INTRODUCTION

Ground water is the major source of water supply in Beaver County. Because of the rapidly increasing demand for the limited supply of water for irrigation, additional geologic and hydrologic data are needed for management of ground-water resources. This report presents general information on the availability of ground water, on the chemical quality of water, and on streamflow. The chemical quality of water generally is poorer than that of water elsewhere in the Oklahoma Panhandle, and the ability to obtain good quality water may become increasingly difficult as the water resources are developed.

Further studies are needed to determine the annual change in water levels, the rate of water-level decline in heavily pumped areas, the volume of water stored in the ground-water reservoir, and the quantity of water that may be withdrawn safely in a given area.

TOPOGRAPHY

Beaver County is part of the High Plains section of the Great Plains physiographic province. In Beaver County, the High Plains surface is gently undulating to flat, slopes generally to the east at about 10 feet per mile, and is broken by only a few large streams. Elevations in the county range from 2,960 feet at the southwest corner to 2,000 feet at the northeast corner.

HYDROGEOLOGIC MAP

The Ogallala Formation is the dominant surficial deposit and principal aquifer in Beaver County. The Ogallala is relatively thin in the county, and is breached in many places, particularly along tributaries of the Beaver River. Where streams have eroded the Ogallala, the underlying Permian red beds crop out in elongate patterns paralleling the stream channels.

Dune sand ranks next to the Ogallala in areal distribution and is most common north of the Beaver River. The prevailing southerly winds blow the sand from the flood plain onto the north slope of the Beaver River valley. Dunes covering the uplands farthest from the river are most stabilized by vegetation. Local relief on the dunes may be as much as 50 feet.

Alluvium generally is limited to Kiowa Creek and the Beaver and Cimarron Rivers. Locally the alluvium is a significant source of ground water, particularly along Kiowa Creek.

The greatest depth to water is about 225 feet below land surface in the southwestern part of the county near Gray. The shallowest water is less than 25 feet deep along the largest streams such as Kiowa Creek and the Beaver and Cimarron Rivers.

The greatest well density coincides with the areas of greatest thickness of saturated materials. The saturated material is in the Ogallala aquifer in the northwestern and southwestern parts of the county and in both alluvium and Ogallala in the rest of the county.

CHEMICAL QUALITY OF WATER

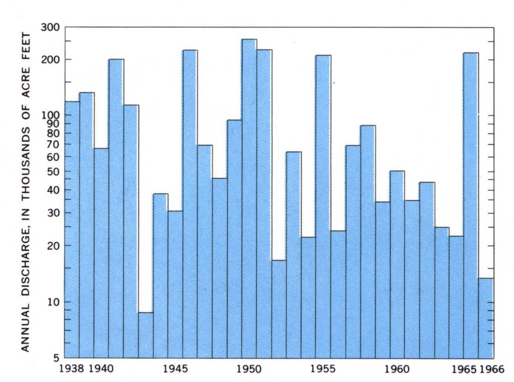
Water from the Ogallala Formation and alluvium is low in concentration of dissolved solids, uniform in chemical character, generally very hard, and of the calcium, magnesium bicarbonate type. Chloride and sulfate concentrations in the unconsolidated deposits are low. Chloride concentrations in water from the Ogallala Formation are shown on the frequency distribution graph. The dissolved-solids concentration (see dissolved-solids map) in water from the Ogallala ranges from approximately 150 to 600 mg/l (milligrams per liter). The median dissolved-solids concentration is 367 mg/l and the median hardness is 229 mg/l. Chloride and sulfate ion concentrations in analyses used to prepare the chemical-quality table indicate that some of the samples contained minor amounts of water from Permian rocks.

Water from the Permian bedrock, or red beds, is high in concentration of dissolved solids, differs widely in chemical character, is very hard, and contains considerable amounts of chloride and sulfate. The dissolved-solids concentration in water from Permian rocks ranges from about 800 to 18,000 mg/l. The median dissolved-solids concentration is 1,820 mg/l and the median hardness is 622 mg/l. Preliminary studies indicate that variability in the chemical quality of water from the red beds is caused by differences in the availability of water-soluble materials such as salt and gypsum.

