QUANTITY AND QUALITY OF DRINKING WATER SUPPLIES

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Summary

Access to clean water is a basic need, which is still not within the grasp of a huge population in the developing world. As international efforts are reaching a decisive momentum to provide clean water to these deprived populations, the estimated rise in use of water will increase sixfold over the next four decades. An assessment of quantity with minimum quality requirements will therefore be important so that the intended benefits of better water supplies can be achieved at lower costs. Quantity of water to be supplied to a community depends on primary and secondary needs of a community that has to be correctly assessed before embarking on a water supply scheme. Technologies for treatment of water to achieve required quality levels are available, the selection of which requires careful evaluation, to suit the local needs.

1. Introduction

Water is essential for human life. Its quantity and quality are equally crucial. However, natural waters are, in most cases, not aesthetically and hygienically fit to be consumed directly, thus calling for some kind of treatment. The plight of over two-thirds of the world's population that lives in developing countries due to exposure to the dangers of unsafe water supply was highlighted during the United Nations International Drinking Water and Sanitation Decade, 1981–1990. Providing access to clean water and sanitation would not eradicate all of such dangers to health, though it would be the single most effective means of alleviating human distress. It has been estimated that domestic water use in developing countries will rise sixfold over the next four decades. Such an increase will demand assessment of quantities of water required and its quality, by different communities, so that safe water can be made available in adequate quantities at reasonable costs. This article describes various factors that are to be considered in assessing quantities of water in schemes for drinking water supply and provides an overview of national and international standards and guidelines on the quality aspects of water used for drinking and other domestic purposes, briefly outlining the treatment technologies to achieve this quality requirement.

2. Assessment of Water Quantity

The basic factors to be considered in the assessment of quantity for a water supply scheme are:

- area and population to be served;
- water demand;
- design period;
- selection of water source
- treatment requirements;
- nature and extent of water transmission and distribution.

2.2. Water Demand

Water consumption is commonly referred as the amount of water taken from distribution systems; however, little of it is actually consumed and most of it is discharged as wastewater. The water demand of a community depends on:

- climate;
- standard of living;
- type of water supply system;
- type and extend of sewerage system used;
- water pricing;
- availability of private supply;
- method of distribution.

Types of water supply	**Typical consumption (Litres/capita/day)**	**Range (Litres/capita/day)**
1. Communal standpipe (walking distance <250 m)	30	20–50
2. Yard connection (tap placed in house-yard)	40	20–80
3. House connection		
Single tap	50	30–60
Multiple tap	150	70–250

Source: IRC (1981), Small community water supplies, International Reference Center for Community Water Supply and Sanitation, The Hague, Netherlands

Table 1. Domestic water supply type and consumption rates.

Depending on the climate and workload, the human body needs about 3 to 10 L of water per day for normal functioning (IRC 1981). While a minimum of 70 to 100 L per capita per day may be considered adequate for the domestic needs of urban communities, the non-domestic needs of urban communities would significantly push this figure up. The non-domestic needs basically depend on standard of living of the community.

Table 1 presents domestic water usage in developing countries for different types of water supply systems indicating the variation in quantity consumed by type of supply. Table 2 presents the design water consumption rates used by various agencies of a developed country (Australia) for comparison.

Agency	**Average daily demand (Litres/capita/day)**
Department of Public Works (PWD)	
Coastal and Table lands	275
Western	340
Water Board	
Total system	550
Sydney	517
South Coast	1000
National Capital Development Corporation (NCDC) average	1700

Table 2. Design consumption rates in Australia.

Category	**Typical water use**
Schools	
Day schools	15–30 L/day per pupil
Boarding schools	90–140 L/day per pupil
Hospitals (with laundry facilities)	220–300 L/day per bed
Hostels	80–120 L/day per resident
Restaurants	65–90 L/day per seat
Cinema Houses, Concert Halls	10–15 L/day per seat
Offices	25–40 L/day per seat
Railway and Bus Stations	15–20 L/day per user
Livestock	
Cattle	25–35 L/day per animal
Horses and mules	20–25 L/day per animal
Sheep	15–25 L/day per animal
Pigs	10–15 L/day per animal
Poultry- Chicken	15–25 L/day per bird

Source: IRC (1981), *Small Community Water Supplies*, International Reference Center for Community Water Supply and Sanitation, The Hague, Netherlands

Table 3. Non-domestic water requirements in developing countries.

