



WATER

THE MAIN REQUIREMENT OF LIFE

For all living beings

SCOPE OF PLANNING

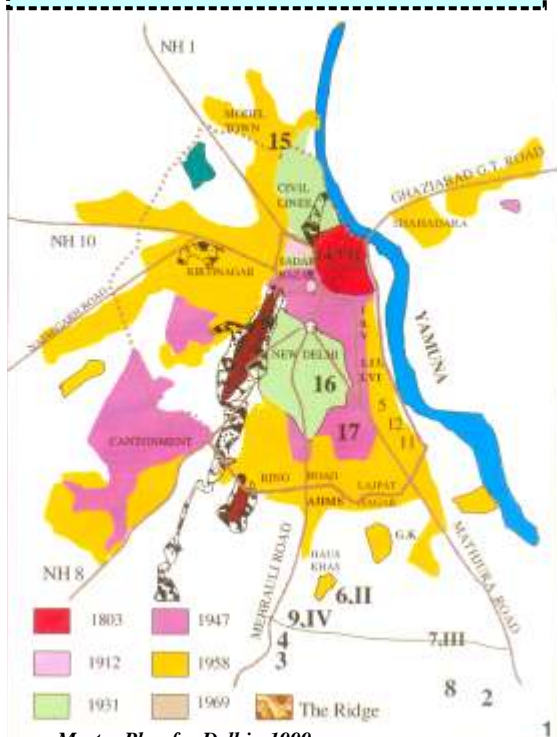


R.G. GUPTA
POLICY/CITY PLANNER

R. G. Gupta (M: 09811018374) City / Policy Planner
email : ram_gopal_gupta@yahoo.co.in
web : www.rgplan.org ; blog. www.ramgopalgupta.blog.com



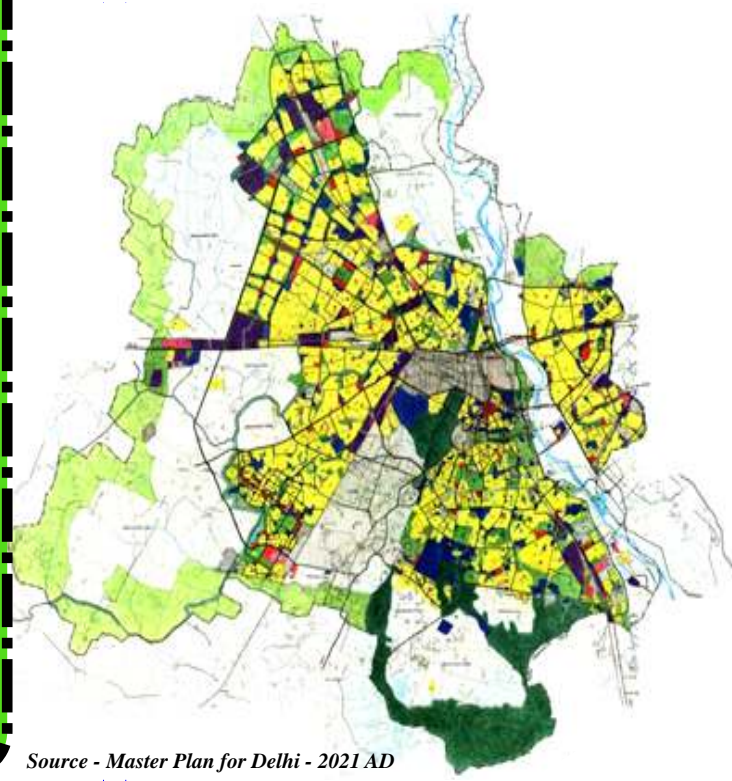
PHYSICAL GROWTH OF DELHI 1803-1959 & SEVEN-SEVENTEEN DELHIS



Source - Master Plan for Delhi - 1999

1. WATER RESOURCES FROM NCR & DMA.
2. PRESENT SOURCES OF WATER : GANGA, YAMUNA, LAKES, EXISTING PONDS, STORM WATER DRAINS. RECYCLING etc.
3. PRESENT SYSTEM OF WATER PROCUREMENT, TREATMENT, DISTRIBUTION, LEAKAGES & COLLECTION, SHORT FALLS/LOOP HOLES & THEIR REMEDIES.
4. REQUIREMENT OF WATER; AUTHORITYWISE AND PLANNING ZONEWISE.
5. MODELS OF PRIVATE SECTOR / JOINT VENTURE.
6. PROPER SYSTEM OF PHYSICAL & FINANCIAL PLANNING WITH COORDINATION, INTEGRATION, EVALUATION & MONITORING.
7. CREATION OF LAKES
8. USE OF OLD PONDS.
9. RECHARGING TECHNIQUES.
10. WORLD BANK SCHEME IF ANY.
11. GROUND WATER, EXPLORATIONS AND USE.
12. CONSERVATION OF WATER.
13. PREVENTION OF MISUSE, LEAKAGES & THEFT.

MASTER PLAN FOR DELHI - 2021



Source - Master Plan for Delhi - 2021 AD

- RIVERS IN INDIA HAVE BECOME HIGHLY POLLUTED. THE FRENZIED RELIGIOUS FERVOR THAT ACCOMPANIES EVENTS LIKE THE MAHA KUMBH, CHHAT ETC. THESE SPARE VERY LITTLE THOUGHT FOR WHAT HAPPENS TO THE RIVERS WHICH HOST THEM.
- HOW SHOULD INDIA MANAGE ITS WATER? THE DROUGHT THAT SCALDED MAHARASHTRA IN 2013 TELLS US THAT OUR WATER MANAGEMENT STRATEGIES ARE SKEWED.
- WATER MUST BE MANAGED IN A WAY TO ENABLE ITS EQUITABLE AND DISTRIBUTED ACCESS. RAIN WATER HAS TO BE HARVESTED.
- IN THE HIMALAYA, HYDROPOWER IS RE-ENGINEERING OUR RIVERS: 70 PROJECTS ARE BEING PLANNED ON THE GANGA AND ITS TRIBUTARIES, WHICH MAY AFFECT 80 PER CENT OF SOME OF THE RIVERS. SHOULD WE ALLOW THIS?
- RIVERS MUST HAVE WATER TO DILUTE THE WASTE IN THEM. FOR EXAMPLE, DELHI MEETS ALMOST ALL ITS REQUIREMENTS OF WATER FROM THE YAMUNA, BUT RETURNS ONLY SEWAGE TO IT. CAN'T WE THINK OF PROPER USE OF WATER AND CONVERT THE BASE WATER IN USEFUL WATER.

Sources : State of India's environment — 2014 (A Down to Earth Annual)

1 1ST MASTER PLAN PRIOR TO DELHI DEVELOPMENT ACT

INTRODUCTION

Adequate water and power, drainage and sewerage facilities are the basic needs of urban life. Their standards, of course, vary according to climatic, economic and other conditions. But in India, of the towns having a population of one lakh and above, only about 50% have a fully protected water supply. Most of them lack integrated sewerage facilities and where any sewerage system exists, the disposal is not always up to the highest standards. With rapid urban growth, additional problems of waste disposal are created. The demand for power will also continue to rise with increased industrialization.

