GENERAL REPORT

FOR

KISHANGARH UNDERGROUND DRAINAGE PROJECT

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CHAPTER-1 SECTOR BACKGROUND CONTEXT & BROAD PROJECT RATIONALE

1.1 STATE PROFILE

The Indian state of Rajasthan is divided into 33 districts for administrative purposes. The responsibilities of district management are carried out by a number of All-India officials and a number of state-appointed officials. Rajasthan is located on the north-western side of the country, where it comprise most of wide and inhospitable Thar Desert and shares a border with the Pakistani provinces of Panjab to the northwest and Sindh to the West, aslong the Sutlej-Indus river valley. Elsewhere it is bordered by th other Indian State.It covers an area of 342239 sq.km. According to India census, the total population of Rajasthan as of 2015 is 7.35 crore souls . The state has diverse climatic conditions.The average rainfall ranges from 313 mm in Westside to over 615 mm in Easter Side of Rajasthan.

1.2 DISTRICT PROFILE

Ajmer District is a district of the state of Rajasthan in western India. The city of Ajmer is the district headquarters.

Ajmer District has an area of 8,481 km², and a population of 2,180,526 (2001 census). Three main religions are; Hindu 1,869,044, Muslim 244,341, Jains 47,812. The district is situated in the center of Rajasthan, and is bounded by Nagaur District to the north, Jaipur and Tonk districts to the east, Bhilwara District to the south, and Pali District to the west.

The eastern portion of the district is generally flat, broken only by gentle undulations. The e western parts, from north-west to south-west, are intersected by the Aravalli Range. Many of the valleys in this region are sandy deserts, part of India's Thar Desert, with an occasional oasis of cultivation. Some fertile tracts are also present; among these is the plain on which lies the town of Ajmer. This valley has an artificial lake, and is protected by the massive walls of the Nagpathar range or Serpent rock, which forms a barrier against the sand. The only hills in the district are the Aravalli Range and its offshoots. Ajmer is almost totally devoid of rivers. The Banas River touches the south-eastern boundary of the district so as to irrigate the pargana of Samur. Four small streams—the Sagarmati, Saraswati, Khari also intersect the district.

The district is divided into four subdivisions, Ajmer, Beawar, Kekri and Kishangarh, and further subdivided into nine tehsils, Ajmer, Beawar,Bhinai, Sarwar, Sawar, Tantoti, Nasirabad, Masuda, Kekri, Kishangarh.

1.3 TOWN PROFILE

Kishangarh is a city and a municipality in Ajmer district in the Indianstate of Rajasthan. It lies 18 miles north-west of Ajmer. It is well connected via Indian Railways and National Highway 8. It is the birthplace of the Kishangarh style of painting, which is known for the beautiful depiction of a courtesan known as Bani Thani. In recent years, Kishangarh has come to be known as the marble city of India. It is purported to be the only place in the world with a temple of nine planets. Kishangarh was the capital of the eponymous princely state during the British Raj, which was located in the Rajputana Agency. It had an area of 2210 km² (858 miles²) and a population in 1901 of 90,970. This figure for population represented a decrease of 27% over the census figure of 1891, something presumably attributable to the famine of 1899-1900. The state enjoyed an estimated revenue of Rs.34,000/- and paid no tribute to the British Raj. In 1840, Prithvi Singh, became the 15th Maharaja of Kishangarh, and reigned till his death in 1879, after which he was succeeded by his son, Sardul Singh.

HISTORY AND REGIONAL IMPORTANCE

Kishangarh state was founded by the Jodhpur prince Kishan Singh in 1609. Prior to the rule of Kishan singh this area was ruled by Maharaja Samokhansingh who was a distant relative of Kishan singh's family and gradfather of Naubat khan. The ruling family of Kishangarh and the family of Naubat khan had close ties. Maharaja

Samokhan lost to the forces of Akabar and his granson Naubat khan was kept under house arrest. Naubat khan later accepted Islam. Maharaja Madan Singh ascended the throne in 1990 at the age of sixteen, at a time when the state was reeling from the impact of a devastating drought. A social reform movment for discouraging excessive expenditure on marriages made remarkable impact during his reign.

The town of Kishagarh has a palace – hotel knows as Phool mahal and a Fort. The city also has a large lake know as the Gondulav lake. There are many picnic and rligious places situated at the banks of Gondulav lake Such as Mukham Vilas and Bhairughat. The city also has a small temple of nine planets knows as NavaGarh. The Kishangarh Fort is being surrounded by canal that was built by Kishansingh.

1.3.1 TOPOGRAPHY:

Kishangarh town is located on a Aravalli ranges plateau terrain. Gondulav lake is located in the north of the Old Population of Kishagarh. Aravalli mountain chain in south-west of the town originated from the north-east of the city. Except some mountanious areas, most of the terrian is flat.

1.3.2 GEOGRAPHY:

Kishangarh is located at 26.57°N 74.87°E It has an average elevation of 433 metres (1421 ft).

1.3.3 CLIMATE:

The climate is often hot and dry weather remains warm and dry in summer and cold in winter days. The winter season extendeds from December to February and the summer season lasts from the March to the end of June. The rainy season lasts from July until mid-september. There is a steady increase in temperature in the month of March –June and the temperature attains highest value during May to mid June. The average maximum & minimum temperatures recorded in summer are 41°c and in winter 27°c.

1.3.4 RAINFALL:

Average annual rainfall of the city is 417mm.

1.3.5 DEMOGRAPHY:

As of 2001 India census, Kishangarh had a population of 116,156. Males constitute 53% of the population and females 47%. Kishangarh has an average literacy rate of 62%, higher than the national average of 59.5%: male literacy is 80%, and female literacy is 64%. In Kishangarh, 12% of the population is under 6 years of age.

1.3.6 TRANSPORT

Kishangarh railway station is on the Jaipur-Ahmedabad line. Kishangarh is presently the only state in Rajasthan where the work of Railway Station, Bus Depot And Airport is going on simultaneously.Kishangarh's old railway station is situated in the heart of the city Transport facilities are available to various places in the city. National highway 8 and Near state highway 7 passes through the Town.

Distance to important places from Kishangarh:

- Ajmer: 29 km
- Beawar: 82 km
- Jaipur: 100 km
- Delhi: 408 km

1.3.7 POPULATION:

The population records for Kishangarh town for the years 1951 to 2001 according to India census are given in the table 1.

