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GROUND WATER IN THE BLANCHARD AREA, McCLAIN COUNTY, OKLAHOMA

By Leon V. Davis and Stuart L. Schoff

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Prepared in cooperation between the U. S. Geological Survey
and the Oklahoma Geological Survey

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Purpose and Scope

A letter from Lloyd L. Bowser, City Clerk, dated January 8, 1948, in behalf of the town council and Mayor Walter Casey, indicates that a serious shortage of water is faced by the town of Blanchard, McClain County, Oklahoma. The town is near the eastern boundary of Grady County, where an investigation of the ground-water resources is being made by the Oklahoma Geological Survey in cooperation with the U. S. Geological Survey as part of a State-wide investigation. Information obtained thus far may aid the town by showing where additional ground water for municipal supply may be sought.

Field Work

Information relating to the present water facilities was provided by Water Superintendent Wheless. The description of the geology of the area is based on the State geologic map, on a brief preliminary examination of the area by both authors, and on several days spent by Mr. Davis in mapping the outcrops of beds of sandstone and collecting samples of water, and in studying the aerial photographs (on which the map with this report is based). Mr. Davis also made the laboratory analyses of the sandstone samples.

Present Water Supply

The town of Blanchard, which in 1940 had a population of 1,139, is in west-central McClain County within a mile of the Grady County line, in an area of gently rolling topography. It is near the crest of a ridge in the drainage basin of Walnut Creek. Its present water supply comes from wells in the alluvium along a small tributary of Walnut Creek immediately east of the town, which heads only about half a mile north of the northern town limit. There are two groups of wells, as follows:

a. Two wells about half a mile northeast of the main intersection in Blanchard are in the NE¼NE¼NE¼ sec. 30, T. 8 N., R. 4 W. The older of these is a dug well about 35 feet in depth and 12 feet in diameter, and has several laterals radiating from the central shaft at a depth of about 6 feet below the surface. The other is a drilled well, completed in 1946, with 8-inch casing and gravel walls about 16 inches thick. A partial log of this well shows clay and shale from 7 to 18 feet and coarse sand from 18 feet to the bottom at 39 feet. The static water level is reported to be about 4 feet below the surface.

b. Two new wells, completed in 1946, are about half a mile southeast of the main intersection, in the NW¼NW¼ sec. 32. The wells have 8-inch casing, with gravel walls 16 inches in thickness. In preparation for their construction, 22 test holes were drilled in an area of about an acre. Logs of two of these test holes are given at the end of this report. Initially the yield of the wells was good, but the ground-water reservoir in the alluvium of the creek appears to be small and was speedily overpumped, so that in January 1948 the maximum yield of the wells was 35 to 40 gallons per minute for a period not exceeding 21 hours.

The drainage area upstream from the lower group of wells is about 1.5 miles in length and 0.25 to 0.5 mile in width, making the maximum area contributing to any of the wells about half a square mile (320 acres).

Formerly, water was obtained from three wells about 80 feet deep in the bed rock, within the town limits. These wells were equipped with small pumps, and although the yields were low, the water was of good quality. They have been abandoned because of mechanical failure or for other reasons. Also, a deep test well was drilled to about 1,500 feet, but it yielded salty water.

Water Requirements

As reported by Water Superintendent Wheless, the average water consumption of Blanchard is about 45,000 gallons per day, which is 31 gallons per minute. The maximum demand is about 55,000 gallons per day, or 38 gallons per minute.

Water in Bedrock Formations

Blanchard is on the outcrop of red-bed formations of Permian age, consisting principally of shale with some layers of fine-grained soft sandstone, which in general will yield only small quantities of water. The sandstone beds are lenticular, and although such beds may be 15 or 20 feet in thickness and may be traceable for several miles, they become thinner in one direction or another, and somewhere not very far distant they disappear into the surrounding shale.

