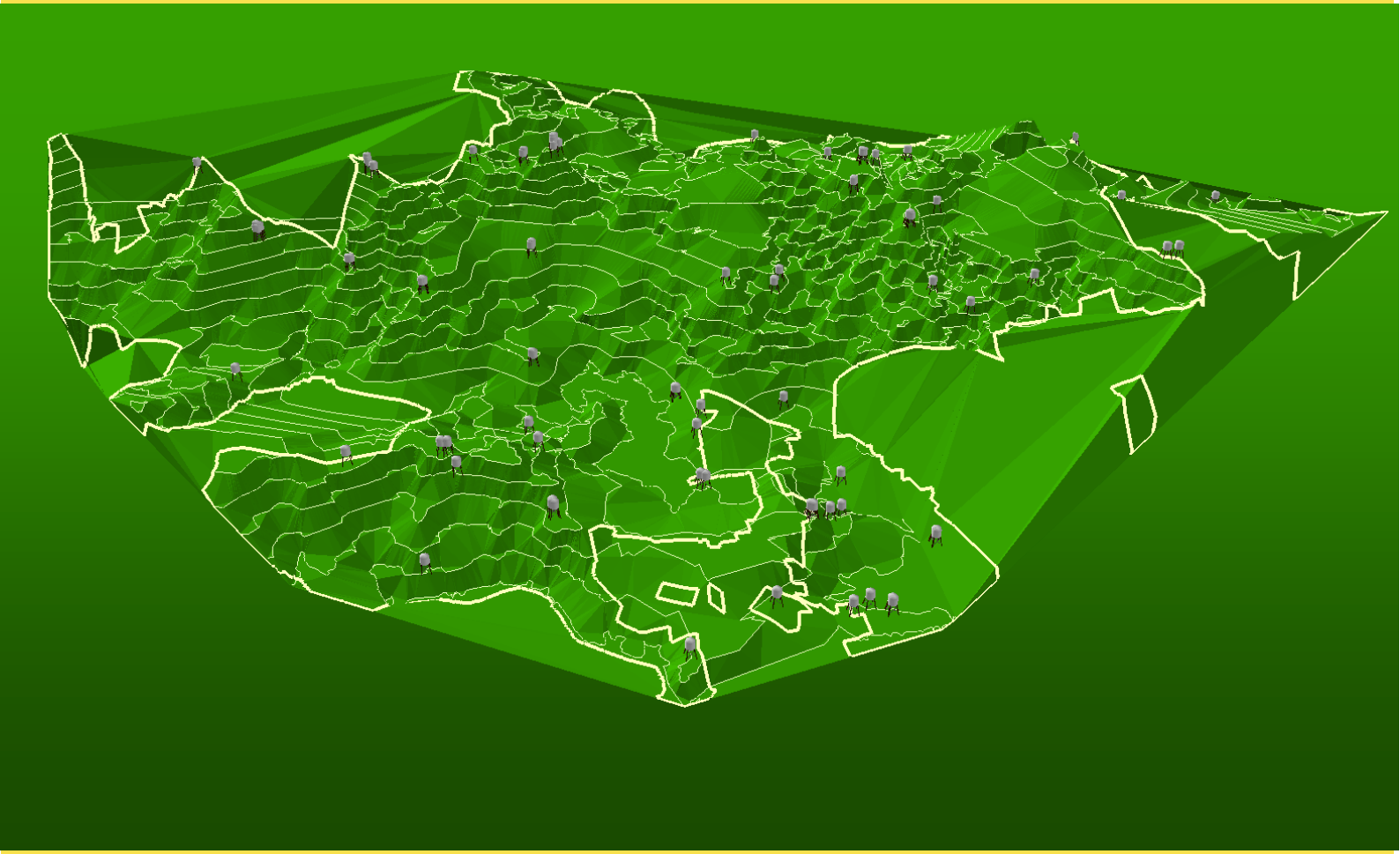
Detailed Project Report

Pimpri-ChinchwadContinuous (24/7) Pressurized Water Supply Project

Volume I: Report, Design and Estimate



Project	**Pimpri-Chichwad 24/7 Pressurized Water Supply Project**
Client	Pimpri-Chinchwad Municipal Corporation
Project Consultant	Administrative Staff College of India, Bela Vista, Raj Bhavan Road, Hyderabad-500082.

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ABBREVIATIONS AND UNITS OF MEASURE

Abbreviations

AC	Asbestos Cement
PCMC	Pimpri-Chinchwad Municipal Corporation
CI	Cast iron
DI	Ductile iron
DMA	District metering area
DPR	Detailed project report
ESR	Elevated service reservoir
GIS	Geographic Information system
GoM	Government of Maharashtra
GoI	Government of India
HGL	Hydraulic grade line
MBR	Master balancing reservoir
MJP	Maharashtra Jeevan Pradhikaran
MS	Mild steel
NRW	Non-revenue water
PVC	Polyvinyl Chloride
WTP	Water treatment plant
GSR	Ground service reservoir

Units of Measure

Km	Kilo meter
LPCD	Liters per capita per day
m	Meter
m^2	Square meter
m^3	Cubic meters
MLD	Million liters per day

Executive Summary

The purpose of this document is to create a detailed project report (DPR) with advance techniques of GIS and simulation Hydraulic Model for the Pimpri-Chinchwad city and recommend a strategy, which would help Pimpri-Chinchwad Municipal Council (PCMC) to design the pipe network of the distribution system of the city. Ultimate objective is to allowPCMC to achieve continuous (24/7) pressurized water supply to all its customers including the poor. The project is designed to cover about 8 lakh population (about 40 % of the city) having diverse socio-economic and demographic structure.

With a aim of increasing drinkingwater availability to the city and improving service level, PCMChas planned acomprehensive water supply project. The Project focuses on- (i) Reducing non-revenue water by leakage management and commercial losses through identification and regularization of illegal connections, metering and improvement in billing and collection systems; (ii) Refurbishment and expansion of transmission and distribution network (iii) reforms to address revenue improvement, expenditure rationalization (water and energy audit), customer relations and redressal systems and ICT enablement of water management for efficiency improvement and (iv) organizational strengthening and capacity building. To achieve these objectives, PCMChas planned this project.

The project is expected to bring significant improvement is service delivery (as per the SLB indicators), reduction of coping costs for citizens, financial sustainability for PCMC and most importantly public health improvement. The project is designed to avoid hindrances (Ex. land acquisition etc) and hence would be completed as per the indicated time.

The Pimpri-Chinchwad city is located (Figure A) in the Pune district of the state of Maharashtra. The population of the city in the year 2011 was 17,30,133.

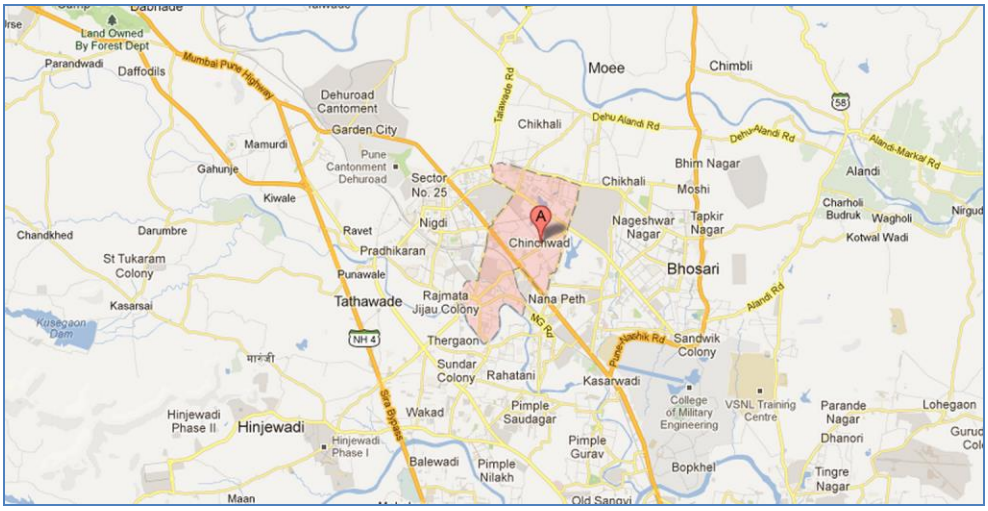


Figure A: Location of Pimpri-Chinchwad town

Background

Present water supply situation in the Pimpri-Chinchwad city is challenging. Presentlyeighty five ESR/GSR are supplying water to the distribution system. Due to lack of investmentand disarrayed distribution system, the current practiceis to maintain water supply on intermittent mode. The Non-Revenue Water is approximately 40% and therefore, the residents of the city get water for just three hours in a day.

The cities in urban India are facing the similar situations, as a result, the coverage is less, per capita share is on lower side, the level of NRW is quite high and there is no consumer satisfaction. To overcome this and ameliorate the present status, Government of India (GoI) has introduced its ambitious program of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for the cities that have low coverage, low per capita share and high values of non- revenue water. Pimpri-Chinchwad city administration is taking advantage of this scheme.

Summary

Presently water is pumped from the head works at the Rawet on Pavana river to the Water Treatment Plant (WTP) at sector 23 through three mild steel (MS) pipelines of diameters 1053mm, 1165mm and 1400mm laid in the years 1989, 1999, 2006 and 2010 respectively. From pure water sumps of the WTP, treated water is pumped to the eighty five existing ESRs and then supplied to the respective water districts of the distribution systems. The plight of the distribution system is in disarrayed form. Existing ESRs are not in a state to supply water on 24/7 system. The city is not divided into operational zones. The design of the operational zone is not proper. Hence, distribution of water is in a haphazard way. Besides this, there is unequal distribution of water too.

Advanced and powerful techniques of GIS mapping and hydraulic modeling have been used in the present study. Using these techniques, a hydraulic model simulating the water supply system, right from the source to the consumers in distribution system has been prepared.

Population forecast and the demand projection is carried out. The demands of water in the water districts have been computed for immediate stage of the year 2030 and the pipe network of the distribution system has been designed for ultimate stage of year 2045. The demand allocation to the 12,022 nodes has been made using advanced feature of the WaterGems.

The base scenario, simulating water supply of the entire city, has been prepared as a first step. Child scenarios of the system for the various water zones have been created. The zoning is made considering the capacity and serviceability of the existing ESRs. Using the model, the sizes of the pipes are worked out.

About 40% of the area has been considered for transformation to 24/7 continuous water supply. The area is so selected that there is enough storage and no new tanks are required to be constructed. Present distribution pipe network is therefore proposed to be divided into 15 zones. Thus the 40% city covering about 8 lakh populations is now divided into 15 operational zones. The district metering areas are also designed and the location of the bulk meters is fixed.

Critical Recommendations

(1) Present Elevated Service Reservoirs (ESR)

Storages of existing ESRs are checked (Chapter 6) and found enough. Hence, new tanks are not proposed. 23 altitude valves (Table A) have been designed to reduce NRW as these valve play important role in preventing overflow from tank.

Table A: Abstract of Altitude valves

Diameter	Number
100	2
150	6
200	1
250	11
300	3
	23

(2) Strengthening of the Primary Network

New transmission pipelines shown shall be laid from the S1 sump at WTP to the Dange Chowk and at other locations as shown red in Figure B and in Table B.

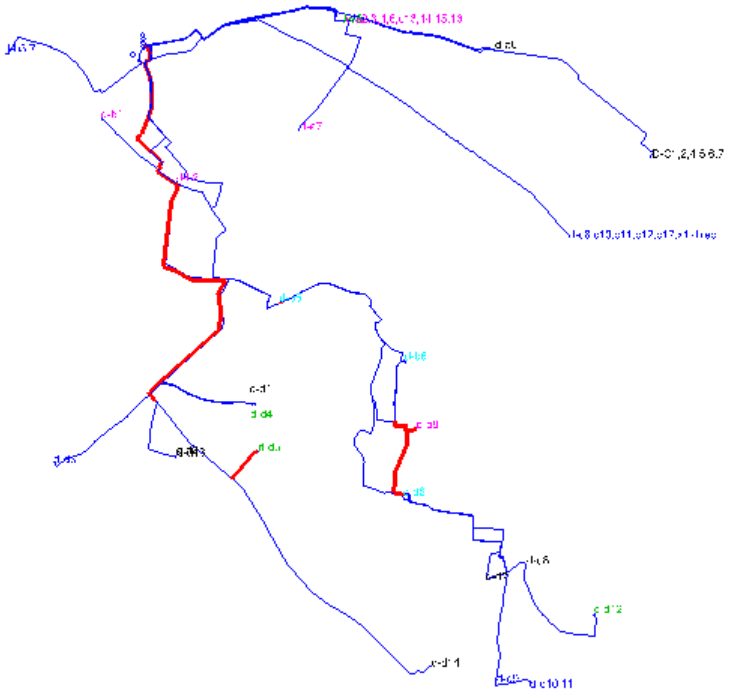


Figure B: New pipelines (red colour) to be laid for strengthening of the primary network

Table B: Details of new DI-K7 transmission mains

Diameter of DI-K7 (mm)	Length (m)
300	903
450	608
500	776
1,000.00	7,436
Total	9723

(3) Pipes in Distribution System

At present the distribution pipe network of length of 1352 km exists in entire city. The diameters of the existing pipes are in the range of sizes of 50mm to 700mm as shown Table C.

Table C: Length of existing pipes in distribution system

Diameter (mm)	Length (m)					
	AC	CI	DI	GI	MS	Grand Total
50		13886		7453		21339
75		296				296
80		27109				27109
100		466807	57571	1260	1618	527256
150		258348	51188		714	310250
175		1543				1543
200		101651	13916		5589	121156
250		51652	7749		2898	62299
300	305	81711	17988	517	14825	115346
350		8239	5756			13995
400		19806	19260		9422	48488
450		17505	18018		9194	44717
500		9092	9243		4647	22982
600		14750	4055		14140	32945
700			2590			2590
Total	305	1072395	207334	9230	63047	1352311

The pipe network in the selected area is shown in Table D.

Table D: Length of existing pipes in selected area of distribution system

Diameter (mm)	Length (m)					
	AC	CI	DI	GI	MS	Grand Total
50		3688		1111		4799
80		8506				8506
100		111763	3299		1463	116525
150		81571	10808		298	92677
175		990				990
200		25256	2349		1081	28686
250		14478	441		2898	17817
300	305	23278	6042		7419	37044
350		841				841
400		6413	1923		1756	10092
450		6847	2461		3561	12869
500		39	2033		286	2358
600		3314	2570		2745	8629
700			1723			1723
Grand Total	305	286984	33649	1111	21507	343556

In order to improve the performance of the distribution system, pipe network rehabilitation is proposed:

- Pipe strengthening for hydraulics in DMA
- Extension of network for coverage
- Rehabilitation- replacing old pipes

Considering above facts the new pipelines proposed are as shown in the Table E and old pipes to be replaced in the selected area are shown in Table F.

Table E: Length of proposed new pipes in selected area of distribution system

Diameter (mm)		Length (m)		
Outer	Inside	DI	HDPE	Grand Total
110	99.3		31251	31251
160	144.4		4177	4177
200	180.6		403	403
225	203.1		3050	3050
250	225.8		316	316
280	252.9		2782	2782
315	284.5		3867	3867
	300	710		771
	350	2566		2566
	400	4306		4306
	450	778		778
	500	131		131
	600	112		112
	700	291		291
	Grand Total	8894	45846	54801

Table F: Length of pipes to be replaced in selected area of distribution system

Diameter (mm)	Length (m)		
	HDPE	DI	Total
110	38949		38949
160	27803		27803
180	297		297
225	8606		8606
280	5345		5345
300		11113	11113
350		252	252
400		3028	3028
450		3861	3861
500		707	707
600		2589	2589
700		517	517
Grand Total	81000	22067	103067

(4) District Metering Areas

Total 26 DMA's are proposed in 13 zones of the selected area. These DMA's in the selected area are shown in Figure C. Care shall be taken to isolate the DMA's.

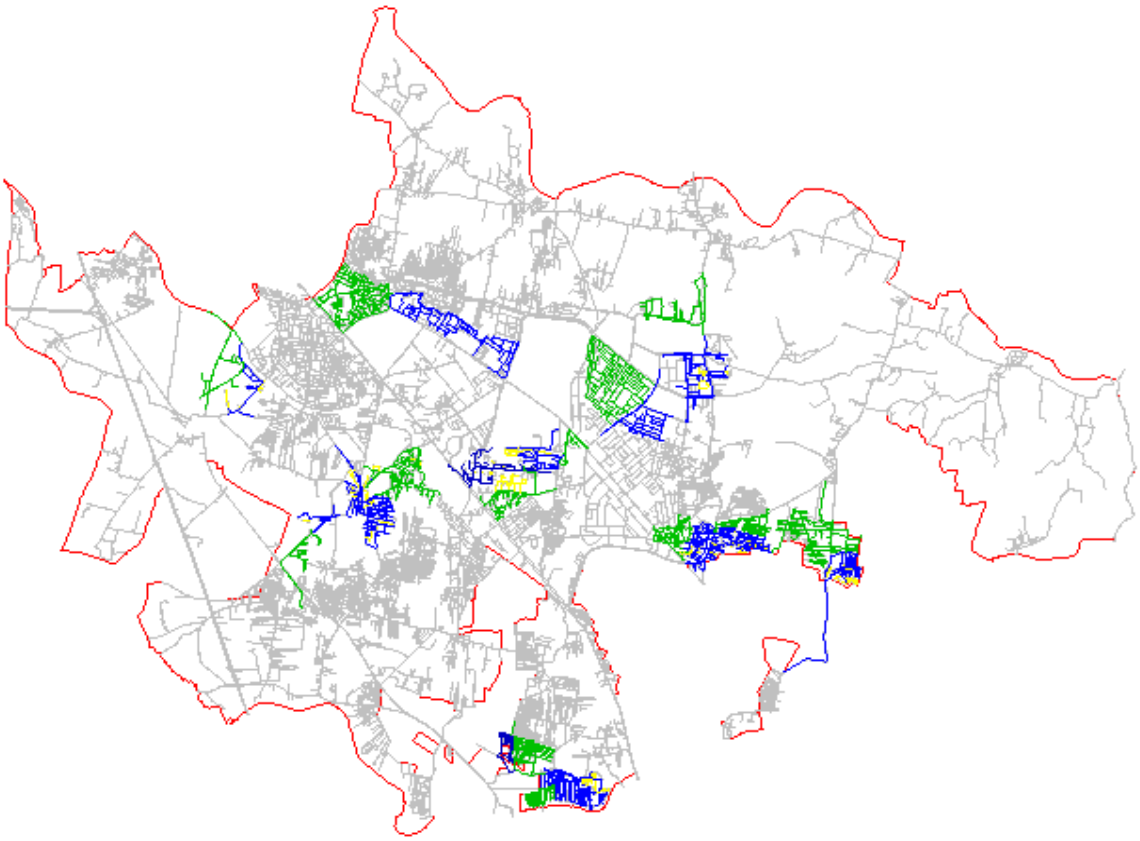


Figure C:DMA in selected area

(5) Bulk Meters

The bulk meters at the entry point of each DMA have been suggested. These meters will be useful in measuring NRW in the system. The details have been given in Table G.

Table G: Abstract of bulk meters

SN	Zones	DMA	Size of Bulk Meter (mm)	Number of Bulk Meters
1	A2	a2-a	600	1
		a2-b	600	1
2	B1	b1-a	300	1
		b1-b	300	1
3	B5	b5-a	450	1
		b5-b	500	1
4	C2-C3	C2-C3-a	80	1
			400	1
		C2-C3-b	600	1
			600	1
			600	1
5	C5	c5-a	600	1
		c5-b	600	1
6	C10	c10-a	300	1
		c10b	400	1
7	C11	c11-a	400	1
		c11-b	300	1
8	C12	c12-a	500	1
			300	1
		c12-b	400	1
9	C13	c13-a	400	1
		c13-b	400	1
10	C14	c14-a	400	1
		c14-b	400	1
11	D9	d9-a	400	1
		d9-b	500	1
12	D10-11	D10-11-a	400	1
		D10-11-b	400	1
			450	1
			450	1
13	D13	d13-a	400	1
		d13-b	400	1
	13	26		32

(6) Pressure Reducing Valves (PRV's)

Abstract of PRV's proposed in the selected area are shown in Table H.

Table H: PRV's proposed in the selected area

Label	Elevation (m)	Diameter (Valve) (mm)	Hydraulic Grade Setting (Initial) (m)	Pressure Setting (Initial) (kg/cm²)
PRV-36	578	100	588.02	1
PRV-15	569.99	100	580	1
PRV-26	603.67	150	613.69	1
PRV-14	568.48	150	588.51	2
PRV-4	608.52	150	618.54	1
PRV-21	599.41	150	609.43	1
PRV-13	583.68	150	593.7	1
PRV-8	604.77	150	614.79	1
PRV-6	590.29	150	600.3	1
PRV-5	608.78	150	618.8	1
PRV-32	562.85	150	572.87	1
PRV-9	596.34	150	606.36	1
PRV-38	594.1	150	604.12	1
PRV-34	600.4	150	625.44	2.5
PRV-35	600.27	150	625.32	2.5
PRV-37	579.3	150	594.32	1.5
PRV-20	604.48	200	614.49	1
PRV-11	585.19	300	593.21	0.8
PRV-12	570.73	300	580.75	1
PRV-16	565.16	300	575.17	1
PRV-23	584.72	300	599.75	1.5
PRV-24	603.82	300	615.84	1.2
PRV-28	582.03	300	592.05	1
PRV-31	580.28	300	590.3	1
PRV-10	604.34	400	614.36	1
PRV-19	604.6	500	614.62	1

(7) SCADA

A SCADA system has been suggested for operations in distribution system. The SCADA will help to monitor and regulate the flows in the various water districts. This technique will be used to distribute the flow in an equitable proportion and equitable pressure.

(8) Leak Detection and Repair Program

A vigorous leak detection and repair program has been proposed for selected area in this project. A new advance technology of detecting the leaks with injection of the helium gas will be used.

Suggestions for 24x7 Water Supply

(1) Zero pressure tests shall be conducted to ensure that the DMA's are perfectly hydraulically discrete.

(2) Water audit is a continuous process and hence shall be conducted from time to time to compute the values of non-revenue water (NRW) of all the DMA's.

(3) Knowing the NRW values, a vigorous leak detection program shall be undertaken and leaks shall be repaired to decrease the NRW values.

(4) House service connection, potential leakage points, will be suitably replaced with MDPE pipe with strap saddle.

(5) PCMC proposes to rationalize the tariff structure for promoting water conservation through demand management. Strengthening billing and collection system is equally important for financial sustainability.

(6) PCMC shall undertake strategy communication & IEC campaigns for ensuring support and collaboration of stakeholders.

7) Customer satisfaction is primordial for sustainability of continuous water supply project. PCMC shall introduce customer facilitation centers and a robust grievance redressal system.

The approach in this study shall help city administration to transform its current intermittent supply to 24/7 continuous water system. The comprehensive approach adopted is depicted in Figure D.

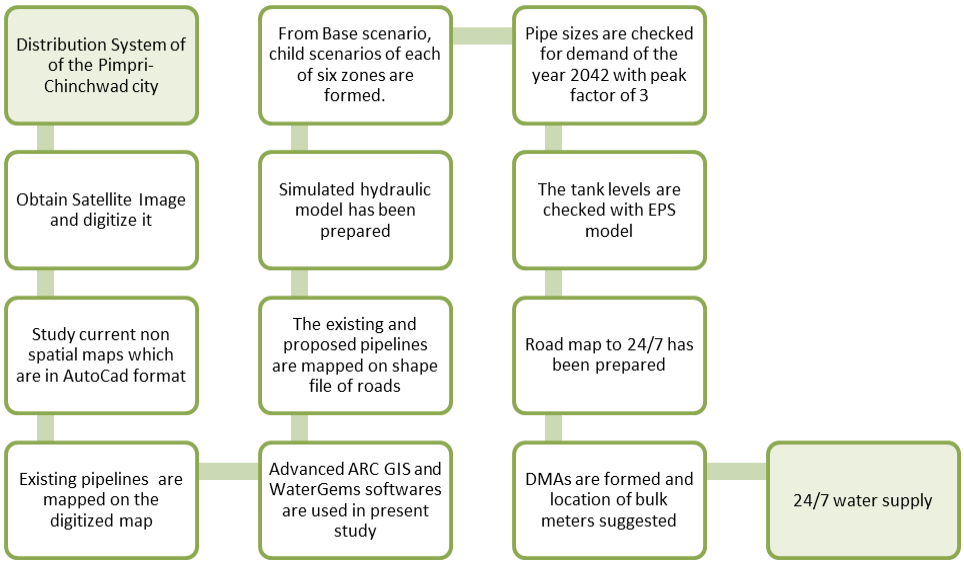


Figure D: Approach adopted

(e) Abstract of Costs

Abstract of the costs is shown in Table I.

Table I: Abstract of the costs

Sr.No	Particulars of Sub Estimate	Cost (Rs)
1	Pure Water Transmission main (9.723 km) from MBR to Various ESR's	20,95,69,665
2	Distribution system of length 54.740 Km (Di 8894 m and HDPE 45846 m)	13,96,03,223
3	Distribution System- Replacement of pipes by DI pipes	16,44,50,466
4	Distribution System- Replacement of pipes by HDPE pipes	11,26,49,031
5	Providing House Service Connections (54000 number) MDPE pipe	15,43,81,750
6	P/F Bulk Meters	1,97,09,228
7	P/F Domestic Meters	11,80,74,000
8	Simulation of Distribution network	1,24,41,276
9	Isolation of DMA (616 places)	1,17,44,944
10	P/F PRV (25 places)	1,47,22,556
11	P/F Altitude valves	2,07,10,679
12	Leak Control Studies: Finding invisible leaks in the Primary network with the aid of helium gas, carrying out repairs and allied works in primary network (185 kms)	4,50,38,835
13	Finding invisible leaks with the aid of helium gas, carrying out repairs and allied works in the distribution system (1352 kms)	28,01,09,533
14	P/F Flow meters at the outlets of ESR	10,40,70,000
15	SCADA System (for distribution system)	15,52,50,000
	Total	156,25,25,186
	Add 3% Contingency Charges	4,68,75,755
	Add 0.5% Admin. Charges	78,12,625
	Total	161,72,13,568

(f) Sustainability of the Project

Income from the project shall exceed cost of O&M in the year 2018 and onward as shown in Figures E.

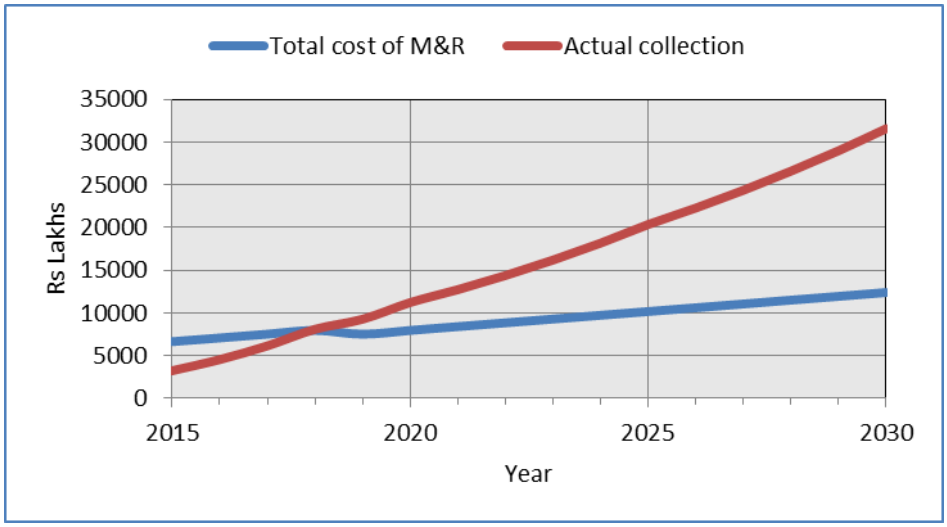


Figure E: Total cost of M&R and actual collection

(g) Financial Pattern (Rs Lakhs)

Financial pattern is shown in Table J.

Table J: Financial pattern

1	Gross cost of scheme	Rs. Crores	**161.72**
2	**Financial Pattern**		
	a) GoI: Grant-in-aid 50% of gross cost	Rs. Crores	**80.86**
	b) GoM: Grant-in-aid 20% of gross cost	Rs. Crores	**32.34**
	b) Local body's share 30% of gross cost	Rs. Crores	**48.52**

CHAPTER 1

Introduction

1.1 INTRODUCTION

Pimpri-Chinchwad is a city (Figure 1.1) in the Punedistrict of Maharashtra. The city comprises of the twin towns of Pimpri and Chinchwad which are governed by a common municipal body (the Pimpri-Chinchwad Municipal Corporation or PCMC).

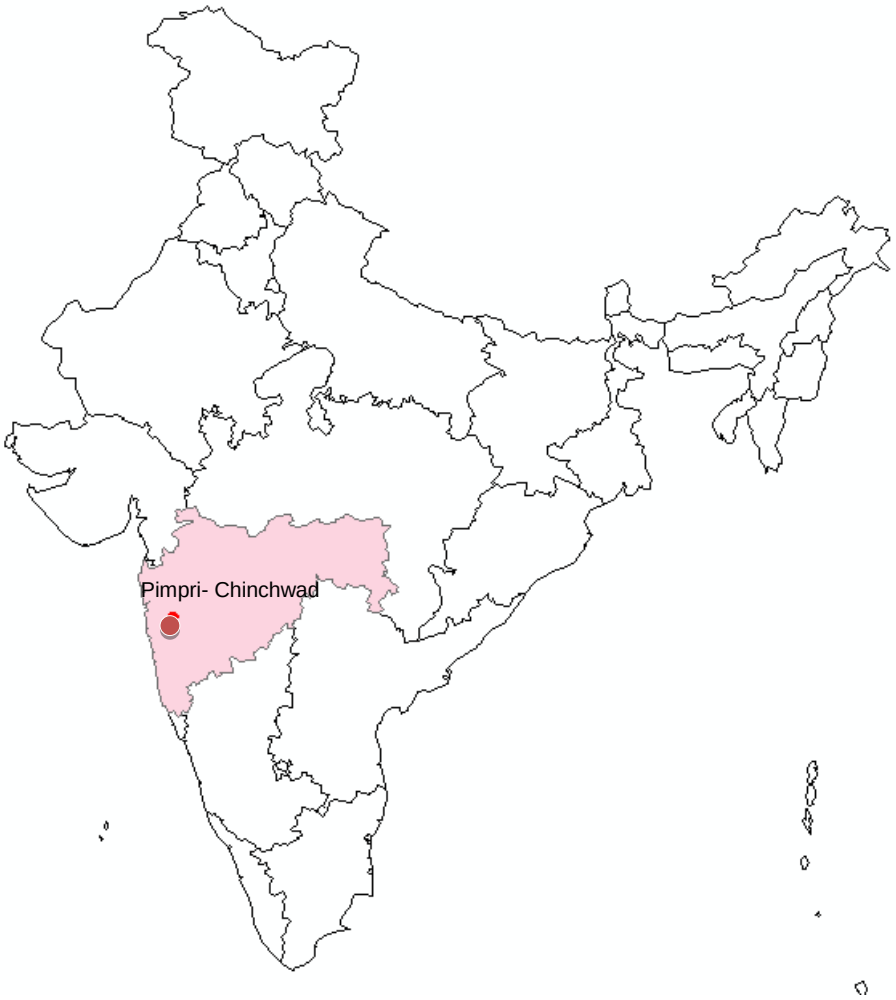


Figure 1.1: Location of Pimpri-Chinchwad city

1.2 History

Pimpri-Chinchwad has main areas- Chinchwad, Pimpri, Nigdi, Akurdi, Kalewadiand Bhosari. Chinchwad is famous for Saint Morya Gosavi's Shrine, which is one of the lord Ganesha's shaktipeeth (Figure 1.2) in Maharashtra state. This temple gets submerged in the river water due to the flooding of the river Pavana every year (Figure 1.3). Local people consider it as bathing of lord Ganesha. Chinchwad is also the birthplace of the Chapekar brothers. Pimpri-Chinchwad is home to the historic town of Bhosari, originally known as Bhojapuri.

The original name of Bhosari is Bhojapur, which was the capital of King Bhoj, a legendary king who ruled central parts of India two thousand years ago. During the period of Mahabharata this city was known as Bhojakata, the capital of the Bhoja-Yadava king Rukmi.

Figure 1.2: Shaktipeeth

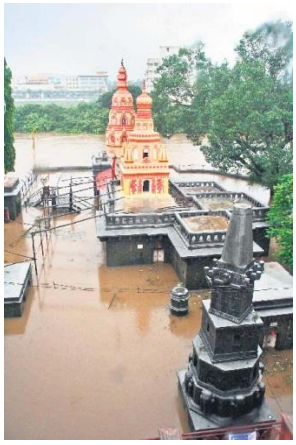


Figure 1.3: Ganesh Temple

1.3 Demographics

As of 2011 India census, Pimpri-Chinchwad had a population of 17,29,320. Male population (9.45 lakh) and female population (7.83 lakh). Pimpri-Chinchwad has an average literacy rate of 87.19 which is higher than the national average of 74.04%. In Pimpri Chinchwad, 14% of the population is under 6 years of age.

1.4 Geography

Pimpri-Chinchwadcity spans between the geographic co-ordinates of latitudeN 18° 37' 07" and longitude E 73° 48' 13.43". The township is situated at a height of 530 m above the sea level. It is blessed with pleasant climate for entire year. Three rivers Pavana, Mula and Indrayani flow through this area. Pimpri-Chinchwad sources its water from Pavana river but release of domestic and industrial effluents, dumping of debris and domestic pollution has

severely affected the quality of the Pavana water, though recently efforts have been taken to improve the quality of water,which have been successful in some places along the riverside.

1.5 Topography

The city has a large area with undulations (Figure 1.4). It falls in Upper Bhima sub basin (Figure 1.5).

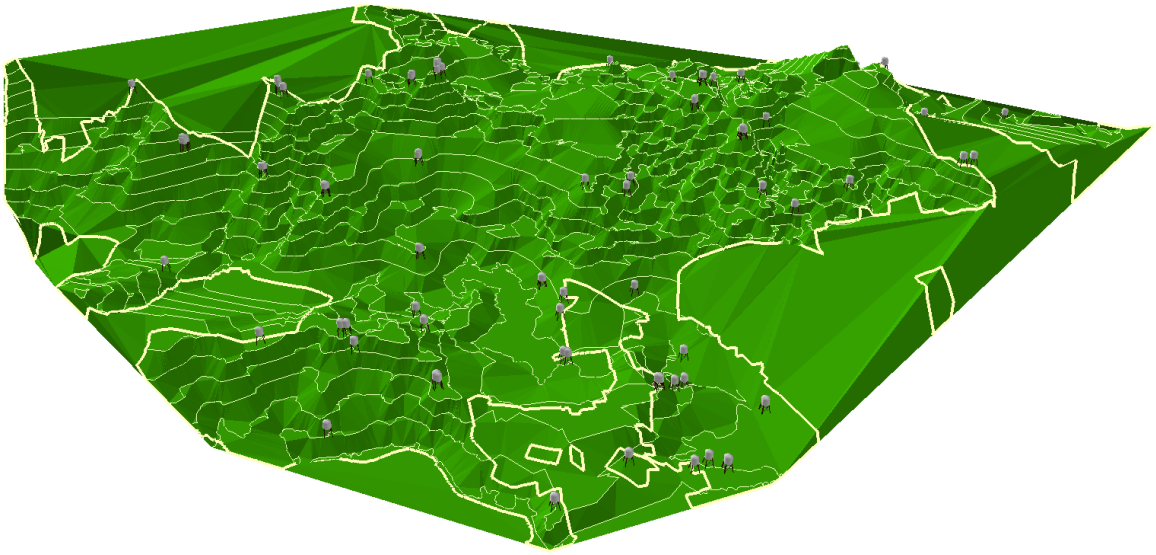


Figure 1.4: Terrain of the city

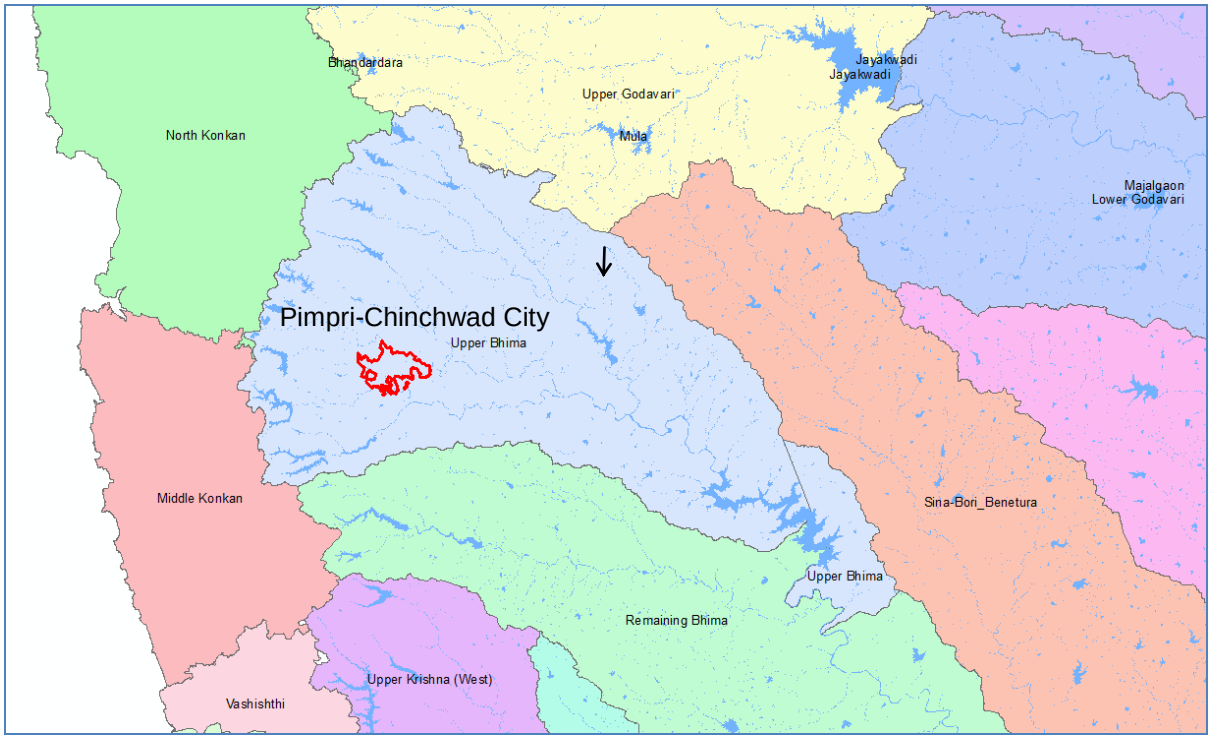


Figure 1.5: Location of Pimpri-Chinchwad city in sub basins

Drain lines of the city are shown in Figure 1.6.

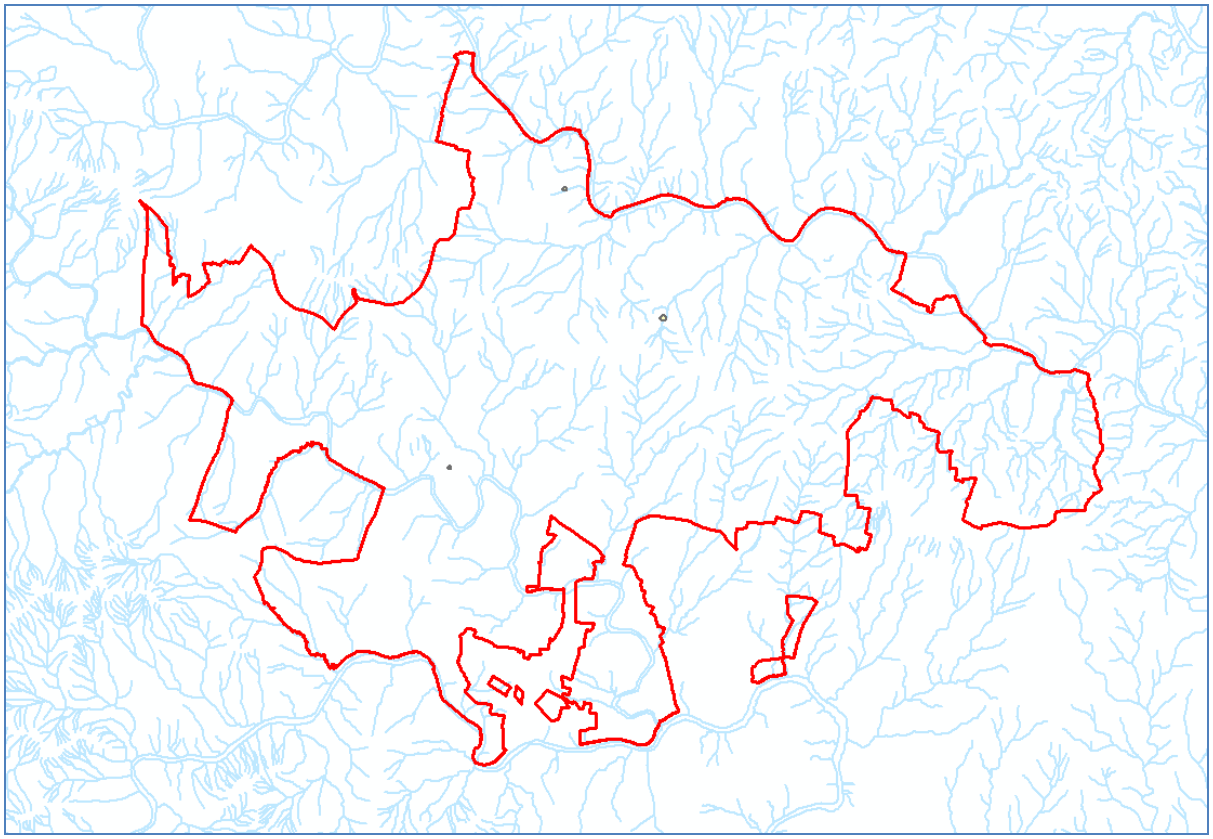


Figure 1.6: Drain lines of the city

1.6 Local administration

Pimpri-Chinchwad Municipal Corporation (PCMC) is the local civil body. PCMC is administratively divided into four zones as shown in Figure 1.7.

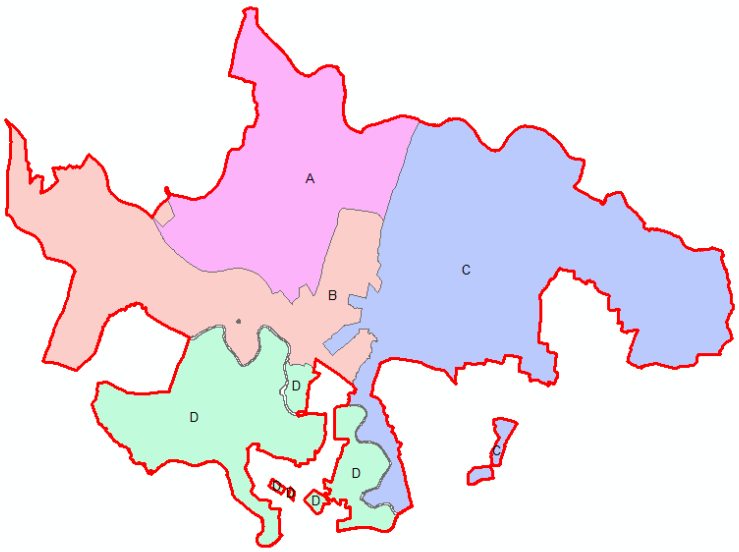


Figure 1.7: Administrative zones of Pimpri-Chinchwad

The city is divided in 105 electoral wards as shown in Figure 1.8. People of each ward elect a Corporator who represents that ward.

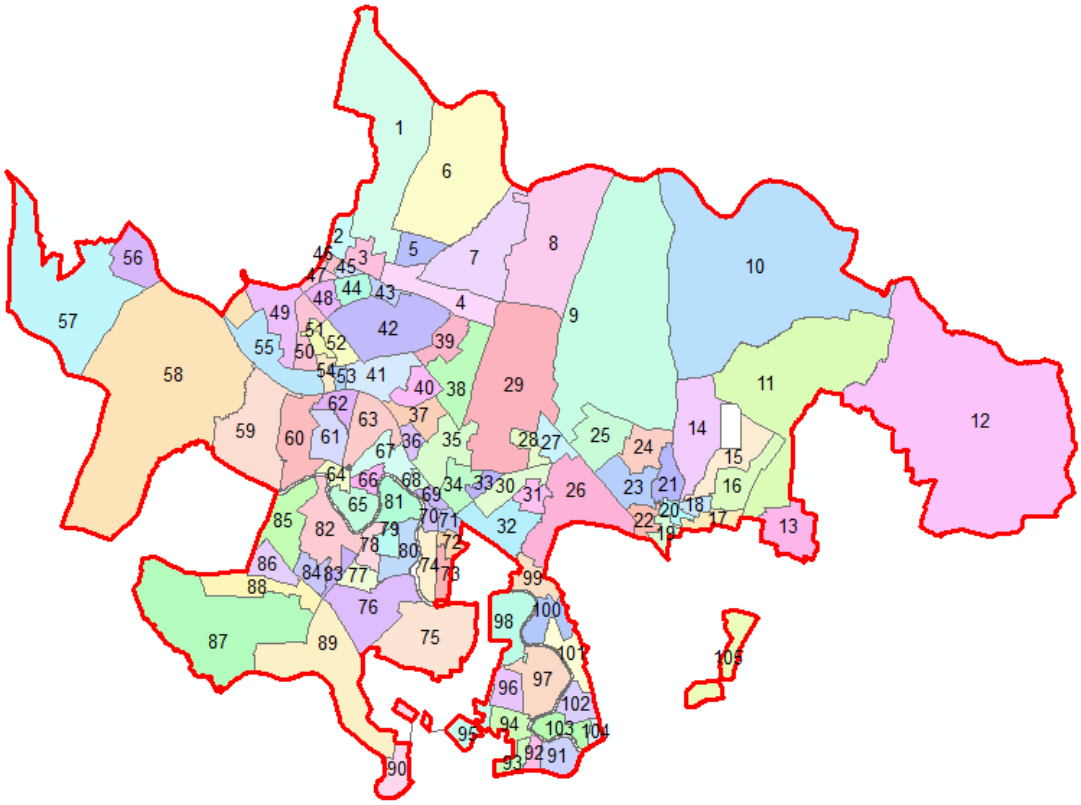


Figure 1.8: Electoral wards of Pimpri-Chinchwad city

The Municipal Corporation was established in the year 1982.At that time the Municipal Corporation area was about 86 km^2. Later on in the year 1997, the limits of the Municipal Corporation were further increased with merging of 18 peripheral villages, thus increasing the total area under its jurisdiction to 170.51 km^2.

PCMCprovides basic amenities like drinking water, drainage facility, road, street lights, etc. and collects its revenue from the urban taxes. Municipal Commissioner; an I.A.S. Officer heads thecity administration.

1.7 Industries

Pimpri-Chinchwad is a major industrial hub. It hosts one of the biggest industrial zones in Asia.Industrialization started way back in 1954 when Hindustan Antibiotics Limited was established. Thecity is home to the Indian operations of major automobile companies like Premier Limited, Mahindra Navistar, Bajaj Auto, BEL Optronic Devices Limited, TATA Motors (formerly TELCO), Kinetic Engineering, Force Motors (formerly Bajaj Tempo) DaimlerChrysler, Thermax and Autoline Industries. Apart from this the city contains several heavy industries such as Forbes-Marshall, ThyssenKrupp and Alfa

Laval & Sandvik Asia. There are many manufacturing units in the city and also the German company KSB Pumps, Swedish bearing company SKF. There is a Rajiv Gandhi Infotech Park which hosts several Software and Information Technology majors like Accenture, IBM India, KPIT Cummins, Tata Technologies, Infosys, Wipro etc. at Hinjewadi near PCMC.

1.8 Transport

Pimpri-Chinchwad is well connected by road, rail and air. It has a nearest airport at Pune. Maharashtra government plans to set up a new airport near Chakan. Pune - Lonavla suburban local trains run through this area. Old Pune–Mumbai Highway has been widened to four lanes, which has improved connectivity to Pune and reduced travel time to less than 30 minutes. It has a State Transport Bus stand at Vallabhnagar. The main railway stations for this area are Chinchwad Railway Station and Pimpri Railway Station.

1.9 Service Levels

The GoI standard performance indicators of water supply, benchmarks achieved so far and the expected goal of benchmarks are summarized in Table 1.1.

Table 1.1: GoI performance indicators and achievement

SN	Indicator	Standard Benchmark	Pimpri-Chinchwad	After implementation of the proposed project
1	Coverage (percentage of households connected)	100%	77%	100%
2	Per capita supply of water (litres per day)	150	170	150 lpcd
3	Extent of metering (%)	100	78%	100%
4	Extent of non-revenue water (%)	20%	50%	20%
5	Continuity of water supply (hours per day)	24	3 hours	24 Hours
6	Quality of water supplied (%)	100%	99%	100%
7	Efficiency in addressing customer complaints (%)	80%	60%	80%
8	Cost recovery in water supply services (%)	100%	85%	100% as per CPHEEO norms
9	Efficiency in collection of water supply-related charges (%)	90%	42%	90%

Source: PMC SLB

1.9PROBLEMS OF THE EXISTING WATER SUPPLY

The city administration, including the water supply department, faces a very difficult task of supply of drinking water supply. Important problems of the water supply system are enumerated as below:

(1) Uneven Terrain: The city terrain has a number of undulating surfaces. The contours are shown in Figure 1.9. The terrain has a level difference is in the range of 540 m to 620 m. The system is lacking a pressure management; as a result there are uneven pressures in the different parts of the city.

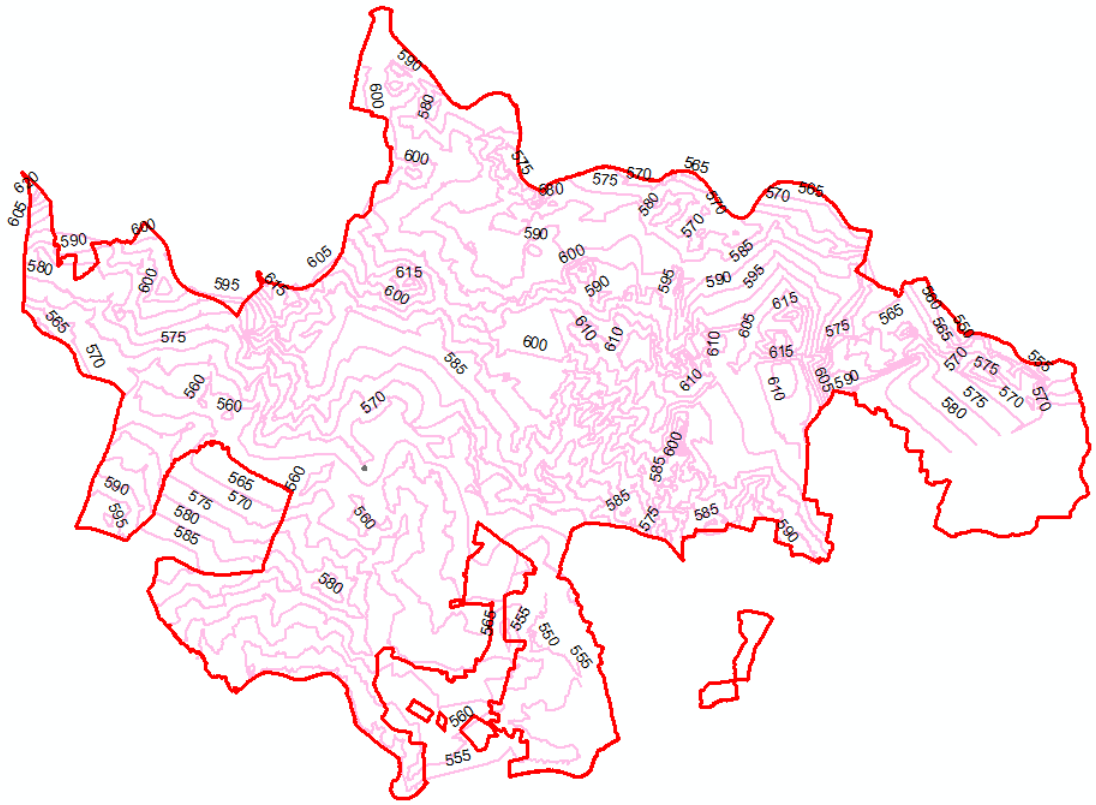


Figure 1.9: Uneven terrain

(2) High NRW: The current NRW is high about 40%.

(3) Contamination due to Intermittent Supply: One of the important drawback of the current intermittent water supply is that the water is contaminated in non-supply hours due to the outside contaminants, which find entry in pipeline due to vacuum in pipeline and through the leaking joints.

(4) Supply Hours: Main problem of the city's water supply is that the residents get water supply for just 3 hours daily. The supply hours are not regular. People have to remain awake

in night hours as well as in the early hours as the timing of the supply are erratic and not regular. Due to this hardship some of the taps of the household connections and public taps are kept open resulting into the loss of precious water resource.

(5) Large number of Valves: Due to intermittent water supply, zoning system for daily operation has to be practiced by the city water supply maintenance engineers. The total number of valves in the distribution system are shown in Table 1.2. The spatial location of these vales is shown in Figure 1.10.

Table 1.2: Number of valves

Water Prabhag	No. of Valves
A	754
B	841
C	1178
D	800
Total	3573

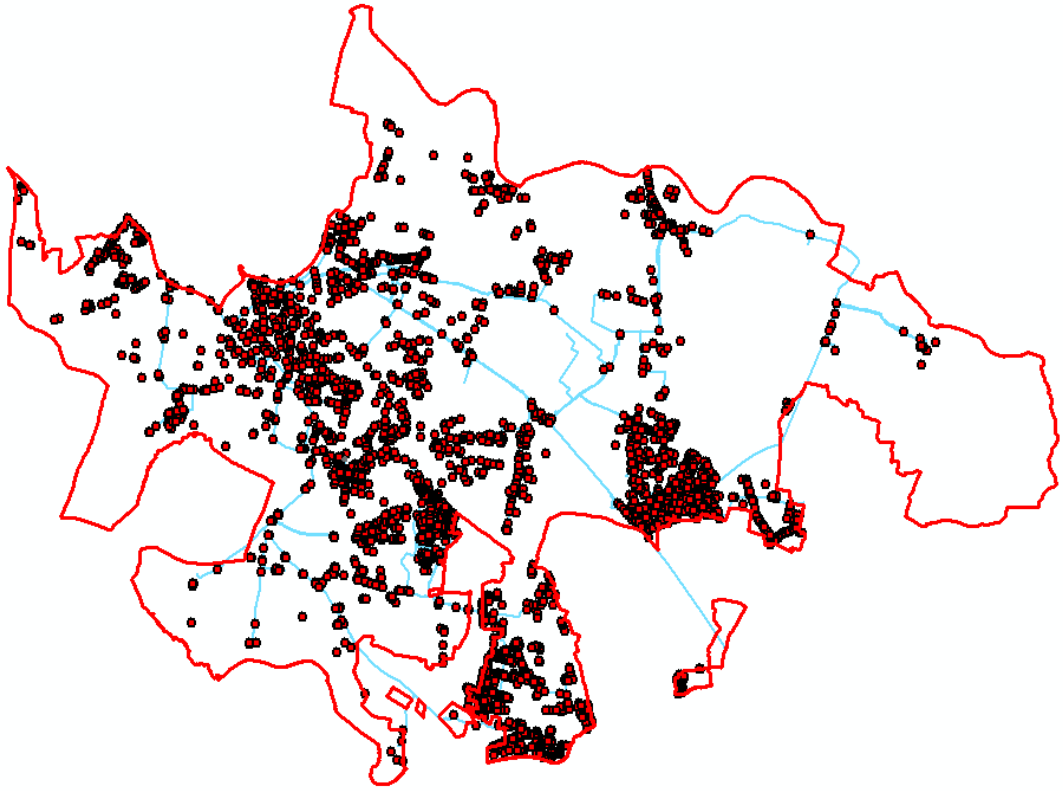


Figure 1.10: Spatial location of operating valves in distribution system

Thus operation of zones require a large number of the staff for mere operation of the valves.

(6) Improper Operation Zones:

Serving area/ zone served by each elevated service reservoir (ESR) was not designed as per their capacity. Despite disarrayed service area, existing pipelines have been found laid in haphazard manner. Thus the residents get water with less pressure.

The operational zones are created with multiple tanks. There is common inlet and outlet for tanks. But as diameter of the tanks vary, there will be fluctuations when transformation to 24/7 system occurs.

Main problems with the distribution system network (DSN) of the citys' water supply system is as follows:

- Capacity of ESR is not enough to cater the demand of its earmarked service area (operational zone),
- ESR remains empty or found overflowing,

(7) Huge Coping Costs: Coping costs is a money which is required to cope up with the poor service. Pimpri-Chinchwad residents have to expend Rs 5640 per annum to buy the plastic overhead tanks, booster pumps, tankers and small purification devices.

1.10 NEED FOR PROJECT

The city is expanding leaps and bound. It is one of the fastest growing metropolitan cities in India. Hence, the coverage needs improvement. The NRW of the city is high (40%). The plight of distribution network is poor as the water districts have not been designed properly. The pipelines have been laid haphazardly. Therefore there is no control on the distribution of drinking water. Due to disarrayed distribution system, the water is not being distributed equitably and with equal pressure.

The supply times are odd due to zoning method. Therefore, the taps are found open. The residents have to expend on the coping costs due to poor delivery of water. In primary network the hydraulic carrying is found insufficient, especially in the area of Chinchwad.

The city needs reduction of non-revenue water by leakage management and commercial losses through identification and regularization of illegal connections, metering and improvement in billing and collection systems. For strengthening the performance of the distribution, refurbishment and expansion of transmission and distribution network is needed. Hence, the project is required.

1.11 OBJECTIVES OF THE CONSULTANCY

The objective of the present consultancy work is to prepare a DPR and create the GIS based hydraulic model of the entire Pimpri-Chinchwad city, which shall simulate the system's behavior. The study shall present the measures to be taken up by the Pimpri-Chinchwad water utility to reduce the NRW and finally convert its existing intermittent water supply to 24/7 continuous water system and then make it sustainable. It shall also provide the measures

for making infrastructure to tackle present as well as future requirements of the city. A detailed project report for converting present water supply into 24/7 system is the outcome of this study. The study will not only solve the problem of inequitable flow, low pressures but shall suggest a road map to 24/7 continuous water supply.

1.12 Strategy to Reduce NRW

A strategy has been formulated for reduction of NRW for which necessary steps are taken/ shall be taken for computation and reduction of NRW from its base line existing today.

i. Setting up correct zones for each ESR/ GSR: Operational zones are demarcated with respect to ESR/ GSR's capacity and serviceability

ii. Setting up District Metering Areas (DMA): District Metering Areas are set up for each correct operational zone for the number of customers between 500 to 2000. These DMA's must be made hydraulically discrete (isolated) by carrying out zero pressure tests,

iii. Out of 344 kms of selected area of distribution pipe network, 54.8 km pipeline will have to bereplaced, so after replacement, NRW can be brought down considerably as thepipes will be new with good joint system

iv. House service connections: All house service connections shall be made by using MDPE pipe,

v. Bulk and consumer metering: Bulk meters shall be installed with a provision of creating agraph of minimum net night flow V/s. hours by sending SMS to the control room.

vi. Leak identification: Identify the leakage areas by conducting step tests and gathering data from the data loggers. Exact location of leak spots shall be thenfixed using leakage identification instruments such as injection of helium gas, sounding rods, noise-corelator etc.,

vii. NRW reduction: Once the commercial and physical losses are known, measuresshall be taken up to bring them in accepted limit,

ix. Water Balance: Components of water balance such as- authorized billed meterconsumption, authorized billed unmetered consumption, unauthorized consumption due to thefts, metering inaccuracies, leakage in transmissionmains, distribution house service connection shall be computed and water audit shall be carried out,

x. NRW reduction: Once the commercial and physical losses are known, measuresshall be taken up to bring them in accepted limit.

CHAPTER 2

Criteria for System Planning

2.1 GENERAL

This Chapter describes consideration of the design parameters that are used in the design of distribution system and steps to be adopted for conversion of the existing system into 24/7 continuous water supply system.

2.2 SYSTEMS OF WATER SUPPLY

The water may be supplied to the consumers by either- (1) continuous system or (2) intermittent system. In the continuous system, the water will be available to the consumers for all 24 hours a day. Whereas, the intermittent system will supply water only during peak water demand period fixed hours in the morning and evening. The exact period of supply of water to the consumers will depend on the availability of water from the source/ water treatment plant, pumping rate, available storage of water, availability of electric power supply during the day, water demand, seasons etc.