Table No. 1:- Census Data

Year	Population
1971	37405
1981	62032
1991	81948
2001	116222
2011	154886

1.4 POPULATION GROWTH:

The Population of Kishangarh town as per 1971 census was 37405 persons which rose to 62032 persons in the year 1981 registering a growth rate of 65.84 percent.

According to 1991 census, the population of Kishangarh town is 81948 persons registering a decadal growth rate of 32.11 percent.

Following table shows the decadal population of the town along with the percentage decadal variation from 1971 onwards.

Table No. 2:- Decadal Variation in Population: (1971 – 2011)

YEAR	POPULATION	INCREASE per DECADE	%age INCREASE per DECADE	INCREMENTAL INCREASE per DECADE
1971	37405			
1981	62032	24627	65.84%	
1991	81948	19916	32.11%	-4711
2001	116222	34274	41.82%	14358
2011	154886	38664	33.27%	4390
TOTAL	**452493**	**117481**		
MEAN	**90499**	**29370**	**43.26%**	**4679.0**

Source: Census of India, Kishangarh District, 1991

The Projected population of Kishangarh Town is worked out based on the population count in the year 2016 considering Arithmetical progression method, geometrical increase method, incremental increase method , graphical method & Geometrical increase method. Average of the population count obtained from the above mentioned methods is considered to forecast population for the year 2048. Table 3 summarizes the results obtained from all five methods and the average population count.

Table No. 3:-Summary of Population forecast

SR.NO.	METHOD	2011	2016	2018	2033	2048	YEAR
1.)	Arithmetical Progression method	154886	169571	175445	219501	263556	Souls
2.)	Geometrical progression method	154886	184186	197403	331958	558231	Souls
3.)	Increamental increase method	154886	171327	178230	235973	304243	Souls
4.)	Graphical method	154886	180000	195000	320000	450000	Souls
5.)	Geometrical increase method	154886	185384	199204	341571	585685	Souls
Average of Five methods		**154886**	**178094**	**189057**	**289801**	**432343**	**Souls**
Adopted Incremental Increase method for forecasting Population		**154886**	**171327**	**178230**	**235973**	**304243**	**Souls**

❖ **Ward Wise Population, 2011:**

There are Forty five wards in the town. The ward wise population distribution for the year 2011 is shown in the following table

Table No. 4:-Ward Wise Population

Ward No.	Ward Pop^{n} (2011)
1	5749
2	6512
3	4580
4	3329
5	2416
6	4027
7	4533
8	3825
9	7951
10	4043
11	3913
12	2760
13	2407
14	1990
15	2040
16	3194
17	2410
18	2426
19	2249
20	3396
21	3673
22	4357
23	5149
24	4053
25	3263
26	1991
27	3815
28	2212
29	3468
30	3097
31	4573
32	2765
33	2830
34	2771
35	2885
36	3420

Ward No.	Ward Pop^{n} (2011)
37	2271
38	2178
39	2323
40	2575
41	3569
42	3257
43	2877
44	3164
45	4600
Total	**154886**

Source: Data from Kishangarh.

The population of the Ward No. 9 as per 2011 census is the highest. There are 7951 persons in ward no.9. The population of the ward no. 14 is the lowest. In this ward only 1990 persons are living out of the total of 154886 as per 2011 census.

1.5 EXISTING WATER SUPPLY SYSTEM- BACK GROUND:

The town receives 9.50 MLD treated water from water treatment plant at Kekri of Bisalpur Syatem. Bisalpur water is received in CWR of capacity 21400 KL at Masaniya Balaji Headworks. From here water is pumped to Azad nagar, Chamda Ghar & Housing board (2 Nos) CWRs. From all these three CWRs , Water is pumped to 7 Nos of Overhead Service reservoir, with total capacity of 4034 KL. The total length of feeder mains is around 50 kms and that of distribution network is 213 kms. At present, water is distributed in 9 zones, 7 by gravity through OHSRs and 2 by direct pumping. At present gross per capita supply is 61.52 lpcd based on Census 2011 Population of 155109 souls. The total no. of service connections are 21368 in which the total functional meters account to 17700.

1.6 PROPOSED WATER SUPPLY BACKGROUND:

Proposed Water Supply scheme is based on 135 lpcd of Domestic demand , floating demand of 40 lpcd , Commercial & Institutional demand of 3% , transmission & distribution losses of 15%. Floating population is adopted as 10% of total population. The Water Demand for future years comes out to be as follows,

PARTICULARS	UNIT	YEAR -2011	YEAR -2021	YEAR -2031	YEAR -2045
Gross water Demand	**MLD**	**25.51**	**37.47**	**47.15**	**64.84**
Recycled Water	**MLD**	**0.00**	**4.50**	**7.07**	**12.97**
Net Fresh water Demand	**MLD**	**25.51**	**32.97**	**40.08**	**51.87**

1.6.1 PROPOSED COMPONENT

The Objective is to improve the pressure and duration of water Supply and convert the ontermittent water supply to 24x7 water supply and to bring the NRW below 15% Level.

1. Zoning : Kishangarh town is devided in 2 Distribution zones and has 45 Ward.
2. Transmission Main: Transmission main is proposed from CWRs to different ESRs of town level of DI-K9 & DI-K7 pipe from 150 mm to 500 mm Dia.
3. Clear Water Sump : CWRs at headworks of Bajrang Colony & Azad nagar are proposed under Phase-I of the project. Hence no CWR is proposed under these proposals.
4. Service Reservoir : In various zones as per requirements 17 OHSRs proposed in Kishangarh Town
5. Pumping Stations and Other Buildings: At bajarang Colony New Pumping Station is proposed & Repairs at existing Pumping Station (i) Azad Nagar Head work & (ii) Chamdaghar Headworks.
6. Distribution System: In Various Zones distribution network of 90 mm to 225 mm Dia HDPE pipe of 495.30 KM and 400 mm to 500 mm Dia DI pipe of 140.91 km length are poposed in town.

1.7 EXISTING DRAINAGE SCHEME:

Underground sewerage system has been laid in Kishangarh town in 2007 to 2012 in Some area of towns. But in still date this Sewage collection system is not in working condition. Due to missing link and system was not connected with house hold connection. Which had 150 mm to 900 mm dia (R.C.C. NP2 & NP4) pipe around 17.07 km length and Sewage Treatment Plant of 10 MLD Exist for Kishangarh drainage. (Existina map is attached in Dwg. Volume.)

