Report on

Diagnostic study of Water Supply System Of Lathi Municipality

OCTOBER 2012

Submitted By
Urban Management Centre

Submitted to
CEPT University, Ahmedabad

Contact Details:
Manvita Baradi
Director, UMC
III Floor, AUDA Building, Usmanpura
Ashram Road, Ahmedabad, Gujarat
Tel: 079 27546403
Email: info@umcasia.org
www.umcasia.org

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For Performance Assessment System In Gujarat

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We all sincerely hope that the recommendations are implemented at the earliest with support from Municipal staff.

Manvita Baradi
Director
Urban Management Centre

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Executive Summary

Performance Assessment System (PAS), five years research program is being implemented by CEPT University and the Urban Management Centre (UMC) since 2009. Under the project, water and sanitation sectors of all Urban Local Bodies (ULBs) of the Gujarat State are being analysed. This program has three major components, performance measurement, monitoring and improvement.

Under the performance improvement component, assessment of basic utilities of class “D” town-Lathi of Saurashtra region of the State was undertaken. Various indicators for performance assessment indicated that the town’s performance needed improvement. Performance assessment was mainly based on the data provided by the ULB that was mainly based on assumption rather than the factual information based data.

Water supply has remained an area of prime concern for all Urban local bodies. It directly impacts the health of the people and special care has to be taken to provide safe, adequate, water quantity with sufficient pressure throughout the year. Sufficient manpower, finances and energy goes towards achieving these requirements. It was decided to have a closer look at the system with an attempt to obtain real time data within the prevailing system in operation. Familiarizing the local staff and the engineer in-charge with this important aspect was also considered while undertaking the study.

Prevailing Scenario

In the process of performance measurement and monitoring, it was observed that the water supply department of Lathi municipality was found lacking in basic records like location drawings of various installations, connecting pipe network, pumps capacities, dimensions and storage capacities, water zone demarcation, demand and supply provided to each of them, formats and log books that is normally required for the operation., water quality checks were neither found, nor is there any routine system of chemical addition. Similarly, the water quantity received by each of the water zone was never practiced for assessment and monitoring purpose. Distribution network maps for the city were not available.

Interventions

Amidst all these deficiencies and lacking, strategy for the diagnostic study was appropriately structured for capturing the required information. The installations were visited and through GPS facilities their locations were properly identified, the route of the trunk and transmission mains from the sources was also tracked and plotted on the satellite map. Similarly, the intake capacity and the discharging capacities of pumps were minutely observed in relation with the incoming and discharging volume which enabled approximate input water quantity in and from the two main sources feeding the town. Similarly, after establishing the storage capacities of the tanks of water distribution stations through physical measurement and deriving the volume/meter, outflow from the WDS supplying water to different zones has been estimated. Similarly, the zone boundaries have been established through the GPS tracking on ground and drawn on the map. Populations with its densities for these zones have also been derived from the election ward boundaries that were fixed from on-ground tracking through GPS. This exercise helped in identifying approximate population served by the Water distribution stations. Since the town is supplied water on alternate days, data for

each day has been captured and computed for further derivation of per capita supply. Special exercise for identifying the water receipt at the consumer end has also been undertaken involving the students of the local school who enthusiastically participated and captured data from around 185 consumer points spread uniformly across the water zones. This exercise helped in identifying the approximate water quantity received at the consumer points and hence the water quantity supplied to each of the water zone has been derived. Special efforts have also been made to check the water quality at different points in the water zones.

Since information on day to day basis assumes an important role, care has also been taken to devise formats that could be well adopted to record day-to-day information. Formats that could be maintained at the installation for daily recording of the hourly or the periodical data have also been attempted. Similarly, formats for water quality checks, complaints and for obtaining important information have been devised and recommended for regular use.

Special efforts were made to record the tank levels at periodical intervals by temporary level gauges and also physical level measurement with tapes. Modern gadgets (ultrasonic level sensors) can also be utilized for recording and storing information. A demonstration was also shown to the officials of the water supply department which evinced interest for its procurement.

Outcome -NRW

Through the interventions for capturing the factual data at various stages of procurement, processing, distribution and the water availability at the consumer end brought out interesting revelations. It is assumed by the ULB that water from the Mahi source is around 2.0 mld whereas the actual measurement revealed that the it was around 1.15 mld and that from the own source was around 1.39 considering the daily operational hours stated by the department. The pump's discharging capacity bringing Mahi water from the forest well was also assessed to be 1.140 m^3/min and that of the pump discharging the own source water was 1.449 m3/min and the pump at Gagadia too was of identical capacity. The total drawl from Mahi as well its own source is around 2.5 mld. Since the town is provided water supply on alternate days with around 9 zones on day 1 and other 6 zones on day 2, water quantity assessment has been done for two consecutive days. Thus the procurement for two days amounts to 5.033 MLD whereas the supply from the Water distribution stations for 2 days approximately accounts to 3.45 MLD amounting to a loss of around 31.55%. The consumer end water quantity assessment has revealed that for the two days the total water receipt is around 3.10 ML which results into a loss of around 9.73%. Hence the total loss from procurement to consumer end is around 38.22% which is considered to be higher by around 23% (considering 15% to be acceptable standard). Study also showed that on an average per capita supply is around 86 liters.

Water Quality

Water quality has also been examined by conducting the required tests. In the first instance Residual Chlorine (RC) was found lacking in almost all samples obtained from different zones during their supply period. After bringing this to the notice of the department, and arranging the chemical addition under the personal supervision of the inspecting team, RC was found though of dosage below 0.2 ppm. Similarly main sources Mahi and Bhidbhajan water quality was examined and found fit and potable, the surface source-the check dam near the head works was found unfit for drinking water use. The bacteriological examination (indicative) was also done and four of the seven samples

failed indicating corrective actions to be followed up. Further samples were recommended for examination in the Govt. approved laboratory.

Recommendations

It is also observed that though the ULB has sufficient storage facilities comprising of Under-ground and Elevated Storage Reservoir (ESR) facilities, there are two ESRs that remain unused and other two ESRs under used whereas the ESR which is oldest of the operational ESRs, is over used. Present pattern of supply has been closely examined and it is observed that around 50 % of the town is supplied water from the old ESR at irregular time whereas other half receiving water from the two under used ESR receives more than the average supply with higher pressure and near regular timings. It has been recommended that if all the ESRs are effectively and optimally utilized it would result into providing water to the town not only on daily basis but at regular timings with improved pressure as well.

Continuous supply

Potentials for continuous supply has also been assessed in view of the more than adequate storage capacity available and also the proximity of a pilot target area to the WDS at Mangalpara. Moreover consumer metering may be an acceptable proposition to the people of the target area. Present water supply assessment has also been undertaken which reveals that the two areas-Gokulnagar and Ramjimandir catered from the WDS has a population of 1693 and 565 respectively. Against a water demand of 0.47 mld and 0.158 mld present supply is 0.359 and 0.249 mld resulting into a per capita supply of 120 and 91 lpcd respectively. However, the supply hours remain confined to 45 min and even less provided on alternate day's amounts to a peak demand of around 31 which normally is 3. Such a heavy demand results into a very excessive pressure drops in the distribution network which is 6.45 mt/100 mts and the over the length of around 250 mts the drop in pressure is around 13 mts. If the present intermittent pattern is switched over to continuous pattern than the drop in pressure would be very negligible. The switch over would also benefit with the various advantages the continuous supply normally offers-no individual storage, reduction in energy consumption, better water quality rid of contamination, and many others. If this is tried out and found successful than other zones could also be taken up for further implementation.

Financial analysis

Financial analysis of the water supply department has also been attempted. Though the collection efficiency has improved from 56% in 2008-09 to around 80% in 2010-11, still revenue receipt is far less than the actual expenditure incurred and liable to be incurred. The present income is around Rs 23.47/ lacs against an expenditure of Rs 54.57/ lacs. This amounts to Rs 7.47/1000 ltrs of water whereas the income is barely around Rs 3.22/1000 ltrs leaving a deficit of Rs 4.26/ 1000. Various measures of savings and enhancing the income have been suggested without resorting to tariff revision which would enable reducing this deficit in four years time to a surplus of Rs 0.54/1000 ltrs. Amongst the various measures recommended, saving in energy (from Rs 11.8/ lacs to Rs 7.07/ lacs)through efficient utilization of the pumping machinery, reduction in NRW which is presently around Rs 2/1000 ltrs needs to be brought down to Rs 0.67/1000 ltrs over the next four years.

Conclusion

Water supply system offer enough potentials for Improvement by streamlining the system through better information generating system, enhance the manpower with skilled and trained staff. It also calls for improving the water quantity and quality with adequacy through optimum utilization of the present facilities and also through measures to reduce the NRW as well as scaling up of the present intermittent supply on alternate days to daily supply in the first instance and continuous supply if the pilot attempt is successful and acceptable to the people and the office bearers of the ULB.

1 Background of the study

1.1 About PAS Program

Access to water and sanitation services in Urban India is widespread, but little is known about the quality and level of service, and coverage of the poor households. For new investments in the sector to be effective, it is important to assess the performance of the existing system and ensure its sustainability and reach for the poor and unserved.

1.1.1 Need of the PAS Program

- Aggregate statistics suggest good coverage of water and sanitation in urban areas in India but, little is known about the quality, level and financial sustainability of service
- Accurate information on access of urban poor households to water and sanitation is not available
- Lack of WSS(Water and Sanitation system) information leads not only to improper monitoring and management of the utility but also leads to misallocation of resources
- Difficult to assess impact of past investments

Performance Assessment System (PAS) aims to measure and monitor the performance of the services and hence improve the overall performance of service delivery system in urban areas reaching the unserved population. The project includes all urban local governments in Gujarat and Maharashtra and is to be implemented by CEPT University (CEPT), the Urban Management Centre (UMC) is undertaking all programmatic activities in Gujarat.

1.1.2 Objectives of PAS

Performance Assessment System (PAS) aims to measure and monitor the performance of the services and hence improve the overall performance of service delivery system in urban areas ensuring equity especially reaching out to the deprived and unserved populations.

The key project objectives of the five year project are:

- To review the quality of services in ULBs i.e. water supply, sewerage, Solid waste management and storm water drainage
- To establish the data base system in ULBs which can be used by decision makers of ULB and others(State, Central Governments)
- To document the good practices of ULBs and sharing it across cities.
- To provide assistance in improving the system of ULB through PIPs (Performance improvement plans and ISIP information system improvement plans
- Performance Improvement Plan (PIP) includes technical and managerial aspects of basic services i.e. water supply, sewerage, Solid waste management and storm water drainage along with advocacy at local as well at state level.
- To compare the indicators of services across the cities for receiving overall picture of the state this will be used for decision makers for identifying the priority of state.

Performance improvement relates to use of information to improve service performance. The Project will provide support to local governments to develop performance improvement plans for reaching the poor and unserved, and increasing financial viability.

1.1.3 Data collection of all ULBs of Gujarat

UMC team visited all 166 ULBs, spent enormous amount of time in field during year 2009-10 and followed-up with ULBs to get the required information for year 2008-09. The process adopted to capture data on water and sanitation services as mentioned below:

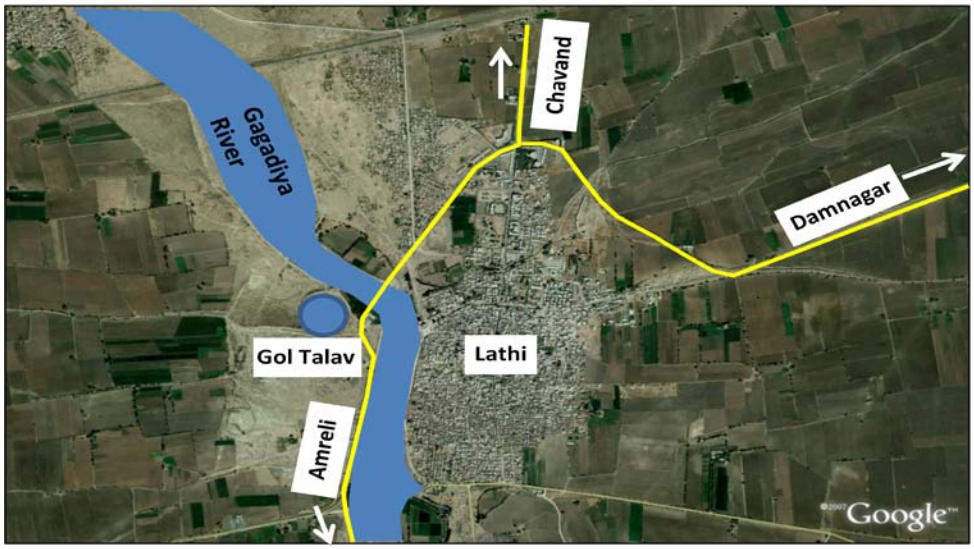
- Meeting with chief officer and department heads, shared briefly about PAS program and objectives of field visit followed by discussion on questionnaire.
- Separately interaction with department officials and gathered data/information.
- Mapping on Google Earth Maps- Area specific information such as ward/zone/city boundaries, Main water distribution lines, Solid waste dumping site, locations of slums, water logging/flooding area.
- Site visit to water sources, water treatment plant, solid waste dumping site, etc.
- Visit to slum settlements for an understanding on access to services to the slum dwellers.
- Wrap up meeting with Chief Officer to summarize the extent of data available with ULB.

After the first round of data collection, UMC team has compiled the data of all 166 ULBs and summarized the Key Performance Indicators (KPIs) values and Reliability in tabulation form for each class (Annexure-1). It was observed that except Water supply coverage, Cost recovery and Collection efficiency, rest all indicators reliability scale are in category D. It means that the information provided by the ULBs are without any measurement and based on their own rough estimation. Therefore, it is necessary to undertake diagnostic studies to understand the existing information system of water utilities and improve upon.

2 Introduction to Lathi

Lathi is a small town, categorized as Class D municipality, located in Amreli district of Gujarat. Lathi is also having a status of taluka headquarter, 24 kms away from Amreli, 100 kms from Rajkot, 235kms from Ahmedabad and 265kms from state capital Gandhinagar.

Figure 2:1: Satellite imagery of Lathi town



The area of the city under jurisdiction of Lathi municipality is around 6 sqkm. Whereas total inhabited area is about 1.58 sqkm which is around 26.33% of the total area.

According to the provisional figure of census 2011, the population of the city is 21,111 against 20,966 in 2001. The decadal growth of the city is less than one percent. The density of the population is 3533 per sqkm. The citizen of the Lathi is mainly dependent on agriculture farming and diamond cutting industries.

2.1 Demography Growth

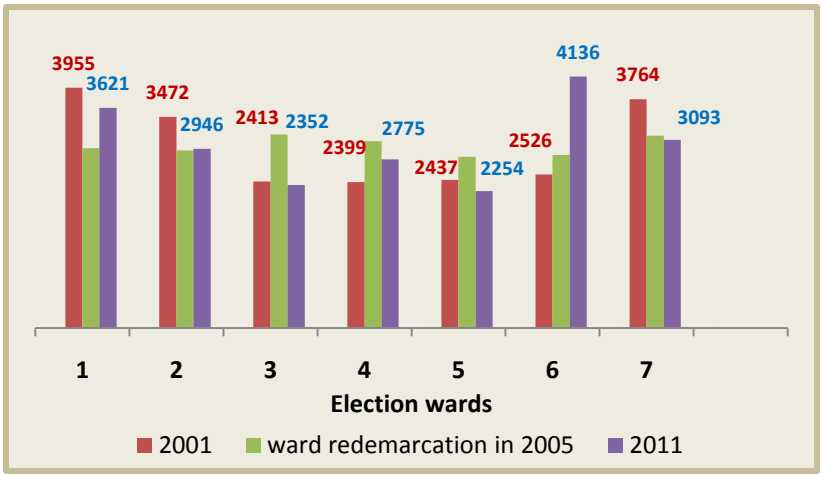
2.1.1 Lathi's demographic growth and other relevant details

Table 2:1: Ward wise Census population deatils

Lathi ward wise Population details as per the census 2001 and 2011									
Sr.No	Election wards	Population				Growth rate (%)	House Holds (2011)	HHs growth rate (%)	No of person/HH
		2001	pop as per revised wards in 2005	House holds as per revised wards (2005)	2011				
1	1	3955	2957	704	3621	-8.45	665	-5.54	5.45
2	2	3472	2923	887	2946	-15.15	589	-33.60	5.00
3	3	2413	3185	853	2352	-2.53	484	-43.26	4.86
4	4	2399	3073	793	2775	15.67	540	-31.90	5.14
5	5	2437	2818	737	2254	-7.51	432	-41.38	5.22
6	6	2526	2849	687	4136	63.74	761	10.77	5.43
7	7	3764	3161	663	3093	-17.83	558	-15.84	5.54
	Total	**20966**	**20966**	**5324**	**21177**	1.01	**4029**	-24.32	**5.26**

Despite the overall demographic growth recorded by the state, smaller towns and rural areas have either remained stagnant or have shown declining growth mainly due to the migratory trend of the people towards larger cities. Lathi also has experienced similar trend and the contents shown in the following table well explains the impact of the trend stated above.

Figure 2:2: Population growth of Lathi 2001-2011



From the above table details it is seen that the population growth in the last decade from 2001-10 overall population has shown insignificant increase of 1.01 %, whereas households have declined by almost 25%. This is apparent from households found locked during the field visit for the survey activities. The decline has been as large as 43 and 41% in ward no 3 & 5, 33 % in ward no. 2 , 15%, 10%, & 5% in ward no. 7, 6, 1 respectively. Only ward no.6 has shown a positive growth in households with 10%. The population growth in this ward also has shown a large increase of 63%.

2.2 Water Utility

2.2.1 Water connection

Lathi nagarpalika has in all 3514 total water connections (year 2011) out of which 3370 connections are for residential usage with 3351 connections of ½" size and other 19 connections are more than ½" size. There are 144 Non residential water connections out of which 133 are of ½" size and rest are of more than 1/2" size. Ward wise distribution show that the percentage share for each of the election ward on an average is 12 % with highest share of 19% in ward no. 2 and lowest share of 8% in ward no.5. The connection details are shown in the table 2.2.

Table 2:2: Ward wise water connection details

Water connection details of Lathi Nagarpalika -ward, size, & usage wise- year 2011												
Election ward no.	1/2"		3/4"		1"		1 1/2"		2		Total	Percentage
	Resi	N.Resi	Resi	N.Resi	Resi	N.Resi	Resi	N.Resi	Resi	N.Rei		
1	426	7									433	12.32
2	622	43		5		1		2			673	19.15
3	499	52	5	1					1		558	15.88
4	668	11	9	1							689	19.61
5	296	9	2	1							308	8.76
6	415	6					2				423	12.04
7	425	5									430	12.24
Total	**3351**	**133**	**16**	**8**	**0**	**1**	**2**	**2**	**1**	**0**	**3514**	

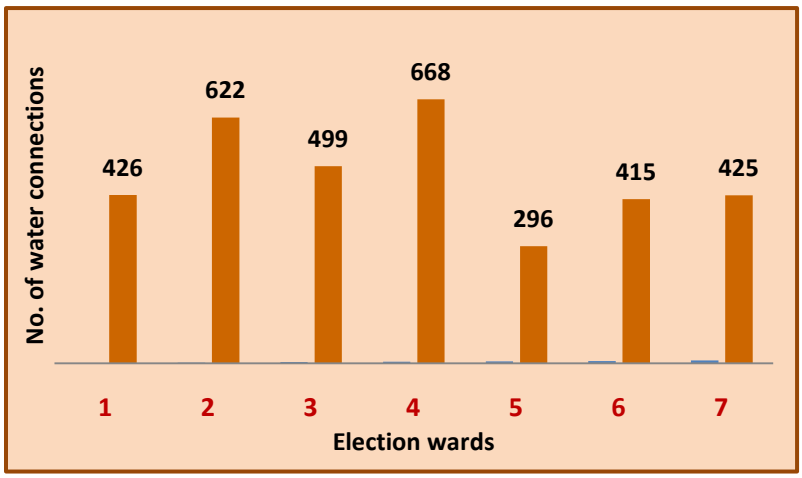
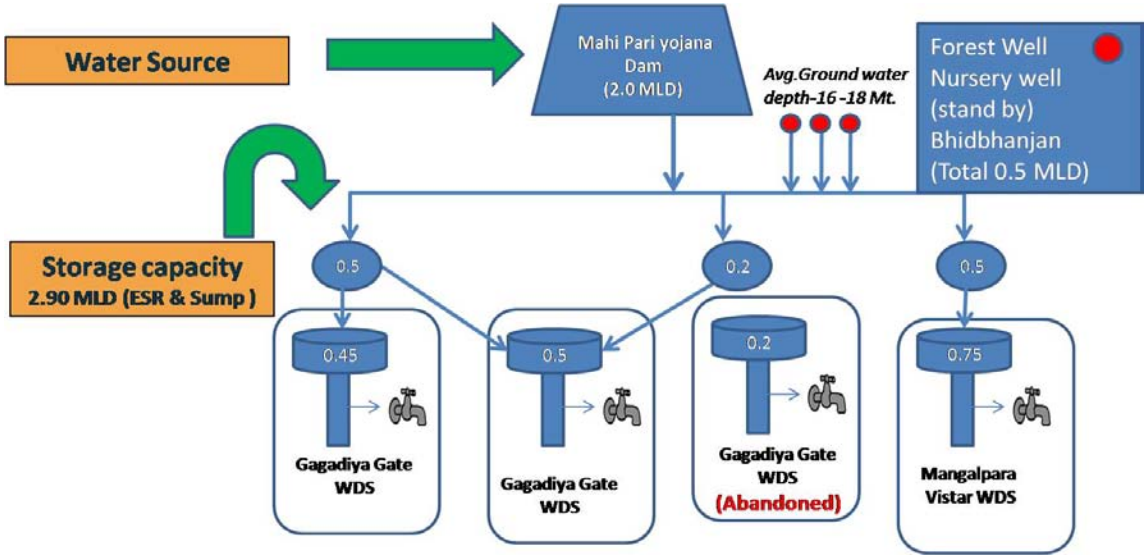


Figure 2:3: Ward wise water connection details

2.2.2 Water procurement, transmission and distribution

The flow of water from source to consumer end is illustrated below.

Figure 2:4: Flow diagram of water supply system



Supply pattern

Town is provided water on every alternate day through 14 zones. The detail of water provided to these zones from different tanks and during different times of the two days is mentioned in the figure given below.

Lathi with present population of around 20000 people is fed by the two major water supply sources, Bhidbhajan bore and well and Narmada based Mahi Pipe line. There are other two wells, one located near the Gagadia water Head works along the Gagadia river bank and the other on the upstream side of this well near the existing forest well in the river bed. However, only the well at Bhidbhajan is operated while the other two wells are not utilized for the town's water supply. Mahi source has been operative for almost past 7 years. Water from Bhidbhanjan well which also has a nearby bore, provides water from the ground water source and delivers it into the sump located at Gagadia Head works through a 110 mm PVC line of -850 mt length . Previously ground water source was found inadequate to cater to town's water needs and the water quality also was poor containing higher dissolved solids and fluoride contents. However, with construction of several check dams on river Gagadia passing nearby resulted into creation of water body with enough storage enabling rise in the surrounding ground water. This helped in improved replenishment in the ground water quantity of the Bhidbhajan well and the bore. Presently this source provides around 1-1.5 Mld of water for the town.

Figure 2:5: Water supply schedule

Mahi pipe line – the prestigious Narmada based water supply project of the state providing water to major towns and cities of the State – started providing water to the Lathi town around 2006. A pipe of 110 mm dia PVC pipe of around 150 mt length provides around 2-2.5 Mld of water for the town. Lathi Nagarpalika has presently made arrangement to collect water provided by the Mahi source in the existing forest well. It is claimed by the authority that there is insignificant water losses occurring in the well on account of the typical soil quality that prevents water percolation. Moreover, the intake point being at lower end allows more water quantity; hence the department prefers this arrangement of drawing water into and from the well. Two submersible pumps of 20 HP capacity pumps up water from the well and delivers through a 200 mm DI pipe line of around 800 mt length into the 4.5 lac ltr ESR located near the Gagadia Head works. There are two branches from this main delivering water to the sump at Mangalpara head works and another sump located at Gagadia Head works.

Gagadia Head works comprises of a sump of 5 lac ltr capacity, pumping station, and 2 ESR of 5.0 and 4.5 lac ltr capacity of 18 mt and 14 mt height respectively. Similarly another head works located at Mangalpara also has a sump of 5 lac ltr capacity and an ESR of 5 lac ltr capacity and 18 mt height.

2.3 Present status of water management

2.3.1 Departmental head

The water supply department is headed by a Qualified Engineer. However, besides the water works the Engineer is also looking after other technical departments like sewerage and Sanitation, Roads and Buildings. As a result he is scarcely in a position to supervise and monitor the activities of water supply on day-to-day basis. The major time allocation by the Engineer is for the capital works planning and execution, and much less time for water supply operation and management.

2.3.2 Operating staff

Though there is a position of foreman in the department set-up, it remains vacant since a long time. The charge of the foreman is given to a senior operator. The foreman mainly looks after the water procurement from different sources, distribution of water from various WDS and also looks after the duty allocation of the staff under him. He also has to take care of the maintenance of the pipe line network, electrical and mechanical maintenance, and also performs the duty of valve man when required.

There are four installations where water is procured and distributed. All these installations operate round the clock and there are other two points which needs attention during the day or night time. Each of these installations that are operating round the clock, have machineries and electrical panels and cables installed that needs constant attention. However acute staff shortage does not allow staff deployment round the clock.

