CHAPTER 7

PROPOSED MASTER PLAN

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7.1 SUMMARY

This section describes the collection and treatment components of the future sewerage system based on the recommended Alternative III selected in the previous section. In addition, this section of the Master Plan evaluates current capacity, and existing deficiencies and identifies capacity of each component to handle projected wastewater flows over the planning horizon.

The Master Plan sewerage layout is presented in Figure 7.1. Capacity of the main facilities are presented in Figure 7.2 for 2015 and Figure 7.3 for 2030. The overall sewerage scheme will consist of 4 separate Sewerage Districts each with its own treatment plant:

- District I: Dubagga area conveying sewage to existing Daulatganj STP,
- District II: Kanausi area and Sarojini Nagar area conveying sewage to proposed Khwajapur STP.
- District III: Trans Gomti side conveying sewage to sanctioned Kakraha STP
- District IV: Cis Gomti side conveying sewage to proposed Mastemau STP

Districts are divided into Zones each with its own pumping station or trunk sewer. Zones are further divided into several sewer sub-catchment areas, as shown in Figure 7.4. Sewer sub-catchment boundaries have been determined primarily on the basis of topographical features, existing sewer network and site investigations.

Populations, and wastewater generated by sewerage district are presented in Planning Framework Section 5 Table 5.2 and 5.6. Sewage generation quantities have been computed considering tributary areas proposed under the Master Plan. These tributaries areas are presented in Table 5.2 and are also shown on layout drawings in Appendix B. Peak sewage generation volumes at various phase years have been computed on peak factors as per Section 5.

Hydraulic calculations for evaluating capacity of existing trunk sewers are presented in Table 7.2 and replacement sewers. Calculations for sizing proposed trunk sewers are presented in Table 7.3.

Existing pumping station data is presented in Table 7.4. Evaluation of pumping station capacity for present and future wastewater loads is presented in Table 7.5.

7.2 STORM WATER DRAINS

Lucknow City has several large drains that carry significant amounts of wastewater to Gomti river. These drains are also a significant source of pollution during wet weather when cow dung and human waste that accumulates during the dry season are flushed away by runoff.

Investigations were carried out in the year 2003, and it has been found that drains discharge a total of 341 mld. A total of 6 drains have already been tapped in GoAP-I diverting 45 mld.

Locations of existing nala/drains are shown in Figure 7.5. A list of existing nala/drains, including measured flows is shown in Table 7.1. Some drains have already been diverted to the sewer system and UPJN has proposed to divert the remaining nalas under GoAP-II as shown in Drawing B2.

These nala-tapping arrangements are essential for intercepting wastewater during dry weather and reducing pollution loads, however the present tapping arrangements are inadequate:

- they allow a substantial quantity of silt and debris into the sewer system which is detrimental to its life and proper function.

- They allow large quantities of storm water into the sewerage system which would cause flooding and hydraulic overloads at treatment plants

Such nala tapping arrangements are considered as interim measures only and should be phased out gradually with the improvement in sewerage cover into all urban areas i.e. implementation of the Master Plan. However, house connection targets for 2030 are at most 80% therefore there will always be some flow in the nalas. It is recommended that each tapping point be provided with screening and grit removal facilities to protect the collection system. Furthermore each tapping point should have a means of automatically regulating the inflow during wet weather.

7.3 GENERAL ASSESSMENT: PHYSICAL CONDITION OF TRUNK SEWERS

A detailed survey of the trunk sewers was beyond the scope of the present Master Plan study however the JICA Study Team did carry out a visual survey of the trunk sewers at random locations to get an appreciation of potential problems.

The visual surveys were supplemented by discussions with UPJN and Jal Sansthan and videotapes from previous camera inspections.

7.3.1 Current Deficiencies

1) Poor maintenance: The majority of the branch sewers are at any time either completely blocked or their capacity is severely reduced by silt and solid wastes. Sewer maintenance is restricted to emergency clearing of blockages and is given low priority.

2) Silting and surcharging: Visual surveys by JICA Study Team indicates that sections of the trunk sewers are heavily silted. Reduced capacity from silting results in sewage overflows from manholes to surface drains during peak flow periods. Problems may also be caused by structural damage in some sections.

3) Ageing infrastructure: The existing trunk sewer system is over 50-60 years old and has been allowed to deteriorate to the point where rehabilitation or replacement is necessary. Many of the sewers have not been inspected.

4) Poor record keeping and inadequate information for planning: The limited availability of records relating to pumping stations and the sewerage system makes planning for extending services and assessing the amount of sewage presently flowing into the sewer system difficult. This also prevents effective maintenance and corrective actions.

5) Storm water and solid waste ingress to sewers: Damaged manholes, sewer defects particularly around the nala and connections of nala to the sewerage system have led to the increased risk of solid waste entering and blocking the system.

7.3.2 Current Capital Needs

Trunk sewers and branch sewers in the city need to be cleaned. Sewers that have been diverted to drains as a temporary relief from chronic blockage or surcharging should be re-instated and connected to the sewage collection system.

Drains that have been diverted directly into sewers must be rerouted to formal tapping points. These tapping points must be constructed with proper screening and grit removal facilities. Tapping points will also require some physical means of by-passing large storm water flows. The present solution of manual gates is inadequate and creates operational difficulties.

7.4 SEWERAGE DISTRICT I: DAULATGANJ STP

7.4.1 General Description

This district has one sewage treatment plant called Daulatganj Sewage Treatment Plant in Lucknow City, which is located in the Gaughat area. For treating wastewater, this STP uses the biological process called "Fluidised Aerobic Bio-reactor (FAB) Treatment Process" and the design capacity is 42 mld. At present the area has no sewer system. Wastewater flows into Nagaria, Gaughat, Sarkata and Pata Nalas. Nala flows are tapped, diverted and pumped to Daulatganj STP. A new sewage treatment plant has been proposed at Hardoi Road, L.D.A Colony by Lucknow Development Authority. The capacity of this sewage treatment plant has been planned initially as 14 mld and treatment plant based on FAB technology. Under this Master Plan, a new sewer system would be connected to the STP, but its capacity should not exceed the maximum capacity of Daulatganj STP (ultimate design capacity of 56 mld with expansion).

7.4.2 Sewers

Tentative alignment and sizing of proposed sewers is presented in Drawing B4. Carrying capacities of the new sewers have been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes. Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

7.4.3 Daulatganj Wastewater Treatment Facility

(1) General

This section includes information pertaining to the City's existing wastewater treatment plant at Daulatganj. Detailed analysis of plant processes to identify potential improvements for optimizing performance of the present treatment plant is beyond the scope of the present Master Plan study. However, some general observations are made on the basis of site visits and the limited operational data provided to the JICA Study Team.

(2) Facility Overview

The work on the Daulatganj STP was started in November 2001 and it was fully commissioned in December 2002. The sewage treatment plant at Daulatganj has been designed with 3 x 14 mld modules giving a total capacity of 42 mld. There is provision for an additional 14 mld module and land for future expansion. Under the proposed Master Plan the treatment capacity will be augmented to 56 mld in 2015. This STP is operated and maintained by UPJN.

The current process diagram is presented in Drawing B5 and it illustrates the major process units. The site plan presented in Drawing B6 provides the actual layout and location of the various process units.

(3) Liquid Process Units

The flow scheme comprises preliminary treatment, followed immediately by fluidised aerated bed reactors and secondary clarifiers. There is no primary clarifier. The wastewater enters the stilling chamber and preliminary treatment is carried out in the subsequent bar screen and grit chamber.

