**MASTER PLAN**

**FOR**

**DRAINAGE OF STORM WATER DRAINAGE OF THE NAJAFGARH BASIN**

**IN**

**UNION TERRITORY OF DELHI**

****

**MASTER PLAN ORGANISATION**

**FLOOD CONTROL WING**

**DELHI ADMINISTRATION**

**1976**

**MASTER PLAN FOR NAJAFGARH BASIN (Rural Part)**

**I N D E X**

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**MASTER PLAN OF NAJAFGARH BASIS.**

**1:1 TOPOGRAPHY & LAND USE.**

 The Najafgarh basin covers the South-Western Part of the Union Territory of Delhi, in addition a large tract in the Haryana State. As this basin covers a very large part of Delhi, it has been divided into several sub-basins for the convenience of description of its problems and their solution. The part of the basin falling in the Najafgarh Block is described below.

This sub-basin is bounded by Kanjhawala Basin on its North-Eastern side and MCD, DDA and Cantonment area on its Eastern side. Mehrauli Block is also bordering the sub-basin in the South-Eastern Corner. The general feature plan and contour plan of the Sub-basin is enclosed at Appendix I &II. Najafgarh road and the Gurgaon Bahadurgarh Road area the two main Road running through this basin from East to West and From North to South sides respectively. The main Delhi Gurgaon High way also passes through this Basin for a short distance on the Eastern side and the meter gauge railway line going towards Gurgaon runs almost parallel to the N. Highway.

The area of the sub-basin is approximately 332 Sq.km. It is generally sloping towards the so and is being drained by the Najafgarh drain starting From the Jheel in the South-West corner of the before its outfall into the Yamuna. The whole area is rural, excepting a very small portion of about 2.00 sq.miles on the South-East side. Two irrigation minors coming from Haryana, irrigate parts of the block. This block has got a number of storm water drains which have been described in detail in the chapter on existing drainage system and its remodeling.

Topographically, Najafgarh block is a flat Area with no ridges. However, the rocky ridge starting near the Wazirabad Barrage and running in Southerly direction joining the hilly areas to the north-east of Gurgaon district drain some areas into this block. These comprise of the Cantonment area, Mehrauli block and Part of the Haryana State. The lie of the country on the North West side of the ridge is also towards the valley formed by the Najafgarh Jheel and hence a considerable area from Haryana & Kanjhawala basin is also draining into the Najafgarh sub-basin from the North West & North directions. The basin contains Approximately 76 villages with a population of about 1.30 Lacs. The drainage zone of the sub-basin as explained above is very extensive and consists of Najafgarh block, part of Urban areas of Cantonment Board, part of Mehrauli & Kanjhawala Block & and adjacent areas of Haryana. A plan showing the present population in the villages as per 1971 census and the projected population in 1981, 1991 & 2001 is enclosed as Appendix-III.

 Najafgarh basin has a natural depression called the Najafgarh Jheel of about 10 Sq.km. area, to the South of the Basin having an independent catchment of 219 sq. miles. It receives the spill from U.T. of Delhi, as well as from Haryana & Rajasthan Territories. The Jheel used to be earlier submerged. Under water throughout the year and evaporation and percolation were the only means for its disposal, until the construction of the Najafgarh Drain in the 19th century. In 1958, an unprecedent rain occurred in the catchment which inundated an area of about 1440 acres in Delhi side. The level of the Jheel reached R.L. 692.40 (GTS). In 1964, a much heavier flood, more than that of 1958 had occurred. The Najafgarh Jheel submerged an around of 60,000 acres both in Delhi & Haryana and the maximum recorded level at Chhawla bridge was 695.60. A committee set up under Shri Moti Ram, Consultant, Ministry of Irrigation and Power carried out studied to estimate the escaping capacity necessary to ensure that, with the intensity of rainfall that occurred the year 1964, the level of the Najafgarh Jheel do not rise above R.L. 692.0 at any time and it is brought down to 686.0 by the end of October and to even lower levels later. The discharging capacity required for this purpose worked out at Kakrola as 4500 cusecs at F.S.L. 690.0. Accordingly a new regulator was constructed in 1965 at Kakrola with sill level at R.L. 681.0 and capable of discharging 3000 cusecs with 690.0 as F.S.L. The old regulator was also modified to pass 1000 cusecs. Previously there only a small drain of about 900 cusecs from the Jheel to Kakrola. A regular drain for a capacity of 3000 cusecs from Dhansa to Kakrola was also constructed in 1965. The right bank in the Jheel portion in Haryana remained unobstructed for reasons unknown. With the above improvements, an area of 3.5 sq.kms. on Delhi side has been reclaimed for Kharif crops. On Haryana side, the Jheel is still under submersion, which covers an area of 6.5 sq.kms.

 On the Mehrauli side, a considerable tract of hilly catchments drains directly into the Najafgarh Drain. The Mahipalpur bund partly restricts this flow from the hills of Mehrauli area.

 The sub-soil water in the block is generally saline and varies from 0.2 m. to 9 m. below G.L. Two Plans showing the minimum and the maximum water tables are enclosed as appendix IV & V. The water table is generally high around the Najafgarh Jheel area and low towards south-east corner of the block.

 A basin map showing approximately the external & internal catchments of the Najafgarh sub-basin is enclosed as Appendix. II.

**1.2 POPULATION STATISTICS :**

 All the 76 villages of the Najafgarh block are covered by the drainage zone of this sub-basin and its total population was 1.31 Lacs in 1971 (vide appendix-I). Out of the total area of 332 sq.km., only a negligible portion on the south eastern boundary has been included for development under the Master Plan Programme for urbanization of U.T. of Delhi and the remaining areas are rural. Accordingly to the National Capital Region Plan, there is a proposal of radial arteries being developed all around the Central Core of the urban Delhi. One of the arteries will be Delhi-Gurgaon Road, passing through the Najafgarh block. However, as per the N.C.R. report, no major development has Been envisaged in the surrounding rural area of Delhi and it has been mentioned that due to over congestion of the city of Delhi, a green belt should be left in the immediate surrounding regions and the excess population to be diverted to satellite towns beyond the border of U.T. of Delhi. Emphasis has been laid by the N.C.R. on the development of rural areas. Accordingly, rural centres have been classified into the following three categories to make the planning more effective, realistic and disperse the population uniformly:-

1**.Growth Centres**: These will serve an around 200-300 sq.km. and 1.2 Lacs to 2 Lacs projected Population in 1981. These centers would have activities mainly non-agricultural in nature with all centralized amenities and facilities in nature with all centralized amenities and facilities in the field of education, medical, public health, better whole-sale and retail shoppings, civic, cultural and recreational centres etc.

**2. Central Place villages:** These will Serve a radius of 3 to 5 Kms. and serve an area of about 30 to 80 sq.kms. and a projected population range of 20,000 to 40,000 in 1981. All such village will also have a predominantly agricultural economy and will provide central service facilities for all the villages in the cluster.

**3.Basic Villages:** Will serve their own existing Abadies. Amongst the important villages in this Basin, Najafgarh has got a population of 10,009 Palam 16,800 Brijwasan 5800, Gumanhera 2050 and Ujwas 2400 according to 1971 census. Out of the above villages, Najafgarh will be developed as Growth centre and Brijwasan, Guman hera, Ujwas and Palam will be developed as central place villages and hence may be facing internal drainage problem unless planned in advance.

**1:3 RAINFALLS:-**

 The Najafgarh sub-basin which falls under the Category of rural areas of U.T. of Delhi covers an Area of about 332.0 sq.m. The net work of rain gauge within Delhi Territory was limited till recently to only two stations i.e. Palam and Safdarjung, for which long term rainfall records are available. The storm rainfall analysis carried out from these data by the Reddy Committee during the 1958, found that the rainfall in Delhi Territory was quite erratic and the existing stations were considered inadequate for detail analysis of rainfall. According to the recommendation of this committee, 14 self-recoding rain gauge stations had been installed throughout the Delhi Territory during 1973.

 However for the rainfall study for Najafgarh Sub-basins, none of the 14 self-recording R.G. Stations recently set up can be utilized, since the data for only 3 years is available.

 Hence only the rainfall data from Palam, R.G. Station has been considered for this catchment. The actual Rainfall Analysis is enclosed as per Appendix No.VI.

**1.4 DESIGN STORM:**

 **Rural drains:**

Najafgarh basin mostly consists of villages Surrounded by vast tracts of agricultural lands drained by natural water courses. The Master Plan experts Committee in their recommendations suggested that the Drainage system in the rural areas of Delhi should be so designed as to restrict flooding to a maximum period of 3 days with a stork for a return period of 5 years. The 3 day maximum rainfall of Palam, which is the nearest station is available for a concurrent period of 24 years i.e. from 1951-1974, which have been put to frequency analysis. The 3 day maximum rainfall corresponding to 5 years return period comes to 8.5” vide Annexure-I. Similar studies of design storm was carried out by the Reddy Committee in 1958, on the basis of Palam data and a figure of 8.2” as the 3 day maximum rainfall for 5 years frequency was recommended. The design storm of 8.5” is adopted for this basin.

**Urban drains:**

 The maximum hourly rainfall data of Palam rain-gauge station is available for a period of 9 years i.e. 1966 to 1974 and the same has been put to frequency analysis. The hourly maximum rainfall corresponding to 1 year, 2 years, 5years, 10 years and 25 years frequency comes to 1.28”, 1.72”, 2.29”, 2.73” and 3.30” respectively vide Annexure-II.

 There are only 3 semi urban drains in the basin for which an hourly intensity of 1.72” is adopted, which is of two years frequency.

**1.5 RAINFALL DISPERSION FCTOR**

The study of rainfall records of recent Years i.e. 1973 & 1974 for various stations spread over the whole Delhi Territory reveals, that the Rainfall in Delhi is quite erratic and the Palam Rainfall cannot be taken as representative for different zones of Delhi Territory.