The intermittent system creates problems like contamination ofwater in the pipes during non-supply hours, unhygienic as well as insanitationproblems due to inadequate use of water by certain group of people byutilizing minimum quantity of water. Besides, at majority of places, theintermittent supplies may not provide much savings of water because of thefollowing reasons:

- In intermittent supply system, water is generally stored by the consumers in tanks, drums, and utensils etc. for use during non-supply hours. They, if unutilized, as soon as the fresh supply is restored, usually throw this stored water away. This increases the wastage and losses of water considerably.
- The consumers have a general tendency to keep the water taps open during non-supply hours; so that they may come to know the restoration of the supply. However, in majority of cases, water goes on flowing to waste, unattended even after the supply is restored, thus resulting into wastage of precious treated and potable water.

Besides, this intermittent supply system causes great inconvenience toconsumers, keeping them on their toes for receiving and collecting water assoon as the supply is restored.

Further, in this system, when the supply of water stops and the waterfrom the pipe is withdrawn off, a partial vacuum may be created in thepipeline. This induces suction through leaky joints and if dirt or parts of sullage or even sewage and other waste waters on the ground surround the pipes, the same may get entries into the pipes. This contaminates the

existing water available in pipes as well as incoming water in thepipelines, when the supply is restored.

Number of sluice valves and control valves are required to be installed in thenetwork of water distribution system.All these valves are operated many times daily, while starting or closing supply. This requires additional operating staff along with high operating and maintenance cost.

Intermittent system should not be continued on long term policy due to thefollowing disadvantages-

1. The consumers have to store water for use during non-supply hours; which is likely to be contaminated.Some consumers may not have sufficient storage facilities; which may lead to insanitary conditions ultimately.
2. It has been observed that the consumers leave their water taps open every time; which causes much wastage of water.
3. If more storage of water is kept for the use during non-supply hours, it is thrown away, causing wastage of water.
4. If any incidents of fire-fighting occur during non-supply hours, no water is available; which may subsequently cause huge damages before the supply could be turned on.

In spite of all these limitations / disadvantages, the intermittent supply systemis being mostly adopted in our towns and cities. For improving the pressures in intermittent system, the entire city area isdivided into number of zones and different zones are supplied with water during different hours of the day, thus obtaining pressures. Most of network of pipe distribution system of water supply oftowns and cities are usually designed as continuous supply system", but afterimplementation operated as an “intermittent" one.

In view of above, the water is to be supplied through continuous system. Thisis the best system and the water is supplied for all the 24 hours a day. In thissystem, ample water is always available for firefighting, or any break-downor emergencies, even by closing the supply of certain localities. Besides, dueto continuous circulation, water always remains fresh, in the pipelines.

Considering these, continuous supply of water around 24 hours a day isproposed for the project area under this DPR.

2.3 DESIGN PERIOD

Design period for this work has been adopted as shown below:

(i) Immediate stage 2015
(ii) Intermediate stage 2030
(iii)Ultimate stage 2045

2.4 POPULATION

Population figures are used by standard methods specified in CPHEEO manual.

2.5 WATER DEMAND

Water demand projections are worked out with 150 liters per capita per day (LPCD) at consumer end. The losses are computed upward for gross demand projections as per CPHEEO manual. Values of the zone/ward wise demand for the Pimpri-Chinchwad city have been considered.

Water demand to the nodes of the distribution system is computed using the water districts data provided by the PCMC.

2.6 Water Distribution Network

The water distribution system for public water supply is a network of pipeswithin the network of streets and roads of the project area. The purpose of thewater distribution network is to convey wholesome (treated) drinking water tothe consumers at an adequate residual pressure in sufficient quantity atconvenient points. Water distribution system usually accounts for 40 to 70%of the capital cost of the water supply system, depending upon the lengths ofstreets and roads to be covered in the project area. As such, proper designand layout of the network is of great importance.

The street plan, topography and location of service reservoirs etc. govern thetype of distribution network. Proper layout of the pipelines, correct locationsof various types of valves and specials are necessary for proper and efficientoperation and maintenance of the system. Sufficient residual pressure at peakdemand period is the prime hydraulic consideration of the distribution system.

(a) Service Storage: Storage in the service reservoirs is provided considering balancing of inflows andoutflows and emergency including water for firefighting. The service storage in the immediate stage year 2030 is computed presuming 23 hour pumping.

With inflow rate of 23 hours and the outflow rate (supply hours) of 24 hours, the capacity of ESRs have been checked as per the methodology mentioned in CPHEEO manual.

(b) Hazen-Williams C-Value: So far cast iron pipes (CI) have been used in the distribution pipe network of the city. C-values of CI, DI and other materials of pipes are shown in Table 2.2.

Table 2.2: Hazen William C -Values for pipes.

Material	HWC-Value
	Proposed
CI	100
Ductile iron (DI)	140
Mild steel (mortar lined)	140
GI	100
HDPE	145

(c) Residual Pressures:CPHEEO "Manual on water supply and treatment" - third edition (1999) has been adopted in fixing residual pressure. Presently most of the houses in the Pimpri-Chinchwad Municipal Corporation area are singlestoried. Therefore,sizes of pipelines and tank storages of the system are checked for minimum residual pressure of 7 m at nodal points. Multi- storied buildings needing higher pressure, will be providing their individual underground storage tanks; from where, the water will be pumped to elevated storage tanks on such buildings for supply of water to their consumers.

(d) Minimum Diameter of Pipes: As per recommendations in CPHEEO Manual, the minimum proposed diameter of pipes considered in the analysis is 100 mm and no serviceconnections would be given from a pipe more than 100 mm dia. Wherever there is single pipelineon a road of size above 100mm, a parallel line of 100 mm is proposed for giving consumerconnections.

(e) Leading Mains: The inlet mains to service reservoirs and trunk mains will carry water for 23 hours.

(f) Peak Factor:

As per CPHEEO manual, a peak factor of 2 is adopted for distribution system in the Hydraulic modeling.

2.7 ROAD MAP TO 24/7 SYSTEM

(a) Bulk Flow Meters: After a careful study of the system's requirements, bulk flow meters shall be proposed at key strategic points in the system such as water treatment plants, service reservoirs and pumpingstations to monitor the quantum of water being handled at these places.
Following bulk meters are recommended:

Diameter of pipe	Type of Bulk meter
▪ ≤ 300 mm	Mechanical
▪ > 300 mm	Ultra sonic or Magnetic type full-bore flow meters whichever is economical

(b) Pressure Gauges: For calibration of the hydraulic model and monitoring of the water supply system pressures at key locations will have to be monitored. In every zone/DMA about 5 points are anticipated.

(c) Flow Controlling Valves: For operation and maintenance of any intermittent supply system a minimum number of valves arenecessary. In a continuous supply system every DMA should have isolation valve to make it hydraulically discrete.

2.8 SOFTWARE USED

For GISmaps, ESRI's ARC-VIEW software has been used. The analysis of the leading mains and the distribution system is made using Bentley WaterGEMS software, Select-4 version.

Chapter-3

Existing Pimpri-Chinchwad Water Supply

3.1 History

History of Pimpri-Chinchwad water supply is shown in Figure 3.1.

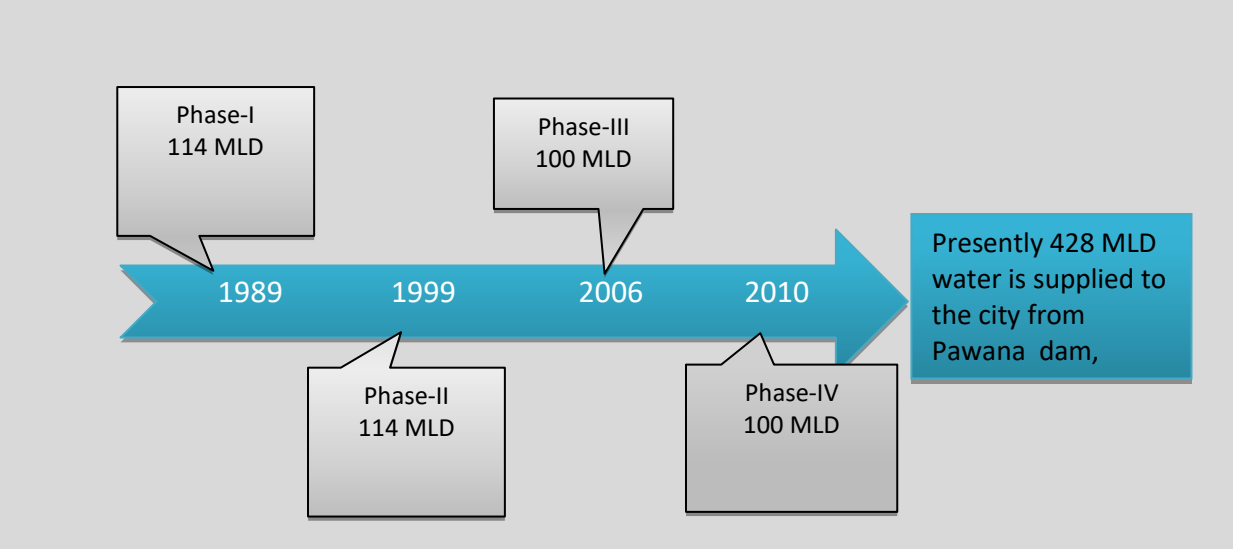


Figure 3.1: History of Pimpri-Chinchwad water supply

3.2EXISTING WATER SUPPLY SYSTEM

Existing water supply scheme is shown in Figure 3.2. The existing water supply to the Pimpri-Chinchwad city is managed by Pimpri-Chinchwad Municipal Corporation (PCMC). The City Engineer of the city and his team of Executive engineers and staff are responsible for ensuring protected drinking water supply in the city.

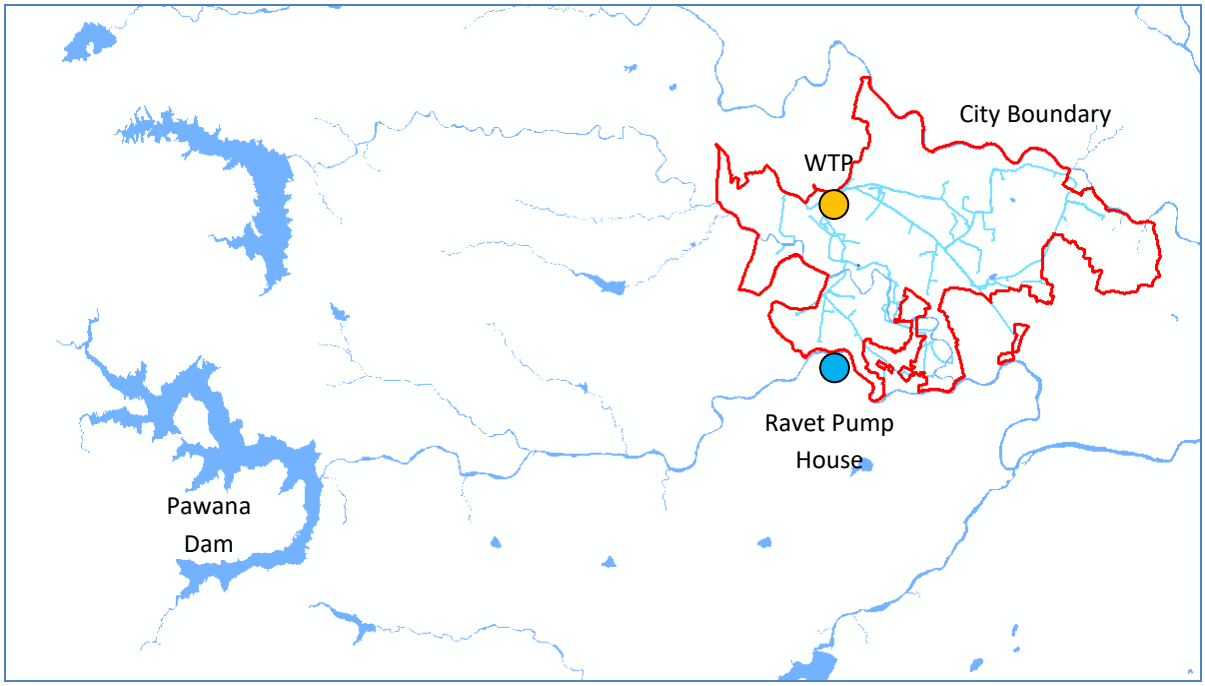


Figure 3.2: Existing main water supply scheme

3.2.1 Sources

Main source of the Pimpri-Chinchwad water supply system is Pawana dam which is shown in Figure 3.2 and 3.3(a). This dam is 35 kilometers away from the city and is in the West direction. There is a pick up weir (Ravet-Punavale) on downstream side of the dam (Figure 3.2 and 3.3b).

(a): Pawana dam

(b): Ravet-Punavale weir

Figure 3.3: Sources of the Pimpri-Chinchwad city

Water is pumped from the pickup weir at Ravet-Punavale dam and conveyed to water treatment plantby three mild steel (MS) pipe pumping mains (1053 mm for 228 MLD, 1165 mm for 100 MLD and 1400 mm 100 MLD). Treated water is pumped to Master Balancing Reservoirs (MBR) at WTP site and then transmitted by pumping/gravity to 85 Elevated Service Reservoirs (ESR)s in the city.

Water Treatment Plants (WTP)

Figure 3.5: Aerial view of Water Treatment Plant

The water treatment plants (WTP) for phase I, II, III and IV are situated in the same premises as shown in Figure 3.4. Clari-flocculator and filter plants are shown in Figure 3.5.

(a)100 MLD - Clariflocculator

(b): 100 MLD – Filter beds

Figure 3.5: Water Treatment Plant

Pure Water Transmission Main

Details of the pure water transmission main are shown in Figure 3.6 and Table 3.1.

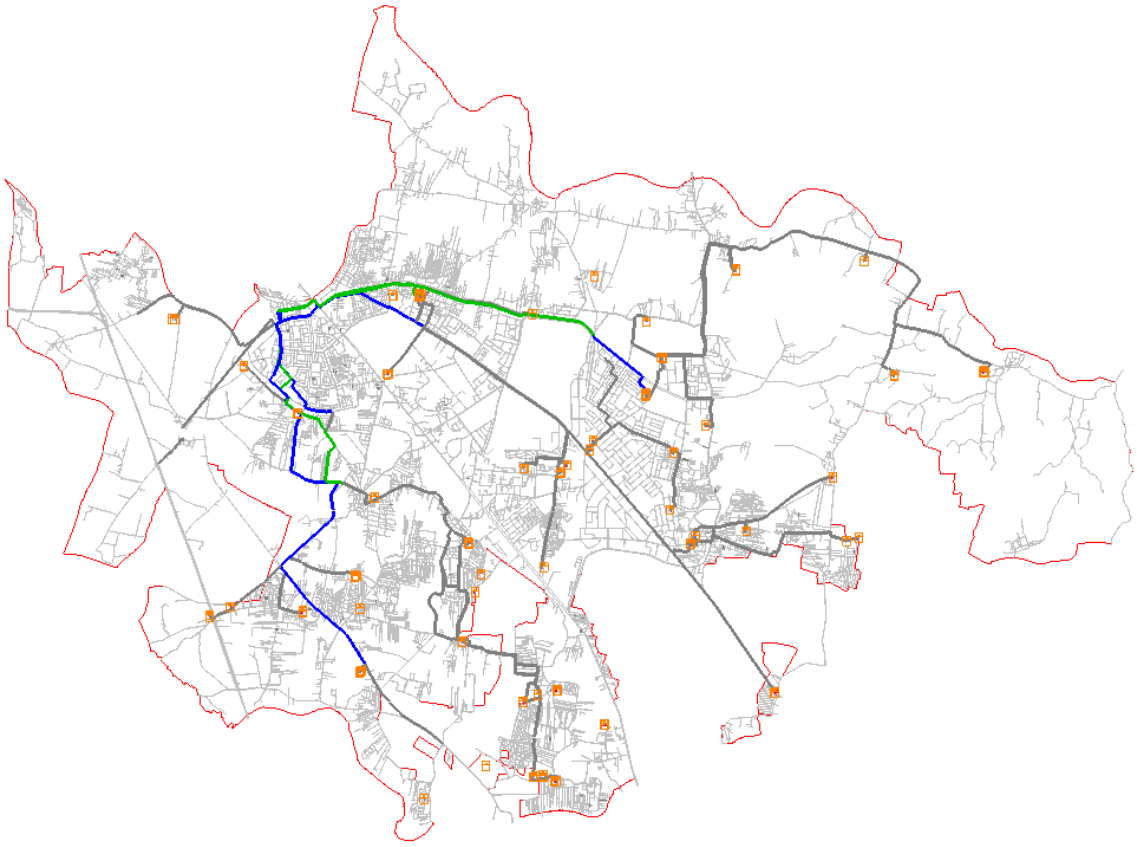


Figure 3.6: Pure water transmission mains

Table 3.1: Details of the pure water transmission mains

Diameter (mm)	Length (m)			
	CI	DI	MS	Grand Total
100	498	400		898
150		1679		1679
200		828	2332	3160
250		1627		1627
300	26	10278	1949	12253
350	221	264		485
400		16911	4712	21623
450		15642	1489	17131
500	35	9973	284	10292
550		14		14
600		24660	4459	29119
700		16429	205	16634
750		8176		8176
800		9	2524	2533
900		14862		14862
1000		16029	9939	25968
1100		4185	35	4220
1200		13927	15	13942
Grand Total	780	155893	27943	184616

Present Service Reservoirs

There are 85 ESRs which are marked and shown in Figure 3.6. A typical ESR is shown in Figure 3.7. Details of the ESRs/ GSRs are shown in Table 3.2.

Figure 3.7:ESR

Table 3.2: Details of the storage tanks

Label	Water District (WD)	Elevation (m)	Elevation (Minimum) (m)	Elevation (Initial) (m)	Elevation (Maximum) (m)	Diameter (m)
91	D14	575.3	575.3	579	580.3	22.57
94	D14	557	557	558	560	15.42
97	Sump	551	551	552.65	555.5	15.05
103	D11	566	566	569.8	570	13.82
104	D11	569.2	569.2	573.2	573.5	13.87
109	Sump	554	554	556	557	9.21
112	D8	570	570	572	573	8.74
119	D7	578	578	581	583	19.54
129		578.3	578.3	580.4	582	18.55
130	D7	578.3	578.3	581.6	583	16.46
131	D7	578.5	578.5	579	583.5	15.96
139	D12	568.2	568.2	568.2	571.7	20.28
140	D12	568.2	568.2	568.2	571.7	20.28
145	B8	580	580	583	585	22.57
149	B8	582.5	582.5	585	586.5	12.62
157	D5	583	583	586	588.5	11.79
165	D5	588	588	591	593	22.57
166	D5	590	590	593	594	28.21
167	D5	590	590	593	594	25.23
173	B1	599.5	599.5	599.5	604	23.79
174	B1	599.5	599.5	602	604	24.95
182	B2	599.5	599.5	599.6	604.5	21.11
183	B2	599.5	599.5	599.64	604.5	21.11
184	B2	599.5	599.5	599.73	604.5	23.67

193	B5	585.7	585.7	590	590.7	25.23
194	B5	585.7	585.7	590	590.7	22.57
201	B6	583.4	583.4	583.4	588.4	22.57
202	B6	583.4	583.4	583.4	588.4	22.57
209	B7	610.9	610.9	614.75	615	19.7
212	B3	610.9	610.9	613.7	615	19.7
219	D4	583	583	587	588	15.96
220	D4	583.8	583.8	588	588.5	20.82
227	Sump	564	564	567	568	12.62
229	D1	584.7	584.7	589	589.7	22.57
232	Sump	585.5	585.5	589.5	590	18.43
234	Sump	582	582	585	586	13.82
236	D3	604.6	604.6	609	609.6	19.54
240	D3	596.4	596.4	600	600.4	9.77
250	D2	596.24	596.24	600	601.24	25.23
251	D13	596.1	596.1	600	601.1	22.57
285	D6	572	572	575	577	19.54
286	D6	572	572	575	577	12.36
290	Sump	553	553	553.5	557	9.77
294	D9	571.2	571.2	571.3	576.2	22.57
298	Sump	549	549	551.3	553	12.62
302	D10	568	568	571	573.5	21.52
347	C3	627.5	627.5	631	633	16.67
350	C3	628.5	628.5	632	633.5	23.67
356		573.68	573.68	576	577.33	13.21
384		613	613	613.75	616	38.54
385		616.39	616.39	620	620.3	31.26
387	A3	631.4	631.4	635	636.4	25.23
388	A6	631.4	631.4	635	636.4	25.23
389	A4	631.4	631.4	635	636.4	25.23
404	C7	594.1	594.1	595	596.5	16.29
405	C7	598	598	601	602.7	6.37
406	C7	599.64	599.64	604.64	604.64	19.54
410		587.44	587.44	590.44	590.44	6.51
412	C2	615.25	615.25	618.01	618.01	10.74
424	C15	599.7	599.7	601.27	604.7	21.11
425	C15	599.7	599.7	601.27	604.7	21.11
437	A2	621.73	621.73	622.93	626.76	25.16
438	A2	621.73	621.73	622.93	626.76	25.16
450		606	606	607	610	25.23
454	C17	625.28	625.28	630	630.28	19.54
462	A5	628.05	628.05	631.3	632	18.83
463	A5	628.05	628.05	631.3	632	18.83
471		574	574	578	578	19.95
473		556	556	558	559	14.57
577		582.2	582.2	585.4	586.2	28.21
624	C9	617	617	620	621	26.46
627	C8	619	619	622	624	8.74
631	C8	619	619	619.09	624	12.87
634	C1	597.5	597.5	598	599.5	17.84
635	C1	617.21	617.21	621	622.21	19.54

640	C4	593	593	595	598	15.96
644	C6	601.5	601.5	605	606	5.83
645	C6	602.5	602.5	605	607.5	22.57
660		584.9	584.9	585.7	589	35.24
664	C5	622.9	622.9	627	627.9	15.14
665	C5	622.9	622.9	627	627.9	15.14
704	C3	628.5	628.5	632	633.5	23.67
737		576.9	576.9	578	581	19.7
771		626.5	626.5	627.17	631.5	14.27
774		639.6	639.6	643	644.6	22.57
804	C10	603.05	603.05	608	608.54	18.66
Ajmera-1	C14	599.5	599.5	602.22	604.5	19.54
Ajmera-2	C14	599.72	599.72	602.22	604.5	19.99
Annasaheb_Magar	C13	599.7	599.7	599.7	604.7	20.5
Jadhavwadi_sump		601	601	605	605.5	11.89
Kasarwadi	C16	583.2	583.2	586	588.2	22.57
Khandoba-1	A7	600.38	600.38	605	605	26.25
Khandoba-2	A7	602.92	602.92	607.9	607.9	22.61
Sant Tukaram	C11	606.57	606.57	610	611	20.76
T-2		606	602	603	606	3.05

Distribution System

The existing pipelines laid in the distribution network of the Pimpri-Chinchwadcity are shown in Figure 3.8.

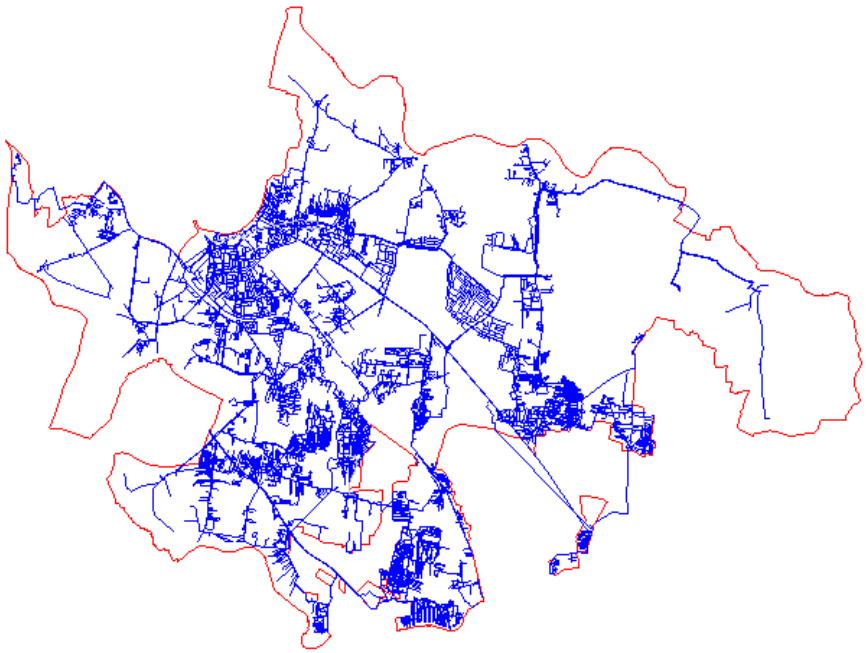


Figure 3.8: Existing pipelines in the distribution network

The total length of the existing distribution network in Pimpri-Chinchwad Corporation is around 1352 km. Length of different pipes in the distribution system is shown in Table 3.3.

Table 3.3: Diameter wise length (in m) of pipes in the distribution system

Diameter (mm)	Length (m)					
	AC	CI	DI	GI	MS	Grand Total
50		13886		7453		21339
75		296				296
80		27109				27109
100		466807	57571	1260	1618	527256
150		258348	51188		714	310250
175		1543				1543
200		101651	13916		5589	121156
250		51652	7749		2898	62299
300	305	81711	17988	517	14825	115346
350		8239	5756			13995
400		19806	19260		9422	48488
450		17505	18018		9194	44717
500		9092	9243		4647	22982
600		14750	4055		14140	32945
700			2590			2590
Total	305	1072395	207334	9230	63047	1352311

Service Connections

There are 1,27,818 service connections as shown in Table 3.4.

Table 3.4: Details of House Connections

Category	Number
Total Connections	127818
Metered Connections	98566
Un-Metered Connections	29252
Slum Connections	6528
Non Domestic Connections	2805

Source: Cities Development Initiative for Asia (CDIA), Prefeasibility Study Report of the Pimpri-Chinchwad 24x7 Project, May, 2012

3.3 Environmental Compliance and Protection

An initial environmental preliminary review of the project has been carried out and is provided below. This project includes the rehabilitation of distribution system, providing and laying of gravity main and installing various sizes of water meters etc

Potential Environmental Impacts and Mitigation Measures:

The proposed project would influence the environment in two stages, i.e. Construction Stage and Operation Stage. The potential impacts and associated mitigation measures are described below. It has been broadly understood that the impacts during the construction stage which would be temporary and short term in nature and that the operation stage could have long term effects. The positive impacts of this project action are also described in subsequent sections.

Pollution

There will be no pollution due to offensive odors of Chlorine as filtered water is supplied to the newly merged area and it is located at 7 km from the water treatment plant. As such there will be no significant offensive odors reaching the residential areas.

No downstream water utilization is hampered by little outflows of soil from open ground created in the construction of the facility. Compensatory plantation will be taken up as per environment management plan if necessary. As a mitigation measure, exposed surface will be resurfaced and stabilized as soon as possible and trenches will have adequate backfill consolidation to prevent subsequent street settlement.

Upon completion of backfill, the surface shall be restored fully to the level existed prior to the construction of the pipe line. Construction surfaces during dry/windy periods resulting in fugitive dust generation will be suppressed by spraying of water or other suitable means and workers working in dust prone areas will be provided with masks and goggles. Excavated material transported by trucks will be covered and /or wetted to prevent dust nuisance.

Noise from Construction

All construction vehicles will be properly maintained and will have valid "Pollution under Control Certificate" and noisy construction activities will be carried out only during normal working hours and local residents will be advised of any unusual or unavoidable areas particularly carrying out works of distribution line.Pipe jacking operations take place below ground level and are generally have low sound intensities.

Natural Environment Issues

Effect of Construction on the Ecology Major construction like laying of Gravity main, chambers and, distribution mains etc shall be done outside designated natural conservation areas such as city parks and green areas established in accordance with the local laws and will not have any significant impacts on Conservation area. During the construction phase there might be some impacts on air, noise and management of solid waste in vicinity with habitations. The effect of project pipelines and access roads on valuable habitat for flora and fauna is anticipated as minimal. Prevention of water logging/flooding shall be made as dewatering during trenching and excavation and water testing of new lines will be done in a manner so that it does not lead to water logging of the nearby area.

Effect on Landscape

There would be temporary social impact with respect to landscape disturbances during construction and operation phase of the project in terms of traffic congestion and disturbances while laying of transmission system, no other impact is envisaged. Protection of trees shall be done by routing of pipe lines to avoid impacting trees to the extent feasible. Prior approval will be obtained where trees have to be felled for laying the pipes etc.

Human Environment Issues

Heritage: Places of historical and heritage importance does not fall in vicinity with any proposed construction work.

Effect of Construction of the Facility on the Historical and Cultural Heritage: There are no places of cultural and historical importance in vicinity with any proposed construction work.

Effect on Existing Infrastructure: Preliminarily study reveals, no significant structures found to be affected. In the narrow sections of road construction, activities may cause traffic disruption while lying of pipe lines. Traffic diversion, lack of access to buildings and air and noise pollution caused by construction activities could have some adverse impact on trade and commerce in the service area.

Road Safety and Traffic Management during Construction

By taking measure to prevent traffic congestion like provision of temporary safe access to buildings, and/or separation of motor vehicle traffic from non-motorized and pedestrian where necessary and measures to be taken to ensure safety of pedestrian, traffic passing through the construction area including signs, marking flags, lights and flagmen as may be required.

Effect on Downstream Water Users

In context of work zones for this Project, this impact is not applicable and not relevant.

Involuntary Resettlement

Social and environmental impacts study reveals that during construction and operation phase there will be no small or large-scale involuntary displacement of persons; hence preparation of Resettlement Action Plan would not be required at a later stage.Net work of distribution system is to be carried out on road where human habitation is minimal.

Living and Livelihood

Living and livelihood forms an important component to be addressed within the social framework. Social impact assessment undertaken in study reveal that no long-term visible negative social impact during the construction and operation phase is envisaged.Field study reveals that there is possibility of generation of more employment activities during the construction phase, wherein local laborers would be engaged in excavation for trenches and laying of gravity main, distribution lines.

Ethnic Minorities and Indigenous Peoples

Study area is mostly under urban extent and field observation found that there are no indigenous groups getting affected.

Others

Effect on the Environment during Construction Stage

The location of installations and equipment, work methods, and the work period shall be arranged so that the execution of the project work will cause the least possible inconvenience in the area.

Environmental health and safety consideration at construction campsites and constructionwork-sites shall be taken as camps / compounds will be located so that they do not interfere with the existing drainage system, construction work-site will be properly barricaded and have adequate provision of drinking water, toilets and dispensing of first aid. Appropriate control measures will be taken to prevent insect/vector diseases especially malaria by measures such as preventing creation of stagnant pool of water.

Effect on the Environment during Operation Stage

During the operation stage the environmental impacts are likely to be mostly positive, a part of several health benefits; WTP will make the supply of treated water where shortage of water is felt and thus people will get quality water. However, there could be some adverse impacts due to inadequate operation and maintenance or control such as inappropriate dumping of excavated stuff retrieved from the excavation of trenches. Mitigation measures include setting of performance requirements to be achieved by the O&M agencies in their contract, and effective monitoring and supervision of the achievements of these requirements.

Positive Impacts of the Project

Improvement in service level of water supply in this area as a result of this project would ensure better improved water quality.

A significant population of the service area would benefit the most from the proposed project as they suffer the most when there is shortage of water which is based on ground water source

Other benefits of the project would include:

People will be satisfied with water supply and people will pay water taxes, skilled and unskilled employment generation during construction stage.

Employment generation during O&M phase.

Institutional Requirements and Environmental Monitoring Plan

It is recommended that the successful Contractors executing the construction of the various components in this project shall carry out appropriate monitoring plans during the construction phase of the project. Those items have also been identified whose impact is not great to justifymodification of the project but which are considered to require monitoring.

The construction of the project will be executed by the successful Contractors under the Management and supervision of PCMC or his authorized consultant of Project Management Consultancy who will carry out the monitoring activities during construction and during the Operations and Maintenance phase of the project. PCMC shall be responsible to carry out monitoring activities who may be aided by other governmental agencies such as Irrigation Department for reserving water in dam, MSEDCL for supplying continuous electrical supply. Effective implementation of the mitigation measures will require the project to undertake a comprehensive monitoring program. The objective of the monitoring program is to ensure that the construction activities are carried out in an environmentally sensitive and responsible manner.

Chapter-4

Population Forecast and Demand Estimation

4.1POPULATION FORECAST

The population of the Pimpri-Chinchwad as per 2011 census is 17,30,133 souls. The present Pimpri-Chinchwad Municipal Corporation area is of 170.51 square kilometers. The decadal population growth of the Pimpri-Chinchwad city is shown in Table 4.1. The projected population is shown in Table 4.2.

Table4.1: Decadal population growth of the Pimpri-Chinchwad city.

Sr. No.	Year	Population	Increase in decade	Incremental increase in decade.	Rate of growth per decade
1	1971	98572			
			153197		1.554
2	1981	251769		115673	
			268870		1.068
3	1991	520639		216908	
			485778		0.933
4	2001	1006417		237938	
			723716		0.719
5	2011	1730133			
	Total	3607530	1631561	570519	
	AVERAGE	721506	407890	190173	1.027

Table4.2: The projected population of the Pimpri-Chinchwad city.

Sr. No.	Year	Arithmetic method	Incremental increase method	Geometric progression method	Average of Incremental increase method and Geometric progression method.
1	2015	1893289	1946538	2295296	2120917
2	2030	2505124	3029053	6625003	4827028
3	2045	3116959	3815740	19122005	11468873

Population forecast, made by the average of Incremental increase method and Geometric progression method, is on very high side. Hence, the forecast as made by the Incremental increase method is adopted which is shown in Table 4.3.

Table4.3: Finally accepted projected population

S.No	Year	Population
1.	2015	1946538
2.	2030	3029053
3.	2045	3815740

4.2DEMAND PROJECTION

4.2.1 Losses

CPHEEO manual restricted total losses to 15% (Ref p11 of CPHEEO manual). Hence, it is assumed that there will be 10% losses (Figure 4.1) in distribution system, 3% in treatment plant (2% is recovered by recirculation) and 2% (1% in raw water transmission and 1% in pure water transmission) in the transmission system.

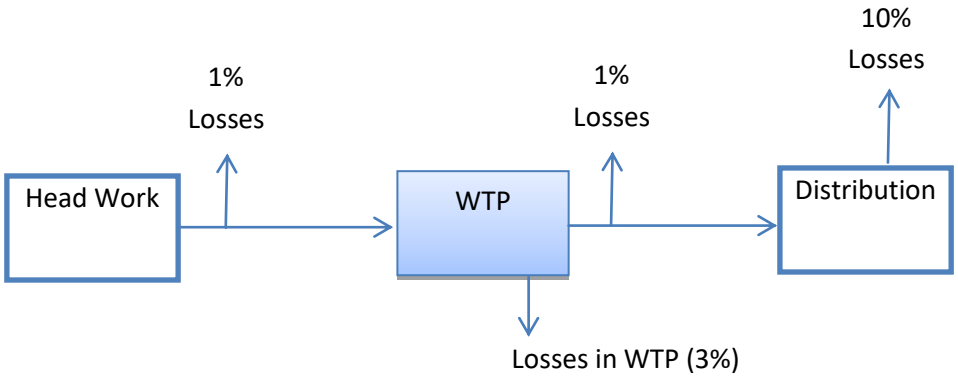


Figure 4.1: Demand of en-route connections and losses in WTP

Rate of supply is considered as 150 LPCD as PCMC has a population of more than 1 million souls. The forecast of the demands for the present, intermediate and the ultimate stages are shown in Table 4.4.

Table4.4: Population forecast and demand of the Pimpri-Chinchwad city.

SN	Demand Spots	Particulars	Base Year	Intermediate Stage	Ultimate stage
1	Demand of Distribution System (MLD)	Design Year	2015	2030	2045
		Population	1946538	3029053	3815740
		Demand at 150 LPCD	291.98	454.36	572.36
		Floating population (@1%	19465	30291	38157
		Floating demand @ 25 LPCD	0.49	0.76	0.95
		Demand	292.47	455.12	573.31
		Demand with 10% losses in Distribution System	324.42	504.84	635.96
		Say	324	505	636
2	Demand at WTP (MLD)	Demand with 1% losses in PW RM at outlet of WTP	327.70	509.94	642.38
		Demand with 3% losses in WTP at inlet of WTP	337.84	525.71	662.25
3	Demand at Head Work (MLD)	Add 1% for losses in RW transmission system	341.25	531.02	668.94
		Say	341	531	669

Chapter-5

Hydraulic Model of Primary Network of Pimpri-Chinchwad

5.1 SIMULATION MODEL

Modeling of the water supply system is a critical part of designing and operating water networks for 24/7 continuous supply. It helps the distribution system to serve community reliably, safely and efficiently in daily operations. Hydraulic models give commanding knowledge of the water infrastructure, and help to take informed decisions. Modeling (Haested Methods, 2003) is *definedas a mathematical description of a real-world system.*

5.2 THE MODELING PROCESS

Main objective of any water utility is to deliver safe and potable water to its customers uninterruptedly. The first step in preparation of the model for water supply project is a creation of maps and records.

5.2.1 Maps and Records

System Maps: System maps of the Pimpri-Chinchwad city in the form of the GIS format have been collected from the computer section of the Pimpri-Chinchwad Municipal Corporation (PCMC). These maps helped to make understanding of the water distribution networks of the city. Themaps illustrate wide range of system characteristics of the Pimpri-Chinchwad city such as pipeline alignment, elevations of nodes, location of tanks and reservoirs and valves etc.

A vast data, describing real-world network system has been used to build a model. Fortunately the city water supply department has a set of drawings pertaining to the water supply of the Pimpri-Chinchwad city. The information available with the PCMC has been tested for accuracy and was validated in consultation with the engineers of PCMC.

The primary network (transmission main from WTP to the various service tanks) is obtained from the PCMC, which was prepared in EPANET. This EPANET file is used to prepare the hydraulic model in WaterGEMS. Water transmission pipelines were shown and the positions of water treatment plants, water districts (WD) and the elevated service reservoirs in the city were used in WaterGEMS. The shape files of roads and the buildings are used as a backdrop of the WaterGEMS software.

5.3 SYSTEM SIMULATION

While making hydraulic model for 24/7 continuous water supply system, various components of the network such as reservoir, tanks, pipelines and valves etc. are required to be simulated. The term simulation (Haested Methods, 2003) refers to the process of imitating the behavior of one system through functions of another. In the present approach, the term simulation represents behavior of real system (model) mathematically. Network simulation is a tool used when it is not possible to make experimentation to the actual system or to predict the behavior of the system before it is actually built. The objectives of the simulation are as follows-

- Replicate the dynamics of an existing and the proposed water supply system,
- Performed when it is not practical for the real system to be directly subjected to experimentation,
- Evaluating a system before it is actually built.

5.3.1 Simulation of 24/7 Continuous Water Supply System

The road map to 24/7 continuous water supply for the Pimpri-Chinchwad city has been shown in Figure 5.1.

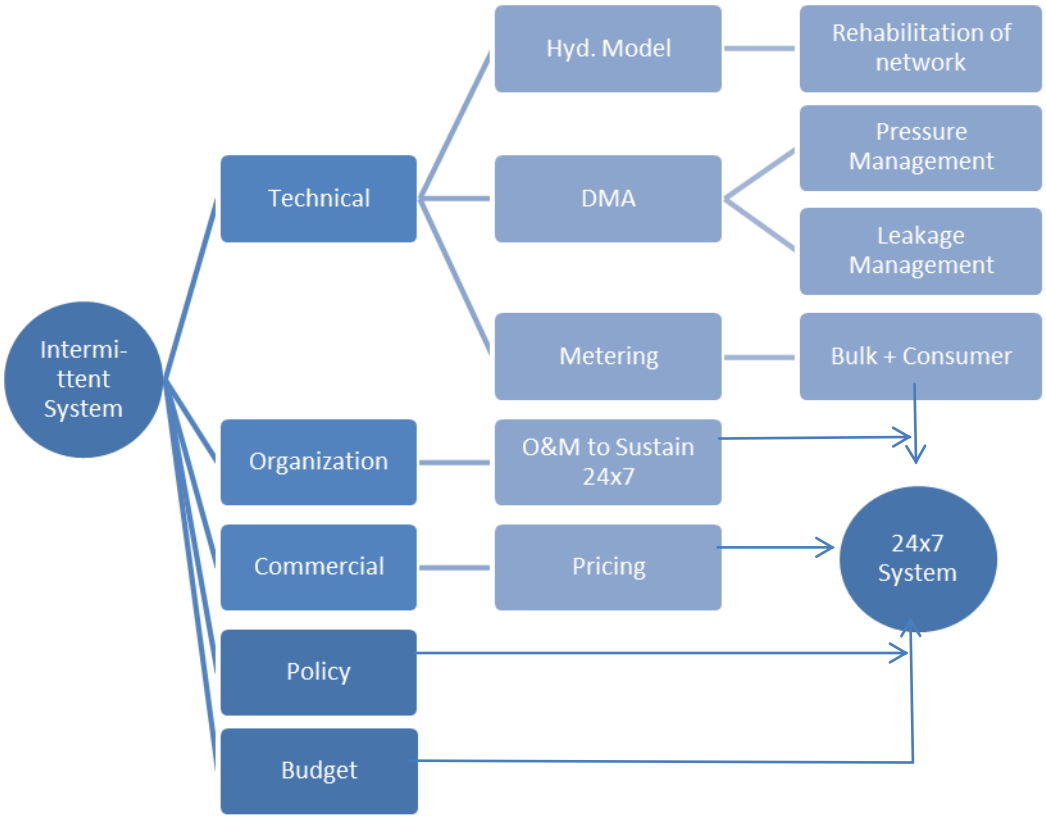


Figure 5.1: Road map of 24/7 continuous water supply

All the parameters, as shown in Figure 5.1, are equally important and are inextricably linked. If anyone of them is not achieved, then it is not possible to convert the existing intermittent supply into 24/7 continuous water supply. For example, if technical parameters such as creation of hydraulic model, using DMA methodology and metering activities are carried out, but if proper tariff is not adopted, then there will be rise in the consumption rather than expected decrease in the supply rate and there will be shortage of water.

Implementation Steps of 24/7 Water Supply: Detailed implementation steps are shown in Figure 5.2.

Basic principle: The basic principle is to save water by plugging of leaks in distribution pipe network. And the saved water is then used to increase the supply hours to 24 hours daily. This process must be a continuous one to constantly reduce NRW.

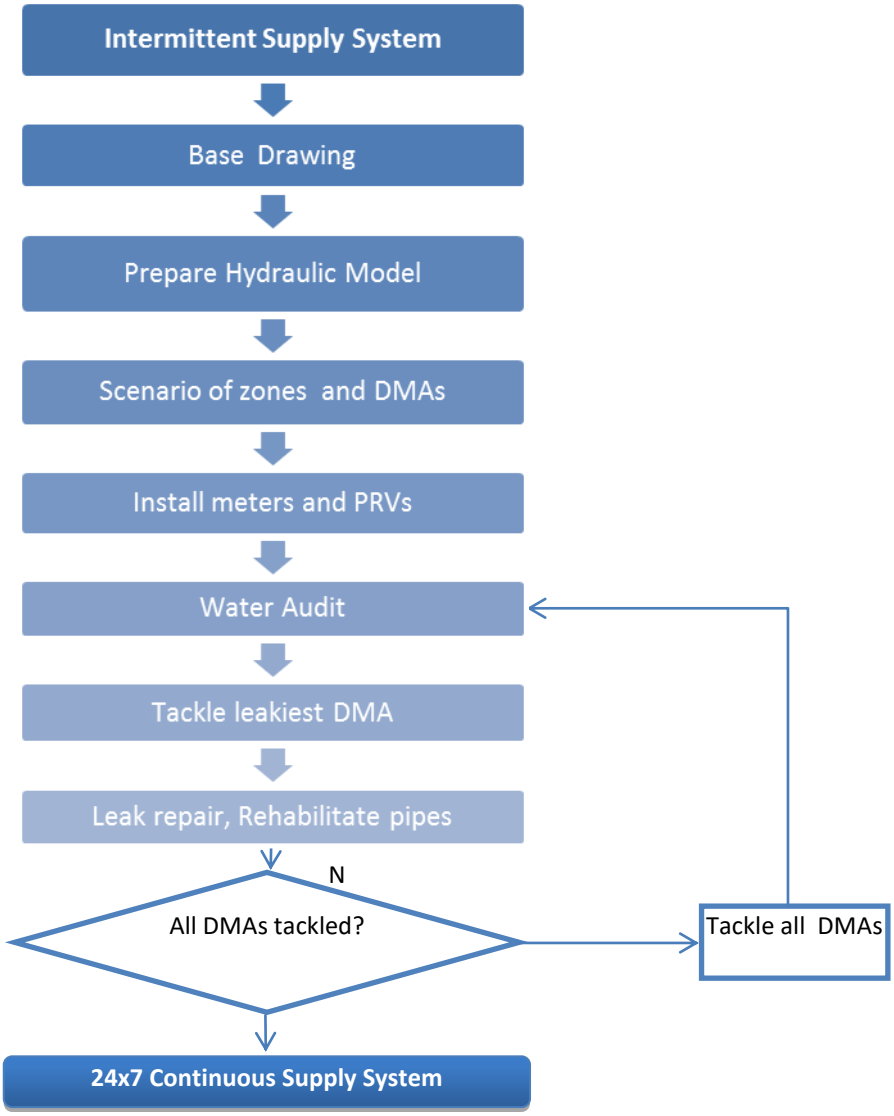


Figure 5.2: Implementation stages of 24/7 continuous water supply

5.3.2Model Scenario

Scenario represents a set of models that describe traits of hydraulic networks of different water works. A typical model scenario requires analysis of a number of alternatives. Analysis of each alternative requires separate set of input data. In the situation where a large number of model runs, it is not possible to edit input data accurately. Working either with many data files or editing frequently with single data file (Haested Methods, 2003) is confusing, inefficient and susceptible to the errors. Hence, to solve this problem alternative data sets are kept with single model data file. The alternatives can be assigned to the scenario and then the batch run of the particular scenario is performed to evaluate the results.

Alternatives: Basically three types of alternatives are used in this study. They are namely- (a) active topology, (b) demand and (c) operational.

(a) Active Topology: System drawings of all water networks showing locations of tanks, intermediate nodes, demand nodes and pipeline alignment of the Pimpri-Chinchwad city are taken from the earlier EPANET file which were prepared by actually visiting the site and plotted using the available drawings. In GIS maps the co-ordinate system of WGS-1984 UTM 43° N has been used. A satellite image of the city along with vector image (shape files) is shown in Figure 5.3.

Figure 5.3: A satellite image of a part of Pimpri-Chinchwad along with vector images of roads and buildings

All elements of model are then suitably named and the corresponding data is fed to the computer software. The base scenario is then separated into various child scenario by making inactive elements of other zones and making active elements of the zones that is considered as a separate child scenario as shown in Figure 5.4. of active topology.

(b) Demand: Demand for all the nodes for the years 2015, 2030 and 2045 are allocated.

(c) Operational: Valve operations are important in the model of pipe network. Flow control valves are used to regulate the flow into each zone.

5.3.3 Base Scenario

Base scenario of pipe network of entire city is the first task in preparation of the hydraulic model.

Back Drop Drawing

A satellite raster image of the Pimpri-Chinchwad city has been made available by the PCMC, which has been used in this study. This image is limited to the extent of the city. This raster satellite image was digitized and the shape files of the features such as road edge boundaries, buildings, water bodies were created. The satellite image and the shape files are geo-referenced (spatial)

Attaching Alternatives

Alternatives of active topology, demand and the operational are created in WaterGEMS and are attached to the base scenario as shown in Figure 5.4.

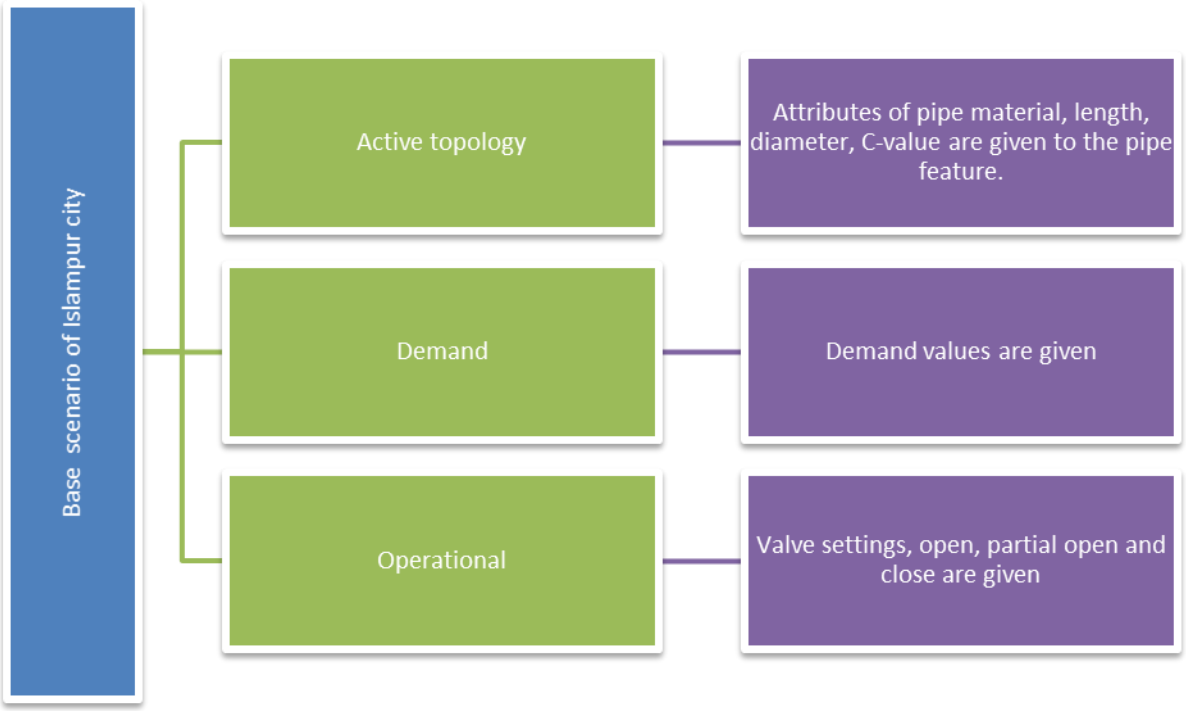


Figure 5.4: Alternative attached to the base scenario

5.3.3 Active Topology of Entire City

The shape files of the roads and buildings are exported to WaterGEMS and are used as the background layers. Various components of the pipe network such as reservoir, pipe, junctions, valves and tanks etc. are drawn on the background layer and are shown in Figure 5.5.

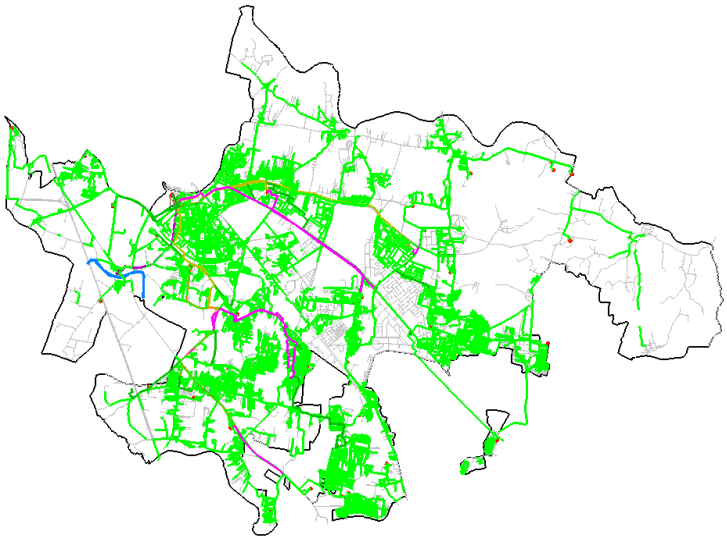


Figure 5.5: Pipe network of Pimpri-Chinchwad

5.4WATER DEMAND

The water districts of the Pimpri-Chinchwad city are shown in Figure 5.6. Demand of the water districts is computed by using the land pattern data given by the PCMC.

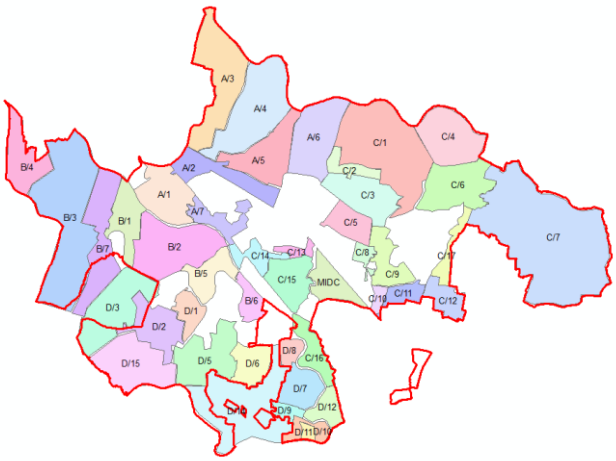


Figure 5.6: Water districts of the Pimpri-Chinchwad city

Population of all the 46 water districts, its area and population density, under study area, is shown in Table 5.1. A GIS layer with population densities as attribute table has been created.

Table 5.1: Population of the water districts under study area

SN	Water Zone No.	Water Zone Name	Area (km^2)	Population (2011)	Population Density (P/km^2)
1	A1	Pradhikaran (E1)	3.653	66252	18135
2	A2	Triveni Nagar	2.894	87455	30219
3	A3	Rupi Nagar	5.923	37221	6284
4	A4	Chikhli	6.593	89232	13534
5	A5	Krishna Nagar	3.969	51834	13059
6	A6	Kudalwadi & Jadhavwadi	4.730	33008	6978
7	A7	Akurdi	1.776	49175	27696
8	B1	Sector 29	2.551	23191	9092
9	B2	Bijli Nagar	2.557	80967	31669
10	B3	Sector 96 Part 1	11.074	33466	3022
11	B4	Mamurdi Direct	3.000	5073	1691
12	B5	Elpro	2.104	59905	28479
13	B6	Pimpri Camp	1.209	59223	48997
14	B7	Sector 96 Part 2	4.728	18000	3807
15	B8	Nav Maharashra	0.782	12542	16043
16	C1	Moshi	9.277	31919	3441
17	C2	Boradewadi	1.131	12799	11315
18	C3	WD4	3.537	24429	6907
19	C4	Dudulgaon	0.046	3561	77553
20	C5	Sector 7 and 10	1.891	6129	3241
21	C6	Wadmukhwadi	4.273	2473	579
22	C7	Charholi	17.411	13502	775
23	C8	Indrayaninagar	0.629	22594	35933
24	C9	Panjarpol	2.214	58639	26486
25	C10	Bhosari Gaothan	0.500	19351	38708
26	C11	Sant Tukaram Nagar	1.049	49409	47100
27	C12	Dighi Gaothan	1.577	41197	26125
28	C13	Anna Saheb Magar Stadium	0.560	11931	21303
29	C14	Ajmera Colony	1.294	29696	22953
30	C15	Nehru Nagar	2.769	67841	24502
31	C16	Kasarwadi	1.917	29711	15495
32	C17	Dighi Magzine	1.132	4214	3722
33	D1	Thergaon Gaothan	1.399	35729	25538
34	D2	Lakshman Nagar	3.153	78211	24808
35	D3	Kala Khadak	5.630	35735	6348
36	D4	Shreenagar	2.635	86392	32785
37	D5	Rahatni	4.072	71368	17528
38	D6	Pimple Saudagar	1.975	56315	28516
39	D7	Pimple Gurao	2.149	60158	27991
40	D8	Jawalkar Nagar	0.769	20350	26470
41	D9	New Sangvi	0.600	25265	42112
42	D10	PWD Sector 85	0.906	21152	23334
43	D11	Old Sangvi	0.343	21191	61847

44	D12	Dapodi	1.313	37956	28901
45	D13	Lakshman Nagar 2	1.319	13325	10101
46	D14	Pimple Nilakh	8.265	31047	3756
		Total		1730133	

5.4.1 Observations on Demand Projection

The City Development Plan (CDP) recommends the growth of population according to the ward density pattern. Water district's density is a ratio of population of each water district to its spread area. Based on the population pattern, the water district are categorized as low dense, medium dense, high dense, very highdense and saturated. Population projection factor was considered in accordance with the growth rate of the city and with discussions with the city planners. It is also considered as per the expected newlayouts, vertical growth, urban poor, slums, land use pattern, residential and commercial properties and industries etc. in each of the 46water districts. A maximum growth factor of 3 has been given to the low dense water districts, followed by the projection factors as shown in Table 5.2.

Table 5.2: Population density pattern

SN	Water district: Density Pattern	Persons/ sq km	No. of Water districts	Projection Factor
1	Low	0 - 10000	15	3
2	Medium	10000 - 20000	8	2.7
3	High	20000-30000	13	2.5
4	Very High	25000-45000	6	2
5	Saturated	>45000	4	1.2
		Total	46	

Numbers of water districts with different density type are shown in Figure 5.7. Distribution of population density in various water districts is shown in Figure 5.8 and Table 5.3.

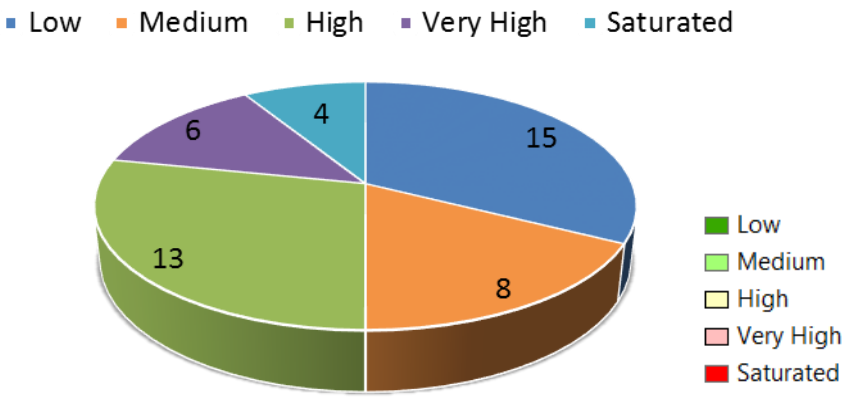


Figure 5.7: Density pattern of water districts in Pimpri-Chinchwad

.

