount fine to medium gravel, and gray silt.....	20	60
Sand, fine to coarse; contains small amount of assorted gravel, and pebbles of white, yellow, and gray chalky shale; gray-green at base....	19.5	79.5
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, fissile, chalky, light- to dark- gray...	.5	80

5-20-1ad. Drilled 10 feet west of center of road and 0.37 mile south of road intersection. Surface altitude, 1,949.2 feet.

Soil, dark-gray silt and fine sand, loose.....	1	1
QUATERNARY--Pleistocene		
Terrace deposits		
Silt and sand, silt, soft, dark-gray, and much quartz sand; contains few small chalky fragments.....	6	7
Silt and sand, silt, soft, gray-tan, and quartz sand, with fragments of chalk and shale.....	6	13
Sand, fine to coarse; contains fine gravel and limestone pebbles, large.....	3	16
Sand, fine to coarse; contains soft, tan silt and gravel.....	12	28
Sand, very fine to medium; contains small amount coarse sand, few granite pebbles, and some gray silt.....	14	42
Silt, medium plastic, soft, light to dark, blue-gray; contains some fine gray sand.....	4	46

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Phillips County--Continued

5-20-1ad--Continued.

	Thickness (feet)	Depth (feet)
QUATERNARY--Pleistocene--Continued		
Terrace deposits--Continued		
Sand, very fine to coarse, gray-green; contains small amount gray silt, and few gravels and chalk pebbles.....	5.5	51.5
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, hard, fissile and chalky, dark-gray; contains bentonite.....	3.5	55

5-20-1da. Drilled 10 feet west of center of road and 0.7 mile south of road intersection. Surface altitude, 1,989.6 feet.

Soil, silt, loose, brown to tan.....	2	2
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, fine, gray-tan; contains some fine sand and few limestone fragments.....	9	11
Sand, very fine to medium, light tan.....	4	15
CRETACEOUS--Gulfian		
Niobrara chalk, Smoky Hill member		
Shale, fissile, soft to medium compact, chalky, light-gray to light-yellow; contains a few shell fragments.....	5	20

Smith County

4-14-18dc. Drilled 6 feet north of center of road and 0.3 mile west of road intersection. Surface altitude, 1,701.0 feet.

Soil, loose, silt, brown.....	2	2
QUATERNARY--Pleistocene		
Sanborn formation		
Silt, very loose, tan.....	5	7
Silt, medium compact, dark-brown.....	6	13
Silt, medium compact, plastic, light-gray.....	3	16
Silt, fairly compact, brown to yellow-brown; contains very fine sand.....	11	27
Silt, medium soft, light-gray to cream; contains little very fine sand.....	5	32

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

4-14-18dc--Continued

	Thickness (feet)	Depth (feet)
Quaternary--Pleistocene--Continued		
Sanborn formation--Continued		
Silt, sand, and gravel; silt, soft, cream to gray, yellow; fine to medium quartz sand; and many chalk pebbles, up to 1 inch in size.....	6	38
Sand, very fine to fine, quartz; contains much white silt and gravel, chalk pebbles and broken shells.....	14	52
CRETACEOUS--Gulfian		
Niobrara chalk, Fort Hays limestone		
Chalky clay, white to yellowish; contains chalk fragments.....	3	55
Chalk, medium consolidated, white and yellow-brown.....	2	57
Chalk, fairly hard, fresh, white.....	3	60

4-14-19bc. Drilled 10 feet east of center of road at one-half mile line. Surface altitude, 1,666.2 feet.

Road fill, silt and limestone pebbles.....	4	4
QUATERNARY--Pleistocene		
High terrace (?) deposits		
Silt, medium, compact, gray-buff; contains small shells.....	7	11
Silt, soft, tan; fine to coarse quartz; and gravel and chalk pebbles.....	5	16
Silt, compact, plastic, tan.....	4	20
Silt, medium compact, gray-tan.....	6	26
Silt, fairly soft, buff; contains very fine sand	4	30
Silt and gravel, silt, tan and much very fine to fine sand and limestone gravel and pebbles...	6	36
Silt, dark chocolate brown and gray-brown; contains small amount very fine sand.....	4	40
Silt, partly iron-stained, light-gray; contains fine sand and little loose gravel, snail shells.....	9	49
Sand and gravel, sand, quartz, very fine to coarse, and gravel up to 1 inch; chalk pebbles; contains small amount of silt.....	8	57
Sand and gravel, very fine sand to 2-inch chalk pebbles, many iron-stained and yellow.....	2	59
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, noncalcareous, dark gray-black.	1	60

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

4-14-29bb. Drilled 10 feet east of center of road and 0.1 mile south of road intersection. Surface altitude, 1,654.1 feet.

	Thickness (feet)	Depth (feet)
Road fill, silt, sandy and limestone pebbles...	6	6
QUATERNARY--Pleistocene		
Terrace (?) deposits		
Silt, light gray-buff; contains few fine quartz grains.....	6.5	12.5
Silt, medium-gray; contains few sand grains....	2.5	15
Silt, light-buff; has white calcareous streaks, and few fine quartz sand grains.....	6	21
Silt, calcareous streaks, buff with white; contains small amount of fine quartz sand.....	14	35
Sand, very fine to fine, mostly quartz; contains small amount of fine chalk pebbles.....	2	37
Sand and gravel, fine to coarse quartz sand, and chalk sand, fine to coarse gravels and silicified chalk pebbles; small amount gray silt.....	11	48
Gravel, coarse, mostly chalk pebbles and fine to coarse sand.....	6.5	54.5
Gravel, coarse, and broken chalk, silicified chalk pebbles, and small amount fine to coarse sand.....	15.5	70
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, noncalcareous, dark gray-black.....	6.5	76.5

4-14-30dd. Drilled 10 feet west of center of road, 140 feet north of bridge over Cedar Creek, and 0.1 mile north of road intersection.

