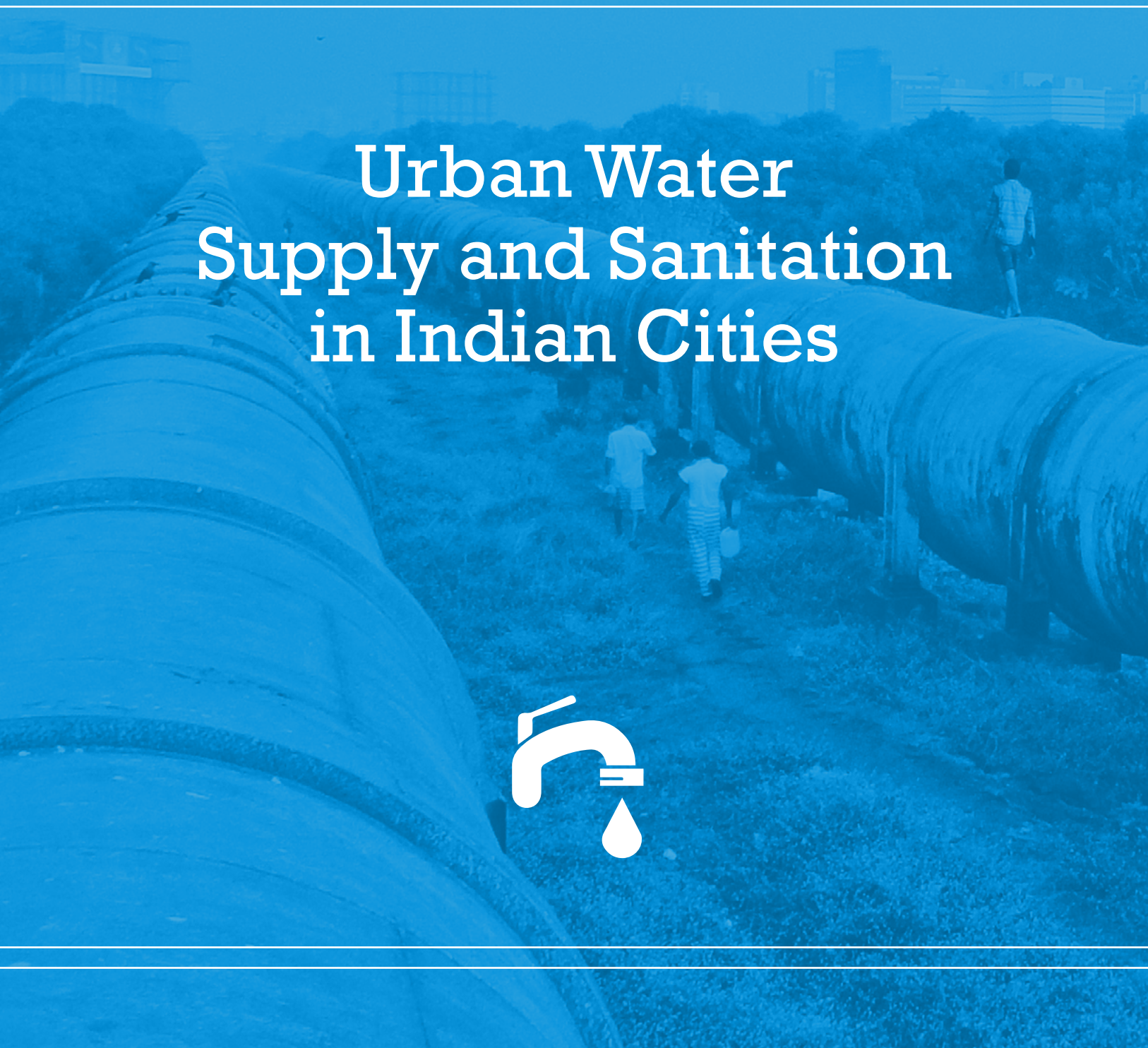
PEARL
Peer Experience and Reflective Learning

COMPENDIUM OF GOOD PRACTICES

Urban Water Supply and Sanitation in Indian Cities



GOVERNANCE AND INSTITUTIONAL STRENGTHENING

INFORMATION AND EFFICIENCY IMPROVEMENT

ENVIRONMENT SUSTAINABILITY AND TECHNOLOGY USE

CITIZEN PARTICIPATION AND CUSTOMER SERVICE

FINANCIAL SUSTAINABILITY

PEARL

Peer Experience and Reflective Learning

an initiative of

National Institute of Urban Affairs

First Published 2015

COMPENDIUM OF GOOD PRACTICES

Urban Water Supply and Sanitation in Indian Cities

National Institute of Urban Affairs

Prepared by

ICRA Management Consulting Service Limited

PREFACE

The National Institute of Urban Affairs is the National Coordinator for the PEARL Initiative (Peer Experience and Reflective Learning). The PEARL program ensures capacity building through cross learning and effective sharing of knowledge related to planning, implementation, governance and sustainability of urban reforms and infrastructure projects – amongst cities that were supported under the JNNURM scheme.

The PEARL initiative provides a platform for deliberation and knowledge exchange for Indian cities and towns as well as professionals working in the urban domain. Sharing of good practices is one of the most important means of knowledge exchange and numerous innovative projects are available for reference on the PEARL website. "Knowledge Support for PEARL" is a program supported by Cities Alliance that aims to qualitatively advance this initiative. One of its key components is to carry out a thematic and detailed documentation of good practices in various thematic areas related to planning, governance and service delivery.

In an effort to fill the critical knowledge gaps for efficient service delivery in Indian cities, a number of exemplarygood practices from cities across the country have been compiled into five thematic volumes. Each volume addresses a specific issue such as water supply & sanitation, urban transportation, solid waste management, cultural heritage and urban reforms. Cases are examined from the perspective of increasing operational efficiency, enhancing systemic capacity, the creation of efficient public private partnerships and building long-term sustainability.

The present volume focuses on the theme of 'Urban Water Supply and Sanitation' (WATSAN) to include planning, practices, projects and innovations in improving the quality and efficiency of water supply and treatment of waste water in Indian cities. The documentation is not confined to duration and coverage of water supply but includes aspects of quality of water; recycling; cost recovery and efficiency in collection of water taxes. It also looks at initiatives in sustainable treatment of waste water and strives to study examples of people's participation in these projects for overall enhancement of services and quality of life.

We hope that this volume can become a useful resource for the practitioners and officials who will provide momentum to the project of improvedwater-supply and sanitation in India.

Jagan Shah
January 2015

ACKNOWLEDGEMENTS

The compendium of good practices titled "Urban Water Supply and Sanitation in Indian Cities'' is an outcome of a collective contribution of several individuals as well as institutions. NIUA would like to acknowledge their contribution to the extent possible.

Firstly, we wish to sincerely thank the Cities Alliance and World Bank whose grant support and knowledge partnership for PEARL has made the documentation possible at a time when urban infrastructure is one of the main agendas of the Government of India.

We would like to thank ICRA Management Consulting Services Limited (IMaCS) for undertaking this documentation and their team comprising of Anand Madhavan, Abhilash Verma, Mahesh Harhare, Preeti Mahapatra and S. M. Sundararajan who have completed this activity successfully. NIUA acknowledges their valuable contribution.

We are grateful to all the Peer Review Group members Marie Helene Zerah, Nitya Jacob, Dr. J.V. Murthy, Vandana Bhatnagar and Prof Usha Raghupati, whose valuable inputs through the entire duration of the documentation have only enriched its content.

NIUA duly acknowledges all who supported and contributed in providing valuable information which has helped compile the document specially the members of local authorities, consultants and other relevant stakeholders. Sharing project details and information with IMaCS in their busy schedule is appreciated.

The report would not have been complete without the coordination and editorial support of the PEARL Team comprising of Shabana Charaniya, A. Nanda Kishore, Yogita Lokhande, ShilpiMadnawat, Shoma Mathew, Sridipta Ghatak; and Deep Pahwa and Kavita Rawat for designing and formatting the compendium.

Finally, a special thanks to Ajay Suri, Regional Adviser-Asia, Cities Alliance and Prof. Jagan Shah, Director NIUA for their support, guidance and inputs. We have all been enriched by the experiences gained in this process and sincerely hope that the report will contribute towards strengthening water supply and sanitation services in India in cities.

Dr. Debjani Ghosh
Project Coordinator

LIST OF ABBREVIATIONS

BWSSB	Bangalore Water Supply and Sewerage Board
CLTS	Community-led Total Sanitation
CMT	Community Managed Toilets
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSP	City Sanitation Plan
DMA	District Metering Area
DPR	Detailed Project Report
GIS	Geographic Information System
ICT	Information and Communications Technology
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
lpcd	Litre Per Capita per Day
MCJ	Municipal Corporation of Jalandhar
MLD	Million Litres per Day
mm	Millimetre
MoU	Memorandum of Understanding
MoUD	Ministry of Urban Development
NESL	Nagpur Environmental Services Limited
NGO	Non- Government Organisation
NIUA	National Institute of Urban Affairs
NMC	Nagpur Municipal Corporation
NRCP	National River Conservation Plan
NRW	Non-Revenue Water
NUSP	National Urban Sanitation Policy
NWMC	Nanded Waghala City Municipal Corporation
O&M	Operation and Maintenance
ODF	Open Defecation Free
PCMC	Pimpri Chinchwad Municipal Corporation
PEARL	Peer Experience and Reflective Learning
PPP	Public Private Partnership
PRG	Peer Review Group
PWSSB	Punjab Water Supply and Sewerage Board
SCADA	Supervisory Control And Data Acquisition
SHG	Self Help Group
SLB	Service Level Benchmark
SMC	Surat Municipal Corporation
SoP	Standard Operating Procedure
SPV	Special Purpose Vehicle
ToR	Terms of Reference
TWAD	Tamil Nadu Water Supply and Drainage Board
UFW	Unaccounted For Water
UGD	Under Ground Drainage
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Town
ULB	Urban Local Body
WSP	Water and Sanitation Programme
WTP	Water Treatment Plant

CONTENTS

EXECUTIVE SUMMARY

The Compendium on 'Good Practices in Water Supply and Sanitation in Indian cities' seeks to showcase select good practices across a variety of sub-themes in the water and sanitation sector. The objective of this Compendium is to draw insights on underlying success factors and contextual nuances in these cases and to distil possible lessons and insights for wider adoption/replication across cities in India.

In order to ensure that the Compendium reflects the diversity and multi-dimensional nature of issues confronting India's urban water and sanitation sector, the projects/initiatives were categorised under five themes. These five categories include: **(a) Governance and Institutional strengthening, (b) Information management and efficiency improvement, (c) Environment sustainability and technology adoption, (d) Community participation and citizen service and (e) Financial sustainability.**

The Compendium details ten case studies under each of these five categories, with the first case as a detailed case (D) and the second one a snapshot case (S). A brief description of each of these themes and a short abstract of the cases profiled in the Compendium are provided below:

THEME I GOVERNANCE AND INSTITUTIONAL ASPECTS

Projects selected under this category involved improvements in governance and institutional structure with a focus on organisation and modes of service delivery.

Nagpur- City-wide Public-Private Partnership for water supply

This case profiles the initiative of Nagpur Municipal Corporation (NMC) to implement a 25-year Public-Private Partnership (PPP) project for provision of continuous water supply on a city-wide scale. It offers vital lessons and insights for other cities seeking ways to transform their water supply service delivery by emphasising the need for holistic planning and an integrated set of actions for implementing city-scale PPPs and highlights the need for institutional clarity, balanced contractual arrangements, political/administrative commitment, rigorous stakeholder engagement and consumer communication processes, and provides some insights for sequencing of tariff reform.

Surat - Formation of a Non-Revenue Water (NRW) cell

One of the pioneering initiatives of the Surat Municipal Corporation (SMC) was the setting up of an NRW cell as an institutional response for tackling non-revenue water. This case elaborates the activities and positive outcomes for creating accountability and early enthusiasm leading to the tangible results of leakage mapping exercise carried out by NRW cell of SMC. Following the initial leakage mapping exercise, the number of leakages was reduced by 30% annually in all zones.

THEME II INFORMATION MANAGEMENT AND EFFICIENCY IMPROVEMENT

Cases under this category focus on improvements in capture, analysis and dissemination of information.

Pimpri - Chinchwad - SLB connect pilot

The case traces the implementation of a pilot project under the SLB Connect program in Pimpri-Chinchwad Municipal Corporation (PCMC) in collaboration with Water Sanitation Program (WSP), World Bank. The SLB connect pilot at PCMC provides a window into the possibilities of addressing the challenge of citizen engagement through use of ICT tools, provides a very replicable approach to effective citizen engagement and demonstrates that effective engagement can be achieved by leveraging the relatively high mobile tele-densities in Indian cities and use of the same to support both data collection and information dissemination.

Bangalore - Bulk metering with intelligent operating system

While some of the Indian water utilities have implemented stand-alone monitoring of systems through facility level SCADA systems, initiatives to implement mechanisms for system wide control, analysis and monitoring have been limited. The case discusses the initiative of the Bangalore Water Supply and Sewerage Board (BWSSB) for implementing two related initiatives namely installation of bulk meters and development of a software application to capture and track information from these bulk meters for monitoring and regulating the water supply system.

THEME III ENVIRONMENT SUSTAINABILITY AND TECHNOLOGY ADOPTION

Under this category, initiatives focusing on water/energy conservation and resource preservation (including pollution control) were profiled. Additionally, initiatives that involved some elements of technology upgradation have also been captured:

Pimpri-Chinchwad - Helium-based Leak detection pilot

For the Pimpri Chinchwad Municipal Corporation (PCMC), leakages and technical losses in its distribution system were

a major constraint in shifting to continuous supply. With technical support from Suez Environment India Limited, PCMC initiated a pilot project in 2012 for a helium gas based leak detection program which identified 132 leaks in the 20 km pilot study. The leak detection program enabled PCMC to take a structured approach to address service delivery improvements in the pilot zone and demonstrate the potential for positive impacts when technology and use of external expertise are combined with a systematic and structured plan with clear objectives.

Jalandhar – Sewerage project

The Municipal Corporation of Jalandhar (MCJ) and Punjab Water Supply and Sewerage Board (PWSSB) implemented a sewerage project with funding under the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT). This case profiled the first phase of Jalandhar's sewerage system implemented under UIDSSMT which resulted in the provision of 13,000 sewerage connections covering a population of 100,000 with safe sanitation and sewerage coverage and resultant implications of reduction in pollution load.

THEME IV CITIZEN PARTICIPATION AND CUSTOMER SERVICE

Cases documented under this category cover initiatives focusing on community participation and citizen facilitation enabling a greater role of citizens in either participative governance or better tackling of citizen grievances or both:

Trichy – Community managed toilet complexes

Tiruchirappalli Municipal Corporation's (TMC) focus on leveraging support of Self-Help Groups (SHG) to build local ownership and involve local community in addressing the challenge of universal sanitation coverage is noteworthy. The case documents the successful transformation of 213 slums out of a total of 285 slums into Open Defecation free slums in its efforts to meet its goal of becoming Open defecation free by 2015.

Nanded – Community-led Total Sanitation

Following the City Sanitation Plan, Nanded-Waghala Municipal Corporation (NWMC) with poor sanitation facilities and over 20% of its population resorting to open defecation, initiated a Community-led Total Sanitation (CLTS) project that sought to put communities in charge and accountable for the process and use their capacity to improve the status of sanitation. With a spending of less than 1% of its budget on sanitation, NWMC managed to achieve fairly positive impacts through its community led approach.

THEME V: FINANCIAL SUSTAINABILITY

Under this category, initiatives that facilitated financial sustainability, cost recovery, and rationalisation of user charges have been profiled.

Pallavaram – Sewerage project with user financing

Despite being a rapidly growing town, Pallavaram did not have a sewerage system and depended on 25,000 septic tanks. 7% of households were resorting to open defecation. Lack of a proper sewerage network, resulted in discharge of sewerage into open drains, unhygienic environmental conditions and breeding of mosquitoes. Pallavaram municipality implemented sewerage system with connection deposits from users (upto 30% of the projects costs) as part of the project's financing mix and fixation of user charges to meet 100% O&M cost recovery. The experience at Pallavaram in Tamil Nadu suggests that user financing is indeed a replicable idea for expanding waste-water treatment.

Nagpur – Energy Audit Project for Water Supply

Energy cost for 2004-05 accounted for nearly 50% of Nagpur Municipal Corporation's (NMC) O&M cost of water supply and provided the trigger for NMC to initiate a study on potential for energy savings. Post the audit, actions undertaken and implemented led to considerable energy cost savings, estimated at Rs. 2.8 lakh per day (at 2010 prices). NMC's experience shows that with a structured approach, specific investment funding and implementation of improvement actions in a time-bound manner helps achieve tangible savings.

The cases featured in the Compendium confirm that with a combination of continued policy commitment, strong institutional support, focus on financial sustainability, appropriate technology and community engagement, Indian cities can exhibit substantial improvements in service delivery for water and sanitation infrastructure and achieve positive impacts in relatively shorter periods of time. This central message emerging from the cases profiled in this Compendium should enthuse stakeholders in Indian cities in their quest and efforts towards achieving universal water supply and sanitation service delivery.

CHAPTER 1

INTRODUCTION

BACKGROUND

Compendium of good practices in Urban Water and Sanitation

Urban Water and Sanitation is identified as a key theme under the Knowledge Support Network initiative of the Cities Alliance support to the PEARL platform given the extensive investment focus and commitments to urban water and sanitation under programs of Government of India, several State governments including those that are being implemented with support from external funding agencies.

This **Compendium on 'Good practices in Water supply and Sanitation projects in Indian cities'** seeks to showcase select good practices from Indian cities across a variety of sub-themes in the water and sanitation sector. The objective of this Compendium is to draw insights on underlying success factors and contextual nuances in these cases and to distil possible lessons and insights for wider adoption/replication across cities in India.

APPROACH AND METHODOLOGY

The approach to preparation of this Compendium involved three steps as described below:

Step 1: Compilation of projects inventory under different themes

To start with a comprehensive inventory of projects in water and sanitation reflecting potential good practices were compiled through secondary research involving literature/web-based research on projects and initiatives from ULBs across the country supported under various schemes of Government of India, State Governments and under multi-lateral/bilateral programs.

In order to ensure that the Compendium reflected the diversity and multi-dimensional nature of issues confronting India's urban water and sanitation sector, the projects/initiatives were categorised under five themes to ensure that the cases profiled in the Compendium reflects the multi-faceted nature of improvement initiatives required to improve service delivery in the sector. These five themes included the following: **(a) Governance and Institutional strengthening, (b) Information management and efficiency improvement, (c) Environment sustainability and technology adoption, (d) Community participation and citizen service and (e) Financial sustainability.**

A brief overview of each of these themes and the list of projects initially shortlisted under each of these is enclosed in *Annexure I.*

Step 2: Shortlisting, fact-finding, analysis and documentation

From the inventory of over 100 project initiatives identified in Step 1, ten projects/initiatives (covering one detailed case and one snapshot case from each of the categories) were shortlisted through a consultative process involving NIUA and PRG for study, analysis and documentation for the Compendium. The shortlisting was also preceded by preliminary interactions with ULB officials and select stakeholders were also undertaken at this stage to confirm prima facie suitability of these cases vis-à-vis the objectives of the Compendium.

Following this, the study team reached out and engaged with respective ULBs to undertake detailed study, analysis and documentation of these cases. The fact-finding covered field visits and interviews with key stakeholders including select city and state level officials, users, private organisations involved. Refer *Annexure II* for a list of people met during the course of preparation of this Compendium.

Step 3: Finalisation and dissemination

The analysis dimensions and documentation structure of the cases and the Compendium has been finalised iteratively in consultations with NIUA and PRG. The Compendium will be presented at a workshop to be organised by NIUA and will also be disseminated through the PEARL platform.

LIMITATIONS

The Compendium has been prepared based on information provided by ULBs, state officials, and other stakeholders met during the course of the study phase complemented by analysis of information available in the public domain. Further in some cases which have been initiated recently and where the final outcomes are yet to be fully realised, the commentary is based on an assessment of the likely impacts on completion based on interaction with stakeholders.

The Compendium also recognises that in evolving urban water and sanitation sector that continues to be constrained by institutional, operational and financial challenges, labelling and showcasing practices as 'good' is fraught with sustainability and timing risks. It is recognised that these 'good practices' will need continued nurture and support beyond the period in which these have been studied. Some of these cases could also become common place or get replaced by other 'better' practices. This limitation is, to some extent, encapsulated in the labelling

of Compendium as 'Good practices' rather than 'Best practices'.

Nevertheless, the cases featured in this Compendium confirm that with a combination of policy commitment, institutional support, focus on financial sustainability and citizen involvement, Indian cities can indeed leapfrog on water and sanitation service delivery and achieve positive impacts in relatively shorter periods of time. This is a central message that this Compendium seeks to reinforce among Indian cities and their stakeholders.

STRUCTURE OF THIS COMPENDIUM

This Compendium is organised along three sections:

I **About the Compendium** discusses the background and objectives of this Compendium. It also discusses the approach for preparing this Compendium.

II **Sector Overview** sets out the macro context and discusses key facets of urban water and sanitation sector in India.

III **Good practices** (organised under chapters 3-12) detail ten case studies under five categories as summarised below with two cases under each theme; the first case as a detailed case (D) and the second one as a snapshot case (S). A brief description of each of these categories and a short abstract of the final two cases selected for profiling as part of this Compendium are given below:

- **Category I - Governance and Institutional aspects:** Projects selected under this category involve improvements in governance and institutional structure with focus on organisation and modes of service delivery. Two cases have been selected for profiling under this theme:
  (D) Nagpur - City-scale Public-Private Partnership for water supply: As one of the first cities to adopt a PPP model for city-wide water supply, Nagpur seeks to scale-up positive outcomes from an earlier pilot project. Notwithstanding teething challenges, this project holds lessons for cities seeking to adopt PPPs in water service delivery.
  (S) Surat - Formation of a Non-Revenue Water (NRW) cell: Building on its success in expanding water supply access in recent years, Surat seeks to accord sharper focus on network efficiency and water losses. Early success of its NRW cell in leak detection and repairs holds promise


McKay Savage

and highlights the importance of institutional support and strengthening to move from 'asset creation', 'access provision' to 'efficient service delivery'.

- **Category II - Information management and efficiency improvement:** Cases under this category focus on improvements in capture, analysis and dissemination of information:
  (D) Pimpri- Chinchwad - SLB connect pilot: This case captures the efforts of Pimpri-Chinchwad Municipal Corporation in developing a bottom-up approach to capture, disseminate and use citizen feedback to improve service delivery vis-à-vis the Service Level Benchmarks set by MoUD.
  (S) Bangalore - Bulk metering with intelligent operating system: This case discusses an initiative by Bangalore Water Supply and Sewerage Board to install and access information from bulk meters through an intelligent operating system to monitor and manage bulk supply.

- **Category III - Environment sustainability and technology** adoption: Under this category, initiatives focused on water/energy conservation and resource preservation (including pollution control) were profiled. In addition, initiatives that involved some element of technology upgradation have also been captured under this category:
  (D) Pimpri-Chinchwad - Helium-based Leak detection pilot: This case profile is a successful outcome of a pilot leak-detection project that involved use of helium-gas injection to identify and arrest invisible leaks.
  (S) Jalandhar - Sewerage project: This case captures insights from Jalandhar's efforts to address environmental sustainability while adopting a relatively higher-end treatment technology in implementing its sewerage project while leveraging capital grant support from Central and State governments.

- **Category IV - Citizen Participation and customer service:** Cases profiled under this category covered initiatives focused on community participation and citizen facilitation. Focus was therefore on initiatives that either enabled greater role of citizens in either participative governance or better tackling of citizen grievances or both:
  (D) Trichy - Community managed toilet complexes: This case traces the efforts of Trichy Municipal Corporation to eliminate open defecation in its slums through involvement of local agencies and citizen participation
  (S) Nanded - Community-led Total Sanitation: This case discusses impacts of adoption of the Community-led Total Sanitation (CLTS) by Nanded-Waghala Municipal Corporation.

- **Category V - Financial Sustainability:** Under this category, initiatives that facilitated financial sustainability, cost recovery, and rationalisation of user charges have been profiled:
  (D) Pallavaram Sewerage project: This case captures efforts of Pallavaram municipality in Tamil Nadu to squarely address financial sustainability aspects of developing and managing its sewerage network.
  (S) Nagpur - Energy Audit Project for Water Supply: This case traces the learnings and potential impacts from the energy audit project implemented by Nagpur Municipal Corporation.

CHAPTER 2

SECTOR OVERVIEW

INDIA'S URBAN WATER AND SANITATION SECTOR: A BRIEF OVERVIEW

URBANISATION CONTEXT IN INDIA

India is set to urbanise rapidly. India's urban population[1] that grew at 32% outpaced rural population growth (12%) during 2001-11. The period between Census 2001-11 also marked an important inflection point; for the first time since independence, incremental urban population during this period was higher than incremental rural population. The share of urban population at 31% during Census 2011 could potentially cross 40%[2] by 2030 with over 200 million getting added to urban population during this period. Refer Exhibit 2.1 for urbanisation trends in the last few decades.

Many of India's large states including Maharashtra, Gujarat and Tamil Nadu have urbanisation levels of over 40% which are tipped to cross 50% before 2020. While larger cities will drive much of this growth (India's million-plus cities are expected to go up from 42 in 1991 to 68 by 2030), the growth of small urban units suggests a wider urbanisation trend beyond major metros. During 2001-11, Census Towns (defined as 'urban' areas other than statutory cities/towns) went up from 1392 to 3894.

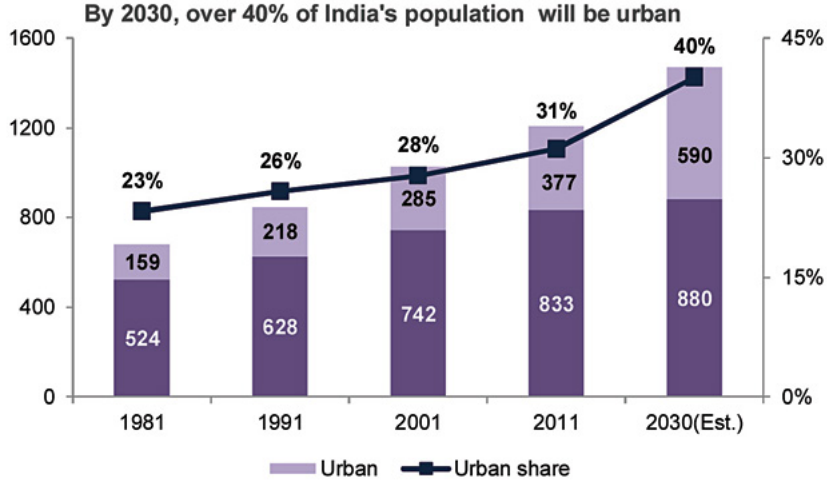
While urbanisation is generally a positive given its strong correlation with economic prosperity, India's urbanisation has been constrained by a combination of inadequate policy focus on cities, weak local governments, inadequate investments and widening gaps in service delivery. Urban water supply and sanitation, the subject of this Compendium, is a critical component of urban service delivery and provision of universally affordable and equitable access to water and sanitation is central to making India's cities liveable.

This chapter provides a review of India's urban water and sanitation scenario, identifies some of the challenges faced, traces recent initiatives and outlines select imperatives for improved service delivery in future.

WATER AND SANITATION CONTEXT IN INDIAN CITIES

Under the Constitution of India, water is a State subject, with the legislative jurisdiction of Central Government largely limited to inter-state river waters. While the intervention of Government

EXHIBIT 2.1: **INDIA'S URBANISATION TRENDS**



Source: Census 2011. Secondary research. IMaCS analysis

[1] Census 2011
[2] Report of the High Powered Expert Committee (HPEC) on Urbanization.Government of India. 2011

of India in water regulation is thus limited, the importance of national regulation in water has been recognised in certain areas. Thus, with regard to water pollution, Parliament adopted the Water Act in 1974, which seeks to prevent and control water pollution and maintain/ restore the wholesomeness of water.

The Draft National Water Policy 2012 recently articulated the need for a National Framework Water Law. While recognising that States indeed have the right to frame suitable policies, laws and regulations on water under the Constitution, it nevertheless argues that an over-arching national legal framework of general principles will pave the way for essential legislation on water governance in every State and effective devolution of authority to lower tiers of government.

Although amendments to the Constitution of India in 1992 regarding Municipalities introduced water and sanitation as functions to be devolved by State Governments to Urban Local Bodies, this transition is incomplete and implementation is still at work-in-progress stage. In most states, the State Governments continue to hold responsibility over urban water supply and sanitation through state-level departments and parastatal agencies. Even in states, where the urban water and sanitation function has technically been transferred to ULBs, ULBs are often inadequately equipped in terms of financial and organisational capacity. They tend to depend on State-level departments and agencies for financing and execution of capital projects and their role is often limited to handling operations and maintenance. As a result, accountability for urban water and sanitation continues to be diffused across multiple tiers of Government. A renewed focus on implementation of several policy and institutional reforms is therefore a critical element in transforming India's water sector.