Table 5.3: Distribution of population density in various wards

SN	Name	Area (m^2)	Area (km^2)	Water District Name	Population (2011)	Population Density (P/sqkm)	Density	Projection factor	Population			Population density (p/m2)		
									2015	2030	2045	Population Density 2015	Population Density 2030	Population Density 2045
1	A1	3653171	3.6532	Pradhikaran (E1)	66252	18135	Medium	2	68246	106199	133780	0.0187	0.0291	0.0366
2	A2	2893995	2.8940	Triveni Nagar	87455	30219	Very High	1.75	78826	122663	154520	0.0272	0.0424	0.0534
3	A3	5923341	5.9233	Rupi Nagar	37221	6284	Low	3	57512	89495	112738	0.0097	0.0151	0.0190
4	A4	6593275	6.5933	Chikhli	89232	13534	Medium	2.5	114897	178793	225228	0.0174	0.0271	0.0342
5	A5	3969321	3.9693	Krishna Nagar	51834	13059	Medium	2.5	66742	103859	130833	0.0168	0.0262	0.0330
6	A6	4730182	4.7302	Kudalwadi & Jadhavwadi	33008	6978	Low	3	51002	79365	99978	0.0108	0.0168	0.0211
7	A7	1775531	1.7755	Akurdi	49175	27696	High	2	50655	78825	99297	0.0285	0.0444	0.0559
8	B1	2550570	2.5506	Sector 29	23191	9092	Low	3	35833	55761	70243	0.0140	0.0219	0.0275
9	B2	2556691	2.5567	Bijli Nagar	80967	31669	Very High	1.75	72978	113563	143057	0.0285	0.0444	0.0560
10	B3	11073858	11.0739	Sector 96 Part 1	33466	3022	Low	3	51710	80467	101365	0.0047	0.0073	0.0092
11	B4	3000458	3.0005	Mamurdi Direct	5073	1691	Low	3	7838	12198	15366	0.0026	0.0041	0.0051
12	B5	2103509	2.1035	Elpro	59905	28479	High	2	61708	96025	120964	0.0293	0.0456	0.0575
13	B6	1208700	1.2087	Pimpri Camp	59223	48997	Saturated	1.2	36603	56959	71752	0.0303	0.0471	0.0594
14	B7	4727993	4.7280	Sector 96 Part 2	18000	3807	Low	3	27813	43280	54520	0.0059	0.0092	0.0115
15	B8	781756.4	0.7818	Nav Maharashra	12542	16043	Medium	2.5	16149	25130	31657	0.0207	0.0321	0.0405
16	C1	9277030	9.2770	Moshi	31919	3441	Low	4	65759	102329	128906	0.0071	0.0110	0.0139
17	C10	499917.6	0.4999	Bhosari Gaothan	19351	38708	Very High	1.75	17442	27141	34190	0.0349	0.0543	0.0684
18	C11	1049013	1.0490	Sant Tukaram Nagar	49409	47100	Saturated	1.2	30538	47520	59862	0.0291	0.0453	0.0571
19	C12	1576909	1.5769	Dighi Gaothan	41197	26125	High	2	42437	66037	83188	0.0269	0.0419	0.0528
20	C13	560074.1	0.5601	Anna Saheb Magar Stadium	11931	21303	High	2	12290	19125	24092	0.0219	0.0341	0.0430
21	C14	1293794	1.2938	Ajmera Colony	29696	22953	High	2	30590	47601	59964	0.0236	0.0368	0.0463
22	C15	2768757	2.7688	Nehru Nagar	67841	24502	High	2	69883	108746	136989	0.0252	0.0393	0.0495
23	C16	1917448	1.9174	Kasarwadi	29711	15495	Medium	2.5	38256	59532	74993	0.0200	0.0310	0.0391
24	C17	1132172	1.1322	Dighi Magzine	4214	3722	Low	3	6511	10132	12764	0.0058	0.0089	0.0113
25	C2	1131161	1.1312	Boradewadi	12799	11315	Low	3	19776	30774	38767	0.0175	0.0272	0.0343
26	C3	3536615	3.5366	WD4	24429	6907	Low	3	37746	58738	73993	0.0107	0.0166	0.0209
27	C4	45916.7	0.0459	Dudulgaon	3561	77553	Saturated	1.2	2201	3425	4314	0.0479	0.0746	0.0940

28	C5	1891204	1.8912	Sector 7 and 10	6129	3241	Low	3	9470	14737	18564	0.0050	0.0078	0.0098
29	C6	4273259	4.2733	Wadmukhwadi	2473	579	Low	3	3821	5946	7490	0.0009	0.0014	0.0018
30	C7	17411135	17.4111	Charholi	13502	775	Low	3	20862	32465	40896	0.0012	0.0019	0.0023
31	C8	628780.4	0.6288	Indrayaninagar	22594	35933	Very High	1.75	20365	31690	39920	0.0324	0.0504	0.0635
32	C9	2213991	2.2140	Panjarpol	58639	26486	High	2	60404	93996	118408	0.0273	0.0425	0.0535
33	D1	1399055	1.3991	Thergaon Gaothan	35729	25538	High	2	36804	57272	72146	0.0263	0.0409	0.0516
34	D10	906487.2	0.9065	PWD Sector 85	21152	23334	High	2	21789	33906	42711	0.0240	0.0374	0.0471
35	D11	342635.1	0.3426	Old Sangvi	21191	61847	Saturated	1.2	13097	20381	25674	0.0382	0.0595	0.0749
36	D12	1313327	1.3133	Dapodi	37956	28901	High	2	39098	60842	76643	0.0298	0.0463	0.0584
37	D13	1319225	1.3192	Lakshman Nagar 2	13325	10101	Medium	2.5	17157	26699	33633	0.0130	0.0202	0.0255
38	D14	8264983	8.2650	Pimple Nilakh	31047	3756	Low	3	47972	74650	94038	0.0058	0.0090	0.0114
39	D2	3152663	3.1527	Lakshman Nagar	78211	24808	High	2	80565	125369	157928	0.0256	0.0398	0.0501
40	D3	5629633	5.6296	Kala Khadak	35735	6348	Low	3	55216	85922	108237	0.0098	0.0153	0.0192
41	D4	2635108	2.6351	Shreenagar	86392	32785	Very High	1.75	77868	121172	152642	0.0296	0.0460	0.0579
42	D5	4071683	4.0717	Rahatni	71368	17528	Medium	2.5	91895	142999	180138	0.0226	0.0351	0.0442
43	D6	1974842	1.9748	Pimple Saudagar	56315	28516	Medium	2.5	72512	112838	142143	0.0367	0.0571	0.0720
44	D7	2149168	2.1492	Pimple Gurao	60158	27991	High	2	61968	96430	121475	0.0288	0.0449	0.0565
45	D8	768789.9	0.7688	Jawalkar Nagar	20350	26470	High	2	20962	32620	41092	0.0273	0.0424	0.0535
46	D9	599944.2	0.5999	New Sangvi	25265	42112	Very High	1.75	22772	35436	44640	0.0380	0.0591	0.0744
									1946538	3029053	3815740			

The demand is given as per the population density (Figure 5.8).

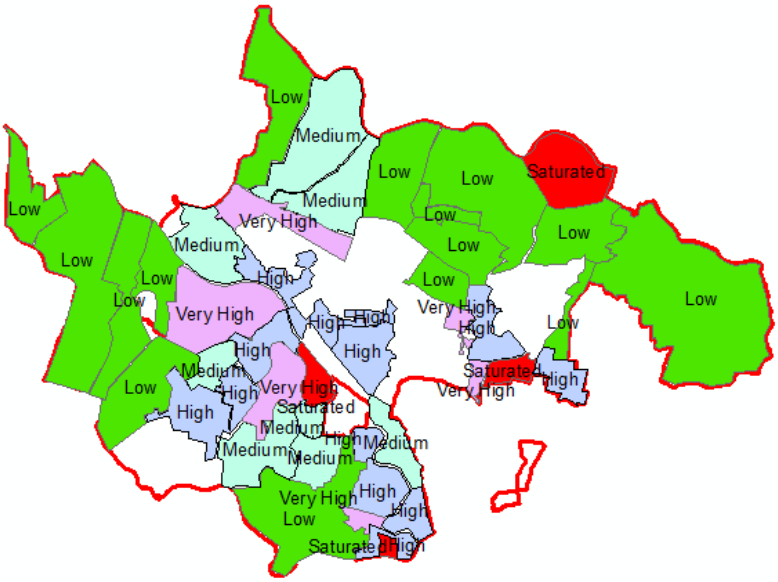


Figure 5.8: Population density of Pimpri-Chinchwad

Population of different water districts are shown in Figures 5.9, 5.10 and 5.11.

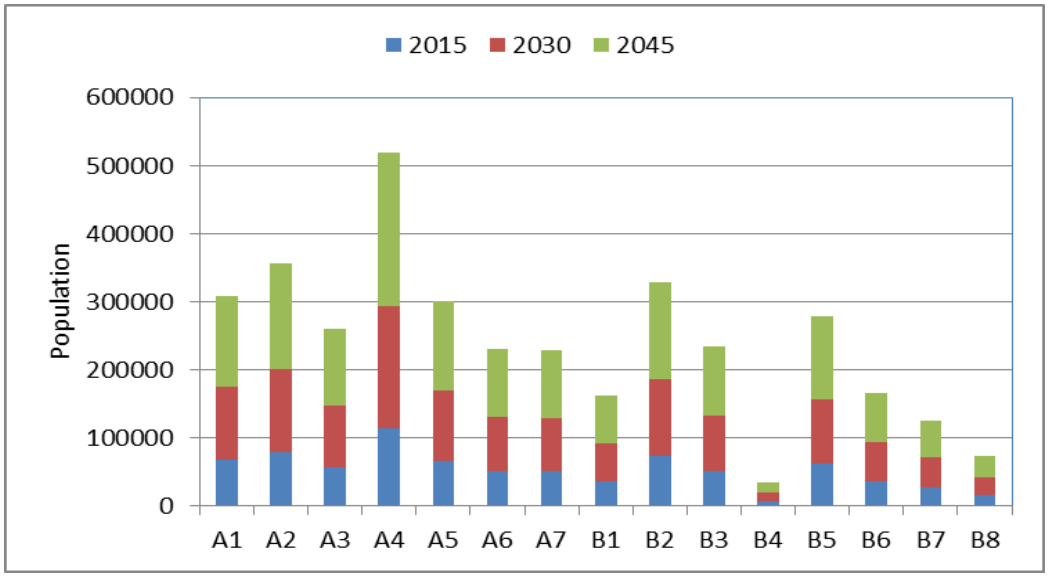


Figure 5.9: Water districts wise population projection of Pimpri-Chinchwad

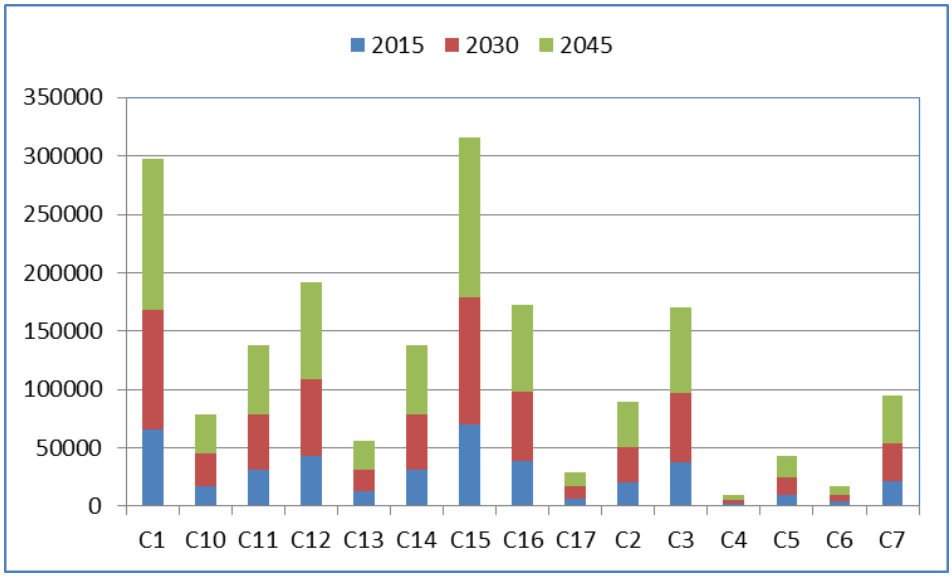


Figure 5.10: Demand of water districts

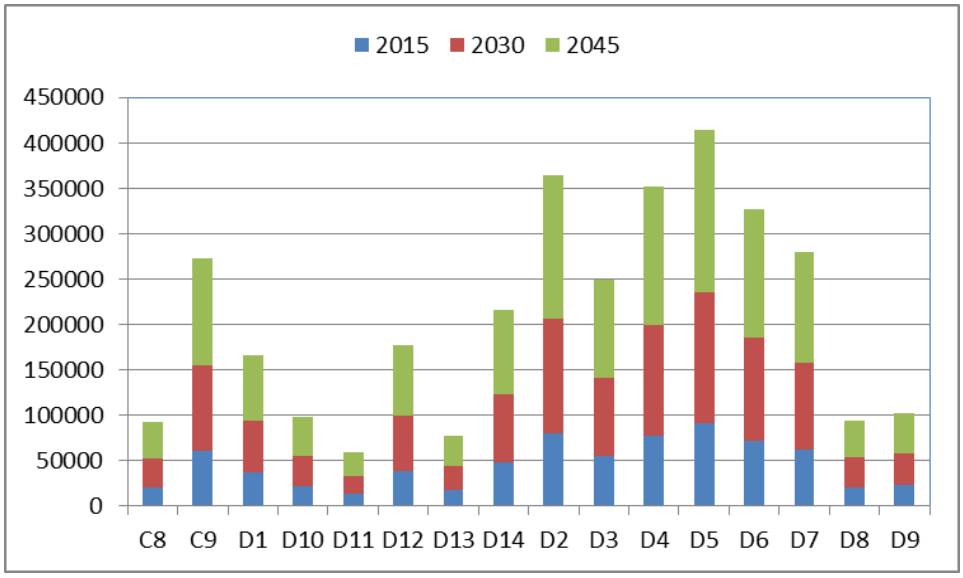


Figure 5.11: Demand of water districts

Demand to Each Node

The primary network on various water districts have been shown in Figure 5.12.

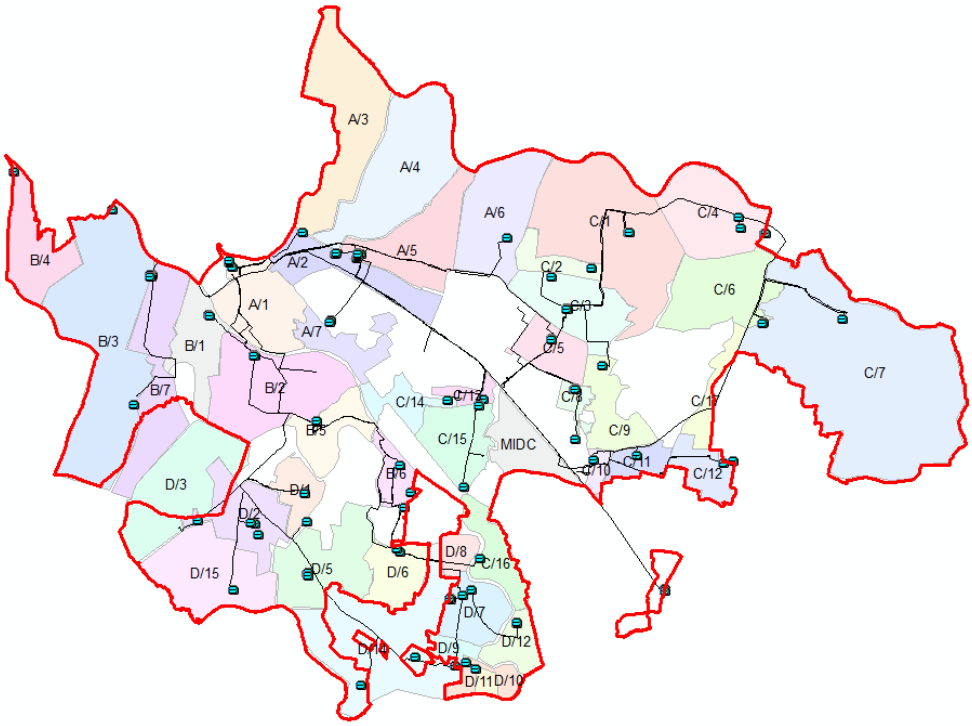
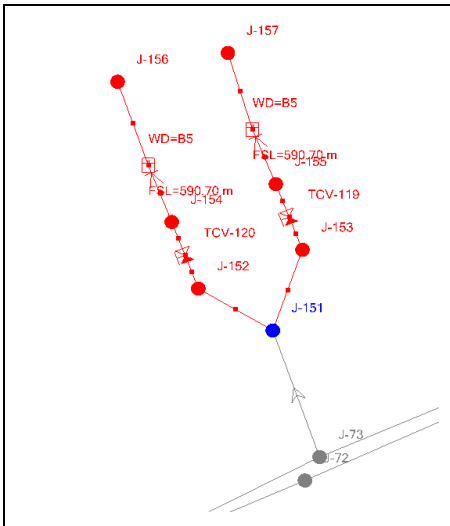
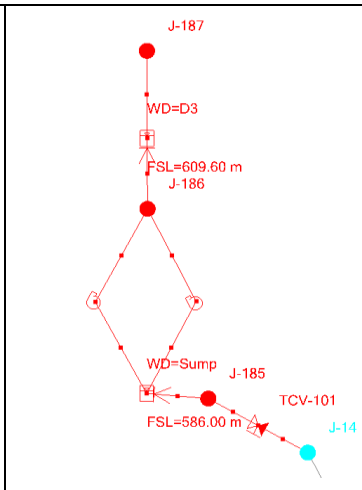


Figure 5.12: Primary network of Pimpri-Chinchwad

ESRs are represented by the demand node. The demands of the water districts are allocated to the nodes. For demand nodes without booster, the full supply level (FSL) of the tank has been taken, while for the nodes with boosters, the FSL of the sump has been considered and given to the node that is on upstream of the tank (Figure 5.13).



(a) Demand nodes: Demand of B5 is given to the node J-151

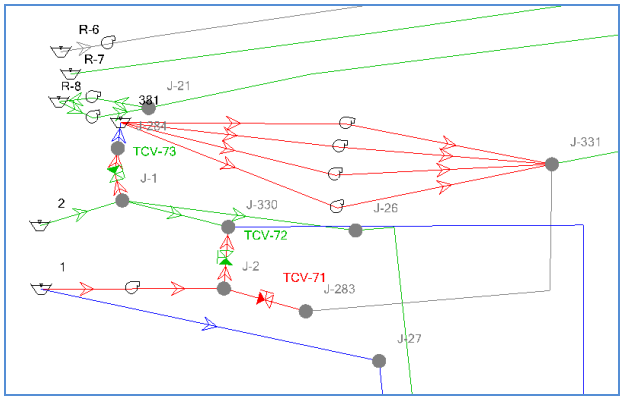


(b) Demand nodes with boosters: Demand of D3 is given to the node J-14

Figure 5.13: Multiple tanks in one water district

Representation of WTP: The satellite image of the WTP is shown in Figure 5.14(a). The clear water sump of the WTP is simulated in model as reservoir. Entire primary network of the city with the demand nodes is shown in Figure 5.15.

(a) Satellite image of the WTP



(b) Reservoirs simulating the clear water sump of WTP

Figure 5.14: Origin of the primary network

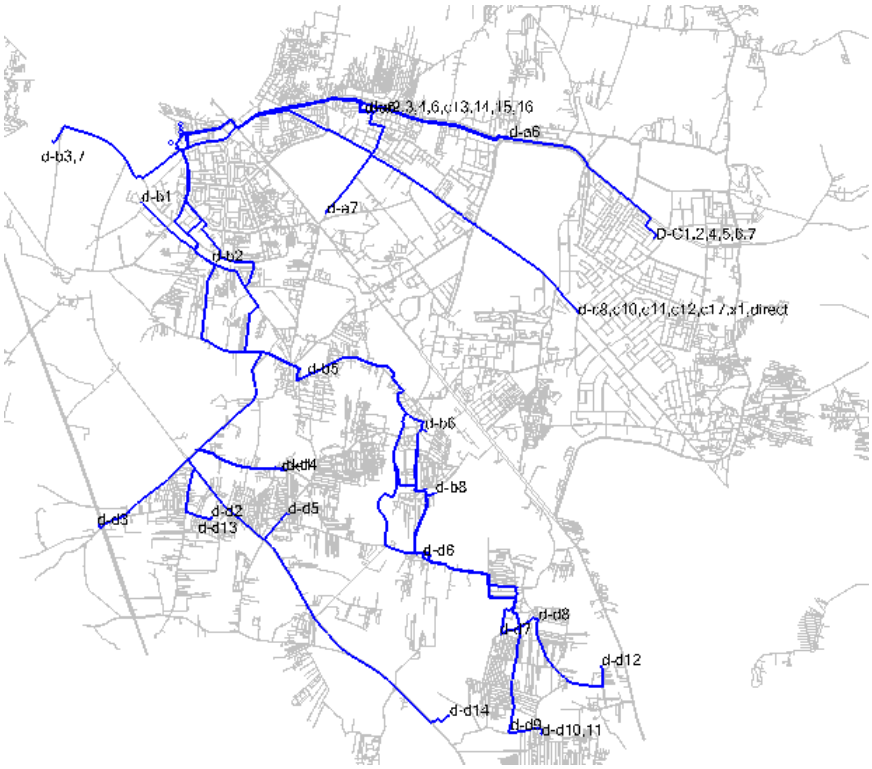


Figure 5.15: Primary network of Pimpri-Chinchwad

Base Scenario

Base scenario of the primary network of the Pimpri-Chinchwad city has been prepared with the alternatives: (i) active topology, demand and the operational as shown in Figure 5.16.

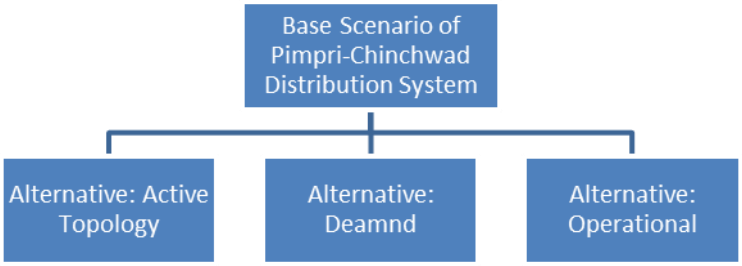


Figure 5.16: Base scenario with alternatives of active topology, demand and operational

Thus the basic hydraulic model of the primary network has been created for further analysis and design of the entire project right from the source to the consumer.

Chapter-6

Formation of Operational Zones

6. INTRODUCTION

The area of the water districts (Figure 6.1), under consideration for transformation to 24x7 continuous water supply, have been so selected that there is enough storage of service tanks which are already built.

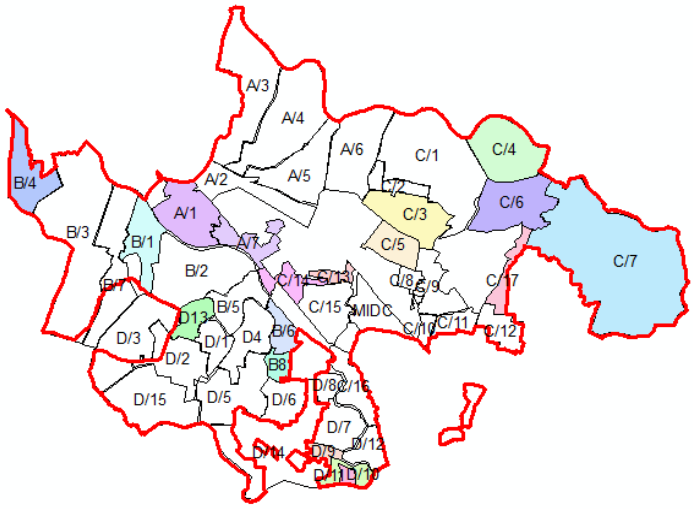


Figure 6.1: Water districts under consideration

The total service tanks in PCMC are 81 and 17 sumps. The tanks in the selected area are 23, the details of which are shown in Table 6.1.

Table 6.1: Details of the service tanks in the selected area

SN		Zones	WD	Label	Elevation (m)	St_Ht	Elevation (Minimum) (m)	Elevation (Maximum) (m)	Diameter (m)	Capacity (ML)	Optimum Demand (ML)	Demand of zone (ML)
1	1	A2	A2	437	609	13.1	622	627	25.2	2.50	11.1	22.2
2			A2	438	608	13.3	622	627	25.2	2.50	11.1	
3	7	B1	B1	173	584	15.1	600	604	23.8	2.00	8.6	7.52
4			B1	174	585	14.9	600	604	25	2.20	9.5	
5	10	B5	B5	193	566	19.3	586	591	25.2	2.50	11.1	19.6
6			B5	194	566	19.3	586	591	22.6	2.00	8.8	
7	15	C2	C2	412	598	17.5	615	618	10.7	0.25	0.8	
8	16	C3	C3	347	609	18.4	628	633	16.7	1.20	5.45	17.1
9			C3	350	609	19.7	629	634	23.7	2.20	9.7	
10		C3	C3	704	609	19.7	629	634	23.7	2.20	9.7	
11	18	C5	C5	664	606	16.7	623	628	15.1	0.90	4	2.9
12	24	C10	C10	804	586	16.9	603	609	18.7	1.50	6.8	6.9
13	25	C11	C11	Sant Tukaram	594	12.4	607	611	20.8	1.50	6.4	6.83
14	26	C12	C12	771	604	22.7	627	632	14.3	0.80	3.5	13
15			C12	774	604	22.7	627	632	22.6	2.00	8.8	
16	27	C13	C13	Annasaheb_Magar	587	12.4	600	605	20.5	1.65	7.3	3.6
17	28	C14	C14	Ajmera-1	590	9.79	600	605	19.5	1.50	6.6	11.8
18			C14	Ajmera-2	590	9.92	600	605	20	1.50	6.5	
19	41	D9	D9	294	555	15.9	571	576	22.6	2.00	8.8	7.88
20	42	D10	D10	302	555	13	568	574	21.5	2.00	9	11.2
21	43	D11	D11	103	555	11	566	570	13.8	0.60	2.5	
22			D11	104	555	14.2	569	574	13.9	0.65	2.75	
23	45	D13	D13	251	580	16.6	596	601	22.6	2.00	8.8	5.57
										38.16	168	136

Analysis of these service tanks has been done. The tank's handling of the optimum demand has been computed and precaution has been taken to see that no tanks remain empty nor overflow. The analysis has been presented in Table 6.2 to 6.25.

Table 6.2: Analysis of ESR 437 in water district A2

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	437
2	Inflow Hours	23.00	Maximum surplus (m3)	1560.4
3	Outflow Hours	24	Minimum surplus (m3)	-641.5
4	Minimum wataer level (m)	621.73	Computed Capacity (m3)	2201.9
5	Initial water level (m)	622.73	Max. serving Demand (mld)	11.10
6	Maximum wataer level (m)	626.76	Max. Population serving	62900
7	Diameter (m)	25.16	Initial Volume (m3)	497.2
8	Area (m2)=	497.18	Fire storage (m3)	0.8
9	Initial water depth in tank	1	Existing capacity (ML)	2500.8
10	Volume of ESR	2500.8	GL (m)	608.6
			Staging Height (m)	13.13

Demand = 11.10

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	482.6		0.1	46.3		0.0	436.4	622.73	19.9	OK
1	482.6	482.6	0.1	46.3	46.3	436.4	436.4	623.61	37.3	OK
2	482.6	965.2	0.1	46.3	92.5	872.7	436.4	624.49	54.8	OK
3	482.6	1447.8	0.3	138.8	231.3	1216.6	343.9	625.36	72.2	OK
4	482.6	1930.4	0.3	138.8	370.0	1560.4	343.9	626.05	86.0	OK
5	482.6	2413.0	1.5	693.8	1063.8	1349.3	-211.1	626.75	99.7	OK
6	482.6	2895.7	2	925.0	1988.8	906.9	-442.4	626.32	91.3	OK
7	482.6	3378.3	2	925.0	2913.8	464.5	-442.4	625.43	73.6	OK
8	482.6	3860.9	2	925.0	3838.8	22.1	-442.4	624.54	55.9	OK
9	482.6	4343.5	2	925.0	4763.8	-420.3	-442.4	623.65	38.2	OK
10	482.6	4826.1	1.5	693.8	5457.5	-631.4	-211.1	622.76	20.5	OK
11	482.6	5308.7	0.2	92.5	5550.0	-241.3	390.1	622.34	12.1	OK
12	482.6	5791.3	0.2	92.5	5642.5	148.8	390.1	623.12	27.7	OK
13	482.6	6273.9	0.2	92.5	5735.0	538.9	390.1	623.91	43.3	OK
14	482.6	6756.5	0.2	92.5	5827.5	929.0	390.1	624.69	58.9	OK
15	482.6	7239.1	0.5	231.3	6058.8	1180.4	251.4	625.48	74.5	OK
16	482.6	7721.7	1.5	693.8	6752.5	969.2	-211.1	625.98	84.5	OK
17	482.6	8204.3	1.8	832.5	7585.0	619.3	-349.9	625.56	76.1	OK
18	482.6	8687.0	1.8	832.5	8417.5	269.5	-349.9	624.85	62.1	OK
19	482.6	9169.6	1.8	832.5	9250.0	-80.4	-349.9	624.15	48.1	OK
20	482.6	9652.2	1.8	832.5	10082.5	-430.3	-349.9	623.45	34.1	OK
21	482.6	10134.8	1.5	693.8	10776.3	-641.5	-211.1	622.74	20.1	OK
22	482.6	10617.4	0.5	231.3	11007.5	-390.1	251.4	622.32	11.7	OK
23	0.0	10617.4	0.1	46.3	11053.8	-436.4	-46.3	622.82	21.7	OK
24	482.6	11100.0	0.1	46.3	11100.0	0.0	436.4	622.73	19.9	OK

Table 6.3: Analysis of ESR 438 in water district A2

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	438
2	Inflow Hours	23.00	Maximum surplus (m3)	1560.4
3	Outflow Hours	24	Minimum surplus (m3)	-641.5
4	Minimum wataer level (m)	621.73	Computed Capacity (m3)	2201.9
5	Initial water level (m)	622.73	Max. serving Demand (mld)	11.10
6	Maximum wataer level (m)	626.76	Max. Population serving	62900
7	Diameter (m)	25.16	Initial Volume (m3)	497.2
8	Area (m2)=	497.18	Fire storage (m3)	0.8
9	Initial water depth in tank	1	Existing capacity (ML)	2500.8
10	Volume of ESR	2500.8	GL (m)	608.41
			Staging Height (m)	0

Demand = 11.10

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	482.6		0.1	46.3		0.0	436.4	622.73	19.9	OK
1	482.6	482.6	0.1	46.3	46.3	436.4	436.4	623.61	37.3	OK
2	482.6	965.2	0.1	46.3	92.5	872.7	436.4	624.49	54.8	OK
3	482.6	1447.8	0.3	138.8	231.3	1216.6	343.9	625.36	72.2	OK
4	482.6	1930.4	0.3	138.8	370.0	1560.4	343.9	626.05	86.0	OK
5	482.6	2413.0	1.5	693.8	1063.8	1349.3	-211.1	626.75	99.7	OK
6	482.6	2895.7	2	925.0	1988.8	906.9	-442.4	626.32	91.3	OK
7	482.6	3378.3	2	925.0	2913.8	464.5	-442.4	625.43	73.6	OK
8	482.6	3860.9	2	925.0	3838.8	22.1	-442.4	624.54	55.9	OK
9	482.6	4343.5	2	925.0	4763.8	-420.3	-442.4	623.65	38.2	OK
10	482.6	4826.1	1.5	693.8	5457.5	-631.4	-211.1	622.76	20.5	OK
11	482.6	5308.7	0.2	92.5	5550.0	-241.3	390.1	622.34	12.1	OK
12	482.6	5791.3	0.2	92.5	5642.5	148.8	390.1	623.12	27.7	OK
13	482.6	6273.9	0.2	92.5	5735.0	538.9	390.1	623.91	43.3	OK
14	482.6	6756.5	0.2	92.5	5827.5	929.0	390.1	624.69	58.9	OK
15	482.6	7239.1	0.5	231.3	6058.8	1180.4	251.4	625.48	74.5	OK
16	482.6	7721.7	1.5	693.8	6752.5	969.2	-211.1	625.98	84.5	OK
17	482.6	8204.3	1.8	832.5	7585.0	619.3	-349.9	625.56	76.1	OK
18	482.6	8687.0	1.8	832.5	8417.5	269.5	-349.9	624.85	62.1	OK
19	482.6	9169.6	1.8	832.5	9250.0	-80.4	-349.9	624.15	48.1	OK
20	482.6	9652.2	1.8	832.5	10082.5	-430.3	-349.9	623.45	34.1	OK
21	482.6	10134.8	1.5	693.8	10776.3	-641.5	-211.1	622.74	20.1	OK
22	482.6	10617.4	0.5	231.3	11007.5	-390.1	251.4	622.32	11.7	OK
23	0.0	10617.4	0.1	46.3	11053.8	-436.4	-46.3	622.82	21.7	OK
24	482.6	11100.0	0.1	46.3	11100.0	0.0	436.4	622.73	19.9	OK

Table 6.4: Analysis of ESR 173 in water district B1

`	Data		Output	
1	Peak Factor	2	ESR Name	173
2	Inflow Hours	23.00	Maximum surplus (m3)	1209.0
3	Outflow Hours	24	Minimum surplus (m3)	-497.0
4	Minimum wataer level (m)	599.50	Computed Capacity (m3)	1706.0
5	Initial water level (m)	600.50	Max. serving Demand (mld)	8.60
6	Maximum wataer level (m)	604.00	Max. Population serving	48733
7	Diameter (m)	23.79	Initial Volume (m3)	444.5
8	Area (m2)=	444.51	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.3
10	Volume of ESR	2000.28	GL (m)	584.43

Demand = 8.60

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	373.9		0.1	35.8		0.0	338.1	600.50	22.2	OK
1	373.9	373.9	0.1	35.8	35.8	338.1	338.1	601.26	39.1	OK
2	373.9	747.8	0.1	35.8	71.7	676.2	338.1	602.02	56.0	OK
3	373.9	1121.7	0.3	107.5	179.2	942.6	266.4	602.78	72.9	OK
4	373.9	1495.7	0.3	107.5	286.7	1209.0	266.4	603.38	86.2	OK
5	373.9	1869.6	1.5	537.5	824.2	1045.4	-163.6	603.98	99.6	OK
6	373.9	2243.5	2	716.7	1540.8	702.6	-342.8	603.61	91.4	OK
7	373.9	2617.4	2	716.7	2257.5	359.9	-342.8	602.84	74.3	OK
8	373.9	2991.3	2	716.7	2974.2	17.1	-342.8	602.07	57.1	OK
9	373.9	3365.2	2	716.7	3690.8	-325.6	-342.8	601.30	40.0	OK
10	373.9	3739.1	1.5	537.5	4228.3	-489.2	-163.6	600.53	22.8	OK
11	373.9	4113.0	0.2	71.7	4300.0	-187.0	302.2	600.16	14.7	OK
12	373.9	4487.0	0.2	71.7	4371.7	115.3	302.2	600.84	29.8	OK
13	373.9	4860.9	0.2	71.7	4443.3	417.5	302.2	601.52	44.9	OK
14	373.9	5234.8	0.2	71.7	4515.0	719.8	302.2	602.20	60.0	OK
15	373.9	5608.7	0.5	179.2	4694.2	914.5	194.7	602.88	75.1	OK
16	373.9	5982.6	1.5	537.5	5231.7	750.9	-163.6	603.32	84.8	OK
17	373.9	6356.5	1.8	645.0	5876.7	479.9	-271.1	602.95	76.7	OK
18	373.9	6730.4	1.8	645.0	6521.7	208.8	-271.1	602.34	63.1	OK
19	373.9	7104.3	1.8	645.0	7166.7	-62.3	-271.1	601.73	49.6	OK
20	373.9	7478.3	1.8	645.0	7811.7	-333.4	-271.1	601.12	36.0	OK
21	373.9	7852.2	1.5	537.5	8349.2	-497.0	-163.6	600.51	22.5	OK
22	373.9	8226.1	0.5	179.2	8528.3	-302.2	194.7	600.14	14.3	OK
23	0.0	8226.1	0.1	35.8	8564.2	-338.1	-35.8	600.58	24.0	OK
24	373.9	8600.0	0.1	35.8	8600.0	0.0	338.1	600.50	22.2	OK

Table 6.5: Analysis of ESR 174 in water district B1

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	174
2	Inflow Hours	23.00	Maximum surplus (m3)	1335.5
3	Outflow Hours	24	Minimum surplus (m3)	-549.0
4	Minimum wataer level (m)	599.50	Computed Capacity (m3)	1884.5
5	Initial water level (m)	600.50	Max. serving Demand (mld)	9.50
6	Maximum wataer level (m)	604.00	Max. Population serving	53833
7	Diameter (m)	24.95	Initial Volume (m3)	488.9
8	Area (m2)=	488.91	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2200.1
10	Volume of ESR	2200.1	GL (m)	584.64

Demand = 9.50

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	413.0		0.1	39.6		0.0	373.5	600.50	22.2	OK
1	413.0	413.0	0.1	39.6	39.6	373.5	373.5	601.26	39.2	OK
2	413.0	826.1	0.1	39.6	79.2	746.9	373.5	602.03	56.2	OK
3	413.0	1239.1	0.3	118.8	197.9	1041.2	294.3	602.79	73.1	OK
4	413.0	1652.2	0.3	118.8	316.7	1335.5	294.3	603.39	86.5	OK
5	413.0	2065.2	1.5	593.8	910.4	1154.8	-180.7	604.00	99.9	OK
6	413.0	2478.3	2	791.7	1702.1	776.2	-378.6	603.63	91.7	OK
7	413.0	2891.3	2	791.7	2493.8	397.6	-378.6	602.85	74.5	OK
8	413.0	3304.3	2	791.7	3285.4	18.9	-378.6	602.08	57.3	OK
9	413.0	3717.4	2	791.7	4077.1	-359.7	-378.6	601.30	40.1	OK
10	413.0	4130.4	1.5	593.8	4670.8	-540.4	-180.7	600.53	22.8	OK
11	413.0	4543.5	0.2	79.2	4750.0	-206.5	333.9	600.16	14.6	OK
12	413.0	4956.5	0.2	79.2	4829.2	127.4	333.9	600.84	29.8	OK
13	413.0	5369.6	0.2	79.2	4908.3	461.2	333.9	601.52	45.0	OK
14	413.0	5782.6	0.2	79.2	4987.5	795.1	333.9	602.21	60.2	OK
15	413.0	6195.7	0.5	197.9	5185.4	1010.2	215.1	602.89	75.3	OK
16	413.0	6608.7	1.5	593.8	5779.2	829.5	-180.7	603.33	85.1	OK
17	413.0	7021.7	1.8	712.5	6491.7	530.1	-299.5	602.96	76.9	OK
18	413.0	7434.8	1.8	712.5	7204.2	230.6	-299.5	602.35	63.3	OK
19	413.0	7847.8	1.8	712.5	7916.7	-68.8	-299.5	601.74	49.7	OK
20	413.0	8260.9	1.8	712.5	8629.2	-368.3	-299.5	601.12	36.1	OK
21	413.0	8673.9	1.5	593.8	9222.9	-549.0	-180.7	600.51	22.5	OK
22	413.0	9087.0	0.5	197.9	9420.8	-333.9	215.1	600.14	14.2	OK
23	0.0	9087.0	0.1	39.6	9460.4	-373.5	-39.6	600.58	24.0	OK
24	413.0	9500.0	0.1	39.6	9500.0	0.0	373.5	600.50	22.2	OK

Table 6.6: Analysis of ESR 193 in water district B5

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	193
2	Inflow Hours	23.00	Maximum surplus (m3)	1560.4
3	Outflow Hours	24	Minimum surplus (m3)	-641.5
4	Minimum wataer level (m)	585.70	Computed Capacity (m3)	2201.9
5	Initial water level (m)	586.70	Max. serving Demand (mld)	11.10
6	Maximum wataer level (m)	590.70	Max. Population serving	62900
7	Diameter (m)	25.23	Initial Volume (m3)	499.9
8	Area (m2)=	499.95	Fire storage (m3)	0.8
9	Initial water depth in tank	1	Existing capacity (ML)	2499.7
10	Volume of ESR	2499.74	GL (m)	566.43

Demand = 11.10

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	482.6		0.1	46.3		0.0	436.4	586.70	20.0	OK
1	482.6	482.6	0.1	46.3	46.3	436.4	436.4	587.57	37.5	OK
2	482.6	965.2	0.1	46.3	92.5	872.7	436.4	588.45	54.9	OK
3	482.6	1447.8	0.3	138.8	231.3	1216.6	343.9	589.32	72.4	OK
4	482.6	1930.4	0.3	138.8	370.0	1560.4	343.9	590.01	86.1	OK
5	482.6	2413.0	1.5	693.8	1063.8	1349.3	-211.1	590.69	99.9	OK
6	482.6	2895.7	2	925.0	1988.8	906.9	-442.4	590.27	91.4	OK
7	482.6	3378.3	2	925.0	2913.8	464.5	-442.4	589.39	73.7	OK
8	482.6	3860.9	2	925.0	3838.8	22.1	-442.4	588.50	56.0	OK
9	482.6	4343.5	2	925.0	4763.8	-420.3	-442.4	587.62	38.3	OK
10	482.6	4826.1	1.5	693.8	5457.5	-631.4	-211.1	586.73	20.6	OK
11	482.6	5308.7	0.2	92.5	5550.0	-241.3	390.1	586.31	12.2	OK
12	482.6	5791.3	0.2	92.5	5642.5	148.8	390.1	587.09	27.8	OK
13	482.6	6273.9	0.2	92.5	5735.0	538.9	390.1	587.87	43.4	OK
14	482.6	6756.5	0.2	92.5	5827.5	929.0	390.1	588.65	59.0	OK
15	482.6	7239.1	0.5	231.3	6058.8	1180.4	251.4	589.43	74.6	OK
16	482.6	7721.7	1.5	693.8	6752.5	969.2	-211.1	589.93	84.7	OK
17	482.6	8204.3	1.8	832.5	7585.0	619.3	-349.9	589.51	76.2	OK
18	482.6	8687.0	1.8	832.5	8417.5	269.5	-349.9	588.81	62.2	OK
19	482.6	9169.6	1.8	832.5	9250.0	-80.4	-349.9	588.11	48.2	OK
20	482.6	9652.2	1.8	832.5	10082.5	-430.3	-349.9	587.41	34.2	OK
21	482.6	10134.8	1.5	693.8	10776.3	-641.5	-211.1	586.71	20.2	OK
22	482.6	10617.4	0.5	231.3	11007.5	-390.1	251.4	586.29	11.8	OK
23	0.0	10617.4	0.1	46.3	11053.8	-436.4	-46.3	586.79	21.9	OK
24	482.6	11100.0	0.1	46.3	11100.0	0.0	436.4	586.70	20.0	OK

Table 6.7: Analysis of ESR 194 in water district B5

`	Data		Output	
1	Peak Factor	2	ESR Name	194
2	Inflow Hours	23.00	Maximum surplus (m3)	1237.1
3	Outflow Hours	24	Minimum surplus (m3)	-508.6
4	Minimum wataer level (m)	585.70	Computed Capacity (m3)	1745.7
5	Initial water level (m)	586.70	Max. serving Demand (mld)	8.80
6	Maximum wataer level (m)	590.70	Max. Population serving	49867
7	Diameter (m)	22.57	Initial Volume (m3)	400.1
8	Area (m2)=	400.09	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.4
10	Volume of ESR	2000.43	GL (m)	566.41

Demand = 8.80

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	382.6		0.1	36.7		0.0	345.9	586.70	20.0	OK
1	382.6	382.6	0.1	36.7	36.7	345.9	345.9	587.56	37.3	OK
2	382.6	765.2	0.1	36.7	73.3	691.9	345.9	588.43	54.6	OK
3	382.6	1147.8	0.3	110.0	183.3	964.5	272.6	589.29	71.9	OK
4	382.6	1530.4	0.3	110.0	293.3	1237.1	272.6	589.98	85.5	OK
5	382.6	1913.0	1.5	550.0	843.3	1069.7	-167.4	590.66	99.1	OK
6	382.6	2295.7	2	733.3	1576.7	719.0	-350.7	590.24	90.8	OK
7	382.6	2678.3	2	733.3	2310.0	368.3	-350.7	589.36	73.2	OK
8	382.6	3060.9	2	733.3	3043.3	17.5	-350.7	588.49	55.7	OK
9	382.6	3443.5	2	733.3	3776.7	-333.2	-350.7	587.61	38.2	OK
10	382.6	3826.1	1.5	550.0	4326.7	-500.6	-167.4	586.73	20.6	OK
11	382.6	4208.7	0.2	73.3	4400.0	-191.3	309.3	586.31	12.3	OK
12	382.6	4591.3	0.2	73.3	4473.3	118.0	309.3	587.09	27.7	OK
13	382.6	4973.9	0.2	73.3	4546.7	427.2	309.3	587.86	43.2	OK
14	382.6	5356.5	0.2	73.3	4620.0	736.5	309.3	588.63	58.7	OK
15	382.6	5739.1	0.5	183.3	4803.3	935.8	199.3	589.41	74.1	OK
16	382.6	6121.7	1.5	550.0	5353.3	768.4	-167.4	589.90	84.1	OK
17	382.6	6504.3	1.8	660.0	6013.3	491.0	-277.4	589.49	75.7	OK
18	382.6	6887.0	1.8	660.0	6673.3	213.6	-277.4	588.79	61.8	OK
19	382.6	7269.6	1.8	660.0	7333.3	-63.8	-277.4	588.10	48.0	OK
20	382.6	7652.2	1.8	660.0	7993.3	-341.2	-277.4	587.41	34.1	OK
21	382.6	8034.8	1.5	550.0	8543.3	-508.6	-167.4	586.71	20.2	OK
22	382.6	8417.4	0.5	183.3	8726.7	-309.3	199.3	586.29	11.9	OK
23	0.0	8417.4	0.1	36.7	8763.3	-345.9	-36.7	586.79	21.8	OK
24	382.6	8800.0	0.1	36.7	8800.0	0.0	345.9	586.70	20.0	OK

Table 6.8: Analysis of ESR 412 in water district C2

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	412
2	Inflow Hours	23.00	Maximum surplus (m3)	112.5
3	Outflow Hours	24	Minimum surplus (m3)	-46.2
4	Minimum wataer level (m)	615.25	Computed Capacity (m3)	158.7
5	Initial water level (m)	616.25	Max. serving Demand (mld)	0.80
6	Maximum wataer level (m)	618.01	Max. Population serving	4533
7	Diameter (m)	10.74	Initial Volume (m3)	90.6
8	Area (m2)=	90.59	Fire storage (m3)	0.0
9	Initial water depth in tank	1	Existing capacity (ML)	250.0
10	Volume of ESR	250.039	GL (m)	597.76

Demand = 0.8

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	34.8		0.1	3.3		0.0	31.4	616.25	36.2	OK
1	34.8	34.8	0.1	3.3	3.3	31.4	31.4	616.60	48.8	OK
2	34.8	69.6	0.1	3.3	6.7	62.9	31.4	616.94	61.4	OK
3	34.8	104.3	0.3	10.0	16.7	87.7	24.8	617.29	74.0	OK
4	34.8	139.1	0.3	10.0	26.7	112.5	24.8	617.56	83.9	OK
5	34.8	173.9	1.5	50.0	76.7	97.2	-15.2	617.84	93.8	OK
6	34.8	208.7	2	66.7	143.3	65.4	-31.9	617.67	87.7	OK
7	34.8	243.5	2	66.7	210.0	33.5	-31.9	617.32	75.0	OK
8	34.8	278.3	2	66.7	276.7	1.6	-31.9	616.97	62.2	OK
9	34.8	313.0	2	66.7	343.3	-30.3	-31.9	616.61	49.4	OK
10	34.8	347.8	1.5	50.0	393.3	-45.5	-15.2	616.26	36.7	OK
11	34.8	382.6	0.2	6.7	400.0	-17.4	28.1	616.09	30.6	OK
12	34.8	417.4	0.2	6.7	406.7	10.7	28.1	616.41	41.9	OK
13	34.8	452.2	0.2	6.7	413.3	38.8	28.1	616.72	53.1	OK
14	34.8	487.0	0.2	6.7	420.0	67.0	28.1	617.03	64.3	OK
15	34.8	521.7	0.5	16.7	436.7	85.1	18.1	617.34	75.6	OK
16	34.8	556.5	1.5	50.0	486.7	69.9	-15.2	617.54	82.8	OK
17	34.8	591.3	1.8	60.0	546.7	44.6	-25.2	617.37	76.7	OK
18	34.8	626.1	1.8	60.0	606.7	19.4	-25.2	617.09	66.7	OK
19	34.8	660.9	1.8	60.0	666.7	-5.8	-25.2	616.81	56.6	OK
20	34.8	695.7	1.8	60.0	726.7	-31.0	-25.2	616.53	46.5	OK
21	34.8	730.4	1.5	50.0	776.7	-46.2	-15.2	616.25	36.4	OK
22	34.8	765.2	0.5	16.7	793.3	-28.1	18.1	616.09	30.3	OK
23	0.0	765.2	0.1	3.3	796.7	-31.4	-3.3	616.29	37.6	OK
24	34.8	800.0	0.1	3.3	800.0	0.0	31.4	616.25	36.2	OK

Table 6.9: Analysis of ESR 347 in water district C3

`	**Data**		**Output** ESR	
1	Peak Factor	2	Name	347
2	Inflow Hours	23.00	Maximum surplus (m3)	766.2
3	Outflow Hours	24	Minimum surplus (m3)	-315.0
4	Minimum wataer level (m)	627.50	Computed Capacity (m3)	1081.1
5	Initial water level (m)	628.50	Max. serving Demand (mld)	5.45
6	Maximum wataer level (m)	633.00	Max. Population serving	30883
7	Diameter (m)	16.67	Initial Volume (m3)	218.3
8	Area (m2)=	218.25	Fire storage (m3)	0.3
9	Initial water depth in tank	1	Existing capacity (ML)	1200.4
10	Volume of ESR	1200.39	GL (m)	609.11

Demand = 5.45

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	237.0		0.1	22.7		0.0	214.2	628.50	18.2	OK
1	237.0	237.0	0.1	22.7	22.7	214.2	214.2	629.48	36.0	OK
2	237.0	473.9	0.1	22.7	45.4	428.5	214.2	630.46	53.9	OK
3	237.0	710.9	0.3	68.1	113.5	597.3	168.8	631.44	71.7	OK
4	237.0	947.8	0.3	68.1	181.7	766.2	168.8	632.22	85.8	OK
5	237.0	1184.8	1.5	340.6	522.3	662.5	-103.7	632.99	99.9	OK
6	237.0	1421.7	2	454.2	976.5	445.3	-217.2	632.52	91.2	OK
7	237.0	1658.7	2	454.2	1430.6	228.1	-217.2	631.52	73.1	OK
8	237.0	1895.7	2	454.2	1884.8	10.9	-217.2	630.53	55.0	OK
9	237.0	2132.6	2	454.2	2339.0	-206.3	-217.2	629.53	36.9	OK
10	237.0	2369.6	1.5	340.6	2679.6	-310.0	-103.7	628.54	18.8	OK
11	237.0	2606.5	0.2	45.4	2725.0	-118.5	191.5	628.06	10.2	OK
12	237.0	2843.5	0.2	45.4	2770.4	73.1	191.5	628.94	26.2	OK
13	237.0	3080.4	0.2	45.4	2815.8	264.6	191.5	629.82	42.1	OK
14	237.0	3317.4	0.2	45.4	2861.3	456.1	191.5	630.69	58.1	OK
15	237.0	3554.3	0.5	113.5	2974.8	579.6	123.4	631.57	74.0	OK
16	237.0	3791.3	1.5	340.6	3315.4	475.9	-103.7	632.14	84.3	OK
17	237.0	4028.3	1.8	408.8	3724.2	304.1	-171.8	631.66	75.7	OK
18	237.0	4265.2	1.8	408.8	4132.9	132.3	-171.8	630.87	61.4	OK
19	237.0	4502.2	1.8	408.8	4541.7	-39.5	-171.8	630.09	47.1	OK
20	237.0	4739.1	1.8	408.8	4950.4	-211.3	-171.8	629.30	32.7	OK
21	237.0	4976.1	1.5	340.6	5291.0	-315.0	-103.7	628.51	18.4	OK
22	237.0	5213.0	0.5	113.5	5404.6	-191.5	123.4	628.04	9.8	OK
23	0.0	5213.0	0.1	22.7	5427.3	-214.2	-22.7	628.60	20.1	OK
24	237.0	5450.0	0.1	22.7	5450.0	0.0	214.2	628.50	18.2	OK

Table 6.10: Analysis of ESR 350 in water district C3

`	Data		Output	
1	Peak Factor	2	ESR Name	350
2	Inflow Hours	23.00	Maximum surplus (m3)	1363.6
3	Outflow Hours	24	Minimum surplus (m3)	-560.6
4	Minimum wataer level (m)	628.50	Computed Capacity (m3)	1924.2
5	Initial water level (m)	629.50	Max. serving Demand (mld)	9.70
6	Maximum wataer level (m)	633.50	Max. Population serving	54967
7	Diameter (m)	23.67	Initial Volume (m3)	440.0
8	Area (m2)=	440.03	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2200.2
10	Volume of ESR	2200.17	GL (m)	608.76

Demand = 9.70

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	421.7		0.1	40.4		0.0	381.3	629.50	20.0	OK
1	421.7	421.7	0.1	40.4	40.4	381.3	381.3	630.37	37.3	OK
2	421.7	843.5	0.1	40.4	80.8	762.6	381.3	631.23	54.7	OK
3	421.7	1265.2	0.3	121.3	202.1	1063.1	300.5	632.10	72.0	OK
4	421.7	1687.0	0.3	121.3	323.3	1363.6	300.5	632.78	85.7	OK
5	421.7	2108.7	1.5	606.3	929.6	1179.1	-184.5	633.47	99.3	OK
6	421.7	2530.4	2	808.3	1737.9	792.5	-386.6	633.05	90.9	OK
7	421.7	2952.2	2	808.3	2546.3	405.9	-386.6	632.17	73.4	OK
8	421.7	3373.9	2	808.3	3354.6	19.3	-386.6	631.29	55.8	OK
9	421.7	3795.7	2	808.3	4162.9	-367.3	-386.6	630.41	38.2	OK
10	421.7	4217.4	1.5	606.3	4769.2	-551.8	-184.5	629.53	20.6	OK
11	421.7	4639.1	0.2	80.8	4850.0	-210.9	340.9	629.11	12.3	OK
12	421.7	5060.9	0.2	80.8	4930.8	130.0	340.9	629.89	27.7	OK
13	421.7	5482.6	0.2	80.8	5011.7	470.9	340.9	630.66	43.2	OK
14	421.7	5904.3	0.2	80.8	5092.5	811.8	340.9	631.44	58.7	OK
15	421.7	6326.1	0.5	202.1	5294.6	1031.5	219.7	632.21	74.2	OK
16	421.7	6747.8	1.5	606.3	5900.8	847.0	-184.5	632.71	84.2	OK
17	421.7	7169.6	1.8	727.5	6628.3	541.2	-305.8	632.29	75.8	OK
18	421.7	7591.3	1.8	727.5	7355.8	235.5	-305.8	631.60	61.9	OK
19	421.7	8013.0	1.8	727.5	8083.3	-70.3	-305.8	630.90	48.0	OK
20	421.7	8434.8	1.8	727.5	8810.8	-376.1	-305.8	630.21	34.1	OK
21	421.7	8856.5	1.5	606.3	9417.1	-560.6	-184.5	629.51	20.2	OK
22	421.7	9278.3	0.5	202.1	9619.2	-340.9	219.7	629.09	11.9	OK
23	0.0	9278.3	0.1	40.4	9659.6	-381.3	-40.4	629.59	21.8	OK
24	421.7	9700.0	0.1	40.4	9700.0	0.0	381.3	629.50	20.0	OK

Table 6.11: Analysis of ESR 704 in water district C3

`	Data		Output	
1	Peak Factor	2	ESR Name	704
2	Inflow Hours	23.00	Maximum surplus (m3)	1363.6
3	Outflow Hours	24	Minimum surplus (m3)	-560.6
4	Minimum wataer level (m)	628.50	Computed Capacity (m3)	1924.2
5	Initial water level (m)	629.50	Max. serving Demand (mld)	9.70
6	Maximum wataer level (m)	633.50	Max. Population serving	54967
7	Diameter (m)	23.67	Initial Volume (m3)	440.0
8	Area (m2)=	440.03	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2200.2
10	Volume of ESR	2200.17	GL (m)	608.84

Demand = 9.70

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	421.7		0.1	40.4		0.0	381.3	629.50	20.0	OK
1	421.7	421.7	0.1	40.4	40.4	381.3	381.3	630.37	37.3	OK
2	421.7	843.5	0.1	40.4	80.8	762.6	381.3	631.23	54.7	OK
3	421.7	1265.2	0.3	121.3	202.1	1063.1	300.5	632.10	72.0	OK
4	421.7	1687.0	0.3	121.3	323.3	1363.6	300.5	632.78	85.7	OK
5	421.7	2108.7	1.5	606.3	929.6	1179.1	-184.5	633.47	99.3	OK
6	421.7	2530.4	2	808.3	1737.9	792.5	-386.6	633.05	90.9	OK
7	421.7	2952.2	2	808.3	2546.3	405.9	-386.6	632.17	73.4	OK
8	421.7	3373.9	2	808.3	3354.6	19.3	-386.6	631.29	55.8	OK
9	421.7	3795.7	2	808.3	4162.9	-367.3	-386.6	630.41	38.2	OK
10	421.7	4217.4	1.5	606.3	4769.2	-551.8	-184.5	629.53	20.6	OK
11	421.7	4639.1	0.2	80.8	4850.0	-210.9	340.9	629.11	12.3	OK
12	421.7	5060.9	0.2	80.8	4930.8	130.0	340.9	629.89	27.7	OK
13	421.7	5482.6	0.2	80.8	5011.7	470.9	340.9	630.66	43.2	OK
14	421.7	5904.3	0.2	80.8	5092.5	811.8	340.9	631.44	58.7	OK
15	421.7	6326.1	0.5	202.1	5294.6	1031.5	219.7	632.21	74.2	OK
16	421.7	6747.8	1.5	606.3	5900.8	847.0	-184.5	632.71	84.2	OK
17	421.7	7169.6	1.8	727.5	6628.3	541.2	-305.8	632.29	75.8	OK
18	421.7	7591.3	1.8	727.5	7355.8	235.5	-305.8	631.60	61.9	OK
19	421.7	8013.0	1.8	727.5	8083.3	-70.3	-305.8	630.90	48.0	OK
20	421.7	8434.8	1.8	727.5	8810.8	-376.1	-305.8	630.21	34.1	OK
21	421.7	8856.5	1.5	606.3	9417.1	-560.6	-184.5	629.51	20.2	OK
22	421.7	9278.3	0.5	202.1	9619.2	-340.9	219.7	629.09	11.9	OK
23	0.0	9278.3	0.1	40.4	9659.6	-381.3	-40.4	629.59	21.8	OK
24	421.7	9700.0	0.1	40.4	9700.0	0.0	381.3	629.50	20.0	OK

Table 6.12: Analysis of ESR 664 in water district C5

`	Data		Output	
1	Peak Factor	2	ESR Name	664
2	Inflow Hours	23.00	Maximum surplus (m3)	562.3
3	Outflow Hours	24	Minimum surplus (m3)	-231.2
4	Minimum wataer level (m)	622.90	Computed Capacity (m3)	793.5
5	Initial water level (m)	623.90	Max. serving Demand (mld)	4.00
6	Maximum wataer level (m)	627.90	Max. Population serving	22667
7	Diameter (m)	15.14	Initial Volume (m3)	180.0
8	Area (m2)=	180.03	Fire storage (m3)	0.2
9	Initial water depth in tank	1	Existing capacity (ML)	900.1
10	Volume of ESR	900.143	GL (m)	606.24

Demand = 4.00

Time from Start (hours)	664	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	173.9		0.1	16.7		0.0	157.2	623.90	20.0	OK
1	173.9	173.9	0.1	16.7	16.7	157.2	157.2	624.77	37.5	OK
2	173.9	347.8	0.1	16.7	33.3	314.5	157.2	625.65	54.9	OK
3	173.9	521.7	0.3	50.0	83.3	438.4	123.9	626.52	72.4	OK
4	173.9	695.7	0.3	50.0	133.3	562.3	123.9	627.21	86.2	OK
5	173.9	869.6	1.5	250.0	383.3	486.2	-76.1	627.90	99.9	OK
6	173.9	1043.5	2	333.3	716.7	326.8	-159.4	627.47	91.5	OK
7	173.9	1217.4	2	333.3	1050.0	167.4	-159.4	626.59	73.8	OK
8	173.9	1391.3	2	333.3	1383.3	8.0	-159.4	625.70	56.1	OK
9	173.9	1565.2	2	333.3	1716.7	-151.4	-159.4	624.82	38.4	OK
10	173.9	1739.1	1.5	250.0	1966.7	-227.5	-76.1	623.93	20.6	OK
11	173.9	1913.0	0.2	33.3	2000.0	-87.0	140.6	623.51	12.2	OK
12	173.9	2087.0	0.2	33.3	2033.3	53.6	140.6	624.29	27.8	OK
13	173.9	2260.9	0.2	33.3	2066.7	194.2	140.6	625.07	43.4	OK
14	173.9	2434.8	0.2	33.3	2100.0	334.8	140.6	625.85	59.0	OK
15	173.9	2608.7	0.5	83.3	2183.3	425.4	90.6	626.63	74.7	OK
16	173.9	2782.6	1.5	250.0	2433.3	349.3	-76.1	627.14	84.7	OK
17	173.9	2956.5	1.8	300.0	2733.3	223.2	-126.1	626.71	76.3	OK
18	173.9	3130.4	1.8	300.0	3033.3	97.1	-126.1	626.01	62.3	OK
19	173.9	3304.3	1.8	300.0	3333.3	-29.0	-126.1	625.31	48.3	OK
20	173.9	3478.3	1.8	300.0	3633.3	-155.1	-126.1	624.61	34.2	OK
21	173.9	3652.2	1.5	250.0	3883.3	-231.2	-76.1	623.91	20.2	OK
22	173.9	3826.1	0.5	83.3	3966.7	-140.6	90.6	623.49	11.8	OK
23	0.0	3826.1	0.1	16.7	3983.3	-157.2	-16.7	623.99	21.9	OK
24	173.9	4000.0	0.1	16.7	4000.0	0.0	157.2	623.90	20.0	OK

Table 6.13: Analysis of ESR 665 in water district C5

`	Data		Output	
1	Peak Factor	2	ESR Name	665
2	Inflow Hours	23.00	Maximum surplus (m3)	562.3
3	Outflow Hours	24	Minimum surplus (m3)	-231.2
4	Minimum wataer level (m)	622.90	Computed Capacity (m3)	793.5
5	Initial water level (m)	623.90	Max. serving Demand (mld)	4.00
6	Maximum wataer level (m)	627.90	Max. Population serving	22667
7	Diameter (m)	15.14	Initial Volume (m3)	180.0
8	Area (m2)=	180.03	Fire storage (m3)	0.2
9	Initial water depth in tank	1	Existing capacity (ML)	900.1
10	Volume of ESR	900.143	GL (m)	606.47