Sr. No.	Dia. (mm)	Length. (Rmt)	Sr. No.	Dia. (mm)	Length. (Rmt)
1	150	1557.00	10	700	352.00
2	200	1505.70	11	900	2004.60
3	250	1489.10	12	450-2	285.00
4	300	699.50	13	450-4	230.00
5	350	1073.30	14	500- NP2	35.00
6	400	605.00	15	900- NP2	43.60
7	450	2520.05	16	900- NP4	47.50
8	500	630.00	17	900-2	1133.00
9	600	932.35	18	900-4	1927.30
				Total	**17,070.00**

Photo of Existing drainage

1.8 CONCLUSION:

Kishangarh town having underground drainage system but in this system only trunk main and STP was constructed in some part. As such government has appointed the consultants for preparing the underground drainage project report for the area where drainage system does not exist. Due to increase in the use of water, they are being filled up soon and their maintenance becomes a nuisance. It causes lot of unhealthy conditions to the people in general and hence it is essential to provide underground drainage scheme for the town. .

1.9 PROPOSED DRAINAGE WORKS:

1. The proposal providing drainage facility for **34.50** MLD of Dry weather flow.
2. The Dry Weather flow is considered 80% of rate of water supply + 5 % of Infiltration that is **135** lpcd,

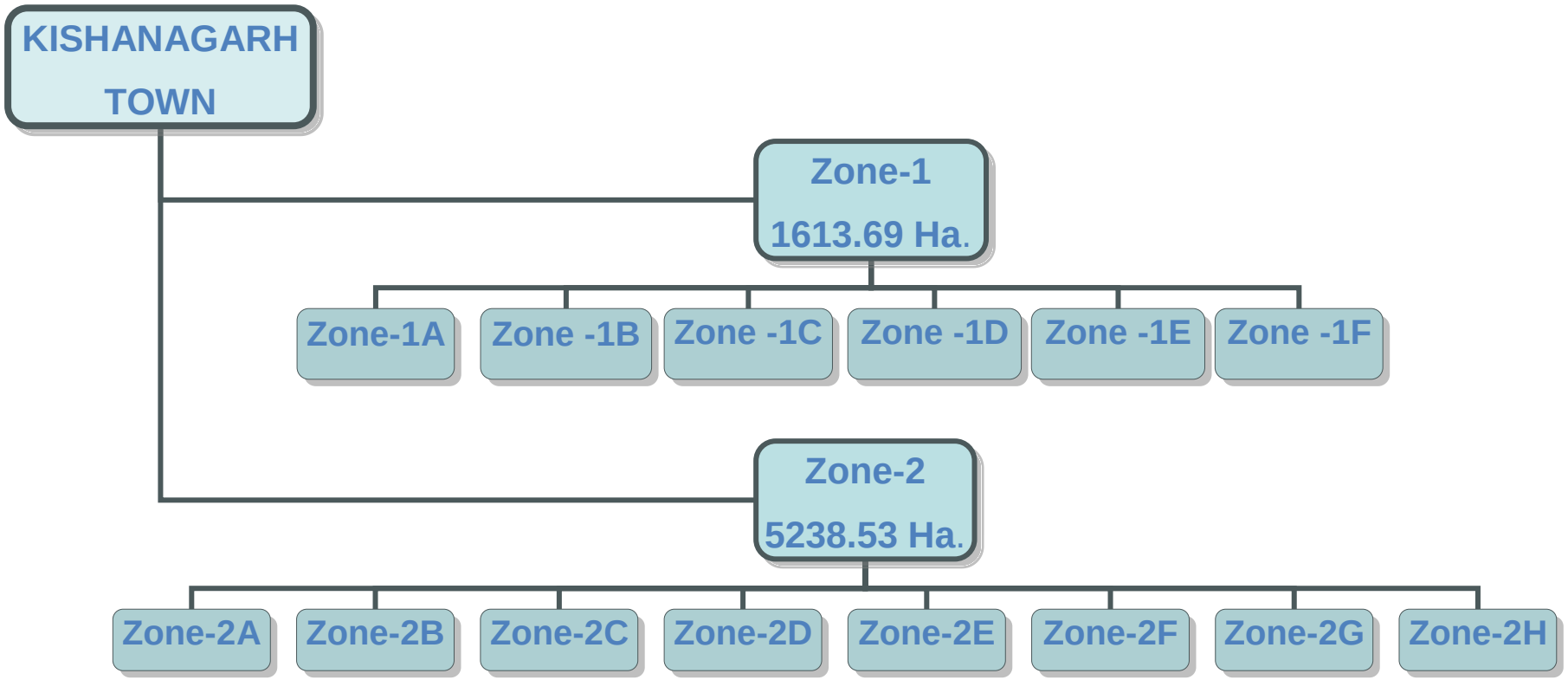
3. Population forecast has been made as per norms, hence prevailing by following four methods.
   a. Arithmetical Progression method
   b. Geometrical progression method
   c. Incremental increase method
   d. Graphical method
   e. Geometrical increase method

   The Incremental increase population is adopted from these five methods for forecasted for DWF.
4. Designs of all component of scheme such as sewer collecting system, Pumping Station, Pumping Machinery, and Rising Main have been furnished.
5. The Pumping Main has been designed using Software for most economical solution with 1DWF, 2 DWF is adopted.
6. The Capacity of Pumping units has been calculated as per norms, the stand by provision is also proposed as per requirement.
7. The Sewer collecting system is designed using hazen William's formula and RCC NP4 & HDPEDWC pipes are proposed.
8. Details Drawing & Estimates will be framed as per the latest SOR of RUIDP 2013 for town.
9. The provision of 3% is made towards contingencies of scheme.
10. The Conventional Sewer treatment plant of **7.3 MLD** is proposed at Zone-1 based on Sequencing Batch Reactor (SBR)
11. The Conventional Sewer treatment plant of **4.87 MLD** is proposed at Zone-2 on Sequencing Batch Reactor (SBR)
12. The Underground drainage project for Kishangarh town **Phase II**, approval at Gross cost of **Rs. 11032.09 lacs.**
13. The Underground drainage project for Kishangarh town **Phase III_Part_I**, approval at Gross cost of **Rs. 12679.64 lacs.**
14. The Underground drainage project for Kishangarh town **Phase III_Part_II**, approval at Gross cost of **Rs. 8814.89 lacs.**
15. The Underground drainage project for Kishangarh town **Phase _ II & III** approval at Gross cost of **Rs. 32527.22 lacs.**

CHAPTER-2 PROJECT DEFINITION, CONCEPT AND SCOPE

2.1 PROJECT DEFINITION

Population of Kishangarh town as per India census for the year 1971 is 37405 souls and for the year 2011 is 154886 souls. An overall population growth of Kishangarh town is calculated to be 43.26% The Project are covered under the scheme is **6852.22 hac.** It is proposed to lay down drainage scheme consisting of 2 separate Zone, Therefore, classification of zones, which is done taking into consideration the locations of the proposed STP, is as under.