Dispersion factors has therefore been workedout by the isohyets method taking hourly and 3 day maximum rainfall series for the year 1973, 1974 &1975 which is considered to be a rational approachfor such analysis. Specific peak storms were selected & by drawing concentric circles around, dispersion factors for different areas were workedout. The dispersion factor for various sizes of catchment areas as worked out are table to below:-

|  |  |
| --- | --- |
| Catchment area in acres. | Rainfall dispersion factor with respect to maximum point rainfall. |
| Acres | Sq.Kms. | Based in hourly rainfall study. | Based on 3 day Maximum rainfall study. | Average% |
| 500 | 2.024 | 94.25 | 95.00 | 95 |
| 1,000 | 4.049 | 93.50 | 94.10 | 94 |
| 2,000 | 8.097 | 92.50 | 92.50 | 93 |
| 3,000 | 12.146 | 91.50 | 91.00 | 91 |
| 4,000 | 16.194 | 90.50 | 89.90 | 90 |
| 5,000 | 20.943 | 89.50 | 88.80 | 89 |
| 6,000 | 24.291 | 88.90 | 88.00 | 88 |
| 7,000 | 28.340 | 88.25 | 87.15 | 87 |
| 8,000 | 32.388 | 87.50 | 86.50 | 87 |
| 10,000 | 40.485 | 86.00 | 85.95 | 86 |
| 15,000 | 60.748 | 83.00 | 82.25 | 82 |
| 20,000 | 80.011 | 80.30 | 77.66 | 80 |
| 30,000 | 121.537 | 76.30 |  |  |
| 40,000 | 162.063 | 74.75 |  |  |
| 50,000 | 202.581 | 73.75 |  |  |

Annexure-I

**3-DAY RAINFALL FREQUENCY ANALYSIS OF PALAM RAINGAUGE STATION**

NUMBER OF YEARS OF RECORDS N=24(1951-1975)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | 3-day rainfall annual peak in mm(y) |  M | T=N/M | X=Log10 T | XY | 1.9100 |
| 1972 | 382.60 | 1 | 24 | 1.3802 | 528 | 1.9100 |
| 1967 | 246.20 | 2 | 12 | 1.0792 | 266 | 1.1600 |
| 1955 | 225.55 | 3 | 8 | 0.9031 | 204 | 0.8200 |
| 1964 | 202.70 | 4 | 6 | 0.7782 | 158 | 0.6100 |
| 1971 | 197.80 | 5 | 4.8 | 0.6812 | 135 | 0.4600 |
| 1961 | 194.70 | 6 | 4 | 0.6012 | 117 | 0.2600 |
| 1958 | 190.00 | 7 | 3.43 | 0.5353 | 102 | 0.2870 |
| 1966 | 188.70 | 8 | 3 | 0.4771 | 90 | 0.2270 |
| 1956 | 185.93 | 9 | 2.67 | 0.4265 | 79 | 0.1820 |
| 1962 | 172.30 | 10 | 2.40 | 0.3802 | 67 | 0.1450 |
| 1963 | 147.10 | 12 | 2 | 0.3010 | 44 | 0.0910 |
| 1957 | 140.90 | 13 | 1.85 | 0.2672 | 38 | 0.0712 |
| 1969 | 125.70 | 14 | 1.71 | 0.2330 | 29 | 0.0544 |
| 1968 | 124.30 | 15 | 1.6 | 0.2041 | 25 | 0.0416 |
| 1973 | 122.20 | 16 | 1.5 | 0.1761 | 22 | 0.0310 |
| 1965 | 119.20 | 17 | 1.41 | 0.1492 | 10 | 0.0223 |
| 1953 | 117.35 | 18 | 1.33 | 0.1239 | 15 | 0.0177 |
| 1960 | 117.10 | 19 | 1.26 | 0.1004 | 12 | 0.0063 |
| 1974 | 87.70 | 21 | 1.14 | 0.0569 | 5 | 0.0032 |
| 1970 | 86.20 | 22 | 1.09 | 0.0374 | 3 | 0.0014 |
| 1959 | 67.00 | 23 | 1.04 | 0.0170 | 1 | 0.0003 |
| 1951 | 63.50 | 24 | 1.0 |  8 | 8 |  0 |

Annexure-1A

 Y = EY = 3774.98 = 157

 N 24

 X = EX = 9.227 = 0.384

 24

 (X)2 = 0.1475

 B = EXY-NXY

 EX2 –N(X)2

 = 2022 - 24 x 157 x 0.384

 6.6265 -24 x 0.1475

 = 2022 - 1450 = 572

 6.6265 -3.54 3.0865

 = 185

* -

 A = Y - B X = 157 -185 x 0.384

 = 157-71 = 86

 Y 5 Years = A+B log10 T= 86+185 Log 10 5

 = 86 + 185 x 0.6990

 = 86 + 130

 = 216 M.M

 = 8.5 inches.

Annexure-II

 Maximum hourly rainfall of Palam rain gauge station for the years from 1966 to 1974 N= 9 years.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  Year | Hourly R/F. Max.In a Year in MM | ‘M’ | T=N M | X= Log T | XY | X2 |
| 1967 | 63.00 | 1 | 9.00 | 0.9542 | 60.1146 | 0.9105 |
| 1973 | 58.00 | 2 | 4.50 | 0.6532 | 37.8856 | 0.4267 |
| 1972 | 55.00 | 3 | 3.00 | 0.4771 | 26.2405 | 0.2276 |
| 1971 | 50.00 | 4 | 2.25 | 0.3522 | 17.6100 | 0.1240 |
| 1970 | 40.00 | 5 | 1.80 | 0.2553 | 10.2120 | 0.0652 |
| 1966 | 39.00 | 6 | 1.50 | 0.1761 | 6.8670 | 0.0310 |
| 1974 | 38.80 | 7 | 1.28 | 0.1072 | 4.1593 | 0.0115 |
| 1968 | 36.20 | 8 | 1.12 | 0.492 | 1.7810 | 0.0024 |
| 1969 | 25.30 | 9 | 1.00 | 0.0000 | 0.0000 | 0.0000 |

Annexure-11 a

 **CALCULATION:**

Y = EY = 405.30 = 45.03

 N 9

X = EX = 3.0245 = 0.3361

 N 9

(X) 2 = 0.1130

B = EXY 2 – NXY 2 = 164.8709 – 9x0.3361x45.03

 EX – N(X) 1.7989-9 x (0.1130)

 = 164.8709-136.2114 = 28.6595

* + - 1. 0.7819

 = 36.65

 A=Y-BX = 45.03-36.65x0.3361

 = 45.03-12.32

 = 32.71

 Line of best fit Y = A+B Log 10 T

 = 32.71 +36.65 Log 10 T

|  |  |  |
| --- | --- | --- |
|  Return period T in years. |  Log T 10 | Estimated Rainfall |
| 1 Year | 0.000 | 32.71 mm = 1.28” |
| 2 Years | 0.3010 | 43.74 mm = 1.72” |
| 5 Years | 0.6990 | 58.33 mm = 2.29” |
| 10 Years | 1.0000 | 69.36 mm = 2.73” |
| 25 Years | 1.3979 | 83.94 mm = 3.30” |

**1.6** **JURISDICTION OF M.C.D. & DELHI ADMINISTRATION AS A REGARDS DRAINAGE ARRANGEMENT.**

 Najafgarh block is mainly an agricultural Area. In the Master Plan prepared by D.D.A. this Area has been demarcated as rural except an area of 2.00 sq. miles on south-east boundary of the Basin. As per National capital Region Report the rural centres have been classified into the following three categories viz.

A)Growth centres. B) Central Place villages & C) Basic villages. (Described in detail in para 1.2 above). In the sub-basin, Najafgarh will be developed as the Growth centre and Brijwasan, Gumanhera, Ujwas and Palam will be developed as Central Place villages as per NCR Report.

The internal drainage of these villages has not been properly taken care of. The responsibility of the internal drainage of these villages lies with the M.C.D. Even the other smaller villages within the Laldora are being looked after by the M.C.D. It is found that in a number of villages the internal drainage system has not been properly maintained.

The following remedial measures are therefore suggested:-

1. **Central place and basic villages.**

(a) Absence of any planned drainage system in the basic villages at present creates a very serious unhygienic condition resulting in various diseases amongst the villagers. All drains must be covered in the villages properly with suitable gradients for quick drainage. The drains must outfall into sumps at the periphery of the villages wherefrom these effluent waters can be distributed to the fields for irrigation purpose. If necessary, the sewage content may be diluted by mixing it with additional tube well water.

A complete plan of the villages showing its drainage system is to be prepared by the local body and submitted to Delhi Administration, Flood Control

Wing for necessary improvements to the same.

(b) Wherever the villages are normally flooded by river water or by surrounding storm water, the plinths of new construction should be above the maximum expected flood level. The existing structures liable to flooding are also to be gradually raised above. No pucca construction in the depressed areas should permitted. Necessary acts/notification in this respect must be enforced.

(c) Villages which are liable to flooding normally must be provided with permanent or mobile pumping sets in draining out water to the nearest available link of the main drain. Development charges will be levied on the villagers for installing such pumps.

**(B ) Growth Centers:-**

The growth centers are at present having some sort of drainage arrangement which is very inadequate. No plan exists showing the details of the village drains. This must be properly surveyed and complete drainage Plan with L-Sections of the drains should be submitted to the Flood Control Wing of Delhi Administration, for approval. Here also, the drains must be terminated at sump wells through which irrigation in the fields can be done. The drains must be well planned. Keeping in view the future increase in population, Increase in the paved areas and increase in the industrial waste. All drains must be covered construction of buildings in low lying areas should be banned and all such construction should be dismantled either by the local bodies or by the owners them selves. If at all, buildings are to be constructed at low areas the plinth must be above the expected flood level. All roads should also be above such water levels. Any construction of road must have a provision of covered drainage system by its side. Persons misusing the drains or responsible for their choking shall be punished under law. Local bodies must employ sanitary personnel’s to clean out the drains and regularly spread DDT etc. in them. Cattles must not be allowed to squat on the road and cause nuisance and block the drainage system. Prizes may be awarded to the villages keeping their sanitary conditions above average.

The drains in the rural fields are being looked after by the FCD, Delhi Administration. It has been observed during inspection that annual maintenance of a number of drains has been neglected all together. In some cases no regular banks are there, whereas at certain places cart tracks are crossing the drains, thus obstructing the natural flow. There is a lot of weed growth in certain reaches of the drains and more over, sections of the drains are not uniform. Farmers are using the bed of the drains for cultivation purposes at a number of places. Such practices are to be checked completely and constant vigil by the field staff of the FCD is required to stop any unauthorized blocking of the drain anytime during the year. The blockings are sometime due to crossing of irrigation channels, which is to be totally discouraged. Crossing if any, shall be with pipes allowing proper water way for the drain to pass unobstructed. The field staff of FCD of Delhi Administration has to submit a report of all obstructions created along the drainage channels every fortnight and these are to be cleared before the next three days positively. Before the start of monsoon, silt clearance of the drains must be taken up every year and sections to be restored to designed sizes. Cultivators blocking the drain or cultivating in the beds of the drains, to be legally punished. Sectional officer allowing such practices are to be dismissed. Villagers causing blockage to drains shall be punished under law. Relevant acts shall be made known to the villagers for strict compliance.

It is also observed that the irrigation channels in the basin coming from Haryana State often over flow near their tail ends in the monsoon season, there being no surplusing arrangements. This inundates the neighboring low lying areas. Problem in sometimes created by small breaches in the Bank or by seepage. Constant watch therefore should be kept by FCD and such breaches must be immediately brought to the notice of the Haryana Government for immediate remedial measures. The Haryana Government must take up construction of surplusing arrangements and connecting them to the regular drains.

**2.0 Design Criteria**

**2.1 Design discharge**

**2.1:1 Rural drains**:- The drains in the rural areas of the basin have been designed as to restrict the flooding in the fields for a maximum period of 3 days with the design rainfall for a return period of 5 years. Studies have been conducted for the three day maximum rainfall intensity for 5 years return period vide Para 1.3 above, for the Palam rain gauge station for which long term data for 24 years is available and the 3 days maximum intensity works out to 8.5” An areal distribution factor of 90% has also been taken into Account as discussed vide 1:3.