Demand = 4.00

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	173.9		0.1	16.7		0.0	157.2	623.90	20.0	OK
1	173.9	173.9	0.1	16.7	16.7	157.2	157.2	624.77	37.5	OK
2	173.9	347.8	0.1	16.7	33.3	314.5	157.2	625.65	54.9	OK
3	173.9	521.7	0.3	50.0	83.3	438.4	123.9	626.52	72.4	OK
4	173.9	695.7	0.3	50.0	133.3	562.3	123.9	627.21	86.2	OK
5	173.9	869.6	1.5	250.0	383.3	486.2	-76.1	627.90	99.9	OK
6	173.9	1043.5	2	333.3	716.7	326.8	-159.4	627.47	91.5	OK
7	173.9	1217.4	2	333.3	1050.0	167.4	-159.4	626.59	73.8	OK
8	173.9	1391.3	2	333.3	1383.3	8.0	-159.4	625.70	56.1	OK
9	173.9	1565.2	2	333.3	1716.7	-151.4	-159.4	624.82	38.4	OK
10	173.9	1739.1	1.5	250.0	1966.7	-227.5	-76.1	623.93	20.6	OK
11	173.9	1913.0	0.2	33.3	2000.0	-87.0	140.6	623.51	12.2	OK
12	173.9	2087.0	0.2	33.3	2033.3	53.6	140.6	624.29	27.8	OK
13	173.9	2260.9	0.2	33.3	2066.7	194.2	140.6	625.07	43.4	OK
14	173.9	2434.8	0.2	33.3	2100.0	334.8	140.6	625.85	59.0	OK
15	173.9	2608.7	0.5	83.3	2183.3	425.4	90.6	626.63	74.7	OK
16	173.9	2782.6	1.5	250.0	2433.3	349.3	-76.1	627.14	84.7	OK
17	173.9	2956.5	1.8	300.0	2733.3	223.2	-126.1	626.71	76.3	OK
18	173.9	3130.4	1.8	300.0	3033.3	97.1	-126.1	626.01	62.3	OK
19	173.9	3304.3	1.8	300.0	3333.3	-29.0	-126.1	625.31	48.3	OK
20	173.9	3478.3	1.8	300.0	3633.3	-155.1	-126.1	624.61	34.2	OK
21	173.9	3652.2	1.5	250.0	3883.3	-231.2	-76.1	623.91	20.2	OK
22	173.9	3826.1	0.5	83.3	3966.7	-140.6	90.6	623.49	11.8	OK
23	0.0	3826.1	0.1	16.7	3983.3	-157.2	-16.7	623.99	21.9	OK
24	173.9	4000.0	0.1	16.7	4000.0	0.0	157.2	623.90	20.0	OK

Table 6.14: Analysis of ESR 804 in water district C10

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	804
2	Inflow Hours	23.00	Maximum surplus (m3)	955.9
3	Outflow Hours	24	Minimum surplus (m3)	-393.0
4	Minimum wataer level (m)	603.05	Computed Capacity (m3)	1348.9
5	Initial water level (m)	604.05	Max. serving Demand (mld)	6.80
6	Maximum wataer level (m)	608.54	Max. Population serving	38533
7	Diameter (m)	18.66	Initial Volume (m3)	273.5
8	Area (m2)=	273.47	Fire storage (m3)	0.5
9	Initial water depth in tank	1	Existing capacity (ML)	1501.4
10	Volume of ESR	1501.36	GL (m)	586.14

Demand = 6.80

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	295.7		0.1	28.3		0.0	267.3	604.05	18.2	OK
1	295.7	295.7	0.1	28.3	28.3	267.3	267.3	605.03	36.0	OK
2	295.7	591.3	0.1	28.3	56.7	534.6	267.3	606.01	53.8	OK
3	295.7	887.0	0.3	85.0	141.7	745.3	210.7	606.98	71.6	OK
4	295.7	1182.6	0.3	85.0	226.7	955.9	210.7	607.75	85.7	OK
5	295.7	1478.3	1.5	425.0	651.7	826.6	-129.3	608.52	99.7	OK
6	295.7	1773.9	2	566.7	1218.3	555.6	-271.0	608.05	91.1	OK
7	295.7	2069.6	2	566.7	1785.0	284.6	-271.0	607.06	73.0	OK
8	295.7	2365.2	2	566.7	2351.7	13.6	-271.0	606.07	55.0	OK
9	295.7	2660.9	2	566.7	2918.3	-257.5	-271.0	605.08	36.9	OK
10	295.7	2956.5	1.5	425.0	3343.3	-386.8	-129.3	604.09	18.9	OK
11	295.7	3252.2	0.2	56.7	3400.0	-147.8	239.0	603.61	10.3	OK
12	295.7	3547.8	0.2	56.7	3456.7	91.2	239.0	604.49	26.2	OK
13	295.7	3843.5	0.2	56.7	3513.3	330.1	239.0	605.36	42.1	OK
14	295.7	4139.1	0.2	56.7	3570.0	569.1	239.0	606.23	58.0	OK
15	295.7	4434.8	0.5	141.7	3711.7	723.1	154.0	607.11	73.9	OK
16	295.7	4730.4	1.5	425.0	4136.7	593.8	-129.3	607.67	84.2	OK
17	295.7	5026.1	1.8	510.0	4646.7	379.4	-214.3	607.20	75.6	OK
18	295.7	5321.7	1.8	510.0	5156.7	165.1	-214.3	606.41	61.3	OK
19	295.7	5617.4	1.8	510.0	5666.7	-49.3	-214.3	605.63	47.0	OK
20	295.7	5913.0	1.8	510.0	6176.7	-263.6	-214.3	604.85	32.7	OK
21	295.7	6208.7	1.5	425.0	6601.7	-393.0	-129.3	604.06	18.5	OK
22	295.7	6504.3	0.5	141.7	6743.3	-239.0	154.0	603.59	9.8	OK
23	0.0	6504.3	0.1	28.3	6771.7	-267.3	-28.3	604.15	20.1	OK
24	295.7	6800.0	0.1	28.3	6800.0	0.0	267.3	604.05	18.2	OK

Table 6.15: Analysis of ESR Sant Tukaram in water district C11

`	Data		Output	
1	Peak Factor	2	ESR Name	Sant Tukaram
2	Inflow Hours	23.00	Maximum surplus (m3)	899.7
3	Outflow Hours	24	Minimum surplus (m3)	-369.9
4	Minimum wataer level (m)	606.57	Computed Capacity (m3)	1269.6
5	Initial water level (m)	607.57	Max. serving Demand (mld)	6.40
6	Maximum wataer level (m)	611.00	Max. Population serving	36267
7	Diameter (m)	20.76	Initial Volume (m3)	338.5
8	Area (m2)=	338.49	Fire storage (m3)	0.4
9	Initial water depth in tank	1	Existing capacity (ML)	1499.5
10	Volume of ESR	1499.51	GL (m)	594.19

Demand = 6.40

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	278.3		0.1	26.7		0.0	251.6	607.57	22.6	OK
1	278.3	278.3	0.1	26.7	26.7	251.6	251.6	608.31	39.4	OK
2	278.3	556.5	0.1	26.7	53.3	503.2	251.6	609.06	56.1	OK
3	278.3	834.8	0.3	80.0	133.3	701.4	198.3	609.80	72.9	OK
4	278.3	1113.0	0.3	80.0	213.3	899.7	198.3	610.39	86.1	OK
5	278.3	1391.3	1.5	400.0	613.3	778.0	-121.7	610.97	99.4	OK
6	278.3	1669.6	2	533.3	1146.7	522.9	-255.1	610.61	91.2	OK
7	278.3	1947.8	2	533.3	1680.0	267.8	-255.1	609.86	74.2	OK
8	278.3	2226.1	2	533.3	2213.3	12.8	-255.1	609.10	57.2	OK
9	278.3	2504.3	2	533.3	2746.7	-242.3	-255.1	608.35	40.2	OK
10	278.3	2782.6	1.5	400.0	3146.7	-364.1	-121.7	607.60	23.2	OK
11	278.3	3060.9	0.2	53.3	3200.0	-139.1	224.9	607.24	15.1	OK
12	278.3	3339.1	0.2	53.3	3253.3	85.8	224.9	607.90	30.1	OK
13	278.3	3617.4	0.2	53.3	3306.7	310.7	224.9	608.57	45.1	OK
14	278.3	3895.7	0.2	53.3	3360.0	535.7	224.9	609.23	60.1	OK
15	278.3	4173.9	0.5	133.3	3493.3	680.6	144.9	609.90	75.1	OK
16	278.3	4452.2	1.5	400.0	3893.3	558.8	-121.7	610.32	84.7	OK
17	278.3	4730.4	1.8	480.0	4373.3	357.1	-201.7	609.96	76.6	OK
18	278.3	5008.7	1.8	480.0	4853.3	155.4	-201.7	609.37	63.2	OK
19	278.3	5287.0	1.8	480.0	5333.3	-46.4	-201.7	608.77	49.7	OK
20	278.3	5565.2	1.8	480.0	5813.3	-248.1	-201.7	608.18	36.3	OK
21	278.3	5843.5	1.5	400.0	6213.3	-369.9	-121.7	607.58	22.8	OK
22	278.3	6121.7	0.5	133.3	6346.7	-224.9	144.9	607.22	14.7	OK
23	0.0	6121.7	0.1	26.7	6373.3	-251.6	-26.7	607.65	24.4	OK
24	278.3	6400.0	0.1	26.7	6400.0	0.0	251.6	607.57	22.6	OK

Table 6.16: Analysis of ESR 771 in water district C12

`	**Data**		**Output**	
1	Peak Factor	2	ESR Name	771
2	Inflow Hours	23.00	Maximum surplus (m3)	492.0
3	Outflow Hours	24	Minimum surplus (m3)	-202.3
4	Minimum wataer level (m)	626.50	Computed Capacity (m3)	694.3
5	Initial water level (m)	627.50	Max. serving Demand (mld)	3.50
6	Maximum wataer level (m)	631.50	Max. Population serving	19833
7	Diameter (m)	14.27	Initial Volume (m3)	159.9
8	Area (m2)=	159.93	Fire storage (m3)	0.2
9	Initial water depth in tank	1	Existing capacity (ML)	799.7
10	Volume of ESR	799.664	GL (m)	603.84

Demand = 3.50

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	152.2		0.1	14.6		0.0	137.6	627.50	20.0	OK
1	152.2	152.2	0.1	14.6	14.6	137.6	137.6	628.36	37.2	OK
2	152.2	304.3	0.1	14.6	29.2	275.2	137.6	629.22	54.4	OK
3	152.2	456.5	0.3	43.8	72.9	383.6	108.4	630.08	71.6	OK
4	152.2	608.7	0.3	43.8	116.7	492.0	108.4	630.76	85.2	OK
5	152.2	760.9	1.5	218.8	335.4	425.5	-66.6	631.44	98.7	OK
6	152.2	913.0	2	291.7	627.1	286.0	-139.5	631.02	90.4	OK
7	152.2	1065.2	2	291.7	918.8	146.5	-139.5	630.15	73.0	OK
8	152.2	1217.4	2	291.7	1210.4	7.0	-139.5	629.28	55.5	OK
9	152.2	1369.6	2	291.7	1502.1	-132.5	-139.5	628.40	38.1	OK
10	152.2	1521.7	1.5	218.8	1720.8	-199.1	-66.6	627.53	20.6	OK
11	152.2	1673.9	0.2	29.2	1750.0	-76.1	123.0	627.12	12.3	OK
12	152.2	1826.1	0.2	29.2	1779.2	46.9	123.0	627.88	27.7	OK
13	152.2	1978.3	0.2	29.2	1808.3	169.9	123.0	628.65	43.1	OK
14	152.2	2130.4	0.2	29.2	1837.5	292.9	123.0	629.42	58.5	OK
15	152.2	2282.6	0.5	72.9	1910.4	372.2	79.3	630.19	73.8	OK
16	152.2	2434.8	1.5	218.8	2129.2	305.6	-66.6	630.69	83.7	OK
17	152.2	2587.0	1.8	262.5	2391.7	195.3	-110.3	630.27	75.4	OK
18	152.2	2739.1	1.8	262.5	2654.2	85.0	-110.3	629.58	61.6	OK
19	152.2	2891.3	1.8	262.5	2916.7	-25.4	-110.3	628.89	47.8	OK
20	152.2	3043.5	1.8	262.5	3179.2	-135.7	-110.3	628.20	34.0	OK
21	152.2	3195.7	1.5	218.8	3397.9	-202.3	-66.6	627.51	20.2	OK
22	152.2	3347.8	0.5	72.9	3470.8	-123.0	79.3	627.10	11.9	OK
23	0.0	3347.8	0.1	14.6	3485.4	-137.6	-14.6	627.59	21.8	OK
24	152.2	3500.0	0.1	14.6	3500.0	0.0	137.6	627.50	20.0	OK

Table 6.17: Analysis of ESR 774 in water district C12

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	774
2	Inflow Hours	23.00	Maximum surplus (m3)	1237.1
3	Outflow Hours	24	Minimum surplus (m3)	-508.6
4	Minimum wataer level (m)	639.60	Computed Capacity (m3)	1745.7
5	Initial water level (m)	640.60	Max. serving Demand (mld)	8.80
6	Maximum wataer level (m)	644.60	Max. Population serving	49867
7	Diameter (m)	22.57	Initial Volume (m3)	400.1
8	Area (m2)=	400.09	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.4
10	Volume of ESR	2000.43	GL (m)	603.15

Demand = 8.80

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	382.6		0.1	36.7		0.0	345.9	640.60	20.0	OK
1	382.6	382.6	0.1	36.7	36.7	345.9	345.9	641.46	37.3	OK
2	382.6	765.2	0.1	36.7	73.3	691.9	345.9	642.33	54.6	OK
3	382.6	1147.8	0.3	110.0	183.3	964.5	272.6	643.19	71.9	OK
4	382.6	1530.4	0.3	110.0	293.3	1237.1	272.6	643.88	85.5	OK
5	382.6	1913.0	1.5	550.0	843.3	1069.7	-167.4	644.56	99.1	OK
6	382.6	2295.7	2	733.3	1576.7	719.0	-350.7	644.14	90.8	OK
7	382.6	2678.3	2	733.3	2310.0	368.3	-350.7	643.26	73.2	OK
8	382.6	3060.9	2	733.3	3043.3	17.5	-350.7	642.39	55.7	OK
9	382.6	3443.5	2	733.3	3776.7	-333.2	-350.7	641.51	38.2	OK
10	382.6	3826.1	1.5	550.0	4326.7	-500.6	-167.4	640.63	20.6	OK
11	382.6	4208.7	0.2	73.3	4400.0	-191.3	309.3	640.21	12.3	OK
12	382.6	4591.3	0.2	73.3	4473.3	118.0	309.3	640.99	27.7	OK
13	382.6	4973.9	0.2	73.3	4546.7	427.2	309.3	641.76	43.2	OK
14	382.6	5356.5	0.2	73.3	4620.0	736.5	309.3	642.53	58.7	OK
15	382.6	5739.1	0.5	183.3	4803.3	935.8	199.3	643.31	74.1	OK
16	382.6	6121.7	1.5	550.0	5353.3	768.4	-167.4	643.80	84.1	OK
17	382.6	6504.3	1.8	660.0	6013.3	491.0	-277.4	643.39	75.7	OK
18	382.6	6887.0	1.8	660.0	6673.3	213.6	-277.4	642.69	61.8	OK
19	382.6	7269.6	1.8	660.0	7333.3	-63.8	-277.4	642.00	48.0	OK
20	382.6	7652.2	1.8	660.0	7993.3	-341.2	-277.4	641.31	34.1	OK
21	382.6	8034.8	1.5	550.0	8543.3	-508.6	-167.4	640.61	20.2	OK
22	382.6	8417.4	0.5	183.3	8726.7	-309.3	199.3	640.19	11.9	OK
23	0.0	8417.4	0.1	36.7	8763.3	-345.9	-36.7	640.69	21.8	OK
24	382.6	8800.0	0.1	36.7	8800.0	0.0	345.9	640.60	20.0	OK

Table 6.18: Analysis of ESR Annasaheb_Magar in water district C13

`	Data		Output	
1	Peak Factor	2	ESR Name	Annasaheb_Magar
2	Inflow Hours	23.00	Maximum surplus (m3)	1026.2
3	Outflow Hours	24	Minimum surplus (m3)	-421.9
4	Minimum wataer level (m)	599.70	Computed Capacity (m3)	1448.1
5	Initial water level (m)	600.70	Max. serving Demand (mld)	7.30
6	Maximum wataer level (m)	604.70	Max. Population serving	41367
7	Diameter (m)	20.50	Initial Volume (m3)	330.1
8	Area (m2)=	330.06	Fire storage (m3)	0.5
9	Initial water depth in tank	1	Existing capacity (ML)	1650.3
10	Volume of ESR	1650.32	GL (m)	587.32

Demand = 7.3

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	317.4		0.1	30.4		0.0	287.0	600.70	20.0	OK
1	317.4	317.4	0.1	30.4	30.4	287.0	287.0	601.57	37.4	OK
2	317.4	634.8	0.1	30.4	60.8	573.9	287.0	602.44	54.8	OK
3	317.4	952.2	0.3	91.3	152.1	800.1	226.1	603.31	72.2	OK
4	317.4	1269.6	0.3	91.3	243.3	1026.2	226.1	603.99	85.9	OK
5	317.4	1587.0	1.5	456.3	699.6	887.4	-138.9	604.68	99.6	OK
6	317.4	1904.3	2	608.3	1307.9	596.4	-290.9	604.26	91.2	OK
7	317.4	2221.7	2	608.3	1916.3	305.5	-290.9	603.38	73.5	OK
8	317.4	2539.1	2	608.3	2524.6	14.5	-290.9	602.50	55.9	OK
9	317.4	2856.5	2	608.3	3132.9	-276.4	-290.9	601.61	38.3	OK
10	317.4	3173.9	1.5	456.3	3589.2	-415.3	-138.9	600.73	20.6	OK
11	317.4	3491.3	0.2	60.8	3650.0	-158.7	256.6	600.31	12.2	OK
12	317.4	3808.7	0.2	60.8	3710.8	97.9	256.6	601.09	27.8	OK
13	317.4	4126.1	0.2	60.8	3771.7	354.4	256.6	601.87	43.3	OK
14	317.4	4443.5	0.2	60.8	3832.5	611.0	256.6	602.64	58.9	OK
15	317.4	4760.9	0.5	152.1	3984.6	776.3	165.3	603.42	74.4	OK
16	317.4	5078.3	1.5	456.3	4440.8	637.4	-138.9	603.92	84.4	OK
17	317.4	5395.7	1.8	547.5	4988.3	407.3	-230.1	603.50	76.0	OK
18	317.4	5713.0	1.8	547.5	5535.8	177.2	-230.1	602.80	62.1	OK
19	317.4	6030.4	1.8	547.5	6083.3	-52.9	-230.1	602.11	48.1	OK
20	317.4	6347.8	1.8	547.5	6630.8	-283.0	-230.1	601.41	34.2	OK
21	317.4	6665.2	1.5	456.3	7087.1	-421.9	-138.9	600.71	20.2	OK
22	317.4	6982.6	0.5	152.1	7239.2	-256.6	165.3	600.29	11.8	OK
23	0.0	6982.6	0.1	30.4	7269.6	-287.0	-30.4	600.79	21.8	OK
24	317.4	7300.0	0.1	30.4	7300.0	0.0	287.0	600.70	20.0	OK

Table 6.19: Analysis of ESR Ajmera-1 in water district C14

	Data		Output	
1	Peak Factor	2	ESR Name	Ajmera-1
2	Inflow Hours	23.00	Maximum surplus (m3)	927.8
3	Outflow Hours	24	Minimum surplus (m3)	-381.4
4	Minimum wataer level (m)	599.50	Computed Capacity (m3)	1309.2
5	Initial water level (m)	600.50	Max. serving Demand (mld)	6.60
6	Maximum wataer level (m)	604.50	Max. Population serving	37400
7	Diameter (m)	19.54	Initial Volume (m3)	299.9
8	Area (m2)=	299.87	Fire storage (m3)	0.5
9	Initial water depth in tank	1	Existing capacity (ML)	1499.4
10	Volume of ESR	1499.37	GL (m)	589.71

Demand = 6.6

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	287.0		0.1	27.5		0.0	259.5	600.50	20.0	OK
1	287.0	287.0	0.1	27.5	27.5	259.5	259.5	601.37	37.3	OK
2	287.0	573.9	0.1	27.5	55.0	518.9	259.5	602.23	54.6	OK
3	287.0	860.9	0.3	82.5	137.5	723.4	204.5	603.10	71.9	OK
4	287.0	1147.8	0.3	82.5	220.0	927.8	204.5	603.78	85.5	OK
5	287.0	1434.8	1.5	412.5	632.5	802.3	-125.5	604.46	99.2	OK
6	287.0	1721.7	2	550.0	1182.5	539.2	-263.0	604.04	90.8	OK
7	287.0	2008.7	2	550.0	1732.5	276.2	-263.0	603.16	73.3	OK
8	287.0	2295.7	2	550.0	2282.5	13.2	-263.0	602.29	55.7	OK
9	287.0	2582.6	2	550.0	2832.5	-249.9	-263.0	601.41	38.2	OK
10	287.0	2869.6	1.5	412.5	3245.0	-375.4	-125.5	600.53	20.6	OK
11	287.0	3156.5	0.2	55.0	3300.0	-143.5	232.0	600.11	12.3	OK
12	287.0	3443.5	0.2	55.0	3355.0	88.5	232.0	600.89	27.7	OK
13	287.0	3730.4	0.2	55.0	3410.0	320.4	232.0	601.66	43.2	OK
14	287.0	4017.4	0.2	55.0	3465.0	552.4	232.0	602.43	58.7	OK
15	287.0	4304.3	0.5	137.5	3602.5	701.8	149.5	603.21	74.1	OK
16	287.0	4591.3	1.5	412.5	4015.0	576.3	-125.5	603.71	84.1	OK
17	287.0	4878.3	1.8	495.0	4510.0	368.3	-208.0	603.29	75.7	OK
18	287.0	5165.2	1.8	495.0	5005.0	160.2	-208.0	602.59	61.9	OK
19	287.0	5452.2	1.8	495.0	5500.0	-47.8	-208.0	601.90	48.0	OK
20	287.0	5739.1	1.8	495.0	5995.0	-255.9	-208.0	601.21	34.1	OK
21	287.0	6026.1	1.5	412.5	6407.5	-381.4	-125.5	600.51	20.2	OK
22	287.0	6313.0	0.5	137.5	6545.0	-232.0	149.5	600.09	11.9	OK
23	0.0	6313.0	0.1	27.5	6572.5	-259.5	-27.5	600.59	21.8	OK
24	287.0	6600.0	0.1	27.5	6600.0	0.0	259.5	600.50	20.0	OK

Table 6.20: Analysis of ESR Ajmera-2 in water district C14

`	Data		Output	
			ESR	Ajmera-2
1	Peak Factor	2	Name	
2	Inflow Hours	23.00	Maximum surplus (m3)	913.8
3	Outflow Hours	24	Minimum surplus (m3)	-375.6
4	Minimum wataer level (m)	599.72	Computed Capacity (m3)	1289.4
5	Initial water level (m)	600.72	Max. serving Demand (mld)	6.50
6	Maximum wataer level (m)	604.50	Max. Population serving	36833
7	Diameter (m)	19.99	Initial Volume (m3)	313.8
8	Area (m2)=	313.84	Fire storage (m3)	0.4
9	Initial water depth in tank	1	Existing capacity (ML)	1500.2
10	Volume of ESR	1500.18	GL (m)	589.8

Demand = 6.5

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	282.6		0.1	27.1		0.0	255.5	600.72	20.9	OK
1	282.6	282.6	0.1	27.1	27.1	255.5	255.5	601.53	38.0	OK
2	282.6	565.2	0.1	27.1	54.2	511.1	255.5	602.35	55.0	OK
3	282.6	847.8	0.3	81.3	135.4	712.4	201.4	603.16	72.0	OK
4	282.6	1130.4	0.3	81.3	216.7	913.8	201.4	603.80	85.4	OK
5	282.6	1413.0	1.5	406.3	622.9	790.1	-123.6	604.45	98.9	OK
6	282.6	1695.7	2	541.7	1164.6	531.1	-259.1	604.05	90.6	OK
7	282.6	1978.3	2	541.7	1706.3	272.0	-259.1	603.23	73.4	OK
8	282.6	2260.9	2	541.7	2247.9	13.0	-259.1	602.40	56.1	OK
9	282.6	2543.5	2	541.7	2789.6	-246.1	-259.1	601.58	38.8	OK
10	282.6	2826.1	1.5	406.3	3195.8	-369.7	-123.6	600.75	21.5	OK
11	282.6	3108.7	0.2	54.2	3250.0	-141.3	228.4	600.36	13.3	OK
12	282.6	3391.3	0.2	54.2	3304.2	87.1	228.4	601.08	28.5	OK
13	282.6	3673.9	0.2	54.2	3358.3	315.6	228.4	601.81	43.8	OK
14	282.6	3956.5	0.2	54.2	3412.5	544.0	228.4	602.54	59.0	OK
15	282.6	4239.1	0.5	135.4	3547.9	691.2	147.2	603.27	74.2	OK
16	282.6	4521.7	1.5	406.3	3954.2	567.6	-123.6	603.74	84.0	OK
17	282.6	4804.3	1.8	487.5	4441.7	362.7	-204.9	603.34	75.8	OK
18	282.6	5087.0	1.8	487.5	4929.2	157.8	-204.9	602.69	62.1	OK
19	282.6	5369.6	1.8	487.5	5416.7	-47.1	-204.9	602.04	48.5	OK
20	282.6	5652.2	1.8	487.5	5904.2	-252.0	-204.9	601.38	34.8	OK
21	282.6	5934.8	1.5	406.3	6310.4	-375.6	-123.6	600.73	21.2	OK
22	282.6	6217.4	0.5	135.4	6445.8	-228.4	147.2	600.34	12.9	OK
23	0.0	6217.4	0.1	27.1	6472.9	-255.5	-27.1	600.81	22.7	OK
24	282.6	6500.0	0.1	27.1	6500.0	0.0	255.5	600.72	20.9	OK

Table 6.21: Analysis of ESR 294 in water district D9

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	294
2	Inflow Hours	23.00	Maximum surplus (m3)	1237.1
3	Outflow Hours	24	Minimum surplus (m3)	-508.6
4	Minimum wataer level (m)	571.20	Computed Capacity (m3)	1745.7
5	Initial water level (m)	572.20	Max. serving Demand (mld)	8.80
6	Maximum wataer level (m)	576.20	Max. Population serving	49867
7	Diameter (m)	22.57	Initial Volume (m3)	400.1
8	Area (m2)=	400.09	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.4
10	Volume of ESR	2000.43	GL (m)	555.34

Demand = 8.80

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	382.6		0.1	36.7		0.0	345.9	572.20	20.0	OK
1	382.6	382.6	0.1	36.7	36.7	345.9	345.9	573.06	37.3	OK
2	382.6	765.2	0.1	36.7	73.3	691.9	345.9	573.93	54.6	OK
3	382.6	1147.8	0.3	110.0	183.3	964.5	272.6	574.79	71.9	OK
4	382.6	1530.4	0.3	110.0	293.3	1237.1	272.6	575.48	85.5	OK
5	382.6	1913.0	1.5	550.0	843.3	1069.7	-167.4	576.16	99.1	OK
6	382.6	2295.7	2	733.3	1576.7	719.0	-350.7	575.74	90.8	OK
7	382.6	2678.3	2	733.3	2310.0	368.3	-350.7	574.86	73.2	OK
8	382.6	3060.9	2	733.3	3043.3	17.5	-350.7	573.99	55.7	OK
9	382.6	3443.5	2	733.3	3776.7	-333.2	-350.7	573.11	38.2	OK
10	382.6	3826.1	1.5	550.0	4326.7	-500.6	-167.4	572.23	20.6	OK
11	382.6	4208.7	0.2	73.3	4400.0	-191.3	309.3	571.81	12.3	OK
12	382.6	4591.3	0.2	73.3	4473.3	118.0	309.3	572.59	27.7	OK
13	382.6	4973.9	0.2	73.3	4546.7	427.2	309.3	573.36	43.2	OK
14	382.6	5356.5	0.2	73.3	4620.0	736.5	309.3	574.13	58.7	OK
15	382.6	5739.1	0.5	183.3	4803.3	935.8	199.3	574.91	74.1	OK
16	382.6	6121.7	1.5	550.0	5353.3	768.4	-167.4	575.40	84.1	OK
17	382.6	6504.3	1.8	660.0	6013.3	491.0	-277.4	574.99	75.7	OK
18	382.6	6887.0	1.8	660.0	6673.3	213.6	-277.4	574.29	61.8	OK
19	382.6	7269.6	1.8	660.0	7333.3	-63.8	-277.4	573.60	48.0	OK
20	382.6	7652.2	1.8	660.0	7993.3	-341.2	-277.4	572.91	34.1	OK
21	382.6	8034.8	1.5	550.0	8543.3	-508.6	-167.4	572.21	20.2	OK
22	382.6	8417.4	0.5	183.3	8726.7	-309.3	199.3	571.79	11.9	OK
23	0.0	8417.4	0.1	36.7	8763.3	-345.9	-36.7	572.29	21.8	OK
24	382.6	8800.0	0.1	36.7	8800.0	0.0	345.9	572.20	20.0	OK

Table 6.22: Analysis of ESR 302 in water district D10

`	Data		Output	
			ESR	
1	Peak Factor	2	Name	302
2	Inflow Hours	23.00	Maximum surplus (m3)	1265.2
3	Outflow Hours	24	Minimum surplus (m3)	-520.1
4	Minimum wataer level (m)	568.00	Computed Capacity (m3)	1785.3
5	Initial water level (m)	569.00	Max. serving Demand (mld)	9.00
6	Maximum wataer level (m)	573.50	Max. Population serving	51000
7	Diameter (m)	21.52	Initial Volume (m3)	363.7
8	Area (m2)=	363.73	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.5
10	Volume of ESR	2000.49	GL (m)	555.03

Demand = 9.00

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	391.3		0.1	37.5		0.0	353.8	569.00	18.2	OK
1	391.3	391.3	0.1	37.5	37.5	353.8	353.8	569.97	35.9	OK
2	391.3	782.6	0.1	37.5	75.0	707.6	353.8	570.95	53.6	OK
3	391.3	1173.9	0.3	112.5	187.5	986.4	278.8	571.92	71.2	OK
4	391.3	1565.2	0.3	112.5	300.0	1265.2	278.8	572.68	85.2	OK
5	391.3	1956.5	1.5	562.5	862.5	1094.0	-171.2	573.45	99.1	OK
6	391.3	2347.8	2	750.0	1612.5	735.3	-358.7	572.98	90.6	OK
7	391.3	2739.1	2	750.0	2362.5	376.6	-358.7	571.99	72.6	OK
8	391.3	3130.4	2	750.0	3112.5	17.9	-358.7	571.01	54.7	OK
9	391.3	3521.7	2	750.0	3862.5	-340.8	-358.7	570.02	36.8	OK
10	391.3	3913.0	1.5	562.5	4425.0	-512.0	-171.2	569.04	18.8	OK
11	391.3	4304.3	0.2	75.0	4500.0	-195.7	316.3	568.57	10.3	OK
12	391.3	4695.7	0.2	75.0	4575.0	120.7	316.3	569.43	26.1	OK
13	391.3	5087.0	0.2	75.0	4650.0	437.0	316.3	570.30	41.9	OK
14	391.3	5478.3	0.2	75.0	4725.0	753.3	316.3	571.17	57.7	OK
15	391.3	5869.6	0.5	187.5	4912.5	957.1	203.8	572.04	73.5	OK
16	391.3	6260.9	1.5	562.5	5475.0	785.9	-171.2	572.60	83.7	OK
17	391.3	6652.2	1.8	675.0	6150.0	502.2	-283.7	572.13	75.2	OK
18	391.3	7043.5	1.8	675.0	6825.0	218.5	-283.7	571.35	61.0	OK
19	391.3	7434.8	1.8	675.0	7500.0	-65.2	-283.7	570.57	46.8	OK
20	391.3	7826.1	1.8	675.0	8175.0	-348.9	-283.7	569.79	32.6	OK
21	391.3	8217.4	1.5	562.5	8737.5	-520.1	-171.2	569.01	18.4	OK
22	391.3	8608.7	0.5	187.5	8925.0	-316.3	203.8	568.54	9.9	OK
23	0.0	8608.7	0.1	37.5	8962.5	-353.8	-37.5	569.10	20.1	OK
24	391.3	9000.0	0.1	37.5	9000.0	0.0	353.8	569.00	18.2	OK

Table 6.23: Analysis of ESR 103 in water district d11

`	Data		Output	
1	Peak Factor	2	ESR Name	103
2	Inflow Hours	23.00	Maximum surplus (m3)	351.4
3	Outflow Hours	24	Minimum surplus (m3)	-144.5
4	Minimum wataer level (m)	566.00	Computed Capacity (m3)	495.9
5	Initial water level (m)	567.00	Max. serving Demand (mld)	2.50
6	Maximum wataer level (m)	570.00	Max. Population serving	14167
7	Diameter (m)	13.82	Initial Volume (m3)	150.0
8	Area (m2)=	150.00	Fire storage (m3)	0.1
9	Initial water depth in tank	1	Existing capacity (ML)	600.0
10	Volume of ESR	600.02	GL (m)	555

Demand = 2.5

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	108.7		0.1	10.4		0.0	98.3	567.00	25.0	OK
1	108.7	108.7	0.1	10.4	10.4	98.3	98.3	567.66	41.4	OK
2	108.7	217.4	0.1	10.4	20.8	196.6	98.3	568.31	57.8	OK
3	108.7	326.1	0.3	31.3	52.1	274.0	77.4	568.97	74.1	OK
4	108.7	434.8	0.3	31.3	83.3	351.4	77.4	569.48	87.0	OK
5	108.7	543.5	1.5	156.3	239.6	303.9	-47.6	570.00	100.0	OK
6	108.7	652.2	2	208.3	447.9	204.3	-99.6	569.68	92.0	OK
7	108.7	760.9	2	208.3	656.3	104.6	-99.6	569.02	75.4	OK
8	108.7	869.6	2	208.3	864.6	5.0	-99.6	568.35	58.8	OK
9	108.7	978.3	2	208.3	1072.9	-94.7	-99.6	567.69	42.2	OK
10	108.7	1087.0	1.5	156.3	1229.2	-142.2	-47.6	567.02	25.6	OK
11	108.7	1195.7	0.2	20.8	1250.0	-54.3	87.9	566.71	17.7	OK
12	108.7	1304.3	0.2	20.8	1270.8	33.5	87.9	567.29	32.3	OK
13	108.7	1413.0	0.2	20.8	1291.7	121.4	87.9	567.88	47.0	OK
14	108.7	1521.7	0.2	20.8	1312.5	209.2	87.9	568.46	61.6	OK
15	108.7	1630.4	0.5	52.1	1364.6	265.9	56.6	569.05	76.3	OK
16	108.7	1739.1	1.5	156.3	1520.8	218.3	-47.6	569.43	85.7	OK
17	108.7	1847.8	1.8	187.5	1708.3	139.5	-78.8	569.11	77.8	OK
18	108.7	1956.5	1.8	187.5	1895.8	60.7	-78.8	568.59	64.6	OK
19	108.7	2065.2	1.8	187.5	2083.3	-18.1	-78.8	568.06	51.5	OK
20	108.7	2173.9	1.8	187.5	2270.8	-96.9	-78.8	567.53	38.4	OK
21	108.7	2282.6	1.5	156.3	2427.1	-144.5	-47.6	567.01	25.2	OK
22	108.7	2391.3	0.5	52.1	2479.2	-87.9	56.6	566.69	17.3	OK
23	0.0	2391.3	0.1	10.4	2489.6	-98.3	-10.4	567.07	26.7	OK
24	108.7	2500.0	0.1	10.4	2500.0	0.0	98.3	567.00	25.0	OK

Table 6.24: Analysis of ESR 104 in water district D11

`	Data		Output	
1	Peak Factor	2	ESR Name	104
2	Inflow Hours	23.00	Maximum surplus (m3)	386.6
3	Outflow Hours	24	Minimum surplus (m3)	-158.9
4	Minimum wataer level (m)	569.20	Computed Capacity (m3)	545.5
5	Initial water level (m)	570.20	Max. serving Demand (mld)	2.75
6	Maximum wataer level (m)	573.50	Max. Population serving	15583
7	Diameter (m)	13.87	Initial Volume (m3)	151.1
8	Area (m2)=	151.09	Fire storage (m3)	0.1
9	Initial water depth in tank	1	Existing capacity (ML)	649.7
10	Volume of ESR	649.697	GL (m)	555

Demand = 2.75

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	119.6		0.1	11.5		0.0	108.1	570.20	23.3	OK
1	119.6	119.6	0.1	11.5	11.5	108.1	108.1	570.92	39.9	OK
2	119.6	239.1	0.1	11.5	22.9	216.2	108.1	571.63	56.5	OK
3	119.6	358.7	0.3	34.4	57.3	301.4	85.2	572.35	73.2	OK
4	119.6	478.3	0.3	34.4	91.7	386.6	85.2	572.91	86.3	OK
5	119.6	597.8	1.5	171.9	263.5	334.3	-52.3	573.47	99.4	OK
6	119.6	717.4	2	229.2	492.7	224.7	-109.6	573.13	91.3	OK
7	119.6	837.0	2	229.2	721.9	115.1	-109.6	572.40	74.5	OK
8	119.6	956.5	2	229.2	951.0	5.5	-109.6	571.68	57.6	OK
9	119.6	1076.1	2	229.2	1180.2	-104.1	-109.6	570.95	40.7	OK
10	119.6	1195.7	1.5	171.9	1352.1	-156.4	-52.3	570.23	23.9	OK
11	119.6	1315.2	0.2	22.9	1375.0	-59.8	96.6	569.88	15.8	OK
12	119.6	1434.8	0.2	22.9	1397.9	36.9	96.6	570.52	30.7	OK
13	119.6	1554.3	0.2	22.9	1420.8	133.5	96.6	571.16	45.6	OK
14	119.6	1673.9	0.2	22.9	1443.8	230.2	96.6	571.80	60.4	OK
15	119.6	1793.5	0.5	57.3	1501.0	292.4	62.3	572.44	75.3	OK
16	119.6	1913.0	1.5	171.9	1672.9	240.1	-52.3	572.85	84.9	OK
17	119.6	2032.6	1.8	206.3	1879.2	153.4	-86.7	572.50	76.9	OK
18	119.6	2152.2	1.8	206.3	2085.4	66.8	-86.7	571.93	63.5	OK
19	119.6	2271.7	1.8	206.3	2291.7	-19.9	-86.7	571.36	50.2	OK
20	119.6	2391.3	1.8	206.3	2497.9	-106.6	-86.7	570.78	36.8	OK
21	119.6	2510.9	1.5	171.9	2669.8	-158.9	-52.3	570.21	23.5	OK
22	119.6	2630.4	0.5	57.3	2727.1	-96.6	62.3	569.86	15.4	OK
23	0.0	2630.4	0.1	11.5	2738.5	-108.1	-11.5	570.28	25.0	OK
24	119.6	2750.0	0.1	11.5	2750.0	0.0	108.1	570.20	23.3	OK

Table 6.25: Analysis of ESR 251 in water district D13

`	Data		Output	
1	Peak Factor	2	ESR Name	251
2	Inflow Hours	23.00	Maximum surplus (m3)	1237.1
3	Outflow Hours	24	Minimum surplus (m3)	-508.6
4	Minimum wataer level (m)	596.10	Computed Capacity (m3)	1745.7
5	Initial water level (m)	597.10	Max. serving Demand (mld)	8.80
6	Maximum wataer level (m)	601.10	Max. Population serving	49867
7	Diameter (m)	22.57	Initial Volume (m3)	400.1
8	Area (m2)=	400.09	Fire storage (m3)	0.7
9	Initial water depth in tank	1	Existing capacity (ML)	2000.4
10	Volume of ESR	2000.43	GL (m)	579.53

Demand = 8.80

Time from Start (hours)	Inflow (m^3)	Cumulative Inflow (m^3)	Peak Factor	Outflow (m^3)	Cumulative Outflow (m^3)	Cumu. Inflow-Cumu. Outflow	Surplus or Deficit (Inflow-Outflow)	Level (m)	%Tank Full	Tank Status
0	382.6		0.1	36.7		0.0	345.9	597.10	20.0	OK
1	382.6	382.6	0.1	36.7	36.7	345.9	345.9	597.96	37.3	OK
2	382.6	765.2	0.1	36.7	73.3	691.9	345.9	598.83	54.6	OK
3	382.6	1147.8	0.3	110.0	183.3	964.5	272.6	599.69	71.9	OK
4	382.6	1530.4	0.3	110.0	293.3	1237.1	272.6	600.38	85.5	OK
5	382.6	1913.0	1.5	550.0	843.3	1069.7	-167.4	601.06	99.1	OK
6	382.6	2295.7	2	733.3	1576.7	719.0	-350.7	600.64	90.8	OK
7	382.6	2678.3	2	733.3	2310.0	368.3	-350.7	599.76	73.2	OK
8	382.6	3060.9	2	733.3	3043.3	17.5	-350.7	598.89	55.7	OK
9	382.6	3443.5	2	733.3	3776.7	-333.2	-350.7	598.01	38.2	OK
10	382.6	3826.1	1.5	550.0	4326.7	-500.6	-167.4	597.13	20.6	OK
11	382.6	4208.7	0.2	73.3	4400.0	-191.3	309.3	596.71	12.3	OK
12	382.6	4591.3	0.2	73.3	4473.3	118.0	309.3	597.49	27.7	OK
13	382.6	4973.9	0.2	73.3	4546.7	427.2	309.3	598.26	43.2	OK
14	382.6	5356.5	0.2	73.3	4620.0	736.5	309.3	599.03	58.7	OK
15	382.6	5739.1	0.5	183.3	4803.3	935.8	199.3	599.81	74.1	OK
16	382.6	6121.7	1.5	550.0	5353.3	768.4	-167.4	600.30	84.1	OK
17	382.6	6504.3	1.8	660.0	6013.3	491.0	-277.4	599.89	75.7	OK
18	382.6	6887.0	1.8	660.0	6673.3	213.6	-277.4	599.19	61.8	OK
19	382.6	7269.6	1.8	660.0	7333.3	-63.8	-277.4	598.50	48.0	OK
20	382.6	7652.2	1.8	660.0	7993.3	-341.2	-277.4	597.81	34.1	OK
21	382.6	8034.8	1.5	550.0	8543.3	-508.6	-167.4	597.11	20.2	OK
22	382.6	8417.4	0.5	183.3	8726.7	-309.3	199.3	596.69	11.9	OK
23	0.0	8417.4	0.1	36.7	8763.3	-345.9	-36.7	597.19	21.8	OK
24	382.6	8800.0	0.1	36.7	8800.0	0.0	345.9	597.10	20.0	OK

Altitude Valves

These valves are designed to reduce NRW. These valves prevents tank's overflow. The design has been made and shown in Table 6.26 and abstract is shown in Table 6.27.

Table 6.26: Altitude valves

SN	WD	Label	Elevation (m)	St_Ht (m)	Elevation (Minimum) (m)	Elevation (Maximum) (m)	Diameter (m)	Capacity (ML)	Optimum Demand (ML)	Depth of water	Flow (LPS)	Altitude Valve Sizing mm	Rate Each including 2 isolation DI Valve on upstream & downstream of Altitude Valve
1	A2	437	609	13.1	622	627	25.2	2.5	11.1	5	134	250	1073709
2	A2	438	608	13.3	622	627	25.2	2.5	11.1	5	134	250	1073709
3	B1	173	584	15.1	600	604	23.8	2	8.6	4	104	250	1073709
4	B1	174	585	14.9	600	604	25	2.2	9.5	4	115	250	1073709
5	B5	193	566	19.3	586	591	25.2	2.5	11.1	5	134	300	1442346
6	B5	194	566	19.3	586	591	22.6	2	8.8	5	106	300	1442346
7	C2	412	598	17.5	615	618	10.7	0.25	0.8	3	10	100	465341
8	C3	347	609	18.4	628	633	16.7	1.2	5.45	5	66	250	1073709
9	C3	350	609	19.7	629	634	23.7	2.2	9.7	5	117	250	1073709
10	C3	704	609	19.7	629	634	23.7	2.2	9.7	5	117	250	1073709
11	C5	664	606	16.7	623	628	15.1	0.9	4	5	48	150	483066
12	C10	804	586	16.9	603	609	18.7	1.5	6.8	6	82	250	1073709
13	C11	Sant Tukaram	594	12.4	607	611	20.8	1.5	6.4	4	77	150	483066
14	C12	771	604	22.7	627	632	14.3	0.8	3.5	5	42	150	483066
15	C12	774	604	22.7	627	632	22.6	2	8.8	5	106	250	1073709
16	C13	Annasaheb Magar	587	12.4	600	605	20.5	1.65	7.3	5	88	200	743764
17	C14	Ajmera-1	590	9.79	600	605	19.5	1.5	6.6	5	80	150	483066
18	C14	Ajmera-2	590	9.92	600	605	20	1.5	6.5	5	79	150	483066
19	D9	294	555	15.9	571	576	22.6	2	8.8	5	106	250	1073709
20	D10	302	555	13	568	574	21.5	2	9	6	109	250	1073709
21	D11	103	555	11	566	570	13.8	0.6	2.5	4	30	100	465341
22	D11	104	555	14.2	569	574	13.9	0.65	2.75	5	33	150	483066
23	D13	251	580	16.6	596	601	22.6	2	8.8	5	106	300	1442346

Table 6.27: Abstract of Altitude valves

Diameter	Number
100	2
150	6
200	1
250	11
300	3
	23

Chapter-7

Design of Primary Network

7.1 JURISDICTION FOR THE AREAS WITH DEMAND OF THE YEAR 2030

The area of the water districts (Figure 7.1), under consideration of transformation to 24x7 continuous water supply, have been so selected that there is enough storage of service tanks which are already built.

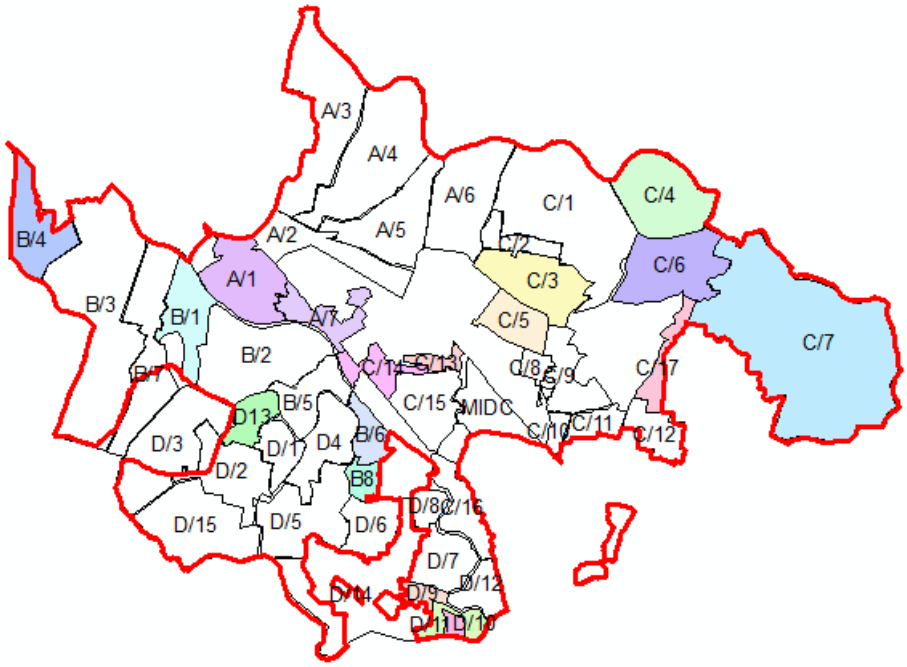


Figure 7.1: Area of Water districts

Existing primary network from the Clear water sump at WTP to various existing ESRs/ GSRs is shown in Figure 7.2. This network is drawn from the WTP to the respective ESRs.

7.2ANALYSIS OF EXISTING PRIMARY NETWORK

7.2.1 Inadequacy of existing primary network

The primary network is checked for the demand of 2045 and for inflow of 23 hours. As per Table 4.4, the demand of the year 2045 is 642.38 MLD. The transmission network is checked for this demand. The pipe results are shown in Table 7.1 and junction results are shown in Table 7.2. It is seen that the velocities in transmission mains are exceeding 1.8 m/s and the pressures are zero/ negative at some of the nodes. Hence, the network needs modifications.

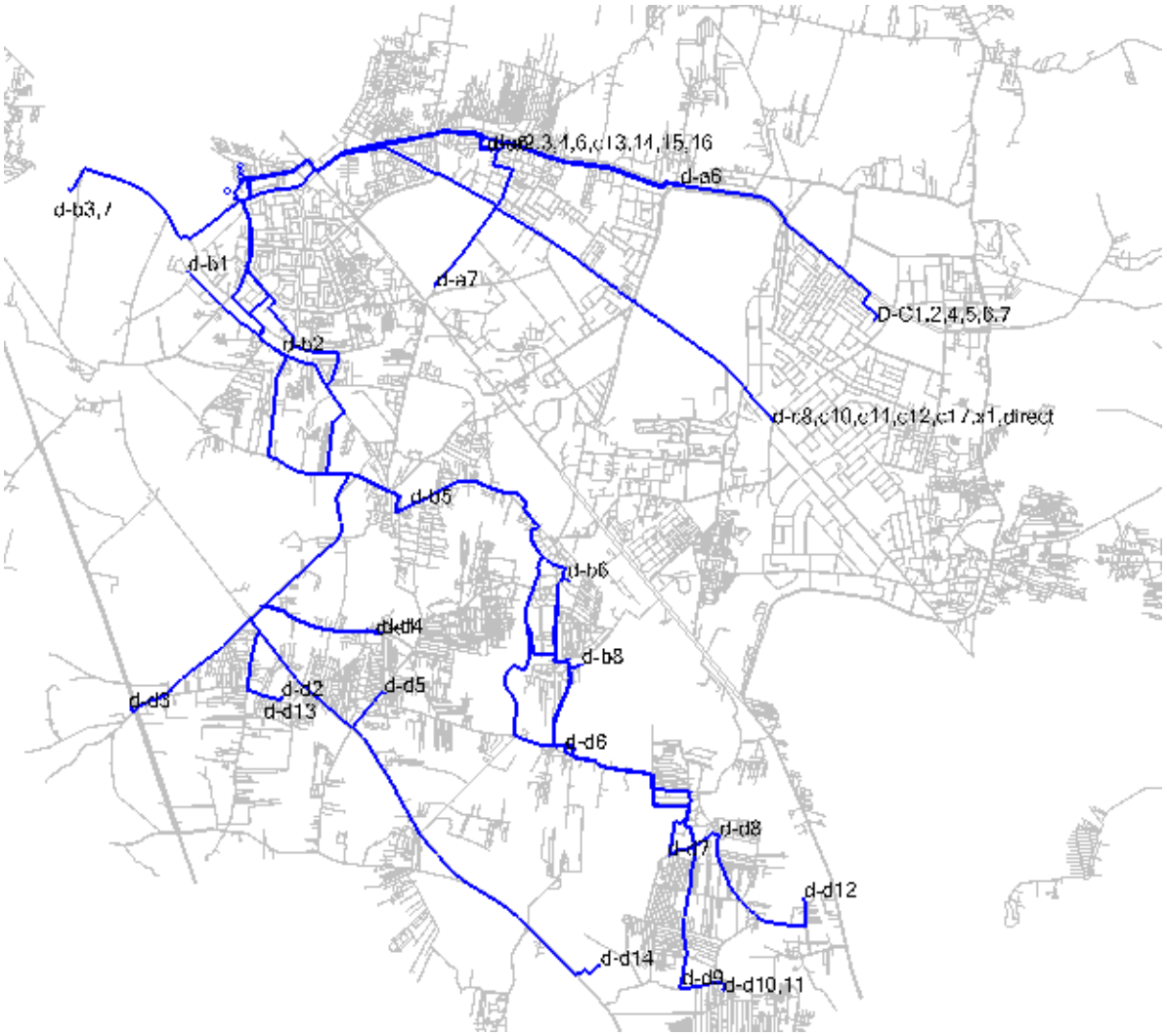


Figure 7.2: Existing primary network

Table 7.1: Analysis of existing primary network- pipe results

Label	Start Node	Stop Node	Material	Hazen-Williams C	Diameter (mm)	Length (m)	Flow (ML/day)	Velocity (m/s)
d-d5	PNJ-244	J-67	DI	140	300	37	39.62	6.49
PNP-909	PNJ-244	PNJ-241	DI	140	300	172	39.62	6.49
PNP-910	PNJ-241	PNJ-237	DI	140	300	17	39.62	6.49
PNP-385	PNJ-247	PNJ-237	MS	140	300	364	39.62	6.49
P-3290	J-67	d-d5	DI	140	300	13	39.62	6.49
PNP-908	PNJ-404	PNJ-381	DI	140	200	141	11.4	4.2
PNP-202	PNJ-383	PNJ-406	MS	140	200	405	11.16	4.11
P-3291	PNJ-406	d-d14	DI	140	200	17	11.16	4.11
PNP-65	PNJ-417	PNJ-379	DI	140	500	251	48.08	2.83
PNP-71	PNJ-380	PNJ-381	DI	140	500	9	48.08	2.83
PNP-72	PNJ-379	PNJ-380	DI	140	500	101	48.08	2.83
PNP-85	R-Phase3	638	DI	140	500	41	43.1	2.54
PNP-86	638	PNJ-487	DI	140	500	25	43.1	2.54
PNP-87	R-Phase3	637	DI	140	500	41	43.1	2.54
PNP-88	637	PNJ-487	DI	140	500	27	43.1	2.54

PNP-89	R-Phase3	636	DI	140	500	40	43.1	2.54
PNP-90	636	PNJ-487	DI	140	500	26	43.1	2.54
PNP-91	R-Phase3	635	DI	140	500	40	43.1	2.54
PNP-92	635	PNJ-487	DI	140	500	25	43.1	2.54
PNP-73	PNJ-381	PNJ-377	DI	140	500	247	36.69	2.16
PNP-74	PNJ-368	PNJ-388	DI	140	500	361	36.69	2.16
PNP-75	PNJ-377	PNJ-368	DI	140	500	535	36.69	2.16
PNP-23	PNJ-231	PNJ-240	DI	140	750	196	77.2	2.02
PNP-24	PNJ-240	PNJ-251	DI	140	750	811	77.2	2.02
PNP-28	PNJ-170	PNJ-227	MS	140	1,000.00	2,952	121.5	1.79
PNP-29	PNJ-209	PNJ-208	MS	140	1,000.00	15	121.5	1.79
PNP-30	PNJ-227	PNJ-229	MS	140	1,000.00	325	121.5	1.79
PNP-927	PNJ-219	PNJ-224	MS	140	1,000.00	335	121.5	1.79
PNP-928	PNJ-224	PNJ-229	MS	140	1,000.00	325	121.5	1.79
PNP-31	PNJ-217	PNJ-209	MS	140	1,000.00	384	121.5	1.79
PNP-32	PNJ-219	PNJ-217	MS	140	1,000.00	334	121.5	1.79
PNP-33	R-CCT	PNJ-170	MS	140	1,000.00	2,264	121.5	1.79
PNP-13	PNJ-496	PNJ-503	DI	140	1,200.00	750	172.4	1.76
PNP-14	PNJ-494	PNJ-496	DI	140	1,200.00	754	172.4	1.76
PNP-15	PNJ-492	PNJ-494	DI	140	1,200.00	646	172.4	1.76
PNP-16	PNJ-490	PNJ-492	DI	140	1,200.00	339	172.4	1.76
PNP-929	PNJ-489	PNJ-488	DI	140	1,200.00	350	172.4	1.76
PNP-17	PNJ-487	PNJ-488	DI	140	1,200.00	385	172.4	1.76
PNP-18	PNJ-489	PNJ-490	DI	140	1,200.00	147	172.4	1.76
PNP-523	PNJ-228	PNJ-220	DI	140	600	443	41.66	1.71
PNP-10	PNJ-221	PNJ-226	DI	140	1,100.00	173	132	1.61
PNP-11	PNJ-225	PNJ-231	DI	140	1,100.00	785	132	1.61
PNP-12	PNJ-226	PNJ-225	DI	140	1,100.00	587	132	1.61
PNP-1	PNJ-204	PNJ-173	DI	140	1,200.00	60	155.6	1.59
PNP-2	PNJ-202	PNJ-204	DI	140	1,200.00	838	155.6	1.59
P-3314	PNJ-251	J-1340	DI	140	500	13	25.76	1.52
P-3316	J-1340	d-b5	DI	140	500	19	25.76	1.52
P-3317	PNJ-173	J-1342	DI	140	1,200.00	345	145.7	1.49
PNP-133	PNJ-426	PNJ-430	DI	140	450	330	20.36	1.48
PNP-921	PNJ-387	PNJ-419	DI	140	500	312	25.09	1.48
PNP-125	PNJ-421	PNJ-425	DI	140	500	493	25.09	1.48
PNP-126	PNJ-408	PNJ-411	DI	140	500	741	25.09	1.48
PNP-127	PNJ-411	PNJ-421	DI	140	500	439	25.09	1.48
PNP-128	PNJ-403	PNJ-408	DI	140	500	653	25.09	1.48
PNP-129	PNJ-423	PNJ-418	DI	140	500	310	25.09	1.48
PNP-922	PNJ-419	PNJ-416	DI	140	500	331	25.09	1.48
PNP-923	PNJ-416	PNJ-418	DI	140	500	162	25.09	1.48
PNP-924	PNJ-424	PNJ-425	DI	140	500	176	25.09	1.48
PNP-130	PNJ-424	PNJ-423	DI	140	500	366	25.09	1.48
PNP-131	PNJ-388	PNJ-403	DI	140	500	178	25.09	1.48
PNP-69	PNJ-208	PNJ-207	MS	140	1,000.00	18	100	1.47
PNP-70	PNJ-207	PNJ-205	MS	140	1,000.00	21	100	1.47
PNP-34	PNJ-231	PNJ-232	DI	140	750	191	54.83	1.44
PNP-35	PNJ-232	PNJ-250	DI	140	750	813	54.83	1.44
PNP-36	PNJ-250	PNJ-253	DI	140	750	557	54.83	1.44
PNP-37	PNJ-253	PNJ-255	DI	140	750	525	54.83	1.44
PNP-38	PNJ-255	PNJ-303	DI	140	750	2,182	54.83	1.44
P-3277	PNJ-503	J-1309	DI	140	1,200.00	19	134.7	1.38
P-3279	J-1309	d-a2,3,4,6,c13,14,15,16	DI	140	1,200.00	30	134.7	1.38
PNP-6	PNJ-220	PNJ-221	DI	140	1,200.00	23	132	1.35
PNP-925	PNJ-417	PNJ-303	DI	140	600	609	33	1.35
PNP-39	PNJ-251	PNJ-254	DI	140	750	560	51.43	1.35
PNP-40	PNJ-254	PNJ-256	DI	140	750	525	51.43	1.35

