



# Pre-Feasibility Study for The Pimpri-Chinchwad 24x7 Project

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Executive Summary

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## i. Executive Summary

### A. Objectives of the 24x7 Project

1. The Pimpri-Chinchwad 24x7 water supply project has been selected as a prefeasibility study (PFS) for a number of reasons: (i) it is a priority for Pimpri-Chinchwad Municipal Corporation (PCMC), (ii) the benefits of continuous, pressurized water supply include health and economic benefits particularly for the poor in slums and chawls, (iii) the project will result in a 25% reduction in required treated water production from 796 mld to 577 mld, as a result of network efficiency improvements and reduced physical losses, and (iv) the preliminary financial analysis and costing has shown that the 24x7 project will result in a 50% (5590 million INR, 114 million USD<sup>1</sup>) saving in Capex, and a 20% (8210 million INR, 168 million USD) saving in Opex in the fifteen year period from 2012 to 2027.

2. Over the past two decades PCMC has implemented phased development of its water supply system, most recently utilizing JnNURM funds. As the city has grown there has been a strong political and social need to meet water demand at tap by augmenting and expanding raw water transmission, water treatment works, service reservoirs, feeder mains, and the distribution network. To date, PCMC has been successful in meeting this challenge. However, the city has already exceeded its allocation from its main raw water source, the Pawana River, and competition with agriculture makes future water rights highly unpredictable. The need to better manage the existing raw water resource by reducing physical losses in the distribution system is an unquestioned priority. The 24x7 project not only achieves this objective, but it does so with considerable financial and social benefit to the city.

3. The focus of this PFS Report is the 24x7 project technical specifications and costs, the project social and environmental impact examinations, the project financial and economic viability (FIRR and EIRR), and the proposed implementation arrangements.

### B. Summary of the Prefeasibility Study Analysis

#### Outline of the Project

4. The main components of the project are summarized as follows and in Table 1.1:

4.1 Network strengthening and replacing faulty household connections and meters is the main infrastructure component.

4.2 Management improvements include training for staff, communications campaign, hydraulic modeling, leak detection equipment, air compressors and jack hammers, pipe welding sets, mobile generators, portable flow meters, cars, crew cabs, tankers and trucks.

4.3 Other supporting activities include a computerized maintenance management system to establish a dynamic asset inventory.

5. One of the key activities for the 24x7 project is setting up a hydraulic network model. Once the modeling and analysis is carried out, the city distribution service area can be divided into 60 district metered areas (DMAs) (or Water Districts) covering approximately

<sup>1</sup> INR:USD exchange rate of 49 in February, 2012.

2500 connections each. Each DMA will be under control of a Junior Engineer, and works for isolation of DMAs can be first taken up followed by distribution improvement interventions.

**Table 1.1: Abstract Estimate for 24x7 Water Supply in PCMC**

Abstract of Cost Estimate					
Category	Description	Basis	Cost (Rs)		
A 24x7 conversion program	Distribution Networks	Estimate	854700000		
	House Service Connections	Estimate	1283734200		
	Customer Metering	Estimate	70465800		
	SCADA	Estimate	180000000		
	Management Improvements*	Estimate	94420000		
B	MTIP other activities**	Estimate	35000000		
	Sub total (A+B)		2518320000		
*Management Improvements are training for staff, communications campaign, hydraulic modeling, leak detection equipment, air compressors and jack hammers, pipe welding sets, mobile generators, portable flow meters, cars, crew cabs, tankers and trucks					
**MTIP other activities are Computerized Maintenance Management System, water quality testing program, water safety plan, augmentation/expansion planning					
Implementation Plan					
	Year-1	Year-2	Year-3	Year-4	Year-5
Connections with 24x7		15000	35000	50000	50000
Expenditure Plan	15%	20%	20%	20%	25%
Expenditure Real	377748000	503664000	503664000	503664000	629580000
Exchange rate: USD (Feb 2012)	49				
USD	7,709,143	10,278,857	10,278,857	10,278,857	12,848,571
Total					51,394,286

6. The 24x7 project would start with a pilot in Premlok Park (800 connections), and then scale up initially in the Pradhikaran Area (about 15000 connections). This will be in the first two years of the Business Plan (2013 to 2014). The scale up will then progressively move downstream from the water treatment works until the entire city is covered with improved water supply services by the fifth year of the Business Plan (2017).

