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AGRICULTURAL STRUCTURES AND ENVIRONMENTAL CONTROL BTAP3105

WATER SUPPLY

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Sources of water supply, norms of water supply for human beings and animals



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Surface water and groundwater

Surface water and groundwater are both important sources for community water supply needs.

Groundwater is a common source for single homes and small towns, and river_sand lakes are the usual sources for large cities.

Although approximately 98 percent of liquid fresh water exists as groundwater, much of it occurs very deep. This makes pumping very expensive, preventing the full development and use of all groundwater resources.



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The hydrologic cycle

Water is in constant circulation, powered by the energy from sunlight and gravity in a natural process called the hydrologic cycle.

Water evaporates from the ocean and land surfaces, is held temporarily as vapour in the atmosphere, and falls back to Earth's surface as precipitation. Surface water is the residue of precipitation and melted snow, called runoff.

Where the average rate of precipitation exceeds the rate at which runoff seeps into the soil, evaporates, or is absorbed by vegetation, bodies of surface water such as streams, rivers, and lakes are formed. Water that infiltrates Earth's surface becomes groundwater, slowly seeping downward into extensive layers of porous soil and rock called aquifers.



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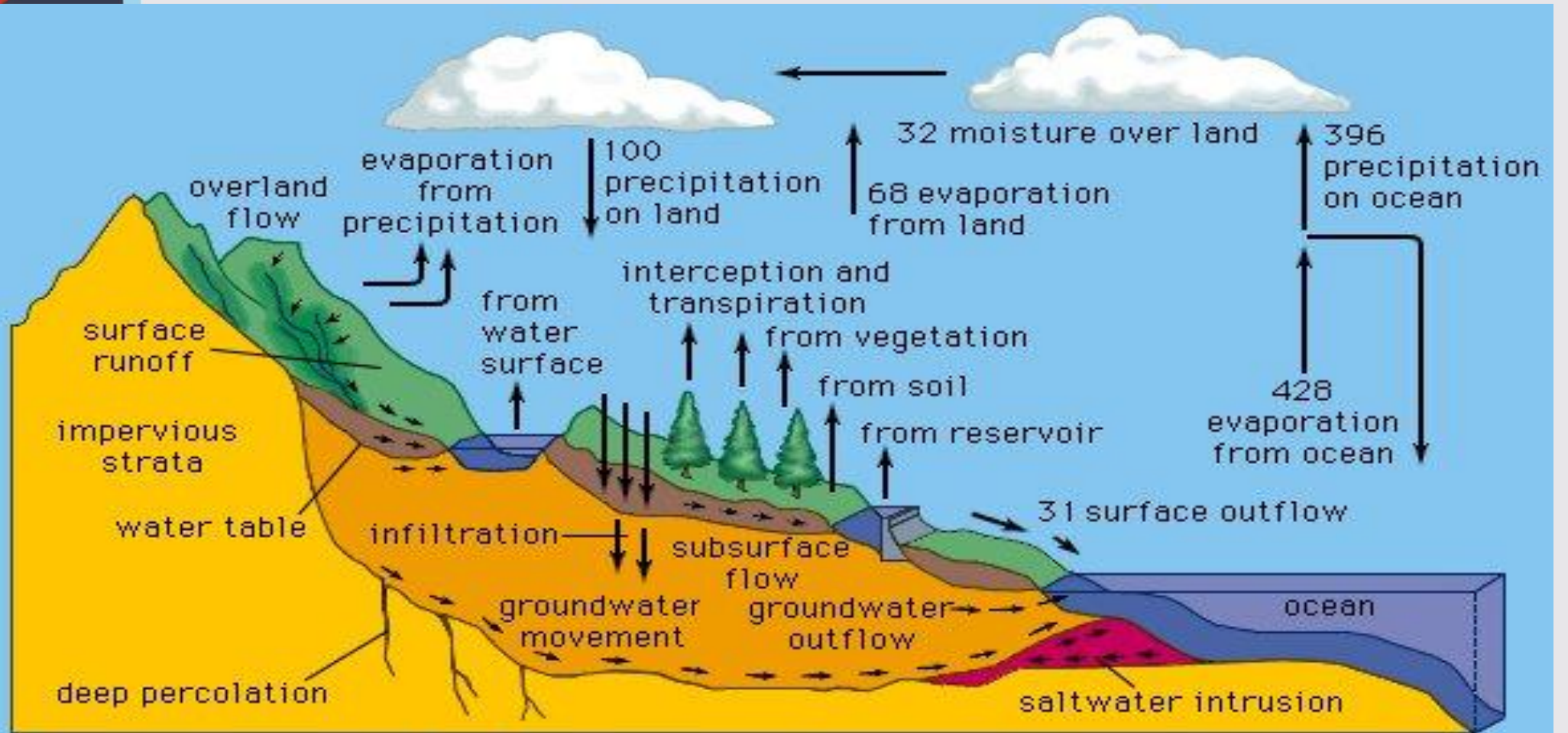
Under the pull of gravity, groundwater flows slowly and steadily through the aquifer.