KISHANAGARH TOWN
Zone-1
1613.69 Ha.
Zone-1A
Zone -1B
Zone -1C
Zone -1D
Zone -1E
Zone -1F
Zone-2
5238.53 Ha.
Zone-2A
Zone-2B
Zone-2C
Zone-2D
Zone-2E
Zone-2F
Zone-2G
Zone-2H

2.2 POPULATION FORECAST

Population data records from the year 1971 to 2011 obtained from India census for Kishangarh Town is given in **Table no. 5**. The underground drainage scheme is to be designed taking into consideration the 30 year future population growth. Base year of the project is considered as 2016 and hence the intermediate stage will be 2033 and ultimate design year will be 2048.

Arithmetical progression method, geometrical progression method, incremental progression method, graphical method & Geometrical increase method are the five methods used to forecast population count and are summarized as follows. The population projected using different methods are given below

2.2.1 Method 1: Arithmetical Progression Method

The arithmetical progression method is applicable to large and old cities, the average increase of population is calculated from the past record and added to census population to find out the population in next decade.

YEAR	POPULATION	INCREASE per DECADE	%age INCREASE per DECADE	INCREMENTAL INCREASE per DECADE
1971	37405			
1981	62032	24627	65.84%	
1991	81948	19916	32.11%	-4711
2001	116222	34274	41.82%	14358
2011	154886	38664	33.27%	4390
TOTAL	**452493**	**117481**		
MEAN	**90499**	**29370**	**43.26%**	**4679.0**

Base Year Total Population = (2011)	**154886**	**Souls**

Current Year	**2016**
Intermediate Year	**2018**
Prospective year	**2033**
Ultimate year	**2048**

Population in Current Year 2016 will be

= 154886 + (29370.3 * 0.5) = 169571.2 **169571** Souls

Population in Intermediate Year 2018 will be

= 154886 + (29370.3 * 0.7) = 175445.2 **175445** Souls

Population in Prospective year 2033 will be

= 154886 + (29370.3 * 2.2) = 219500.6 **219501** Souls

Population in Ultimate year 2048 will be

= 154886 + (29370.3 * 3.7) = 263556 **263556** Souls

2.2.2 Method 2: Geometrical Progression Method

In this method, percentage increase in arithmetical increment is assumed to be rate growth and the average of percentage is increased to find out future increment population. This method is mainly applicable for growing town and cities having vast scope.

Rate of growth per decade between		
1971 TO 1981	24627/37405	65.8%
1981 TO 1991	19916/62032	32.1%
1991 TO 2001	34274/81948	41.8%
2001 TO 2011	38664/116222	33.27%
$4\sqrt{}$ * 0.6584 * 0.3211 * 0.4182 * 0.3327	**=**	**41.41%**

Assuming that future growth follows the geometrical mean between 1971 to 2011

Population in current year 2016		
= 154886 * (1+0.4141)^0.5	**184186**	Souls
Population in intermidiate year 2018		
154886 * (1+0.4141)^0.7	**197403**	Souls
Population in intermidiate year 2033		
154886 * (1+0.4141)^2.2	**331958**	Souls
Population in ultimate year 2048		
154886 * (1+0.4141)^3.7	**558231**	Souls

MIN. % GROWTH RATE

min. % increase	**0.321**	
Population in Current Year2016		
=154886 *(1+0.3211)^0.5	**178022**	**Souls**
Population in year 2018 INTERMEDIATE STAGE		
=154886 *(1+0.3211)^0.7	**188217**	**Souls**
Population in year 2033 INTERMEDIATE STAGE		
=154886 *(1+0.3211)^2.2	**285787**	**Souls**
Population in year 2048 ULTIMATE STAGE		
=154886 *(1+0.3211)^3.7	**433936**	**Souls**

MAX. % GROWTH RATE

max. % increase	**0.658**	
Population in Current Year2016		
= 154886 * (1+0.658)^0.5	**199460**	Souls
Population in year 2018 INTERMEDIATE STAGE		
= 154886 * (1+0.658)^0.7	**220695**	Souls
Population in year 2033 INTERMEDIATE STAGE		
= 154886 * (1+0.658)^2.2	**471326**	Souls
Population in year 2048 ULTIMATE STAGE		
= 154886 * (1+0.658)^3.7	**1006586**	Souls

2.2.3 Method 3: Increamental Increase Method

In this method, percentage increase in arithmetical increment is assumed to be rate growth and the average of percentage is increased to find out future increment population. This method is mainly applicable for growing town and cities having vast scope

YEAR	POPULATION	INCREASE	INCREMENTAL INCREASE
1971	37405		
1981	62032	24627	
1991	81948	19916	-4711
2001	116222	34274	14358
2011	154886	38664	4390
TOTAL	**TOTAL**	117481	14037
AVERAGE	**AVERAGE**	**29371**	**4679**