2.3.3 Valve men (insert photo of valve operation)

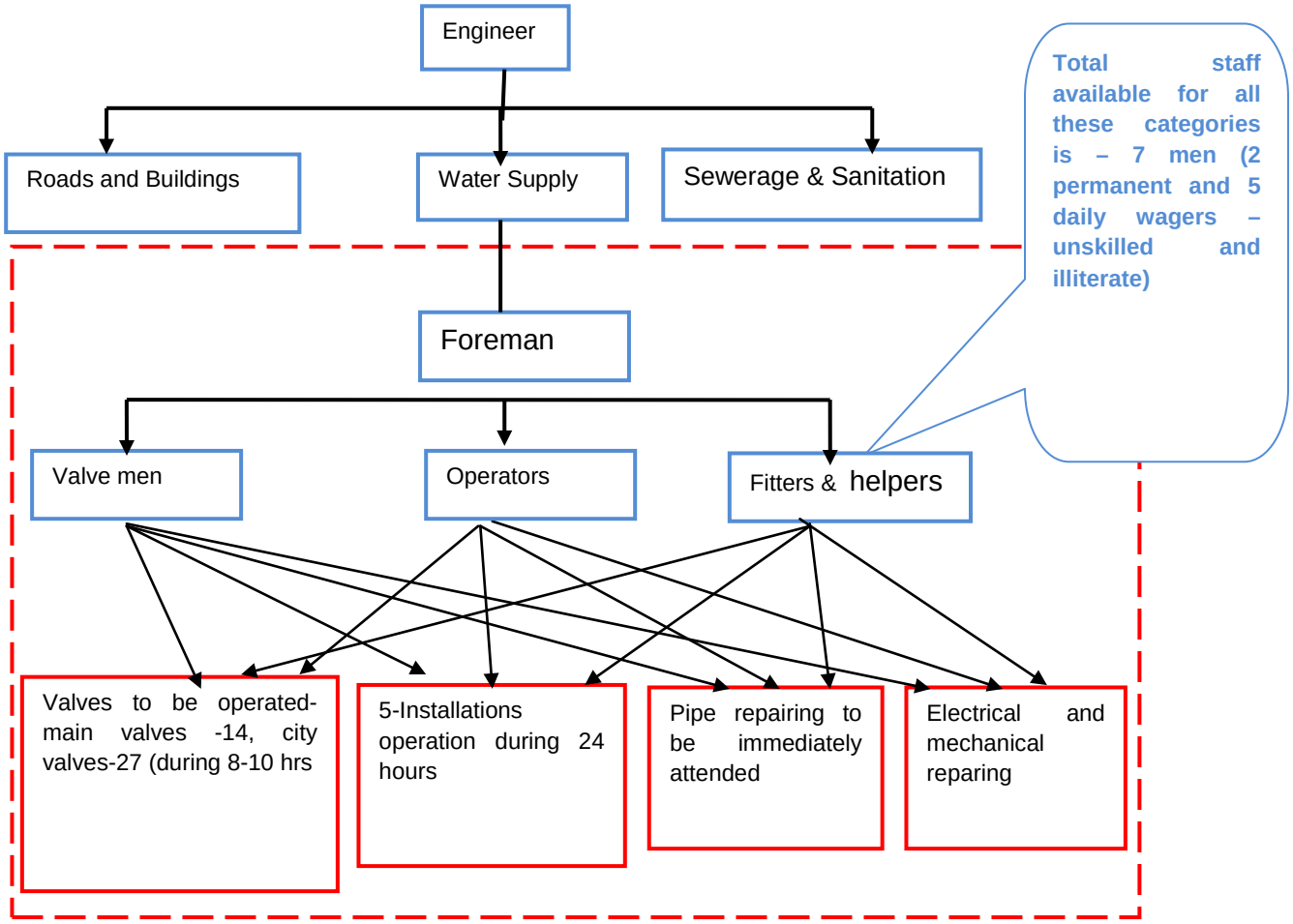
Besides, there are around 14 valves that are operated on daily basis and are located near the Head works and there are other 27 valves in the city away from the head works at Gagadia that needs to be operated during sub-zoning of supply. Thus there are in all 41 valves that are operated and there are no fixed valve man deployed for their daily routine operation.

2.3.4 Staff for repair and maintenance

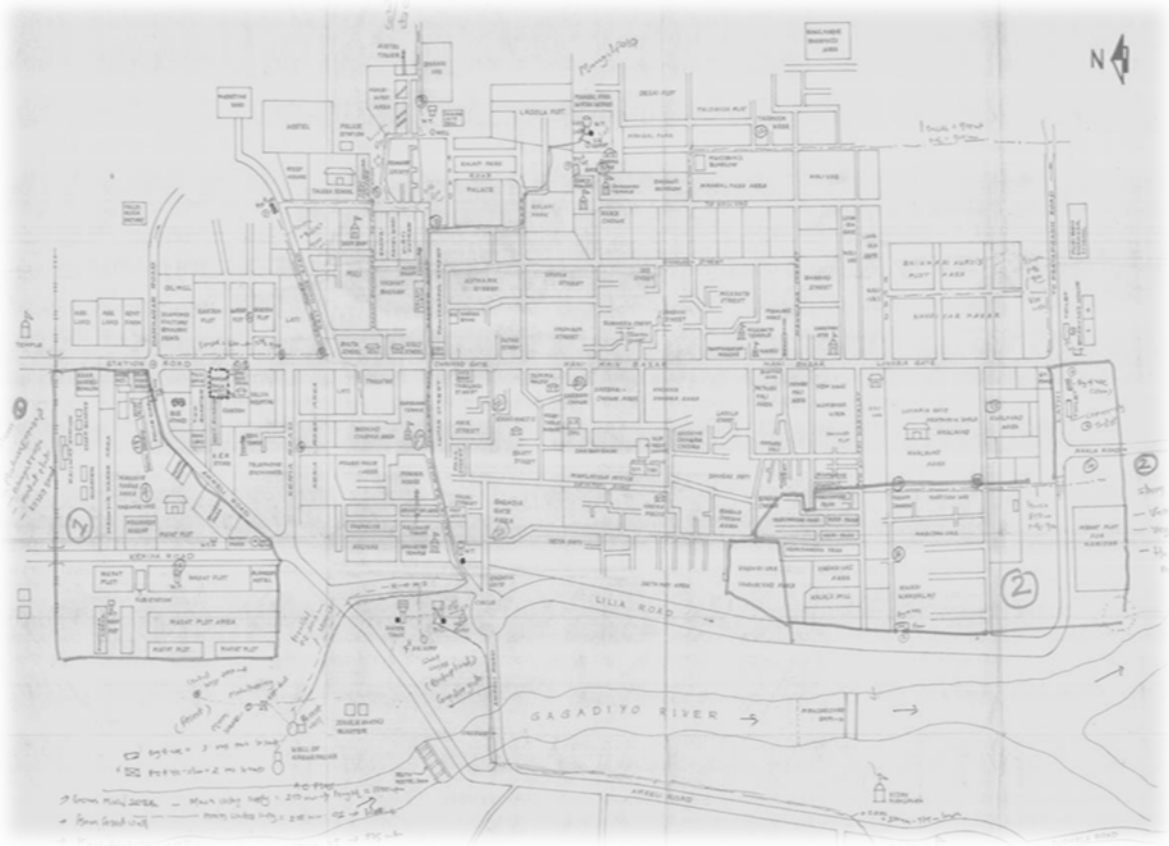
The trunk and the distribution mains as well as the distribution network of branches also needs frequent repairing as the lines which are mostly of Galvanize iron have rusted due to the surface drains carrying sullage water often found overflowing. There are no fitters and their helpers in the municipality to undertake the repair work. Nor is there a supervisor or inspector specially designated to supervise the ongoing repair or the capital work.

2.3.5 Record keeping and information collection and monitoring

Proper log sheet and appropriate formats for recording the routine operation at the installations is totally lacking. The records that are daily maintained are related to mainly supply zone timings. Following is the sketch showing the present staff and their main focus area.


Engineer
Roads and Buildings
Water Supply
Sewerage & Sanitation
Foreman
Valve men
Operators
Fitters & helpers
Total staff available for all these categories is – 7 men (2 permanent and 5 daily wagers – unskilled and illiterate)
Valves to be operated-main valves -14, city valves-27 (during 8-10 hrs
5-Installations operation during 24 hours
Pipe repairing to be immediately attended
Electrical and mechanical reparing

2.4 Other technical information



Technical information related to water supply was found totally lacking. There is a map of the town (one that is available is not to scale) showing main landmarks but lacks total direction and orientation that are on ground. This map does not show the election ward boundaries and the city limits of the town. Nor does it have water pipe line network including its trunk, transmission and distribution mains. Locations of the installations though are shown on the map, they are not of much use as the length and dimensions and directions are not clear. The map also does not show the water zone boundaries; hence the extent of the zone supply, the population it caters to, the density of the zone etc cannot be derived from the available map.

2.4.1 Water quantity assessment

There are no flow meters for assessment of water quantity that is procured, processed and distributed from its various distribution stations. Normally, tank level gauges installed helps in recording the water level at periodic interval which further helps in deriving the water quantity that is processed and distributed. But water works does not have such tank level recording gauges fitted on its various tanks; hence water quantity assessment is not possible in the prevailing conditions.

2.4.2 Water quality assessment

Assessment of Residual chlorine at procurement, processing and distribution stage as well as at consumer end is found totally lacking. Chemical and bacteriological testing is not being done by the department nor water samples are sent to the regional water testing laboratory at Amreli.

2.4.3 Complaint recording & Redressal system

Water supply related complaints are received either on phone or in person. Councilors also receive complaints and pass it to the department staff and the engineer for its mitigation. However, Practice of recording the complaints, time for its disposal and nature of the complaints received is not being recorded and documented.

2.5 Financial aspects of Water supply system

Water supply department maintains water connections related records. Ward wise,size and usage wise connection detail is available with the local body. These details have been provided for the study. The demand charges based on this record is annually derived by the tax department and records of its demand, collection and arrears is regularly maintained and submitted to higher authorities and has remained a regular routine practice. Bills for the water charges are linked to the property tax bills and issued along with it to the customers.

2.5.1 Cost recovery

ULB maintain records of Income and expenditure details related to water supply department. These details are maintained under different heads and posted as per the required classification. This practice helps in deriving the income and expenditure details under different heads. However, only the cash based accounting system is followed. The income and expenditure that is entitled and liable does not get reflected in the books of account, hence the actual picture of true liabilities and accruals is not derived.

2.5.2 Collection efficiency

Though ULB pays attention towards recovery of its past dues and arrears, it does not derive the cost of water that enables appropriate decision making measures to improve the cost effectiveness of water supply system.

2.5.3 Capital works under Government grants

ULB's financial condition does not allow budgetary allocation towards wss related capital works. The major capital works are undertaken under several grants received from the State and Central Government. Some of the major capital works undertaken for the improvement of water supply is mentioned as under

Table 2:3: Capital works under Government grants

Sr.no	Capital works	Grant	Year	Amount
1	ESR at pratakund -18 mt height and 5 lac ltre capacity	BNVY	2004	Rs 21.40/lacs
2	150 mm AC pressure pipe from Pratapkund to Mangalpara	BNVY	2004	Rs 12.60/ lacs
3	U/G sump 5 lac ltre at pratapkund	UDY	2005	Rs 5.85/ lacs
4	ESR at Mangalpara 5 lac ltr cap. & 18 mt height	UDY	2005	Rs 21.40/lacs
5	U/G sump 5 lac ltr cap. at Mangalpara	UDY	2005	Rs 5.85/lacs
6	DI line 200 mm from forest well to Pratapkund	12 th Fin.comm.	2010	Rs. 40.12/lacs

BNVY: Bajpayee Nagar Vikas Yojana, UDY: Urban Development Year

2.6 Information collected for the years 2008-2011 under the PAS program

Under the PAS program, UMC team visited Lathi municipality and collected information for the year 2008-09, 2009-10 and 2010-11. The collected information related to various utilities was fed into the prescribed check list that enabled deriving Indicator values and the Reliability scale. Water formes the major concern of the ULB as it requires substantial resources, manpower, maximum time allocation and expenditure to be incurred. The details mentioned under, covers mainly the aspects related to water supply.

Table 2:4 Indicator values and Reliability scale for water supply system- Lathi

Key Performance Indicators (KPIs)					Reliability scale		
Sr.No	**Indicators**	**2008-09**	**2009-10**	**2010-11**	**2008-09**	**2009-10**	**2010-11**
1	Coverage of water supply Connections	61	71.2	72.6	C	B	B
2	Per capita supply of water in Lpcd	81	84.55	86.46	D	D	D
3	Extent of Non Revenue water	nd	25.31	23.44	-	D	D
4	Extent of metering of water supply connection	NA	NA	NA	D	D	D
5	Continuity of water supply in hours	0.37	0.37	0.37	D	D	D
6	Efficiency of redressal customer complaints	100	100	100	B	D	D
7	Quality of water supplied	100	100	100	D	D	D
8	Cost recovery in water supply services	129	58.99	101.44	B	D	D
9	Collection efficiency of water supply service	61	73.94	77.68	B	D	D

The details under the Reliability column mentioned in the above table show that most of the scale value is D which reflects the need to maintain the data and required information in appropriate formats for substantiating the above indicated values. This would also help in assessing the status of the system in operation and would assist in taking right decision for its further improvement. If the guidelines provided under the SLB/PAS manuals are followed adequately it would help in achieving targets with measures that would ultimately help in enhancing the indicator values with improved scale of reliability.

2.7 Prevailing practices in water supply management

The following are the prevailing practices in water supply system of Lathi municipality

- Department procures water in bulk quantity from the GWSSB at the rate of Rs 4/1000 ltrs. Though the meter is installed by the Board, the same is found non-functional but charges ULB on the fixed drawl of 2.5 mld of water. ULB has not raised the non-functional aspect of the meter with the Board authority and also does not make the payment to the Board, resulting into heavy dues to be paid by the ULB
- There is no measurement device that can record the incoming water quantity at the well and the sump of ULB where water is received

- Water quantity pumped and its pumping records i.e. the pumping hours and the meter consumption is not recorded by the ULB at any of its installations. Nor is the time of starting and closing of the pump or the water income from the Board is recorded
- There is no measuring device installed at any of the installation, nor is there any recording done of the tank's water level at regular interval. The level gauges at one of its installation is also not in proper order and hence the pointer outside moves vertically without any measurement indication. Operating staff though assumes the filling of the tank on the basis of the RCC wall's plate impression that is of standard height
- The valve operation is also not recorded properly, though the supply provided to various zones and subzones is recorded in the register with its time details.
- Cluster of zones are taken up for the supply on consecutive days, and the zones receives supply on alternated days.
- Water quality check is also not done and its records too are not maintained.
- Similarly there is no documentation of water related complaints practiced and its redressal recorded.

2.8 Identification of Information gaps and needs for diagnostic study

While commencing the diagnostic study, it was found that the ULB and especially the water supply department was lacking in basic data required for the study. In order to pursue the study it became imperative to provide guidance and technical support that would facilitate and enable the crucial information required for the study. The following are the major deficit areas that need to be addressed.

- Demand assessment of water zones
  - Election wards boundaries in appropriate scale.
  - Water zone spread, area and its population.
  - Water demand of each of the water zone.
- Assessment of water quantity during
  - Procurement
  - Distribution
  - Consumer end availability.
- Assessment of water loss
- Water quality Surveillance
- Financial sustainability of water supply
- Appropriate Information generation

2.9 Need for the diagnostic study

The study under the PAS program highlights and indicates the prevailing deficiencies in Water supply system operation. Since water supply forms the major concern of every ULB and it expends considerable resources in terms of finances, man power, machinery and time devotion, the system needs closer attention and scrutiny that could lead to remedial measures for affecting overall improvement.

From the study, It is also observed that the Indicators related to a) Per capita supply of water, b) Extent of Non Revenue water, c) Quality of water supplied and d) cost recovery of water supply services are directly or indirectly related to water being processed during procurement, treatment and distribution. The present practices followed by the Lathi municipality neither have appropriate methodology nor equipments and documentation practices for assessment of water quantity, quality and equity.

This deficiency mainly requires to be properly addressed hence, needs a closer study of the prevailing practices. It is also necessary to identify the exact deficit and evolve means and measures that would lead to proper quantification with suitable strategy that could be easily followed by the ULB staff. Hence it was planned to undertake a Diagnostic study related to major operational aspects of water supply.

During the data collection exercise undertaken under the PAS program, it was observed that the water supply system operation was managed in an ad-hoc manner, due to which no factual details related to water procurement, and distribution was available. The information provided by the ULB officials was based on mere assumptions rather than document based.

2.10 Objectives of the study

- To assess the water demand and water supply of each water zone.
- To derive the quantity of water (LPCD) procured, distributed and available at consumer
- To assess the water losses in transit
- To assess the quality of water provided to consumers
- To assess financial sustainability of water supply system
- To explore the possibilities of information system improvement

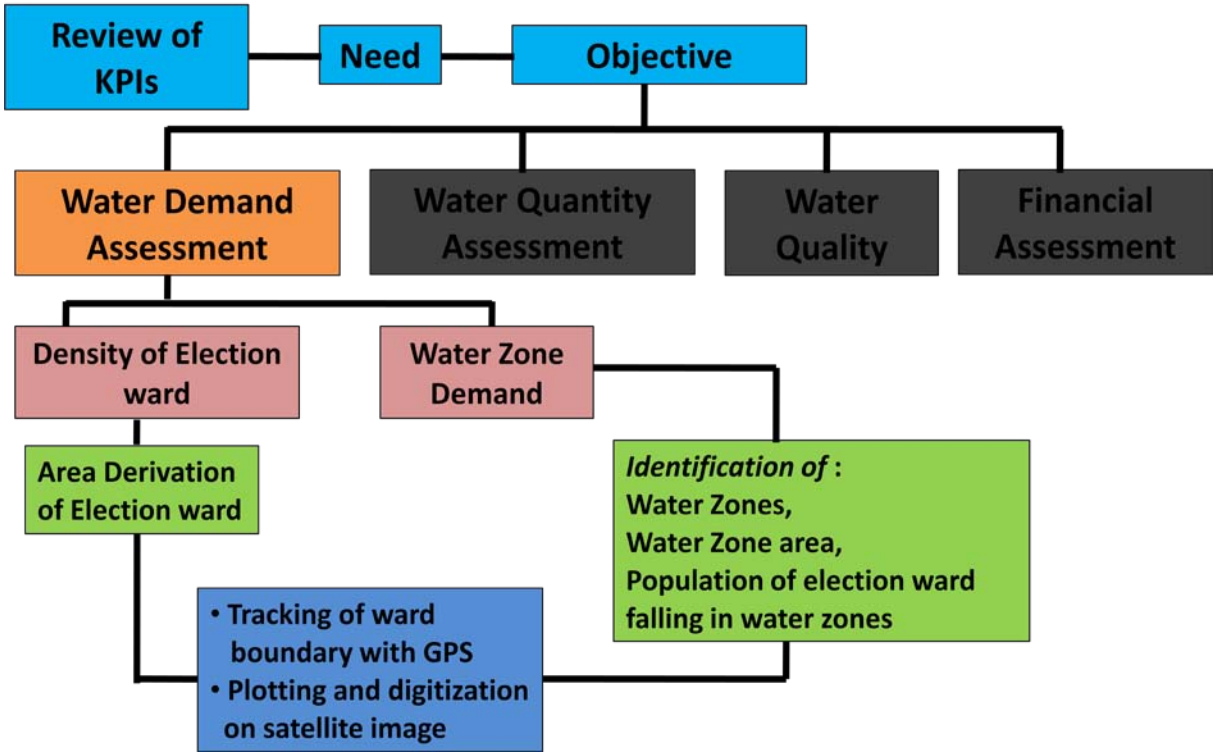
2.11 Methodology

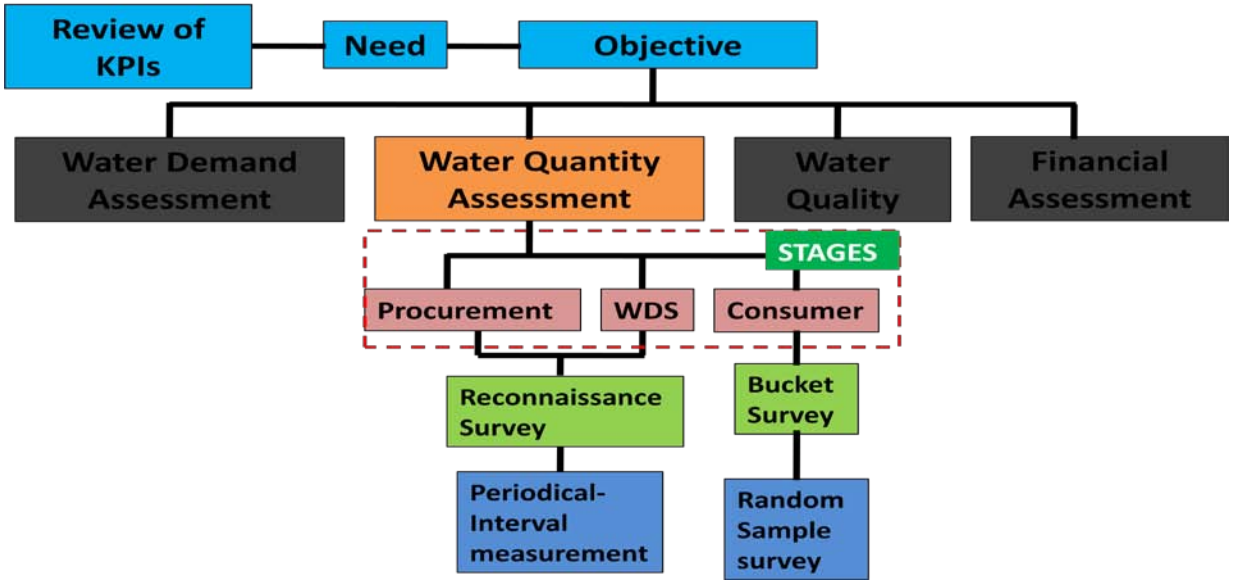
Methodology for the Diagnostic study of water supply system in Lathi municipality, the UMC team met the President, Chief Officer, City Engineer and other staff during several visits to Lathi municipality. The outcome of the performance measurement i.e is Key performance indicator values as per the service level benchmarking (SLB) was presented and discussed in detail during the preliminary visit. During the initial two meetings it was decided by the municipality to undertake detail water diagnostic study with technical support from UMC.

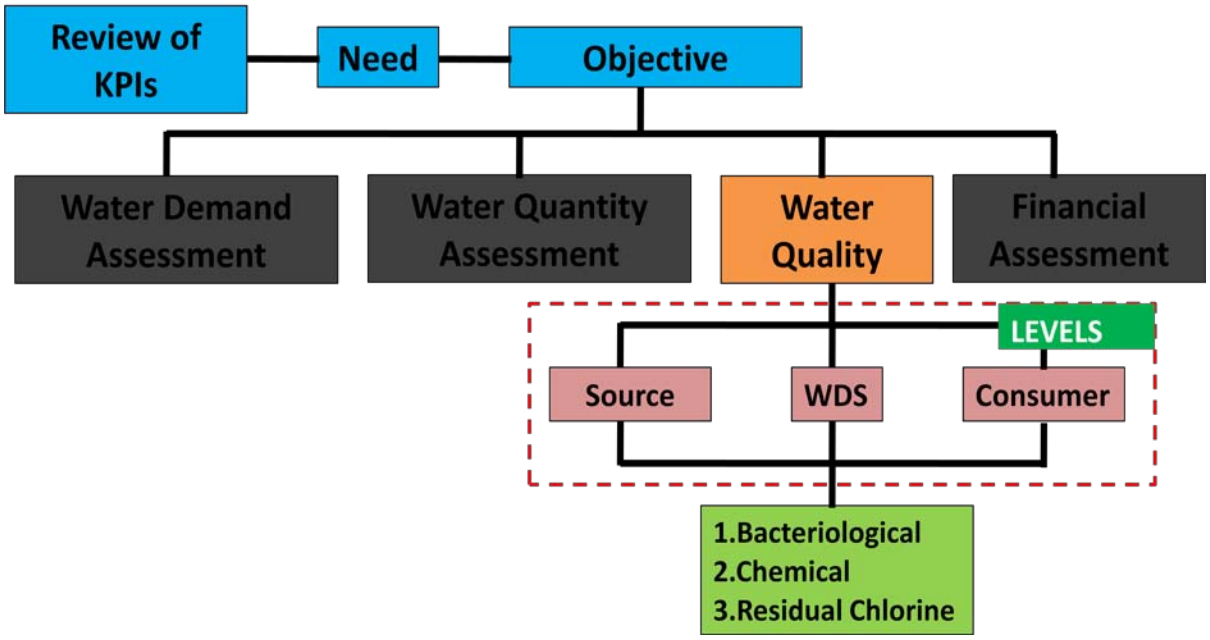
The three major components of the diagnostic study is as mentioned below:

(i) water demand assessment
(ii) water quantity assessment
(iii) Water quality assessment

The detail methodology of each component is illustrated below:






Review of KPIs
Need
Objective
Water Demand Assessment
Water Quantity Assessment
Water Quality
Financial Assessment
LEVELS
Source
WDS
Consumer
1.Bacteriological
2.Chemical
3.Residual Chlorine

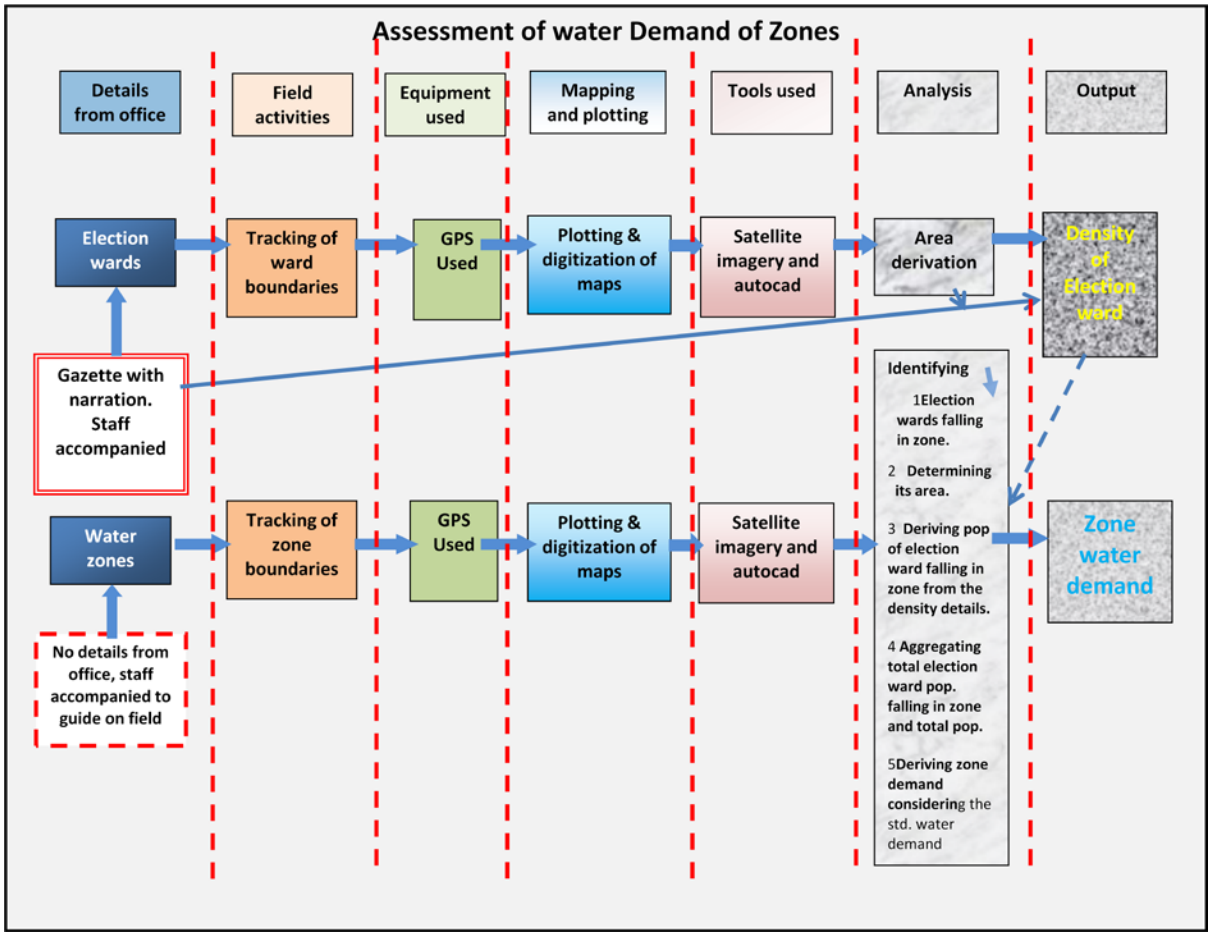
3 Intervention and technical support

As per the objective, UMC team has undertaken measures with technical support, for demand assessment of water zones, assess water quantification at procurement, distribution, and supply at consumer end. Similarly, water quality tests were also undertaken. Financial analysis of wss was also undertaken. Improving the system through better information was also emphasized recommending appropriate formats for recording and reporting.