Road fill, silt and chalk boulders.....	6	6
QUATERNARY--Recent		
Alluvium		
Sand, very fine to medium, quartz, some silt, brown, gravels; and angular fragments of broken chalk.....	22	28
Sand, very fine to medium, quartz; small amount coarse sand and few limestone pebbles.....	8	36
Sand, fine to coarse, quartz, and fine to coarse gravel, mostly chalk pebbles up to ½ inch and shale fragments.....	4	40
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale concretion, very hard, calcareous, dark-gray to gray; contains calcite fragments, and shale fragments.....	1	41

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

4-14-31ad. Drilled 10 feet west of center of road and 0.4 mile south of road intersection. Surface altitude, 1,630.3 feet.

	Thickness (feet)	Depth (feet)
Soil, silt with limestone fragments.....	4	4
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, tan.....	7	11
Silt, soft, light-tan.....	7	18
Silt, fairly soft, dark gray-tan.....	3	21
Silt, soft, light-gray; contains many snail shells.....	2	23
Sand, very fine to fine; contains small amount medium to coarse sand, and few gravel and chalk pebbles.....	15	38
Sand and gravel, fine to coarse quartz sand, and fine to very coarse quartz gravels, with some chalk pebbles.....	10	48
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale concretion (?), very hard, calcareous, dark-gray to brown.....	1.5	49.5
Shale, clayey, noncalcareous, dark-gray.....	5.5	55

4-14-31dd. Drilled 36 feet west of center of road and 120 feet south of railroad crossing at Cedar. Surface altitude, 1,627.3 feet.

Soil, medium compact, dark-brown silt.....	4	4
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, light gray-tan; contains few quartz grains.....	14	18
Sand, very fine to medium; contains small amount of coarse sand, fine gravel, and limestone pebbles.....	22	40
Sand and gravel, fine to coarse.....	4	44
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, clay-shale, plastic, noncalcareous, dark gray-black.....	6	50

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

5-13-25bb. Drilled 12 feet east and 50 feet south of center of crossroads. Surface altitude, 1,611.3 feet.

	Thickness (feet)	Depth (feet)
Soil, loose brown silt.....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, gray to tan; contains a little sand.....	3	5
Silt, fairly soft, tan and brown.....	3	8
Silt, cream to buff; contains chalk pebbles....	3	11
Gravel, chalk pebbles up to 1 inch in size; contains small amount of sand.....	5	16
Silt, fairly soft, brown; a few chalk pebbles..	3	19
Silt, fairly soft, tan to gray; few chalk pebbles	2	21
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, light blue-gray, small amount is cream-streaked and iron-stained.....	5	26
Shale, light to dark gray-blue; contains fragments of iron-clay and much iron-stain; noncalcareous, plastic-shale.....	4	30

5-13-25bc. Drilled 12 feet east of middle of road and 0.3 mile north of intersection of section road with Kansas Highway 9. Surface altitude 1,588.7 feet.

Soil, soft brown silt.....	2	2
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, soft, tan.....	3	5
Silt, very loose, light-buff.....	9	14
Silt, medium compact, plastic, buff to tan.....	9	23
Silt, soft, light-buff; contains much fine sand	7	30
Sand, very fine to fine; contains some soft tan-buff silt, and a few small snail shells.....	14	44
Sand, very fine to coarse, and tan-buff silt; contains few pebbles and gravels of chalk....	10	54
Sand, fine to coarse, and some fine to medium gravel, partly chalk pebbles.....	5	59
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, dark gray-blue, noncalcareous, traces of iron-stain.....	1	60

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

5-13-25cc. Drilled 25 feet east of center of road and 0.1 mile north of road intersection. Surface altitude, 1,570.1 feet.

	Thickness (feet)	Depth (feet)
Soil, soft silt, dark gray-brown.....	5	5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, very loose, tan and brown; contains a small amount of chalk sand.....	14	19
Silt, soft, tan.....	9	28
Sand, and gravel, worn chalk fragments, from fine sand to ½-inch pebbles, also small amount tan silt.....	16	44
Sand and gravel, very fine to fine quartz sand and coarse chalk sand; gravel, fine to medium pebbles of chalk, and shale fragments.....	4	48
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, noncalcareous, dark-gray.....	2	50

5-13-36bc. Drilled 10 feet east of center of road and 0.3 mile south of road intersection. Surface altitude, 1,550.4 feet.

Soil, dark-brown compact silt.....	3	3
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, slightly coarse, tan; contains few sand grains.....	8	11
Silt, medium loose, light gray-tan.....	4	15
Silt, dark-tan.....	3	18
Silt and sand, silt, loose, tan, and very fine to fine sand.....	8	26
Sand, very fine to medium, with small amount coarse sand and fine to medium gravel, with many chalk pebbles up to ½ inch; material at base coarser.....	11.5	37.5
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, clayey, noncalcareous, partly iron-stained, light- to dark-gray.....	2.5	40

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

5-13-36cc. Drilled 6 feet east of center of farm road and 0.8 mile south of road intersection. Surface altitude, 1,525.0 feet.

	Thickness (feet)	Depth (feet)
QUATERNARY--Recent		
Alluvium		
Silt, loose, brown, and very fine sand.....	5	5
Sand, very fine to medium, small amount coarse, tan.....	10	15
Sand, very fine to coarse; contains small amount of quartz gravel, fine to coarse and angular chalk pebbles up to 1 inch; shale fragments..	5	20
Sand, very fine to medium with small amount of coarse, gray-green; contains a few limestone pebbles up to ½ inch and many wood fragments.	25	45
CRETACEOUS--Gulfian		
Carlile shale, Fairport member		
Shale, plastic to silty, calcareous, dark gray-black.....	5	50

5-14-6aa. Drilled 12 feet west of center of road and 0.15 mile south of crossroads at southeast corner of Cedar. Surface altitude, 1,625.7 feet.

