PREPARED IN COOPERATION WITH THE
COLORADO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RESOURCES,
OFFICE OF THE STATE ENGINEER; THE DENVER BOARD OF WATER COMMISSIONERS;
AND ADAMS, AND ARAPAHOE, COUNTIES

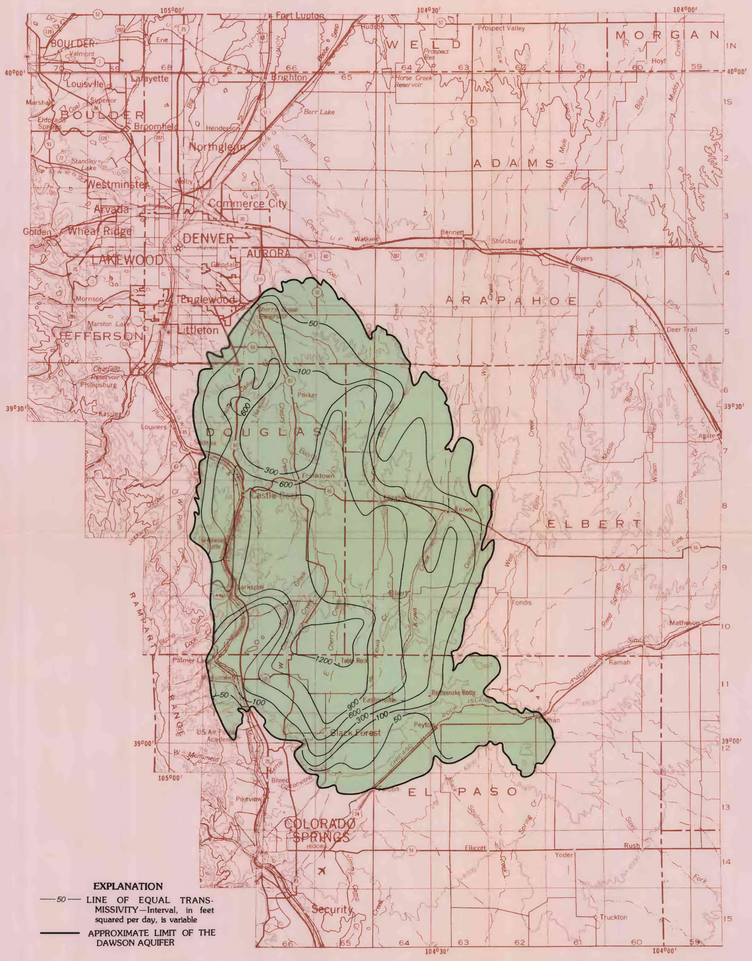

FIGURE 8.—MAP SHOWING THE TRANSMISSIVITY OF THE DAWSON AQUIFER

Table 2.—Physical properties of sampled water-yielding materials.