3.1 Demand assessment of water zones

Election wards and its boundaries form a very crucial aspect for deriving demand of targeted service area. In absence of the water connection details of water supply zone, deriving population from the election ward becomes a handy tool for assessing the population served and its water demand. This also enables easy computation of per capita supply in different zones. The entire process of demand assessment exercise is illustrated in figure below.

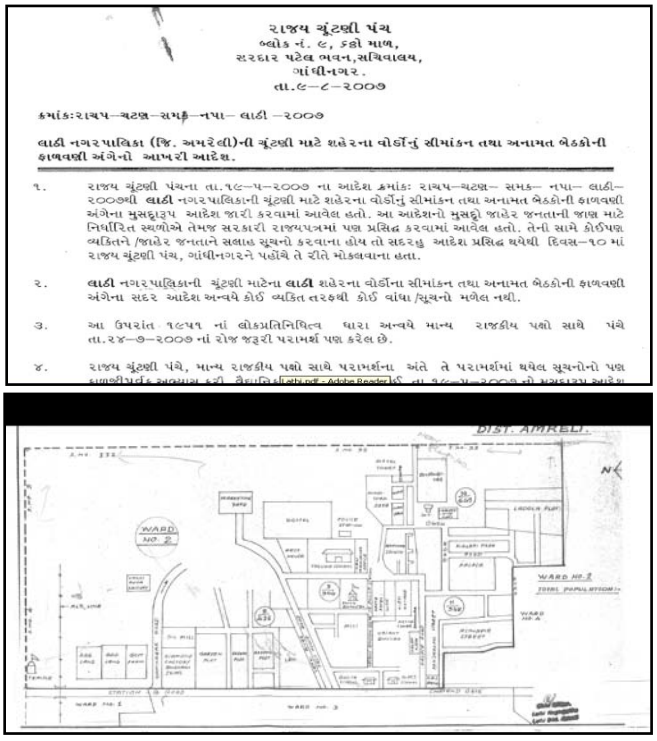
Figure 3:1: Assessment of water demand of zones



3.1.1 Tracking of Election ward boundaries

Election wards of municipalities are notified in the state gazette with ward population and the ward boundaries described in a narrative form. ULBs have not- to - scale sketch depicting the extent of each ward boundary. These details were procured from the ULB office. However, in order to derive

population density of each ward, inhabitable geographical area of each ward had to be derived after physical tracking and plotting the boundaries on map and computing its area.



રાજ્ય ચૂંટણી પંચ
બ્લોક નં. ૯, ૬ઠ્ઠો માળ,
સરદાર પટેલ ભવન,સચિવાલય,
ગાંધીનગર.
તા.૯–૮–૨૦૦૭

ક્રમાંકઃરાચપ–ચટણ–સમક–નપા– લાઠી –૨૦૦૭

લાઠી નગરપાલિકા (જિ. અમરેલી)ની ચૂંટણી માટે શહેરના વોર્ડોનું સીમાંકન તથા અનામત બેઠકોની ફાળવણી અંગેનો આખરી આદેશ.

૧. રાજ્ય ચૂંટણી પંચના તા.૧૯–૫–૨૦૦૭ ના આદેશ ક્રમાંકઃ રાચપ–ચટણ– સમક– નપા– લાઠી–૨૦૦૭થી **લાઠી** નગરપાલિકાની ચૂંટણી માટે શહેરના વોર્ડોનું સીમાંકન તથા અનામત બેઠકોની ફાળવણી અંગેના મુસદ્દારૂપ આદેશ જારી કરવામાં આવેલ હતો. આ આદેશનો મુસદ્દો જાહેર જનતાની જાણ માટે નિર્ધારિત સ્થળોએ તેમજ સરકારી રાજ્યપત્રમાં પણ પ્રસિદ્ધ કરવામાં આવેલ હતો. તેની સામે કોઈપણ વ્યક્તિને /જાહેર જનતાને સલાહ સૂચનો કરવાના હોય તો સદરહુ આદેશ પ્રસિદ્ધ થયેથી દિવસ–૧૦ માં રાજ્ય ચૂંટણી પંચ, ગાંધીનગરને પહોંચે તે રીતે મોકલવાના હતા.

૨. **લાઠી** નગરપાલિકાની ચૂંટણી માટેના **લાઠી** શહેરના વોર્ડોના સીમાંકન તથા અનામત બેઠકોની ફાળવણી અંગેના સદર આદેશ અન્વયે કોઈ વ્યક્તિ તરફથી કોઈ વાંધા /સૂચનો મળેલ નથી.

૩. આ ઉપરાંત ૧૯૫૧ નાં લોકપ્રતિનિધિત્વ ધારા અન્વયે માન્ય રાજકીય પક્ષો સાથે પંચે તા.૨૪–૭–૨૦૦૭ નાં રોજ જરૂરી પરામર્શ પણ કરેલ છે.

૪. રાજ્ય ચૂંટણી પંચે, માન્ય રાજકીય પક્ષો સાથે પરામર્શના અંતે તે પરામર્શમાં થયેલ સૂચનોનો પણ ધ્યાનપૂર્વક અભ્યાસ કરી [illegible] તા.૧૯–૫–૨૦૦૭ થી મુસદ્દારૂપ આદેશ

અનુસૂચિ–૧
લાઠી નગરપાલિકા, જીલ્લો, અમરેલી.

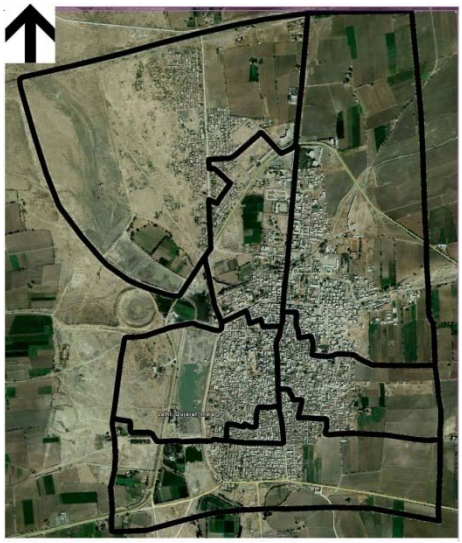
વોર્ડ નં.૧

સૂચિત વોર્ડ નંબર	ઈલેકશન વોર્ડના સેન્સસ બ્લોક, તાલુકા વિસ્તાર, ૬ર નંબરો તથા હદનું વર્ણન					
	બ્લોક નંબર	અ.જા. વસ્તી	અ.જ.જા. વસ્તી	કુલ વસ્તી	સેન્સસના બ્લોકના ૬ર નંબરની વિગત ૬ર નંબરથી ૬ર નંબર સુધી	બ્લોકના વિસ્તારની વિગત
૧	૨	૩	૪	૫	૬	૭
૧	૪	૧૦૪	૧૬	૫૩૨	૧ થી ૧૭૭	રેલ્વે સ્ટેશન પાસે, ખોડીયાર નગર, કેરીયા રોડ
	૫	૩	–	૮૪૧	૧ થી ૧૫૯	રેલ્વે સ્ટેશન કવાર્ટર, મફત પ્લોટ, કેરીયા રોડ,
	૬	૧૪૧	–	૬૫૦	૧ થી ૧૪૯	મફત પ્લોટ, કેરીયારોડ, સબસ્ટેશન પાસે,
	૭	–	–	૯૩૪	૧ થી ૨૧૯	મફત પ્લોટ
		૨૪૮	૧૬	૨૯૫૭		

હદનું વર્ણન :–
સ.નં.૧ના વાયવ્ય ખૂણાથી ઉત્તર તરફ જતા સ.નં.૧, ૨, ૩ ઉત્તરની હદે હદે સ.નં.૧, ૨, ૩ને આવરી લઈ સ.નં.૩ના ઈશાન ખૂણા સુધી ત્યાંથી પૂર્વ તરફ જતા સ્ટેશન રોડ સુધી ત્યાંથી દક્ષિણ તરફ રોડે રોડે રેલ્વે ફ્રોસ કરી ફ્રાક્ષ તાલેમનો બંગલો, ગજેરાની ફેક્ટરી, કબાપી વિનય મંદિરને આવરી લઈ કબાપી વિનય મંદિરના અગ્નિ ખૂણા સુધી ત્યાંથી પશ્ચિમ તરફ જતા કબાપી. વિનય મંદિરને આવરી લઈ કબાપી વિનય મંદિરના નૈઋત્ય ખૂણા સુધી ત્યાંથી ઉત્તર તરફ જતા કોર્ટ રોડની પૂર્વની હદે હદે કબાપી વિનય મંદિર, ગજેરાની ફેક્ટરીને આવરી લઈ ગજેરા ફેક્ટરીના વાયવ્ય ખૂણા સુધી ત્યાંથી પશ્ચિમ તરફ જતા મહાવીર નગર વિસ્તારની દક્ષિણની હદે હદે રેલ્વે સ્ટાફ કવાર્ટર, રેલ્વે સ્ટેશનની આવરી લઈ મહાવીર નગરના અગ્નિ ખૂણા સુધી ત્યાંથી દક્ષિણ તરફ જતા કેરીયા રોડના પૂર્વની હદે હદે મફત પ્લોટને આવરી લઈ મહાવીર નગરના નૈઋત્ય ખૂણા સુધી ત્યાંથી પશ્ચિમ તરફ જતા મહાવીર નગરના પશ્ચિમની હદે હદે મફત પ્લોટ, વો.વર્કસ ટાંકીને આવરી લઈ મહાવીર નગરના અગ્નિ ખૂણા સુધી ત્યાંથી દક્ષિણ તરફ જતા મફત પ્લોટની પૂર્વની હદે–હદે મહાવીર નગર, ચોટર વર્કસ ટાંકીને આવરી લઈ મફત પ્લોટના અગ્નિ ખૂણા સુધી ત્યાંથી દક્ષિણ તરફ જતા ભગતપરા વિસ્તારની ઉત્તરની હદે–હદે મફત પ્લોટ, ચોટર ટાંકીને આવરી લઈ ભગતપરાના વાયવ્ય ખૂણા સુધી ત્યાંથી પશ્ચિમ તરફ જતા કેરીયા રોડ ફ્રોસ કરી ભગતપરાના વાયવ્ય ખૂણા સુધી ત્યાંથી પશ્ચિમ તરફ જતા મફત પ્લોટ પશ્ચિમના સ.નં.૭૮ની હદે હદે આહમગીરી મફત પ્લોટને આવરી લઈ નૈઋત્ય ખૂણા સુધી ત્યાંથી ઉત્તર તરફ જતા સ.નં.૭૮ ઉત્તરની હદે હદે સનં.૧ મફત પ્લોટને આવરી લઈ સ.નં.૧ના વાયવ્ય ખૂણા સુધીમાં અંદર સમાવેશ થતો તમામ વિસ્તાર.

વાયવ્ય : (ઉત્તર–પશ્ચિમ)
ઈશાન : (ઉત્તર – પૂર્વ)
અગ્નિ : (દક્ષિણ – પૂર્વ)
નૈઋત્ય : (દક્ષિણ – પશ્ચિમ)

Lathi Nagarpalika has a map showing the election ward boundaries, however, the map is not-to-scale and provides no details of the area covered under each ward. The concerned staff of the election branch conversant with the town's topography accompanied the survey team of UMC for showing the exact location of the boundaries on-ground. Each of the seven wards was visited and the location verified with the one shown on the map. The boundaries were tracked with the help of GPS facilities available in Mobile phone. After tracking, the details were transferred on the Google map and the boundaries clearly marked. These details were also converted into AutoCAD compatible data.



3.2 Derivation of ward density

Election wards so marked were used for area derivation and with its population details obtained from the office; the election ward density was derived.

3.2.1 Mapping of distribution network

The major sources providing water to the town and the trunk mains linking it to the current Head works at Gagadia and Mangalpara were tracked and marked on the map, the details of which are shown in the figure below.

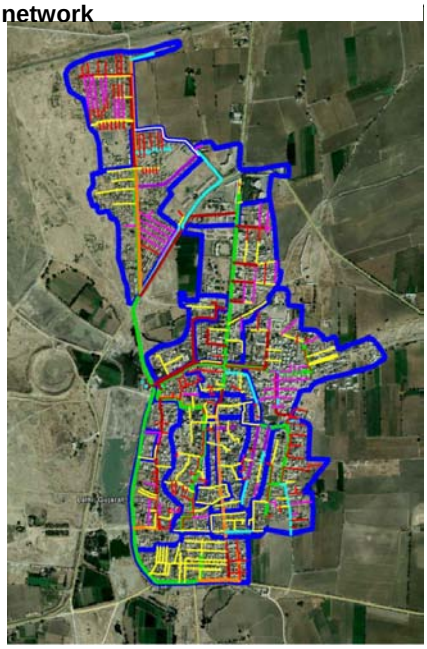
Figure 3.2: Trunk main feeding head works at Gagadia

Figure 3.3 : Emerging distribution main from the head works

During the study, it was necessary to understand the complex pipe network coming into and emerging from the head works at Gagadia and Mangalpara. This was necessitated, as ULB have no network maps for the junctions and lines entering and emerging out of the Head works.

The trunk mains and the water zone boundary were tracked with the help of GPS and details plotted on the map. Subsequently it was found necessary to map the entire distribution network, so that exact water supply zone boundaries could be demarcated and established. The foreman Mr Dhanabhai described the details of each zone distribution up to the smallest size of 2" and 2 ½". These details have been plotted on the map, and attempt has been made to prepare a pipe network map of the town.

Figure 3.4: Water distribution network



3.3 Mapping of water zones and population

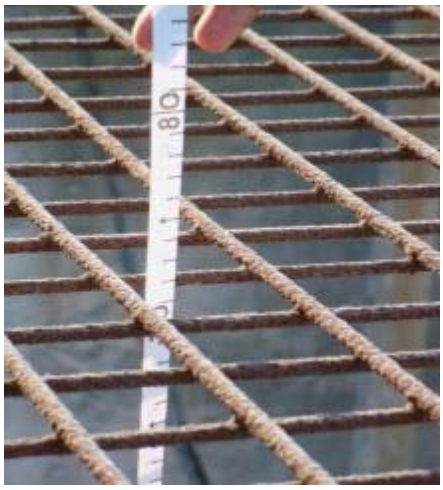
Similarly the extent of each of the water zone was tracked with the GPS and marked on the map. The details of the same are shown in the figure below. The foreman narrated the main location points of the related mains which could be marked on the imagery map. However, map reading was found difficult and the marking it on the map was not possible. It was decided to follow the same strategy of tracking as done previously.

As there are four sets of twin mains of 10 and 8 inch mains emerging from the Gagadia WDS, and as the tracking requires to be commenced a fresh from the starting point, commencement for each set had to be undertaken four times from the same head works. Only the mains have been taken up for the tracking exercise.

3.4 Water quantity assessment

3.4.1 Water procurement from source - Mahi and Bhidbhajan

Water is drawn from the two main source Mahi and Bhidbhnjan. Water from Mahi pipeline is made available by the GWSSB through its pipe network. From the tapping point, department has laid a pipe line of 150 mm dia PVC pipe of approximately 100 mt length. The discharging end of this PVC pipe ends into the Forest well from where water is pumped by 2-20 HP submersible pumps (1 working +1 Standby). Though the meter was functional as stated by the department, on verification by observing two consecutive readings at an interval of 30 minutes, the reading was found unchanged. This showed the meter was non-functional.



1 Forest well diameter	6 mt
2 Initial measurement at 4:45 pm	11.75 mt
3 Measurement at 5:55pm	9.12 mt
4 Difference of level	2.63 mt
5 Volume of water /mt depth of well	28.26 m3
6 Time span between the two recordings.	70 min.
7 Water volume/min	1.06 m3/min
8 Water volume/day in ML (20 hrs)	1.27 Mld

However, Board provides a monthly bill to Lathi Nagarpalika on presumptions that 2.0 Mld of water is provided for the town's water supply and charges a rate of Rs 4/ 1000 ltrs Appendix 1 show the water bill during the past years. In absence of proper working meter, it was decided to assess the approximate water quantity being received at the Forest well. Initially a random study on 10/11/2011 for about 70 min. showed that only 1.06 m3/min of water was received during the trial exercise.

3.4.2 Water distribution from the WDS

This process of water distribution from the ESRs forms the most important part of the supply system. The main aim is to provide adequate equitable quantity of water to different parts of the town. It resembles the functioning of heart in human beings. Lathi has in all five Elevated tanks and two underground sumps from where water gets distributed. Out of these five tanks only three tanks are in use, whereas the other old tank at the Gagadia HW is old and out of use. Similarly other tank at Mangalpara of lesser height is not in use. Out of the three tanks in use the two new tanks of 5 lac ltr capacities are used only during the early first supply in the morning and remains idle throughout the day. Only tank of 4.5 lac ltr capacity which is almost 20 yrs old is actively used catering to almost 50 % of the population.

The tanks and the underground sumps have no means for measuring the water quantity that is being processed in the WDS. There are neither flow meters nor tank level gauges fitted which can be used for level observation. Since this diagnostic study is mainly based on tank level observation at periodical intervals, it was imperative to have some means for the water level measurement and recording.

U/G sump level reading

- In absence of level gauge, the water level was observed by physically measuring the tank level by climbing on the top of the sump.
- Levels were observed continuously for the required period of three days and recorded.
- Special formats were designed for recording purpose and the municipal staff was apprised of the methodology of recording observations.

ESR reading

- Existing level gauge staff which was rusty was fixed with a flex tape specially marked with measure points and the level staff positioned on the tank level top.
- Reading from distance not visible were tried by double zooming through the digital camera.
- Subsequently Readings were observed by the help of theodolite instrument for better visibility and clarity.
- Attempt was also made to transfer the level through a guy wire which was lowered up-to the ground level for ease in observing the level variation.
- Municipal employee was also trained to take the tank level observation through the instrument.
- Effort of level sensing through modern gadgets (demo. exercise) - sonic level sensor was also tried out with the help and courtesy of Ahmedabad based dealer.

3.4.3 Water availability at consumer end

The objective of the study was to assess the availability of water at consumer end through bucket survey by engaging local school students of Lathi. The following preliminary steps were undertaken.

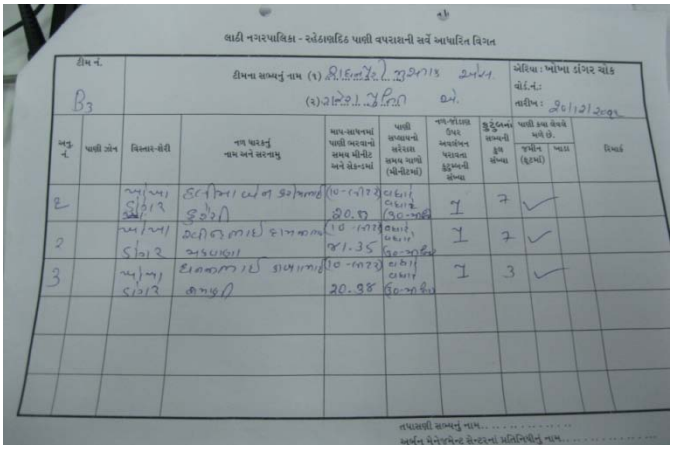
Prior meeting with the Principal of Kalapi vinay mandir school was held on 8/11/2011 regarding briefing about the program and the need for the consumer end survey. A formal letter requesting the Principal for allowing the student for participation in the activity was dispatched, and confirmation towards the above request was received from the principal vide their letter dt: 12/12/2011.

Figure 3.5: Sample points for Bucket survey

The consumer end survey points were identified using the standard statistical method and the points were marked on the city map. Totally 164 points were identified and points were marked on each of the water supply zone specially prepared and printed on A3 size page for easy reading and understanding of the students.

The student group identified for the exercise was addressed and the program objectives were explained in detail. Program documentary was also shown to the students to explain the program objectives.

Figure 3.6: Format for Bucket Survey



The survey formats were also prepared and copies procured for each of the student group. Bucket duly marked for 5/10 ltr capacity was procured. Suitable map for monitoring of the entire exercise was also prepared.

Students were divided into two major groups **A & B.** each group was further divided into four sub groups **(A_1,A_2,A_3,A_4- B_1,B_2,B_3,B_4)** and each subgroup comprising of two students. **I**n view of the short time available (45 min. supply time), approximately 3-4 survey points were allocated to each of the sub group.

Students were given detail explanation about the mode of carrying out the survey, identification of the survey points from the map. They were also trained for Interacting with the target consumers, during the main bucket exercise, filling of the format. The explanation was repeated 3-4 times so that the students properly understand and grasp the required methodology. A demonstration of the bucket filling. Observing the time from the stopwatch was specially demonstrated with the group as a whole and sub-group as part, in order to familiarize them of the intricacies involved.

Another group of 4 students was identified for the tank level observation at three different locations and shown the site and the mode of undertaking the measurement. The tank level observation was required for longer time duration throughout the day and night. Moreover, The students were also shown the point on the tank top almost 20 mt high where they would be taking the reading every hour and during the supply time. This exercise involved long distant commuting as well as a location being in isolated area, involving the students was not found appropriate, hence the exercise was decided to be undertaken by ULB staff conversant with observing and recording the measurement. However, though attempt was made for recording it was decided to undertake at later time.

As the water supply to each of the zone is on alternate days, the exercise also had to be scheduled for two days. Allocation of activity for each group was done as per the zone wise supply, the details of which are shown in the table below

Table 3:1: Zone wise number of samples and survey team- Day1

Sr.No	Day	Area	Group	Sub group			
				A1/ B1	A2/ B2	A3/ B3	A4/ B4
1	Day 1	Mahavirnagar	A	1-4	5-8	9-12	13-16
2		Ramjimandir Mangalpara		1-4	5-8	9-12	13-16
3		Police line area		1-4	5-8	9-12	
4		Panjrapole		1-3	4-6		
5		Railway				2	
6		Khoka danger	B	1-3	4-6	7-9	10-12
7		Khodiyar		1-3	4-6		
8		Koliwad andarbar		1-4	5-8	9-12	
9		Palace road			1-4	5-8	9-12

Table 3:2: : Zone wise number of samples and survey team- Day 2

Sr.No	Day	Area	Group	Sub group			
				A1/ B1	A2/ B2	A3/ B3	A4/ B4
1	Day 2	Bagicha plot area	A	1-4	5-8	9-12	13-16
2		Sagorapir-Mangalpara		1-4	5-8	9-12	13-16
3		Vania seri		1-4	5-8	9-12	
4		Bhagubhai naku		1-3	4-6		
5		Kharawad	B	1-3	4-6	7-9	9-12
6		Setapati harischandra		1-4	5-8	9-12	13-16
7		Sanghvi seri		1-3	4-6	7-9	

Monitoring the students undertaking sampling exercise (subgroup wise) was also done with the help of specially prepared table as shown below.

Table 3:3: Schedule for consumer end bucket survey

Timings		Day 1								Day -2							
6:00 AM	6:15 AM	A				B				A				B			
6:00 AM	6:15 AM	A1	A2	A3	A4	B1	B2	B3	B4	A1	A2	A3	A4	B1	B2	B3	B4
6:00 AM	6:15 AM	3	3	3	3	3	3	3	3	4	4	4	4				
6:15 AM	6:30 AM																
6:30 AM	6:45 AM	Bagicha plot area				Kharwad				Mahavirnagar				4	4	4	4
6:45 AM	7:00 AM																
7:00 AM	7:15 AM													Khoka dangar chowk			
7:30 AM	7:45 AM	4	4	4	4					4	4	4	4				
6:30 AM	8:00 AM																
8:00 AM	8:15 AM	Sagorapir -mangalpara				4	4	4	4	Ramji mandir Mangalpara				3	3		
8:15 AM	8:30 AM																

8:30 AM	8:45 AM					**Setapati-harischandrpara**								**Khodiyar**				
9:00 AM	9:15 AM									4	4	4						
9:15 AM	9:30 AM																	
9:30 AM	9:45 AM									**Polic line area**								
10:15 AM	10:30 AM														4	4	4	
10:30 AM	10:45 AM																	
10:45 AM	11:00 AM														**Koliwad andarbar**			
11:00 AM	11:15 AM	4	4	4	4					3	3	2						
11:15 AM	11:30 AM																	
11:30 AM	11:45 AM	**Vania seri**								**Panjrapol**		**Rail.**						
12:00 PM	12:15 PM														4	4	4	
12:15 PM	12:30 PM					3	3	3										
12:30 PM	12:45 PM														**Palace area**			
12:45 PM	1:00 PM					**Sanghvi sheri**												
1:30 PM	1:45 PM	3	3															
1:45 PM	2:00 PM																	
2:00 PM	2:15 PM	**Bhagubhai**																
2:15 PM	2:30 PM	**Nako**																
	Total	**14**	**14**	**11**	**11**	**10**	**10**	**10**	**7**	**15**	**15**	**14**	**8**	**7**	**15**	**12**	**12**	

Bucket survey exercise in action:






3.5 Water quality assessment

The assessment of water quality has also been undertaken. Department does not undertake testing of water samples for the RC, chemical or bacteriological analysis. Addition of bleaching powder or the hypo chlorite solution is not uniformly undertaken nor is the dosage appropriately identified and monitored.