 According to the recommendations of the expert Committee, a runoff co-efficient of 15% and 30% for the rural plan & semi hilly rural drains has been adopted. After applying the run off factor of 15% and ADF of 90% to the rainfall intensity of 8.5”, the discharge for the rural drains works out to 10 cusecs/Sq.miles as under:-

 Run off from 8.5” of rainfall

 8.5 x 640 x 15 x 90 = 10.18 cusecs/sq.miles

 12 2x3 100 100

Thus the discharge for semi hilly drain will be Rs.20 cusecs/sq.miles. Say 10 cusecs/sq. miles.

**2.1:2 Urban drains**. The drains in the Najafgarh basin coming from the urban areas have been designed for a rainfall intensity of 1.72”. This is the maximum rain-fall intensity for a return period of two years according to the Palam rain gauge station (vide para 1:3 above). An aerial distribution factor of 90% and run off 35% have been adopted for arriving at The actual run off as discussed for arriving at the actual run off as discussed in the outlines of the master plan.

Actual run off = 1.72 x 0.9 x 0.35 = 0.54”/hr.

Say =0.5” hr.

The runoff of ½” per hr. comes to ½ Cusecs/acre s below:

Run off from ½”/hour over an acre

 = 1/2x1/12x4840x9 of cft./hr/acre

 = 1815 cft/hour/acre

 = 1815cusecs/acre = ½ cusecs/acre

 60x60

* 1. **Design section**: The sections of the drains have been designed with Manning’s formula for open channels for uniform flow.

Q =A x 1.486 x H2/3 S1/2

 N

Where n is rugosity co-efficient, depending upon the type of surface and S = Bed slope.

* 1. The flowing values of N has been adopted.
1. Unlined section In natural earth = 0.025 }
2. Lined Sections (Brick lining & Rubble masonry = 0.017 to 0.018}

**2.2.2 Bed Slope**: - The Bed slopes drain the drains have generally been kept with the following consideration:-

1. To limit the velocities in the drains within none silting and non-securing values.
2. To avoid falls in the drains as far as possible.
3. To maintain the existing sections of bridges and culverts. Generally the Bed slopes vary from 1 in 1000 to 1 in 7000. But in exceptional cases they have been kept flatter or steeper, where the levels of the main drains do not permit it otherwise.

**2.2.3 Velocities**: - Velocities in the drains have been Kept within the following limits:-

Unlined sections 0.45 to 1.50 meters/Sec.

Lined Sections (Brick lining or Rubble Masonry) 1.50 to 3.0 meters/Sec.

 However, in exceptional cases, velocities upto 0.3 meters per second has also been allowed in the drains where discharge are very low, of the order of 5 to 10 cusecs, with the following considerations:-

1. To limit the bed slope as per topography of the area.
2. To retain the existing section of the drain.
3. To adopt the minimum section of the drain.
4. To adjust the level at the outfall points.

**2.2.4 Side slopes**

 a) Earthen channel 1.5:1 ( in filling ) 1:1 (in cutting)

1. Dry brick pitching 0.5:1

**2.2.5 Free board**: - Minimum free board of 0.3 meter has been provided where the section of the drain is very small. In other cases free board has been provided as below:-

Discharge upto 150 cusecs: 0.5 meter. Discharge 150 cusecs and above: 0.5 meter to 1 meter in exceptional cases, free board slightly varying from above has been allowed, to retain the existing sections of the drain.

**2.2.6: Provision of roadway**: A minimum roadway of 15 ft. has been provided on both sides of the drain in case of major drains only.

**2.3 Bridges.**

* + 1. **Waterway:** Water way for the bridges and culverts has been provided for the full design discharge, limiting the afflux between 15 & 25 Cms.
		2. **Afflux:-**Afflux in the bridges/culverts has been allowed as below:-
1. New bridges and culverts closely located:15 Cm./
2. New bridges & culverts far off located: 25 cm.
3. Existing bridges & culverts: 125 to 25 cm.
	* 1. **Vertical clearance**:- Minimum vertical clearance in the bridges/culverts has been proposed as below:-

Discharge upto 0.3 m3 per second = 150 mm.

Discharge above 0.3 m3 per second upto 3 m3 per second = 450 mm

Discharge above 3 m3 per second to 30 m3 per second = 600 mm.

Discharge above 30 m3 per second = 900 mm.

**3. PROBLEMS OF DRAINAGE CONGESTION AT PRESENT**

The water logging and drainage problems in the Najafgarh block are mainly categorized as below:-

**3:1 Drainage congestion during rainy season:-**

The area to the South-East of Najafgarh Block has got very few regular drains for draining the discharges from its own catchment and also that coming from the hilly areas of the Cantonment and Mehrauli block. Moreover, two soil conservation bunds namely Mahipalpur bund and Brijwasan bund in the Mehrauli block and Najafgarh block have also not been connected by regular drains to drain off the surplus water. With the result, the fields and the surrounding villages of the area namely Brijwasan, Kapashera, Shahabad, Mohammadpur, Barthal and Bagrola are affected badly in rainy season, due to stagnation.

**3.1:1 Bagrola Drainage Scheme**:

 During the 1967 monsoon there was about 4 to 5 feet of water in the village and the necessity of constructing a drain was very much felt during that period. Accordingly a scheme to drain out the water from this area was framed, investigated and approved, but was not taken up for execution. The same should be implemented early. The alignment of the proposed drain has been marked on the drawing. The L-section and cross sections of the drain along with the relevant details are also enclosed at Appendix-VII.

**3.1:2 Brijwasan Drainage Scheme.**

 During the monsoon, a large quantity of water flow from the Haryana Territory through a culvert in Delhi-Gurgaon Road Near village Kapashera. A small drain is already existing from the culvert and is ending abruptly at village at village Brijwasan without any surplusing or out falling arrangements. Due to inadequate capacity of the drain and due to the fact that this drain is not connected to any other drain, village Brijwasan and Kapashera are flooded every year causing crop-damage. The Delhi-Rewari Railway. Line is also affected. Sometimes Flooding is caused even on Najafgarh Brijwasan Road. To solve this problem, a drain is proposed to be ‘Constructed from the culvert of Delhi-Gurgaon Road to the Najafgarh drain utilizing the existing drain on the way. At the first instance, the drain should be constructed only upto culvert No.44 of the Delhi-Rewari Railway line, thus allowing the water to accumulate in the low lying area of Brijwasan Bund. This will help in recharging the sub-soil water table in the surrounding areas of the bund. The surplus water if, will over flow from the weir of the bund and will automatically flow to Najafgarh drain through the natural drainage path already existing. The above natural drainage path should be converted into the regular drain at a later date if necessary. The L-section and cross-section of the drain along with other necessary details are enclosed herewith at Appendix-XI.

**3.2 Village Ponds situated in the Abadies:-**

 A few villages are having their ponds in their neigh bourhood where all the storm water collects during the monsoon. These ponds are to be connected to regular N-23 drains as otherwise they get flooded in updating the hutments and the roads. The major problems in this category are in the following villages:-

**3.2.1. Najafgarh Village**

 There is a pond behind the Govt. Girls Higher secondary School, which gets filled up and over flow during monsoon, submerging the nearby houses and part of the Delhi-Najafgarh Road near the bus stop. The problem becomes worse with the local sullage of the area collecting in the ponds in the midst of houses. M.C.D. who is responsible for the maintenance of internal drainage of the area has to resort to pumping every year. Flood Control Department of Delhi Administration has carried out detailed survey of the area. A link drains of a capacity of 30 cusecs, off taking from the pond and out falling into Najafgarh Drain U/s. of Kakrola regulator, where an inlet is already available can solve the problem permanently. The bus stop connected to the pond, for draining the area one the other sides of the road. The road level also needs rising above the present eyelevel by 2’. The alignment of the drain has been marked on the plan and its L-section is shown at appendix XI. The above measures are urgently necessary to remedy the serious drainage problem.

* + 1. **Chhawala Village: -** A similar problem also exists in the Chhawala village where three local ponds in the abadies get filled up during the monsoon and submerge the neighboring houses. It is therefore, recommended that all the three ponds may be connected to N-24 each other by link and ultimately connected to the Najafgarh drain U/s. of Chhawala Bridge. The alignment of the drain and its sections are shown at appendix XII.

**3.2:3** **Brijwasan Village**: A pond near the Brijwasan village gets filled up during the monsoon thus inundating the surrounding houses. A link drain off taking from the pond and out falling into the area surrounded by Brijwasan Bund through the culvert No.43 (Delhi-Gurgaon Railway Line) is proposed to be constructed to drain off the Surplus water. The alignment of the drain is marked on the drawing enclosed at appendix I & II. The L-section and its cross section along with other relevant details are also enclosed at appendix-XIII.

**3.2:4** **Malikpur Pond Scheme:** There is a big pond near the village Malikpur situated near Dhansa. In certain years when the rainfall is high this pond gets inundated causing great hardship to the villagers. In addition to the problem caused to the villagers. In addition to the problem caused to the village on agricultural area of about 100 acres also gets submerged. In this area water stands to a depth 2-3 feet. Earlier a scheme was prepared for draining the area by a link drain connecting this village to Najafgarh Drain U/s. of Rawta Bridge. It has now been proposed to construct a small drain off taking from the pond in the Malikpur village and out falling into the proposed Mundela Khurd drain vide para 3.4:1. The scheme should be implemented very urgently. The alignment of the drain is revised to avoid hardship of villages as marked on the plan enclosed a appendix. Its L-section & cross-section with other relevant details are enclosed at appendix XIV

**3.2:5 Sagarpur Scheme:** Sagarpur is an unauthorized colony and is located near the banks of the Palam drain. The house of the colony have been constructed in the low lying area. During 1975 monsoon, lot of water got accumulated in this area causing great hardship to the local people. There was about 2’ to 3’ of water in about 100 acres of land. If a drain is constructed connecting this area to the Palam drain, the problem can be solved permanently. The alignment of the drain is marked on plan enclosed at appendix I & II. The L-section and cross-section is also enclosed at appendix -XV.

**3.2:6 Palam Pond Scheme:** There are a few constructions near the Palam Airport where lot of water gets accumulated during monsoon period. During heavy rains, even the road gets/submerged causing inconvenience to the public. The water stands in the field to a depth of about 1 foot in an area of about 100 acres causing damage to the crops. A link drain is therefore suggested to be constructed off taking from the said area and out falling into Nasirpur drain flowing at a distance of hardly 500 meters. The alignment of the drain is marked on the plan enclosed at appendix I & II. The L-section and cross section along with other relevant details is also enclosed at Appendix XVI.