In low areas it emerges in springs and streams. Both surface water and groundwater eventually return to the ocean, where evaporation replenishes the supply of atmospheric water vapour.

Winds carry the moist air over land, precipitation occurs, and the hydrologic cycle continues.



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Soil moisture

Groundwater

Ocean covers 71 percent of Earth's surface
510,000,000 sq km (196,950,000 sq mi)

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Surface water sources

The total land area that contributes surface runoff to a river or lake is called a watershed, drainage basin, or catchment area.

The volume of water available for municipal supply depends mostly on the amount of rainfall. It also depends on the size of the watershed, the slope of the ground, the type of soil and vegetation, and the type of land use.

The flowrate or discharge of a river varies with time. Higher flow rates typically occur in the spring, and lower flow rates occur in the winter, though this is often not the case in areas with monsoon systems.



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When the average discharge of a river is not enough for a dependable supply of water, a conservation reservoir may be built. The flow of water is blocked by a dam, allowing an artificial lake to be formed. Conservation reservoirs store water from wet weather periods for use during times of drought and low streamflow.

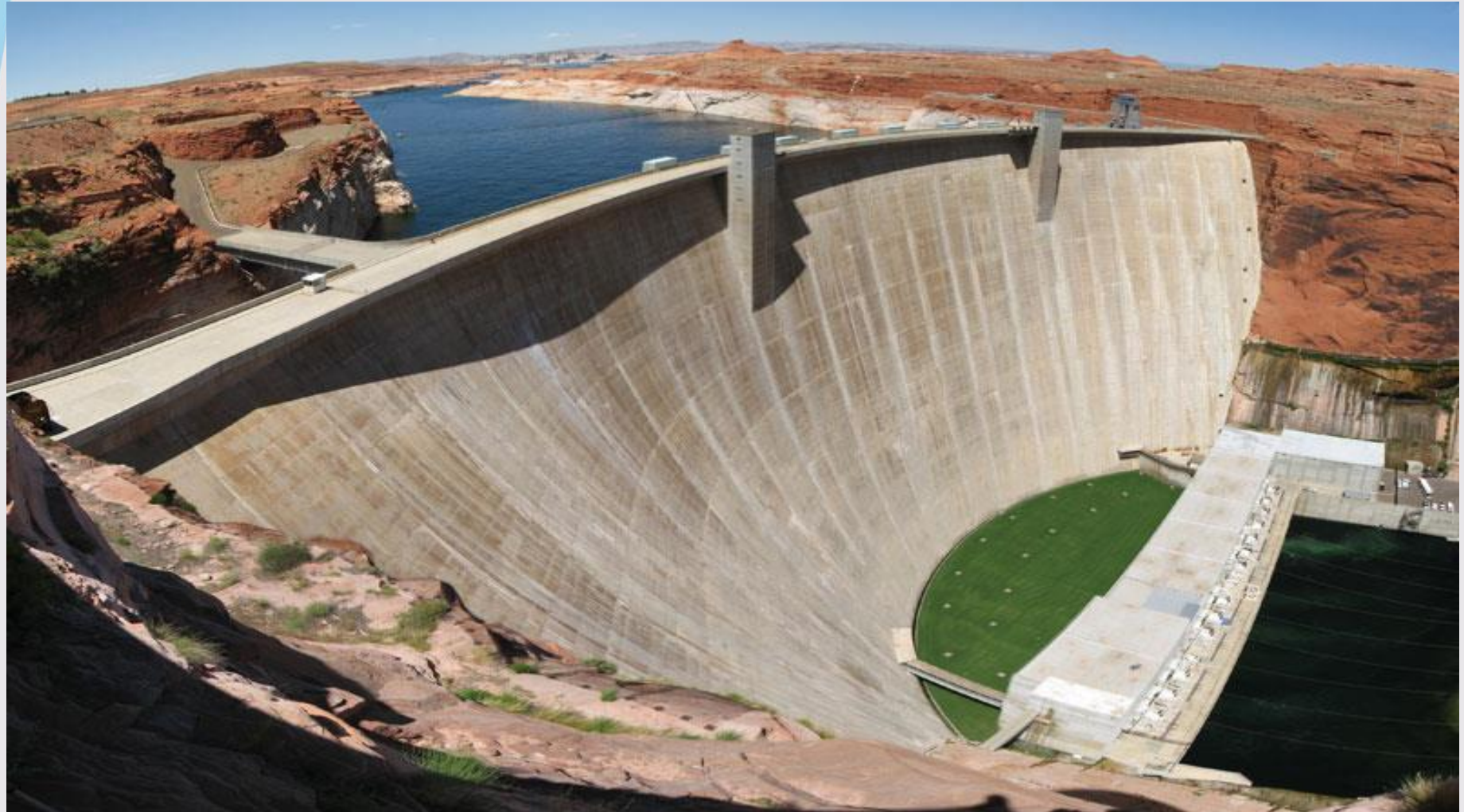
A water intake structure is built within the reservoir, with inlet ports and valves at several depths. Since the quality of water in a reservoir varies seasonally with depth, a multilevel intake allows water of best quality to be withdrawn.

A multipurpose reservoir is designed to satisfy a combination of community water needs. In addition to drinking water, the reservoir may also provide flood control, hydroelectric power, and recreation.



