

Table 1.3.1 Major Purposes of Water Use

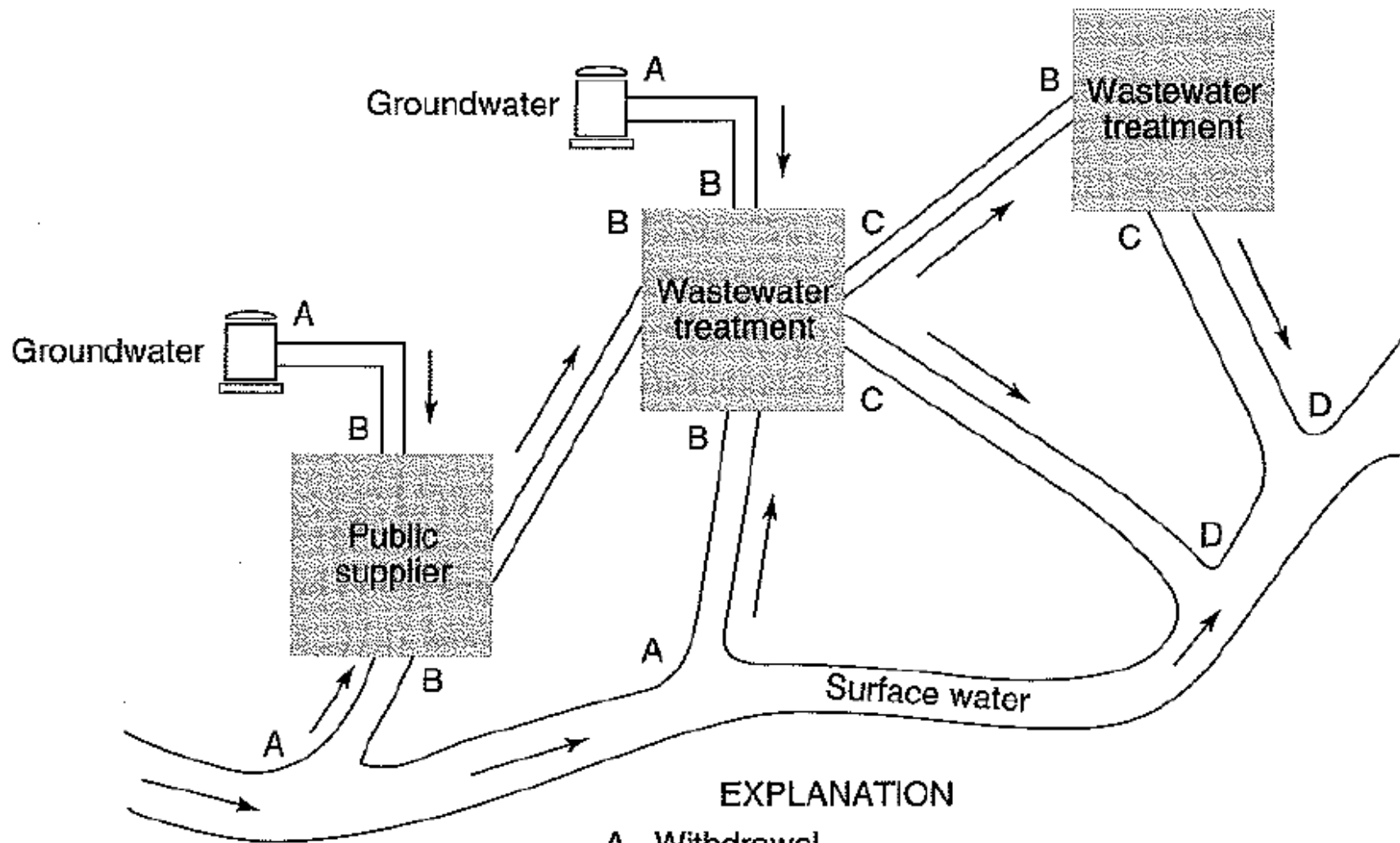
Water-use purpose	Definition
Domestic use	Water for household needs such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens (also called residential water use).
Commercial use	Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions.
Irrigation use	Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands such as parks and golf courses.
Industrial use	Water for industrial purposes such as fabrication, processing, washing, and cooling.
Livestock use	Water for livestock watering, feed lots, dairy operations, fish farming, and other on-farm needs.
Mining use	Water for the extraction of minerals occurring naturally and associated with quarrying, well operations, milling, and other preparations customarily done at the mine site or as part of a mining activity.
Public use	Water supplied from a public water supply and used for such purposes as firefighting, street washing, municipal parks, and swimming pools.
Rural use	Water for suburban or farm areas for domestic and livestock needs, which is generally self-supplied.
Thermoelectric power use	Water for the process of the generation of thermoelectric power.

