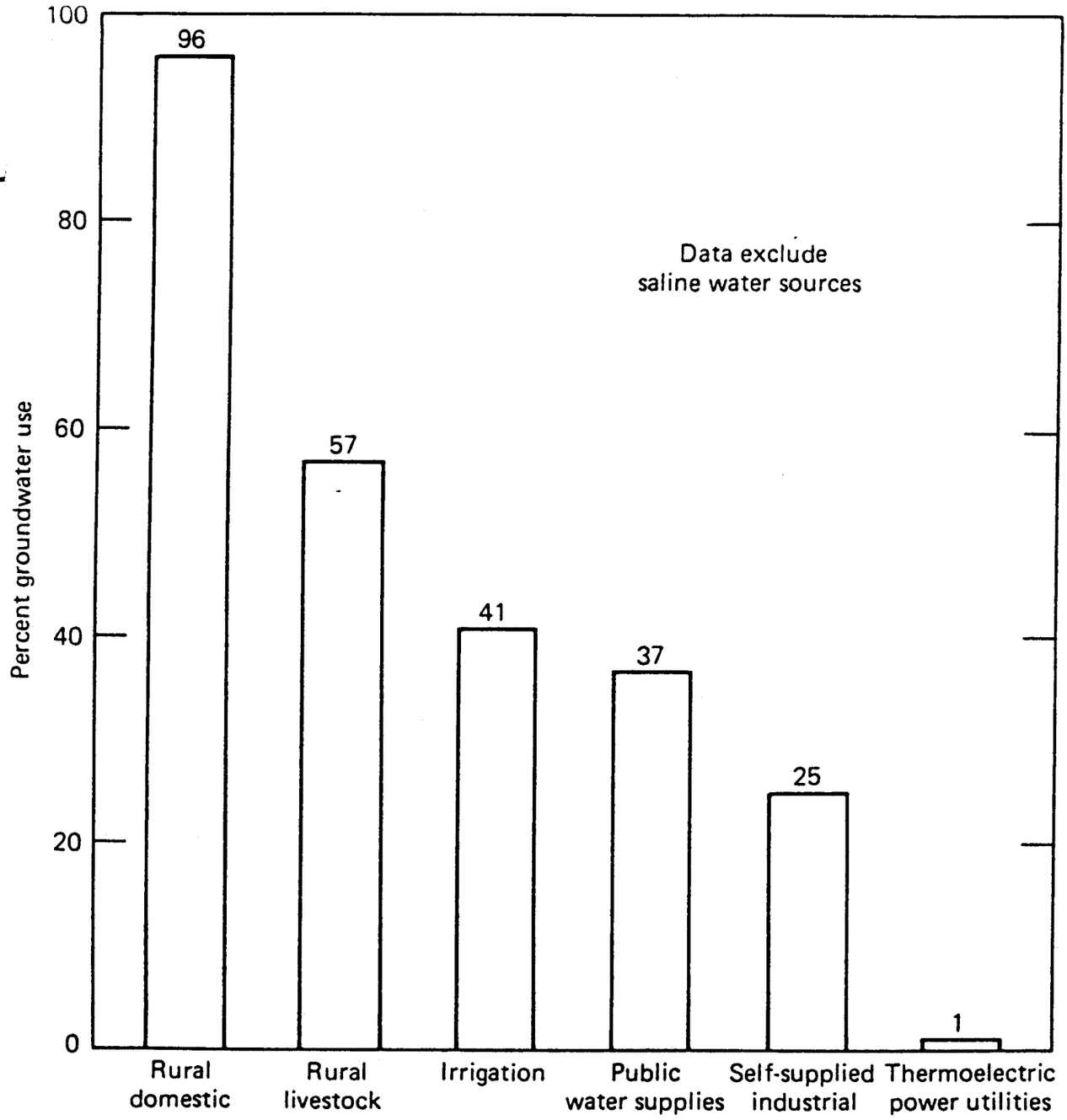

Fig. 1.5 Percentage of groundwater use to total water use for various types of use in the United States, 1975 (after Murray and Reeves[44]).