The Service Delivery Benefits of the 24x7 Project

7. The key benefits from introducing 24x7 water services can be summarized as follows:

- 7.1 Increased universal access to water.
- 7.2 Measured and visible impact on public health.
- 7.3 Improved services to customers.
- 7.4 Reliable services to the urban poor.
- 7.5 Reduction in water consumption.
- 7.6 Conservation of water resources.
- 7.7 Increased cost recovery due to increased customer satisfaction.
- 7.8 Reduction in operating costs for the utility.
- 7.9 Significant reduction in coping costs for customers.
- 7.10 Enhanced asset life.

8. These points are discussed below, based on the social, poverty and gender analysis presented in Section 4, and the associated baseline and house to house surveys which were undertaken as part of the project.

*Increased universal access to water*

9. At the overall city level, roughly 85% of sample households reported coverage by municipal water supply service connections. The 24x7 project is part of a broader improvement program which has the goal of 24x7 self-sustaining, safe drinking water for the entire city by 2017. This includes 100% metered connection coverage. The 24x7 project will replace existing faulty connections and meters, and strengthen the existing network. People living in slums and chawls will be the main beneficiaries in terms of access. Currently, 15% of households in chawls (low income groups) do not have access to municipal water supply connections. All slum households have access to municipal supply, though a majority (69%) depend on public standposts (Baseline Survey, 2012).

*Measured and visible impact on public health*

10. Disease incidence among sample households (based on 180 days recall method) reveals that incidence of water-borne disease is about 52 per 1000 population; while that of vector-borne diseases is 15 per 1000 population. This translates into opportunity costs for households in terms of cost of treatment and for poor households dependent on daily wage labour, loss of wages, making a case for safe drinking water as well as environmental sanitation interventions. One of the main benefits of 24x7 continuous, pressurized water supply is that the risk of ingress of contaminating water is reduced. This is discussed further below.

*Improved services to customers*

11. Key issues in water supply are:
- 11.1 Inadequate pressure in certain areas.
  - 11.2 Supply timings at odd hours, greatly inconveniencing the poor.
  - 11.3 Power cuts / load shedding affecting water supply.
  - 11.4 Common standposts with/without leaking taps and continuous water wastage during supply hours.
  - 11.5 Large number of unauthorized connections, leading to unsafe water.
  - 11.6 Need to promote sense of ownership of community facilities by charging for such services.

12. Areas of improvement under the 24x7 project include reliability (hours of supply and pressure) and quality (although this is already reported as 100% in PCMC, nevertheless continuous, pressurized supply reduces the need for excessive chlorination, and risk of ingress of contaminated water). Standposts will be metered and over time replaced with group and individual connections. Unauthorized connections will be regularized.

13. Improved meter reading, billing and collection (currently 32% of customer do not get a regular bill, and collection efficiency is estimated as between 24% to 48% in different wards) combined with a new Customer Charter will also ensure a better experience for the customer. Customer care units will be set up in Head Office and all operational units/ service areas. Training in handling customers will be provided for all front end staff including plumbers and meter readers. Resolving queries and complaints is a priority, but should not impede operational staff in their daily routines (over time predictive and preventive maintenance should be established in place of reactive maintenance).

*Reliable services to the urban poor*

14. 15% of households in chawls (low income groups) do not have access to municipal water supply connections. All slum households have access to municipal supply, though a

majority (69%) depend on public standposts (Baseline Survey, 2012). In the overall analysis, the poorest households in chawls are worse off than those in slums, indicating perhaps that past programs and facilities for the poor have mainly been targeted at slums.

15. The 24x7 conversion program will introduce group and individual connections. A lifeline supply of 40 lpcd will be provided free of cost in slums and chawls, and average prices for these groups will be kept at 2.25 Rs./KL which represents a subsidy of 75%. (Business Plan, Section 11).