**3.3 Inadequate surplusing arrangement of irrigation channels.**

There are two irrigation channels namely Dhansa Minor and Surkhpur minor flowing through this block. Both of them are having their tail ends in this block. Dhansa minor is having its tail end near the village Gummanhera whereas Surakhpur minor near Jafarpur. None of them is having surplusing arrangement near their tail ends. During the rainy season, when water is not needed for cultivation purposes, farmers plug the outlets of the minors near the tail end. With the result, minors start overflowing and inundate the surrounding low lying areas. Sometimes, seepage water from the above minors also create problem. The major problem of drainage congestion due to overflow of minors occurred in 1975 in the village Kair which is situated near the left bank of Surakhpur minor and is built up in a low lying area. The whole village got submerged for about twenty days due to chocking of the siphon across the minor near the village resulting in overflowing of the minor. The water was standing in the village and in the surrounding field nearly to a depth of about 2 ft. in an approx. area of 50 acres, thus causing inconvenience to the people as well as damage to the crops. The following measures are therefore suggested to overcome the above problem permanently.

**3.3.1: Dhansa Minor**: Surplusing arrangement should be constructed slightly U/S of the tail end of the minor at is crossing with proposed Mundela Khurd drain suggested vide para 3.4.1. The above surplusing arrangement will thus directly discharge surplus water from the irrigation channel into the drain without causing submergence in the low lying area.

**3.3:2 Surakhpur Minor:** Surakhpur Minor and sub-Minor area having their tail ends near Zafarpur and Mitraon villages respectively. At present there is no surplusing arrangement for the minors. As a result, the surplus irrigation water used to spread out in the open fields between Zafarpur Kalan and Sorada.

 As a matter of fact, the Surakhpur minor at present brings very little irrigation water to Delhi during the periods irrigation is necessary. However, discharge are passed into this channel from Haryana territory, during the monsoon, to relieve the water logging in the Haryana Territory. Since the minor is practically not in use for irrigation purpose, the syphon across Mitraon Kair Road is lying choked for the last few years. The Haryana Irrigation Department, who are supposed to maintain this Syphon. Did not care to get it repaired or make it workable. During 1975 monsoon after a heavy rain a sudden enrush of drainage water started flowing through Surakhpur minor from the Haryana Territory and within 24 hours its levels went up considerably after the water was blocked at the siphon point. The banks of the minor breached during the night and the Kair village was surrounded with 2 to 4 feet of water all round submerging some buildings in the low lying areas as well. As large tract of cultivated area also was inundated. The Flood Control Wing immediately employed a number of pumps. In spite of continuous pumping and throwing the water on the other side of the minor, the stagnated wate4r could not be appreciably lowered for a long time. The villagers suffered for at least 3 to 4 days. All the ponds in the village got filled up. The wells for drinking water got connected with the ponds., In order to avoid recurrence of this sort of hardship in future, the following remedial measures are proposed:-

(a) The syphon across the Surakhpur minor under the Kair-Mitraon road must be immediately silt cleared and repaired.

(b)The embankments of the Surakhpur minor should be completely remodeled to wider sections so as to stand the water pressure up to the top level.

(c) A surplusing channel is to be constructed of required section which is shown as proposed “Kair link drain” and to be connected to the proposed Mundela Khurd drain. The alignment of the link drain as well as its cross sections and L-sections are shown in the Appendix-XVII.

**3:4 Drains carrying storm water from outside Delhi.**

As already mentioned in the previous chapter Najafgarh basin though flat is sloping towards its South West corner from all directions, where there is a natural Jheel called the Najafgarh Jheel. This Jheel receives spills from far off places of Haryana & Rajasthan States during heavy Rains, through Jahazgarh Jheel, which is connected to Najafgarh Jheel by a link drain and also to Sahibinadi. These discharges ultimately drain in to the Yamuna through the Najafgarh drain, which is the only drainage outlet for the Jheel. This drain is also joined by the Mungeshpur drain on its left and Palam drain on its right, which again receive discharges from Haryana and Delhi Cantonment respectively. During heavy rainfall, the Najafgarh Jheel gets filled up and used to submerge about 4000 acres of cultivable lands. The problems of the Jheel area are described in para 1. Various committees setup from time to time to look into the flood problems of Delhi have gone into the details of the problem. The various measures suggested by the different committees to deal with this drainage problem, are summarized in the next chapter.

In addition to above, drains which have their origin in the other states and carry discharges into the U.T. of Delhi are mainly the West Jua drain, and Thanekurd drain which are not capable of carrying their full discharge due to their limited capacity. They therefore overflow and cause flooding in the low Lying areas of their States as well as the areas of the U.T. of Delhi. A major problem of drainage had occurred in 1975 in the villages Mundela Khurd and Mundela Kalan.

**3.4:1 Mundela Khurd Drainage Scheme.**

Mundela Khurd is a village situated in the Najafgarh basin near the Haryana Delhi Border, during the 3rd week of August, 1975, a huge quantity of storm water flowed from Haryana Territory towards Mundela village due to the cutting of Bahadurgarh Badli Road by Haryana Govt. causing thereby serious drainage problem in the area. The above drainage problem mainly occurred due to the overflow from existing irrigation channel & non-existence of adequate drainage system in the Haryana Territory in this area. An area of about 800 across was under 4’ of water for about a month or so, near Mundela Khurd and Mundela Kalan villages inDelhi territory. After detailed survey of the area, the following Remedial measures are suggested to relieve the drainage congestion of the Mundela Khurd and its surrounding areas:-

**A.** A bund of about 6 ft. average height with top Level at R.L.699 along the boundary of Haryana and Union Territory of Delhi between Dhansa Minor and Bahadurgarh Minor should be constructed to restrict the overflow of storm water from Haryana into the U.T. of Delhi. The alignment and the cross section of the proposed bund have been marked on the enclosed plan. The above bund should be provided with a gated regulator of 10 cusecs capacity at R.D. 697 and should be used only in a case of emergency. To provide a drainage path from this, the proposed regulator should be connected to the Najafgarh Drain by means of a link drain. The alignment of the drain should be kept along the natural drainage path already existing up to the Najafgarh Rohtak Road and afterwards it should be kept along the above said road till its outfall into the Najafgarh drain. The alignment of the drain is marked on the enclosed plan. The drain has been designed for 75 cusecs capacity between the regulator and Dhansa Najafgarh road, i.e. to cater for 10 cusecs discharge from Haryana territory and 65 cusecs from the local catchment area of the Mundela Khurd. Its capacity has gradually been increased to 170 cusecs at the outfall point to cater for additional discharge coming from the local catchment and discharge expected as an overflow from Dhansa Minor and Surakhpur Minor. It

has been observed in 1975 that Haryana Government was sending drainage water through minors during the monsoons. The discharge in the different reaches have been calculated at the rate of 10 cusecs per sq.miules of the catchment area as per design criteria laid down for rural area of Delhi. While designing the above drain, it has been observed that the FSL of the proposed drain at the outfall point is slightly lower than the FSL of the Najafgarh Drain which cannot be avoided even after keeping the water surface slope to the minimum. Gradient possible, considering the topographically conditions of the area. In this reach the FSL of the Najafgarh Drain is slightly above the natural surface level.

Hence chances of back flow from Najafgarh Drain at the time of its running in full capacity into the above drain cannot be ruled out. It is therefore suggested that:

1. Mundela Khurd link drain should be provided with a gated regulator at the outfall point so that gates could be operated only when the conditions are N/32 favorable. However it has been examined that the Najafgarh drain will not be running for more than 10 days above the design outfall level of the proposed drain.

2. Temporary pumping set may be installed at the outfall points in exceptional cases of continuous high flood in the Najafgarh drain, so that this storm water from the link drain is pumped out in to the Najafgarh drain.

The L-section and cross section of the Mundela Khurd Link drain along with the other relevant details are enclosed herewith.

**B.** The Haryana Government is required to construct proper adequate drainage system in the Rohtak and Bahadurgarh area so that the storm water from all these catchments in their area and not allowed to simply spill across the border and cause serious damage to the crops and properties in Delhi Territory.

1. **Improvement proposals made by previous consultants.**

The following committees had examined the drainage problem of Delhi and dealt with the remodeling of the Najafgarh drain and its tributaries which is the main drain age system of the entire U.T. of Delhi.

 a) Reddy Committee 1959

 b) Moti Ram Committee 1964

 c) J.P. Jain Committee 1968

 d) J.P. Tripathy Committee 1973

The summary of recommendations of these committees relevant to the Najafgarh system is given below:-

**4:1 Reddy Committee (1959)**

**4.1:1** Urban drains may be designed for the rainfall intensity of 1.67”/Hr. with a runoff factor of 0.30 i.e. ½” net runoff.

**4:1:2** The storm water drains in the rural area shall be designed so as not to allow storm water to stand in the fields for more than 3 days and shall be for worst condition, occurring once in 5 years with a runoff factor of 0.15. The maximum 3 days rainfall occurring once in five years is 8.2” which works out to runoff of about 10 cusecs/sq.mile of catchment area. Similarly runoff for hilly area is 20 cusecs /sq,miles of catchment area.

**4:1:3** An immediate interim relief by regarding the Najafgarh drain above the reach which has already been regarded will even up the existing bed slope and local humps between Kakrola bridge and Basaidarapur bridge and relief about 2900 acres for Rabi cultivation by bringing down the level of Jheel to R.D.690.00.

**4:1:4** A substantial intermediate scheme to ensure an area of 6300 acres for Rabi cultivation by bringing down the level of the Jheel below 690. This envisages widening the Najafgarh drain to 60’ bed width and steepening the present flat slope to 1 in 10,000 in the reach of 13 miles below Kakrola bridge, thus providing 900 cusecs capacity from R.D. 65000 to R.D. 134,000.

**4:1:5 The complete relief could be afforded**

If the rain water is prevented from flooding the area for a long duration and the same is drained away within three to four days after rainfall. This will relieve an area of 14400 acres within the Jheel. Works necessary to achieve the objects are:-

* + - 1. Provision of catch drain/around the Jheel.

2. Provision of detention basin on the Palam Drain.

3. Regarding and diversion of Mungeshpur drain.

4. Through improvement of the Najafgarh drain in its entire reach from Kakrola to outfall.

**4:2 Moti Ram Committees (1964)**

**4:2:1** The capacity of the Najafgarh drain should be increased to 3000 cusecs throughout as soon as possible. It should be further increased to 10,000 cusecs in tail reaches to suit present as well as urban development according to Delhi Master Plan.

**4:2:2:-**A drain of adequate size to ensure utilisation of full capacity of Najafgarh drain should be constructed from Kakrola bridge upto the Najafgarh Lake.

**4:2:3:-**The Kakrola regulators should be modified to pass a discharge of 3000 cusecs.

**4:2:3:-**The Chhawala bridge should also have a capacity to pass 3000 cusecs without submerging the area.

**4:2:4:-** A ring bund about 6’ high should be constructed all round the Najafgarh Jheel with its bottom on the 690 contour. The work should be completed only after the remodeling of the Najafgarh drain is complete.

**4:2:6:-** The Dhansa bund and the Najafgarh Jheel should be connected by a drain so that the water released from the regulator may flow down without submerging the country side.

**4:2:7:-** The capacity of the regulators in the Dhansa bund should be increased to 3000 cusecs in all with a drop in head of 1 foot.