Source: Solley et al. (1993).

Table 11.1.1 Definitions of Water-Use Terms

Term	Definition
Consumptive use	That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment.
Conveyance loss	The quantity of water that is lost in transit from a pipe, canal, conduit, or ditch by leakage or evaporation.
Delivery and release	The amount of water delivered to the point of use and the amount released after use.
Instream use	Water that is used, but not withdrawn, from a surface- or ground-water source for such purposes as hydroelectric-power generation, navigation, water-quality improvement, fish propagation, and recreation.
Offstream use	Water withdrawn or diverted from a surface- or ground-water source for public water supply, industry, irrigation, livestock, thermoelectric-power generation, and other uses.
Public supply	Water withdrawn by public or private water suppliers and delivered to users.
Return flow	The water that reaches a surface- or ground-water source after release from the point of use and thus becomes available for further use.
Reclaimed wastewater	Wastewater-treatment-plant effluent that has been diverted for beneficial use before it reaches a natural waterway or aquifer.
Self-supplied water	Water withdrawn from a surface- or groundwater source by a user rather than being obtained from a public supply.
Withdrawal	Water removed from the ground or diverted from a surface-water source for offstream use.

Source: Adapted from Solley, et al. (1993) as presented in Dziegielewski, et al. (1996).



- A Withdrawal
- B Delivery
- C Release
- D Return flow
- A-B = Conveyance loss (also C-D)
- B-D = Consumptive use

Figure 1.3.1 Definition of water-use flows and losses (from Solley et al. (1993)).

