



QFL4520 – Química Ambiental II

Parte II – Recursos Naturais

Prof. Dr. Reinaldo C. Bazito

bazito@iq.usp.br



Parte II – Recursos Naturais: Energia e Água

- *Energia - produção e usos;*
- *Combustíveis fósseis;*
- *Energia nuclear;*
- *Energia de fontes renováveis;*
- *Água – produção e uso.*



Aula 7:

- *Água – Produção e uso.*



Recursos Hídricos



Ciclo da Água

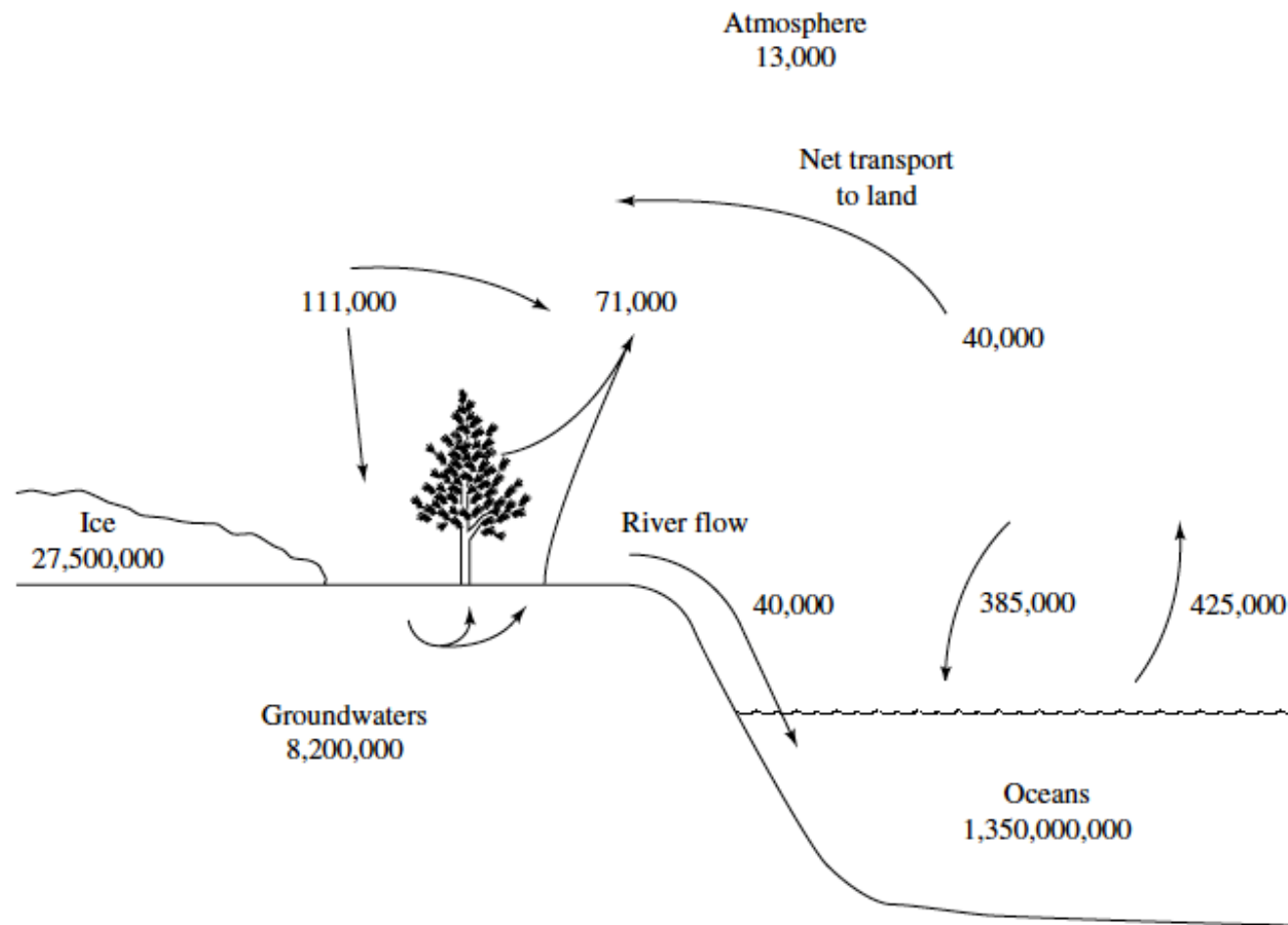


Figure 10.1 The global water cycle. The numbers are in km^3 for the water reservoirs, and km^3/yr for the flows. Figure from "The Global Water Cycle" in *Biogeochemistry: An Analysis of Global Change* by William H. Schlesinger. Copyright © 1991 by Academic Press. Reproduced by permission of the publisher.