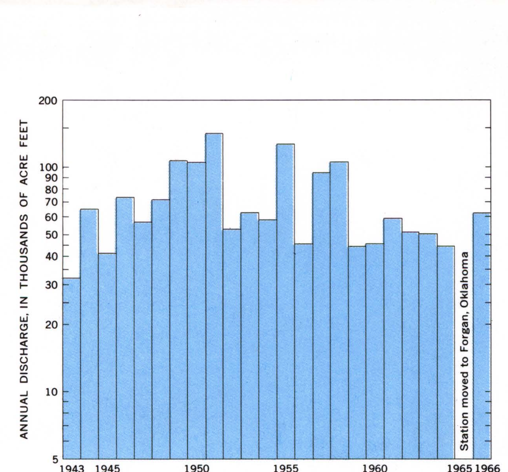
Water with chemical characteristics of water from the Ogallala and the red beds is produced locally from wells. This water is a mixture of calcium, magnesium bicarbonate type from the Ogallala and the sodium chloride, calcium sulfate type from the red beds. The dissolved-solids concentration in the mixed water ranges from 600 to 800 mg/l. The median dissolved-solids concentration is 688 mg/l and the median hardness is 275 mg/l. An explanation for the occurrence of the mixed water is suggested by Irwin and Morton (1969, p. 9, 13).

STREAMFLOW

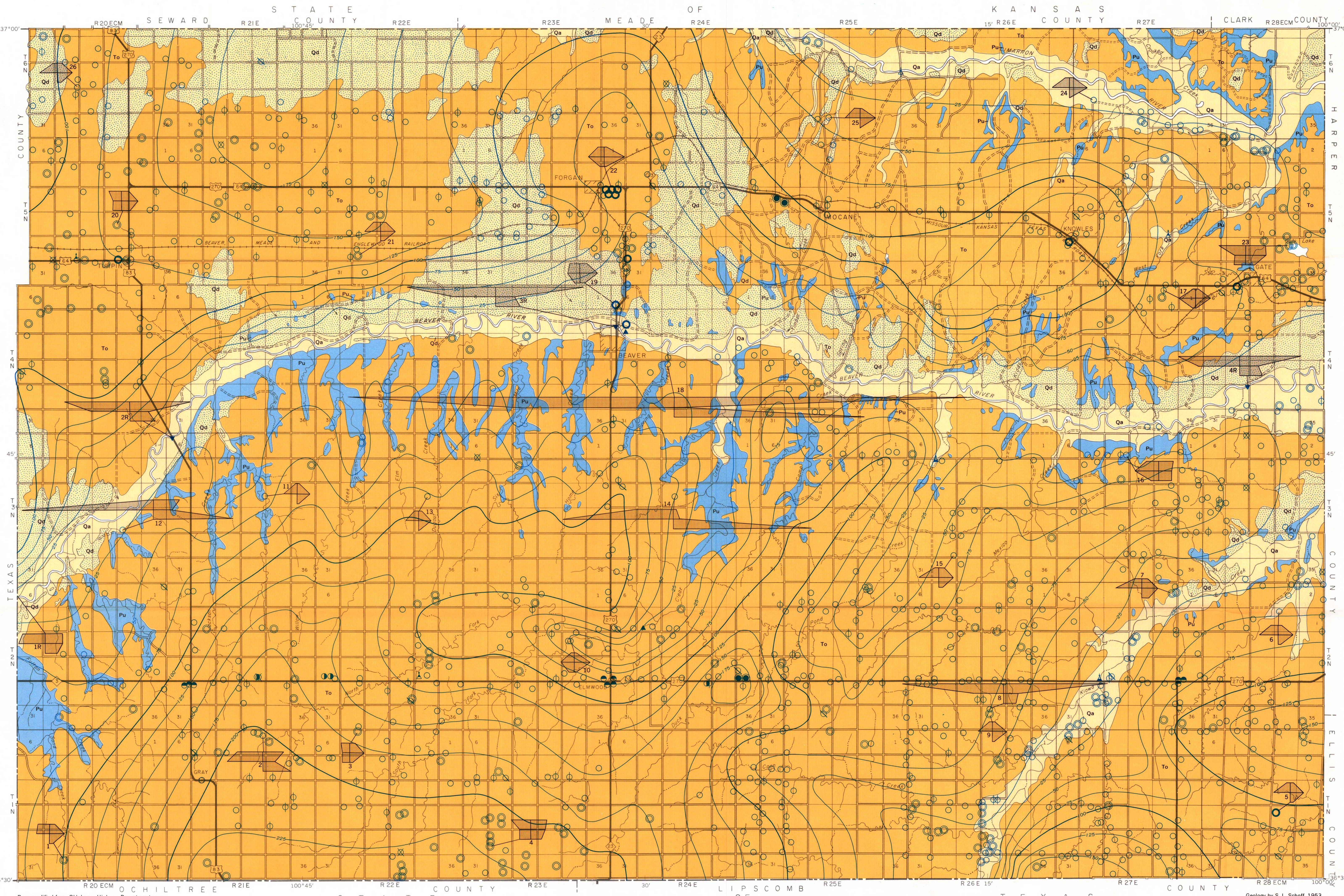
The largest streams in the county are the Cimarron and Beaver Rivers. Water flows in the Cimarron all of the year whereas the Beaver is dry one or more months during the year. The alluvial deposits along each stream probably are equally extensive and capable of carrying approximately the same amount of ground-water flow. The difference in low-water discharge of the two streams is explained by the fact that the Cimarron River receives more ground water than the Beaver because the river bed is at a lower elevation, and the ground-water gradient toward the Cimarron is steeper (Marine and Schoff, 1962, pl. II). The discharge graphs show: (1) flow in the Cimarron generally is more constant than in the Beaver (2) total annual stream discharge for both streams is highly variable.