Soil, dark-brown, loose silt.....	5	5
QUATERNARY--Pleistocene		
Terrace deposits		
Silt, compact, gray.....	3	8
Silt, compact, slightly iron-stained, light-tan	12	20
Silt and sand; silt, fairly soft, gray; and fine to medium quartz sand.....	5	25
Sand, fine to medium, quartz, tan; contains small amount coarse sand.....	3	28
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, noncalcareous, plastic, dark blue-gray..	2	30

Table 24.--Logs of test holes drilled by the State Geological Survey of Kansas and the U. S. Bureau of Reclamation in the Kirwin Unit--Con.

Smith County--Continued

5-14-6ad. Drilled 10 feet west of center of road and 0.5 mile south of road intersection at Cedar. Surface altitude, 1,627.7 feet.

	Thickness (feet)	Depth (feet)
Soil, soft, silt, gray-tan.....	5	5
QUATERNARY--Pleistocene (?)		
Terrace deposits		
Silt, soft, light-tan; contains few sand grains	16	21
Sand, very fine to fine; contains small amount medium to coarse sand and few chalk pebbles..	10	31
Clay and sand, clay or silt, rusty-brown to brown, with small amount rusty-brown silt; contains fine sand, pebbles, and angular fragments of hard, calcareous gray shale. Also some fine to coarse sand and gravel.....	1	32
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, plastic, noncalcareous clay-shale, dark gray-black.....	8	40

5-14-6dd. Drilled 10 feet west of center of road and 0.05 mile north of Solomon River bridge. Surface altitude, 1,603.9 feet.

QUATERNARY--Recent		
Alluvium		
Silt and sand, loose brown silt, and fine to very fine sand.....	5	5
Sand, tan, very fine to fine; contains small amount loose gray silt, and a few small snail shells.....	12	17
Sand, very fine to coarse, and fine gravel, with small amount of medium and coarse; is mixed quartz and chalk material, with few gray clay balls.....	6	23
Sand, very fine to coarse, gray; contains few fine gravels, and some soft dark-gray silt...	7	30
Silt, dark-gray, soft; contains very fine sand and a little loose coarser sand and gravel, partly chalk material.....	5	35
Sand, fine to coarse, and gravel, fine to coarse; contains shale fragments, chalk sand and small chalk pebbles.....	15	50
Gravel and sand, fine to medium quartz gravel, with sand; contains many chalk pebbles up to 1-inch; stained greenish gray-white.....	3	53
CRETACEOUS--Gulfian		
Carlile shale, Blue Hill member		
Shale, dark gray-black, noncalcareous, plastic, clay-shale.....	7	60