EXISTING SOURCE AND DISTRIBUTION

Filtered water supply for Delhi was first started in 1890 with its source from the infiltration galleries, laid on the bed of river Yamuna behind the old

secretariat. Then the total supply was only 1.73 million gallons per day. In 1912 the Government of India wanted to set up its new capital in New Delhi and an increase in water supply became essential. Later in 1925, a new water works was installed near Wazirabad village and the intake works were shifted from near the old Secretariat. To meet the growing demands, an additional intake was provided during the war years and the capacity was increased to 28 million gallons per day. The augmentation of the source has since been taken up and the total water output now is about 90 MGD. Due to post independence housing development in south Delhi, another intake was installed near Okhla of three million gallons per day capacity. As it is situated on the downstream side of the city, this source undergoes pollution threatening public health.

Source - Master Plan for Delhi - 1957

DISTRIBUTION OF WATER

Zone No.	Population in millinos	Quantity of water required in MGD (at 45 gallons per capital)	Remarks
1 (Old & New Delhi)	1.5	67.5 From Wazirabad Sources.	Water supply exists but inadequately in Old Delhi & New Delhi extensions.
2 (West Delhi)	0.1	4.5 From Okhla Sources.	(Only about 0.75 lakh get intermittent supply - rest nil).
3 (South Delhi)	0.1	4.5 From Okhla Sources.	(Only about 0.75 lakh get from Okhla water polluted.
4 (North West Delhi)	Nil		No protected water supply exists.
5 (Shahdara)	0.1	4.5	-do-
	2.0	90.0	

No.	Population in millinos	Qty. of water required in MGD (at 45 gallons per capital).	Sources and Total Capacity
1	1.60	72.00	To be met from Wazirabad First stage augmentation
2	0.45	20.25	-do-
3	0.18	8.1	0.6 MGD from Wazirabad, 7.5 MGD from tube wells in South Delhi
4	0.05	2.25	to be met from Wazirabad.
5	0.22	9.9	To be met from U.P. Tube well sources first instalment capacity of 10 MGD.
Total	2.50	112.50	Total of all source (112.5 MGD)

No.	Population in millinos	Qty. of water required in MGD (at 45 gallons per capital).	Sources
1	1.70	85.00	72 MGD from Wazirabad source; the rest 13 MGD from Bhakhra Source
2	1.45	72.50	Wazirabad source 20.25 MGD; rest 52.25 MGD from Bhakhra source.
3	0.65	32.50	7.5 MGD from South Delhi Tube Wells; 0.6 MGD from Bhakhra source
4	0.40	20.00	2.25 MGD from Wazirabad and the rest 17.75 MGD from Bhakhra source
5	0.80	40.00	20 MGD from U.P. tube wells and the rest from Ram Ganga Source
Total	5.00	250.00	Total of all sources — 250 MGD

Source - Master Plan for Delhi - 1957

2ND MASTER PLAN FOR DELHI — 1962

Public Utilities and Services (Extract taken from page 36 of MPD-1962)

Water: Additional land to the extent of about 20 acres has been earmarked for the expansion of the Chandrawal Purification Plant. Also, 40 acres of additional land has been reserved for the Wazirabad Headworks. The other waterworks is in Okhla which has sufficient land. Water supply to Shahdara will be from tube-wells and only a pumping station will be required. Additional land for pumping stations and reservoirs may be met from residential acres and the extensive park areas of the ridge.

Staging of Development of Delhi Master Plan (Extract taken from page 43)

SL.No.	Description	stage	stage	Total
(a)	Water Supply			
	Bulk supply and distribution	100 M.G.D.	60 M.G.D.	160 M.G.D.

Source - Master Plan for Delhi - 1962

3ND MASTER PLAN FOR DELHI-1990 (EXTRACT TAKEN FROM PAGE 183)

Water Supply : Delhi would need additional water supply to the extent of 671 million gallons per day (MGD) by the year 2001. This is expected from Tehri Dam in U.P., Kishau and Lakhwar and Giri Dams in Himachal Pradesh and through exchange of water with Haryana. The supply system would require enhancement of the existing four water treatment plants and construction of a new treatment plant.



Source - Master Plan for Delhi - 1990

4ND MASTER PLAN FOR DELHI-2021 (EXTRACT TAKEN FROM PAGE 258 TO 273)

DELHI JAL BOARD
GOVT. OF NCT OF DELHI

Sub:- MPD 2021 - Perspective Plan for Infrastructure Services - Water Supply.

PERSPECTIVE PERSPECTIVE PLAN FOR INFRASTRUCTURAL SERVICES FOR DELHI - 2021 WATER SUPPLY WATER SUPPLY

The total area of the National Capital Territory of Delhi (N.C.T.D) is 1,48,639 Ha. As per 2001 census, the population of Delhi is 137.8 lacs. Taking into account, the past trends, the population of Delhi is estimated to be around 190 lacs by 2011 & 230 lacs by 2021.

PRESENT WATER AVAILABILITY

The Delhi Jal Board has an installed capacity of 805 MGD against which on an average 800 to 820 MGD potable water is expected to be produced by optimization of Water Treatment Plants.

PRESENT WATER DEMAND

The present waer demand for potable water in Delhi has been assessed as 990 MGD@60 gpcd for all uses. No allowance is made for use of potable water for parks & lawns/horticulture/agriculture purposes due to water shortage.

BASIS FOR ADOPTING PER CAPITA WATER REQUIREMENT

(a) Delhi Jal Board

The Delhi Jal Board is adopting the domestic consumption as per C.P.H.E.E.O. Manual 1999 on water supply which provides for domestic consumption in Metropolitan & mega cities as 150 LPCD plus 15% losses. As per the Manual, the water requirement for other uses is to be assessed separately. To assess the water demand for other uses, the Delhi Jal Board has

Source - Master Plan for Delhi - 2021

At present raw water from the Wazirabad intake is treated at the filtration plants located near Chandrawal. The head works at Wazirabad suffer from two major setbacks (a) reduction of flow in the river during the three summer months (b) change in the direction of the river course during floods from the right to the left bank. However, the change in direction of the river course has been rectified by the construction of a barrage on the downstream of the Wazirabad intakes. But the problem of reduction in flow of water during summer will still remain and the Punjab Government have been obliging the Delhi Municipal Corporation by releasing about 130 cusecs of water from their irrigational net work, as the average summer flow in the river is only 50 cusecs. Water for irrigation to Punjab & U.P. is diverted from the Tajewala Dam to the Eastern and western Yamuna canals and no surplus water is released into the river Yamuna for Delhi's water supply. As such the water that is available near Wazirabad is due to regeneration between Tajewala and Wazirabad.