SAMPLE NUMBER	SPECIFIC YIELD (percent)	SPECIFIC RETENTION (percent)	POROSITY (percent)	EFFECTIVE POROSITY (percent)	GAS PERMEABILITY (millidarcys)[1]	HYDRAULIC CONDUCTIVITY (feet per day)
SAMPLES FROM DAWSON ARKOSE						
5S/66W-34BD	8.8*	28.8	37.6	—	122.	0.07 *
6S/63W-31BA	11.1*	8.8	19.9	—	43.4	0.01 *
6S/64W-28CB	11.4*	17.5	28.9	—	1220.	1. *
6S/65W-15CB	16.7*	14.3	31.0	—	1280.	1. *
6S/66W-27AB	8.0	19.6*	27.6	15.9	68.4	0.02 *
6S/67W- 6BB	6.9	23.4*	30.3	11.8	51.8	0.01 *
6S/68W-21CC	25.1*	10.2	35.3	—	—	—
7S/62W-32AD	18.8*	17.5	36.3	—	1880.	2. *
7S/67W- 5BC	26.8*	4.8	31.6	—	—	—
8S/63W-17CC	—	—	36.2	—	1370.	1.5 *
8S/64W-18AA	16.5*	15.6	32.1	—	10,300.	11. *
8S/65W-29AC	3.6*	17.2	20.8	—	186.	0.1 *
8S/66W- 3AB	26.9	13.2*	40.1	30.6	1330.	1.3 *
9S/67W-34CC	—	—	39.7	—	3760.	4. *
10S/62W-36AB	23.4*	12.2	35.6	—	—	—
10S/67W-33CA	19.1*	9.2	28.3	—	628.	0.5 *
11S/62W-31AB	24.1*	12.1	36.2	—	—	—
13S/65W- 6DA	21.5*	0.6	22.1	—	1170.	1. *
SAMPLES FROM DENVER FORMATION						
2S/67W-26BC	0.2*	30.0	30.2	—	24.	—
	7.6	26.8*	34.4	20.5	1800.	—
	17.3	11.6*	28.9	20.3	—	—
3S/63W-28DD	23.9*	20.5	44.4	—	8070.	8.5 *
3S/64W-19DC	18.5*	11.9	30.4	—	—	—
3S/69W-23BB	—	—	28.5	—	750.	0.7 *
4S/63W-33CC	4.7	10.1*	14.8	12.9	32.4	0.006*
4S/65W- 8AB	—	—	—	—	210.	0.1 *
4S/67W-36DD	—	—	40.8	—	—	—
4S/69W-21CC	5.5	25.2*	30.7	17.7	5.6	—
5S/63W-28CC	29.4*	9.2	38.6	—	1020.	0.9 *
8S/61W-11AA	24.6	13.8*	38.4	31.1	3760.	4. *
10S/62W-14AA	—	—	35.4	—	—	—
13S/66W-24AD	6.6*	20.6	27.2	—	102.	0.05 *
14S/64W- 8DD	—	—	25.0	—	18.5	0.002*
SAMPLES FROM ARAPAHOE FORMATION						
2N/64W-26BD	19.1*	9.8	28.9	—	1650.	1.6 *
2S/62W- 2DA	—	—	36.4	—	—	—
2S/62W-29DA	22.6*	9.8	32.4	—	5190.	5. *
2S/69W- 1BB	26.8*	3.0	29.8	—	—	—
2S/69W- 7CC	14.2*	12.9	27.1	—	681.	0.6 *
4S/61W-16DB	—	—	32.6	—	4840.	5. *
4S/62W- 2AC	5.6	16.9*	22.5	17.5	64.0	0.002*
5S/62W-24CC	11.2	26.0*	37.2	19.6	211.	0.1 *
6S/61W- 6AD	14.8	18.0*	32.8	29.0	85.3	0.002*
7S/60W-19CD	23.0*	16.5	39.5	—	1925.	2. *
8S/60W-35AD	—	—	12.2	—	1.34	—
10S/59W- 2BB	16.5*	1.5	18.0	—	559.	0.5 *
10S/60W-11BC	25.2	16.1	41.3	32.3	483.	0.4
SAMPLES FROM LARAMIE FORMATION						
3N/66W-31AB	22.3*	10.3	32.6	—	—	—
1N/68W- 7DD	5.6	21.5*	27.1	13.3	1070.	1. *
	—	—	26.4	11.5	—	—
1N/69W- 8BB	22.6	7.5*	30.1	—	672.	0.6 *
4S/59W-30CD	21.1	14.1*	35.2	31.1	490.	0.4 *
4S/70W-14BD	4.8	20.3*	25.1	13.4	32.	0.006*
8S/58W-23AB	37.8*	1.0	38.8	—	—	—
10S/59W-30DC	17.1	25.6*	42.7	28.0	788.	0.7 *
15S/63W-20CB	22.7*	8.3	31.0	—	1590.	1.6 *
15S/64W- 4CC	11.0*	22.2	33.2	—	1010.	0.9 *
SAMPLES FROM FOX HILLS SANDSTONE						
5N/65W-19AA	28.5	10.0*	38.5	35.7	—	—
4N/67W-23CD	21.9*	11.9	33.8	—	910.	0.8 *
3N/67W-20AC	12.8	7.9*	20.7	15.2	760.	0.7 *
1N/60W- 9BB	28.0*	11.8	39.8	—	—	—
1S/70W- 1DD	22.8*	10.0	32.8	—	1330.	1.3 *
2S/59W- 7BA	—	—	41.5	—	—	—
2S/70W-21CA	12.0	14.7*	26.7	20.2	190.	0.1 *
4S/59W- 3AB	—	—	44.1	—	—	—
4S/70W-14BD	14.3	20.5*	34.8	22.9	150.	0.09 *
5S/58W-19AA	29.0*	12.1	41.1	—	6380.	7. *
7S/58W- 1AB	38.0*	6.2	44.2	—	—	—
8S/57W-18BA	36.0*	4.8	40.8	—	—	—
9S/58W- 5CA	32.8	5.4*	38.2	37.1	—	—
9S/68W- 3AA	11.1	21.4*	32.5	21.7	250.	0.2 *
14S/64W-30CC	13.5*	12.1	25.6	—	66.3	0.02 *
15S/62W-19CD	22.0*	11.9	33.9	—	1430.	1.5 *