The flow is divided into three equal streams and enters fluidised aerated bed (FAB) reactors (two in series) in which the conversion of soluble organic material into settleable biomass is accomplished by utilizing the metabolic mechanism of micro-organisms. The notable feature of fluidised aerated bed reactors is the presence of special plastic media that is used as the base material for the growth of the biomass, and there is no requirement for sludge recirculation.

In the secondary clarifiers, excess sludge is removed from the bottom and conveyed to solids handling process.

The effluent is chlorinated in order to comply with the criteria for Faeacal coliform. To save space, a circular chlorine contact chamber has been added to the perimeter of the secondary clarifier.

Table 7.6 contains an itemized list of major components related to liquid process. The various components are listed by treatment stage. Each component appears to be in good condition and working efficiently.

Table 7.6 Major Liquid Process Components

Level	Process	Component	Condition
Preliminary Treatment	Stilling chamber	1 – 4.6m x 4.6m x 2.5 m SWD	Good
	Bar screen chamber	4 – 1.0m x 6.8m x 0.566 m SWD	Good
	Grit chamber	3 – 6.0m x 6.0m x 1.0 m SWD	Good
Secondary Treatment	FAB reactors	6 – 10.6m diameter, SWD = 5.5 m	Good
Post Treatment	Secondary clarifiers	3 – 17.5m diameter, SWD =3.75 m	Good
	Chlorine contact tank	3 – 21.5m diameter, SWD = 2.75 m	Good

(4) Solids Handling Units

Sludge consists of biological sludge from secondary clarifiers. Table 7.7 provides an inventory of the solids handling process. The sludge that has settled at the bottom of clarifier is conveyed to the sludge thickener and transported directly to the sludge drying beds without digestion process, because the sludge produced from the FAB reactors is fully stabilised.

Table 7.7 Major Solids Handling Components

Process	Component	Condition
Sludge thickner	1 – 14.4m diameter, SWD = 3.0 m	Good
Sludge drying beds	11 – 15.0m x 16.0m 3 – 12.5m x 16.0m 6 – 7.5m x 7.5m	Good

(5) Evaluation

Average monthly data made available to the JICA Study Team is presented in Table 7.8 and Figure 7.6. The effluent quality data shows that average monthly BOD ranges from 16 to 37 mg/l (average 25 mg/l) and suspended solids from 23 to 86 mg/l (average 43 mg/l). These values represent removal efficiencies of 76% and 80% respectively.

Figure 7.6 also indicates that effluent efficiencies during January 2003 to May 2003 (this period corresponds to start-up period) are somewhat lower; whereas, the performance of June 2003 to January 2004 is well within the discharge criteria. This difference is due to the unstable activity of micro-organism in the reactors during habituation period. The FAB system appears to have the potential to perform well even when influent BOD increases in the future.

7.5 SEWERAGE DISTRICT II: KHWAJAPUR STP

7.5.1 General Description

This district is on the south side from Sharda Canal and, at present, the area has no sewage treatment plant. Some areas have existing sewer networks developed by the Lucknow Development Authority (LDA); however, collected sewage is discharged into natural nalas.

A large part of this area is occupied by low-density peri-urban settlements. It has recently experienced growth and is at present becoming urbanized. Wastewater flows are expected to increase with the recent extension of water supply services into the area.

7.5.2 Sewers

Tentative alignment and size of the future sewer network are shown in Drawing B7. Carrying capacities of the new trunk sewers have been computed in accordance with Manning's formula with values of 'n' = 0.015 corresponding to concrete pipes. Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

7.5.3 Khwajapur STP

The ultimate capacity of the treatment plant proposed for the year 2030 is 135 mld. A detailed comparison of various treatment process options is presented in Appendix A.

Table 7.9 Khwajapur STP: Preliminary Cost Comparison of Process Alternatives

Cost (Rs. million)	WSP	AL	AL+	AS	AS+	UASB++
Capacity 135 mld						
Land area for treatment process (ha)	169	47	101	27	81	47
Land cost	675	189	405	108	324	189
Capital cost	216	338	432	365	459	405
Annual O&M	8	41	43	49	51	18
Total present value (including land cost)	1,018	1,182	1,530	1,290	1,642	922

The comparison indicates that waste stabilization ponds offer the lowest O&M cost. However the land requirements are excessive. The next most attractive option would be UASB with post treatment by aerated lagoons because it is simple to operate and maintain, and has a low running cost compared to other options. Effluent could be discharge to the Sai River or alternatively to irrigation. The addition of maturation ponds to reduce faecal coliform counts would significantly increase the land requirements probably beyond the limits of land available. The effluent would be chlorinated if land cannot be acquired for the maturation ponds.

A potential site has been identified near south/east of the Airport but UPJN has not yet confirmed that land could be acquired. Final site location and the potential for effluent re-use should be investigated in more detail in subsequent studies.

7.6 SEWERAGE DISTRICT III: KAKRAHA STP

7.6.1 General Description

This district is on the left bank of the Gomti River which is called Trans-side. The Trans Gomti Trunk Sewer (TGTS) runs parallel to the river from west to east and collects city sewage through connecting lateral sewers. The TGTS discharges to the Trans Gomti Pumping Station (TGPS) near Nishatganj Bridge. The TGTS starts from the left bank of Daliganj D/S nala and receives discharge from Daliganj IPS located near the head of this sewer through a rising main. This Daliganj IPS receives discharge from Mohan Meakin Sewer and Daliganj Sewer, and sewage is pumped into the TGTS through the rising main. At present, Daliganj IPS is utilized as a flood pumping station; therefore, wastewaters from Mohan Meakin Sewer and Daliganj Sewer flow directly into the Gomti river.

Mahanagar locality contributes sewage into the Mahanagar sewage pumping station at Nishatganj crossing from where it is pumped through the rising main coming from the Paper Mill colony sewage pumping station. The rising main diameter increases to 375 mm ultimately joining the 1350 mm diameter rising main near the Paper Mill. The diameter of the rising main remains 1350 mm up to Kukrail nala.

Chhaoni, Mirzapur, Janki Puram, ALiganj and Vikas Nagar areas in the northwest of the Kukrail nala have existing sewer networks developed by the Lucknow Development Authority (LDA) and Housing Board. All sewage collected is discharged directly into the Kukrail nala. There are also existing sewer networks at Indira Nagar and Gomti Nagar.

At present the area has no sewage treatment plant; however, under the GoAP (Gomti Action Plan), one sewage treatment plant at Kakraha has been sanctioned by NRCD.

Under this Master Plan, all wastewaters of the Trans Gomti area are proposed to be conveyed to the Kakraha STP. This district shall consist of 7 separate sewerage Zones each with its own pumping station, as follows:

- Zone A: Mohan Meakin area conveying sewage to sanctioned Mohan Meakin PS
- Zone B: Trans core area conveying sewage to existing TGPS.
- Zone C: Lunia Purwa area conveying sewage to proposed Lunia Purwa PS
- Zone D: Hasanganj area conveying sewage to proposed Kukrail No. 2 PS
- Zone E: Vikas Nagar area conveying sewage to proposed Kukrail No. 3 PS.
- Zone F: Kukrail Nala left bank side area conveying sewage to sanctioned Kukrail No. 1 PS
- Zone G: Gomti Nagar area conveying sewage to sanctioned Guari MPS

Tentative alignment and size of the future sewer network for District III are shown in Appendix B Drawing B8.1 to 8.3.