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Groundwater sources

The value of an aquifer as a source of groundwater is a function of the porosity of the geologic stratum, or layer, of which it is formed.

Water is withdrawn from an aquifer by pumping it out of a well or infiltration gallery.

An infiltration gallery typically includes several horizontal perforated pipes radiating outward from the bottom of a large-diameter vertical shaft. Wells are constructed in several ways, depending on the depth and nature of the aquifer.



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Wells used for public water supplies, usually more than 30 metres (100 feet) deep and from 10 to 30 cm (4 to 12 inches) in diameter, must penetrate large aquifers that can provide dependable yields of good-quality water.

They are drilled using impact or rotary techniques and are usually lined with a metal pipe or casing to prevent contamination. The annular space around the outside of the upper portion of the casing is filled with cement grout, and a special sanitary seal is installed at the top to provide further protection. At the bottom of the casing, a slotted screen is attached to strain silt and sand out of the groundwater.

A submersible pump driven by an electric motor can be used to raise the water to the surface. Sometimes a deep well may penetrate a confined artesian aquifer, in which case natural hydrostatic pressure can raise the water to the surface.



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Norms for Rural Water Supply in India

The study concerns norms that have been established by the Government of India in order to attain a network of facilities to provide an acceptable level of water consumption within a stipulated time frame.

