Water Distribution Network Layout for Pune City

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Abstract -*This Paper describes Pune as open system with porous boundaries and highlights the importance of a system perspective for understanding sustainable water management system. Similarly, a framework of system helps us to understand the existing water management system as well as water distribution system and nexus between social equity, environment sustainability. India is urbanizing rapidly with characteristics inequality and conflicts across social and economic axis. By following the changing Global pattern, Indian cities like Pune use social and natural resources of the rural hinterland and their own resources for survival and growth and in this process, needs large amount of water. water is the most important 'resource floe' in an urban are like Pune driven by complex set of economic, social, educational, political, infrastructural, hydrological and other factors. This drives very great deal within a city. This has significant impact on water flow and management and requires micro and macro level study in order to address it. In this paper the emphasis is given at Layout of water distribution network system for Pune city. The approach in this paper will solve the main problems affecting water distribution in Pune, such as, low water pressure in several parts of the network*

*Key Words***: meter, network, , water management, water supply**

1. INTRODUCTION

Water Supply Department is one of major and important departments of Pune Municipal Corporation. This department is formed as per Maharashtra Municipal Corporation act of 1949. The goal of Water Supply Department is to provide adequate safe water for drinking, cooking and other basic needs in a sustainable manner. The water should meet minimum water quality standards and be readily and conveniently accessible at all times and in all situations. There are many roles of water supply department in Pune city, such as, Identifying and minimizing water losses, Improving and creating a system which is energy as well as water efficient. Water supply department of Pune Municipality is also responsible for improvement in customer service level and implementing best management practices. Establishing an equitable distribution of water throughout the city is a prime task of water supply department.

Around the Pune water level has to be collected manually. In delivery system Reading from flow meter and pressure meter are taken manually. Analyst analyses the data and by spending time then takes action in short time at low cost. Where smart water management systems include real time monitoring of water levels, identifying leaks in distribution system, monitoring and maintaining the quality of water

1.1 Study area

Pune city is situated on valley formed by Mula-Mutha Rivers with latitude 18.5204°N and Longitude73.8567° E. Pune city has been strategically one of the most important cities of modern India. It's the 7th largest city in the country and second largest city in Maharashtra. It has developed into a major center for higher education and research, commerce field, IT industry as well as automobile services. The city is well connected with all major urban centers in the country, by road, by rail and by air.
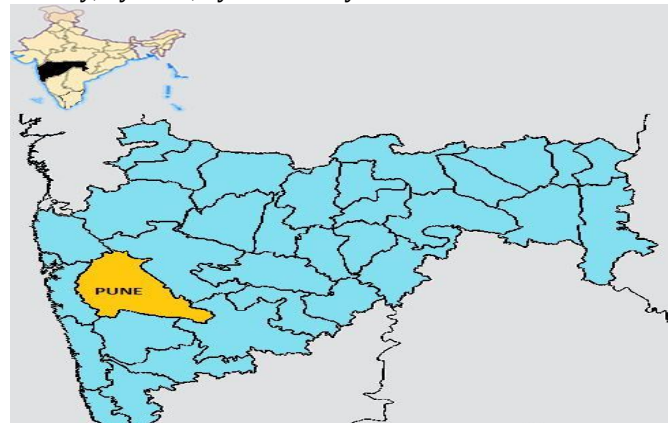

Fig -1: Location of Pune in Maharastra

1.2 Current scenario

PMC has proposed the merger of 23 villages after which the PMC will be responsible for 518.16 sq km.

In 2017 11 villages were merged with PMC with a total area of 331sq km. The 23 new villages will add 187.16 sq km to the existing 331sqkm. This merger will add a population of approximately 5 lakhs to the PMC. Which will be a burden to the water supply system of the PMC in order to meet the increased demand. The area of PMC was 145 sq Km in 1985, the city's limit grew. To 243 sq km in 2001 and 331 sq km in 2017. After the merger the PMC will face the main problem of water supply. Hence the planning of water supply i.e. Source, timing, new connections etc. will become necessary.