7.6.2 Zone A

(1) Daliganj No. 1 Pumping Station

This pumping station has been sanctioned by NRCD on the left bank at the tail end of Daliganj U/S Nala under the GoAP (Gomti Action Plan).

As per the sanctioned plan, wastewater from four nalas; namely, the Maheshganj Nala, Rooppur Khadra Nala, Mohan Meakin nala and Daliganj U/S nala, will be collected at the Daliganj No.1 Pumping Station and diverted to the Trans Gomti Trunk Sewer (TGTS). The sanctioned pumping capacity of this pumping station is based on the flow measured for each nala in 1993 (flows measured by UPJN). The pumping station is sanctioned for an ultimate average discharge of 34 mld and a peak flow of 635 lps.

Site investigation by the JICA Study Team and UPJN has revealed that there is no space to construct the collection chamber and sump for sanctioned PS at Daliganj U/s nala outfall. Furthermore, levelling surveys and hydraulic calculations by the JICA Study Team confirm that the Trans Gomti Trunk Sewer does not have sufficient hydraulic capacity to accept additional flows from the pumping station. As a result of the Study Team's assessment, UPJN is at present revising the sanctioned project as follows:

- Only Daliganj U/S Nala will be tapped at Daliganj No.1 Pumping Station ;
- Flows from Daliganj No.1 PS will be diverted to TGPS;
- The other three nalas i.e., Maheshganj nala, Rooppur Khadra nala and Mohan Meakin Nala will be tapped at the tail end of each nalas and diverted to Mohan Meakin Pumping Station;
- Flow from Mohan Meakin PS will be pumped by force main to TGPS to prevent overloading the TGTS.

The Master Plan for sewerage development has taken revised proposals of UPJN into account in laying out future sewerage development.

(2) Mohan Meakin PS

This pumping station is also sanctioned by NRCD on the left bank at the tail end of Mohan Meakin nala. In the present Master Plan the pumping station will be in the same location as proposed under the sanctioned GoAP.

For this sanctioned project, three nalas; namely, the Maheshganj nala, Rooppur Khadra Nala and Mohan Meakin Nala, will be tapped and diverted to the Mohan Meakin Pumping Station. The wastewater from Mohan Meakin PS will be conveyed to Trans Gomti Pumping Station (TGPS) through proposed rising main. The tentative alignment of this proposed rising main is shown in Drawing B8.1 and in the Master Plan the pumping station will be in the same location as proposed.

The required capacity in the present Master Plan is the average discharge of 28 mld in the year 2030. Details of the required capacities of pumps, rising mains and sumps are presented in Table 7.5.
The pumping station will cater to the following design flows from Zone A:

- 2015 :19 mld average :441 lps peak
- 2030 :28 mld average :648 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 6,600 lpm
- Pumps ultimate stage :6 x 10,200 lpm
- Rising main :800 mm dia. L= 4,000m
- Sump capacity :194 m^3

7.6.3 Zone B

(1) Existing Trans Gomti Trunk Sewer

The invert levels for this sewer have been resurveyed for the Master Plan by UPJN in order to provide data for hydraulic calculations. The existing TG Trunk Sewer has a carrying capacity of 300 lps as computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to old concrete sewers.

Sewage quantities in Table 7.2 are peak flows that the collection system has to sustain. From the hydraulic analysis it is evident that the TG Trunk Sewer does not have sufficient hydraulic capacity. Furthermore the trunk sewer is old and reported to be in poor condition. Therefore, it is necessary to

reduce the sewer sub-catchments area that contributes to the TG Trunk Sewer by providing a relief sewer.

The sub-catchments identified in Table 7.10 will be diverted away from the TG sewer and conveyed from proposed Mohan Meakin PS to TGPS. The plan of the trunk sewer and lateral sewers is shown in Drawing B9.6 and the profile of the trunk sewer is shown in Drawing B9.7.

Table 7.10 Sub-catchment of TG Trunk Sewer (existing & proposed)

Sub-catchment	Wastewater flow to	
	Existing	Proposed.
TS-10	TG Trunk Sewer	Mohan Meakin PS
TS-10A		
TS-12		Daliganj No.1 PS
TS-13		TG Trunk Sewer
TS-14		
TS-15		
TS-16		

(2) TG Pumping Station

The TG Pumping Station is located near the Nishatganj Bridge on left bank of the Gomti River. The Trans Gomti Trunk Sewer receives discharge from the existing Daliganj IPS. This Daliganj IPS receives discharge from the Mohan Meakin and Daliganj Sewers, and sewage is pumped into the TG Trunk Sewer through the rising main. At present, the Daliganj IPS is utilized as a flood pumping station; therefore, wastewaters from both the Mohan Meakin and Daliganj Sewers flow directly into the Gomti River.

The GoAP has proposed to renovate the TG Pumping Station with the provision of additional sump capacity. The TG Pumping Station is to receive discharge from the existing TG Trunk Sewer and the newly proposed Daliganj No. 1 Pumping Station through the TG Trunk Sewer and the sanctioned Daliganj No. 1 Pumping Station is to collect wastewater from the four nalas mentioned above in the previous Subsection. The required capacities in the GoAP are in the order of:

- Average discharge : 62 mld in the year 2034
- Peak discharge : 717 lps in the year 2034

However, UPJN is in the process of revising the sanctioned plan as mentioned in Subsection 7.6.2.1 and 7.6.2.2.

Under the present Master Plan, the existing TG Pumping Station will collect wastewater flow from the TG Trunk Sewer, Daliganj No.1 PS and Mohan Meakin PS.

From the TG Pumping Station the wastewater is to be conveyed via rising main which will run across Kukrail nala on the way to the Kukrail No.1 Pumping Station. This raising main also has been sanctioned by NRCD under the GoAP.

Details of the required capacities of pumps, rising mains and sumps are presented in Table 7.5. The pumping station will cater to the following design flows from Zone B:

- 2015 :35 mld avg. : 810 lps peak
- 2030 :51 mld avg. : 1,181 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 12,600 lpm
- Pumps ultimate stage :6 x 18,000 lpm
- Rising main :1 x 600mm dia. L= 2,590m
- Sump capacity :354 m^3 (less 74 m3 existing) = 280 m^3

7.6.4 Zone C

(1) Lunia Purwa Pumping Station

A new pumping station is proposed to collect wastewater from Zone C and is to be located in lower elevations near Ghosi Purwa. Wastewater is to be conveyed via a 700 mm diameter rising main of approximately 2400 m to a new gravity sewer (Mahanagar Sewer) that will lead to the Kukrail No. 2 Pumping Station. Details of the required capacities of pump, rising main and sump are given in Table 7.5. The pumping station will cater to the following design flows from Zone A:

- 2015 :12 mld avg. : 278 lps peak
- 2030 :33 mld avg. : 764 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 4,200 lpm
- Pumps ultimate stage :6 x 13,000 lpm
- Rising main initial stage :1 x 700 mm dia. L= 2,380m
- Rising main ultimate :2 x 700 mm dia. L= 2,380m
- Sump capacity :229 m^3

7.6.5 Zone D

(1) Mahanagar Sewer

The tentative alignment of this proposed relief sewer is shown in Drawing B8.1. The beginning point of Mahanagar Sewer (Node number NN1) receives discharge from Lunia Purwa Pumping Station through rising main. The Mahanagar Sewer leads towards the Kukrail No. 2 Pumping Station by gravity. Carrying capacity of the proposed sewers has been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

(2) Kukrail Nala Interceptor Right Bank

The Kukrail nala is the largest nala on the Trans Gomti side. The right bank of Kukrail nala is divided into upstream, middle, and downstream areas. Zone D includes the middle area (sewer sub-catchments: TS-21A, TS-22A) and this Zone will be served by the interceptor sewer to the Kukrail No. 2 Pumping Station located on the right bank of Kukrail nala.