Population in Current Year2016

154886+ (0.5*29371) +[(0.5*(1 +0.5) *(4679))/2]= **171327** Souls

Population in year 2018 INTERMEDIATE STAGE

154886+ (0.7*29371) +[(0.7*(1 +0.7) *(4679))/2]= **178230** Souls

Population in year 2033 INTERMEDIATE STAGE

154886+ (2.2*29371) +[(2.2*(1 +2.2) *(4679))/2]= **235973** Souls

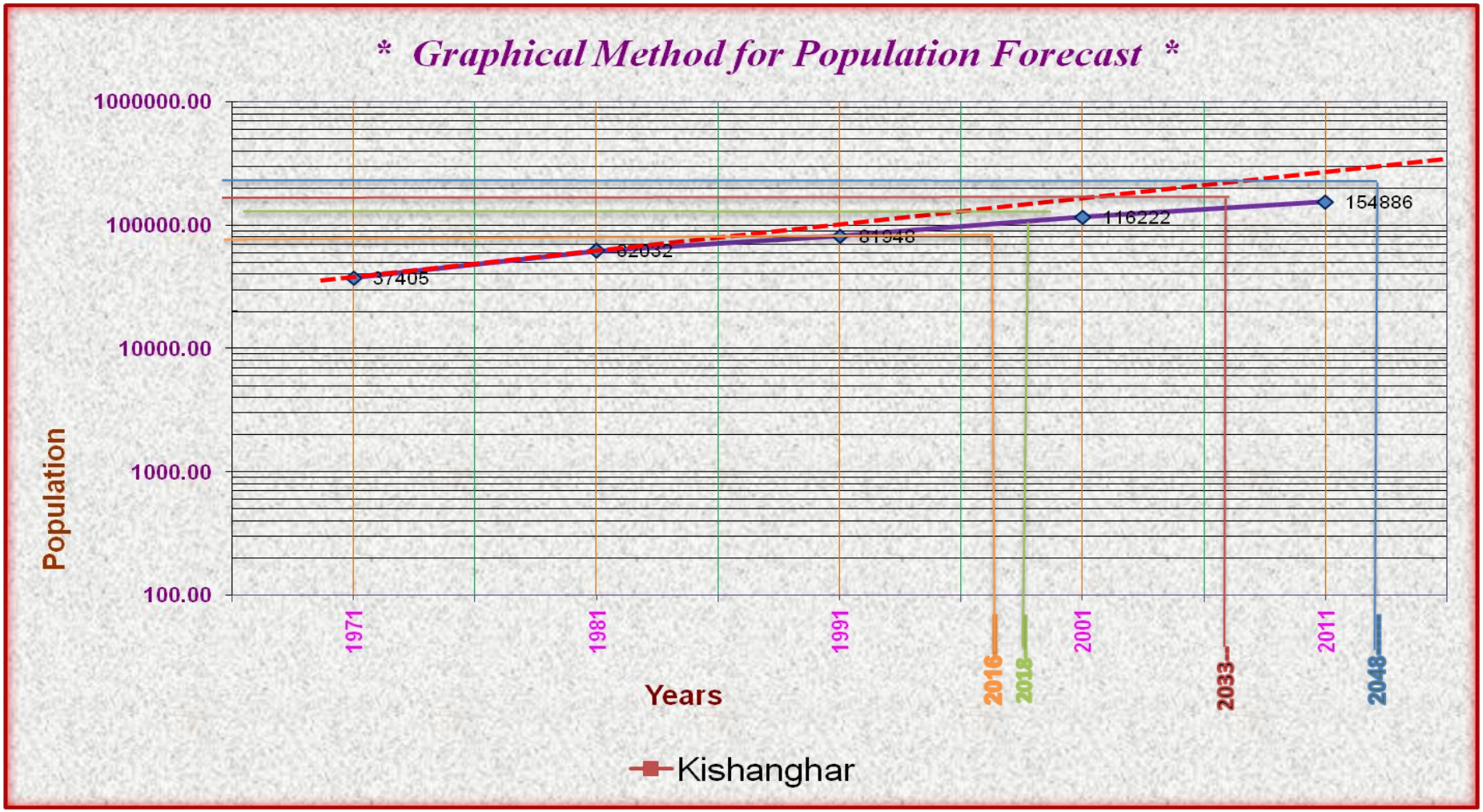
Population in year 2048 ULTIMATE STAGE

154886+ (3.7*29371) +[(3.7*(1 +3.7) *(4679))/2]= **304243** Souls

2.2.4 Method 4: Graphical Method

In this method, percentage increase in arithmetical increment is assumed to be rate growth and the average of percentage is increased to find out future increment population. This method is mainly applicable for growing town and cities having vast scope.

YEAR	POPULATION	
1971	37405	Souls
1981	62032	Souls
1991	81948	Souls
2001	116222	Souls
2011	154886	Souls


* Graphical Method for Population Forecast *
1000000.00
100000.00
10000.00
1000.00
100.00
Population
37405
62032
81948
116222
154886
1971
1981
1991
2001
2011
2016
2018
2033
2048
Years
Kishanghar

YEAR	POPULATION	
2016	180000	Souls
2018	195000	Souls
2033	320000	Souls
2048	450000	Souls

2.2.5 Method 5: Geometrical incremental Method

In this method, percentage increase in arithmetical increament is assumed to be rate growth and the average of percentage is increased to find out future increament population.This method is mainly applicable for growing town and cities having vast scope

Rate of growth per decade between		
1971 TO 1981	24627/37405	65.84%
1981 TO 1991	19916/62032	32.11%
1991 TO 2001	34274/81948	41.82%
2001 TO 2011	38664/116222	33.27%
Average		**43.26%**

Assuming that future growth follows the geometrical mean between 2016 To 2048 Year

$$P = P_o\lambda^t$$

$$P = P_o (1+i)^t$$

Population in Current Year2016

P =154886 *(1+0.4326)^0.5 **185384** **Souls**

Population in year 2018 INTERMEDIATE STAGE

P =154886 *(1+0.4326)^0.7 **199204** **Souls**

Population in year 2033 INTERMEDIATE STAGE

P =154886 *(1+0.4326)^2.2 **341571** **Souls**

Population in year 2048 ULTIMATE STAGE

P =154886 *(1+0.4326)^3.7 **585685** **Souls**

AVERAGE POPULATION IN THE YEAR OF ALL FIVE METHOD WILL BE AS UNDER POPULATION							
SR.NO	METHOD	2011	2016	2018	2033	2048	year
1.)	Arithmetical Progression method	154886	169571	175445	219501	263556	Souls
2.)	Geometrical progression method	154886	184186	197403	331958	558231	Souls
3.)	Increamental increase method	154886	171327	178230	235973	304243	Souls
4.)	Graphical method	154886	180000	195000	320000	450000	Souls
5.)	Geometrical increase method	154886	185384	199204	341571	585685	Souls
	Average	**154886**	**178094**	**189057**	**289801**	**432343**	**Souls**
	Adopted Incremental Increase method for forecasting Population	**154886**	**171327**	**178230**	**235973**	**304243**	**Souls**

Justification – Looking to the result of prospective population arrived by variance method. It is seams that the prospective population arrived by Geometrical method is to high it can be adopted only the very fast growing city hear growth of our city is not abnormal. Like wide the prospective population arrived with in method of Arithmetical is population arrived is too little. This method can be adopted for a slow growing city hear our growth is not slow and is having normal the Incremental Increase method is fairly adopted for a normal growing town. The prospective population arrive by this method is matching with past record of growth last three ducats. Hence it is most appropriate method to arrive prospective population. This arrived population is matching with previously prepaid DPR for Water supply and sewerage project. Hence it is in line with the population projection adopted in the past project.