The term acceptable level is crucial and it has a two-fold rationale. First, competing demand for greater investment in other sectors has left relatively small allocation for the domestic sector.

With normal output of 12 litres per minute, one handpump or standpost is estimated for every 250 persons.



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In the face of resource constraint, the tendency was to impose economy measures. Second, the wide inter-state differences in the provision of rural water supply services and infrastructure requires governmental intervention. Thus, standard norms have been fixed for the provision of rural and urban water supply service.

The current central rural water supply norms govern all central programs and are mostly adhered by state sector programs.

A rural habitation not having any safe water source with a permanently settled population of 20 households or 100 persons, whichever is more, is taken as the unit for coverage with funds under the ARWSP.



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Definition of habitation

A 'Habitation' is a locality within a village where a cluster of families reside. The total population should be 100 or more for consideration for coverage under the rural water supply norms laid down by the Department.

It is generally assumed that around 20 families reside in a habitation.

Average number of persons in a family is taken as 5. In case of hilly areas, a habitation may have a population, which is less than 100.

Number of sources required for habitations other than main habitation – the number of sources actually required is to be calculated on the basis of one source for every 250 persons



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However, if the population of the habitation is less than 250 but the habitation is located within 1.6 k.m. of another habitation or main habitation, the population can be grouped in cluster of 250 each to determine the number of sources.

In case the habitation is located at more than 1.6 k.m. from the main/ nearest habitation, one source is needed independently irrespective of the population.

Accordingly the number of sources required are to be worked out and entered in this column.



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Design

- (a) In order to have maximum coverage with the limited available resources, the schemes to be taken up under the ARWSP are designed on the basis of 40 litres per capita per day (lpcd).
- (b) The schemes are framed for a designed the population in a period of 15 years. In general, the increase in the projected population for the design period should not exceed 40% of the 2001 census population.
- (c) Cost effective designs evolved under the Technology Mission are adopted under the ARWSP & State Sector (MNP).



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(d) In case of hand pump schemes one source should be provided for every 50-300 persons. Pipe water supply schemes are designed for supplying water through public stand-posts and house connections (where adequate drinking water is available). In Meghalaya, being a hilly terrain & people are living scatteredly in a habitations, no fixed norm for the number of stand-posts can be fixed and is based on actual requirement vis- vis technical feasibility & availability of water.



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Dairy Cattle

Milk is composed of nearly 87% water. An adequate supply of quality water for dairy cattle is extremely important. Farmers typically provide cows with free access to fresh water at all times. The water requirements of lactating cows are closely related to milk production, moisture content in the feed and environmental factors such as air temperature and humidity. The cow's peak water intake generally occurs during the hours of greatest feed intake.



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Dairy Cattle Type	Level of Milk Production (kg milk/day)	Water Requirement Range ^a (L/day)	Average Typical Water Use ^b (L/day)
Dairy calves (1-4 months)	-	4.9-13.2	9
Dairy heifers (5-24 months)	-	14.4-36.3	25
Milking cows ^c	13.6	68-83	115
Milking cows ^c	22.7	87-102	115
Milking cows ^c	36.3	114-136	115
Milking cows ^c	45.5	132-155	115
Dry cows ^d	-	34-49	41



Swine

The housing method, growth stage and feeding method used affect the drinking water requirements of pigs. The table gives a breakdown of drinking water consumption by weight range or level of maturity.

Swine Type	Weight Range (kg)	Water Requirement Range ^a (L/day)	Average Typical Water Use ^b (L/day)
Weaner	7-22	1.0-3.2	2.0
Feeder pig	23-36	3.2-4.5	4.5
Feeder pig	36-70	4.5-7.3	4.5
Feeder pig	70-110	7.3-10	9
Gestating sow/boar	-	13.6-17.2	15
Lactating cow ^c	-	18.1-22.7	20



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Horses

Horses typically consume 2-3 kg of water per kilogram of dry feed. They drink more in hot weather and while doing heavy work.