The sewage from Kukrail No. 2 Pumping Station is to be pumped though a rising main which will cross Kukrail nala to point "KC1" of Kukrail Nala Interceptor Left Bank.

Drains discharging into Kukrail nala will be collected into the right bank interceptor. The tentative alignment of this sewer is shown in Drawing B8.1. The carrying capacity of the proposed sewers has been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

(3) Kukrail No. 2 Pumping Station

This pumping station would be located on the right bank of Kukrail nala in close proximity with Faizabad Road. The pumping station will received inflow from the 1600 mm diameter Mahanagar Sewer and the 2000 mm diameter Kukrail Nala interceptor on the right bank. Wastewater is to be conveyed via a 600 mm diameter rising main of approximately 300 m that will run across Kukrail nala to a proposed Kukrail Nala Interceptor Left Bank leading to Kukrail No.1 PS.

Details of the required capacities of pumps, rising mains and sumps are presented in Table 7.5. The pumping station will cater to the following design flows from Zone D:

- 2015 :28 mld avg. : 648 lps peak
- 2030 :59 mld avg. : 1366 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 10,800 lpm
- Pumps ultimate stage :6 x 21,000 lpm
- Rising main initial stage :1 x 900 mm dia. L= 300m
- Rising main ultimate :2 x 900 mm dia. L= 300m
- Sump capacity :410 m^3

7.6.6 Zone E

(1) Vikas Nagar Sewer

This zone includes two future service areas (FSA122, FSA126). Sewage from Zone E will be collected by gravity to the newly proposed Vikas Nagar Sewer and flow into Kukrail No. 3 Pumping Station. The sewage from Kukrail No. 3 Pumping Station will be pumped through the rising main crossing Kukrail nala to the point "KL1A" of Kukrail Nala Interceptor Left Bank (refer to Drawing B8.1).

The tentative alignment of this sewer is shown in Drawing B8.1. Carrying capacity of the proposed sewers has been computed in accordance with Manning's formulae with values of 'n' = 0.015 corresponding to concrete pipe Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

(2) Kukrail No. 3 Pumping Station

This pumping station will be located in the right bank of upstream near Sakte Purwa. The pumping station is to receive inflow from Vikas Nagar Sewer of 2000 mm diameter. Wastewater would be conveyed via a 1100 mm diameter rising main of approximately 700 m that will run across Kukrail nala to Kukrail Nala Interceptor Left Bank.

Details of the required capacities of pumps, rising mains and sumps are presented in Table 7.5. The pumping station will cater to the following design flows from Zone E:

- 2015 :49 mld avg. : 1134 lps peak
- 2030 :93 mld avg. : 2153 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 17,400 lpm
- Pumps ultimate stage :12 x 16,200 lpm
- Rising main initial stage :1 x 1100 mm dia. L= 700m
- Rising main ultimate :2 x 1100 mm dia. L= 700m
- Sump capacity :646 m^3

7.6.7 Zone F

(1) Kukrail Nala Interceptor Left Bank

Sewage from Zone F will be collected in gravity sewers and drains which would discharge into the left bank interceptor and also this proposed interceptor will receive sewage from Kukrail No.2 PS and Kukrail No.3 PS. The tentative alignment of this sewer is shown in Drawing B8.1. Carrying capacity of the proposed sewer has been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipe with some allowance for deposit of sediment. Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain

(2) Kukrail No. 1 Pumping Station

In the Gomti Action Plan (GoAP) this sanctioned pumping station is to intercept and divert wastewater from the tail end of Kukrail nala. The Kukrail No. 1 Pumping Station discussed in the Detailed Project Report (DPR) is designed to receive the sewage pumped from the CG Pumping Station and the TG Pumping Station through a common 1600 mm diameter PSC rising main. Sanctioned capacity is based on the flow measured in 1993 by UPJN. The wastewater from Kukrail No. 1 Pumping Station is proposed to be pumped though a 1400 mm diameter rising main to the sanctioned Guari Main Pumping Station and leading to the sanctioned STP at Kakraha.

The proposed capacities in the GoAP are:

- Average discharge : 320 mld in the year 2034
- Peak discharge : 5417 lps in the year 2034 (peak factor = 1.5)

In the present Master Plan the pumping station will be in the same location as proposed under the sanctioned GoAP will receive sewage from TGPS, Kukrail No.2 PS and Kukrail No.3 PS. In the GoAP, Kukrail No.1 PS will receive sewage from TGPS, CGPS and Kukrail nala. This sanctioned plan can be implemented in the interim period until Mastemau STP is augmented. The sanctioned capacity at Kukrail No.1 PS is larger than that proposed under the Master Plan because UPJN has assumed that nala flows will increase in the future i.e., proposed sewerage improvements may not reduce flows in the nalas because it may take time to implement sewerage in the catchment area it is therefore prudent to implement the larger sanctioned capacity at Kukrail No.1 PS. The station can be downsized at a later stage to much reduced flows if and when these begin to drop. Details of the required capacities of pumps, rising mains and sumps under the proposed Master Plan are presented in Table 7.5.

The pumping station will cater to the following design flows from Zone F:

- 2015 : 180 mld avg. : 4167 lps peak
- 2030 : 234 mld avg. : 5417 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :12 x 31,800 lpm
- Pumps ultimate stage :12 x 40,800 lpm
- Rising main :1 x 1800 mm dia. L= 4,100m
- Sump capacity :1,625 m^3

7.6.8 Zone G

(1) Gomti Nagar No. 1 Sewer and Gomti Nagar No. 2 Sewer

In the Gomti Nagar area, there are some sewer systems that have been developed by the Lucknow Development Authority (LDA). For the southeast area of Gomti Nagar, Gomti Nagar No. 1 Sewer and Gomti Nagar No. 2 Sewer will collect the wastewater flows by gravity and will discharge into the

Guari Main Pumping Station. Details of the existing and tentative alignments for the future sewer network are shown in Drawing B8.1.

Carrying capacities of the proposed sewer have been computed in accordance with Manning's formulae with values of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection systems have to sustain

(2) Gomti Nagar Main Sewer

This sewer will be installed at the central part of this zone from north to south. The sewer will have a large catchment area. The Gomti Nagar Main Sewer will lead to Guari Main Pumping Station. The tentative alignment of this sewer is shown in Drawing B8.1.

Carrying capacity of the proposed sewer has been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes. Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain

(3) Guari Main Pumping Station

As per the sanctioned GoAP this pumping station is proposed to be located on the north side of Northern Railway Varanasi Lucknow Loop line in Gomti Nagar. The Guari Main Pumping Station is designed to receive the sewage pumped from Kukrail No. 1 Pumping Station through a 1800 mm diameter raising main, and the GH Canal Pumping Station through a 1400 mm rising main that will cross the Gomti River. Sanctioned capacity is based on flows measured in 1993 by UPJN. The wastewater from Guari Main Pumping Station is to be pumped though a 2100 mm diameter rising main to the sanctioned Kakraha sewage treatment plant. The proposed capacities in the GoAP are:

- Average discharge : 478 mld in the year 2034
- Peak discharge : 8,102 lps in the year 2034

In this Master Plan the pumping station is proposed at the same location as that sanctioned under the GoAP but it will receive wastewater from of the Trans Gomti area only. The sanctioned GoAP project however, envisages that sewage from of the whole Trans Gomti area as well as, CGPS and GH Canal Pumping Station will be conveyed across the Gomti River to Guari MPS for treatment at Kakraha STP. This plan may be implemented in the interim period until proposed STP at Mastemau augmented after 2015. The sewage from the Guari Main Pumping Station is to be conveyed via two parallel rising mains to the proposed treatment plant at Kakraha.