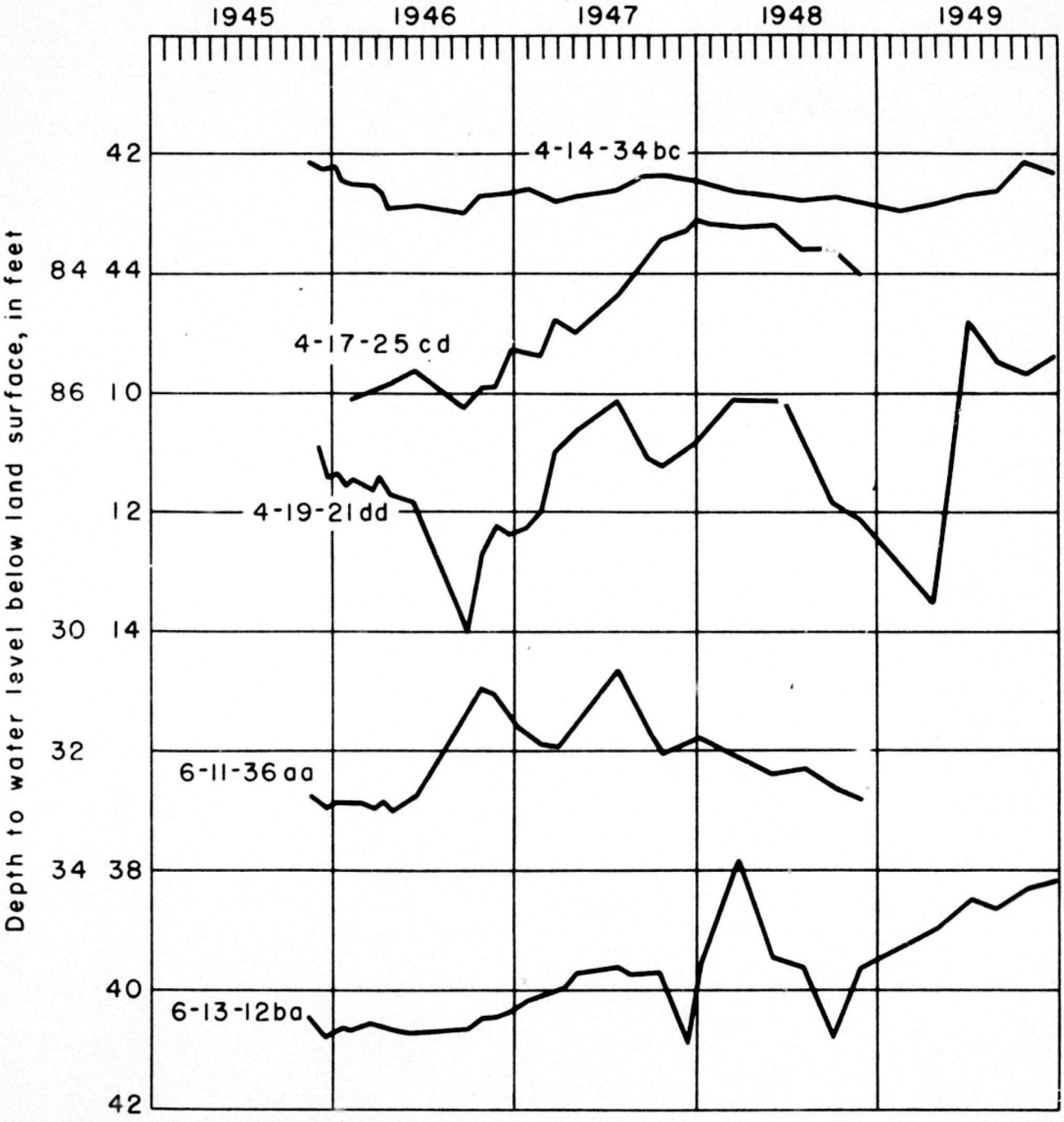

Figure 9.-Hydrographs of five wells, Kirwin Unit

As a continuation of the observation-well program which was initiated in 1946, measurements of the water level in 21 wells have been made periodically. The highest and lowest water levels for the period of record are given in table 25; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 26; and the water-level measurements made in 1949 are given in table 27. Hydrographs of five wells are shown on figure 10.

Table 25.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 21 wells in the St. Francis Unit

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
1-38-1cd	2	21.90	June 8, 1949	23.09	Oct. 5, 1948
-8dd	4	11.24	Feb. 25, 1947	1/ 14.83	Aug. 2, 1949
-10cc	4	19.97	June 8, 1949	21.67	Oct. 22, 1946
-17cd	4	11.32	June 8, 1947; June 8, 1949	12.57	Oct. 5, 1948
2-39-2cb	4	13.56	Dec. 18, 1949	19.03	Mar. 28, 1946
-10bb	3	25.27	July 29, 1947	27.10	Aug. 3, 1948
-17ba	3	10.38	June 8, 1947	12.56	Sept. 7, 1947
-27bb	4	17.08	July 29, 1947	19.50	Mar. 27, 1946
2-40-25db	2	15.52	Aug. 2, 1949	16.45	Oct. 5, 1948
3-39-6aa 2/	4	4.94	June 8, 1949	8.73	Dec. 5, 1947
3-40-9ba	4	11.69	Feb. 25, 1947	13.10	Sept. 7, 1947
-16da	4	9.67	June 8, 1949	11.90	Sept. 7, 1947
-22ab	4	10.02	July 29, 1947	15.18	Mar. 9, 1946
-28bd	4	10.02	Mar. 20, 1946	12.75	Aug. 16, 1946
-33dd	4	11.90	July 29, 1947	14.50	Mar. 4, 1946
3-41-13cc	4	7.83	Nov. 16, 1949	15.78	Aug. 16, 1946
4-41-2aa	4	23.67	Mar. 1, 1946	28.53	Oct. 4, 1949
4-41-32dd 3/	4	113.39	June 8, 1949	114.76	Aug. 16, 1946
4-42-24ca	4	24.50	June 8, 1949	25.89	Sept. 7, 1947
-34db	4	8.73	June 8, 1949	10.31	Sept. 7, 1947
5-42-4aa	4	21.83	Dec. 5, 1947; June 8, 1948	23.68	Aug. 2, 1949

1/ Pumped recently.
2/ Well destroyed.
3/ Measurements discontinued.

Table 26.--Difference between highest and lowest recorded water levels, net change in water levels in 1949, and net change in water levels for period of record, in feet, in the St. Francis Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or decline (-) for period of record
1-38-1cd	1.19	+0.24	-0.07
-8dd	3.59	+.60	+.37
-10cc	1.70	+.23	+1.18
-17cd	1.25	+.39	-.15
2-39-2cb	5.47	+1.76	+5.47
-10bb	1.83	+.43	-.01
-17ba	2.18	.00	+.31
-27bb	2.42	+.57	+1.88
2-40-25db	.93	-.08	.00
3-39-6aa	3.79	+1.96	+.06
3-40-9ba	1.41	+.55	+.05
-16da	2.23	+.91	-.46
-22ab	5.16	+2.19	+3.31
-28bd	2.73	+.73	-1.38
-33dd	2.60	+.06	+1.67
3-41-13cc	7.95	+2.55	+5.25
4-41-2aa	4.86	+.61	-1.70
4-41-32dd	1.37	+.46	+1.17
4-42-24ca	1.39	+.37	+.98
-34db	1.58	+.54	+.23
5-42-4aa	1.85	+.03	+.23

Table 27.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit, 1949

1-38-1cd.

Date	Water level	Date	Water level	Date	Water level
June 8	21.90	Oct. 4	22.75	Dec. 18	22.56
Aug. 2	22.72	Nov. 16	22.62		

1-38-8dd.

June 8	12.77	Oct. 4	12.55	Dec. 18	12.15
Aug. 2	a 14.83	Nov. 16	12.30		

a Pumped recently

1-38-10cc.

June 8	19.97	Oct. 4	20.65	Dec. 18	20.44
Aug. 2	20.20	Nov. 16	20.40		

Table 27.--Water-level measurements, in feet below land-surface datum, in the St. Francis Unit, 1949--Continued

1-38-17cd.

Date	Water level	Date	Water level	Date	Water level
June 8	11.32	Oct. 4	12.12	Dec. 18	11.89
Aug. 2	12.06	Nov. 16	11.99		

2-39-2cb.

June 8	14.22	Oct. 4	13.84	Dec. 18	13.56
Aug. 2	13.70	Nov. 16	13.79		

2-39-10bb.

June 8	26.55	Oct. 4	26.35	Dec. 18	25.76
Aug. 2	26.28	Nov. 16	25.85		

2-39-17ba.

June 8	12.01	Oct. 4	11.38	Dec. 18	10.72
Aug. 2	11.92	Nov. 16	10.85		

2-39-27bb.