**4:2:8** The Dhansa bund should be allowed to remain permanently as a means of communication and should be strengthened and raised if necessary to ensure freedom from breach.

**4:2:9:-** A new drain with a capacity of 3000 cusecs should be constructed from a place above Dhansa bund upto the river Yamuna. It may be taken through Gurgaon district and may join the Yamuna north of Faridabad. The existing Shainten Nalla may be used in tail reaches.

**4:2:10:-**The capacity of the link drain is between the Jahazgarh and Dhansa bund should be increased to suit the dia mentions of the new drain above bund and it should have a regulator at RD-12,000. This work should however be started only after the new drain taking off above Dhansa bund is completed.

**4:2:11:-** There should be a unified authority to control and supervise flood regulation with U.T. and concerned Haryana areas.

**4:2:12:-** The Project estimate for a dam across the Sahibi nadi proposed by the Rajasthan Govt. at Ajmeripura may be approved and work commenced as early as possible.

**4:12:13:-** The Punjab Government may be requested to provide small storage dams on hill streams flowing into Sahibi Nadi in that State.

**4:12:14:-** Remodeling of Mungeshpur and Nangloi drains designed to increase their capacity may be complete as soon as possible.

**4:3 J.P. Jain Committee (1968)**

**4:3:1:-**Dhansa bund should be raised to R.L.702.00 and strengthened suitably so as to have a top width of 16’ and D/S slope as 3:1 .The u/s. slope should be pitched with 9’ to 12’ thick stone against wave action. This bund should also be connected with Najafgarh Dhansa Road by an approach road and provided with two 1.5 to 2’’ cra-toways on the top.

**4:3:2:-** It is essential that the work of preparing a Master Plan for drainage of Delhi is taken up without further delay and completed as early as possible so that no difficulty may be experienced later on, either in constructing new drains or remodeling the existing areas within the urbanized limits.

**4:3:3:-** The capacity of Najafgarh drain from Jhatikera upto Kakrola regulator at R.D. 65000 should be increased to 3000 cusecs as early as possible.

**4:3:4:-** The old regulator at Kakrola should be remodeled so as to have its erect at same level of 681.00 as that of new regulator. This will improve the discharging capacity of the drain at this point and will help in passing discharges upto 4000 cusecs through the two regulators in times of need.

**4.3.5:-** The Najafgarh drain below Kakrola regulator upto Basaidarapur Bridge at RD 1, 14859 should be regarded to a slope of 1 in 9000. this will increase the capacity of the drain to 3600 cusecs.

**4:3:6:-** The capacity of the drain connecting Dhansa bund with the Najafgarh Jheel and the latter with the Najafgarh drain should be increased to 3000 cusecs as early as possible.

**4.3.7:-** For reducing the inflow into Najafgarh Jheel from its own catchment areas, possibility of constructing bund on the hill stream coming down from rocky areas on the north east of Gurgaon district and storing water for Irrigation and Water supply in addition to the existing bund should be investigated and those found economically feasible should be constructed.

**4:3:8**:- In order to deal effectively with the water coming down from the rural and urban areas of Delhi State itself. A supplementary drain of the capacity very in from 4000 cusecs at head to 4500 cusecs at the tailed which will take off from the Najafgarh drain from its lefts bank near RD 88000 opposite to the outfall of the proposed Pankha Road or the cantonments drain and run in a north easterly direction for about 7 miles and then take a turn towards east until it meets the Shahalam bund which will form its bank and fall into Najafgarh drain below its tail regulator should be constructed now or later as may be found feasible. However, necessary steps to acquire the land required for constructing the drain which will be 15 to 18 miles and will have a bed slope of 1 in 8000 should be taken up as early as possible, as the acquisition proceedings take a long time.

**4:3:9**:- Automatic rain gauge stations should be installed at 15 places given in the text before the rainy season so that we may have reliable data for hourly rainfall after a few years.

**4:3:10:-**The construction of a reservoir with a capacity of 5000 m3 cut on Sahibi Nadi near village Ajmerpur in Rajasthan may be taken up as early as possible.

**4.3.11:-** Lower down, either a few check dams or low diversion weirs with short channels taking off from them may be constructed across Sahibi Nadi on either side of Rewari-Sohana road crossing the Haryana state for See page irrigation.

**4.3.12:-**Haryana Government may be requested to provide small storage dams on hill streams coming down into Sahibi Nadi in that State.

**4.3.13:-**Mungeshpur drain which is reported to have a catchment area of 192 Sq.miles Proper drainage crossing for its branch drain Madanpur on roads where they do not exist should be constructed before the next rainy season.

**4.3.14:-** Until a Master Plan for drainage of Delhi State is prepared, clearance of all drainage schemes out falling into Najafgarh drain should be given by FCD of Delhi Admn. However, after the Master Plan is approved by the competent authority, the clearance of all drainage scheme whether old or new should be obtained from the Flood Control Wing before they are taken up for execution.

**4:4** **J.P. Tripathy Report ( 1973)**

Present drain with improvements suggested below should be able to cater for the discharge from the area already urbanized and likely to be urbanized. However it will not be able to carry discharge of Sahibi Nadi when it is in floods. For this purpose alignments of the supplementary drain which is already suggested by Sh. J.P. Jain should be fixed right now and its capacity may be fixed later on when full data regarding Sahibi Nadi is made available as Najafgarh drain after improvement should be able to carry discharges in normal years.

**4:4:2:-**The catchment area of Najafgarh drain within the urbanized limits below Kakrola regulator is 40425 acres. Assuming a runoff factor of 0.45 for density of 100-120 per acre and 0.6 for density of 150 persons/acre and 0.70 serial distribution factors, discharge at outfall point for intensity of rainfall corresponding to return period I in 5 years (2.17c) works out to 10,400 cusecs.

* + 1. :- Since the present Master Plan indicates the areas likely to be urbanized upto 1981, studies were also carried out by rational method to find out the discharge if the balance areas are urbanized at later data, which revealed that even if these areas are urbanized there will not be significant differences in outfall discharges on account of larger time concentration.
		2. :- Contribution of rural areas discharge at Kakrola may be of the order of 5000 cusecs when the drain is carrying peak discharge from urban areas.

**4:4:5** Design discharges of different reach as suggested are given below:-

Discharge B.W. Slope F.S.D. Bed Slope.

1. Bharat Nagar

 Bridge to Rajpur 8500 72 ft. 1:1 15:25 1 in 4000

 Road bridge.

1. Rajpur Road to

 Rifle range bridge. 9400 80 ft. 1:1 15.25 -do-

1. Rifle range bridge To

 start of rocky reach. 10400 85 ft. 1:5:1 15.25 -do-

4. Rocky reach to outfall. “ 65 ft. 10.5:1 -do- 1 in 2000

 The capacity of the Najafgarh drain in the reaches U/S of Bharat Nagar should be examined with reference to design discharge it will have to carry for rainfall intensity of 1 in 5 years and with the progress of urbanization.

**4:4:6:-** At present there are only two main gauge stations in Delhi that is Palam & Safdarjung. Since the area draining into Najafgarh drain is more than the intensity of rainfall cannot be applied to entire areas 4000 acres. As now some additional rain gauge stations are set, it is necessary to accurately observe and analysis the rainfall from these stations to work out the correct intensity of rainfall for the likely discharge in Najafgarh.

**4:4:7:-**The discharge in Najafgarh drain should be observed during the monsoon period as frequent interval at different locations vis-à-vis upto date urbanization of the catchment area. This enables to determine the likely duration of peak discharge and working out of the correct runoff factor.

5. **Existing drainage system & their proposed remodeling.**

There are three major drainage systems in the Najafgarh block.

1. Najafgarh drain (including Dhansa outfall channel and rain through Najafgarh Jheel)
2. Mungeshpur drain
3. Palam Drain.
	1. **Najafgarh Drain**

Najafgarh drain together with its branches serves a catchment area of 508 Sq.miles. It starts from Dhansa Bund where it is called Dhansa outfall channel situated near Dhansa village about 20 miles South West of Delhi city and joins river Yamuna D/S of Wazirabad. It is also joined by Mungeshpur drain on its left and Palam drain on is right in the Najafgarh block. Total length of the drain within U.T. of Delhi is 38.50 miles from Dhansa to outfall. Najafgarh Jheel is a natural depression and is having an independent catchment area of 219 Sq.miles and in addition receives spills during the exceptional rainfall from neighboring states of Haryana and Rajasthan through link drains/connected from Jahajgarh Jheel and Sahibi Nadi respectively. Thus during heavy rains the Jheel used to get flooded and submerge a lot of agricultural land for days together causing damage to crops and property. Four different committee viz. Reddy Committee, Moti Ram, J.P. Jain & Tripathy committee were set up in the past to deal with the problem but none of the committees could arise at the definite discharge for which the section of drain in the rural portion is to be designed in the absence of the detail data regarding catchment areas. And likely inflow coming into Jheel from neighboring States etc.

The summary of the recommendation is given in Chapter-4. Reddy committee and suggested that the discharge capacity of the drain should be of 900 cusecs from Kakrola (RD 65000 ) to Bharat Nagar bridge ( RD-134000) and 3000 cusecs beyond Bharat Nagar bridge ( RD 134000) upto outfall. Moti Ram committee suggested that a regular drain of 3000 cusecs capacity to be constructed from Dhansa Bund upto Kakrola regulator and its capacity to be increased to 10,000 at outfall. J.P. Jain also recommended the same capacity of 3000 cusecs upto Kakrola (RD 65000) to Basaidarapur bridge (RD 1, 14.000) and its capacity to be further increased to 10400 cusecs at the outfall point. The above recommendations were mainly based on the fact that maximum area of the submerged land should be available for agricultural purposes as early as possible. Shri J.P. Tripathy( Member),(Floods) had gone into details of the problems but restricted his studies to the urban area below Kakrola regulator and made no allowance for the discharge brought by the Sahibi Nadi in the worst years of rainfall. He recommended a discharge of 10400 cusecs at the outfall point from only the urban Delhi.

The discharge was calculated on the basis of the available rainfall data until that date. A return Period of 5 years was adopted and the designed intensity of hourly rainfall was taken as 2.17 inch. An aerial distribution factor of 70% was assumed. The runoff co-efficient of 0.45 and 0.6 was assumed for the density of 100-120 persons per acre and 150 persons per acre respectively. Only the rainfall data from Palam rain gauge station was utilized. The rainfall data of Safdarjung was not considered as it showed comparatively much less intensity.

The designed discharges proposed by the Member (Floods) for the different reaches were as under:-

1. Upto Nangloi Drain 2060 cusecs.

2. Upto Junction of Tilak Nagar Drain 3740 cusecs.

3. Upto Paschimpuri Drain 4760 cusecs.

4. Upto Ramesh Nagar Drain 6200 cusecs.

5. Upto Pritam Pura drain. 6970 cusecs.

6. Upto Daryai Nalla 8400 cusecs.

7. Darai Nalla to Rajpur road 9400 cusecs.

8. Rajpur road to Rifle range road. 8500 cusecs.

9. Rifle range bridge to outfall in Yamuna 10400 cusecs.

The bed slope of the Nalla just downstream of Bharat Nagar bridge was proposed as / 1 in 4000 and F.S.D. below Bharat Nagar was proposed as 15.75 feet.