Table 1.2.3 Dynamics of Water Use in the World by Human Activity

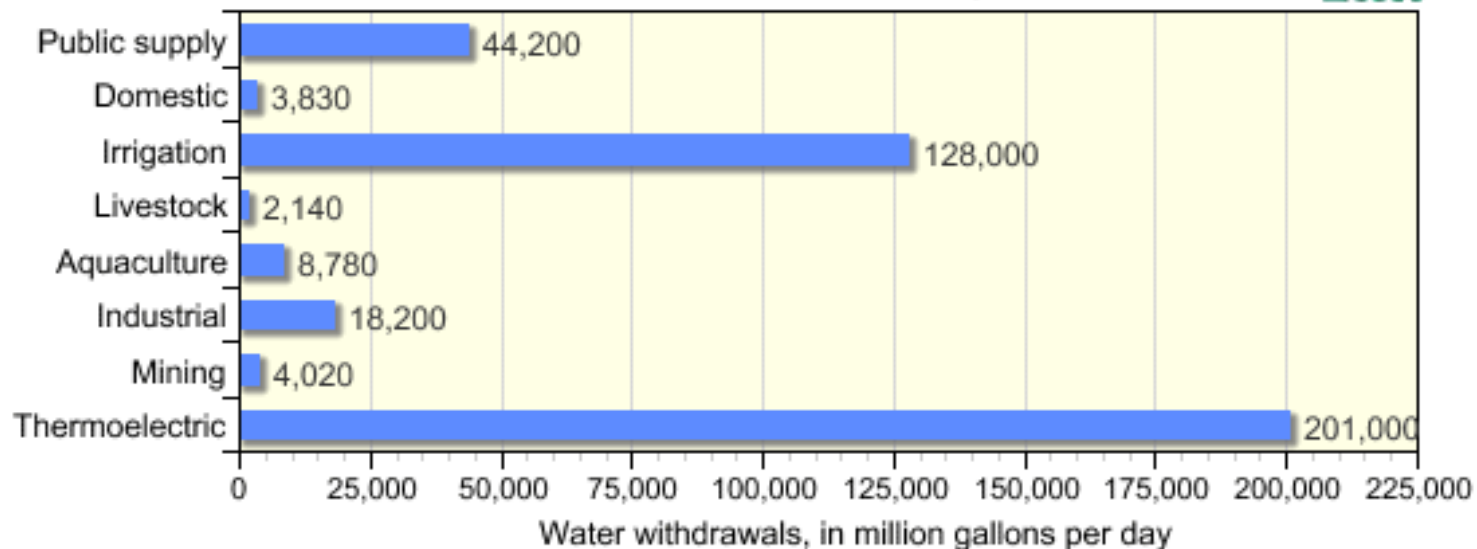
Water users ^a	1900	1940	1950	1960	1970	1975	1980		1990 ^b		2000 ^b	
	(km ³ per year)	(km ³ per year)	(km ³ per year)	(km ³ per year)	(km ³ per year)	(km ³ per year)	(km ³ per year)	(%)	(km ³ per year)	(%)	(km ³ per year)	(%)
Agriculture												
Withdrawal	525	893	1130	1550	1850	2050	2290	69.0	2680	64.9	3250	62.6
Consumption	409	679	859	1180	1400	1570	1730	88.7	2050	86.9	2500	86.2
Industry												
Withdrawal	37.2	124	178	330	540	612	710	21.4	973	23.6	1280	24.7
Consumption	3.5	9.7	14.5	24.9	38.0	47.2	61.9	3.2	88.5	3.8	117	4.0
Municipal supply												
Withdrawal	16.1	36.3	52.0	82.0	130	161	200	6.0	300	7.3	441	8.5
Consumption	4.0	9.0	14	20.3	29.2	34.3	41.1	2.1	52.4	2.2	64.5	2.2
Reservoirs												
Withdrawal	0.3	3.7	6.5	23.0	66.0	103	120	3.6	170	4.1	220	4.2
Consumption	0.3	3.7	6.5	23.0	66.0	103	120	6.2	170	7.2	220	7.6
Total (rounded off)												
Withdrawal	579	1060	1360	1990	2590	2930	3320	100	4130	100	5190	100
Consumption	417	701	894	1250	1540	1760	1950	100	2360	100	2900	100

^aTotal water withdrawal is shown in the first line of each category, consumptive use (irretrievable water loss) is shown in the second line.

^bEstimated.

Source: Shiklomanov (1993).