The hill slopes in the vicinity of Blanchard expose three distinguishable zones of sandstone and shale whose distribution is shown on the Areal Geologic Map (fig. 1). The lowest zone is mainly sandstone, and the other two consist of shale grading upward into sandstone, as illustrated and described in figure 2. The tops of the sandstones are rather definite, but the bottom contacts are not clear-cut because of the gradual transition from shale into sandstone.

The lowest zone is about 15 feet in thickness, and underlies nearly all of Blanchard, and may have furnished most of the water pumped from the former 80-foot wells.

The middle zone is about 30 feet in thickness, approximately half of which may be sandstone capable of yielding water to wells, and it may have furnished some water to the former 80-foot wells.

The upper zone is about 45 feet in thickness, of which about half may be sandstone capable of yielding water to wells, but in Blanchard it is only a thin, narrow tongue of negligible capacity, readily drained by seepage, evaporation, and plant use along its outcrop. It probably furnished no water to the 80-foot wells.

The sandy parts of these beds appear to be the most promising of the bedrocks of the area, but they are hardly first-class aquifers. An obvious drawback is the smallness of their intake areas, occasioned both by their thinness and by the steepness of the slopes on which they crop out. Another drawback is their fine texture. When several samples were broken down in the laboratory and sieved, it was found that the largest single fraction is fine sand (0.25 to 0.125 mm.), but with one exception this fraction is less than 50 percent of the sample, (table 1, at end). The second largest fraction is very fine sand (0.125 to 0.062 mm.). The fine grains mean small openings between grains, much frictional resistance to the passage of water, and low yield per foot of drawdown.

Near Blanchard, furthermore, these sandstones are rather intricately dissected by the many creeks and ravines that drain into Walnut Creek, and hence along some parts of their outcrops they may lose much of the water recharged from precipitation. To penetrate all three layers of sandstone where they are not greatly dissected, a well site would have to be about 2 miles west of Blanchard. Despite these drawbacks, it appears possible that enough a supply of water sufficient to meet the needs of Blanchard might be obtained from the sandstones by wells drilled to penetrate two or three of them where they are fully saturated and not too close to their outcrops. It should be noted that the old 80-foot wells apparently drew water mainly from the lowest sandstone, which makes up much less than half the total sandstone available.

The following paragraphs summarize a pumping test made by the Geological Survey in a well south of Chickasha in 1946, at the Ninnekah Compressor Station of the Oklahoma Natural Gas Company. Mr. Davis examined the sands from the water-bearing zone, and states that they are coarser than the sands of the Blanchard area. As other differences may be less readily apparent, it is clear that the results of the test cannot be applied blindly to the Blanchard area, but they are suggestive. The "Duncan sandstone" of the quotation is approximately equivalent to the sandy beds near Blanchard.

"A new well was drilled to a depth of 392 feet, casing being set and cemented from the surface to 339 feet. The top of the Duncan sandstone was found at 340 feet. The interval between 340 feet and the bottom of the hole was uncased, and included 34 feet of sandstone with shale layers totaling 18 feet.

"This well was pumped by gas-lift for 12 hours, and the discharge was measured by means of a weir box with a V-notch. During the first 20 minutes the discharge was about 80 gallons per minute, but it rapidly decreased during the next 20 minutes to 60 gallons per minute.

After five and a half hours of pumping, the discharge had dropped to 47 gallons per minute, thereafter remaining steady to the end of the test, although a further decrease might have occurred with protracted pumping. The average discharge for the 12-hour pumping period was slightly less than 50 gallons per minute.

"During pumping, the water level in a similar well was about 250 feet to the west of the pumped well was observed. The total drawdown in this well was 34.72 feet after 12 hours of pumping. An attempt to measure the drawdown in the pumped well failed because the discharge pipe was leaking. After pumping was stopped, the recovery of the water level in the observation well was recorded during a 12-hour period, at the end of which the water level had risen 29.56 feet.