 It was also mentioned that the likely discharge from rural area synchronizing with the urban discharge may be of the order of 500 cusecs. Based on the recommendations of the above Committees a portion of drain upto outfall of Nangloi drain (RD 98000) has already been remodeled for a capacity of 3000 cusecs. The reach between the outfalls of Nangloi Drain and the Bharat Nagar bridge has been redesigned in light of the recommendations of Shri J. Tripathy. The portion of the Najafgarh drain below Bharat Nagar upto its tail end has already been redesigned and the work of remodeling is in progress. The revised L-section and the cross-section of the drain upto outfall point are enclosed at Appendix-XXIII in three parts i.e. (a) from Dhansa to Tilak Nagar(b) from Tilak Nagar to Bharat Bridge and (c) from Bharat Nagar to outfall point.

In the reach between Tilak Nagar outfall to Bharat Nagar it is proposed to keep; an unlined section from Tilak Nagar upto Rohtak Road and lined section from Rohtak Road bridge onward to Bharat Nagar. Proposed bed width are 120’ and 72’ against 95 & 65 ft. respectively in the above two reaches. The bed slopes are also proposed to be regarded to 1 in 7800, 1 in 6000, 1 in 3000 from 1 in 12000 in the reaches between the outfall of Tilak Nagar drain to outfall of Paschim Puri drain, outfall of Paschim Puri drain to Rohtak road bridge and Rohtak road bridge to Bharat Nagar bridge respectively. Minimum free board of 2’ has been kept. Inspection road of 22’ have been provided on both sides of the drain. While redesigning, special care has been taken to ensure that the min. clearance of ………feet is there in the existing bridges and the afflux is also within permissible limits. The following guidelines are also suggested for future maintenance, possible remodeling and utilization of water of Najafgarh drain at the future date.

(1) Najafgarh drain shall be desilted every year a few months before monsoon so that the full cross section is available for utilization before the start of next monsoon. An L-section of the drain from Dhansa to Kakrola as surveyed in past 1975 monsoon is enclosed. The design cross section is also super imposed. It may be seen that on an average 3 feet of silting is there, which is to be immediately cleared. It was noted in 1975 flood that at a number of places water stagnation occurred due to this heavy siltation in upper reach of Najafgarh drain. The level reached were that of nearly 3000 cusecs whereas the actual discharge passed was nearly 1500 cusecs maximum. Pre-monsoon and post monsoon L-sections are to be invariably taken every year and submitted to Chief Engineer for record. Cross-sections at 100’ interval should also be taken for calculating desilting proposal. Executive Engineers failing to take action on annual desilting and taking L-sections should be suspended forthwith.

 (2) The bridges to be constructed at the future data should be preferably single span without any intermediate pier. The scour depth should be calculated for at least 10 years flood. Permissible afflux of should be provided. In future well type inlet structures should be constructed.

(3) Kakrola regulator shall be operated to control the discharges from the U/S areas of the regulator only when the discharge D/S of it has been exceeded 3000 cusecs/ the water level has exceeded the safe limits in the Najafgarh drain to cause overflow of its banks in any of the localities in the city reaches. The Kakrola regulator gates should be lowered in the receding stage of the flood when the water level in U/s. of the regulator is at RL-685. The water level U/s of the Kakrola regulator is to be maintained at Rl-685 during the dry period for recharging of water table.

 (4) For Dhansa regulators, emergency should be declared when the water level in the Najafgarh Jheel touches RL-690. The gates of the Dhansa Regulators may be kept open as long as the level in Najafgarh Jheel is less than RL-690 the discharge in Najafgarh drain in city reaches is less than 3000 cusecs/ the safe level in the Najafgarh drain has not been exceeding to cause overflow of its banks in city reaches. After the level reaches R.L.690 in Najafgarh Jheel or 3000 cusecs discharge is observed in Najafgarh drain, the safe level in the Najafgarh drain has been exceeding, the gates shall be opened keeping in view both the upstream and downstream conditions that would provide reasonable relief to the areas in Haryana and Delhi.

The design flood level for Dhansa bund is R.L.698.0ft. Water overflows at Dhansa Regulator above R.L. 695.5 since the top of the gates is R.L. 695.5 in the closed position.

 The combined discharge of new regulator and the existing regulator would be 3000 cusecs with the U/s. water level of 694 and D/S water level of 693.

 Proper regulation should be made when U/s. water level is 697.00 or D/S water level is 690 so that higher differential head is not acting on the structure.

**Discharge table for various u/s and d/s water level**

**For New Dhansa Regulator.**

Water way, 4 Spans of 8’ 0’ each -32 clear

Crest level + 688 : Bed level = 685.73

Discharge Capacity in cusecs.

U/s Water level

+690.0+690.5+691.0/+692+692.5+693+693.5+694+694.5+695+695.5+696+696+696.5+697 + 691.5

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| +690.0 | 170 |  |  |  |  |  |  |  All Gates fully opened. |
| +690.5 | 390 | 240 |  |  |  |  |  |
| +691.0 | 540 | 500 | 320 |  |  |  |  |
| +691.5 | 690 | 670 | 620 | 400 |  |  |  |
| +692.0 | 840 | 830 | 810 | 740 | 500 |  |  |
| +692.5 | 1020 | 1010 | 1000 | 970 | 870 | 595 |  |
| +693.0 | 1190 | 1190 | 1190 | 1160 | 1120 | 1000 | 700 |
| +693.5 | 1370 | 1370 | 1370 | 1360 | 1340 | 1290 | 1140 | 810 |  |
| +694.0 | 1470 | 1470 | 1570 | 1560 | 1540 | 1510 | 1490 | 1280 | 920 |  |  |
| +694.5 | 1730 | 1780 | 1780 | 1770 | 1760 | 1750 | 1700 | 1610 | 1440 | 1040 |
| +695.0 | 1980 | 1980 | 1980 | 1970 | 1960 | 1940 | 1890 | 1770 | 1570 | 1160 |
| +695.5 | 2200 | 2200 | 2200 | 2190 | 2180 | 2160 | 2140 | 22080 | 1970 | 1700 | 2290 |  |  |  |  |
| +696.0 | 2440 | 2440 | 2440 | 2440 | 2420 | 2410 | 2400 | 2350 | 2260 | 2130 | 1890 | 1420 |  |  |  |
| +696.5 | 2680 | 2680 | 2680 | 2680 | 2670 | 2670 | 2650 | 2630 | 2570 | 2490 | 2310 | 2050 | 1540 |  |  |
| +697.0 | 2920 | 2920 | 2920 | 2920 | 2920 | 2900 | 2900 | 2840 | 2830 | 2780 | 2680 | 2500 | 2250 | 1690 |  |

**STATEMENT SHOWING THE CAPACITY OF NAJAFGARH JHEEL BETWEEN R.L.695 AND R.L. 684 UPTO KAKRAULA BRIDGE.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S.L.No. | Areas submerged in acres. | Total Area submerged acres. | Capacity in acre feet. | Rate of absorption. |
|  | Delhi |  Haryana | Above Dhansa (in cusecs/day) | Below Dhansa |
|  312.60 |
| 684 | 125.20 | - | 437.80 | 1.46 |  |  |
| 685 | 890.40 | 681.40 | 1571.80 | 10.95 |  |  |
| 686 | 1654.25 | 1067.40 | 2722.00 | 3216.67 |  |  |
| 687 | 3282.80 | 1667.60 | 4950.40 | 6993.88 | 624 | 123.4 |
| 688 | 5280.40 | 2503.10 | 7783.40 | 13304.75 | 1040 | 2140 |
| 689 | 6992.72 | 2798.20 | 9790.92 | 22072.57 | 1325 | 3068 |
| 690 | 9342.20 | 2660.90 | 13003.00 | 32427.89 | 1615 | 4084 |
| 691 | 12772.08 | 4568.20 | 17340.80 | 45585 | 2057 | 5528 |
| 692 | 17645.20 | 5798.30 | 23444.00 | 67830.78 | 2591 | 7604 |
| 693 | 22747.20 | 6807.80 | 29555.00 | 94313.11 | 3402 | 10098 |
| 694 | 29834.60 | 90080.80 | 38243.40 | 138412.29 | 3954 | 13153 |
| 695 | 34295.80 | 11061.00 | 45366.80 | 170482.11 | 5020 | 16032 |

**Discharge table for various u/s and /s water level for Kakrola Regulator.**

Water way, 4 Spans of 15- 0’ each 677.85

 Discharge Capacity in cusecs.

 Water level D/S W.L.

 688 688.5 689 689.5 690 690.5 691 691.5 692 692.5 693 693.5 694 594.5 695

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| +688 | 2160 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| +688.5 | 3290 | 2400 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| +689 | 4000 | 3660 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| +689.5 | 4570 | 4300 | 3360 | 2920 |  |  |  |  |  |  |  |  |  |  |  |
| +690 | 5200 | 5010 | 4660 | 4300 | 3140 |  |  |  |  |  |  |  |  |  |  |
| +690.5 | 5800 | 5660 | 5400 | 5050 | 5480 | 4500 |  |  |  |  |  |  |  |  |  |
| +691 | 6250 | 6150 | 6040 | 5800 | 5450 | 4850 | 3710 |  |  |  |  |  |  |  |  |
| +691.5 | 6850 | 6800 | 6650 | 6480 | 6200 | 5800 | 5180 | 4000 |  |  |  |  |  |  |  |
| +692 | 7360 | 7330 | 7250 | 7120 | 6900 | 6570 | 6150 | 5550 | 4290 |  |  |  |  |  |  |
| +692.5 | 7900 | 7840 | 7750 | 7660 | 7540 | 7310 | 7000 | 6380 | 6540 | 4650 |  |  |  |  |  |
| +693 | 8410 | 8390 | 8350 | 8270 | 8180 | 8040 | 7830 | 7490 | 6959 | 5800 | 4000 |  |  |  |  |
| +693.5 | 9010 | 8990 | 8980 | 8900 | 8800 | 8700 | 8560 | 88760 | 8100 | 7600 | 6600 | 5180 |  |  |  |
| +694 | 9620 | 9600 | 9520 | 9530 | 9490 | 9430 | 9290 | 9060 | 8740 | 8300 | 7700 | 6980 | 5500 |  |  |
| +694.5 | 10160 | 10130 | 10100 | 10090 | 10080 | 10050 | 9900 | 9720 | 9500 | 9250 | 8800 | 8300 | 7550 | 5900 |  |
| +695 | 10750 | 10700 | 10700 | 10650 | 10600 | 10600 | 103200 | 10200 | 9900 | 5650 | 9420 | 8680 | 7720 | 6120 | 6120 |

**5.2:MUNGESHPUR DRAIN:-**This drain starts from Mundora village in Haryana State where it is called Mundrola drain and after running in South & South Eastern direction joins Najafgarh drain about half a mile below Kakrola regulator at about RD 67000. During the course it mainly passes through Kanjhawala Block and is thus intended to relieve flooding in low lying area of the block and part of neighboring Haryana State. It is joined by the following branch and link drains during its run from Haryana and U.T. of Delhi.