* Calculated value.
[1] 1 millidarcy = 9.87×10^{-16} m² = 1.06×10^{-15} ft²

Maps of the transmissivity of each aquifer (figs. 8, 9, 10, and 11) were prepared by multiplying the average hydraulic conductivity times the thickness of the water-yielding materials in each aquifer. Maps of total sandstone and conglomerate thickness in reports by Robson and Romero (1981a, 1981b), Robson, Romero, and Zawistowski (1981), and Robson, Wacinski, Zawistowski and Romero (1981) were used for this purpose. Transmissivity values were found to range from less than 5 feet squared per day in the extreme northwestern part of the Laramie-Fox Hills aquifer to more than 2,100 feet squared per day in the Arapahoe aquifer near Littleton. Transmissivity values calculated directly from aquifer tests were found to be in reasonable agreement with the values shown. Where differences occur, the discrepancy seems to be due to local variations in the aquifer characteristics, partial penetration of the well, or multiple-aquifer completion of the well.

POROSITY

As part of this study, laboratory porosity determinations were made on about 90 undisturbed bedrock samples using a helium-gas expansion porosimeter. Results of 71 of these analyses are shown in table 2 with results of 23 effective-porosity determinations. This porosity data, data from Major and others (1982), selected data from McConaghy and others (1964), and other unpublished porosity data indicated that the porosity of the sandstone and conglomerate strata in the aquifers commonly ranges from 20 to 40 percent. Smaller porosities normally are associated with smaller hydraulic conductivities and larger porosities are associated with larger hydraulic conductivities as shown in figure 12. The mean porosity of the samples from the siltstone, sandstone, and conglomerate members of each aquifer is shown to range from 30 to 32 percent in table 3. The difference between the average porosity and the range is an indication of the porosity differences that can occur both vertically and laterally in these sediments.

Neutron-density geophysical logs provide a means of determining the in-situ sandstone porosity of the aquifers in areas where the logs extend into the shallower bedrock formations. Of the approximately 6,000 oil wells drilled in the study area, only 50 were found to have logs suitable for this purpose. Porosity determinations for 97 sandstone and conglomerate intervals shown on the logs indicate that the mean in-situ porosity of these intervals is in good agreement with the mean porosity based on laboratory analysis of samples (table 3). This indicates that the laboratory samples, many of which come from surface outcrops, are probably representative of the undisturbed water-yielding sediments found at depth. The degree of correlation demonstrated between the results of the two analytical techniques also supports the results of specific-yield and storage-coefficient determinations that are based in part on porosity data.