2.3 NEED OF THE PROJECT

The design and construction of the underground drainage system for Kishangarh town is necessary as currently drainage facilities are available in some part of town and also due to increase in water needs for the growing population and systematic infrastructure development.

The town is equipped with the modern facilities viz. electricity and water supply. With increase in the requirement of Water Supply, the proper disposal of sewage is necessary. At present, there are individual soak pits to discharge sewage; some discharge is drained off at nearby nahla beside the main road. Due to increase in the use of water, they are being filled up soon and their maintenance becomes a nuisance. It causes lot of unhealthy conditions to the people in general and the people rightly desire to have underground drainage scheme.

- The projected population based on the present stage is calculated including outskirts area as under.

1) Year 2011 = 154886 Souls.
2) Present Year 2016 = 171327 Souls.
3) Commissioning Year 2018 = 178230 Souls.
4) Intermediate Year 2033 = 235973 Souls.
5) Ultimate Stage Year 2048 = 304243 Souls.

2.4 PER CAPITA SEWAGE CONTRIBUTION

The entire spent water of a community should normally contribute to the total flow in a sanitary sewer. However, the observed dry weather flow is usually slightly less than the per capita water consumption due to seepage in the ground, leakage etc. So Per capita sewage contribution of 112 lpcd is considered as 80% of water supply rate.

Table No. 6:- DWF for Kishangarh Town and Project Area

Year	Population (Souls)		Projected DWF (MLD)	
	Phase II	Phase III	Phase II	Phase III
Base (2016)	90585	81481	10.27	9.24
Intermediate (2033)	148711	112335	16.86	12.74
Ultimate (2048)	164766	139728	18.68	15.85

2.5 PROPOSED DESIGN COMPONENTS

Following components will be proposed for the Underground drainage scheme for the whole town:

- Sewer Collecting system comprising of RCC NP4 ring fit joints type and HDPEDWC pipes

- Manholes at every 30 m interval in the straight line
- Rising main
- Non Clog Pump Set
- Sewage treatment Plant

The details of population and sewerage contribution of all area & ward is given in **Table no. 7**.

Location (Zone)	Total Area of Zone (Hectare)	Contributory Ward ,Area, Population			Projected Population (Souls)			Projected DWF (MLD)		
		Ward	Area (Hectare)	Population (2011)	2016	2033	2048	2016	2033	2048
Zone1	1613.69	Ward-01	110.09	5749	5835	7707	8808	0.66	0.87	1.00
		Ward-02	130.24	6512	6642	7814	9117	0.75	0.89	1.03
		Ward-03	109.90	4580	4946	6045	7144	0.56	0.69	0.81
		Ward-04	11.11	3329	3389	3556	3667	0.38	0.40	0.42
		Ward-05	6	2416	2437	2502	2566	0.28	0.28	0.29
		Ward-06	9	4027	4094	4187	4653	0.46	0.47	0.53
		Ward-07	117	4533	4685	7027	8198	0.53	0.80	0.93
		Ward-08	9	3825	3841	3888	3981	0.44	0.44	0.45
		Ward-09.	896	7951	8960	22400	31360	1.02	2.54	3.56
		ward-10	34	940	1021	1362	1702	0.12	0.15	0.19
		Ward-11	4	789	797	818	859	0.09	0.09	0.10
		Ward-12	6	386	406	435	464	0.05	0.05	0.05
		Ward-13	0.80	193	197	201	205	0.02	0.02	0.02

Location (Zone)	Total Area of Zone (Hectare)	Contributory Ward ,Area, Population			Projected Population (Souls)			Projected DWF (MLD)		
		Ward	Area (Hectare)	Population (2011)	2016	2033	2048	2016	2033	2048
		ward-14	2	330	334	352	361	0.04	0.04	0.04
		Ward-15	1.03	386	391	396	401	0.04	0.04	0.05
		Ward-21	8	64	77	155	232	0.01	0.02	0.03
		Ward-42	3	7	17	33	67	0.00	0.00	0.01
		Ward-43	50	2514	2754	3004	3505	0.31	0.34	0.40
		Ward-44	34	317	343	685	1199	0.04	0.08	0.14
		Ward-45	71	4600	4985	5698	7122	0.57	0.65	0.81
Total Area of Zone-1			**1613.69**	**53447**	**56152**	**78263**	**95609**	**6.37**	**8.88**	**10.84**
Zone-2	**5238.53**	ward-10	112.35	3103	3370	4494	5617	0.38	0.51	0.64
		Ward-11	16.20	3124	3159	3240	3401	0.36	0.37	0.39
		Ward-12	35.70	2374	2499	2677	2856	0.28	0.30	0.32
		Ward-13	9.23	2214	2262	2309	2355	0.26	0.26	0.27
		ward-14	8.86	1660	1684	1773	1817	0.19	0.20	0.21

Location (Zone)	Total Area of Zone (Hectare)	Contributory Ward ,Area, Population			Projected Population (Souls)			Projected DWF (MLD)		
		Ward	Area (Hectare)	Population (2011)	2016	2033	2048	2016	2033	2048
		Ward-15	4.41	1654	1676	1698	1720	0.19	0.19	0.20
		Ward-16	69.79	3194	3490	4187	5583	0.40	0.47	0.63
		Ward-17	16.03	2410	2484	2644	2804	0.28	0.30	0.32
		Ward-18	10.73	2426	2469	2576	2683	0.28	0.29	0.30
		Ward-19	10.21	2249	2296	2398	2449	0.26	0.27	0.28
		Ward-20	52.49	3396	3674	4199	5249	0.42	0.48	0.60
		Ward-21	434.48	3609	4345	8690	13034	0.49	0.99	1.48
		Ward-22	293.52	4357	5870	7338	8806	0.67	0.83	1.00
		Ward-23	39.38	5149	5316	5513	5513	0.60	0.63	0.63
		Ward-24	17.24	4053	4137	4224	4310	0.47	0.48	0.49
		Ward-25	3.11	3263	3269	3284	3300	0.37	0.37	0.37
		Ward-26	5.14	1991	2003	2054	2080	0.23	0.23	0.24
		Ward-27	357.60	3815	5364	7152	10728	0.61	0.81	1.22