The objective of this exercise was to tests the various parameters such as biological, chemical and residual chlorine and assesses the fitness for human consumption.

Water quality tests were undertaken with the help of the testing kit. The kit provided by WASMO to Lathi municipality for periodical tests has remained unused in absence of skilled personnel to carry out this exercise.

The 7 parameters (Residual chlorine, pH, Chloride, Nirates, Fluorides, TDS and microbiological indicative (E.coli) test) were tested at source, WDS and consumer end. Altogether 79 samples were taken for water quality analysis.

Samples were identified from each of the water zones and testing done during the time of its supply. Similarly samples from the source -i.e Mahi water from the forest well and water samples from the Bhidbhajan wells - were also taken for the testing. Samples from the surface water near the Gagadia head works were also taken to test the fitness of the surface water. Similarly ground water samples from the bores in the town were also identified.

BOX 1: ***Residual Chlorine Test at source:- Interventions and its Instantaneous Impact***

While undertaking the Rc examination, It was found that almost every sample of each zone showed negative results indicating total absence of chlorine. Matter was brought to the notice of the Engineer, who immediately inquired the reasons for the total negative results. It was later learnt that the stock of the bleaching powder, the disinfectant used for providing the required chlorine, had exhausted. Only two bags were retained to be used during emergency situation. The bags were used at Forest well to check the efficacy of the chemical and to see its result at the consumer end. The powder mix was prepared in presence of the UMC team and injected into the well. The sample at the well site was examined to check the presence of chlorine, and compared to the colour code of the testing equipment. Rc around 0.5 ppm and more was detected.

4 Analysis

4.1 Analysis of Demand Assessment

Area and the density of each election ward have been derived as shown in table below.

Table 4:1: Area and density of each election ward

Election wards	1	2	3	4	5	6	7	Total
Population	3621	2946	2352	2775	2254	4136	3093	21177
Water connections	426	622	499	668	296	415	425	3351
Area in hector	30.94	33.70	21.61	16.07	18.02	3.50	17.05	140.89
Households	665	589	484	540	432	761	558	4029
Density/Hect.	117.03	87.42	108.84	172.68	125.08	1181.71	181.41	282.02
Conn.coverage	64.06	105.60	103.10	123.70	68.52	54.53	76.16	83.17

Area derived from plotted map

Density derived from pop. & area

The highest density of 1181 has been found in ward no. 6 as the population of 4136 person remains confined in an area of 3.5 hectors being the smallest of all election wards. Besides the table also show the households in each of the wards and the water connection coverage of each of the election wards. Ward wise connection details obtained from water supply department and household details obtained from the census were compiled to get better understanding of connection coverage. It is observed that the ward no.2,3 and 4 are having more than 100 percent coverage, reveals that some of the households are having more than one connection. Ward no. 1, 5, 6 and 7 are having even less coverage than the city average of 83.17%. This information leads to special measures that need to be taken in these wards to improve the connection coverage.

Similarly after tracking and plotting the water zones on map, the zone areas were also derived and the election wards falling in each of the zone were duly identified and the density of the election wards were utilized in deriving the zone population and its water demand. The details are mentioned in table given below.

Table 4:2: Area and population of each water zone

Details of election wards falling in water zone and its area and population								
Election wards	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Density/Hect	**117.03**	**87.42**	**108.84**	**172.68**	**125.08**	**1181.71**	**181.41**	**282.02**
1 Khalawad (16)							8.1	**8.1**
Population ser.							1469	**1469**
2 H.para setapati (8-9)					7.55		1.512	**9.062**
pop.served					944		274	**1219**
3 Khoka dangar (10)			0.39		8.28	1.54		**10.21**
pop.served			42		1036	1820		**2898**
4 Sanghvi seri (11)					1.25	0.95	0.213	**2.413**
pop.served					156	1123	39	**1318**
5 Vania seri (12)				24.86			1.29	**26.15**
pop.served				4293			234	**4527**
6 Panjrapole (6)		0.86	1.4	1.17				**3.43**
pop.served		75	152	202				**430**
7 Koliwad (5-a)			4.13					**4.13**
pop.served			450					**450**
Andarbar (5 b)				1.02				**1.02**
pop.served				176				**176**
8 Bagicha plot (4)		9.17	7.11					**16.28**
pop.served		802	774					**1575**
9 Police line (3)	1.86	2.07	10.99					**14.92**
pop.served	218	181	1196					**1595**
10 Mahavirngr (2)	12.18		3.66					**15.84**
pop.served	1425		398					**1824**
11 Khodiyarngr (1)	10.29							**10.29**
pop.served	1204							**1204**
12 Mglpara r.ma (13)				3.27				**3.27**
pop.served				565				**565**
13 Palace area (7)		16.03						**16.03**
pop.served		1401						**1401**
14 Mglpara Gok (14)				7.59			2.11	**9.7**
pop.served				1311			383	**1693**
15 Bhagubhai naku-(15)						0.47	1.3	**1.77**
pop.served						1182	181	**1363**
Inhabited area of Election Wards & water Zone					**Total inhabited area covered**			**152.62**
Population of Election ward falling in water zone					**Total Population covered**			**23706**

The above table show that vania seri water zone has the highest inhabitable area of 26.15 hect. With a population of 4527 person. Andarbar WZ 5-b has the smallest area of 1.02 hectors and covers a population of 176, whereas bhagubhain naku with an area of 1.77 hect. Covers 1363 person. Table contents clearly show the unevenness of the zone area and its population spread, however, all these zones are supplied water for equal time period of 45 min. that leads to inequity in supply. The total inhabitable area coverage is 152.62 hectors and it covers a population of 23706 person. This varies from the recent census figure of 21111 person, as the methodology adopted for the population coverage by the zones is based on election ward area, its density and utilizing this for zone population computation. On the basis of the zone population so derived, the water demand of each zone considering the national standards has been derived and shown in the table below.

Table 4:3: Estimation of water demand of each water zone

Estimation of water demand of each zone				
Sr. no.	**Water zones**	**Population**	**Demand (lac. Ltr)**	**Procurement (lac.ltr)**
1	Khalawad	1469	4.11	3.50
2	Harishchadrapara-Setapati	1219	3.41	2.90
3	Khoka dangar	2898	8.11	6.90
4	Sanghvi seri	1318	3.69	3.14
5	Vania seri	4527	12.68	10.77
6	Panjrapole	430	1.20	1.02
7	(a)Koliwad	450	1.26	1.07
8	(b)Andarbar	176	0.49	0.42
9	Bhagicha plot	1575	4.41	3.75
10	Police line	1595	4.47	3.80
11	Mahvirnagar	1824	5.11	4.34
12	Koidyarnagar	1204	3.37	2.87
13	Mangalpara ramji mandir	565	1.58	1.34
14	Palace Area	1401	3.92	3.34
15	Mangalpara Gokulnagar	1693	4.74	4.03
16	Bhagubhai no nako	791	2.21	3.24
	Total	**23135**	**64.78**	**56.42**

Since census exercise is not based on area calculations, the variation would occur when the area calculation forms the basis of computation for deriving area and density. The variation in this case is around 12% on higher side.

The zone population and water demand has been considered on the basis of 140 LPCD and 280 LPC for two days. as the supply is provided on alternate day. The highest demand is for water zone Vania sheri 12.68 Lac ltrs for population of 4527. The lowest demand for Panjarapole is around 1.20 lacs liters for population of 176.

The above exercise of water demand assessment would help the ULB to provide required quantity of water to each zone on volumetric basis depending on the zone population.

4.2 Analysis of water quantity assessment

4.2.1 Procurement

Discharge capacity of the pumps at Forest well and Bhidbhanjan well was found essential to assess , the pumping capacity for the submersible pumps located at Forest and Bhidbhajan well as they are constantly operated during the supply hours and for sump and ESRs filling. Pump's discharging volume also needs to be added during the supply to different zones, hence the need to assess the discharge capacities of these pumps. Attempts at both the wells were undertaken for the above purpose. Following table show the details of its discharging capacity. However, there would be variations in the discharging capacities at different suction heads of the well, at present it is not considered. For computing the discharge capacity of pumps, Mahi intake valve was closed during the observation period. Pumping discharge of the pump at forest well after observation was derived to be 68.4 m3/hr or 1.140 m3/min. that of Bhidbhajan well discharging into the gagadia sump has been derived as 1.449 or 86.94 m3/hr.

Table 4:4: Pump discharge capacity at Forest Well

Measurement of Pump's discharging capacity of main pump at Forest well								
Location	Forest well	Water qty in m3/mt		28.6	time of observation		1:18 pm-2:20 pm	Dt: 3/2/2012
Sr.No	time noted	level of well in mt	level diff	time dur.in min.	water qty in m3/mt	water qty(m3) per min.	Avg qty in m3/min	Total water qty in ml considering 16 hrs of water receipt in a day
1	1:18 PM	6.53	mahi val X					
2	1:33 PM	7.1	0.57	15		1.07		
3	1:48 PM	7.76	0.66	15	28.6	1.24	1.140	**1.09**
4	2:03 PM	8.35	0.59	15		1.11		
5	2:18 PM	8.95	0.6	15		1.13		
6	2:20 PM	9.1	mahi val O	2				

Table 4:5:Discharge from Bhidbhajan well

Measurement of Income from Bhidbhajan well during the day								
Location	Bhidbjan	Water qty in m3/mt		98.82	time of observation		4:50 pm-5:05 pm	Dt: 4/2/2012
Sr.No	time noted	level of well in mt	level diff	time dur.in min.	water qty in m3/mt	water qty(m3) per min.	Avg qty in m3/min	Total water qty in ml considering 16 hrs of water receipt in a day
1	4:50 PM	2.33	Bhid. X					
2	5:05 PM	2.11	-0.22	15		1.45		
	5:05 PM		Bhid. O		98.82		1.449	**1.39**

Total water procured from the sources is 2.83 Mld. Since alternate day supply is provided the total town population is served in two days time, hence water procurement is also considered for two days making it 5.67 ML. considering the present population the per head procurement is derived to be 244 against demand of 280 lpc. Zone wise population helps to derive the above per head procurement for zone.

Levels at periodic intervals were also taken during 2-4/2/2012 at the Forest well. In absence of the records for Mahi valve operation not maintained, however it is informed that the Mahi water flow is for around 20 hrs. the quantity derived from this observation is also shown in the table below. The above detail reveals that though Board charges for water for a quantity of 2.0 MLD. Zone wise water

Table 4:6: Water levels at Forest well during pumping operation

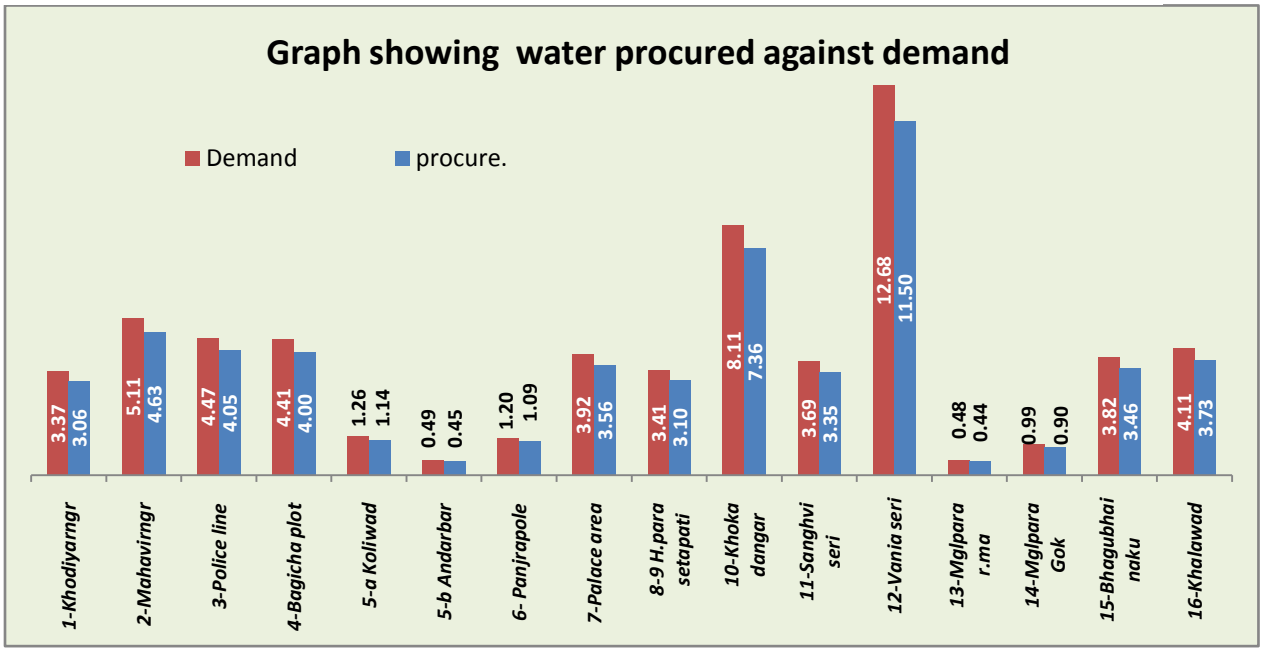
Water levels of Forest well during the pump operation during 2-3-4/2/2012							
Forest well levels at diff.time				28.6	pump cap.	1.154	
Date	Time	level	Diff.	Water volume	Time dur. In min	Outflow	Total Mahi Inflow
2/2/2012	1:45 PM	11.05					
	2:50 PM	10.99	-0.06	-1.72	65.00	75.01	76.73
	3:50 PM	10.96	-0.03	-0.86	60.00	69.24	70.10
	5:05 PM	8.30	-2.66	-76.08	75.00	86.55	162.63
	7:00 PM	4.6	-3.70	-105.82	115.00	132.71	238.53
	7:30 PM	7.2	2.60	74.36	30.00	34.62	-39.74
	9:30 PM	9.16	1.96	56.06	120.00	138.48	82.42
	10:55 PM	10.3	1.14	32.60	85.00	98.09	65.49
3/2/2012	12:30 AM	11.88	1.58	45.19		0	-45.19
	2:35 AM	11.16	-0.72	-20.59	125.00	144.25	164.84
	5:20 AM	9.16	-2.00	-57.20	165.00	190.41	247.61
	6:50 AM	8.76	-0.40	-11.44	90.00	103.86	115.30
	8:15 AM	8.15	-0.61	-17.45	85.00	98.09	115.54
	10:20 AM	6.96	-1.19	-34.03	125.00	144.25	178.28
	11:28 AM	7.01	0.05	1.43	68.00	78.472	77.04
	12:20 PM	6.9	-0.11	-3.15	0.04	0.041672	3.187672
	5:30 PM	5.45	-1.45	-41.47	52.00	60.008	101.478
	9:30 PM	6.2	0.75	21.45	240.00	276.96	255.51
	10:35 PM	8.09	1.89	54.05	65.00	75.01	20.956
	11:40 PM	8.9	0.81	23.17	65.00	75.01	51.844
4/2/2012	12:56 AM	9.42	0.52	14.87		0	-14.872
	2:30 AM	10.15	0.73	20.88	94.00	108.476	87.598
	3:35 AM	10.68	0.53	15.16	65.00	75.01	59.852
	5:00 AM	11.26	0.58	16.59	85.00	98.09	81.502
	6:55 AM	10.93	-0.33	-9.44	115.00	132.71	142.148
	7:55 AM	10.45	-0.48	-13.73	60.00	69.24	82.968
	9:20 AM	9.78	-0.67	-19.16	85.00	98.09	117.252
	11:00 AM	8.08	-1.70	-48.62	100.00	115.4	164.02
	12:21 PM	4.84	-3.24	-92.66	81.00	93.474	186.138
	3:35 PM	6.46	1.62	46.33	194.00	223.876	177.544
				Total min.	2509.04		3026.70
			Average Ml/per day- 20 hrs		1447.58		

procurement has also been attempted considering the present procurement quantity against the total population which comes to around 119 lpcd for a single day and 238 lpc for 2 days. Zone population also helps in deriving the procurement for each zone, thus it can also be stated as a share of each zone for which water is procured at present. The figure below shows share of each zone in procurement.

The graph details also show that the water quantity that is being procured falls slightly short of the water demand of each zone. the highest demand is for the zone of vania seri which is 12.68 lac ltrs

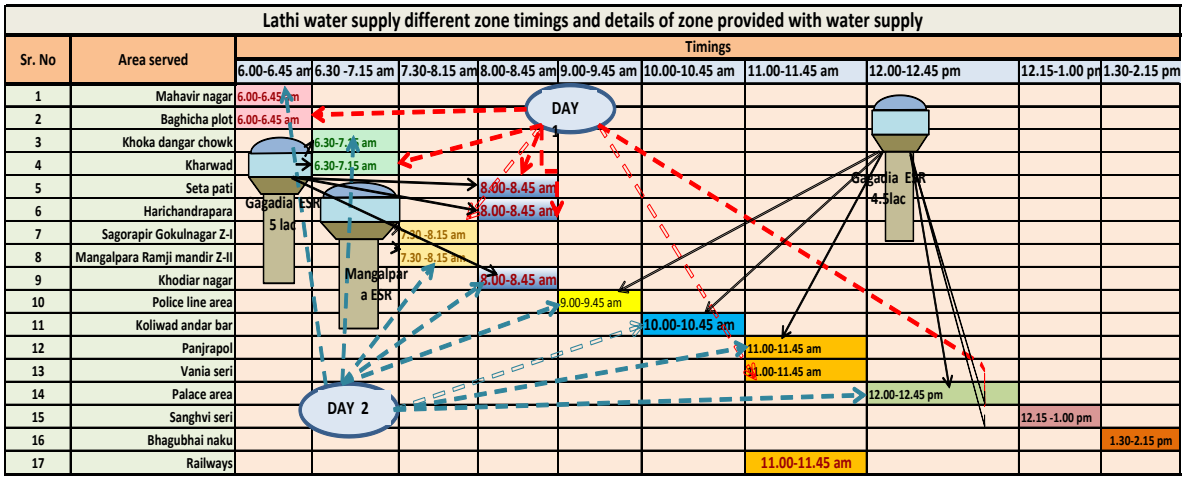
and the procurement share is 11.50 lac ltrs, whereas the lowest is for mangalpara ramji mandir which has a demand of 0.48 lac ltr against procurement of 0.44 lac ltrs.

Figure 4:1: Water produced against demand



4.2.2 Water Distribution Station

Water to the entire town is supplied from the two ESRs (5 lac & 4.5 lac ltr cap.) located at Gagadia Head works and Mangalpara Head works –ESR cap 5 lac ltr. The supply to the town is on alternate days and the during the two different days the supply provided to different zones is showed in the table below. Picture show the detail of different days on which supply is provided to different zones and the tanks from which it is provided along with its timings. The sketch has been specially prepared to understand the complexities of the zone supply from diff. tanks at different time on different days.



Supply from the WDSs were observed for their related days supply provided to different zones. The tank volume/mt and the pumping discharge for the inflows were taken into consideration while deriving the water volume for each of the zone. Also the zone supply time of starting and shutting was also noted along with the levels. Details of the observation are shown in the following tables and graphic comparison also shows the variation between the zones.

Table 4:7: Water quantity supply details from Gagadiya ESR(4.5 lac ltr)

Water quantity supply details from Gagadia ESR (4.5 lac ltr) capacity										
Tank volume per mt		85.23	Pump dis. Capacity		1.154	1.45	Day	Wednesday	Date	29/2/2012
Sr.no	Time	Tank level	level diff	dur.time in min	pump inflow		Supply valve	Area supplied	supply to area	
					Forest	Bhidbajan				
1	6:05 AM	1.45			O	O	Bagicha plot O	Bagicha plot	290.3824	
2	7:05 AM	3.33	1.88	50	O	O	Bagicha plot X			
3	7:20 AM	3	-0.33	15	O	O				
4	7:22 AM	3.29	0.29	2	O	O				24.7167
5	7:30 AM	2.7	-0.59	8	O	O				
7	7:35	2.55	-0.15	5	O	O				
8	7:43 AM	2.35	-0.2	8	O	O				
9	7:50 AM	2.1	-0.25	7	O	O				
10	7:55 AM	1.9	-0.2	5	O	O				
11	8:05 AM	1.64	-0.26	10	O	O	Setapati O			
12	8:15 AM	2.1	0.46	15	O	O				
13	8:30 AM	2.85	0.75	15	O	O				
14	8:45 AM	3.47	0.62	15	O	O				
15	8:50 AM	3.8	0.33	5	O	O	Setapati X		314.2468	
16	9:04 AM	3.57	-0.23	14	O	O				
17	9:45 AM	2.5	-1.07	41	O	O	Kalapi pk O			
18	9:52 AM	2.72	0.22	7	O	O				
19	10:00 AM	3.13	0.41	8	O	O				
20	10:15 AM	3.86	0.73	15	O	O				
21	10:20 AM	4.08	0.22	5	O	O				
22	10:30 AM	4.08	0	10	O	O	Kalapi pk X		160.69	
23	10:50 AM	4.3	0.22	20	O	O				18.7506
24	11:00 AM	3.93	-0.37	10	O	O				
26	11:30 AM	3.57	#REF!	15	O	O				
27	11:45 AM	3.36	-0.21	15	O	O	Vania seri O			
28	12:00 PM	3.83	0.47	15	O	O				
29	12:15 PM	4.55	0.72	15	O	O				
30	12:30 PM	5.05	0.5	15	O	O	Vania seri X		183.08	
31	1:45 PM	3.82	-1.23	45	O	O				
32	2:00 PM	3.44	-0.38	15	O	O	Bhagunku O			
33	2:15 PM	3.68	0.24	15	O	O				
34	2:30 PM	3.92	0.24	15	O	O	Bhagunku x		79.96	20.4552
35	2:45 PM	4.35	0.43	15						36.6489
36	3:10 PM	3.55	-0.8	25			Sanghvi seri O			
37	4:00 PM	3.95	0.4	50			Sanghvi seri X		164.24	
38										
Mahi	1440	Bhidbhajan	1390	Total Input	2830	Total Output	1551			Total outflow
						Deficit	1279.40	Supply to area	1192.60	
						Deficit %	45.21	Blank supply	100.57	1193
								Total outflow from Gagadia ESR (5 lac ltr capacity) Khalawad area		249
								Total outflow from Gagadia ESR (5 lac ltr capacity Mangalpara Ramjimandir		109

Table 4:8: Water supplied to various zones from WDS

Water supplied to various water zones from WDS					
Sr.no.	**Water zones**	**Population**	**Demand (lac. Ltr)**	**Procurement (lac.ltr)**	**Supply from WDS (lac.ltr)**
1	Khalawad	1469	4.11	3.50	2.49
2	Harishchadrapara-Setapati	1219	3.41	2.90	3.14
3	Khoka dangar	2898	8.11	6.90	4.5
4	Sanghvi seri	1318	3.69	3.14	2.23
5	Vania seri	4527	12.68	10.77	1.83
6	Panjrapole	430	1.20	1.02	1.21
7	(a)Koliwad	450	1.26	1.07	0.58
8	(b)Andarbar	176	0.49	0.42	1.59
9	Bhagicha plot	1575	4.41	3.75	2.9
10	Police line	1595	4.47	3.80	1.1
11	Mahvirnagar	1824	5.11	4.34	2.48
12	Koidyarnagar	1204	3.37	2.87	1.64
13	Mangalpara ramji mandir	565	1.58	1.34	1.09
14	Palace Area	1401	3.92	3.34	1.6
15	Mangalpara Gokulnagar	1693	4.74	4.03	3.04
16	Bhagubhai no nako	791	2.21	3.24	0.79
	Total	**23135**	**64.78**	**56.42**	**32.21**

Against procurement of 56.42 Lacs litre , only 32.21 Lacs litre water supplied from the WDS to for two days supply amounting to a loss of around 42.91% against procurement and deficit of around 65.89% against demand.

