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Leachate treatment of solid waste dumping sites in Bangalore

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ABSTRACT: Geographic Information Systems (GIS) are an effective tool for storing, managing, anddisplaying spatial data often encountered in water resources management. In the urban area,the physical infrastructure plays an important role. In water distribution system, the water supplied from the reservoir to the consumer end. The pattern of the pipeline will follow the road network of the area. Due to rapid urbanization in an urban area, the water demand is rapidly increasing. Therefore, the pressure on the existing network is growing. This may result in the gap between supply and consumer chain in a different manner. Leak detection plays a significant role in the efficient management of Water Distribution System (WDS), as it will help in reducing water wastage. By applying modern tools in the system, the existing problems will be minimized and give one step ahead for the making of the smart city.

I. INTRODUCTION

1.1 General

Water is one of the most important natural resource and water scarcity is the most challenging issue at a global level. The water is most crucial for sustaining life and is required for almost all the activities of humankind, i.e., industrial use, domestic use, for irrigation; to meet the growing food and fiber needs, power generation, navigation, recreation, and also required for animal consumption. Due to population growth, climate change and there developed a huge gap between the supply and demand of water. In developing countries like India, the gap in supply and demand of water is increasing and predominant. The existing system of water supply is facing problems like a higher rate of leakage, poor maintenance, poor customer service, and poor quality of water.

A water distribution system is a hydraulic infrastructure that consists of different elements like pipes, valves, pumps, tanks and reservoirs. This Infrastructure helps to convey water from the source to the consumers. Designing and operation a water distribution system is the most important consideration for a lifetime of expected loading conditions. Furthermore, water distribution system must be able to assist the abnormal conditions such aspipe breakage, mechanical failure of pipes, valves, and control systems, power outages and inaccurate demand projections.

Because of the spatial nature of the required data, GIS can be utilized effectively in water resources modeling. It has been used to predict and monitor nonpoint source pollution from agricultural areas and urban environments; to monitor flow and pollutants in storm sewer networks; and to assist with contingency plans and environmental impact assessments, among others.

Here in, the fundamentals, evolution, and application of Geographic Information Systems, related to water resources management, are presented. Future research and developmental need are also discussed based on problems commonly encountered in implementing GIS in water resources modeling.

1.2 Fundamentals and Need of Geographic Information Systems

GIS is defined as a system of capturing, storing, manipulating,analyzing,and displaying spatial information in an efficient manner. It can becharacterized as a software package that efficiently relates graphicalinformation to attribute data stored in a database and vice-versa . GIS provides tools to improve efficiency and effectiveness when working with map and non-graphic attribute data. Although different GIS software may vary in capabilities, most contain the following components;

• A data input subsystem which collects and/or processes spatial data derived from existing maps, remote sensors, etc. The data input is usually accom- plished using computer tapes, digitizers, scanners or manual encoding of geographically registered grid cells, points, lines, polygons or tables.

• A data storage and retrieval subsystem which organizes the spatial data in a form that permits it to be quickly retrieved by the user for subsequent analysis, as well as allows for rapid and accurate updates and corrections to be made to the spatial database. Typical directories include: land cover, soils imagery, topography, and water information.

• A data manipulation and analysis subsystem which converts data through user- defined aggregation rules, or pruduces estimates of parameters and constraints for various space-time optimization or simulation models.

• A data reporting subsystem which displays all or part of the original database, as well as manipulated data, and the output from spatial models in tabular or map form.

1.3 USES AND ADVANTAGES

 Storage and management of geospatial data: Geographic information Systems keep data and records about water sources. The data collected about water resources is stored on servers in different parts of the world. Some of the information is usually as a result of processing done on data collected by GIS. Huge amounts of data related to water resources can thus be stored for shared access with the help of GIS

 Hydrologic management: Studies on the water have shown that water is in most cases under motion, or changes its state and pressure with time. GIS comes to play a big part in keeping track of these water conditions. Hydrologists are thus among the biggest beneficiaries of Geographic information systems.

 Quality analysis of water: Not all water that exists on earth is safe for consumption by human beings or animals. Taking unsuited water can lead to adverse health conditions. Through GIS, studies on a slope, drainage features, and land utilization patterns can be used to predict whether the water in a given area is safe. Due to the ability of GIS to handle large amounts of data sets, sample data can be processed, stored as well as reports generated.

 Water supply management: As we have seen earlier rain is a handy resource that no government or individual can afford to waste. Water supply pipes are laid on the ground and can be monitored on a real-time basis. Leaking water system components can also be identified and fixed on a real-time basis, which is much possible due to the integration of supply systems with GIS.

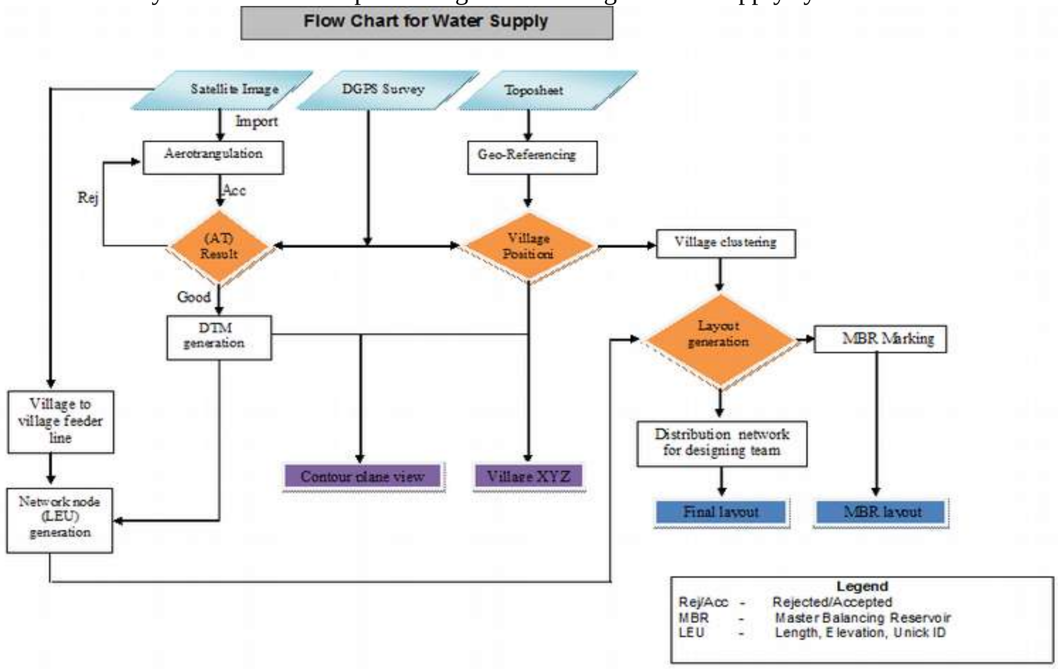

Fig 1:FLOW CHART FOR WATER SUPPLY

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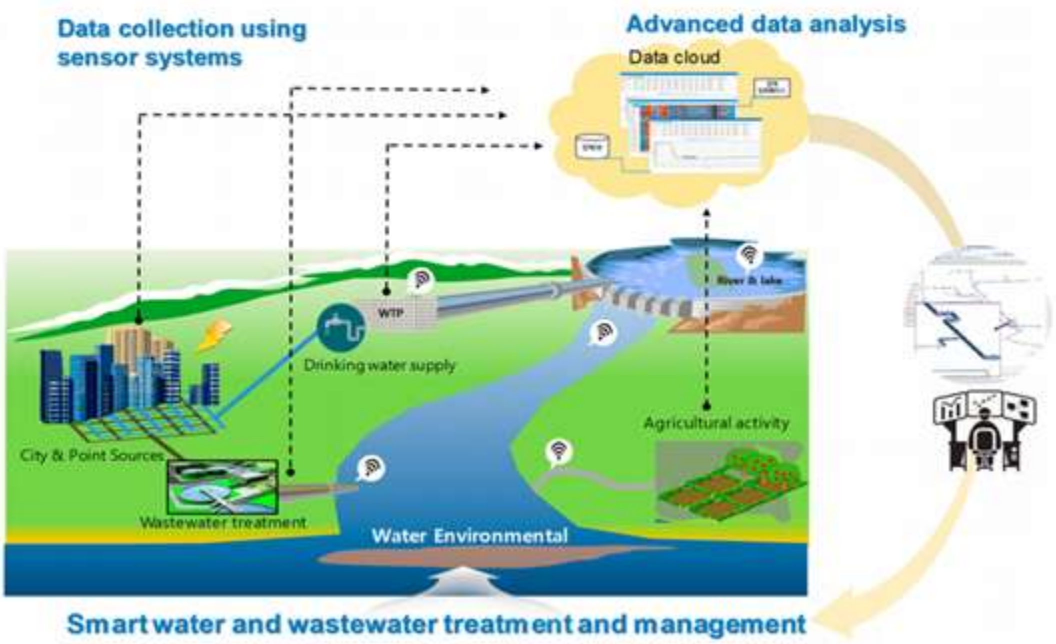

Fig 2: Smart water and wastewater treatment and management

Fig 3; Showing Spatial information in water supply(example)