The water after treatment is distributed to various parts of the city through storage reservoirs, all located on the ridge. The presence of the ridge gives the necessary hydrostatic pressure without any need for elevated reservoirs. Today the total storage is about 25 million gallons which is about a third of the total daily supply. The total water supply is inadequate for the present population. The average per capita supply in the areas served is only 40 gallons per day which, of course, conceals great differentials in the levels of supply in various localities. Out of the present population, only about 15 lakhs of people get continuous water supply. Four lakhs of people living in new colonies such as Rajendra Nagar, Patel Nagar, Lajpat Nagar and Defence Colony etc. have only intermittent water supply. At the same time, with the housing construction activity in South and West Delhi, new colonies are being added to the city, adding to the current deficit of protected water. Besides, there are many slums in the city where scarcity of water has become an old cry. It is, thus, clear that unless urgent steps are taken to augment the source and distribution of water supply many more areas will fall inside the net of sub-standard development.

The Delhi Metropolitan area comprises the Delhi urban area and the ring towns. Ring towns as compared to the central city are smaller in size and designed for a population varying from 25,000 to 5 lakhs. These ring towns will have different levels of services according to their size and economic potential. While the standard of water supply in the central city may be called "Class 'A'", the ring towns will have "Class 'B'" and "Class 'C'" standards.

SUGGESTED SOURCES FOR AUGMENTATION OF URBAN WATER SUPPLY :

(a) The Bhakhra Reservoir (b) The Ramganga Reservoir (c) Ground Water from Punjab (d) Ground Water from U.P. (e) Ground Water from Delhi (f) Ground Water from South Delhi:

The geological survey of India has reported that about 25 square miles of area in South Delhi consisting of about 13 villages bear potable ground water, suitable for drinking purposes. It has been estimated that on a minimum about 15 cusecs of water could be tapped from this area. With this source it would be possible to replace the Okhla source which undergoes considerable pollution. With the above source, in addition to the areas currently served by the Okhla plant, an additional population of about 75,000 could be served in South Delhi. Possibly, the colonies which are fast developing in South Delhi could be provided with piped water supply.

PROGRAMME OF AUGMENTATION

The possible sources that could be augmented in future have been indicated about but the periods in which they could be tapped will vary. Hence the phasing of the augmentation programme should be such that it fulfills the city demands adequately from time to time. While the requirements of water for later years can be met from bulk sources which will mature only after some years, Delhi, in the meantime, continues to be confronted with water scarcity even for the present population. This situation has to be overcome. So the total programme has been divided into two stages; the first stage will consist of providing water supply to the population till 1966, the end of the Third Five Year Plan and the 2nd stage consisting of a comprehensive programme for augmentation of the sources for the requirements till 1981.

Source - Master Plan for Delhi - 1957

followed the Master Plan Document – 2001. Consequently, the per capita water requirement works out as follows:

I	Domestic (150 + 22)	172 LPCD
II	Industrial, Commercial and Community requirement at 45,000 Lts. Per Ha. Per Day	47 LPCD
III	Special uses, embassies, floating population, hotels, airports and railway stations etc.	52 LPCD
IV	Fire Protection @ 1% of total demand	3 LPCD
V	Total	274 LPCD

(Say 60 gallons per Capita per day (GPCD)).

(b) Delhi Development Authority

The total city requirement is considered as 80 gpcd out of which 50 gpcd is for domestic requirement and 30 gpcd for non-domestic purposes. This domestic water requirement of 50 gpcd comprises of 30 gpcd for potable needs and 20 gpcd for non-potable water. The requirement of potable water out of total requirement of 80 gpcd has been assessed as 35 gpcd (30 gpcd for domestic and 5 gpcd for non-domestic demand) while the demand for non-potable water has been assessed as 45 gpcd i.e. 20 gpcd for domestic and 25 gpcd for non-domestic purposes.

However, the stand of DJB is that it is more realistic to calculate demand projection @ 60 gpcd., as 80 gpcd unrealistic to achieve.

PRESENT SOURCES OF RAW WATER

The present sources of raw water available to Delhi are as under:-

Yamuna water – 750 cusec (includes 130 cusec transit losses from tajewala to Haidepr)

Ganga – 470 cusec at Bhagirathi and Sonia Vihar Water Works.

BBMB Water – 225 cusec (Ex. Nagal 371 cusec)

Ground – 40 cusec (Ex. Nanagla 60 cusec)

Ground Water – 185 cusec.

Based on the availability of above raw water, following water treatment plants are functioning :-

S.No.	Source of Raw Water	Name of the Plant	Installed
1.	Domestic (150 + 22)	Chandrawal I & II	90 MGD
2.	River Yamuna	Wazirabad I & II & III	120 MGD
3.	Bhakra Storage	Haiderpur I	100 MGD
4.	Yamuna	Nangloi	40 MGD
5.	Bhakra Storage	Nangloi	40 MGD
6.	Upper Ganga Canal	Bhagirathi	100 MGD
7.	Upper Ganga Canal	Sonia Vihar	140 MGD
8.	Sub-Surface Water	Ranney Wells/Tube wells	115 MGD
		Total	805 MGD

Although, installed capacity of Nangloi Water Treatment Plant is 40 MGD, but presently it is treating only 20 MGD, due to raw water constraints. Balance 20 MGD water is likely to be available for this plant after the commissioning of Parallel lined channel by Haryana Government.

SHARE IN YAMUNA WATER

A MoU for sharing of Yamuna water between five riparian states, Haryana, U.P., Himachal Pradesh, Rajasthan & N.C.T. of Delhi has been signed on 12.05.1994 and Delhi share in Yamuna water has been fixed as 0.724 BCM (consumptive). The above allocation is subject to construction of Renuka Dam, Kishau Dam, Lakhwar Vyasi Project. Pending construction of these dams, following seasonal allocations have been made:-

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Source - Master Plan for Delhi - 2021

S.No.	States	July to Oct.	Nov. to Feb.	Mar. to June	Total
1.	Haryana	4.107	0.686	0.937	5.730
2.	Uttar Pradesh	3.216	0.343	0.473	4.032
3.	Rajasthan	0.963	0.070	0.086	1.119
4.	Himachal	0.190	0.108	0.080	0.378
		0.578	0.068	0.76	0.724
5.	Delhi	(1926	(231	(255	(808
		Cusec)	Cusec)	Cusec)	Cusec)

Presently, Delhi is getting about 750 cusecs of raw water during the lean season against a consumptive allocation of 255 cusecs. After fulfilling the consumptive need, 495 cusecs flows back in the river as return flow.

With the construction for the dams in the upper reaches of river Yamuna, Delhi's consumptive allocation will be 808 cusecs and total allocation will be 2400 cusecs.