Total water withdrawals in the United States, 2005



Trends in total water withdrawals and population, 1950-2005

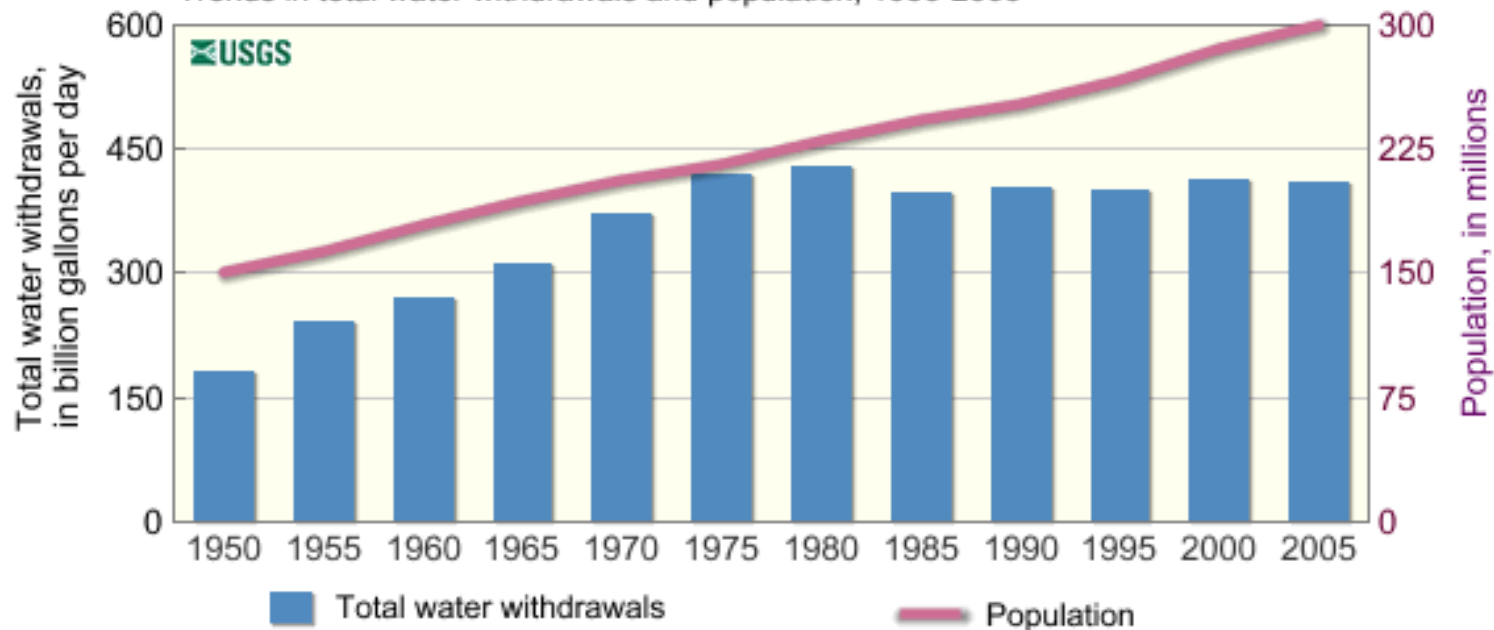


Table 11.1.4 Water Requirements for Municipal Establishments

Type	Unit	Average Use	Peak Use
Hotels	Liter/day/square meter	10.4	17.6
Motels	Liter/day/square meter	9.1	63.1
Barber shops	Liter/day/barber chair	207	1470
Beauty shops	Liter/day/station	1020	4050
Restaurants	Liter/day/seat	91.6	632
Night clubs	Liter/day/person served	5	5
Hospitals	Liter/day/bed	1310	3450
Nursing homes	Liter/day/bed	503	1600
Medical offices	Liter/day/square meter	25.2	202
Laundry	Liter/day/square meter	10.3	63.9
Laundromats	Liter/day/square meter	88.4	265
Retail space	Liter/day/sales square meter	4.3	11
Elementary schools	Liter/day/student	20.4	186
High schools	Liter/day/student	25.1	458
Bus-rail depot	Liter/day/square meter	136	1020
Car washes	Liter/day/inside square meter	194.7	1280
Churches	Liter/day/member	0.5	17.8
Golf-swim clubs	Liter/day/member	117	84
Bowling alleys	Liter/day/alley	503	503
Residential colleges	Liter/day/student	401	946
New office buildings	Liter/day/square meter	3.8	21.2
Old office buildings	Liter/day/square meter	5.8	14.4
Theaters	Liter/day/seat	12.6	12.6
Service stations	Liter/day/inside square meter	10.2	1280
Apartments	Liter/day/occupied unit	821	1640
Fast food restaurants	Liter/day/establishment	6780	20,300

Source: Gleick (1993b).