GRAPH SHOWING DISCHARGE OF BEAVER RIVER AT BEAVER



GRAPH SHOWING DISCHARGE OF CIMARRON RIVER NEAR MOCANE



Base modified from Oklahoma Highway Department map
Drainage from U.S. Department of Agriculture aerial photographs, 1941

Geology by S. L. Schoff, 1953
Hydrology by R. B. Morton and R. L. Goemaat, 1968

SCALE 1:125 000

2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETERS

1970 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 10°00' EASTERLY FOR THE EAST EDGE TO 10°30' EASTERLY FOR THE WEST EDGE

HYDROGEOLOGIC MAP

EXPLANATION

Geologic formations and their water-bearing characteristics. Thicknesses are approximate

QUARTERNARY — Pleistocene and Holocene

Qd — Dune sand 0-50 feet thick

Fine to coarse, round to subround, windblown sand consisting mostly of quartz grains
Water supply: Mostly above water table and not saturated. Where saturated, yields water to domestic or stock wells but supply may not be dependable. Occurrence of water in this unit most likely where underlain by impermeable red beds. Aids recharge by absorbing and transmitting precipitation and surface runoff downward to underlying rocks. Water quality suitable for most purposes

Qa — Alluvium 0-50 feet thick

Sand, gravel, silt, and clay in discontinuous lenses along courses of larger streams
Water supply: Yields about 400 to 2,000 gpm (gallons per minute) to wells. Water level commonly within 20 feet of surface. Water quality suitable for most purposes except where contaminated by water from the red beds. Water-table aquifer

TERTIARY — Pliocene

To — Ogallala Formation 0-700 feet thick

Interbedded sand, siltstone, clay, gravel lenses, and thin limestone. Caliche common near surface but occurrence is not limited to the surface. Caliche accounts for most of white color in the Ogallala. Other colors generally light tan or buff but locally may be pastel shades of almost any color. The Laverne and Rexroad Formations of Pliocene age and the Meade Group and Odee (of local usage) and other formations of Pleistocene age occur locally and are included with the Ogallala Formation
Water supply: Principal water-table aquifer. Irrigation wells yield 200 to 1,760 gpm, and average 700 gpm. Specific capacities range from 2.4 to 100 gpm per foot of drawdown, and average 15 gpm per foot. Water quality suitable for most uses. Representative gravel sample had a porosity of about 25 percent and a permeability of 850 gallons per day (Marine and Schoff, 1962, p. 33)