Urban water supply: status and challenges

As per Census 2011, over 71.2% of India's urban households had access to drinking water within their premises; up from 65.4% during Census 2001. Another 20.7% households had a water source within 100 m of their premises. Over 8% of India's urban households need to move beyond 100 m from their premises to access drinking water; this has come down only marginally from the levels of 9.4% of households during Census 2001 and is a cause for concern.

Even as basic access eludes about 8% of urban population, a bigger challenge has been in making access to urban water supply consistent, equitable and sustainable. The HPEC report points out that inadequate coverage, intermittent supplies, low pressure, and poor quality are prominent features of water supply in the cities of India. A vicious circle is at play; high commercial and physical losses in the distribution network compounded by unwillingness to charge and collect user fees, often results in water utilities unable to improve service levels. Water utilities in India typically recover only a third of their operations and maintenance (O&M) cost, which is lower than peer Asian city counterparts.

It is in this context that some of the cases showcased in this Compendium hold promise. They reinforce the view that with sharp institutional focus and commitment, urban water supply systems can indeed be transformed in a relatively shorter period of time. Nagpur is attempting to scale up positive results from delivering 24x7 supply in a demonstration zone, to the entire city. The efforts of Bangalore, Pimpri-Chinchwad and Surat towards improvements in efficiency and information management are a welcome shift from asset creation towards a greater focus on service delivery improved efficiencies.

Urban sanitation: status and challenges

A City Sanitation Ranking study (2010) conducted by MoUD found that none of 423 cities covered were found to be 'healthy' and 'clean'. While Chandigarh, Mysore, Surat and New Delhi were the only four ULBs that fared relatively better, nearly 190 cities were rated to be in a state of emergency with respect to public health and the environment.

Urban India has still not been able to eliminate the scourge of open defecation; at Census 2011, over 12.6% of urban households resorted to open defecation. While this is a sharp reduction from the 18% at Census 2001, concerted efforts on a war-footing are required to eliminate open defecation all-together. As articulated in the National Urban Sanitation Policy (NUSP), achieving totally sanitised cities requires going beyond building toilets towards adopting holistic city-wide and community-led approaches. The relative successes of Trichy and Nanded in combating open defecation through city-wide community-led efforts reaffirm this philosophy and hold insights for rest of urban India.

Less than a third of the domestic waste-water undergoes any form of treatment. Pollution impacts and loss of fresh water owing to pollution is an area of serious concern. The NUSP reiterates the need for a combination of city-level sewerage systems complemented with onsite systems and effective septage management in smaller cities and in unserved areas to effectively address this situation.

In recent years, capital funding from Government of India's Jawaharlal Nehru National Urban Renewal Mission (JnNURM), State-level initiatives and funding from multi-lateral / bi-lateral programs have helped a number of cities to expand their sewerage systems. However, the inability to deal with financing O&M has raised serious questions over long-term sustainability of some of these projects. The use of connection deposits, loans, tax earmarking and user charges in Tirunelveli's sewerage system (an approach adopted initially in Alandur in the mid-1990s and replicated in over 25 ULBs in Tamil Nadu) suggests that with policy commitment, effective project appraisals and citizen involvement, long-term sustainability of sewerage systems can be achieved.

RECENT INITIATIVES IN URBAN WATER AND SANITATION

National-level

- **Jawaharlal Nehru National Urban Renewal Mission (JnNURM):** In 2005, the Government of India launched the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) and its allied Programme, the Urban Infrastructure Development Scheme for Small and Medium Towns

(UIDSSMT) to provide reform-linked grants for urban infrastructure with an outlay of Rs. 54,000 crore. As of March 2014, over 319 water and sewerage projects were sanctioned under JnNURM with an outlay of Rs. 39078 crore and another 753 water and sewerage projects were sanctioned under UIDSSMT with an outlay of Rs. 22662 crore. Achieving 100% O&M cost recovery in water and sewerage services and transfer of water management function to local bodies are mandatory reforms to be implemented by participating cities under the mission program.

- **Service Level Benchmarking:** The Ministry of Urban Development (MoUD), Government of India has launched the Service Level Benchmarking (SLB) initiative covering water, sanitation, solid waste management and storm water drainage. A Handbook on Service Level Benchmarking has been released by MoUD to identify a minimum set of standard performance parameters, to define a common minimum framework for monitoring and reporting and to set out guidelines on how to operationalize this framework in a phased manner. To encourage and facilitate adoption of the SLB framework outlined in the Handbook, the MoUD launched an SLB Pilot Initiative in February 2009 in 28 pilot cities. As a follow up to the Workshop, cities developed Plans, which identified specific actions to be taken along with targets for expected service levels consequent to their implementation. Since then a number of states and cities have adopted these SLB framework to facilitate a planned approach to undertake improvements in performance and service delivery.
- **National Urban Sanitation Policy:** In 2008, Ministry of Urban Development, Government of India (MoUD) launched the National Urban Sanitation Policy (NUSP) with an aspirational vision for Indian cities – 'All Indian cities and towns become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women'. To support implementation of this vision, the NUSP envisaged formulation of City Sanitation Plan (CSP) at a city level as a comprehensive document that would detail short, medium and long term plans for governance, technical, financial, capacity building, awareness and pro-poor actions to ensure 100% access to safe sanitation. As a follow up to the NUSP, the Government of India initiated a periodic rating of cities by independent agencies on a range of sanitation indicators. A National Annual Award has also been instituted on the basis of this rating.

Select state-level initiatives

A few notable initiatives undertaken in the area of urban water and sanitation in some of more urbanised large states in the country are summarised below:

- **KARNATAKA:** The Government of Karnataka (GoK) formulated the Karnataka Urban Drinking Water and Sanitation Policy 2002, which articulated the need for full cost recovery of services, volumetric pricing and gradual private sector participation (PSP) in service delivery. With assistance from World Bank, GoK launched the Karnataka Urban Water Supply Improvement Project (KUWASIP) in 2007 under which 24x7 pilot projects were successfully implemented in three cities, namely Hubli-Dharwad, Belgaum and Gulbarga. Preparatory work and Bidding for up scaling these projects is currently underway.
- **MAHARASHTRA:** Maharashtra has several programmatic initiatives in water supply and sanitation to its credit. The 'Sant Gadge Baba Abhiyan Urban Sanitation Campaign' implemented since 2002-03 grades ULBs in the state based on factors including elimination of open defecation, supply of drinking water, waste water & solid waste management and enhancement of public health. The 'Sujal Nirmal Maharashtra Abhiyan' launched in 2010 seeks to enable universal access to water supply and sanitation services through a systematic technical, managerial and financial assistance program. The Maharashtra Suvarna Jayanti Nagarotthan MahaAbhiyan provides urban infrastructure to all `D' Class Municipal Corporations, Municipal Councils and Nagar Panchayats in water supply, sewerage and solid waste management.
- **GUJARAT:** The Government of Gujarat announced year 2005 as the Urban Year as a part of 'Vibrant Gujarat' program and launched 'a comprehensive and holistic urban governance vision', coinciding with the launch of JnNURM. In 2007, the 'Nirmal Gujarat Campaign' was launched to renew focus on urban environment, particularly sanitation and to develop city-level plans for water and sanitation. The Swarnim Jayanti Mukhya Mantri Shehari Vikas Yojana (SJMMSVY) launched in 2009 seeks to dove-tail earlier efforts with an explicit focus on administrative and governance reforms to improve sustainability of urban investments.
- **TAMIL NADU:** Tamil Nadu was the first state to create an institutional mechanism to provide access to loans on a non-guaranteed mode to Urban Local Bodies through creation of the Tamil Nadu Urban Development Fund (TNUDF) in 1996 under which it has enabled access to water supply and sewerage systems in a financially sustainable manner. The State has accessed low cost long-term lines of credit from development agencies including World Bank, KFW and JICA to implement water supply and sewerage systems in its cities in a programmatic manner. Tamil Nadu's Vision 2023 launched in 2012 envisions universal access to continuous 24x7 water supply and 100% waste-water management systems in all its urban areas by 2023.

IMPERATIVES GOING FORWARD

Fixing the challenges faced in urban water and sanitation will require a massive step-up in investment. The HPEC report[3] estimates that over the next 20 years, Rs. 3.20 lakh crore would be required in urban water supply and another Rs. 2.44 lakh crore would be required in waste-water management. Given that Local

[3] Report of the High Powered Expert Committee (HPEC) on Urbanization. Government of India. 2011

Government revenues are negligible, this will require substantial step-up in public funding from State and National Governments in the short-medium term. The HPEC calls for stepping up Government of India funding on urban infrastructure to 0.25% of GDP annually.

A closed loop approach with a concerted focus not only on urban water supply, but also waste-water management and sanitation is critical. Cities should be supported to prepare and implement actions to achieve the HPEC's recommended norms of '100 per cent piped water, 24x7 flow, and 135 LPCD consumption per capita' for water supply and 'Underground sewerage with 100 per cent collection and treatment of waste water' along with the Service Level Benchmarks outlined by MoUD in a time-bound manner. Waste-water reuse should be a critical focus area.

As service delivery improves, it is critical to step up efforts towards financial sustainability. Stepping up reforms including creation of a state-level regulatory framework is necessary to address financial visibility and discipline. States should empower ULBs to introduce transparent clear and periodic revision of taxes and user charges while taking care of the downtrodden through targeted subsidy framework can go a long way in improving financial sustainability of urban water and sanitation systems. This will enable stronger local government finances and create a positive spiral to enable further improvements in service delivery.

Finally, 'fixing the institutions that fix the pipes' is an oft-repeated cliché but one that requires serious commitment and efforts at the level of State Governments in particular. States will need to plan and implement transition arrangements to enable a smooth transfer of urban water supply and sanitation function in letter and spirit to empowered and autonomous Local Governments, while re-defining, restructuring and clarifying roles of parastatals / state-level departments that may need to continue to play a role. Further, implementation of critical governance and administrative reforms (including ring-fencing of finances and accrual accounting, creation of a capable Human resources cadre, building rigor in project development, streamlining procurement processes and making them transparent, creating effective monitoring and evaluation processes, adopting city-wide e-governance systems and relevant technology interfaces, strengthening citizen engagement and public disclosure systems) are equally critical to make universal equitable and affordable access to water and sanitation in our cities a reality.

Hockadilly

CATEGORY I

GOVERNANCE AND INSTITUTIONAL STRENGTHENING

In case of water and sanitation facilities within ULBs, institutional capacity of ULBs both in terms of management of facilities and provision of improved service delivery is very important. Many cities have multiple agencies involved in service delivery where inter-agency coordination and ownership tend to be diffused.

To address some of these issues, many ULBs have taken up initiatives to improve institutional capacity, service delivery and bringing more accountability. For instance, a PPP model is being adopted by Nagpur Municipal Corporation to manage city water supply system on a long-term contract while Surat Municipal Corporation focused on addressing the major issue of NRW in a phase wise manner by creating a separate NRW cell. These kinds of projects or initiatives, which can be replicated by other cities, are taken up as case studies.

The projects identified under this category include areas related to institutional structuring/ development such as formation of a separate cell for management of services, formation of a separate company, SPV or Board which involve participation of private entity for investment, management or operation of the system and for improvement of overall service delivery. Illustrative projects that come under this category are given in Exhibit 1.

A brief project profile was prepared based on secondary research and in consultation with respective ULBs/ utilities wherever feasible. Based on feedback and inputs from PRG members, priority projects were identified from inventory of cases considering various aspects and then shortlisting of two projects done keeping in mind following criteria,

- Status of projects and likely availability of data/ information with ULBs.
- Key takeaways or learning from the project, which can be replicated elsewhere.
- Projects or initiatives which are already covered or published in earlier case studies or compendiums were not considered, wherever possible.

Based on above criteria, two projects were shortlisted which are given below,

- **Nagpur water supply PPP project** - SPV Model: Management of city wide water supply system was handed over to private operator on performance based long term contract. Here, ULB and the private operator to ensure more accountability form a SPV.
- **Surat NRW Cell** – NRW, a key issue faced by most of the ULBs in India, is conventionally addressed in a piece meal approach. NRW reduction is a long term and continuous process upon which SMC has taken up an initiative to institutionalise this process by formation of NRW cell. The Cell will identify various interventions including technical and management related to tackle this in phase wise manner.

S.No.	Project Name	Location (city)	Year initiated
1	Operation and Maintenance of water supply system through O&M contracts	Navi Mumbai	2011
2	Desalination Plant at Kattupalli Village, Minjur	Chennai	2010
3	24X7 Urban Water Supply in Hubli-Dharwad and Gulbarga	Hubli-Dharwad-Gulbarga	2009
4	Tirupur Water Supply and Sewerage PPP Project	Tirupur	2005
5	Salt Lake City Water Supply and Sewerage PPP Project	Kolkata	2010
6	Haldia Water Supply PPP Project	Haldia	2008
7	Nagpur Water Supply PPP Project- SPV model	Nagpur	2013
9	Surat NRW Cell	Surat	2010

Source: JnNURM, IMaCS Research

NAGPUR: PPP IN CITY-WIDE WATER SUPPLY

Case abstract

This case profiles the initiative of Nagpur Municipal Corporation (NMC) to implement a 25-year Public-Private Partnership (PPP) project for provision of continuous water supply on a city-wide scale. The Project, among the first few initiatives in India to attempt continuous water supply on a city-wide scale, seeks to build on positive experience from a demonstration pilot to provide 24x7 water supply to 15,000 connections in the Dharampeth zone of the city.

The case discusses pre-cursor actions leading up to the Project, reviews the salient features of the PPP agreement and traces its progress and current status. It summarises positive outcomes achieved, challenges faced, and distils lessons for other Indian cities that are considering use of PPPs for provision of reliable and continuous water supply.

City profile

About Nagpur city

Nagpur, located in the Vidarbha region of Maharashtra is among India's fast growing cities. It is an important political/administrative centre and hosts the State Assembly's winter sessions. It is home to several Government agencies and Research institutions including the National Environmental Engineering and Research Institute (NEERI) and is a centre for Maintenance Command of Indian Air Force. Nagpur is also a hub of industrial activity in the Vidarbha region. While Butibori is the largest industrial estate in its vicinity (located 25-30 km from Nagpur city), other industrial areas around Nagpur include Kamptee, Hingna, Wadi, Khapri and Kalmeshwar. The Government of Maharashtra (GoM) has also initiated efforts to develop the existing airport at Nagpur as a Multimodal International Hub Airport at Nagpur (MIHAN) along with creation of a Special Economic Zone (SEZ) and allied facilities. MIHAN is being developed as a multi-dimensional, multidisciplinary project of global standards.

About Nagpur Municipal Corporation

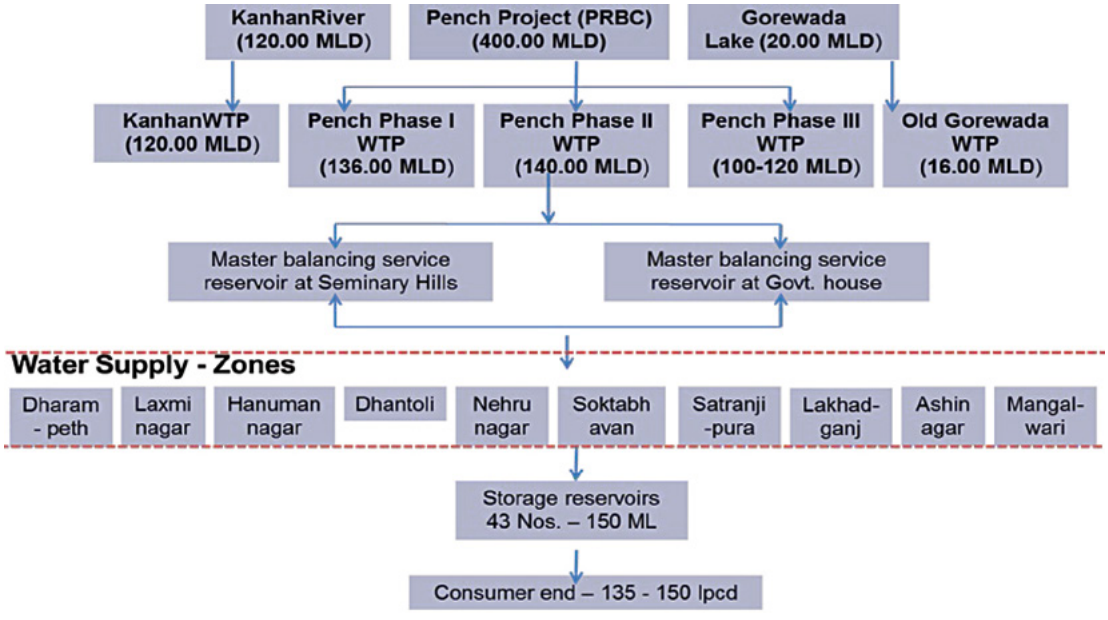
Nagpur Municipal Corporation (NMC) is mandated with provision of civic services in Nagpur city. At the time of Census 2011, NMC had a population of 2.46 million, spread over an area of 218 sq.km, (average population density of 113 persons per hectare). Of this, about 8.6 lakh people (or 34% of population) live in slums. A slum-mapping exercise undertaken by NMC in 2010-11 identified 447 slums, 287 of which were notified slums while the rest were non-notified slums.

Water supply scenario prior to Project

Water supply system in Nagpur

Water supply service delivery in Nagpur city is the responsibility

EXHIBIT 3.1 **NMC – WATER VALUE CHAIN**



Source: Draft CSP & NMC

EXHIBIT 3.2: **FINDINGS OF WATER AUDIT (2005)**

<table>
<tr><td rowspan="4">System Input Volume
625 MLD</td><td rowspan="2">Authorised Consumptions (Billed + Unbilled)
263 MLD</td><td>Billed consumption
241 MLD</td><td>Revenue Water
241 MLD</td></tr>
<tr><td>Unbilled consumption
22 MLD</td><td rowspan="3">Non-Revenue Water
384 MLD</td></tr>
<tr><td rowspan="2">Water Losses
362 MLD</td><td>Apparent losses
214 MLD</td></tr>
<tr><td>Real Losses
148 MLD</td></tr>
<tr><td colspan="3">Unidentified Losses
43 MLD</td></tr>
</table>

Source: NMC Detailed Project Report for 24x7 supply

of NMC. Even prior to the Project, NMC had piped water supply access to over 80% of its citizens. Supply was intermittent with an average duration of 4 hours (ranging from 2 hours in some areas to 12 hours in others). Thus NMC was doing relatively better vis-à-vis several Indian cities on access and duration of supply indicators. Refer Exhibit 3.1 for a snapshot of Nagpur city water supply system.

NMC gets its water supply from three surface sources namely Pench canal, Kanhan river and Gorewada Tank, with the treatment capacity of Water Treatment Plants (WTPs) at approximately 500-530 Million Litres per Day (MLD).

Water from these WTPs flow into two master balancing reservoirs at Seminary Hills and at the Government House, from where it is supplied through a distribution network of approximately 2,100 km organised across three areas namely, (a) parts of North/East/South supplied from Kanhan Head Works/WTP, (b) parts of North/West/South/Central areas from Pench and from Gorewada and(c) parts of North/Central parts from Pench and Kanhan.

The distribution network is also organised along ten zones for efficient Operations and Maintenance (O&M). The storage capacity in the 43 service reservoirs (spread across 31 locations in the city) is 151 Million Litres (ML) which translated to about 29% of daily supply.

Pench III augmentation project and water audit findings

In March 2003, NMC had completed commissioning of the Pench III project (involving increase in raw water pumping capacity, construction of Water treatment facilities, water mains, 14 Elevated service reservoirs and distribution network) which augmented bulk water supply capacity by 120 MLD. Even though input volume of treated water into NMC's water supply system went up by nearly 32% post this project (from 370 MLD to 490 MLD), billed output volume remained static at 240 MLD.

Dissatisfaction among stakeholders including citizens and elected representatives went up post commissioning of Pench-III when actual water supply to their door-step did not improve despite the bulk infrastructure being in place. The output of Pench III was not translating to increase in effective supply or into revenues for NMC. This dissatisfaction and inability to supply reflected in the financials. Water billings actually dipped from Rs. 73 crore to Rs. 71 crore between 2002-03 and 2003-04, even as receipts marginally went up from Rs. 4.5 crore to Rs. 5 crore during this period.

Earlier in 2000, the Government of Maharashtra had appointed the Sukthankar committee to review efficiency of urban water supply systems, following which the Government of Maharashtra provided 75% funding to cities for undertaking water audits. NMC was among the first cities to undertake a water audit under this initiative. This brought to light the excessive losses in its water supply and identified areas for improvement.

NMC's water audit assessed its Non-Revenue Water (NRW) at a high 62%. (Refer Exhibit 3.2) Of the 625 MLD of raw water available to NMC, only 241 MLD was assessed as billed authorised consumption. Real losses (on account of technical and network losses) accounted for an estimated 148 MLD (39% of NRW) and apparent losses / unbilled consumption account for 226 MLD or (61% of NRW).

Apart from helping in assessing the extent of water losses, the water audit also identified specific areas for improvement and NRW reduction. It facilitated NMC in taking a structured response in three steps; firstly, NMC initiated a series of performance improvement measures to tackle 'real' or technical losses, secondly it initiated a pilot project to demonstrate reduction of NRW and improve supply standards from intermittent to continuous water supply and finally, it sought to use the experience from the pilot project to scale-up 24x7 supply on a city-wide scale.

Measures to augment water availability and reduce technical losses

NMC undertook a series of measures to reduce losses in its water intake and sources. The water audit observed that of the 625 MLD that was made available to NMC, it was losing 120-140 MLD in the canals from where it was drawing the water owing to seepage, illegal use and evaporation losses. NMC since then initiated a project with funding under JnNURM to replace canal supply with pipelines. Further, it has undertaken a project to

increase treatment capacity at Kanhan from 120 MLD to 240 MLD. As a result of these initiatives, treatment capacity is expected to increase to 765 MLD sufficient to meet water demand till 2021, without additional investments in new source development. Further, these initiatives are expected to bring down effective cost of raw water by 75%.

PPP initiatives in water supply

NMC had experience of using private participation in several areas of its water supply system. Since 1999, all new facilities that were implemented by NMC in water supply including WTPs, pumping stations, valve operation etc., were being managed through Service Contracts. A couple of facility projects including the Pench I WTP and Kanhan improvement project are being done on a Built-Operate-Transfer format with private investment accounting for 30% of Project Cost. While the Pench I WTP was built with a 5-year O&M period, the Kanhan system involved a 15-year O&M period.

Thus, when NMC initiated a pilot project for continuous water supply in the Dharampeth zone, it had some experience in structuring and managing PPPs in water supply, although these were in the nature of service contracts and bulk facility PPPs.

Pilot project for 24x7 supply

While NMC initiated several upstream projects to improve its water supply system, it became clear from the findings of the water audit that a perceptible improvement in service delivery required tackling last-mile challenges relating to inequitable and intermittent supply, inconsistent water supply pressure and high NRW. As a first step to address this challenge, NMC initiated a pilot project in the Dharampeth zone in 2007. The project covered 15,000 connections (including 10 slum areas) and covered implementation of continuous water supply, 100% metering, rehabilitation of tertiary network, hydraulic modelling, installation of new billing and customer management system.

The project was implemented through a 7-year Performance Management Contract and was sequenced with 9 months preparatory work, 15 months for rehabilitation and 60 months of O&M at a cost of Rs. 27 crore. The Operator was contracted on a Performance-fee model with bonuses built in with respect to five Key Performance Indicators (KPIs) namely (i) Reduction in Unaccounted for Water level to below 30%, (ii) 10% increase in volume billed over 2007-08 baseline, (iii) 24x7 supply with pressure higher than 2 m. (iv) Water quality with residual chlorine greater than 2 ppm and (v) handling of customer complaints within three days.

At the request of NMC, the Administrative Staff College of India (ASCI) had carried out a post-impact assessment of the pilot project and reported the following outcomes:

- Over 7,500 connections were converted to continuous water supply. The entire zone experienced improved pressures, eliminating the need for booster pumps deployed by households earlier.
- Coverage improved with an incremental 5000 connections being given in slum households in the zone (although all these connections did not receive continuous supply).
- Billed water volume increased from 22 MLD to 33 MLD in the zone (an increase of 50%) although part of this increase was attributed to leakages at the customer end.
- NRW reduced from 50% to 38% and was attributed to reduction in illegal connections and improved accuracy of meter reading.

Further, it made the following observations on challenges and shortcomings of the pilot project:

- Stakeholder communication could have been handled better. Consumers were not adequately informed of the need to fix internal leakages when they transitioned to metered supply resulting in higher billed volumes. A tariff hike along with such billed volumes led to spikes in billing (in some cases, billings went up by two to three times) and caused disquiet among citizens. This triggered protests from citizens' organisations.
- Continuous 24x7 supply was achieved only in 7500 connections or 50% of total connections. While this was partly due to challenges in addressing last-mile connection within consumer premises and non-replacement of pipelines in 70% of network, this became an additional sore point that was highlighted by consumer organisations in their protests.

Eventually, NMC was forced to back down from its intended tariff reforms. Yielding to protests, NMC rolled back tariffs from Rs. 8 per KL (as revised in 2009) to Rs. 5 per KL and capped user charges at 50 units of supply, till such time a detailed assessment of metering was not completed.

The Project: PPP for City-wide water supply

Project rationale and preparatory activities

Notwithstanding challenges discussed above in the pilot project, the Dharampeth pilot project did provide evidence for improvement in service delivery with single-point accountability for last-mile distribution revamp. Interestingly, an independent assessment undertaken among urban poor living in slum areas in the pilot zone revealed that 80% of those surveyed favoured implementation of the project city-wide. Even though the corresponding figure for general public (56%) was relatively muted, a majority were still in favour of expansion of the pilot project. While early PPP efforts of NMC which involved outsourcing facilities on service contracts to multiple players, the pilot project demonstrated tangible benefits of a performance-led PPP and helped align political and administrative support in NMC in favour of a single city-wide PPP contract.

Thus in 2008, encouraged by early results from the pilot project, the General Body of NMC passed a resolution for implementing 24x7 water supply city-wide. Following this NMC appointed a Project Management Consultant to take the process forward. A Detailed Project Report for city wide 24x7 supply along on a PPP format was prepared by NMC's consultants and obtained approval for funding support for the Project under JnNURM in early 2009.

Around this time, the Government of Maharashtra also

approved an earlier proposal from NMC's General Body to ring-fence water supply assets of NMC (managed under its water works department since 1936) and transfer of water supply functions under a separate company, namely, the Nagpur Environmental Services Limited (NESL) as a wholly owned subsidiary of NMC. The Board of NESL comprises select elected representatives and officials of NMC. In April 2009, the municipal byelaws for water supply were revised to include a provision for annual tariff revision upto 5% to be taken by Commissioner without having to be approved by General Body and the provision to pass on the raw water charges and electricity charges to customers separately.

The bid process for inducting a Private Operator was initiated with a Request for Qualification (RFQ) in 2008. Three of the ten applicants were shortlisted following an evaluation of responses to the RFQ. Efforts were made to keep the bidding process transparent. Meetings were held with citizens, local organisations and elected officials. The draft RFP was made available on NMC's website and extensive efforts to reach out to stakeholders were undertaken during the Bid process. However, as in the case of the pilot project, pockets of opposition continued during the course of the bidding process.

Post formation of NESL and securing approvals for Request for Proposal (RFP) from NMC's General Body, bids were invited in 2010 from the three shortlisted consortiums namely, Veolia-Vishvaraj consortium, IVRCL-Aqualia, and Cascal-Nagarjuna Construction. The evaluation involved an assessment of technical proposals followed by a series of meetings with bidders to seek clarifications or amendments. The bidder with the lowest evaluated bid (which is the Operator Rate in Rs. per cubic metre of water billed and collected), consistent with technical and financial requirements was awarded the contract. At the end of the evaluation process, the consortium comprising Veolia India and Vishvaraj Infrastructure Ltd. was declared the winning bidder. A Special Purpose Vehicle was set up by Veolia-Vishvaraj consortium called 'Orange City Water Private Limited' (OCWPL). A tri-party agreement was signed in June 2011, among OCWPL, NMC and NESL for executing the Project.