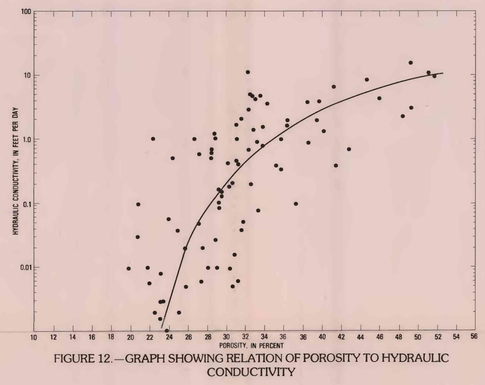

FIGURE 12.—GRAPH SHOWING RELATION OF POROSITY TO HYDRAULIC CONDUCTIVITY

Table 3.—Porosity statistics for water-yielding materials

Aquifer	Porosity data based on laboratory analysis of samples				Porosity data based on geophysical logs			
	Mean (percent)	Range (percent)	Number of Samples	Standard Deviation (percent)	Mean (percent)	Range (percent)	Number of Samples	Standard Deviation (percent)
Dawson	32	19-46	20	6.7	*	25-30	5	*
Denver	31	15-44	24	6.0	29	24-34	19	2.9
Arapahoe	30	12-46	33	7.3	30	22-35	52	3.8
Laramie-Fox Hills	32	21-44	42	6.1	32	24-36	21	2.5