PNP-41	PNJ-256	PNJ-364	DI	140	750	1,122	51.43	1.35
PNP-42	PNJ-364	PNJ-366	DI	140	750	293	51.43	1.35
PNP-43	PNJ-366	PNJ-233	DI	140	750	271	51.43	1.35
P-3274	PNJ-511	J-1307	DI	140	500	1,265	22.58	1.33
P-3276	J-1307	d-a7	DI	140	500	16	22.58	1.33
PNP-100	PNJ-205	PNJ-197	MS	140	1,000.00	20	87.22	1.29
PNP-21	PNJ-197	PNJ-239	MS	140	1,000.00	188	87.22	1.29
PNP-406	R-Phase1	PNJ-206	DI	140	1,000.00	1,450	84.91	1.25
PNP-132	PNJ-386	PNJ-426	DI	140	500	28	20.36	1.2
PNP-3	R-Phase2	PNJ-202	DI	140	1,200.00	1,440	112.4	1.15
PNP-27	PNJ-239	PNJ-203	MS	140	1,000.00	205	77.95	1.15
PNP-148	PNJ-201	PNJ-238	MS	140	600	538	27.17	1.11
PNP-151	PNJ-238	PNJ-199	MS	140	600	16	27.17	1.11
PNP-77	PNJ-199	PNJ-213	MS	140	600	443	27.17	1.11
PNP-44	PNJ-531	PNJ-532	DI	140	900	60	60.89	1.11
PNP-55	PNJ-565	PNJ-566	DI	140	900	57	60.89	1.11
PNP-56	PNJ-535	PNJ-565	DI	140	900	1,354	60.89	1.11
PNP-57	PNJ-532	PNJ-535	DI	140	900	248	60.89	1.11
PNP-45	PNJ-527	PNJ-531	DI	140	900	248	60.89	1.11
PNP-46	PNJ-524	PNJ-527	DI	140	900	327	60.89	1.11
PNP-47	PNJ-521	PNJ-524	DI	140	900	300	60.89	1.11
PNP-48	PNJ-518	PNJ-521	DI	140	900	570	60.89	1.11
PNP-49	PNJ-514	PNJ-518	DI	140	900	27	60.89	1.11
PNP-52	PNJ-509	PNJ-514	DI	140	900	598	60.89	1.11
P-3262	PNJ-566	J-1299	DI	140	900	562	60.89	1.11
P-3264	J-1299	d-c8,c10,c11, c12,c17,x1, direct	DI	140	900	27	60.89	1.11
PNP-688	PNJ-404	PNJ-32	DI	140	400	14	11.4	1.05
P-3307	PNJ-32	d-b8	DI	140	400	17	11.4	1.05
PNP-203	PNJ-295	PNJ-383	MS	140	400	830	11.16	1.03
PNP-169	PNJ-435	PNJ-436	DI	140	400	169	10.84	1
PNP-170	PNJ-429	PNJ-433	DI	140	400	560	10.84	1
PNP-171	PNJ-433	PNJ-434	DI	140	400	81	10.84	1
PNP-172	PNJ-434	PNJ-435	DI	140	400	343	10.84	1
PNP-173	PNJ-428	PNJ-429	DI	140	400	65	10.84	1
PNP-175	PNJ-436	PNJ-437	DI	140	400	96	10.84	1
P-3295	PNJ-437	J-1326	DI	140	400	668	10.84	1
P-3297	J-1326	d-d12	DI	140	400	8	10.84	1
PNP-76	PNJ-233	PNJ-375	DI	140	750	93	35.63	0.93
P-3311	PNJ-205	J-1338	MS	140	450	1,482	12.8	0.93
P-3313	J-1338	d-d1	DI	140	450	22	12.8	0.93
PNP-7	TCV-121	PNJ-292	MS	140	1,200.00	7	90.37	0.92
PNP-8	PNJ-292	PNJ-220	DI	140	1,200.00	697	90.37	0.92
PNP-5	PNJ-178	PNJ-174	MS	140	1,200.00	4	90.37	0.92
PNP-9	PNJ-174	TCV-121	MS	140	1,200.00	4	90.37	0.92
P-3318	J-1342	PNJ-178	DI	140	1,200.00	2	90.37	0.92
P-3305	PNJ-413	d-d7	DI	140	600	14	22.02	0.9
PNP-50	PNJ-493	PNJ-509	DI	140	1,000.00	1,575	60.89	0.9
PNP-51	PNJ-491	PNJ-493	DI	140	1,000.00	654	60.89	0.9
PNP-53	R-Phase1	PNJ-491	DI	140	1,000.00	1,512	60.89	0.9
PNP-109	PNJ-382	PNJ-410	DI	140	600	433	21.82	0.89
PNP-110	PNJ-420	PNJ-386	DI	140	600	475	21.82	0.89
PNP-105	PNJ-365	PNJ-385	DI	140	600	457	21.82	0.89
PNP-106	PNJ-303	PNJ-365	DI	140	600	2,032	21.82	0.89
PNP-107	PNJ-385	PNJ-407	DI	140	600	655	21.82	0.89
PNP-108	PNJ-407	PNJ-382	DI	140	600	309	21.82	0.89
PNP-111	PNJ-410	PNJ-420	DI	140	600	438	21.82	0.89
PNP-155	PNJ-373	PNJ-374	DI	140	500	15	15.08	0.89

PNP-156	PNJ-370	PNJ-417	DI	140	500	101	15.08	0.89
PNP-919	PNJ-373	PNJ-375	DI	140	500	262	15.08	0.89
PNP-157	PNJ-374	PNJ-370	DI	140	500	488	15.08	0.89
PNP-137	PNJ-215	PNJ-223	MS	140	600	532	21.48	0.88
PNP-138	PNJ-208	PNJ-215	MS	140	600	337	21.48	0.88
PNP-139	PNJ-223	PNJ-235	MS	140	600	506	21.48	0.88
P-3308	PNJ-235	J-1336	MS	140	600	123	21.48	0.88
P-3310	J-1336	d-d4	DI	140	600	26	21.48	0.88
PNP-161	PNJ-387	PNJ-427	DI	140	500	331	14.74	0.87
PNP-239	PNJ-427	PNJ-10	DI	140	500	260	14.74	0.87
PNP-240	PNJ-10	PNJ-431	DI	140	500	143	14.74	0.87
P-3292	PNJ-431	d-d10,11	DI	140	500	12	14.74	0.87
PNP-79	R-CCT	PNJ-181	DI	140	600	1,287	20.65	0.85
PNP-80	PNJ-181	PNJ-180	DI	140	600	268	20.65	0.85
PNP-81	PNJ-180	PNJ-179	DI	140	600	387	20.65	0.85
PNP-82	PNJ-179	PNJ-176	DI	140	600	259	20.65	0.85
PNP-83	PNJ-176	PNJ-175	DI	140	600	529	20.65	0.85
P-3320	PNJ-175	J-1344	DI	140	600	322	20.65	0.85
P-3322	J-1344	d-b3,7	DI	140	600	71	20.65	0.85
PNP-112	PNJ-402	PNJ-409	DI	140	600	959	20.55	0.84
PNP-113	PNJ-367	PNJ-402	DI	140	600	591	20.55	0.84
PNP-114	PNJ-369	PNJ-376	DI	140	600	700	20.55	0.84
PNP-115	PNJ-376	PNJ-367	DI	140	600	539	20.55	0.84
PNP-116	PNJ-371	PNJ-369	DI	140	600	493	20.55	0.84
PNP-117	PNJ-409	PNJ-412	DI	140	600	255	20.55	0.84
PNP-118	PNJ-412	PNJ-422	DI	140	600	634	20.55	0.84
PNP-119	PNJ-422	PNJ-413	DI	140	600	651	20.55	0.84
PNP-120	PNJ-375	PNJ-372	DI	140	600	271	20.55	0.84
PNP-121	PNJ-372	PNJ-371	DI	140	600	11	20.55	0.84
PNP-149	PNJ-203	PNJ-201	MS	140	700	178	27.17	0.82
P-3286	PNJ-213	J-1317	MS	140	600	17	19.85	0.81
P-3288	J-1317	d-d2	DI	140	600	17	19.85	0.81
PNP-174	PNJ-430	PNJ-428	DI	140	450	168	10.84	0.79
PNP-61	PNJ-203	PNJ-210	MS	140	1,000.00	228	50.78	0.75
PNP-62	PNJ-210	PNJ-218	MS	140	1,000.00	369	50.78	0.75
PNP-63	PNJ-218	PNJ-222	MS	140	1,000.00	686	50.78	0.75
PNP-64	PNJ-222	PNJ-247	MS	140	1,000.00	346	50.78	0.75
P-3237	PNJ-183	J-1282	DI	140	1,000.00	1,830	48.25	0.71
P-3239	J-1282	D-C1,2,4,5,6,7	DI	140	1,000.00	14	48.25	0.71
P-3301	PNJ-430	d-d8	DI	140	450	16	9.517	0.69
PNP-913	PNJ-508	PNJ-502	DI	140	900	33	37.65	0.68
PNP-243	PNJ-508	PNJ-510	DI	140	900	36	37.65	0.68
PNP-244	PNJ-503	PNJ-502	DI	140	900	15	37.65	0.68
P-3306	PNJ-388	d-d6	DI	140	500	14	11.59	0.68
P-3326	PNJ-233	J-1348	DI	140	600	86	15.8	0.65
P-3328	J-1348	d-b6	DI	140	600	54	15.8	0.65
PNP-902	PNJ-202	PNJ-206	DI	140	1,000.00	7	43.25	0.64
PNP-524	PNJ-206	PNJ-228	DI	140	1,000.00	1,561	41.66	0.61
PNP-199	PNJ-387	PNJ-415	DI	140	500	37	10.36	0.61
P-3294	PNJ-415	d-d9	DI	140	500	10	10.36	0.61
P-3319	J-1342	d-b2	DI	140	1,200.00	21	55.38	0.57
PNP-25	R-Phase1	PNJ-183	DI	140	1,200.00	7,127	48.25	0.49
PNP-869	PNJ-30	PNJ-29	DI	140	700	534	15.06	0.45
PNP-868	PNJ-28	PNJ-27	DI	140	700	134	15.06	0.45
PNP-675	PNJ-23	PNJ-24	DI	140	700	94	15.06	0.45
PNP-677	PNJ-25	PNJ-26	DI	140	700	138	15.06	0.45
PNP-678	PNJ-24	PNJ-25	DI	140	700	344	15.06	0.45
PNP-674	PNJ-26	PNJ-27	DI	140	700	308	15.06	0.45
PNP-676	PNJ-510	J-328	DI	140	700	58	15.06	0.45

PNP-949	PNJ-30	J-329	DI	140	700	233	15.06	0.45
PNP-950	J-329	PNJ-31	DI	140	700	54	15.06	0.45
P-1126	J-328	PNJ-23	DI	140	700	4	15.06	0.45
P-1365	PNJ-29	J-459	DI	140	700	486	15.06	0.45
P-1366	J-459	PNJ-28	DI	140	700	24	15.06	0.45
P-3241	PNJ-31	d-a6	DI	140	700	12	15.06	0.45
PNP-245	PNJ-512	PNJ-511	DI	140	900	179	22.58	0.41
PNP-246	PNJ-510	PNJ-507	DI	140	900	150	22.58	0.41
PNP-247	PNJ-507	PNJ-506	DI	140	900	76	22.58	0.41
PNP-248	PNJ-506	PNJ-512	DI	140	900	500	22.58	0.41
PNP-134	PNJ-239	PNJ-171	MS	140	600	1,346	9.267	0.38
PNP-159	PNJ-171	PNJ-177	MS	140	600	576	9.267	0.38
P-3284	PNJ-177	d-d3	DI	140	600	16	9.267	0.38
P-3289	PNJ-213	d-d13	DI	140	600	11	7.322	0.3
PNP-166	PNJ-173	PNJ-200	DI	140	700	166	9.885	0.3
PNP-167	PNJ-189	PNJ-186	DI	140	700	419	9.885	0.3
PNP-168	PNJ-200	PNJ-189	DI	140	700	255	9.885	0.3
P-3324	J-1346	PNJ-186	DI	140	700	322	9.885	0.3
P-3325	J-1346	d-b1	DI	140	700	25	9.885	0.3
PNP-920	PNJ-295	PNJ-252	MS	140	800	1,420	11.16	0.26
PNP-135	PNJ-248	PNJ-252	MS	140	800	925	11.16	0.26
PNP-66	PNJ-247	PNJ-230	MS	140	1,000.00	60	11.16	0.16
PNP-67	PNJ-245	PNJ-248	MS	140	1,000.00	265	11.16	0.16
PNP-68	PNJ-230	PNJ-245	MS	140	1,000.00	599	11.16	0.16
P-3333	PNJ-187	d-a5	DI	140	1,100.00	3,431	10.12	0.12
PNP-911	PNJ-384	PNJ-386	DI	140	500	14	1.463	0.09
PNP-607	PNJ-413	PNJ-414	DI	140	500	100	1.463	0.09
PNP-608	PNJ-414	PNJ-384	DI	140	500	213	1.463	0.09
PNP-818	R-Phase3	PMP-9	MS	140	1,100.00	8	5.06	0.06
PNP-773	PMP-9	PNJ-187	MS	140	1,100.00	7	5.06	0.06
PNP-768	R-Phase3	PMP-10	MS	140	1,100.00	10	5.06	0.06
PNP-769	PMP-10	PNJ-187	MS	140	1,100.00	7	5.06	0.06

Table 7.2: Analysis of existing primary network- junction results

Label	D-Nodes	Elevation (m)	Demand (ML/day)	Hydraulic Grade (m)	Pressure (kg/cm²)
d-d5	d-d5	588.5	39.62	538	-5.044
PNJ-244		588.5	0	542.7	-4.571
J-67		574.4	0	539.1	-3.522
PNJ-237		588.5	0	560.4	-2.809
PNJ-241		575	0	558.9	-1.605
d-b8	d-b8	586.5	11.4	581	-0.546
PNJ-404		586.5	0	581.1	-0.539
d-a2,3,4,6,c13,14,15,16	d-a2,3,4,6,c13,14,15,16	620.3	134.7	617.4	-0.287
J-1309		615.7	0	617.5	0.172
PNJ-502		615	0	617.5	0.247
J-1282		606	0	608.7	0.27
d-b2	d-b2	604.5	55.38	607.3	0.278
PNJ-503		614.6	0	617.5	0.29
d-b1	d-b1	604	9.885	607.6	0.357
J-1346		603.5	0	607.6	0.409
d-d14	d-d14	560	11.16	565.3	0.528
d-d6	d-d6	577.5	11.59	582.8	0.53
d-d4	d-d4	588.5	21.48	594.3	0.577
d-a7	d-a7	607.9	22.58	613.8	0.586
PNJ-406		560	0	566.4	0.64
PNJ-507		611	0	617.4	0.641
d-b6	d-b6	588.4	15.8	595.8	0.738
J-1336		585.9	0	594.3	0.838

PNJ-508		609	0	617.5	0.845
PNJ-535		597	0	606	0.897
PNJ-521		598	0	607.1	0.911
PNJ-177		586	0	595.2	0.914
PNJ-493		600	0	609.2	0.922
PNJ-506		608	0	617.4	0.939
d-b5	d-b5	590.7	25.76	600.6	0.991
PNJ-532		596	0	606.2	1.022
PNJ-531		596	0	606.3	1.025
PNJ-510		607	0	617.5	1.043
PNJ-527		596	0	606.5	1.049
d-d3	d-d3	584.6	9.267	595.2	1.053
J-1299		592.7	0	604	1.134
PNJ-23		606	0	617.4	1.141
J-328		606	0	617.4	1.141
PNJ-524		595	0	606.8	1.181
d-d9	d-d9	557	10.36	568.9	1.184
PNJ-415		557	0	568.9	1.185
PNJ-387		556.5	0	568.9	1.234
d-d10,11	d-d10,11	555.5	14.74	568	1.243
PNJ-424		561	0	573.8	1.281
J-1317		580.6	0	593.6	1.3
PNJ-206		595.9	0	608.9	1.3
d-a5	d-a5	614.3	10.12	627.7	1.334
d-d12	d-d12	571.7	10.84	585.3	1.353
PNJ-32		567.5	0	581.1	1.354
J-1326		571.7	0	585.3	1.358
PNJ-230		581	0	594.7	1.368
PNJ-247		581	0	594.7	1.368
PNJ-222		581	0	594.9	1.382
PNJ-431		554	0	568	1.394
PNJ-171		581.3	0	595.3	1.396
PNJ-175		594	0	608	1.4
PNJ-425		560	0	574.5	1.443
PNJ-10		553.7	0	568.2	1.447
PNJ-411		563	0	577.6	1.453
d-d2	d-d2	579	19.85	593.6	1.459
PNJ-423		558	0	572.6	1.459
PNJ-491		595	0	609.6	1.459
d-d13	d-d13	579	7.322	593.6	1.462
PNJ-213		579	0	593.7	1.462
PNJ-518		593	0	607.7	1.466
PNJ-509		593	0	608.3	1.527
PNJ-427		553	0	568.5	1.544
PNJ-514		592	0	607.7	1.568
PNJ-487		610	0	625.9	1.59
PNJ-24		601	0	617.4	1.637
PNJ-565		588	0	604.7	1.662
PNJ-496		602	0	618.8	1.672
PNJ-199		577.6	0	594.4	1.675
PNJ-238		577.5	0	594.4	1.682
J-1344		590.2	0	607.7	1.745
PNJ-418		554	0	571.6	1.755
PNJ-566		587	0	604.6	1.756
d-b3,7	d-b3,7	590	20.65	607.7	1.761
PNJ-187		610	0	627.7	1.767
d-c8,c10,c11,c12,c17,x1,direct	d-c8,c10,c11,c12,c17,x1,direct	586.2	60.89	604	1.778
PNJ-419		552	0	569.9	1.79
J-1340		582.7	0	600.7	1.795
PNJ-494		602	0	620	1.798
PNJ-416		553	0	571	1.801
PNJ-201		577	0	595.3	1.822
PNJ-195		577.4	0	595.8	1.832

PNJ-176		590	0	608.5	1.85
PNJ-170		587.1	0	605.8	1.865
PNJ-512		598	0	617.3	1.929
PNJ-183		590	0	609.4	1.931
J-1348		576.4	0	595.8	1.94
PNJ-488		603	0	622.5	1.946
PNJ-421		556	0	576.1	2.004
PNJ-203		575	0	595.4	2.036
PNJ-173		587.1	0	607.7	2.054
PNJ-202		588	0	608.9	2.093
PNJ-210		574	0	595.3	2.126
J-1342		586	0	607.3	2.127
PNJ-178		586	0	607.3	2.128
PNJ-174		586	0	607.3	2.129
PNJ-292		585.9	0	607.3	2.133
PNJ-245		573	0	594.7	2.165
PNJ-179		587	0	608.8	2.173
PNJ-489		600	0	621.9	2.187
PNJ-239		573.6	0	595.6	2.195
PNJ-218		573	0	595.1	2.21
PNJ-511		595	0	617.3	2.226
PNJ-25		595	0	617.3	2.227
PNJ-408		557	0	580	2.299
PNJ-197		572.2	0	595.8	2.36
PNJ-490		598	0	621.7	2.362
PNJ-248		571	0	594.7	2.364
PNJ-205		572	0	595.8	2.377
PNJ-207		572	0	595.9	2.38
PNJ-208		572	0	595.9	2.381
PNJ-209		572	0	595.9	2.382
PNJ-403		558	0	582.2	2.418
PNJ-26		593	0	617.3	2.424
PNJ-220		582.1	0	606.9	2.477
PNJ-221		582	0	606.9	2.486
PNJ-223		570	0	595	2.491
PNJ-492		596	0	621.1	2.506
d-d1	d-d1	568	12.8	593.4	2.534
J-1338		568	0	593.4	2.536
PNJ-215		570	0	595.5	2.546
PNJ-186		582	0	607.6	2.557
PNJ-388		557.1	0	582.8	2.571
J-1307		588	0	613.8	2.577
PNJ-180		583	0	609.1	2.609
d-a6	d-a6	590.4	15.06	616.8	2.634
PNJ-295		568	0	594.5	2.645
J-459		590.6	0	617.2	2.651
PNJ-252		568	0	594.6	2.656
J-329		589.9	0	616.9	2.695
d-d7	d-d7	563.5	22.02	590.9	2.736
PNJ-226		579	0	606.6	2.758
PNJ-31		589	0	616.8	2.778
PNJ-377		561	0	588.9	2.783
PNJ-413		563	0	590.9	2.788
PNJ-414		563	0	590.9	2.788
PNJ-29		589	0	617.1	2.799
PNJ-28		589	0	617.2	2.812
PNJ-27		589	0	617.2	2.815
PNJ-409		564	0	592.4	2.834
PNJ-181		581	0	609.4	2.835
PNJ-228		580	0	608.5	2.844
PNJ-217		568	0	596.7	2.868
PNJ-30		588	0	616.9	2.885
PNJ-410		563	0	591.9	2.886

PNJ-412		563	0	592.2	2.91
PNJ-189		578	0	607.7	2.961
PNJ-381		560.3	0	590.6	3.017
PNJ-368		555	0	585.3	3.021
PNJ-380		560.3	0	590.7	3.03
PNJ-428		559	0	589.4	3.036
PNJ-384		560.5	0	590.9	3.038
PNJ-386		560.3	0	590.9	3.055
PNJ-426		560	0	590.9	3.081
PNJ-429		558	0	589.3	3.122
PNJ-235		563	0	594.4	3.138
PNJ-219		566	0	597.4	3.138
PNJ-383		561	0	592.7	3.16
PNJ-200		576	0	607.7	3.163
PNJ-379		560	0	591.8	3.175
d-d8	d-d8	557	9.517	589.6	3.254
PNJ-430		557	0	589.6	3.256
PNJ-204		575	0	607.8	3.274
PNJ-434		555	0	588	3.289
PNJ-433		555	0	588.1	3.305
PNJ-376		561	0	594.4	3.332
PNJ-224		564	0	598.2	3.409
PNJ-437		552	0	586.7	3.461
PNJ-436		552	0	586.9	3.482
PNJ-435		552	0	587	3.493
PNJ-402		558	0	593.3	3.524
PNJ-382		557	0	592.4	3.53
PNJ-417		559.3	0	594.7	3.531
PNJ-385		558	0	593.4	3.533
PNJ-374		560	0	595.4	3.536
PNJ-420		556	0	591.5	3.538
PNJ-373		560	0	595.5	3.538
PNJ-371		560	0	595.5	3.545
PNJ-372		560	0	595.5	3.546
PNJ-422		556	0	591.6	3.548
PNJ-407		557	0	592.7	3.563
PNJ-225		570	0	605.7	3.565
PNJ-370		559	0	594.8	3.572
PNJ-369		559	0	595.1	3.598
PNJ-366		560	0	596.4	3.628
PNJ-365		557	0	593.9	3.681
PNJ-303		559	0	596.1	3.698
PNJ-251		563	0	600.8	3.767
PNJ-233		557.8	0	595.9	3.804
PNJ-375		557	0	595.8	3.871
PNJ-229		560	0	598.9	3.877
PNJ-367		555	0	593.9	3.88
PNJ-250		563	0	602.5	3.943
PNJ-254		560	0	599.8	3.968
PNJ-256		559	0	598.8	3.976
PNJ-240		563	0	603.8	4.068
PNJ-364		556	0	596.9	4.078
PNJ-232		563	0	604.1	4.104
PNJ-255		559	0	600.4	4.128
PNJ-253		560	0	601.4	4.132
PNJ-231		562	0	604.5	4.241
PNJ-227		556	0	599.5	4.345
D-C1,2,4,5,6,7	D-C1,2,4,5,6,7	0	48.25	608.6	60.74

7.2.2Modifications required

New Pipelines: New pipes, shown in red in Figure 7.3, are proposed in the primary network. The details of the new pipes are shown in Table 7.3.

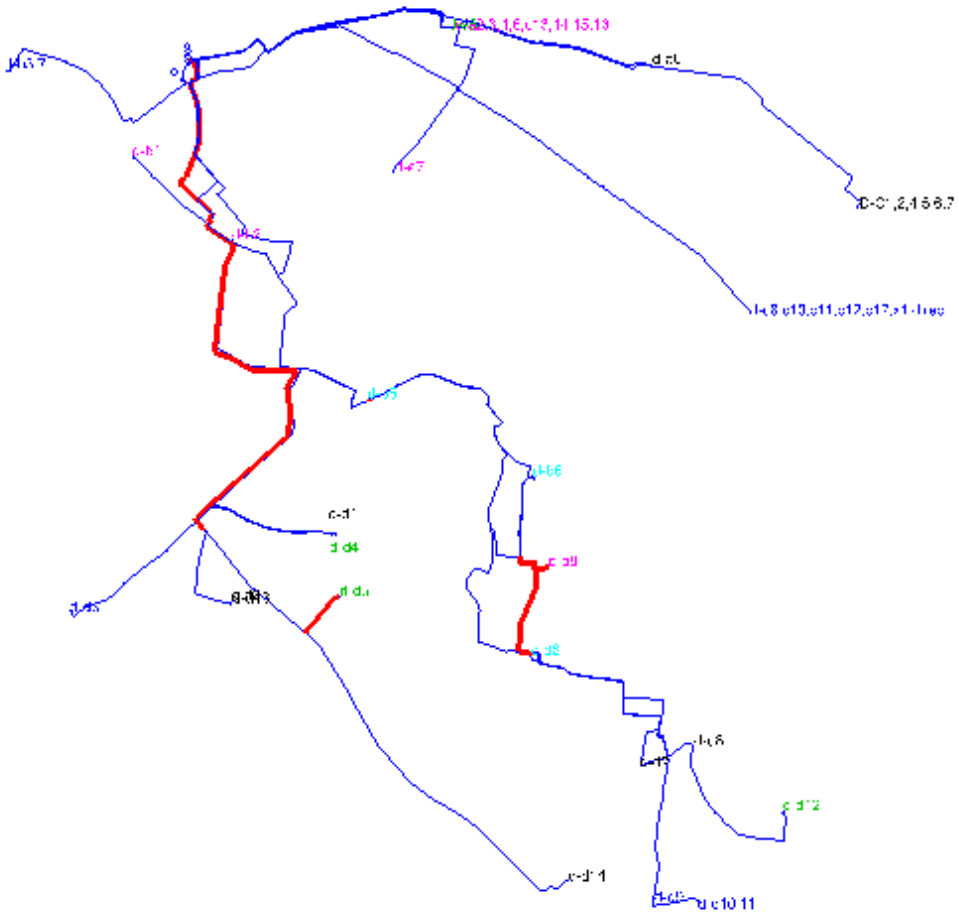


Figure 7.3: New pipes required in primary network

Table 7.3: New pipelines

Label	Start Node	Stop Node	Material	Hazen-Williams C	Diameter (mm)	Length (m)
P-3337	J-1352	J-67	DI	140	500	597
P-3340	PNJ-417	J-1353	DI	140	450	599
P-3342	J-1353	PNJ-388	DI	140	300	903
PNP-22	R-Phase1	PNJ-195	DI	140	1,000.00	6,956
P-3344	PNJ-250	PNJ-251	DI	140	500	4
P-3341	J-1353	PNJ-377	DI	140	450	9
P-3338	PNJ-380	d-b8	DI	140	500	169
PNP-944	PNJ-195	J-225	DI	140	1,000.00	301
PNP-945	J-225	PNJ-198	DI	140	1,000.00	143
PNP-926	PNJ-197	PNJ-195	DI	140	1,000.00	36
P-3343	PNJ-232	PNJ-240	DI	140	500	6
						9723

7.2.3Results of Modified Primary Network

The model has been run and the analysis results of pipe are shown in Table 7.4 and the junction results are shown in Table 7.5.

Table 7.4: The pipe results

Label	Start Node	Stop Node	Material	Hazen-Williams C	Diameter (mm)	Length (m)	Flow (ML/day)	Velocity (m/s)	New_Pipe
P-3337	J-1352	J-67	DI	140	500	597	31.38	1.80	New
PNP-85	R-Phase3	638	DI	140	600	41	43.1	1.76	
PNP-86	638	PNJ-487	DI	140	600	25	43.1	1.76	
PNP-87	R-Phase3	637	DI	140	600	41	43.1	1.76	
PNP-88	637	PNJ-487	DI	140	600	27	43.1	1.76	
PNP-89	R-Phase3	636	DI	140	600	40	43.1	1.76	
PNP-90	636	PNJ-487	DI	140	600	26	43.1	1.76	
PNP-91	R-Phase3	635	DI	140	600	40	43.1	1.76	
PNP-92	635	PNJ-487	DI	140	600	25	43.1	1.76	
PNP-13	PNJ-496	PNJ-503	DI	140	1,200.00	750	172.4	1.76	
PNP-14	PNJ-494	PNJ-496	DI	140	1,200.00	754	172.4	1.76	
PNP-15	PNJ-492	PNJ-494	DI	140	1,200.00	646	172.4	1.76	
PNP-16	PNJ-490	PNJ-492	DI	140	1,200.00	339	172.4	1.76	
PNP-929	PNJ-489	PNJ-488	DI	140	1,200.00	350	172.4	1.76	
PNP-17	PNJ-487	PNJ-488	DI	140	1,200.00	385	172.4	1.76	
PNP-18	PNJ-489	PNJ-490	DI	140	1,200.00	147	172.4	1.76	
PNP-34	PNJ-231	PNJ-232	DI	140	750	191	66.43	1.74	
PNP-24	PNJ-240	PNJ-251	DI	140	750	811	66.11	1.73	
PNP-35	PNJ-232	PNJ-250	DI	140	750	813	65.92	1.73	
PNP-23	PNJ-231	PNJ-240	DI	140	750	196	65.6	1.72	
PNP-74	PNJ-368	PNJ-388	DI	140	500	361	29.11	1.72	
PNP-75	PNJ-377	PNJ-368	DI	140	500	535	29.11	1.72	
PNP-65	PNJ-417	PNJ-379	DI	140	500	251	29.05	1.71	
PNP-72	PNJ-379	PNJ-380	DI	140	500	101	29.05	1.71	
PNP-523	PNJ-228	PNJ-220	DI	140	600	443	41.66	1.71	
P-3290	J-67	d-d5	DI	140	600	13	39.62	1.62	
PNP-10	PNJ-221	PNJ-226	DI	140	1,100.00	173	132	1.61	
PNP-11	PNJ-225	PNJ-231	DI	140	1,100.00	785	132	1.61	
PNP-12	PNJ-226	PNJ-225	DI	140	1,100.00	587	132	1.61	
PNP-1	PNJ-204	PNJ-173	DI	140	1,200.00	60	155.6	1.59	
PNP-2	PNJ-202	PNJ-204	DI	140	1,200.00	838	155.6	1.59	
P-3314	PNJ-251	J-1340	DI	140	500	13	25.76	1.52	
P-3316	J-1340	d-b5	DI	140	500	19	25.76	1.52	
P-3317	PNJ-173	J-1342	DI	140	1,200.00	345	145.7	1.49	
PNP-133	PNJ-426	PNJ-430	DI	140	450	330	20.36	1.48	
PNP-921	PNJ-387	PNJ-419	DI	140	500	312	25.09	1.48	
PNP-125	PNJ-421	PNJ-425	DI	140	500	493	25.09	1.48	
PNP-126	PNJ-408	PNJ-411	DI	140	500	741	25.09	1.48	
PNP-127	PNJ-411	PNJ-421	DI	140	500	439	25.09	1.48	
PNP-128	PNJ-403	PNJ-408	DI	140	500	653	25.09	1.48	
PNP-129	PNJ-423	PNJ-418	DI	140	500	310	25.09	1.48	
PNP-922	PNJ-419	PNJ-416	DI	140	500	331	25.09	1.48	
PNP-923	PNJ-416	PNJ-418	DI	140	500	162	25.09	1.48	
PNP-924	PNJ-424	PNJ-425	DI	140	500	176	25.09	1.48	
PNP-130	PNJ-424	PNJ-423	DI	140	500	366	25.09	1.48	
PNP-131	PNJ-388	PNJ-403	DI	140	500	178	25.09	1.48	
PNP-39	PNJ-251	PNJ-254	DI	140	750	560	54.49	1.43	
PNP-40	PNJ-254	PNJ-256	DI	140	750	525	54.49	1.43	

PNP-41	PNJ-256	PNJ-364	DI	140	750	1,122	54.49	1.43	
PNP-42	PNJ-364	PNJ-366	DI	140	750	293	54.49	1.43	
PNP-43	PNJ-366	PNJ-233	DI	140	750	271	54.49	1.43	
P-3340	PNJ-417	J-1353	DI	140	450	599	19.03	1.39	New
P-3277	PNJ-503	J-1309	DI	140	1,200.00	19	134.7	1.38	
P-3279	J-1309	d-a2,3,4,6,c13,14,15,16	DI	140	1,200.00	29	134.7	1.38	
PNP-36	PNJ-250	PNJ-253	DI	140	750	557	51.77	1.36	
PNP-37	PNJ-253	PNJ-255	DI	140	750	525	51.77	1.36	
PNP-38	PNJ-255	PNJ-303	DI	140	750	2,182	51.77	1.36	
PNP-6	PNJ-220	PNJ-221	DI	140	1,200.00	23	132	1.35	
d-d5	PNJ-244	J-67	DI	140	300	37	8.237	1.35	
PNP-909	PNJ-244	PNJ-241	DI	140	300	172	8.237	1.35	
PNP-910	PNJ-241	PNJ-237	DI	140	300	17	8.237	1.35	
PNP-385	PNJ-247	PNJ-237	MS	140	300	364	8.237	1.35	
P-3274	PNJ-511	J-1307	DI	140	500	1,265	22.58	1.33	
P-3276	J-1307	d-a7	DI	140	500	16	22.58	1.33	
PNP-925	PNJ-417	PNJ-303	DI	140	600	609	30.57	1.25	
PNP-406	R-Phase1	PNJ-206	DI	140	1,000.00	1,450	84.91	1.25	
P-3342	J-1353	PNJ-388	DI	140	300	903	7.577	1.24	New
PNP-132	PNJ-386	PNJ-426	DI	140	500	28	20.36	1.2	
PNP-3	R-Phase2	PNJ-202	DI	140	1,200.00	1,440	112.4	1.15	
PNP-148	PNJ-201	PNJ-238	MS	140	600	538	27.17	1.11	
PNP-151	PNJ-238	PNJ-199	MS	140	600	16	27.17	1.11	
PNP-77	PNJ-199	PNJ-213	MS	140	600	443	27.17	1.11	
PNP-44	PNJ-531	PNJ-532	DI	140	900	60	60.89	1.11	
PNP-55	PNJ-565	PNJ-566	DI	140	900	57	60.89	1.11	
PNP-56	PNJ-535	PNJ-565	DI	140	900	1,354	60.89	1.11	
PNP-57	PNJ-532	PNJ-535	DI	140	900	248	60.89	1.11	
PNP-45	PNJ-527	PNJ-531	DI	140	900	248	60.89	1.11	
PNP-46	PNJ-524	PNJ-527	DI	140	900	327	60.89	1.11	
PNP-47	PNJ-521	PNJ-524	DI	140	900	300	60.89	1.11	
PNP-48	PNJ-518	PNJ-521	DI	140	900	570	60.89	1.11	
PNP-49	PNJ-514	PNJ-518	DI	140	900	27	60.89	1.11	
PNP-52	PNJ-509	PNJ-514	DI	140	900	598	60.89	1.11	
P-3262	PNJ-566	J-1299	DI	140	900	562	60.89	1.11	
P-3264	J-1299	d-c8,c10,c11,c12,c17,x1,direct	DI	140	900	27	60.89	1.11	
PNP-71	PNJ-380	PNJ-381	DI	140	500	9	18.75	1.11	
PNP-73	PNJ-381	PNJ-377	DI	140	500	247	17.65	1.04	
PNP-155	PNJ-373	PNJ-374	DI	140	500	15	17.52	1.03	
PNP-156	PNJ-370	PNJ-417	DI	140	500	101	17.52	1.03	
PNP-919	PNJ-373	PNJ-375	DI	140	500	262	17.52	1.03	
PNP-157	PNJ-374	PNJ-370	DI	140	500	488	17.52	1.03	
PNP-202	PNJ-383	PNJ-406	MS	140	400	405	11.16	1.03	
PNP-203	PNJ-295	PNJ-383	MS	140	400	830	11.16	1.03	
P-3291	PNJ-406	d-d14	DI	140	400	17	11.16	1.03	
PNP-76	PNJ-233	PNJ-375	DI	140	750	93	38.69	1.01	
PNP-169	PNJ-435	PNJ-436	DI	140	400	169	10.84	1	
PNP-170	PNJ-429	PNJ-433	DI	140	400	560	10.84	1	
PNP-171	PNJ-433	PNJ-434	DI	140	400	81	10.84	1	
PNP-172	PNJ-434	PNJ-435	DI	140	400	343	10.84	1	
PNP-173	PNJ-428	PNJ-429	DI	140	400	65	10.84	1	
PNP-175	PNJ-436	PNJ-437	DI	140	400	96	10.84	1	
P-3295	PNJ-437	J-1326	DI	140	400	668	10.84	1	
P-3297	J-1326	d-d12	DI	140	400	8	10.84	1	
P-3311	PNJ-205	J-1338	MS	140	450	1,482	12.8	0.93	
P-3313	J-1338	d-d1	DI	140	450	22	12.8	0.93	
PNP-7	TCV-121	PNJ-292	MS	140	1,200.00	7	90.37	0.92	
PNP-8	PNJ-292	PNJ-220	DI	140	1,200.00	697	90.37	0.92	
PNP-5	PNJ-178	PNJ-174	MS	140	1,200.00	4	90.37	0.92	
PNP-9	PNJ-174	TCV-121	MS	140	1,200.00	4	90.37	0.92	
P-3318	J-1342	PNJ-178	DI	140	1,200.00	2	90.37	0.92	
P-3305	PNJ-413	d-d7	DI	140	600	14	22.02	0.9	
PNP-28	PNJ-170	PNJ-227	MS	140	1,000.00	2,952	60.91	0.9	
PNP-29	PNJ-209	PNJ-208	MS	140	1,000.00	15	60.91	0.9	
PNP-30	PNJ-227	PNJ-229	MS	140	1,000.00	325	60.91	0.9	

PNP-927	PNJ-219	PNJ-224	MS	140	1,000.00	335	60.91	0.9	
PNP-928	PNJ-224	PNJ-229	MS	140	1,000.00	325	60.91	0.9	
PNP-31	PNJ-217	PNJ-209	MS	140	1,000.00	384	60.91	0.9	
PNP-32	PNJ-219	PNJ-217	MS	140	1,000.00	334	60.91	0.9	
PNP-33	R-CCT	PNJ-170	MS	140	1,000.00	2,264	60.91	0.9	
PNP-50	PNJ-493	PNJ-509	DI	140	1,000.00	1,575	60.89	0.9	
PNP-51	PNJ-491	PNJ-493	DI	140	1,000.00	654	60.89	0.9	
PNP-53	R-Phase1	PNJ-491	DI	140	1,000.00	1,512	60.89	0.9	
PNP-22	R-Phase1	PNJ-195	DI	140	1,000.00	6,956	60.59	0.89	New
PNP-137	PNJ-215	PNJ-223	MS	140	600	532	21.48	0.88	
PNP-138	PNJ-208	PNJ-215	MS	140	600	337	21.48	0.88	
PNP-139	PNJ-223	PNJ-235	MS	140	600	506	21.48	0.88	
P-3308	PNJ-235	J-1336	MS	140	600	123	21.48	0.88	
P-3310	J-1336	d-d4	DI	140	600	26	21.48	0.88	
PNP-161	PNJ-387	PNJ-427	DI	140	500	331	14.74	0.87	
PNP-239	PNJ-427	PNJ-10	DI	140	500	260	14.74	0.87	
PNP-240	PNJ-10	PNJ-431	DI	140	500	143	14.74	0.87	
P-3292	PNJ-431	d-d10,11	DI	140	500	12	14.74	0.87	
PNP-109	PNJ-382	PNJ-410	DI	140	600	433	21.2	0.87	
PNP-110	PNJ-420	PNJ-386	DI	140	600	475	21.2	0.87	
PNP-105	PNJ-365	PNJ-385	DI	140	600	457	21.2	0.87	
PNP-106	PNJ-303	PNJ-365	DI	140	600	2,032	21.2	0.87	
PNP-107	PNJ-385	PNJ-407	DI	140	600	655	21.2	0.87	
PNP-108	PNJ-407	PNJ-382	DI	140	600	309	21.2	0.87	
PNP-111	PNJ-410	PNJ-420	DI	140	600	438	21.2	0.87	
PNP-112	PNJ-402	PNJ-409	DI	140	600	959	21.18	0.87	
PNP-113	PNJ-367	PNJ-402	DI	140	600	591	21.18	0.87	
PNP-114	PNJ-369	PNJ-376	DI	140	600	700	21.18	0.87	
PNP-115	PNJ-376	PNJ-367	DI	140	600	539	21.18	0.87	
PNP-116	PNJ-371	PNJ-369	DI	140	600	493	21.18	0.87	
PNP-117	PNJ-409	PNJ-412	DI	140	600	255	21.18	0.87	
PNP-118	PNJ-412	PNJ-422	DI	140	600	634	21.18	0.87	
PNP-119	PNJ-422	PNJ-413	DI	140	600	651	21.18	0.87	
PNP-120	PNJ-375	PNJ-372	DI	140	600	271	21.18	0.87	
PNP-121	PNJ-372	PNJ-371	DI	140	600	11	21.18	0.87	
PNP-79	R-CCT	PNJ-181	DI	140	600	1,287	20.65	0.85	
PNP-80	PNJ-181	PNJ-180	DI	140	600	268	20.65	0.85	
PNP-81	PNJ-180	PNJ-179	DI	140	600	387	20.65	0.85	
PNP-82	PNJ-179	PNJ-176	DI	140	600	259	20.65	0.85	
PNP-83	PNJ-176	PNJ-175	DI	140	600	529	20.65	0.85	
P-3320	PNJ-175	J-1344	DI	140	600	322	20.65	0.85	
P-3322	J-1344	d-b3,7	DI	140	600	71	20.65	0.85	
P-3344	PNJ-250	PNJ-251	DI	140	500	4	14.15	0.83	New
P-3341	J-1353	PNJ-377	DI	140	450	9	11.46	0.83	New
PNP-149	PNJ-203	PNJ-201	MS	140	700	178	27.17	0.82	
P-3286	PNJ-213	J-1317	MS	140	600	17	19.85	0.81	
P-3288	J-1317	d-d2	DI	140	600	17	19.85	0.81	
PNP-174	PNJ-430	PNJ-428	DI	140	450	168	10.84	0.79	
PNP-61	PNJ-203	PNJ-210	MS	140	1,000.00	228	50.78	0.75	
PNP-62	PNJ-210	PNJ-218	MS	140	1,000.00	369	50.78	0.75	
PNP-63	PNJ-218	PNJ-222	MS	140	1,000.00	686	50.78	0.75	
P-3335	PNJ-222	J-1352	MS	140	1,000.00	342	50.78	0.75	
P-3237	PNJ-183	J-1282	DI	140	1,000.00	1,830	48.25	0.71	
P-3239	J-1282	D-C1,2,4,5,6,7	DI	140	1,000.00	14	48.25	0.71	
PNP-21	PNJ-197	PNJ-239	MS	140	1,000.00	188	48.14	0.71	
P-3301	PNJ-430	d-d8	DI	140	450	16	9.517	0.69	
PNP-913	PNJ-508	PNJ-502	DI	140	900	33	37.65	0.68	
PNP-243	PNJ-508	PNJ-510	DI	140	900	36	37.65	0.68	
PNP-244	PNJ-503	PNJ-502	DI	140	900	15	37.65	0.68	
P-3306	PNJ-388	d-d6	DI	140	500	14	11.59	0.68	
P-3326	PNJ-233	J-1348	DI	140	600	86	15.8	0.65	
P-3328	J-1348	d-b6	DI	140	600	54	15.8	0.65	
PNP-902	PNJ-202	PNJ-206	DI	140	1,000.00	7	43.25	0.64	
PNP-524	PNJ-206	PNJ-228	DI	140	1,000.00	1,561	41.66	0.61	
PNP-199	PNJ-387	PNJ-415	DI	140	500	37	10.36	0.61	
P-3294	PNJ-415	d-d9	DI	140	500	10	10.36	0.61	

P-3338	PNJ-380	d-b8	DI	140	500	169	10.3	0.61	New
PNP-69	PNJ-208	PNJ-207	MS	140	1,000.00	18	39.43	0.58	
PNP-70	PNJ-207	PNJ-205	MS	140	1,000.00	21	39.43	0.58	
P-65	PNJ-198	PNJ-203	DI	140	1,000.00	37	39.08	0.58	
PNP-944	PNJ-195	J-225	DI	140	1,000.00	301	39.08	0.58	New
PNP-945	J-225	PNJ-198	DI	140	1,000.00	143	39.08	0.58	New
PNP-27	PNJ-239	PNJ-203	MS	140	1,000.00	205	38.87	0.57	
P-3319	J-1342	d-b2	DI	140	1,200.00	21	55.38	0.57	
PNP-25	R-Phase1	PNJ-183	DI	140	1,200.00	7,127	48.25	0.49	
PNP-869	PNJ-30	PNJ-29	DI	140	700	534	15.06	0.45	
PNP-868	PNJ-28	PNJ-27	DI	140	700	134	15.06	0.45	
PNP-675	PNJ-23	PNJ-24	DI	140	700	94	15.06	0.45	
PNP-677	PNJ-25	PNJ-26	DI	140	700	138	15.06	0.45	
PNP-678	PNJ-24	PNJ-25	DI	140	700	344	15.06	0.45	
PNP-674	PNJ-26	PNJ-27	DI	140	700	308	15.06	0.45	
PNP-676	PNJ-510	J-328	DI	140	700	58	15.06	0.45	
PNP-949	PNJ-30	J-329	DI	140	700	233	15.06	0.45	
PNP-950	J-329	PNJ-31	DI	140	700	54	15.06	0.45	
P-1126	J-328	PNJ-23	DI	140	700	4	15.06	0.45	
P-1365	PNJ-29	J-459	DI	140	700	486	15.06	0.45	
P-1366	J-459	PNJ-28	DI	140	700	24	15.06	0.45	
P-3241	PNJ-31	d-a6	DI	140	700	12	15.06	0.45	
PNP-245	PNJ-512	PNJ-511	DI	140	900	179	22.58	0.41	
PNP-246	PNJ-510	PNJ-507	DI	140	900	150	22.58	0.41	
PNP-247	PNJ-507	PNJ-506	DI	140	900	76	22.58	0.41	
PNP-248	PNJ-506	PNJ-512	DI	140	900	500	22.58	0.41	
PNP-908	PNJ-404	PNJ-381	DI	140	200	141	1.094	0.4	
PNP-100	PNJ-205	PNJ-197	MS	140	1,000.00	20	26.63	0.39	
PNP-134	PNJ-239	PNJ-171	MS	140	600	1,346	9.267	0.38	
PNP-159	PNJ-171	PNJ-177	MS	140	600	576	9.267	0.38	
P-3284	PNJ-177	d-d3	DI	140	600	16	9.267	0.38	
PNP-926	PNJ-197	PNJ-195	DI	140	1,000.00	36	21.51	0.32	New
P-3289	PNJ-213	d-d13	DI	140	600	11	7.322	0.3	
PNP-166	PNJ-173	PNJ-200	DI	140	700	166	9.885	0.3	
PNP-167	PNJ-189	PNJ-186	DI	140	700	419	9.885	0.3	
PNP-168	PNJ-200	PNJ-189	DI	140	700	255	9.885	0.3	
P-3324	J-1346	PNJ-186	DI	140	700	322	9.885	0.3	
P-3325	J-1346	d-b1	DI	140	700	25	9.885	0.3	
P-3336	J-1352	PNJ-247	MS	140	1,000.00	4	19.4	0.29	
PNP-920	PNJ-295	PNJ-252	MS	140	800	1,420	11.16	0.26	
PNP-135	PNJ-248	PNJ-252	MS	140	800	925	11.16	0.26	
PNP-66	PNJ-247	PNJ-230	MS	140	1,000.00	59	11.16	0.16	
PNP-67	PNJ-245	PNJ-248	MS	140	1,000.00	265	11.16	0.16	
PNP-68	PNJ-230	PNJ-245	MS	140	1,000.00	599	11.16	0.16	
P-3343	PNJ-232	PNJ-240	DI	140	500	6	0.511	0.15	New
P-3333	PNJ-187	d-a5	DI	140	1,100.00	3,431	10.12	0.12	
PNP-688	PNJ-404	PNJ-32	DI	140	400	14	1.094	0.1	
P-3307	PNJ-32	d-b8	DI	140	400	17	1.094	0.1	

The velocity in pipes are now less than 1.8 m/s. Hence, results are OK.

Table 7.5: The junction results

Label	D-Nodes	Elevation (m)	Demand (ML/day)	Hydraulic Grade (m)	Pressure (kg/cm²)
J-1309		615.7	0	617.5	0.173
PNJ-502		615	0	617.5	0.248
J-1282		606	0	608.7	0.27
d-b2	d-b2	604.5	55.38	607.3	0.278
PNJ-503		614.6	0	617.5	0.29
d-a2,3,4,6,c13,14,15,16	d-a2,3,4,6,c13,14,15,16	614	134.7	617.4	0.342
d-b1	d-b1	604	9.885	607.6	0.357
D-C1,2,4,5,6,7	D-C1,2,4,5,6,7	605	48.25	608.6	0.364

J-1346		603.5	0	607.6	0.409
d-a7	d-a7	607.9	22.58	613.8	0.587
PNJ-507		611	0	617.4	0.641
d-b8	d-b8	586.5	11.4	593	0.649
PNJ-404		586.5	0	593	0.649
d-b6	d-b6	588.4	15.8	596.2	0.777
PNJ-508		609	0	617.5	0.845
PNJ-535		597	0	606	0.897
PNJ-521		598	0	607.1	0.911
PNJ-493		600	0	609.2	0.922
PNJ-506		608	0	617.4	0.94
PNJ-532		596	0	606.2	1.022
PNJ-531		596	0	606.3	1.025
PNJ-510		607	0	617.5	1.043
PNJ-527		596	0	606.5	1.049
d-b5	d-b5	590.7	25.76	601.6	1.085
d-d6	d-d6	577.5	11.59	588.7	1.117
J-1299		592.7	0	604	1.134
PNJ-23		606	0	617.4	1.141
J-328		606	0	617.4	1.141
PNJ-524		595	0	606.8	1.181
PNJ-206		595.9	0	608.9	1.3
d-a5	d-a5	614.3	10.12	627.7	1.334
d-d12	d-d12	571.7	10.84	585.4	1.363
J-1326		571.7	0	585.4	1.368
d-d5	d-d5	588.5	39.62	602.5	1.399
PNJ-175		594	0	608	1.4
PNJ-244		588.5	0	602.8	1.423
PNJ-491		595	0	609.6	1.459
PNJ-518		593	0	607.7	1.466
PNJ-237		588.5	0	603.7	1.519
PNJ-509		593	0	608.3	1.527
PNJ-514		592	0	607.7	1.568
PNJ-487		610	0	625.9	1.59
d-d4	d-d4	588.5	21.48	604.8	1.63
PNJ-24		601	0	617.4	1.638
PNJ-565		588	0	604.7	1.662
PNJ-496		602	0	618.8	1.672
J-1344		590.2	0	607.7	1.745
PNJ-566		587	0	604.6	1.756
d-b3,7	d-b3,7	590	20.65	607.7	1.761
PNJ-187		610	0	627.7	1.767
d-d9	d-d9	557	10.36	574.8	1.771
PNJ-415		557	0	574.8	1.772
d-c8,c10,c11,c12,c17,x1,direct	d-c8,c10,c11,c12,c17,x1,direct	586.2	60.89	604	1.778
PNJ-494		602	0	620	1.798
PNJ-387		556.5	0	574.8	1.822
d-d10,11	d-d10,11	555.5	14.74	573.8	1.831
PNJ-176		590	0	608.5	1.85
PNJ-424		561	0	579.7	1.869
J-1340		582.7	0	601.6	1.89
J-1336		585.9	0	604.9	1.891
PNJ-512		598	0	617.3	1.93
PNJ-183		590	0	609.4	1.931
PNJ-488		603	0	622.5	1.946
J-1348		576.4	0	596.2	1.979
PNJ-431		554	0	573.9	1.982
PNJ-177		586	0	605.9	1.987
PNJ-425		560	0	580.3	2.03
PNJ-10		553.7	0	574	2.034

PNJ-411		563	0	583.4	2.04
PNJ-423		558	0	578.5	2.047
PNJ-173		587.1	0	607.7	2.054
PNJ-202		588	0	608.9	2.093
d-d3	d-d3	584.6	9.267	605.9	2.126
J-1342		586	0	607.3	2.127
PNJ-178		586	0	607.3	2.128
PNJ-174		586	0	607.3	2.129
PNJ-427		553	0	574.4	2.131
PNJ-292		585.9	0	607.3	2.133
PNJ-179		587	0	608.8	2.173
PNJ-489		600	0	621.9	2.188
PNJ-170		587.1	0	609.2	2.201
PNJ-511		595	0	617.3	2.226
PNJ-25		595	0	617.3	2.228
PNJ-418		554	0	577.5	2.342
PNJ-490		598	0	621.7	2.362
PNJ-419		552	0	575.8	2.377
J-1317		580.6	0	604.5	2.386
PNJ-416		553	0	576.9	2.388
PNJ-26		593	0	617.3	2.424
PNJ-230		581	0	605.6	2.454
PNJ-247		581	0	605.6	2.454
J-1352		581	0	605.6	2.454
PNJ-222		581	0	605.7	2.468
PNJ-171		581.3	0	606	2.469
PNJ-220		582.1	0	606.9	2.477
PNJ-221		582	0	606.9	2.486
PNJ-492		596	0	621.1	2.506
d-d2	d-d2	579	19.85	604.5	2.545
PNJ-32		567.5	0	593	2.545
d-d13	d-d13	579	7.322	604.5	2.548
PNJ-213		579	0	604.5	2.548
PNJ-186		582	0	607.6	2.557
J-1307		588	0	613.8	2.577
PNJ-421		556	0	582	2.592
PNJ-180		583	0	609.1	2.609
d-a6	d-a6	590.4	15.06	616.8	2.634
J-459		590.6	0	617.2	2.651
J-329		589.9	0	616.9	2.695
d-d7	d-d7	563.5	22.02	591	2.747
PNJ-226		579	0	606.6	2.758
PNJ-199		577.6	0	605.3	2.761
PNJ-238		577.5	0	605.3	2.768
PNJ-31		589	0	616.8	2.778
PNJ-413		563	0	591	2.798
PNJ-414		563	0	591	2.798
PNJ-29		589	0	617.1	2.799
J-67		574.4	0	602.6	2.807
PNJ-28		589	0	617.2	2.812
PNJ-27		589	0	617.2	2.815
PNJ-181		581	0	609.4	2.835
PNJ-228		580	0	608.5	2.844
PNJ-409		564	0	592.6	2.853
PNJ-241		575	0	603.6	2.858
PNJ-30		588	0	616.9	2.886
PNJ-408		557	0	585.9	2.886
PNJ-410		563	0	592	2.891
PNJ-195		577.4	0	606.4	2.891
PNJ-201		577	0	606.1	2.908

J-225		577.1	0	606.3	2.92
PNJ-412		563	0	592.3	2.927
PNJ-189		578	0	607.7	2.961
PNJ-403		558	0	588.1	3.005
PNJ-428		559	0	589.5	3.046
PNJ-384		560.5	0	591	3.048
PNJ-386		560.3	0	591	3.065
PNJ-426		560	0	591	3.092
PNJ-198		575.2	0	606.3	3.106
PNJ-203		575	0	606.3	3.122
PNJ-429		558	0	589.4	3.133
PNJ-388		557.1	0	588.7	3.159
PNJ-377		561	0	592.7	3.16
J-1353		561	0	592.7	3.163
PNJ-200		576	0	607.7	3.163
PNJ-210		574	0	606.2	3.212
PNJ-245		573	0	605.6	3.251
d-d8	d-d8	557	9.517	589.7	3.265
PNJ-430		557	0	589.7	3.266
PNJ-239		573.6	0	606.3	3.268
PNJ-381		560.3	0	593.1	3.27
PNJ-204		575	0	607.8	3.274
PNJ-380		560.3	0	593.1	3.274
PNJ-218		573	0	606	3.296
PNJ-434		555	0	588.1	3.299
PNJ-433		555	0	588.2	3.315
PNJ-379		560	0	593.6	3.349
PNJ-376		561	0	594.7	3.362
PNJ-197		572.2	0	606.4	3.418
PNJ-205		572	0	606.4	3.433
PNJ-207		572	0	606.4	3.434
PNJ-208		572	0	606.4	3.434
PNJ-209		572	0	606.4	3.434
PNJ-248		571	0	605.6	3.45
PNJ-437		552	0	586.8	3.472
PNJ-436		552	0	587	3.492
PNJ-435		552	0	587.1	3.503
PNJ-368		555	0	590.3	3.523
PNJ-385		558	0	593.4	3.53
PNJ-417		559.3	0	594.7	3.533
PNJ-382		557	0	592.4	3.533
PNJ-223		570	0	605.5	3.544
PNJ-420		556	0	591.5	3.545
PNJ-402		558	0	593.6	3.548
PNJ-374		560	0	595.7	3.562
PNJ-422		556	0	591.7	3.562
PNJ-407		557	0	592.7	3.564
PNJ-373		560	0	595.7	3.565
PNJ-225		570	0	605.7	3.565
PNJ-370		559	0	594.9	3.578
PNJ-371		560	0	595.9	3.582
PNJ-372		560	0	595.9	3.583
d-d1	d-d1	568	12.8	604	3.591
J-1338		568	0	604	3.592
PNJ-215		570	0	606.1	3.599
PNJ-369		559	0	595.4	3.632
PNJ-366		560	0	596.8	3.672
PNJ-365		557	0	593.8	3.676
PNJ-303		559	0	595.9	3.681
PNJ-295		568	0	605.4	3.731

PNJ-252		568	0	605.5	3.742
PNJ-233		557.8	0	596.3	3.844
PNJ-217		568	0	606.7	3.858
PNJ-251		563	0	601.7	3.861
PNJ-250		563	0	601.7	3.862
PNJ-367		555	0	594.2	3.907
PNJ-375		557	0	596.2	3.909
PNJ-256		559	0	599.6	4.049
PNJ-254		560	0	600.6	4.051
PNJ-253		560	0	600.7	4.062
PNJ-255		559	0	599.8	4.069
PNJ-219		566	0	606.9	4.077
PNJ-240		563	0	604	4.087
PNJ-232		563	0	604	4.087
PNJ-364		556	0	597.4	4.129
PNJ-235		563	0	605	4.191
PNJ-231		562	0	604.5	4.241
PNJ-383		561	0	603.6	4.246
d-d14	d-d14	560	11.16	602.6	4.253
PNJ-406		560	0	602.7	4.256
PNJ-224		564	0	607.1	4.296
PNJ-229		560	0	607.2	4.715
PNJ-227		556	0	607.4	5.133

Pressures at nodes are enough. Hence, results are OK.

CHAPTER 8

Establishing DMAs and Bulk Meters

8.1 FORMATION OF DMAS

District Metering Areas (DMA)'s are the building blocks of the 24/7 continuous water supply scheme. DMA's are created to facilitate easy leak detection program. A typical operation zones and the DMA are shown in Figures 8.1 and 8.2.

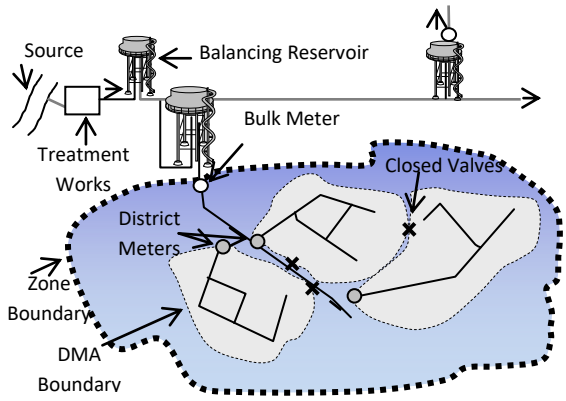


Figure 8.1: Operational zones

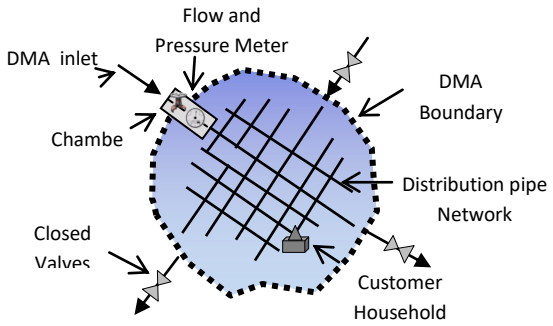


Figure 8.2: District Metering Area.

Operational Zone and DMA: Schematic arrangement of a big sector of distribution system called as "operational zone" is shown in Figure 8.1. Source supplies water to the water treatment plant. Treated water is stored into balancing reservoir, which supplies water to various service reservoirs. Operational zone consists of a number of district metering areas (Figure 8.2). Zones are demarcated from the consideration of critical study of storages of the service reservoirs (shown in design of Tanks in Chapter 6). A service reservoir ESR/ GSR, with the pump, supplies water to the operational zone.The operational zones and DMA's are the most strategic blocs for improvement of the system.

8.2 DMAS FOR ALL ZONES

In Pimpri-Chinchwad, total numbers of customers are 1,27,818 in number. There are total 47 water districts (zones). It is required that in each DMA, there should be 500 to 3000 connections. Operational zones for entire city are shown in Figure 8.3.The zones,in the selected area (40% of area), are further divided into 26 DMA's.

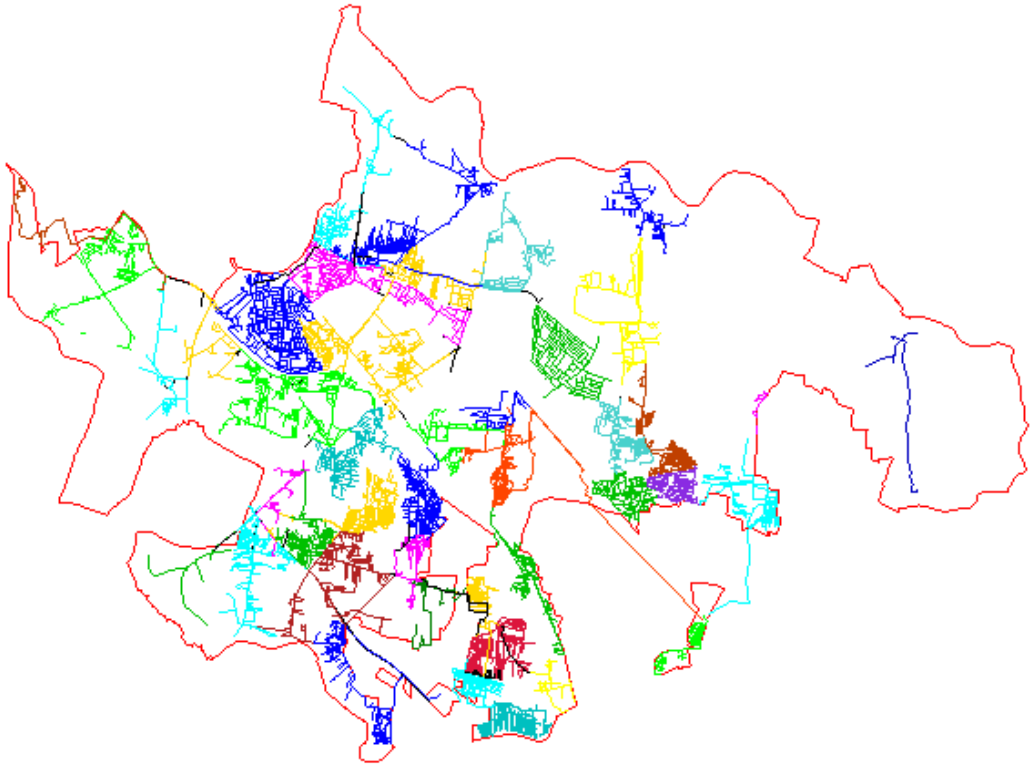


Figure 8.3: Operational Zones in Pimpri-Chinchwad

8.2.1 DMA's in Operational Zone- A2

(a) DMA Formation: The operational zone A2 is divided into 2 DMA's. These DMA's are termed as a2-a, and a2-b. Active topology of these DMA's in the hydraulic model is shown in Figures8.4.