It is recommended that D.D.A may explore possibility of dual pipe system in limited way for flushing purpose only, in all group housing societies and new colonies. The idea is to collect the waste water from bathrooms in a storage tank and pump it to separate overhead storage tank for this purpose at roof-top and then connect the same with cisterns in the toilets for flushing purpose only.

The present population of Delhi is 165 lacs and it is projected to be 190 lacs by 2011 which means the population will increase by 25 lacs. Now, assuming that 60% of this population will come up in new planned colonies the population works out to be about 15 lacs. As per D.D.A., the domestic non-potable consumption is 20 gpcd. Out of this 20 gpcd for toilet and flushing purposes. This means that saving on water by application of partial dual piping system will be 15 MGD.

Water reclamation

The D.J.B. shall also explore the possibility of reclamation of sewage water on the lines of NE Water of Singapore using ultra-filtration, reverse osmosis

and UV treatment processes by going through a pilot project of 6 MGD at Okhla S.T.P. If, it is found technologically feasible, then large scale reclamation of weage waer at Treatment Plants can be taken up in phases. The first plant for such large scale tertiary treatment of water will be at Rithala swewage treatment plant, which can add upto 40 MGD of treated water. This can be further taken to Hyderpur WTP for distribution.

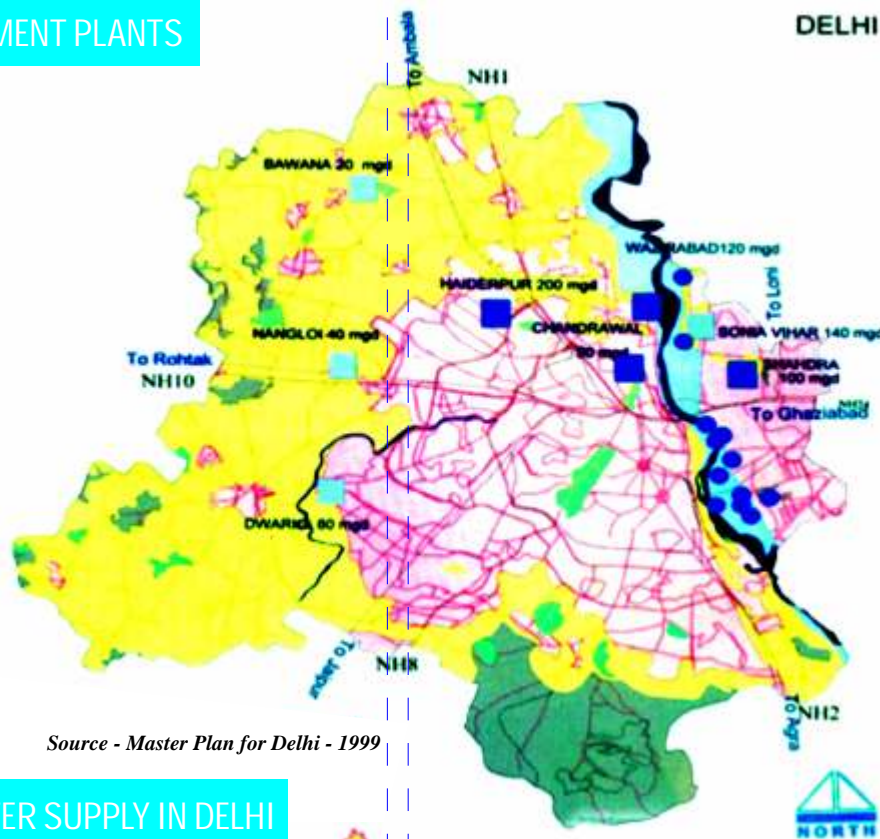
In view of above, it is obvious that the shortfall of 200 MGD by 2011 can only be met either by increased allocation of Delhi during lean period or by developing a system of tube wells in the NCR or by combination of two as an interim measure till the dams in Upper reaches in Yamuna are completed. The intervention of Ministry of Water Resources is needed for both cases. The existing corridor for raw water transportation after the lining of Western Yamuna canal and completion of parallel lined channel will be more or less sufficient to carry the additional requirement of 2011. The D.D.A. will have to allocate the land measuring about 300 acres @ 1.5 acres/mgd (That is 1.5 Acres for every additional population of 15000 persons) also the equal amount of land may also be kept reserved for construction of UGR's and Pumping station at strategic locations for the construction of additional 200 mgd treatment plants and its allied works. While allocating the land for additional treatment capacity, location of new developing colonies and sources of raw water shall have to be kept in view.

WATER SUPPLY SCENARIO IN 2021

S.No.	Source of raw Water	Name of the Plant	Installed Capacity in 2021
1.	River Yamuna	Chandrawal I & II	90 MGD
2.	River Yamuna	Wazirabad I, II & III	120 MGD
3.	Bhakra Storage	Haiderpur I	100 MGD
4.	Yamuna	Haiderpur II	100 MGD
5.	Bhakra Storage	Nangloi	40 MGD
6.	Upper Ganga Canal	Bhagirathi	100 MGD
7.	Sub-Surface Water	Ranney Wells / Tubewells	125 MGD
8.	Upper Ganga Canal	Sonia Vihar	140 MGD
9.	Saving from seepage losses with the construction of new parallel lined channel	Dwarks	40 MGD
10.	-do-	Bawana	20 MGD
11.	-do-	Okhla	20 MGD
12.	-	Recycling of waste water	45 MGD
		Total	940 MGD

