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ARTESIAN WATER IN THE ELKHART AREA, SOUTHERN ANDERSON COUNTY, TEXAS

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INTRODUCTION

Rural residents in the Elkhart area in southern Anderson County, obtain moderate supplies of fresh water from an artesian aquifer in the Queen City formation. The water is confined in a sand at depths ranging from 47 to 95 feet below land surface and is under sufficient artesian pressure to produce flowing wells. Wells, seismic shot-holes, and springs in areas below elevation 384 feet (datum mean sea level) consequently discharge artesian water by free flow unless they are capped.

The Board of Water Engineers received written complaints from Mr. J. A. Perry stating that Mr. Scaly Sowell, tenant on Joe Spivia's farm, permitted a well (Well 1, table 2 and figure2) to flow without making beneficial use of the water. Also a citizens' committee, headed by Mr. D. E. Leatherwood, visited the Board's office in Austin and requested that an investigation be made on the above mentioned complaints.

The Board of Water Engineers authorized this investigation under Article 7601, Volume 21, Vernon's Civil Statutes of the State of Texas to determine if the law was applicable. The area was visited October 16, 17, and 18, 1956 in company with Mr. George La Bounty, Investigator for the Board. The area considered in this report is about 28 square miles in the vicinity of Elkhart (figure 1). The occurrence of artesian water in the upper sand of the Queen City formation and related conditions of recharge, discharge and use are described. Unconfined water in the shallow subsurface and confined water in

