

Optimization of Treated Water Consumption through Phased Conversion of a District Metered Area (DMA) from Intermittent to Continuous (24×7) Water Supply

Lakhamanahalli DMA Conversion

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Abstract - Continuous (24×7) water supply is a key objective for improving urban water distribution efficiency, reducing water losses, and providing reliable service to consumers. World Bank (WB)-funded projects have aimed to transform India's intermittent water supply (IWS) to a 24×7 model. This paper presents the successful conversion of the Lakhamanahalli District Metered Area (DMA), located in Dharwad City under the Hubli-Dharwad 24×7 Water Supply Project, from an intermittent water supply system to a continuous 24×7 supply.

Keywords: Continuous Water Supply, District Metered Area (DMA), 24×7 Water Supply, Leakage Reduction, Pressure Management, Water Conservation, SCADA, Smart Water Distribution, Dharwad

Introduction: Urban water utilities across the world are increasingly transitioning from intermittent water supply (IWS) systems to continuous (24×7) water supply in order to improve service reliability, enhance public health, reduce non revenue water (NRW), and optimize the utilization of treated water. Intermittent water supply, which is common in many developing countries, often results in inequitable distribution, low system pressures, contamination through intrusion, excessive consumer storage, and increased leakage due to repeated pressurization and depressurization of pipelines. These challenges significantly affect the efficiency and sustainability of urban water distribution systems.

Methodology: A District Metered Area (DMA) is a hydraulically isolated section of a water distribution network where inflow can be accurately measured and monitored. DMAs enable utilities to quantify water balance, detect and localize leakages, manage pressure, monitor consumption patterns, and improve operational efficiency. Successful implementation of DMA-based management is considered one of the most effective approaches for reducing NRW and facilitating the transition from intermittent to continuous water supply.

The Hubballi-Dharwad 24×7 Water Supply Project, implemented under the Karnataka Urban Water Supply Modernization Project (KUWSMP), is one of India's largest urban water distribution modernization initiatives. The project aims to provide equitable, continuous, and pressurized water supply to consumers

Lakhamanahalli DMA in Dharwad City for conversion from intermittent to continuous water supply. The DMA comprises 1,232 house service connections (HSCs) serving a population of approximately 6,160. Prior to the intervention, consumers received water only once every seven days, leading to extensive household storage, highly variable demand, and operational challenges.

The conversion process involved much more than simply increasing the duration of water supply. It required detailed hydraulic assessment, phased commissioning, continuous pressure monitoring, bulk flow measurement, active leakage detection, ELSR level monitoring, consumer awareness, and systematic validation of the entire distribution network. Pressure loggers were strategically installed at highest & farthest locations within the DMA, while the flow meters ELSR level sensors & Pressure Logger were integrated with a Remote Terminal Unit (RTU) to enable real-time monitoring through a centralized SCADA dashboard. The DMA was further divided into six sub-DMAs, allowing controlled and gradual commissioning while minimizing operational risks.

During the initial stages of daily supply, water consumption was observed to be substantially higher than the estimated demand because consumers continued their previous storage practices and several hidden leakages became apparent under continuous pressurized conditions. Through systematic leakage detection and repair, pressure management, operational optimization, and gradual stabilization of consumer behaviour, the demand reduced significantly while maintaining uninterrupted 24×7 supply.

Methodology: The conversion of the Lakamanahalli DMA from an intermittent to a continuous (24×7) water supply system was carried out in a phased manner to ensure hydraulic stability, effective pressure management, and controlled consumer demand. Rather than introducing continuous supply immediately, the commissioning process was designed to gradually stabilize the distribution network while continuously monitoring system performance.

Phase I – Initial Commissioning

The DMA was divided into **six sub-DMAs** to facilitate controlled commissioning. Initially, water was supplied to two sub-DMAs at a time according to the following schedule:

- 6:00 AM – 8:00 AM: Sub-DMA 1 & Sub-DMA 2
- 8:00 AM – 10:00 AM: Sub-DMA 3 & Sub-DMA 4
- 10:00 AM – 12:00 Noon: Sub-DMA 5 & Sub-DMA 6

This operating cycle was maintained for 10 days. During this period, the average daily water consumption within the DMA was approximately 1.9 MLD, which was considerably higher than the estimated design demand. The increased consumption was attributed to the filling of household underground and overhead storage tanks, consumer storage practices developed during intermittent supply, and the identification of hidden leakages under continuous pressurized conditions.

Throughout this phase, bulk flow, reservoir levels, and network pressures were continuously monitored using the SCADA system. Pressure loggers installed at critical locations were used to optimize valve operations and regulate the distribution pressure. The system was adjusted to maintain a minimum residual pressure of approximately 7 m head at both the highest elevation point and the hydraulically farthest end of the DMA, ensuring equitable water distribution throughout the network.

Phase II – Expansion of Supply Zones

After achieving satisfactory hydraulic stability during the first phase, the supply arrangement was modified by operating three sub-DMAs simultaneously. The revised supply schedule was:

- 6:00 AM – 9:00 AM: Sub-DMA 1, Sub-DMA 2 & Sub-DMA 3
- 9:00 AM – 12:00 Noon: Sub-DMA 4, Sub-DMA 5 & Sub-DMA 6

This operating pattern was also maintained for 10 days. Continuous monitoring of flow rates, pressures, and reservoir levels was carried out to verify network performance and identify any operational issues. During this period, the daily water consumption reduced from approximately 1.9 MLD to 1.4 MLD, indicating stabilization of consumer demand as household storage tanks became regularly replenished and leakage control measures became effective.

