

Feasibility Study of Converting Existing Intermittent Water Supply Into 24x7 Water Supply of Ramnagar, Gondia District

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Abstract: At present water supply scheme (WSS) in India practice intermittent system and provide sub-optimal service to end consumers. Maharashtra is one of the states facing severe drinking water crisis. To solve the water crisis problem number of experiments has been done for water supply system. Intermittent schemes are still in practice. Actual behaviour of intermittent system is difficult to predict, due to the limited hours of water supply & meeting peak demands simultaneously which leads to varying pressure and frequent failures. Wastage of water and problems in storing water can be reduced by 24x7 water supply scheme. To convert the intermittent supply into 24x7 continuous water supply role of Hydraulic modeling is very important. It includes the provision of water treatment work for the area to supply the treated water to the public & providing distribution networks and water meters to save water. Ramnagar is an area of Gondia district having drinking water problem because of intermittent supply scheme. The current practice is to maintain water supply on an intermittent mode. WaterGEMS software is used for designing hydraulic modeling and providing efficient pipe network for the present study. WaterGEMS is the only software, which provides appropriate satisfactory design and efficient solution.

Keywords: WaterGEMS, hydraulic modeling

1. Introduction

Water is one of the most basic amenities required for every living being. The other beneficial uses of water includes, for industries, generation of electric power, transportation, recreation and many other uses. Not only the use of water is increasing rapidly with the growth in population, but also there is an acute shortage of both surface and underground water due to many manmade activities.

24x7 Water, supply system, in which water is available in the tap round the clock on all days on a continuous basis as in case of electric supply. In a continuous supply, the distribution system remains continuously pressurized so that no contamination can come into the water pipelines even when there are small leaks in the system. It also means water with sufficient pressure so that it can flow automatically up to the third floor of the houses without need of any in home storage or pumping.

In Ramnagar area of Gondia district intermittent water supply system is used to supply drinking water. In this intermittent system water is supplied to users for less than 24 hours in a day for specified hours. Water supplied to the consumers is usually at the peak hours of the water usage. The consumers have to store the water in between supply hours. The need to replace this intermittent system to reduce the level of contamination of pipes under pressure, due to the pressure created in pipes the life of pipe is increased.

Management of water is possible due to metering and reduction in NRW (Non-Revenue Water). Hydraulic modeling is the important parameter in converting this system into 24x7, it includes the balancing of nodes, junction, creation of DMA's (District Metering Area) and converting it into 24x7 system.

2. Aim & Objective

Feasibility study, of converting existing intermittent water supply into 24/7 water supply

- To convert the intermittent water supply to 24x7 water supply.
- To achieve residual head at tail end.
- To achieve NRW

3. Problem Statement

To provide equitable water supply by 24/7 water supply system, reducing NRW and water losses.

4. Literature Review

[3] This paper shows approximate approach to leaks, which were found very accurately by using helium gas techniques. A total of 31 spots were studied, out of that, 5 have no leakage and 26 have the leakages which were repaired. The paper says that leaks were found out by helium gas as it is nontoxic. The paper suggest that new system for locating pipe leaks is introduced and the system incorporates several new developments like recycling of waste water for gardening. Pilot project of 24x7 water supply scheme is studied.

Paper says that it helps to reorganize and restructure the wards as per increase of people in area. The main water supply pipe lines were checked for its thickness, diameter, pressure, flow and quality of the pipe material. Paper concludes that there is no need to change/replace the pipelines according to paper. According to paper water provided by PCMC to all people of sector 21 is of standard quality and passes the safe permissible limit. The needs of the study as per paper is 24 x 7 system reduces

contamination level as the pipes are under positive pressure and entry of contaminants into the pipes is restricted. Due to steady pressure in the pipe increase the life of pipe distribution network. No fatigue for pipes and a better demand management is possible due to elaborate metering and effective leakage control. It is also easy & just to calculate water charges based on consumed volume.

[2] The paper presents that Current project was been carried out on design a 24x7 water supply scheme for a Ranebennur town for domestic use. It also includes the provision of design of intake structure, water treatment work, for the area in order to supply the treated water to the publics. Providing distribution networks, pipe appurtenances, and water meters, to save water. Quality and quantity of water supplied should be satisfactory. At the beginning aim of paper was to supply pure wholesome drinking water to the public of Ranebennur town with minimum cost. Such that it also calculates population projection and quantity of water required to the town at year 2046. But as far as possible authors have avoided costly installation and gone for conventional methods which may prove economical. As in paper mode is less costly as compared to the one which has been discussed. The initial plan was same, but after the results of analysis of water it became necessary to treat the water before supply and hence a full water supply scheme was designed for benefit of the people who are going to reside there. As per paper 100% computerized records maintained/bills based on monthly readings issued. Simplification of billing procedure with AMR type meter installation ensured that reading could be taken remotely by driving through the streets using radio-frequency driven hand-held devices. This Project has helped prove that 24x7 is feasible and durable. Became milestone in India, other cities, in-state and outside state have shown interest in 24x 7 water supply systems.