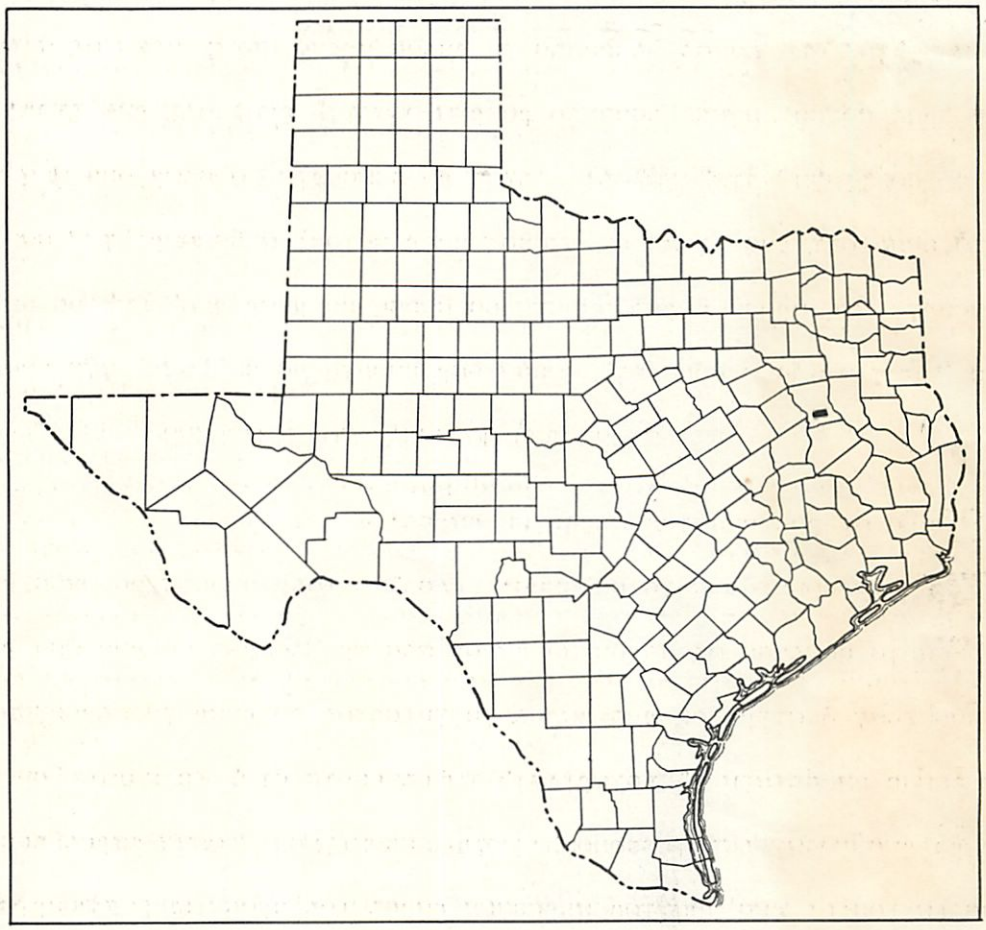

Figure 1.- Index map of Texas showing area covered by this report

formations below the Queen City sand are considered briefly. All known wells, shot holes and springs that discharge ground-water for non-beneficial use are located on Figure 2 and information about them is given in table 2.

GEOLOGIC SETTING

The area lies near the axis of the East Texas syncline, a regional, structural trough plunging southwest. A sequence of Eocene sedimentary formations consisting of persistent and lenticular beds of sand, clay and shale occupy the trough (figure 3). Near the trough axis the sequance has an aggregate thickness of more than 3,200 feet. Only formations of the Claiborne and Wilcox groups were studied in this investigation. Information concerning rock types and their water bearing characteristics are given in table 1. The Midway group is excluded from this study because it is not important as a water-bearing formation.

The Queen City formation forms rolling sand covered hills over all of the Elkhart area. The surficial sand of the Queen City is 5 to 15 feet thick; it grades into a sandy clay and then to a tight clay 40-75 feet thick. Below this clay there is 30-50 feet of artesian water sand. Two other distinct sand layers, separated by clay or shale, are reported in the Queen City formation.

The Reklaw formation is about 100 feet thick. It lies between the Queen City and the Carrizo formation. The Carrizo, a predominantly medium-grained sand, 150-165 feet thick, produces good quality water locally. Oil is produced from the Carrizo sand near Elkhart.

The above formations, are underlain by those of the Wilcox group. In table 1, the Wilcox group includes three formations, but as a practical matter no

Table 1.- Rocks of Eocene age, except the Midway group, in the Elkhart area

Group	Formation	Thickness	Physical character	Hydrologic Characteristics
Claiborne	Sparta	--	Loosely, cemented, well-bedded sand separated by thin layers of clay and silt. Soils derived are sandy.	Surface water infiltrates these sands rapidly and issues as springs, along the Weches contact. Shallow wells yield good water but are apt to go dry in a period of prolonged drought.
	Weches	70-100	Essentially dark green, glauconitic clay with beds of black and brown iron ore. Fresh exposures are rare; weathered exposures are deep red in color. The rocks resist erosion and form steep ridges and hills in parts of East Texas.	Has very low permeability-yields only small amounts of highly mineralized water.
	Queen City	400-500	Medium to fine-grained, gray sand layers interbedded with silty clay and shale; sandy soils characterize surface exposures. Locally lenses of lignite are present.	Sand layers produce large supplies of potable water. Unconfined water in the outcrop near the Weches contact is highly mineralized and contains objectionaal amounts of iron. Confined water in sand beds yield artesian water of good quality.
	Reklaw	100-125	Chiefly stratified layers of chocolate-colored shales; thinly laminated, fine-grained sandstone near the base.	Contains little or no ground water. Important as the upper confining bed for the Carrizo sand.
	Carrizo	150-165	Chiefly medium-grained sand and locally lentils of clayey sand. In some places contains considerable ferruginous(iron) material	Yield large quantities of fresh water to the Elkhart City well. This water is rather high in iron and sometimes contains a little oil. Five miles east of Elkhart, oil produced from the Carrizo.