PERMIAN

Pu — Permian rocks, undifferentiated (red beds) 3800 feet thick

Red shale, sandstone, and siltstone are predominant rocks, with lesser amounts of limestone, dolomite, gypsum, and salt. The undifferentiated Permian rocks include the Whitehorse Group, the Cloud Chief Formation, and the Quartermaster Formation; also included are local outcrops in southwestern part of the county which may be Triassic in age
Water supply: Supplies small quantities to stock wells but yields are too small for irrigation. Water normally high in dissolved-solids concentration and generally unsuitable for drinking. Artesian (confined) conditions are more likely to occur in the red beds than in the unconsolidated deposits

Contact

100
75
Line of equal depth to water, January 1968
Interval is 25 feet. Datum is land surface

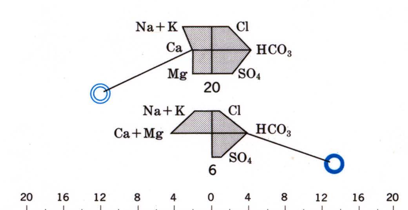
Wells

Domestic or stock — Industrial — Dry or destroyed
Irrigation — Institutional — Unused or abandoned
Municipal or public — Commercial — Monthly observation

Gaging stations

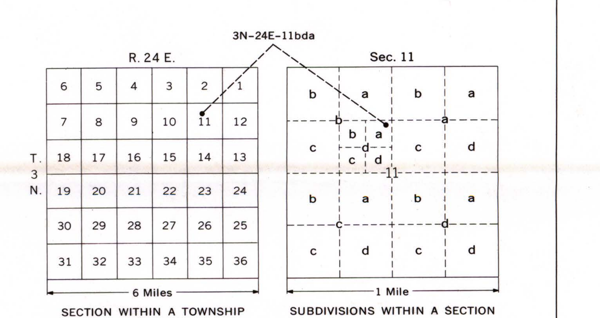
Continuous record — Discontinued
Crest stage, partial record — Low flow, partial record