Table 11.15 Typical Household Water Use in the United States

Use	Unit	Range
Washing machine	Liters per load	130–270
Standard toilet	Liters per flush	10–30
Ultra volume toilet	Liters per flush	6 or less
Silent leak	Liters per day	150 or more
Nonstop running toilet	Liters per minute	20 or less
Dishwasher	Liters per load	50–120
Water-saver dishwasher	Liters per load	40–100
Washing dishes with tap running	Liters per minute	20 or less
Washing dishes in a filled sink	Liters	20–40
Running the garbage disposal	Liters per minute	10–20
Bathroom faucet	Liters per minute	20 or less
Brushing teeth	Liters	8
Shower head	Liters per minute	20–30
Low-flow shower head	Liters per minute	6–11
Filling a bathtub	Liters	100–300
Watering a 750 m ² lawn	Liters per month ^a	7600–16,000
Standard sprinkler	Liters per hour	110–910
One drip-irrigation emitter	Liters per hour	1–10
1/2 in diameter hose	Liters per hour	1100
5/8 in diameter hose	Liters per hour	1900
3/4 in diameter hose	Liters per hour	2300
Slowly dripping faucet	Liters per month	1300–2300
Fast-leaking faucet	Liters per month	7600 or more
Washing a car with running water	Liters in 20 minutes	400–800
Washing a car with pistol-grip faucet	Liters in 20 minutes	60 or more
Uncovered pool (60 m ²)	Liters lost per month ^a	3000–11,000 +
Covered pool	Liters lost per month ^a	300–1200

^aDepending on climate.

Source: Gleick (1993b).