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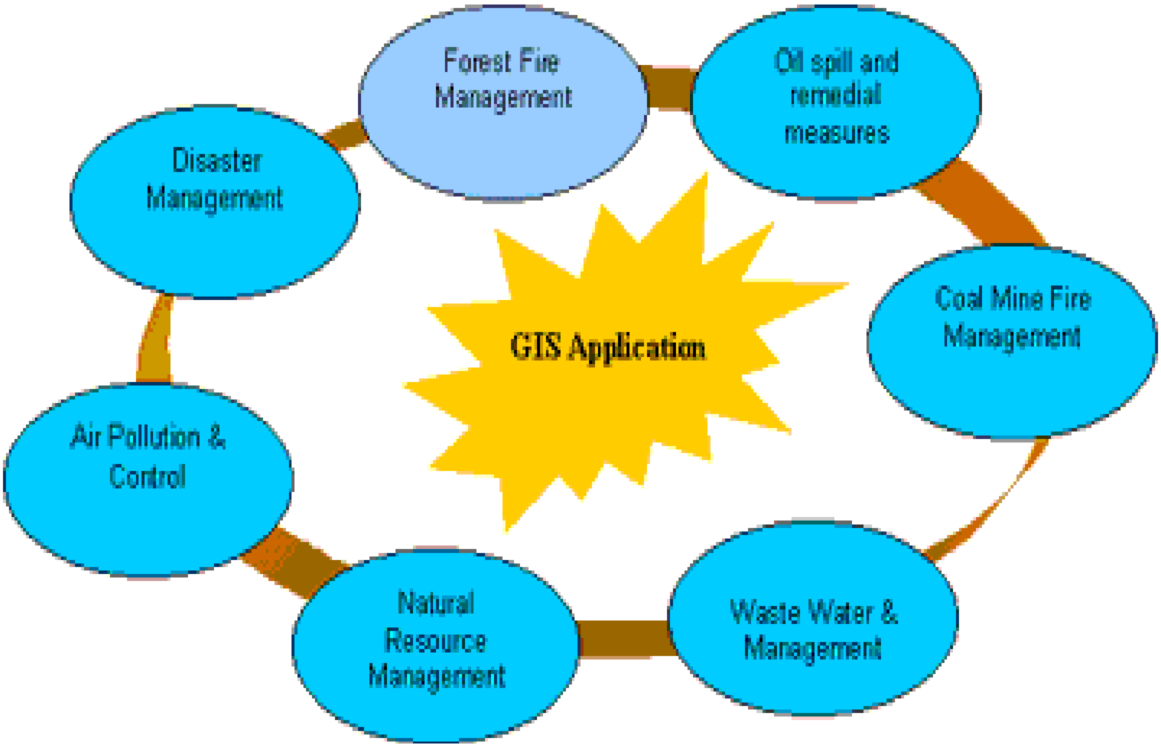

Fig 4; GIS application Flow chart

II. LITRATURE REVIEW

1. Prajapati Mansi,BMMarava,Ajaypatel and IndraPrakash et.al "**Planning of water distribution network , ussing GIS technique**"SJIF ,2016 This paper has covered the analysis and the conceptual planing of water supply system To improve quality of life and economic well-being of people in rural areas this study has been taken up. Aim of this paper is to assess the inadequacy of the infrastructure facilities in Baspa village and plan better systematic facilities such as suitable Water supply system.The study has been carried out by developing various thematic maps and integrating various field and administration information in GIS environment With the help of the GIS studies modification animprovement of the infrastructure facilities like Water supply, Drainage network and sanitation system has been suggested for better management of the area.

2. Khadri,S.F.R And Chaitanya pande **"Urban Water Supply Systems- A case study on Water Network Distributio in Chalisgaon City in Dhule District in Maharastra using Remote Sensing & GISW Techniques"**IOSR,2015 This paper has covered the GIS based analysis of the pattern of urban expansion over the demographic change and land use modification is identified by satellite image.The existing water distribution network and transmission network supply system. Data was collected by GPS survey with council engineer and all water network from source to distribution network digitize by Arc GIS software.Present population and expected rate of growth are critical factors in design of water distribution in chalisgaon city.

3. Lates lustina **"The management of water supply system using GIS application"** this paper gives the system of water works becomes effective through monitoring,moderanization, rehabilitation development and automution roulting water from source to consumer arduous one that involves a multitude of technologies that are in a constant evaluation .Effective monitoring of water system is faciliated ny creating a database that facilitate the design and management of water and using models GIS analysis functions and facilitates the process of inspection and maintenance theof . Creating a GIS system of water supply network ensure more efficient management and operation and potential of the area based on technical,economic and legal.water supply systems modeling through GIS data facilitates the introgation process. shortness working ,reduce cost of the maintenance, upgrading and rehabilatation by combining textule data with graphs.

4. M.Girish Kumar **"Delineation of potential sites for water harvesting structures using Remote**

Sensing and GIS" j.IndianSoc.2008 The site suitability analysis for locating the rain water harvesting structures using GIS analysis has an added advantage structures using GIS analysis has an added advantage over conventional survey. The multi layer integration like geomorphology, landuse, geology, lineament,drainage (Buffer) and road and village buffer gives smaller suitability units as a composite layer The interlayer ranking and intralayer weightage further intensity the interpolation.

5. Mustafa.ym,MSM Amin and TS Lee **"Evaluation of land development impact on a tropical watershed hydrology using Remote Sensing and GIS"** (Journal of spatial hydrology) This method of evaluating of the impacts of land development on water availability can be used when planning for the agricultural seasons particularly for the time time of higher demands of the irrigation water supply. In addition, this method can be implemented for future land use scenarios to predict the changes that may happen to the river flow regimes.The integration of remote sensing,GIS model provides a powerful tool for assessing the impacts of land development on the river flow pattern and irrigation water availibility.

III. SUMMARY

By above collected journals we have made an effort to collect the how the GIS is much essential for palning a water supply system. By referring to above collected journals we observe that most of the journals specifizes that nowdays requirement of GIS is needfull in distribution of water to any field . By using above applications, we have created a plan in QGIS software and used this to analysis how GIS works in water supply system and the data collected by GIS will store and maintain .It collects the overall data of distribution of water supply system from source to consumer.

So GIS is a powerful tool in developing water supply system and facilitates to use the following process.
1) Data collection and monitoring.
2) Site selection for source of water.
3) Site selection for Storage and pumping Stations.
4) Site selection for sum and control valves.
5) Network analysis and design of pupe line path.
6) Water quality assessment.

Aim

Aim is to design , develop and implement GIS application for field level water source locations and its allied asset data collection, in a standardizedand integrable format and to store and maintain Geo-spatial database.

OBJECTIVES

● Mapping of all water supply schemes from the source to the stand post using geographic information system evaluate and standardize the water supply.
● Selection of site for positioning of water tank.
● Water quality assessment.
❖ Use of open softwares like QGIS.

STUDY AREA:
Banashankari 6th Stage (Vajarahalli)
Banashankari 6th Stage 3rd Block, Thurahalli is a Locality in Bangalore City in Karnataka State,India.It is belongs to Bangalore Division. Banashankari 6th Stage 3rd Block, Thurahalli Pin code is 560062 and postal head office is Doddakallasandra .

Formed in the mid 2000 and still in nascent stage in terms of development, this is the largest of all the BDA developed layouts, so far. It is further divided into 15 blocks. This is a sprawling locality nestling between Kanakapura Road in the East, Dr. Vishnuvardhan Road in the North, NICE Road in the West and South. The famous Thurahalli hill and reserved forest around is in the heart of Banashankari 6th Stage. This is a very scenic, serene layout with lot of greenery and rolling hills around. **Elevation / Altitude:** 874 meters. Above Seal level.

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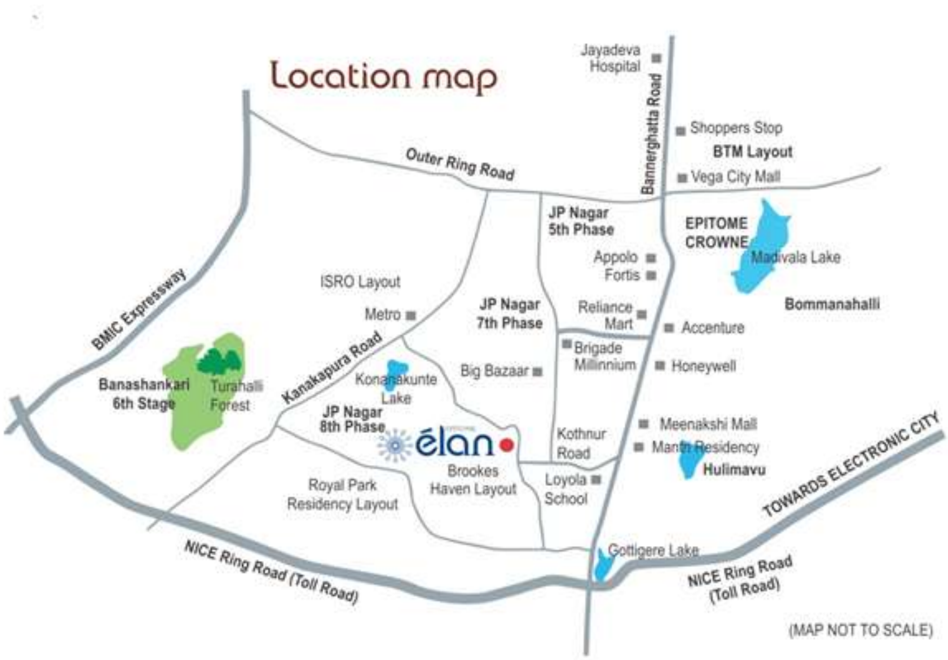
Fig: Top view of Banshankari 6th phase