Frame size (weight)	Water Requirement Range ^a (L/day)	Average Water Use ^b (L/day)
Small (500 lb)	13-20	16.5
Medium (1,000 lb)	26-39	32.5
Large (1,500 lb)	39-59	49



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Sheep

Grazing sheep, particularly in the cooler seasons of the year, can require relatively little additional water beyond what they receive through forage. Hot, drier weather, however, will result in increased water intake the table provides an estimate of water consumed daily by different categories of sheep.



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Animal Type	Weight Range (kg)	Water Requirement Range^a (L/day)	Average Typical Water Use^b (L/day)
Feeder lamb	27-50	3.6-5.2	4.4
Gestating meat ewe/ram	80	4.0-6.5	5.25
Lactating meat ewe plus unweaned offspring	80+	9.0-10.5	10
Gestating dairy ewe/ram	90	4.4-7.1	5.75
Lactating dairy ewe	90	9.4-11.4	10.4



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Drinking water standards

BIS (Bureau of Indian Standards) –
BIS is the National Standard Body of India established under the BIS Act 1986 for the harmonious development of the activities of standardization, marking and quality certification of goods and for matters connected therewith or incidental thereto.



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COLOUR, HAZEN UNITS

IS 10500-1991

Desirable : 5 Hz. , Permissible : 25 Hz.

Risks or effects

Visible tint, acceptance decreases

Sources

Tannins, Iron, Copper, Manganese
Natural deposits

Treatment

Filtration, Distillation, Reverse osmosis, Ozonisation





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ODOUR	
IS 10500-1991	Unobjectionable
Risks or effects	Rotten egg, Musty, Chemical
Sources	Chlorine, Hydrogen sulphide, Organic matter, Septic contamination, Methane gas
Treatment	Activated carbon, Air stripping, oxidation, Filtration





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pH	
IS 10500-199 1	Desirable :6.5 – 8.5, Permissible :No relaxation
Risks or effects	Low pH - corrosion, metallic taste High pH – bitter/soda taste, deposits
Sources	Natural
Treatment	Increase pH by soda ash Decrease pH with white vinegar / citric acid

Concentration of hydrogen ions compared to distilled water

Examples of solutions at this pH

10,000,000	pH = 0	Battery acid, strong hydrofluoric acid
1,000,000	pH = 1	Hydrochloric acid secreted by stomach lining
100,000	pH = 2	Lemon juice, gastric acid, vinegar
10,000	pH = 3	Grapefruit, orange juice, soda
1,000	pH = 4	Tomato juice, acid rain
100	pH = 5	Soft drinking water, black coffee
10	pH = 6	Urine, saliva
1	pH = 7	"Pure" water
1/10	pH = 8	Seawater
1/100	pH = 9	Baking soda
1/1,000	pH = 10	Great Salt Lake, milk of magnesia
1/10,000	pH = 11	Ammonia solution
1/100,000	pH = 12	Soapy water
1/1,000,000	pH = 13	Bleach, oven cleaner
1/10,000,000	pH = 14	Liquid drain cleaner





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Hardness

IS 10500-1991	Desirable :300 mg/l , Permissible : 600 mg/l
Risks or effects	Scale in utensils and hot water system, soap scums
Sources	Dissolved calcium and magnesium from soil and aquifer minerals containing limestone or dolomite
Treatment	Water Softener Ion Exchanger , Reverse Osmosis

<http://www.portatreatment.com/yours.htm>





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Alkalinity

IS 10500-1991

Desirable : 200 mg/l , Permissible : 600 mg/lit

Risks or effects

Low Alkalinity (i.e. high acidity) causes deterioration of plumbing and increases the chance for many heavy metals in water are present in pipes, solder or plumbing fixtures.