Uso da água

TABLE 10.1 ANNUAL WATER SUPPLY AND WITHDRAWAL FOR CONTINENTS AND VARIOUS COUNTRIES

Continents/ countries	Water supply			Water withdrawal		Per capita use/supply ratio (%)	Status [†]
	Total (km ³)	Per km ² (m ³)	Per capita (m ³)	Total* (km ³)	Per capita (m ³)		
World	41,022	314,386	6,761.5	3,240.0	534.0	7.9	Potential problems
Africa	3,996	134,842	4,995.0	145.1	181.4	3.6	Potential problems
Kenya	20	35,492	665.8	2.1	67.6	10.1	Scarcity
Congo, D.R.	935	412,430	17,992.9	0.4	6.9	0.0	Surplus
North America [‡]	6,365	302,698	14,373.2	608.4	1,373.9	9.6	Surplus
Mexico	357	187,249	3,586.9	77.6	779.0	21.7	Potential problems
Canada	2,850	309,024	92,624.5	45.1	1,466.0	1.6	Surplus
South America	9,526	543,435	27,628.7	106.2	308.0	1.1	Surplus
Peru	40	31,250	1,474.1	6.1	224.8	15.3	Stress
Brazil	5,190	613,728	30,508.8	36.5	214.4	0.7	Surplus
Asia	13,207	428,038	3,584.4	1,633.9	443.4	12.4	Potential problems
China	2,800	301,367	2,214.3	460.0	363.8	16.4	Potential problems
Indonesia	2,530	1,396,579	11,922.3	16.6	78.2	0.7	Surplus
Europe	6,235	275,826	8,570.3	455.3	625.9	7.3	Potential problems
Poland	49	162,276	1,278.2	12.3	317.7	24.9	Stress
Russia	4,313	255,363	29,695.5	77.1	530.9	1.8	Surplus
Oceania	1,614	190,105	52,072.6	16.7	539.7	1.0	Surplus
Australia	343	44,648	17,864.6	14.6	760.4	4.3	Surplus
Papua New Guinea	801	1,768,759	166,528.1	0.1	20.8	0.0	Surplus

*Total water withdrawals are for various years ranging from 1980 to 1995 as provided in WRI (1999).

[†]Refers to per capita water supply:

Water surplus: >10,000 m³/capita

Potential water management problems: >2,000 m³/capita <10,000 m³/capita

Water stress: >1,000 m³/capita <2,000 m³/capita

[‡]Includes Central America

Sources: Population data is for mid-2000, as reported in the Population Reference Bureau (2000), *2000 World Population Data Sheet*, Washington, DC.

Other data from the World Resources Institute (in collaboration with the United Nations Environment Programme and the United Nations Development Programme) (1999). *World Resources 1998–1999* (Oxford, UK: University Press).



Uso da água

TABLE 10.2 USES OF WATER FOR CONTINENTS AND COUNTRIES

Continents/countries	Domestic (%)	Industry/power (%)	Agriculture (%)
World	8	23	69
Africa	7	5	88
Kenya	20	4	76
Congo, D.R.	61	16	23
North America*	12	41	47
Mexico [†]	6	8	86
Canada [†]	18	70	12
South America	18	23	59
Peru [†]	19	9	72
Brazil [†]	22	19	59
Asia	6	9	85
China [†]	6	7	87
Indonesia [†]	13	11	76
Europe	14	55	31
Poland [†]	13	76	11
Russia	19	62	20
Oceania	64	2	34
Australia [†]	65	2	33
Papua New Guinea [†]	29	22	49

*Includes Central America

[†]Sectoral withdrawal estimates are for 1987

Source: World Resources Institute (in collaboration with the United Nations Environment Programme and the United Nations Development Programme) (1999). *World Resources 1998–1999* (Oxford, UK: University Press).