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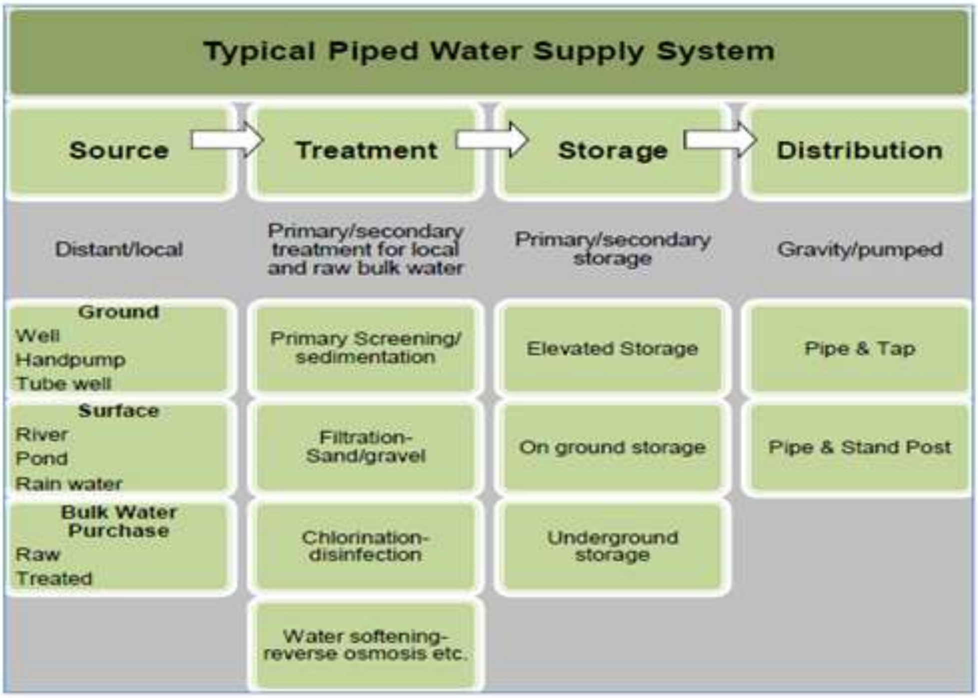
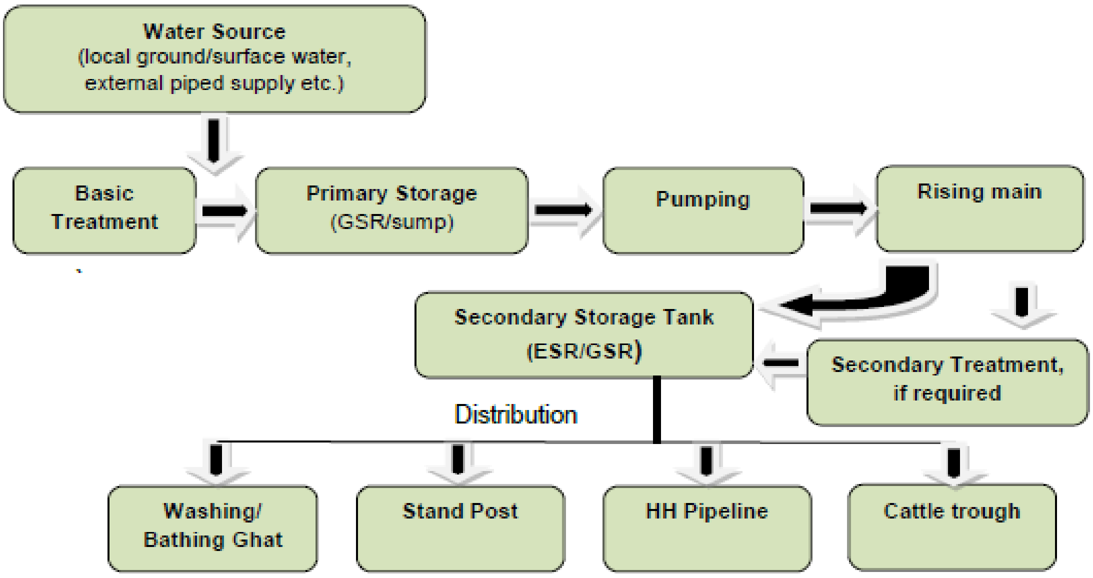
Typical Water Supply System

- Typical Village/town water supply system constitutes of a gravity/pumping based transmission and distribution system from local/distant water source with needed water treatment system





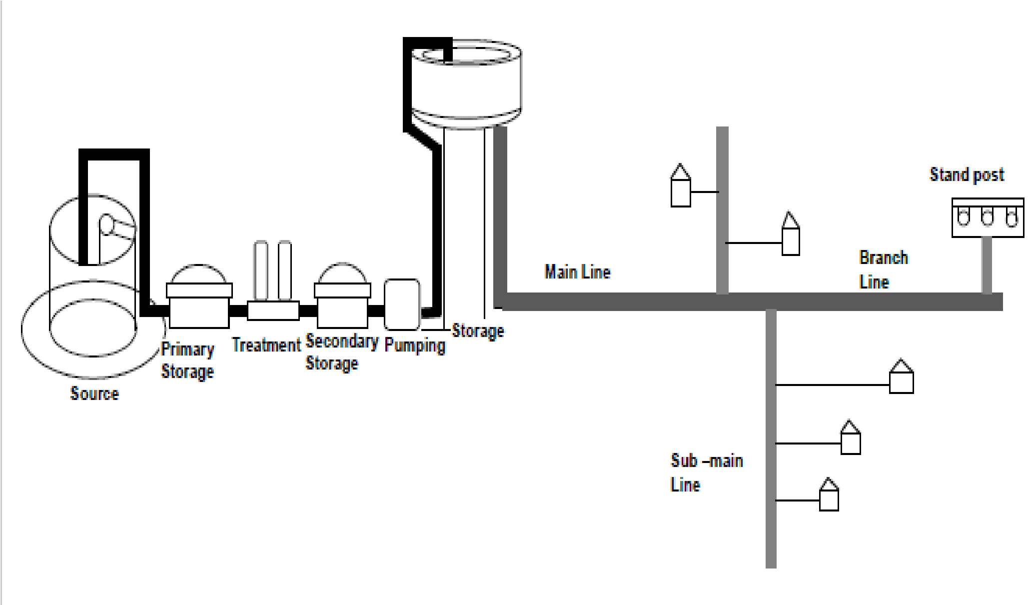


Fig: Standard Water supply System

Water Treatment

Water from source is treated at village level and even at household level, if needed. If bulk water available from the distant source is treated and potable, then further treatment may not be required at village level. There are various processes of treatment based on the source and quality of water in specific region.

• Village/town level water treatment systems are located mainly near head works. The treatment units are located in such a manner, where possible that flow of water from one unit to other can be done by gravity, so that additional pumping of water is not required. Sufficient area should be reserved near the treatment units for further expansion in future. Basic treatment system at village/town level involves removal of suspended solids through sedimentation, removal of micro-organisms and colloidal matter through sand/gravel filters, water softening through reverse osmosis (RO) system, disinfection through chlorination and any other chemical/specialised treatment for removal of fluoride, salinity etc.

• Treatment at household level is needed as there may be chances of water contamination while transmission of water. This mainly includes basic filtration for removal of any silt, etc.; boiling for removal of micro organisms or chlorination for disinfection.

It is very important to carry out water test in order to decide upon the type of treatment. It is also essential to carry regular water testing from various points starting from source to distribution points to maintain potable water quality.

Water Supply Mechanism:

Pump House and Pumping Machinery: Pump is used to fetch water from source like bore well, open well, sump or ground water storage and supply it to pipelines or elevated storage. There are three main components: a) pump, b) electrical or oil engine, c) panel board. Pump house is constructed for security and safety of machineries.

Rising Main: The delivery line carrying water from pump to storage tank (elevated or ground) is called rising main.

PHOTOS OF THE WORK WE CARRIED OUT

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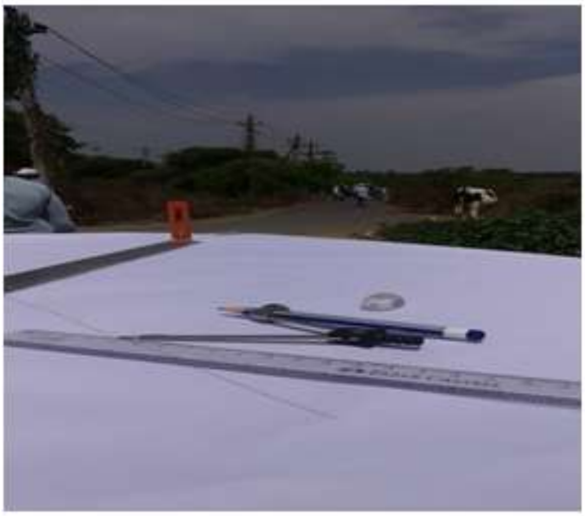

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NEW TANK PROJECT:

New tank is constructed across the valley in order to store the water for irrigation and domestic water supply. Irrigation may be defined as the process of artificial supply of water to the soil for raising crops. It is the science of planning and designing an efficient, low cost economic irrigation system tailored to fit in natural conditions. It is an engineering of controlling and harvesting the various natural resources of water by the construction of dams and various reservoirs and finally distributing the water to the agricultural fields. Irrigation engineering includes the study and design of works in connection with water control, drainage of water logged areas and generation of hydroelectric power. The site for the proposed tank project should be so selected that it should satisfy all the requirements of the best possible site and to irrigate the area at the downstream side of the dam.

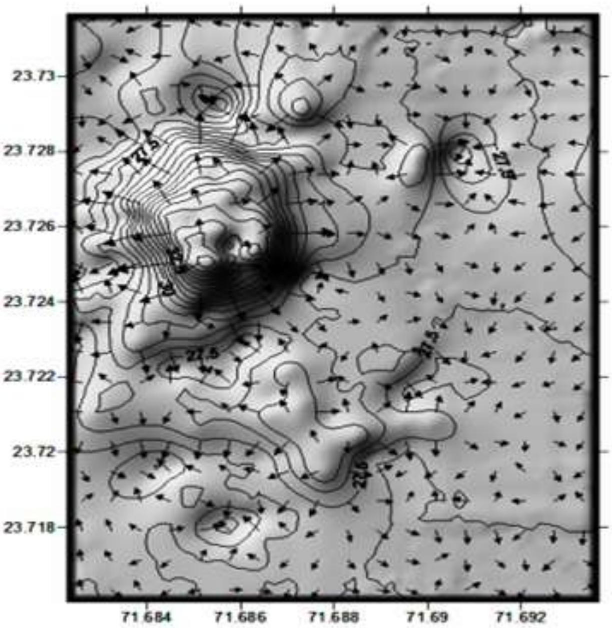
SELECTION OF SITE FOR RESERVOIR:

- Geological condition of catchment area should be such that the percolation losses are minimum and the runoff is maximum.
- Suitable dam site should exist.
- Adequate storage of water
- Area of submergence should be less, and submergence cost should be as minimum as possible.

CONTOURS:

Contour line, a **line** on a map **representing** an imaginary **line** on the land surface, all points of which are at the same elevation above a datum plane,usually **mean** sea level. ...

Numbers on the **lines** give the height in feet. (Sea level is zero.) **Lines** drawn closely together **indicate** that a slope



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IV. LONGITUDINAL AND CROSS SECTION:

4.1.1 Objective: -

To get construction details.

4.1.2 Specification: -

- The length of the proposed bund should be a minimum.
- There should be the availability of good foundation.