* Insufficient data

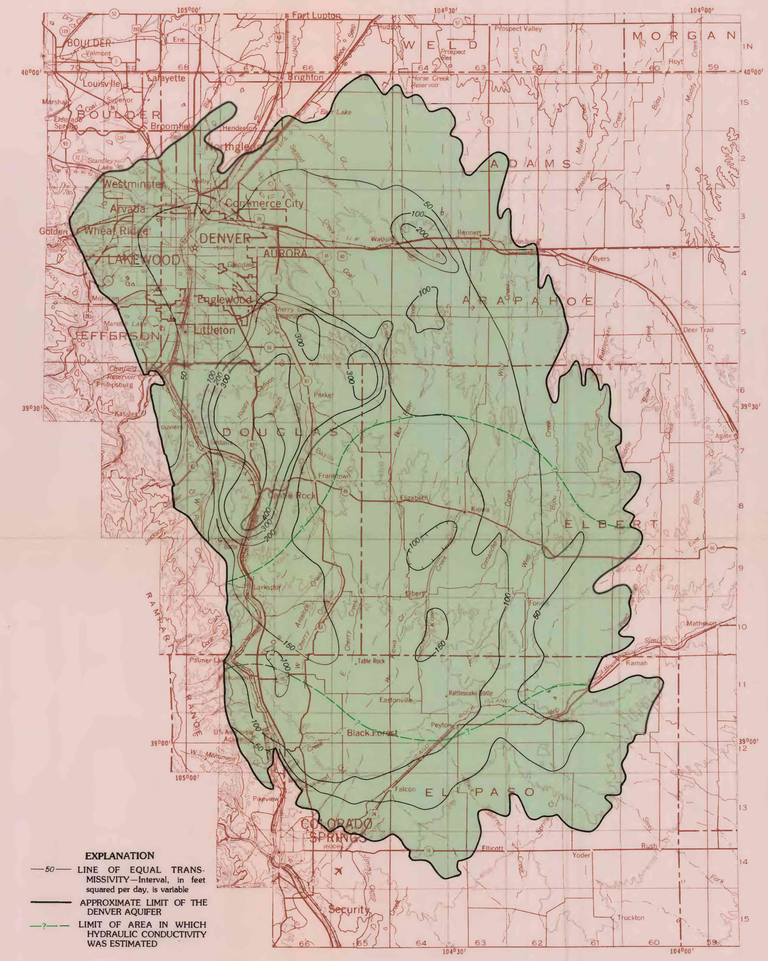

FIGURE 9.—MAP SHOWING THE TRANSMISSIVITY OF THE DENVER AQUIFER

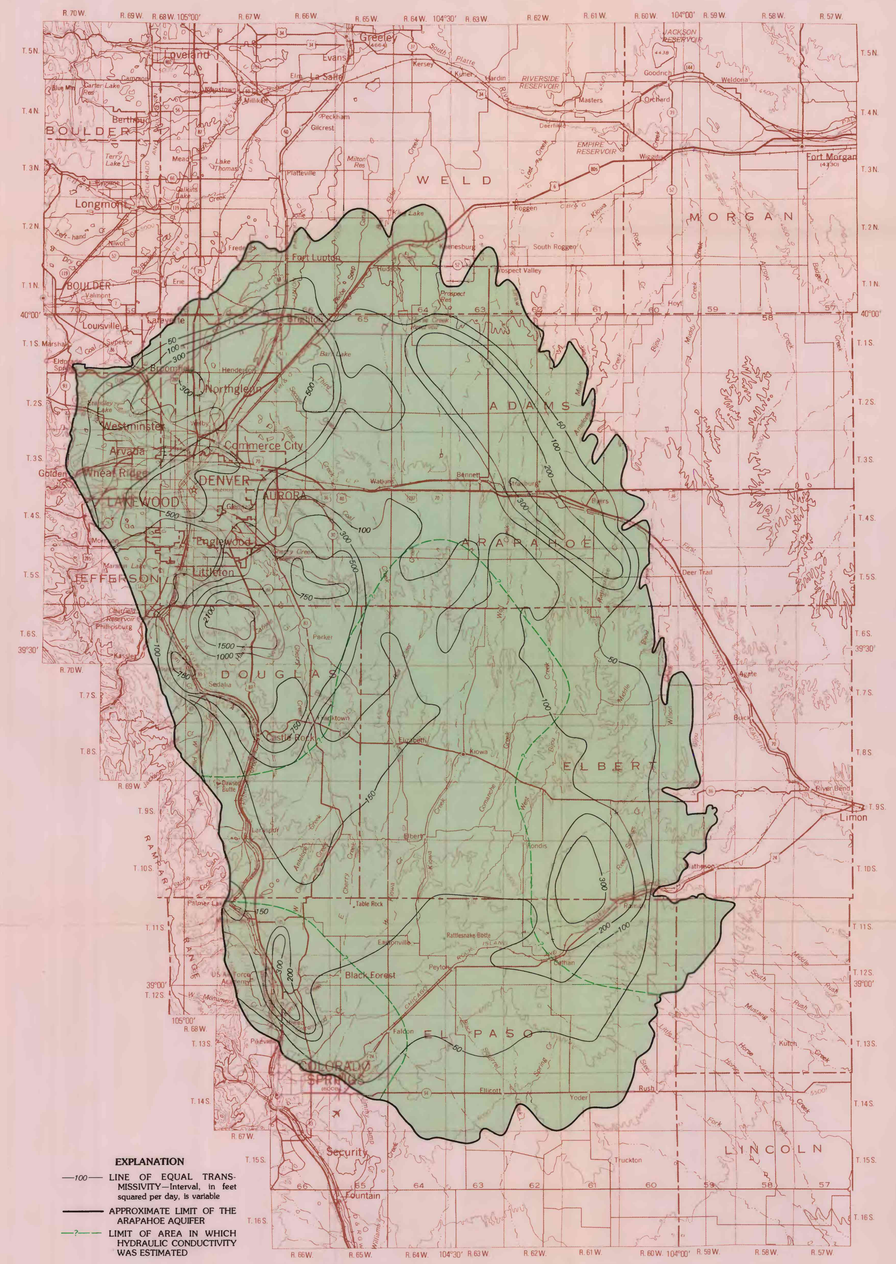

FIGURE 10.—MAP SHOWING THE TRANSMISSIVITY OF THE ARAPAHOE AQUIFER

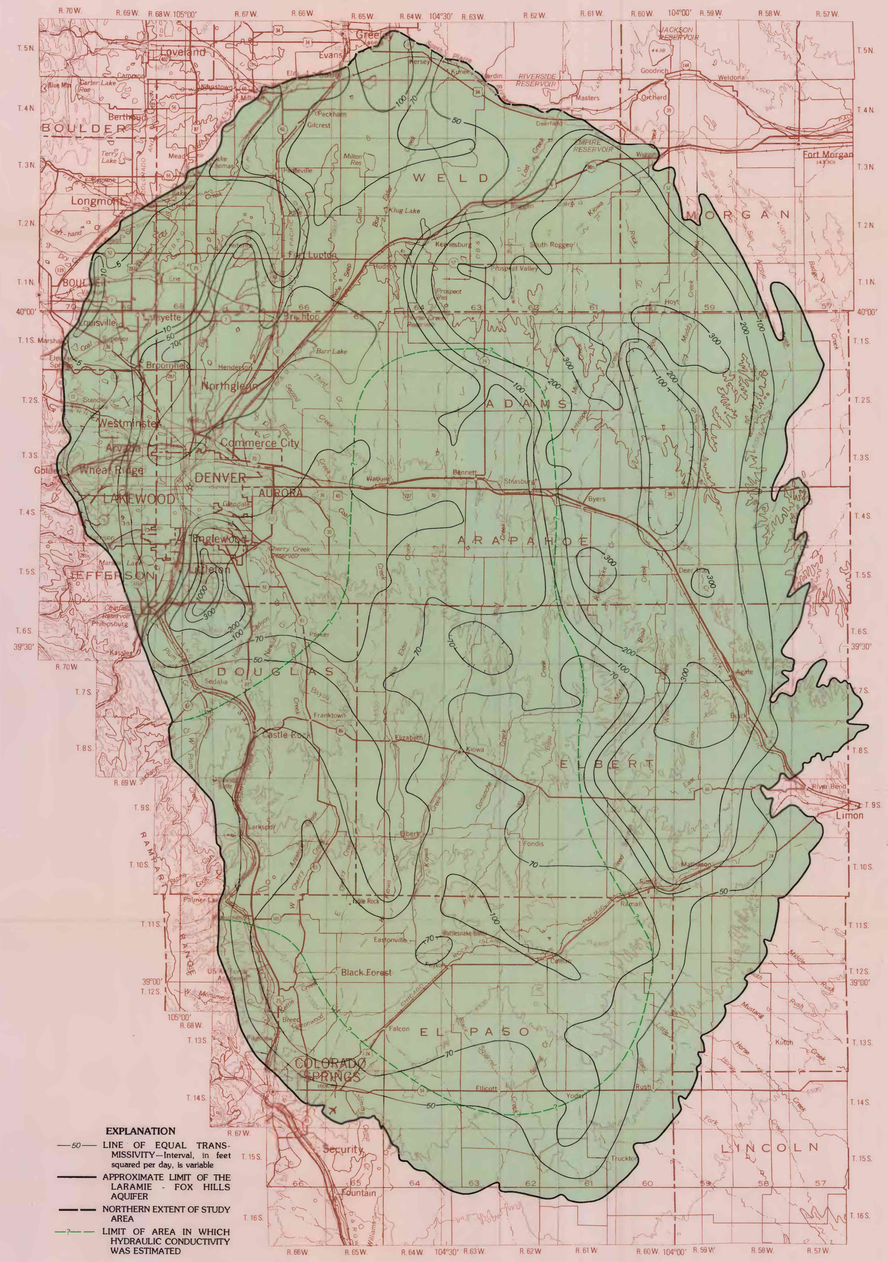

FIGURE 11.—MAP SHOWING THE TRANSMISSIVITY OF THE LARAMIE-FOX HILLS AQUIFER

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1983—W82786

Base from U.S. Geological Survey
1:500 000 State base map

SCALE 1:500 000

10 0 10 20 30 40 50 MILES

10 0 10 20 30 40 50 KILOMETERS

CONTOUR INTERVAL 500 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

HYDRAULIC CHARACTERISTICS OF THE PRINCIPAL BEDROCK AQUIFERS IN THE DENVER BASIN, COLORADO

By
S. G. Robson

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