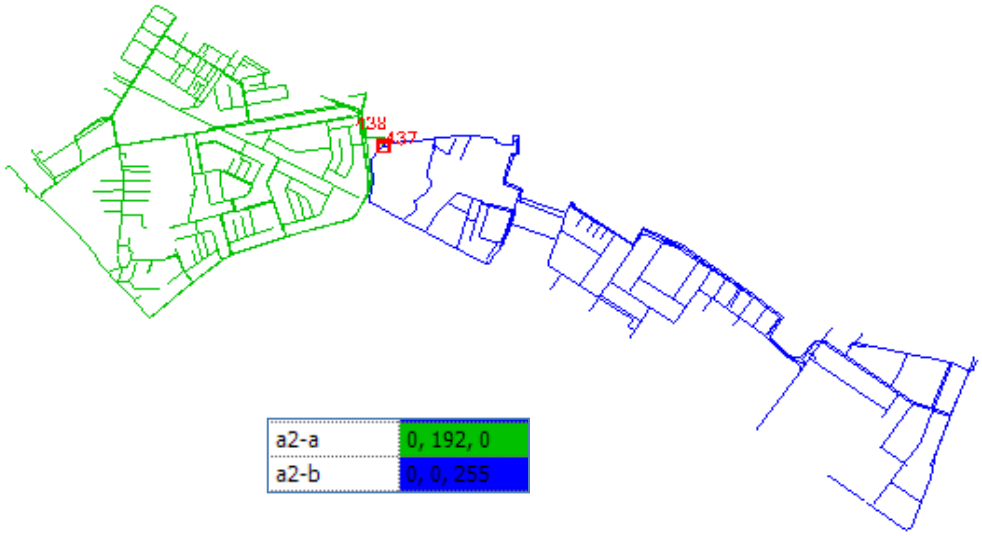


Figure 8.4: DMA's in Operational Zone- A2

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figure 8.5.

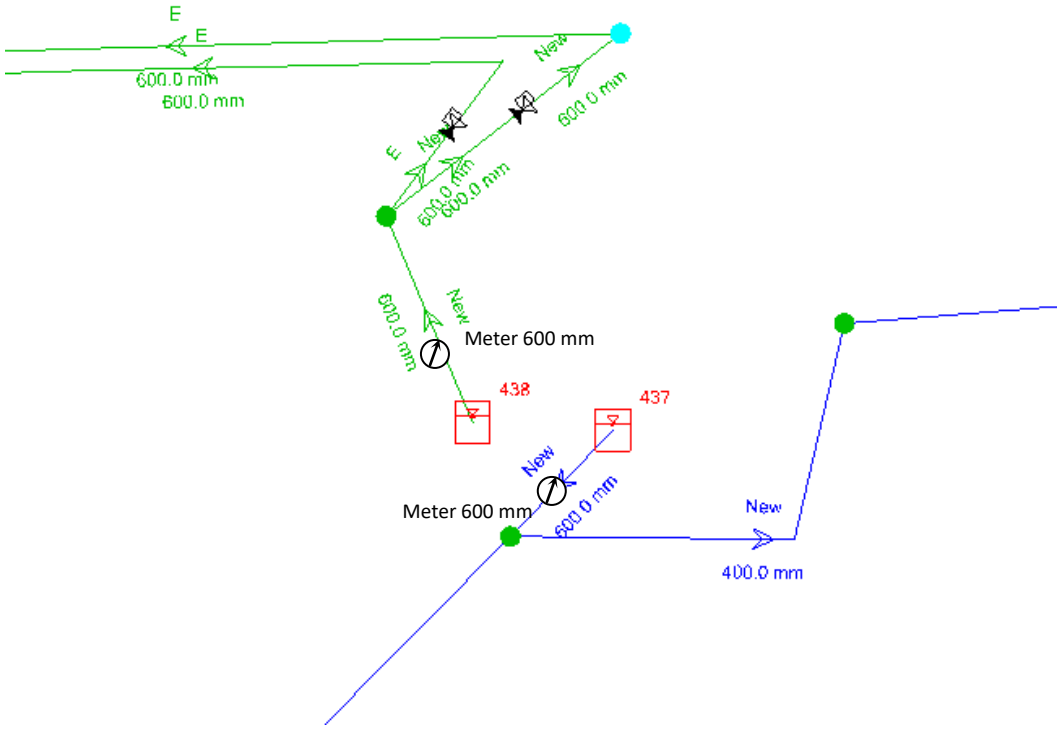


Figure 8.5: Size and location of the bulk meter

8.2.2 DMA's in Operational Zone- B1

(a) DMA Formation: The operational zone B1 is divided into 2 DMAS. These DMA's are termed as b1-a, and b1-b. Active topology of these DMA's in the hydraulic model is shown in Figures8.6.

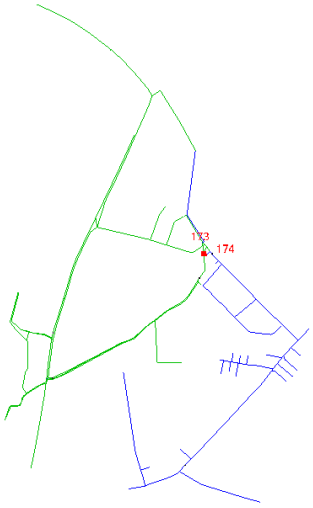


Figure 8.6: DMA's in Operational Zone- B1

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figure 8.7.

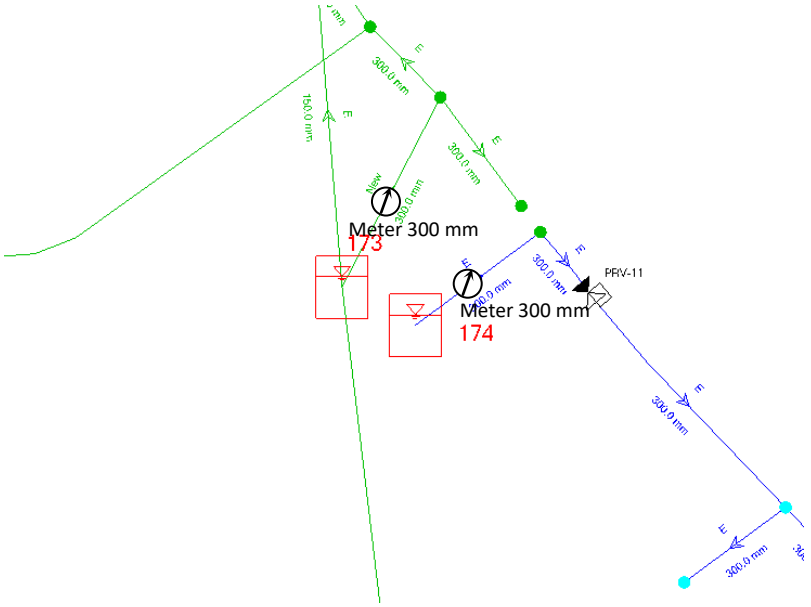


Figure 8.7: Size and location of the bulk meter

8.2.3 DMA's in Operational Zone- B5

(a) DMA Formation: The operational zone B5 is divided into 2 DMA's. These DMA's are termed as b5-a, and b5-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.8.

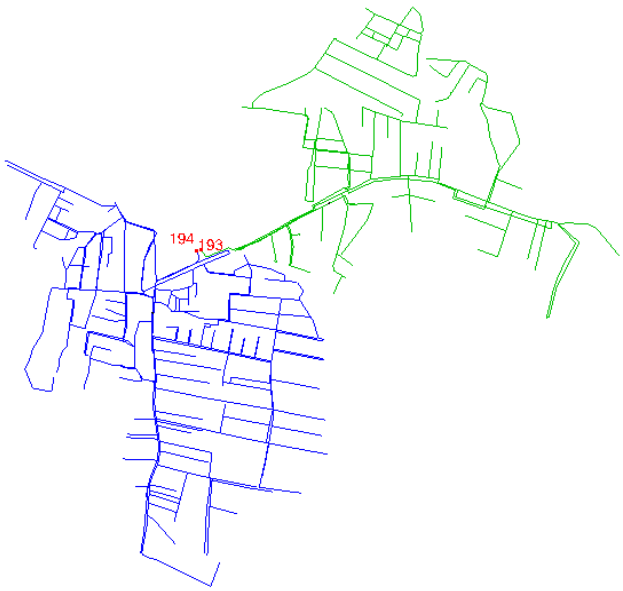


Figure 8.8: DMA's in Operational Zone- B5

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figure 8.9.

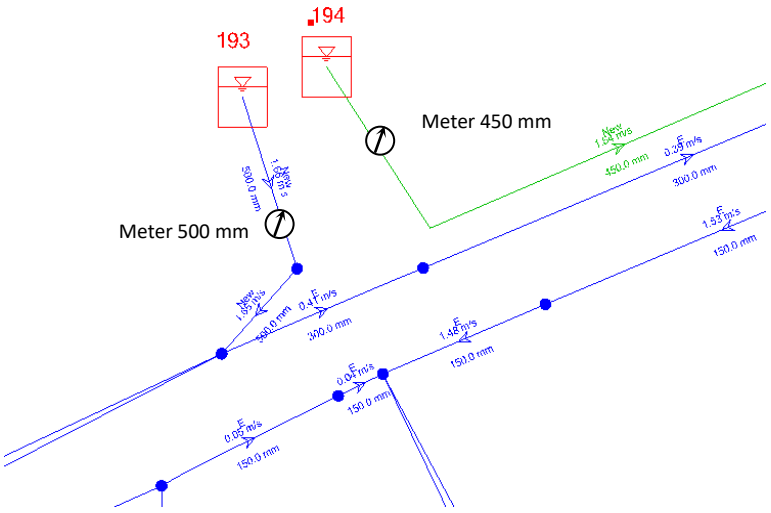


Figure 8.9: Size and location of the bulk meter

8.2.4 DMA's in Operational Zone- C2-C3

(a) DMA Formation: The operational zone C2-C3 is divided into 2 DMA's. These DMA's are termed as C2-C3-a, and C2-C3-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.10.

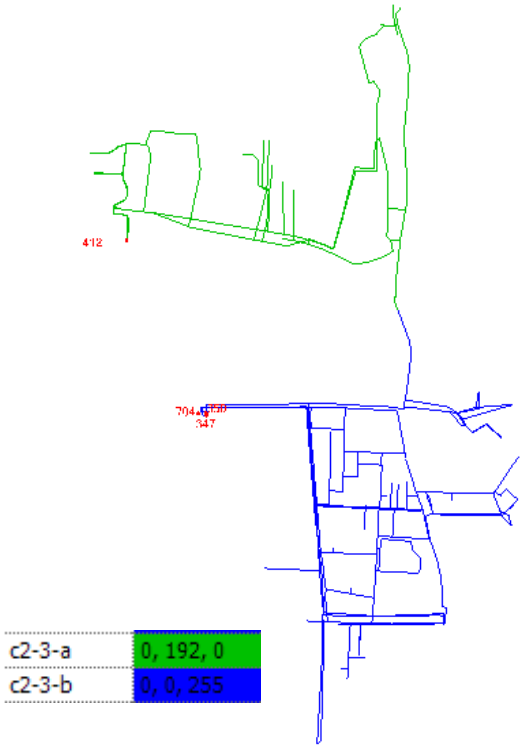


Figure 8.10: DMA's in Operational Zone- C2-C3

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.11 and 8.12.

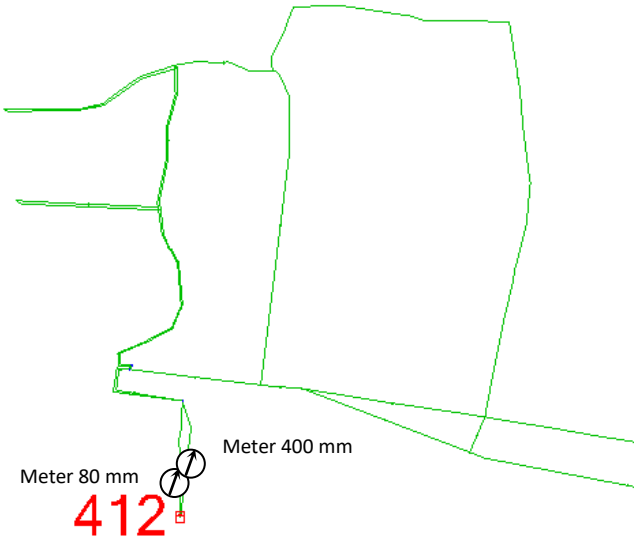


Figure 8.11: Size and location of the bulk meter

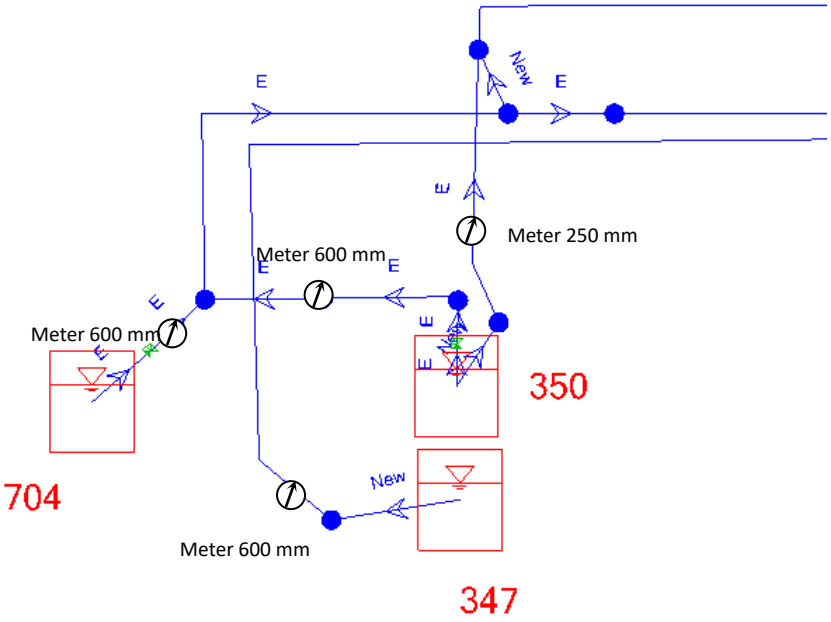


Figure 8.12: Size and location of the bulk meter

8.2.5 DMA's in Operational Zone- C5

(a) DMA Formation: The operational zone C5 is divided into 2 DMA's. These DMA's are termed as C5-a, and C5-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.13.

Figure 8.13: DMA's in Operational Zone- C5

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.14.

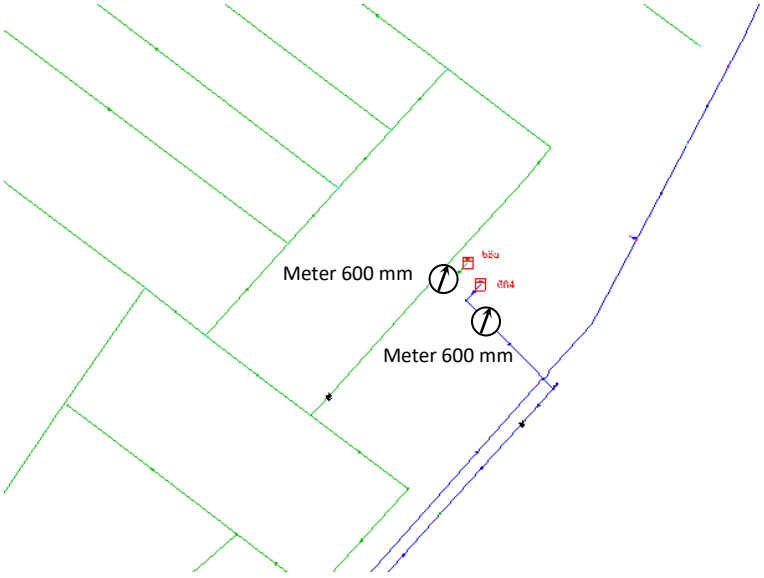


Figure 8.14: Size and location of the bulk meter

8.2.6 DMA's in Operational Zone- C10

(a) DMA Formation: The operational zone C10 is divided into 2 DMA's. These DMA's are termed as C10-a, and C10-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.15.

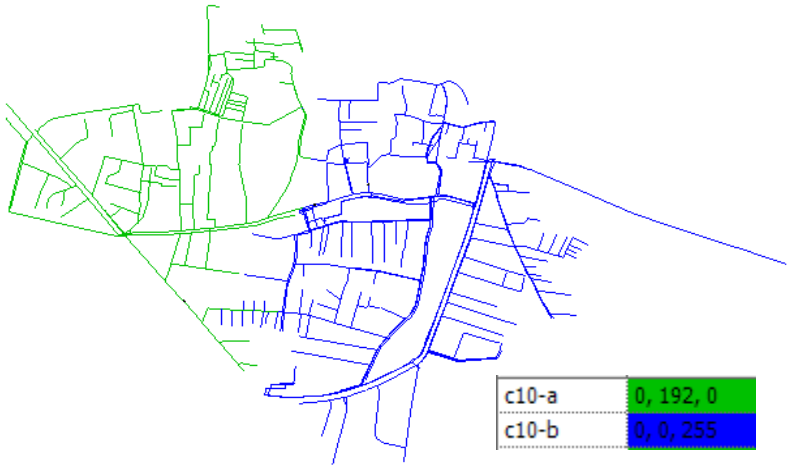


Figure 8.15: DMA's in Operational Zone- C10

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.16.

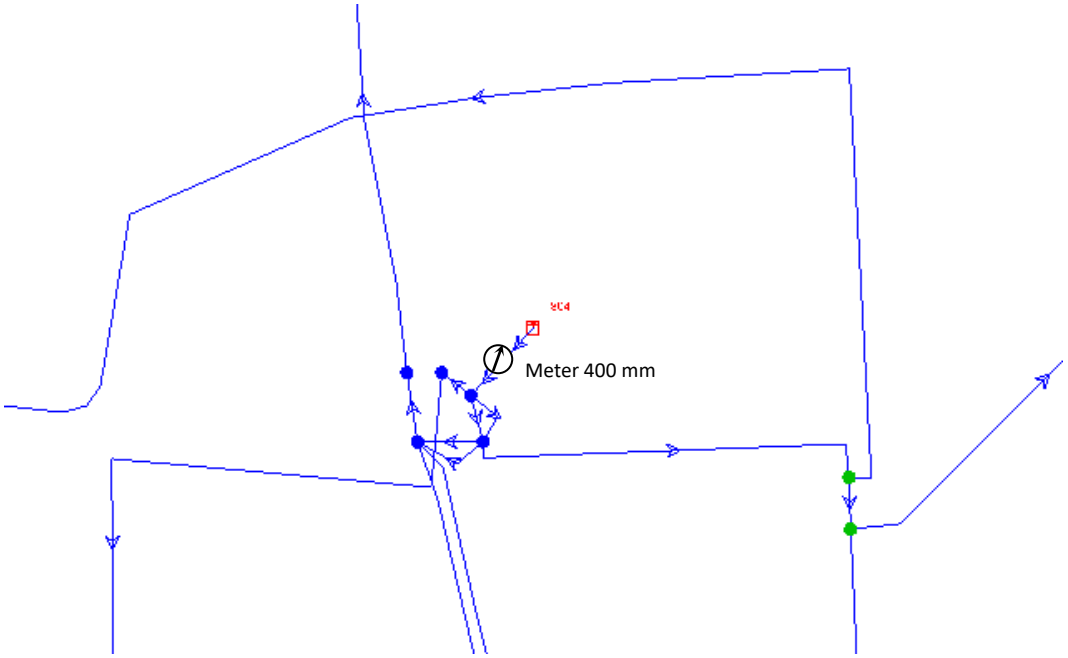


Figure 8.16: Size and location of the bulk meter

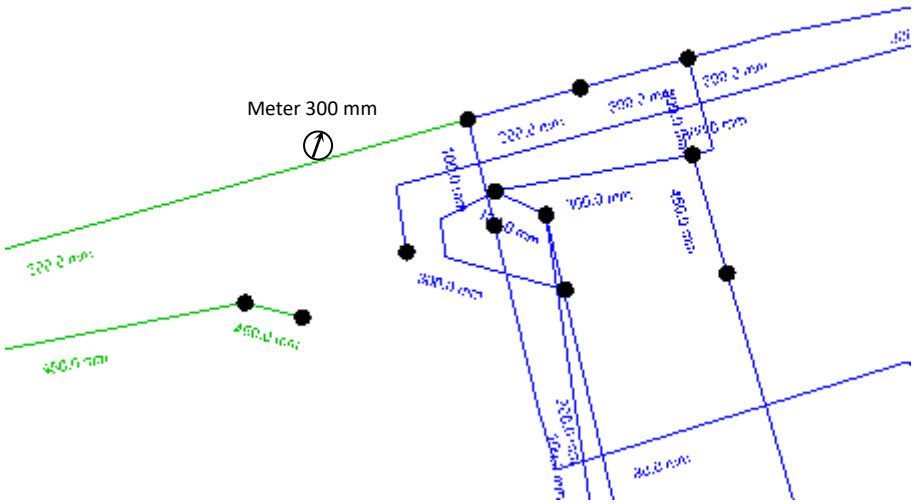


Figure 8.16(b): Size and location of the bulk meter

8.2.7 DMA's in Operational Zone- C11

(a) DMA Formation: The operational zone C11 is divided into 2 DMA's. These DMA's are termed as C11-a and C11-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.17.

Figure 8.17: DMA's in Operational Zone- C11

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.18 and 8.19.

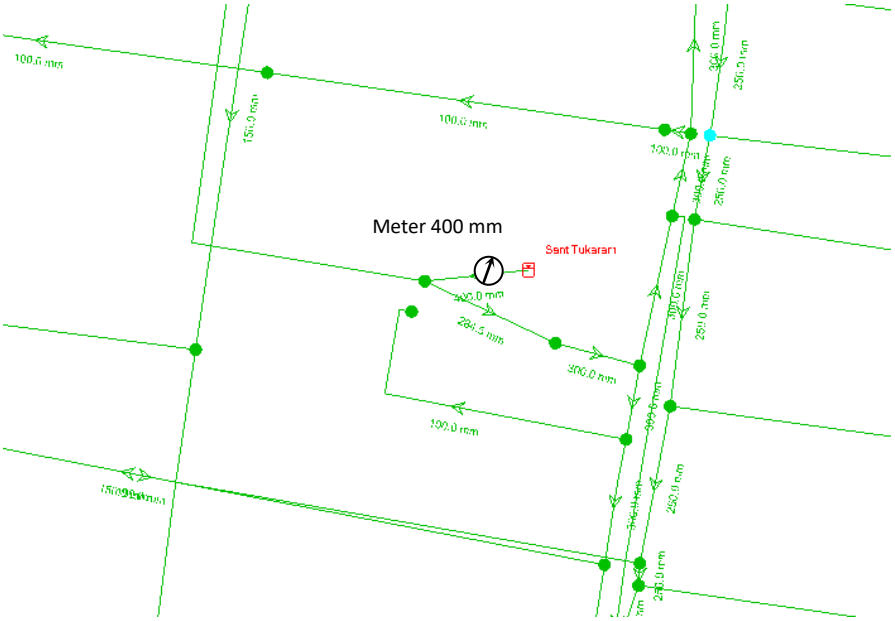


Figure 8.18: Size and location of the bulk meter

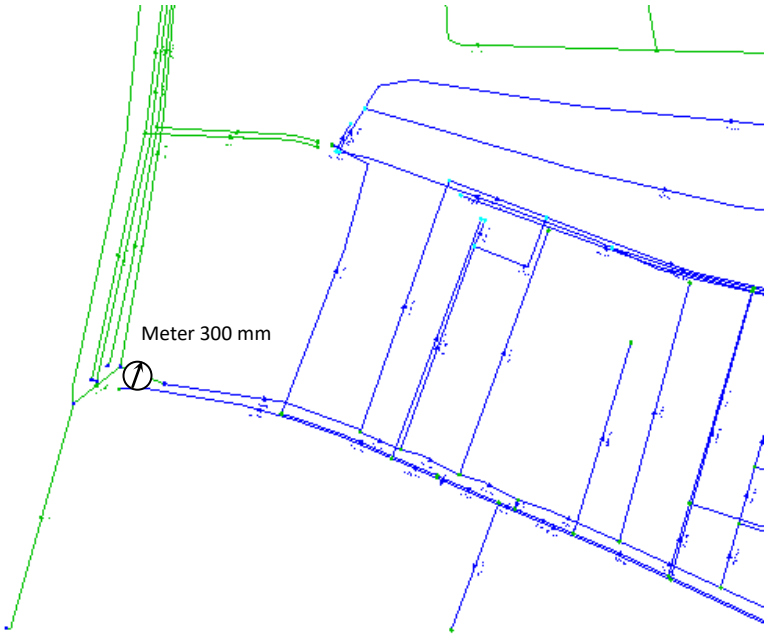


Figure 8.19: Size and location of the bulk meter

8.2.8 DMA's in Operational Zone- C12

(a) DMA Formation: The operational zone C12 is divided into 2 DMA's. These DMA's are termed as C12-a, and C12-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.20.

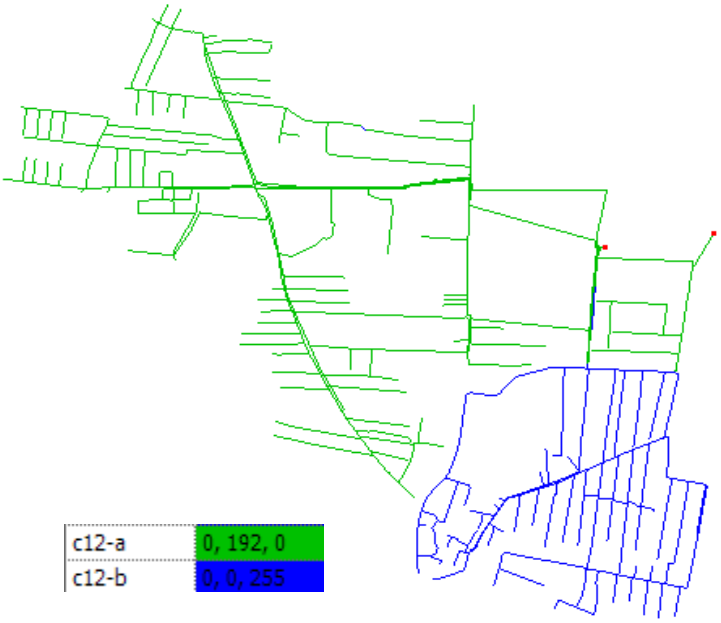


Figure 8.20: DMA's in Operational Zone- C12

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.21 and 8.22.

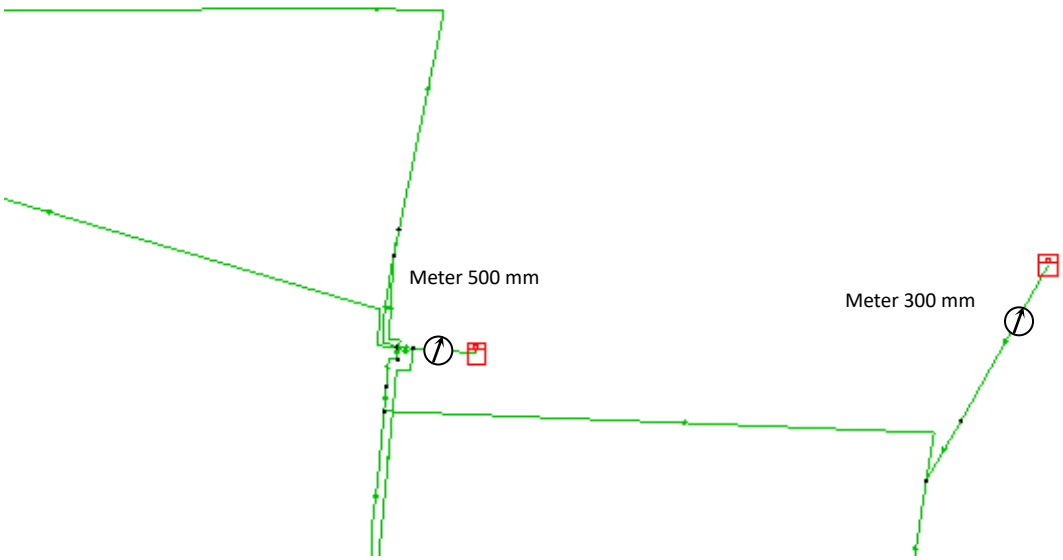


Figure 8.21: Size and location of the bulk meter

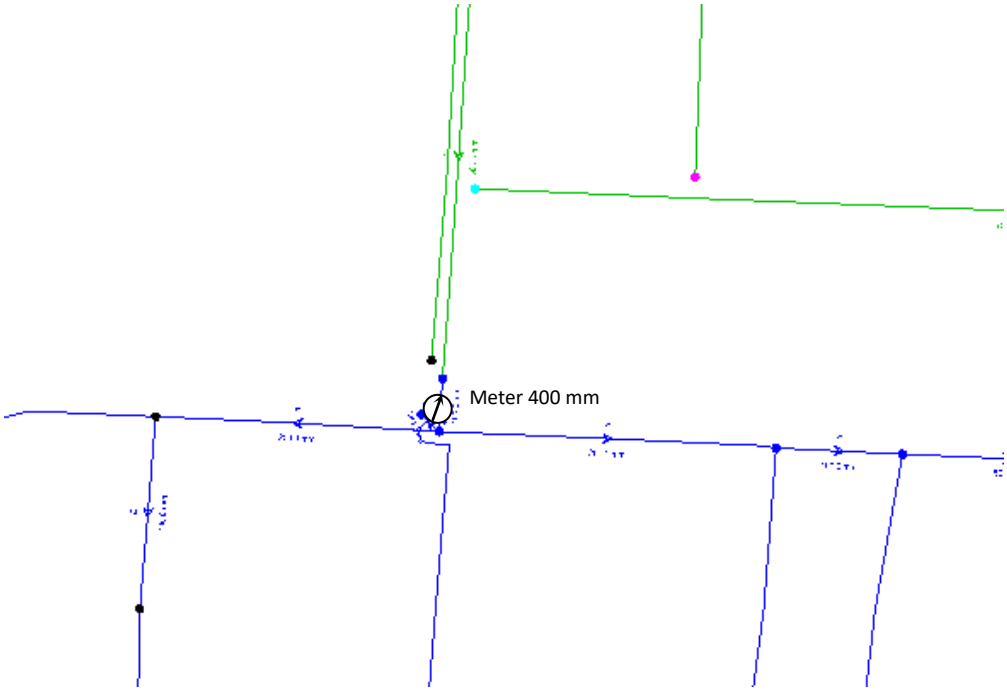


Figure 8.22: Size and location of the bulk meter

8.2.9 DMA's in Operational Zone- C13

(a) DMA Formation: The operational zone C13 is divided into 2 DMA's. These DMA's are termed as C13-a, and C13-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.23.

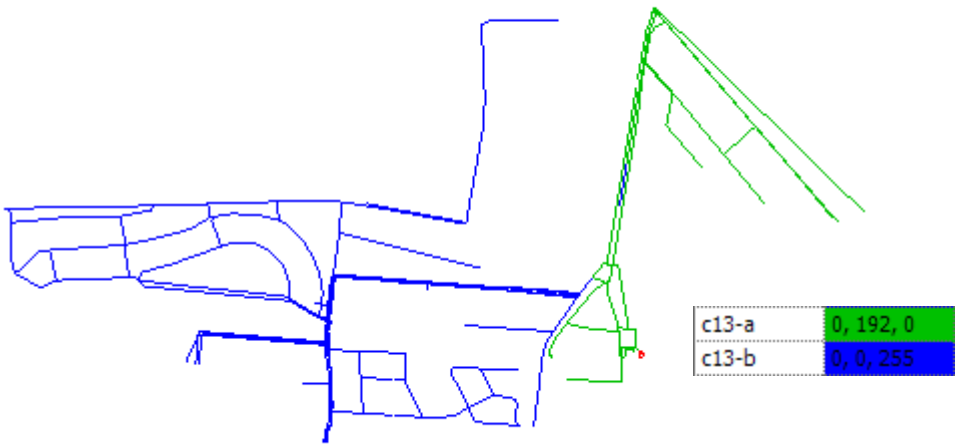


Figure 8.23: DMA's in Operational Zone- C13

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.24.

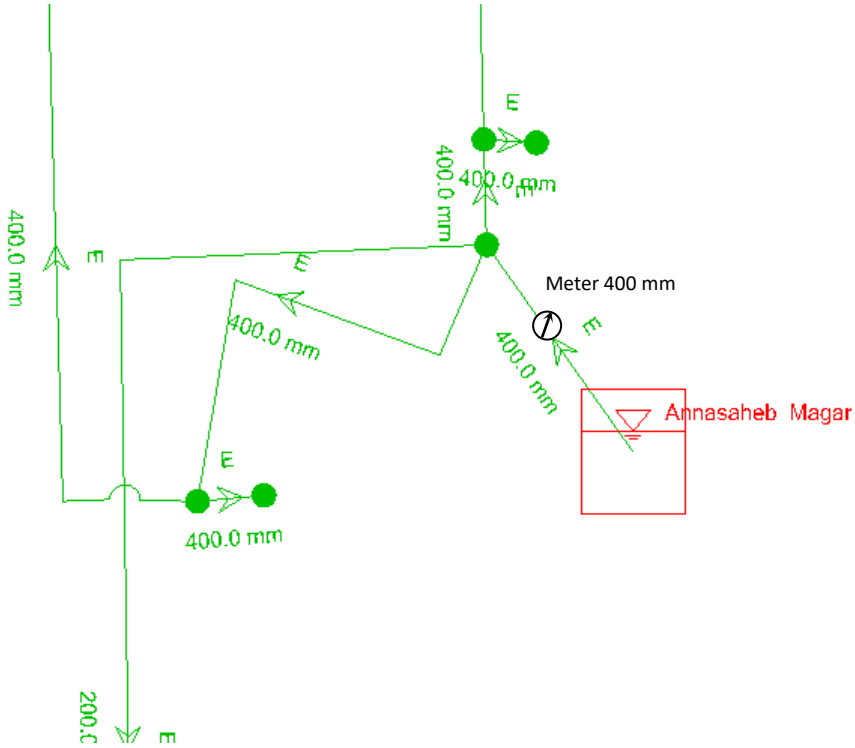


Figure 8.24: Size and location of the bulk meter

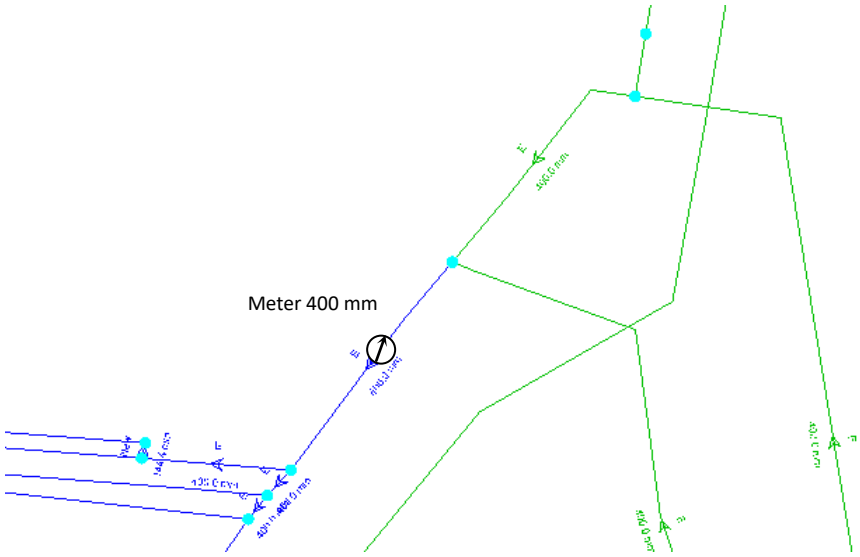


Figure 8.25: Size and location of the bulk meter

8.2.10 DMA's in Operational Zone- C14

(a) DMA Formation: The operational zone C14 is divided into 2 DMA's. These DMA's are termed as C14-a, and C14-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.26.

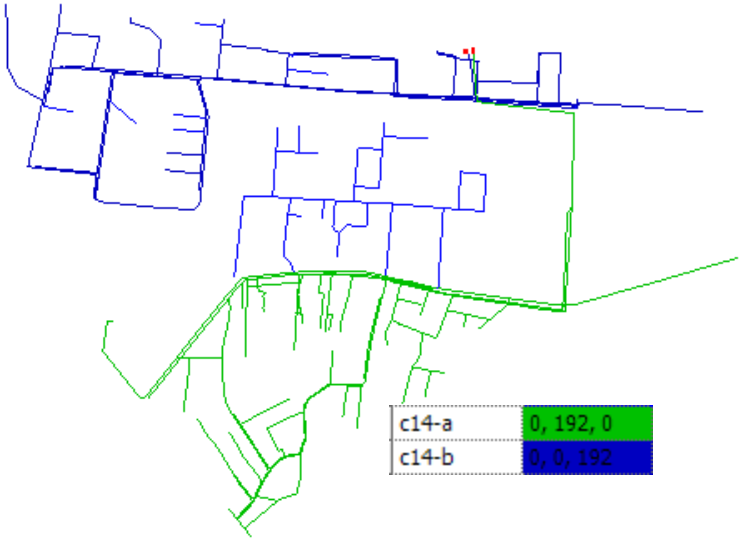


Figure 8.26: DMA's in Operational Zone- C13

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figure 8.27.

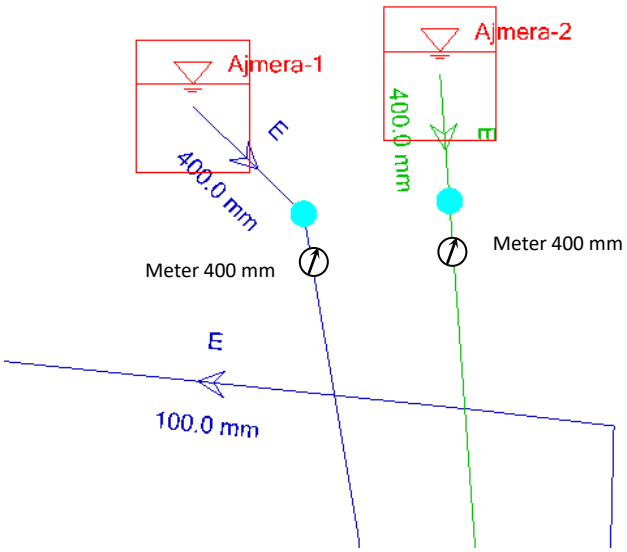


Figure 8.27: Size and location of the bulk meter

8.2.11 DMA's in Operational Zone- D9

(a) DMA Formation: The operational zone D9is divided into 2 DMA's. These DMA's are termed as D9-a, and D-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.28.

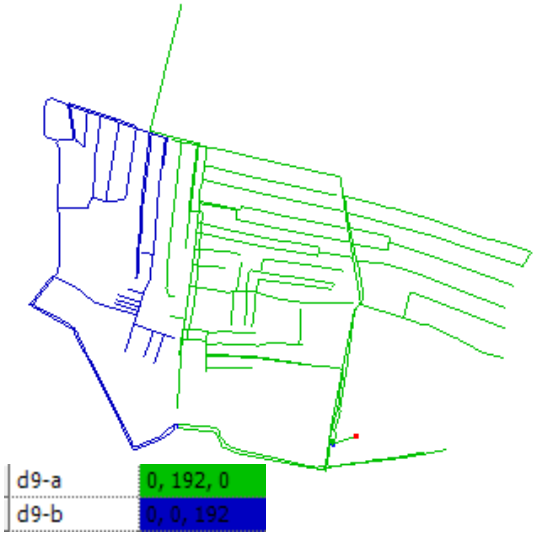


Figure 8.28: DMA's in Operational Zone- D9

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figure 8.29.

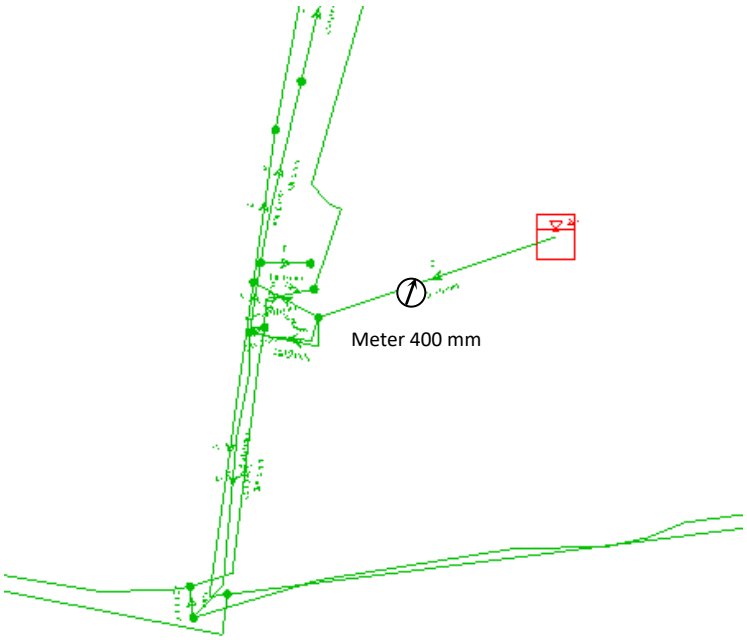


Figure 8.29: Size and location of the bulk meter

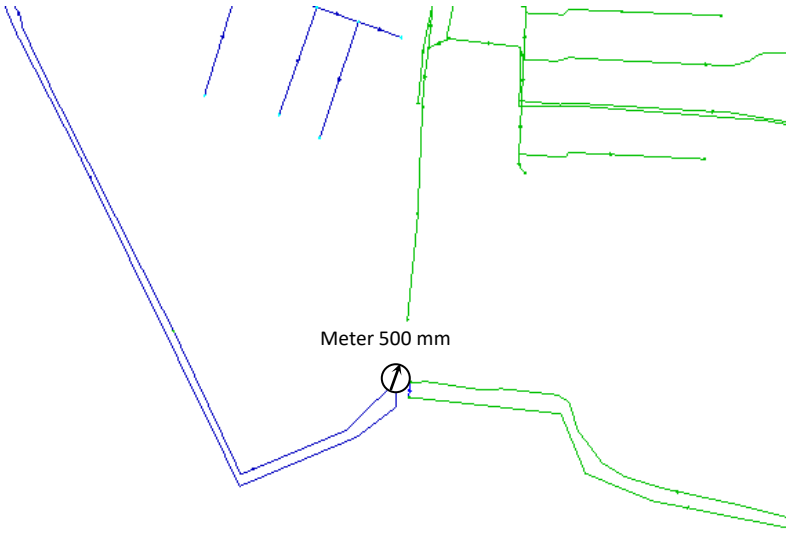


Figure 8.30: Size and location of the bulk meter

8.2.12 DMA's in Operational Zone- D10-11

(a) DMA Formation: The operational zone D10-11 is divided into 2 DMA's. These DMA's are termed as D10-11-a, and D10-11-b. Active topology of these DMA's in the hydraulic model isshown in Figures 8.31.

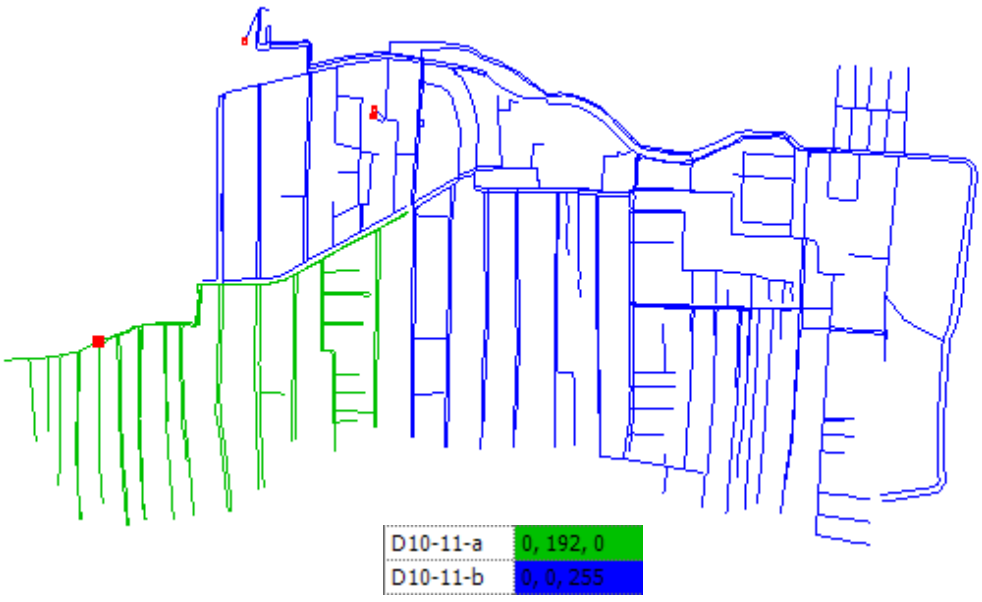


Figure 8.31: DMA's in Operational Zone- D10-11

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.32, 8.33 and 8.34.

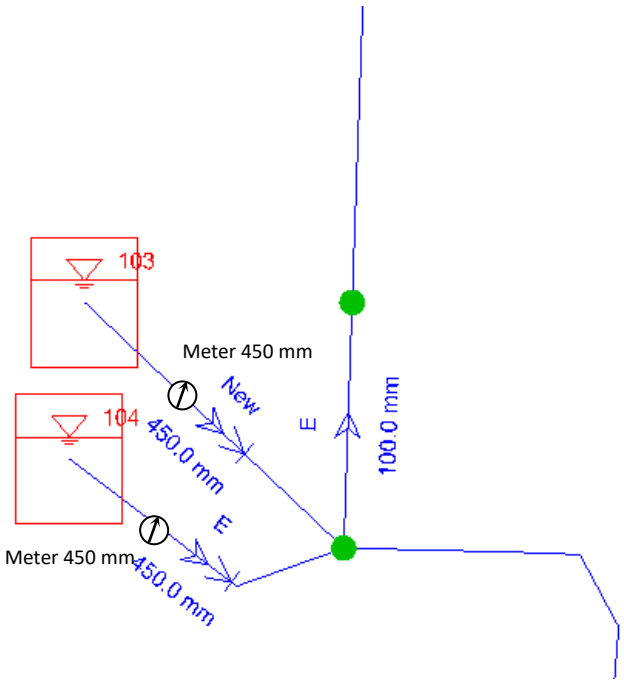


Figure 8.32: Size and location of the bulk meter

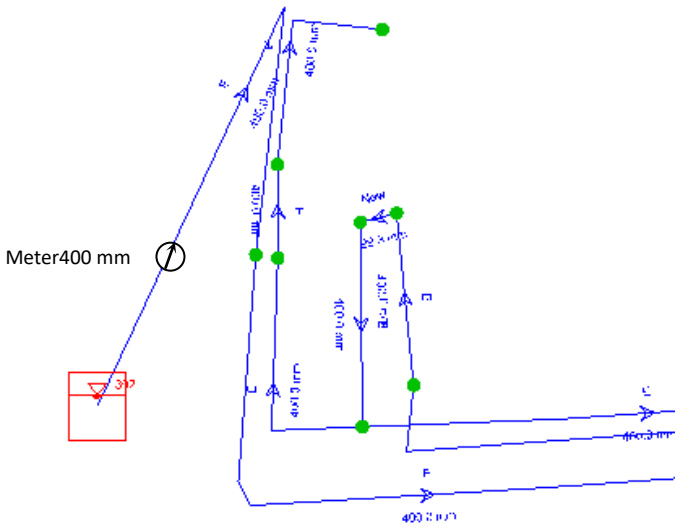


Figure 8.33: Size and location of the bulk meter

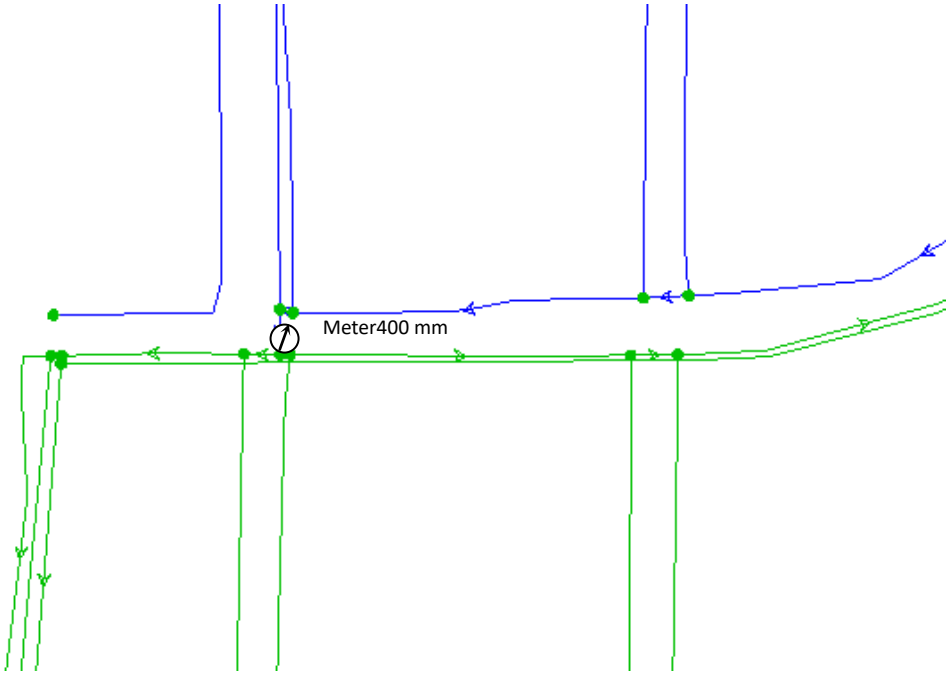


Figure 8.34: Size and location of the bulk meter

8.2.13 DMA's in Operational Zone- D13

(a) DMA Formation: The operational zone D13is divided into 2 DMA's. These DMA's are termed as D13-a and D13-b. Active topology of these DMA's in the hydraulic model is shown in Figures 8.35.

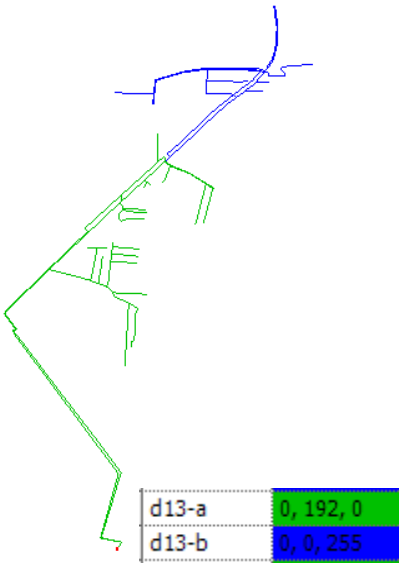


Figure 8.35: DMA's in Operational Zone- D13

(b) **Size and Location of Bulk Meters:** The size and location of the bulk meters is shown in Figures 8.36 and 8.37.

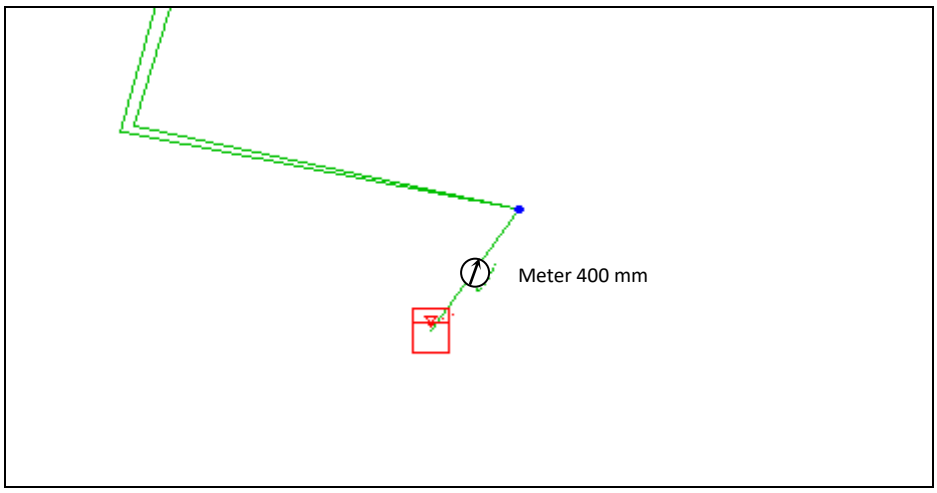


Figure 8.36: Size and location of the bulk meter

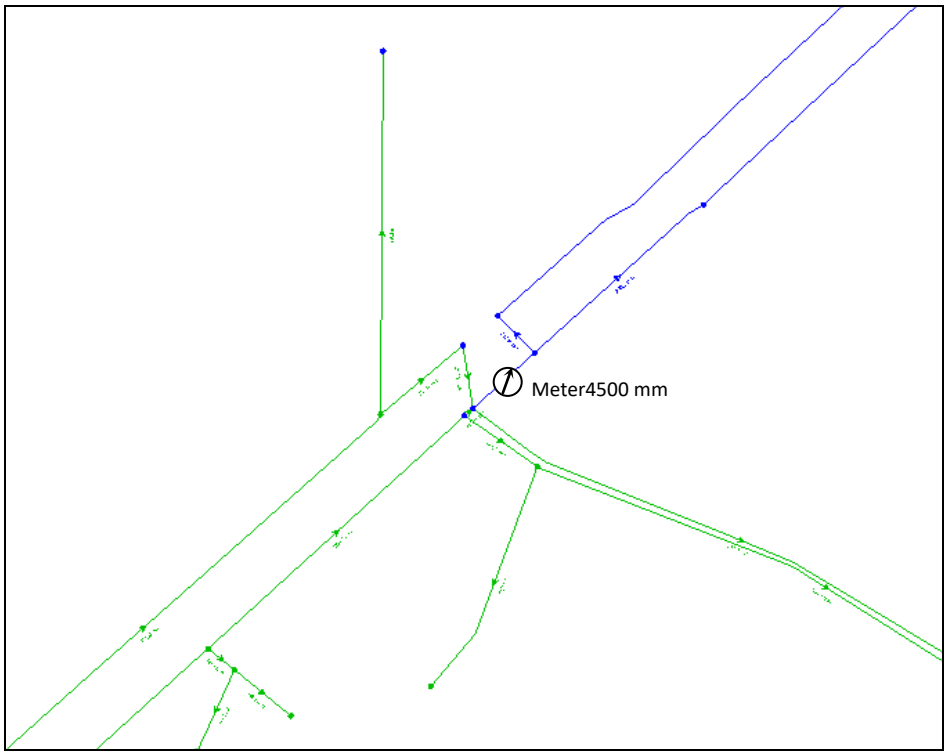


Figure 8.37: Size and location of the bulk meter

Abstract of the bulk meters is shown in Table 8.1.

Table 8.1: Abstract of bulk meters

SN	Zones	DMA	Size of Bulk Meter (mm)	Number of Bulk Meters
1	A2	a2-a	600	1
		a2-b	600	1
2	B1	b1-a	300	1
		b1-b	300	1
3	B5	b5-a	450	1
		b5-b	500	1
4	C2-C3	C2-C3-a	80	1
			400	1
		C2-C3-b	600	1
			600	1
			600	1
5	C5	c5-a	600	1
		c5-b	600	1
6	C10	c10-a	300	1
		c10b	400	1
7	C11	c11-a	400	1
		c11-b	300	1
8	C12	c12-a	500	1
			300	1
		c12-b	400	1
9	C13	c13-a	400	1
		c13-b	400	1
10	C14	c14-a	400	1
		c14-b	400	1
11	D9	d9-a	400	1
		d9-b	500	1
12	D10-11	D10-11-a	400	1
		D10-11-b	400	1
			450	1
			450	1
13	D13	d13-a	400	1
		d13-b	400	1
	13	26		32

Chapter-9

Design of Distribution Network

The existing pipelines laid in the distribution network of the Pimpri-Chinchwadcity are shown in Figure 9.1.

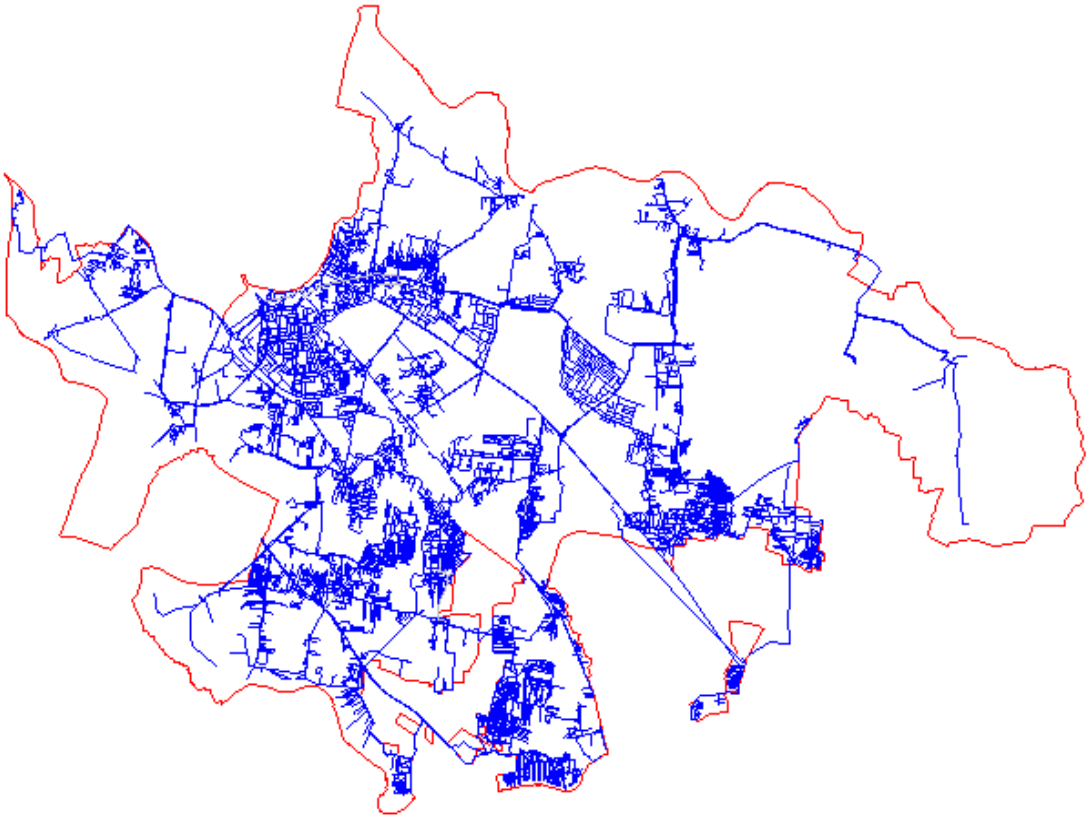


Figure 9.1: Existing pipelines in the distribution network

The total length of the existing distribution network in Pimpri-Chinchwad Municipal Corporation is 1352 km. Length of different pipes in the selected area of distribution system is shown in Table 9.1.

Table 9.1: Diameter wise length (in m) of pipes in the selected distribution system

Diameter (mm)	Length (m)					
	AC	CI	DI	GI	MS	Grand Total
50		3688		1111		4799
80		8506				8506
100		111763	3299		1463	116525
150		81571	10808		298	92677
175		990				990
200		25256	2349		1081	28686
250		14478	441		2898	17817
300	305	23278	6042		7419	37044
350		841				841
400		6413	1923		1756	10092
450		6847	2461		3561	12869
500		39	2033		286	2358
600		3314	2570		2745	8629
700			1723			1723
Grand Total	305	286984	33649	1111	21507	343556

9.1 JURISDICTION FOR THE AREAS WITH DEMAND OF THE YEAR 2030

The area of the water district has already been shown in Figure 9.2. The area in this DPR is so selected (Figure 9.2) that the capacity of the storage tanks is enough and there is no need to construct the new ESR's.