"The drawdown and recovery curves were analyzed by the Theis non-equilibrium formula to obtain coefficients of transmissibility and storage, which are defined below:

"The coefficient of transmissibility is the amount of water in gallons per day that will move through a vertical cross section one foot wide with a height equal to the thickness of the aquifer, under a hydraulic gradient of 100 per cent.

"The coefficient of storage is the amount of water, in cubic feet, released from storage from a vertical column of the aquifer having a basal area of one square foot while the head declines one foot.

"These two coefficients are characteristics of the water-bearing formation, and they determine the shape of the cone of depression around a pumping well, the size of which is proportional to the discharge.

"A curve was prepared showing the theoretical drawdown in an infinite aquifer having a coefficient of transmissiblity of 500 and a coefficient of storage of 0.0000008 — approximately these determined in the pumping test — at several distances from a well pumping 50 gallons per minute for periods of one year, two years, and five years. This curve showed that after a year of continuous pumping the decline in water level would be 75 feet at a point 1 mile away and 62 feet at a distance of two miles. If a line of five wells spaced 1 mile apart were assumed, the drawdown in the middle well caused by pumping 50 gallons per minute each from the other four wells would be about 270 feet after one year. In addition, the pumping of the middle well would roughly double the drawdown, making the total about 540 feet. Such a drawdown, however, would not actually be attained, because the discharge would decline as the water levels went down."

The pumping test described above indicates that 50 gallons per minute is too much to expect for a protracted period from sandstones such as occur in the Blanchard area. It is likely that a sustained yield of 25 gallons per minute would be a maximum, and even so, the wells should be spaced far apart.

Ground water at greater depths. Below zone 1 of the section described above, the rocks to a depth of about 650 feet consist mainly of red shale, from which little water can be obtained. The shale is underlain by sandstones belonging to the zone that furnishes the public water supplies of Noble, Norman, Moore and Edmund, and many industrial and private water supplies in Oklahoma City, but at Blanchard the water in these sandstones is certain to be too saline for use, as indicated by the test hole drilled to a depth of 1,500 feet, which should have penetrated them but yielded salty water. This conclusion is also indicated by several wells that obtained poor water from the sandstones between Blanchard and the area where they yield good water.

Ground Water in Alluvium

Alluvium is the material deposited by a stream. It may consist of gravel, sand, and clay in any proportion, and it underlies the flood plain, or "bottom". It is generally thickest near the middle of a valley and thinnest where the flood plain adjoins the bluffs. It may be more than 100 feet in thickness along major rivers, but only a few feet along small creeks. In many places the alluvium is an excellent water-bearing formation, both because the coarser beds in it will transmit water freely and because replenishment of the ground-water supply is likely to be greater in the valley than in adjacent areas.

The coarsest portions of an alluvial deposit are best found by test drilling because the locations of the old buried channels usually cannot be predicted from surface indications. It is probable that no gravel, or at least very little gravel, is to be found in the alluvial deposits along Walnut Creek or its tributaries near Blanchard, because these streams cross areas underlain principally by shale and fine-grained sandstone, from which little gravelly material can be derived. Hence the coarsest materials are likely to be fine-to medium-grained sand similar to that found in the present water wells, which would yield only small supplies to wells. Special treatment, such as gravel packing, may materially increase their productivity.

The present wells of Blanchard appear to draw water principally from alluvium. This water comes from rain falling on the surface of the flood plain and from surface runoff from the adjacent slopes onto the flood plain. After seeping into the ground, the water moves by underflow in a downstream direction. It is lost when it has moved downstream beyond the lower wells. The principal difficulty with the present well system seems to be the small total capacity of the alluvium that has been tapped and the very limited drainage area feeding it. The total area from which water could drain into the alluvium tapped by the lower wells is only about half a square mile, or approximately 320 acres. The Areal Geologic Map (fig. 1) shows three larger areas of alluvium in the vicinity of Blanchard. Two of these are on branches of Walnut Creek, respectively about 1 and 2 miles south of town, and the third is Walnut Creek 2½ to 3 miles north of town. The first two alluvial localities range from a quarter to a third of a mile in width and the deposits are of undetermined thickness. The contributing drainage areas have not been estimated, but obviously are much larger than that above the present wells.