Sources

Pipes, landfills
Hazardous waste landfills

Treatment

Neutralizing agent





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Water treatment suitable to rural community

The various methods which may be adopted for purifying the public water supplies are,

- (i) Screening
- (ii) Plain Sedimentation
- (iii) Sedimentation aided with Coagulation
- (iv) Filtration
- (v) Disinfection
- (vi) Aeration
- (vii) Softening
- (viii) Miscellaneous treatments such as fluoridation, recarbonation, liming, desalination etc.



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Screening : Screens are generally provided in front of the pumps or intake works

They remove the large sized particles like debris, branches, bushes, ice etc.

Coarse and fine screens may be provided. Coarse screens are parallel iron rods which are placed vertically or at an angle to the horizontal at $30^\circ - 60^\circ$ at 2-10 cm centre to centre. Fine screens are made of fine wires or perforated metal with openings less than 1 cm wide. The velocity through the screen should not be more than 0.8 to 1 m/sec.

Plain Sedimentation : Most of the suspended impurities present in water have a specific gravity more than that of water (1.0). These impurities will remain in suspension in flowing water (turbulence). If the water is made to stand still, the impurities will settle down under gravity. Hence, if the turbulence is retarded, i.e. if the water is made to stand still or stored, these impurities tend to settle down at the bottom of the tank. This is the principle behind sedimentation. The basin in which the flow of water is retarded is called settling tank or sedimentation tank or sedimentation basin or clarifier. The theoretical average time for which the water is detained in the tank is called the detention period.



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Filtration

The water after the treatment of screening, sedimentation & coagulation sedimentation also may contain very fine suspended particles and bacteria in it. In order to remove the remaining impurities, the water is passed through the beds of fine granular material like sand etc. The process of passing the water through beds of granular materials is known as filtration. Filtration helps in removing colour, odour, turbidity & Pathogenic bacteria from water.

Filter materials :

Either fine sand or coarse sand is used as filter media. The layers of sand is supported on gravel and this layer permits the filtered water to move freely to the bottom.

Sand :

The filter sand should be obtained from rocks like quartzite & should be (i) free from dirt & other impurities (ii) uniform in nature & size (iii) hard and resistant (iv) should not loose greater than 5% of its weight after being placed in HCl for 24 hours. Effective size i.e D_{10} is defined as the size of sieve in mm through which 10% of the sample of sand by weight will pass through. Uniformity coefficient D_{60}/D_{10} is defined as the ratio of the sieve size in mm through which 60% of the sample will pass to the effective size of sand.

Gravel :

The gravel which is used below the sand should be hard, durable, free from impurities, properly rounded and should have a density of @ $1600\text{km}/\text{m}^3$.



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Site and orientation of building in regard to sanitation

INTRODUCTION

The main purpose of sanitation is to maintain such environments as will not affect the public health in general. Thus sanitation aims at the creation of such conditions of living which will not result into serious outbreak of epidemic or in other words, it is a preventive measure for the preservation of health of community in general and individual in particular. It is to be noted that the word health indicates the physical and mental soundness of human body such that it is in a position to discharge its daily routine functions. This lesson deals about the principles of sanitation and terms related to it.



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Principles of sanitation

Following are some of the fundamental or rather ideal principles of sanitation which, if observed, result in better living conditions

Collection and conveyance

The basic principle of sanitation is to remove any waste matter as early as possible after its formation. The earlier it is removed, the easier it becomes to render it harmless. The waste matter may be in any of the three forms – solid, liquid or gas

Interior decoration

The interior decoration of the building should be done after giving a serious thinking. The substances which are likely to catch dust should not be generally placed in room or if placed, arrangement should be made to clean them periodically

Orientation of building

In order to achieve natural ventilation, the orientation of building should be made to adjust with the prevailing natural conditions at site of construction of building. The building should be so oriented with respect to the local climatic conditions that all the rooms are properly lighted naturally and that there is free circulation of fresh air.