June 8	17.56	Oct. 4	17.20	Dec. 18	17.62
Aug. 2	17.41	Nov. 16	17.39		

2-40-25db.

June 8	15.88	Oct. 4	15.74	Dec. 18	15.77
Aug. 2	15.52	Nov. 12	15.80		

3-39-6aa.

June 8	4.94	Oct. 4	6.42	Well destroyed
Aug. 2	6.91			

3-40-9ba.

June 8	12.31	Oct. 4	12.35	Dec. 18	12.25
Aug. 2	12.30	Nov. 16	12.25		

Table 27.--Water-level measurements, feet below land-surface datum, in the St. Francis Unit, 1949--Continued

3-40-16da.

Date	Water level	Date	Water level	Date	Water level
June 8	9.67	Oct. 4	9.82	Dec. 18	10.20
Aug. 2	10.40	Nov. 16	10.22		

3-40-22ab.

June 8	11.71	Oct. 4	10.50	Dec. 18	11.87
Aug. 2	10.77	Nov. 16	11.49		

3-40-28bd.

June 8	10.92	Oct. 4	11.53	Dec. 18	11.40
Aug. 2	12.13	Nov. 16	11.48		

3-40-33dd.

June 8	13.20	Oct. 4	12.23	Dec. 18	12.83
Aug. 2	13.44	Nov. 16	12.74		

3-41-13cc.

June 8	10.73	Oct. 4	8.02	Dec. 18	9.45
Aug. 2	9.80	Nov. 16	7.83		

4-41-2aa.

June 8	24.55	Oct. 4	28.53	Dec. 18	25.37
Aug. 2	25.56	Nov. 16	25.34		

4-41-32dd.

June 8	113.39	Nov. 16	113.57	Measurements	
Aug. 2	113.65	Dec. 18	113.53	discontinued	
Oct. 4	113.57				

4-42-24ca.

June 8	24.50	Oct. 4	25.02	Dec. 18	24.80
Aug. 2	25.14	Nov. 16	24.85		

Table 27.--Water-level measurements, feet below land-surface datum, in the St. Francis Unit, 1949--Continued

4-42-34db.

Date	Water level	Date	Water level	Date	Water level
June 8	8.73	Oct. 4	9.32	Dec. 18	9.19
Aug. 2	9.08	Nov. 16	9.20		

5-42-4aa.

June 8	22.22	Oct. 4	22.84	Dec. 18	22.65
Aug. 2	23.68	Nov. 16	22.80		

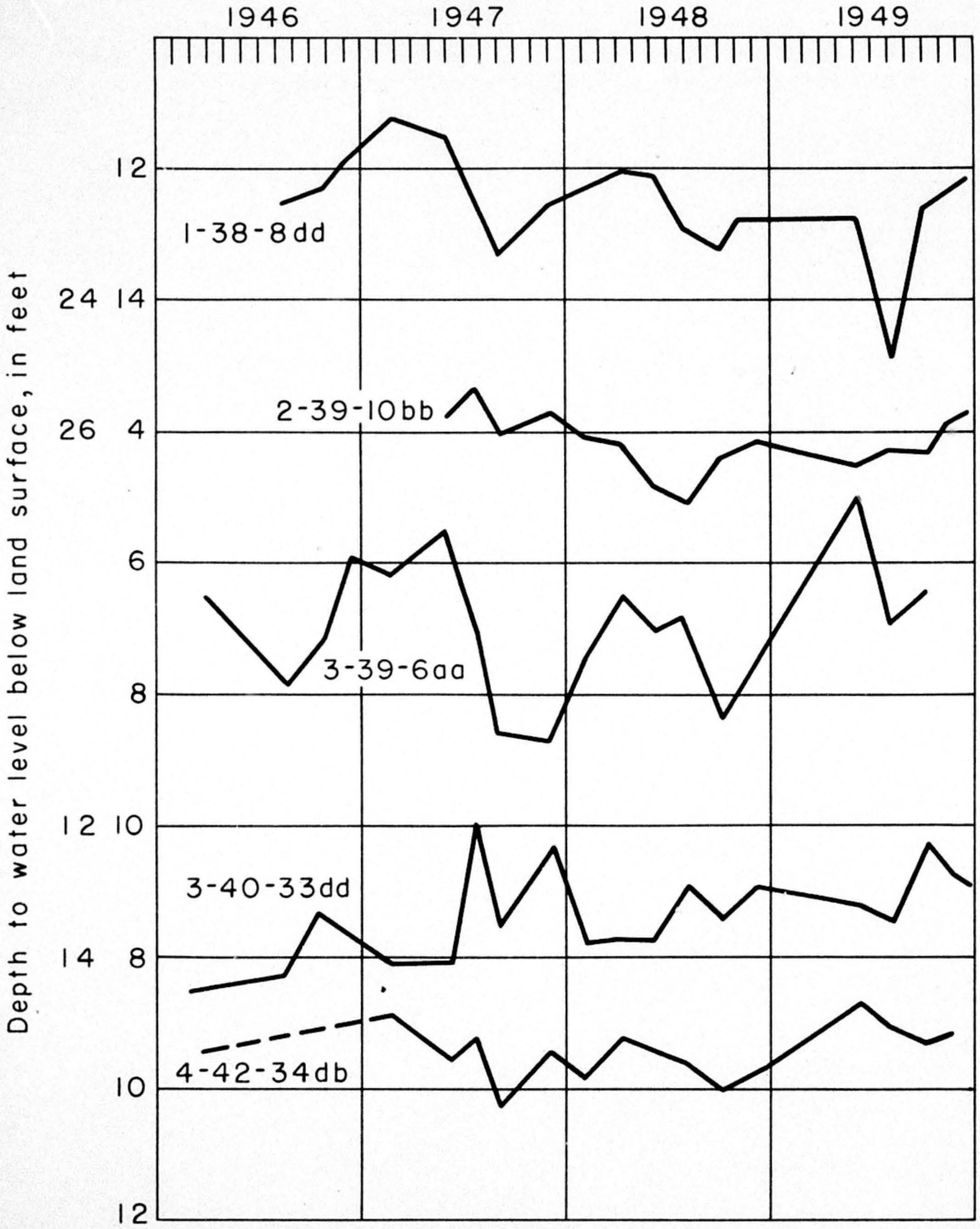

Figure 10.-Hydrographs of five wells, St. Francis Unit

Periodic measurements of the water levels have been made since 1946 in eight 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 28; the difference between the highest and lowest water levels, the net rise or decline in 1949, and the net rise or decline for the period of record are given in table 29; and the water-level measurements made in 1949 are given in table 30. Hydrographs of five wells are shown in figure 11.