4.1.3 Equipments Required: -

- Dumpy level with Tripod stand.
- Leveling staff
- 30m chain and tape
- Arrows
- Compass with stand
- Ranging rods
- Wooden pegs

4.1.4 Procedure: -

A temporary bench mark is selected whose reduced level is been determined previously. Starting from this TBM, the RL of the bottom of the point is determined with the help of fly level. From that point (whose RL is been established), levels are carried along the center line of the bund, called "Longitudinal section". Cross sections are taken at every 10m distance on the either side of the center line of the bund at right angles to it.

- ❖ Wooden pegs are driven at every 5m along the centre line and temporary bench mark is left to facilitate taking cross section readings.
- ❖ Block leveling is done at waist weir site.

Calculation of Bund: an embankment used to control the flow of water.

BUND VALUES	B M =2.510

Back sight	Intemediate	Fore Sight	PlanOf Gollimation	Reduced Level	Distance
0.325			846.325	846.00	
	3.095			843.23	A0
	3.050			843.275	L1
	3.3050			843.275	L2
	3.095			843.23	L3
	3.200			843.125	R1
	3.313			843.010	R2
	3.225			843.100	R3
1.230		3.975	843.580	842.350	A10
	2.100			840.25	A20
	2.630			839.72	A30
	2.630			839.72	L1
	2.580			839.77	L2
	2.570			839.78	L3
	2.790			839.56	R1
	2.815			839.535	R2
	2.900			839.45	R3
	3.190			839.16	A40
0.300		3.685	838.965	838.665	A50
	0.855			838.11	A6
	0.830			838.135	L1
	0.850			838.115	L2
	0.900			838.065	L3
	0.925			838.04	R1
	0.995			838.04	R2
	1.105				R3
	1.290				A70
	0.490				A80
	1.480				A90
	1.470				L1

	1.455				L2
	1.505				L3
	1.150				R1
	1.540				R2
	1.570				R3
	1.435				A100
	1.285				A110
	0.950				A120
	1.050				L1
	1.250				L2
	1.300				L3
	1.025				R1
	1.085				R2
	1.135				R3
	0.650				A130
2.540		0.150	841.365	838.815	A140
	2.045				A150
	2.025				L1
	2.215				L2
	2.205				L3
	2.070				R1
	2.130				R2
	2.190				R3
	1.515				A160
	0.810			840.545	A170
	0.225				A180
	0.220				L1
	0.215				L2
	0.300				L3
	0.235				R1
	0.300				R2
2.020		0.375	843	840.98	R3
	1.340				A190
	1.275				B191.3
	1.290				L1
	1.215				L2
	1.245				L3
	1.255				R1
	1.275				R2
		1.425			R3

DESIGN OF BUND:

The available volume of water by Rain in the catchment area is to be stored on the river basin in the upstream side. The volume of water that can be stored at different level is determined only after tracing the capacity contour keep in view of yearly yield of water and the freeboard for the required height of dam is fixed. T.B.L 846 m

1. HEIGHT OF BUND:

H = Highest RL – Lowest RL

= 842.785-839.355

= 3.595 m

Maximum depth of water stored, H = 3.595 m

Height of free board required, = 0.25 x √ (H+0.58)

= 0.25 x √(3.595+0.58)

= 0.510 m

2. TOP WIDTH:-

As the height of the Dam (H= 3.595 m) is less than 15m, the bund has to be designed as a small dam.

T = (0.2 x H) +3

=(0.2 x 3.595) +3

= 3.719 m ≈ 4.0 m

SIDE SLOPE TABLE:

Sl.No	Type of material	U/S slope	D/S slope
1	Homogeneous well graded	2.5:1	2:1
2	Homogeneous coarse silt	3.0:1	2.5:1
3	Homogeneous silt clay Ht. less than 15m Ht. more than 15m	 2.5:1 3:1	 2.0:1 2.5:1
4	Sand/Gravel with central clay core	3.0:1	2.5:1

Adopting side slopes for homogeneous well graded material from the above table
U/S = 2.5:1 and D/S = 2:1

FREE BOARD:

TABLE AS PER STORAGE RECOMMENDATIONS

Sl.No	Height of the dam (m)	Maximum free board in metres
1	Up to 4.5	1.2 – 1.5
2	4.5 to 7.5	1.5 – 1.8
3	7.5 – 15	1.85
4	15 to 22.5	2.1

Adopt 2 m because our bund height lies between 7.5 m to 15 m

Bottom width of bund

L= 4.0+ (3.595 x 2.5) + (3.595 x 2) = 20.178m. ≈ 21m

EARTHWORK CALCULATION OF BUND

CHAINAGE	GROUND	FORMATION	filling(m)	Cutting	DEPTH	MEAN	AREA Cutting 1:1	LENGTH		

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				(m)			**Filling2:1**			
In m	**LEVEL**	**LEVEL**			**in m**	**DEPTH**	**(Bd+Sd^2)**	**in m**	**QTY OF**	**QTY OF**
	In m	**In m**				**"d" in m**	**In m^2**		**CUTTING (m3)**	**FILLING(m3)**
0	842.785	842.785	0		0	0	0	0		0
10	842.62	842.62	0.165		0.165	0.0825	0.3436	10		3.436
20	841.845	841.845	0.94		0.94	0.5525	2.8205	10		28.205
30	841.31	841.31	1.475		1.475	1.2075	7.7461	10		77.461
40	840.875	840.875	1.91		1.91	1.6925	12.4991	10		122.991
50	840.315	840.315	2.47		2.47	2.19	18.3552	10		183.552
60	839.81	839.81	2.975		2.975	2.7225	25.7140	10		257.140
70	839.505	839.505	3.28		3.28	3.1275	32.0725	10		320.725
80	839.455	839.455	3.33		3.33	3.305	35.0660	10		350.660
90	839.475	839.475	3.31		3.31	3.32	35.3248	10		353.248
100	839.565	839.565	3.22		3.22	3.265	34.38045	10		343.8045
110	839.825	839.825	2.96		2.96	3.09	31.456	10		314.56
120	840.165	840.165	2.62		2.62	2.79	26.7282	10		267.282
130	840.585	840.585	2.200		2.2	2.41	21.256	10		212.56
140	841.085	841.085	1.7		1.7	1.95	15.405	10		154.05
150	841.625	841.625	1.16		1.16	1.43	9.8098	10		98.098
160	842.275	842.275	0.51		0.51	0.835	4.7344	10		47.344
170	842.06	842.06	0.725		0.725	0.6175	3.2326	10		32.326
180	842.785	842.785	0		0	0.3625	1.7128	10		17.128
										9790.916

WASTE WEIR:

A **waste weir** on a navigable canal is a slatted gate on each canal level or pound, to remove excess water and to drain the canal for repairs or for the winter shutdown.This differs for a dam or reservoir, for which a waste weir is another name for a spillway, i.e. not having the boards to adjust the water height nor the paddles to drain all the water as on a canal, only to drain the excess.

WASTE WEIR				**R.L=842.380**		
1.980	**1.940**	**1.950**	**1.990**	**2.040**	**2.090**	**2.160**
1.875	**1.850**	**1.860**	**1.870**	**1.920**	**1.980**	**2.030**
1.825	**1.780**	**1.795**	**1.825**	**1.840**	**1.870**	**1.935**
1.730	**1.700**	**1.710**	**1.735**	**1.745**	**1.770**	**1.820**
1.710	**1.670**	**1.620**	**1.595**	**1.575**	**1.635**	**1.745**
1.635	**1.570**	**1.525**	**1.501**	**1.490**	**1.490**	**1.515**
1.510	**1.450**	**1.440**	**1.425**	**1.410**	**1.425**	**1.435**
1.410	**1.355**	**1.340**	**1.330**	**1.325**	**1.325**	**1.345**

1.265	**1.235**	**1.245**	**1.260**	**1.275**	**1.295**	**1.335**
1.185	**1.150**	**1.150**	**1.180**	**1.210**	**1.230**	**1.270**
1.095 **L3**	**1.065** **L2**	**1.070** **L1**	**1.100** **L10**	**1.145** **R1**	**1.165** **R2**	**1.210** **R3**

4.4 SLUICE:

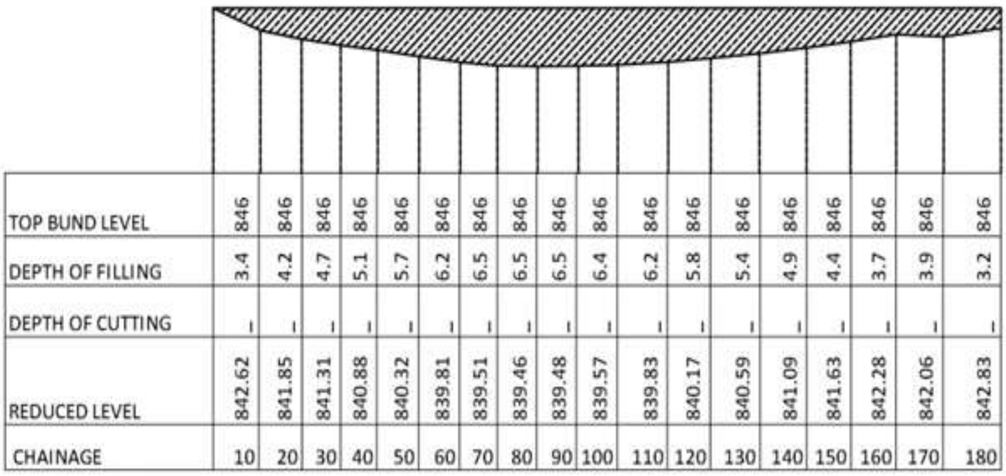
A **sluice** is a water channel controlled at its head by a gate. A mill race, leet, flume, penstock or lade is a sluice channelling water toward a water mill. The terms **sluice**, **sluice gate**, **knife gate**, and **slide gate** are used interchangeably in the water and wastewater control industry.