16. Woman-headed households comprise about 4.5% of the households in the pilot Premlok Park area, of which an overwhelming majority (65%) are poor, living in *kutcha* houses in slums and *chawls*. About 19% of woman-headed households do not have security of tenure, rendering them more vulnerable. Disparities in economic conditions between woman-headed and other households are evident. While no real differences in access to services within a particular locality type (e.g. slum/*chawl*/bungalow/flat) are observed for woman-headed and other households, considering the fact that a larger proportion of woman-headed households lives in slums and *chawls*, such households do have lower levels of service access. The issues of gender and vulnerability will be actively taken up in the 24x7 project.

17. Households belonging to most backward community / those living in a *kutcha* house / Below Poverty Line (BPL) households (assessed on the basis of asset ownership) and those where the Chief Wage Earner is disabled are categorized as other disadvantaged households, for whom there is need for policy support, especially related to tariff subsidies and concessionary charges for availing connections.

#### *Reduction in water consumption*

18. For purposes of planning and design, it has been assumed that average consumption would increase from 120 lpcd (2012) to 150 lpcd (2017) and then decrease as increasing block tariffs are introduced and people become more aware of the need for water conservation.

19. The demand for water has been assessed with the following assumptions (Section 3.3):

- 19.1 The service level would increase from current level of 120 lpcd to about 150 lpcd by the year 2017 and then would reduce due to increase in tariff and prudent demand management by the utility as well as increased awareness of customers.
- 19.2 The proportion of urban poor currently at 10% of city population would reduce to 8% as prosperity increases in the city. The service level for urban poor would increase from current level of 70 lpcd and stabilise at 100 lpcd
- 19.3 Physical losses in distribution would reduce from current level of 45% to 15% progressively by the year 2041 and NRW would reduce from 59% to 17% in the same period.

20. As the population increases, the requirement for treated water production will increase; however, the active Non-revenue water management program will ensure physical losses are minimized.

**Table 1.2: Population and demand projections**

Year	Population	Service Levels (lpcd)		NRW	Treated Water Demand (KLD)			Raw Water Demand (KLD)	
		General	Poor	%	At Tap	At ESRs	At WTW	WTW Input	At River
2011	1730133	120	70	55%	210276	386479	392364	400371	406468
2012	1790940	125	72	50%	226931	392812	398693	406760	412850
2013	1853880	130	74	45%	244533	399990	405875	414017	420109
2014	1919040	135	76	40%	263132	407958	413855	422086	428188
2015	1986490	140	78	35%	282775	416665	422581	430912	437030
2016	2056310	145	80	30%	303516	426085	432025	440467	446608
2017	2128580	150	82	30%	325407	456568	462816	471780	478236

*Conservation of water resources*

21. Augmentation of raw water transmission and water treatment works is critical to meet demand at tap from a growing population (Table 1.2); but the optimum solution is to implement the 24x7 service improvement plan including reductions in NRW/ physical losses. Financial modeling carried out in the Business Plan (BP Section 11), shows that in the base-case the production requirement at the water treatment works increases from 412 mld (2012) to 796 mld (2027), while for the base-case with the service improvement plan the increase is only from 399 mld (2012) to 577 mld (2027). This represents a saving of 25% in treated water production.

22. Discussions with stakeholder agencies (Business Plan, Section 7.2) clearly bring out the need for a **communication strategy** focusing on service level targets, 24x7, tariffs vs. costs, issues in service provision in areas where illegal construction is predominant, water conservation, importance of proper internal plumbing and solid waste management practices (waste segregation and proper disposal) at household level. They also point to the need for a shared policy outlook related to slums/urban poor settlements, with clearly defined and accepted roles and responsibilities for each agency, which is presently lacking / inadequate. Issues relating to water conservation are a main area of focus.

*Increased cost recovery due to increased customer satisfaction*

23. At the current tariff of 2.5 Rs./KL up to 30 KL, PCMC is unable to recover the entire O&M costs for water supply from the existing tariff policy and water operation policy. The table below gives the O&M cost recovery pattern as analyzed from the Water Account:

**Table 1.3: Summary of O&M Cost Recovery - Water Account**

Particulars	2008-09	2009-10	2010-11
% Recovery of O&M Cost (Collection of Own Revenues to O&M Cost)	52.28%	43.86%	57.14%
% Recovery of O&M Cost (Collection of Own Revenues + Grant Revenues to O&M Cost)	62.85%	63.07%	59.22%

24. As part of the improvement program, it is recommended that PCMC phase in (by 2017) an average domestic tariff of 8 Rs./KL which is adequate for 100% O&M cost recovery. Use of a increasing block tariff, can help to ensure that poorer households in slums and chawls continue to receive a 50% to 75% subsidy, which is recovered from high income group households and non-domestic consumers.