Table 28.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in eight wells in the Webster Unit

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
7-11-21da	3	31.83	June 29, 1949	33.86	Nov. 29, 1948
-26aa 1/	3	18.79	Nov. 20, 1946	25.67	Aug. 27, 1947
7-12-28ab	3	31.57	Oct. 26, 1949	34.60	Jan. 7, 1947
7-13-15da	3	36.20	Nov. 7, 1946	2/ 38.94	Sept. 30, 1947 Apr. 23, 1949
7-14-6cb	3	22.70	Sept. 1, 1949	24.19	Nov. 29, 1948
-10dd	3	31.29	Oct. 26, 1949	32.22	Feb. 4, 1947
7-15-8cc	3	22.60	Oct. 26, 1949	23.64	Feb. 16, 1948
-12dc	3	10.60	June 29, 1949	3/ 20.85	Dec. 2, 1948

1/ Well number changed from 7-11-23dd to 7-11-26aa, Dec. 29, 1949.
2/ Well pumped recently.
3/ Well pumping.

Table 29.--Difference between highest and lowest recorded water levels, net change in water levels in 1949, and net change in water levels for period of record, in feet, in eight wells in the Webster Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
7-11-21da	2.03	+1.04	+0.61
-26aa 1/	6.88	+4.87	-.06
7-12-28ab	3.03	+1.54	+1.50
7-13-15da	2.74	+.31	-1.36
7-14-6cb	1.49	+1.19	+.70
-10dd	.93	+.87	+1.11
7-15-8cc	1.04	+.40	+.59
-12dc	10.25	-1.45	-5.36

1/ Well number changed from 7-11-23dd to 7-11-26aa, Dec. 29, 1949.

Table 30.--Water-level measurements, in feet below land-surface datum, in the Webster Unit, 1949

7-11-21da.

Date	Water level	Date	Water level	Date	Water level
Apr. 23	32.52	Sept. 1	32.06	Dec. 29	32.82
June 29	31.83	Oct. 26	32.53		

7-11-26aa.

Apr. 23	21.33	Oct. 26	19.68	Dec. 29	19.86

7-12-28ab.

Apr. 23	33.30	Sept. 1	32.32	Dec. 29	32.34
June 29	32.89	Oct. 26	31.57		

7-13-15da.

Apr. 23	38.94	Sept. 1	37.85	Dec. 29	38.16
June 29	36.47	Oct. 26	37.58		

7-14-6cb.

Apr. 23	23.68	Sept. 1	22.70	Dec. 29	23.00
June 29	22.95	Oct. 26	22.85		

7-14-10dd.

Apr. 23	31.83	Sept. 1	31.32	Dec. 29	31.30
June 29	31.65	Oct. 26	31.29		

7-15-8cc.

Apr. 23	23.54	Sept. 1	22.63	Dec. 29	22.70
June 29	22.75	Oct. 26	22.60		

7-15-12dc.