A sluice gate is traditionally a wood or metal barrier sliding in grooves that are set in the sides of the waterway. Sluice gates commonly control water levels and flow rates in rivers and canals. They are also used in wastewater treatment plants and to recover minerals in mining operations, and in watermills

SLUICE	**RL=842.380**

2.225	**2.210**	**2.185**	**2.200**	**2.250**	**2.305**	**2.375**
2.295	**2.205**	**2.205**	**2.175**	**2.105**	**2.155**	**2.300**
2.150	**2.105**	**2.135**	**2.145**	**2.195**	**2.240**	**2.280**
2.950	**2.350**	**2.220**	**2.120**	**2.225**	**2.250**	**2.240**
2.065	**2.040**	**2.050**	**2.065**	**2.010**	**2.005**	**2.225**
2.020	**1.995**	**1.885**	**2.020**	**2.000**	**2.010**	**2.185**
1.945	**1.950**	**1.960**	**1.970**	**1.995**	**2.005**	**2.150**
1.910	**1.930**	**1.935**	**1.925**	**1.955**	**1.985**	**2.125**
1.855	**1.845**	**1.834**	**1.845**	**1.905**	**1.925**	**2.060**
1.810	**1.825**	**1.835**	**1.805**	**1.855**	**1.955**	**2.100**
1.760	**1.730**	**1.710**	**1.750** **L60**	**1.815**	**1.890**	**1.940**

LONGITUDINAL SECTION OF NEW TANK PROJECT Datum Head 846 m



QUALITY OF WATER:

Introduction

Water quality is determined by physical, chemical and microbiological properties of water. These water quality characteristics throughout the world are characterized with wide variability. Therefore the quality of natural water sources used for different purposes should be established in terms of the specific water-quality parameters that most affect the possible use of water. That is why the aim of this chapter is to provide an overview of

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water quality characteristics - Physical, Chemical, Microbiological, and Biological characteristics.

Physical Characteristics of Water

Physical characteristics of water (temperature, colour, taste, odour and etc.) are determined by senses of touch, sight, smell and taste. For example temperature by touch, colour, floating debris, turbidity and suspended solids by sight, and taste and odour by smell.

Temperature

The temperature of water affects some of the important physical properties and characteristics of water: thermal capacity, density, specific weight, viscosity, surface tension, specific conductivity, salinity and solubility of dissolved gases and etc. Chemical and biological reaction rates increase with increasing temperature. Reaction rates usually assumed to double for an increase in temperature of 10 °C.

Taste and Odour

Taste and odour are human perceptions of water quality. Human perception of taste includes sour (hydrochloric acid), salty (sodium chloride), sweet (sucrose) and bitter (caffeine). Relatively simple compounds produce sour and salty tastes. However sweet and bitter tastes are produced by more complex organic compounds. Human detect many more tips of odour than tastes. Organic materials discharged directly to water, such as falling leaves, runoff, etc., are sources of tastes and odour-producing compounds released during biodegradation.

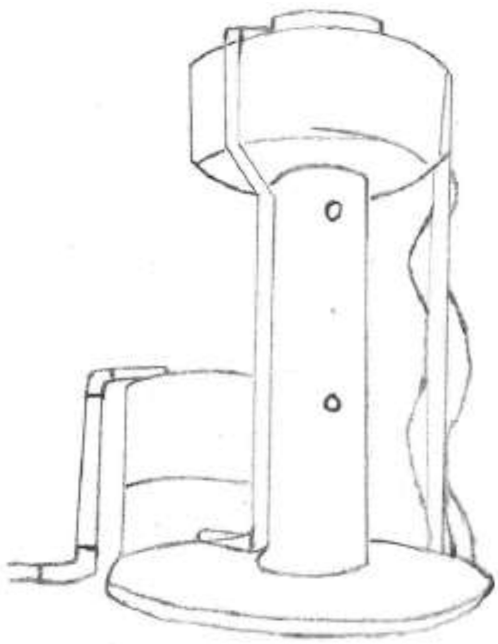
Turbidity

Turbidity is a measure of the light-transmitting properties of water and is comprised of suspended and colloidal material. It is important for health and aesthetic reasons. Here the water is of high turbid.

pH

The source for pH is natural like biological activities and temperature. The desirable pH range is 6.5 – 8.5. Lower values cause corrosion and metallic taste and higher values cause bitter/soda taste and deposits over the pipes and fixtures.

POSITIONING OF WATER TANK:



GSR & ESR

Elevated Surface Reservoir (ESR) or elevated storage tank:

ESR is constructed, where water is to be supplied at elevated height (less than the level of ESR) or where the distance is large and topography is undulating. Generally, ESR is at height more than 15 m. Water can be distributed directly from this storage tank by gravity or pump.

Ground Service Reservoir (GSR):

GSR is ground level or plinth level storage tank. The plinth level is generally not more than 3 m. Storage capacity of the service reservoirs is estimated based on pumping hours, demand and hours of supply, electricity available for pumping. Systems with higher pumping hours require less storage capacity

Basic Planning Principles of Water Supply System

• water supply system should be designed to provide :

- ❖ Atleast 70 liter per capita per day (lpcd) for piped water supply with household tap connections,
- ❖ Atleast 55 lpcd for mix system with household (HH) tap supply + public taps/standpost + handpump
- ❖ Atleast 40 lpcd where no other source except hand pump, open wells, protected ponds etc are available. Such areas can be augmented with alternative sources.

• Stand posts/hand pumps should be provided where household water supply is not possible. They should have normal output of 12 litres/minute. Generally, one stand post/hand pump is estimated for every 250 persons. In case of independent habitation, even if population is less than 250 and there is no potable water source, once stand post/hand pump is provided. Moreover, stand posts/hand pump should not be more than 500 m from targetted household. (Source: Accelerated Rural Water Supply Programme (ARWSP), Ministry of Rural Development, Government of India)

• For towns, water supply is designed to provide atleast 40 litres/person/day where water is made available through standposts,70 litres/person/day where piped supply is provided but sewerage system is not available. For urban areas with piped supply and sewerage system, water supply is designed for 135 litres/person/day (Source: Manual on Water Supply & Treatment, CPHEEO, 1999)

• The water supply system should be designed for at least 20-30 years.

• Population forecast needs to be done while designing of system. There are various methodologies for population forecast. However, population for 15 years can be considered 1.1 times current population and for 20 years can be considered 1.2 times current population for design.

• Public storage tanks are designed to store at least 50 percent of total daily requirement (or for atleast 12 hours supply) or requirement of peak period (Water Demand in peak period = average water demand * peak factor). Peak factor is about 3 for population upto 50,000 persons, 2.25 for population ranging from 50,000- 2,00,000 and 2 for population over 2,00,000. Such tanks can be installed at cluster/falia level or one single tank can be installed for a village/town.

Basics on Water Pumping

Pumping Machinery is used for transfer of water from one place to another and pumping of water from water source. Pumping is required for

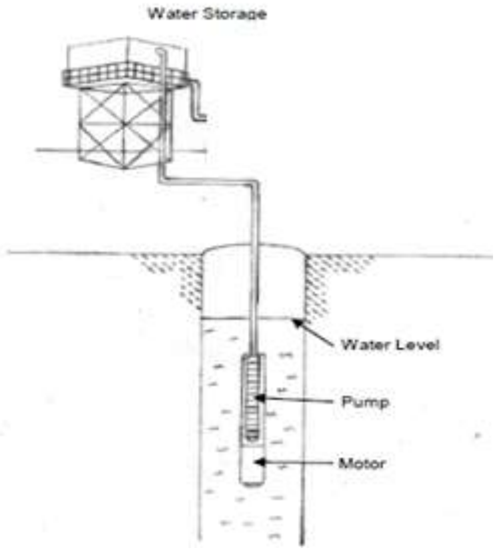
- ▪ Lifting water from the source (surface or ground) to purification works or the service reservoir.
- ▪ Transfer of water from source to distribution system.
- ▪ Pumping water from sump to elevated/ground surface tanks.

Pump house (civil works) is constructed for installation of pumping machinery.

Pump House is designed for life of atleast 30 years, while pumping machinery is designed for atleast 15 years lifespan.

Pumping Machinery consists of 3 major components:

- ❖ **Pump for lifting of water** :The function of pump is to transfer water to higher elevation or at higher pressure. Pumps are driven by electricity or diesel or even solar power. They are helpful in pumping water from the sources, that is from intake to the treatment plant and from treatment plant to the distribution system or service reservoir.
- ❖ Electric/diesel/solar powered motor For pumping, 3 phase electric connection is required.
- ❖ **Panel board :** Panel board consists of circuit breaker or switch and fuse, starter level controls etc for transmission of electric supply.

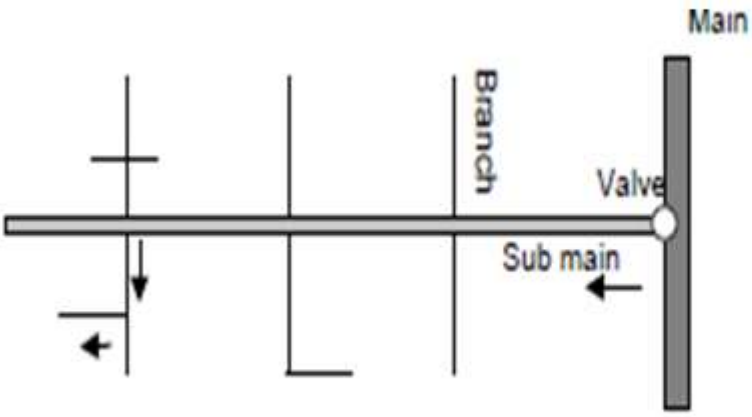


Pipeline Distribution Networks:

Pipeline distribution networks are aimed at design of suitable routes for piping. It is very important for proper water pressure, capital cost and operation and maintenance cost. Different types of networks are adopted looking to the pressure requirement, operation and maintenance (O&M) strategy adopted, cost parameter and over all length of distribution system.

Dead end distribution system

In such system, sub main pipes are connected at right angles from main pipeline and branch pipes are connected to sub mains at right angles. This system is easy to lay. However, in case of failure in pipeline, it will be difficult to supply water to the area ahead of affected area. Also pressure at the tail end will be low compared to other area and there will be stagnation of water.