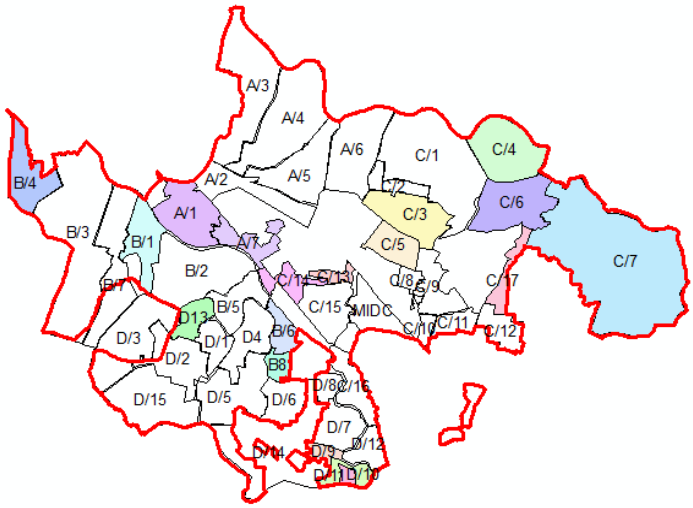


Figure 9.2: Water districts in selected area

The Population and the demand for the year 2015, 2030 and 2045 is shown in Table 9.2.

Table 9.2: Population and demand of water district

SN	Name	WD Name	Population 2011	Density	Population			Demand (MLD)		
					2015	2030	2045	2015	2030	2045
1	A1	Pradhikaran (E1)	66252	Medium	68246	106199	133780	11.39	17.73	22.33
2	A2	Triveni Nagar	87455	Very High	78826	122663	154520	13.16	20.47	25.79
3	A3	Rupi Nagar	37221	Low	57512	89495	112738	9.6	14.94	18.82
4	A4	Chikhli	89232	Medium	114897	178793	225228	19.18	29.84	37.59
5	A5	Krishna Nagar	51834	Medium	66742	103859	130833	11.14	17.34	21.84
6	A6	Kudalwadi & Jadhavwadi	33008	Low	51002	79365	99978	8.51	13.25	16.69
7	A7	Akurdi	49175	High	50655	78825	99297	8.46	13.16	16.57
8	B1	Sector 29	23191	Low	35833	55761	70243	5.98	9.31	11.72
9	B2	Bijli Nagar	80967	Very High	72978	113563	143057	12.18	18.96	23.88
10	B3	Sector 96 Part 1	33466	Low	51710	80467	101365	8.63	13.43	16.92
11	B4	Mamurdi Direct	5073	Low	7838	12198	15366	1.31	2.04	2.56
12	B5	Elpro	59905	High	61708	96025	120964	10.3	16.03	20.19
13	B6	Pimpri Camp	59223	Saturated	36603	56959	71752	6.11	9.51	11.98
14	B7	Sector 96 Part 2	18000	Low	27813	43280	54520	4.64	7.22	9.1
15	B8	Nav Maharashra	12542	Medium	16149	25130	31657	2.7	4.19	5.28
16	C1	Moshi	31919	Low	65759	102329	128906	10.98	17.08	21.52
17	C10	Bhosari Gaothan	19351	Very High	17442	27141	34190	2.91	4.53	5.71
18	C11	Sant Tukaram Nagar	49409	Saturated	30538	47520	59862	5.1	7.93	9.99
19	C12	Dighi Gaothan	41197	High	42437	66037	83188	7.08	11.02	13.89
20	C13	Anna Saheb Magar Stadium	11931	High	12290	19125	24092	2.05	3.19	4.02
21	C14	Ajmera Colony	29696	High	30590	47601	59964	5.11	7.95	10.01
22	C15	Nehru Nagar	67841	High	69883	108746	136989	11.66	18.15	22.87
23	C16	Kasarwadi	29711	Medium	38256	59532	74993	6.39	9.94	12.52
24	C17	Dighi Magzine	4214	Low	6511	10132	12764	1.09	1.69	2.13
25	C2	Boradewadi	12799	Low	19776	30774	38767	3.3	5.14	6.47
26	C3	WD4	24429	Low	37746	58738	73993	6.3	9.8	12.35
27	C4	Dudulgaon	3561	Saturated	2201	3425	4314	0.37	0.57	0.72
28	C5	Sector 7 and 10	6129	Low	9470	14737	18564	1.58	2.46	3.1
29	C6	Wadmukhwadi	2473	Low	3821	5946	7490	0.64	0.99	1.25
30	C7	Charholi	13502	Low	20862	32465	40896	3.48	5.42	6.83
31	C8	Indrayaninagar	22594	Very High	20365	31690	39920	3.4	5.29	6.66
32	C9	Panjarpol	58639	High	60404	93996	118408	10.08	15.69	19.76
33	D1	Thergaon Gaothan	35729	High	36804	57272	72146	6.14	9.56	12.04
34	D10	PWD Sector 85	21152	High	21789	33906	42711	3.64	5.66	7.13

35	D11	Old Sangvi	21191	Saturated	13097	20381	25674	2.19	3.4	4.29
36	D12	Dapodi	37956	High	39098	60842	76643	6.53	10.16	12.79
37	D13	Lakshman Nagar 2	13325	Medium	17157	26699	33633	2.86	4.46	5.61
38	D14	Pimple Nilakh	31047	Low	47972	74650	94038	8.01	12.46	15.7
39	D2	Lakshman Nagar	78211	High	80565	125369	157928	13.45	20.93	26.36
40	D3	Kala Khadak	35735	Low	55216	85922	108237	9.22	14.34	18.07
41	D4	Shreenagar	86392	Very High	77868	121172	152642	13	20.23	25.48
42	D5	Rahatni	71368	Medium	91895	142999	180138	15.34	23.87	30.07
43	D6	Pimple Saudagar	56315	Medium	72512	112838	142143	12.1	18.83	23.73
44	D7	Pimple Gurao	60158	High	61968	96430	121475	10.34	16.1	20.28
45	D8	Jawalkar Nagar	20350	High	20962	32620	41092	3.5	5.44	6.86
46	D9	New Sangvi	25265	Very High	22772	35436	44640	3.8	5.91	7.45
					2E+06	3029053	3815740	324.91	505.6	636.91

9.2 Design of Distribution Pipe Network

The demand is given as per the population density (Figure 5.8). The design is carried out by a steady state method. The sizes are computed for the demand of the year 2045 with a peak factor of 2 as per CPHEEO manual. Existing pipe network in the selected area is shown in Table 9.3.

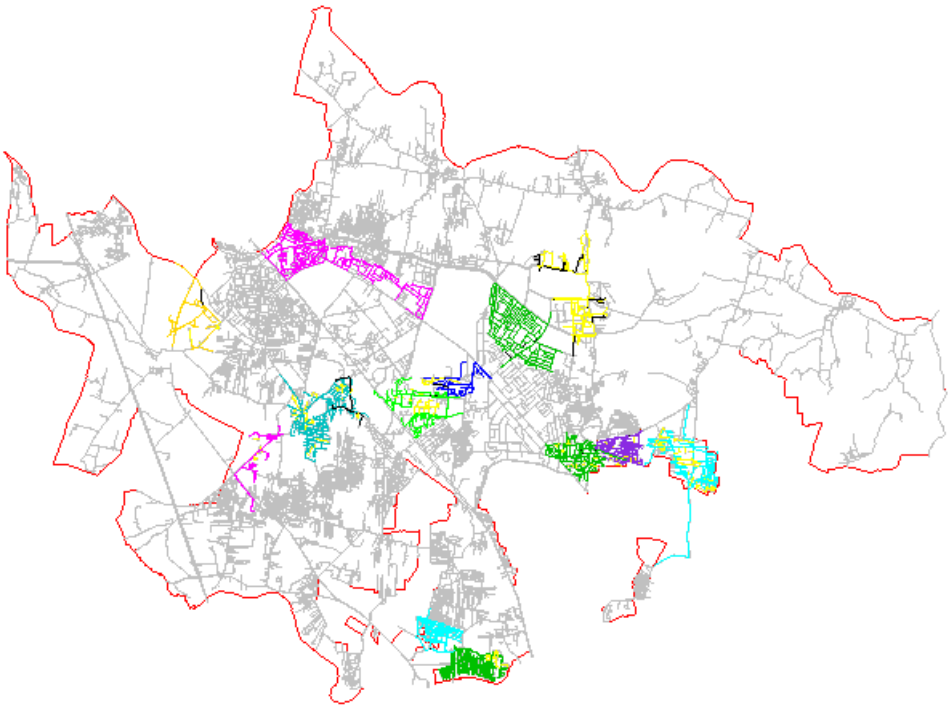


Figure 9.3: Pipe network in selected area of Distribution System

Length of the new pipes proposed is shown in Table 9.3 and length of the old pipes to be replaced is shown in Table 9.4.

Table 9.3: New pipes proposed in the selected area

Diameter (mm)		Length (m)		
Outer	Inside	DI	HDPE	Grand Total
110	99.3		31251	31251
160	144.4		4177	4177
200	180.6		403	403
225	203.1		3050	3050
250	225.8		316	316
280	252.9		2782	2782
315	284.5		3867	3867
	300	710		771
	350	2566		2566
	400	4306		4306
	450	778		778
	500	131		131
	600	112		112
	700	291		291
	Grand Total	8894	45846	54801

Table 9.4: Length of pipes to be replaced in selected area of distribution system

Diameter (mm)	Length (m)		
	HDPE	DI	Total
110	38949		38949
160	27803		27803
180	297		297
225	8606		8606
280	5345		5345
300		11113	11113
350		252	252
400		3028	3028
450		3861	3861
500		707	707
600		2589	2589
700		517	517
Grand Total	81000	22067	103067

Pipe results for all the zones in the selected area are shown in Appendix-A. It is observed that the velocity of flow is less than 1.8 m/s and most of the nodal pressures are above 0.6 m.

Pressure Reducing Valves (PRV's)

PRV's proposed in the selected area are shown in Table 9.4 and abstract is in Table 9.5.

Table 9.4: PRV's proposed in the selected area

Label	Elevation (m)	Diameter (Valve) (mm)	Hydraulic Grade Setting (Initial) (m)	Pressure Setting (Initial) (kg/cm²)
PRV-36	578	100	588.02	1
PRV-15	569.99	100	580	1
PRV-26	603.67	150	613.69	1
PRV-14	568.48	150	588.51	2
PRV-4	608.52	150	618.54	1
PRV-21	599.41	150	609.43	1
PRV-13	583.68	150	593.7	1
PRV-8	604.77	150	614.79	1
PRV-6	590.29	150	600.3	1
PRV-5	608.78	150	618.8	1
PRV-32	562.85	150	572.87	1
PRV-9	596.34	150	606.36	1
PRV-38	594.1	150	604.12	1
PRV-34	600.4	150	625.44	2.5
PRV-35	600.27	150	625.32	2.5
PRV-37	579.3	150	594.32	1.5
PRV-20	604.48	200	614.49	1
PRV-11	585.19	300	593.21	0.8
PRV-12	570.73	300	580.75	1
PRV-16	565.16	300	575.17	1
PRV-23	584.72	300	599.75	1.5
PRV-24	603.82	300	615.84	1.2
PRV-28	582.03	300	592.05	1
PRV-31	580.28	300	590.3	1
PRV-10	604.34	400	614.36	1
PRV-19	604.6	500	614.62	1

Table 9.5: Abstract of PRVs proposed in the selected area

Dia	Number
100	2
150	14
200	1
300	7
400	1
500	1
Total	26

CHAPTER 10

Estimate of Proposed Works

Abstract of Costs

Table 10.1: Abstract of costs

Sr.No	Particulars of Sub Estimate	Cost (Rs)
1	Pure Water Transmission main (9.723 km) from MBR to Various ESR's	20,95,69,665
2	Distribution system of length 54.740 Km (Di 8894 m and HDPE 45846 m)	13,96,03,223
3	Distribution System- Replacement of pipes by DI pipes	16,44,50,466
4	Distribution System- Replacement of pipes by HDPE pipes	11,26,49,031
5	Providing House Service Connections (54000 number) MDPE pipe	15,43,81,750
6	P/F Bulk Meters	1,97,09,228
7	P/F Domestic Meters	11,80,74,000
8	Simulation of Distribution network	1,24,41,276
9	Isolation of DMA (616 places)	1,17,44,944
10	P/F PRV (25 places)	1,47,22,556
11	P/F Altitude valves	2,07,10,679
12	Leak Control Studies: Finding invisible leaks in the Primary network with the aid of helium gas, carrying out repairs and allied works in primary network (185 kms)	4,50,38,835
13	Finding invisible leaks with the aid of helium gas, carrying out repairs and allied works in the distribution system (1352 kms)	28,01,09,533
14	P/F Flow meters at the outlets of ESR	10,40,70,000
15	SCADA System (for distribution system)	15,52,50,000
	Total	156,25,25,186
	Add 3% Contingency Charges	4,68,75,755
	Add 0.5% Admin. Charges	78,12,625
	Total	**161,72,13,568**

24/7 Water Supply Scheme of Pimpri-Chinchwad City
Estimate of Capital Works

Sub-Work No. 1: Pure Water Transmission main from MBR to Various ESRs

ABSTRACT SHEET

Particulars of item	No.	Length	Width	Depth	Quantity	Rate	Unit	Amount
Item No.1								
Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No. 3 / P.No.35)								
For 300 to 500 mm dia.	1	2287	1.20	0.60	1646.64			
For 1000 mm dia.	1	7436	1.80	0.60	8030.88			
					9677.52	184.8	Cum	1788405.70
Item No.2								
Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No. 5 / P.No.35)								
For 300 to 500 mm dia.	1	2287	1.20	0.40	1097.76			

For 1000 mm dia.	1	7436	1.80	0.40	5353.92			
					6451.68	454.3	Cum	2930998.22
Item No.3								
Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging,,line drilling , by mechanical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer incharge normal dewatering excluding backfilling etc complete by all means.								
(MJP CSR 12-13, I.No. 7 / P.No.28)								
Lift 0 to 1.5								
For 300 to 500 mm dia.	1	2287	1.20	0.40	1097.76	771.1	Cum	846482.74
For 1000 mm dia.	1	7436	1.80	0.50	6692.4	771.1	Cum	5160509.64
Lift 1.5 to 3.0 m						-		
For 1000 mm dia.	1	7436	1.80	0.50	6692.4	790.9	Cum	5293019.16
Item No.4								
Manufacturing, providing and supplying spirally welded/ ERW/SAW fabricated MS pipes (commercial quality) including procurement of plates, gas cutting to required size, rolling, tack welding, assembling in suitable lengths to form pipes, welding on automatic welding machine and forming 'V' edge on both ends of pipes including all taxes (Central and local), railway freight, insurance, unloading from railway wagon, loading into truck, transport to stores/site, unloading, stacking etc. complete as per IS-3589 and IS 5504 as applicable as per specifications (No negative tolerance in thickness is permissible).								

(MJP CSR 12-13, I.No. 2(A) / P.No.176,178)								
1300 mm dia (ID) MS pipes, 12.0 mm thick.	1	150			150	23369	Rmt.	3505350
800 mm dia (ID) MS pipes, 10 mm thick.	1	150			150	12024	Rmt.	1803600
Item No.5 :-								
Providing D.I.K-7 grade pipes with internal cement mortar lining including all taxes, insurance, railway freight, unloading from railway wagon, loading into truck, transport to departmental stores/site, unloading, stacking etc. complete. **(IS:8329-2000 Latest Version)** (MJP CSR 12-13, I.No.3/P.No.63)								
Including 2% breakages								
1000 mm dia. DI K-7 Pipe	1	7436	1.02		7584.72	17860	Rmt.	135463099.20
500 mm dia. DI K-7 Pipe	1	776	1.02		791.52	5326	Rmt.	4215635.52
450 mm dia. DI K-7 Pipe	1	608	1.02		620.16	4545	Rmt.	2818627.20
300 mm dia. DI K-7 Pipe	1	903	1.02		921.06	2569	Rmt.	2366203.14
(Without excise duty)								
Item No.6 :-								
Providing and supplying ISI standard MS Specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and Local), octroi, inspection charges, transportation to stores/site and stacking etc. complete. (All types of specials) (MJP CSR 12-13, I.No.7(d) / P.No.65)	1	4000			4000	72.1	Kg	288400
Item No.7 :-								

Providing and supplying ISI standard D.I. specials and fitting with sealing rubber gasket of S.B.R. complete with cast iron follower gland and M.S. bolts coated or otherwise protected from rusting and suitable for D.I. pipes including cost of labour, materials, and transportation to stores / site, loading and unloading including all taxes etc. complete as per I.S.-9523.								
(MJP CSR 12-13, I.No.10 / P.No.68)								
80 to 300 mm dia.	1	700			700	107	Kg	74900
350 mm and above dia	1	55000			55000	130	Kg	7150000
Item No.8 :-								
Providing Double flanged sluice valve conforming for I.S.-2906/14846 including 1 gear arrangements as per test pressure. stainless steel spindle, caps including all transportation etc complete.						-		
(MJP CSR 12-13, I.No.2(c) / P.No.139)								
Sluice valves-PN-1								
1000 mm dia. DI K-7 Pipe	2				2	814189	No.	1628378
500 mm dia. DI K-7 Pipe	1				1	113477	No.	113477
450 mm dia. DI K-7 Pipe	1				1	88187	No.	88187
300 mm dia. DI K-7 Pipe	1				1	37695	No.	37695
Item No.9								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4 / P.No. 143)								
1000 mm dia. DI K-7 Pipe	2				2	15022	No.	30044
500 mm dia. DI K-7 Pipe	1				1	7997	No.	7997
450 mm dia. DI K-7 Pipe	1				1	7722	No.	7722

300 mm dia. DI K-7 Pipe	1				1	4366	No.	4366
Item No.10								
Transporting within 500 meters, laying in position to correct line and level M.S. specials/pipes with/without any outcoating, such as distance pieces, straps, bends, tapers, etc. on prepared bedding in trenches including marginal cutting wherever required, assembling tack welding the same. The rate to including loading, unloading, hoisting etc. complete as specified.						-		
(MJP CSR 12-13, I.No.5(a) / P.No.195)						-		
1300 mm dia (ID) MS pipes, 12.0 mm thick.	1	150			150	760	Rmt.	114000
800 mm dia (ID) MS pipes, 10 mm thick.	1	150			150	601	Rmt.	90150
Item No. 11								
Lowering, laying and jointing with SBR rubber gaskets D.I. K-7 of various classes with CI/MS specials of following diameter in proper position, grade and alignment as directed by Engineer in charge including conveyance of material from stores to site of work, including cost of jointing materials and rubber rings labour, giving hydraulic testing etc. complete. (Without rubber ring)								
(MJP CSR 12-13, I.No.2(a) / P.No.50)								
1000 mm dia. DI K-7 Pipe	1	7436			7436	794	Rmt.	5904184
500 mm dia. DI K-7 Pipe	1	776			776	242	Rmt.	187792
450 mm dia. DI K-7 Pipe	1	608			608	209	Rmt.	127072
300 mm dia. DI K-7 Pipe	1	903			903	140	Rmt.	126420
Item No.12								
Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6								

proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m. (MJP CSR 12-13, I.No. 1(F,G)/ P.No.241)								
1.5 m x 1.5 m x 1.5 m	3				3	18551		55653
1.50 m x 1.50 m x 2.1 m	2				2	23547		47094
Item No.13 Providing and laying in situ, following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete. (MJP CSR 12-13, I.No. 1 P.No.43)					2000	4491.9		8983800
Item No.14 :- Providing and applying with mechanical arrangement 1:3 proportion cement sand gunite, 40 to 50 mm thick to M.S. pipe surface under 2.1 kg per sqcm to 2.80 kg. per sqcm pressure including removing the loose materials as directed by Engineer in charge and including scrapping the surface with wire brushes, degreasing, cleaning by compressed air and providing fixing BRC fabric no.14 as reinforcement, curing for 21 days, disposing off the rebound materials within a lead of 50 m. etc. complete as directed by Engineer in charge. (MJP CSR 12-13, I.No.18 / P.No.201)								
800 mm dia (ID) MS pipes, 10.0 mm thick.	1	150	3.142	0.82	386.466	437	Sqm	168885.64
Item No.15 :-								

Providing and making inner cement mortar lining to M.S. pipes with mechanical devices in cement mortar 1:1 proportion, including cost of all materials, labour, equipments and taking necessary access openings and manholes, cuts at suitable intervals as directed by Engineer in charge and rewelding the same after done with doubler plates pipes including necessary excavation, refilling concrete breaking and remaking if any, breaking guniting and remaking the same, repainting wherever required with epoxy paint in 3 coats, all dewatering including emptying the pipeline and refilling the same after done with (water to be supplied by department free of cost within 5 km lead at fixed point and all other arrangements to be done by agency), including carrying out "C" value performance test of pipeline, complete job as per the directions of the Engineer in charge. (MJP CSR 12-13, I.No. 22 / P.No. 202)								
800 mm dia (ID) MS pipes, 10 mm thick.	1	150	3.142	0.8	377.04	385	Sqm	145160.40
12 mm thick lining								
Item No.16 :- Welding in all positions with required number of runs, for M.S. pipes internally and / or externally including gauging wherever necessary, fixing appurtenances and other accessories in connection with pi pe laying work as per specification. (MJP CSR 12-13, I.No.7(A&B) / P.No.197)								
Butt joints **12 mm thick**								
1300 mm dia (ID) MS pipes, 12.0 mm thick.	25		3.142	1.324	104.0002	897	Rmt.	93288.18
8 mm thick								

800 mm dia (ID) MS pipes, 8.0 mm thick.	25			3.142	0.816	64.0968	684	Rmt.	43842.21
Lap joints									
12 mm thick		5				5	545	m	2725.00
8 mm thick		5				5	326	m	1630.00
Item No.17 :-									
Gas cutting (either square cut or 'V' cut) pipes, plates, etc. of thickness.									
(MJP CSR 12-13, I.No.12/P.No.188)									
5 to 10 mm	1		50			50	68.25	Cum	3412.50
10 to 12 mm	1		15			15	94.5	Cum	1417.50
Item No.18 :-									
Providing and fixing in position steel bar reinforcement of various diameters for RCC pipes, caps, footings, foundations, slabs, beams, columns, canopies, staircases, newels, chajjas, lintels, pardies, copings, fins, arches etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete (including cost of binding wire)									
(MJP CSR 12-13, I.No. 8(b)/ P.No. 46)									
	1		10			10	59044	MT	590440
Item No.19 :-									

Pushing of M.S. pipe of following dia. For road crossing and railway crossing by push through method in all types of strata by using hydraulic jack and drilling machine of required diameter, below 3.0 m depth including lowering, laying, jointing of M.S. casing pipe including cost of all labour, fuel and material required welding machinery, tripod, chain pulley block, crane, blower etc. transportation and dewatering etc. complete as directed by Engineer in charge but excluding cost of M.S. pipes.								
(MJP CSR 12-13, I.No.14 / P.No.58)								
For 1200 mm dia.								
(Rate for 1000 mm = 28435, increased by 10% for 1200 mm)	1	150			150	32842.43	Rmt.	4926364.5
Item No.20 :-								
Reinstating the road surfaces with excavation, 30 cm soling, murum blindage, 40 cm size metal, 25 mm thick premixed bitumen carpet with hot mixed seal coat including compacting etc. comp.								
(AS per rate analysis)		2287	1.20		2744.4	517	sqm	1418854.8
		7436	1.80		13384.8	517	sqm	6919941.6
Item No.21 :-								
Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc. complete.								
(MJP CSR 12-13, I.No.15 / P.No.38)								
Total Excavation		**30611.76**			**30611.76**			
Deduct RCC		**2000**			**2000**			
Deduct Pipe volume								
1000 mm dia. DI K-7 Pipe	1	7436	0.7854	1	5840.23			
500 mm dia. DI K-7 Pipe	1	776	0.7854	0.25	152.37			

450 mm dia. DI K-7 Pipe	1	608	0.7854	0.2025	96.70			
300 mm dia. DI K-7 Pipe	1	903	0.7854	0.09	63.83			
					6153.13			
Net quantity of refilling					**22458.63**	63	Cum	1414893.70
Item No.22 :- Disposing off the surplus excavated stuff upto 5 km range beyond initial lead included in the excavation item								
(MJP CSR 12-13, statement VI					**10645**	199	Cum	2118355
Item No.23 :- Making interconnection to existing transmission main of any type including excavation, breaking and removing existing pipes, lowering laying of specials and pipes in their position, refilling closing w/s in that area, dewatering and restarting the w/s etc comp (MJP CSR 12-13, I.No.10 / P.No.55)								
1000 mm	8				**8**	46567	No	372536
500 mm	8				**8**	7262	No	58096
450mm	4				**4**	5859	No	23436
300mm	2				**2**	3562	No	7124
							Total Rs.	**209569664.54**

Sub-Work No. 2 (A): Distribution System- New Pipes (DI Pipes)

Particulars of item	No.	Length	Width	Depth	Quantity	Rate	Unit	Amount
Item No.1 Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete. (MJP CSR 12-13, I.No. 3 / P.No.35)	1	8894	1.30	0.60	6937.32	184.8	Cum	1282016.74
Item No.2 Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								

(MJP CSR 12-13, I.No. 5 / P.No.35)								
	1	8894	1.30	0.40	**4624.88**	454.3	Cum	2101082.98
Item No.3 Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging, line drilling , by mechanical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer incharge normal dewatering excluding backfilling etc complete by all means.								
(MJP CSR 12-13, I.No. 7 / P.No.28)								
Lift 0 to 1.5	1	8894	1.30	0.50	5781.1	771.1	Cum	4457806.21
Lift 1.5 to 3.0 m	1	8894	1.30	0.20	2312.44	790.9	Cum	1828908.80
<u>Item No.5 :-</u>								

Providing D.I.K-7 grade pipes with internal cement mortar lining including all taxes, insurance, railway freight, unloading from railway wagon, loading into truck, transport to departmental stores/site, unloading, stacking etc. complete.								
(IS:8329-2000 Latest Version)								
(MJP CSR 12-13, I.No.3/P.No.63)								
Including 2% breakages								
300mm		710	1.02		724	2826	Rmt.	2046024.00
350mm		2566	1.02		2617	3480	Rmt.	9107160.00
400mm		4306	1.02		4392	4143	Rmt.	18196056.00
450mm		778	1.02		794	5000	Rmt.	3970000.00
500mm		131	1.02		134	5859	Rmt.	785106.00
600mm		112	1.02		114	7717	Rmt.	879738.00
700mm		291	1.02		297	10409	Rmt.	3091473.00
(Without excise duty)								
Item No.6 :-								
Providing and supplying ISI standard MS Specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and Local), octroi, inspection charges, transportation to stores/site and stacking etc. complete. (All types of specials)								

(MJP CSR 12-13, I.No.7(d) / P.No.65)	1	4000			4000	72.1	Kg	288400.00
Item No.7 :- Providing and supplying ISI standard D.I. specials and fitting with sealing rubber gasket of S.B.R. complete with cast iron follower gland and M.S. bolts coated or otherwise protected from rusting and suitable for D.I. pipes including cost of labour, materials, and transportation to stores / site, loading and unloading including all taxes etc. complete as per I.S.-9523.								
(MJP CSR 12-13, I.No.10 / P.No.68)								
80 to 300 mm dia.	1	1000			1000	107	Kg	107000.00
350 mm and above dia	1	20000			20000	130	Kg	2600000.00
Item No.8 :- Providing Double flanged sluice valve conforming for I.S.-2906/14846 including 1 gear arrangements as per test pressure. stainless steel spindle, caps including all transportation etc complete.						-		

(MJP CSR 12-13, I.No.2(c) / P.No.139)								
Sluice valves-PN-1								
300mm	2				2	37695	No	75390.00
350mm	5				5	53477	No	267385.00
400mm	10				10	72101	No	721010.00
450mm	2				2	88187	No	176374.00
500mm	1				1	113477	No	113477.00
600mm	1				1	167606	No	167606.00
700mm	1				1	300430	No	300430.00
Item No.9								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4 / P.No. 143)								
300mm	2				2	4366	No	8732.00
350mm	5				5	5380	No	26900.00
400mm	10				10	6491	No	64910.00
450mm	2				2	7722	No	15444.00
500mm	1				1	7997	No	7997.00
600mm	1				1	8487	No	8487.00

700mm	1				1	9150	No	9150
Item No. 11 Lowering, laying and jointing with SBR rubber gaskets D.I. K-7 of various classes with CI/MS specials of following diameter in proper position, grade and alignment as directed by Engineer in charge including conveyance of material from stores to site of work, including cost of jointing materials and rubber rings labour, giving hydraulic testing etc. complete. (Without rubber ring) (MJP CSR 12-13, I.No.2(a) / P.No.61)								
300mm		710			724.2	140	Rmt.	101388.00
350mm		2566			2617.32	174	Rmt.	455413.68
400mm		4306			4392.12	209	Rmt.	917953.08
450mm		778			793.56	209	Rmt.	165854.04
500mm		131			133.62	245	Rmt.	32736.90
600mm		112			114.24	318	Rmt.	36328.32
700mm		291			296.82	410	Rmt.	121696.20
Item No.12 Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc.								

complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m.								
(MJP CSR 12-13, I.No. 1(F,G)/ P.No.241)								
1.5 m x 1.5 m x 1.5 m	17				17	18551		315367.00
1.50 m x 1.50 m x 2.1 m	5				5	23547		117735.00
Item No.13								
Providing and laying in situ, following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete.								
(MJP CSR 12-13, I.No. 1 P.No.43)					1500	4491.9		6737850.00
Item No.18 :-								

Providing and fixing in position steel bar reinforcement of various diameters for RCC pipes, caps, footings, foundations, slabs, beams, columns, canopies, staircases, newels, chajjas, lintels, pardies, copings, fins, arches etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete (including cost of binding wire)								
(MJP CSR 12-13, I.No. 8(b)/ P.No. 46)	1	7			7	59044	MT	413308.00
Item No.20 :-								
Reinstating the road surfaces with excavation, 30 cm soling, murum blindage, 40 cm size metal, 25 mm thick premixed bitumen carpet with hot mixed seal coat including compacting etc. comp.								
(AS per rate analysis)		8894	1.30		11562.2	517	sqm	5977657.40
Item No.21 :-								
Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc. complete.								
(MJP CSR 12-13, I.No.15 / P.No.38)								

Total Excavation					**19655.74**			
Deduct RCC					**1500**			
Deduct Pipe volume								
300mm	1	710	0.7854	0.09	50.19			
350mm	1	2566	0.7854	0.1225	246.88			
400mm	1	4306	0.7854	0.16	541.11			
450mm	1	778	0.7854	0.2025	123.74			
500mm	1	131	0.7854	0.25	25.72			
600mm	1	112	0.7854	0.36	31.67			
700mm	1	291	0.7854	0.49	111.99			
					1131.29			
Net quantity of refilling					**17024.45**	63	Cum	1072540.34
<u>Item No.22 :-</u>								
Disposing off the surplus excavated stuff upto 5 km range beyond initial lead included in the excavation item								
(MJP CSR 12-13, statement VI					**2631**	199	Cum	523569.00
<u>Item No.23 :-</u>								
Making interconnection to existing transmission main of any type including excavation, breaking and removing existing pipes, lowering laying of specials and pipes in their position, refilling closing w/s in that area, dewatering and restarting the w/s etc comp								

(MJP CSR 12-13, I.No.10 / P.No.55)								
300mm	25				**25**	3667	no	91675.00
350mm	100				**100**	4463	no	446300.00
400mm	175				**175**	5249	no	918575.00
450mm	30				**30**	6031	no	180930.00
500mm	5				**5**	7476	no	37380.00
600mm	5				**5**	12945	no	64725.00
700mm	15				**15**	16011	no	240165.00
							Total Rs.	**71673210.69**

Sub-Work No. 2 (B): Distribution System- New Pipes (HDPE) Pipes

MEASUREMENTS CUM ABSTRACT

Particulars of item	No.	Length	Width	Depth	Quantity	Unit	Rate	Amount
1	2	3	4	5	6	7	8	9
LABOUR PART								
Item No.1 :-								
Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No.3, P.No.35)	1	45846	1.00	0.60	27507.6	Cum	160	4401216
Item No.2 :-								
Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No.5, P.No.35)	1	45846	1.00	0.40	18338.4	Cum	449	8233941.6
Item No.3								
Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging,line drilling , by meachnical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer encharge normal dewatering excluding backfilling etc complete by all means.								

(MJP CSR 12-13, I.No. 7 / P.No.35)	1	45846	1.00	0.30	13753.8	Cum	771.1	10605555.18
Item No.4								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4(iv), P.No. 143)								
100 mm dia	50				50	No.	1975.05	98752.5
150 mm dia	10				10	No.	3104.85	31048.5
200 mm dia	5				5	No.	3229.8	16149
250 mm dia	10				10	No.	4208.4	42084
300 mm dia	6				6	No.	4365.9	26195.4
Item No. 5 :-								
Lowering, laying and jointing of HDPE pipes by heating to the ends of pipes with the help of tefflon coated elecric mirror/heater to the required temperature and then pressing the ends together against each other, to form a monolithic and leak proof joint by thermosetting process. The pressing may be required to be done with hydraulic jacks/butt fusion machine etc. complete with all materials, labours as directed by Engineer in charge including giving satisfactory hydraulic test.								
(MJP CSR 12-13, I.No.2, P.No.102)								
110 mm dia.	31251				31251	m	60.9	1903185.9
160 mm dia	4177				4177	m	99.75	416655.75
200 mm dia	403				403	m	111.3	44853.9
225 mm dia	3050				3050	m	142.8	435540
250 mm dia	316				316	m	148.05	46783.8

280 mm dia	2782				2782	m	182.7	508271.4
315 mm dia	3867				3867	m	200.55	775526.85
Item No.6 :-								
Providing and supplying ISI standard CI flanged S&S specials including all taxes (Central & Local), railway freight, insurance, unloading from railway wagon,loading into truck, transport to departmental store/site, unloading stacking etc. complete.								
(MJP CSR 12-13, I.No.6, P.No.65)								
D/F Specials								
80 to 300 mm dia.		700			700	kg	73.6	51520
S/S Specials/Socketted Br.Flanged Specials								
80 to 300 mm dia.		500			500	kg	71.3	35650
Item No.7 :-								
Making interconnection to existing transmission main of any type including excavation, breaking and removing existing pipes, lowering laying of specials and pipes in their position, refilling closing ws in that area, dewatering and restarting the ws etc comp								
(MJP CSR 12-13, I.No.10 / P.No.55)								
100 mm	350				350	No	1993.95	697882.5
150 mm	50				50	No	2464.35	123217.5
200 mm	40				40	No	2565.15	102606
250 mm	10				10	No	3021.9	30219
300 mm	75				75	No	3666.6	274995
Item No.8 :-								
Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc. complete.								
(MJP CSR 12-13, I.No.15 / P.No.38)								
Total Excavation					**59599.8**	Cum		
Deduct RCC					500	Cum		
Deduct Pipe volume								
110 mm dia.	1	#######	0.7854	0.0121	296.99			

160 mm dia	1	4177.00	0.7854	0.0256	83.98			
200 mm dia	1	403.00	0.7854	0.04	12.66			
225 mm dia	1	3050.00	0.7854	0.05063	121.28			
250 mm dia	1	316.00	0.7854	0.0625	15.51			
280 mm dia	1	2782.00	0.7854	0.0784	171.30			
315 mm dia	1	3867.00	0.7854	0.09923	301.38			
Net quantity of filling					**58096.69**	Cum	63	3660091.733
TOTAL LABOUR PART								**32561941.51**
MATERIAL PART								
Item No.1 :-								
Providing and supplying in standard lengths Polyethelene Pipes, confirming to IS-4984/ 14151/12786/13488 with necessary jointing material like mechanical connectors i.e. thread/insert joint/quick release coupler joint/compression fitting joint or flanged joint, including all local & central taxes, transportation & freight charges, inspection charges, loading/ unloading charges, conveyance to the departmenal stores/ site and stacking the same inclosed shade duly protecting from sunrays and rains, etc. complete.								
(MJP CSR 12-13, I.No.1, P.No.99)								
110 mm dia.	1	31251			31251	m	267	8344017
160 mm dia	1	4177			4177	m	592	2472784
200 mm dia	1	403			403	m	876	353028
225 mm dia	1	3050			3050	m	1129	3443450
250 mm dia	1	316			316	m	1385	437660
280 mm dia	1	2782			2782	m	1737	4832334
315 mm dia	1	3867			3867	m	2201	8511267
Item No.2 :-								
Providing and supply of electro fusion fittings in accordance with BS EN 12201:Part-3 suitable for drinking water with in black/blue colour manufactured from compounded PE100 virgin polymer and compatible with PE100 pipes, in pressure rating SDR11 with min PN 12.5 rated for water application and shall be inclusive of all cost such as testing, all taxes related to central, state and municipal, inspection charges, transportation upto site, transit insurance, loading, unloading, stacking etc. complete.								
(MJP CSR 12-13, I.No.2, P.No.107)								

All types of specials including specials required for interconnection					10% of cost of providing			2839454
Item No.3 :-								
Providing Double flanged sluice valve conforming for I.S.-2906/14846 including 1 gear arrangements as per test pressure. stainless steel spindle, caps including all transportation etc complete.								
(MJP CSR 12-13, I.No.2a, P.No.139) Sluice valves - PN -1								
100 mm dia	50				50	No.	6812.00	50
150 mm dia	10				10	No.	10217.00	10
200 mm dia	5				5	No.	19333.00	5
250 mm dia	10				10	No.	29913.00	10
300 mm dia	6				6	No.	37695.00	6
Item No.4 :-								
Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m								
(MJP CSR 12-13, P.No. 255, I.No. 1(c))								
0.90 m x 0.60 m x 1.20 m	50				50	No.	7904.4	50
1.20 m x 1.20 m x 1.20 m	25				25	No.	12674.55	25
1.50 m x 1.50 m x 1.50 m	6				6	No.	18551.4	6
Item No.5 :-								
Providing and laying in situ,following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete.								
For reinstating of road surfaces (M-15)	1	500			500	Cum	4491.9	500
(MJP CSR 12-13, P.No. 43, I.No. 1(b))								

			TOTAL MATERIAL PART RS.	**35368071.15**
			TOTAL MATERIAL+ LABOUR RS.	**67930012.66**

Abstract of Distribution System

Pipe	Length(m)	Cost (Rs)
DI	8894	**71673210.69**
HDPE	45846	**67930012.66**
	54740	**139603223.35**

ESTIMATE NO.3A:-Distribution System- Replacement of pipes by DI pipes

MEASUREMENTS CUM ABSTRACT

Particulars of item	No.	Length	Width	Depth	Quantity	Rate	Unit	Amount
Item No.1 Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete. (MJP CSR 12-13, I.No. 3 / P.No.35)	1	22067	1.40	0.60	18536.28	184.8	Cum	3425504.544
Item No.2 Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								

(MJP CSR 12-13, I.No. 5 / P.No.35)								
	1	22067	1.40	0.40	12357.52	454.3	Cum	5614021.336
Item No.3 Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging,line drilling , by mechanical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer incharge normal dewatering excluding backfilling etc complete by all means.								
(MJP CSR 12-13, I.No. 7 / P.No.28)								
Lift 0 to 1.5	1	18961	1.40	0.50	13272.7	771.1	Cum	10234578.97
Lift 1.5 to 3.0 m	1	3101	1.40	0.20	868.28	- 790.9	Cum	686722.652
<u>Item No.5 :-</u>								

Providing D.I.K-7 grade pipes with internal cement mortar lining including all taxes, insurance, railway freight, unloading from railway wagon, loading into truck, transport to departmental stores/site, unloading, stacking etc. complete. **(IS:8329-2000 Latest Version)** (MJP CSR 12-13, I.No.3/P.No.63) **Including 2% breakages**							
	300	11113	1.02	11335.26	2826	Rmt.	32033444.76
	350	252	1.02	257.04	3480	Rmt.	894499.2
	400	3028	1.02	3088.56	4143	Rmt.	12795904.08
	450	3861	1.02	3938.22	5000	Rmt.	19691100
	500	707	1.02	721.14	5859	Rmt.	4225159.26
	600	2589	1.02	2640.78	7717	Rmt.	20378899.26
	700	517	1.02	527.34	10409	Rmt.	5489082.06
(Without excise duty) **<u>Item No.6 :-</u>** Providing and supplying ISI standard MS Specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and Local), octroi, inspection charges, transportation to stores/site and stacking etc. complete. (All types of specials)							

(MJP CSR 12-13, I.No.7(d) / P.No.65)	1	6000			6000	72.1	Kg	432600
Item No.7 :-								
Providing and supplying ISI standard D.I. specials and fitting with sealing rubber gasket of S.B.R. complete with cast iron follower gland and M.S. bolts coated or otherwise protected from rusting and suitable for D.I. pipes including cost of labour, materials, and transportation to stores / site, loading and unloading including all taxes etc. complete as per I.S.-9523.								
(MJP CSR 12-13, I.No.10 / P.No.68)								
80 to 300 mm dia.	1	5000			5000	107	Kg	535000
350 mm and above dia	1	40000			40000	130	Kg	5200000
Item No.8 :-								
Providing Double flanged sluice valve conforming for I.S.-2906/14846 including 1 gear arrangements as per test pressure. stainless steel spindle, caps including all transportation etc complete.						-		

(MJP CSR 12-13, I.No.2(c) / P.No.139)								
Sluice valves-PN-1								
300mm	11				11	37695	No	414645
350mm	1				1	53477	No	53477
400mm	4				4	72101	No	288404
450mm	4				4	88187	No	352748
500mm	1				1	113477	No	113477
600mm	3				3	167606	No	502818
700mm	1				1	300430	No	300430
Item No.9								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4 / P.No. 143)								
300mm	11				11	4366	No	48026
350mm	1				1	5380	No	5380
400mm	4				4	6491	No	25964
450mm	4				4	7722	No	30888
500mm	1				1	7997	No	7997
600mm	3				3	8487	No	25461

700mm	1				1	9150	No	9150
Item No. 11								
Lowering, laying and jointing with SBR rubber gaskets D.I. K-7 of various classes with CI/MS specials of following diameter in proper position, grade and alignment as directed by Engineer in charge including conveyance of material from stores to site of work, including cost of jointing materials and rubber rings labour, giving hydraulic testing etc. complete. (Without rubber ring)								
(MJP CSR 12-13, I.No.2(a) / P.No.61)								
300mm		11113			11335.26	140	Rmt.	1586936.4
350mm		252			257.04	174	Rmt.	44724.96
400mm		3028			3088.56	209	Rmt.	645509.04
450mm		3861			3938.22	209	Rmt.	823087.98
500mm		707			721.14	245	Rmt.	176679.3
600mm		2589			2640.78	318	Rmt.	839768.04
700mm		517			527.34	410	Rmt.	216209.4
Item No.12								
Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m.								

(MJP CSR 12-13, I.No. 1(F,G)/ P.No.241)								
1.5 m x 1.5 m x 1.5 m	16				16	18551		296816
1.50 m x 1.50 m x 2.1 m	9				9	23547		211923
Item No.13								
Providing and laying in situ, following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete.								
(MJP CSR 12-13, I.No. 1 P.No.43)					5000	4491.9		22459500
Item No.18 :-								

Providing and fixing in position steel bar reinforcement of various diameters for RCC pipes, caps, footings, foundations, slabs, beams, columns, canopies, staircases, newels, chajjas, lintels, pardies, copings, fins, arches etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete (including cost of binding wire)								
(MJP CSR 12-13, I.No. 8(b)/ P.No. 46)								
	1	15			15	59044	MT	885660
Item No.20 :-								
Reinstating the road surfaces with excavation, 30 cm soling, murum blindage, 40 cm size metal, 25 mm thick premixed bitumen carpet with hot mixed seal coat including compacting etc. copmp.								
(AS per rate analysis)		8894	1.30		11562.2	517	sqm	5977657.4
Item No.21 :-								
Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc. complete.								

(MJP CSR 12-13, I.No.15 / P.No.38)								
Total Excavation					**45034.78**			
Deduct RCC					**5000**			
Deduct Pipe volume								
300mm	1	11113	0.7854	0.09	785.533518			
350mm	1	252	0.7854	0.123	24.3442584			
400mm	1	3028	0.7854	0.16	380.510592			
450mm	1	3861	0.7854	0.203	615.5831682			
500mm	1	707	0.7854	0.25	138.81945			
600mm	1	2589	0.7854	0.36	732.024216			
700mm	1	517	0.7854	0.49	198.965382			
					2875.780585			
Net quantity of refilling					**37158.99942**	63	Cum	2341016.963
Item No.22 :-								
Disposing off the surplus excavated stuff upto 5 km range beyond initial lead included in the excavation item								
(MJP CSR 12-13, statement VI					**7874**	199	Cum	1566926
Item No.23 :-								
Making interconnection to existing transmission main of any type including excavation, breaking and removing existing pipes, lowering laying of specials and pipes in their position, refilling closing ws in that area, dewatering and restarting the ws etc comp								

(MJP CSR 12-13, I.No.10 / P.No.55)								
300mm	222.26				**222.26**	3667	no	815027.42
350mm	5.04				**5.04**	4463	no	22493.52
400mm	60.56				**60.56**	5249	no	317879.44
450mm	77.22				**77.22**	6031	no	465713.82
500mm	14.14				**14.14**	7476	no	105710.64
600mm	51.78				**51.78**	12945	no	670292.1
700mm	10.34				**10.34**	16011	no	165553.74
							Total Rs.	**164450466.3**

ESTIMATE NO.3B:-Distribution System- Replacement of pipes by HDPE pipes

ESTIMATE NO.3B:-Distribution System- Replacement of pipes by HDPE pipes
length=45846m
MEASUREMENTS CUM ABSTRACT

Particulars of item	No.	Length	Width	Depth	Quantity	Unit	Rate	Amount
1	2	3	4	5	6	7	8	9
LABOUR PART								
Item No.1 :-	-							
Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No.3, P.No.35)	1	81000	1.00	0.60	48600	Cum	160	7776000
Item No.2 :-								
Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No.5, P.No.35)	1	81000	1.00	0.40	32400	Cum	449	14547600
Item No.3								
Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging,line drilling , by meachnical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer encharge normal dewatering excluding backfilling etc complete by all means.								

(MJP CSR 12-13, I.No. 7 / P.No.35)	1	81000	1.00	0.30	24300	Cum	771.1	18737730
Item No.4								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4(iv), P.No. 143)								
100 mm dia	40				40	No.	1975.05	79002
150 mm dia	28				28	No.	3104.85	86935.8
200 mm dia	9				9	No.	3229.8	29068.2
300 mm dia	6				6	No.	4365.9	26195.4
Item No. 5 :-								
Lowering, laying and jointing of HDPE pipes by heating to the ends of pipes with the help of tefflon coated elecric mirror/heater to the required temperature and then pressing the ends together against each other, to form a monolithic and leak proof joint by thermosetting process. The pressing may be required to be done with hydraulic jacks/butt fusion machine etc. complete with all materials, labours as directed by Engineer in charge including giving satisfactory hydraulic test.								
(MJP CSR 12-13, I.No.2, P.No.117)								
110	38949				38949	m	60.9	2371994.1
160	27803				27803	m	99.75	2773349.25

180	297				297	m	99.75	29625.75
225	8606				8606	m	142.8	1228936.8
280	5345				5345	m	182.7	976531.5
Item No.6 :-								
Providing and supplying ISI standard CI flanged S&S specials including all taxes (Central & Local), railway freight, insurance, unloading from railway wagon,loading into truck, transport to departmental store/site, unloading stacking etc. complete.								
(MJP CSR 12-13, I.No.6, P.No.65)								
D/F Specials								
80 to 300 mm dia.		700			700	kg	73.6	51520
S/S Specials/Socketted Br.Flanged Specials								
80 to 300 mm dia.		500			500	kg	71.3	35650
Item No.7 :-								
Making interconnection to existing transmission main of any type including excavation, breaking and removing existing pipes, lowering laying of specials and pipes in their position, refilling closing ws in that area, dewatering and restarting the ws etc comp								
(MJP CSR 12-13, I.No.10 / P.No.55)								
100 mm	400				400	No	1993.95	797580
150 mm	300				300	No	2464.35	739305
200 mm	100				100	No	2565.15	256515
250 mm	10				10	No	3021.9	30219
300 mm	50				50	No	3666.6	183330
Item No.8 :-								
Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm								

layers with all leads and lifts including consolidation, surcharging, etc. complete.								
(MJP CSR 12-13, I.No.15 / P.No.38)								
Total Excavation					**105300**	Cum		
Deduct RCC					500	Cum		
Deduct Pipe volume								
110 mm dia.	1	38949.00	0.785	0.0121	369.9570765			
160 mm dia	1	27803.00	0.785	0.0256	558.729088			
180 mm dia	1	297.00	0.785	0.0324	7.553898			
225 mm dia	1	8606.00	0.785	0.0506	341.838926			
280 mm dia	1	5345.00	0.785	0.0625	262.2390625			
Net quantity of filling					**103259.6819**	Cum	63	6505359.963
TOTAL LABOUR PART								**57262447.76**
MATERIAL PART								
Item No.1 :-								
Providing and supplying in standard lengths Polyethelene Pipes, confirming to IS-4984/ 14151/12786/13488 with necessary jointing material like mechanical connectors i.e. thread/insert joint/quick release coupler joint/compression fitting joint or flanged joint, including all local & central taxes, transportation & freight charges, inspection charges, loading/ unloading charges, conveyance to the departmenal stores/ site and stacking the same inclosed shade duly protecting from sunrays and rains, etc. complete.								
(MJP CSR 12-13, I.No.1, P.No.99)								
110 mm dia.	1	38949			38949	m	267	10399383
160 mm dia	1	27803			27803	m	592	16459376
180 mm dia	1	297			297	m	746	221562
225 mm dia	1	8606			8606	m	1129	9716174
280 mm dia	1	5345			5345	m	1737	9284265

Item No.2 :-								
Providing and supply of electro fusion fittings in accordance with BS EN 12201:Part-3 suitable for drinking water with in black/blue colour manufactured from compounded PE100 virgin polymer and compatible with PE100 pipes, in pressure rating SDR11 with min PN 12.5 rated for water application and shall be inclusive of all cost such as testing, all taxes related to central, state and municipal, inspection charges, transportation upto site, transit insurance, loading, unloading, stacking etc. complete.								
(MJP CSR 12-13, I.No.2, P.No.107)								
All types of specials including specials required for interconnection					10% of cost of providing			4608076
Item No.3 :-								
Providing Double flanged sluice valve conforming for I.S.-2906/14846 including 1 gear arrangements as per test pressure. stainless steel spindle, caps including all transportation etc complete.								
(MJP CSR 12-13, I.No.2a, P.No.139)								
Sluice valves - PN -1								
100 mm dia	40				40	No.	6812	272480
150 mm dia	28				28	No.	10217	286076
200 mm dia	9				9	No.	19333	173997
300 mm dia	6				6	No.	29913	179478
Item No.4 :-								
Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m								

(MJP CSR 12-13, P.No. 255, I.No. 1(c)) 1.50 m x 1.50 m x 1.50 m	83				83	No.	18551.4	1539766.2
Item No.5 :- Providing and laying in situ,following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete. For reinstating of road surfaces (M-15) (MJP CSR 12-13, P.No. 43, I.No. 1(b))	1	500			500	Cum	4491.9	2245950
							TOTAL MATERIAL PART RS.	**55386583.2**
							TOTAL MATERIAL+ LABOUR RS.	**112649031**

Abstract of Distribution System (Replacement)

Pipe	Length(m)	Cost (Rs)
DI	22067	164450466
HDPE	81000	112649031
	103067	277099497

24/7 Water Supply Scheme of Pimpri-Chinchwad City
Estimate of Reform Works

Sub Work No. 1: Providing House Service Connections MDPE pipe

Qty.	Item	Rate/ number	Amount (Rs)
50000	Providing and making MDPE pipe consumer service connection on CI/DI pipes with the help of electro fusion machine or Ratchet and dye drill including all labour, MDPE pipe 10 m length, MDPE specials like electro fusion tee, double compression elbow, female threaded adopter with metal insert, UPVC compression in ball valve, GI casing pipe of 40/50 mm for road crossing. The rate to include labour required, excavation, fitting, refilling, closing water supply in that area, dewatering and restarting the water supply, transportation etc complete as directed by Engineer-in-Charge. - For connection on CI/DI/GI pipe with road crossing (15mm) (Ref. MJP CSR 12-13, New Items, Dt 15.04.2013)	2775	138750000
1050	Providing and making MDPE pipe consumer service connection on CI/DI pipes with the help of electro fusion machine or Ratchet and dye drill including all labour, MDPE pipe 10 m length, MDPE specials like electro fusion tee, double compression elbow, female threaded adopter with metal insert, UPVC compression in ball valve, GI casing pipe of 40/50 mm for road crossing. The rate to include labour required, excavation, fitting, refilling, closing water supply in that area, dewatering and restarting the water supply, transportation etc complete as directed by Engineer-in-Charge. - For connection on CI/DI/GI pipe with road crossing (20mm) (Ref. MJP CSR 12-13, New Items, Dt 15.04.2013)	3447	3619350
2950	Providing and making MDPE pipe consumer service connection on CI/DI pipes with the help of electro fusion machine or Ratchet and dye drill including all labour, MDPE pipe 10 m length, MDPE specials like electro fusion tee, double compression elbow, female threaded adopter with metal insert, UPVC compression in ball valve, GI casing pipe of 40/50 mm for road crossing. The rate to include labour required, excavation, fitting, refilling, closing water supply in that area, dewatering and restarting the water supply, transportation etc complete as directed by Engineer-in-Charge. - For connection on CI/DI/GI pipe with road crossing (25mm) (Ref. MJP CSR 12-13, New Items, Dt 15.04.2013)	4072	12012400
	Total		154381750

Measurements:City has total 1,27,818 connections. Out of which there are 54000 connections are in the selected area. These connections have been identified by consumer survey which was carried out through PCMC's own resources. All these connections are on the metallic pipe as there are no nonmetallic pipes in the distribution system. There is item now in corrigendum of CSR of MJP which has been now proposed above in the estimate.