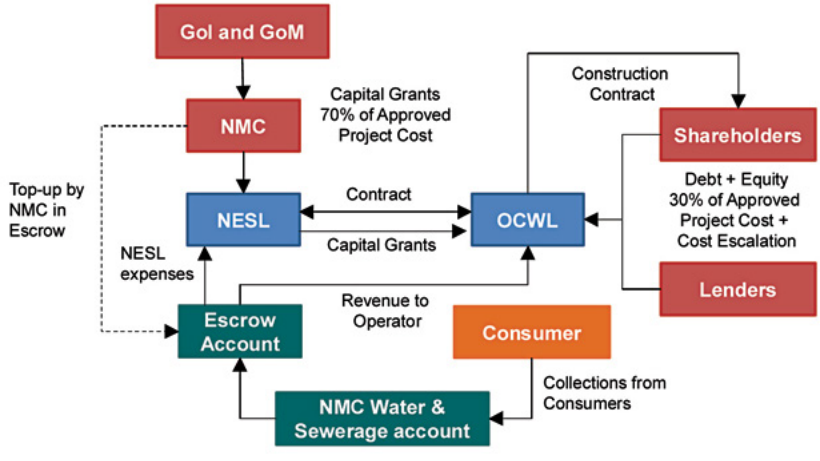
Bidding effectiveness hinges on achieving the oft-delicate balance between stringent pre-qualification and competition. Of the three applicants that got shortlisted, only two bids were received and the final bid price of Rs. 7.90 per KL was only marginally lower than the base price set.

Features of the PPP agreement

Refer Exhibit 3.3 for an overview of the PPP structure of Nagpur city wide 24x7 water supply project. The scope of project and salient features of the agreement are discussed below.

- **Term, Transition Period and Project Scope:** The Project is being implemented through a 25-year Management Contract (extendable by mutual agreement for another 25 years) between NESL, NMC and OCWPL. The Term included first 5-years as Transition Period during which OCWPL is responsible for operating and maintaining the existing network and have to undertake rehabilitation of the network (including replacement of consumer connections and metering). Post the Transition Period, the operator will carry out O&M of the water supply system for next 20 years during which the revenue and collection risk is also loaded on to the Operator. During this period, operator's performance will be monitored against a set of performance parameters and the remuneration is based on metered volume that is billed and collected.
- **Financing of Initial Performance Improvement project:** The Initial Performance Improvement program is envisaged to be completed with funding under JnNURM within the 5-year transition period. The approved project cost of the DPR for this program was Rs. 387.86 crore and 70% of this will be brought in by NMC through grants from Government of India and Government of Maharashtra. The remaining funds (30% of the approved project along with escalation over the initial estimate) are to be brought in by OCWPL. The rehabilitation program is to be implemented through a Bill-of-Quantities

EXHIBIT 3.3: **NAGPUR CITY WIDE WATER SUPPLY: PPP STRUCTURE**



Source: NMC PPP contract and IMaCS analysis

EXHIBIT 3.4 **PERFORMANCE TARGETS SPECIFIED IN THE CONTRACT**

Performance Indicator	Target as per Contract
Technical Aspects	
Treatment Efficiency (%) (Volume delivered/Volume produced)	97.5%
Water Quality	
Bacteriological conformity (%)	96%
Conformity to physical / chemical parameters (%)	95%
Quality of service	
Incidental interruption for repairs > 12 h (%)	100
Operational Efficiency (Volume billed/Volume supplied)	60% progressively by 60th month Achieve 75% by 120th month, maintain
Bills based on metered consumption	100%
Financial	
On-time payment of NMC dues	100%
Collection Rate (Effective collection /billings)	75% progressively by 60th month 98% by 120th month and maintain

Source: PPP contract agreement between NESL and OCWL

item rate contract. The Contract allowed for revisions to the approved project cost to address any additional elements to meet performance standards subject to NESL's approval and cost escalations on the basis of a Bill-of-quantities contract. The incremental capital cost (over and above the 30% of approved Project Cost) incurred by OCWPL was to be compensated through an increase in his base Operator Rate to ensure a fixed Project IRR of 14.5% for OCWPL.

- **Staffing:** Employees of NMC's water works department were deputed to OCWPL at the start of the contract for three phases covering (i) Mobilisation Period of 120 days, (ii) Personnel Integration Period of 90 days, (iii) Change Consolidation Phase of 180 days and (iv) Revocation Period of 60 days. The costs of NMC employees thus deputed would be borne by OCWPL. At the end of the Change consolidation period, NMC's employees may choose to join OCWPL and Operator can make offers to NMC employees who wish to join. At the end of the Revocation period, NMC employees not joining OCWPL would revert back to NMC and will be redeployed in other departments of NMC. OCWPL will need to mobilise staff replacements during this period.
- **Revenue model:** The Operator will need time to understand the existing system and do rehabilitation of various components. Therefore, during the Transition period, the Operator is compensated on the basis of Operator Rate (in Rs. Per KL) for a fixed volume of 250 MLD or actual metered volume billed and collected by Operator on behalf of NMC whichever is higher. Thus there is a minimum guaranteed offtake and hence assured revenue during this period. After the Transition Period, the revenue payable to the Operator will be compensated on the basis of the escalated Bid Tariff on the basis of actual metered volumes that are billed and collected.
- **Performance standards, linkages with Operator payments and maximum liability:** The Operator is expected to complete the Initial Performance Improvement Program and achieve continuous water supply during the Transition period. During this period, Contract does not specify intermediate performance standards. From the fifth year of contract, there are specific deductions from Operator's remuneration for excess raw water consumption and excess electricity charges vis-à-vis norms specified. From the sixth year, revenue and collection risk is also loaded on to the Operator as his remuneration is based on metered volume that is billed and collected. Refer Exhibit 3.4 for a list of other performance targets specified in the contract. While there are no specific penalties or incentives against performance indicators other than for operational efficiency, collection efficiency, raw water and electricity charges, the contract allows levy of liquidated damages for performance non-compliance, which is capped at 5% of annual Operator revenue.
- **Operator's Rate adjustments:** The Contract provides for three kinds of rate adjustments; (i) Standard Rate adjustment, which is done annually based on CPI and WPI to provide for changes in price inflation, (ii) Rate rebasement, done once in 5 years systematically to put the Operator at the same financial health as per his bid and to ensure a fixed Project IRR of 14.5% for OCWPL, and (iii) Extraordinary rate rebasement-

Even though the operating risks are borne by the Operator, the Extraordinary Rate Adjustment clause allows for the rate adjustment against unforeseen events such as amendments to Operator obligations, Change in Law, availability of grant financing for NESL, changes in Business plan, increase in Operator's cost due to delay / overruns, failure of NESL to supply water, non-insurable Force Majeure events and additional capital expenditure by Operator. This is to put the Operator at the same financial health as per his bid.

- **Escrow mechanism and Payment Security:** Two escrow accounts are maintained – (i) Escrow account-1 (Sewage and Water Fund) - parties to this escrow account are NMC, NESL and Escrow Bank, and (ii) Escrow account-2: parties to this escrow account are NESL, OCWPL and Escrow Bank. All the revenue collected from customers as well as the capital grant from NMC passes through Escrow Account-1 and then to Escrow Account-2 before it is paid to OCWPL. Three months reserve fund is maintained in this Escrow Account-2. NMC is also responsible for provision of raw water (from irrigation department) and electricity (from MSEDCL) as both the service providers are committed to subsidise the services to public utility.

The PPP Agreement addresses bankability concerns effectively through several features: a realistic 5-year transition period, minimum off-take, annual indexation of Operator rate, Re-basing for extraordinary events, capital grant support and escrow mechanism for payment security. However, with a relatively high capital grant support, minimum off-take and guaranteed revenues during the Transition Period, incentives for capital investment efficiency appear somewhat limited.

There has also been some criticism in several quarters, that the performance requirements could have been more stringent. The relatively long transition period of 5 years, trajectory of NRW reduction targets, non-inclusion of penalties for 24x7 supply, non-inclusion of intermediate milestones and performance targets during Transition period, have been questioned in several forums. Yet, given the information baseline limitations, legacy challenges in rehabilitation and replacement of internal plumbing in existing water connections, low baseline tariffs and challenges of cost recovery etc., it seems that NMC took a considered view in favour of conservative yet impactful targets to avoid the 'set-up to fail' syndrome that has plagued water supply PPPs with unrealistic targets in the past. Notwithstanding this limitation, Operator's revenues after the Transition Period are indeed contingent on actual water delivery at doorstep, collection efficiency and norms on raw water use and energy consumption, which if achieved will be path-breaking outcomes on their own.

Project progress and current status

The Project commenced in March 2012 and is in the middle of the Transition period of the Contract. OCWPL has taken over the water supply system and is currently in the process of implementing the Initial Rehabilitation and Improvement Program. The rehabilitation is being sequenced along command areas of Elevated Service Reservoirs and capital works for the same have been contracted out. NMC also has a Project Management Consultant to monitor and report on the implementation progress.

Interactions with NMC reveal that the improvement program is progressing as per the timeline. As of August 2014, physical progress of nearly 50% has been achieved with over 400 km out of 539 km of pipeline replacement having been completed. Following the positive experience from its pilot project, NMC is using HDPE pipes in the network in view of favourable costs and hydraulic properties. However, there have been delays in provision of house service connections. As against a target of 321,000 connections, only about 61,000 connections have been completed. The delay was due to protests against imposition of connection charges and delay in certain infrastructure works not in scope of OCWPL.

NMC has attempted to overcome some of these issues. In July 2014, as a means to enlist public support to get the rehabilitation program moving, NMC passed a resolution waiving connection charges for all connections. This is also expected to help bring erstwhile unauthorised connections (close to 100,000 unauthorised connections have been identified during the rehabilitation phase till July 2014) into the consumer database and this will help in reducing commercial losses and improving NMC's revenues. The service delivery related issues are also being tacked through infrastructure augmentation and increase in capacity of Elevated Service Reservoirs.

OCWPL has also set up a round-the-clock call centre with a toll-free number to address consumer grievances. Bill payments are currently managed through zone-level kiosks set up by OCWPL and through Bank of Maharashtra. OCWPL plans to launch a web portal for information dissemination and billings in the next few months. Discussions with OCWPL reveal that it has also initiated efforts to update and clean up the consumer connections database. Till July 2014, it has identified and submitted for NMC's approval and regularisation, close to 100,000 incremental unauthorised connections which when regularised and added could potentially add to NMC's revenues.

NMC has revised their bye-laws to make a provision of revision of water tariff annually by 5%. On staffing, it is understood that most of the NMC staff deployed to OCWPL have been transferred back and are getting re-deployed in other departments within NMC. As of July 2014, of the 495 employees that were in NMC's water works department and deputed to OCWPL, OCWPL has 66 employees and NESL has 70 employees. Rest of the employees have been transferred back to NMC.

Challenges ahead

Notwithstanding the progress made, the Project continues to face a number of challenges:

- The foremost challenge relates to continued stakeholder engagement and communication to build trust and credibility. Pockets of opposition to the project have continued from time of the demonstration pilot. A project of this nature calls for pro-active stakeholder engagement, awareness creation and building bridges with all concerned. While NMC and

OCWPL will need to continue to address this aspect, building positive behavioural disposition will require delivering on service improvements expeditiously.

- NMC will need to find ways to deal with sequencing and moving forward on tariff reforms. Though NMC took a positive step towards revising the tariff at 5% per annum as per its Byelaws (post 2009), it has to carry it forward with its tariff increases.
- Replacement of consumer connections and addressing last-mile and internal plumbing issues will need to be tackled head-on as these aspects are critical to consistently deliver 24x7 supply. Inadequate customer awareness and spike in billings following implementation of 24x7 supply during the pilot project did contribute to negative vibes for the project. Therefore, it is critical that lessons learnt in this process are adequately factored during the rehabilitation program. NMC's recent decision to waive connection charges could potentially help with this and in monetising erstwhile unauthorised connections.
- Given that the initial Improvement program started in 2012, two years after the DPR was approved under JnNURM, it is likely that there could be an escalation in costs of the Initial Improvement Program. While NESL is vested with the responsibility of contract supervision and management, it may be important for NESL to ensure that formal mechanisms and build in capabilities for contract monitoring and information dissemination not just during the Transition Period but also throughout the duration of the Contract.

Lessons learnt and insights for replication

Most urban water supply systems in India continue to be stuck in a vicious circle of poor service quality-low tariffs-weak investment capacity. While conceptually, PPPs could help ULBs break this vicious circle by separating monitoring and regulation from service provision and bringing in technical and managerial know-how, structuring and implementation challenges have often led to sub-optimal outcomes. While a few pilot scale projects notably in Karnataka and in Nagpur have managed to make an impact, Nagpur is probably among the first few city-scale PPP taking shape. Therefore, even in its early days of implementation, this Project offers vital lessons and insights for other cities seeking ways to transform their water supply service delivery including the following:

- **Implementation of city-scale PPPs will need holistic planning and integrated set of actions.** The genesis of this Project can get traced back to NMC's water audit which highlighted the need for focus on customer-end distribution infrastructure. Even as NMC continued to invest in bulk supply augmentation, the results of the water audit triggered NMC taking concrete actions for reducing NRW and for delivering water to the consumer's doorstep in a consistent reliable manner. As is documented earlier, the PPP project was not a one-off effort. On hindsight, it does seem that the city wide PPP was only a logical step in the series of actions that NMC had set sights on, and articulated post its water audit. Cities would be well-advised to not see PPPs as a panacea to their ills, but as a strategic lever to leapfrog on performance even as they fix other elements of the water value chain.
- **Institutional clarity on the public side helps; needs to be backed with building adequate contract monitoring and administration capacity:** Anchoring the PPP contract in an SPV of NMC provided a good institutional basis for contract management. NMC went an extra step and ring-fenced its water assets under NESL prior to executing the PPP structure. At the same time, PPPs are complex agreements with changes that could happen during the course of the contract. NMC's PPP agreement builds in some flexibility by providing for tariff re-basing and for partly expanding scope using the Bidders IRR as a benchmark. However, administering complex contracts requires a very high level of maturity and capability on the ULB side and it is critical that these capabilities are build as cities move towards implementing PPPs.
- **Political and administrative commitment is critical; so is wider stakeholder engagement and achieving consumer support.** Notwithstanding several challenges and protests from various quarters at various stages, there needs to be reasonable policy continuity and commitment for the Project within NMC right from the stages of the pilot, during the preparatory phases and in the implementation phase currently. Notwithstanding efforts take by NMC, protests and opposition to the project in some form has persisted. A coherent and strategic approach to communication,to inform and engage stakeholders, is critical for sustained broad-based positive support for successful implementation.
- **Sequencing tariff reform:** Average water tariffs in urban India continue to be low relative to costs, even as affordability concerns often constrain meaningful progress on user charge led cost recovery. Even though, NMC's early efforts to raise tariffs have been thwarted by protests, it has had the cushion of other revenue streams and resources to support the project in early stages to achieve improvements in service delivery, which can hopefully provide it the flexibility with tariff revision in future. The case suggests that it would be difficult to sequence tariff rationalisation upfront and cities attempting to structure PPPs will therefore need to find alternative resources at least in the early stages.

SURAT: FORMATION OF AN NRW CELL

SNAPSHOT

Case abstract

Though reduction in Non-Revenue Water is among the key imperatives for water utilities, ULBs in India have seldom been able to tackle this challenge adequately. The lack of appropriate institutional focus towards this subject has often been considered a key reason underlying this situation.

Surat Municipal Corporation (SMC) is considered among the better municipal corporations in India and has won several awards under the National Urban Awards program instituted by Government of India to recognise excellence in urban service delivery. Leveraging support under JnNURM and from Government of Gujarat, SMC has successfully extended coverage of water supply into recently added areas too. Notwithstanding these achievements, SMC had made limited progress on measuring and tackling Non-Revenue Water and to bring about sharper focus on this subject, SMC set up an NRW cell as an institutional response.

This case discusses the objectives of this NRW cell and traces the outcomes of the leakage mapping exercise carried out by this Cell. Building on this experience, the case seeks to identify some pointers for strengthening institutional mechanisms to tackle cross-cutting aspects like NRW reduction.

City profile

Surat is the second largest city in Gujarat state in terms of population and area and is known as the commercial capital of Gujarat. The city is famous for its diamond and textile industry. The city which set about tackling civic services post a plague epidemic in 1994 now ranks among the top cities in the country in terms of performance on urban services. Incidentally, it ranked third among Indian cities under the National Sanitation Rating survey conducted following the launch of the National Urban Sanitation Policy. Surat Municipal Corporation is spread over 326 sq.km and had a population of 4.4 million at the time of Census 2011. It continues to be among India's fastest growing cities in the country, with a decadal growth rate of 83% during 2001-11 and with its population having grown ten-fold in the last four decades.

Water supply scenario in Surat

SMC manages the water supply and sewerage system of Surat city. River Tapi is the major source of water supply and the city has a piped water supply network since 1898. Over the decades, the city has invested in its water supply system to cater to its growing populace. SMC's gross average daily water supply is about 980 MLD translating to a per capita supply of about 147 LPCD. Five water works at Varachha, Sarthana, Katargam, Rander and Kosadhave a treatment capacity of 1300 MLD.

SMC has 7 distribution zones, viz. Western, Eastern, Central, North, South, Southeast and Southwest with 17 water distribution stations, four pumping stations and a distribution network of over 3000 km. Though piped water supply coverage dipped from 98% to 57% following city expansion from 106 sq.km to 326 sq.km in 2006, Surat has since then implemented a new water supply Master Plan by 2015, under which it expects to cover the entire city and meet water demand up to year 2041. At present, 94% of SMC's population is covered with piped water supply and by 2015, Surat expects to achieve its goal of universal coverage of water supply in areas within its jurisdiction.

Drivers for creation of an NRW cell

Under the SLB framework, SMC has reported NRW at 20.4%. But in the absence of volumetric metering at consumer level and critical points in the water supply system, SMC's reported NRW scores a 'D' with respect to reliability levels under the SLB framework, suggesting that this is a serious cause for concern.

Even in 2006 and 2007, before SMC's expansion was fully in place, SMC continued to receive frequent complaints (9,644 complaints in 2006 and 9,903 complaints in 2007) from various zones about pressure, leakages and breakages in the system. To address these issues SMC decided to adopt a systematic approach of leakage mapping and leak repairs; while the city wide water audit was also planned during the same time. However, these initiatives were on piecemeal approach without the necessary institutional support and clarity for planning, implementation and monitoring.

Recognising this importance of improving improved service delivery, beyond just addition of physical infrastructure, SMC constituted an NRW Cell in 2007 with the mandate to plan, develop, implement and monitor an action plan for reduction of NRW, conducting periodic water audits, undertaking leakage mapping and repairs in a phased manner.

The Initiative: NRW cell in Surat

Structure

SMC's NRW Cell is headed by Commissioner, and is guided/ supervised by an NRW Committee comprising of City Engineer, Additional City Engineer-Civil, Additional City Engineer-Electrical and Hydraulic Engineer. These are supported by six Assistant Engineers, one Deputy Engineer; and one Nodal Officer in each of the seven zones of the city. Staff from SMC's hydraulic department is involved in execution of the repair and related work. The NRW cell comprises Civil Engineers, Instrumentation Engineers, Electrical / Mechanical Engineers, etc.

Objectives and actions planned

The NRW cell was formed with the objective of undertaking a thorough estimate of NRW levels and then progressively improving and maintaining overall NRW level at 20%. The NRW Cell had six main objectives:

1. Efficiency enhancement in transmission and distribution network.
2. Achieving equity in distribution.
3. Achieving financial recovery.
4. Creating awareness for water conservation.
5. Conducting periodic water audit (every 3 years).
6. Implementation of efficiency and equity measures as per requirement.

As a part of this action plan, SMC initiated two major activities- (a) Water audit of core city area of 112.28 sq. km., and (b) initial leakage mapping exercise. This case study elaborates the activities and outcomes under the leakage mapping exercise carried out by NRW cell of SMC.

These six objectives listed above were converted into targets by SMC and the activities under each of these six objectives were identified. Although several activities within these six main targets, were already in progress under different initiatives, for example, installation of SCADA system at WTPs, GIS mapping of water networks etc., the NRW Cell was mandated with taking an integrated perspective in evaluating the efficacy of these initiatives and to ensure streamlined implementation.

As a first step, the NRW cell identified leakage mapping as a priority initiative and involved identification of leakages based on current and historical complaints from citizens/areas and ground level assessment by SMC's Hydraulic department.

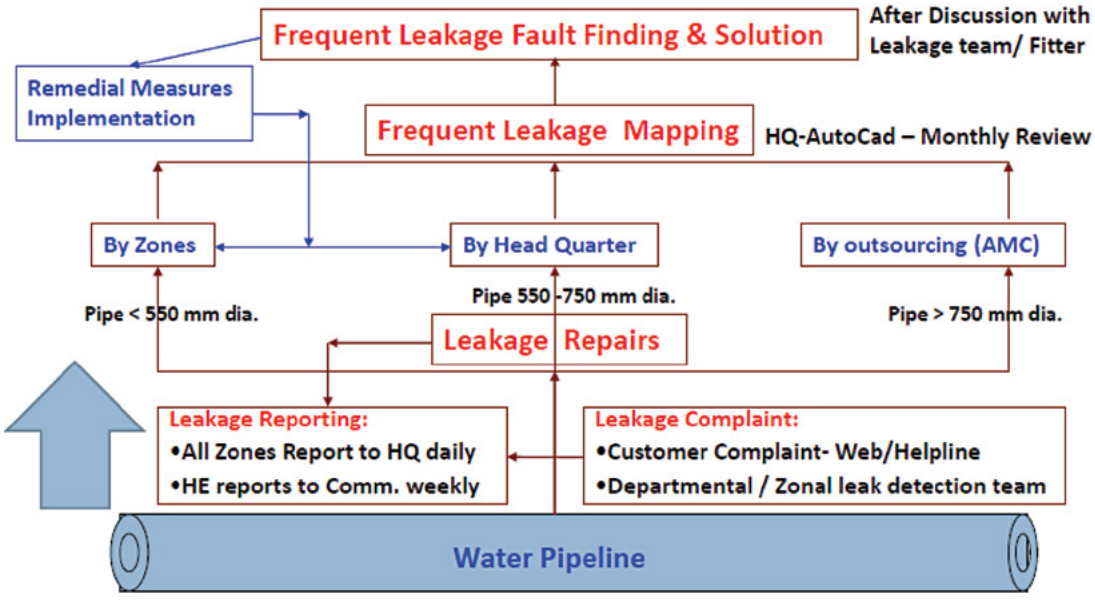
1. An analysis of customer complaints by SMC revealed that customers' leakage related complaints were mostly relating to ferrule-level water connection. The leakage complaints were received either through web or helpline numbers. These leakages were then addressed by respective departmental or zonal leak detection team.
2. The discussions were held with leakage team and fitters in various areas to identify the frequent leakage points which were then transferred to headquarters for mapping on AutoCAD.
3. Leakage repairs were done at three levels based on the size of the pipes i.e.,
   - Leakages in pipe sizes > 750 mm: by outsourcing by AMC to private operators.
   - Leakages in pipe sizes 550- 750 mm: by AMC.
   - Leakages in pipe sizes < 550 mm: by zonal offices.
4. Leakage Repairs: Reporting was done at two levels; all zones report to headquarters daily and the Engineering Head reported to the Commissioner on a weekly basis.

   Refer Exhibit 4.1 for the snapshot of leakage mapping mechanism adopted by SMC.

Leak detection and mapping project

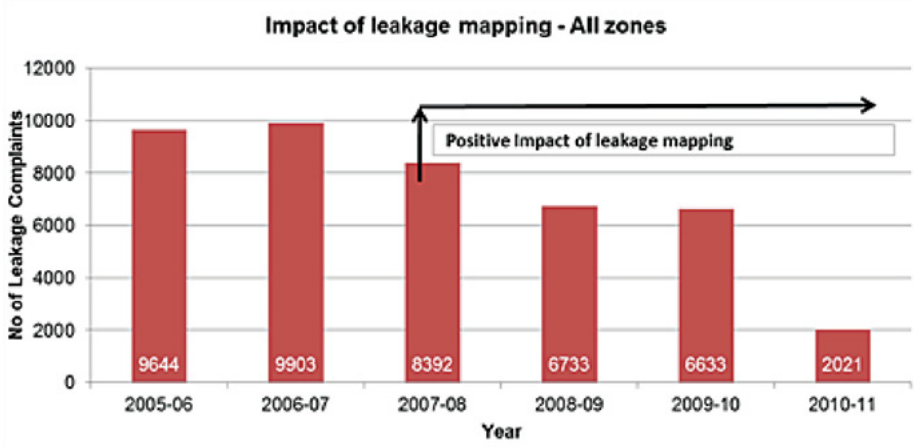
The Leakage Mapping exercise was carried out for Rander Gamtal area and Central Zone and specific spots were identified. As per Leakage Mapping, few pipelines in that area were replaced stage-wise in year 2010-11. After successful implementation in Central zone & Rander Gamtal, the same initiative was extended to other zones of the city too. After mapping leakages in all zones of Surat, corrective action of changing the required pipelines, faulty valves etc. has been initiated. SMC carried out

EXHIBIT 4.1: **LEAKAGE MAPPING MECHANISM**



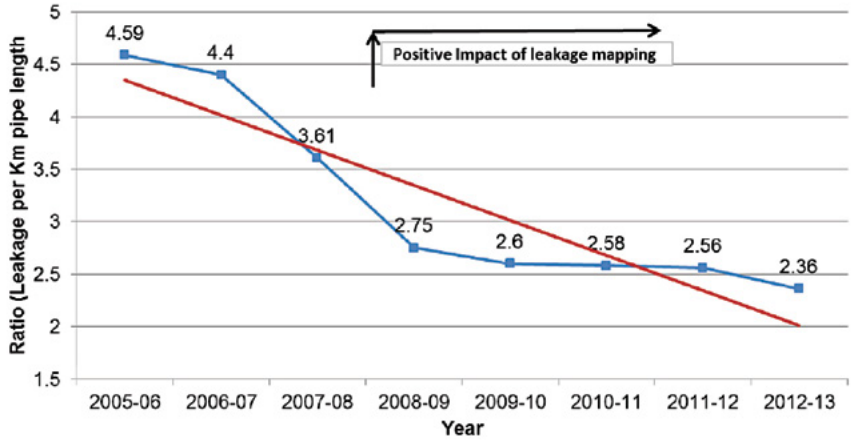
Source: SMC

EXHIBIT 4.2: **REDUCTION IN NUMBER OF COMPLAINTS DURING 2006-11**



Source: SMC

EXHIBIT 4.3: **REDUCTION OF LEAKAGES PER KM LENGTH DURING 2006-13**



Source: SMC

EXHIBIT 4.4: **NUMBER OF LEAKAGES AND CONTAMINATION SPOTS**

Sl. No.	Area	Frequent leakage spots attended (Nos.)	Frequent contamination spots attended (Nos.)
1	Central Zone	22	13
2	Rander Gamtal	68	44
3	West Zone (Except Rander Gramtal)	7	0
4	North Zone	23	19
5	South Zone	33	11
6	East Zone	11	12
7	South – West Zone	17	4
8	South – East Zone	4	7
Total		**185**	**110**

Source: SMC

the leakage mapping and leak repair works internally (except for larger leakages) with the available conventional technologies sand tools. However, in the long run, SMC can adopt better and efficient leak detection and repair techniques; and consider appointing a private player to leverage upon the private player's experience.

Results achieved

The early stage leakage mapping exercise bore some constructive and impactful results.

1. **Reduction in leakages per km length of pipeline:** After the leakage mapping initiative started, the number of leakages in water supply pipelines gradually reduced in last 7 years. In the recent years, length of water supply pipeline network has also increased considerably from 2,100 Km in year 2005-06 to about 3,000 Km at present. Hence, ratio of number of leakages per km length of pipeline is reduced, which is shown in Exhibit 4.3.
2. **Reduction in number of complaints:** The number of leakages was reduced by 30% annually in all zones and accordingly the number of complaints received reduced by a corresponding level. Refer Exhibit 4.2 for the reduction in number of complaints.
3. **Better tracking of complaints:** Daily reporting of the leakage repairs is done by all the zones to the head office of SMC; and there is weekly reporting of the same to the Commissioner by the Engineering head. Refer Exhibit 4.4 for the Zone-wise record of complaints attended.
4. **Leak repairs and water savings:** SMC reported comprehensive identification and repair of over 185 frequent leakage points and over 110 contamination points post creation of the NRW cell. It also estimated saving to the extent of 708 ML of potable water translating to a net savings in water costs and road reinstatement costs of Rs. 212 lakh annually.

Challenges to sustainability and current status

Encouraged by the successful results of the leakage mapping and rectification exercise, SMC's NRW Cell had planned to appoint a Consultant to carry out the water audit of the core area of SMC spread over 150 sq. km. However, as members of SMC's NRW Cell got involved in other priority projects, activities relating to the six target areas of the NRW Cell have since then slowed down a bit.