Type of Pipe Material for Pipelines for Water Distribution

Various types of pipes are used for water supply system including metallic and non-metallic pipes. Most common types of pipes used for water supply system are:

1. Galvanised Iron Pipes – metal pipe
2. Mild Steel Pipes metal pipe
3. Poly Vinyl Chloride pipes - non- metal pipe
4. High Density Poly Ethylene Pipes - non metal pipe
5. Ductile Iron Pipes

For water mains, mainly GI and MS pipes or even large HDPE pipes are used, while for branch/service pipes, most commonly used are galvanised iron and HDPE/PVC pipes. DI pipes are used for both purposes.

Mild Steel Pipes

- Number of joints are less as they are available in longer length.

- Pipes are durable and can resist high internal water pressure and highly suitable for long distance high pressure piping.
- Flexible to lay in certain curves.
- Light weight and easy to transport. Damage in transportation is minimal.
- Pipes are prone to rust and require higher maintenance.
- Require more time for repairs and not very suitable for distribution piping.
- Available in diameter of 150-250 mm for water supply and cut lengths of 4 - 7 m (2.6-4.5 mm wall thickness).
- Steel Pipes are joined with flanged joints or welding.

Galvanised Iron (GI) Pipes

- Cheap in cost and light in weight.
- Light in weight and easy to join.
- Affected by acidic or alkaline water.
- GI pipes are highly suitable for distribution system. They are available in light (yellow colour code), medium (blue colour code) and heavy grades (red colour code) depending on the thickness of pipe used. Normally, medium grade pipes (wall thickness 2.6-4.8 mm) are used for water supply system. Normally, 15-150 mm size pipes (nominal internal diameter) are used for distribution system. They are available in length of 3 m.
- GI pipes can be used in non-corrosive water with pH value greater than 6.5.
- GI pipes can be used for rising main as well as distribution.
- GI pipes are normally joined with lead putty on threaded end.

Poly Vinyl Chloride (PVC unplasticised) Pipes

- Cheap in cost and light in weight.
- Economical in laying and jointing.
- They are rigid pipes.
- Highly durable and suitable for distribution network..
- Free from corrosion and tough against chemical attack.
- Good electric insulation.
- Highly suitable for distribution piping and branch pipes.
- Less resistance to heat and direct exposure to sun. Hence, not very suitable for piping above the ground.
- PVC pipes weigh only 1/5th of steel pipes of same diameter.
- Certain types of low quality plastic impart taste to water.
- Available in size 20-315 mm (nominal internal diameter) for water supply with pressure class of 2.5, 4, 6, 8 & 10 kg/cm2 for water supply. Ideally pipes with 6 kg/cm2 should be used.

HDPE

- Light in weight.
- Flexible than PVC pipes.
- HDPE pipes are black in colour.
- Suitable for underground piping and can withstand movement of heavy traffic.
- Allows free flowing of water.
- Highly durable and suitable for distribution network.
- Free from corrosion..
- Good electric insulation.
- Useful for water conveyance as they do not constitute toxic hazard and does not support microbial growth.

Normally, 20-315 mm diameter pipes are used for water supply and distribution system with pressure ranging from 6-kg/cm2. Available in coils in small diameters. Above 110 mm diameter, available in lengths starting from 6 m.

Ductile Iron Pipes

- Ductile Iron pipes are better version of cast iron pipes with better tensile strength.
- DI pipes are prepared using centrifugal cast process.
- DI pipes have high impact resistance, high wear and tear resistance, high tensile strength, ductility and good internal and external corrosion resistance.
- DI pipes are provided with cement mortar lining on inside surface which provides smooth surface and is suitable for providing chemical and physical barriers to water. Such pipes reduce water contamination.
- The outer coating of such pipes is done with bituminous or Zinc paint.
- DI pressure pipes are available in range from 80-1000 mm diameter in lengths from 5.5-6 m.
- Available in thickness class K7 and K9 with barrel wall thickness ranging from 5-13.5 mm. Also available in pressure class (Like C25, C30, C40 etc.).
- They are about 30 percent lighter than conventional cast iron pipes.
- DI pipes lower pumping cost due to lower frictional resistance.

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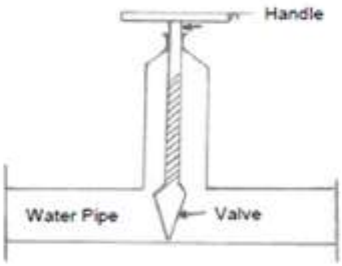
Type of Valves for Water Flow Control and Estimation

Valves are used for control of water flow in pipeline and cleaning of pipes.

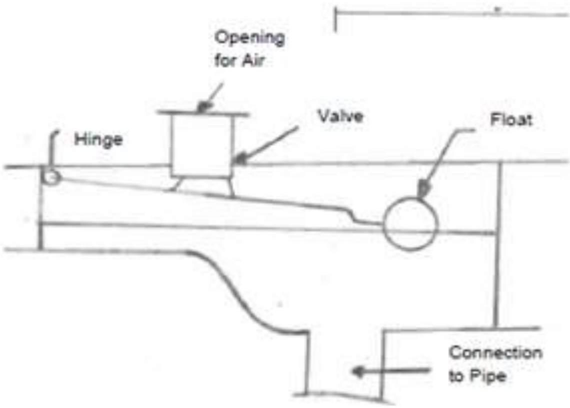
1. Sluice Valve

It is used for control on water flow in pipeline. It is fixed in main line and at start of branch line. It is also used as scour valve for cleaning of pipeline. They are provided in straight pipeline at 150-200 m intervals. When two pipes lines interest, valves are fixed in both sides of intersection.



2. Air Valve

Air valve are fixed in order to allow air circulation in pipeline. It is placed in pumping main line and distribution line mainly which are at higher levels. Air valves may be placed at every 1000 m for pipe lines upto 600 mm dia.



3. Water Meters

- These are devices installed on pipes to measure quantity of water flowing in particular area. These are installed to keep control on water usage in case of metered water supply.
- Meters installed to measure household consumption are called domestic water meters. Water meters can also be installed for measuring quantity at stand posts.
- Water meters having sizes from 15 mm to 50 mm are considered for domestic water meters.
- Water meters are made normally of cast iron/brass/plastic body and plastic gears.
- Meters are classified according to the operating principle, type of end connections, the standard by which the same are covered, constructional features, method of coupling between the counter and primary sensor, the metrological characteristics etc.
- Automatic water meter reading system are used now in order to collect data from all the meters at central point through GSM/internet. This help in saving time for collecting data from each individual place. This system helps in collection, displaying and processing of data at one single place. It also helps in monitoring of data daily.

- Sizing of water meter Water meter has to be selected according to the flow to be measured and not necessarily to suit a certain size of water main. The maximum flow shall not exceed the maximum flow rating. The nominal flow should not be greater than the nominal flow rating.
- Installation guidelines and sizing reccomendations for water meters are normally given by the supplier.

4. Flow Meters

- Flow meters are devices installed mainly to measure velocity/speed of water and also derive quantity of water.
- Flow meters are placed near water intake/head works, transfer mains, storage tanks/reservoirs, distribution network like branch/main/sublines etc.
- Various type of flow meters are available based on characteristic and performance line accuracy of measurement, range, resolution etc.

Difference of water meter against flow meter

- Water meter is a quantity meter and not a flow rate meter.
- Water meter is a mechanical device whereas flow meter is mechanical or an electronic device.
- Water meter is always specified in two accuracies i.e. lower range and upper range accuracies whereas a flow meter it is specified in a single range accuracy.
- The upper range and lower range accuracies are 2 percent and 5 percent of the actual quantity respectively for the water meter whereas it is variable for flow meter as per the customer's requirement.

Installation of Water Meters

• Installation manual is normally given by the meter supplier.

• Domestic Water Meters can fixed at household level in case there is 24 hours supply and water tariff is collected based on actual water consumption.

• A masonry pit is constructed around the meter to protect it. A lid should be placed on pit for taking readings. The protective lid should normally be kept closed and should be opened only for reading the dial.

• Technical parameter for fixing of water meters

a) Water meters must be fitted in the right direction of flow and positioned to allow easy visibility for manually reading the meter and for viewing the serial number.

b) The length of pipe that accommodates the water meter must be completely filled with water immediately upstream and downstream of the meter under all operating conditions.

c) Install meter such that top of the meter is below the level of the communication pipes so that meters always contain water.

d) Water meters are to be located to avoid damage (eg. vehicles, livestock, vandalism, flooding) a protective box/masonry pit may be necessary in some situations.

e) Water meters are to be installed as close as practicable to the extraction point and must be located upstream of any valves (except air valves), tees, takeoffs, diversions or branches.

f) Water meters are to be installed above ground if possible and located outside of wells to allow for safe and easy meter reading. If a water meter is required to be located below ground, or down a well then it should not be deeper than 500 mm below ground level.

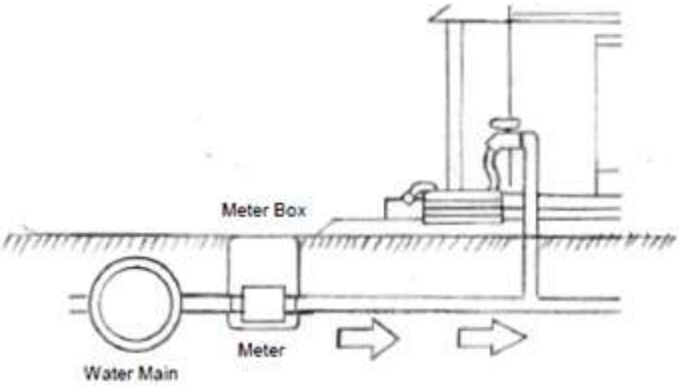
g) Water meters fitted onto PVC, or HDPE pipeline must be adequately supported by a concrete block, or fabricated steel bracing to ensure stability.

h) Before connecting the meter to the water pipe, it should be thoroughly cleaned by installing in the place of the water meter a pipe of suitable length and diameter and letting the passage of a fair amount of water flow through the pipe work to avoid formation of air pockets. It is advisable that the level of the pipeline where the meter is proposed to be installed should be checked by a spirit level.

i) Before fitting the meter to the pipeline check the unions nuts in the tail pieces and then insert the washers. Thereafter screw the tail pieces on the pipes and install the meter in between the nuts by screwing. In order to avoid its rotation during the operation, the meter should be kept fixed with suitable non-metallic clamps. Care should be taken that the washer does not obstruct the inlet and outlet flow of water.

j) Where intermittent supply is likely to be encountered the meter may be provided with a suitable air valve before the meter in order to reduce inaccuracy and to protect the meter from being damaged.

k) Test and calibrate the water meter before use and at regular intervals as per instructions given by manufacturer.