Levels recorded at start and close time of supply zones

Pump capacity added when they are operating

Volumes derived based on the tank dimension and level diff & also adding pumping volume

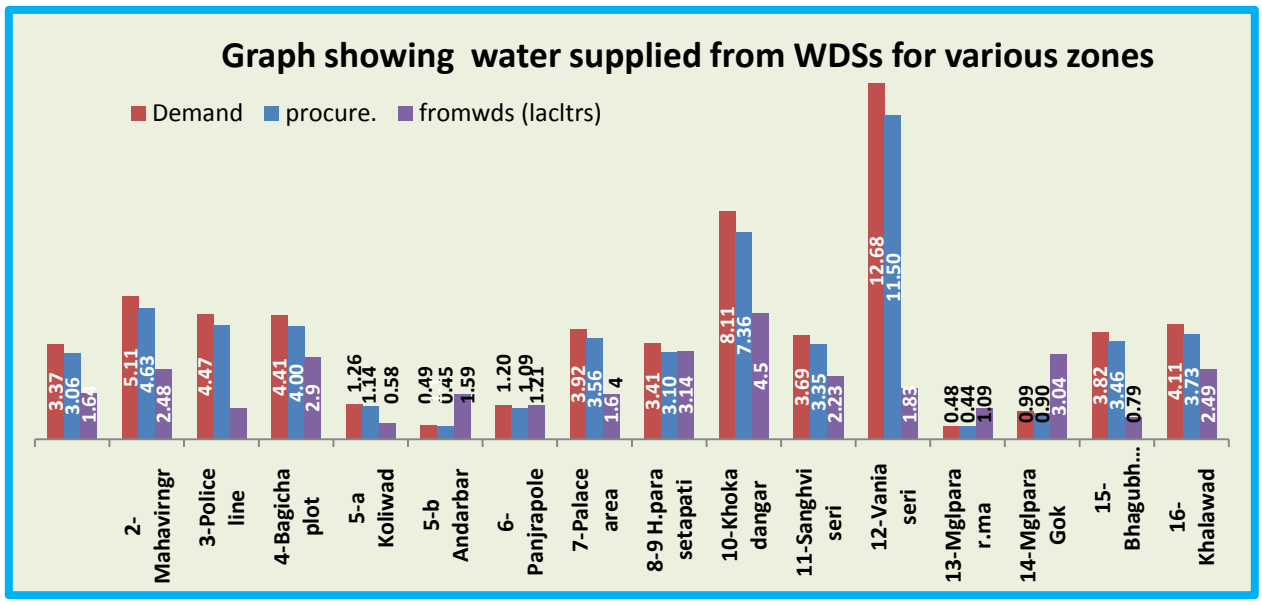
Water quantity supply details from Gagadia ESR (4.5 lac ltr) capacity										
Tank volume per mt		85.23	Pump dis. Capacity		1.154	1.45	Day	Saturday	Date	4/2/2012
Sr.no	Time	Tank level	level diff	dur.time in min	pump inflow		Supply valve	Area supplied	supply to area	Total supp.
					Forest	Bhidbajan				
1	6:30 AM	1.45			O	X	Mahavirngr O	Mahavirngr	248.223	
2	7:30 AM	3.55	2.1	60	O	X	mahavirngr X			
3	8:18 AM	4.5	0.95	45	O	X				
4	8:43 AM	3.9	-0.6	25	O	X			-22.288	
5	8:40 AM	3.5			O	O				
6	9:00 AM	3.5	0	22	O	O	Khod. valve O	Khodyar ngr	57.266	
7	9:50 AM	3.9	0.4	50	O	O	Khod. valve X		164.242	
8	9:50 AM	3.9	0	40	O	O	Panjra.valve O	Panjrapole	121.166	
9	10:30 AM	4.1	0.2		O	O	Panjra.valve X			
10	10:45 AM	3.7	-0.4	15	O	O	Blank		4.953	
11	10:45 AM	3.7	0	40	O	O	Police valve O	Police line	110.0861	
12	11:25 AM	3.77	0.07		O	O	Police valve X			
13	11:45 AM	3.4	0.37	20	O	O	Blank		83.5951	
14	11:45 AM	3.4	0	40	O	O	Andarbar O	Andarbar	159.5195	
15	12:25 PM	4.05	0.65		O	O	Andarbar X			
16	1:30 PM	2.6	1.45	65	O	O	Blank		292.78	
17	1:30 PM	2.6	0	45	O	O	Sanghviseri O	Sanghvi seri	223.67	
18	2:15 PM	3.85	1.25		O	O	Sanghviseri X			
Mahi	1440	Bhidbhajan	1390	Total Input	2830	Total Output	1780.91			Total outflow
						Deficit	1049.09	Supply to area	1026.91	
						Deficit %	37.07	Blank supply	416.30	1026.91
Total outflow from Gagadia ESR (5 lac ltr capacity) Khokha dangar area										450
Total outflow from Gagadia ESR (5 lac ltr capacity Mangalpara Gokulngr										304

Zone demand assessment has enabled quantifying the water demand of each zone, and the water quantity that has been procured has also been divided amongst the zone. This has been attempted to derive an equitable water quantity towards the demand and the entitlement of each zone from the present water quantity that is procured. However, the distribution from the wds is found inequitable amongst the zone. The largest variation is for the zone of Vania seri, where against the procurement the zone barely gets barely around 17%. There are zones, like andarbar and panjrapole that gets more water than its procurement share. Rests of the zones get around 50-70% of the water procurement share. Thus there is inequity found in the distribution between various zones. This further gets reduced while the water is received at the consumer end, though the difference is marginal. This inequity mainly occurs due to the supply pattern is managed on time basis, irrespective of the zone water demand. This observation has emerged from the water quantity assessment undertaken during the diagnostic study based on tank water level observation.

If the distribution from wds is monitored on the basis of the volume of water supplied to different zones, this inequity of water supply can be well managed and provide the zones the water quantity as

per their demand. This calls for bulk water meter installation of the distribution mains emerging from the wds or observing the water volume supplied through tank level details.

Figure 4:2: Water supplied from WDS for various zones



Water quantity supply details from Gagadia ESR (4.5 lac ltr) capacity										
Tank volume per mt		85.23	Pump dis. Capacity		1.154	1.45	Day	Friday	Date	1/3/2012
Sr.no	Time	Tank level	level diff	dur.time in min	pump inflow		Supply valve	Area supplied	supply to are	tank fill
					Forest	Bhidbajan				
1	6:40 AM	1.45			O	O	Mvrngr-o			
2	6:55 AM	1.78	0.33	15.00	O	O				
3	7:00 AM	2.04	0.26	5	O	O				
4	7:05 AM	2.25	0.21	5	O	O				
5	7:10 AM	2.46	0.21	5	O	O				
7	7:17	2.76	0.3	7	O	O		Mvrngr		
8	7:20 AM	2.9	0.14	3	O	O				
9	7:25 AM	3.16	0.26	5	O	O				
10	7:32 AM	3.46	0.3	7	O	O				
11	7:40 AM	3.77	0.31	8	O	O	Mvrngr-X		353.9136	
12	8:00 AM	3.22	-0.55	20	O	O				
13	8:05 AM	3.19	-0.03	5	O	O	kodyrngrO	Kodyrngr		
14	8:15 AM	3.28	0.09	10	O	O				
15	8:32 AM	3.51	0.23	17	O	O				
16	8:45 AM	3.73	0.22	13	O	O				
17	9:04 AM	3.9	0.17	19	X	X	KodyrngrX	power shut	214.0903	
18	10:17 AM	4.2	0.3	73	X	X				
19	2:15 PM	4.99	0.79	233	O	O		restored	0.304	437.18
20	2:30 PM	4.55	-0.44		O	O				
21	2:45 PM	4.07	-0.48		O	O			Loss/min	Loss/day
22	3:00 PM	3.65	-0.42		O	O				
23	3:05 PM	3.54	-0.11		O	O	Policline O			
24	3:50 PM	3.64	0.1	45	O	O	Policline X		125.66	
26										
27										

The table of wds supply show the water quantity lost during non-supply hours. This may be as a result of either valve leakages that allow water passing through the valves even during their shut off position. This is normally found in valves over a long period and due to daily operations the valve seats are worn out, resulting into leakages unintended. There could be possibilities of the error or intentions on the part of the valve men not to fully tight closing the valve allowing water supply to unintended areas. The table show water quantity to an extent of around 416 m3 almost the ESR capacity lost and in this study it has been termed as 'blank supply'. If compared to the total water quantity procured it amounts to almost 7%. This aspect was also seen during the power failure on 1/3/2012 that has caused disruption in the supply from the wds. The levels during this period were observed and the depletion of 0.79 mt was observed during the spell of 233 min (3:50 min) which indicates a loss of around 0.304 m3/min or a loss of around 437 m3/day. This observation corroborates the 7% loss occurring from the ESR found as blank supply stated in the previous pragraphs. From the above observation it can be reasonably assumed that the losses occurring from the network's valve leakages to be around 8-10% out of the 43% losses that have been derived.

4.2.3 At consumer end

Under the Diagnostic study of Lathi water supply, special attempt was made for assessing the water quantity available at the consumer end. As described in the chapter of "intervention and technical support" students of the local school were engaged to carry out this exercise. The strategy adopted has been explicitly dealt with in the said chapter. The findings and the critical observations emerging out of this special study is dealt with in the following content.

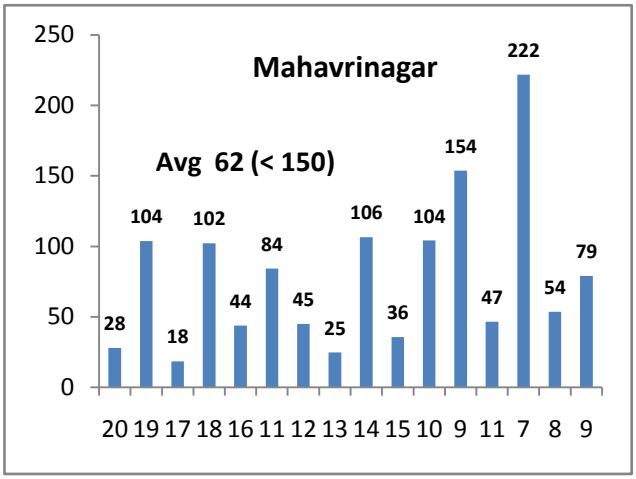
As stated earlier, the town is divided into 14 zones where water is provided on alternate days at different time of the day. The zone area name and the extent of its spread is shown in the relevant map. Each of the zone was visited by the student group and the water quantity actually received at the consumer end during the supply time was measured in the bucket marked for its 10 ltr and 5 ltr capacity. The time for filling the 10 or 5 ltr capacity was noted from the stop watch facility available in the mobile phone. The target consumers across the zone were selected on the basis of statically selected points. The locations were so selected that the relevant zone is uniformly covered up. At the consumer end, besides observing the filling time of water during the supply hours, details of the persons dependent on the water available from the tap and also the level at which the water is normally available and the normal supply duration at the consumer end was also inquired and noted. At some of the points even the pressure available was also observed through a pressure gauge carried by the group. The locations of the consumer survey point was previously selected and marked on the map. The details of the information so collected at 165 points have been shown in the following table.

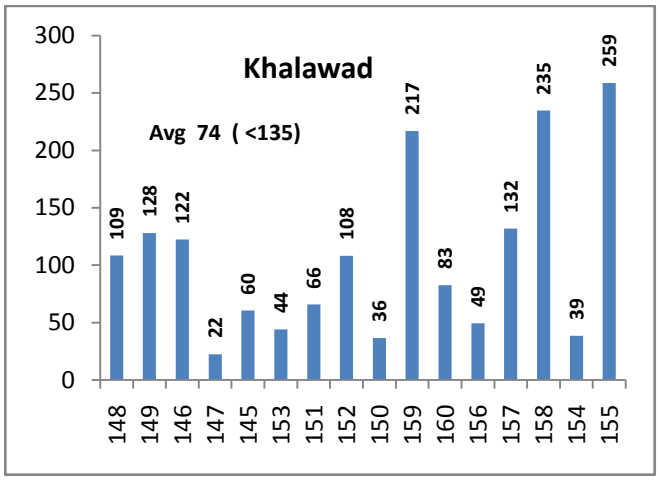
It may be noted that around 8-12 samples from different places located in a zone have been targeted for the consumer end water quantity assessment. The quantity that has been observed may not be uniform across the zone and cannot be taken as the qty received by all households or the water connections of a zone. Hence a 20% variation has been considered in consumer end water quantity of the zone.

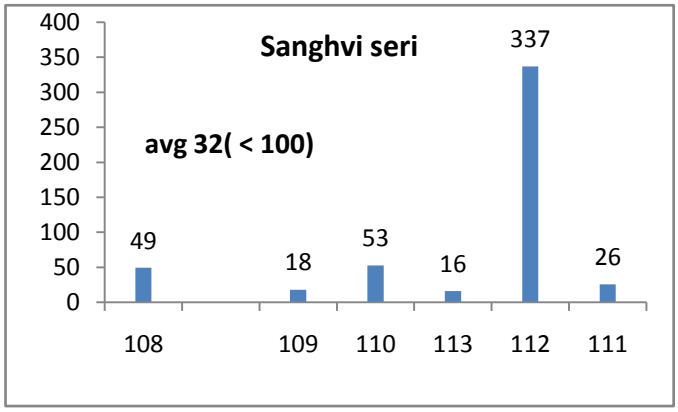
Table 4:9: Spot observation of water quantity at consumer end

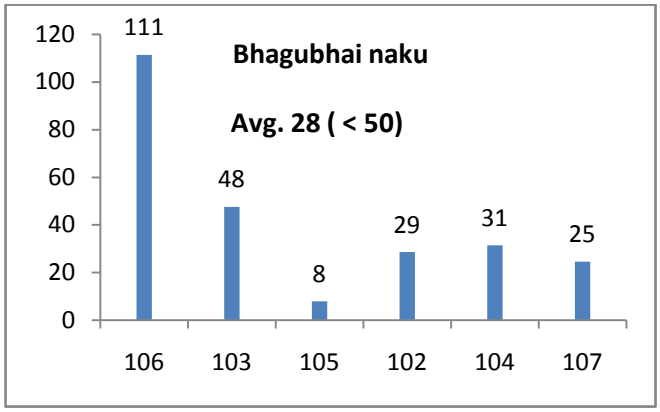
Lathi spot observation of water quantity at consumer end during 20-21 December 2011															
Sr.No	Zone	No. as in autocad maps	No. As per field point in GIS	Type	Qunatity of water measured (litres)	Time Taken (sec)	Supply duration for the location (hrs)	No of person dependent on the supply	litres /sec	Supply Estimation					
										litres/min	litres/hrs	App. Supply	Gross qty. at consume	LPCD for alt. days	average per capita per zone
1	Kharwad	148	194	Residential	10	24.88	0.75	5	0.40	24.12	1447	1085	217	108.52	
2	Kharwad	149	197	Residential	10	21.11	0.75	5	0.47	28.42	1705	1279	256	127.90	
3	Kharwad	146	196	Residential	10	22.08	0.75	5	0.45	27.17	1630	1223	245	122.28	
4	Kharwad	147	193	Residential	5	50.18	0.75	6	0.10	5.98	359	269	45	22.42	
5	Kharwad	145	195	Residential	10	27.93	0.75	8	0.36	21.48	1289	967	121	60.42	
6	Kharwad	153	198	Residential	10	50.98	0.75	6	0.20	11.77	706	530	88	44.13	
7	Kharwad	151	199	Residential	10	41.08	0.75	5	0.24	14.61	876	657	131	65.73	
8	Kharwad	152	190	Residential	10	20.78	0.75	6	0.48	28.87	1732	1299	217	108.28	106.8
9	Kharwad	150	191	Residential	5	26.50	0.75	7	0.19	11.32	679	509	73	36.39	
10	Kharwad	159	186	Residential	10	31.12	0.75	2	0.32	19.28	1157	868	434	216.90	
11	Kharwad	160	187	Residential	10	23.37	0.75	7	0.43	25.67	1540	1155	165	82.52	
12	Kharwad	156	188	Residential	5	34.17	0.75	4	0.15	8.78	527	395	99	49.39	
13	Kharwad	157	189	Residential	10	25.60	0.75	4	0.39	23.44	1406	1055	264	131.84	
14	Kharwad	158	201	Residential	10	28.76	0.75	2	0.35	20.86	1252	939	469	234.70	
15	Kharwad	154	200	Residential	5	25.02	0.75	7	0.20	11.99	719	540	77	38.54	
16	Kharwad	155	192	Residential	10	26.10	0.75	2	0.38	22.99	1379	1034	517	258.62	

However, during observation of consumer end water quantity, it is found that in almost all water zones there are one or two connections that show a very high water quantity availability. This could be mainly due to the larger size of the individual water connection that results into more water quantity discharged out of the connection then the average -1/2 inch size connections. While discussing with the department officials, they also confirmed the likelihood of such large size connections. In view of this, it is found appropriate not to consider connections showing higher discharge.






Sanghvi seri
avg 32(< 100)
400
350
300
250
200
150
100
50
0
49
18
53
16
337
26
108
109
110
113
112
111


Bhagubhai naku
Avg. 28 (< 50)
120
100
80
60
40
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0
111
48
8
29
31
25
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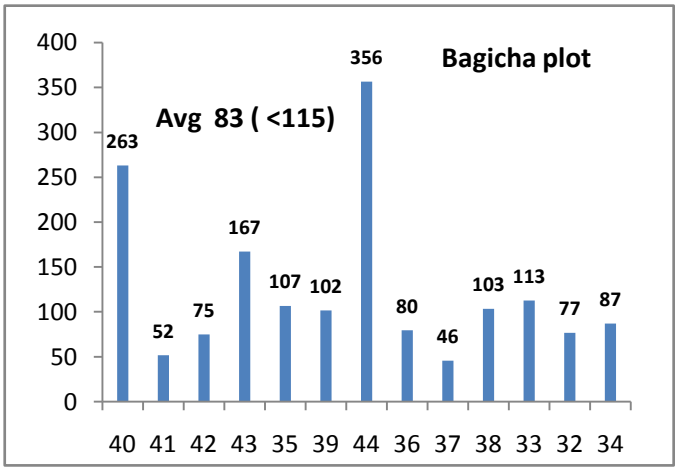
103
105
102
104
107


Bagicha plot
Avg 83 (<115)
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350
300
250
200
150
100
50
0
263
52
75
167
107
102
356
80
46
103
113
77
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40
41
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43
35
39
44
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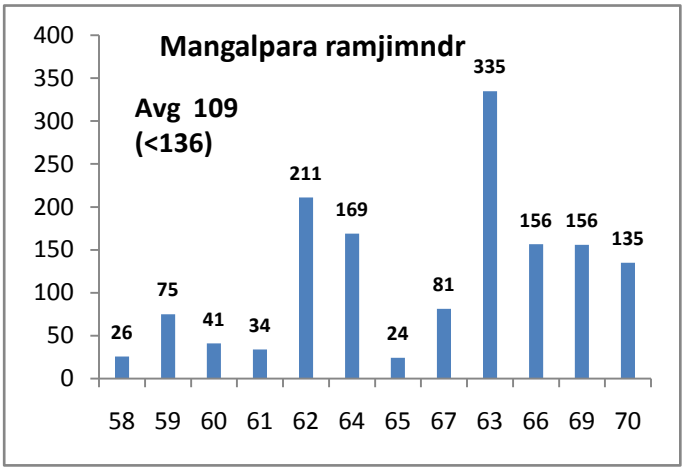
37
38
33
32
34


Mangalpara ramjimndr
Avg 109
(<136)
400
350
300
250
200
150
100
50
0
26
75
41
34
211
169
24
81
335
156
156
135
58
59
60
61
62
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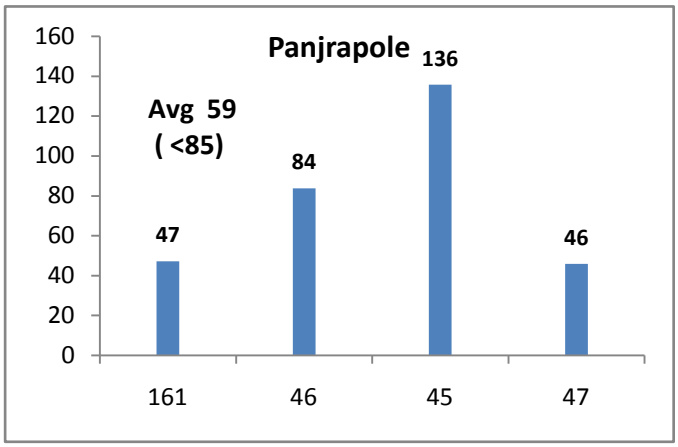
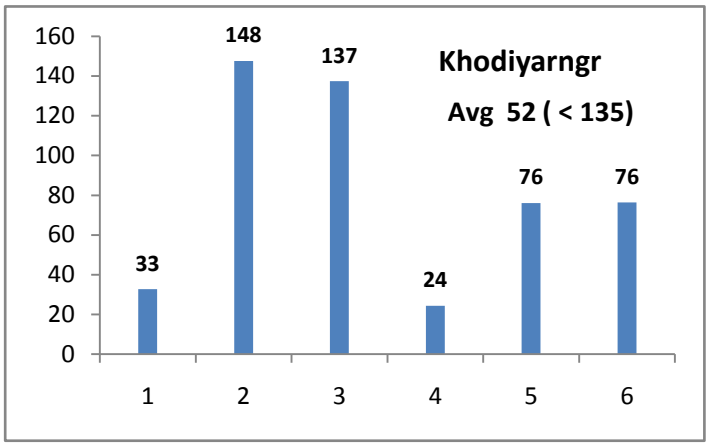
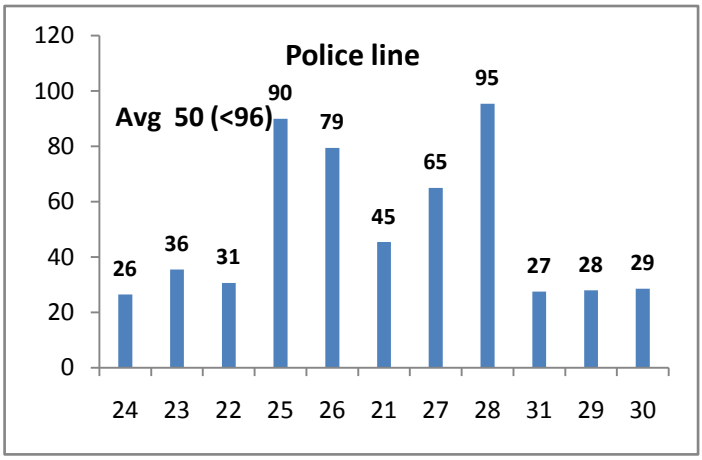
63
66
69
70


Panjrapole
Avg 59
(<85)
160
140
120
100
80
60
40
20
0
47
84
136
46
161
46
45
47


Khodiyarngr
Avg 52 (< 135)
160
140
120
100
80
60
40
20
0
33
148
137
24
76
76
1
2
3
4
5
6


Police line
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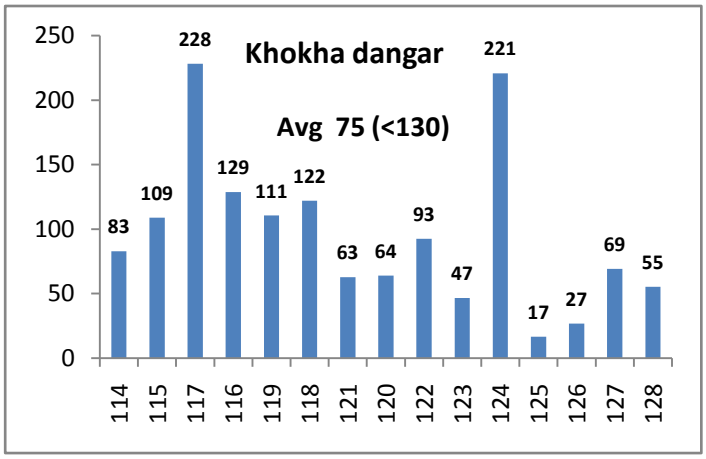
24 23 22 25 26 21 27 28 31 29 30


Khokha dangar
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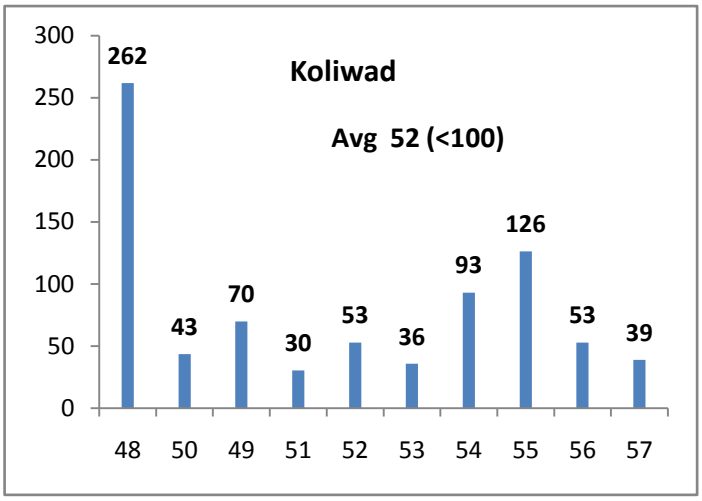
114 115 117 116 119 118 121 120 122 123 124 125 126 127 128


Koliwad
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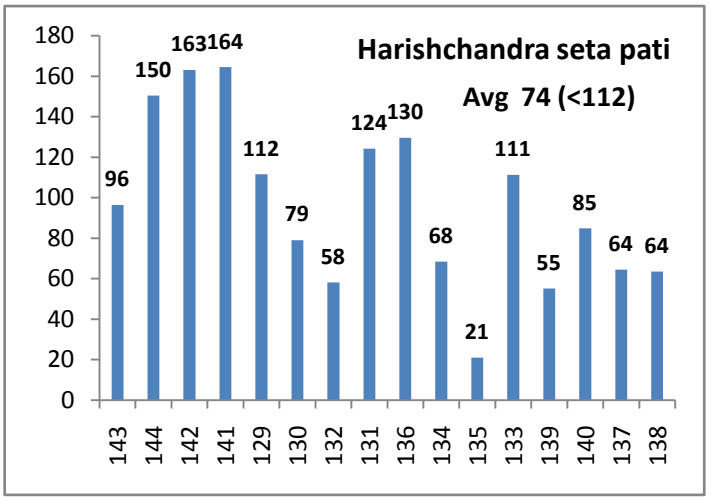
48 50 49 51 52 53 54 55 56 57


Harishchandra seta pati
Avg 74 (<112)
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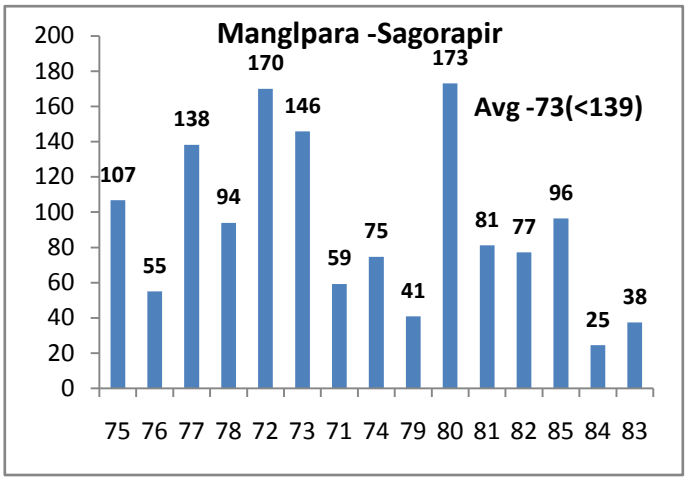
143 144 142 141 129 130 132 131 136 134 135 133 139 140 137 138


Manglpara -Sagorapir
Avg -73(<139)
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75 76 77 78 72 73 71 74 79 80 81 82 85 84 83