1. Mundrola drain (length) 6.48 Miles.

2. Thana Khurd rain (length) 7.6 Miles.

3. Katewara link drain (length) 0.96 Miles.

4. Mungeshpur link drain (length) 0.54 Miles.

5. West Juan Drain (length) (in Delhi in Haryana).

6. Madanpur drain (length) 5.10 Miles.

a) Sultanpur drain (length) 5.60 Miles

b) Mohammadpur Majri link drain (length) 1.00 Miles

c) Rasulpur link drain (length) 0.47 Miles

d) Gheora link drain (length) 0.33 Miles.

e) Rani Khera link drain (length) 0.57 Miles.

7. Bazidpur drain (length) 4.99 Miles.

a) Jatkhore Link drain (length) 2.44 Miles.

8. Bawana Drain (length) 7.18 Miles.

a) Bawana Jheel link drain (length) 1.23 Miles.

 b) Nangal Thakran drain (length) 1.61 Miles.

 c) Chandpur link drain (length) 1.57 Miles.

Out of the above drains, Thana Khurd drain and Mandrola drains have their catchment areas partly in Haryana and partly in Delhi whereas that of West Jua drain is entirely in Haryana State. With the construction of Diversion Drain No.,8 in the Haryana State, part of the U/S catchments of West Jua drain, Thana Khurd drain and Mandrola drain have been diverted into this drain, which are, directly flowing to the Yamuna through Haryana area.

The present proportionate details of Thana Khurd Mandora & East Jua drains in Haryana & Delhi are as given below:-

(C.A.=Catchment Area in SQ. miles and Length in miles)

**S.No. Name of Drain Detail Haryana Delhi Total**

 1. Mandrola Drain C.A. 11.11 0.74 11.85

 Length 5.40 1.44 6.88

 2. Thana Khurd drain. C.A. 26.80 0.40 27.20

 Length 7.00 0.63 7.63

 3. West Jua drain C.A. 1.80 - 1.80

 Length - - -

The total catchment area served by the Mungeshpur drain at present as per contour plan at its outfall point except west jua drain is 11.27 sq. miles. The catchments area of West Jua as intimated by the Haryana Irrigation Department; vide their approved L-Section received with letter No.6283 dated 30.7.75 is 180.00 Sq,miles. No plan has been furnished showing the catchment basin. The discharge for the above catchment contributed by the drain has been assumed as 325 cusecs by them. The records of Flood Control Wing reveals that total catchment of West Jua drain is 71 Sq. miles. Assuming the whole catchment is rural the expected discharge from the above drain will be 710 cusecs @ 10 cusecs /Sq.miles as per recommendations or Reddy Committee for rural drains. The discharge of 710 cusecs is much on the higher side than 335 cusecs as summed by Haryana Government. Therefore, catchment area of 71 sq. miles for West Jua drain has been retained to be on the safer side. The total catchment area of Mungeshpur drain at outfall point will thus be 111.27 + 71 sq. miles = 182.27 sqm. Miles. As the entire catchment area of drain lies in rural areas, the drain has been designed for 1820 cusecs at the outfall point at the rate of 10 cusecs/sq.miles. The branch and the link drains of the Mungeshpur drain have also been designed on the same basis. The remodeled L-section and cross section of Mungeshpur drain along with its branch and link drains are enclosed at Appendix XXIV. It is evident from the L-section that the bed width of drain is to be increased to 32’,34’,50’52’54’76’ and 85’ from 24’,28’,43’.72 and 80’ in the reaches between the RD 112100 to 96800, 96800 to 79120 765850 to 62100, 62100 to 56500, 56500 to 43600 , 43600 to 21900 and 21900 to 0 R.D. respectively. The bed slopes are also to be regarded to 1 in 5000, 1 in 4000, 1 in 6000, 1 in 7000, 1 in 9000, 1 in 9000 and 1 in 9000 from the existing bed slopes 1 in 3600, 1 in 3600, 1 in 4000, 1 in 4000, 1 in 4000, 1 in 7000 and 1 in 10,000 in the reaches between the R.Ds 120900 to 112100, 112100 to 96800, 96800 to 79120, 79120 to 76850 to 65600, 56500 to 52500 and 52500 to o R.D. respectively, There is 2 ‘ of average deepening through the length of the drain.

The bridges/culverts at R.Ds 15125, 43500, 75700 are to be remodeled completely and 1 or 2 spans are to be added to bridges/culverts or slight modification in the floor level of the structures at R.Ds 8845, 29600, 47010, 62100, 63900, 76815, 872300, 96800, 98100, 182375, 109700, 112100 and 120700 to send the proposed design discharge.

It is a general complaint from the farmers in the Najafgarh Block that water table goes down in winter season and thus Irrigation by means of tube wells becomes difficult. It is therefore suggested that gates of the outfall structures of Mungeshpur drain should be closed in winter season to allow the water to stagnate in the drain as well in the fields for automatic recharging of the water table. The above water can also be used for water supply purposes after treatment if necessary. Possibility of construction of gated structures in the intermediate parts of the above drain and also providing gates to the inlets of the drain which could be closed when necessary should also be explored.

 It is however pointed out that portion of Mungeshpur, West Jua, thana Khurd and Mandrola drains in Haryana State are not having adequate sections and even not maintained properly. At several places no proper banks are there. With the result, the above drains over flow during heavy rains in that state and submerge neighboring low lying area in the U.T. Of Delhi. The major problem due to overflow has occurred 1975 in the villages, Jharoda Kalan. Mundela Khurd & Mundela Kalan described in detail in chapter 3:4 “Drains carrying storm water from outside Delhi.” Haryana Government should, therefore, remodel the sections of the drains in their territory and should maintain them properly.

**5:3 PALAM DRAIN**

Palam drain rises from hilly areas of South Delhi and after running through cantonment area in the north and North-west direction, joins Najafgarh drain U/s. of Kakrola regulator. During the course it is joined by the following link drains:-

1. Palam Link drain

2. Nasirpur drain.

3. Palam Pond drain.

It collects discharges from hilly, urban and rural areas and serves a total catchment area of 20 Sq. miles at its outfall point (Urban 10.25 Sq. miles Hilly. 3.17 Sq. miles Rural 6.85 sqm. Miles). The total discharge as per design criteria discussed vide para 2.0 above at the outfall point of Palm drain comes to 3410 cusecs, at the run off rates of 10 cusecs/sqm. Miles for rural: 320 cusecs/ sq. miles for urban and 20 cusecs/sq. miles for/semi-hilly area, which seems to be on the higher side. As the total catchment of this drain is more than 5000 acres the design discharge should have been calculated by rational method, according to the recommendations of the expert Committee. In that case, the design discharge would have considerably reduced taking the large time of concentration. However the sections of the drain from 20200 RD to RD 0 outfall point has already been remodeled for the discharge capacity of 3042 cusecs capacity. The above discharge seems to be reasonable and hence the original remodeled section in the above reach has been retained. The section of the drain from 28000 RD upto 20200 should also be remodeled for 1840/ cusecs discharge. It is further pointed out that there is no regular section of drains U/S of 28000 RD. The drain U/s of 28000 RD therefore should be surveyed and a regular section is provided at different reaches on the above basis. The catchment area of its link drains also lie partly in rural and partly in urban areas and hence been designed on the above basis (i.e. @ 10 cusecs/ sq,.miles for rural and 32 cusecs for urban). The proposed sections of Palam drain along with its link drains are enclosed at Appendix XXV to XXVIII. It is evident from the L-Section that i) Palam Link drain is to be remodeled to B.W of 9’ and 15’ from 7’ and 10’ and to a bed slope of 1 in 1200 and 2000 from existing 1 in 1000 and 1 in 2000 in the reaches between the R.Ds 10400 to 5200 and 5200 to O respectively. There is average of 5’ deepening throughout the length of the drain. ii) Nasirpur drain is to be remodeled to a B.W. of 25’ from 8 ft and to a bed slope of 1 in 2500 from 1 in 2000 with an average deepening of 6 feet.

**5:4 Proposed remodeling of the present system.**

The system of drainage at printing in Najafgarh Block are neither adequate nor maintained properly. The following new link drains are needed for relieving the drainage congestion of the block more effectively:

 1. Najafgarh Pond Link Drain.

2. Chhawla Link drain.

3.Bijwasan link drain.

4. Mundella khurd Link drain.

5.Bagrola drain.

6. Barthal drain.

7. Shahbad drain.

8. Brijwasan pond link drain.

9. Malikpur pond link drain.

10. Nasirpur pond link drain.

11. Sagarpur link drain.

12. Kair link drain.

It is necessary that all the drains of the block should be immediately remodeled as per L-sections enclosed. All the bridges and culverts whose floors are higher are to be lowered to the design bed level. Widening of culverts are also to be done wherever these are liable to cause more than the permissible afflux in order to carry the new design discharge. Necessary approach roads to the bridge where none constructed should be constructed.

**6.0:- OUTFALL STRUCTURE:-**

The outfall structures in future should be constructed on the flowing guide lines.

* 1. Masonry structures with open foundation will generally be constructed.
	2. Gates are to be provided only in case water is to be stored in the respective drains. Where this is not necessary gates are to be avoided. Gates should be normally manually operated. Screw type gates are to be provided where the span is big.
	3. Scour depth to be provided for 1.25 D only for piers and abutments.
	4. Fluming should not be more than 80%
	5. Flared type wing walls to be preferred against right angled ones.
	6. Where the inspection path is to cross the regulator single lane class A loading to be adopted for the bridge. 3.0’ footpath on either side will also be provided.
	7. **SUB SOIL WATER CONDITIONS FOR THE NAJAFGARH BLOCK.**

Flood Control Department, Delhi Administration is maintaining a number of sub-soil water observation points fixed by them all over the Union Territory of Delhi, at an approximate spacing of one Km. Observation of these points are taken normally four times a year. This work was started in the end of 1972. Since then whatever data collected upto date has been analyzed and two plans are enclosed as Appendix IV & V indicating there in the contours of sub –soil water table at highest and lowest saturation conditions. It may be seen that the water tables are normally high around the Najafgarh Jheel. On the south east side, the water table is relatively low with an average depth of 6 to 9 meters below the ground.

As mentioned above the water table is generally high around the Najafgarh Jheel in post monsoon seasons but there is a complaint from the farmers of the area that the water table goes down considerably in pre monsoon season in the Central areas of the Najafgarh block and thus irrigation by means of ordinary wells and even tube wells becomes difficult.