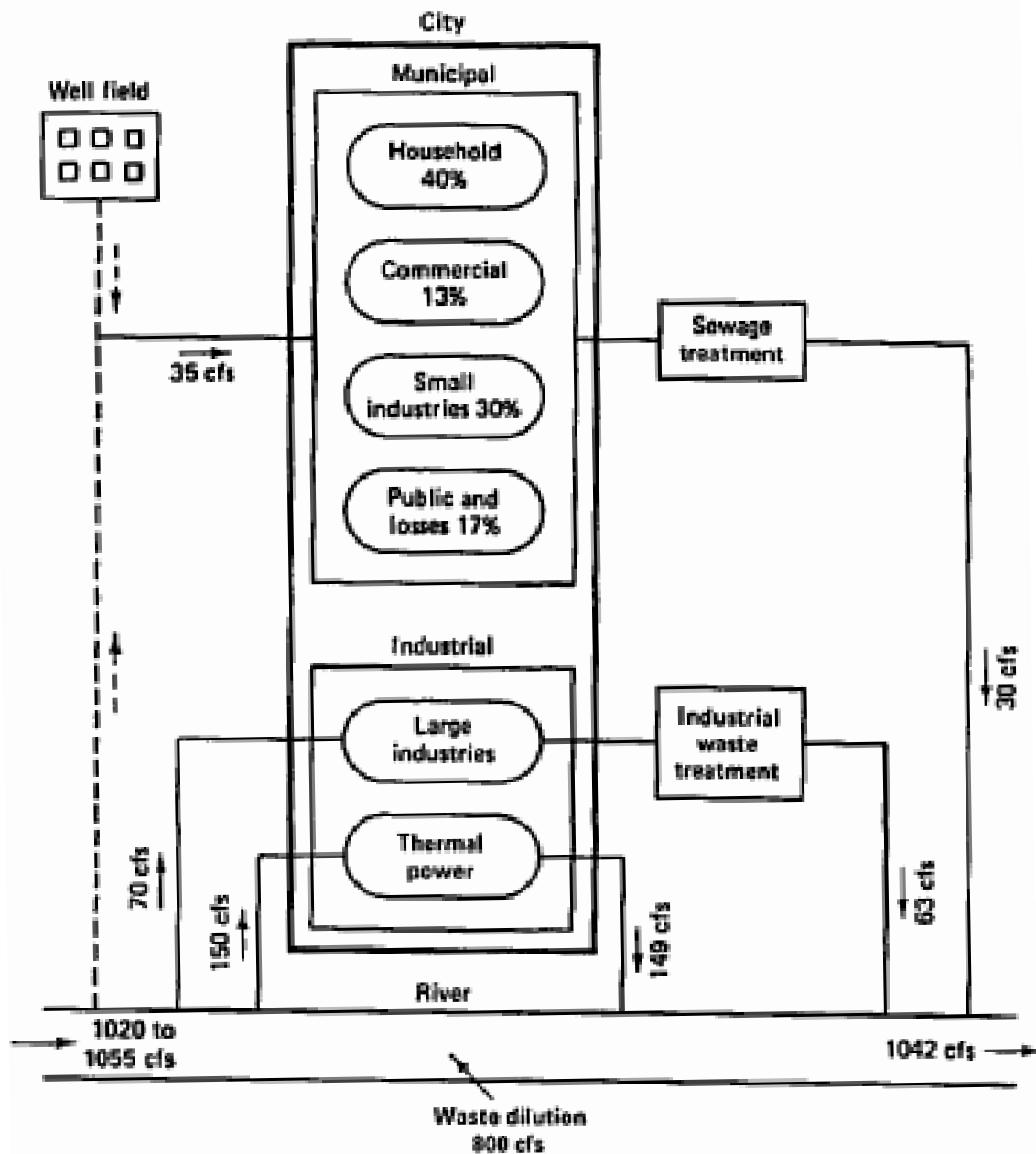


Figure 1.1 Water requirements of a city of 150,000 population.

Iowa City

Population ~60,000
Average usage ~6 million gpd
~100 gpcd

Peak daily usage: 10.6 million gpd (Summer 1989)

Source

2 Cambrian-Ordovician (Jordan) wells (1600 ft deep)

4 Silurian wells (400 ft deep)

4 Alluvial wells (40 ft deep) [primary source]

Lake (manmade @ plant)

River intakes (future; intake available)

Distribution System

280 miles of mains (2" – 24" cast iron/ductile plastic)

Storage reservoirs (4 + 1): 7 + 4 MG (at plant)