*Reduction in operating costs for the utility*

25. The savings made in treated water production (Table 1.2), translate directly in savings in capital expenditure and operating expenditure. The analysis presented in the

Business Plan (BP Section 11.4) shows that for the fifteen year period 2012 to 2027 the medium term 'performance improvement plan' associated with the 24x7 project (2581 million INR, 51.4 million USD<sup>2</sup>) will result in a 25% reduction in required treated water production from 796 mld to 577 mld, an associated 50% (5590 million INR, 114 million USD) saving in Capex, and a 20% (8210 million INR, 168 million USD) saving in Opex.

26. Capex savings are mainly for raw water transmission and water treatment works. Opex savings are from the costs associated with production such as staff costs, electricity, chemicals and repairs and maintenance all of which increase with increased volumes of water produced.

#### *Significant reduction in coping costs for customers*

27. Some of the savings for customers will come from no longer needing to purchase tanker water or water purification systems, or invest in pumps and storage. This is confirmed by the baseline survey (2012)

27.1 **Purchase of water from tankers.** This is reported by about 1% sample households in the event of disruption in water supply by PCMC due to various reasons (repair work, power cuts, drought year etc.) and on occasions when a large number of guests are expected. Average cost of a tanker load of water is reported as Rs. 900.

27.2 **Storage.** Opportunity costs related to storage capacity created (capital cost and installation cost of storage tanks and their maintenance) were reported by about 75% of sample households. The average storage capacity reported by MIG and HIG households is 3229 litres. Cost of a sintex storage tank of 5000 litres is in the range of Rs. 4500.

27.3 **Pumps.** About 209 respondent households indicated opportunity costs related to pump installation, maintenance and operation. A majority of these (96%) reported use of pumps of 1 or 2 HP capacity. Average capital cost for a 1 HP and 2 HP pumps are Rs. 6000 and Rs. 10,000 respectively. Thirty-three percent of those reporting pump usage indicated use of borewell pumps.

27.4 **Borewells.** Borewell installation was reported by about 11% of sample households. Installation costs (20-25 ft deep) are typically in the range of Rs. 25,000-30,000.

27.5 **Water purification.** Focus group discussions revealed that a majority of households in slums do not purify water as boiling water eats into their productive time while cost of installation and maintenance of purification devices is high. On the other hand, a majority of MIG and HIG households reported the use of purification devices such as aqua guard, UV filters etc. while some prefer to boil drinking water. Installation costs of purification devices like aqua guard, RO/UV etc. typically range between Rs. 2000-10,000.

#### *Enhanced asset life*

28. Delivery of 24x7 water supply improves and extends the life of the network assets as it avoids daily operation of valves resulting in surge, water hammer and wear and tear. As part of the improvement program, it has been recommended that PCMC adopt a Computerized Maintenance Management System with an up-to-date asset inventory, and

<sup>2</sup> INR to USD exchange rate of 49 in February , 2012

PDA/smart phones for operational staff to better manage work orders and preventive maintenance schedules, track equipment downtime, generate alerts of needed actions, track spare parts, and maintain asset inspection reports.

29. Asset management requires knowledge of levels of service, assets and their characteristics (which requires an asset inventory), the physical condition of assets, the performance of assets, and the total cost of asset ownership (life-cycle costs). Closely related to asset management are the optimization of O&M activities (using standard operation and maintenance procedures), regular condition and performance assessments of assets, and preparing/updating an Asset Replacement Schedule. With prudent asset management there is a shift from reactive maintenance to preventive maintenance and predictive maintenance (based on asset condition and performance) which helps enhance asset life and performance.

#### Findings of the Environmental Examination

30. Findings of the environmental examination are described below:

30.1 No major environmental impact is anticipated in the PCMC area. Minor impacts will be mitigated through the implementation of mitigation measures as suggested.