The following remedial measures are therefore suggested to improve the sub-soil water level in the pre-monsoon season:

i) Irrigation by means of tube wells should be discouraged. On the other hand the present Irrigation Channels should be extended and a few more should be constructed as suggested in the plan enclosed to cover larger areas. CGWB also has mentioned in their report on “Report on the Ground Water Condition Around Najafgarh Jheel in parts of Delhi and Haryana State” that three factors namely ( a) continuous low rainfall (b) effective drainage of the Jheel area and (c) increase in withdrawal from ground water reservoir are mainly the cause for the decline in water levels of the area. It has been found by them that factor (b) and (c) constitute the cause of decline of water table but the chief cause for fall is rise in installation of tube well pumping sets. The extract of conclusions and the recommendations of the report is enclosed as Annexure-II. (ii) Crops such as sugarcane, paddy which needs more water and can stand standing water for a few days should be sown in the area around the Jheel in post monsoon season, in consultation with the Agricultural Department( iii) In winter season, when the water table goes down the gates of the outfall structures of the Najafgarh drain at Kakrola and Mungeshpur drains should be closed to allow the water to stagnate in the drains as well as in the fields for automatic recharging of the water table. Possibility of construction of gated structures in the intermediate parts in the above drains as well as inlets to the bunds which can be closed when necessary should also be explored.

 On south east side of the Najafgarh block the water table is relatively lower with an average depth of 6 to 9 meters below ground. This area being hilly, irrigation by means of tube-wells is difficult. Presently, only the Surukhpur minor coming from the Haryana Territory has its tail end upto Mitran villages. It is suggested that this minor should be further extended upto Najafgarh drain. Water from here can be stored at a higher place farther by pumping and distributed for irrigating a larger area by means of gravity as marked in plan at Appendix II.

 **8.00 SUPPLEMENTARY DRAIN**

 The Moti Ram Committee, the J.P. Committee and Shri J.N. Tripathy Member (Floods) have proposed construction of a supplementary drain to divert the rural discharge falling into Najafgarh drain. As per their recommendations, the present Najafgarh drain with some improvements suggested by them would be able to cater for the discharges expected after complete urbanization of the Union Territory as envisaged by D.D.A as has already been recommended by them the proposed alignment of the drain should be kept protected with barbed wire against encroachment. It will, however, be constructed at a later date only when the need arises and also when the need arises and also when details regarding the discharge that is expected from the Haryana Territory ( viz. in flow from Jahazgarh Jheel and Sahibi Nadi etc.) are available.

1. **IRRIGATION SYSTEM IN NAJAFGARH BLOCK AND THEIR PROBLEMS.**

Najafgarh Block is being irrigated mainly by means of wells and tube well. A few irrigation channels viz. Dhansa minor and Surakhpur minor coming from Haryana are also irrigation a limited area in the block.

As mentioned in para 3.3. above, the main problems relating to these minors are their want of proper surplusing arrangements and their connection to the nearest regular drains, and inadequate capacity of culverts through which they pass.

Sometimes, the water in these minors is stopped abruptly without notice thus depriving utilization of water when required.

 As these irrigation channels are under the Haryana Government, it is very necessary that the irrigation system in the Union Territory should be taken over by Delhi Administration. With this, the irrigation channels can be extended further to cover a larger area for irrigation.

**ANNEXURE-II**

EXTRACT FROM THE ‘REPORT ON THE GROUND WATER CONDITIONS AROUND NAJAFGARH JHEEL IN PARTS OF DELHI AND HARYANA STATE BY CENTRAL GROUNDWATER BOARD.

**G.S.L. REPORT ON GROUND WATER CONDITIONS AROUND NAJAFGARH JHEEL:**

 The Najafgarh Jheel is a very shallow natural depression in the Southern part of the block and used to receive runoff from adjoining areas of Delhi and Haryana. This used to cause large scale flooding of the area. The original Najafgarh drain was constructed to carry away the excess water from the area to the river Yamuna. The earlier records indicate that the Jheel and its surrounding areas used to remain water logged for 5 to 6 months, i.e. from July to December, rendering the land uncultivable for Kharif crop. To reclaim part of this land for Kharif cultivation, the drain modification work was started in 1965 and completed in 1972, by raising its capacity from 28 m3/Sec to 94 m3/Sec. The drain was extended across the Jheel to Dhansa bund to effectively drain out that area and also Sahibi Nadi badi. The drain through the Jheel bed is embanked only on Delhi side. Out of a total area of about 10 Sq,km. occupied by the Jheel bed is embanked only on Delhi side. Out of a total area of about 10 Sq.km. has been reclaimed by this process for Kharif cultivation.

The records of the water levels indicate no marked variation prior to 1962. The records of 1962 and post monsoon 1975, show a definite decline in water levels in the area. The decline is varying from 0 to 4 Meters but in general it is about 2 meters. At places away from depressions the decline is more.

 Three factors namely (a) continuous low rainfall (b) effective drainage of the Jheel area and (c) increase in withdrawal from ground water reservoir, were considered for the decline in water levels of the area. It has been found that factors (b) and (c) constitute the cause of decline of water table, Further the contribution to decline of water table by the effective drainage from the Jheel area has been found very low. The chief cause for the fall in the water table could be attributed to a steep rise in the installation of tube wells/pumping sets, with a consequent increase in the ground water withdrawal.

 The utility of filling the Najafgarh Jheel partially or fully or excavation of the Jheel bed and filling it with flood waters for recharging the ground water body were examined. It has been found that no much benefit would be gained by practicing these measures, as the reclamation of a part of the Jheel bed is not a major cause for the fall of the water table. The results of experiments by Haryana State Minor Tube wells Corporation on the utility of village ponds/tanks as recharging sources have not been found encouraging and as such are not recommended for application here.

 The recommendations of the J.P. Jain Committee need further scrutiny for their benefits to the Najafgarh Block. But any scheme by which fresh water could be brought to the area for irrigation would be beneficial to the availability of irrigation resources of the area. This is further supported by the fact, that the ground water at deeper levels in most of the area is brackish to saline and the available fresh water would not be able to meet the demands of the area at the present rate of withdrawal without getting adversely affecting the quality.

 The trend of water levels in the area indicates possible over draft. To precisely determine the extent of the over draft a more detailed ground water balance survey would be required because the data collected during this short term investigation is insufficient.

 As the major withdrawal of ground water is by means of tube wells/pumping sets, and the increase in a number of these structures is comparatively higher in last 4 years, it is recommended that further installation of these is discouraged.

 The relationship between water table and drain bed confirms discharge of ground water through drain immediately after the monsoon period. To curtail or minimize this loss, a proper regulation of the drain at Kakrola regulator is essential. The regulation precise is very good as it keeps the depth of water in the drain to such a level that the ground water flow is at its minimum.

 The water logging conditions near Mundela and Kair need special attention. A drain may be essential to link the depression to the Najafgarh drain so that some areas could be reclaimed. The area around Kair may also be connected b y the same drain. The effect of canal around Kair should also be examined and the canal a should be lined if already not done.

1. **Summary of Master Plan Report On Najafgarh Basin.**
2. **Najafgarh Drain:** (a) The bed slope of the drain should be regarded to 1 in 7800, 1 in 6000 and 1 in 3000 from 1 in 12000 in the reaches between the outfall of Tilak Nagar to outfall of Paschimpuri drain, outfall of Pachimpuri drain to Rohtak Road Bridge and Rohtak Road bridge to Bharat Nagar bridge respectively. The bed width of the drain should also be increased to 120’ and 72’ from 95’ and 65’ in the reaches between outfall of Tilak Nagar drain to Rohtak Road Bridge and Rohtak Road Bridge to Bharat Nagar Bridge respectively. The reach between Rohtak road bridge and Bharat Nagar Bridge should be lined.

(b) The Punjabi Bagh bridge at RD 118250 should be widened to suit the design discharge.

(c ) The drain should invariably to desilted to the design section every year as it gets heavily silted up by 3’-4’ at various reaches all through.

(d) The bridges to be constructed at future date should be preferably single span without any intermediate pier well type inlet structures should be constructed.

**(2) Mungeshpur Drain:** a) The bed width of the drain should be increased to 32’, 34’, 50’.,52’ 54’, 76’and 85’ from the existing bed width of 24’, 28’, 43’, 43’, 43’ ,72’, and 80 ft. in the reaches between the R.D.’s 112100 to 96800, 96800 to 29120, 76850 to 62100, 62100 to 56500, 56500 to 43600, 43600 to 231900 and 21900 to O respectively.

b) The bed slope of the drain should be regarded to 1 in 5000, 1 in 4000, 1 in 6000, 1 in 7000, 1 in 7000, 1 in 9000, 1 in 9000 from existing bed slope of 1 in 3600, 1 in 3600 1 in 4000, 1 in 4000, 1 in 4000 1 in 7000 and 1 in 10000 in the riches between the R.D’s 120900 to 112100, 112100 to 96800, 96800 to 79120, 79120 to 76850, 76850 to 56500, 56500 to 52500 and 52500 to O respectively. Small falls of 1.7’, 0.8’,2.4’,0.60 and 1.60 should be constructed at R.D’s 112100, 96800, 79120, 76850 and 43600 respectively. There is an average deepening of about 2’ in the entire length of the drain.

c) The bridges culverts at R.D’s 15125, 43500. 75700 ft. should be remodeled and one or two spans should be added or slight modification should be done in the floor levels of the existing structures at R.D’s 8845, 29600,47090, 62100, 63900, 76815, 87300, 96800, 98100, 102375, 109700, 112100, 11435 and 120700 to send the proposed design discharge.

**(3) Palam Drain:** The reach between the R.D’s 20000 to 28800 should be remodeled as per latest design requirements along with the structures.

**(4) Palam Link Drain: -** Palam Link drain should be widened to 9’ and 15’ from 7’ and 15’ and regarded to bed slope of 1 in 1200 and 1 in 2000 from 1 in 1000 and 1 in 2000 from 1 in 1000 and 1 in 2000 in the reaches between the R.D’s 10400 to 5200 and 5200 to O respectively. The culverts at R.D’s 5900 and 5200 should also be remodeled.

**(5) Nasirpur link drain:-** Nasirpur link drain should be remodeled to a bed width of 25’ from 5 ft. and regarded to bed slope of in 2500 from 1 in 2000. The culverts at R.D’s 6000 and 750 should also be remodeled.

Necessary surplusing arrangements of 20 causecs capacity/Dhansa minor at its crossing with proposed Mundela Khurd drain and on Surakhpur minor at its crossing with Kair-Mitraon road connected to Mundela Khurd drain by a link drain should be constructed.

**(6) Mundela Khurd Scheme:-** A bund of about 6’ average heigh with top at R.L. 699 should be constructed along the Harayana and U.T. of Delhi boundary between Dhansa minor and Bahadurgarh minor near the Mundela Khurd Village. The above bund should be provided with gated regulators of 10 cusecs capacity of R.L. 697 and the regulators should be connected to Najafgarh drain by means of link drain called mundela khurd link drain.

 In addition to above, the following proposed link drains discussed vide para 3.00 should also be constructed:-

1. Najafgarh Pond link drain.
2. Chaawla link drain.
3. Bagrola drain
4. Barthal drain
5. Shahbad drain
6. Kair link drain
7. Malikpur Pond link drain
8. Bijwasan link drain
9. Sagarpur link drain
10. Nasirpur pond link drain
11. Bijwasan pond link drain