The proposed capacities for this MPS in the Master Plan are far below those of the sanctioned plan. In the case of the sanctioned plan, i.e., The GoAP (Gomti Action Plan), sewage from the Cis Gomti area and the GH Canal Pumping Station was to be conveyed to the Guari Main Pumping Station. In the case of the present Master Plan, however, this pumping station will receive discharge from the Trans Gomti area only. Therefore, the catchment area for the pumping station is smaller.

Details of the required capacities of pumps, rising mains and sumps are presented in Tables 7.5. The pumping station will cater to the following design flows from Zone A:

- 2015 :344 mld avg. : 7,731 lps peak
- 2030 :323 mld avg. : 7,477 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :12 x 58,200 lpm
- Pumps ultimate stage :12 x 57,000 lpm
- Rising main initial stage :2 x 2100 mm dia. L= 4,100m
- Rising main ultimate :2 x 2100 mm dia. L= 4,100m

- Sump capacity :2,243 m^3

7.6.9 Kakraha STP

The District III at present has no sewage treatment plant. Under the Gomti Action Plan, sewage treatment plant at Kakraha has been sanctioned. The site for the proposed STP however, with ground elevation of about 103 m, is located on the eastern part of the Lucknow city near to the Khargapur Village. Projected flows based on populations in future service area are as follows:

- 345 mld in 2015
- 345 mld in 2030

UPJN in consultation with NRCD has elected to construct a 345 mld UASB plant, with 1 day retention time FPU and a 25 mld WSP system to treat projected sewage flows of 370 mld for the year 2014. The required land of 120 ha, has also been identified.

The proposed UASB plant will not be able to meet the required effluent standards set by NRCD. Therefore the Study Team recommends that the sanctioned plan be revised to include post treatment by Aerated Lagoons. The space allocated in the plan for the proposed WSP could be utilised for the Aerated Lagoons.

7.7 SEWERAGE DISTRICT IV: MASTEMAU STP

7.7.1 General Description

This district is on the right bank side of Gomti River called Cis-Side and includes the old city core with an old sewerage network. The main interceptor sewer named as Cis Gomti Trunk Sewer runs parallel to the river along the west to east axis leading to Cis Gomti Pumping Station (CG Pumping Station) near Nishatganj Bridge. It receives city sewage through lateral collector sewers.

In the past, the sewage from CG Pumping Station used to be pumped through a rising main across Nishatganj Bridge to a sewage farm. The rising main coming from TG Pumping Station also joined the rising main from CGPS and the combined rising main conveyed the city sewage to the sewage farm for irrigation. At present, however this system is defunct and the sewage farm also has become non existent. Therefore, the swage from CG Pumping Station goes directly into the Gomti River.

The GH Canal is the largest drain on the Cis-side and has wider sections and longer lengths
At present it serves as storm water and wastewater drain for the city and carries a substantial amount of sullage. Two old trunk sewers run parallel to the GH Canal on both banks. These sewers however are now defunct.

At present this district has no sewage treatment plant and under the GoAP, the sewage from this district is proposed to be conveyed to the sanctioned sewage treatment plant at Kakraha.

In the present Master Plan, a new sewage treatment plant has been proposed at Mastemau and all wastewaters of the Cis Gomti area are proposed to be conveyed to the Mastemau STP.

This district shall consist of four separate sewerage Zones each with its own pumping station or new sewer, as follows:

- Zone H: The core city area along the Gomti River conveying sewage to existing CGPS
- Zone I: The core city area to convey the sewage to the proposed new Cis Gomti Relief Sewer
- Zone J: GH Canal area conveying sewage to sanctioned GH Canal PS
- Zone K: Arjunganj-Telibagh area to convey sewage in to proposed new sewer along Sultanpur Road

Details of the existing and tentative alignments of future sewer network for District IV are shown in Drawing B9.1 and B9.4.

7.7.2 Zone H

(1) Existing Cis Gomti Trunk Sewer

The existing Cis Gomti Trunk Sewer starts from right bank of Sarkata nala near western gate of Chhota Imambara and receives discharge from some lateral sewers on its way, as follows:

- Sarkata A Sewer	750 mm dia	3,360m length
- Sarkata B Sewer	1050 mm dia	3,460m length
- Pata Nala Sewer	900 mm dia	1,430m length
- Shahmina Road Sewer	300 mm dia	800m length
- Wazirganj Sewer	1200 mm dia	3,540m length
- Kutchchary Road Sewer	450 mm dia	1,000m length
- Ashok Marg Sewer	600 mm dia	1,500m length

The size of the existing Cis Gomti Trunk Sewer gradually increases from 700 mm diameter to 2100 mm diameter and the total length is about 7290 m. The plan of the trunk sewer and lateral sewers is shown in Drawing B9.6 and the profile of the trunk sewer is shown in Drawing B9.7.

This sewer has been surveyed by UPJN for the present Master Plan in order to provide invert elevations for hydraulic calculations. The existing CG Trunk Sewer has a carrying capacity of 1900 lps as computed in accordance with Manning's formula with value of 'n' = 0.017 corresponding to old brick sewers.

Sewage quantities in Table 7.2 are peak flows that the collection system has to sustain. From the hydraulic analysis it is evident that the Cis Gomti Trunk Sewer does not have sufficient hydraulic capacity. Furthermore the trunk sewer is old (1960) and reported to be in poor condition.

Therefore, a new relief sewer is proposed to reduce the inflow to the Cis Gomti Trunk Sewer. For new catchment area, the hydraulic analysis is as given in Table 7.3. Sewage quantities are peak flows that the collection system has to sustain.

(2) Existing Cis Gomti Pumping Station (CG Pumping Station)

At present, CG Pumping Station receives discharge from Cis Gomti Trunk Sewer. The flow from the Wazir Hasan Road Sewer also is pumped into the sump of CGPS through an Auxiliary Pumping Station located in the same campus. Thus, all wastewater from the Cis Gomti area flows in to the CG Pumping Station.

Under the GoAP, the pumping station is proposed to be rehabilitated for an ultimate average discharge of 172 mld and a peak flow of 2,980 lps. However, the Cis Gomti Trunk Sewer, does not have sufficient hydraulic capacity as mentioned in Subsection 7.7.2.1. Therefore, the new Cis Gomti Relief Sewer is proposed in this Master Plan to reduce the inflow to the CG trunk sewer and hence the average discharge capacity of only 51 mld will be required at CG Pumping Station which is far less than the capacity proposed in the sanctioned GoAP.

As proposed in the present Master Plan sewage from this pumping station will be conveyed to the proposed Cis Gomti Relief Sewer. However, UPJN has a sanctioned project to convey sewage from CG Pumping Station across the Gomti River for treatment at Kakraha STP. This plan may be implemented in the interim period until proposed STP at Mastemau is augmented.