Sub Work No. 2: Estimate for the work of Providing and Installing Bulk Flow Meter

M E A S U R E M E N T - C U M - A B S R A C T

QTY.		DESCRIPTION	RATE	UNIT	AMOUNT
1		2	3	4	5
		ITEM NO. 1 : A) ELECTROMAGNETIC FLOW METER Designing, providing, installing and commissioning of various Dia Full Bore (Inline) Electromagnetic Flow Meter, for Raw / Pure water with accuracy 0.5% of measured value and protection as per given specifications including sensor, transmitter, printer, surge protections, data logger, sensor / transmitter cable – 25 m, GI duct – 25 m with necessary tool tackles, cranes etc as may be required at site etc. as per detailed specification. (MJP Elec. CSR 12-13 Pg. It. NoWM 4)			
13	No	400 mm dia	396839	No	5158907.00
3	No	450 mm dia	424599	No	1273797.00
3		500 mm dia	494951	No	1484853.00
7		600 mm dia	570595	No	3994165.00
		B) MECHANICAL FLOW METER Providing, installing and giving satisfactory trial of flange ends bulk meter of EEC mark removable mechanism type without remote reading facility as per ISO 4064 (MJP Elec. CSR 12-13 Pg. 88 It. No. C - 3 to5)			
1	No	80 mm dia	21713	No	21713.00
5	No	300 mm dia	180613	No	903065.00
		ITEM NO. 2 : SENSOR / TRANSMITTER CABLE :- Providing, laying and jointing with test and trail of sensor / Transmitter cable 4 x 0.38 mm PVC cable common, braided copper shield etc. as per detailed specification. (MJP Elec. CSR 12-13 Pg. 94 It. No. 6)			
1300	Mtr		230	Mtr	299000.00
		ITEM NO. 3 : COIL CABLE :- Providing, laying and jointing with test and trial of COIL cable 3 x 0.75 mm PVC cable common, braided copper shield etc. as per detailed specification. (MJP Elec. CSR 12-13 Pg. 105 It. No. 7)			
1300	Mtr		210	Mtr	273000.00
		ITEM NO. 4 : GI DUCT :- Providing and laying GI duct of 100 mm with all the necessary fittings, joints etc, for housing the cables between sensor and transmitter etc. complete as per detailed specification. (MJP Elec. CSR 12-13 Pg. 105 It. No. 9)			

1300	Mtr		332	Mtr	431600.00
		ITEM NO. 5 : PANEL CABINET :- Fixing of flow meter transmitter to internal walls of building / inside suitable designed panel cabinet with proper locking arrangement with glass window on front door for seeing reading of flow transmitter and data logger without opening of panel cabinet. It should house complete ancillaries and including the provision of connection of electrical power supply from nearby apartments. The panel cabinet shall be pre wired and suitable gland entries etc. as per detailed specification. (MJP Elec. CSR 12-13 Pg. 93 It. No. B-2)			
26	Nos		26500	No	689000.00
		ITEM NO. 6 : EXCAVATION FOR FOUNDATION :- Excavation for Foundation/ pipe trenches in earth soil of all types, sand, gravel and soft murum including removing the excavated material up to a distance of 50 mtr. And lift 1.5 mtr. Stacking and spreading as directed, manual dewatering preparing the bed for foundation and as per detailed specification. Size : 0.75 x 0.75 x 50 (Average) (MJP Civil CSR 12-13 Pg. 35 It. No.5)			
768	cum	(Qty = 32 x 8.00 x 2 x 1.5 = 768 cum	392.7	cum	301594.00
		ITEM NO. 7 : CUTTING OF EXISTING PIPELINE :- Cutting and champhering of pipes of following diameter including cost of all materials and labour involved etc., competed as directed by in Engineer in charge (For all class of pipes)			
64	No		750	No	48000.00
		ITEM NO.8 : MS PIPES AND SPECIALS :- Providing and supplying ISI standard MS specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and local), octroi, inspection charges, transportation to stores / site, and stacking, etc. complete.. (MJP Civil CSR 12-13 Pg. 66 It. No. 7-C)			
10000	Kg	Double flanged specials of all diameters	72.1	Kg	721000.00
		ITEM NO. 9 : MECHANICAL JOINTS AND FITTINGS :-			

		Mechanical compression collar couplings (Populary known as Jiffy TM collar coupling) suitable for C.I. Spun pipes (As per IS 1536-2001) and D.I. Pipes (As per IS 8329-2000) complete with sealing rubber gasket of S.B.R., cast iron follower glands and mild steel nut bolts. The whole assembly should be mechanically and hydrualically tested to the provision as laid down in IS 1538/1993. The rates are including cost of material, forwarding charges, sale tax, loading, transportaion and unloading at departmental store etc. complete. (MJP Civil CSR 12-13 Pg. 155 It. No.2)			
14	Nos.	600 mm dia	13000	No	182000.00
6	Nos.	500 mm dia	10422	No	62532.00
6	Nos.	450 mm dia	7626	No	45756.00
26	Nos.	400 mm dia	6792	No	176592.00
10	Nos.	300 mm dia	3541	No	35410.00
2	Nos.	80 mm dia	784	No	1568.00
		Item No. 10 :- Supply of C.I. mechanical compression flanged/socket tail pieces (Popularly known as I-TM flanged/socket tail piece) suitable for making flanged connection with the plain barrel of C.I. spun pipes (As per IS 1536/2001) AND d.i. PIPES (As per IS 8320/2000). the tail piece to be supplied complete with sealing rubber gasket of S.B.R. cast iron follower glands and mild steel nut bolts. The whole assembly should be mechanically and hydraulically tested as per provisions laid down in IS 1538/1993) (MJP CSR 12-13, I.No. 1, P.No.155)			
14	Nos.	600 mm dia	18200	No	254800.00
6	Nos.	500 mm dia	14193	No	85158.00
6	Nos.	450 mm dia	11295	No	67770.00
26	Nos.	400 mm dia	9623	No	250198.00
10	Nos.	300 mm dia	5589	No	55890.00
2	Nos.	80 mm dia	1302	No	2604.00
		ITEM NO. 11 :- RCC VALVE CHAMBERS :- Providing and constructing R.C.C. chamber for Electromagnetic / Mechanical Flow Meter with 15 cm thick M - 100 PCC bedding, 15 cm thick bottom slab, walls and precast RCC covers on chamber in RCC M - 200 as per detailed drawing and design including normal dewatering,centering, formwork, bully / steel prop. - UPS, compaction, finishing the formed surface with C.M. 1:3 of sufficient minimum thickness to give a smooth and even surface finish with curing including providing and fixing in position steel bar reinforcement of various diameter for RCC slabs, walls etc. including cutting, bending, hooking the bars, binding with wires etc. complete as directed by Engineer - in - charge for following size. (MJP Civil CSR 12-13 Pg. 254 It. No. 1 f)			
38	No	B) Size 2.0 x 1.2 x 1.5 m Depth	32766	No	1245108.00

		Item No. 11 : COMPREHENSIVE MAINTENANCE FOR ELECTROMAGNETIC FLOW METER :- Carrying comprehensive maintenance of Flow Meter along with all the accessories for one Year exclusive of 12 months guaranty period for trouble free performance as per detailed specification.			
26	Nos.	(As per Rate Analysis)	50000	Per No	1300000.00
		Item No. 12 : Providing and fixing CI strainer "T" (Basket) type flange end and stainless steel or Brass mesh wire opening of 2.5 mm to 3 mm and suitable for operating pressure of 16 Kg/cm^2			
		(MJP Elect. CSR 12-13 it. No. B-ii to vii)			
1	No	80 mm dia	6388	No	6388.00
5	No	300 mm dia	67552	No	337760.00
		(For mechanical meters)			
				TOTAL Rs.	19709228.00

Sub Work No. 3: Estimate for the work of Providing and Installing domestic customer meters

MEASUREMENT - CUM - ABSRACT					
QTY.		DESCRIPTION	RATE	UNIT	AMOUNT
1		2	3	4	5
35780		Providing, installing and giving satisfactory field testing of domestic water meter, horizontal inferential single or multi jet type with magnetic drive and dry dial suitable for ambient 50 degree C temperature duely sealed against tampering complete with couplings at both ends and conforming to class B as per IS 779/ 1994 (6^{th} revision) with ISI mark along with manufacturers test certificate and guarantee certificate including cost of all materials and labour. (Ref. MJP CSR Ele and Mech, Section 17-WM, item no. A(e) -EEC mark 15 mm	3300	Number	118074000
		Total			118074000

Measurement:

Category	Number
Total Connections	127818
Metered Connections	98566
Un-Metered Connections	29252
Unmetered in Slum Connections	6528
Non Domestic Connections	2805

Number of 15 mm meters required = 29252 + 6528 = 35780

Sub Work No. 4: Simulation of Distribution network

(a) Measurements: One

Qty.	Item	Rate	Unit	Amount
1	Supply and installation of international standard Software for single users for hydraulic design and modelling of existing and proposed water supply system with provision of making analysis of steady state and extended period stimulation and capability of calibrating the pipe network. Software should be capable of carrying out multiobjective optimisation for performance and cost, should be user friendly and compatiable to GIS software. Supplied installation include required training to staff of minimum 20 person so as to handle the software satisfactorily. The cost is inclusive of all taxes, freights, octroi if any with complete support for upgrade for two years etc. complete	12441276	Software unlimited nodes and pipes	12441276
				12441276

Quotation (Appendix A) of Simulation of Distribution network

Sr. No.	Description	Bentley Utilities Designer	WaterGEMS
1	No Of Pipes	NA	Unlimited Pipes
2	Quantity	4	4
3	Product Cost	2700000	5507040
4	Excise Duty (12.36%)	333720	680670.14
5	Central Sales Tax (5%) on (3+4)	151686	309385.51
6	Total Product Cost with taxes	3185406	6497095.7
7	Select Subscription for One Year	780000	1267300
8	Service Tax (12.36%)	96408	156638.28
9	Select Subscription for One Year With taxes	876408	1423938.3
10	Actual Cost without Taxes (3+7)	3480000	6774340
11	Total Cost with Taxes (6+9)	4061814	7921033.9
	GROSS TOTAL WITH TAXES	1,19,82,847	
Training Fees			
12	Training days	10	
13	Training fees	408000	
14	Service Tax (12.36%)	50428.8	
15	Total Training Cost with taxes	458428.8	
16	GRAND TOTAL	12441276.7	

Sub Work No. 5: Isolation of DMA

Measurements of isolation of DMA's are made from hydraulic model

Measurements: Diameter wise number of such places are

Diameter (MM)	Number of places	Isolation valves
100	320	80
150	150	90
200	70	100
250	40	87
400	36	60

Table 1: Measurements of isolation of DMA's for diameter of 100 mm

	Diameter =100						
No.	Description	L	B	D	Q	Rate	Amount
1	Excavation in all strata for pit for isolating DMA	1.00	1.00	1.20	1.20	250.00	300.00
2	Cutting of pipes	2 Nos.			2.00	39.00	78.00
3	Providing and fixing CID joints.	2 Nos.			2.00	355.00	710.00
4	Providing and fixing Bun flange tail piece	6 Kg.			6.00	64.00	384.00
5	Refilling	1.00	1.00	1.20	1.20	60.00	72.00
	TOTAL :-						1544.00

Table 2: Measurements of isolation of DMA's for diameter of 150 mm

No.	Diameter =150						
	Description	L	B	D	Q	Rate	Amount
1	Excavation in all strata for pit for isolating DMA	1.00	1.00	1.20	1.20	250.00	300.00
2	Cutting of pipes	2 Nos.			2.00	59.00	118.00
3	Providing and fixing CID joints.	2 Nos.			2.00	553.00	1106.00
4	Providing and fixing Bun flange tail piece	9 Kg.			9.00	64.00	576.00
5	Refilling	1.00	1.00	1.20	1.20	60.00	72.00
	TOTAL :-						2172.00

Table 3: Measurements of isolation of DMA's for diameter of 200 mm

No.	Diameter =200						
	Description	L	B	D	Q	Rate	Amount
1	Excavation in all strata for pit for isolating DMA	1.50	1.50	1.40	3.15	250.00	787.50
2	Cutting of pipes	2 Nos.			2.00	76.00	152.00
3	Providing and fixing CID joints.	2 Nos.			2.00	922.00	1844.00
4	Providing and fixing Bun flange tail piece	12 Kg.			12.00	64.00	768.00
5	Refilling	1.50	1.50	1.40	3.15	60.00	189.00
	TOTAL :-						3740.50

Table 4: Measurements of isolation of DMA's for diameter of 250 mm

No.	Diameter =250						
	Description	L	B	D	Q	Rate	Amount
1	Excavation in all strata for pit for isolating DMA	1.50	1.50	1.40	3.15	250.00	787.50
2	Cutting of pipes	2 Nos.			2.00	109.00	218.00
3	Providing and fixing CID joints.	2 Nos.			2.00	1047.00	2094.00
4	Providing and fixing Bun flange tail piece	16 Kg.			16.00	64.00	1024.00
5	Refilling	1.50	1.50	1.40	3.15	60.00	189.00
	TOTAL :-						4312.50

Table 5: Measurements of isolation of DMA's for diameter of 400 mm

No.	Diameter =400						
	Description	L	B	D	Q	Rate	Amount
1	Excavation in all strata for pit for isolating DMA	1.5	1.5	1.4	3.15	250	787.5
2	Cutting of pipes	2 Nos.			2	109	218
3	Providing and fixing CID joints.	2 Nos.			2	1047	2094
4	Providing and fixing Bun flange tail piece	20 kg			20	64	1280
5	Refilling	1.5	1.5	1.4	3.15	60	189
	TOTAL :-						4568.5

Abstract of Isolating operating zone/DMA

Table 6: Abstract of places in isolation of DMA's

Qty.	Item	Rate	Unit	Amount
320	100	1544	Number	494080
150	150	2172	Number	325800
70	200	3740.5		261835
40	250	4312.5	Number	172500
36	400	4568		164448
			Total	1418663

Cost of isolation valves

Diameter (MM)	Isolation valves	Rate/ number	Cost Rs	Ref
100	80	6812	544960	MJP CSR 12-13, P139, Item 2A
150	90	10217	919530	
200	100	19333	1933300	
250	87	29913	2602431	
400	60	72101	4326060	
		Total	10326281	

Total cost

Diameter (MM)	Cost of labours	Cost of valves Rs	Total (Rs)
100	494080	544960	1039040
150	325800	919530	1245330
200	261835	1933300	2195135
250	172500	2602431	2774931
400	164448	4326060	4490508
Total	1418663	10326281	11744944

Sub Work No. 6: Pressure Reducing Valves (PRV)

Measurements: Diameter wise number of such places are shown in following table.

Diameter (MM)	Number of places
100	2
150	14
200	1
300	7
400	1
500	1

Quotations are provided in Appendix B.

Particulars of item	No.	Length	Width	Depth	Quantity	Rate	Unit	Amount
Item No.1								
Excavation for foundation/pipe trenches in hard murum and boulders, W.B.M. road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking and spreading as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No. 3 / P.No.35)								
100	2	11	1.20	0.60	15.84			
150	14	77	1.20	0.60	776.16			
200	1	6	1.20	0.60	4.32			
300	7	39	1.20	0.60	196.56			
400	1	6	1.20	0.60	4.32			
					997.2	184.8	Cum	184282.56
Item No.2 Excavation for foundation/pipe trenches in soft rock and old cement and lime masonry foundation asphalt road including removing the excavated material upto a distance of 50 M beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling, etc. complete.								
(MJP CSR 12-13, I.No. 5 / P.No.35)								
100	2	11	1.20	0.40	10.56			
150	14	77	1.20	0.40	517.44			
200	1	6	1.20	0.40	2.88			
300	7	39	1.20	0.40	131.04			
400	1	6	1.20	0.40	2.88			
					664.8	454.3	Cum	302018.64
Item No.3								

Excavation for foundation / pipe trenches in hard rock by and concrete Road by chiselling, wedging,line drilling , by meachnical means or by all meansother than blasting, including trimming and levelling the bed, removing the excavated material upto a distance of 50 meters beyond the area and lifts as below,stacking as directed by Engineer encharge normal dewatering excluding backfilling etc complete by all means.								
(MJP CSR 12-13, I.No. 7 / P.No.28)								
100	2	11	1.20	0.50	13.2			
150	14	77	1.20	0.50	646.8			
200	1	6	1.20	0.50	3.6			
300	7	39	1.20	0.50	163.8			
400	1	6	1.20	0.50	3.6			
					831	771.1	Cum	640784.1
Item No.9								
Lowering, laying and jointing in position following C.I. D/F Reflux valves, Butterfly valves and Sluice valves including cost of all labour jointing material, including nut bolts and giving satisfactory hydraulic testing etc.complete. (Rate for all class of valves.)								
(MJP CSR 12-13, I.No.4 / P.No. 143)								
100	2				2	1975	No.	3950
150	14				14	3105	No.	43470
200	1				1	3230	No.	3230
300	7				7	4366	No.	30562
400	1				1	6491	No.	6491
Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M.1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.Note: Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 m.								

(MJP CSR 12-13, I.No. 1(F,G)/ P.No.241)								
1.50 m x 1.50 m x 2.1 m	25				25	23547		588675
Item No.13 Providing and laying in situ, following grade of plain cement concrete of trap granite /quartzite /gneiss metal for foundation and bedding including normal dewatering formwork compaction and curing etc. complete.								
(MJP CSR 12-13, I.No. 1 P.No.43)	25	5.5	1.2	0.15	24.75	4491.9		111174.53
Item No.14 :-								
Providing PRV (Singer) with straight type body and rolling diaphragm 150 mm and above as per quotation								
100	2					165495		**330990**
150	14					270683		**3789562**
200	1					454971		**454971**
300	7					920601		**6444207**
400	1					1788188		**1788188**
Total								**14722556**

Sub Work No. 7: ESTIMATE FOR ALTITUDE VALVES

Designing, manufacturing, providing, erecting altitude control valve for maintaining water level in the service reservoir and reducing NRW on account of overflowing. (Singer makes 106-A-Type 4- One-Way flow with adjustable differential, altitude control valve fully mechanically operated).

SN		Zones	WD	Label	Elevation (m)	St_Ht (m)	Elevation (Minimum) (m)	Elevation (Maximum) (m)	Diameter (m)	Capacity (ML)	Optimum Demand (ML)	Depth of water	Flow (LPS)	Altitude Valve Sizing mm	Rate Each including 2 isolation DI Valve on upstream & downstream of Altitude Valve
1	1	A2	A2	437	609	13.1	622	627	25.2	2.5	11.1	5	134	250	1073709
2			A2	438	608	13.3	622	627	25.2	2.5	11.1	5	134	250	1073709
3	7	B1	B1	173	584	15.1	600	604	23.8	2	8.6	4	104	250	1073709
4			B1	174	585	14.9	600	604	25	2.2	9.5	4	115	250	1073709
5	10	B5	B5	193	566	19.3	586	591	25.2	2.5	11.1	5	134	300	1442346
6			B5	194	566	19.3	586	591	22.6	2	8.8	5	106	300	1442346
7	15	C2	C2	412	598	17.5	615	618	10.7	0.25	0.8	3	10	100	465341
8	16	C3	C3	347	609	18.4	628	633	16.7	1.2	5.45	5	66	250	1073709
9			C3	350	609	19.7	629	634	23.7	2.2	9.7	5	117	250	1073709
10		C3	C3	704	609	19.7	629	634	23.7	2.2	9.7	5	117	250	1073709
11	18	C5	C5	664	606	16.7	623	628	15.1	0.9	4	5	48	150	483066
12	24	C10	C10	804	586	16.9	603	609	18.7	1.5	6.8	6	82	250	1073709
13	25	C11	C11	Sant Tukaram	594	12.4	607	611	20.8	1.5	6.4	4	77	150	483066
14	26	C12	C12	771	604	22.7	627	632	14.3	0.8	3.5	5	42	150	483066
15			C12	774	604	22.7	627	632	22.6	2	8.8	5	106	250	1073709
16	27	C13	C13	Annasaheb_Magar	587	12.4	600	605	20.5	1.65	7.3	5	88	200	743764
17	28	C14	C14	Ajmera-1	590	9.79	600	605	19.5	1.5	6.6	5	80	150	483066
18			C14	Ajmera-2	590	9.92	600	605	20	1.5	6.5	5	79	150	483066
19	41	D9	D9	294	555	15.9	571	576	22.6	2	8.8	5	106	250	1073709
20	42	D10	D10	302	555	13	568	574	21.5	2	9	6	109	250	1073709
21	43	D11	D11	103	555	11	566	570	13.8	0.6	2.5	4	30	100	465341
22			D11	104	555	14.2	569	574	13.9	0.65	2.75	5	33	150	483066
23	45	D13	D13	251	580	16.6	596	601	22.6	2	8.8	5	106	300	1442346
									Total	38.16	168				20710679

Note: Budgetary offer is enclosed in Appendix C

Sub Work No. 8: Leak Control Studies (Quotation in Appendix D)

Name of work : Finding invisible leaks in Primary Network with the aid of helium gas, carrying out repairs and allied works in all wards of Pimpri Chinchwad Municipal Corporation.

Qty	Unit	Item	Rate	Per	Amount
555	Kms	Item no 1 :- Invisible leak detection in water pipe primary network using helium technique including excavation, preparation works for injection, injection of gas, leak detection complete will all consumables, instruments, machinery and reporting of leaks detected and repaired on half monthly basis and preparing a report with detail drawing on leaks, location with GPS co-ordinates, leak type and repair done inclusive of all taxes (central state and municipal), insurance, freight, loading, unloading, stacking, refilling and all necessary works required for the helium technique etc complete as directed by the Engineer In Charge. (as per Approved RA)	33718	Kms	18713490
		Item no 2:- Excavation for foundation/pipe trenches in soft rock & old cement and lime masonry foundation aspahlt road including removing the excavated material up to a distance of 50 meters beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling etc complete (Bd-A-4/259)			

16103	Cum	Lift 0 to 1.5 M (MJP/DSR/20012-13/Page No 35/Item no 5)	411.400	Cum	6624774.2
13695	Cum	Lift 1.5 to 3.0 M (MJP/DSR/20012-13/Page No 35/Item no 9)	431.2	Cum	5905284
26791	Cum	Item no 3:- Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc complete as directed by the Engineer In Charge. (MJP/DSR/20012-13/Page No 38/Item no 15)	63.0	Cum	1687833
24840	HP/Hr	Item no 4:- Dewatering the excavated trenches and pools of water in the building trenches/ pipeline trenches, well works by using pumps and other devices including disposing off water to safe distance as directed by Engineer-in-charge (including cost of machinery, labour, fuel) etc complete (Bd-A-9/261) (MJP/DSR/2012-13/Page No 38/Item no 14)	63.0	HP/Hr	1564920
		Item No 5: Providing and making lead caulked joint with molten lead to Cast Iron pipes and/or specials of all classes and fittings of following dia including cost of lead and all jointing material, labour, hydraulic testing etc complete as directed by Engineer In Charge (MJP/DSR/2012-13/Page No 64/Item no 4)			
7	Joint	100 mm pipe	852.6	Joint	5968.2
8	Joint	200 mm pipe	1837.5	Joint	14700

4	Joint	250 mm pipe	2232.3	Joint	8929.2
28	Joint	300 mm pipe	2692.2	Joint	75381.6
114	Joint	400 mm pipe	3558.5	Joint	405669
24	Joint	500 mm pipe	5313.0	Joint	127512
43	Joint	600 mm	6826.0	Joint	293518
24	Joint	700 mm	8019.0	Joint	192456
11	Joint	750 mm	9108.3	Joint	100191.3
8	Joint	800 mm	9781.7	Joint	78253.6
20	Joint	900 mm	10433.0	Joint	208660
50	Joint	1000 mm	11123.8	Joint	556190
		Item No 6: Providing DI K-9 grade pipes with internal cement mortar lining including all taxes, insurance, railway freight, unloading from railway wagon, loading into truck, transport to departmental stores/site, unloading, stacking, etc complete as directed by Engineer In Charge (IS-8329-2000 latest version) (MJP/DSR/2012-13/Page No 63/Item no 3A)			
12	RMT	100 mm	1145.0	RMT	13740
12	RMT	200 mm	2076.0	RMT	24912
6	RMT	250 mm	2768.0	RMT	16608
42	RMT	300 mm	3519.0	RMT	147798
174	RMT	400 mm	5208.0	RMT	906192
36	RMT	500 mm	7308.0	RMT	263088
36	RMT	600 mm	9664.0	RMT	347904
20	RMT	700 mm	12386.5	RMT	247730
8	RMT	750 mm	14076.3	RMT	112610.4

8	RMT	800 mm	15420.0	RMT	123360
16	RMT	900 mm	18813.0	RMT	301008
40	RMT	1000 mm	22131.0	RMT	885240
		Item No 7: Providing and supplying ISI standard D.I specials and fittings with sealing rubber gasket of S.B.R complete with Cast Iron follower gland and M.S nut bolts coated or otherwise protected from rusting and suitable for D.I pipes including cost of labour, material and transportation to stores/site, loading, unloading including all taxes, etc complete as per IS 9523 as directed by Engineer-in Charge. For all types of specials, bends, tees etc (MJP/DSR/2012-13/Page No 68/Item no 10)			
15360	KG	b) 350 mm and above dia	130.0	KG	1996800
		Item No 8: Supply of CI Mechanical Compression Collar Coupling (popularly known as Jiffy™ Collar Coupling) suitable for CI Spun Pipes (as per IS 1536/2001) and DI pipes (as per IS 8329/2000) complete with sealing rubber gasket of SBR, C.I follower glands and M.S nut bolts. The whole assembly should be mechanically and hydraulically tested to the provisions as laid in IS -1538/1993 as directed by Engineer-in Charge. (MJP/DSR/2012-13/Page No 155/Item no 2)			
12	Nos	100 mm	841.0	Nos	10092
12	Nos	200 mm	1726.0	Nos	20712
6	Nos	250 mm	2767.0	Nos	16602
42	Nos	300 mm	3541.0	Nos	148722

174	Nos	400 mm	6792.0	Nos	1181808
36	Nos	500 mm	10422.0	Nos	375192
36	Nos	600 mm	13000.0	Nos	468000
20	Nos	700 mm	16985.0	Nos	339700
8	Nos	750 mm	19929.0	Nos	159432
5102	KG	Item no 9: Providing and supplying ISI standard MS specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and Local), octroi, inspection charges, transportation to stores/site and stacking etc complete as directed by Engineer in Charge. (d) All socketed specials or socketed brach flanged specials of all diameters (MJP/DSR/2012-13/Page No 65/Item no 7d)	72.1	KG	367854.2
				Total	45038834.7

Sub Work No. 9

Name of work : Finding invisible leaks in Distribution Network with the aid of helium gas, carrying out repairs and allied works in all wards of Pimpri Chinchwad Municipal Corporation.

Qty	Unit	Item	Rate	Per	Amount
4056	Kms	Item no 1 :- Invisible Leak detection in water pipe distribution network using helium technique including excavation, preparation works for injection, injection of gas, leak detection complete will all consumables, instruments, machinery and reporting of leaks detected and repaired on half monthly basis and preparing a report with detail drawing on leaks, location with GPS co-ordinates, leak type and repair done inclusive of all taxes (central state and municipal), insurance, freight, loading, unloading, stacking, refilling and all necessary works required for the helium technique etc complete as directed by the Engineer In Charge. (as per Approved RA)	33718	Kms	136760208
		Item no 2:- Excavation for foundation/pipe trenches in soft rock & old cement and lime masonry foundation aspahlt road including removing the excavated material up to a distance of 50 meters beyond the area and lifts as below, stacking as directed by Engineer-in-charge, normal dewatering, preparing the bed for foundation and excluding backfilling etc complete (Bd-A-4/259)			

99548	Cum	Lift 0 to 1.5 M (MJP/DSR/20012-13/Page No 35/Item no 5)	411.400	Cum	40954047
33183	Cum	Lift 1.5 to 3.0 M (MJP/DSR/20012-13/Page No 35/Item no 9)	431.2	Cum	14308510
132730	Cum	Item no 3:- Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation, surcharging, etc complete as directed by the Engineer In Charge. (MJP/DSR/20012-13/Page No 38/Item no 15)	63.0	Cum	8361990
109320	HP/Hr	Item no 4:- Dewatering the excavated trenches and pools of water in the building trenches/ pipeline trenches, well works by using pumps and other devices including disposing off water to safe distance as directed by Engineer-in-charge (including cost of machinery, labour, fuel) etc complete (Bd-A-9/261) (MJP/DSR/2012-13/Page No 38/Item no 14)	63.0	HP/Hr	6887160

		Item no 5:- Dismantling dead pipeline of M.S/R.C.C/C.I/P.S.C and G.I/A.C/P.V.C/S.W/H.D.P.E pipe including cost of necessary excavation and refilling of trenches, breaking the joints, lifting the pipes and stacking to the place as directed by Engineer-in-charge with all leads and lifts including cleaning the surface etc complete (MJP/DSR/2012-13/Page No 56/Item no 11A)			
732	RMT	100 mm	156.5	RMT	114558
616	RMT	150 mm	162.8	RMT	100284.8
282	RMT	200 mm	180.6	RMT	50929.2
174	RMT	250 mm	199.5	RMT	34713
350	RMT	300 mm	216.3	RMT	75705
36	RMT	350 mm	243.6	RMT	8769.6
126	RMT	400 mm	265.7	RMT	33478.2
170	RMT	450 mm	286.0	RMT	48620
70	RMT	500 mm	300.0	RMT	21000
120	RMT	600 mm	368.0	RMT	44160
		Item No 6: Providing and making lead caulked joint with molten lead to Cast Iron pipes and/or specials of all classes and fittings of following dia including cost of lead and all jointing material, labour, hydraulic testing etc complete as directed by Engineer In Charge (MJP/DSR/2012-13/Page No 64/Item no 4)			
255	Joint	100 mm	852.6	Joint	217413
231	Joint	150 mm	1260.0	Joint	291060
106	Joint	200 mm	1837.5	Joint	194775

65	Joint	250 mm	2232.3	Joint	145099.5
131	Joint	300 mm	2692.2	Joint	352678.2
14	Joint	350 mm	3051.3	Joint	42718.2
141	Joint	400 mm	3558.5	Joint	501748.5
191	Joint	450 mm	4942.4	Joint	943998.4
79	Joint	500 mm	5313.0	Joint	419727
135	Joint	600 mm	6826.0	Joint	921510
		Item No 7: Providing DI K-9 grade pipes with internal cement mortar lining including all taxes, insurance, railway freight, unloading from railway wagon, loading into truck, transport to departmental stores/site, unloading, stacking, etc complete as directed by Engineer In Charge (IS-8329-2000 latest version) (MJP/DSR/2012-13/Page No 63/Item no 3A)			
732	RMT	100 mm	1145.0	RMT	838140
616	RMT	150 mm	1670.0	RMT	1028720
282	RMT	200 mm	2076.0	RMT	585432
174	RMT	250 mm	2768.0	RMT	481632
350	RMT	300 mm	3519.0	RMT	1231650
72	RMT	350 mm	4405.0	RMT	317160
252	RMT	400 mm	5208.0	RMT	1312416
340	RMT	450 mm	6288.0	RMT	2137920
140	RMT	500 mm	7308.0	RMT	1023120
240	RMT	600 mm	9664.0	RMT	2319360

		Item No 8: Providing and supplying ISI standard D.I specials and fittings with sealing rubber gasket of S.B.R complete with Cast Iron follower gland and M.S nut bolts coated or otherwise protected from rusting and suitable for D.I pipes including cost of labour, material and transportation to stores/site, loading, unloading including all taxes, etc complete as per IS 9523 as directed by Engineer-in Charge. For all types of specials, bends, tees etc (MJP/DSR/2012-13/Page No 68/Item no 10)			
91760	KG	a) 80 to 300 dia	107.0	KG	9818320
91560	KG	b) 350 mm and above dia	130.0	KG	11902800
		Item No 9: Supply of CI Mechanical Compression Collar Coupling (popularly known as Jiffy™ Collar Coupling) suitable for CI Spun Pipes (as per IS 1536/2001) and DI pipes (as per IS 8329/2000) complete with sealing rubber gasket of SBR, C.I follower glands and M.S nut bolts. The whole assembly should be mechanically and hydraulically tested to the provisions as laid in IS -1538/1993 as directed by Engineer-in Charge. (MJP/DSR/2012-13/Page No 155/Item no 2)			
732	Nos	100 mm	841.0	Nos	615612
616	Nos	150 mm	1512.0	Nos	931392
282	Nos	200 mm	1726.0	Nos	486732
174	Nos	250 mm	2767.0	Nos	481458
350	Nos	300 mm	3541.0	Nos	1239350
72	Nos	350 mm	4364.0	Nos	314208

252	Nos	400 mm	6792.0	Nos	1711584
340	Nos	450 mm	7626.0	Nos	2592840
140	Nos	500 mm	10422.0	Nos	1459080
240	Nos	600 mm	13000.0	Nos	3120000
6554	KG	Item no 10: Providing and supplying ISI standard MS specials of required thickness with 3 coats of approved make epoxy paint (Shalimar, Ciba or Mahindra & Mahindra make) from inside and outside including all taxes (Central and Local), octroi, inspection charges, transportation to stores/site and stacking etc complete as directed by Engineer in Charge. (d) All socketed specials or socketed brach flanged specials of all diameters (MJP/DSR/2012-13/Page No 65/Item no 7d)	72.1	KG	472543.4
		Item no 11: Providing and supplying Blue MDPE pipes conforming to ISO 4427:1996 manufactured from virgin resin PE 80 foood grade compounded Raw Material having blue colour only with quality assurance certificate from quality agencies like WRC/CIPET(India)/DVGM/KIWA/SPGN etc for usage in Drinking Water System. The cost shall include testing of all materials, all taxes (Central, State, Municipal), inspection charges, transportation upto site, transit insurance, loading as specified, unloading, stacking etc complete as specified and directed by Engineer in Charge A) PN 16 (SDR 9) (MJP/DSR/2012-13/Page No 119/Item no 1)			

7529	RMT	20 mm	28.0	RMT	210812
4518	RMT	25 mm	40.0	RMT	180720
3011	RMT	32 mm	66.0	RMT	198726
		Item no 12: Providing and supply of Compression fittings, PN 16 rated in conformation to ISO 14236-2000 and shall be tested as per ISO 3459, ISO 3501 and ISO 3503, suitable for drinking water and approved by WRAS, UK/KIWA etc in food grade polypropylene and shall be inclusive of all cost such as testing, all taxes related to central, state and municipal, inspection charges, transportation upto site, transit insurance, loading, unloading, stacking etc complete as directed by Engineer in Charge Female Adaptor (MJP/DSR/2012-13/Page No 125/Item no 3 B)			
1673	No	20X 1/2"	73.0	No	122129
1004	No	25X 3/4"	86.0	No	86344
669	No	32X 1"	108.0	No	72252

		Item no 13: Providing and supply of Compression fittings, PN 16 rated in conformation to ISO 14236-2000 and shall be tested as per ISO 3459, ISO 3501 and ISO 3503, suitable for drinking water and approved by WRAS, UK/KIWA tec in food grade polypropylene and shall be inclusive of all cost such as testing, all taxes related to central, state and municipal, inspection charges, transportation upto site, transit insurance, loading, unloading, stacking etc complete as directed by Engineer in Charge. Coupling (MJP/DSR/2012-13/Page No 125/Item no 3 C)			
3346	No	20X 20	70.0	No	234220
2008	No	25X 25	77.0	No	154616
1338	No	32X 32	98.0	No	131124
		Item no 14: Providing and supply of Compression fittings, PN 16 rated in conformation to ISO 14236-2000 and shall be tested as per ISO 3459, ISO 3501 and ISO 3503, suitable for drinking water and approved by WRAS, UK/KIWA etc in food grade polypropylene and shall be inclusive of all cost such as testing, all taxes related to central, state and municipal, inspection charges, transportation upto site, transit insurance, loading, unloading, stacking etc complete as directed by Engineer in Charge. Elbow 90 Deg threaded male offtake (MJP/DSR/2012-13/Page No 126/Item no 3 F)			

1673	No	20X 1/2"	78.0	No	130494
1004	No	25X 3/4"	95.0	No	95380
669	No	32X 1"	123.0	No	82287
		Item No 15: Providing ISI mark G.I pipes of following class and dia including all local and central taxes, octroi, inspection charges, transportation to stores, etc complete (IS-1239-2004) as directed by Engineer in Charge. Note: One coupler shall be provide with each full length pipe, cost of which is included in rates below B) Medium (MJP/DSR/2012-13/Page No 87/Item no 1)			
6692	RMT	40 mm (3.65 kg/m)	240.0	RMT	1606080
		Item no 16: Providing, lowering, laying and fixing SS saddle strap of following bore size and pipe diameter including all taxes(central, state and municipal), insurance, freight, loading, unloading, stacking, etc complete as directed by Engineer in Charge (As per approved RA) Saddle Strap Make : AlAziz, Kimplas			
558	Nos	for 15 mm connection on 100 mm pipe	1107	Nos	617706
558	Nos	for 15 mm connection on 150 mm pipe	1148	Nos	640584
558	Nos	for 15 mm connection on 200 mm pipe	1189	Nos	663462
335	Nos	for 20 mm connection on 100 mm pipe	1292	Nos	432820

335	Nos	for 20 mm connection on 150 mm pipe	1343	Nos	449905
335	Nos	for 20 mm connection on 200 mm pipe	1404	Nos	470340
223	Nos	for 25 mm connection on 100 mm pipe	1445	Nos	322235
223	Nos	for 25 mm connection on 150 mm pipe	1527	Nos	340521
223	Nos	for 25 mm connection on 200 mm pipe	1563	Nos	348549
		Item No 17: Providing, lowering, laying and fixing DI Joint (bell joint) leak repair clamp including all taxes (Central, state and municipal), insurance, freight, loading, unloading, stacking, etc complete as directed by Engineer in Charge. (As per approved RA) Joint Repair Clamp Make : Multimould Casting			
510	Nos	100 mm	2721	Nos	1387710
463	Nos	150 mm	3198	Nos	1480674
211	Nos	200 mm	4756	Nos	1003516
131	Nos	250 mm	5627	Nos	737137
263	Nos	300 mm	7093	Nos	1865459
		Item No 18: Providing, lowering, laying and fixing Stainless steel single/double/tripple band leak repair clamp of following sizes including all taxes (Central, state and municipal), insurance, freight, loading, unloading, stacking, etc complete as directed by Engineer in Charge (As per approved RA) Crack Repair Clamp Make: AVK, Viking Johnson, Georg Fischer			
340	Nos	100 mm	7252	Nos	2465680
308	Nos	150 mm	8720	Nos	2685760
141	Nos	200 mm	10059	Nos	1418319
87	Nos	250 mm	12426	Nos	1081062
10	Nos	300 mm	13658	Nos	136580
				Total	280109533

Sub Work No. 10:ESTIMATE FOR SCADA COMPONENTS (Quotation in Appendix E)

No.	Item Description			Size mm	Qty	Rate	Amount
A	Design, supply, installation, testing , interfacing to PLC and commissioning of full bore magnetic Flow Transmitter at ESR outlets at various locations		2	600	70	845000	59150000
B	Design, supply, installation, testing , interfacing to PLC and commissioning of full bore magnetic Flow Transmitter at ESR outlets at various locations in DMA		1	300	40	475000	19000000
	Design, supply, installation, testing , interfacing to PLC and commissioning of full bore magnetic Flow Transmitter at ESR outlets at various locations in DMA		2	200	80	324000	25920000
C	Supply, Installation, Testing and Commissioning of Motor Actuated Butterfly valve with the following specifications including all accessories as required a) Designed line pressure: 4-kg/sq cm. b) Operating Angle: 90 degrees c) Disc Material: C.I. d) Position Indicator : 4-20mA e) Mounting: Splash proof – Direct mounting adaptor on Valve. f) Input Supply: 230V, A.C., 50 Hz g) Valve position indicator with an output of 4-20mA h) The actuator should be capable of accepting 4-20mA of input for regulating purposes and have integral starter i) Manual Operation: Hand Wheel						

			2	600	80	535000	42800000
D	Supply, installation, testing , interfacing to PLC and commissioning of Pressure transmitter at Water Distribution System						
			10		400	65000	26000000
E	Design, supply, installation, testing , and commissioning of PLC with panel at each ESR / DMA Location with Modem to have pressure and flow monitoring. The PLC to be housed in Panel with related accessories The Communication ON GPRS (WITHOUT FIXED IP)						
	For DMA Flow meters				120	115000	13800000
	For Pressure Transmitters				400	115000	46000000
E	GPRS Communication Charges for 05 years			520	5	10000	26000000
F	Miscellaneous - Cables, Civil Works etc						650000
	Total						259320000

CHAPTER 11

PROJECT FINANCIAL VIABILITY & SUSTAINABILITY

11.1 ANNUAL M & R CHARGES

Annual M&R charges are worked out for present stage of 2015, and intermediate stage of 2030.

11.1.1 Present Stage - (2015)

It is required to compute annual charges on account of establishment, energy, chemical cost, raw water charges etc.

(a) Establishment

A number of staff working is shown in Table 11.1 Annual establishment charges are shown in Table 11.2

Table 11.1: Staff working

Post	Wtp	A ward	B ward	C ward	D ward	Electrical	Total		
Jt.City Engineer			1			1	2	7	Seniors
Ex. Engineer	1	1	0	1	1	1	5		
Dy. Engineer	4	2	3	2	2	1	14	69	Engineers
Junior Engineer	7	7	8	12	9	4	47		
Technical Assistant / Supervisor	0	2	1	2	1	2	8		
Clerk	2	2	2	2	2	1	11	11	Clerk
work Inspector	2	0	0	0	0	0	2	19	
Meter Inspector	1	0	0	0	16	0	17		
Driver	1	1	1	5	0	3	11	62	
Electrition/Fitter	3	1		1	0	5	10		
Pump Operator	0	6	1	5	8	21	41		
Line man Plumber	1	12	9	12	7	0	41	69	
Filter Operator	3	0	0	0	0	0	3		
Store Assistant	2	0	0	0	0	0	2		
Lab Assistant	1	0	0	0	0	0	1		
Security							22		
Labour	17	51	41	72	96	24	301	301	
							Total	538	

Table 11.2: Annual establishment charges

Regular Staff & Administration	Rs in Laks.
A Ward	341.48
B ward	245.89
C Ward	495.05
D Ward	453.91
WTP	195.01
Electrical	292.93
Meter Reader (A Ward)	40.99
Meter Reader (B Ward)	47.00
Meter Reader (C Ward)	35.47
Meter Reader (D Ward)	53.71
Security	74.33
Total	**2275.77**

(b) Energy Charges

Annual energy units and charges are shown respectively in Tables 11.3 and 11.4.

Table 11.3: Annual energy units

Recommended HP	KW-H	KW-H/y
250	186.5	1089160
300	223.8	1306992
5	3.73	21783.2
555	571	2417935

Annual energy charges are shown in Table 11.2(b)3

Table 11.4: Annual energy charges

Name Of Area	Units Consumed Per Year	Bill Amount Per Year
Rawet Raw Water	48877991	2354.18
A & C Ward	16222627	747.96
B & D Ward	1998891	100.06
Total	67099509	3202.20

(a) Chemical Charges

Annual chemical charges are shown in Table 11.5

Table 11.5: Annual chemical charges

SN	Charges	Calculation	Amount/year
1	Bleaching powder requirement Considering 25% chlorine available	341 MLD x 90 days x 8 @ Rs 25/- per Kg	61.38
2	Chlorine Gas	341 MLD x 365 days x 2 @ Rs 17.78/- per Kg	44.26
3	Alum requirement Considering 40 Kg. Per MLD	341 MLD x 40 x 365 days @ Rs 8/- per Kg	398.29
	Total Rs.(in lakh)		503.93

(d) Raw water Charges

Annual raw water charges are shown in Table 11.6

Table 11.6: Annual raw water charges

Sr.No.	Particulars	Calculation	Amount/year
D)	Raw water Charges: A) (DOMESTIC USE)Rs. 4.20/- Per 10000 Litres, Total demand 334 MLD	341 x 365 x 420	512.75
	B)Commercial use		
	Rs. 32/- Per 10000 Litres for July to October Total Demand 8.509 MLD	8.509 x 120 x 3200	32.67
	TOTAL		555.42

(e) Other Charges

Annual other charges are shown in Table 11.7

Table 11.7: Annual other charges

Other Cost	Rs in Laks.
A Ward	6.11
B ward	0.06
C Ward	0.00
D Ward	20.00
WTP	0.63
Electrical	0.14
Total	**26.94**

Total M & R charges for present stage = (a)+(b)+(c)+(d)+(e) = Rs 6564.26**Lakhs**

11.1.2 Immediate Stage - (2030)

It is required to compute annual charges on account of establishment, energy, chemical cost, raw water charges etc.

(a) Establishment

Annual establishment charges are shown in Table 11.8

Table 11.8: Annual establishment charges

Regular Staff & Administration	Rs in Laks.	
	2015	2026
A Ward	341.48	709.91
B ward	245.89	511.19
C Ward	495.05	1029.17
D Ward	453.91	943.65
WTP	195.01	405.41
Elecrtical	292.93	608.98
Meter Reader (A Ward)	40.99	85.22
Meter Reader (B Ward)	47	97.71
Meter Reader (C Ward)	35.47	73.74
Meter Reader (D Ward)	53.71	111.66
Security	74.33	154.53
Total	**2275.77**	4731.16

(b) Engery Charges

Annual energy charges are shown in Table 11.9
Table 11.9: Annual energy charges

Name Of Area	Bill Amount Per Year	
	2015	2030
RAWET RAW WATER	2354.18	4894.17
A & C WARD	747.95	1554.94
B & D WARD	100.06	208.02
TOTAL	320220276	6657.141

(c) Chemical Charges

Annual chemical charges are shown in Table 11.10

Table 11.10: Annual chemical charges

SN	Charges	Calculation	Amount/year
1	Bleaching powder requirement Considering 25% chlorine available	531 MLD x 90 days x 8 @ Rs 25/- per Kg	95.58
2	Chlorine Gas	531 MLD x 365 days x 2 @ Rs 17.78/- per Kg	68.92
3	Alum requirement Considering 40 Kg. Per MLD	531 MLD x 40 x 365 days @ Rs 8/- per Kg	625.16
	Total Rs.(in lakh)		789.66

(d) Raw water Charges

Annual raw water charges are shown in Table 11.11

Table 11.11: Annual raw water charges

Raw water Charges: A) (DOMESTIC USE)Rs. 4.20/- Per 10000 Litres, Total demand 334 mld ,	531 x 365 x 420	814.02
B)Commercial use		
Rs. 32/- Per 10000 Litres for july to October Total Demand 8.509 Mld	8.509 x 120 x 3200	32.67
TOTAL		846.69

(e) Other Charges

Annual other charges are shown in Table 11.12

Table 11.12: Annual other charges

Other Cost	Rs in Laks.	
	2015	**2030**
A Ward	6.11	12.70
B ward	0.06	0.12
C Ward	0.00	0.00
D Ward	20.00	41.58
WTP	0.63	1.31
Electrical	0.14	0.29
Total	**26.94**	56.01

Total M & R charges for immediate stage = (a)+(b)+(c)+(d)+(e) = Rs 13080.66 Lakhs

Annual M&R charges and depreciation charges are shown in Table 11.13

Table 11.13: Annual M&R charges and depreciation charges (in Rs lakhs)

Name of work	Nett Cost	Gross cost	90% of Gross cost	Life in Years	Depreciation factor	Annual depreciation on 90% of Gross cost	Percentage of M&R	M&R charges
2	**3**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Primary network	2094.14	2167.74	1951.00	50	0.0078	15.22	0.5	10.84
Distribution System.	4239.31	4388.32	3949.00	50	0.0078	30.80	0.5	21.94
					Total	**46.02**		**32.78**

Operation and Maintenance costs are shown in Table 11.14

Table 11.14: Operation and Maintenance costs (in Rs lakhs)

Sr.No.	Year	Population	Daily require-ment in mld	Yearly require-ment (m3)	Direct Charges									Indirect Charges	Total cost of O&M
					Establish-ment	Energy	Chemical			Raw water	Other	M&R	Total		
							Alum	Bleaching	Chlorine gas						
1	2015	1946538	341.00	124465000	2275.77	3202.20	398.29	61.38	44.26	555.42	26.94	32.78	6597.04	46.02	6643.06
2	2016	2018706	353.67	129088333	2439.46	3432.53	413.41	63.71	45.90	574.84	28.88	35.07	7033.81	49.24	7083.05
3	2017	2090873	366.33	133711667	2603.15	3662.86	428.54	66.04	47.55	594.26	30.82	37.53	7470.74	52.69	7523.43
4	2018	2163041	379.00	138335000	2766.84	3893.19	443.66	68.37	49.19	613.67	32.75	40.16	7907.84	56.38	7964.22
5	2019	2235209	391.67	142958333	2930.53	4123.52	458.79	70.70	50.84	633.09	34.69	42.97	8345.13	60.32	8405.45
6	2020	2307376	404.33	147581667	3094.22	4353.85	473.91	73.03	52.48	652.51	36.63	45.98	8782.61	64.55	8847.15
7	2021	2379544	417.00	152205000	3257.91	4584.18	489.04	75.36	54.12	671.93	38.57	49.19	9220.30	69.06	9289.37
8	2022	2451712	429.67	156828333	3421.60	4814.51	504.16	77.69	55.77	691.35	40.51	52.64	9658.22	73.90	9732.12
9	2023	2523879	442.33	161451667	3585.29	5044.83	519.29	80.03	57.41	710.76	42.44	56.32	10096.38	79.07	10175.45
10	2024	2596047	455.00	166075000	3748.98	5275.16	534.41	82.36	59.06	730.18	44.38	60.26	10534.80	84.61	10619.40
11	2025	2668215	467.67	170698333	3912.67	5505.49	549.54	84.69	60.70	749.60	46.32	64.48	10973.49	90.53	11064.02
12	2026	2740382	480.33	175321667	4076.36	5735.82	564.66	87.02	62.34	769.02	48.26	69.00	11412.48	96.87	11509.34
13	2027	2812550	493.00	179945000	4240.05	5966.15	579.79	89.35	63.99	788.44	50.20	73.83	11851.78	103.65	11955.43
14	2028	2884718	505.67	184568333	4403.74	6196.48	594.91	91.68	65.63	807.85	52.13	78.99	12291.43	110.90	12402.33
15	2029	2956885	518.33	189191667	4567.43	6426.81	610.04	94.01	67.28	827.27	54.07	84.52	12731.43	118.66	12850.09
16	2030	3029053	531.00	193815000	4731.16	6657.14	625.16	96.34	68.92	846.69	56.01	90.44	13171.86	126.97	13298.83

11.2 Present tariff

Present tariff is shown in Table 11.15
Table 11.15: Present tariff

Sr.No.	Type	Present tariff (Volumetric)
1	Domestic	Rs. 2.5/kl
2	Non-domestic	Rs. 35/kl
3	Institutional	Rs. 2.5/kl

Assessment statement is shown in Table 11.16

Table 11.16: Assessment statement

Sr.No.	Year	Population	Daily require-ment in mld	Yearly production in kl	NRW %	Proposed billed volume	Domestic Assessment			Institutional Assessment			Non-Domestic Assessment			Total assessment in lakh	Collection efficiency in %	Expected revenue in lakh
							Quantity to be billed	Rate per kl	Amount in lakh	Quantity to be billed	Rate per kl	Amount in lakh	Quantity to be billed	Rate per kl	Amount			
1	2015	1946538	341.00	124465000	50	62232500	56009250	5.0	2800.46	311162 5	5.0	155.58	311162 5	35.0	1089.1	4045.1	80.0	3236.1
2	2016	2018706	353.67	129088333	40	77453000	69707700	5.5	3833.92	387265 0	5.5	213.00	387265 0	38.5	1491.0	5537.9	82.0	4541.1
3	2017	2090873	366.33	133711667	30	93598167	84238350	6.0	5054.30	467990 8	6.0	280.79	467990 8	42.4	1981.9	7317.0	84.0	6146.3
4	2018	2163041	379.00	138335000	20	110668000	99601200	6.5	6474.08	553340 0	6.5	359.67	553340 0	46.6	2577.7	9411.5	86.0	8093.9
5	2019	2235209	391.67	142958333	20	114366667	102930000	7.0	7205.10	571833 3	7.0	400.28	571833 3	51.2	2930.3	10535.7	88.0	9271.4
6	2020	2307376	404.33	147581667	15	125444417	112899975	7.5	8467.50	627222 1	7.5	470.42	627222 1	56.4	3535.5	12473.4	90.0	11226.1
7	2021	2379544	417.00	152205000	15	129374250	116436825	8.0	9314.95	646871 3	8.0	517.50	646871 3	62.0	4010.9	13843.3	92.0	12735.9
8	2022	2451712	429.67	156828333	15	133304083	119973675	8.5	10197.76	666520 4	8.5	566.54	666520 4	68.2	4546.0	15310.3	94.0	14391.7
9	2023	2523879	442.33	161451667	15	137233917	123510525	9.0	11115.95	686169 6	9.0	617.55	686169 6	75.0	5148.0	16881.5	96.0	16206.3
10	2024	2596047	455.00	166075000	15	141163750	127047375	9.5	12069.50	705818 8	9.5	670.53	705818 8	82.5	5825.0	18565.0	98.0	18193.7
11	2025	2668215	467.67	170698333	15	145093583	130584225	10.0	13058.42	725467 9	10.0	725.47	725467 9	90.8	6585.9	20369.8	100.0	20369.8
12	2026	2740382	480.33	175321667	15	149023417	134121075	10.5	14082.71	745117 1	10.5	782.37	745117 1	99.9	7440.7	22305.8	100.0	22305.8
13	2027	2812550	493.00	179945000	15	152953250	137657925	11.0	15142.37	764766 3	11.0	841.24	764766 3	109.8	8400.6	24384.2	100.0	24384.2
14	2028	2884718	505.67	184568333	15	156883083	141194775	11.5	16237.40	784415 4	11.5	902.08	784415 4	120.8	9478.1	26617.5	100.0	26617.5
15	2029	2956885	518.33	189191667	15	160812917	144731625	12.0	17367.80	804064 6	12.0	964.88	804064 6	132.9	10687.0	29019.7	100.0	29019.7
16	2030	3029053	531.00	193815000	15	164742750	148268475	12.5	18533.56	823713 8	12.5	1029.64	823713 8	146.2	12043.0	31606.2	100.0	31606.2

Surplus/ deficit statement is shown in Table 11.17

Table 11.17: Surplus/ deficit statement

Sr.No.	Year	Population	Daily require-ment in mld	Yearly require-ment in kl	Total cost of O&M in lakh	Actual collection (Rs.in lakh)	Deficit/ surplus (Rs.in lakh)
1	2015	1946538	341.00	124465000	6643.06	3236.09	-3406.97
2	2016	2018706	353.67	129088333	7083.05	4541.07	-2541.98
3	2017	2090873	366.33	133711667	7523.43	6146.31	-1377.12
4	2018	2163041	379.00	138335000	7964.22	8093.88	129.66
5	2019	2235209	391.67	142958333	7523.43	9271.38	1747.95
6	2020	2307376	404.33	147581667	7964.22	11226.09	3261.87
7	2021	2379544	417.00	152205000	8405.45	12735.88	4330.43
8	2022	2451712	429.67	156828333	8847.15	14391.69	5544.54
9	2023	2523879	442.33	161451667	9289.37	16206.27	6916.90
10	2024	2596047	455.00	166075000	9732.12	18193.72	8461.60
11	2025	2668215	467.67	170698333	10175.45	20369.76	10194.31
12	2026	2740382	480.33	175321667	10619.40	22305.76	11686.35
13	2027	2812550	493.00	179945000	11064.02	24384.19	13320.17
14	2028	2884718	505.67	184568333	11509.34	26617.53	15108.18
15	2029	2956885	518.33	189191667	11955.43	29019.69	17064.26
16	2030	3029053	531.00	193815000	12402.33	31606.20	19203.87

Total cost of M&R and actual collection are shown in Figure 11.1

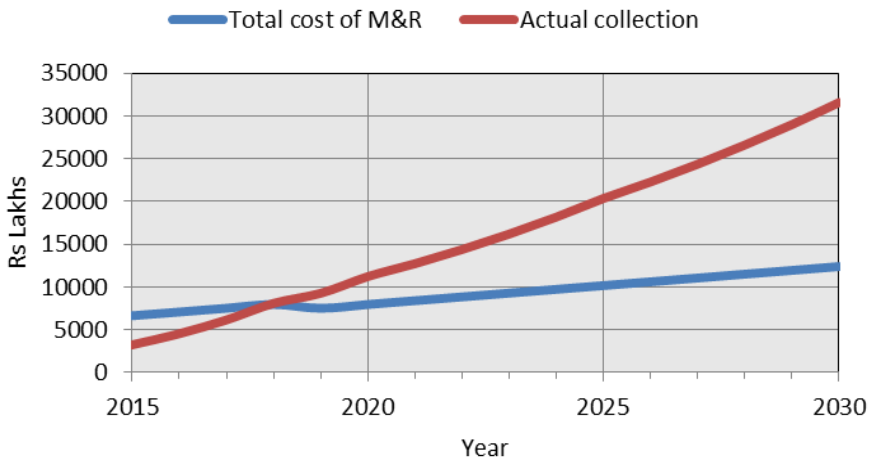


Figure 11.1: Total cost of M&R and actual collection

11.3 Financial Pattern (Rs Lakhs)

Financial pattern is shown in Table 11.17.

Table H: Financial pattern

1	**Gross cost of scheme**	**Rs. Crores**	**161.72**
2	**Financial Pattern**		
	a) GoI: Grant-in-aid 50% of gross cost	**Rs. Crores**	**80.86**
	b) GoM: Grant-in-aid 20% of gross cost	**Rs. Crores**	**32.34**
	b) Local body's share 30% of gross cost	**Rs. Crores**	**48.52**

APPENDICES

Appendix-A

Snehal.Bokare@bentley.com
to me

Respected Sir,

Sincere thanks for placing Bentley technology in upcoming PCMC tender. As discussed yesterday, the costing is as below:

Sr. No.	Description	Bentley Utilities Designer	WaterGEMS
1	No Of Pipes	NA	Unlimited Pipes
2	Quantity	4	4
3	Product Cost	2700000	5507040
4	Excise Duty (12.36%)	333720	680670.144
5	Central Sales Tax (5%) on (3+4)	151686	309385.5072
6	**Total Product Cost with taxes**	**3185406**	**6497095.651**
7	Select Subscription for One Year	780000	1267300
8	Service Tax (12.36%)	96408	156638.28
9	**Select Subscription for One Year With taxes**	**876408**	**1423938.28**
10	**Actual Cost without Taxes (3+7)**	**3480000**	**6774340**
11	**Total Cost with Taxes (6+9)**	**4061814**	**7921033.931**
	GROSS TOTAL WITH TAXES	**11982847.93**	

	Training Fees	
12	Training days	10
13	**Training fees**	**408000**
14	Service Tax (12.36%)	50428.8
15	**Total Training Cost with taxes**	**458428.8**
16	**GRAND TOTAL**	**12441276.73**

Please note that for financial year 2013-2014, the taxes may change, so we need to keep the provision of increase in taxes, if any.
They have one old WaterGEMS-1000 pipes, we shall upgrade to unlimited pipes, latest version in this procurement, the costing will be approx 16.3 lacs with taxes.
Please let us know if you need any more information.

Thanks and Best regards,
Snehal

Appendix-B

BUDGETARY OFFER FOR SINGER PRESSURE REDUCING VALVES

Dear Sir,

Please see the rates as under.

Singer make, Ductile Iron, Pressure Reducing Valve, complete with Pilot, Tubings, Strainers, The valve maintains a constant Downstream pressure regardless of fluctuation in the inlet pressure, flow. PN 10/16. Model No. PR-106/206

SIZE

RATE EACH INR

100 mm

165495/-

400 mm

1788188/-

1. EXCISE : NA.

2. CST : Inclusive @ 2% against form C.

3. DELIVERY : 3-5 months from the date of techno-commercially clear PO.

4. PAYMENT : 50% advance and balance against Proforma Invoice before dispatch.

5. INSPECTION : The PR valve will be internally inspected at Singer works at Canada pre-

dispatch and shall be ready to install. In case of any Inspection, the same

will be done at Singer Works at extra cost and expenses to be borne by you.

6. FREIGHT : Ex-Howrah/Kolkata.

7. INSURANCE : Transit insurance will be covered by you.

Mayannk - RM-Business Development

Durga Valves Private Limited

109, 1st Floor, Wing C, Urvi Park

Opp. Oswal Park, Pokhran Road No. 2, Majiwada

THANE-W. (MUMBAI). PIN: 400607

Mobile: 09324515987. Tel: 022-40242529 / 65812262

Fax: 022-21736860. Email: durvalve@bom8.vsnl.net.in

mumbai@durgavalves.com. www.durgavalves.com

cid:image003.jpg@01CD8B87.D3654E50

PRESSURE - LEAKAGE - FLOW - LEVEL SOLUTIONS

CUT YOUR NRW WITH US

Singer Poster Rep DVPL

Appendix-C

Budgetory Offer for Altitude Valve

DVPL/1229/2013-14 **24.07.2013**

To

Dr. S. V. Dahasahasra,

Consultant

PCMC 24 X 7 WSP.

Thane

Sub: Offer of Altitude Control Valve for PCMC 24 X 7.

Ref: Your enquiry dated 24.07.2013

Dear Sir,

We thank you for your enquiry mentioned above. With reference to it we are pleased in offering most competitive rates for the manufacturing & supplying of following Valves.

Sr No.	SPECIFICATIONS	
1	**106-A-Type 4- One-Way FLOW WITH ADJUSTABLE DIFFERENTIAL, ALTITUDE CONTROL VALVE**	
	Function: Closes on high reservoir level. Opens when reservoir level drops a set (Adjustable) amount.	
	Body, Cover, Stem Cap	: Ductile Iron ASTM A536 65/45/12
	Stem, Seat Ring, Spring	: AISI: 316 SS
	Diaphragm, Seals, O Rings	: EPDM/Buna N
	Stem Nut	: Brass B16

	External fasteners	: SS: 304
	Pilots	: Precise, Repeatable Low maintenance.
	Painting	: NSF 61, Fusion Bonded Epoxy Coating safe for Drinking water.
	Flange Drilling Std.	: PN 10/16/Cl-150/Cl-300
	Warrantee	: 3 years limited warrantee for Potable water application.
	Life Time Guarantee	: SS: 316 Seat Ring.
	Other Approvals	: WRAS, UL, FM, NSF, ISO-Intertek,
	Removable Stem Cap	: For in line inspection and easy maintenance.
	Body Pattern	: Globe Straight Pattern, Angle.
	Rolling Diaphragm	: 150 mm and above, Offers unequalled flow stability.

TERMS & CONDITIONS:

1)	PRICE	: Free delivery upto Pimpri Godown.
2)	CST	: Inclusive @ 4%
3)	EXCISE DUTY	: Inclusive if applicable.
4)	PAYMENT	: 30% advance along with PO, balance against Proforma Invoice before dispatch.
5)	INSURANCE	: Transit Insurance will be covered by you.
6)	INSPECTION	: Inspection if any at Singer Canada at extra cost / Our work in Howrah.
7)	DELIVERY	: 14 to 18 weeks from the date technically and commercially clear PO.
8)	GUARANTEE	: Singer limited warranty sheet attached.
9)	VALIDITY	: 30 days from the date hereof.

NOTES:	**2 Nos. Resilient Seated Gate Valve of each size is recommended for maintainence Isolation. Rates included in price.** **No packing and jointing material will be supplied.** **In absence of any detailed specifications provided by you, our quoted specification will be final.**

Thanking You and expecting your valued PO.

Yours Faithfully,

for DURGA VALVES PRIVATE LIMITED

(Sole Authorised Singer Valves Representatives, India)

MAYANNK.

CELL NO. 9324515987

RM-Business Development

CC TO HO.

Appendix-D

Budgetory Offer for Leak Detection and Repairs

SUEZ ENVIRONNEMENT INDIA
UNITECH BUSINESS PARK
TOWER A, 2nd FLOOR, SOUTH CITY -1,
GURGAON – 122001, Haryana, India
Tel : +91-124-4680120 Fax : +91-124-4680121
www.suez-environnement.com

Dated: 5th November 2012

To
Mr Praveen Ladkat
Executive Engineer
Water Treatment Plant
Pimpri Chinchwad Municipal Corporation (PCMC)
Sector 23, Nigdi
Pune 411044

Subject: Revised Price for Helium Leak Detection

Reference: PCMC letter No WTP/WS/46/2012, dated 26th June 2012.
Reference: Suez price offer dated 16th July 2012.

Dear Sir:

We take this opportunity to thank you for showing interest in our leak detection technique. We refer to our discussions on the price offer submitted by Suez Environnement on 16th July 2012.

We are pleased to offer our final best price of Rs 33718/- (Rupees Thirty Three Thousand Seven Hundred and Eighteen Only) per KM of leak detection inclusive of all taxes and duties. The price proposal is arrived assuming a minimum 500 kms of network for detection.

Kindly get in touch for any further information you may require on the offer. We once again thank you for your interest and look forward to work soon with you on the leak detection program.

Kind regards

Jacques Manem
Chief Executive Officer
Suez Environnement India Pvt Ltd
Unitech Business Park
Tower 'A', First floor
South City 1, Gurgaon 122001
Haryana

Appendix-E
Budgetory Offer for SCADA

R D S
Recktronic Devices & Systems

Head Office : 132/2 Jeevan Nagar,
Mumbai-Bangalore Highway, Tathwade,
Pune - 411 033, INDIA
Tel : +91 - 20 - 67301200 (26 Lines)
Fax : +91 - 20 - 67301230
Email : info@rds.co.in
Website : www.rds.co.in

RDS/PUN/PCMC/2013/119

Date : 19/05/2013

The Executive Engineer
Pimpri Chinchwad Municipal Corporation
Pimpri
PUNE
INDIA

Sub.: Submission of proposal for the SCADA based Monitoring & Control System for the PCMC Water Supply System

Dear Sir

We would like to introduce ourselves as turn key implementers of **Comprehensive SCADA and Automation Solutions in the water supply, treatment and distribution domain.** We have been executing projects for automation of water supply systems for the past 17 years and have been able to successfully install such systems for various government and semi government customers.

The comprehensive automation systems have been able to successfully automate the following sub systems of the water supply and distribution systems :

A. **Water Treatment Plants** :

B. **Water Pumping Systems** :

We have been executing such systems since the past decade and have to our credit satisfied government/ semi government / private clients like

1. Bhabha Atomic Research Centre (BARC)

2. ONGC
3. IOCL
4. Ministry of Defence (MoD)
5. World Bank
6. Ministry of Urban Development

At RDS, we pride ourselves on being able to deliver value with technical excellence to our customers, aided by our experience and understanding of effective automation solutions

Over the years we have been able to design and implement effective, practical and reliable automation solutions. These solutions rest on optimal design and product support from global majors in the field of PLCs, Instrumentation and Communication Systems.

We sincerely hope that we shall be able to add you to our list of satisfied clients.
Please do visit our web site (rds.co.in) for detailed information regarding our projects and services

Thanking you
Yours sincerely
For **Recktronic Devices & Systems**

Saurabh Varma
9422516784

RDS
Recktronic Devices & Systems

Head Office : 132/2 Jeevan Nagar,
Mumbai-Bangalore Highway, Tathwade,
Pune - 411 033, INDIA
Tel : +91 - 20 - 67301200 (26 Lines)
Fax : +91 - 20 - 67301230
Email : info@rds.co.in
Website : www.rds.co.in

PROFORMA INVOICE FOR THE PROPOSAL

A.	Flow meters at the outlets of ESR	
		104070000
B.	Electric Actuators with Valve at ESR	
		42800000
C.	Pressure Transmitters	
		26000000
D	PLC Based Monitoring & Control Panels	
1	For ESR FMs	13800000
2	For Pressure Monitoring Systems	46000000
E	Communication Charges for 05 years	26000000
F	Miscellaneous - Cables, Civil Works etc	650000
		259320000