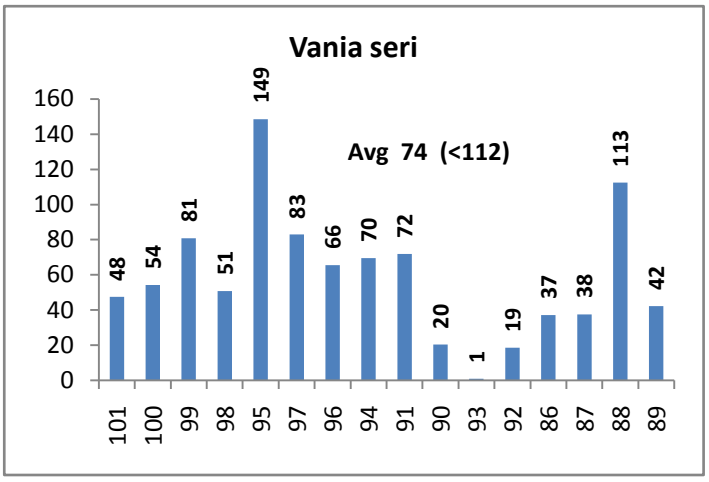

Vania seri
Avg 74 (<112)
48 54 81 51 149 83 66 70 72 20 1 19 37 38 113 42
101 100 99 98 95 97 96 94 91 90 93 92 86 87 88 89

Table 4:10: Average per capita supply

Average per capita supply		
Area	**lpcd**	Average
Khalwad	74.82	61.61
Sanghvi seri	32.28	
Bhagu naku	28.01	
Bagicha plot	83.95	
Mahavrngr	65.57	
mglpara ram	109.91	
police line	50.17	
panjrapole	58.99	
khokha dgr	62.59	
khodyrngr	52.37	
koliwad	52.12	
setapati	74	
vaniyaseri	48.56	
sagorapir	73.8	
Palace rd	57	

Figure 4:3: Water quantity received at consumer end

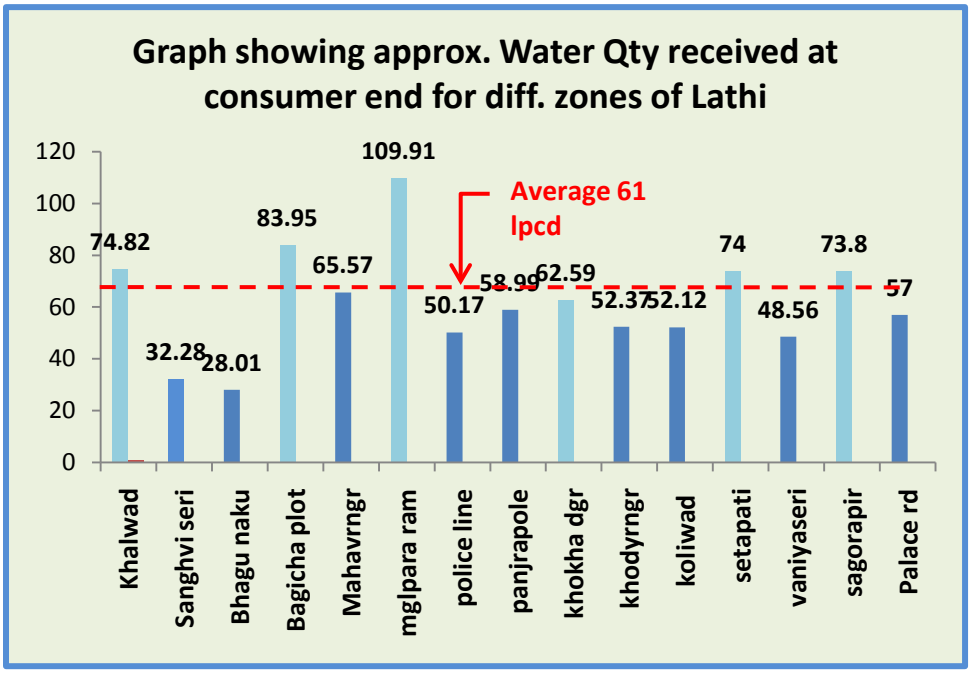


Table 4:11: Water Supplied at consumer end

Water supplied at consumer end						
Sr. no.	**Water zones**	**Population**	**Demand (lac. Ltr)**	**Procurement (lac.ltr)**	**Supply from WDS (lac.ltr)**	**Consumer End (lac.ltr)**
1	Khalawad	1469	4.11	3.50	2.49	2.20
2	Harishchadrapara-Setapati	1219	3.41	2.90	3.14	1.80
3	Khoka dangar	2898	8.11	6.90	4.50	3.63
4	Sanghvi seri	1318	3.69	3.14	2.23	0.85
5	Vania seri	4527	12.68	10.77	1.83	4.40
6	Panjrapole	430	1.20	1.02	1.21	0.25
7	(a)Koliwad	450	1.26	1.07	0.58	0.47
8	(b)Andarbar	176	0.49	0.42	1.59	
9	Bhagicha plot	1575	4.41	3.75	2.9	2.65
10	Police line	1595	4.47	3.80	1.1	1.60
11	Mahvirnagar	1824	5.11	4.34	2.48	2.39
12	Koidyarnagar	1204	3.37	2.87	1.64	1.26
13	Mangalpara ramji mandir	565	1.58	1.34	1.09	1.24
14	Palace Area	1401	3.92	3.34	1.6	1.60
15	Mangalpara Gokulnagar	1693	4.74	4.03	3.04	2.50
16	Bhagubhai no nako	791	2.21	3.24	0.79	0.76
	Total	**23135**	**64.78**	**56.42**	**32.21**	**27.60**

Against 32.21 lacs ltr water supplied from water distribution stations 27.60 Lacs ltr quantity of water reaches to the consumer end amounting to the total loss of 51.08% against procurement and 14.31% losses against the water delivered from the WDS and deficit of 57.39% against the present demand.

The above details show that the water quantity received at the consumer end of the water zones vary from 50 lpcd for police line to 110 lpcd for mangalpara ramji mandir. The average per capita received for all zones is 61.61lpcd. The supply being for 2 days, double of the above average for each zone has been considered. The lowest quantity received happens to be 0.47 lac ltr for the zone of Andarbar and Koliwad, the highest 3.63 lac is for the zone khokha dangar and 4.40 lac ltre for Vania seri. However, water quantity received by Vania seri from the wds is 1.83 lac ltre, the quantity received at consumer end show almost double the quantity released. This matter needs to be dealt with further investigation. The reasons could either be number of closed houses could be more or the supply provided during other zone supplies. From the valve man's operation observation, it was observed that during the starting and closing of almost 6-8 valves for the Vania seri zone,there is time delay occurring which leaves the valve open for some longer duration then the time allocated. However, this does not justify the double quantity received by that zone, hence needs further investigation, which could be taken up if and when the department starts level recording on uniform daily basis. The above table content also compares the water quantity demand, procurement, distribution from wds and that received at the consumer end for the various zones. The loss against the procurement is substantial about 51.08 %. The above analysis also indicates the corrective measures needed to plug the loss occurring from procurement to distribution and also strive for equitable distribution across the zones. Highest priority is needed for the vania seri zone which is supplied 1.83 lac ltrs against whereas receives 3.63 lac ltrs against the demand of 12.68 lac ltr and procurement of 11.05 lac ltr.

4.3 Analysis of water quality assessment

The analysis of the water quality exercise illustrates that prior to interventions before 10:00 am there was no presence of RC seen in the 15 samples were analyzed. After the interventions again the samples were tested to check the presence of Rc. 25 samples taken from different zones during the supply time indicated Rc to be less then 0.2 ppm. 57% of the samples passed during the testing.

Chemical analysis

Fluorides

Samples tested for the chemical analysis at source, wds and at consumer end indicated that the fluoride content in the Mahi source was less than 0.2 ppm whereas the Bhidbhajan source, (the ground water source) the fluoride content was around 0.9 and the surface

water near the Gagadia tank, the fluoride content was around 1 ppm.

Nitrates

Nitrates were found to be within the desirable limit of 45, though the surface water near the Gagadia HW showed higher nitrate contents than of Mahi water which was less than 15. Higher nitrate content of the surface water indicates the likely pollution of the underground septic tank seepages entering the water body.

Chloride

The chloride contents of the surface water was also in the higher range (400 ppm) more than the desirable limit of 250 ppm.

TDS

The TDS value for Mahi water is around 137 less than the desirable limit of 500 ppm, whereas the value of Bhidbhajan well is around 625 whereas the surface water show a higher TDS of around 550 ppm.

Bacteriological analysis

Mahi water passed the bacteriological analysis whereas the surface water near the HW failed the test. However, the District Laboratory, Amreli (accredited lab of GWSSB) report indicates the samples are unfit for human consumption, and the Rc was found absent in the samples offered for lab testing.

4.4 Financial sustainability

Lathi's Water supply financial status is far from satisfactory. The expenditure that is incurred towards procuring, processing and distribution of water far exceeds the income that is generated out of the taxes and charges of the department. The present water supply of the town is around 2 mld and the supply to the town is provided on every alternate day. The total expenditure it incurs is Rs 5457966 whereas the Income that it receives from the taxes is Rs 2347821 leaving a deficit of Rs 3435966/ thus making it 43% of the total incurred expenditure. There are 3370 domestic ½" connections and 144 non residential connections ranging from ½- 2" size. The present water charge is Rs 600/ per anum which is grossly inadequate for meeting the total expenditure of the department. However, the following table show the exemplary effort made by the ULB to increase its collection efficiency.

Table 4:12: Financial details

Year	Demand	Amount	Collection	Percentage collection
2008-09	Arrears	1506838	782388	51.92
	Current	2724115	1587661	58.28
	Total	4230953	2370049	56.01
2009-10	Arrears	871852	441525	50.62
	Current	1296626	958725	73.93
	Total	2168478	1400250	64.57
2010-11	Arrears	761539	557728	73.23
	Current	2186400	1790093	81.87
	Total	2947939	2347821	79.64

The above table show the efforts made by ULB towards improving its tax collection efficiency. The increase in arrears collection has increased from 51.92 % in 2008-09 to 73.23 % in 2010-11. Similarly the collection of the current demand has increased from 58.28% in 2008-09 to 81.87 % in 2010-11. The overall collection has also increased from 56.01% in 2008-09 to 79.64% in 2010-11. The above improvement is also shown in the graph below.

4.4.1 Special note

ULB draws around 2 mld of water from the Narmada based Mahi Pariyej pipe line. The cost of this water is Rs 28.80 lacs/p.a at the rate of Rs 4/1000 ltr. However, ULB has not made any remittance towards the water supplied so far since 2005. This liability is not reflected in the expenditure details of the ULB, though it is taken into account in the present financial analysis, Since it is an important and crucial due that has to be paid by the ULB in future when there is recovery drive of the Board. The daily water quantity that is being charged by the Board is 2.0 mld. A meter has also been installed by the authority but is non-functional and the fact has been verified during the trial specially undertaken to check up whether the meter is functional or not. Besides, the water normally received from this source was assessed during the trial was observed to be 1.14 m3/min. and considering total supply duration available from this source to be20 hours on an average, the water quantity approximately received from this source is considered to be around 1.447 mld. This quantity has been taken up for consideration during the analysis.

Taking bulk water purchase into consideration, the deficit as shown in the above para is Rs 3110238/- p.a. considering the total supply to be around 2.0 mld the cost and revenue income per 1000 ltr works out to be Rs 7.44 and Rs 3.22 per 1000 ltrs leaving a deficit of Rs 4.26/1000 ltrs.

In order to bridge this deficit , the normal strategy is to raise the water rates and plug the deficit. If this were to happen the present rate of Rs 600/ would need to be increased two times i.e to be made Rs 1300/ p.a and commercial consumers by an average of Rs 7150/ p.a. Such a steep rise is likely to meet much resistance from the people.

This necessitates into thinking of other alternatives for meeting with the income deficit. A closer look at the expenditure sub heads for its head wise expenditure, the following details are observed.

Table 4:13: Share of each expenditure: 2010-11

Share of each of the expenditure head.: Year 2010-11		
Components	**Amount (in Rs)**	**Percentage**
Establishment	1,002,850	18.40
Energy (Electricity)	1179688	21.61
O & M	395,428	7.24
Bulk Water (purchase)	2,880,000	52.75
Total	5,457,966	100.00

4.4.2 Bulk water purchase on the basis of actual water quantity drawn.

Bulk water purchase assumes the largest proportion of the total expenditure contributing 52.75%. as stated in the above para. The meter installed to record the daily and monthly drawal of water is non-functional and the ULB is provided an ad-hoc water bill for 2.0 mld of water, whereas the approximate water quantity that is received is around 1.44 mld of water. If the matter is brought to the notice of the authority, and the bill amount corrected to the actual water quantity that is received the expenditure is likely to reduce to an extent of 28% to around RS 2102400/-.

4.4.3 Reduction of energy expenditure

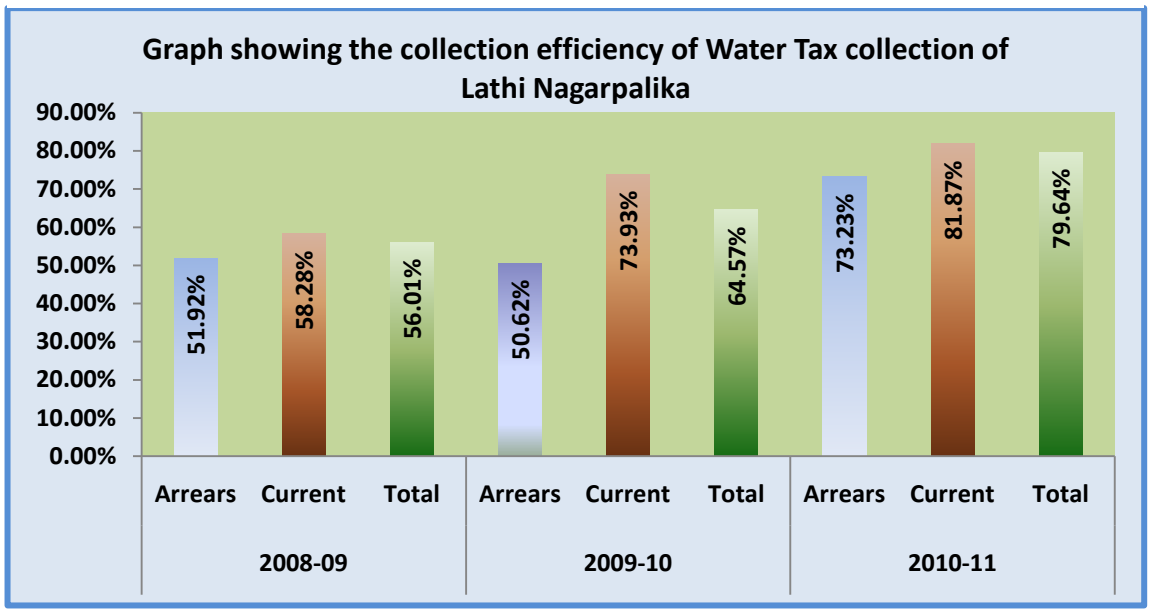
The energy expenditure at Rs 1179688/- forms 21.61% also needs to have a closer look. The pumps may be operating at lesser efficiency on account of varying heads as well as the age. There are chances of the pumping main not being of appropriate size, offering more head loss. All these aspects could be well explored by undertaking energy audit which would pin-point the exact deficiencies and suggest appropriate measures for its rectification. It has been considered in the analysis that on an average if the energy expenditure is brought down to an extent of 10% every year, the overall energy expenditure of the department at the end of 4th year would be reduced to Rs 707812/- from the present Rs 1179688/-

4.4.4 Reducing the water wastage (NRW)

During the diagnostic study, it is found that Nagarpalika provides around 2.0 mld of water to the town, on alternate days. Around 50% of population is served water on each day, i.e around 11000 people are served with 2. 0 mld of water every alternate day. Besides, there are losses occurring during procurement, and distribution which may be around 38% making the loss of water to be around 44%. Such a loss if taken up for financial cost amounts to Rs 2.07/1000 ltrs out of the total Rs 7.47/1000 ltrs. Resulting into 27% of the total cost of water. Such loss towards the NRW needs to be attended and measures taken to reduce it. It has been considered that if 5% of this loss is attended and reduced every year, at the end of the fourth year the loss could be well brought down to 18% from the present 38%. If such measures are taken up on yearly basis, the present cost of Rs 2.074/1000 ltrs could be reduced to Rs 0.67/1000 ltrs.

Tax collection drive

Figure 4:4: Collection efficiency of water tax



Though the ULB has taken stringent and exemplary measures for improving its tax collection efficiency, further improving it to yield better results and bringing down its arrears would prove to be helpful in improving of its water finances. If an amount of Rs 40000 and Rs 80000/ is further increased in its collection drive, this would help in bridging the deficit.

Resulting effect of all these measures

All these measures would greatly help in reducing its present deficit of Rs 3110238/ to a surplus of Rs 394450/ which would convert into a surplus of Rs 0.54/1000 ltrs at the end of the fourth year. The table below shows the details that have been discussed in the foregoing paras.

Table 4:14: Potential for reducing deficits by non-tariff revision measures

Lathi's potentials for reducing the deficit by non-tariff revision measures						
Cost of water						
	Budget. Heads	Present Year	1st year	2nd year	3rd year	4th year
Expenditure	Est	10.028	10.028	10.028	10.028	10.028
	Energy	11.79	10.61	9.432	8.253	7.074
	O & M	3.950	3.753	3.565	3.387	3.217
	B.Water	28.80	16.79	16.79	16.79	16.79
	total	54.57	41.18	39.81	38.46	37.11
	cost/1000 ltrs	7.475	5.641	5.454	5.268	5.083
	Ann.NRW cost	2.728	1.65	1.19	0.77	0.37
	total cost post NRW red.	4.75	3.99	4.26	4.50	4.71
		34.65	29.16	31.10	32.84	34.40

Income from water						
Income	**metered**	**0**	**0**	**0**	**0**	**0**
	unmetered	**0**	**0**	**0**	**0**	**0**
	miscell.	0	**0**	**0**	**0**	**0**
	Arrears coll	0	**1.200**	**1.200**	**1.200**	**1.200**
	total	**23.48**	**26.999**	**31.05**	**35.71**	**41.06**
	income /1000	**3.22**	**3.70**	**4.25**	**4.89**	**5.62**
total Conn.	**ress**	**3370**				
	commer.	**144**				
Rate	**Dom.rate**	**600**				
	comm. Rate	**2262**				
	deficit	**31.09**	**14.18**	**8.77**	**2.75**	**-3.95**
	deficit/1000 lt	**4.26**	**1.94**	**1.20**	**0.38**	**-0.54**
Dem/coll.	**Arrears**	**current**	**total**	**From arrears**	**from current**	**Total**
	761539	2,186,400	2,947,939	557,728	1,790,093	2,347,821
				40762.2	**79261**	
Reduction suggested			**(Values except f33 are in %)**			
Establish.	**0**	**Energy**	**10**	**total supp**	**2**	**dem/coll.**
NRW %	**50**	**Connection**	**5**	**Met. Supply**	**5**	**20**
NRW red %	**10**	O & M incr.	5	Miscell.	5	

- Bulk water purchase

- Present Bill amount @ Rs 4/kl- Rs 29.20/ lacs
- Actual bill 1.44 mld considered-Rs 21.02/lacs

Savings - Rs 8.18/lacs

- Energy Efficiency measures

- Present Energy bill Rs 11.80/ lacs
- Energy efficiency measures @ 10% reduction Rs 10.61

Savings - Rs 1.20/ lacs

- NRW reduction measures

- Present NRW cost/kl Rs 2.07
- Post 10% NRW measures cost Rs 1.15

Savings Rs 9.40/ lacs

- These measures would reduce the deficit in the ensuing four years period

Figure 4:5: Expenditure details with improvement measure

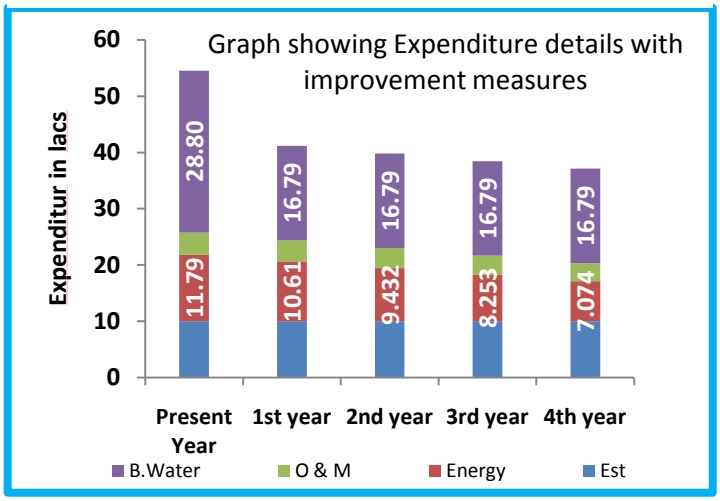
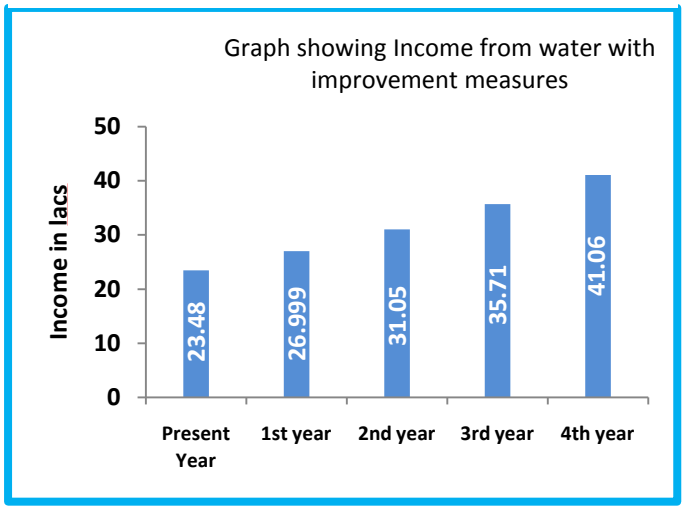


Figure 4:6: Income details with improvement measures



Present deficit Rs 4.26/KL

Deficit after yr 1 Rs 1.94/KL

Deficit after yr 2 Rs 1.20/KL

Deficit after yr 3 Rs 0.38/KL

Deficit after yr 4 Rs -0.54/kL

5 Other observations

5.1 Present water supply pattern and its Impact

5.1.1 Water supply pattern

- Water is supplied to consumer on an average 45 minutes on alternate day.
- 166 liters per capita for two days (83 lpcd) supplied to consumer.
- Six zones namely, Mangalpara – Gokul nagar, Sagorapir, Khoka danger , Khalawad ,Bagicha plot and Harishchandra Setapati receives water with sufficient pressure and quantity.
- The old ESR (4.5 Lac ltr capacity) located at Gagadia water works supplies water to almost 60% city population.
- Whereas rest 40% population served by two ESRs with 5 lac ltrs capacity each.

Table 5:1: Water zones receiving sufficient quantity of water

Sr.no	Area	Population
1	Kharawad	1469
2	Khokha dangar	2898
3	Bagicha plot	1318
4	Seta pati harischnpara	1219
5	Ramji mandir	565
6	Mahvirnagar	1824
Total pop. Receiving regular supply		**9293**
Total pop. of the town		**23134**
Percentage of pop receiving sufficient pressure and quantity on regular basis		**40.17 %**
Percentage of population receiving irregular supply		**59.82%**

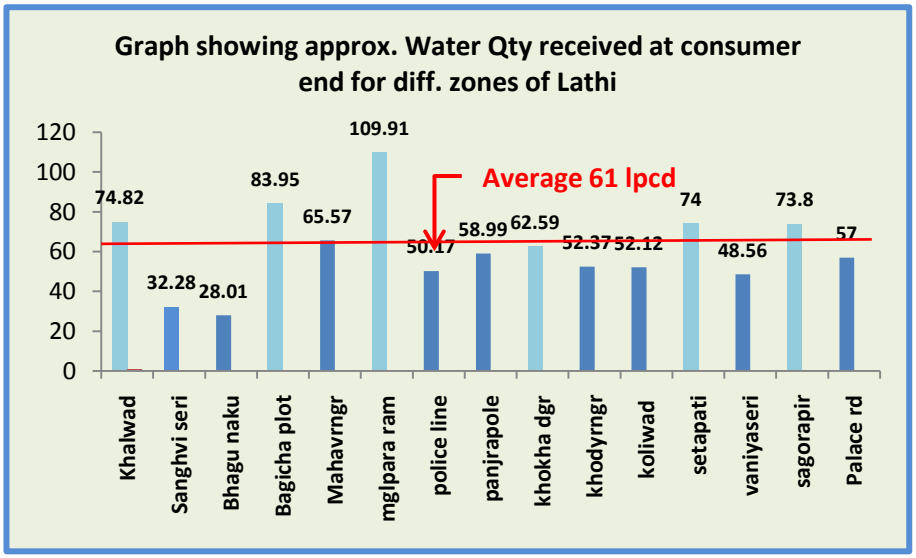
The following table provides details of zones supplied by the three ESRs during the first morning hours supply leads to sufficient pressure, quantity on regular time.

Table 5:2: Supply timing of zones

Sr. no	Tanks	Location	Day	Time	Area
1	ESR-5 lac	Gagadia HW	1	6-6:45 am	Khoka danger chora
2	ESR-4.5 lac	Gagadia HW	1	6-6:45 am	Bagicha plot
3	ESR-5 lac	Gagadia HW	2	6-6:45 am	Khalawad
4	ESR-4.5 lac	Gagadia HW	2	6-6:45 am	Setapati Harishchandra
5	ESR -5 lac	Mangalpara HW	1	7:30 -8:15 am	Sagorapir/Gokulngr
6	ESR -5 lac	Mangalpara HW	2	7:30 -8:15 am	Ramji mandir

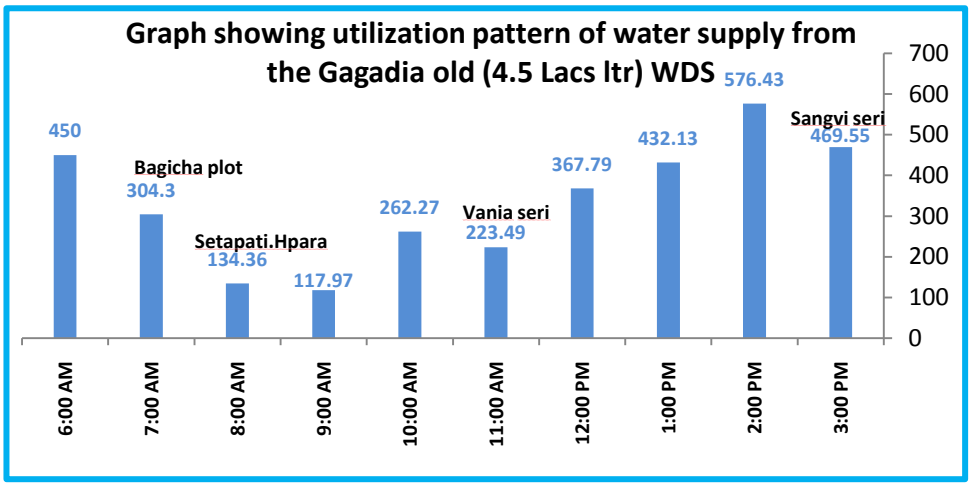
The details of average lpcd supplied of each zone is as illustrated in figure given below. Reveals that the maximum of 125 lpcd provided in Bagicha plot zone and the minimum of 42 lpcd receives at Baghubhai Nakka zone.