Estimates of water use in the United States as of 1975 were prepared by the U.S. Geological Survey. The largest single demand on groundwater is irrigation, amounting to 71 percent of all groundwater used. More than 90 percent of this water is pumped in the western states, where arid and semiarid conditions have fostered extensive irrigation development. The relative importance of groundwater in relation to various types of water use is indicated in Fig. 1.5. It can be seen that 96 percent of rural homes are supplied by groundwater. The largest industrial users of groundwater include, in order of water requirements, oil refineries, paper manufacturers, metalworking plants, chemical manufacturers, air-conditioning and refrigerating units, and distilleries.[37]

There has been a steady increase in the production of groundwater in recent years, as demonstrated in Fig. 1.6. Furthermore, the proportion of groundwater use to total water use has been rising. This may be attributed to a reduction in physical and environmental opportunities to develop additional fresh surface-water supplies. In addition, a growing awareness of the ready availability, the low cost, and the high quality of groundwater is a contributing factor.

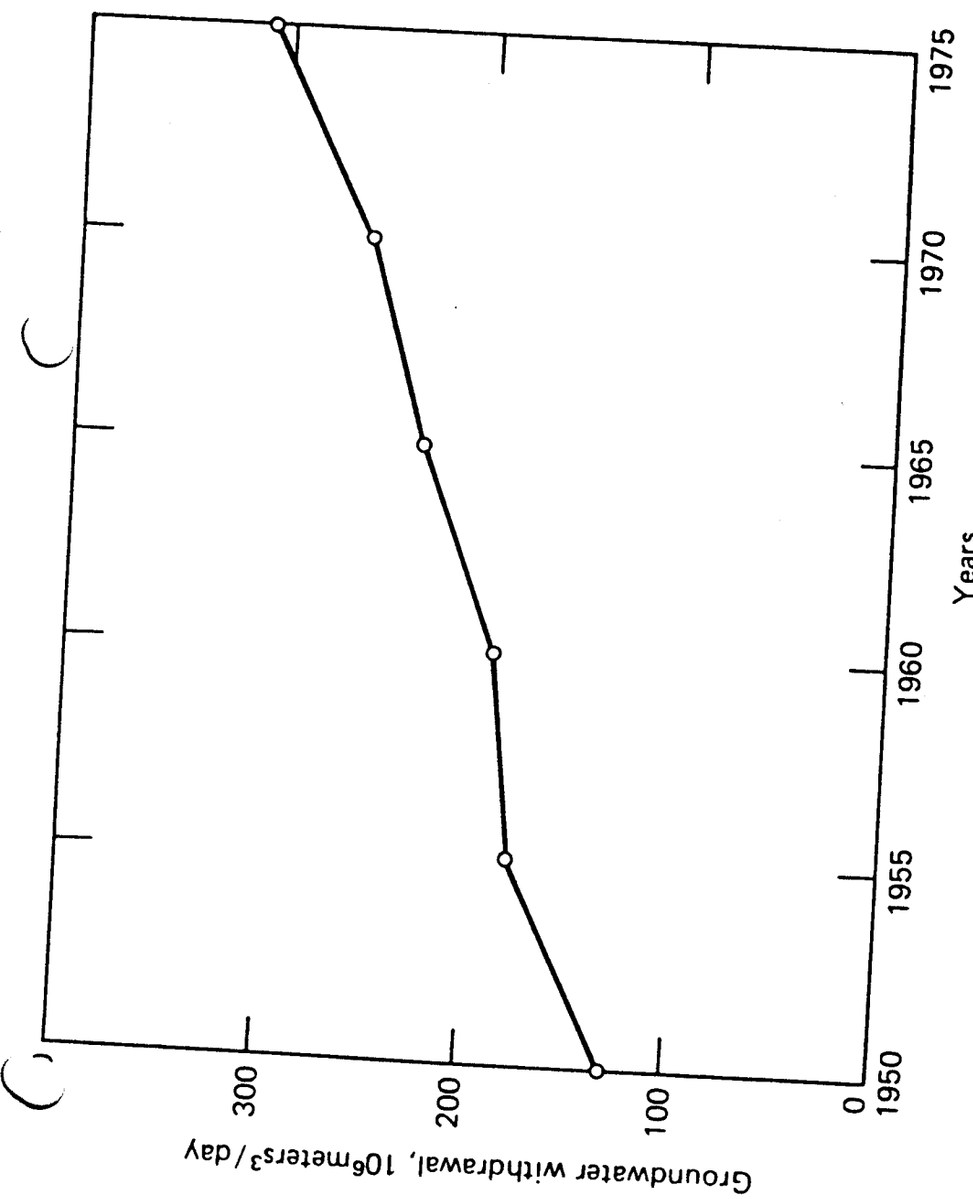

Fig. 1.6 Trend of groundwater withdrawal in the United States (after Murray and Reeves[44]).