Table -1: List of Villages added Under PMC

Name	Level	Area of PMC	Remark
Pune(M Corp)	Urban	243 sq km	
Yewalewadi (CT)	Urban	6.18 sq km (Total = 249.18 sq km)	Notification dt 21 Dec 2012 newly added Village
Lohgaon(N.V.), Hadapsar (N.V.), Keshavnagar-Mundwa(N.V.), Shivne (Part) (N.V.), Ambegaon Kh(Part) (N.V.), Shivne (Part) (N.V.),	Rural	81.82 sq km (Total=331 sq km)	Notification dt 04 OCT 2017 newly added 11 villages
Mhalunge, Sus, Bavdhan Budhruk, Kirkatwadi, Pisoli, Kondhwe-Dhawade, New Kopre, Nanded, Khadakwasla, Manjari Budhruk, Narhe, Mantarwadi, Holkarwadi, Autade-Handewadi, Wadachiwadi, Shewalewadi, Nandoshi, Mangdewadi, Bhilarewadi, Gujar Nimbalkarwadi, Jambhulwadi, Kolewadi and Wagholi.	Rural	187.16 sq km (Total=518.16 sq km)	Villages Planning to be added

2. Related Works

Aditya Gupta[1], Et.Al., 2016,"Need of smart water system in India", International Journal of Applied Engineering Research, issue-4, volume-11, 2216-2223, March 2016.According to survey 50% of world population is under danger as per UN repot in terms of water scarcity. 99% of sea water can't be used as it is salty and 1% includes the available water for human survival which is groundwater and surface water. Using Information and Communication Technology and sensors it is possible to save water resource for future use. With the help of sensor, it is possible to monitor, control, and alarm if there are any water leakages.

Rosiberto Goncalves [2], Et.Al., 2020," An IoT-Based Framework for Smart Water Supply System Management" MDPI, issue-12, volume-114, 7 July 2020. The main reason for water losses is leakage in pipes, error in measurements and water theft. To overcome these the IoT that is Internet of Thing is a valuable tool, it enables real time data storing as well as monitoring. So that awareness can be sent to users and leakage can be found much easily.

Mohammed Shahanas. [3]K, El.At., 2016," Framework for a smart water management system in the context of smart city initiatives in India", ICCC 2016, 142-147, 10 October 2016. Internet, one of the biggest inventions of century, IoT is next level of internet. By using IoT it is possible to help out in the concept of the smart city. With the help of IoT based cloud platform it is possible to make a smart water management system that can analyse, forecast and detect the water leakage.

Shweta Bhausaheb Hadawale[4], Et.Al., 2017," Smart Water Meter And Management System", International Journal of Interdisciplinary Innovative Research and Development, volume-1, issue-04, 47-50, may 2017.Water resource management is a scheme of planning, distributing, monitoring and managing the best use or water resources. Over 15% of water electricity is used for delivering, pumping and treating the water. So, to overcome this a smart water management system is proposed with help of Arduino 1.6.5 software and some concept of c programming. With help of software, it is very easy to find the leakage, measurement and data of water in the system. This process removes the traditional pen and paper errors causing the system to be more accurate and reliable.

3. Water distribution network

For Urban city like Pune, proper planning of distribution, management and monitoring is necessary in order to avoid conflicts. Solution for Distribution of network is given below:

3.1 Formulation of water supply system into zones

While designing a efficient water supply network the project area is divided into no of water supply zones to be supplied by a individual supply source, i.e. Service reservoir, river etc. The formation of water supply zones is primarily based upon the considerations given below:

a) Utilization of existing service reservoirs

Every effort is made to increase the utilization of storage capacity and hydraulic levels of the existing reservoirs. The zone of reservoir is selected to ensure that the hydraulic levels result in adequate terminal pressure in the distribution system. The consideration of size and alignment of the existing distribution system is an important factor of this exercise

b) selection of Efficient service reservoir

An effort to be made to identify geographical location at adequate ground elevation. All such locations can be

shortlisted and a visit should be conducted to finalize the size of the proposed reservoir.

c) selection of boundaries of zone:

Apart from the considerations of the storage capacity and the hydraulic levels, the zone boundaries are finalized considering the natural or artificial barriers such as natural drainage channels for example viz. Rivers & Nallas, irrigation canals, highways and expressways, major city roads. The selection of zone boundaries is made to avoid the major undulations and to limit the distance of the zone boundary from the service reservoir.