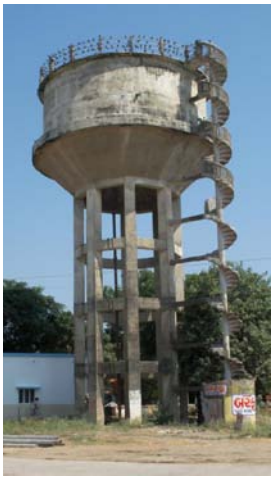
Figure 5:1: Water quantity received at consumer end



The supply timings also keep varying as the tank in use needs continuous filling for maintaining the level to ensure adequate pressure head. This leads to persistent irregular timings for 60 % of the population. The figure shows the water quantity being supplied from the Gagadia old ESR during the day between 6.00 A.M and 3.00 P.M. It was observed that water supplied to Bagicha Plot at 6.00 – 7.00 A.M when tank was fully filled and gradually decreases upto supply to Palace road (Kalapi Park). Before supplied to Vania Sheri, it takes one hour to fill the tank at adequate level for further supply. After supplying to Vania Sheri ESR allowed to filled again prior to subsequent supply to Sangavi sheri.

Figure 5:2: Utilization pattern of water supply from Gagadia old ESR (4.5 L.L)

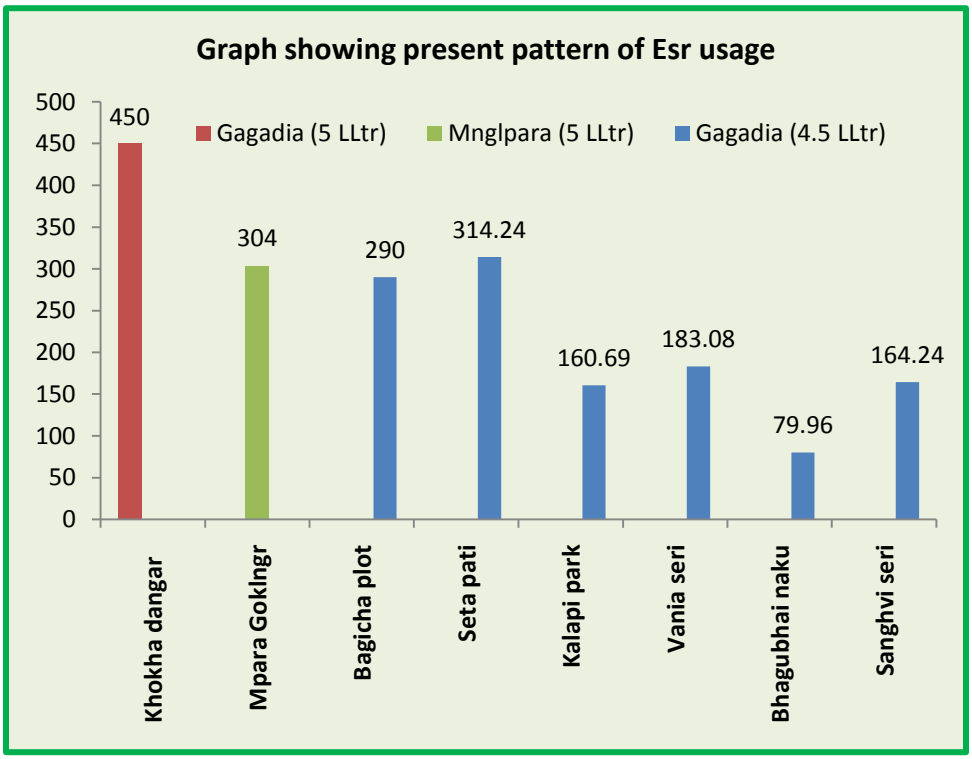




The table shows the water quantity being supplied from all the three ESRs during the day one supply. Presently all the three ESRs are being used for supplying water to all water zones. Out of three ESRs, only one (old ESR at gagadia) ESR is being used to supply water throughout the day and serves around 60 percent of population. Whereas the other two ESRs with higher storage capacity with higher head are used only for single supply during morning hours.

Table 5:3: Water supply from WDS- Day 1

Water supply from WDS- Day 1			
Water Zone	**Gagadia (4.5 L.L))**	**Gagadia (5 L.L)**	**Mangalpara (5 L.L)**
Khokha dangar		450	
Mangalpara Gok ulnagar			304
Bagicha plot	290		
Seta pati	314.24		
Kalapi park	160.69		
Vania seri	183.08		
Bhagubhai naku	79.96		
Sanghvi seri	164.24		
Total supply form each ESR	1192.21	450	304
		Total supply	**1946.21**



The old ESR provides around 1.19 mld of water to around 6 water zones during the day, whereas the other two ESRs provide around 0.45 and 0.3 mld of water to the two zones catering to around 40 % of the population. This indicates that the two ESRs are being grossly underutilized whereas the old ESR is overburdened and provides water at irregular time intervals with less pressure and quantity of water. Besides, there is another ESR at Mangalpara of 4.5 lac ltr capacity presently not in use.

From this it transpires that though there is sufficient underground and over-ground storage, the supply is erratic with per head water quantity far from satisfactory, it also affects the water quality as well.

However study of the supply pattern of 10 days supplied during the month of Dec 2011 shows that areas receiving water during the first supply period i.e at 6:00 am to 6:45 am get water regularly at 6:00 am from the two ESRs located at Gagadia Head works and Mangalpara head works. Quantum

of water required for these supply gets filled up during the previous evening and night time, hence the regularity in the supply timing is well maintained. These areas receiving supply at regular time are mentioned below. Areas other than this get water during the day at irregular timings with no certainty.

Table 5:4: Observation of water supply timings of various zones during 1-10 December 2011

Details showing supply's varied timings for diffent zones of Water supply system of Lathi Nagarpalika during December 2011 -1-10/12/2011

Sr.no	Timings		1/12/2011			2/12/2011			3/12/2011			4/12/2011			5/12/2011			6/12/2011			7/12/2011			8/12/2011			9/12/2011			10/12/2011		
			4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M	4.5 G	5 G	M
1	6:00 AM	6:15 AM	Bagicha 6:10	Vankar was 6:15					Bagicha 6:10	Vankar was 6:15		mahvirngr 6:00	Khokadangar 6(		Bagicha	Vankar was		mahvirngr 6:00	Khokadangar 6(		Bagicha	Vankar was			Khokadangar 6(		Bagicha	Vankar was		mahvirngr 6:00	Khokadangar 6(	
2	6:15 AM	6:30 AM				mahvirngr 6:20	Khokadangar 6:20																									
3	6:30 AM	6:45 AM																														
4	6:45 AM	7:00 AM																														
5	7:00 AM	7:15 AM																Khodiyarngar 7:00														
6	7:15 AM	7:30 AM																														
7	7:30 AM	7:45 AM												ramji 7:30			Sagorapir 7:30			ramji 7:05									Sagorapir 7:30			ramji 7:30
8	7:45 AM	8:00 AM			sagorapir 7:45	Khodiyarngar 8:		ramji 7:45			Sagorapir 7:45															ramji 7:30						
9	8:00 AM	8:15 AM	Setapati 8:10 harischpara						Setapati 8:00 harischpara						Setapati 8:05 harischpara								Sagorapir 8:00								palace rd 8:05		
10	8:15 AM	8:30 AM																						panjrapole 8:20								
11	8:30 AM	8:45 AM										Khodiyarngar 8:30									Setapati 8:30 harischandra para						setapati 8:30 harichdrapara			Khodiyarngar 8:30		
12	8:45 AM	9:00 AM																														
13	9:00 AM	9:15 AM				panjrapole 9:0																										
14	9:15 AM	9:30 AM										panjrapole 9:20																				
15	9:30 AM	9:45 AM																polic line 9:30						palace rd 9:25	Bhat sheri 9:25							
16	9:45 AM	10:00 AM	Kalapi pk 9:50						kalapi pk9:40																					polic line 10:05		
17	10:00 AM	10:15 AM																														
18	10:15 AM	10:30 AM				police line 10:25						polic line 10:20																				
19	10:30 AM	10:45 AM																														
20	10:45 AM	11:00 AM																														
21	11:00 AM	11:15 AM	Railway 11:05															panjrapole 11:05														
22	11:15 AM	11:30 AM																														
23	11:30 AM	11:45 AM				palace rd 11.25	Bhat sheri 11:25		Vania seri 11:25			palace rd 11.30	Bhat sheri 11:30											Railway 11:05						Railway 11:05		
24	11:45 AM	12:00 PM																Railway 11:05														
25	12:00 PM	12:15 PM													Vania sheri 12:10																	
26	12:15 PM	12:30 PM																														
27	12:30 PM	12:45 PM				Railway 11:05			Baghu naku 12:4(			Railway 11:05						palace rd 12.30	Bhat sheri 12:30													
28	12:45 PM	1:00 PM																														
29	1:00 PM	1:15 PM																														
30	1:15 PM	1:30 PM																			Vania sheri 1:20											
31	1:30 PM	1:45 PM	Vania seri 1:30																					mahvirngr 1:30			Vania sheri 1:50					
32	1:45 PM	2:00 PM				Khokadangar cho																										
33	2:00 PM	2:15 PM													Baghu naku 2:05															panjrapole 2:10		
34	2:15 PM	2:30 PM																														
35	2:30 PM	2:45 PM							Sangvi seri 2:30												Baghu naku 2:25						Baghu naku 2:05					
36	2:45 PM	3:00 PM																						Khodiyarngar 2:40								
37	3:00 PM	3:15 PM	Baghu naku 3:00												Sangvi seri 3:00												Sangvi seri 3:05					
38	3:15 PM	3:30 PM																														
39	3:30 PM	3:45 PM																			Sangvi seri 3:30			polic line 3:30								
40	3:45 PM	4:00 PM																														
41	4:00 PM	4:15 PM	Sangvi seri 4:00																											Bhat sheri 4:05		
42	4:15 PM	4:30 PM																														
43	4:30 PM	4:45 PM																														
44	4:45 PM	5:00 PM																														
45	5:00 PM	5:15 PM																														

5.1.2 Optimum utilization of ESRs

If all the three tanks are used simultaneously then the daily water supply would be possible. The table below shows the possibilities of using all the three tanks simultaneously.

Table 5:5 : Possibility showing optimum utilization of ESRs (quantity of present supply)

Details of utilizing all 3 tanks for supply to different water zones of Lathi with present supply								
Sr.No	Water zones		Time		Zone dem.in m3	Gagadia 5 L.L	Gagadia-4.5 L.L	Mglpara-5 L.L
			st. time	End time		500	450	500
1	Khokha dangar		6:00 AM	6:45 AM	450	117		
2	Mangalpara Gokngr		6:00 AM	6:45 AM	350			172.5
3	Mahavirngr		6:00 AM	6:45 AM	353		127	195
4	Palace road		6:45 AM	7:30 AM	160		157	57.5
5	Bhagubhai naku		6:45 AM	7:30 AM	79	184	108	80
6	Koliwad		7:30 AM	8:15 AM	55	251	83	102.5
7	Panjrapole		8:15 AM	9:00 AM	87	231	113	125
8	Khodiyrngr		9:00 AM	9:45 AM	214	84	143	147.5
9	Andarbar		9:45 AM	10:30 AM	49	102	173	170
10	Polic line		9:45 AM	10:30 AM	125	169	78	192.5
11			10:30 AM	11:15 AM		236	108	215
12	Vania seri		11:15 AM	12:00 PM	183	120	138	237.5
13	Mangalpara ramji mdr		12:00 PM	12:45 PM	249	187	168	11
14			12:45 PM	1:30 PM		254	198	33.5
15			1:30 PM	2:15 PM		321	228	56
16	Bagicha plot		2:15 PM	3:00 PM	290	98	258	78.5
17	Khalawad		3:00 PM	3:45 PM	325	165	-37	101
18			3:45 PM	4:30 PM		232	-7	123.5
19	Harandra para setapati		4:30 PM	5:15 PM	314	-15	23	146
Pump Inflow details for 45 min.					3283			
Gagadia – (5 L.L)	67	Forest G 4.5	30	Forest Mgl 5	22.5			

The above table shows the details with the present supply quantity being maintained. The table mentioned below show the details if the supply to the different zones is maintained as per their standard requirement of 140 lpcd. This could be achieved by curtailing the water zones that are provided more than the required water quantity. In such a case there would be equity in supply maintained across the town, but would also help in leaving higher storage volume in each of the tank, allowing sufficient time for the tank filling for the next day. This would also ensure saving in water quantity which is higher in the present conditions.

Table 5:6: Utilizing all 3 ESRs for supply to different water zones

Details of utilizing all 3 tanks for supply to different water zones of Lathi with zone standard demand								
Sr.No	Water zones		Time		Zone dem.	Gagadia 5 L.L	Gagadia-4.5 L.L	Mglpara-5 L.L
			st. time	End time		500	450	500
1	Khokha dangar		6:00	6:45	405	162		
2	Mangalpara Gokngr		6:00	6:45	237			285.5
3	Mahavirngr		6:00	6:45	255		225	308
4	Palace road		6:45	7:30	196		255	134.5
5	Bhagubhai naku		6:45	7:30	110	229	175	157
6	Koliwad		7:30	8:15	63	296	142	179.5
7	Panjrapole		8:15	9:00	60	303	172	202
8	Khodiyrngr		9:00	9:45	168	202	202	224.5
9	Andarbar		9:45	10:30	24	269	232	223
10	Polic line		9:45	10:30	223	336	39	245.5
11			10:30	11:15		403	69	268
12	Vania seri		11:15	12:00	183	287	99	290.5
13	Mangalpara ramji mdr		12:00	12:45	79	354	129	234
14			12:45	13:30		421	159	256.5
15			13:30	14:15		488	189	279
16	Bagicha plot		14:15	15:00	184	371	219	301.5
17	Khalawad		15:00	15:45	325	438	249	-1
18			15:45	16:30		505	279	21.5
19	Harandra para setapati		16:30	17:15	170	572	139	44
			17:15	18:00	2682		169	66.5
			18:00	18:45			199	89
Gagadia -5	67	Forest G 4.5	30	Forest Mgl 5	22.5			

5.1.3 Corrective measures with optimum utilization of storage capacity

- Utilizing all the ESR tanks and undertake necessary measures to rectify the network enabling such action.
- If necessary, enhance the pumping capacity to meet with the increased peak demand.
- Control the water quantity being supplied in the early hours from each of the ESR to ensure equity in water quantity being supplied to different water zones.
- If necessary, further division of the water zones for streamlining of the water supply levels.
- With the above measures attempt for providing the city with daily supply.

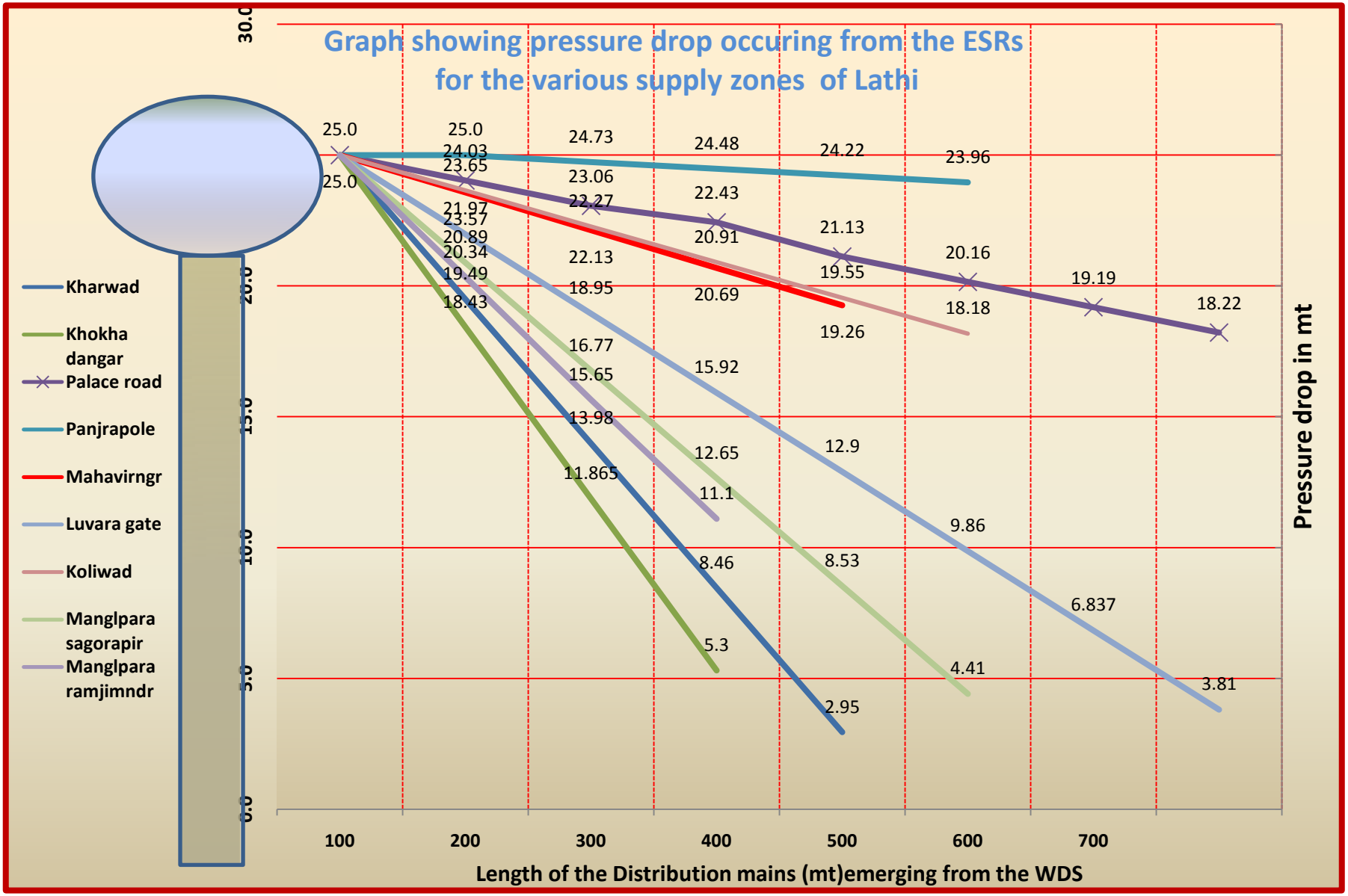
5.2 Hydraulic assessment of the present Water supply pattern

As stated in the previous paragraphs, the supply to the different zones of the town is on alternate day restricted to 45 min. period provided at different times. However, since the supply period is restricted to 45 min and even less, there is excessive pressure drop occurring because the peak hour demand is almost 30 and more. Normally the network is designed for a flow with a peak period demand of 3, and if the peak demand exceeds this value, it would result in pressure drops occurring more than the designed value. In this case, like all urban areas resorting to intermittent supply, there is excessive pressure drop occurring and it is more severe in cases of larger and dense area where the supply quantity is more. The table below provides the details of the pressure drop occurring for different water zones which has been computed on the basis of hydraulics' friction loss formula for different lengths of the mains emerging from the WDS. (the lengths of the distribution mains have been derived from the network map that has been prepared for the town).

Table 5:7: Pressure drop details of water supply zones

Water zones of Lathi		Discharge in cumecs	Water col. ht at ESR	Pressure drop along the distribution main for every interval of							
				0	100	200	300	400	500	600	700
1	Gagadia -Kharawad	0.152	25.0	25.0	19.49	13.98	8.46	2.95			
				25.0	50	100					
2	Gagadia- Harishchdra setapati	0.116	25.0	25.0	23.31	-15.72					
				25.0							
3	Gagadia - Khokha dangar	0.167	25.0	25.0	18.43	11.865	5.3				
4	Gagadia-Chavand gt-Bagicha	0.107		25.0							
				25.0							
5	Gagadia-chavnd gt-Palace rd	0.059	25.0	25.0	24.03	23.06	22.43	21.13	20.16	19.19	18.22
6	Gagadia-chavnd gt- Panjrapole	0.03	25.0	25.0	24.73	24.48	24.22	23.96			
7	Gagadia-Mahvirngr	0.073	25.0	25.0	23.57	22.13	20.69	19.26			
8	Gagadia-Alamgiri-Police line		25.0	25.0							
9	Gagadia-Khodiyrngr		25.0	25.0							
				25.0							
10	Gagadia-Luvara gate	0.061	25.0	25.0	21.97	18.95	15.92	12.9	9.86	6.837	3.81
11	Gagadia-Koliwad	0.019	25.0	25.0	23.65	22.27	20.91	19.55	18.18		
12	Mangalpara-sagorapir	0.13	25.0	25.0	20.89	16.77	12.65	8.53	4.41		
13	Mangalpara-ramjimdr	0.139	25.0	25.0	20.34	15.65	11.1				

Figure 5:3: Pressure drop occuring at ESRs



5.2.1 Critical observation

1. Intermittent and curtailed supply leads to higher peak factor resulting into sever pressure drop.
2. Though the larger and populous areas is provided more water (higher discharge) the pressure drop is higher than the smaller area supplied with less water quantity.
3. Severe pressure drop areas are the beneficiaries of regular supply (refer Graph:5.1) and higher lpcd, still however are subjected to higher pressure drops as well.
4. Reduced pressure leads to people resorting to illegal means of direct pumping through electric motors.
5. Higher outflows during the early supply period, empties the ESRs requiring considerable time for its filling resulting into frequent delays for the supply that follows.
6. Where the pressure drop is less in small water zones, still people tend to draw water at the ground or below ground level for maximizing the water quantity that is available in the short duration of 45 min.

7. This results in a greater loss of residual head – this was commonly observed while undertaking the pressure readings at certain locations. People tend to receive water at ground level despite of the higher pressure head available.
8. People also have to make arrangement of storage facilities at their household level.

5.3 Opting for continuous supply

Of all the water zones, the two zones fed by the Mangalpara wds namely the Gokulnagar and Ramji mandir could be well considered for the continuous supply options and if found successful the same pattern could be scaled up for the other zones adjacent to the WDSs. The above mentioned zones are primarily identified, since there are sufficient storage facilities available at present, and the supply area's proximity to the water distribution stations. In fact out of the two tanks (ESRs) with a storage sump available at Mangalpara Head works, presently ESR with higher capacity and head is utilized for the surrounding areas of Gokulnagar and Ramji mandir areas falling under Mangalpara head works. The population serving the two zones on alternate days is 1693 and 565 respectively.

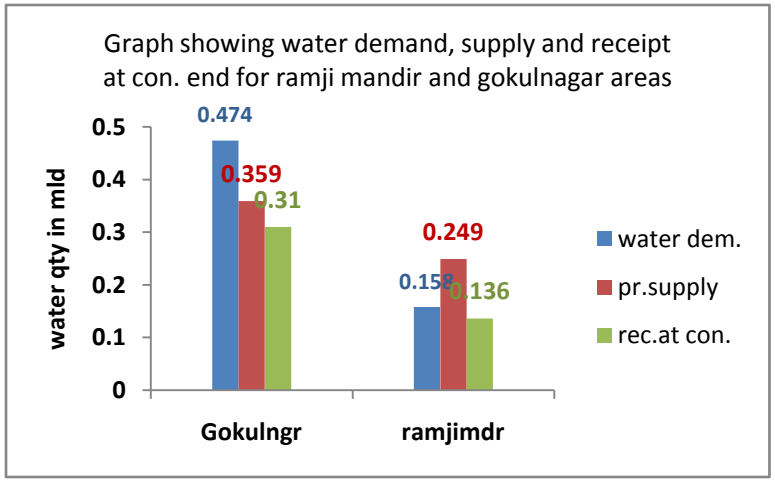
Table 5:8: Present water demand and supply of Mangalpara ESR

Sr. No	Area	Pop.	Household With 5.1 family size	Water demand	Present supply from wds	Receipt at con. end	LPC2D	LPCD
1	Gokulnagar	1693	328	0.474 mld	0.359 mld	0.31	240	120
2	Ramjimandir	565	110	0.158 mld	0.249mld	0.136	183	91

The above table shows that the per capita supply for water for the two zones is 120 and 91. It also show that against a demand of 0.474 and 0.158 mld supply provided is 0.359 and 0.249

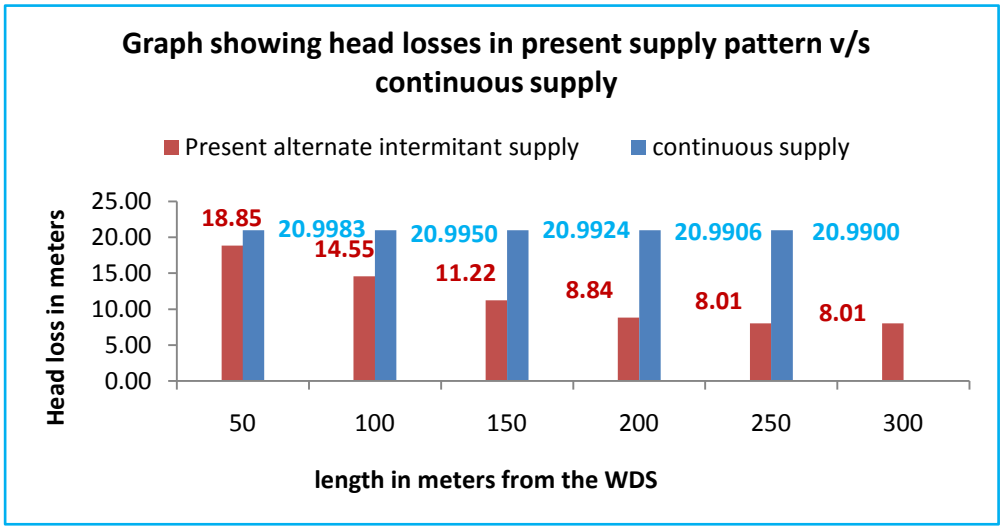
mld respectively. However, the consumer end water testing revealed that the receipt is only around 0.31 and 0.136 mld. There is a loss of 13.64% for Gokulnagar area whereas the loss for the ramjimnadir where the supply is more than its demand the loss is 45.38%.