Although the NRW cell was headed by the Commissioner, it was started out as an initiative of the Hydraulic department. Therefore issues relating to commercial losses and improving revenues which were handled by Revenue department did not receive adequate attention. On hindsight, it seems that cross-cutting initiatives like NRW would require resourcing that cut across these departmental silos.

Interactions with SMC reveal that NRW reduction continues to be a key focus area and that the NRW cell would be strengthened with dedicated accountability and better resourcing in due course to ensure sharper focus going forward.

Lessons learnt and ideas for replication

Early results from its leakage mapping exercise demonstrate the value of creating dedicated institutional mechanisms to tackle critical aspects like NRW reduction. The creation of an NRW cell with specific objectives helped create accountability and early enthusiasm which is also reflected in the results of the leakage mapping exercise demonstrate.

However, such mechanisms need to be backed with adequate and appropriate resourcing. Despite these encouraging early results, the Cell seems to have lost some momentum in view of some of the resourcing and structural limitations. As members of the Cell that were involved in the initiative became pre-occupied and loaded with other activities, the momentum achieved by early results was lost. Also, the NRW cell appears to have been largely housed within the Hydraulic department which possibly explains the Cell's early focus being on technical losses and leakage mapping, even though addressing revenue recovery was listed as a key objective.

Areas like NRW reduction will require more than 'mission-mode' actions; they will require integrated planning, sustained institution building and diligent process transformation. Achieving transformational changes in areas like NRW reduction will call for greater institutional perseverance over much longer time spans. They will require diligent nuts-and-bolts efforts and call for broad-based cross cutting efforts across multiple departments (including hydraulic department, revenue etc.). It would also require institutional re-alignment and putting in place consumer aligned processes.

CATEGORY II

INFORMATION AND EFFICIENCY IMPROVEMENT

Major constraint experienced by ULBs in India during planning, implementation and management of facilities is availability of updated information, in some cases even availability of base level information is an issue. The data/ information are generally in the form of facilities, demographics, finances, coverage or service levels etc. Major ULBs have recently taken various initiatives for proper information management by adopting tools such as information technology, however these efforts are still very limited and in their nascent stage.

This category covers improvement of information system and efficiency of ULBs and deals with two aspects namely (a) improvement in overall data/information system and (b) use of Information Technology to improve the availability of information and efficiency of the system.

The Ministry of Urban Development (MoUD), Government of India launched the Service Level Benchmarking (SLB) initiative covering water, sanitation, solid waste management and storm water drainage. The SLB initiative also focused on reliability of various parameters, which indicated the quality of data available to arrive at service levels.

Understanding this, many ULBs have made efforts in overcoming the information gap and introducing accountability in service delivery by measuring and monitoring the service levels. This involved use of technology to increase operating efficiency as in case of Bangalore, where bulk meters were installed at strategic locations and were linked to IT systems for advanced data management, visualization, correlation and collaboration of vast data to convert it into actionable information for improved decision making. Similarly, Pimpri-Chinchwad Municipal Corporation (PCMC) leveraged the potential of mobile and emerging media technologies to facilitate tracking of service delivery (on SLB indicators linked to customer service) based on citizen feedback. Such technology initiatives that could be replicated by other cities are taken up as case studies. A number of projects focusing on service delivery improvement were identified. These include projects where SCADA, GIS technology and other online software were used to monitor service levels. List of such projects that can come under this category is identified which is given in Exhibit 2 below.

A brief project profile was prepared based on secondary research and in consultation with respective ULBs/ utilities wherever feasible. Then two priority projects were chosen based on following criteria,

- Feedback and inputs from PRG members was taken on various aspects.
- Status of project and likely availability of data/ information with ULBs.
- Key takeaways or learning from the project, which can be replicated elsewhere.
- Projects or initiative which are already covered or published in earlier case studies or compendiums were eliminated.

Based on the above criteria two projects were shortlisted from the inventory of projects.

- **SLB Connect - Pimpri-Chinchwad Municipal Corporation:** Pimpri-Chinchwad Municipal Corporation (PCMC) took initiative on pilot project basis and used the potential of mobile and emerging media technologies to facilitate tracking of service delivery (on SLB indicators linked to customer service) based on citizen feedback.
- **Bangalore Bulk Flow Metering and online monitoring system :** Installation of Bulk flow meters at strategic locations helped BWSSB to identify demand of its water supply divisions and provide water to all. Linking the bulk meters with advanced data management technology helped in retrieving actionable information for executive and operational decisions.

EXHIBIT 2

S.No.	Project Name	Location (city)	Completion Year
1	Supervisory Control and Data Acquisition (SCADA) system for all reservoirs and bulk supply pipe lines in the entire system of HMWSSB	Hyderabad	2009
2	Bulk Flow Metering System for Bangalore water transmission network	Bangalore	2010
3	24X7 Water Supply Project of Mysore- Comprehensive survey and database management as a part of the Integrated Management Information System (IMIS)	Mysore	Ongoing (commissioned 2011)
4	Central Monitoring System for Nagpur Water Treatment & Distribution Management System	Nagpur	Not available
5	SCADA system for Water Supply System of Pimpri-Chinchwad Municipal Corporation	Pimpri Chinchwad	2011
6	Online water quality monitoring system, Surat Municipal Corporation	Surat	2009
7	Enhancing Billing and Collection of Revenue by Online Bill generation: Hyderabad Metropolitan water supply and sewerage board	Hyderabad	Not available
8	GIS based Hydraulic Modelling for a Pilot 24/7 water Supply Initiative in Amravati	Amravati	Not available
9	Unaccounted for Water Reduction & Control and Water Distribution System Rehabilitation (UFW & WDSR)- a pilot project at Bangalore	Bangalore	2006
10	SCADA system for sewerage system in Surat	Surat	2012
11	SLB Connect – Pilot at Pimpri Chinchwad City	Pimpri-Chinchwad	2012

Source: JnNURM, IMaCS Research

PIMPRI-CHINCHWAD: SLB CONNECT PILOT

Case abstract

The Ministry of Urban Development (MoUD), Government of India launched the Service Level Benchmarking (SLB) initiative in 2009 to introduce service delivery indicators and benchmark norms for water supply, sewerage, solid waste management and storm water drainage as a means to encourage greater focus on improved service delivery and to encourage ULBs to initiate actions to realise these targets in a time-bound manner. As a follow-up, MoUD in association with the World Bank's Water and Sanitation Program (WSP) launched SLB Connect in 2012, an initiative to strengthen citizen engagement to track service delivery from a citizen's perspective through use of Information and communications technology (ICT).

The case traces the implementation of a pilot project under the SLB Connect program in Pimpri-Chinchwad Municipal Corporation (PCMC) in collaboration with WSP. It discusses the steps leading up to launch of the pilot, reviews its salient features and traces its progress and current status. It summarises positive outcomes achieved, challenges faced, and provides useful insights for Indian cities seeking to incorporate citizen feedback in tracking and improving service delivery outcomes.

City profile

Pimpri-Chinchwad and Pimpri-Chinchwad Municipal Corporation

Pimpri-Chinchwad is an industrial twin city in the Pune Metropolitan Region, adjoining Pune Municipal Corporation and is situated 165 km from Mumbai. It is among the most industrialised regions in Maharashtra and in India. Pimpri-Chinchwad city is administered by the Pimpri-Chinchwad Municipal Corporation (PCMC), which was constituted in 1982 and has an area of 177.3 Sq.km.

At the time of Census 2011, PCMC was the fifth most populated Urban Local Body in Maharashtra with a population of 1.7 million. Although population growth dipped from 93% during 1991-2001 to 72% during 2001-11, PCMC is still among the fastest growing urban areas in the country with 60% of the growth driven by in-migration owing to creation of employment opportunities arising out of the continued industrial investments in the region.

Water supply and sewerage scenario prior to the initiative

Water supply

Water supply service delivery is managed under the water supply and drainage department of PCMC. PCMC gets water from the Pavana River by drawing 455 MLD from intake at the Ravet bund. It is then transmitted and treated at Nigdiin four Water Treatment Plants with a total treatment capacity of 428 MLD. As per information from PCMC, the treated water is pumped through 26 water pumping stations and supplied to 47 water distribution zones with the help of 85 ESRs and 17 GSRs.

Apart from its physical infrastructure improvements, PCMC had also initiated several reform initiatives for improvement in SLB parameters including computerised water billing, metering of connections, introduction of volumetric tariff, setting up of citizen facilitation centres and implementation of SCADA in water supply and sewerage system.

EXHIBIT 5.1: **SERVICE LEVELS – PCMC'S WATER SUPPLY SYSTEM**

S.No.	Service level	Unit	SLB Norms	Status 2011-12
1	Coverage of connection	%	100	85
2	Per capita supply	Lpcd	135	182
3	Extent of metering	%	100	78
4	Non-revenue water	%	20	25
5	Continuity of supply	Hrs /day	24	6
6	Quality of water supplied	%	100	N.A
7	Redressal of customer complaints	%	80	80
8	Cost recovery	%	100	90
9	Collection efficiency	%	90	65

Source: PCMC

EXHIBIT 5.2: **SERVICE LEVELS – PCMC'S SEWERAGE SYSTEM**

S.No.	Service level	Unit	SLB Norms	Status 2011-12
1	Coverage of toilets	%	100	96
2	Coverage of sewerage	%	100	76
3	Collection efficiency of sewerage network	%	100	72
4	Adequacy of sewerage treatment capacity	%	100	100
5	Quality of sewage treatment	%	100	100
6	Extent of reuse and recycle of sewage	%	20	2.4
7	Efficiency in redressal of customer complaints	%	80	100
8	Extent of cost recovery in sewage management	%	100	88
9	Efficiency in collection of sewerage charges	%	90	63

Source: PCMC

Refer Exhibit 5.1 for a summary of performance of PCMC on water supply SLB indicators in 2011-12. Even prior to the SLB initiative, PCMC scored well on coverage (85%) and in fact had a higher per capita supply (182 lpcd) relative to MoUD's SLB norms. While it reported a 90% cost recovery, collection efficiency was lower at 65%. Although Non-Revenue Water was reported at 25%, discussions with PCMC suggests that their actual NRW may be higher as data acquisition was constrained by non-availability of volumetric measurements on water flows.

Sewerage

As per PCMC, the estimated sewage generated in PCMC is 277 MLD, which is collected through a network of 1,250 Km and is transferred to 13 Sewage Treatment Plants (STPs) for further treatment. Of the 13 STPs, five are based on Activated Sludge Process and six incorporate Sequential Batch Reactor process / Improved Sequential Batch Reactor process. The remaining two STPs operate on Fluidised Aerobic Bioreactor process and Bio Tower process. The Operation and Maintenance (O&M) of STPs is managed through private contractors. Under JnNURM, PCMC has implemented a number of projects at an approved project cost of Rs. 218 crore to enhance STP capacity, improve coverage and monitor sewerage flows at STPs through implementation of SCADA.

Refer Exhibit 5.2 for performance of PCMC on sewerage SLB indicators in 2011-12. PCMC had 76% coverage and 72% sewage collection efficiency. Reported service levels in adequacy/quality of sewerage treatment and redressing customer complaints met or exceeded norms. PCMC's service levels were lower than SLB norms on reuse, cost recovery and collection efficiency.

The Initiative: SLB Connect pilot

Steps leading up to the initiative

Even as several cities had started implementing projects approved under JnNURM and as sizeable investments were being approved and invested in these projects, there was a felt need to ensure that these projects were translating into universal equitable and affordable access of services to citizens.

Recognising the need to put in place measures to facilitate and encourage adoption of a systematic approach to track, monitor and improve service delivery at the ULB level, MoUD launched the Service Level Benchmarking (SLB) initiative in 2009. The emphasis in SLB was on the delivery of measurable service outcomes, as opposed to conventional measurement mechanisms that relied heavily on tracking 'input' indicators relating to asset creation. The SLB program was initiated with definition of a set of Service Level Indicators and benchmark norms to be achieved against these indicators in water supply, wastewater, solid waste management and storm water drainage. Later, to make it an integral part of the urban reform agenda, reporting and notification of performance against these SLB indicators was made mandatory for receiving a portion of grant support under the 13th Finance Commission grants.

Although many cities initiated reporting of performance with respect to the SLB indicators, accuracy of such performance reporting has been heavily constrained by weaknesses in data acquisition and compilation processes and mechanisms at ULB level. To address this limitation, the SLB process outlined by MoUD required cities to track and report the 'reliability' of reporting of performance against each of these indicators. Further cities were encouraged to initiate an Information Systems Improvement Plan to improve reporting reliability. At the same time, reporting on SLB performance relied too heavily on ULB-level reporting without adequately reflecting citizens' voice. Accordingly, it was felt that reporting by ULBs need to be strengthened with mechanisms to engage citizens in capturing and reporting of citizen feedback on service delivery performance.

With the objective of supporting ULBs towards putting in place mechanisms to capture citizen feedback on service delivery, the MoUD in collaboration with the Water and Sanitation Program of the World Bank (WSP) launched implementation 'SLB Connect' with the aim of strengthening citizen engagement in the delivery of services and as a starting point launched a pilot project within PCMC. The objective of SLB Connect was to collect

and analyse citizen feedback on service delivery using innovative mobile and ICT tools being aligned with the SLB framework, and providing feedback on SLB indicators that address customer service aspects. The initiative sought to leverage potential of mobile and emerging media technologies to facilitate tracking of service delivery on SLB indicators linked to customer service, based on citizen feedback. In the first phase, water supply and sewerage services were covered under this initiative.

Features of the initiative

Refer Exhibit 5.3 for the architecture of SLB Connect. The scope of project and salient features of the agreement are discussed below.

WSP selected PCMC as a pilot for SLB Connect study in consultation with MoUD in 2012. A three stage process was adopted:

- **Conducting a mobile-based survey** of sample households on service aspects using a mobile application. To ensure equitable representation of all citizens (including those living in informal settlements) the activity used an android-based mobile application to gather feedback on service-related issues from sample households that were statistically selected.
- **Real time monitoring of survey using web-based survey management module.** This two-way communication module lets survey managers and sector experts monitor and manage survey activities and progress in real time, thus enhancing quality control.
- **Real time analysis of survey results using online dashboard and data analysis tools.** SLB Connect developed a customized dashboard to address information needs of various stakeholder groups and presents survey results using easy-to-read graphs, tables, and maps.

In case of water supply, the performance attributes covered included (i) Access (ii) Adequacy (iii) Continuity (iv) Water quality (v) Customer complaints, and (vi) Ease of bill payments. In case of Sewerage, these attributes were (i) Toilet Access, (ii) Access to Sewerage Network, (iii) Sewerage Collection and (iv) Alternate Disposal. The feedback from citizens was compiled into a score card and along with the detailed analysis made available to interested stakeholders as measured service outcomes. The analysed outputs from SLB Connect helped strengthen the SLB programme by:

- Providing a 'reality check' on service levels from the citizens' standpoint.
- Providing city managers with more 'granular' data at the sub-city level (ward/zone) which could facilitate improved monitoring and problem solving.
- Providing inputs into project planning processes.

The operating methodology adopted by WSP and PCMC involved the following:

1. **Household surveys:** In October–November 2012, trained enumerators conducted a survey of 5,208 households selected through randomized stratified sampling that was designed to ensure representation of all citizens. For surveys, Stratified Random Sampling was used and the Probability Proportionate to Size (PPS) method followed to ensure correct representation. As part of the exercise, over 3,200 mobile numbers were collected from respondents who confirmed their willingness to provide feedback on an on-going basis. The municipality intended to use this database for strengthening its citizen engagement efforts. The sample points from slums were taken in proportion to the total slum population of PCMC i.e. around 9.6% of the total samples. The basic information of these respondents collected includes economic status as per income and ration card, gender respondents etc. This was done to add various dimensions to the analysis of basic water and sewerage service levels and the satisfaction levels. Exhibit 5.4 shows economic status of respondents.
2. **Assessment of survey findings:** Following survey, the administrators held a meeting with the city manager and senior officials to share survey findings; detailed orientation sessions on SLB Connect and the survey findings were also held for all water department functionaries.
3. **Workshop for dissemination of findings:** In March 2013, a city-level workshop was conducted to disseminate the findings more widely to political representatives, citizens, and representatives from media and NGOs. The workshop helped highlight some gaps in service levels between informal settlements and other parts of the city, in particular with respect to water quality and complaint redressal. City functionaries have since then initiated efforts to identify reasons for water quality problems in certain areas, increase public awareness of safe water storage practices, and widened dissemination of formal channels for lodging complaints to enable better accountability for redressal.

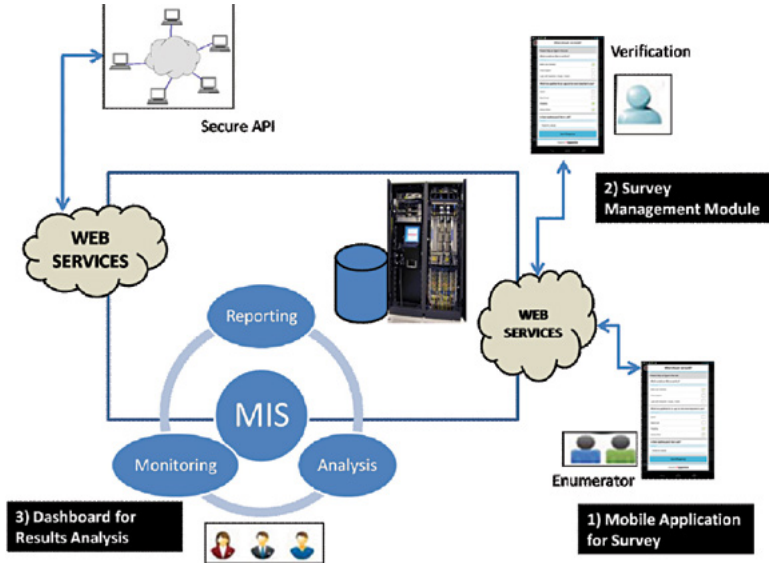
Started in 2012, activities were completed for design of sampling methodology, questionnaire, mobile survey application, survey management module, online dashboard, training of enumerators, conduct of household survey, and sharing of survey findings with city functionaries in a 5-month period. Over 3,200 mobile numbers were collected from respondents who confirmed their willingness to provide feedback on an on-going basis. The municipality envisaged use of this database of numbers for strengthening its citizen engagement and capturing service information periodically.

Results and findings

The analytical tools enabled PCMC to review and analyse the data under various dimensions including comparison of the level of services to the previous year, level of satisfaction with respect to service indicators, and top three citizen priorities etc. A website has been maintained by WSP wherein the results and findings can be viewed by even the citizens. Some of the key results of the SLB Connect pilot are summarised below:

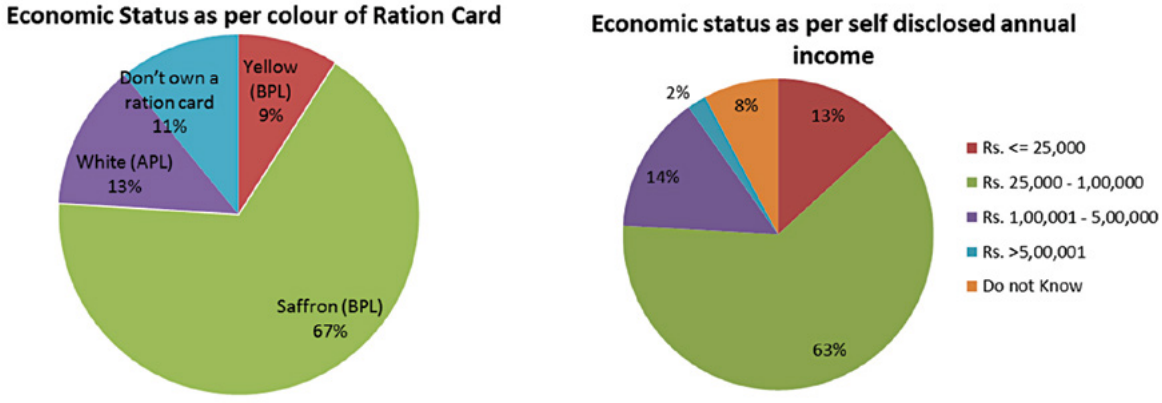
1. **Assessment of changes in service levels over to preceding levels:** The change in service levels within slum and non-slum areas vis-à-vis the previous year are captured. At the time of the pilot over 54.6% respondents from the non- slum area and the 45.8% respondents from the slum area reported no

EXHIBIT 5.3: **SLB CONNECT ARCHITECTURE**



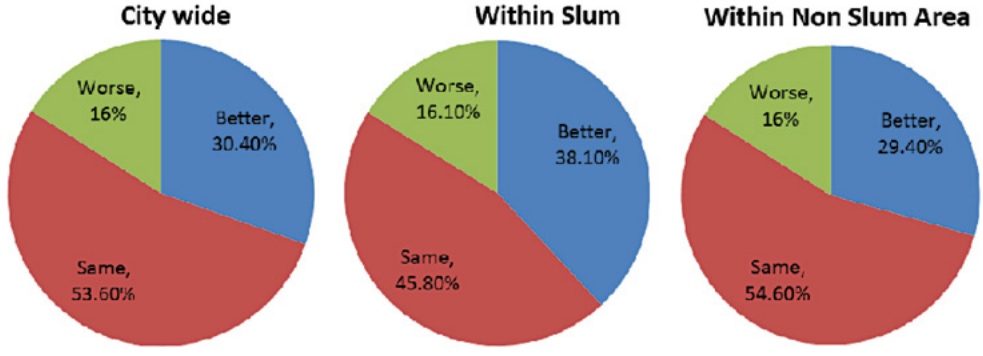
Source: PCMC

EXHIBIT 5.4: **SURVEY - ECONOMIC STATUS OF RESPONDENTS**



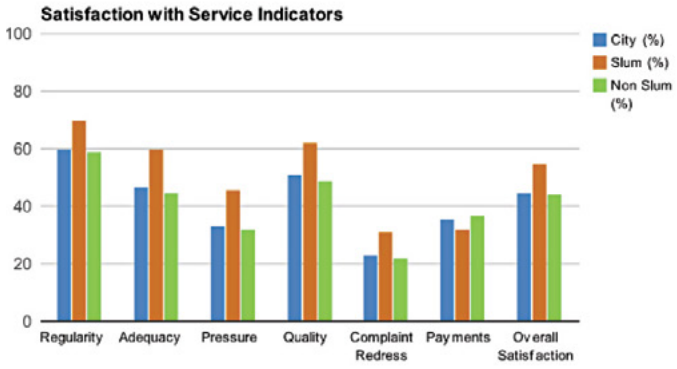
Source: http://slbconnect.in/pcmc/dashboard/survey_details.php#

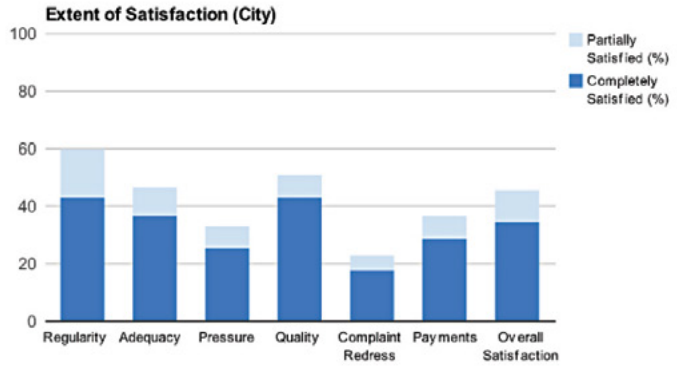
EXHIBIT 5.5: **KEY FINDINGS - CHANGE IN SERVICE LEVELS**



Source: http://slbconnect.in/pcmc/dashboard/water/satisfaction.php?#

EXHIBIT 5.6: **KEY FINDINGS – CHANGE IN SERVICE LEVELS IN SLUM AND NON SLUM AREAS**





Source: http://slbconnect.in/pcmc/dashboard/water/satisfaction.php?#

change in service levels from the previous year. Refer Exhibit 5.5.

2. **Extent of satisfaction levels across parameters:** The assessment of the citizen's satisfaction with service levels in three spatial areas – at city level, within slums and non-slum areas are captured along the seven parameters. Refer Exhibit 5.6. Here, PCMC scored high on regularity of services across the city, slum and non-slum areas, while the redressal of complaints recorded lowest satisfactory levels. Thus, the tracking of service delivery in different parts of the city was made possible, providing an internal change management tool to help systematically identify and address performance gaps through incorporation of citizen feedback.
3. **Identification of citizen priorities:** The SLB connect program's analysis tool also helps in carrying out the ranking of indicators by Satisfaction and help identify priority service needs. Refer Exhibit 5.7. The tool also provided for capturing the prioritisation across slum and non-slum areas.
4. **Other key results and impacts.** This program ensures disclosure of key performance related information, which is necessary from transparency and accountability point of view. Also in case of emergencies or frequent problems, this program helps in providing data and related information to respond in time. It helps in institutional capacity building and powerful motivators for the ULB officials for improving the performance ensuring accountability.
5. **Other benefits.** Use of ICT in SLB Connect is expected to provide other benefits in future including integration of information cost effectively through geo-tagging, uploading pictures and recording relevant data points, increasing transparency and accountability of local bodies, enhancing efficiency of service delivery and reduction in transaction cost of doing business. For example, use of a mobile-based household survey shortened the survey duration to a few weeks as opposed to a few months required for conventional surveys.

EXHIBIT 5.7: **RANKING AND PRIORITISATION OF SERVICES BY CITIZENS**

Ranking of indicators by Satisfaction			
Indicators	**City**	**Slum**	**Non Slum**
Regularity of water	1	2	1
Adequacy	2	3	2
Water Pressure	3	1	3
Quality of water	4	4	4
Complaint Redress	5	5	5
Payments	6	6	6
1. Top Priority	**6. Least Priority**		

Top three Priorities			
	City	**Slum**	**Non Slum**
1	Regularity of water	Water Pressure	Regularity of water
2	Adequacy	Regularity of water	Adequacy
3	Water Pressure	Adequacy	Water Pressure

Source: SLB Connect website

Implementation challenges and mechanisms adopted

SLB connect was a new and innovative concept for PCMC and implementation of the survey. Program design and hand-holding support provided by WSP came in handy in getting the program off the ground. WSP and PCMC had several rounds of interactions to achieve clarity on the objectives and activities under the program.

Engaging with the local citizens to address their appre-

hensions and involving them for regular feedback through registration of their mobile numbers was the next challenge. Apart from creating awareness among citizens, PCMC under the guidance of WSP, selected a survey team of local persons, which were given training on the entire program and on interacting with citizens. Aspects including the program objectives, mechanisms for gathering information, steps to make citizens comfortable were incorporated in the training design.

The selection of sample for household survey was done carefully using stratified random sampling. On-field activities were also monitored closely by WSP and PCMC. Since some areas of the city had poor mobile connectivity, it was felt that complementary mechanisms for offline data capture and batch transfer of data would need to be incorporated in future phases of the program.

Current status

The dissemination workshop held in PCMC in March 2013 was attended and received well, with several key stakeholders including the Commissioner PCMC and Deputy Mayor PCMC attending the workshop. In June 2013, MoUD recognised the SLB connect pilot as a good practice for citizen engagement and requested all state governments to consider replication and implementation of the initiative at the ULB level.

Discussions with PCMC indicates keenness to take the initiative forward with plans for integration of the SLB connect surveys and analysis into their planning and operating processes. PCMC has sought WSP's support in carrying out the next round of survey in 3000 households as a next phase of the project. Future plans include localised interactions with citizens to discuss survey findings, creating a households panel to track SLB connect progress periodically and encouraging citizens to voluntarily provide feedback through online questionnaires or downloadable versions from mobile devices and to incorporate performance incentives using survey feedback. PCMC also is considering creating an SLB Connect Innovation Centre within the city's IT department to showcase the initiative for stakeholders and other cities to learn from.

Lessons learnt and insights for replication

The SLB connect pilot at PCMC provides a window into the possibilities of addressing the challenge of citizen engagement through use of ICT tools, backed by surveys and dissemination and provides a very replicable approach to effective citizen engagement. It also demonstrated that effective engagement can be achieved by leveraging the relatively high mobile tele-densities in Indian cities and use of the same to support both data collection and information dissemination. Key features of the system that bears mention with respect to replication potential include the following:

- **Use of simple survey-based methodology leveraging mobile penetration and ICT tools.** ULBs have traditionally depended on time-consuming and costly conventional household surveys separately for each service. The use of registered mobile phones to track and capture household level feedback is an innovative element that can be adopted in most Indian cities.
- **Sustainability and expanding the scope of surveys to other aspects of ULB functioning:** The SLB connect exercise provides a standardised template to engage citizens on different aspects of city governance. While the focus here was on service delivery, the same approach can be adopted by ULBs in different areas. For instance, a number of ULBs are now using mobile based applications effectively for complaint registration, tracking and redressal.