Irrigação

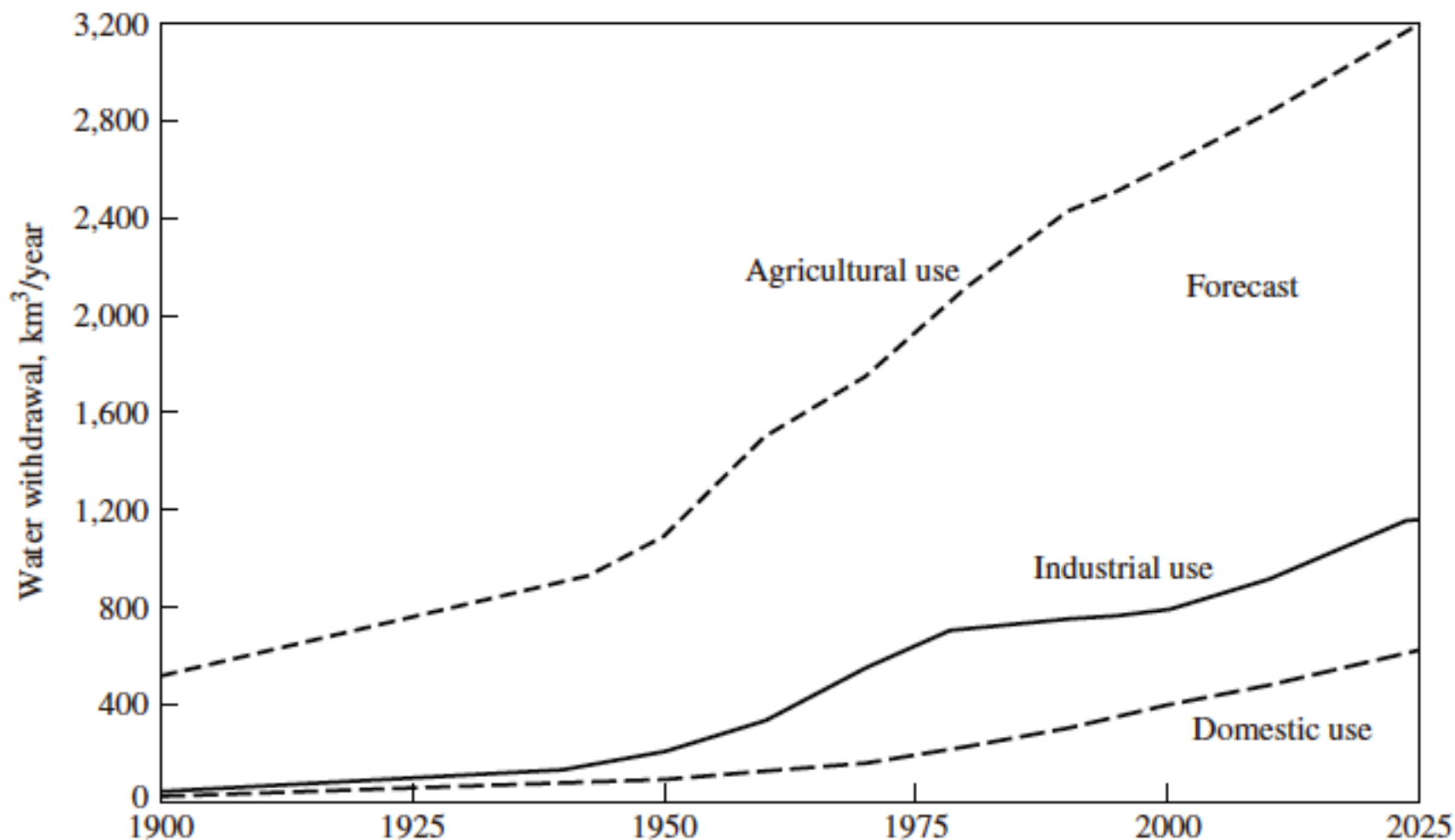


Figure 10.2 Global water use, 1900 to 2025. *Source:* I. A. Shiklomanov (ed.) (1999). *World Water Resources at the Beginning of the 21st Century* (St. Petersburg, Russia: State Hydrological Institute/UNESCO).