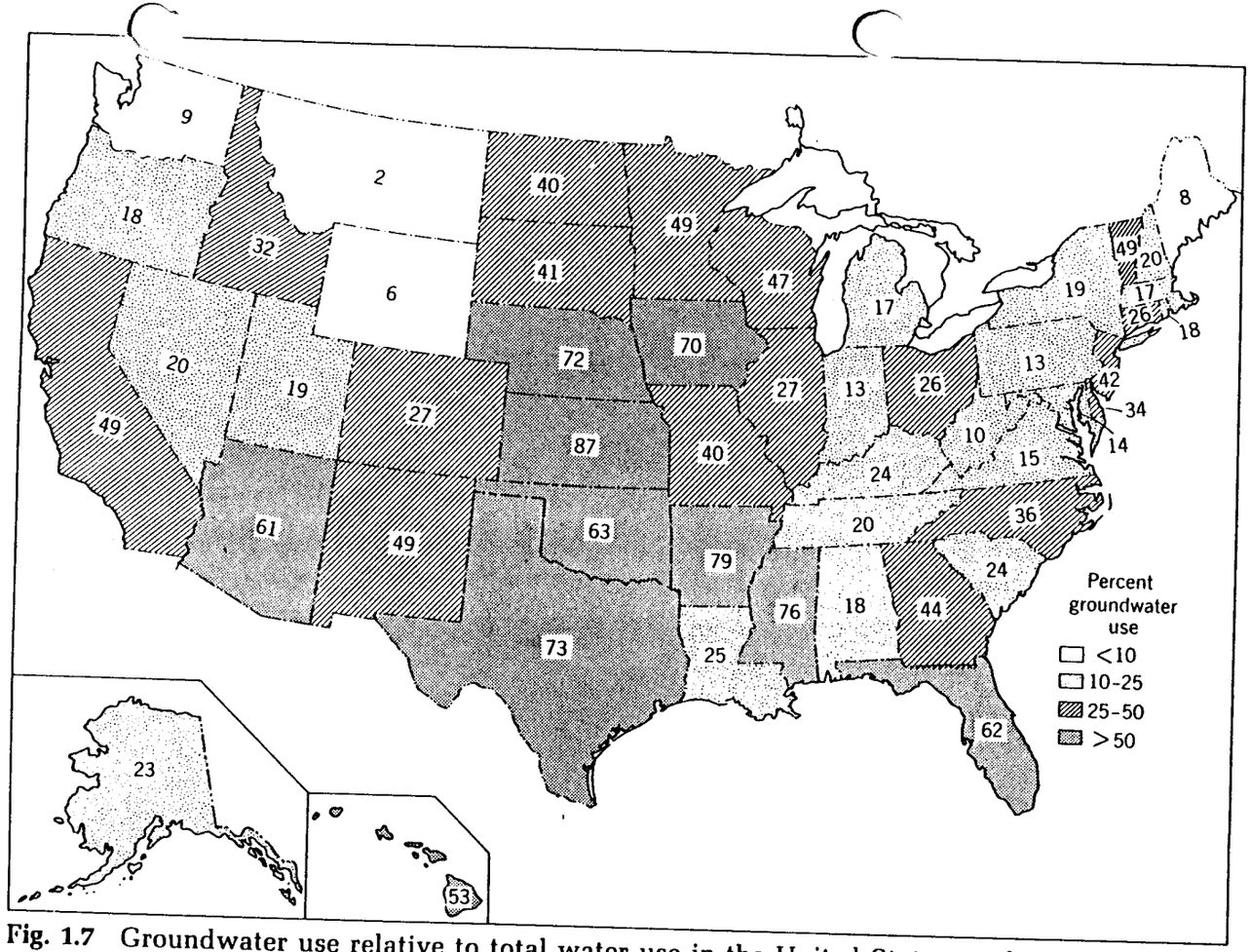

Fig. 1.7 Groundwater use relative to total water use in the United States, excluding power generation and saline water uses (after Murray and Reeves[44]).

TABLE Use of Groundwater in the United States, 1975 (after Murray and Reeves[45])[a] (quantities in 1000 m^3/day)

State	Public Supplies	Rural	Irrigation	Self-supplied Industrial	Total Groundwater Use	Ratio of Groundwater Use to Total Water Use, percent
California	6,400	610	64,000	1,500	73,000	49
Texas	3,200	870	36,000	1,600	42,000	73
Nebraska	830	420	20,000	320	22,000	72
Idaho	420	180	13,000	7,200	21,000	32
Kansas	530	330	17,000	490	18,000	87
Arizona	1,000	230	16,000	720	18,000	61
Florida	3,700	950	4,500	3,000	12,000	62
Colorado	200	130	9,500	220	10,050	27
Arkansas	340	280	8,000	1,300	9,900	79
New Mexico	640	140	4,900	250	5,900	49
Louisiana	760	190	3,100	1,700	5,800	25
Oklahoma	530	130	3,800	220	4,700	63
Oregon	250	610	3,500	300	4,700	18
Mississippi	680	130	2,100	1,300	4,200	76
Ohio	1,500	490	21	1,900	3,900	26
Illinois	2,700	170	110	910	3,900	27
Pennsylvania	1,300	640	23	1,300	3,300	13
New York	2,100	570	72	490	3,200	19
Georgia	570	260	91	2,100	3,000	44
New Jersey	1,400	420	420	770	3,000	42

TABLE 1.2 Leading States as to Intensity of Groundwater Use (based on data from Table 1.1)

Rank	State	Intensity of Groundwater Use, $m^3/day/km^2$
1	California	180
2	Hawaii	160
3	New Jersey	150
4	Nebraska	110
5	Idaho	98
6	Kansas	89
7	Florida	86
8	Arkansas	73
9	Massachusetts	64
10	Arizona	61

The proportion of groundwater use relative to total water use for each state is shown on the map in Fig. 1.7. This indicates the significant contribution that groundwater makes in the semiarid central states and the arid southwestern states. A further interesting group of statistics appears in Table 1.2 listing states where groundwater