In future backward integration of citizen engagement initiatives into reporting service levels for state and central government initiatives can be conceived and implemented. State Governments could also consider expanding this initiative by instituting a state-level cell having technical wing and a hardware system to hosting database and common server. This cell could guide ULBs to undertake the SLB Connect exercise across multiple municipalities. Such an effort could also help capture, monitor and track information across ULBs within a state and this could help generate opportunities for peer learning and knowledge sharing.

BANGALORE: BULK METERING WITH INTELLIGENT OPERATING SYSTEM

SNAPSHOT

Case Abstract

Inadequate systems for measurement of water flows and for monitoring of operation of equipment in water treatment and pumping facilities severely constrains most water utilities and ULBs in India. Many ULBs do not even have mechanisms to monitor water flows and key indicators at even important installations like Water Treatment Plants and major pumping facilities.

This case discusses initiatives by the Bangalore Water Supply and Sewerage Board (BWSSB) to install bulk meters at strategically important locations and to develop an ICT application to capture information from these bulk meters and use of the same for analysis and decision making.

Context

Bangalore city and Bangalore Water Supply and Sewerage Board

Bangalore, the capital city of Karnataka is among India's fastest growing cities with its population growing from 57 lakh to 84 lakh during 2001-11. Its growth has been fuelled by its emergence as an Information Technology hub. Apart from Information Technology, Textiles, machine tools, aviation, space, defence and bio-technology are other industries that are prominent.

Bangalore is managed under the jurisdiction of the Bruhat Bangalore Mahanagar Palike (BBMP). Water supply and sewerage in Bangalore is managed under the Bangalore Water Supply and Sewerage Board (BWSSB).

Status of water supply infrastructure within BWSSB

Refer Exhibit 6.1 for a brief overview of Bangalore's water supply and Exhibit 6.2 for reported service level performance. The major source of water supply to the Bangalore city is river Cauvery from which it receives about 910 million litres daily. Water is treated at Torekadanahalli Water Treatment Plant (WTP). The elevation difference between the water treatment plant at TK Halli and the city reservoirs is about 400 m and distance between them is about 100 km. Water is pumped to the city reservoirs through three stages of pumping to the city reservoirs.

Need for bulk metering and system wide monitoring

BWSSB had undertaken several initiatives for improvement of water supply infrastructure. However, in order to effectively manage the entire water supply system and to achieve desired service levels it was necessary to do proper control and management of water flows. This required both generation of the system level data, assessment and analysis of it to further process into useful information.

To address these requirements, BWSSB has undertaken two related initiatives. In 2006-07, BWSSB received funding under JnNURM for installation of 218 bulk meters. More recently in 2013, it has implemented a software application, Intelligent Operation of Water (IOW) developed by IBM on a pilot scale to monitor and regulate the flow of water across the system.

The initiative: Bulk metering and monitoring application

The initiative involved implementation of two related initiatives namely installation of bulk meters and development and implementation of a software application to capture and track information from these bulk meters and to monitor and regulate the water supply system.

EXHIBIT 6.1: **BWSSB: WATER SUPPLY SNAPSHOT**

S.No.	Description	Value
1	Service Area	800.29 sq Km
2	Population	9.5 Mn*
3	Present demand	1283 MLD
4	Present supply	900 MLD
5	Deficit	383 MLD
6	Per capita supply	90 – 100 MLD
7	No. of service stations	106*
8	No. of water supply connection	6.23 Lakh*
9	Total length of water supply line	8,746 Km

Source: BWSSB; *Presentation by BWSSB, 2011

EXHIBIT 6.2: **BWSSB SERVICE LEVELS**

S.No.	Service level	Benchmark	Current status
1	Coverage of connection	100%	51 %
2	Per capita supply	135 lpcd	96
3	Metering of connections	100 %	98%
4	Non-revenue water	20 %	46%
5	Continuity of supply	24 hrs	5 Hrs
6	Quality and treatment	100 %	83 %
7	Redressal of customer complaints	80 %	87 %
8	Cost recovery	100 %	92 %
9	Collection efficiency	90 %	97 %

Source: SLB for Bangalore, 2011-12; ASCI, Hyderabad

Installation of Bulk Meters and monitoring system

In 2006, BWSSB prepared a Detailed Project Report (DPR) for procurement and installation of bulk meters and setting up a monitoring system for Bangalore's water distribution network. The project was sanctioned under JnNURM at a cost of Rs. 13.7 crore. At the time of initiation of the project, BWSSB had six water supply zones.

Chetas Control System Private Limited was selected through a competitive bidding to procure and install the bulk meters; and to provide monitoring system for the same. With the help of BWSSB official flow meters were installed at critical locations including inlet & outlet of all Ground Level Reservoirs (GLRs) and Elevated Service Reservoirs (ESRs) and on feeder mains which feed water directly to distribution network.

All the inlet and outlet flow meters were given an ID, based on the location and were geo-referenced. The filtering of devices (Pipes, Flow meter, GLR) and events was done across division's boundary to help visualise location of flow meter and parameters. For instance, if a particular location of flow meters is looked into and a specific flow meter is selected, the rate of flow and consumption till that particular hour can be obtained.

Each flow meter measures the rate of flow of water at a given moment of time.The flow at that particular time is transmitted through GSM network and is transferred to the central server. A specific quantity of the flow was assigned to a flow meter based on the requirement of the service area and the availability of water. If it goes below or above the set limit it triggers an alarm, which helps to increase or decrease the flow from that particular flow meter.

Online data capture and management

While the above system provided for installation of bulk meters and acquisition of information, an ICT application was required to capture the data for analysis, decision making and online tracking and monitoring. This is being done through implementation of IT software, Intelligent Operations for Water (IOW), developed by IBM, which will capture data from the bulk meters and transmit it to the users for analysis.

In December 2013, IBM entered into an agreement with BWSSB to implement a pilot project to install IOW without any cost. Besides helping BWSSB to monitor the flow of water in 100 bulk flow meters, IOW will facilitate the regulation of water as required, which in turn helps in equitable distribution of water in different areas. It is expected that this software will help BWSSB in identifying the leakages in the system by analysing the real time monitoring of the flows and then minimising leakages in the system to further reduce Non-Revenue Water (NRW). As per interactions with BWSSB, IBM has agreed to install the devices and software required to monitor the water flow in the 218 bulk flow meters in the city and the project is likely to take off during Sept 2014. After evaluating the benefits of implementing IOW, BWSSB will consider implementing it in other areas of the city.

GSM interface between IOW application and the bulk meters

The communication between the bulk flow meters and the IOW system is through GSM transmitters fitted to the ultrasonic bulk flow meters installed by BWSSB.

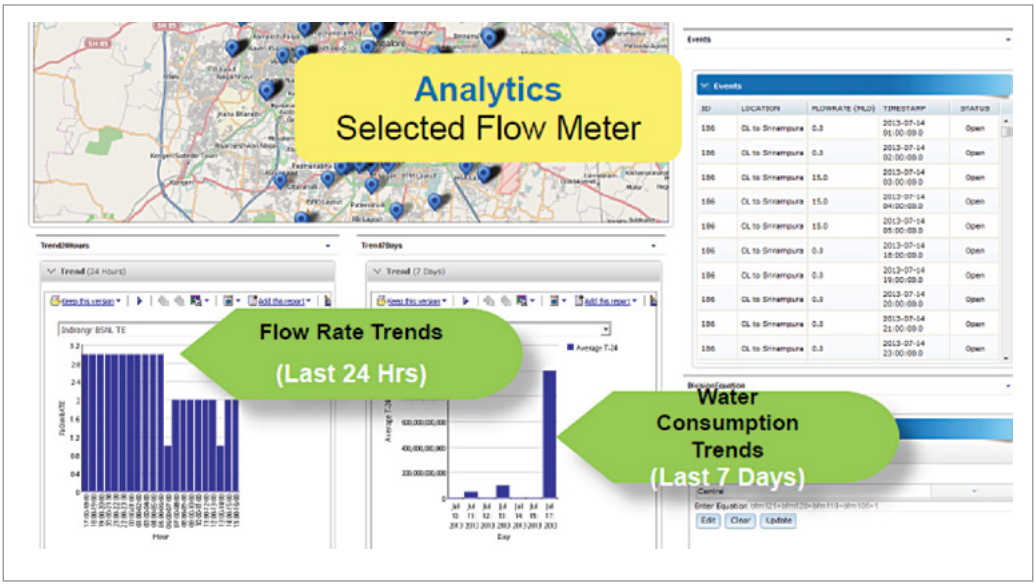
Readings from the bulk flow meters are relayed by the GSM transmitters to a mobile phone tower installed at one of the BWSSB offices. The GSM modem installed in the BWSSB office receives the real-time data through the mobile phone tower and transmits it to a centralised server that is connected to different offices monitoring the data.

A water information hub that is part of IOW provides predictive and historical analysis, which helps in tracking leakages and other types of transmission and distribution losses. The software has been customised to BWSSB's bulk flow on the State Data Centre and the water management system is based on IBM's Intelligent Operations Centre and Integrate Information Core platforms. Refer Exhibit 6.3.

Expected impacts and outcomes

Although the application is yet to be fully operational, discussions with BWSSB and the IBM team stationed at BWSSB office, bulk metering and implementation of the monitoring application

EXHIBIT 6.3: **WATER OPERATIONS DASHBOARD**



Source: BWSSB

is expected to help BWSSB in achieving a number of operational objectives including the following:

Bulk Flow metering helps the water operators in assessing the overall water balance along with identification of illegal connections. It provides indicators for leakage reduction program and helps inefficient water distribution management through helping BWSSB control drawing of water.

The Intelligent Water solution is expected to help BWSSB in leveraging operational data holistically to create insights and improve water management and to anticipate potential delivery disruption and better forecast long-term water demand. It is also expected to coordinate resources to protect water supply and drive conservation and sustainability.

In the long run, BWSSB plans to keep an account of water supply to each division. This will enable BWSSB to have real time data on water supply per connection per day and use it as a first step towards achieving equitable water distribution. The application software has been developed to automate the process of preparing and approving estimates. It is a web-based application software and a unique user name and password has been created for all the Board's engineers. This application software is also being used for processing and clearing of bills before making payments to contractors. This application would be capable of uploading the contractor bills, verify with original estimate or e-measurement book and finally issue the approved amount to the contractor through a cheque.

IOW would help BWSSB to manage water balance and provide equitable water distribution across city. It would generate flow rate trend for last 24 hrs and water consumption trends for last 7 days. For the equitable supply of water, the tool would also have a built-in water equation for each division that would help in capturing exact amount of water supplied to each division and to make changes in valve setting for even distribution of water.

Lessons learnt

Indian water utilities have generally been laggards in adoption of Information Technology for effective monitoring and decision making. While some of them have implemented stand-alone monitoring of systems through facility level SCADA systems, there have been very few initiatives to implement mechanisms for water supply system-wide monitoring, control, analysis and decision support.

- BWSSB's initiative, although at a nascent stage, provides a glimpse into the possibilities when ICT applications are combined with system-wide metering. An integrated system, based on an IT application helps the utility in not only capturing the data/ information from various components of the water supply system but also enables the water operators to use it as a tool for decision making.
- For effective decision making, water utilities and ULBs will need to use technology to capture, generate and relay information on water flows at a central location, but also leverage the spatial distribution of the same through integration on a GIS platform to transition towards real-time information analysis for effective decision making.
- Given the complex interplay of variables in large urban water supply systems, there is clearly a need for shifting to remote monitoring through building a comprehensive system that enables data capture at various locations and relaying of information through appropriate networking and software applications.

Finally, as ULBs and water utilities move forward, it is important to ensure that there is clarity of objectives of technology adoption; to ensure that use of technology leads to achievement of core service delivery objectives which is to provide universal, affordable and equitable water supply to citizens while minimising Non-Revenue Water consistently and reliably.

CATEGORY III

ENVIRONMENT SUSTAINABILITY AND TECHNOLOGY USE

Indian urban water and sanitation sector is beset with the problems relating to inadequate coverage, lack of proper O&M, poor financial sustainability; and weak institutional ownership and accountability. Urban waste-water collection and treatment is a major concern with only 20% of the sewage being treated in Class I and Class II cities. On the other hand, towns are struggling to cater to the increasing demand with limited availability of resources. There are cases where ULBs are taking initiatives to tackle this by adopting water conservation measures and focusing more on wastewater treatment. These areas are covered under the environmental sustainability aspect. Similarly, there is a need for use of innovative technologies, for effective and efficient management of the water sanitation system. Therefore, it is necessary to look at the good practices in innovative technology area as well.

The initiatives or projects identified under this category include measures to reduce pollution of water bodies, improved coverage of sewerage system, addition of sewage treatment capacity, wastewater recycling and reuse etc. Some of the identified projects are construction of Sewage Treatment Plant with energy generation facility at Bamroli in Surat; pay and use toilets at Hyderabad etc.

This category also includes projects on adoption of new technology which requires lesser land, lesser power, lesser manual control and brings higher efficiency including Helium gas based leak detection method adopted in PCMC, which is an innovative technology used for leak detection in water supply system and subsequent reduction of NRW. A number of projects identified under this category mainly include use of innovative technology for water or wastewater treatment, energy conservation and water conservation.

A brief project profile was prepared based on secondary research and in consultation with respective ULBs/ utilities wherever feasible. Then two priority projects were chosen based on following criteria,

- Feedback and inputs from PRG members was taken on various aspects.
- Status of project and likely availability of data/ information with ULBs.
- Key takeaways or learning from the project, which can be replicated elsewhere.
- Projects or initiatives which are already covered or published in earlier case studies or compendiums were eliminated.

Based on the above criteria two projects were shortlisted from the inventory of projects.

- **Use of Innovative Technology: Helium Gas Based Leak Detection at Yamuna Nagar in Pimpri Chinchwad. Pimpri-Chinchwad** Municipal Corporation (PCMC) took initiative on pilot project basis to identify leakage points in the water supply system and repair them to reduce NRW.
- **Environmental Sustainability: Jalandhar Sewerage Project (Phase-II) under UIDSSMT.** Municipal Corporation of Jalandhar (MCJ) has executed a project for extension and augmentation of sewerage system for part of Jalandhar city. The sewerage scheme was sanctioned under UIDSSMT scheme of GoI with the project cost of Rs. 54.79 crore. The case study assesses sewerage project of Jalandhar city right from planning to commissioning.

S.No.	Project Name	Location (city)	Completion Year
1.	Waste Water Treatment through biofiltration, sludge treatment through dissolved air floatation at Rithala	Delhi	2002
2.	Chennai Water Supply Project – II	Chennai	2004
3.	Desalination Plant at Kattupalli Village, Minjur	Chennai	2010
4.	Sewerage treatment plant for underground drainage in Alandur	Alandur	2004
5.	STPs in Chennai with sludge treatment and generation of power using bio-gas	Chennai	2005/06
6.	Yamuna Action Plan Phase II for Branch and Lateral Sewer Lines in Northern Zone and Western Zone in Agra	Agra	2012
7.	Bio-remediation for Municipal Sewage Treatment in Kanpur City	Kanpur	Information not Available
8.	Water Supply Scheme to Anaiyar Municipality in Madurai	Madurai	2010
9.	Combined Water Supply Scheme for Thiruppakundram municipality and Harveypatty Town Panchayat in Madurai	Madurai	2010
10.	Helium Gas Based Leak Detection at Yamuna Nagar in Pimpri-Chinchwad	Pimpri-Chinchwad	2011
11.	Jalandhar Sewerage Project (Phase-I) under UIDSSMT	Jalandhar	2011

Source: JnNURM, IMaCS Research

PIMPRI-CHINCHWAD: HELIUM GAS-BASED LEAK DETECTION PILOT

Case abstract

Putting in place a comprehensive process for identifying and plugging leakages in distribution networks is a critical ingredient in reducing technical losses in urban water supply systems. Yet this is an issue that has not received adequate attention among ULBs in India. Haphazard expansion of distribution networks and absence of an effective city-level spatial information baseline on distribution networks have also constrained positive improvements in this area.

When the Pimpri-Chinchwad Municipal Corporation (PCMC) considered shifting from intermittent supply to continuous supply, it identified the leakages and technical losses in its existing distribution system as a constraint towards achieving this. This case discusses the steps and outcomes of PCMC's pilot project for a helium gas based leak detection program in Yamuna Nagar area of PCMC.

City profile

Pimpri-Chinchwad and Pimpri-Chinchwad Municipal Corporation

Pimpri-Chinchwad is an industrial twin city in the Pune Metropolitan Region, adjoining Pune Municipal Corporation and is situated 165 km from Mumbai. It is among the most industrialised regions in Maharashtra and in India. Pimpri-Chinchwad city is administered by the Pimpri-Chinchwad Municipal Corporation (PCMC), which was constituted in 1982 and has an area of 177.3 sq.km.

At the time of Census 2011, PCMC was the fifth most populated Urban Local Body in Maharashtra with a population of 1.7 million. Although population growth dipped from 93% during 1991-2001 to 72% during 2001-11, PCMC is still among the fastest growing urban areas in the country with 60% of the growth driven by in-migration owing to creation of employment opportunities arising out of the continued industrial investments in the region.

Water supply scenario in PCMC

Water supply service delivery is managed under the water supply and drainage department of PCMC. PCMC gets water from the Pavana River by drawing 455 MLD from intake at the Ravet bund. It is then transmitted and treated at Nigdiin four Water Treatment Plants with a total treatment capacity of 428 MLD. As per information from PCMC, the treated water is pumped through 26 water pumping stations and supplied to 47 water distribution zones with the help of 85 ESRs and 17 GSRs. PCMC has also initiated several reform initiatives for improvement in SLB parameters including computerised water billing, metering of connections, introduction of volumetric tariff, setting up of citizen facilitation centres and implementation of SCADA in water supply and sewerage system.

Refer Exhibit 7.1 for a summary of performance of PCMC on water supply SLB indicators. Even prior to the SLB initiative, PCMC had 85% coverage and reported a supply of 182 litres per capita per day (LPCD). It reported a 90% cost recovery and 65% collection efficiency. Although Non-Revenue Water was reported at 25%, discussions with PCMC suggests that their actual NRW

EXHIBIT 7.1: **SERVICE LEVELS – PCMC'S WATER SUPPLY SYSTEM**

S.No.	Service level	Unit	SLB Norms	Status 2011-12
1	Coverage of connection	%	100	85
2	Per capita supply	Lpcd	135	182
3	Extent of metering	%	100	78
4	Non-revenue water	%	20	25
5	Continuity of supply	Hrs /day	24	6
6	Quality of water supplied	%	100	N.A
7	Redressal of customer complaints	%	80	80
8	Cost recovery	%	100	90
9	Collection efficiency	%	90	65

Source: PCMC

may be higher as data acquisition was constrained by non-availability of volumetric measurements on water flows.

The Initiative: Helium gas-based leak detection pilot program

Triggers for the project and selection of pilot area

As seen in the service level performance above, PCMC had initiated several projects to gradually improve urban water supply service delivery. PCMC has also been considering efforts to shift from an intermittent water supply system towards continuous water supply. However, it recognised that addressing NRW and maintaining adequate pressure in its water supply systems were areas that offered scope for improvement. As an initiative to move towards these two objectives, PCMC was seeking to address the aspect of technical losses in its distribution system but felt that conventional approaches including the sounding rod method were not accurate enough in noisy Indian conditions.

Suez Environment Limited (Suez), a French water operator offered to support PCMC on a pilot leak detection program and suggested use of a helium gas based leak detection approach for the same. Suez's deployment of this approach in other cities successfully to track and plug leaks provided PCMC the necessary confidence that this could work. Further, to support the program, partial funding from Fonds d'Étudeset d'Aide au Secteur Privé (FASEP - Private Sector Study and Aid Fund) was also forthcoming. Armed with technical support from Suez and funding support from FASEP, PCMC decided to initiate the project in 2011.

Even though PCMC was reporting a per capita supply of over 180 LPCD, supply was not uniform across different parts of the city. While some parts of the city received water twice a day, others received water in an irregular manner and complained of low pressure and uneven supply timings. PCMC decided to undertake the leak detection pilot in a zone that had uneven supply, low water pressure and relatively higher customer complaints.

The Yamuna Nagar area of PCMC falling in Wards 11 and 13 of PCMC reported all these problems and in particular reported the maximum number of customer complaints, despite having adequate water being made available through a dedicated Elevated Service Reservoir (ESR) at Triveni Nagar.

Further, this area was relatively isolatable, de-limited by the old Mumbai Pune highway on one side and a large Bajaj factory (with its own water supply infrastructure) on the other side. The eastern parts adjoining Yamuna Nagar were being served by other reservoirs. With a population of 17,000 and spread across 4 sq.km, Yamuna Nagar had over 1725 buildings served from the Triveni Nagar ESR and was just about the size that the pilot program intended to target. Given these factors, Yamuna Nagar was chosen as the pilot zone for undertaking the leak detection program.

Project timelines

Post an MoU between PCMC and Suez in October 2010, approvals for the Project were obtained from PCMC (its General Body and Standing Committee), State Government and Government of India in 2011. In early 2012, a change in policy of the Government of France, the grant support from FASEP reduced from 65% to 49%. Following this, the leak detection program was undertaken in the Yamuna Nagar pilot zone between January and July 2012.

Steps in project implementation

The approach adopted by PCMC and SEI for the leak detection program involved the following steps:

1. Selection of pilot area, zoning and hydraulic isolation:
Yamuna Nagar was thus selected based on the number and frequency of complaints received, availability of dedicated water source under a single ESR and ease of isolation of the area from the rest of the city's water supply network.

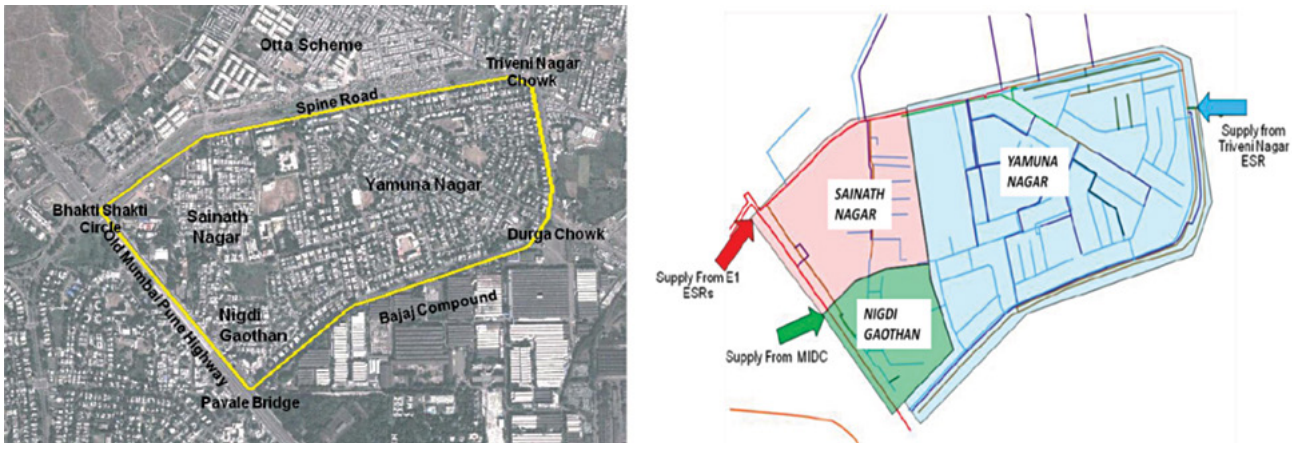
Suez reviewed the spatial orientation of the network on PCMC's GIS application and also under took a comprehensive walk-through survey along with PCMC's valve operators and officials. Based on this, the supply system and the valve operations in the areas were mapped to confirm the water supply pattern for different parts of the zone. The survey confirmed that the area was receiving water twice a day between 5 AM to 8 AM and between 5 PM to 8 PM. This supply timing was regulated by operations of valves at reservoir outlet and based on three supply points, the area was divided into three different zones.

Apart from meeting other criteria, Yamuna Nagar also offered relative ease of network isolation. Boundary valves were installed to isolate Yamuna Nagar from the rest of the areas. Further, one of the two mains supplying water to the pilot zone was disconnected to ensure single source of supply. Mechanical meters were also installed to measure the supply that was catering to other parts outside the zone. A zero pressure test carried out at the start also helped identify a main (earlier not captured in PCMC's GIS) connecting the reservoir to areas outside the Yamuna Nagar zone.

2. Zone Monitoring:
Flow of water into the zone was then measured using temporary ultrasonic flow meters and pressure loggers. This helped to collect data to confirm boundary of pilot zone. As shown in Exhibit 7.3, the balancing reservoir and primary pumping station at the treatment plant were used to feed the pilot zone. Additional pumping capacity available at primary pumping station in the treatment plant was to be utilised to meet peak demand. This helped assure minimum disturbance in supply to the zone, reduction in energy cost and better utilization of pumping capacity and reservoir storage capacity.

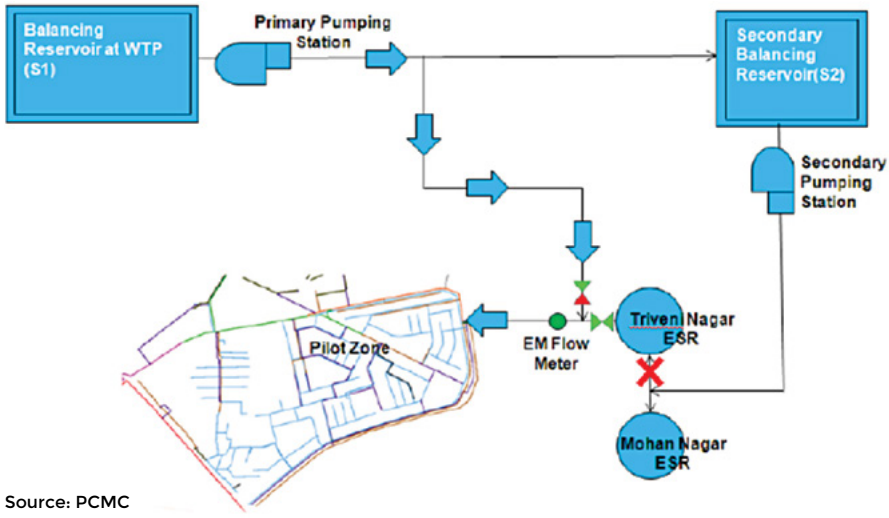
3. Customer surveys and meter reading:
A survey record format was developed by Suez to record number of connections, type and size of connections, type of property, metered and unmetered connections, current status of meter, type of billing (through actual reading or average reading), number of person per connection, supply hours and complaints.

EXHIBIT 7.2: **SELECTION OF PILOT ZONE, SUPPLY POINT AND SUPPPLY COVERAGE**



Source: PCMC

EXHIBIT 7.3: **SCHEMATIC REPRESENTATION OF WATER SUPPLY TO THE PILOT ZONE**



Source: PCMC

Water meter reading was also noted and was followed up with subsequent rounds of meter reading to establish consumption in the zone and average consumption per connection.

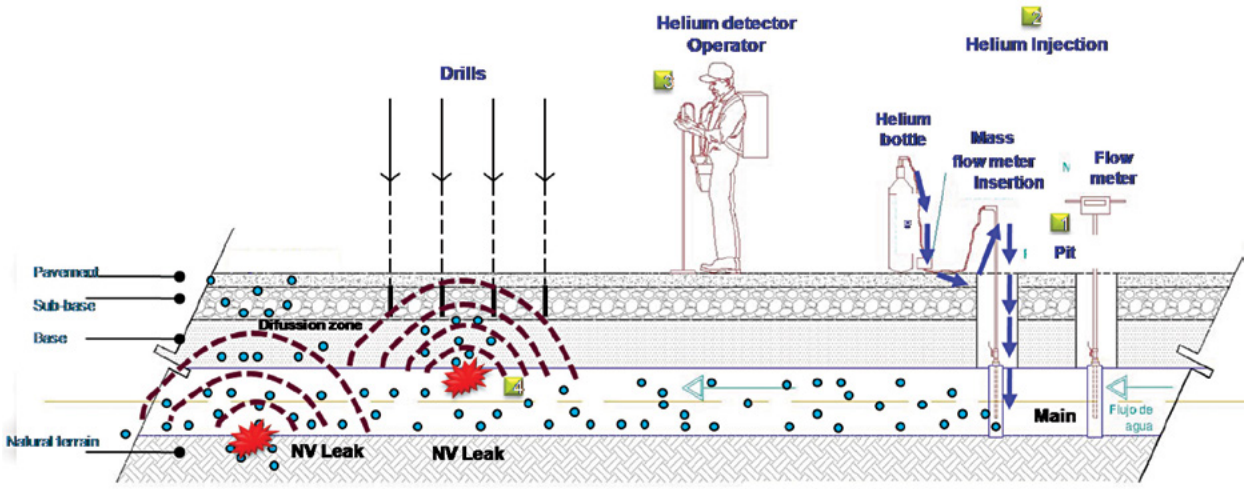
4. Leak detection and repairs:

Leaks can be categorised into two groups, visible leaks and invisible leaks. Acoustic and gas based leak detection techniques are generally used to identify invisible leaks. In this leak detection program, Suez introduced helium gas technique for detecting invisible leaks, which it found effective for intermittent supply systems with low pressure as in case of the Yamuna Nagar pilot.