Table 1.- Rocks of Eocene age, except the Midway group, in the Elkhart area--Continued

Group	Formation	Thickness	Physical character	Hydrologic Characteristics
Wilcox	Sabinetown	1850-2000	Massive and lenticular sands interbedded with clay and shale. Lentils of black lignite locally.	Permeable layers contain large amounts of water under artesian pressure which has not been developed in the Elkhart area.
	Rockdale			
	Seguin			

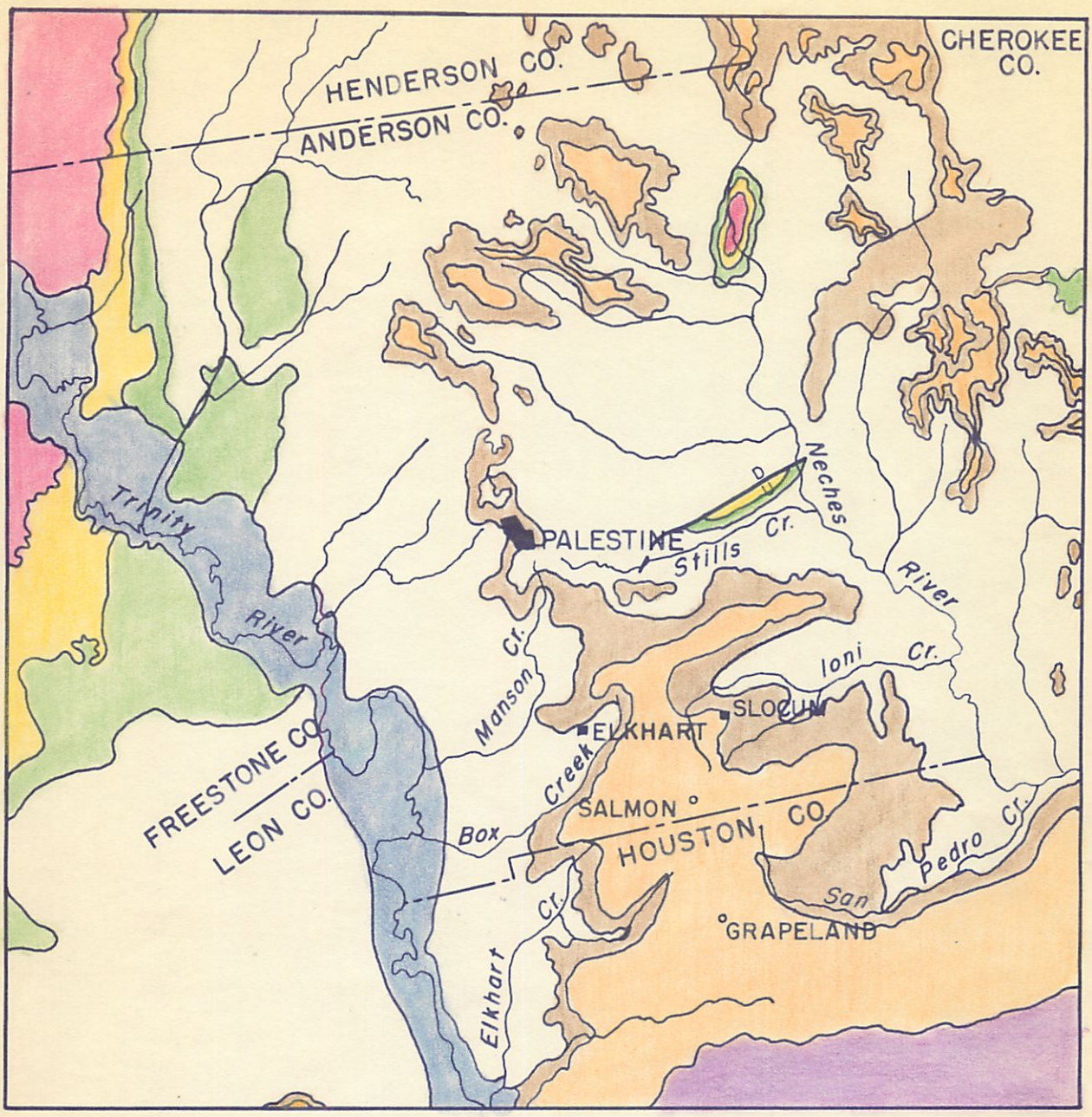

FIGURE 3

GEOLOGIC MAP OF ANDERSON COUNTY AND PARTS OF ADJACENT COS.