has been most intensely developed. Here states are ranked by groundwater production rate per area. It can be noted that humid, populous eastern states such as New Jersey and Massachusetts, which use substantial quantities of groundwater for urban water supply purposes, outrank large, arid western states such as Arizona and Texas where irrigation is the predominant water demand.

TABLE 1.3 Approximate Distribution of Water in the United States (after Ad Hoc Panel on Hydrology[2])[a]

	Volume, $10^9 m^3$	Annual Circulation, $10^9 m^3/yr$	Detention Period, years
Frozen water			
Glaciers	67	1.6	40
Liquid water			
Freshwater lakes	19,000	190	100
Salt lakes	58	5.7	10
Average in-stream channels	50	1900	0.03
Groundwater			
Shallow (<800 m deep)	63,000	310	200
Deep (>800 m deep)	63,000	6.2	10,000
Soil moisture			
1-m root zone	630	3100	0.2
Gaseous water			
Atmosphere	190	6,200	0.03

[a]Excluding Alaska and Hawaii.

Data in Table 1.3 show the approximate distribution of all water in the United States. The first column lists the volume of water in storage within each domain, while the second column lists the annual volume of water circulating within each domain. Dividing the first column by the second gives an average detention period for water within each domain. It can be noted that groundwater constitutes about 86 percent of the total water stored within the United States, but at the same time its annual replacement rate amounts to only 3 percent of the total water circulation. Thus, groundwater represents a large reserve water source that is little affected by the eccentricities of rainfall from year to year. Furthermore, Table 1.3 indicates that shallow groundwater, into which most wells penetrate, has an average residence time of some 200 years; this contrasts with a period of several days for surface water.