5. Watergems

WaterGEMs is software business analysis, hydraulic modeling and network management pressure (distribution systems or risk), owned by Enterprise Software Bentley systems incorporated produces solutions for the design, construction and operation of infrastructure in various fields.

WaterCAD allows hydraulic simulation of a computational model represented in this case by type elements: Line (pipe sections), point (Nodes Consumption, Tanks, Reservoirs, hydrants) and Hybrid (pumps, control valves, regulation, etc.)

6. Study Area

Ranbennur is an area at Gondia district of Maharashtra. The present population is about 138500 i.e., approximately 140000. Present population of ranbennur is approximately 23460. It is located at latitudes 21°28'N and



Figure 1: Gondia (Maharashtra)

Longitudes 80°29'E. The water supply scheme has Wainganga River as its source. The location is shown in Figure below. It is 170 km away from Nagpur. The present water supply in Ranbennur area is moderate. The area gets water daily but only for 1-2 hours in morning. The NRW is quite high in this area to overcome such problems 24x7 supply systems is good option. The whole area is divided into 5 zones according to the rules from (CPHEEO Manual). The area selected for study is Ranbennur area where the conversions of intermittent supply into 24x7 supply system by using WaterGEMs software.



Figure 2: Ranbennur area

7. Methodology and Results

WaterGEMs is being used for the design of pipe network supply system for Ranbennur area. CI pipes are used for the entire design, as they provide more efficiency and durability as compared to other ones. The methodology is simply based on the hydraulic and hydrologic principles. Calculations are performed by analyzing the Population forecasting, water demand, flow. Contour data is taken.



Figure 3: Methodology

8. Design Criteria

Design Period:

Design period for this work has been adopted same as that suggested by CPHEEO Manual. Hence, following design years have been considered:

- (i) Immediate stage - 2011
- (ii) Intermediate stage - 2035
- (iii) Ultimate stage - 2050

As per 2011 Census, population of ramnagar area. The population figures for the last three decades are as under:

Table No. 6.1: Population data for Ramnagar area

Sr. No	Year	Population
1	2011	18916
2	2035	26866
3	2050	32143

The population for these stages is projected by using population projection methods mentioned in the water supply manual of CPHEEO (Central Public Health & Environmental Engineering Organization)

The projection methods adopted are average of Arithmetic Method and Incremental Increase Method as indicated in the table below.

Arithmetic Increase Method

$$P_n = P + n.C$$

Where, P = Present Population

n = No. of decades

C = Average Increment

2) Increment Increase Method

$$P_n = P + n.X + \{n(n+1)/2\}.Y$$

Where, P_n = Population after nth decade

X = Average increase

Y = Incremental increase

Water demand projections are worked out with 135 liters per capita per day (LPCD) at consumer end as GMC intends to take up full-fledged sewerage scheme. The losses are computed upward for gross demand projections as per CPHEEO manual. Considering the densities for each ward derives values of the ward wise demand. Also, for ultimate stage scenario, demand is estimated by length wise demand estimation method. The Present, Intermediate & Ultimate demands of the city are projected by ward wise density method (proportional distribution area method).

Table No. 6.2: Demand Calculation for Ramnagar area

Sr No.	Year	Demand
1	2011	2.83
2	2035	4.02
3	2050	4.82

Hazen-Williams C-Value so far PVC, CI, GI and AC pipes have been used as material for pipe network in the existing distribution systems of water supply projects, among which, AC pipes are quite old and need to be replaced and however, CI pipes which are brittle in nature and micro

cracks in the pipe body lead to leakages; so in case of AC & CI pipes, the inner surface becomes rough and Hazen-Williams's coefficient of roughness, C-value, gets deteriorated with passage of time. C-values of CI, DI and other materials of pipes are shown in table.

Table No. 6.3: Hazen Williams roughness coefficient values

Material	C-value
AC	120
CI	100
DI	130
PVC	130
HDEP	140

9. Residual Pressures

Presently the houses in the Gondia Municipal Council area are mostly single storied. Therefore, sizes of pipelines and tank storages of the system are checked for minimum residual pressure of 12 m at nodal points.

1. Minimum Diameter Of Pipes

The minimum proposed diameter of pipes considered in the analysis is 100 mm. No service connections would be given from a pipe having diameter more than 200 mm. However, as aim of this consultancy study is not to design the system but to check overall performance, the minimum size of the pipeline which 100 mm in our case, is considered

2. Leading Mains

The inlet mains to service reservoirs and trunk mains will carry water for 20 hours. A minimum residual head of 2m is considered over the full level of the reservoir. The inlet mains to the service reservoirs are checked to cater projected flows for the year 2050 and are also checked for intermediate (2035) flow conditions.

3. Pattern

The pattern with the 24 hours supply is considered for analysis.