SCALE: 1" = 8 MILES APPROX.

LEGEND

- Alluvium
- Queen City Formation
- Cook Mtn. Formation
- Reklaw Formation
- Sparta Formation
- Carrizo Formation
- Weches Formation
- Wilcox Group

distinction is made by drillers in the Elkhart area. The Wilcox group is 1,850-2,000 feet thick and consists principally of massive sands interbedded with clay and shale. Some beds of sand in the Wilcox are permeable and thus are potential sources of water supply for the Elkhart area.

The Elkhart graben is the major structural feature in the area. The graben was mapped by E. H. Sellards and Leo Hendricks, (1946, Structural Map of Texas) by contouring the Georgetown limestone between elevations of 5,000 to 6,000 feet below mean sea level. Contours drawn on the top of the Carrizo sand, shows this same general trend of major faulting (Figure 4). Mr. Dale Shroyer of Crockett Drilling Company and Mr. Gibson of Gibson Drilling Company state that there are smaller faults associated probably with the major faults of the Elkhart graben.

The two major faults trending west-southwest, that define the graben, also form the northwest and southeast boundaries of the shallow artesian reservoir. One is about 3½ miles northwest and one about 2½ miles southeast of Elkhart. Both Mr. Gibson and Mr. Shroyer believe that the Elkhart graben has downdropped about 50 to 100 feet relative to its bounded sides, and that northeast of the city the rock formations slope southwest into the graben to form a small monocline. Farther east near the town of Slocum this monocline forms a structural trap which contains oil in the Carrizo sand at depths ranging from 450 to 480 feet below land surface.

GROUND-WATER OCCURRENCE

Ground water in the Elkhart area occurs in a small unconfined (water table) aquifer and several shallow and deep confined (artesian) aquifers. Water levels in the unconfined aquifer are near land surface, the depth depending upon the topographic situation. Water table measurements of 8.25 feet below the land surface were obtained in wells 31 and 32 (table 2). Reportedly it is deeper at higher land