In assessing per capita demand, one needs to know domestic and small industry needs, institutional and major industry needs, municipal and fire-fighting needs, requirements for live stock, and percentage of wastes among all users. Typical values of various water requirements in developing countries are presented in Table 3. In assessing these needs, attention should be paid to the local needs, habits of the people, and their living standards, and industrial and commercial importance of the area. In the absence of specific data, a preliminary estimation of 1.5 Ls^{-1} (or more) per 1000 people can be assumed for small community water supply schemes.

An allowance of about 20% for water losses and wastes is also normally included. To allow for future population growth and higher use of water per capita (or per household), a community water supply system must also have sufficient surplus capacity.

In any water supply project, the design period is fixed to compute the design population and thus the design demand. Generally, different components in the system are designed for different periods, as given in Table 4.

Component of water supply	**Design period in years**
1. Storage by dams	50
2. Infiltration works	30
3. Pump sets	
– all prime movers except electric motors	30
– electric motors and pumps	15
4. Small community water treatment units	15
5. Pipe connection to the several treatment units and other small appurtenances	30
6. Raw water and clear water conveying mains	30
7. Clear water reservoirs at the head works, balancing tanks, and service reservoirs (overhead or ground level)	15
8. Distribution system	30

Source: *Manual on Water Supply and Treatment*, 3rd edition, 1991, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, Government of India

Table 4. Design periods of different components of water supply schemes.

3. Assessment of Water Quality

Public, in general, judges the quality of water supplied based on its appearance, taste and odor at the point of its use. Although appearance, taste, odor etc., are useful indicators of the quality of drinking water, their presence may not necessarily make water unsafe to drink. In the same way, the absence of any unpleasant qualities does not guarantee water to be safe for consumption. True that drinking water should be aesthetically pleasing, ideally looking clear, colorless and well aerated with no unpalatable taste and odor. However, suitability in terms of public health is determined by microbiological, physical, chemical and radiological characteristics. Of these, the most important is microbiological quality. Also a number of chemical contaminants (both organic and inorganic) are found in water. These cause health problems in the long run and, therefore, detailed analyses are warranted. The drinking water, thus, should be:

- Free from pathogenic (disease causing) organisms.
- Clear (with low turbidity and little color).
- Not saline (salty in taste).
- Free from offensive taste or smell.
- Free from compounds that may have adverse effects on health or harmful in long term.
- Free from chemicals that may cause corrosion of water supply system or stain clothes washed using it.

Although in small community water supplies (especially in developing countries), the water quality problems are mainly due to bacteriological contamination, a significant number of very serious problems may occur as a result of chemical contamination of water resources. To ensure safe drinking water, detailed quality standards for physical, chemical, microbiological and radiological characteristics of water have been proposed by different countries and international organizations. These guidelines provide the following information for water authorities, health officials, and consumers:

- Day-to-day operational value to ensure that the supplied water does not carry any significant risk to the consumer.
- A basis for planning and designing water supply schemes.
- Assessment of long-term trends of the performance of the system.

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Biographical Sketches

S. Vigneswaran is currently a Professor and a Head of Environmental Engineering Group in Faculty of Engineering, University of Technology, Sydney, Australia. He has been working on water and wastewater research since 1976. He has published over 175 technical papers and authored two books (both through CRC press, USA). He has established research links with the leading laboratories in France, Korea, Thailand and the USA. Also, he has been involved in number of consulting activities in this field in Australia, Indonesia, France, Korea and Thailand through various national and international agencies. Presently, Dr. Vigneswaran is coordinating the university key research strengths on "water and waste management in small communities", one of the six key research centers funded by the university on competitive basis. His research in solid liquid separation processes in water and wastewater treatment namely filtration, adsorption is recognized internationally and widely referred.

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