Typical Installation System for Domestic Water Meter

Checklist for Quality Check of Basic Construction Materials for Water Supply System (at Site/Village/Town level)

This checklist is mainly for understanding specifications of materials to be ordered, its storage mechanism on site as well as quality check on site as per the order placed.

1. Cement

- Cement should be 53 grade ordinary Portland cement (OPC) with ISI mark.
- Cement should be used within three months from the date of manufacture. Date of manufacture is written on cement bags.
- Do not purchase cement bags which are damp.
- Store cement bags so that they do not catch dampness.

2. Sand

- River sand should be clean and sieved. It should not contain silt and dust.
- Use sand after washing it.

3. Gravel/Kaptchi/Aggregates

- Such aggregates come is 4-40 mm size.
- They should not be larger than 40 mm each.
- They must be hard, non-porous and free from excessive quantities of dust.
- They should not be rounded or with flakes.
- They should be angular, tough, and sharp and well graded stone metal, Basalt from approved source.

4. Stone

- Use stone from standard mines.
- Use stone which are hard and similar colour.
- Do not use stones which are round or very irregular in shape.
- Length of stone should not exceed three time its height. Height of stone can be upto 300 mm.
- Width/breadth of stone base shall not be greater than 3/4th of wall thickness. However, width of stone shall not be less than 150 mm.

5. Bricks

- Use bricks of even sizes from standard suppliers.
- Standard traditional size of bricks is 9” x 4.5” x 3”.
- Use first class bricks.
- Bricks should not be over burnt or under baked.
- Bricks should be free from cracks, chips, flaws and stone.
- Compressive strength of bricks should be atleast 35 kg/cm2.
- Use bricks with frog in it.

- Check few bricks on unloading for its size. The size (length/breadth/height) individually should not be more/less than 5 percent of size ordered.

6. Cement Concrete Blocks

- Compressive strength of blocks should be atleast 35 kg/cm2.

7. Water

- Use clean water as far as possible.
- Do not use saline water.
- Water should be free from oils, acids, salts and other organic material/substances which may be harmful to concrete/pipes.

8. Steel Reinforcement Bars

- Use steel bars with ISI mark only.
- Store steel bars on site in such a manner that it does not catch corrosion and is not in contact with moisture/water.

9. Pipes for water distribution

General

- Check manufacturer's trademark and name, ISI mark, outside diameter in mm, class of pipe and pressure rating, month and year of manufacture as well as length of pipe, once the pipes are unloaded on site. Check whether the pipes unloaded are as per specifications while ordering.

Metal pipes

- Pipes and fittings should not be thrown from trucks, nor dragged or rolled along hard surface. Pipes may be handled in slings of canvas or non-abrasive materials.
- Pipes can be stored in layer with each layer at right angle to another. Height of stack should not exceed 2 meter. Alternatively, parallel stacking can be done using timber.
- The pipes should be inspected while unloading for defect like grooves, dents, notches. If large portion of such defect are found, material should be replaced.
- The pipes should be stored under cover on the site if it is to be used after long period.
- Pipes of different sizes should be stacked separately.

Plastic pipes

- Pipes should be stored undercover if it has to be used after longer period as it will get damaged due to direct sunlight.
- HDPE coils may be stored either on edge or stacked flat one on top to another. Straight lengths PVC/HDPE can be stored in horizontal racks with support. Pipes should not be stored in stacks more than 1.5 m in height. Pipes of different sizes should be stacked separately.

Types of Water Treatment System at Village/Town Level

1. Primary Screening

- Screens are fixed in the intake works or at the entrance of treatment plant so as to remove the floating matters as leaves, dead animals etc.

2. Sedimentation

- In this process, suspended solids are made to settle by gravity under still water conditions. The sedimentation tanks may be rectangular or circular in shape.

Advantages

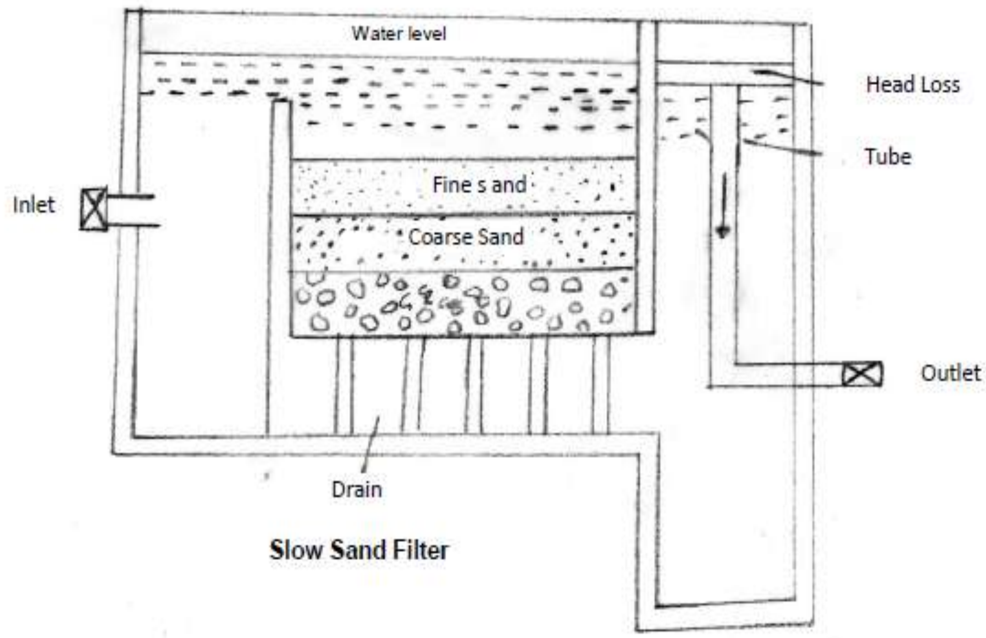
- Plain sedimentation lightens the load on the subsequent process.
- The operation of subsequent purification process can be controlled in better way.
- Less quantity of chemicals is required in the subsequent treatment processes.

3. Sedimentation with coagulation

- This process is used when raw water contains fine clay and colloidal impurities and needs extra chemical treatment for them to settle unlike plain sedimentation. In this process certain chemical/coagulant are added in the process along with sedimentation for impurities to settle down. This process is useful in removal of colour, odour and taste from water. Turbidity and bacteria can also be removed to certain extent.
- Coagulants are added based on pH of water. Alum or aluminium sulphate is common and cheaper coagulants added in the process. They are added in powder or solution form to raw water through some mechanical means.

4. Filtration

- This involves treatment of water by passing it through bed of sand, gravel and other granular materials. This system is useful in removal of bacteria, colour, odour, taste.
- This system is highly useful in removal of suspended impurities.



Slow Sand Filter

- The common type of filtration system is slow sand filter mainly used in rural/small urban areas. Such filter is made up of tank containing sand in top layer (size 0.2-0.3mm) upto thickness of 750-900 mm. Course sand layer is placed below fine sand layer upto 300 mm. The last layer is of graded gravel (2-45 mm) upto thickness of 200-300 mm. Water from sedimentation tank is passed through sand filter tank. Average flow of water from such filter is about 2400-3600 litres/m2/day. Hence, size of tank is decided upon daily requirement of water to be treated. The sand needs to be replaced every 6-8 weeks as it gets clogged with impurities. Gravel can be washed and cleaned and replaced again.

5. Water chlorination

- Chlorination is the cheapest form of water disinfection.
- Chlorination is done at head works/main storage tank in village/town prior to water distribution.
- Water test of the source needs to be done in laboratory in order to derive require amount of dosage of chlorination. Additional test should be done during monsoon and in case of epidemics.
- Bleaching powder or chlorine solutions are used for this purpose. If chlorine is used in powder form, it should be first diluted in form of solution and mixed in tank for proportionate mixing in the tank. Any form of chlorine should be of ISI mark. Normal dosages used for chlorination are listed below, however, prior test of water source needs to be done for deriving exact dosage:

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Quantity of water to be used (litres)	Quantity of chlorine	
	Powder form chlorine/bleach (grams)	Chlorine solution (milliliter)
	25-35% powder	5% solution
1000	5	25
5000	15	125
1 lakh	500	1500
5 lakhs	2500	12500

POPULATION FORECASTING:

Population firecasting is defined as the method of determining the expected **population** for a particular design period of a water supply system with the help of the study and analysis of future events and available records.

The population is an important parameter that is determined for the design of the water system of a particular area. Water supply systems are designed for a population expected for a certain design period instead of taking into consideration the present population of the area.

There are several mathematical methods that can be used to determine the population for a design period.

Population Forecasting Methods

The population forecasting methods require the values of present and past population records to undergo the calculation. The local census records of a particular area provide the value of present and past populations.