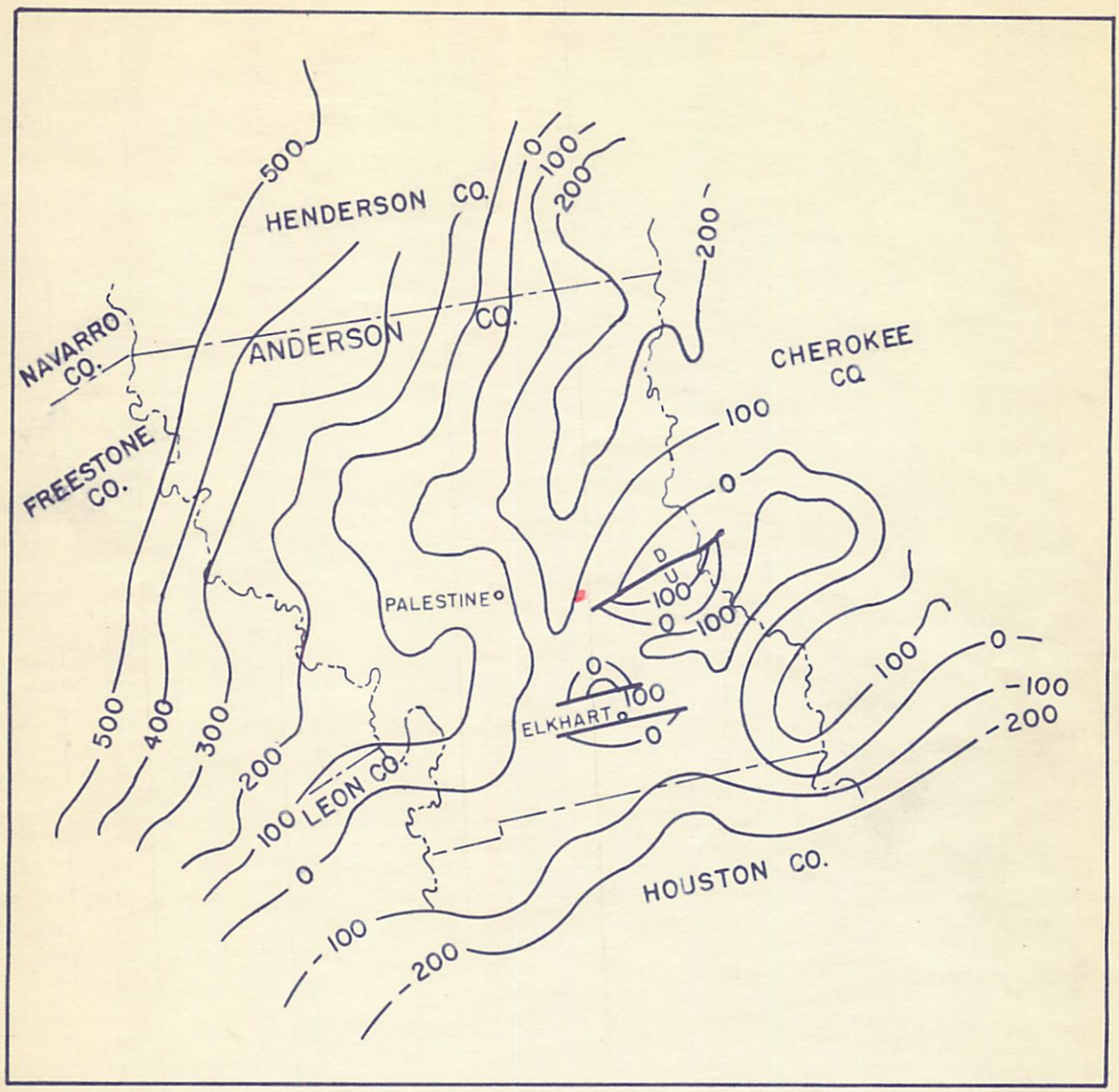

FIGURE 4

STRUCTURAL MAP OF ANDERSON COUNTY AND PARTS OF ADJACENT COS.

SCALE: 1" = 12 MILES APPROX.

CONTOURS ON TOP OF CARRIZO SAND

CONTOUR INTERVAL 100'

(DATUM MEAN SEA LEVEL)

elevations. Water in a shallow confined aquifer is under sufficient artesian head to produce flowing wells in areas in which the surface elevation is below 384 feet above mean sea level.

Precipitation and runoff temporarily saturate surficial deposits of sand underlain by impermeable clay. Wells tapping these surficial sands go dry in periods of drought. Water in the shallow sands contains objectionable quantities of iron which presumably are derived from the Wesches formation. Reportedly it stains plumbing fixtures and containers a deep red.

The artesian aquifer of concern in this investigation is in the upper part of the Queen City formation. This aquifer is a gray, poorly cemented, medium-grained sand, about 30-50 feet thick, and is confined above and below by clay layers. The artesian reservoir thus formed is defined also by structional conditions because it occupies the Elkhart graben. Its northwest and southeast sides are bounded by faults of the graben. Well 12 which is south of the southeast fault, encounted the first good water sand at 370 feet below land surface according to the driller, Mr. Dale Shroyer. Outside of the graben near Slocum, Gibson Drilling Company found no usable water to a depth of 280 feet in the Queen City formation. Two other sand layers are present in the Queen City formation in the Elkhart area but data concerning their hydrologic conditions are not available.

The hydraulic gradient is southwest hence ground water moves southwest from the area of recharge to points of discharge. The recharge area lies about 6 to 12 miles northeast of Elkhart where the sand is exposed at higher elevations but its areal extent is not known. The sources of recharge are direct precipitation

and water from seeps and springs that issue at the Sparta-Weches contact above the Queen City formation.

No samples of the artesian water were obtained in this investigation. Mr. Thomas, Mayor of Elkhart, reported that analyses of water samples from well 2 indicated that its utility was limited only by the high iron content (about 1.5 ppm). The quality of the artesian water makes it more desirable for most uses than the unconfined water which prior to 1949 had been the principal source of domestic and stock supplies.