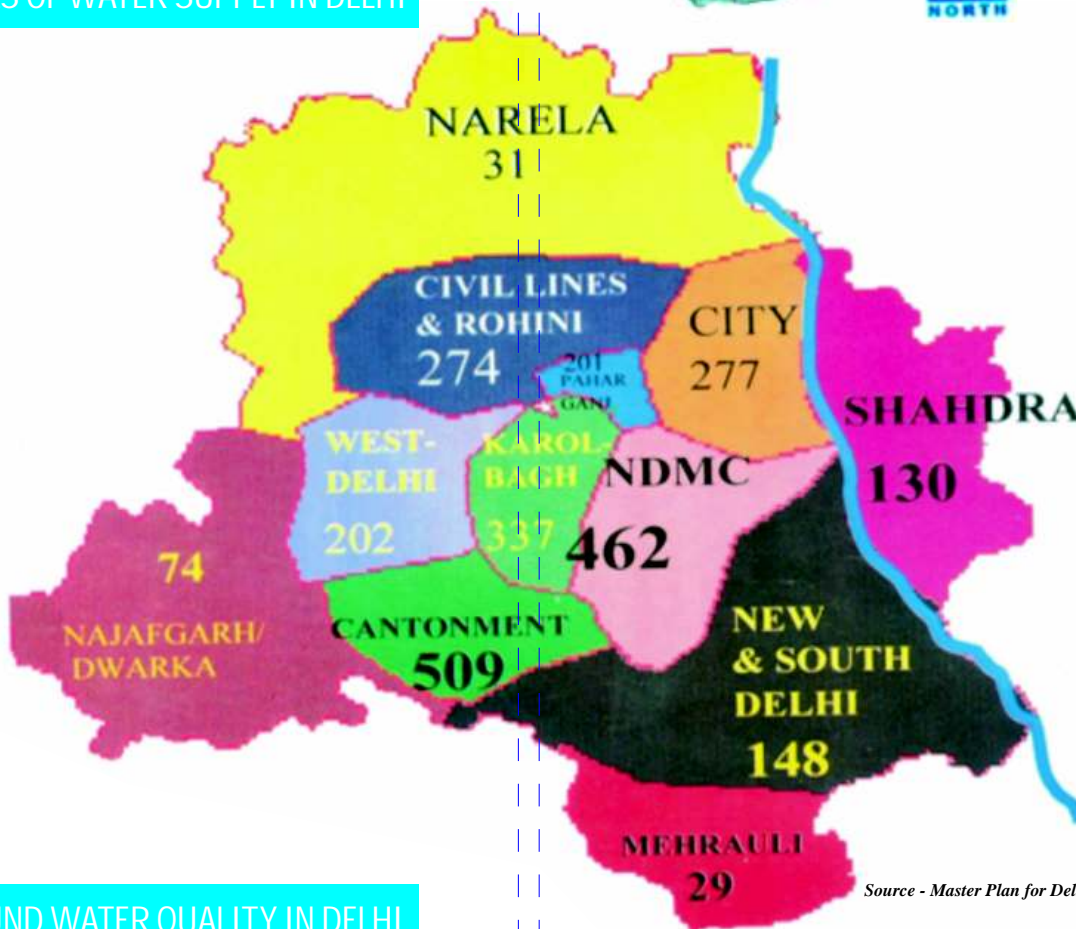
Source - Master Plan for Delhi - 2021

WATER TREATMENT PLANTS



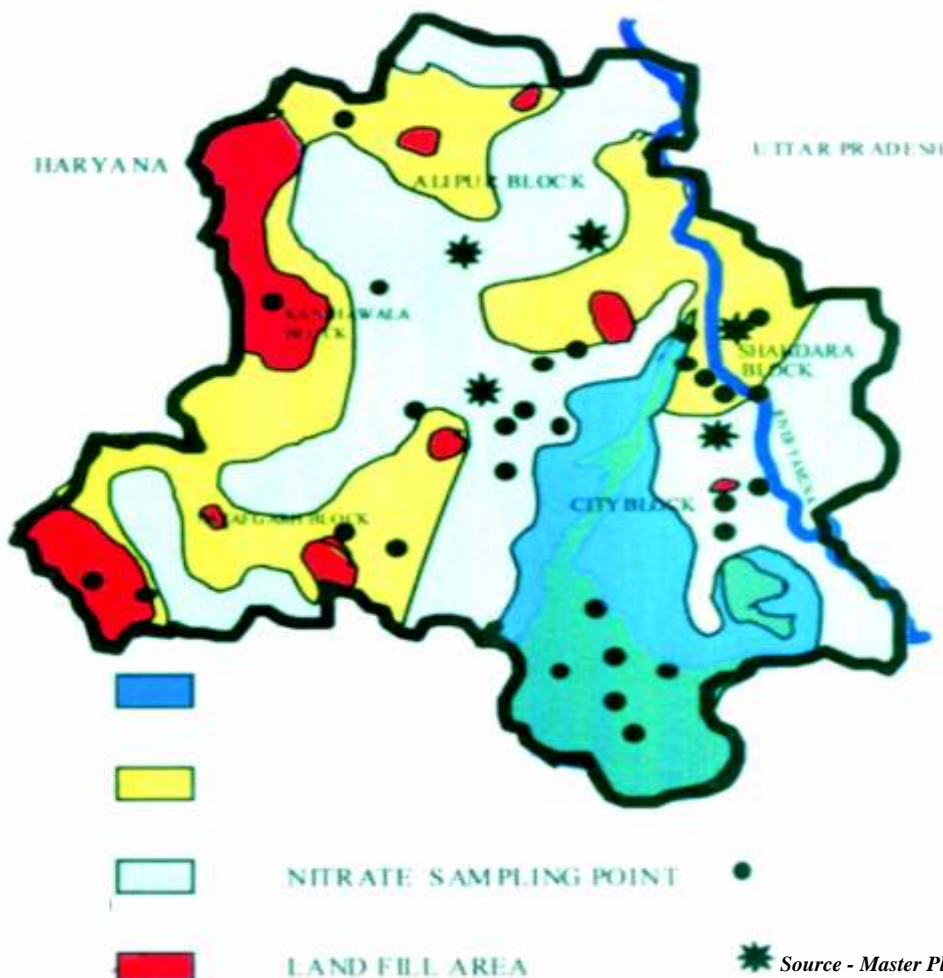
Source - Master Plan for Delhi - 1999

LEVELS OF WATER SUPPLY IN DELHI



Source - Master Plan for Delhi - 1999

GROUND WATER QUALITY IN DELHI



Source - Master Plan for Delhi - 1999

PROPOSED STEPS TO BE TAKEN TO MEET THE SHORTFALL UPTO 2021

As seen from the above table, Delhi Jal Board will not be in a position to increase its treatment capacity of 941 MGD by the year 2011 from the existing resources and raw water sources. The projected demand in 2021 will be of 1380 MGD @ 60 gpcd for 230 lacs population, thus, there will be a shortfall of about 440 MGD. To meet this shortfall, the work on following dams has to be expedited. There seems to be no other alternative.

On completion of above projects, Delhi will receive its full share of 0.724 BCM (808 Cusecs Consumptive). The total allocation works out to 2400 cusecs that means an additional 1600 cusecs (865 MGD) will be available to Delhi which is more than enough to meet the projected shortfall of 440 MGD by 2021.

(A) Renuka Dam

Renuka Dam is contemplated as a 148 meter high rock filled dam on River Giri, a tributary of Yamuna, in Sirmour district of Himanchal Pradesh, mainly to augment water supply to Delhi, Estimated cost is 1225 crores at May 1997 price level. The project has been cleared by CEC and approval of MOE&F is likely to be obtained shortly.

(B) Kishau Dam

This dam is to be constructed on the River Tons in Uttaranchal. Kishau Dam project has been examined in C.W.C. for broad technical and economic aspects and was found technically and economically feasible. It was recommended for consideration by the Advisory Committee at an estimated cost of rs. 35,662, million (December 1998 price level). The Kishau Dam project was taken up in the 72nd meeting of the advisory Committee on Irrigation, Flood Control and Multipurpose Projects, on 18 January 2000. After discussion, it was decided that consideration of the project be deferred until a further elaboration of the economic viability has been prepared, including apportioning project costs among the irrigation, power and water supply components. As per latest information from Uttaranchal govt, a MOU has been signed with the Tehri Hydro Development Corporation (THDC) for construction of the dam.