Details of the required capacities of pumps, rising mains and sumps are presented in Table 7.5. The pumping station will cater to the following design flows from Zone A:

- 2015 :50 mld avg. : 1,157 lps peak
- 2030 :51 mld avg. : 1,181 lps peak

The new pumping station will have the following characteristics:

- Pumps :6 x 18,000 lpm
- Rising main :1 x 1100 mm dia. L= 2,000m
- Sump capacity :354 m^3

7.7.3 Zone I

(1) Cis Gomti Relief Sewer

The hydraulic capacity of the existing Cis Gomti Trunk Sewer is smaller than previously assumed and the sewer is in poor physical condition as mentioned above. Therefore a new Cis Gomti Relief sewer has been proposed in the Master Plan and its alignment has been so proposed that the it may be able to take in much of the sewage from the center core. The sewer sub-catchment areas for existing Cis Gomti Trunk Sewer and the proposed Cis Gomti Relief Sewer have been proposed, as tabulated below:

Table 7.11 Sub-catchment of CG Trunk Sewer (Existing & Proposed)

Sub-catchment	Wastewater flow to	
	Existing	Proposed
TS-10 ↓ TS-22	Existing Cis Gomti Trunk Sewer	Existing Cis Gomti Trunk Sewer
TS-21A		
TS-12A ↓ TS-18A		Cis Gomti Relief Sewer

A tentative alignment based on site investigations with UPJN is shown in Drawing B9.1. The carrying capacity of the proposed sewer has been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

7.7.4 Zone J

(1) GH Canal Interceptor Sewers

The GH Canal is the largest drain on the Cis Gomti side. At present the zone has no sewers and wastewater flows directly into the GH Canal. Sanctioned under the GoAP II (Gomti Action Plan Phase II), the GH Canal Pumping Station is designed to tap flow at the tail end of GH Canal. In the Master Plan, not only the GH Canal Pumping Station but also the GH Canal Interceptor Sewers are proposed on the left and right banks. For the GH Canal area, all wastewater will flow into the two interceptors and will be conveyed to the GH Canal Pumping Station located on the right bank of the GH Canal.

The tentative alignments of three sewers is shown in Drawing B9.1and typical cross sections showing the conceptual arrangements of the sewers along the right and left banks is shown in Drawing B9.3.

(2) GH Canal Pumping Station

A pumping station at the tail end of the GH Canal has already been sanctioned under the GoAP to tap and divert wastewater from the GH Canal. Under the sanctioned project the wastewater from the GH Canal Pumping Station is proposed to pumped through a 1400 mm diameter rising main across the Gomti River to the sanctioned Guari Main Pumping Station.

In the present Master Plan, the pumping station is proposed at the same location as that proposed in the GoAP. It will receive wastewater from the newly proposed GH Canal Interceptors of the right and left banks. At present, wastewater of the whole Zone J flows directly into GH Canal. Therefore during Stage I, the canal will serve as a conveyance vehicle but in the future, wastewater will be collected by these interceptors.

The sewage from GH Canal Pumping Station will be conveyed by rising main to the new Cis Gomti Relief Sewer (Node number CT9). However, as mentioned above UPJN has sanctioned project to convey sewage from GH Canal pumping station to Guari MPS across the Gomti River for treatment at Kakraha STP. This plan could be implemented in the interim period until proposed STP at Mastemau is augmented.

Under the GoAP, the pumping station is sanctioned for an ultimate average discharge of 158 mld and peak flow of 2560 lps. In this Master Plan the pumping station would be required to handle an average discharge of 125 mld which is less than the sanctioned capacity. Sanctioned capacity is based on flows of 134 mld measured by UPJN in 1993. The flow measured by the Study Team in 2003 was 100 mld which correlates with sewage projections based on population in the catchment area. Therefore the Master Plan has adopted the projected lower capacity for the year 2015 and 2030 based on population in the catchment area. The flow in the nala should however, be reconfirmed before determining the required design capacity. Several measurements should be taken for two or three days over a period of a few months. Assuming that sewerage will be improved, the peak sullage flow in GH Canal is expected to decrease, however it is difficult to predict when or how much less the flows will be. If sewerage schemes are not implemented the flow could even increase, therefore a program of on-going flow monitoring is essential.

Sanctioned pumping station data is presented in Table 7.4. Details of the capacities of pumps, rising mains and sumps proposed in the Master Plan are presented in Table 7.5. The pumping station will cater to the following design flows from Zone A:

- 2015 :107 mld avg. : 2,477 lps peak
- 2030 :125 mld avg. : 2,894 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :12 x 18,600 lpm
- Pumps ultimate stage :12 x 22,200 lpm
- Rising main ultimate :1 x 1600 mm dia. L= 2,000m
- Sump capacity :868 m^3

(3) Martin Purwa Main Pumping Station

This pumping station will be located on the north side of Northern Railway Track in the Martin Purwa locality adjacent to the existing storm water pumping station. The pumping station will receive discharge from Cis Gomti Relief Sewer via a 2200 mm diameter gravity sewer and GH Canal Pumping Station. However in the interim period until Mastemau STP is augmented, sewage from GH Canal pumping station will be conveyed to Kakraha STP as mentioned in Sub section 7.7.4.2. Sewage from this main pumping station will be conveyed by rising main to Dilkusha crossing at the head of the proposed Sultanpur Road Trunk Sewer leading to the Mastemau STP.

Details of the capacities of pumps, rising mains and sumps are presented in Table 7.5.

- 2015 :85 mld avg. : 1,968 lps peak
- 2030 :246 mld avg. : 5,694 lps peak

The new pumping station will have the following characteristics:

- Pumps initial stage :6 x 30,000 lpm
- Pumps ultimate stage :12 x 43,200 lpm
- Rising main ultimate :2 x 1600 mm dia. L= 890m
- Sump capacity :1,708 m^3

7.7.5 Zone K

(1) Sultanpur Road Trunk Sewer

The tentative alignment of this sewer is shown in Drawing B9.4. The beginning point of Sultanpur Road Trunk Sewer (Node number AR1) will receive discharge from Martin Purwa Main Pumping Station through rising main. The Sultanpur Road trunk sewer will lead towards the Mastemau STP by gravity.

Carrying capacity of the proposed sewer has been computed in accordance with Manning's formulae with values of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

(2) Shakurpur Sewer, Lilamatha Sewer, and Ghuswal Sewer

Sewage from Zone K, FSA123 and FSA124 is to be collected in the three proposed gravity sewers (Shakurpur Sewer, Lilamatha Sewer, and Ghuswal Sewer) and conveyed to treatment plant at Mastemau. The Lilamatha Sewer is to be installed at the central area of this Zone from north to south. This sewer will join with Shakurpur sewer at point LS3 on the way to the Ghuswal Sewer, which will further proceed to the treatment plant at Mastemau.

The tentative alignments of these sewers are shown in Drawing B9.4. Carrying capacities of these proposed sewers have been computed in accordance with Manning's formula with value of 'n' = 0.015 corresponding to concrete pipes Sewage quantities in Table 7.3 are peak flows that the collection system has to sustain.

7.7.6 Mastemau STP

The proposed site far this STP with ground elevation of about 107 m is located on the eastern part of the Lucknow city near to the Gomti River. The District at present has no Sewage Treatment Plant. Projected flows based on populations in future service area are as follows:

- 100 mld in 2015
- 305 mld in 2030

A detailed comparison of various treatment process options is presented in Appendix A and discussed in Section 6 of this Report. UASB with post treatment by Aerated Lagoons has been selected as the preferred treatment process because it is the most cost effective solution. Effluent can be discharged to the Gomti River or alternatively to irrigation. The effluent would be chlorinated if land cannot be acquired for the maturation ponds.