June 29	10.60	Oct. 26	12.20	Dec. 29	17.70
Sept. 1	10.92				

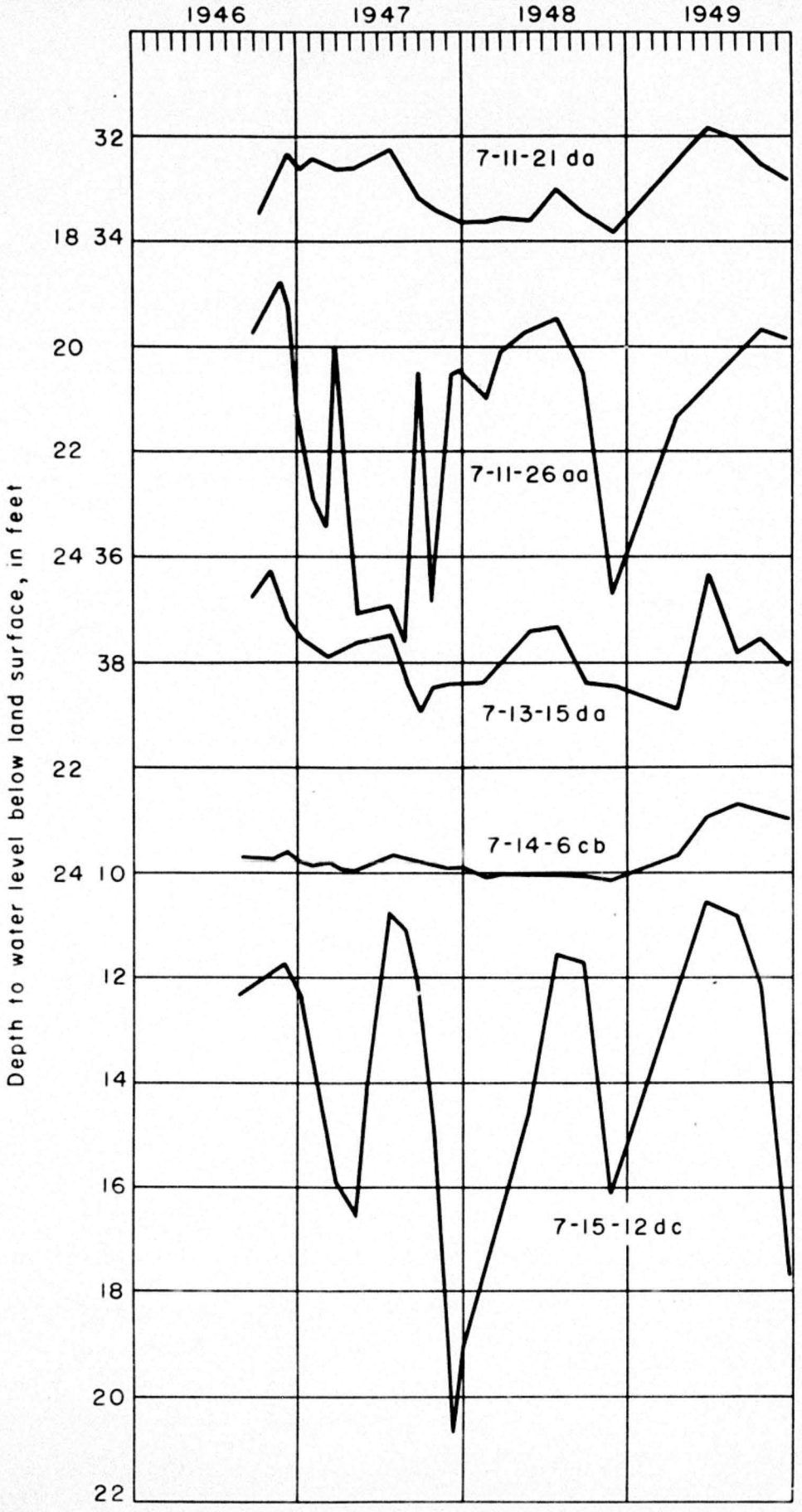

Figure 11.-Hydrographs of five wells, Webster Unit

Measurements of the water level in 15 wells have been made periodically since 1947. The highest and lowest water levels for the period of record are given in table 31; the difference between the highest and lowest recorded water levels, the net rise or decline of the water level in 1949, and the net rise or decline of the water level for the period of record are given in table 32; and the water-level measurements made in 1949 are given in table 33. Hydrographs of five wells are shown on figure 12.

Table 31.--Highest and lowest water levels for the period of record, in feet below land-surface datum, in 15 wells in the Wilson Unit

Well number	Length of record (years)	Highest water level	Date	Lowest water level	Date
11-7-32dc	3	73.18	July 11, 1949	74.67	Sept. 8, 1947
12-6-12cd	3	11.64	Aug. 9, 1948	15.52	Jan. 12, 1948
-16cc	3	20.08	July 11, 1949	24.87	Nov. 28, 1947
12-7-18aa	3	20.15	July 24, 1947	23.43	Nov. 28, 1947; Jan. 12, 1948
-19dd	3	9.80	July 11, 1949	13.18	Jan. 12, 1948
-23aa	3	8.36	Apr. 26, 1949	13.43	Jan. 12, 1948
-34ad	3	49.90	Aug. 9, 1948	50.84	Feb. 21, 1947
12-8-6aa	3	5.92	Apr. 28, 1947	10.53	Sept. 8, 1947
-8cd	3	12.50	July 11, 1949	14.30	Jan. 12, 1948
-11cb	3	15.62	July 11, 1949	19.35	Jan. 12, 1948
12-9-10ad	3	17.90	July 11, 1949	20.26	Jan. 12, 1948; Apr. 6, 1948
12-10-8bb	3	13.52	July 11, 1949	16.58	Jan. 12, 1948
-13aa	3	16.92	July 11, 1949	24.48	Jan. 12, 1948
-17ab	3	24.99	July 11, 1949	28.49	Dec. 7, 1948
-21dd	3	25.98	July 24, 1947	27.85	Apr. 26, 1949

Table 32.--Difference between highest and lowest water levels, net change in water levels in 1949, and net change in water levels for the period of record, in feet, in 15 wells in the Wilson Unit

Well number	Difference between highest and lowest water level	Net rise (+) or net decline (-) in 1949	Net rise (+) or net decline (-) for period of record
11-7-32dc	1.49	+0.01	+0.05
12-6-12cd	3.88	-1.43	-1.61
-16cc	4.79	+1.91	-1.40
12-7-18aa	3.28	-.25	-2.42
-19dd	3.38	-.70	+.34
-23aa	5.07	-.19	+1.87
-34ad	.94	-.23	+.57
12-8-6aa	4.61	-.47	-1.86
-8cd	1.80	+.70	+.37
-11cb	3.73	-.59	-.66
12-9-10ad	2.36	-.38	+.65
12-10-8bb	3.06	+1.03	+.80
-13aa	7.56	+.23	+3.89
-17ab	3.50	+2.99	+.66
-21dd	1.87	+.22	-.23

Table 33.--Water-level measurements, in feet below land-surface datum, in the Wilson Unit, 1949

11-7-32dc.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	73.85	Aug. 22	73.80	Dec. 27	74.29
July 11	73.18	Oct. 25	73.92		

12-6-12cd.

Apr. 26	12.79	Aug. 22	12.82	Dec. 14	15.20
July 11	11.82	Oct. 25	13.89		

12-6-16cc.

Apr. 26	21.68	Aug. 22	21.92	Dec. 27	22.58
July 11	20.08	Oct. 25	22.45		

12-7-18aa.

Apr. 26	21.50	Aug. 22	22.20	Dec. 27	23.04
July 11	20.45	Oct. 25	22.60		

Table 33.--Water-level measurements, in feet below land-surface datum, in the Wilson Unit, 1949--Continued

12-7-19dd.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	9.84	Aug. 22	10.80	Dec. 27	12.26
July 11	9.80	Oct. 25	12.14		

12-7-23aa.