Location (Zone)	Total Area of Zone (Hectare)	Contributory Ward ,Area, Population			Projected Population (Souls)			Projected DWF (MLD)		
		Ward	Area (Hectare)	Population (2011)	2016	2033	2048	2016	2033	2048
		Ward-28	15.67	2212	2272	2350	2507	0.26	0.27	0.28
		Ward-29	17.81	3468	3562	3651	3829	0.40	0.41	0.43
		Ward-30	22.31	3097	3124	3236	3570	0.35	0.37	0.40
		Ward-31	470.33	4573	5644	11758	16462	0.64	1.33	1.87
		Ward-32	8.13	2765	2804	2845	2926	0.32	0.32	0.33
		Ward-33	10.32	2830	2838	2890	2993	0.32	0.33	0.34
		Ward-34	176.92	2771	3362	7077	8846	0.38	0.80	1.00
		Ward-35	12.09	2885	2901	2961	3021	0.33	0.34	0.34
		Ward-36	873.39	3420	4350	8745	14968	0.49	0.99	1.70
		Ward-37	5.43	2271	2279	2387	2441	0.26	0.27	0.28
		Ward-38	4.17	2178	2187	2312	2333	0.25	0.26	0.26
		Ward-39	6.30	2323	2331	2456	2519	0.26	0.28	0.29
		Ward-40	18.34	2575	2659	2934	3118	0.30	0.33	0.35

Location (Zone)	Total Area of Zone (Hectare)	Contributory Ward ,Area, Population			Projected Population (Souls)			Projected DWF (MLD)		
		Ward	Area (Hectare)	Population (2011)	2016	2033	2048	2016	2033	2048
		Ward-41	240.22	3569	4291	9609	12598	0.49	1.09	1.43
		Ward-42	1545.27	3250	7726	15453	30905	0.88	1.75	3.50
		Ward-43	7.23	363	397	434	506	0.05	0.05	0.06
		Ward-44	308.17	2847	3082	6163	10786	0.35	0.70	1.22
Total Area of Zone-2			**5167.88**	**101439**	**115175**	**157709**	**208634**	**13.06**	**17.88**	**23.66**
Total Area of Kisangadh Town			**6781.57**	**154886**	**171327**	**235973**	**304243**	**19.43**	**26.76**	**34.50**

- **Population Density Workout as a whole & the consideration for design is taken as per actual design of Industrial Wards:**

Kishangarh Town		
Population Density per Hectare to be considered for Design:		
Projected population for 2048:	304243	souls
Population density per hectare in 2048:	44.87	souls per hectare

PHASE II		
Population Density per Hectare to be considered for Design:		
Projected population for 2048:	164766	souls
Population density per hectare in 2048:	36.96	souls per hectare
PHASE III		
Projected population for 2048:	139728	souls
Population density per hectare in 2048:	38.85	souls per hectare

2.6 DESIGN CRITERIA

Peak factor:	2.0 if population is More than 750000 2.25 – If Population is 50001 to 750000 2.50 – If Population is 20001 to 50000 3.00 – If Population is up to 20000
R.C.C NP3 Ring Fit Joint Pipe Manning's co-efficient of roughness:	0.011
SWG Pipe Manning's co-efficient of roughness:	0.012
Actual velocity at present Peak flow V_a:	0.3 m/s for Dia. Upto 200 mm 0.6 m/s for Dia. More than 200 mm
Actual Velocity for Ultimate Peak flow V_a:	0.8 m/s for Dia. More than 250 mm
Minimum allowable cover:	1 Mt.
Maximum allowable cover:	7 Mt.
No. of commercial dia for RCC NP3 Ring Fit Joint Pipe:	200 mm to 700 mm Dia
Deviation Drop:	$K_d V^2/2g$,

	Where K_d = Bend coefficient, 0.4 for 90 degree and 0.32 for 45 degree and linearly propotioned for other deflection angle
Drop due to change in size:	(D-d)/2
Maximum allowable slope:	250
Minimum allowable slope:	1000
Adopted bedding:	PCC Bedding

2.7 PROPOSED DESIGN COMPONENTS

This section describes the proposed components of the sewer collecting system for Kishangarh town. It includes details of sewer collecting pipe network, pumping machineries and rising mains, STP.

2.7.1 SEWER COLLECTING SYSTEM:

As explained in section 2.1, the sewer collecting system of the whole town is proposed to lie in two different zones. The sewage from houses will flow into laterals and branches and then into main sewers, which will carry sewage to proposed pumping stations. Eventually the collected sewage shall be pumped to the STP.

Following CPHEEO manual, all sewer lines are designed for the peak flow discharge with the peak factor as 3.0. These lines are designed to run 0.80 full at peak flow for all diameter. Manholes are proposed at every 30 m interval in the straight line, at intersections and turns on the roads, at changes in grade and size of sewers. The drop arrangement has been proposed where one sewer pipe meets another sewer pipe at different level (where level difference is more than 0.6m). RCC NP4 ring fit joints type & HDPEDWC pipes are proposed for all sewer lines. For efficient functioning of sewer lines, jetting machine is proposed to achieve self-cleaning velocity. Scraper manhole is also provided at every 300 m distance in & above 200 mm Dia. **Table no. 9** gives the total length of the pipes of different diameters proposed in sewer network of all zones are as under.

2.7.2 PUMPING MACHINERY:

It is proposed to provide submersible non-clog pump sets at all pumping stations. Proposed machinery details are given in table 10. Pumps are designed for intermediate stage requirements, as the life of the machinery is 15 years.