A potential site has been identified by UPJN but availability of land has not yet been confirmed. Final site location and the potential for effluent re-use should be investigated in more detail in subsequent studies.

Table 7.1 Nalas Measured Flow

	Name of Nala & Drain	Measured Discharge (mld)				Remark
		Measured by UPJN			Measured by JICA Study	
		1993	2003	2004	2003	
CIS SIDE	NAGARIA NALA	-	10.10	-	-	Diverted and Intercepted into STP under GoAP Ph-I.
	GAUGHAT NALA	1.80	-	-	-	Diverted and Intercepted into STP under GoAP Ph-I.
	SARKATA NALA	18.00	18.00	-	-	Diverted and Intercepted into STP under GoAP Ph-I.
	PATA NALA	7.80	16.73	-	-	Diverted and Intercepted into STP under GoAP Ph-I.
	SARKATA Sewer	-	22.00	-		Intercepted into Cis Gomti Trunk Sewer under GoAP Ph-I.
	PATA Sewer	5.20	10.00	-	-	Intercepted into Cis Gomti Trunk Sewer under GoAP Ph-I.
	NER U/S NALA	0.50	-	0.00	-	
	NER D/S NALA	0.50	1.46	1.15	-	
	WAZIRGANJ NALA	43.00	14.00	-	10.80	Intercepted into Cis Gomti Trunk Sewer under GoAP Ph-I.
	GHASIYARI MANDI NALA	10.00	13.50	-	14.90	Intercepted into Cis Gomti Trunk Sewer under GoAP Ph-I.
	CHINA BAZAR NALA	2.00	2.94	3.15	4.10	
	LAPLACE NALA	1.00	1.60	3.16	16.30	
	JOPLIMG ROAD NALA	1.00	0.91	0.98	-	
	LAMARTINIERE NALA	0.50	0.02	0.02	-	
	JIAMAU NALA	Running almost dry	0.29	0.14	-	
	G.H. CANAL	73.00	142.56	102.18	100.70	
TRANS SIDE	MAHESH GANJ NALA	Running almost dry	3.80	6.39	-	
	ROOPPUR KHADRA NALA	0.50	1.20	0.95	-	
	MOHAN MEAKIN	3.00	5.74	6.95	5.20	
	DALIGANJ U/S NALA	8.00	7.37	6.35	-	
	DALIGANJ D/S NALA	1.00	1.47	2.64	-	
	ARTS COLLEGE NALA	0.50	1.73	1.58	-	
	HANUMAN SETU NALA	0.50	6.28	4.09	-	
	T.G.P.S. DRAIN	1.00	1.66	0.27	-	
	KEDARNATH NALA	2.00	3.20	3.08	-	
	NISHATGANJ NALA	1.00	1.66	1.39	-	
	BABA KA PURWA NALA	Running almost dry	0.12	0.09	-	
	KUKRAIL NALA	29.00	97.75	85.71	73.10	
	GOMTINAGAR	18.00	-	-	3.70	

NOTE CIS SIDE : Right Bank of Gomti River TRANS SIDE : Left Bank of Gomti River

Table 7.2 Existing Trunk Sewers: Hydraulic Capacity Analysis (Page 1 of 3)

District III: Trans Gomti Truink Sewer (1/1)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
Mohan Meakin Sewer																			
M1	M2	46,119	46,119	208	450	480	429	107.96	106.84	110.87	109.69	2.38	2.32	0.75	120	0.80	0.857	116	
M2	M3	0	46,119	208	450	32	267	106.84	106.72	109.69	109.29	2.32	2.04	0.95	152	0.80	1.086	147	
M3	D5	0	46,119	208	600	120	255	106.72	106.25	109.29	111.05	1.89	4.12	1.18	333	0.80	1.344	323	
Daliganj Sewer																			
D2	D3	15,852	15,852	84	450	502	120	111.61	107.41	112.73	109.09	0.59	1.15	1.42	226	0.80	1.622	219	
D3	D5	0	15,852	84	600	154	133	107.41	106.25	109.09	111.05	1.00	4.12	1.64	463	0.80	1.865	448	
D5	MMH	0	15,852	84	600	70	109	106.25	105.61	111.05	111.61	4.12	5.32	1.80	510	0.80	2.054	493	
Qutubpur Sewer																			
K1	K2	14,495	14,495	78	600	202	145	108.19	106.80	109.35	108.35	0.48	0.87	1.56	442	0.80	1.782	428	
K2	K3	0	14,495	78	600	20	333	106.80	106.74	108.35	107.97	0.87	0.55	1.03	292	0.80	1.176	282	
K3	MMH	0	14,495	78	600	35	31	106.74	105.61	107.97	111.61	0.55	5.32	3.39	957	0.80	3.860	927	
TG Trunk Sewer																			
MMH	TT1	14,378	90,844	367															
TT1	TT1A	90,844	90,844	367	900	300	2308	106.55	106.42	108.70	108.57	1.15	1.15	0.51	327	0.80	0.586	317	
TT1A	TT2	0	90,844	367	900	350	2333	106.42	106.27	108.57	109.67	1.15	2.40	0.51	325	0.80	0.583	315	
TT2	TT3	21,095	111,939	452	900	330	1650	106.27	106.07	109.67	109.67	2.40	2.60	0.61	387	0.80	0.693	374	
TT3	TT4	0	111,939	452	900	470	1516	106.07	105.76	109.67	109.56	2.60	2.80	0.63	403	0.80	0.723	390	
TT4	TT5	13,113	125,052	504	900	950	2568	105.76	105.39	109.56	108.94	2.80	2.55	0.49	310	0.80	0.555	300	
TT5	TGPS	0	125,052	504	900	950	2568	105.76	105.39	109.56	108.94	2.80	2.55	0.49	310	0.80	0.555	300	
(TS17)	TGPS	50,826	50,826	205															
(TS18)	TGPS	12,538	12,538	66															
Total flow to	TGPS	12,538	200,954	812															

Table 7.2 Existing Trunk Sewers: Hydraulic Capacity Analysis (Page 2 of 3)