Apr. 26	8.36	Aug. 22	10.26	Dec. 27	11.53
July 11	9.26	Oct. 25	11.05		

12-7-34ad.

Apr. 26	50.25	Aug. 22	50.08	Dec. 27	50.27
July 11	50.15	Oct. 25	50.27		

12-8-6aa.

Apr. 26	6.10	Aug. 22	8.59	Dec. 27	8.20
July 11	7.37	Oct. 25	8.18		

12-8-8cd.

Apr. 26	14.02	Aug. 22	12.68	Dec. 27	13.30
July 11	12.50	Oct. 25	12.85		

12-8-11cb.

Apr. 26	16.68	Aug. 22	18.50	Dec. 27	19.03
July 11	15.62	Oct. 25	18.21		

12-9-10ad.

Apr. 26	18.26	Aug. 22	18.14	Dec. 27	18.96
July 11	17.90	Oct. 25	18.56		

12-10-8bb.

Apr. 26	15.84	Aug. 22	14.62	Dec. 27	15.40
July 11	13.52	Oct. 25	14.90		

Table 33.--Water-level measurements, in feet below land-surface datum, in the Wilson Unit, 1949--Continued

12-10-13aa.

Date	Water level	Date	Water level	Date	Water level
Apr. 26	19.60	Aug. 22	17.84	Dec. 27	20.19
July 11	16.92	Oct. 25	19.22		

12-10-17ab.

Apr. 26	25.95	Aug. 22	25.48	Dec. 27	25.50
July 11	24.99	Oct. 25	25.50		

12-10-21dd.

Apr. 26	27.85	Aug. 22	26.64	Dec. 27	27.10
July 11	26.42	Oct. 25	26.92		

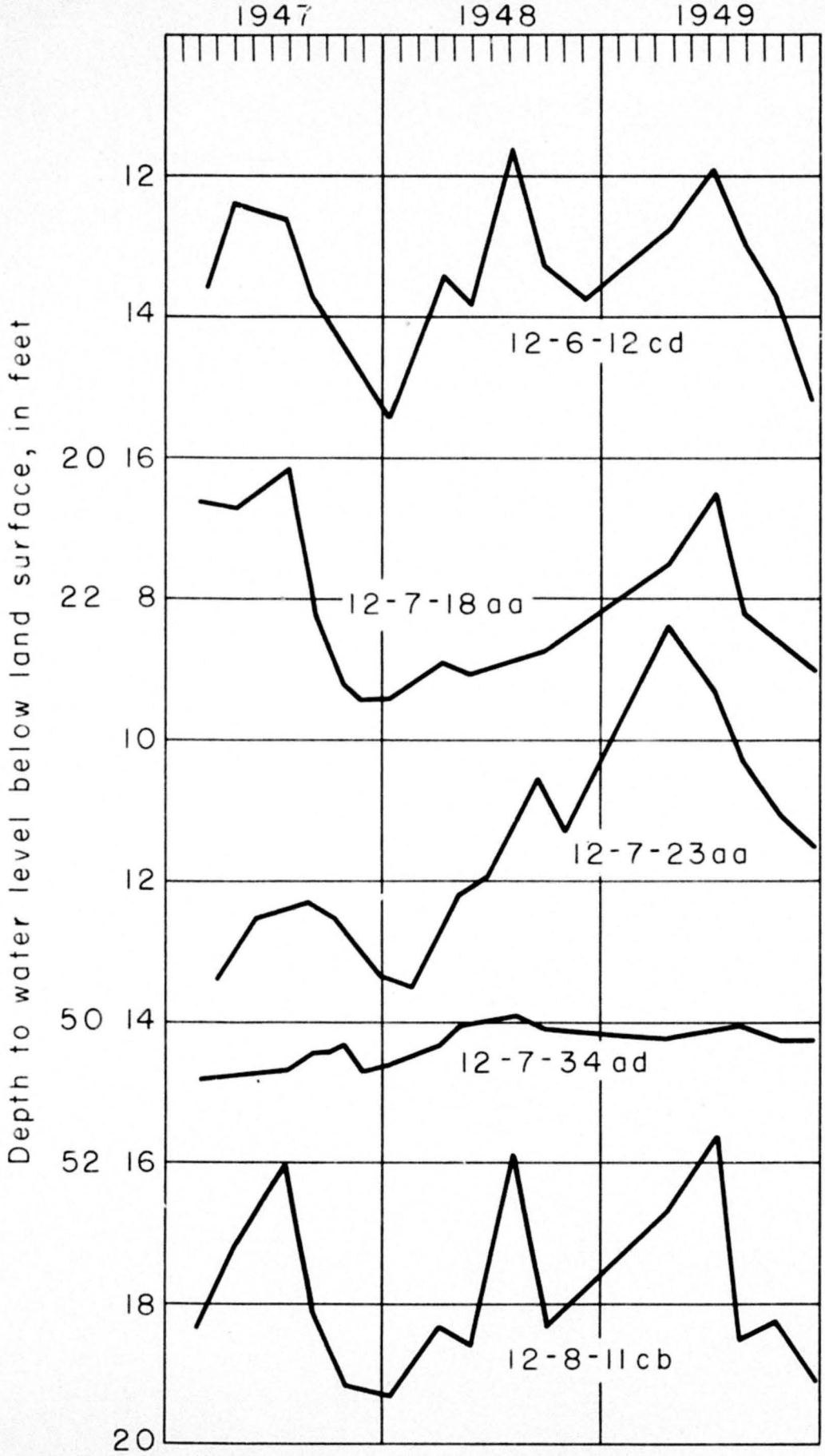

Figure 12.-Hydrographs of five wells, Wilson Unit