Helium Mass Spectrometer leak detection also scores in terms of being non-toxic, inert and non-condensable and being present only in trace amounts in the atmosphere. Also it readily passes through leaks due to its small atomic size, is non-flammable and available in various size cylinders and in different purities, appropriate for safe use in drinking water. Refer Exhibit 7.4 for a schematic representation of Helium based leak detection. The methodology involved is summarised below:

1. **Injection of Helium gas in the water supply network:** A cylinder of Helium gas is fixed to the outlet of the ESR. The injecting pressure of the Helium gas was maintained such that 30% of the Helium gas in the cylinder has to be injected in 30 minutes.
2. **Detection of underground pipes and Cables to avoid drilling in cables:** With the help of Pipe & Cable Detector, the underground pipes and cables are detected. The Locator has a receiver and transmitter. The Receiver receives reflected waves from the cables and indicates the location and the depth of cables. After detecting the cable, a hole is drilled at every 2 m to 3 m apart from the point where the cable is detected so as to avoid drilling cables.
3. **Leakage Detection along the network:** Above the drilled holes, a vacuum pipe is placed that is connected to the Spectrometer. There is a filter in between the vacuum pipe and spectrometer which filters the moisture and soil particles coming from the vacuum pipe, if any so that only air is carried away further. Next to the filter there are two jars containing

EXHIBIT 7.4: **SCHEMATIC REPRESENTATION OF HELIUM GAS BASED LEAK DETECTION METHOD**



Source: PCMC

EXHIBIT 7.5: **LEAKAGES IDENTIFIED AND MAPPED**

silica gel (Blue colour). A sniffing probe is connected to one of the jars. The filtered air finally enters in the spectrometer. The spectrometer then shows the amount of the Helium gas.

Results and outcomes

- The pilot program involved five rounds of survey along a 20 km network between January and July 2012. Refer Exhibit 7.5 for spatial mapping of the leaks.
- **Leak detection:** The leak detection program identified 132 leaks in the 20 km network across the five rounds. During detection of invisible leaks, it was found that more than 50% of the leaks appeared from leaking service connection pipes, old discontinued connections, and leaks at ferrule points. It brought to light the need for greater attention to provision of service connections for reducing leaks and avoiding technical losses. It was observed that the number of leaks per kilometre in the last two rounds was less compared to the number of leaks in the initial rounds of invisible leak detection.
- **Leak repairs:** After mapping the leakage points, PCMC organised leak repairs with their own contractors. Suez team found that the quality of leak repair works carried out were not of desired quality and assisted PCMC in use of better techniques including use of mechanised cutting tools, under-pressure drill and tap machine; and repair clamps. Further they assisted PCMC in monitoring these works to identify deviations and initiated corrective measures including revisions to the network map and preparation of a proper network O&M plan, for future reference and use by PCMC.
- **Shifting to continuous supply:** PCMC started its activities related to conversion of intermittent supply to continuous supply and began increase in duration of supply in the zone progressively to reach 24 hour supply. Since the demand in the zones takes time to stabilise when the system is shifted from intermittent to continuous supply, this was done over a period of 3 months after completion of the first round of leak repairs. During the second and third round of Helium leak

detection, the efforts in finding invisible leaks and repairs were started. Simultaneously PCMC initiated consumer awareness programs to repair their sumps to avoid overflows for which consumers responded positively. Thus, all round efforts were taken to stabilise water demand while providing supply with adequate pressure.

Thus the leak detection program enabled PCMC to take a structured approach to address service delivery improvements in the pilot zone. While technical improvement i.e., identification and replacement of leads was a primary focus of the program, it helped achieve other related service delivery objectives including better network planning, consistent pressure in water supply, diligence in provision of service connections and greater consumer awareness on within-premises leaks.

The Program thus paved the way for all-round improvements in the pilot area and helped PCMC officials get a strong orientation on addressing distribution level service delivery improvements in a structured manner. Discussion with PCMC officials also confirm a significant reduction in complaints relating to uneven and low pressure water supply from the zone post implementation of pilot program.

Challenges faced

Although conceived as a Leak detection program, the project brought to light the multi-faced nature of such improvements and the need to address a number of aspects along the way. Key challenges faced during implementation of the pilot project included the following:

- **Weak baseline information:** Although PCMC had initiated the process of preparation of GIS based maps for all its utilities, the fact-finding at the start of the project revealed considerable gaps in information available. Thus, although the GIS mapping initiative provided a starting point, a fair level of field level reconnaissance and validation was necessary to confirm the network details.
- **Importance of zone selection:** Further, PCMC had a heterogeneous situation with respect to service delivery and it was important to select a zone / area that was challenging yet was amenable to delivery of results in a time-bound manner. PCMC and Suez tackled this challenge by establishing some objective criteria for zone selection.
- **Importance of hydraulic isolation of the Pilot zone:** The lack of inadequate baseline information on the network was compounded by multiple water mains supplying to the pilot zone and made hydraulic isolation challenging. An iterative approach was adopted to isolate water mains one by one to ensure a single source and measurement of supply into the zone. This was complemented by Pressure Zero Tests which actually helped identify and isolate a large main that was getting serviced from the reservoir.

The pilot program was therefore conceived and implemented in the context of these challenges and the efforts served well to raise the level of awareness and the actions required with respect to some of the 'nuts-and-bolts' aspects of achieving service delivery improvements, lessons which are likely to be of great relevance as PCMC seeks to replicate the results city wide.

Recent initiatives and current status

The Leak detection program thus helped take a structured approach to plugging leaks and served to fix about 132 leaks in the 20 km stretch of the network. As PCMC set out to undertake repairs, it also found resolve to progressively increase supply in the zone towards achieving the ultimate goal of 24x7 supply in this zone.

By July 2012, PCMC had managed to carry out necessary actions towards transitioning to 24x7 supply including rectifying and achieving consistent pressure in the network and at consumer end, improve pumping hours and reduce technical losses in the system. Although PCMC maintained near continuous supply in the pilot zone till about June 2014, a late monsoon and incidental water cut forced authorities to reduce the 24x7 supply to intermittent supply recently. Post the recent rains, PCMC is hopeful of improving water supply duration in this zone shortly.

Meanwhile, PCMC has initiated efforts to replicate the leak detection and helium gas based mapping in three other parts of the city, namely, Pradhikaran, Premlok Park and Ajmera Complex which would cover a served population of over 100,000. In the Pradhikaran and Premlok Park, PCMC has identified 130 leakages at critical points in the network and have already repaired 100 leakages. In the next phase it seeks to cover areas of Sambhajinagar, Rahatani, Bijli Nagar and Chinchwad, taking the areas covered under the leak detection initiative to an incremental 150,000 population.

Lessons learnt and insights for replication

With the need for increasing focus on service delivery, ULBs will clearly need to leapfrog through adoption of newer technologies and leveraging external expertise. The PCMC case demonstrates the potential for positive impacts when technology is combined with a systematic and structured plan with clear objectives and use of external expertise.

While ULBs ought to be open to bring in external expertise in areas that it does not have existing capabilities, it is critical that these initiatives are structured to help build know-how and expertise within the ULB. PCMC's preparatory efforts in terms of an extended engagement with Suez upfront to get convinced on the demonstrated benefits of the technology and use of a pilot approach to test and validate potential outcomes before attempting a city-wide scale up are features noteworthy of replication.

The case also brings to light the need for ULBs to upgrade not just their own capacities but also the capacities of their supply chain of contractors who will need to upgrade their capacities as well. In its pilot program, PCMC and Suez worked with contractors to enable them to adopt better methods and processes including use of mechanised cutting tools, under pressure drill and tap machine and repair clamps etc., and these efforts would help PCMC as it seeks to expand the initiative city-wide.

JALANDHAR: SEWERAGE PROJECT WITH SBR/ CYCLIC ACTIVATED SLUDGE PROCESS

SNAPSHOT

Case abstract

In order to provide access to sanitation to the existing uncovered population, the Municipal Corporation of Jalandhar (MCJ) and Punjab Water Supply and Sewerage Board (PWSSB) have implemented a sewerage project with funding under the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT).

This case discusses the first phase of Jalandhar's sewerage system implemented under UIDSSMT. The project completed within the stipulated timeframe had adopted the Sequential Batch Reactor (SBR) Method/Cyclic Activated Sludge Technology process for its Sewage Treatment Plant . This case traces the objectives and scope of the Project (Phase-I of the sewerage project), details the actions implemented and summarises positive impacts in terms of sustainability and adoption of better technology for waste water treatment.

Context

Jalandhar city and Municipal Corporation of Jalandhar

Jalandhar city falls within Doaba region of Punjab and located 160 km from Chandigarh. Jalandhar is managed under the Municipal Corporation of Jalandhar (MCJ) and is the third largest city in Punjab with a population of 8.7 lakh (as of Census 2011).

Sanitation infrastructure prior to the Project

MCJ and Punjab Water Supply and Sewerage Board (PWSSB) are together responsible for management of water supply and sewerage system in Jalandhar city. PWSSB is responsible for implementing capital investments and projects in water supply and sewerage which are then handed over to ULBs for O&M. Before implementation of sewerage project, nearly 82% of Jalandhar's population had access to sewerage network while the remaining households relied on septic tanks or discharged into open drains.

- Population served by septic tanks was 55,000 and no. of sewerage connections were 95,012.
- Approximately 100 MLD of wastewater was treated in STP and remaining wastewater discharged into Sutlej River.
- The total sewerage network was 682 km with pipes of different sizes ranging from 200 mm to 2,440 mm.
- The wastewater from the remaining households was discharged into drains or septic tanks, which ultimately affected the quality of ground water.

Triggers for the initiative

Although Jalandhar city had both forms (onsite and offsite) of sanitation systems, many parts of the city lacked proper sanitation facilities, evident from its low Sanitation ranking (388th out of the 423 cities) under National Urban Sanitation Policy (NUSP) in 2009.

Prior to the commencement of the sewerage project the city faced several issues related to water and sanitation, including contamination of water network due to dilapidated sewerage network (parts of the network were implemented in 1920s); low coverage, poorly maintained septic tanks and open discharge, contamination of both ground water and Sutlej River.

Therefore, the need to improve wastewater management in these unserved/partly served areas became necessary and funding became available under UIDSSMT, MCJ and PWSSB initiated the process for implementing a sewerage project for Jalandhar. In view of limited availability of land and need for improved treatment, the authorities adopted Sequential Batch Reactor (SBR) Method/ Cyclic Activated Sludge Technology System, for the Sewage Treatment Plant (STP)

The Project: Sewerage project Phase-I

Project objective and scope

The objective of the project was to cover 100% population in Zone I with sewerage facility. The scope of the project covered (a) provision of additional 25 MLD capacity STP to augment the existing STP capacity to 125 MLD and (b) increase in sewerage coverage by construction of Main Sewer and lateral sewer to cover 100% population in Zone I. Jalandhar city is divided into four zones based on the topography. The Sewerage Project for Phase-I was proposed for Zone-I, which covered the areas with highest population density and relatively high growth.

Project implementation

PWSSB appointed WAPCOS to prepare the DPR for water supply and sewerage; and submitted it further to the MoUD seeking finding under UIDSSMT. After approval and sanctioning of the project from the Ministry in March 2008, the project was commissioned by PWSSB in October 2011 and then transferred to the MCJ for operation and maintenance.

The project was divided into two phases with a total project cost of Rs. 112 crore of which Phase I involved an expenditure of Rs. 50 crore. Keeping in view the increasing growth trends of Jalandhar city, the DPR for Phase I adopted geometrical increase method for population projection and arrived at design capacity to cater to 2.1 million in 2040.

Government, Rs. 4.95 crore from state government) while

EXHIBIT 8.1: **COMPONETS OF THE SEWERAGE PROJECT PHASE-I**

Particulars	Phase-I	Phase-II
Design Population, year	21,75,356, (2040)	NA
Treatment capacity	25 MLD	25 MLD
Sewerage network length- - lateral sewers - main sewers	 11.91 km (lateral sewer) 70.26 km (main sewer)	 57.92 km (trunk sewer) 118.35 km (lateral sewer)
Project cost	**Rs. 49.55 Crore**	**Rs. 62.37 Crore**

Source: Punjab Water Supply and Sewerage Board

EXHIBIT 8.2: **SEWAGE AND TREATED EFFLUENT QUALITY RESULTS**

Date	Sewage quality			Treated effluent quality		
	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	TSS (mg/l)
05/04/2014	130.0	336	242	4.2	28	8
10/04/2014	145.0	348	252	4.7	32	9
15/04/2014	154.2	362	266	4.5	32	8
20/04/2014	108.0	312	215	4.0	24	6
25/04/2014	133.7	336	240	4.2	28	8
30/04/2014	111.5	316	217	4.0	28	7

Source: Punjab Water Supply and Sewerage Board

the balance amount of Rs. 4.95 crore was the share of MCJ. This way MCJ was able to leverage on the government funding and keeping its own contribution to 10%. Key project components are given in Exhibit 8.1. PWSSB and MCJ adopted the SBR technology for this STP (25 MLD) because of some of its several advantages over the conventional/Activated Sludge Process including lower capital and operating cost, better quality of effluent and production of digested and odourless sludge. Further, land requirement was one-third that of conventional aerobic process and one-tenth of flotation ponds/ lagoon type treatment process. The process used deep RCC basins and efficient oxygen transfer to achieve highest possible treatment in a single tank with 14-20 hours retention. The STP has in-built de-nitrification and bio-phosphorus removal mechanism and this prevents treated water from getting affected from algae and other contaminations. Further, low resultant values of suspended solids of less than 10 mg/l were achievable through the use of effective decanters.

The Project was completed with a delay of five months owing to the clearances required from the Forest Department and the Punjab State Electricity Board and owing to delays in budget provision form the MCJ and Government of Punjab.

The total capacity of STPs after commencement of Phase-I is 125 MLD as against the generation of 246 MLD in all the four zones of the city. In order to achieve 100% sewerage coverage, PWSSB is implementing two more projects. Phase-II is being implemented under UIDSSMT and another sewerage project is being implemented under National River Conservation Plan (NRCP) Phase-II.

Key findings and outcomes

Key results and outcomes of Phase-I project are summarised below

- 13,000 sewerage connections have been provided in Zone-I covering 6 of the 60 wards and a population of 100,000. Slum population in this zone is around 15,000 and spread mainly in Kot Sadiq, Tilak Nagar and Khurla Kingra areas of the zone.
- After the successful implementation of the project, the Government of Punjab has directed the Irrigation department to formulate schemes for using the treated sewage produced for irrigation purposes under the National River Conservation Plan. Under the directions of Government of Punjab, the Irrigation Department has prepared a draft report for utilizing the treated sewage.
- With adequate treatment, the quality of effluent has improved thus reducing the pollution load on the river. (Refer Exhibit 8.2)

Non-availability of the detailed O&M cost for sewerage system however, constrained analysis of financial sustainability.

Conclusion

Jalandhar presents an example of a city that managed to leverage

grant funds from UIDSSMT to address at least partially the gaps in its sanitation infrastructure, while reducing pollution loads. Notwithstanding the difficulties faced, it is also a case where a higher order technology namely, SBR process was selected in view of the need for lower land foot print and better treatment levels in view of downstream use of the water for irrigation.

Building on the positive experience from Phase-I, Jalandhar has successfully managed to find funding resources under UIDSSMT and under NRCP Phase-II for expanding the sewerage network to other parts of the city and these project are expected to substantially improve coverage of sewerage in the near future.

CATEGORY IV

CITIZEN PARTICIPATION AND CUSTOMER SERVICE

Citizen participation is an essential aspect in provision of urban infrastructure facilities and in improvement of service delivery. It has been observed that involving citizens at the initial stages of the project helps in spreading awareness about the project, takes into account the stakeholders' viewpoint and causes less protest from citizens during the implementation phase. The role of ULBs is changing over the period of time from service provider to facilitator, in which the citizen participation and ownership plays an important role. Hence, this category was identified in order to highlight some of the best practices where the project success can be directly credited to public participation. There are many initiatives seen where community participation was a key factor in the success of the project completion/ implementation. These include projects related to CLTS, water conservation and sanitation initiatives. List of such projects that can come under this category is identified which is given in Exhibit below.

One such case is Alandur Sewerage Project, where citizens contributed their share of capital investment instead of totally depending upon the government funding. Another such example is Public Toilet Complexes in Hyderabad managed on pay and use.

A brief project profile was prepared based on secondary research and in consultation with respective ULBs/ utilities wherever feasible. Then two priority projects were chosen based on following criteria,

- Feedback and inputs from PRG members was taken on various aspects.
- Status of project and likely availability of data/ information with ULBs.
- Key takeaways or learning from the project, which can be replicated elsewhere.
- Projects or initiatives which are already covered or published in earlier case studies or compendiums were eliminated.

Based on the above criteria two projects were shortlisted from the inventory of projects.

- **Community managed toilet complexes in Tiruchirappalli** – The case details out steps taken for involvement of community, especially women's self-help groups, to foster overall slum development and maintain the community toilets. A revenue model for the slum communities with sustainable approach by levying user charge was adopted.
- **Community-led Total Sanitation in Nanded city:** The approach adopted by Nanded to meet the challenges of open defecation and improper sanitation was to attain final outcome as improved sanitation standards rather than physical infrastructure created. NWMC appointed private firms to carry out the work of 'behavioural change' for sanitation in Nanded city. Community participation was carried out through City level and Prabhag level workshops to create awareness to CLTS approach. Women's self-help groups (SHG), youth groups, etc. were engaged in the activity.

S.No.	Project Name	Location (city)	Completion Year
1	Slum Environmental Sanitation Initiatives in Bhopal, Indore, Jabalpur & Gwalior	Bhopal, Indore, Jabalpur & Gwalior	2009
2	Community managed Pro-poor Water Purification and Bottling Scheme at Gwalior and Jabalpur under Water for Asian Cities Program	Gwalior and Jabalpur	2009
3	Community-led Total Sanitation in Nanded City	Nanded	2011
4	Community-led Sanitation in Kalyani Town (West Bengal)	Kalyani Town (West Bengal)	2008
5	Community managed toilet complexes in Tiruchirappalli	Tiruchirappalli	2002
6	Water Conservation and supply at Gautampura town in Indore District	Gautampura, Madhya Pradesh	2009

Source: Secondary Research, IMaCS Analysis

TRICHY: COMMUNITY MANAGED TOILETS

Case abstract

Open defecation continues to be a major sanitation and health challenge with more than 53 per cent of Indian households resorting to open defecation at the time of Census 2011. The National Urban Sanitation Policy launched in 2008 advocates a multi-pronged approach to effectively tackle and eliminate this scourge in a time-bound manner.

This case profiles the efforts of Tiruchirappalli Municipal Corporation (TMC) to strengthen O&M sustainability of public toilets by leveraging the capacities of community based organizations. The business model adopted by TMC seeks to improve service levels while incorporating aspects of gender balance, women empowerment, employment generation, and heightened awareness of sanitation and hygiene among the general public. It traces the situation prior to the project and details actions by various stakeholders, presents the challenges in implementation and outcomes achieved. It finally summarizes lessons learnt from the initiative and insights for replication.

City Profile

Tiruchirappalli also called as Trichy or Tiruchi, is the fourth largest city in Tamil Nadu. By virtue of its location at the centre of the state, it serves as an important transport node. Famous for its temples including the Rock Fort Temple, Ranganathaswamy Temple and Jambukeshwaram Temple, Trichy is an important centre for trade and commerce. It has a fairly large industrial presence with establishments such as BHEL, three SIDCO industrial estates and one SIPCOT industrial complex. Other industries including cotton and textile milling, tanning, cement, and tobacco related products, occupy an important place in the city's economy.

Trichy is managed under the administration of Tiruchirappalli Municipal Corporation (TMC) which is responsible for provisioning of the urban services in the city. Water supply and sanitation comes under the purview of two departments namely, Engineering and Public Health. As of Census 2011, Trichy had a population of 9.2 lakh spread across 167 sq.km. Slum population in the city was 1.6 lakh (or 22% of the population).

Sanitation scenario before this initiative

TMC is in charge of operation and maintenance of all toilets across the city. Around the year 2000, the city had a total of 313 toilets. All the toilets were run as free to use toilets and the operation and maintenance (O&M) expenses were borne by TMC.

However, there was inadequate awareness on the ills of open defecation and water borne diseases among the slum population. Due to inefficient control and monitoring mechanisms, and lack of ownership among the users, most of the toilets in the city were rendered unhygienic and unusable. Some of these toilets also became the centre for anti-social activities. Due to frequent physical damages, the TMC had to do continuous investment on toilet infrastructure. Subsequently, many of the toilets were abandoned or neglected. This led to continuance of open defecation, resulting in significant health hazards to the community. As budgets on public toilets shrunk, the situation further deteriorated.

Community managed toilets

Project background

The idea of Community-managed toilets sought to address O&M challenges through involvement of local Self Help Groups (SHGs) in management of the toilets. Originally mooted by Gramaalaya, a local Non-Governmental Organisation (NGO), the idea involved combining use of SHGs in maintenance while involving the local community through effective door-to-door awareness campaigns. As the awareness campaigns gathered momentum, a number of SHGs showed willingness to operate and maintain community toilets as pay-and-use toilets. While TMC provided land for construction, Gramaalaya with the help of WaterAid (an international non-profit organization) undertook construction of toilets in 8 slum areas including a toilet in Karuvapettai exclusively for children. SHGs were involved in O&M of these toilets. When this initial project was successful, TMC decided to undertake a phased transfer of O&M of TMC's toilets to the SHGs. Gramaalaya, SEVAI and SCOPE were the first group of NGOs that assisted SHGs in undertaking the activity. Since then TMC has scaled up support and mobilisation of community for managing all its public toilets.

Project objective and scope

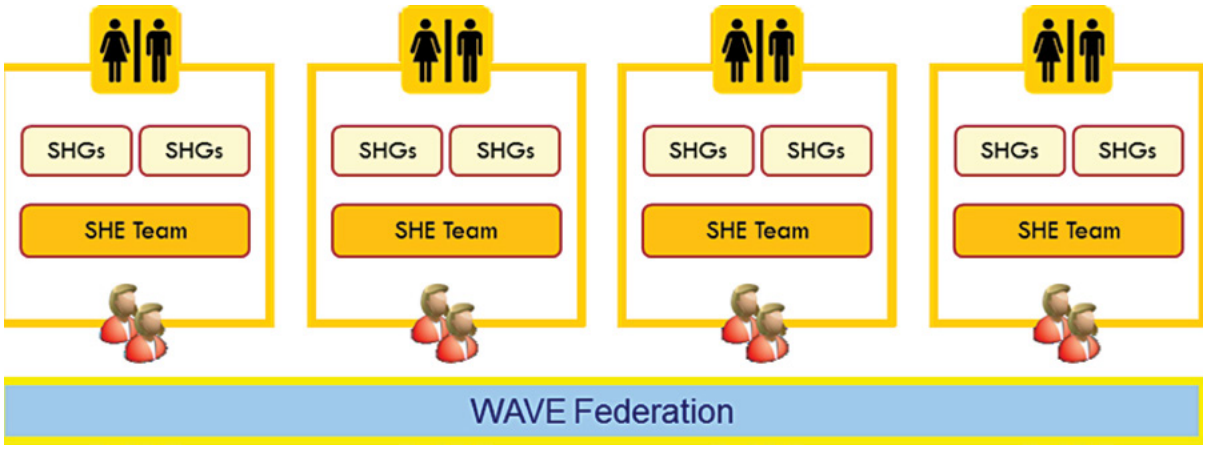
The project focused on addressing the O&M challenge with the following objectives laid out by TMC:

- Stop the practice of Open Defecation in the slums
- Motivate the slum dwellers to use the community toilets
- Train the slum dwellers to manage their community toilets
- Improve management of toilets and provide high quality service.
- Provide for cost effective provisioning of services
- Link service delivery with awareness creation, women empowerment and employment generation
- Prohibit inhuman practice of manual scavenging

Project implementation

Major beneficiaries of the community managed toilet systems were the urban poor living in slum pockets with lack of access to individual toilets. At Census 2011, the city had a sizeable slum

EXHIBIT 9.1: **TEAM STRUCTURE**



Source: TMC

population of 1.6 lakh that constituted 22% of population living across 286 slum pockets.

To address the needs of these slum communities, an area-based approach was adopted for provisioning of toilet services. TMC identifies user groups and demarcates area for usage of each Community Toilet. Each of these toilets are provided with water supply and are either connected to sewerage or onsite sanitation infrastructure. Where piped water supply is limited, toilets are connected to groundwater through bore wells. Electricity charges for the same are provided by TMC. Since only the core city area of Trichy have access to sewerage network, a majority of the Community Toilets are connected to septic tanks and in some cases are linked to decentralised treatment systems.

Women's SHGs each with 15 to 20 members were established in the slum communities with each slum community having 2 to 7 SHGs. On an average, almost half the households in a community are part of the SHG, thereby ensuring a direct involvement of at least half the community in this programme.

- The SHG members in a community jointly form a Sanitation and Hygiene Education Team (SHE team). The SHE team represents the particular slum community and is responsible for the O&M of toilets in the community as well as other softer aspects like raising awareness within community especially with respect to proper use of toilets.
- The toilets are managed by the SHE teams on a rotational basis in such a way that each SHG member is in charge of the management of toilets for atleast a day. The SHG member works on an 8-12 hour shift. Generally, separate manpower is earmarked for cleaning, security & maintenance of toilets. SHG members also provide soap, shampoo sachets, oil etc. in the sanitary complexes creating awareness among users regarding health and personal hygiene.
- The SHE conducts regular monthly meeting with the SHGs to gauge the performance of the SHGs and also to address their concerns. Two SHE team members – Caretakers and Assistant caretakers are chosen to operate the bank account and also represent the slum community in the WAVE (Women's Action for Village Empowerment) Federation. The WAVE serves as the face of the slum communities. The WAVE team is in charge of centralized procurement of sanitation materials, procurement of account books/ token receipts and has an outlet in Ariyamangalam. The SHE's through WAVE also engages with the TMC, the NGOs and any other government or non-government organizations for addressing the concerns of the SHEs and for marketing the success of the models.
- During the course of implementation, the women SHGs faced resistance from the men in the community especially in collecting payments. Faced with the challenge, the SHGs initiated the formation of Association for Water and Sanitation, Hygiene (AWASH) which brought in men, women as well as respected people from the community into one fold. Consequently, all the sections of the community started to contribute towards water and sanitation improvements within the community.
- Based on the success of the community managed toilets, the city subsequently transferred all the newly created toilets (funded by various agencies) to the SHGs. For example, TNUIFSL supported the TMC in promoting the model. TNUIFSL was the state level nodal agency for World Bank supported Tamil Nadu Urban Development Programme scheme under which funds were allotted for the construction of Integrated Sanitary Complexes (ISCs). The corporation has handed over the O&M of all ISCs to the SHGs.

The SHE Team fixes the user charges on per-use basis and. monthly card basis. Each SHE Team opens a bank account for depositing funds collected from the community toilet. The SHG members working as caretaker are responsible for collecting user charges.The monthly cash collections are deposited by SHE Teams in a common bank account and the financial statement are presented at monthly SHE Team meetings. After deducting expenses, profits are deposited in a common fund, which is used for awareness generation activities, and execution of other works

related to sanitation. The SHG communities have also built a modern training facility.

Financial sustainability

User charges are the source of income from the community toilets. The user charges charged range between Rs 1 to Rs 2 per use for adults and Rs 15 to Rs 30 per month per user (in case of monthly card system). The major expenditure heads were towards electricity charges, cleaning materials and salaries. The CMTs are run on reasonable profits. On an average, the profitability is high at 15 per cent of the total income.

The improved performance of the CMTs is a reflection of the efficiency of the SHG communities in rationalizing the salary and expenditure on cleaning materials and also the high collection efficiency. The ULB managed toilets were less efficient due to the high salary cost as well as due to inefficient management of resources like water, manpower and cleaning materials. The financial performance of five sample toilets is given in Exhibit 9.3.