Phase III – Transition to Continuous Supply

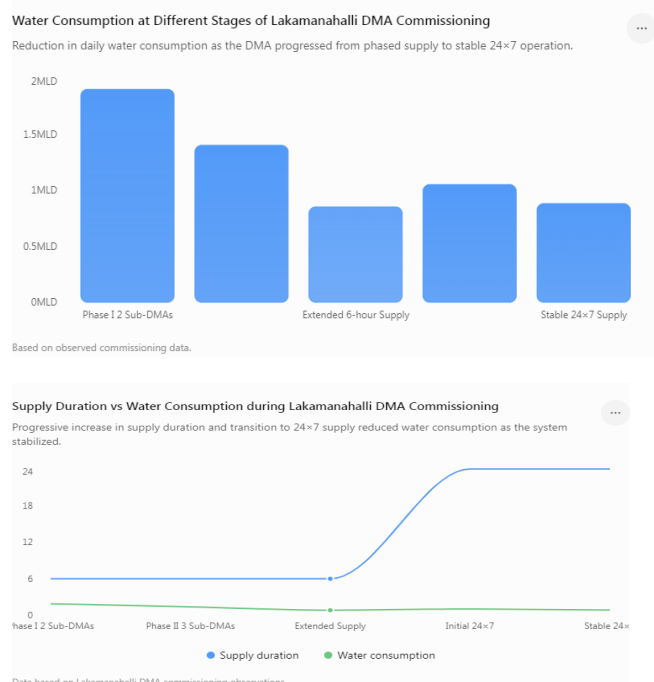
Once consumer underground and overhead storage tanks were consistently filled through daily supply, the overall demand within the DMA reduced further to approximately 0.85 MLD. The supply duration was then gradually extended from the scheduled supply periods to 6 hours, while maintaining continuous pressure monitoring and system surveillance.

Following successful stabilization under the extended supply duration, the DMA was converted to continuous (24×7) water supply. Immediately after commissioning, the observed daily water consumption ranged between 1.0 and 1.1 MLD, primarily due to the final balancing of consumer storage and system stabilization.

After several weeks of continuous operation, consumer demand stabilized, leakage repairs were completed, and the distribution network achieved steady hydraulic conditions. The present average water consumption within the Lakamanahalli DMA varies between 0.85 and 0.9 MLD, while maintaining uninterrupted 24×7 water supply with adequate pressure throughout the network.

This phased commissioning methodology demonstrates that gradual expansion of supply duration, combined with continuous monitoring of flow and pressure, effective pressure management, and systematic leakage reduction, is an effective approach for converting an intermittent water supply system into a stable and sustainable continuous water supply system.

Supply Duration vs Water Consumption during Lakamanahalli DMA Commissioning



Interpretation

- **Phase I (2 Sub-DMAs):** Daily consumption was approximately 1.9 MLD, primarily due to filling of consumer storage tanks and hidden leakages.
- **Phase II (3 Sub-DMAs):** Consumption reduced to 1.4 MLD after pressure optimization and leakage repairs.
- **Extended Supply:** Consumer storage stabilized, reducing demand to 0.85 MLD.
- **Initial 24×7 Supply:** Consumption temporarily increased to about 1.05 MLD as consumers adapted to continuous supply.
- **Stable 24×7 Operation:** The DMA stabilized with an average daily consumption of 0.85–0.90 MLD, while maintaining uninterrupted supply and adequate pressure.

Conclusion: The successful conversion of the Lakamanahalli District Metered Area (DMA) from an intermittent water supply system to a continuous (24×7) pressurized supply demonstrates that a systematic, phased commissioning approach is essential for achieving a stable and sustainable distribution network. The study confirms that continuous water supply cannot be established merely by increasing the duration of supply; instead, it requires careful hydraulic management, continuous monitoring, pressure optimization, and active leakage control.

The phased commissioning strategy, involving the division of the DMA into six sub-DMAs and gradual expansion of the supply regime, enabled controlled stabilization of the network while minimizing operational risks. Continuous monitoring of flow, reservoir levels, and network pressures through SCADA, combined with pressure loggers installed at critical locations, facilitated real time operational decisions and ensured equitable pressure distribution throughout the DMA. Maintaining a minimum residual pressure of approximately 7 m at both the highest elevation and the hydraulically farthest consumer ensured reliable service across the entire network.

During the initial stages of commissioning, the observed water consumption reached approximately 1.9 MLD, nearly twice the estimated demand, primarily due to the filling of household storage tanks and the presence of hidden network leakages. Systematic leakage detection and repair, pressure management, network validation, and gradual stabilization of consumer storage practices resulted in a significant reduction in water demand. Following the transition to continuous supply, the system stabilized with an average daily consumption of 0.85–0.90 MLD, corresponding to approximately 135 LPCD, while maintaining uninterrupted 24×7 water supply.

Overall, the conversion resulted in a treated water saving of nearly 0.9 MLD per day, representing a reduction of approximately 50% from the initial commissioning demand. These results demonstrate that the benefits of continuous water supply extend beyond improved customer service to

include substantial water conservation, reduced operational losses, improved hydraulic performance, and enhanced distribution efficiency.

The Lakamanahalli DMA serves as a practical model for utilities planning the transition from intermittent to continuous water supply. The methodology adopted in this study including phased commissioning, RTU based monitoring, pressure management, active leakage control, and continuous performance evaluation provides a replicable framework for achieving sustainable 24×7 water supply in urban distribution networks. The findings emphasize that effective DMA management is a critical component in reducing non-revenue water, optimizing treated water utilization, and ensuring long-term resilience of urban water supply systems.

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