Figure 5:4: Water demand, supply and receipt at consumer end- Mangalpara zone



It is also seen that during the intermittent supply (which is barely for 45 minutes) occurring on alternate day, there is tendency of drawing water simultaneously by all consumers of the area. This practice results in a very heavy peak demand. In case of Gokulnagar the present supply of 0.359 mld which supplied within 45 min. results into an outflow of 7.97 m3/min. If the same outflow were to be provided within 24 hours duration the outflow than would be barely 0.24 m3/min, which show that the present peak demand is around 33.20. The network is mainly designed for 24 hrs supply with the peak demand of 3 times the average. In this case the peak demand would be 0.72 m3/min, whereas the actually the present peak demand is almost 10 times more than what is ought to be. This excessive demand affects the pressure head in the network during the supply hours. The graph below show the declining pressure head over the distance of 50-250 mts, whereas there is negligible pressure loss occurring during continuous supply.

Figure 5:5: Head losses in present supply Vs Continuous supply

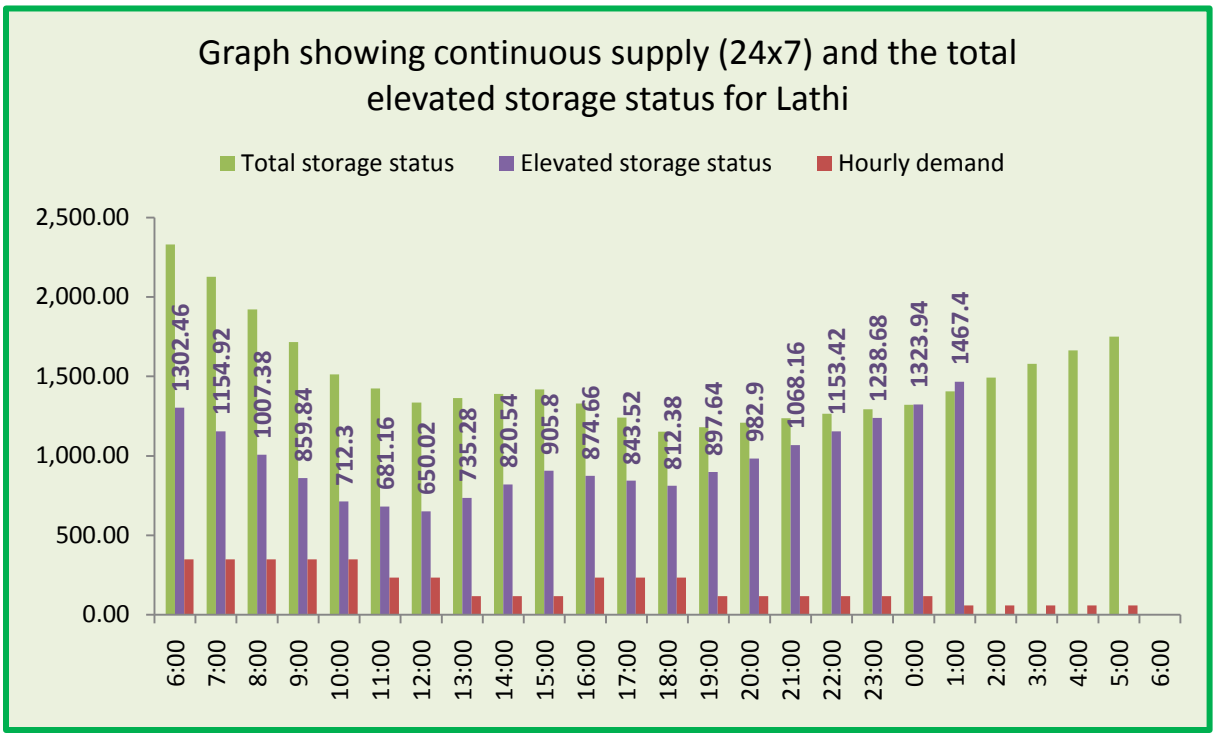


Continuous supply (24 hours supply) would also result into advantages as enumerated under

- Reduce pumping at the WDS.
- No storage requirement at the consumer end.
- No pumping required at the consumer end hence saving in energy at the consumer end.
- Economic use of water by the consumers as this system would require installation of meters at the consumer end and billing based on volumetric consumption.

The quality of water would also improve as the network would be in pressure condition throughout the day avoiding contamination chances due to negative pressure created in intermittent supply conditions otherwise.

Figure 5:6: Continuous supply and ESRs storage status



The above figure shows the uniform drawl from the storage throughout 24 hours, whereas the elevated storage and total storage remains adequate.

However, the proposal for continuous supply on trial basis for a pilot study should be followed by detail survey of the network and consumer connection status. The pipe network if old requiring replacement or rehabilitation should be carried out. People ought to be well educated about the proposed switch over from intermittent to continuous pattern of supply. The water supply department should also allocate staff and undertake their capacity building through training and should be headed by a full time engineer with supporting trained staff. There should be sufficient funds allocated for this program. The office bearers of the ULB and the stakeholders should also be well consulted and kept apprised of the program while in progress.

The basic operational parameters which drives water supply currently are adequate enough for consideration of continuous water supply. The table given below provides factual details of present water supply system along with ideal conditions for continuous supply.

Table 5:9: Operational parameters of present water supply system

Sr .no	Main operational parameters of WSS	Unit	Qty
1	Present one day total supply to the town	(cubic mtr)	1946
2	Present lpcd considering alternate supply	lpcd	92
3	outflow from wds with above supply	(m3/min)	5.41
4	Present storage available (excl. forest well)	(m3)	2750.00
5	Present elevated storage available	(m3)	1650.00
6	Present lpcd considering alternate supply	(lpc2d)	194.6
7	total water requirement considering std. demand (140 lpcd) & permissible losses	(cubic mtr)	3409
8	water availability per capita with std losses	lpcd	161
9	outflow from the system with 140 lpcd with daily supply to 21177 person	m3/min	2.06
10	sufficiency of present outflow against ideal daily supply (24x7)	%	262.55
11	Outflow reqd during peak deamand	(m3/min)	6.18
12	Storage sufficiency against daily requirement	%	80.66
13	time for which the present storage can last without filling	hours	13.36
14	required pumping capacity for std daily supply	m3/min	2.37
15	present discharging capacity of pumps	m3/min	2.64

6 Recommendations

6.1 General Observations

While undertaking the diagnostic study of Lathi water supply, it was generally observed that though the department was headed by a qualified engineer, he was responsible for other technical department activities like road, drainage, sanitation, building and town planning, slum development and others. Consequently, the engineer was scarcely devote the required attention towards water supply needs. The other departmental staff was grossly insufficient in strength and technical skills, besides inability of reading and writing which resulted in lack of recording and reporting. The meager staff strength of 7 remained engaged in valve and pump operations leaving the installation without any attendant even during regular operation.

This state of affairs has resulted in several deficiencies which needs to be properly addressed immediately. Some of the major deficiencies are highlighted as under.

Establishment

1. Lack of technical full time supervisor.
2. Inadequate staff strength for varying departmental activities including office administration.
3. Required skills and capabilities to handle various job requirements found lacking.

Water supply operation and management

1. Full time staff for every installation needed.
2. Appropriate format for recording the operating parameters lacking.
3. Reporting formats absent.
4. Equipment for water assessment like level gauges absent.
5. Monitoring of the daily water supply found absent.
6. Required action for ensuring water quality lacking and also regular inspection of quality at various stages not undertaken.
7. Installations were found to be in need of repairs and renovation including lighting and electrifications of mechanical electrical equipments.
8. Sanitary conditions around the installations was found wanting.

6.2 Recommendations

1. Engage full time technically qualified staff for supervision and monitoring. Also engage required staff for various activities like pumping operations, valve operation, maintenance and repairs, clerical staff for administration.
2. To immediately undertake upgrading and rehabilitating the installation with repairs and rehabilitation measures.
3. To have all water supply components like sumps and ESRs fitted with level measuring instruments like level gauges/ sensors for level observations and later with flow meters on incoming and outgoing mains of the installations.

4. To adopt appropriate formats/log-sheet for recording the operating parameters. To put in place proper recording and reporting practices and procedures.
5. Optimum utilization of existing components especially the RSRs at Gagadia and Mangalpara.
6. To arrange for regular chemical dozing arrangement followed by inspecting procedures at different stages.
7. To arrange for periodic checking of water availability at consumer end and maintain records with reporting practices.

These recommendations have been further dealt regarding its impact and logistic requirement in the following table.

Table 6:1: Recommendations

Sr.no	Actions required	Likely Impact of the action	Logistic requirement	Cost intensive
1	To immediately start recording the operational parameters at various installations of appropriate formats- daily review by the engineer.	For the required information and noting of the timings to ensure timeliness and punctuality.	Formats	No
2	To arrange for tank level measurement through temporary arrangements followed by installation of either proper level gauges or other modern equipments for recording the levels	It would provide the required information of the water quantity supplied to various zones and enable taking remedial measures for equitable supply	1 Arrangement for easy reading of the tank levels. 2 Arrangement for installation of proper level gauges	Least cost. 7 nos Rs 1.0 lac. Or Rs 3.0 lac for sensors
3	Ensure equitable supply from all tanks with close daily observation.	It would help in bringing about uniformity in supply against the demand of each zone.	Controlling the supply valves	No
4	Optimum utilization of the available tanks with the department	Improve the water quantity in areas that are lacking and improve their per head supply.	Detail study of the existing network and supply pattern, followed by rescheduling of the connecting mains or zone isolation	Cost after exact field assessment.
5	To get the meter installed at the tapping point of the Mahi supply either by	Would provide the information related to exact drawal from	Meter installation	No cost or Rs 1.5 lacs for 2

Sr.no	Actions required	Likely Impact of the action	Logistic requirement	Cost intensive
	GWSSB or from own funds	the main sources	through GWSSB	nos- mahi and bhidbhajan
6	Arrange for survey of consumer end supply of each zone on periodic basis	Enables decision for rescheduling of the supply and also provides justification for the corrective measures.	Through own staff after necessary training	No cost
7	Training of the operating staff for proper observation recording and reporting on daily basis	Would ensure objectivity of the water supply activities and create responsiveness and accountability.	In house efforts	No cost
8	To take immediate actions for the repairs and maintenance of the net work and mechanical and electrical equipments. Also streamline improve and renovate the existing pumping stations	It would ensure freedom from recurrent maintenance. It would also improve the efficiency of the machinery and equipments	Retain expert to carry out the technical audit and suggest suitable plans for up-gradation and improvement	Rs 2. 0 lacs as consultancy charges. And Rs 20-25 lacs for execution
9	Strengthening of the civil works and making arrangements for site office and storages	Would enable proper environmental setup for efficient management	Through own funds or from Govt. grants	Rs 15 lacs
10	To undertake installation of meters for the bulk supply at the stage of procurement , processing and distribution.	Would provide the day to day records of the water quantity procured , processed and distributed and help in monitoring and supervision.	From own funds or through grants from the government	App. 15 meters of size ranging from 4- 8 inches. Approx cost Rs 10.0 lacs
11	Explore the possibilities of switching over to continuous supply in convenient areas on pilot basis.	It would help in equitable supply, reduction in energy cost, less contamination and other many accruing benefits.	From govt. grants or own funds	Rs 20 lacs or as per the site condition survey.

7 Information System Improvement

Water supply department of Lathi nagarpalika only maintains information related to zone supply and their timings on daily basis. It is mainly used for deciding the area which needs to be provided the water supply, as there is alternate days supply. The person in charge of the valve operation at Gagadia Head works makes an entry in the register angaist the time the supply was provided. The attendance of people in charge of the shift especially the one who is not present is recorded and all others are deemed to be present and their muster bill prepared accordingly. However, this record is not being utilized for monitoring and review enabling proper decision making. Except this no other entry of valve and pump's start and shut is recorded, nor is the tank levels get recorded.

The crucial information necessary for assessment of water quantity is grossly lacking. Consequently, department is not in a position to quantify

- The water quantity provided to different zones and sub zones.
- To derive the water quantity that is being received from the main sources.
- To assess the pumping hours and the volume of water that gets processed through it.
- Duration of the supply and the intake duration from the sources.
- The energy consumption at the pumping stations.
- The disruption in supply due to electrical or mechanical failures.

For proper monitoring of the system, it is imperative that the required information is available from the operating system at regular interval. Based on this available information the supervisor can take up required measures for improving the efficiency. It also helps in monitoring on day-to-day basis. It also creates appropriate documentation which could be preserved for future references. In view of this necessity, appropriate formats would greatly help in recording the operational data.
Since the staff strength is not adequate nor is their skill and competence of required capacity for follow up, the formats ought to be simple and easily adoptable by the field staff and also need to be in local vernacular language. In fact, every pumping installation and water distribution stations ought to have appropriate format where the operational data of each of them gets recorded properly. But in case of Lathi water department the staff strength is quite low that does not permit deploying staff round the clock. The present staff visits the installation when the pumping operation or the valve operation has to be carried out and returns to the main head works at Gagadia. In view of this practice, a single format is found to serve the purpose for gathering information. It is also designed in local vernacular language so that the local staff can feel at ease while recording the data.

7.1 Main parameters considered for information collection

1. Water procurement duration from the main sources Mahi and Bhidbhajan which would provide the details of the approximate water quantity received during the day.

2. Pumping duration at different installations – forest well, gagadia sump, Bhidbhajan well, mangalpara sump.
3. Tank levels at forest well, bhidbhajan well, gagadia sump, esr at gagadia, sump and esr at mangalpara for assessing the water quantity being pumped and provided during the supply duration.
4. Valve operation for different zones that would help in providing the supply duration and the water quantity provided during their supply.

Information that would be generated

1. Water quantity daily procured from the two sources.
2. Pumped up water quantity from the various pumping installation that would provide the inflow details into the tank during the supply period.
3. Pumping capacity and efficiency of the pumps.
4. Total water supplied to different zones which would be further utilized to derive per head water supply.

Logsheet of Lathi Water supply																	Day:		Date:										
			Timings																										
Sr.No	Location	0:00	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	12:00 AM	Total
1	**Mahi pariyej flow**																										
	Valve O/X																										
2	**Forest well**																										
	Well Water level																										
	Pump O/X																										
	Water quantity received																										
3	**Bhidbhajan well**																										
	Well Water level																										
	Pump O/X																										
	Water quantity received																										
4	**Gagadia sump**																										
	Flow from Bhidbhjan (B)																										
	Flow from Mahi pariye (M)																										
	Gagadia sump water level																										
	Gagadia pump O/X																										
	Gagadia pump to ESR (5 lac/4.5 lac																										
5	**Gagadia ESR (5 lac ltr)**																										
	5 lac ltr ESR Water level																										
	Supply to area																										
	water qty supplied																										
6	**Gagadia ESR (4.5 lac ltr)**																										
	4.5 lac ltr ESR water level																										
	Supply to area																										
	water qty supplied																										
7	**Mangalpara Sump**																										
	Inlow O/X																										
	Sump water level																										
	Mangalpara pump O/X																										
8	**Mangalpar ESR**																										
	Water level																										
	supply valve O/X																										
	Supply to area																										
	water qty supplied																										
					Operator								Checked by									Water Works Engineer						

લઠી નગરપલિકેમ પણ પુરવઠમ લેગશીટ															તરીખ:													
															સમય													
અનુક્રમ	સ્થળ	12:00	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	12:00 AM	કુલ
૧	મહ પણની આવક																											
	વલવમલે /બધ (O/X)																											
૨	ફેરસ્ટ કવે																											
	કવની પણી સપતી																											
	પમપમલે /બધ(O/X)																											
	મહથી મેળવેલ પણી જથ્થો																											
3	ભીડભજન કવે																											
	કવની પણી સપતી																											
	પમપમલે /બધ(O/X)																											
	મેળવેલ પણી જથ્થો																											
૪	ગગડીય સપ																											
	ભીડભજન મથી મળતં પણી (B)																											
	મહી પરીએજ મથી મળતં પણી																											
	ગગડીય સપની પણી સપતી																											
	ગગડીય પમપમલે /બધ																											
	ગગડીય સપ થી ટકી (૪.૫/૫ લખ)																											
૫	ગગડીય ટકી (૫ લખ)																											
	ટકી ની પણી સપતી																											
	સપલાય વલવમલે /બધ O/X																											
	સપલાય વિતર																											
	સપલાય થયેલ પણી જથ્થો																											
૬	ગગડીય ટકી (૪.૫ લખ)																											
	ટકી ની પણી સપતી																											
	સપલાય વલવમલે /બધ O/X																											
	સપલાય વિતર																											
	સપલાય થયેલ પણી જથ્થો																											
7	મગલપર સપ																											
	પણીની આવક ચલ/બધ																											
	સપની પણી સપતી																											
	મગલપર પમપમલે /બધ																											
૮	મગલપર ટકી																											
	ટકીની પણી સપતી																											
	સપલાય વલવમલે /બધ																											
	સપલાય વિતર																											
	સપલાય થયેલ પણી જથ્થો																											
					ઓપરેટર								ચકસન ર મપરવ ડર									વેટર વક્સ એજીનિયર						

7.2 Other formats for better Information

7.2.1 Complaints

The formats recommended for the water quantity assessment at procurement, and distribution and supply stage would help in better evaluation and monitoring of the system. It would also enhance the reliability of the related indicators which at present is at scale D in most of the cases. Other indicator related information deals with the complaints and quality.

At present there is no system of recording the complaints. They are either orally received or by phone or in person. The engineer passes on the instruction for its resolution, however no details are recorded as to the type of complaints and the time in which it gets resolved. There is no mechanism of monitoring its pendency. The format shown below would help in recording and monitor for its follow up actions.

The main parameters considered are

1. The details of the complainant and its address and the complaint type.
2. The mode of receiving the complaints.
3. The time duration in which the complaints are attended to the satisfaction of the complainant.

Table 7:1: Complaint format

Complaint format											
municipality:									month:		
sr no	Date	Person name	Address	ward no	Complaint details	Type	Dept related	disposal dt	reasons for non		remarks
Total complaints received			complaint recording staff				total compl disposed				

Table 7:2: Complaint format department wise

complaint type department wise					
Type	**Water supply**	**Drainage**	**street light**	**Bandhkam**	**Solid waste**
A	Direct pumping	Chociking up of line	short circuit	damage pipe M.H	Sewage water on road
B	Illegal water conn.	Illegal drg. Conn.	TL damaged	M.H. reqd levelling	dead animal lying
C	Less water pressure	Main line overflowing	Tl not wkg	Valve chamber level.	Dustbin not lifted
E	Less water time	Inlet chamber damage	others	Water flooded on rds	No garbage collected
F	No water	storm water collection		others	sweeper not attending
G	Pipe line leakage	others			dustbin point to be removed
H	Polluted water				Throwing of bio-medical waste
I	others				Throwing of lunch waste
J					others

Table 7:3: Complaint Statement

STATEMENT SHOWING DETAILS OF COMPLAINT RECEIVED- CLEARED & PROGRESS MADE DEPARTMENT WISE													
Sr no	**Period**	**Complaint received, redressed & progress made department wise**											
		Water works			**Drainage**			**Solid waste**			**Storm water**		
		Received	**Cleared**	**Progress**	**Received**	**Cleared**	**Progress**	**Received**	**Cleared**	**Progress**	**Received**	**Cleared**	**Progress**
clerk complaint cell:				Date:			Period:				**Officer i/c complaint cell:**		

Complaint report									
sr.no	**period**	**no. of complaints received dept.wise**				**no. of complaints resolved dept.wise**			
		water supp	**sewerage**	**street light**	**sanitation**	**water supp**	**sewerage**	**street light**	**sanitation**
	Total								
Date:		**officer in charge of the complaint cell:**							

Complaint report													
Sr no	Period	Complaint received, redressed & progress made department wise											
		Water works			Drainage			Solid waste			Storm water		
		Received	Cleared	Progress	Received	Cleared	Progress	Received	Cleared	Progress	Received	Cleared	Progress

7.2.2 Benefits that would accrue

The format would help in providing information related to ward wise complaints of each department, their nature, the time in which it is disposed off. Frequently occurring complaints would guide for proper short or long time action to stop its recurrence. For example, poor pressure in some area –complaints coming often would prompt the department to take measures for either pipe line replacement or clearing the pipe line of blockages. Lack of sweeping in particular ward, and the oft repeated complaints would call for proper deployment of manpower for cleaning. The action would have sufficient justification for long time capital intensive measures. It would also prove to be very useful tool for monitoring and reporting to higher authorities.

7.3 Water quality monitoring

Presently water quality testing is absent or if done, it is infrequent. There are no records maintained for further follow up and monitoring. Formats as shown below would help in undertaking the testing and inspection activities properly.

Parameters that are mainly considered

1. The Residual chlorine available at different stages –like procurement, distribution and consumer end.
2. Confirmation of samples taken up for inspection to the prevailing norms followed by actions in case of samples non confirming.
3. Proper documentation of the inspection activities.

Table 7:4: Residual Chlorine availability details

Ressidual Chlorine availability details														
Nagarpalika:				Water Works Deptt.				Year:		Month:				
Sr No	Date	Sample collection location			Location details	Election wd No.	No of samples coll.	Sample result		% of pass samples	% of failed samples	Sign. Of staff	Remark	
		at Wtp	at Wds/Esr	at cons.end				Pass	fail					
				Total no	At WTP									
					At Wds									
					At Consumer end									
supervisor		Deputy engineer - Water works Engineer												

7.3.1 Monitoring of water connection release

Presently there is no mechanism for follow up of water connection released on demand of the consumers. Quite often the approvals and release is time consuming. The slum dwellers may not have proper records hence there could be time delay on that count. In order to hasten up the connection release process, it is suggested to have proper records for its monitoring in order to reduce the delay.

Main aspects considered are

1. Monitoring of the approval and releasing process.
2. Proper documentation that would assist in future for easy retrieval.
3. Avoidance of irregular practices occurring while releasing.
4. Providing speedy information to higher authorities.

Table 7:5: Water Connection register format

Water connection register format																	
Nagarpalika:			Water works deptt:										Month			Year	
Sr.No	Date	Name of the applicant	Address			Elect.w.no-slum?	P.T a/c no.	Owner /ten.	Conn.size	intended use	no.of dep. families	Charges paid /recpt.no	Sanction reso.no	muni line size conn. derived	Conn. given on dt	Plumber name and licence no	Remarks
	water works tax officer				Deputy Enginner			Water works Engineer									

7.3.2 Benefits that would be derived

This would help in proper documentation and records of the connections that are released. It would also provide the connection details election ward wise, type wise and usage wise. The slum connection details could be easily derived and the dependant families on each connection also easily derived.

7.4 Assessment of water availability at consumer end

There is no practice of assessing the water quantity availability at the consumer end. This assume greater importance in bringing about equity in distribution across the town. Appropriate format is recommended so that the exercise when periodically undertaken provides useful information for proper decision making.

Main parameter considered are

1. Identification of water quantity availability at the consumer end in different parts of the city.
2. The per head supply also could be easily derived from the exercise.
3. The information could also provide useful information related to the available pressure at the consumer end.

STATEMENT SHOWING APPROXIMATE CONNECTION DISCHARGE AT THE CONSUMER END BASED ON RANDOM SAMPLING																	
Sr No.	Ward no 1	Locations	Time	Name of conn.holder and address	size and length of conn.	Container	Container size	Qty of Water in container	Container filling time in min/sec	Duration of water supply	Normal duration for Water qty normally received	No. of families dependant on conn. and its ave. size	Level at which water is available in the conn.	Water discharge in ltr/min	approx water qty available at the conn. point 14x10	Avg. per capita water avail. At consm. End - 15/12(fam.size)	Remarks
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16

Benefits that accrues

This exercise helps in identifying the water quantity availability at the consumer end of the town. It also provides information related to the equity aspect of the water supply in different zones and sub zones. It provide the pressure at the consumer end, enabling appropriate action in case of poor pressure and water quantity provided.

7.5 Cost and Income from water

Information related to income and expenditure of water forms very crucial aspects of water supply system. The efficiency of the service delivery and hence consumer satisfaction mainly depends on this aspect. The information collected under this exercise proves very valuable for taking up follow up action for corrective measures. Self sufficient system leads to better efficiency and customer satisfaction.

Main parameters considered are

1. Quantifying the total water quantity procured , processed, and distributed up to the consumer end.
2. Expenditure incurred towards the operation and maintenance of the system.
3. Income from the tax collection and other charges through current demand collection, arrears collection, and other charges and sources.
4. Relating the income and expenditure to the 1000 ltr or cubic meter unit to obtain better relative idea of the concept

Benefits that accrues

The exercise helps enormously to optimize the expenditure incurred for water for each of the expenditure head- mainly energy, establishment, O & M, Bulk purchase on one hand and maximizing the income of water under various subheads. The exercise helps in improving the overall efficiency and plugging of the physical as well as financial leakages.

Table 7:6: Income and expenditure of water supply system

Income and expenditure of water supply system											
City:	Nagarpalika:	Date:		Date:		Date:		Date:		Date:	
Sr No	Period	2007-08		2008-09		2009-2010		2010-2011		2011-2012	
	Details	Total	% of total	Total	% of total	Total	% of total	Total	% of total	Total	% of total
1	Total water process.per yr in 1000 m3										
2	Cost of water in Rs (lacs)										
2.1	Establ										
2.2	M &R										
2.3	Energy										
2.4	Bulk wt prch										
2.5	Chemicals										
2.6	Others										
2.7	Total										
3	Cost of water / 1000 ltrs										
4	Income from water in lacs/yr										
4.1	from taxes/chgs										
4.2	from non tax inc										
4.3	from bulk water sell.										
4.4	Others										
4.5	Total										
5 5.1	water Demand - Arrears										
5.2	Current										
5.3	Total										
5.4	Collection- from Arrears										
5.5	from - Current										
5.7	Total										
6	Income from water/1000 ltrs										
7	Surplus/Deficity in lacs										
8	Surplus/Deficity per 1000 ltr										
9	Surplus or deficit / conn.										
	Tax suptd:	Accounts officer:		Water works Enginner		Chief officer:					