(C) Lakhwar Vyasi Dam

This project envisages construction of 204 m high concrete dam on river Yamuna near Lakhwar Village in Dehradun district of Uttaranchal, and another dam down stream at Vyasi, for providing drinking water, irrigation and power generation. This project was approved by the planning commission way back in 1976. However, the State Government submitted revised estimate in 1979, 1994 and 1998. Uttaranchal government has entrusted the construction of the project and preparation of its revised DPR to NHPC.

The preparation of DPR by NHPC is in advanced stage but the sharing of cost of project for Irrigation and drinking water is yet to be accepted by the beneficiary states. Thereafter, NHPC has to sign MOU with other basin states on cost sharing of Irrigation and Drinking water components.

The D.D.A. may reserve the land measuring 600 acres by 2011 and additional 1320 acres by 2021 to construct the additional water treatment plants and its allied works. While allocating the land for additional treatment capacity, location of new developing colonies and sources of raw water shall have to be kept in view.

ANNEXURE-'B'

WATER MANAGEMENT FROM THE USE OF RECYCLED WASTE WATER

Concept of water management includes water conservation, water harvesting and water recycling for sustainable water management. In India traditional water conservation and water harvesting have been in proactive and many cities have modified their byelaws to encourage water harvesting in residential buildings of new development. But little has been done in water reuse

and recycling within the building as a strategy to reduce the water demand.

Delhi, the capital of India, is experiencing a rapid population increase from 0.4 million in 1911 to 13.8 million in 2001. The Delhi Development authority is projecting a population of 23 million in 2021 and water requirement of 1150 million gallon per day (MGD). On the other hand Delhi Jal Board's (DJB) capacity augmentation plan 2021 says the capacity can be increased to a maximum of 919MGD by all possible sources (Table 1). Inadequate and intermittent supply of piped water has led to unchecked exploitation of ground water resources in different parts of the city.

TABLE 1: WATER AUGMENTATION PLAN OF DELHI JAL BOARD

S.No.	Water Treatment Plans	Capacity 2001 in MGD	Capacity *2021 in MGD
1.	Chandrawal I & II	90	100
2.	Wazirabad	120	130
3.	Haidepur I & II	200	216
4.	Bhagirathi	100	110
5.	Dwarka	-	40
6.	Sonia Vihar	-	140
7.	Nangloi	40	40
8.	Bawana	-	20
9.	Okhla	-	20
10.	Ranney wells at Okhla	100	12
11.	Palla and other ground water sources		91
	Total	650	919

About 40 percent of the treated water supplied by the DJB daily is never used for drinking. Instead it is used for domestic chores, including flushing of toilets. The avoidable wastage has continued for years even as the city's demand for drinking water is rising by 20MGD per year. From the breakup of use of water required for different activities in our day-to-day life viz for drinking and cooking, for washing, for toilet flushing, for industries, for recreation, for maintaining garden and urban green, it can be seen that 90 lpcd is absolutely waste which is about 40% of the total demand.

TABLE 2: BREAKUP OF WATER USAGE FOR 50 GPCD IS AS UNDER :

Purpose	Potable @ 30 gpcd (135 lpcd)	Non-potable @ gpcd (90 lpcd)
1. Drinking	05	
2. Cooking	10	
3. Washing clothes	30	
4. Washing Utensil	20	
5. Washing hand and faces	10	
6. Bathing	60	
7. Floor washing		30
8. Flushing of toilets		60
Total @ 225 lpcd		90 lpcd

As per the new buildings byelaws in Delhi, all the buildings having a minimum discharge of 10,000 litres or above per day shall incorporate wastewater recycling system. The recycled water would be used for horticulture purpose (GOI notification, 28th July 2001). Although the agencies are taking care while sanctioning the plans, but enforcement of the provision are to be strengthened at ground. The figure of 10,000 liters discharge generated from a plot would mean it should have at least 32 dwelling units with a total population of 144 persons. The group housing societies, shopping malls, institutions hotels etc are suitable to implement the provisions.

Group Housing Societies and other institutions mentioned above have bore wells of their own, which rather made their supply 24 hours in spite of the intermittent supply by Delhi Jal Board. In these societies/institutions the Jal Board water is collected in the underground reservoir (Wherever possible) from where the water is pumped to the overhead tanks are also filled with ground water whenever required and thus water is made available round the clock. Due to the absence of adequate water supply there is over exploitation of ground water. The level of

ground water is decreasing at a rate of 0.5 m per annum. Therefore immediate measure should be taken to discourage the residents to extract ground water for residential use. Thus, there is a need for alternative methods to reduce the residential water demand in such institutions viz-a-viz abstraction of ground water.

WATER MANAGEMENT IN INSTITUTION & GROUP HOUSING SOCIETIES

It is found from a primary survey conducted (in 2005) by a group of planning students from School of Planning and Architecture, New Delhi (sample from group housing apartments) that most of these group-societies are spending on an average Rs. 20,000/- per month to collect water (an average of @ Rs. 600/- per dwelling unit per month) from the sources other than the supply from Delhi Jal Board. The 27 percent reduction in domestic demand will lead to a saving of Rs. 5400/- per month and Rs. 64,800/- Factor 27% has been assumed on the basis that 80% of 90 lpcd shall be converted into sewage and out of remaining another 5% has been discounted for other losses.

Requirement of Space

The major component of such recycle system is septic tank, dis-infections chamber, simple sand filters (at least two, one for sand by) and pump sets