The Carrizo sand and sandsof the Wilcox group are fresh water aquifers. However, because of expense of deep drilling, these sands are not tapped in this area except for municipal supply at Elkhart.

DISCHARGE AND USE OF ARTESIAN WATER

Prior to 1949, the artesian water discharged only from springs and from two very old shot holes, 23 and 24. Local residents were unaware that good quality artesian water could be reached at a depth of 100 feet until a seismic crew in 1949 drilled shot holes through the producing sand and abandoned them open, uncased and some flowing. Since this date, several wells have been drilled into this aquifer (table 2).

Much of the water discharged is not beneficially used. Shot holes 15 through 24 are on right-of-way of Farm to Market road 1817 and an unnumbered dirt road. Shot holes 13, 14, and 25 are privately owned. Water discharged from shot holes 23 and 24 supplies many people in the area who transport the water

to their homes in barrels.

Wells 3 and 6 are not capped and flow continuously. Well 1 is capped and was shut in at the time of the investigation. Mr. J. A. Perry reported in his letter of complaints that well 1 was allowed to flow for long periods for no apparent beneficial use.

Mr. J. A. Perry and Mr. George Hutton use artesian water from wells 2 and 7 to maintain storage in fish ponds. Mr. Sealy Sowell and Mr. C. L. Howell irrigate with water from wells 1, 4 and 5. The remainder of the wells in the area supply water for stock and domestic use.

Reportedly artesian pressure in the aquifer has steadily declined in the last few years and presently the flows of many of the wells are only about one-half of what they were two years ago. Some wells and springs have ceased to flow. The effect of increased discharge and deficient preciptation in the present drought which began in 1950, has caused a decline in the artesian head of the aquifer. The combined flow of the springs observed is estimated at 125 gpm (gallons per minute). The amount of artesian water discharged annually from wells, shot holes and springs is estimated to be about 865 acre feet. Data concerning the aerial extent and hydrologic properties of the intake and catchment areas are lacking. According to records of the U. S. Weather Bureau from the Palestine precipitation station, Anderson County, the average annual deficiency in normal precipitation since 1951 has been 8.03 inches.

SUMMARY

The shallow artesian aquifer of the Queen City formation is small and has a small recharge in the Elkhart area. The artesian head has declined due to increased discharge from wells and shot holes, and decreased recharge from precipitation in the present drought.

Some of the well owners believe some of the discharge is not used beneficially and have requested that the Board of Water Engineers control the alleged waste. There are two wells and 13 shot holes that discharge water by free flow.

Conservation of the shallow artesian water for stock and domestic uses is important to the local rural economy. The unconfined ground-water reservoir in these surficial sands underlain by relatively impermeable clay is not dependable. Moreover the chemical quality of the water is inferior to that in artesian reservoirs. Other dependable sources of artesian water are at greater depths and their development would entail considerable expense. Every effort should be made therefore to eliminate waste of the shallow artesian water.

SUGGESTED CONSERVATION MEASURES

Wells 3 and 6 are adequately cased but should be capped. All shot holes that supply domestic and stock water should be cased so that they may be capped when not in use. To shut off the flows of unused shot holes, a cement plug can be spotted in the upper confining clay layer. Prior to cementing operations mud should be pumped into the holes under pressure to temporarily shut off the flow. The usual method of applying mud under pressure is through the drill stem of a rotary drilling rig and any local driller with a light rotary rig should be able to perform the mudding operations. It is suggested that a specialized cementing firm do the cementing.