2350 hydrants; ~7000 valves

City Requirements

Residential 93 %

Commercial 6 %

Industrial 1 %

Treatment Plant

2551 N. Dubuque Street
(since March 2003)

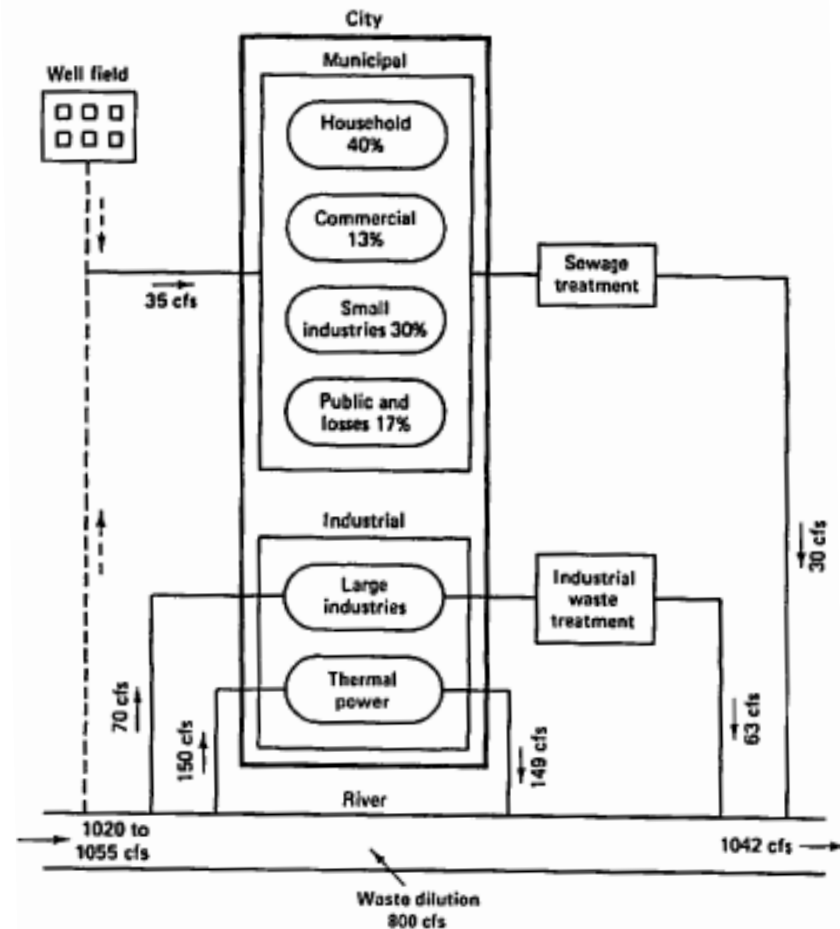


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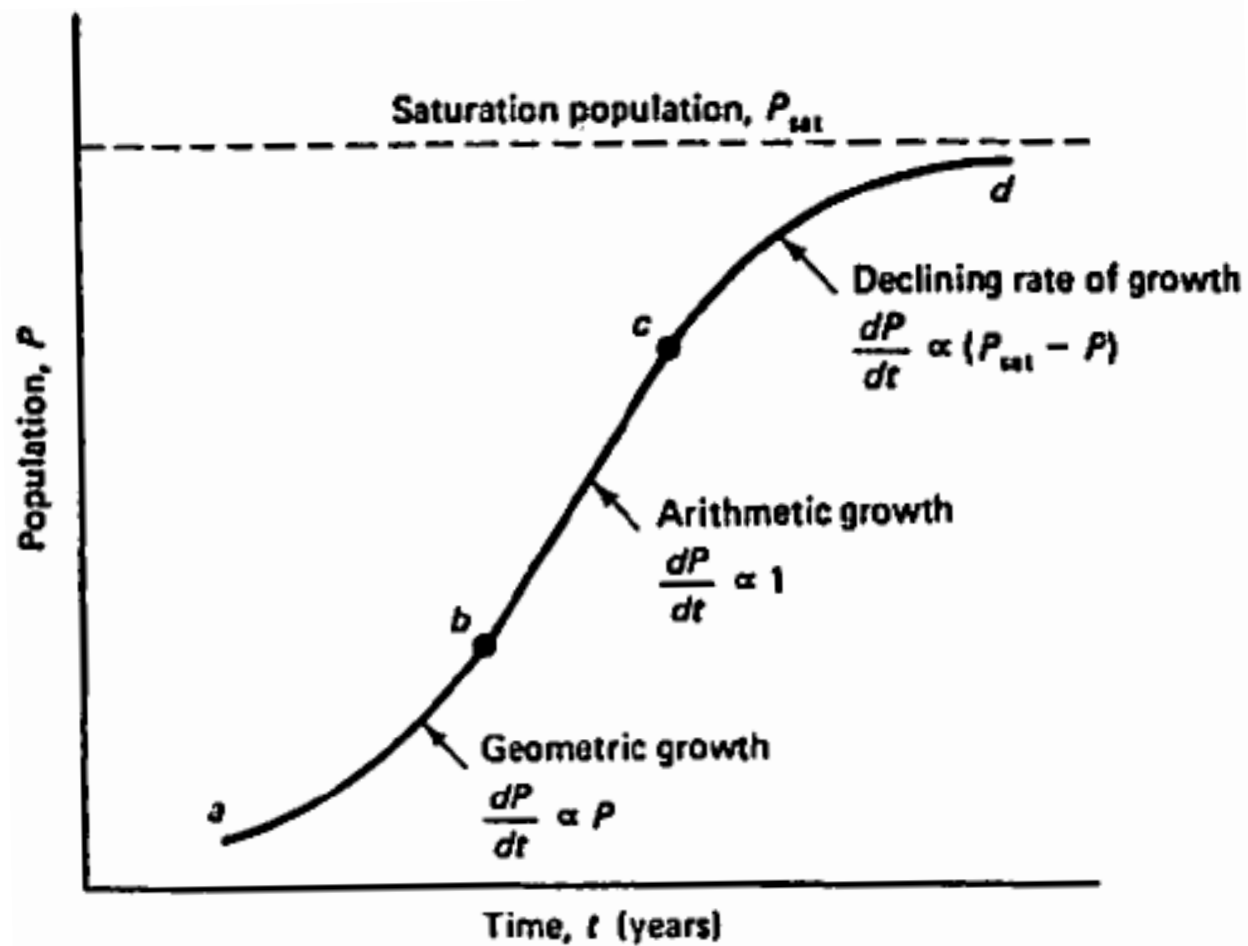


Figure 1.2 Population growth curve.