Surface-water chemical-quality sample site

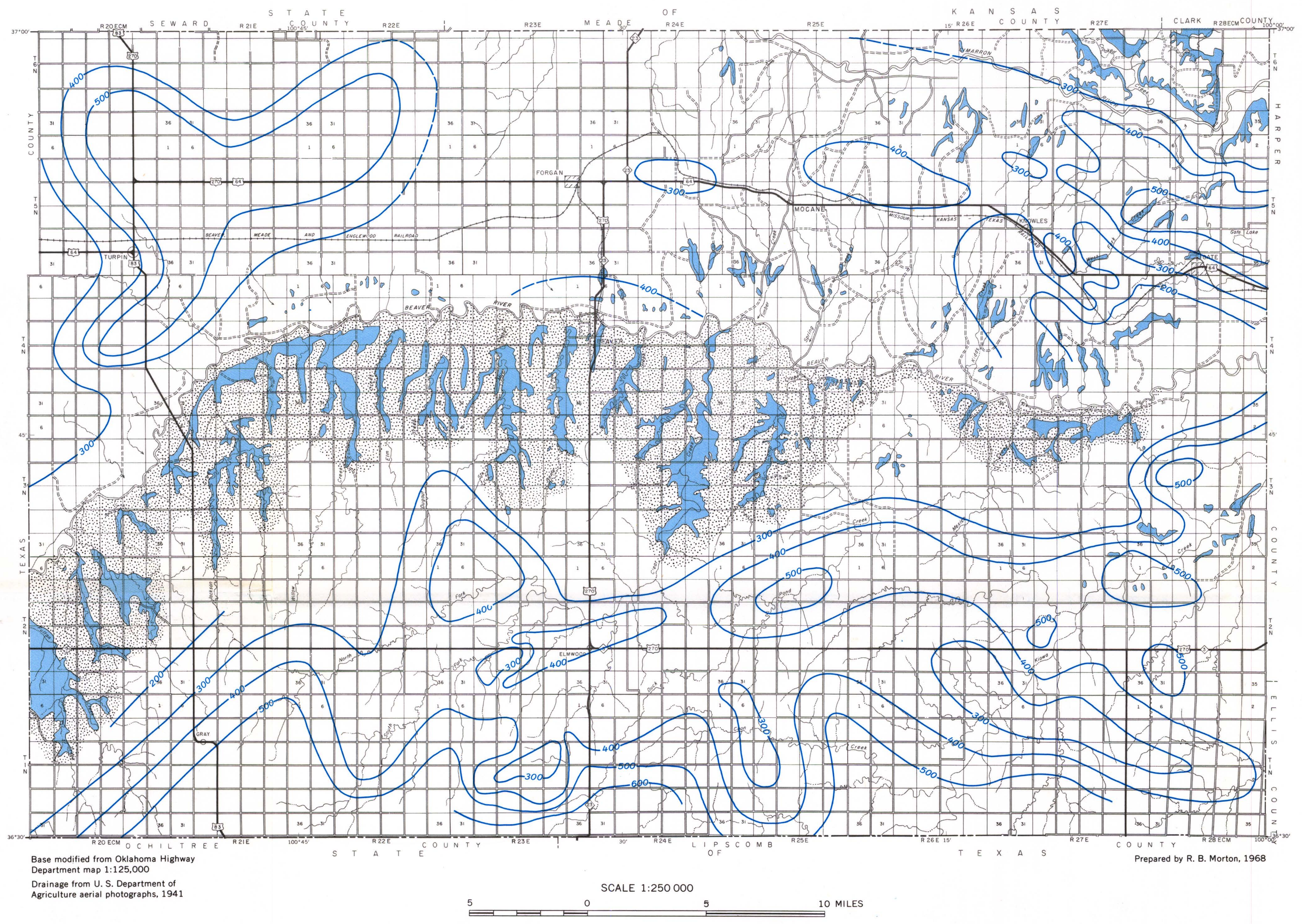


Chemical constituents in, milliequivalents per liter
Chemical quality diagrams

Number refers to diagram number on hydrologic map and table. R, *after number indicates river sample*
The size of the diagram is an indication of the dissolved-solids content. The smaller the diagram, the lower the dissolved-solids, and the better the chemical quality. Differences in the size or shape of the diagrams indicate differences in the concentration of one or more of the ions and therefore, differences in chemical quality



SECTION WITHIN A TOWNSHIP — SUBDIVISIONS WITHIN A SECTION
WELL-NUMBERING SYSTEM



Base modified from Oklahoma Highway Department map 1:125,000
Drainage from U. S. Department of Agriculture aerial photographs, 1941

Prepared by R. B. Morton, 1968

SCALE 1:250 000

5 0 5 10 MILES

5 0 5 10 KILOMETERS

MAP SHOWING DISSOLVED SOLIDS CONCENTRATION IN GROUND WATER FROM OGALLALA FORMATION

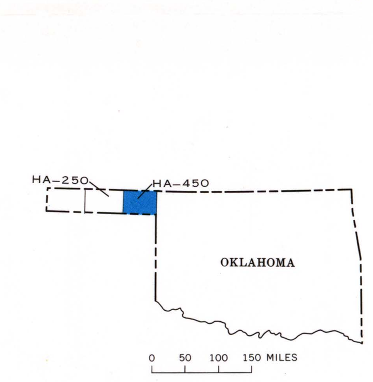
EXPLANATION

Outcrop of Permian rocks, undifferentiated

Area of widely ranging ground water quality
Ogallala Formation water frequently degraded by water from Permian rocks

300
Line of equal concentration of dissolved solids
Dashed where approximately located. Interval 100 milligrams per liter

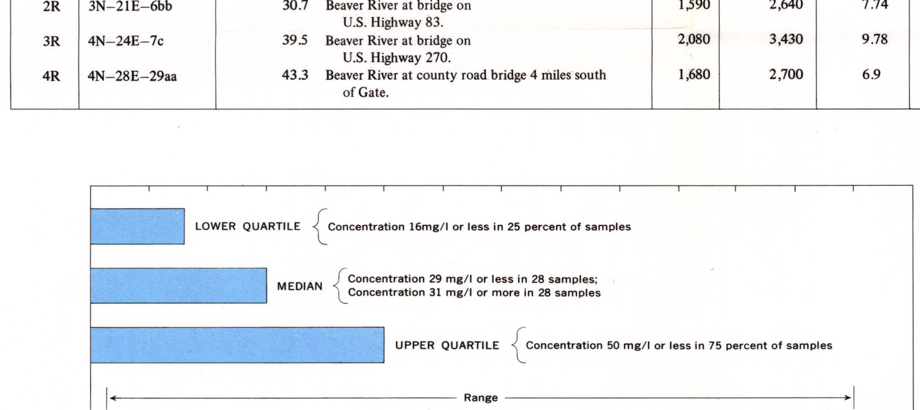
NOTE
Map based on 112 analyses. About 25 percent of the analyses were furnished by the Cooperative Extension Service of the Oklahoma State University