4. Proposed Methodology

4.1 Formation of Block Metered Areas

In order to solve the main problems affecting water distribution in Pune, such s, low water pressure in several parts of the network, the most important factor is the establishment of the Blocked Metered Areas (BMA). The BMAs are also essential elements required for achieving the equitable water pressures, reduction of NRW (Non-Revenue Water) and active leakage control which are the main objectives of our Project. BMA: Block metering areas is a sub zone in the water distribution network that can be hydraulically isolated and for which water consumption is monitored using smart water meters. All the inlets and outlets are provided with bulk flow meters and users connections are fully metered.

The distribution of water can be managed better for flow, pressure, control of the NRW if the network is divided in the smaller areas fed from preferable one inlet and zero or minimum number of outlets from the source. A typical proposed scheme of BMA is shown in the figure no. 2.
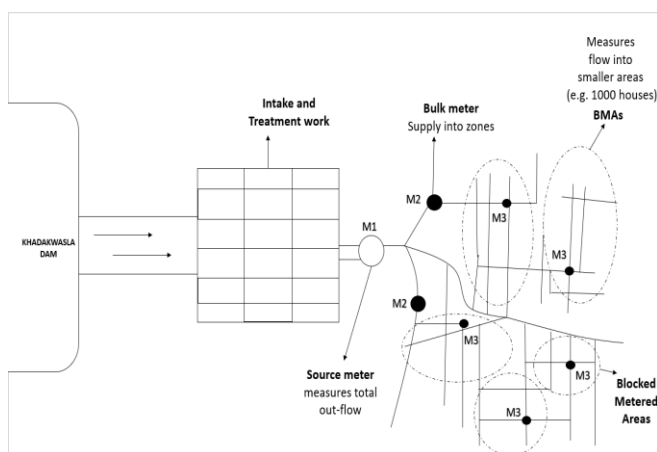

Fig -2: Layout of network distribution

When the system has outlets then the volume of water entering the BMA and leaving the BMA as well as the total consumption of all the consumers are compared allowing to

estimate the water balance and, hence the Non-Revenue Water within the BMA.

The pressure at the inlet points and at other critical nodes in the DMA is also measured, which allows to monitor the actual performance of the water distribution within the network.

The water audit carried out in all the DMAs of a water distribution area allows prioritizing the leakage detection where the water losses are more significant.

The BMA zone should ideally include between 500 to 5000 connections and should present moderate ground level differences. Moreover, the configuration of the existing distribution network and the topography of the given area play an important role in the definition of the BMA border zones. This is also required due to limitations on the availability of the sites for additional service reservoirs. The BMAs are also formed within the zone if excessive pressures may develop in part of the area, which shall be isolated to form a separate BMA. A pressure reducing valve (PRV) is sometimes used at the inlet of such BMAs to reduce the pressure, were excessive. Therefore, such supply zones can be divided in the PMC distribution network.
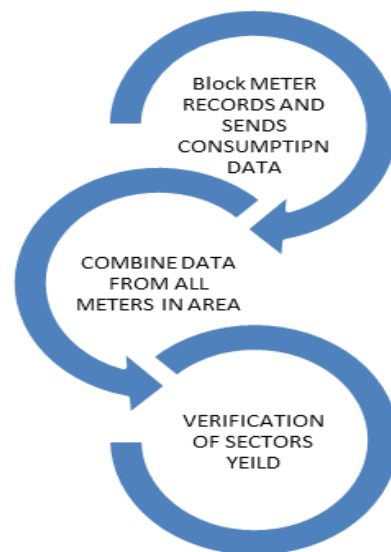

Fig -3: Working of meters in BMAs

5. CONCLUSIONS

Pune Municipal corporation is naturally, the parent agency involved in the operation and maintenance of the water supply system. PMC is maintaining all the old water treatment plants. It is now mandatory to adopt a system which utilizes Smart meters to analyze the water usage, measure water levels in the pump as well as control the distribution of water. By adopting the BMA layout, getting access to present operation conditions, flow, actual water consumption, water balance and pressure condition at user level will be possible. Using BMA networking data from source meter, Bulk meters the Consumption data will get

recorded every day so by combining data from all meters in the Pune city verifying the yield of sectors will be possible. The system will analyze and check if the quantity of water delivered is equal to quantity of water consumed. The real time flow information will be helpful to identify inappropriate consumption. Verification of improvement of distribution pattern and user service for 24*7 is mandatory in order to manage water distribution. User's level of satisfaction will be achievable by the system improvement with 24*7 distribution.

ACKNOWLEDGEMENT

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