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Prevention of dampness

The construction of building should be damp proof. The health of human body is considerably affected when there is presence of damp in the surroundings. The preventive measures to admit damp should invariably be taken to achieve proper sanitation of the building

Supply of water

There should be plentiful supply of pure water to the building. The scarcity of water leads to the development of unhygienic conditions in the building

Treatment of water

All the waste matter received from the building should be disposed off only after giving proper treatment to it. Thus the effluent from sewage plant should be thrown into natural river or stream after it has been made harmless.



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Site for sewage treatment works

The site for treatment units sewage of any town should be carefully selected and the following aspects are to be considered at the time of its final selection

1. Good foundation soil should be available for various sewage treatment units to rest firmly on the ground and thus to grant the structural stability to them
2. The general slope of the site should neither be too steep nor too flat. It will assist in placing various treatment units at such levels that sewage may flow from one unit to the other by gravity only
3. The general level of the site should be lowest level area of the town or city so that the sewage from the entire town or city can be collected and conveyed by gravity only
4. The location of site should be appropriate with respect to the method of sewage treatment to be adopted for the project



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5. The location of site should be such that enough area is available nearby when it becomes necessary in future to expand the existing project.
6. The proximity of water course near the site or enough waste land for irrigation will be considered as an additional advantage.
7. The site should be safe from floods for all the time
8. The site should be situated on the leeward side of wind so that the undesirable odours will be prevented from entering the town or city
9. The site should not be, as far as possible, far away from the town or city
10. The subsoil water level at the site should remain low even during monsoon



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Design aspects

Following aspects should be kept in mind while making design of the sewage treatment plant:

Every unit of the plant should have flexibility in control and operation

The design of the plant should be aimed at granting the safety of health of the personnel operating the plant

The major units of the plant should have bypass facilities which can be put into commission during emergency

The overall design of the plant should be such that there is easy accessibility for operating and maintaining valves, sampling points and various other operating devices.

There should be adequate alternative provisions in case the plant fails or is shut down for repairs or any other reason

There should be some alternative for operating of the plant when its outlet is submerged under high water.

The treatment plant should accommodate a full-fledged laboratory in which routine tests can be carried out for the performance of various units of the plant.



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Community sanitation system

Community-led total sanitation (CLTS) is an approach used mainly in [developing countries](#) to improve [sanitation](#) and [hygiene](#) practices in a community. It focuses on spontaneous and long-lasting [behavior change](#) of an entire community. The goal of CLTS is to end [open defecation](#). The term "triggering" is central to the CLTS process. It refers to ways of igniting community interest in ending open defecation, usually by building simple [toilets](#), such as [pit latrines](#). CLTS involves actions leading to increased self-respect and pride in one's community. It also involves [shame](#) and [disgust](#) about one's own open defecation behaviors.



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The concept was developed around the year 2000 by Kamal Kar for rural areas in [Bangladesh](#). CLTS became an established approach around 2011. [Non-governmental organizations](#) were often in the lead when CLTS was first introduced in a country. Local governments may reward communities by certifying them with "open defecation free" (ODF) status. The original concept of CLTS purposefully did not include subsidies for toilets as they might hinder the process.

CLTS is practiced in at least 53 countries. CLTS has been adapted to the [urban](#) context. It has also been applied to post-emergency and [fragile states](#) settings.

Challenges associated with CLTS include the risk of [human rights](#) infringements within communities, low standards for toilets, and concerns about usage rates in the long-term. CLTS is in principle compatible with a [human rights based approach to sanitation](#) but there are bad practice examples in the name of CLTS. More rigorous coaching of CLTS practitioners, government [public health](#) staff and local leaders on issues such as stigma, awareness of [social norms](#) and pre-existing inequalities are important. People who are disadvantaged should benefit from CLTS programmes as effectively as those who are not disadvantaged.