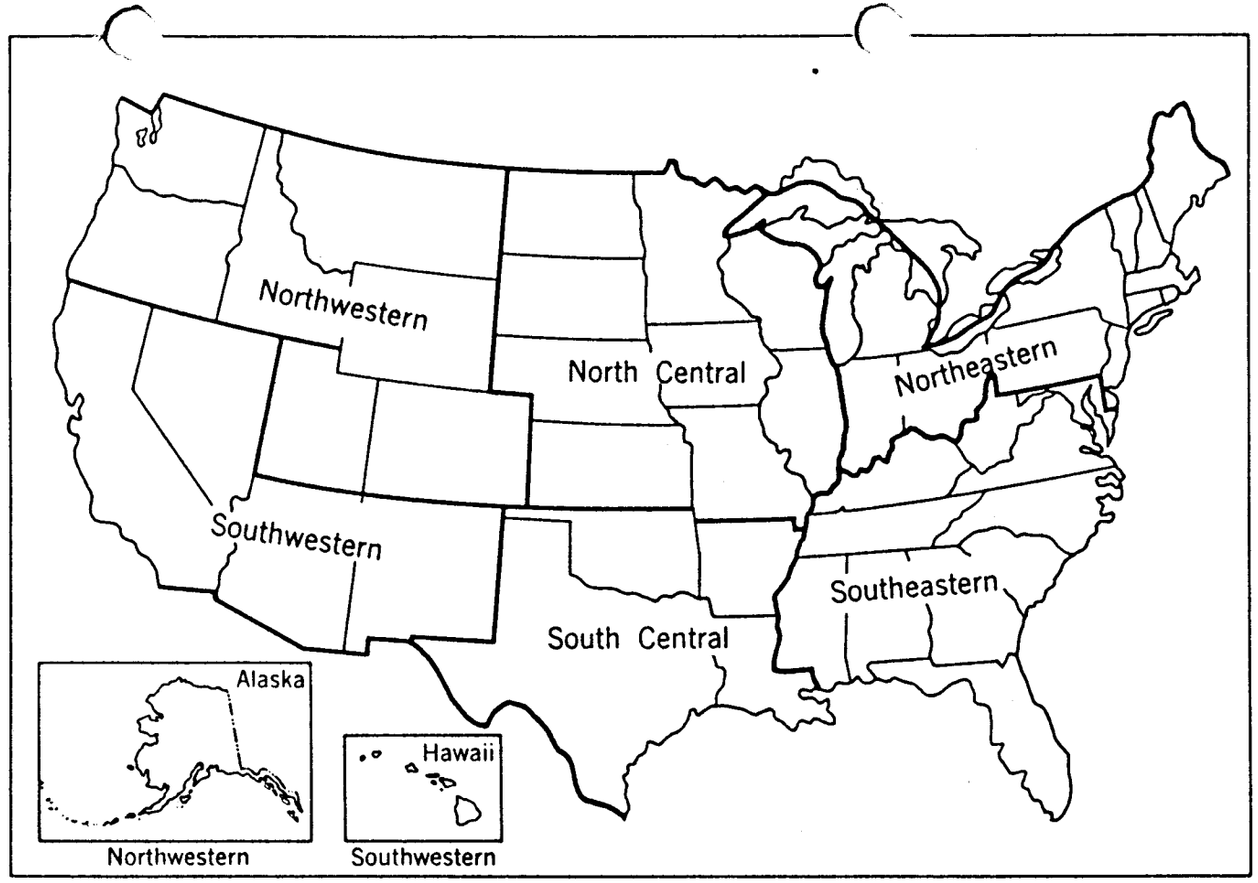

Fig. 1.9 Outline map of the United States showing areas included in *U.S. Geological Survey Water-Supply Papers* on water levels in observation wells.