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Table 2.- Partial record of wells, springs and shot holes in the Elkhart area, Anderson County

No. [1]	Owner	Driller	Date completed	Depth (feet)	Diameter of casing (in.)	Land surface elevation (feet above msl)	Depth to water from land surface (10-16&17,1956) [2]	Use [3]	Remarks
1	Joe Spivia	Crockett Drilling Co.	1954	119	7	340	flows	Irr	Estimated flow at 100 gpm; capped; open end pipe.
2	J.A. Perry	Frank Laird	1952	110	6	345	flows	FP	Estimated 90 gpm flow; capped.
3	W.F. Knott	do.	1954	110	2	380	flows	D	Has flowed 2 years without shut-off valve. Flows 12 gpm(Reported one-half of original flow)
4	C.L. Howell	do.	1952	102	2	380	flows	Irr	Estimated 5 gpm flow; open end pipe; capped.
5	do.	do.	1952	100	2	385	4 ft[F]	Irr	Well flows at pipe joint 4 feet below land surface; capped.
6	W.F. Knott	--	1954	80	4	378	flows	D	Small flow and not capped.
7	George Hutton	--	1949	70	4	370	flows	FP	Capped. Small flow.
8	do.	--	1955	126	2	370	--	D	Reportedly flowed 20 inches above pipe when drilled. Has electric pump.
9	C.L. Howell	Frank Laird	1952	47	2	402	11 ft[F]	D	47 feet to artesian sand; Screened below 47 feet. High iron content reported.
10	Mann Sewell	--	1955	95	4	386	1.35ft[M]	D	Electric pump.
11	D.E. Leather-wood	Frank Laird	1953	66	2½	380	1.5 ft[F]	S	Water level 14 inches below land surface when drilled.
12	Otto Galm	Crockett Drilling	1956	393	--	460	108 ft[F]	S	In Queen City formation but may not be same as of flowing wells. Log obtained.
13	W.F. Knott	--	--	--	--	383	flows	S	Shot hole; small flow not cased.
14	Jim Houston	--	--	95	--	380	flows	S	Shot hole; estimated 50 gpm flow; not cased.

Table 2.- Partial record of wells, springs and shot holes in the Elkhart area, Anderson County--Continued

No. 1/	Owner	Driller	Date completed	Depth (feet)	Diameter of casing (in.)	Land surface elevation (feet above msl)	Depth to water from land surface (10-16&17,1956) 2/	Use 3/	Remarks
15	Right-of-way of Farm to Market Road 1817	--	--	--	--	340	flows	N	Shot hole; estimated 50 gpm flow. Water pipe under road to flow to fields of Ivan Cambage. Not cased.
16-22	do.	--	--	--	--	340-360	flows	N	(7) shot holes; estimated 20-50 gpm flow each, not cased.
23-24	Right-of-way of unnumber dirt road	--	--	--	--	260-240	flows	D	(2) shot holes; estimated 3 gpm flow; not cased.
25	Braden Warren	--	1956	--	--	290	flows	S	Shot hole reported to be flowing in pasture; not cased. Not visited.
26	V.M. Howell	--	--	--	--	395	11.25 ft[m]	N	Open shot hole in field; water is from artesian sand.
27	McCracken Heirs	Spring	--	--	--	380	-- SP	--	Spring at head of Box Creek. Estimated 30 gpm flow.
28	do.	do.	--	--	--	375	-- SP	--	Spring near head of Box Creek. Estimated 50-100 gpm flow.
29	--	do.	--	--	--	300	-- SP	S&D	Spring feeding Manson Creek.
30	Wilson	do.	--	--	--	310	-- SP	--	Spring feeding Parker Creek.
31	Mann Sewell	--	Old	18	48	388	8.25 ft[m]	N	Dug well in unconfined water in Queen City formation. Highly mineralized.
32	C.L. Howell	--	Old	22	48	385	8.25 ftm	N	Do.

1/ Numbers 1-11 are wells tapping the upper artesian sand of the Queen City formation; number 12 is in Queen City but may not be in the same sand as above wells; 13-26 are uncased shot holes, producing water from same sand as wells 1-11; 27-30 are springs supplied with water from same sand; 31 and 32 are water-table wells.

2/ m means the water levels was measured; r represents a reported depth to water.

3/ D, domestic use; FP, water used to fill fish pond; Irr, irrigation; N, no beneficial use of water; S, water for stock.