Current status and key outcomes

With the scale up of projects, the project has also received financial

BOX 11. 1: **TERMS OF ENGAGEMENT WITH THE SHGs**

The TMC enters into contract with the SHGs for each community toilet for management of toilets. The contract lays out the conditions for proper monitoring and control of the toilets by the groups. A snapshot of the tender conditions is as follows:

1. The Male and Female Toilets should be manned by uniformed, trained staff both male and female respectively. They should wear name badges.
2. The staff should be available in toilets round the clock for 24 hours for the usage of public.
3. Regular cleaning of urinals and toilets shall be done. Thorough sweeping, flushing and cleaning shall be done at least 3 times per shift. Toilets and urinals should be free from stink for all the 24 hours.
4. Arrangements should be made to ensure proper usage of water without any wastage.
5. All cob-web on walls, roof etc., and dust on all electrical and water supply fittings, doors, windows, panel with glass, mirrors should be cleaned daily at frequent intervals to maintain fixtures and structures neat and clean.
6. Any minor repair to any fittings including replacement of fused bulbs, chokes shall be provided by the SHG.
7. It is the duty of SHG to check and ensure water availability and lights are in order every time when shift is changed or whenever required.
8. The SHG staff shall not allow open urination or open defecation around the toilets. However, if there is any incident of such nature, it is the duty of SHG to remove the night soil from the site in and around toilets and to spray phenyl in those sites to prevent spread of infection.
9. In addition to creating awareness on open urination, steps should be taken up to enforce check on open urination. SHG will be authorized to post workers to prevent open urination.
10. Good quality Naphthalene balls should be placed in all urinals, inlets for drains, sanitary lines, etc.
11. Articles and utensils required for cleaning purposes like brushes, detergents, duster cloths, mops, broom stick, bamboo stick, buckets, mugs, etc., besides detergents, disinfectants, soap solution, etc., of good reputed quality should be provided by SHG. It should be ensured by SHG that these items are always available in adequate quantity. In this regard, a stock register should be maintained.
12. Cleaning and washing of toilets using detergents and disinfectants round the clock and keeping the entire area clean and tidy throughout the day.
13. Acid cleaning of sanitary wares in toilets like urinals, water closets, wash basin and tiles shall be carried out at frequent intervals every day and removal of blockages if any shall be done immediately.
14. The SHG shall post minimum number of sanitary workers for cleaning of toilets and collection of user charges.
15. The SHG should not take responsibility for keeping the luggage of users of toilet under their custody.
16. The SHG should provide closed container in suitable place at each Ladies toilet for disposal of napkins and other Sanitary Waste to avoid blockage of UGD.
17. Any unclaimed luggage / article, if found, should be reported to the Sanitary Inspector of the area concerned without touching it.
18. The SHG shall hand over any articles left out or missed by the users to the Sanitary Inspector of the area concerned.
19. The SHG should not allow unwanted gathering in the close vicinity of toilets. They should be alert in this aspect.
20. The toilets shall be manned by man only during the night hours.

EXHIBIT 9.2: **TOKEN USED IN CMT COMPLEX AND SHG MEMBER MANAGING THE COMMUNITY TOILET**

Source: Tiruchirappalli shows the way, WaterAid, 2008 and Sulabh ENVIS News letter

EXHIBIT 9.3: **FINANCIAL PERFORMANCE**

S.No.	Location of the Toilet	Avg. No. of Users / day	Average collection/ day	Income and Ex-penditure (2012-13)		Savings during 2012-13
		Nos.	Rs.	Income (Rs. Lakh)	Exp. (Rs. Lakh)	(Rs. Lakh) Exp.
1	Kamala Nehru Nagar	625	500	1.82	1.57	0.25
2	Dharmanathapuram	950	880	3.21	2.9	0.31
3	Sathiyamoorthy Nagar	400	650	2.37	2.09	0.28
4	Anna Nagar	550	505	1.84	1.6	0.23
5	Kalmanthai	635	650	2.37	2.1	0.27
				14.33	**12.72**	**1.61**

assistance from a multitude of organizations/ schemes. It also involved assistance from a agencies for technical support and financial support from NGOs like SEVAI, SCOPE, GUARDIAN and Gramalaya and donor agencies like Water and Sanitation Programme – South Asia (WSP-SA), Water Aid and Arghyam. The city recently secured 1st Place in the State, and 6th Place in the country in terms of Sanitation.

Starting from one slum in 2002 the city has converted 213 slums of 285 into open Defecation free slums and is on track to meet its goal of becoming open defecation free by 2015.

At present, Trichy has a total of 385 toilets with 4,643 seats and 431 bathrooms. Of this, 148 toilets are managed by the SHGs. 61 of these are managed by WAVE federation supported by Gramalaya, 28 by SCOPE and 54 by the remaining SHGs. The impact of the project is not only from a sanitation and public health perspective but also from a social empowerment and financial perspective.

- From a social empowerment perspective, the Community management toilets owe its success to the role of SHGs. The project has managed to leverage on the support extended by Government of Tamil Nadu to SHGs. It has been able to improve the employment opportunities for the weaker sections especially women, mitigate the socio-cultural barriers to women empowerment, and also helped in providing them skills.
- From a sanitation perspective, the community toilets have helped improve health indicators for the city. A study conducted by Water Aid found that the incidence of diseases like diarrhoea among children fell from 73% to 10% and among adults from 10% to 2%. Conversion of dry pit latrines into modern flush toilets and eradication of manual scavenging have been other benefits of the program.
- From a financial standpoint, the project has a higher economic return vis-a-vis the traditional TMC managed toilets driven by the rationalization of expenditure. The proper monitor-

ing of the toilets ensures that the toilets are protected against physical damages which will bring down life cycle cost of the toilets. The fiscal discipline of the service model through rationalization of cost will ensure financial sustainability. It will also drive use of latest technology and proper management.

Way forward

As indicated, TMC plans to continue to engage local SHGs in scaling up its community toilet management. As a first step, it plans to transfer O&M of the remaining 237 toilets for 3 years to the SHGs through the assistance of local NGOs. TMC also plans to call for annual tenders for engaging agencies to attend to repair works of community toilets with a view to improve repair completion within 48 hours of complaint being received. TMC also proposes to introduce modern cleaning equipment and outsource cleaning to professional service providers. Building on the positive experience of using SHGs in toilet maintenance, TMC plans to expand their scope of activities to cover management of 20 parks, urban forestry and in other vocational streams including plumbing, masonry and security.

Challenges faced and measures to address them

This section highlights challenges faced under the initiative and steps being taken to address them.

- **Keeping SHGs involved and engaged:** Keeping the SHGs and SHE teams motivated and engaged is a key challenge for sustaining the initiative. As the first line service providers, it is critical that they remain committed to their tasks envisaged. While TMC seeks to achieve financial accountability through proper monitoring and audit of accounts, there have been instances where SHG managed toilets have not been maintained well and this may need to be addressed by proactive monitoring, adequate penal provision and periodic third party inspection.
- **Continued user engagement and financial sustainability:** Handling the mind-set of the slum population to shift to pay and use toilets from TMC managed free toilets was initially a big challenge. The challenge for the SHGs as well as TMC will be to work with the slum community to continuously make the users aware of the health and hygiene impacts to ensure patronage and avoid communities slipping back into open defecation.
- **Continued focus on O&M:** TMC's plans to improve accountability for O&M through longer-term contracts and regular monitoring are steps in the right direction. TMC should also ensure that these facilities are equipped with provision of round-the-clock water supply and electricity.
- **Financial sustainability of toilets with lesser users:** It is possible that some of the toilets especially in areas with limited number of users, user charges alone may not suffice to meet the costs of operations. A Water Aid study suggests that viability will require patronage by over 500 users. It may therefore be necessary for TMC to review the financial status of these facilities from time to time, to ensure proper upkeep.

EXHIBIT 9.4: **TOILET INFRASRUCTURE PERFORMANCE**

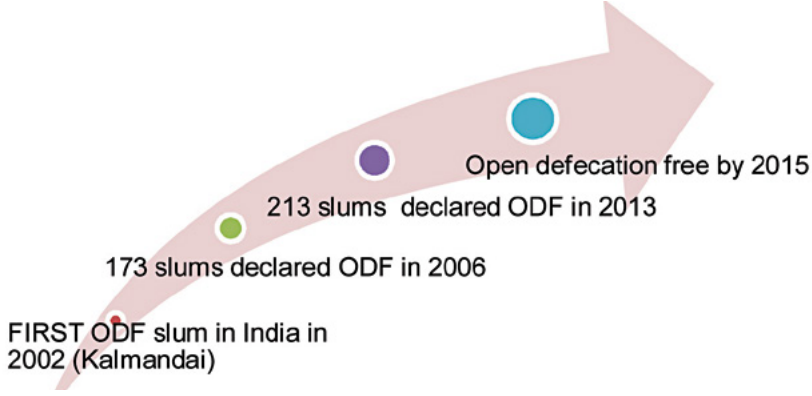


EXHIBIT 9.5: **TOILET INFRASRUCTURE PERFORMANCE**

Details	Number of units	Number of toilet seats				Number of bathroom		
		Male	Female	Children	Total	Male	Female	Total
Public toilets	311	1540	1749		3289			
Integrated sanitary complexes	74	485	524	345	1354	216	215	431
Total	**385**	**2025**	**2273**	**345**	**4643**	**216**	**215**	**431**

- **Accountability and transitioning challenges:** In some cases, the facilities faced protests from sweeper communities (who were responsible for maintenance of toilets and adjoining areas) with SHE teams taking over their role. Considering that the remaining toilets are expected to be handed over to the SHGs, it is important to ensure smooth transitioning arrangements.

Lessons learnt and insights for replication

TMC's painstaking efforts in collaboration with local NGOs are beginning to deliver positive outcomes as the city seeks to achieve ODF status in all its slums by 2015. TMC's focus on leveraging support of Self-Help Groups to build local ownership and involvement of local community in addressing the challenge of universal sanitation coverage is noteworthy and offers a number of lessons for replication.

1. **Involvement of Community (especially women) is very critical to address the scourge of open defecation:** Sanitation improvements in Tiruchirapalli reflect the fact that the key to the success of such initiatives is the involvement of communities, especially women. The organisation of Women's SHGs with access to credit facilities empowered them to manage their own toilet units resulting in improved cleanliness compared to those managed by the municipality.
2. **Willingness of communities to pay for better sanitation facilities:** Trichy had taken an approach to adopt user charges in its toilets. As seen from specific experience in few of the toilets, it appears that the SHGs were able to sustainably manage the toilets with user charges. While this may not be the case in all contexts, as is also pointed in the case in low use locations, it nevertheless reinforces that users do not mind paying when facilities are maintained well.
3. **Pro-active role of the ULB:** Although the local management was being handled by SHGs who were being supported by NGOs, TMC has progressively played a more pro-active facilitating role towards ensuring systematic and city wide scale-up. In due course, it may also become necessary for TMC to build rigor in contractual obligations of both the NGOs and SHGs to ensure consistency and standardisation of services.
4. **Leveraging scale-up opportunities:** As discussed earlier TMC is already exploring the extension of the SHG approach to some of the other areas of service delivery including maintenance of parks, municipal properties etc. It is also exploring potential for additional revenue generation options including advertising billboards at toilet complexes.
5. **Support for skill development:** Trichy's experience shows that presence of active and capable NGOs helps in skilling and providing a bridge between the ULB and community. In this regard, it may be necessary for ULBs to explore potential partnerships for bridging gaps in sanitation.

NANDED: COMMUNITY-LED TOTAL SANITATION

SNAPSHOT

Case abstract

This case profiles the positive results achieved by Nanded Waghala Municipal Corporation (NWMC) through adoption of Community-led Total Sanitation (CLTS) approach on a city-wide scale to address all aspects of sanitation including open defecation, solid waste management, drainage, water security etc. Nanded had prepared a City Sanitation Plan in February 2011 to identify the sanitation related challenges and action plan for the city with the active participation from community and successfully made over 85 neighbourhoods open defecation free. This case captures the context, implementation mechanisms and insights from this experience.

Context

Nanded city and Nanded Waghala Municipal Corporation

Nanded is the headquarters of Nanded District and is the second largest urban centre in the Marathwada region, after Aurangabad in Maharashtra. It is about 260 km from Aurangabad and 300 km from Nagpur.

Nanded Waghala City Municipal Corporation (NWMC) was established in 1997, by merging Nanded Municipal Council and Waghala Municipal Council. At Census 2011, Nanded – Waghala had a population of 5.5 lakh. There are 246 slum settlements in NWMC with a total population of 256,000. Of the 246 slums, only 25 slums are notified and the remaining 221 slums are non-notified.

Status of sanitation prior to the initiative

Nanded ranked 198th out of the 423 cities under the National Urban Sanitation Ranking undertaken by MoUD, highlighting the relatively poor sanitation situation in the city. In 2011, NWMC prepared a City Sanitation Plan, which helped in identifying the following key issues related to sanitation:

- The existing sewerage system was practically non-functional and the solid waste management system was not effective.
- 46% of the total population was staying in slums where open defecation was prevalent. Around 20% of the city population was defecating in open.
- Negligence towards maintenance of Multiuser community toilets was observed.
- There was a misconception regarding affordability to construct toilets as the community thought that constructing a toilet was a costly affair.

Nanded had a sewerage system that was designed and developed by Maharashtra Jeevan Pradhikaran (MJP) during 1969-71. The sewerage system was thereafter, handed over to then Nanded Municipal Council in 1974 for operation and maintenance. The sewerage system was designed for a peak load of 10 MLD. The

BOX 10.1 CLTS IN KALYANI MUNICIPALITY

In Kolkata Metropolitan Area, through, health and development programmes, counting of number of toilets per households were carried out and toilets were constructed for needy. Despite huge expenditures over many years, total sanitation was not achieved. The constructed toilets through these programmes were often not used and other households / slums kept waiting for their turn to have the toilets constructed rather than taking their own initiative.

Kalyani is a town near Kolkata with a population of 82,000. There were 52 slums around the city, where 10974 families were residing. Many of the slums' inhabitants are migrants from neighbouring states and Bangladesh. Majority of houses have no toilet facilities and open defecation was prevalent.

In 2006, the idea of Community-led Total Sanitation (CLTS) was introduced to the councillors and health officials of Kalyani ULB through Community-led Health Initiative (CLHI), a programme initiated by Kolkata Urban services for Poor (KUSP). Dr. Kamal Kar was instrumental in training CLTS teams in Kalyani and they were persuaded to start a pilot project in five slums initially. The major objectives of this pilot was to study and learn the possibilities of introducing community led development initiatives with special reference to public health such as environmental sanitation, elimination of open defecation, solid waste disposal and other public health issues.

In Kalyani, the concept of Sanitary Toilets was introduced and the same were constructed at affordable cost. A decision was taken in Kalyani Municipality to stop sanitation subsidy for household sanitation. The money saved on subsidy was used for other development works in slum. In six months' time span all pilot slums were open defecation free. After success of pilot project remaining slums were taken up and in 2008 Kalyani was declared as Open Defecation free city.

system has a total length of about 425 km, comprising about 25 km of main sewers and about 400 km of laterals.

Triggers for the initiative

Nanded city was facing several sanitation issues including open defecation and poor management of community/ public toilets. Post the launch of the National Urban Sanitation Policy by Government of India, NWMC initiated preparation of its City Sanitation Plan to make Nanded open defecation free, healthy and liveable.

The Municipal Commissioner of NWMC had exposure to Community-led Total Sanitation (CLTS) having implementing Total Sanitation Campaigns in rural areas earlier. This experience reinforced the need for focus on community-owned and community-led efforts in sanitation to reduce open defecation and littering, coupled with the investments in infrastructure and services would deliver better results for the city. He led the city's adoption of the CLTS approach in improving the sanitation situation in the city.

CLTS in Nanded

Project objectives and scope

The main objective of the project was to make communities in charge and accountable for the process and use their capacity to improve the status of sanitation in Nanded.

The scope of the project was to empower communities for participatory activities and provide capacity building and training facilities to the communities. The scope of work also included provision of required sanitation infrastructure and equipment. The work was initiated by carrying out initial surveys in Nanded for which two private firms were appointed.

Some of the major findings of the survey are listed below.

- **Higher levels of Open Defecation:** Many wards and localities in Nanded had large prevalence of Open Defecation (OD) with around 80-100% population defecating in open. Overall, 21% of the city's population were resorting to OD, with serious implications for health of its populace and leading to bacteriological contamination of water and high incidence of water borne illnesses. Since there was practically no treatment, almost 100% of waste-water was getting discharged untreated into River Godavari, creating significant water contamination.
- **Poor Solid Waste Management practices:** There was a city wide door to door waste collection mechanism in place in Nanded. "Ghanta gadis" were visiting all localities at a designated time to collect household waste and transport it to dumping sites. The collection and transportation of solid waste was outsourced to a private agency, which was not very effective as frequency of waste collection is not fixed. In many localities sometimes solid waste was collected once a week. This resulted in dumping of waste in to open drains and other open spaces.
- **Health risk to the citizens:** The city recorded high incidence of malaria, diarrhoea and jaundice. Several deaths of children and adults on account of these avoidable ailments have been reported, more so in summer months and during the monsoons. The ineffectiveness of solid waste management practices and open defecation underline its strong linkages to the poor health of the citizens.
- **Poor quality of water supply:** The quality of water being supplied in many parts of the city was visibly bad, with odour and practically unusable even for washing and bathing. In the initial stage of community mobilization, participants reported yellow and black coloured water with foul smell from public taps.

Project Implementation

Preparatory work: NWMC appointed two private firms, Knowledge Links and Feedback Foundation to carry out the work of 'behavioural change' for sanitation in Nanded city and preparatory activities included the following:

- A city level workshop was organised in first quarter of 2011, where stakeholders such as experts and prominent citizen groups from the city were invited. During the workshop, deliberations were undertaken on various aspects of city sanitation.
- Prabhag level workshops were then organised for a period of three days to encourage greater participation from citizens and potential 'natural leaders' and to promote CLTS approach.
- The real work with the communities began after this. Knowledge Links and Feedback Foundation started work in 2 Prabhags each.

Formulation of City Sanitation Plan: In the months of February and March 2011, both the agencies worked closely with NWMC and Nanded residents to formulate the City Sanitation Plan. The data available with the NWMC was validated through many citizen workshops.

- Visits were carried out in local communities to gauge their interest in sanitation issues and in coming together to talk about it. Both the firms tried to find out if there are active community based organizations such as women's self-help groups (SHG), youth groups, etc. These groups and other leaders from the community were involved to arrange meetings that were used as an opportunity for creating interest and awareness among citizens.
- Different tools were used to get communities to confront the consequences of leaving garbage in their streets or defecating in the open. Through trial and error method the triggering strategies were refined and adopted by target segments of the urban dwellers - working class communities living in the mill areas, slum communities, middle class neighbourhoods, schools, markets, etc. While for some communities the issues related to privacy and dignity mattered more, others were catalysed to take action when they were made aware of the health risks related due to food and water contamination and the expenses associated with the same.
- Communities were believed to be 'triggered' when they started expressing their disgust at the germs, dirt and faecal

matter they are consuming everyday as a result of open defecation and leaving garbage out. At this stage, communities started realising the sanitation situation in their locality. Then, finally the communities resolved to take action immediately on their own. Once the communities resolved to act, facilitators provided them with some ideas on how they might want to organize themselves through sanitation committees and help to identify volunteers who will take the lead. A Participative plan was prepared in March 2011 and NWMC began implementation in April, 2012.

Community facilitators conducted follow up meetings with communities to check the progress of the work. The follow up meetings mainly focused on understanding more about the municipal services, land tenure issues or technical advice on matters like garbage separation and compositing.

Positive impact and outcomes

Results of CLTS in Nanded

Of the 342 neighbourhoods, 238 were organised neighbourhoods and initiated actions to improve sanitation. Sanitation committees are formed in 157 neighbourhoods. Solid waste collection is done by private operator, 115 neighbourhoods regularly monitor the process of garbage collection. Drain cleaning is done by the communities. 129 neighbourhoods are involved in storm water drain cleaning. Since then, 85 neighbourhoods are open defecation free and 34 neighbourhoods became garbage free.

Impact of CLTS in Nanded

The positive impacts of implementation of CLTS in Nanded are as follow:-

1. **Active Community Participation:** Communities undertook new roles and responsibilities towards sanitation issues including the following:
   - Organizing sanitation committees – 157 committees were formed in Nanded
   - Stopping and preventing open defecation
   - Constructing or renovating toilets
   - Separating garbage and composting at household and community level – 115 communities regularly monitors garbage collection mechanism daily
   - Creating kitchen gardens
   - Demanding greater accountability from service providers and municipal officials
   - Transferring their experiences to other communities

2. **Clean settlements with zero open defecation:**
   - Settlements are much cleaner than before. Open defecation has been stopped.
   - Women and children have formed vigilance committees to report open defecation.
   - Streets and pathways in settlements that used to stink are now clean and usable.

3. **Women are being empowered:** Communities that are mobilized and taking action reveal that most leaders at community level – whether in poor, low income or middle income communities – are women. CLTS is clearly a very strategic entry point for women's empowerment because it addresses both the practical and strategic interests of women. Feedback from women active in community sanitation committees pointed to the following ways in which CLTS program addresses everyday practical problems they faced.
   - Children aren't falling sick as frequently as they did before.
   - Service efficiency levels for sanitation services have improved as service providers know that communities have access to officials and can report them.
   - Garbage collection is more regular.

4. **Change in governance processes:** The CLTS has also catalysed the process and introduced new mechanism which is strengthening democratic processes in Nanded. Implementation of CLTS resulted in regular Zonal Review Meetings. These meetings are a win-win for communities and the ULB. Communities are given opportunities to report progress, voice grievances and seek redressal, while the ULB gets direct, accurate information of how communities are experiencing the sanitation program. This information is otherwise filtered through various layers of people before it came to the ULB. Municipal Corporation's formal involvement and commitment to CLTS was critical in introducing new incentives for improving both community involvement and government's effectiveness in sanitation. Regular visits to communities and Zonal Review Meetings coupled with regular garbage collection demonstrate to communities that they are being heard.

Lessons learnt and potential for replication

With a spending of less than 1% of its budget on sanitation, NWMC managed to achieve fairly positive impacts through its community led approach. Community participation is an important part of the provision of the urban infrastructure whether its demand based planning or management of the facility. There are many cases where the community participation was undertaken in a particular manner such as for managing public toilet complexes.

Communities are claiming newer roles and responsibilities towards the sanitation issues and are becoming more active. ULBs can leverage the strength and capability of communities to allow them to take the ownership of the municipal assets and its upkeep. After initiation of the CLTS in Nanded, various committees were formed and reports of those committees were prepared. In fact in many Indian cities, ward committees exist and can be given the task of sanitation management as well. In case of Nanded, communities that are mobilized and taking actions, revealed that most leaders at community level are women. Communities can be involved with the help of supporting agencies and with the use of government supported programmes as well.

CATEGORY V

FINANCIAL SUSTAINABILITY

Two important aspects of financing of water and sanitation projects in ULBs in India are – (a) capital investment which is mostly supported by grants from state/ central government and (b) O&M expenditure on the facilities coupled with weak or absence of user charge framework. To make the ULBs financially sustainable and to bring in the financial discipline, the GoI started insisting upon the O&M cost recovery of water and sanitation services. The initiatives and projects taken up for cost recovery and financial sustainability are identified under this Category.

Projects identified under this category are related to the initiatives such as cost recovery through introduction of user charges, effective billing and collection, water and energy audit projects to reduce costs, citizen facilitation projects, tariff revision and infrastructure improvement for overall sustenance of the water supply and sewerage system.

List of such projects that can come under this category is identified which is given in Exhibit 5 below.

A brief project profile was prepared based on secondary research and in consultation with respective ULBs/ utilities wherever feasible. Then two priority projects were chosen based on following criteria,

- Feedback and inputs from PRG members was taken on various aspects.
- Status of project and likely availability of data/ information with ULBs.
- Key takeaways or learning from the project, which can be replicated elsewhere.
- Projects or initiatives which are already covered or published in earlier case studies or compendiums were eliminated.

Based on the above criteria two projects were shortlisted from the inventory of projects.

- **Pallavaram Sewerage project:** This case captures efforts of Pallavaram municipality in Tamil Nadu to squarely address financial sustainability aspects of developing and managing its sewerage network.
- **Energy audit project for water supply system in Nagpur** - In order to improve operational efficiency of the water supply system, Nagpur Municipal Corporation (NMC), decided to conduct a water and energy audit for the entire city in 2005. The study resulted in recommendations for improvement at two levels: water distribution and energy efficiency to increase the efficiency of the treatment plants.

EXHIBIT 5

S.No.	Project Name	Location (city)	Completion Year
1	Municipal resource mobilization through rationalization of water supply and sewerage charges	Chandigarh	2002
2	Revenue generation from supplying treated waste water and then recycling it for the use of Thermal Power plant, Nagpur	Nagpur	2009
3	Mapping of Leakages and Leak audit in water supply system in Surat	Surat	2010
4	24X7 Water Supply PPP Project of Mysore city – revenue enhancement while improving system efficiency	Mysore	2011 (ongoing)
5	Pallavaram Sewerage project	Pallavaram	2012
6	Energy audit project for water supply system	Nagpur	2005

Source: JnNURM, IMaCS Research

PALLAVARAM: USER-FINANCING IN SEWERAGE PROJECT IMPLEMENTATION

Case abstract

Less than a third of domestic sewage in India gets treated and even in large cities in the country, a significant portion of sewage goes untreated. Further, even in cities where sewerage projects have been executed, financial and O&M sustainability of these projects have been areas of concern.

This case profiles the experience of Pallavaram municipality, one of the 25 ULBs in Tamil Nadu that have implemented sewerage systems with connection deposits from users as part of the project's financing mix and fixation of user charges to meet 100% O&M cost recovery. In Pallavaram, user deposits were set to cover nearly 30% of the project cost even as a combination of user charges and earmarked property taxes are envisaged to cover debt servicing and O&M costs during the course of operations. This case traces the challenges faced and positive outcomes achieved and generates insights for other Indian cities seeking to implement sewerage projects with user financing.

City profile

About Pallavaram town and Pallavaram municipality

Pallavaram is a peri-urban area just beyond the limits of Corporation of Chennai and falls within the Chennai urban agglomeration, along the Grand Southern Trunk (GST) Road, a National Highway from Chennai towards Madurai and Trichy. The city is under the administrative jurisdiction of Pallavaram municipality. Pallavaram municipality is spread over 18 sq.km and had a population of 1.4 lakh as of 2011. As a peri-urban area of Chennai, its population grew by 50% during 2001-11, much higher than Tamil Nadu's urban population growth at 22% during the same period.

Triggers for the Project

Experience from 'Alandur' project and launch of TNUDP-III

The project's genesis lay in the implementation of a sewerage project in an adjoining town, Alandur (which has since then been amalgamated into Corporation of Chennai), which was the first city in the country to implement a sewerage system with connection deposits from users being used to part finance the project. Loans from the World Bank-assisted Second Tamil Nadu Urban Development Project (TNUDP-II) and grants from Government of Tamil Nadu (GoTN) met the rest of Project cost. One-time connection deposits from over 15,000 households (each of whom contributed Rs 5,000 each) covered one-third of the project cost. When the Third Tamil Nadu Urban Development Project (TNUDP-III) was launched by World Bank and GoTN, it sought to replicate the Alandur model in other cities in Tamil Nadu seeking to implement sewerage projects.

Accrual accounting and ring-fenced water-sewerage account

By 2000, all ULBs in Tamil Nadu had implemented accrual accounting along with a separate water and sewerage account under which the water and sewerage assets, revenues and costs were separately accounted and reported. Thus ULBs in Tamil Nadu had the necessary building blocks in place for rigorous project appraisals and external financing of projects.

Sanitation scenario in Pallavaram

Despite being a rapidly growing town, Pallavaram did not have a sewerage system. About 25,000 households had access to septic tanks. 7% of households were resorting to open defecation. Due

EXHIBIT 11.1: **PROJECT COMPONENTS**

S.No.	Description of Works	Target
1	Sewer Network (km)	160
2	Pumping Main (km)	42
3	Manholes (Nos.)	6602
4	House Service Connections (Nos.)	16602
5	Pumping Station (Nos.)	11
6	Sewage Treatment Plant	Pumped to an existing STP in Perungudi

Source: Pallavaram Municipality

EXHIBIT 11.2: **FUNDING PATTERN**

S.No.	Funding	Initial Estimate (Rs. In Lakh)	%
1	Loans	2578.49	52%
2	Grants	850.00	17%
4	Public Contribution	1500.00	30%
	Total	**4928.49**	**100%**

Source: TNUIFSL Project Appraisal and Board Note.