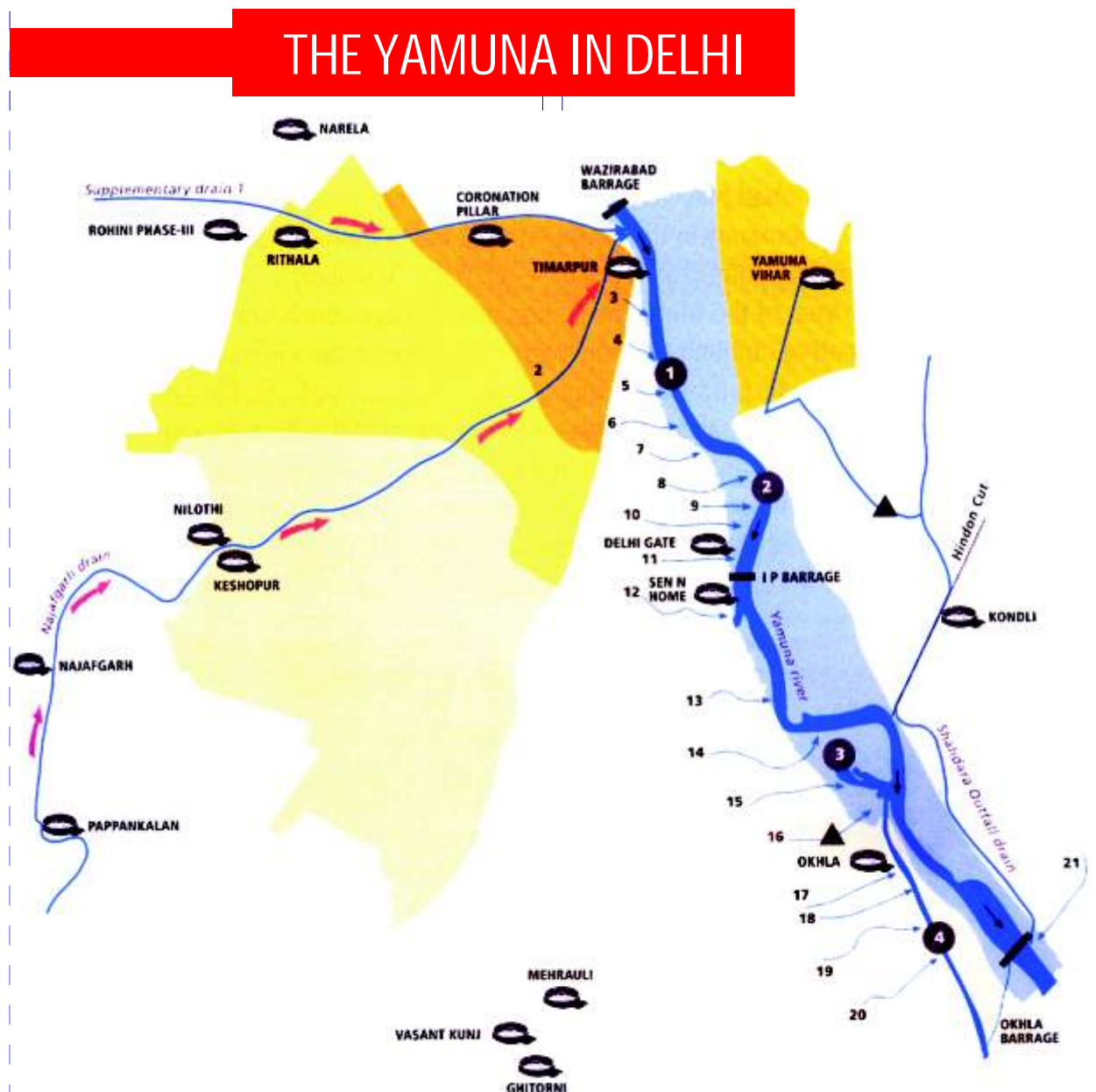
and pipe systems. The septic tank should be able to retain 11,450 liters for two days. The capacity required for the same should be around 24 kiloliters and size = 3x4.5x2 m3 will be sufficient. The total area required for all other components can be located within the plot.

The recycled water can be pumped to the tank over the apartment blocks and connected to the toilet/flush with totally separate plumbing system.

The construction of the undergrounds septic tank of capacity of 27 kilolitres (@2/- per	Rs. 54,000/-
Construction of Sand filter two in number	Rs. 40,000/-
Cost of pump + additional plumbing etc.	Rs. 26,000/-
The total capital cost of the system	Rs. 1,20,000/-

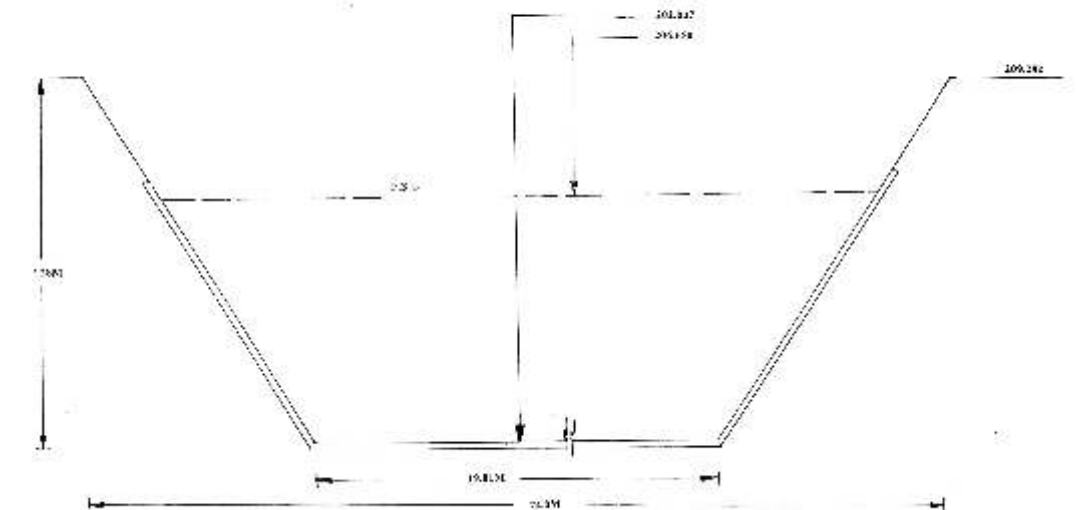
After discounting the saving of Rs. 64,800/- per year from the procurement of additional water, the total capital cost will be recovered within two year.

Source - Master Plan for Delhi - 2021



Sources : State of India's environment — 2014 (A Down to Earth Annual)

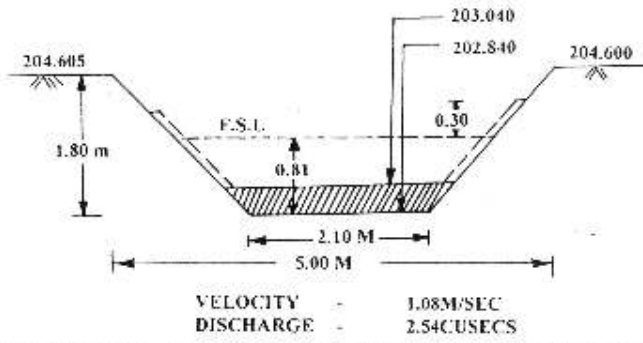
NAJAFGARH DRAIN



Source - Report of River Yamuna Prepared by R.G. Gupta (Ex. A. Comm. Planning, DDA)

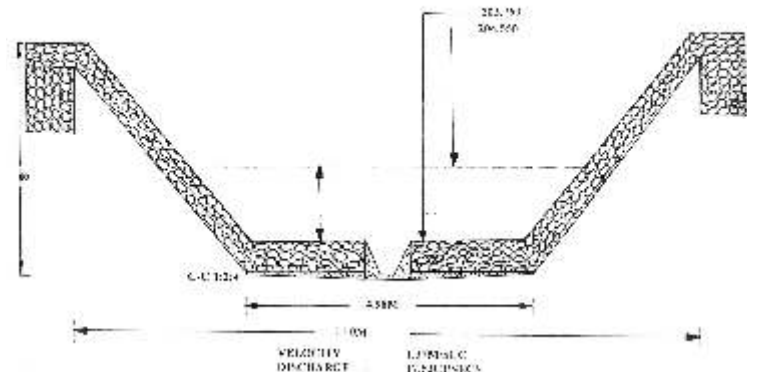
VELOCITY — 2.62M/SEC
DISCHARGE — 294.54 CUSECS