Irrigação

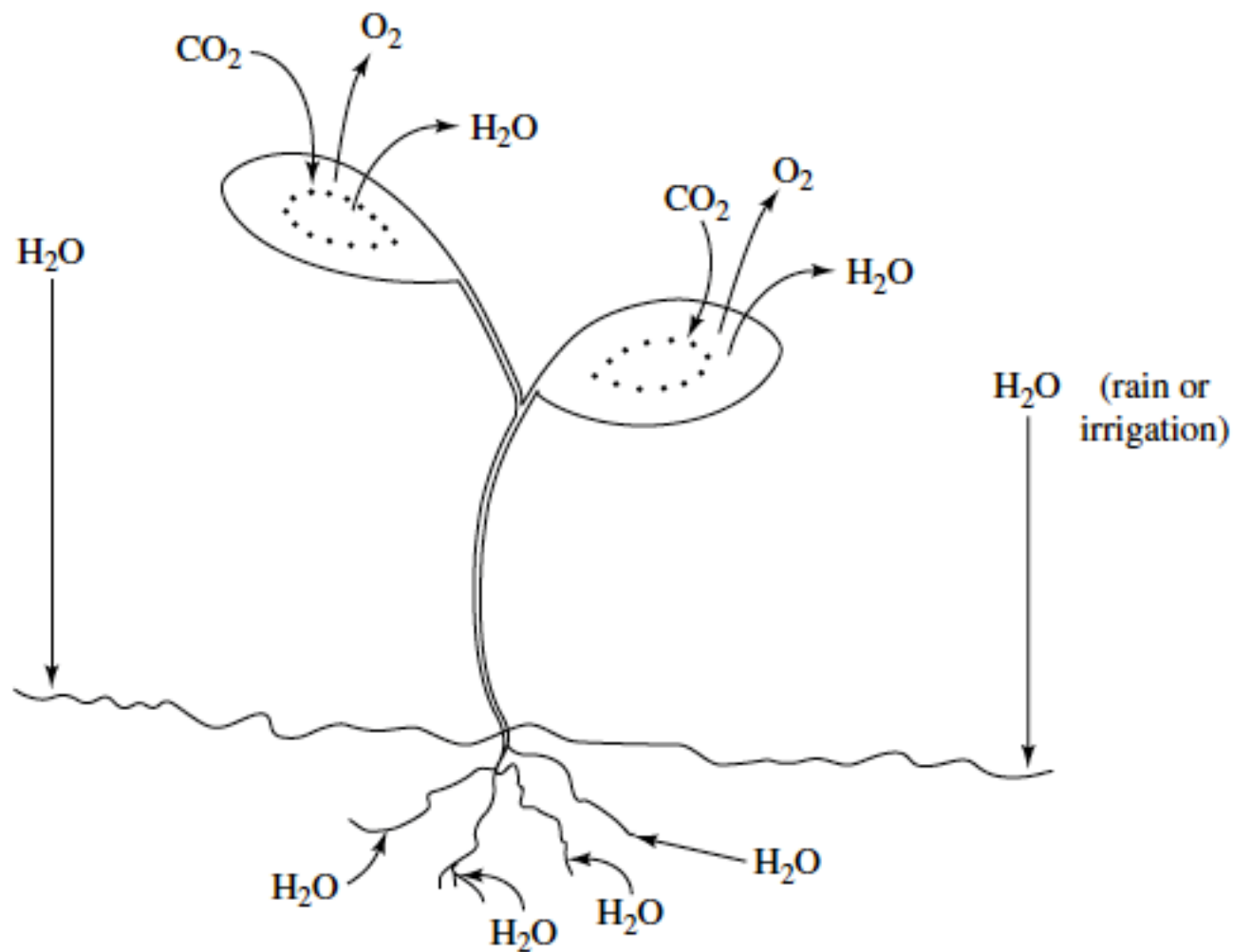


Figure 10.3 Exchange of gases on the stomata of leaves, and loss of water through transpiration.