BOX 11.1 KEY STAKEHOLDERS AND ROLES

The execution of Pallavaram UGSS project involved multiple stakeholders including the following:

- **Municipal Administration and Water Supply Department, Government of Tamil Nadu (MAWS)** is the nodal department for municipal administration in Tamil Nadu.
- **Office of Commissioner of Municipal Administration (CMA)** which is the nodal department under MAWS and oversees functioning of all ULBs other than Corporation of Chennai.
- **Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL)** is a nodal financial intermediary and functions as the Fund Manager of the Tamil Nadu Urban Development Fund (TNUDF). TNUDF was set up in 1996 with TNUIFSL as its asset management with a Line of Credit support from the World Bank to extend loans on a non-guarantee mode for urban projects.
- **Chennai Metro Water Supply and Sewerage Board (CMWSSB)** is a parastatal agency mandated with implementation of water supply and sewerage facilities in the Chennai Metropolitan area. It was designated as the implementing agency for Pallavaram UGSS and was responsible for overseeing the procurement and construction of the project.
- **Pallavaram Municipality** as the ULB administering Pallavaram city was responsible for managing the system post hand over of the system by CMWSSB on construction. The municipality is also responsible for O&M and financial sustainability including meeting its commitments of debt servicing and levy and collection of user charges as per the project appraisal and loan commitments.

to lack of a proper sewerage network, there was discharge of sewarage into open drains resulting in unhygienic environmental conditions and breeding of mosquitoes. So, when GoTN took a policy decision to initiate a programmatic implementation of sewerage projects in all large towns and peri-urban areas within Chennai Agglomeration, Pallavaram which did not have a sewerage network, emerged as a logical contender for a sewerage system.

The Project: Sewerage system with user financing

Early approvals, scope, components and capital costs

A Detailed Project report (DPR) for the Pallavaram Underground Drainage Scheme (UGSS) was prepared to cover all the 42 wards of the city. The project was designed for an ultimate population of 250,000 (2036) and estimated sewage generation of 18 MLD. The proposed project was designed as a partial flow system with the sewers being laid at sufficient depths to receive all the sewerage inflow from house service connections. A design period of 30 years was considered for the system and 15 years for pumping machinery. Refer Exhibit 11.1 for project components.

Project appraisal and financing plan

In 2005, GoTN accorded administrative sanction for the project. The project cost was estimated at Rs. 49 Crore. The project was appraised by the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL), the fund manager for the Tamil Nadu Urban Development Fund (TNUDF) and the initial financing plan (refer Exhibit 11.2) envisaged a combination of long term loans and user deposits. Grants in TNUDP-III were introduced as viability gap funding to make the project feasible. User charges were fixed to meet O&M costs and Debt Servicing.

The implementation of the Project involved a variety of stakeholders (captured in Box 11.1 above)

Loan financing and payment security

Since Underground sewer projects are capital intensive in nature and have a long life of assets, it was proposed to fix the repayment tenor at 15 years and 5 years moratorium with an interest rate of 8.5%. The Loan Agreement between TNUDF and Pallavaram Municipality incorporated payment security mechanisms including escrow of user charge revenues and earmarked property taxes and creation of a debt service reserve fund.

Consultations with Municipal Council and approval by ULB

Consultations were held with the Municipal Council to make them aware of the project benefits and of the obligations of the ULB with respect to loans, connection deposits and user charges. Following this, the Municipal council passed a resolution accepting the conditions of loan sanction and financing plan as per the Project appraisal by TNUIFSL and to enter into a Loan agreement with TNUIFSL. The loan agreement between Pallavaram municipality and TNUDF was signed in June 2005. The adoption of a council resolution and the signing of loan agreement set the stage for implementation.

Project implementation

The project implementation was envisaged in six packages and construction commenced with award of contracts for construction of the sewerage network. Although four of the six packages were awarded in 2005 and construction commenced, the project soon got hit by a number of implementation challenges that needed to be tackled.

EXHIBIT 11.3: **PALLAVARAM UGSS: INFRASTRUCTURE ADDED UNDER THE PROJECT**

S.No.	Parameters	Unit	Before project	After project
1	Treatment	MLD	0	9
2	Distribution	Km	0	160
3	Connections	No.	0	15,650
4	Public conveniences	No.	4	10

Source: Pallavaram Municipality

EXHIBIT 11.4: **PALLAVARAM UGSS: REPORTED SERVICE LEVELS**

S.No.	Proposed Indicators	Benchmark	Status	Reliability
1	Coverage of Sewage network services	100%	76%	B
2	Collection efficiency of the sewage system	100%	100%	A
3	Adequacy of sewage treatment capacity	100%	200%	A
4	Quality of Sewage treatment	100%	100%	B
5	Efficiency of redressal of Customer Complaints	80%	100%	A
6	Cost recovery	100%	96%	A
7	Efficiency in collection of sewage Charges	90%	30%	A

Source: Pallavaram Municipality. As in 2013-14

Delays, mid-course corrections, and cost escalation

Even though the initial contracts were awarded and construction commenced, the Project faced some serious challenges that led to delays and warranted mid-course corrections and cost revision.

- **Land acquisition challenges:** Delay in acquiring land for pumping station and public objection resulted in the halting of work in the construction site. Acquisition of land for main pumping station near Kilkattalai Lake was delayed due to litigation and had to be shifted to a different location.
- **Additions to project scope:** The approved Detailed Project Report (DPR) for the project had not adequately assessed the rapid growth of population in the suburb. The population grew 50% and the properties had doubled within a decade. The ultimate population of 2.45 lakhs used to design the sewerage network for the ultimate year of 2036 was eventually reached by 2013 itself. This unanticipated growth of town led to pumping bottlenecks and re-sizing of select pumping mains. Additional street side lifting stations had to be added. As against 4 pumping stations and 2 lift stations, 4 pumping stations plus 7 lifting stations have been added.

As a result, the Project faced significant delays and in 2009, the project cost had to be revised from the original estimate of Rs. 49 crore. The cost escalation was due to delay in acquisition of pumping station sites, change in location of main pumping station from Kilkattalai, tender access for collection system packages, change in alignment of the sewer lines, trunk main and pumping main, construction of an additional pumping station at Nanmangalam Nagar and presence of hard rock soil.

Eventually, after mid-course corrections and a revised administrative sanction, the remaining two packages were awarded in 2009, four years after the initial contracts had been awarded. Construction was finally completed in 2013, 7 years after construction started, at a Project Cost of Rs. 59 crore and the project was handed over to Pallavaram municipality.

Positive impacts and outcomes

Notwithstanding the challenges faced the Project led to several positive impacts and outcomes some of which are summarised below. Refer Exhibit 11.3 for details of infrastructure added and Exhibit 11.4 for reported service levels for 2013-14.

- **Sewage treatment:** The treatment of the sewage generated has increased from 0 to 9 MLD with the ultimate capacity of Sewage Treatment Plant at Perungudi for Pallavaram city at 2036 (Ultimate stage) as 18 MLD. The current ratio of Treatment to Generation is 100%.
- **Network coverage:** The sewerage network covered 98% of the area. However, as the town expanded the 160 km of sewer lines ended up covering only 76% of road length.
- **Household Connections:** Over 15,650 connections had been provided as of March 2014.

- **Public Conveniences:** New Public conveniences were added to take the total number of public toilets available in the city from 4 to 10.
- **Connections to urban poor:** Over 1300 connections serving an urban poor population of over 7000 in the 13 slums in Pallavaram are envisaged to be covered.

Other recent initiatives

Pallavaram Municipality also established a complaints redressal system for addressing the complaints regarding the UGSS system and has made provision for the toll free number. Over 150 complaints were recorded and resolved within the first three months of the system going live. As the city expanded at unprecedented speeds leading to increase in road length from 180 km to 210 km, a proposal to add 41 km of sewerage network serving 10,000 households has been submitted to GoTN for extending coverage to uncovered and expanded areas of the city.

Initial results of user financing

- **Connection deposits:** Connection charges for different categories of users were fixed as follows:
  - Domestic: Rs. 10,000 per house connection
  - Commercial: Rs. 20,000 per connection
  - Industrial: Rs. 20,000 per connection

For the 15,650 connections provided, fixed deposit of Rs. 16.39 crore has been collected. Upon completion of target connections of 16,602 are provided, the collection is expected to reach about Rs. 17.5 crore, translating to roughly 30% of the Project cost. At the same time, subsidized connections were provided to slum areas within the city. Notwithstanding the challenges faced during construction in terms of protests against project locations and delays, the successful mobilization of user deposits was made possible owing to strong political commitment, a clear state-level policy on use of connection deposits and community support made possible through extended awareness creation initiatives by ULB officials and elected representatives.

- **User fees:** The user charges to cover O&M cost were proposed to be collected at the following rates:
  - Rs. 150 per month per connection from the domestic users
  - Rs. 450 per month per connection from commercial and
  - Rs. 750 per month from industrial users.

Post provision of connections, the city has faced resistance from some quarters as the user charges at Rs. 150 per month was significantly higher than the Rs. 75 per month collected in adjoining areas of Corporation of Chennai, where user charges for sewerage have not been revised in recent years. As a measure to address citizen concerns, a proposal to introduce slab rate linked to size of property and property taxes paid is under consideration. ULB officials are confident that citizens would come around to see the benefits of the project and collection efficiency would improve from 30% in 2013-14 to over 70% this year.

Lessons learnt and potential for replication

When user financing was introduced in Alandur sewerage project in the late 1990s, it was seen as an innovative financing mechanism, but doubts persisted on its replicability. Since then the Government of Tamil Nadu has implemented sewerage schemes in over 40 cities many of which have involved some level of user financing and elements of the user charge structure discussed here. From a financing and financial sustainability stand point therefore, the experience at Pallavaram and a number of other cities in Tamil Nadu suggest that user financing is indeed a replicable idea for expanding waste-water treatment. A few insights from this case are summarised below:

- **Benefits of a city wide sewerage system:** Pallavaram town was devoid of sewerage system and sewage disposal was dependent upon the septic tanks and public conveniences, which were directly and indirectly polluting the ground water. Apart from providing a city-wide solution, care has been taken to make the project inclusive by connecting slum areas and low-income neighbourhoods with subsidised connection charges.
- **With a participative approach and credible implementation, user-financing is do-able and provides a means to tackle the financing challenge.** Traditionally, sewerage projects have tended to rely excessively on capital grant funding and projects have been constrained when grant financing has not been available. The experience of Pallavaram and other cities show that with a credible implementation plan, citizen participation can help alleviate pressure on grants which can be disbursed on the basis of project appraisals and assessment of ability to pay.
- **Importance of O&M sustainability:** Financial sustainability during O&M phase is equally important to ensure sustained operation. In case of Pallavaram, while there is a provision for periodic escalation of user charges to to reflect cost inflation, it is important that this is implemented in practice.
- **Harmonization of user charges across the state:** Resistance has been seen owing to higher user charges of Rs. 150 collected vis-à-vis Chennai Corporation of Rs. 75. As GoTN scales up its sewerage program, it would need to, in consultation with ULBs, articulate a Tariff Policy for urban services that would harmonise mechanisms for setting targets for cost recovery, tariff fixation and revision while balancing affordability and sustainability considerations.
- **Benefits of a state-level nodal urban financing framework:** The project also suggests that having a strong nodal urban financing framework for effective design, development and appraisal of projects can help bridge the capacity gaps and help programmatic replication of ideas across the state.

NAGPUR: ENERGY AUDIT OF WATER SUPPLY

SNAPSHOT

Case abstract

Energy costs account for a sizeable portion of operation and maintenance costs of urban water supply systems. Apart from potential for savings in electricity from improved efficiency of water supply operations, good energy management practices also play a significant role in prolonging life of equipment in water supply networks.

This case profiles the results and outcomes of an energy audit of water supply system initiated by Nagpur Municipal Corporation (NMC) with capital grant support under GoI's JnNURM scheme in 2006. The energy audit was undertaken concurrently along with a water loss audit as part of a comprehensive water sector efficiency program. Covering all Water Treatment Plants and select pumping stations, actions undertaken and implemented following the energy audit exercise led to considerable energy cost savings, estimated at Rs. 2.8 lakh per day (at 2010 prices).

This case traces the objectives and scope of the audit, details the actions implemented following the audit and summarises positive impacts in terms of energy and costs savings achieved by NMC.

Context

Nagpur city and Nagpur Municipal Corporation

Nagpur, located in the Vidarbha region of Maharashtra is among India's fast growing cities. It is an important political/administrative centre and is home to several Government agencies and Research institutions including the National Environmental Engineering and Research Institute (NEERI) and is a centre for Maintenance Command of Indian Air Force. Nagpur is also a hub of industrial activity in the Vidarbha region. While Butibori is the largest industrial estate in its vicinity (located 25-30 km from Nagpur city), other industrial areas around Nagpur include Kamptee, Hingna, Wadi, Khapri and Kalmeshwar. The Government of Maharashtra (GoM) has also initiated efforts to develop the existing airport at Nagpur as a Multimodal International Hub Airport at Nagpur (MIHAN) along with creation of a Special Economic Zone (SEZ) and allied facilities. MIHAN is being developed as a multi-dimensional, multidisciplinary project of global standards. Nagpur Municipal Corporation (NMC) is mandated with provision of civic services in Nagpur city. At the time of Census 2011, NMC had a population of 2.46 million, spread over an area of 218 sq.km.

Energy costs in water supply system prior to this initiative

Water supply service delivery in Nagpur city is the responsibility of NMC. In 2005, prior to this initiative, water supply was managed under NMC's water supply department. At this point, NMC was treating close to 480 MLD (which has since then gone up to 675 MLD in 2011). A water audit undertaken by NMC around this time (in 2005) had recorded its water losses at a 62%, with metered billed consumption assessed at 241 MLD. Energy cost for 2004-05 was Rs. 21.1 crore and accounted for nearly 50% of NMC's O&M cost of water supply.

Triggers for the initiative

In 2000, the Government of Maharashtra (GoM) appointed the Sukthankar committee to review efficiency of urban water supply systems. The report of the committee highlighted the high energy costs of pumping (at 50-60 per cent of Operational costs of urban water supply systems) and recommended funding support for energy efficiency and water loss reduction initiatives. In 2002, following the recommendations of this Committee, the Government of Maharashtra (GoM) launched a capital grants program to support efficiency improvement initiatives (in leakage reduction and energy savings) in urban water supply in cities and towns in Maharashtra. All ULBs with population more than 100,000 were directed to carry out the assessment and develop action plans to reduce UFW and energy conservation.

Around the same time, NMC had initiated preparation of a water supply master plan and a water loss audit exercise. When funding under JnNURM became available, NMC decided to undertake an energy audit and to implement an energy efficiency plan.

Energy audit of water supply

Project objective and scope

The main objective of the project was to improve energy efficiency and to reduce operational costs of water supply through optimisation of energy consumption.

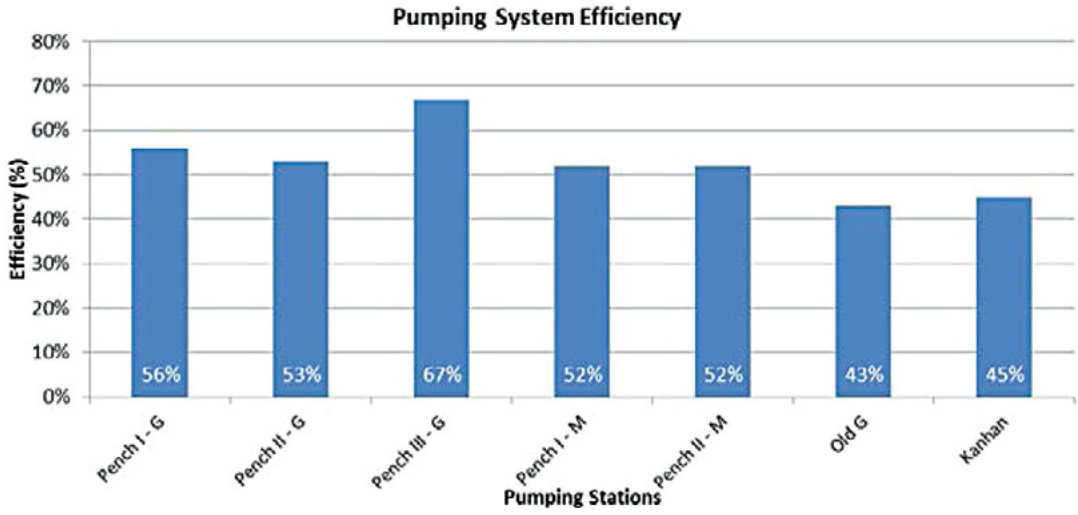
The scope of the audit covered two components namely, (a) Analysis of potential savings in the pumping and transmission systems, and (b) potential efficiency improvements through automation, instrumentation and setting up Water Distribution Management System (WDMS).

Key findings from the energy audit

The energy audit revealed the significant potential for energy cost reduction in NMC's water supply system, particularly through improvement of pumping equipment efficiencies. Pumping system efficiency was less than the minimum desired efficiency level of 70% at all the locations, with maximum achieved being 67% at Pench–III. Refer Exhibit 12.1 for pumping efficiencies of various pumping stations.

NMC estimated that cost burden of excess energy consumption, due to these inefficiencies in pumping system was Rs. 77

EXHIBIT 12.1: **FINDINGS FROM WATER AUDIT – PUMPING EFFICIENCY AT VARIOUS LOCATIONS**



Source: NMC

EXHIBIT 12.2: **PACKAGES UNDER ENERGY EFFICIENCY IMPROVEMENT PLAN**

Package	Component	Cost (Rs. Lakh)
1	Replacement of pumping machinery at Pench-I Mahadula	295.38
2	Replacement of pumping machinery at Pench-I Gorewada	260.86
3	Retrofit of existing pumping equipment at Pench-II Mahadula	54.81
4	Retrofit of existing pumping equipment at Pench-II Gorewada	30.94
5	1200 mm MS pipeline from Gittikhadan Sq. to Governor House	522.87
6	Parallel pipeline for Kanhanpumping main	407.35
7	Pench-I WTP Improvement on PPP (38% funding by private operator)	641.35
8	Instrumentation of pumping Station & WTP on PPP (30% by private operator)	614.37
	TOTAL	**2827.93**

Source: NMC

million annually. In addition, the energy audit identified other potential areas for reduction of energy consumption including optimisation of pumping heads, replacement of old machinery, which were operating below their Best Efficiency Point.

Implementation program

With the intention to optimize energy consumption, NMC prepared an implementation plan and a Detailed Project Report focused on three action areas:

1. Rationalisation of water distribution and pumping system to reduce static and frictional head.
2. Replacement of old and inefficient pumps with energy efficient pumps and improving existing pumping machinery to operate at their Best Efficiency Point.
3. Installation of remote monitoring system to operate the pumps at prescribed efficiency.

The Detailed Project Report was approved under JnNURM in 2006 at a cost of Rs. 25 crore and the implementation was completed in 2010.

Components of the implementation program

Major components of the project included replacement of the existing pumping machinery, laying of 1,200 mm MS (mild steel) pipeline to connect to the Master Balancing Reservoir (MBR), improvement of Water Treatment Plant (WTP) and automation of the existing Pumping stations. The project was divided into eight packages as given below of which six packages were done on Engineering Procurement and Construction (EPC) & two packages

were implemented on PPP mode. Refer Exhibit 12.2.

The Project was completed without escalation and managed to get private investment of Rs. 3.8 crore in two of the packages which were done on PPP mode. The O&M cost was estimated at Rs. 7.11 crore including supply, installation, commissioning and comprehensive operation and maintenance for a period of five years.

Further, to monitor the working of Water Treatment Plants and pumping stations, NMC implemented a Water Distribution Management System (WDMS) by providing a central monitoring station at NMC administrative head office & local monitoring at each WTP and pumping location.

The objective of the WDMS was to measure, record and monitor the parameters like energy consumption, voltage, current, power factor, flow level, pressure, residual chlorine of, pH, turbidity, etc. at WTPs and pumping stations. Logical controllers, input & output signals, sensors and transmitters have been provided along with suitable Telemetry / monitoring system based on Radio Frequency (RF) technology.

Positive impacts and outcomes

Results and savings

The initiative resulted in several tangible gains for NMC including the following:

- Reduction of system head from 60m to 12m for Pench I scheme and reduction in specific energy consumption by 106.96 Kwh/MLD.
- Aided in recovery of 7 MLD of backwash water.
- Effective annual savings of over Rs. 10 crore in O&M costs and a payback period of less than 2 years on investments made.
- Increase in per capita availability by 24 lpcd and water supply to an incremental 4.5 lakh persons.

Refer Exhibit 12.3 for some specific outcomes achieved as a result of the energy efficiency improvement plan.

Other overall impacts

Other positive impacts from the project included the following:

- Assessment of system level gaps and necessary changes helped in improvement in pressure, reduction in energy consumption and utilisation of equipment/ instruments at their best efficiency.
- The project contributed to improving environmental sustainability through recovery of backwash water, energy conservation and proper monitoring & control of the system operations.
- Savings in energy cost resulted into improved O&M cost recovery.
- Better monitoring and management of the working of WTPs and pumping stations is now being done through WDMS. Various parameters of the water supply system are measured and recorded and provide useful inputs in decision making.

Lessons learnt and potential for replication

- **High potential for energy cost savings in water supply systems.** As pointed out earlier, Energy costs forms a major part of operating costs of water supply and sewerage systems. With ever-increasing costs of energy, need for reduction in carbon footprint and constraints faced by ULBs to increase user charges, steps to rationalise energy costs should be a key focus area for ULBs in India. Yet, even while areas of cost savings and potential improvement areas are generally known and understood, a structured approach, specific investment funding and tangible actions to realise the same have often been lacking. As demonstrated by NMC, with a focused implementation program and with increment investments, tremendous cost and energy savings are indeed achievable, given the high baseline costs in many of our ULBs. Apart from energy cost savings, such projects can improve net water availability (through reduction in need for backwash water and adoption of multi-use flow technology) as demonstrated by NMC.
- **Utility of system-wide instrumentation in data acquisition, monitoring and decision making:** Implementation of system wide instrumentation and information acquisition through SCADA and WDMS can potentially help ULBs in monitoring the entire water supply system. In case of NMC, implementation of a central monitoring system has contributed to ease of monitoring and effective decision making.
- **With thoughtful structuring, investments and capacities of private sector can be leveraged.** Apart from other aspects, NMC also managed to structure a couple of packages on PPP mode to get private funding and capability.
- **The scope for energy savings at ULB level transcends water supply systems.** Clearly the scope for realising energy savings at ULBs extends beyond water supply systems. Building on the positive momentum from its energy savings initiatives in water supply, NMC has extended the scope of energy assessment to a comprehensive citywide assessment in other sectors. Following the energy audit in water supply, NMC compiled energy consumption data in other areas (including street lighting, transportation, water pumping system, residential, commercial and industrial sectors) over the past few years to use this as a baseline to analyse trends and prioritize actions for energy conservation, cost minimisation and carbon footprint reduction.

EXHIBIT 12.3: **KEY OUTCOMES- ENERGY AUDIT NMC**

S.No.	Pumping station		Pumping head re-duction	Pump re-placement	Protective Coating	Control & Remote Monitor-ing	System Upgra-dation	Annual Saving in 000' Kwh	Annual Saving (Rs. Lakh)	Invest-ment (Rs. Lakh)	Payback period (Years)
1	Mahadula	Pench I		Y	Y	Y	Y	2,053	92.39	295	3.2
		Pench II		Y	Y	Y		2,014	90.67	59	0.7
2	Gorewada	Pench I	Y	Y	Y	Y	Y	4,269	192.11	261	1.4
		Pench II		Y	Y	Y		1,376	61.92	31	0.5
								9,712	**437.09**	**646**	**1.5**
3	Old Gorewada	Y	Y	Y	Y	Y		N.A			
4	Kanhan WTP	Y	Y	Y	Y	Y					
5	Improvement & Upgradation to GorewadaPench -I WTP								438	641.35	1.5
6	Laying of parallel pipeline Kanhan pumping main from Automotive square to Subhannagar ESR 700 mm dia.								146	407	2.8
							Total	-	**1021.09**	**1694.35**	**1.66**

Note:
1. For S.No. 1 & 2 all action plan have been implemented. Savings as per measurement.
2. For S.No. 5 & 6, these two projects was also covered in EA projects and it has resulted into savings in the form of 40 MLD additional water supply to city and these savings are calculated for energy value saved.
3. Remote monitoring project under implementation.
4. Energy cost considered as per revised tariff i.e. Rs. 4.5 / Unit.

Source: NMC

ANNEXURE II

LIST OF PEOPLE MET

S.No.	Name	Organization	Designation	Contact Number	Email
Nagpur Municipal Corporation					
1	Mr. Shyam Wardhane	Nagpur Municipal Corporation	Municipal Commissioner	0712 - 2567035	nmcegov@gmail.com
2	Mr. Rehman	Nagpur Municipal Corporation	Executive E - Water supply	+91 9823128270	-
3	Mr. Ganveer	Nagpur Municipal Corporation	Deputy Engineer	+91 9823387604	-
4	Mr. Mahesh Gupta	Nagpur Municipal Corporation	OSD to Municipal Commissioner	+91 9823167153	maheshgupta@nmc.org.in
5	Mr. S.V.K. Babu	Veolia			babu.svk@veolia.com
6	Mr. Shrikant Samrutkar	Vishvaraj infrastructure ltd	Manager	8806666835	Shrikant.samrutkar@vilindia.com
Surat Municipal Corporation					
1.	Mr. Jatin Shah	Surat Municipal Corporation	City Engineer	+91 9724345207	ce@surat municipal.org
2	Mr. Jagdish Thadani	Surat Municipal Corporation	Deputy Engineer	9724344877	Jagdishthadani77@gmail.com
Pimpri Chinchwad Municipal Corporation					
1	Mr. Pravin Ladkat	PCMC	Executive Engineer	+91 9922501727	p.ladkat@pcmcindia.gov.in
2	Mr. P. Deshmukh	PCMC	Deputy Engineer	+91 8380059408	p.deshmukh@pcmcindia.gov.in
3	Mr. Vasant Joshi	Suez Environment India	Manager - Sales and Business Development	+91 9972520150	-
Bangalore Water Supply and Sewerage Board					
1	Mr. H.M. Ravindra	BWSSB	Deputy Chief Engineer - I	+91 9845823556	-
2	Dr. P.N Ravindra	BWSSB	Executive Engineer, New Initiatives	+91 9845444127	drpnravindra@gmail.com
3	Mr. S. Narahari	BWSSB	Executive Engineer, Revenue billing and collection	+91 9880668431	-
4	Mr. Maheshwarappa	BWSSB	Executive Engineer, Water Audit and Control	+91 7760990274	pmwac@bwssb.org
5	Mr. Venkatesh Patil,	IBM	Solution Architect	+91 9845296024	venpatil@in.ibm.com

S.No.	Name	Organization	Designation	Contact Number	Email
Municipal Corporation, Jalandhar					
1	Sh. M.S.Chattwal, PCS	Municipal Corporation, Jalandhar	Commissioner	0181 – 2227015	-
2	Mr. P.S. Jaggi	Municipal Corporation, Jalandhar	Additional Commissioner (O&M)	+91 9815966444	psjaggimcj@yahoo.com
3	Mr. ReshamLal	Punjab water Supply and Sewerage Board	Executive Engineer	+91 9646700151	eepwssd1jal@gmail.com
4	Mr. Kanwaljit Singh	Punjab water Supply and Sewerage Board	SDE	-	eepwssd1jal@gmail.com
Tirunelveli City Municipal Corporation					
1	P. Gurusamy	TWAD	Joint Chief Engineer	044-28553562	jcepdctwad@gmail.comgurusamy_04@yahoo.co.in
2	K.P. Jai Xavier	Tirunelveli City Municipal Corporation	City Engineer	0462 - 2336633	jaixavier_ce@yahoo.com
3	Muthy	TWAD, Tirunelveli	Executive Engineer	+91 9442067773	eeurtly@gmail.com
Nanded Waghala City Municipal Corporation					
1.	Mr. Nipun Vinayak	Government of India	Deputy sec,	+91 9650307575	-
2.	Mr. Ratnakar Waghmare	NWMC	Dy. Municipal Commissioner	+91 9011000920	Ratnakar.dmc@yahoo.co.in
3.	Mrs. Vasudha Phad	NWMC	Asst. Municipal Commissioner	+91 8888847092	vasudhaphad@gmail.com
4	Sanjeev Patil	IL&FS	VP		sanjeev.nanded@gmail.com
5	Mr. Ajay Sinha	Feedback Foundation	COO	0124 -4211840	ajays@feedbackfoundation.in
Tiruchirappalli City Municipal Corporation					
1	V.P. Thandapani	TCMC	Commissioner	0431 2412860	commr.trichy@tn.gov.in
2	R. Chandran	TCMC	CE	0431 2418586	commr.trichy@tn.gov.in
3	Arunachalam	TCMC	EE	0431 2418586	commr.trichy@tn.gov.in
Pallavaram Municipality					
1	K. Sreenuvasan	Pallavaram Municipality	Municipal Engineer	9003003606	-
2	R.S. Venkatachalam	Pallavaram Municipality	Assistant Engineer	-	-

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