INDEX MAP SHOWING THE LOCATION OF THIS REPORT (SHADED) AND PUBLISHED REPORTS IN THIS SERIES

CHEMICAL–QUALITY TABLE

Diagram number	Sample location	Well depth (feet)	Sample source	Dissolved solids (mg/l)	Specific conductance (micromhos at 25°C)	Sodium-adsorption-ratio (SAR)	Hardness as calcium carbonate (mg/l)
1	1N–20E–32a	430	Ogallala Formation.	347	602	2.4	156
2	1N–21E–3aab	430	Permian red beds.	1,040	1,560	3.1	460
3	1N–22E–5aa	Unknown	Ogallala Formation.	353	567	1.6	188
4	1N–23E–29cbc	585	Mixed Ogallala Formation and Permian red beds.	672	1,100	3.0	290
5	1N–28E–22b	95	Ogallala Formation.	303	501	.60	207
6	2N–28E–10bbd	10.5	Alluvium.	485	748	1.15	228
7	2N–27E–2acd	50	Ogallala Formation or alluvium.	568	822	.9	344
8	2N–26E–34bb	494	Permian red beds.	2,040	3,500	13.0	384
9	2N–26E–34bdb	186	Ogallala Formation.	281	444	.6	186
10	2N–23E–14bd	....	Spring (Ogallala Formation).	325	506	.33	248
11	3N–21E–15ad	....	..........do.	210	382	.26	174
12	3N–20E–23ccd	20	Permian red beds.	2,045	3,400	.10	1,680
13	3N–22E–14caa	50	Ogallala Formation.	265	455	.81	174
14	3N–24E–16dbb	83	Permian red beds.	2,252	3,770	2.34	1,440
15	3N–26E–29ddd	109	Ogallala Formation.	402	632	.67	261
16	3N–27E–4ddb	62	Mixed Ogallala Formation and Permian red beds.	778	1,100	1.6	400
17	4N–27E–2ba	200	Ogallala Formation.	323	538	.3	260
18	4N–24E–21bba	120	Permian red beds.	8,080	11,000	18.0	2,140
19	4N–24E–6d	Probably <100	Ogallala Formation.	413	691	1.58	234
20	5N–20E–22dbb	256	..........do.	476	759	2.2	236
21	5N–22E–29cdb	402	..........do.	360	596	1.2	218
22	5N–23E–13baa	90	..........do.	359	602	.95	262
23	5N–28E–27ac	137	Mixed Ogallala Formation and Permian red beds.	750	1,260	4.3	275
24	6N–27E–30dbb	65	Alluvium and (or) Ogallala Formation.	370	586	.8	231
25	6N–25E–33bb	40	Ogallala Formation.	325	530	.95	198
26	6N–20E–20ddd	180	..........do.	405	592	.7	246
		Discharge (cfs)					
1R	2N–18E–2ad (Texas County)	26.3	Beaver River at county road bridge 7 miles due west of county line.	767	1,260	3.12	340
2R	3N–21E–6bb	30.7	Beaver River at bridge on U.S. Highway 83.	1,590	2,640	7.74	480
3R	4N–24E–7c	39.5	Beaver River at bridge on U.S. Highway 270.	2,080	3,430	9.78	555
4R	4N–28E–29aa	43.3	Beaver River at county road bridge 4 miles south of Gate.	1,680	2,700	6.9	540



GRAPH SHOWING FREQUENCY DISTRIBUTION OF CHLORIDE IN GROUND WATER FROM THE OGALLALA FORMATION (57 SAMPLES)

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RECONNAISSANCE OF THE WATER RESOURCES OF BEAVER COUNTY, OKLAHOMA

By
R. B. Morton and R. L. Goemaat

1973

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