Água subterrânea

- Problemas com "excesso de bombeamento"
- Contaminação humana;
- Contaminação natural

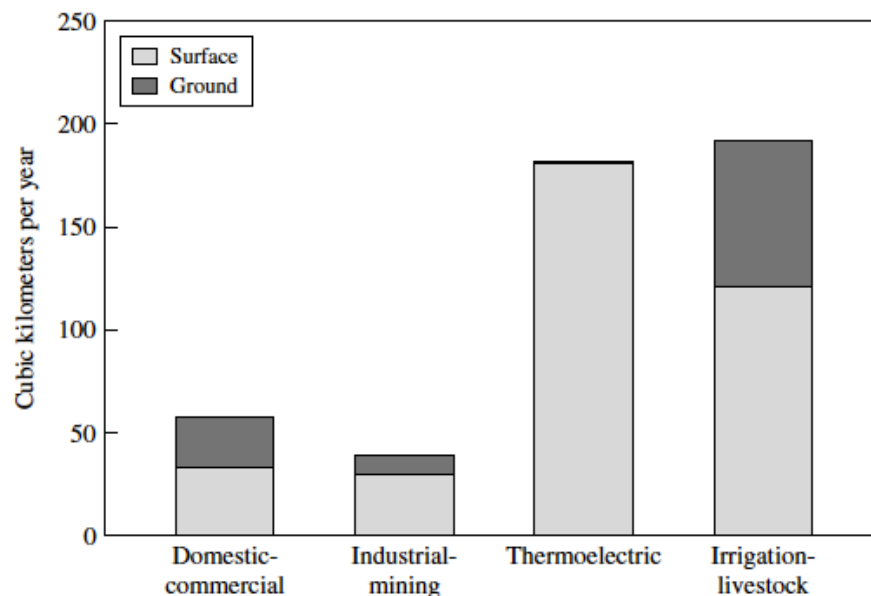


Figure 10.5 Sources and uses of water in the United States in 1995. Total use was 470 km³/yr. *Source:* Data from W. B. Solley et al. (1998). *Estimated Use of Water in the United States in 1995*, U.S. Geological Survey, Circular 1200 (Washington, DC: U.S. Department of Interior).



Água subterrânea

- Problemas com "excesso de bombeamento"
- Contaminação humana;
- Contaminação natural

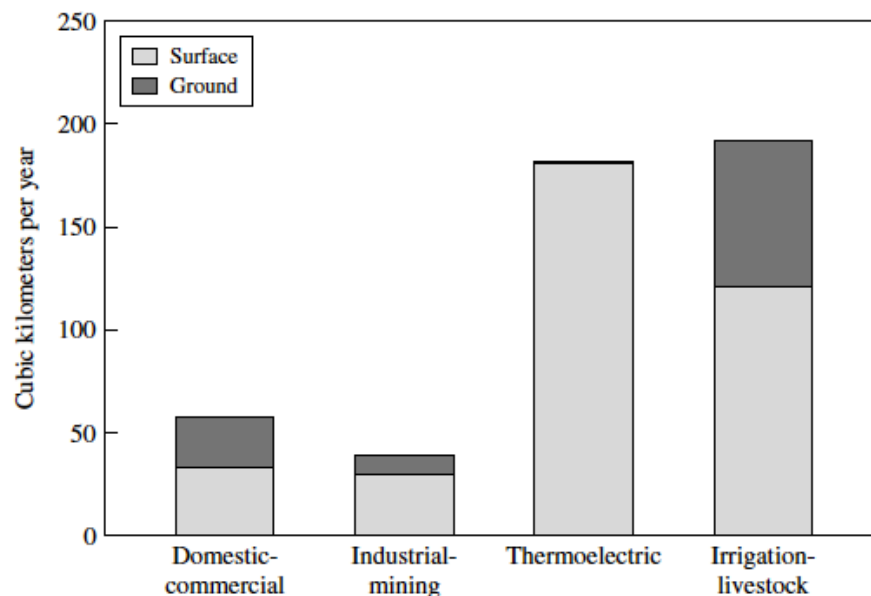


Figure 10.5 Sources and uses of water in the United States in 1995. Total use was 470 km³/yr. Source: Data from W. B. Solley et al. (1998). *Estimated Use of Water in the United States in 1995*, U.S. Geological Survey, Circular 1200 (Washington, DC: U.S. Department of Interior).