1. Arithmetic increase method
2. Geometric Progression method
3. Incremental increase method
4. Graphical method
5. Comparative graphical method

In banashankari 6th phase , the population with respect to year is as follows

Year	Population	Increment
2018	210	
2019	345	135
2020	482	137

So the avg Increment is 135+137/2 = 136

So in the year, 2021 the population = 482+136 = 618

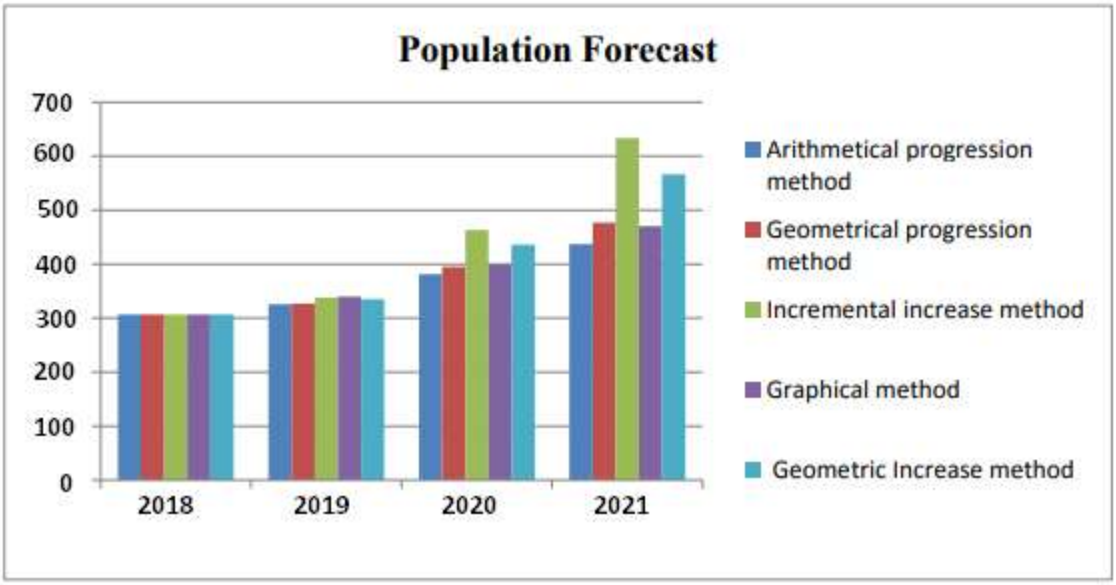

Fig : Graphical representation

PLANNING OF WATER SUPPLY NETWORK USING QGIS SOFTWARE:

QGIS (until 2013 known as **Quantum GIS**) is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data.

Functionality

- QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps.[3] QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images.
- QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.
- QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer.[5] Plugins written in Python or C++ extend QGIS's capabilities. Plugins can geocode using the Google Geocoding API, perform geoprocessing functions similar to those of the standard tools found in ArcGIS, and interface with PostgreSQL/PostGIS, SpatiaLite and My SQL databases.
- QGIS can also be used with SAGA GIS and Kosmo

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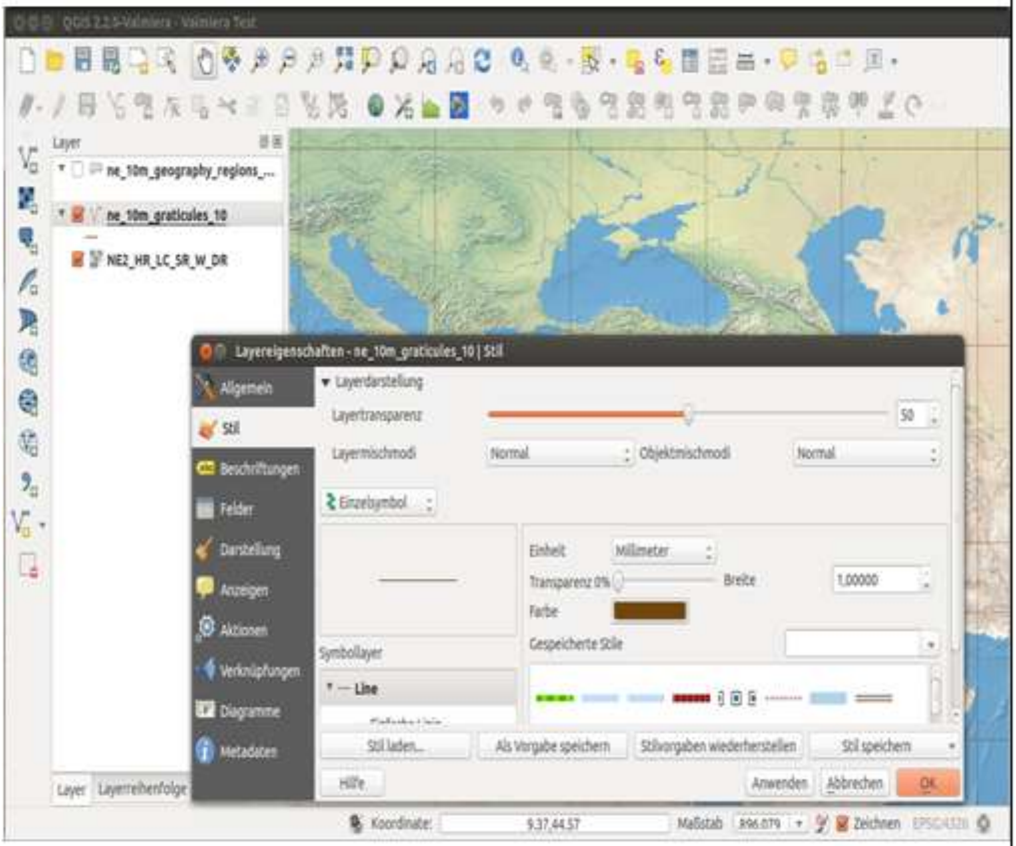
OPEN STREET MAP:



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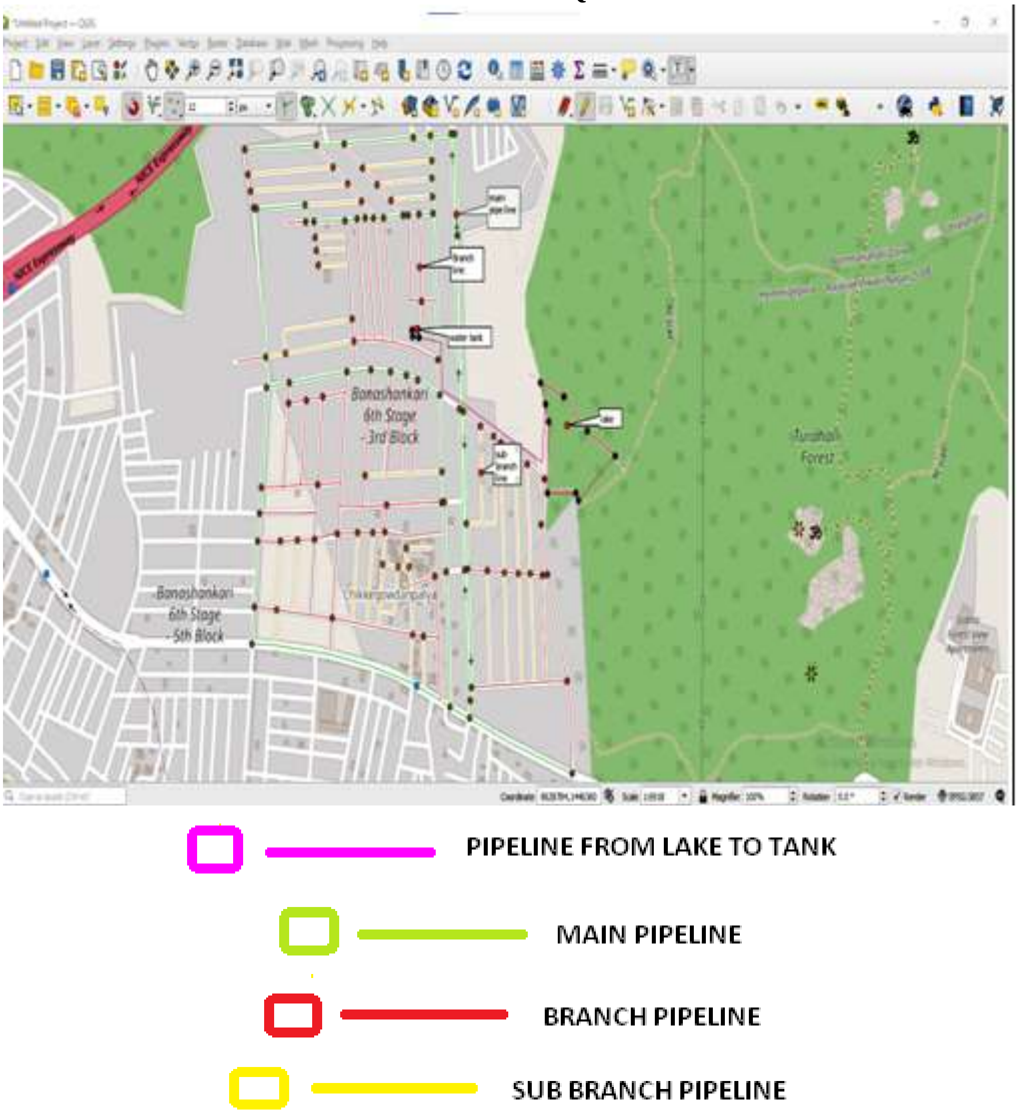
SHOWNIG THE WATER SUPPLY NETWORK USING QGIS SOFTWARE:



V. METHODOLOGY:

1. The methodology was developed according to the needs and requirements for the study based on the overlaying the future on the LULC(Land Use Land cover) Map and to determine the water distribution network .
2. As WSS uses spatial database, GIS technology can act as important rules in collecting, storing, managing and analysing of spatial data set that are used in designing of WSS.
3. In this above papers we focused on the train data that uses for water quality assessment, network analysis and routing the pipe lines through the barriers.
4. The method to evaluate the hydrological impacts due to land use modifications can be achieved through integrating GIS.

WORKFLOW OF PROPOSED GIS BASED WATER SUPPLY

START

↓

CONDUCT HOUSE TO HOUSE GPS SURVEY

↓

GIS MAPPING

↓

PREPARE DATABASE

↓

FEASIBLE WATER SUPPLY FACILITY

↓

EASTABLISH WATER NETWORK AS PER HYDRAULIC DESIGN

VI. CONCLUSION:

By above collected information we have made an effort to collect the how the GIS is much essential for palning a water supply system. By referring to above collected information/Data we observe that most of these specifizes that nowdays requirement of GIS is needfull in distribution of water to any field . By using above applications, we have created a plan in QGIS software and used this to analysis how GIS works in water supply system and the data collected by GIS will store and maintain .It collects the overall data of distribution of water supply system from source to consumer.

So GIS is a powerful tool in developing water supply system and facilitates to use the following process.

1) Data collection and monitoring.
2) Site selection for source of water.
3) Site selection for Storage and pumping Stations.
4) Site selection for sum and control valves.
5) Network analysis and design of pupe line path.
6) Water quality assessment.

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