VIJAY GHAT DRAIN



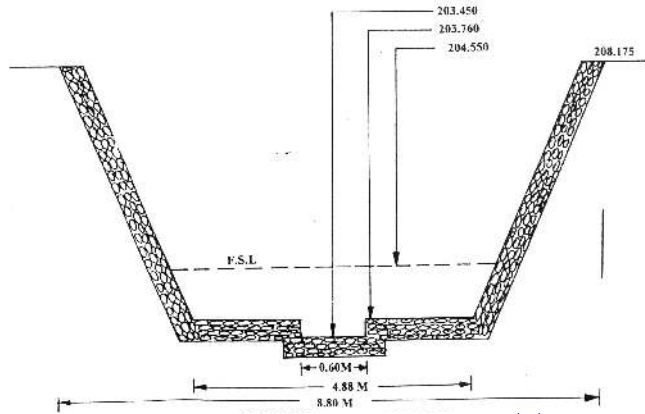
SECTION AT OUT FALL INTO RIVER YAMUNA THROUGH REGULATOR

DELHI GATE DRAIN



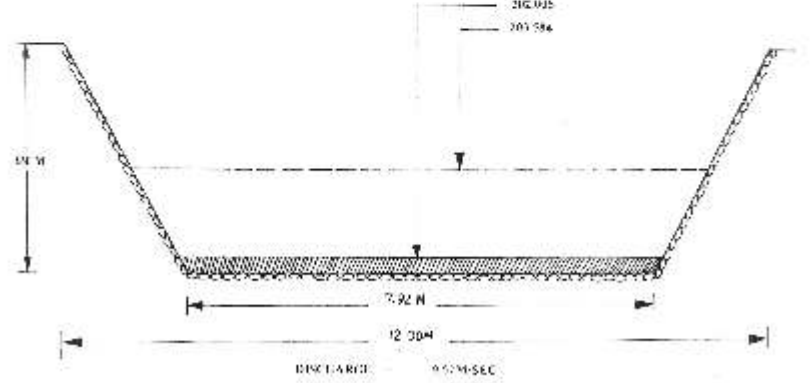
X SECTION FROM REGULATOR FALL INTO RIVER YAMUNA

CIVIL MILITARY DRAIN



VELOCITY - 0.894 M/SEC

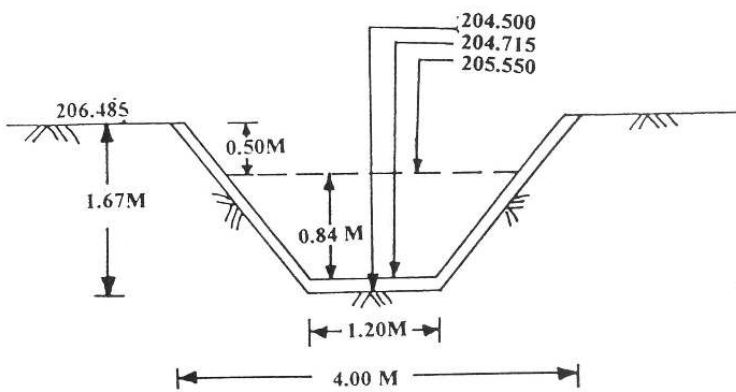
DRAIN NO 14



X SECTION AT OUTFALL INTO RIVER YAMUNA

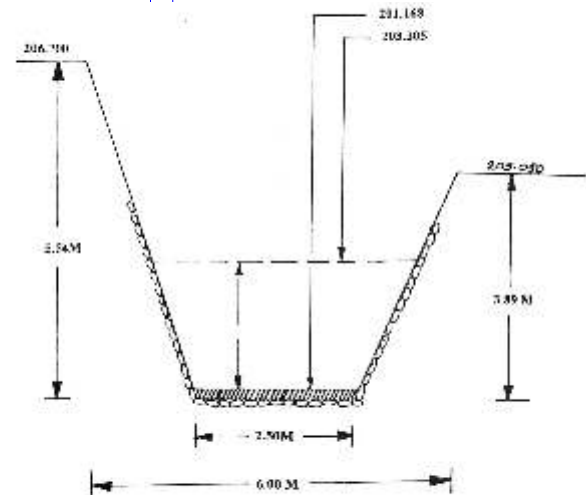
MAP NO. 6.9

RED FORT DRAIN



OUT FALL INTO CIVIL MILITARY DRAIN AT 204.715 BED LEVEL

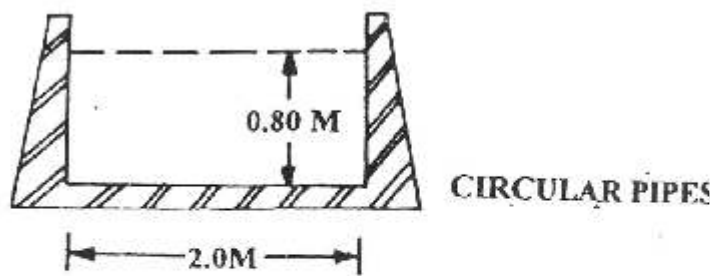
DRAIN NO2 & 12



X SECTION AT OUTFALL INTO RIVER YAMUNA THROUGH REGULATOR NEW OKHLA BARRAGE

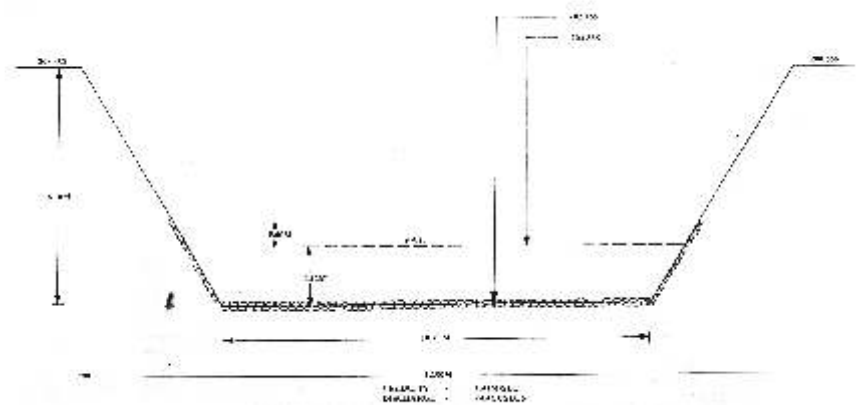
VELOCITY - 0.82M/SEC
DISCHARGE - 7.86CUSECS

TONGA STAND DRAIN



VELOCITY - 1.98M

SEN NURSING HOME DRAIN



X SECTION AT OUTFALL INTO RIVER YAMUNA THROUGH REGULATOR