The third area is the largest, having alluvium from a half to three-quarters of a mile in width, and a drainage area upstream from the east line of sec. 7, T. 8 N., R. 4 W., that totals about 19,000 acres (fig. 3). Considering the probable thickness of the water-bearing materials, their capacity, and the size of the contributing drainage area, this is the most favorable locality in the Blanchard area.

Quality of Water

Samples of water from wells tapping the bedrock sandstones and from the alluvium of Walnut Creek have been submitted to the Quality of Water laboratory of the Geological Survey in Stillwater, Oklahoma. The results will be available at a later date. Meanwhile, it is clear that the water from the sandstone is at least potable, as it is used on farms, and the water in the alluvium should be similar to that now used by Blanchard.

Conclusions

The bedrocks in the Blanchard area may provide some additional water if adequately prospected, but they do not appear to be a very promising source for large quantities of water.

The alluvium along the creeks appears to be a more promising aquifer. Two alluvial deposits receiving replenishment from areas much larger than those contributing to the present municipal wells are available within 2 miles south of Blanchard, and the alluvium along Walnut Creek about 2½ miles north of town is even more promising inasmuch as it receives drainage from an area of about 19,000 acreas. The Walnut Creek alluvium, if it is permeable, should supply water more than adequate for the present requirements. In developing wells in the alluvium, the main problem will be that of constructing wells so as to obtain satisfactory yields from fine sand.

WELL LOGS

1. Log of test hole in the lower well field, NW¼NW¼ sec. 32, T. 8 N., R. 4 W.), about 8 feet from completed water well 1. Drilled in 1946 by the Sawyer Drilling Company.

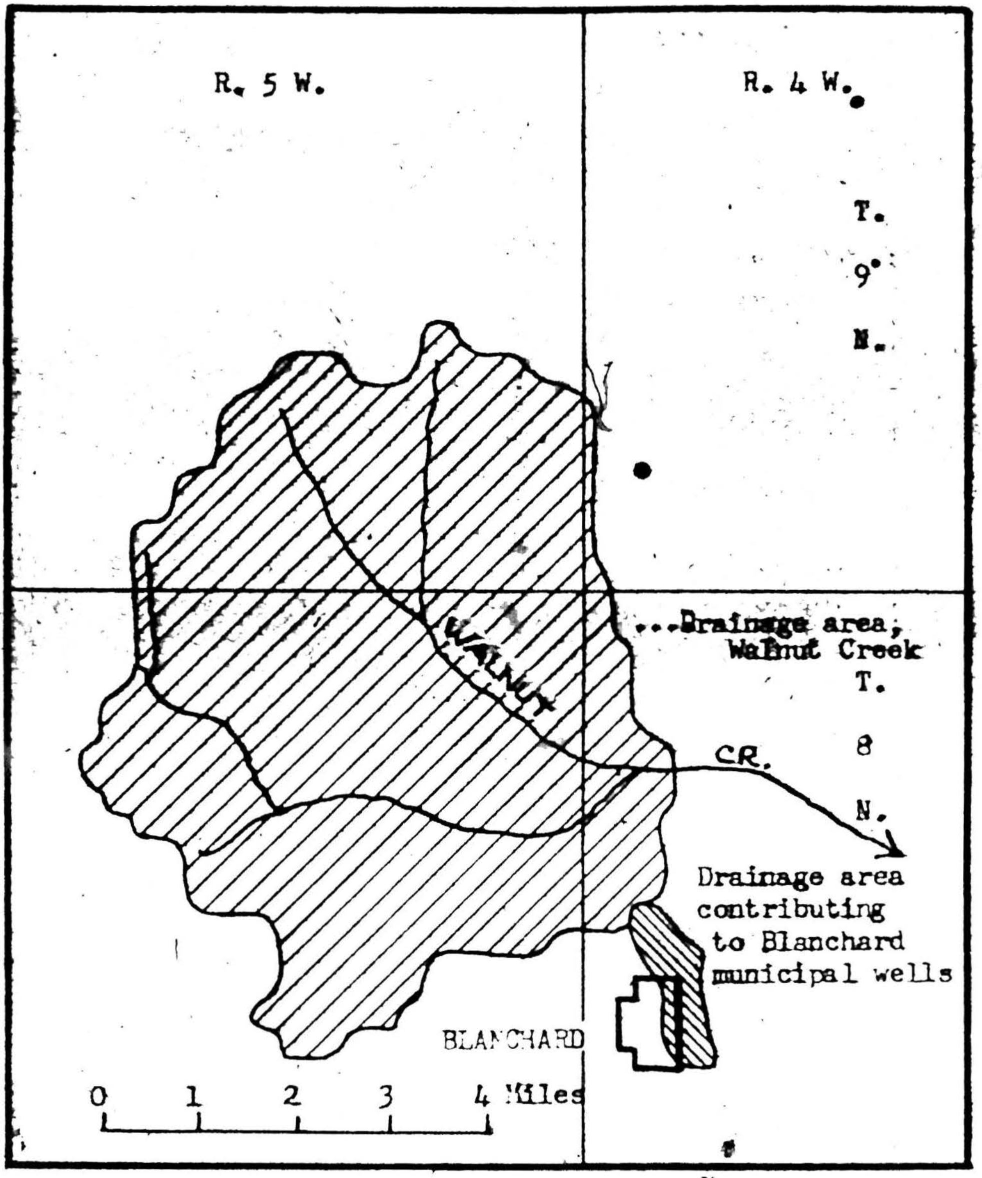
	Thickness (feet)	Depth (feet)
Muck	15	15
Sand, fine to coarse	37	52
Red bed	..	52