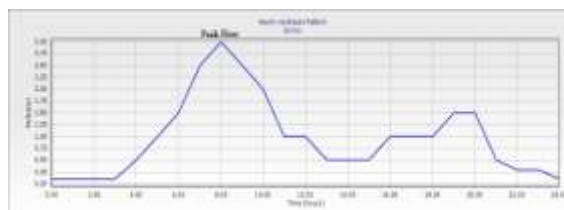


Figure 4: Hourly hydraulic pattern for 24 hours

10. Software Used

For GIS maps, ARC-VIEW and ARC-GIS software has been used. The analysis of the distribution system is made using BentleyWaterGEMs V8i (SELECT series-2) version software.

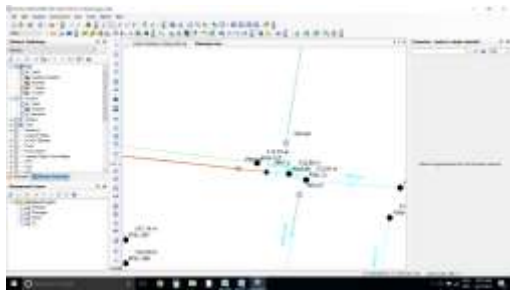


Figure 5: Nodes joining of network

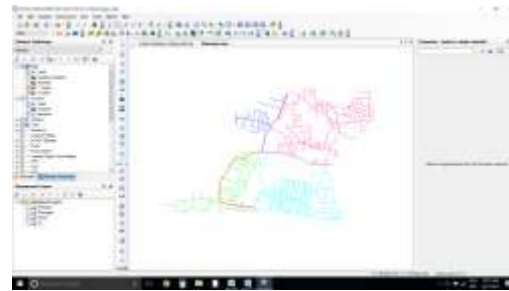


Figure 7: creation of DMA

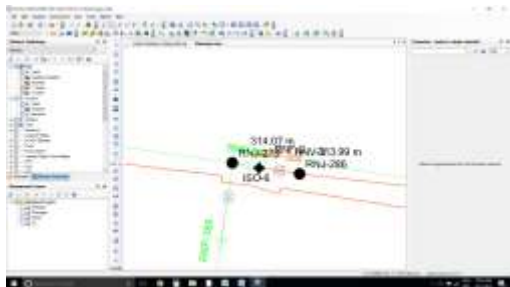


Figure 6: Balancing of junctions



Figure 8: Creation of network



Figure 9: Supply in system RUN

Changes that can be observed for successful implementation of 24x7 water supply operation:

1. ESR will not become empty and not overflow.
2. There are equitable pressures in the system actually observed. Valve operation will be minimized.
3. Consumers at any point will get practically equal water quantity in a day.
2. Household storages will be eliminated.
3. Any shut downs can be planned shutdowns.
4. Billing efficiency will be improved.
5. When the staff is consistently on watch in the transition period, unauthorized connections are identified.
6. Working of meters will be improved.
7. Seasonal changes in supply can be easily worked out.

11. Results and Discussion

In present study of existing water supply system it was found that the amount of water supplied at consumer end was 1.8774 MLD and water loss is 1.1026 MLD. So the total NRW observed is 37 %. The demand for Year 2050 was found to be 4.82 MLD by analytical method and 4.92 MLD was calculated by performing Hydraulic Modeling at Ramnagar area.

Ramnagar command area	Demand in MLD			
	2017	2020	2035	2050
	2.98	3.24	4.02	4.82

8. Consumer behavior will be correlated with operational system.

12. Conclusion

1. The study shows that it is Feasible to convert the existing intermittent water supply into 24x7 water supply.
2. The demand for Year 2050 was found to be 4.82 MLD by analytical method and 4.92 MLD was calculated by performing Hydraulic Modeling at Ramnagar area
3. For present year 2017, it was found that in addition to existing demand of 2.98 MLD (millions liter per day) which is stored in ESR, 1 MLD is required for successfully converting the Ramnagar command area into continuous pressurized system and some new pipe lines will also be needed as per design outcomes.
4. The entire distribution system is designed as per the guidelines of CPHEEO Manual.
4. It was found out that to calculate the population forecast and demand for ultimate year 2050, the population census data is very necessary.
5. Residual head achieved at tail end is 12 m.
6. It was found that the valve schedules, which were calculated came out same as that of existing system so cost will be reduced, as there is no need to replace the valves.
2. The study shows that achieving 24x7 in old water supply scheme is challenging task. In this study it has been emphasized that before undertaking transition of WSS (water supply system) to 24x7 water supply it is necessary to undertake reform works. Reform works gives an opportunity to ULBs (urban local bodies) it gives better understanding of Water Supply Systems technically and financially. Without knowing the present status of WSS it is difficult to develop a road map for conversion of 24x7 water supply.
3. It is found that hydraulic modeling plays a critical role in development of road map for converting WSS from

intermittent operation to 24x7 continuous mode. Hydraulic modeling analysis help in developing rehabilitation plan for WSS with better utilization of existing water supply infrastructure. The optimal investment can be suggested with Hydraulic Modeling. Hydraulically isolated DMAs can be formulated for better service delivery and monitoring of WSS

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