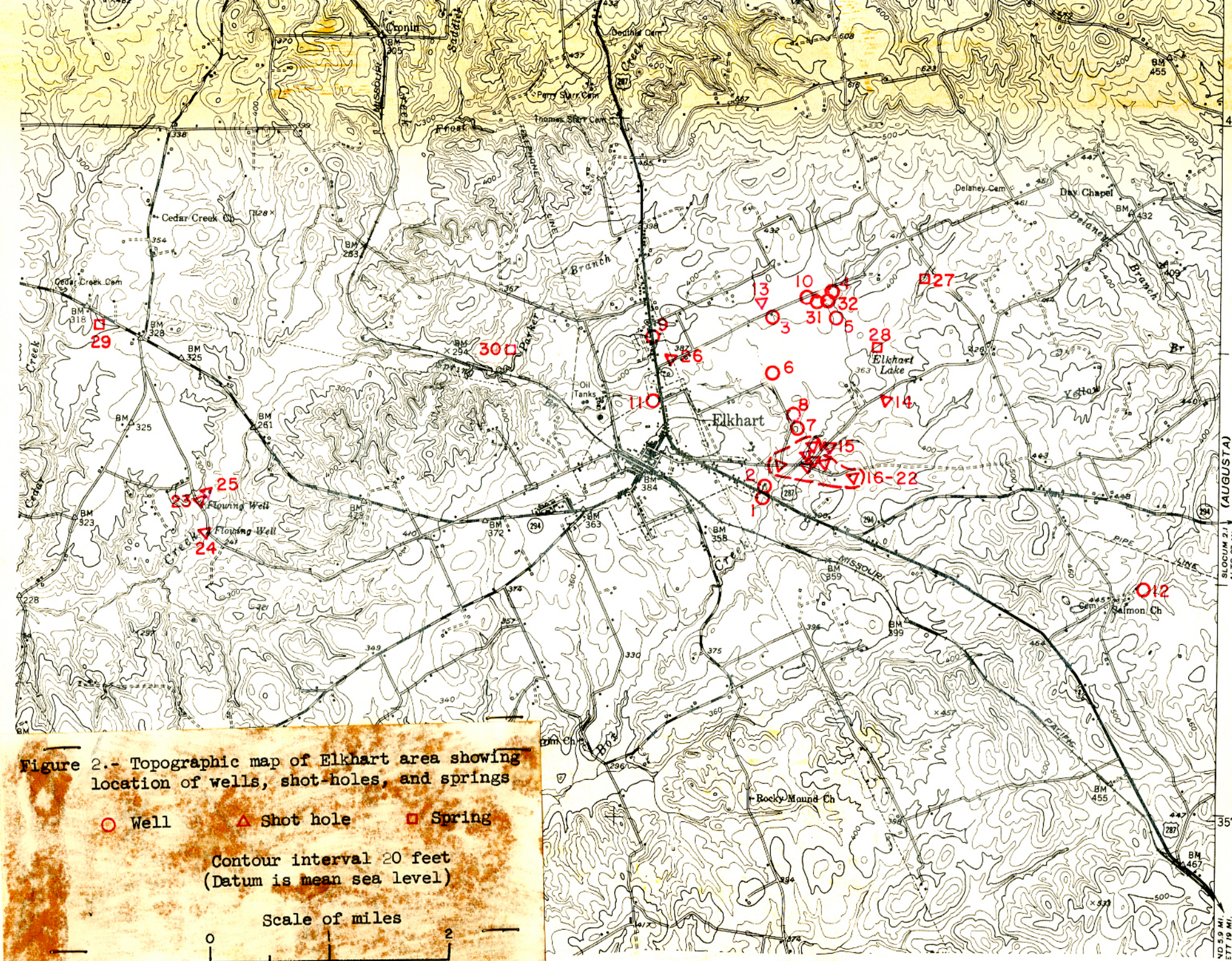

Figure 2.- Topographic map of Elkhart area showing location of wells, shot-holes, and springs

○ Well △ Shot hole □ Spring

Contour interval 20 feet
(Datum is mean sea level)

Scale of miles
0 2