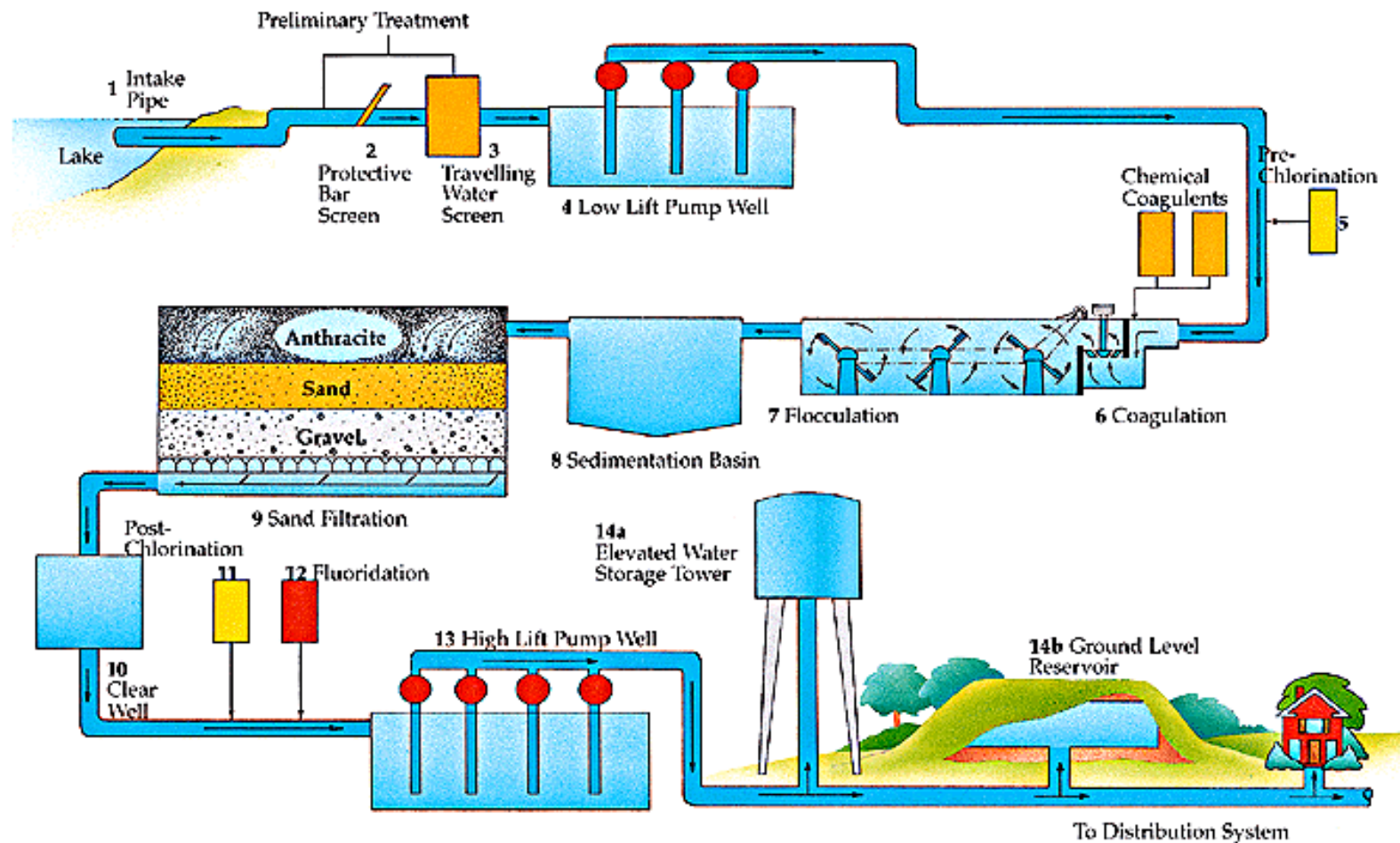
Produção da Água

http://site.sabesp.com.br/uploads/image/noticias/eta_rio_grande02.jpg



ETA – Estação de Tratamento de Água

WATER TREATMENT PLANT SURFACE WATER SUPPLY





ETA – Estação de Tratamento de Água