2. Log of test hole in the lower well field, (NW¼NW¼ sec. 32, T. 8 N., R. 4 W.), southeast of completed water well 1. Drilled in 1946 by the Sawyer Drilling Company.

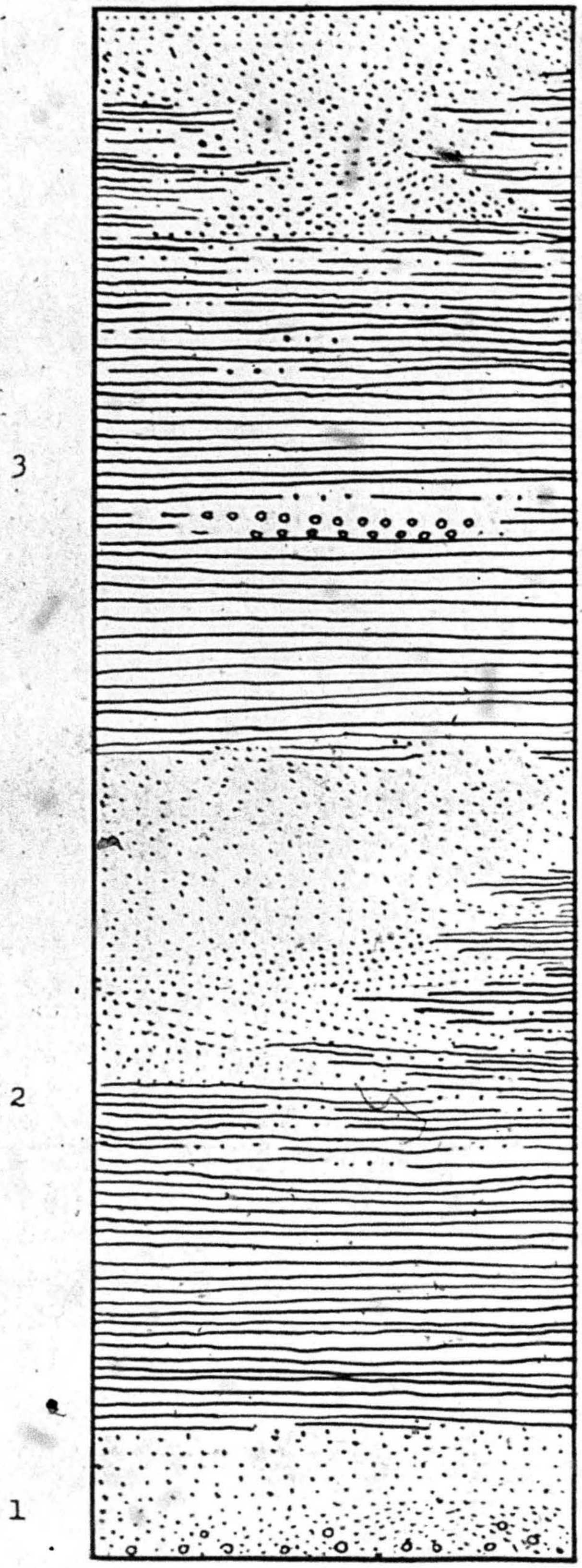
	Thickness (feet)	Depth (feet)
Sand, fine	57	57