Table no. 15:- Proposed Pumping Machineries for Phase_II

Pumping Machinery	DWF	Discharge (m^3/hr)	Head m	HP	No.of set
Pumping Machinery at MH-8300 to MH 8301 at Zone 2H	1DWF	16.00	7.00	12.00	1W
Proposed Pumping Machineries for Phase_III					
Pumping machinary at MH 2499 to MH- 2500 at Zone-1D	1DWF	50.00	6.00	5.00	1W
Pumping machinary at MH 3424 to MH- 3425 at Zone-1D	1DWF	135.00	6.00	10.00	1W
Pumping machinary at MH 4216 (Zone 1E) to MH- 5147 (Zone1F)	1DWF	19.00	12.00	2.00	1W
Pumping machinary at MH 1020 to MH 1023 at Zone 2A part II	1DWF	16.00	8.00	1.50	1W
Pumping machinary at MH 1412 to MH 1413 at Zone 2A part II	1DWF	27.00	8.00	2.00	1W
Pumping Machinery at MH 2432 (PS) (Zone 2B)	1DWF	121.00	8.00	10.00	1W
Pumping Machinary At MH 5239 Zone 1F Punping Statiopn	1DWF	370.00	5.00	25.00	2(1W+1S)
	2DWF	740	5.00	50.00	2(1W+1S)

2.7.3 RISING MAIN:

Rising mains are proposed to convey sewage from one MH to unother Zone MH. Table 14 gives details of pipe diameter and length of proposed rising mains.

Table no. 16:- Proposed Rising Main

Location	Dia (mm)	Length (Mt.)	Design Discharge (MLD)
Phase_II			
Rising Main from MH MH-8300 to MH 8301 Zone 2H	150.00	40.00	5.02
Phase_III			
Rising Main from MH 2499 to MH- 2500 at Zone-1D	150.00	30.00	1.24
Rising Main from MH 3424 to MH- 3425 at Zone-1D	250.00	30.00	3.36
Rising Main from MH 4216 (Zone 1E) to MH- 5147 (Zone1F)	100.00	570.00	0.54
Rising Main from MH 1020 to MH 1023 at Zone 2A part II	100.00	30.00	0.45
Rising Main from MH 1412 to MH 1413 at Zone 2A part II	150.00	30.00	0.75
Rising Main from MH 2432 to MH 2433 at Zone 2B	250.00	30.00	3.52
Rising Main from Pumping Station to STP	400.00	50.00	10.84

2.7.4 STP Details:

Particulars	Khasra No.	Area
Phase_II		
Upgradation Proposed of Existing Sewage Treatment Plant (Capacity-10 MLD)	Existting STP	23.42 Ha
Phase_III		
Proposed Sewage Tretament Plant at for Zone-1 (Capacity-7.3 MLD)	733	1.13 Ha
Proposed Sewage Tretament Plant at for Zone-2 (Capacity-4.87 MLD)	733	0.86 Ha

2.7.5 Pipe & Manhole Details:

PHASE II_DETAIL										Demand in MLD		
Zone	Area (Hact.)	Population			No of House Hold	Sewer Length		Road Length	No of MH			
		2016	2033	2048		Dia	Length			2016	2033	2048
ZONE 2C_I	414.44				1937	200 mm	15657	14029	655	1.10	1.61	2.05
						250 mm	118					
						Total	**15775**					
ZONE 2D	58.07				1793	200 mm	11968	13277	563	1.02	1.12	1.18
						450 mm	967					
						500 mm	292					
						Total	**13227**					
ZONE 2E	62.44				1852	200 mm	16765	18892	632	1.05	1.10	1.15
						450 mm	861					
						500 mm	958					
						600 mm	308					
						Total	**18892**					
ZONE 2F	193.21				3286	200 mm	27232	27922	1156	1.86	4.78	2.29
						500 mm	690					
						Total	**27922**					
ZONE 2G	2181.67				3484	200 mm	19954	22853	935	1.98	3.75	6.37
						250 mm	511					
						300 mm	29					
						350 mm	608					
						450 mm	29					
						500 mm	778					
						600 mm	538					
						Total	**22447**					
ZONE 2H	1202.07				5766	200 mm	28941	32641	1388	3.27	4.51	5.66
						250 mm	969					
						300 mm	2040					
						350 mm	691					
						Total	**32641**					
Missing Link						200 mm	270		39			
						500 mm	30					
						900 mm	90					
						Total	**390**					
TOTAL	**4112**	**73032**	**104862**	**126468**	**18117**	**Total**	**131294**	**129614**	**5368**	**10.27**	**16.86**	**18.68**

PHASE III_DETAIL										Demand in MLD		
Zone	Area (Hact.)	Population			No of House Holde	Sewer Length		Road Length	No of MH			
		2016	2033	2048		Dia	Length			2016	2033	2048
ZONE 1A	649.31	6488	16228	22729	1298	200 mm	8904	10633	427	0.74	1.84	2.58
						250 mm	691					
						300 mm	1038					
						Total	**10633**					
ZONE 1B	189.09	4868	6958	10488	974	200 mm	30969	32828	1389	0.55	0.79	1.19
						400 mm	695					
						450 mm	1164					
						Total	**32828**					
ZONE 1C	34.03	9963	10276	11027	1993	200 mm	9380	9983	424	1.13	1.17	1.25
						450 mm	365					
						500 mm	201					
						600 mm	37					
						Total	**9983**					
ZONE 1D	524.59	19807	27457	31227	3961	200 mm	31150	34634	1421	2.25	3.11	3.54
						250 mm	538					
						300 mm	1026					
						350 mm	1077					
						400 mm	821					
						450 mm	29					
						Total	**34641**					
ZONE 1E	82.80	2850	3545	4727	570	200 mm	13035	13035	555	0.32	0.40	0.54
						Total	**13035**					
ZONE 1F	133.87	12176	13799	15411	2435	200 mm	22362	24272	1023	1.38	1.56	1.75
						250 mm	481					
						300 mm	312					
						450 mm	459					
						500 mm	314					
						600 mm	325					
						700 mm	19					
						Total	**24272**					
ZONE 2A_I	602.07	8354	13136	18072	1671	200 mm	17368	20166	788	0.95	1.49	2.05
						250 mm	1172					
						350 mm	740					
						400 mm	886					
						Total	**20166**					

ZONE 2A_II	204.47	7919	9824	11870	1584	200 mm	26407	26746	1075	0.90	1.11	1.35
						250 mm	189					
						300 mm	150					
						Total	**26746**					
ZONE 2B	72.29	1740	2188	2665	348	200 mm	15999	17060	719	0.20	0.25	0.30
						250 mm	144					
						300 mm	432					
						450 mm	485					
						Total	**17060**					
ZONE 2C_II	282.14	7316	8924	11512	1463	200 mm	13553	14059	576	0.83	1.01	1.31
						250 mm	45					
						300 mm	461					
						Total	**14059**					
TOTAL	**2775**	**81481**	**112335**	**139728**	**16296**	**Total**	**203423**	**203416**	**8397**	**9.24**	**12.74**	**15.85**