30.2 There is no sensitive environmental impact anticipated to arise due to implementation of the 24x7 project.

31. The key environmental issues, which need attention during the construction phase of the 24x7 project, are as follows:

31.1 During design, it will be ensured that current water supply and other utilities (if any) are not disturbed.

31.2 Construction waste should be collected and disposed of in an environmentally sound manner.

31.3 The contractor will make arrangements for water required for construction in such a way that the water supply to nearby communities is unaffected.

31.4 Vehicles transporting construction waste, loose and fine materials like sand and fine aggregates should be covered to reduce spills on existing roads.

31.5 Provision will be kept for water sprinkling at the construction sites to reduce effects of dust.

31.6 Regular maintenance of machinery and equipment/ vehicles will be carried out.

31.7 To control traffic, adequate signage and barriers during construction will be provided near construction sites as per requirement.

31.8 No construction works related to the 24x7 project will be undertaken at 'night time' to avoid nuisance to the community on account of noise.

### The Project Financial Internal Rate of Return

32. The financial evaluation has indicated that the proposed 24x7 project is financially viable, with the calculated FIRR value very high and exceeding the hurdle rate or the WACC. The sensitivity analysis has demonstrated the robustness of this result, with the subproject component financially viable even when a rigorous stress testing is done.

33. The very high positive FIRR is due to savings in Capex in implementing the Base-case with SIP relative to the Base-case by almost 3010 million INR (61.4 million USD), and savings in Opex under the Base-case with SIP relative to the Base case by almost 8210 million INR (167.6 million USD). This high savings in cost as per the technical estimates, as well as the increase in revenue, would result in a very high positive FIRR.

34. The details are as follows. The hurdle rate or the weighted average cost of capital (WACC) was calculated based on project financing and compared with the project Financial Internal Rate of Return (FIRR) to ascertain the financial viability of the improvements planned under the 24x7 project. The sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed. The financial evaluation has indicated that the proposed water supply project for ensuring 24x7 supply of water at PCMC is financially viable, with the calculated FIRR value high and exceeding the hurdle rate or the WACC. The following are the salient points of the financial analysis:

- 34.1 All costs are expressed in February 2012 prices and adjusted to inflation @ 7%.
- 34.2 The hurdle rate or the weighted average cost of capital (WACC) employed in the financial analysis estimated at 1.71%.
- 34.3 The financial analysis is carried out based on the revenue projections (assumed to recover the O&M costs), the proposed capital outlays, and the proposed O&M costs.
- 34.4 The Financial Net Present Value (FNPV) of project inflows (financial benefits) in the base scenario over a period of 15 years @ 1.71% is 18,801.06 million INR (383.69 million USD);
- 34.5 There is sufficient incremental cash inflow for implementing the 24x7 project that would be able to create an internal reserve for additional investment requirements beyond 2027;
- 34.6 The FIRR @ 1.71% is positive and more than the hurdle rate; and
- 34.7 Separate analyses were carried out to examine the sensitivity of the FIRR and financial net present value to adverse changes in key variables. The variables considered for the sensitivity analyses were – (a) Increase in revenue projections by increasing the tariff by 37.5% percent so as to meet 100% O&M and depreciation costs; (b) 10 percent increase in capital costs; and (c) 10 percent increase in O&M costs. Of the three scenarios considered for sensitivity analysis, the FIRR is most sensitive to the increase in tariffs, followed by the Opex cost overrun.

### The Project Economic Internal Rate of Return

35. The economic evaluation has indicated that the proposed 24x7 project for PCMC is economically viable, with the calculated EIRR value exceeding the economic opportunity cost of capital. The sensitivity analysis has demonstrated the robustness of this result, with

the 24x7 project economically viable even when a rigorous stress testing is done. Further, for the proposed 24x7 project, the calculated EIRR value is considered a minimum estimate of economic return, as there are a number of other economic benefits, like prevention of the depletion of the ground water table and improved social capital, which have not been considered in the analysis.