Table 1. Sieve analyses of sands from the Blanchard area, in percent by weight

Sample No.	Zone	Grain sizes, in millimeters: Coarse sand 1.0-0.5	Medium sand 0.5-0.25	Fine sand 0.25-0.125	Very fine sand 0.125-0.062	Silt and clay Less than 0.062
D-9	3	2.77	14.58	70.22	9.14	3.28
D-1	3	10.83	10.93	28.29	34.15	15.81
D-3	2	6.92	17.11	36.41	30.46	9.10
D-10	2	2.44	20.77	56.94	16.32	3.53
D-11	2	4.95	19.57	45.91	23.66	5.91
D-14	2	24.25	17.71	33.80	15.09	9.16
D-12	2	4.79	12.59	37.46	33.61	11.55
D-13	2	6.12	13.04	52.88	21.13	6.84
D-15	2	3.49	5.60	33.88	38.48	18.55
D-8	2	7.20	11.24	48.99	26.89	5.68
D-4	2	4.14	8.81	39.72	36.78	10.56
D-7	1	0.00	7.49	78.63	11.34	2.53
D-6	1	2.92	17.37	55.47	21.31	2.92
D-5	1	0.00	17.39	65.98	12.10	4.54



Comparison of the drainage area contributing to the present water wells of Blanchard with the drainage area of Walnut Creek upstream from the east line of sec. 7, T. 9 N., R. 4 W.



ZONE 3. Shale, sandy, yellow to buff, grading upward into cross-bedded, fine-grained, light reddish-buff sandstone, which where best developed amounts to about one-third of the total thickness. At about one-third of the distance above the base, there is locally a lenticular claystone conglomerate that is not water-bearing. Mechanical analyses D-1 and D-9 represent this zone.
THICKNESS, about 45 feet.

ZONE 2. Shale, sandy, yellow to buff, grading upward into cross-bedded, fine-grained, dark reddish-buff sandstone, which where best developed amounts to about half the thickness of the zone. Mechanical analyses D-3, D-4, D-8, D-10, D-11, D-12, D-13, D-14, and D-15 represent this zone.
THICKNESS, about 30 feet.

ZONE 1. Sandstone, conglomeratic and cross-bedded in lower part, even-bedded and fine-grained in upper part. Mechanical analyses D-5, D-6 and D-7 represent this zone.
THICKNESS, about 15 feet.