36. The following are the salient points of the economic analysis:

- 36.1 The cost – benefit analysis is carried out for the 24x7 water supply project by using the discounted cash flow (DCF) technique to obtain the economic internal rate of return (EIRR) and economic net present value (ENPV) for the proposed investments and the likely quantified project benefits linked with the project during the defined project analysis period.
- 36.2 Given the complexity of estimating country-specific economic opportunity cost of capital (EOCC), as per convention in the ADB financed projects, a discount rate of 12% has been used as a proxy for EOCC.
- 36.3 Economic Capital Cost assumed at 1,944.3 million INR (39.68 million USD), Economic O&M Cost assumed at 1,168.7 million INR (23.85 million USD), hence, total economic costs assumed at 3,113.0 million INR (63.53 million USD);
- 36.4 Economic Benefits – Resource Cost Savings (Non Incremental) assumed at 140.5 million INR (2.87 million USD) include benefits from savings in cost of procuring water through Hand Pump/Vendor, Bore Well, Bottled/Mineral Water, Tanker, and Cost incurred by the Households for Procuring Water (from alternative sources) to meet the existing Demand - Supply Gap;
- 36.5 Economic Benefits – Savings in Health Costs, assumed at 4,239.6 million INR (86.52 million USD) include benefits from savings in family expenditure from reduced spending due to reduced instances of water-borne diseases;
- 36.6 Total Economic Benefits calculated at 4,380.2 million INR (89.39 million USD);
- 36.7 The Economic Net Present Value (ENPV) of 24x7 project's economic benefits over a period of 15 years in the base scenario is 1,267.2 million INR (25.86 million USD);
- 36.8 EIRR when calculated at a discount rate of 12% results in a positive value of 19.84%, which is higher than the discount rate;
- 36.9 The sensitivity analysis has been carried out under the assumptions with scenarios, (a) Capital Cost Overrun by 20%; (b) O&M Cost Overrun by 20%; (c) Benefits Reduce by 20%; and (d) Worst Case Scenario – combination of all the above scenarios. Of the scenarios considered for sensitivity analysis, the EIRR is most sensitive to the decrease in project benefits, followed by the capital cost overrun; and
- 36.10 Further, for the proposed 24x7 project, the calculated EIRR value is considered a minimum estimate of economic return, as there are a number of other economic benefits like (a) benefits accruing due to over usage of ground water and reduction of the ground water table; (b) benefits arising due to development of a healthy community of residents in the PCMC area with a positive impact on the social capital formation; (c) benefits accruing due to time savings (for collecting water); (d) benefits accruing due to diversion of water from agricultural use; and (e) Benefits accruing due to conservation of water, all of which have been excluded from the numerical analysis of the costs and benefits at the PFS stage. These factors must be taken up under the full feasibility study.

**Implementation Arrangements**

37. In the case of a donor financed project, the 24x7 project will be implemented and monitored by the designated project manager in PCMC, who will be supported by a Project Management Consultant (PMC).

38. For the 24x7 conversion program, there will be 60 district metered areas (DMAs), each under the responsibility of a Junior Engineer. Thus there will be need for recruitment and training of an additional 30 to 35 Junior Engineers during 2012 to 2017. A centralized NRW unit will be established under the Executive Engineer WTP. This will have four teams working on active leak detection and repair, with all necessary equipment and transport vehicles. A summary of management improvements is given in Table 1.4 below.

**Table 1.4: Management Improvements**

Item No.	Assumptions	Unit	Quantity
1	Training for Staffs	Nos.	40
2	Communication Campaign		
3	Hydraulic Modelling		
5	Leak Detection Equipment		
6	Air Compressor + Jack hammer	Nos.	5
7	Pipe Welding Sets	Nos.	5
8	Mobile Generator	Nos.	5
9	Portable Flow meter	Nos.	5
10	Cars	Nos.	5
11	Crew Cabs	Nos.	5
12	Tankers	Nos.	5
13	Truck	Nos.	5
4	Enhancing SCADA		

39. PCMC may also consider a Technical Assistance Agreement in key areas such as network efficiency (NRW/leak detection and repair), customer care and commercial management (metering, billing and collections), and managing the up-scaling of the 24x7 conversion program.

40. Further recommendations for institutional service delivery options and organizational/human resource issues are provide in the Business Plan (Sections 13 and 14).