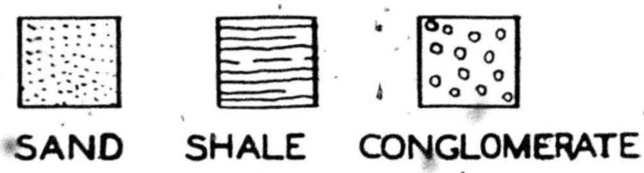


Figure 2. Generalized geologic section, Blanchard Area, Grady County, Oklahoma

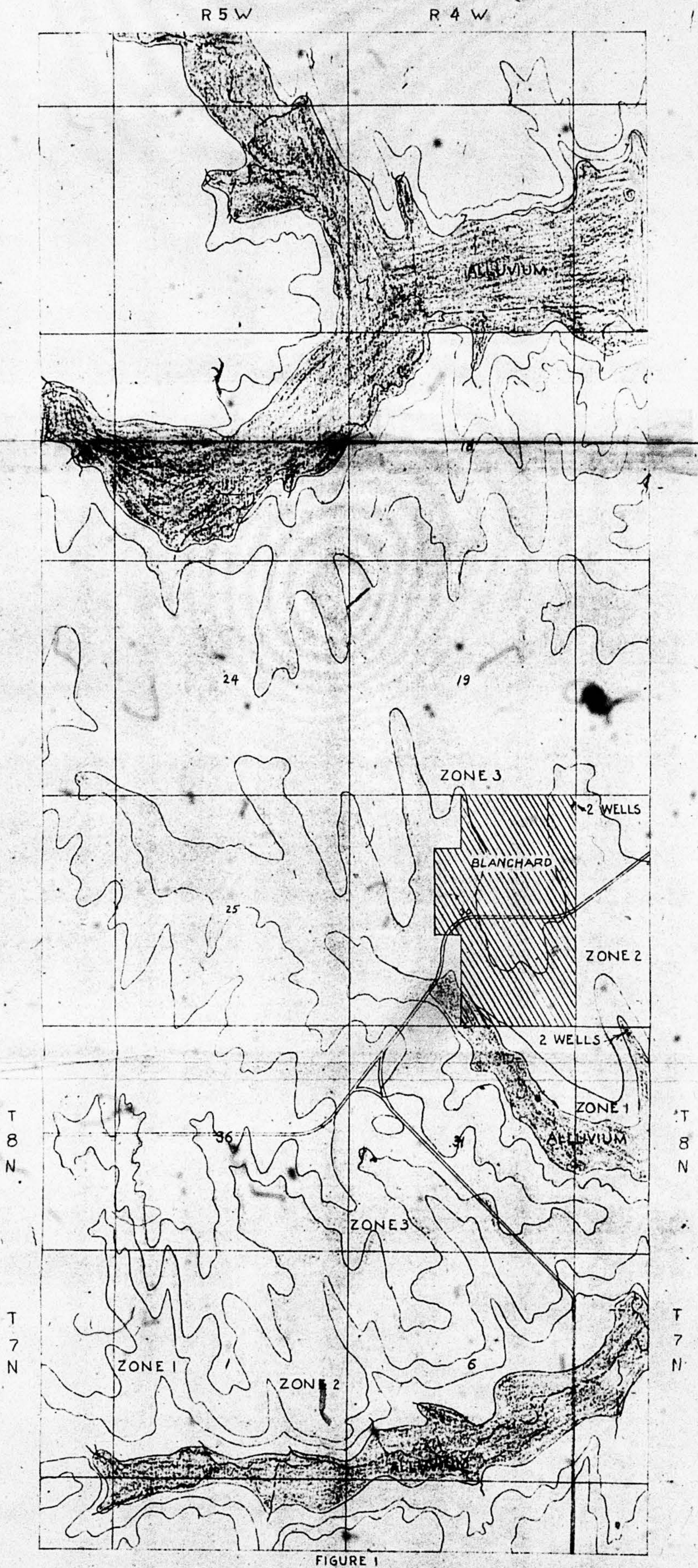


FIGURE 1

AREAL GEOLOGIC MAP BLANCHARD AREA