District IV: Cis Gomti Truink Sewer (1/2)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
CT51	**CT46**	**5,362**	**5,362**	**30**	**750**	**269**	**690**	**108.76**	**108.37**	**111.23**	**111.07**	**1.64**	**1.87**	**0.74**	**325**	**0.80**	**0.838**	**314**	**CG Trunk Sewer (CS11)**
SA5	SA4	79,969	79,969	322	450	1,995	607	115.74	112.45	117.69	114.65	**1.42**	**1.67**	0.56	89	0.80	0.635	86	
SA4	SA3	24,606	104,575	423	600	856	335	112.45	109.90	114.65	113.65	**1.52**	**3.07**	0.91	257	0.80	1.035	248	Sarkata A Sewer
SA3	SA2	14,763	119,338	482	750	460	460	109.90	108.90	113.65	110.62	**2.92**	**0.89**	0.90	397	0.80	1.025	384	
SA2	CT46	3,691	123,029	497	750	47	582	108.90	108.82	110.62	111.07	**0.89**	**1.42**	0.80	353	0.80	0.911	342	
CT46	**CT43**	**123,029**	**128,391**	**518**	**1,050**	**383**	**912**	**108.37**	**107.95**	**111.07**	**110.01**	**1.55**	**0.91**	**0.80**	**692**	**0.80**	**0.911**	**670**	**CG Trunk Sewer (CS10)**
SB7	SB6	31,689	31,689	143	450	480	475	115.93	114.92	118.73	118.42	**2.27**	**2.97**	0.63	100	0.80	0.718	97	
SB6	SB5	6,338	38,027	170	600	210	568	114.92	114.55	118.42	118.28	**2.82**	**3.05**	0.70	197	0.80	0.796	191	
SB5	SB4	31,689	69,716	281	750	599	302	114.55	112.56	118.28	115.93	**2.90**	**2.54**	1.11	491	0.80	1.267	475	Sarkata B Sewer
SB4	SB3	19,014	88,730	358	900	597	340	112.56	110.81	115.93	114.91	**2.37**	**3.10**	1.18	751	0.80	1.346	727	
SB3	SB2	34,224	122,954	497	1,050	1,557	654	110.81	108.43	114.91	110.59	**2.95**	**1.01**	0.94	817	0.80	1.076	791	
SB2	CT43	3,814	126,768	511	1,050	14	37	108.43	108.06	110.59	110.19	**1.01**	**0.98**	3.95	3,424	0.80	4.508	3,314	
CT43	**CT39A**	**126,768**	**255,159**	**1,031**	**1,400**	**351**	**2194**	**107.95**	**107.79**	**110.01**	**110.44**	**0.53**	**1.11**	**0.62**	**961**	**0.80**	**0.711**	**930**	**CG Trunk Sewer (CS12)**
P4	P3	148,044	148,044	599	750	544	232	112.48	110.14	115.43	113.49	**2.12**	**2.52**	1.27	560	0.80	1.444	542	
P3	P2	31,024	179,068	722	900	860	691	110.14	108.89	113.49	110.34	**2.35**	**0.45**	0.83	527	0.80	0.945	511	Pata Sewer
P2	CT39A	5,475	184,543	745	900	17	340	108.89	108.84	110.34	110.59	**0.45**	**0.75**	1.18	751	0.80	1.346	727	
CT39A	**CT30A**	**184,543**	**439,702**	**1,775**	**1,500**	**1,159**	**2318**	**107.79**	**107.29**	**110.44**	**109.79**	**1.01**	**0.87**	**0.64**	**1,124**	**0.80**	**0.725**	**1,088**	**CG Trunk Sewer (CS13)**
Shahmina Rd. Sewer + NER	CT30A																		Shahmina Rd. Sewer + NER U/S Drain
CT30A	**CT29**	**12,674**	**452,376**	**1,827**	**1,650**	**77**	**1283**	**107.29**	**107.23**	**109.79**	**109.71**	**0.72**	**0.69**	**0.91**	**1,946**	**0.80**	**1.037**	**1,884**	**CG Trunk Sewer (CS14)**
NER D/S Drain	CT29																		NER D/S Drain
CT29	**CT27**	**452,376**	**452,376**	**1,827**	**1,650**	**428**	**1297**	**107.23**	**106.90**	**109.71**	**109.44**	**0.69**	**0.75**	**0.91**	**1,937**	**0.80**	**1.033**	**1,875**	**CG Trunk Sewer**
WG6	WG5	33,914	33,914	153	600	750	286	117.73	115.11	120.63	118.31	**2.22**	**2.52**	0.98	278	0.80	1.121	269	
WG5	WG4	22,276	56,190	227	800	650	558	115.11	113.95	118.31	116.85	**2.31**	**2.01**	0.85	429	0.80	0.972	415	
WG4	WG3	11,638	67,828	275	1,050	850	193	113.95	109.55	116.85	112.15	**1.75**	**1.45**	1.74	1,503	0.80	1.979	1,455	Wazirganj Sewer
WG3	WG2	41,361	109,189	441	1,200	1,244	754	109.55	107.90	112.15	110.26	**1.29**	**1.04**	0.96	1,087	0.80	1.096	1,052	
WG2	CT27	3,671	112,860	455	1,200	46	148	107.90	107.59	110.26	109.88	**1.04**	**0.97**	2.17	2,450	0.80	2.469	2,371	

Table 7.2 Existing Trunk Sewers: Hydraulic Capacity Analysis (Page 3 of 3)

District IV: Cis Gomti Truink Sewer (2/2)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
CT27	**CT25**	**112,860**	**565,236**	**2,282**	**1,800**	**503**	**1479**	**106.90**	**106.56**	109.88	110.28	**1.04**	**1.79**	**0.90**	**2,288**	**0.80**	**1.025**	**2,214**	**CG Trunk Sewer (CS15)**
Kutchary Rd.	CT25																		Kutchary Rd. Sewer
CT25	**CT22**	**55,279**	**620,515**	**2,504**	**1,800**	**667**	**1450**	**106.56**	**106.10**	**110.28**	**110.80**	**1.79**	**2.77**	**0.91**	**2,311**	**0.80**	**1.035**	**2,237**	**CG Trunk Sewer (CS16,17**
G3	G2	42,937	42,937	193	600	1,254	653	109.96	108.04	112.26	111.64	**1.62**	**2.92**	0.65	184	0.80	0.742	178	Ghasiyari Mandi Sewer
G2	CT22	28,513	71,450	288	900	984	631	108.04	106.48	111.64	110.83	**2.60**	**3.35**	0.87	552	0.80	0.988	534	
CT22	**CT20**	**71,450**	**691,965**	**2,792**	**1,950**	**281**	**1405**	**106.10**	**105.90**	**110.80**	**111.13**	2.62	3.14	**0.97**	**2,906**	**0.80**	**1.109**	**2,813**	**CG Trunk Sewer (CS18)**
China Bazar Drai	CT20																		China Bazar Drain
CT20	**CT17**	**12,653**	**704,618**	**2,844**	**2,100**	**516**	**1032**	**105.90**	**105.40**	**111.13**	**110.62**	2.99	2.99	**1.19**	**4,129**	**0.80**	**1.359**	**3,996**	**CG Trunk Sewer (CS19)**
Shahmina Rd. + Laplace Drain	CT17																		Shahmina Rd. + Laplace Drain
CT17	**CT8**	**17,629**	**722,247**	**2,916**	**2,100**	**1,165**	**4481**	**105.40**	**105.14**	**110.62**	**110.30**	2.99	2.93	**0.57**	**1,981**	**0.80**	**0.652**	**1,918**	**CG Trunk Sewer (CS20)**
CT8	**CT1**	**17,496**	**739,743**	**2,986**	**2,100**	**1,371**	**4570**	**105.14**	**104.84**	**110.30**	**109.93**	2.93	2.86	**0.57**	**1,964**	**0.80**	**0.646**	**1,901**	**CG Trunk Sewer (CS21)**
CT1	**CGPS**	**42,613**	**782,356**	**3,159**	**2,100**	**7**	**4567**	**104.84**	**104.84**	**109.93**	**109.93**	2.85	2.86	**0.57**	**1,964**	**0.80**	**0.646**	**1,901**	**CG Trunk Sewer(CS21A)**

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District I

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
Lakarmandi Sewer																			
LM1	HR3	57,968	57,968	234	700	2,300	1000	119.22	116.92	122.00	122.00	2.00	4.30	0.66	254	0.80	0.752	246	
Musabagh Sewer																			
MB1	MB2	27,124	27,124	123	600	1,910	900	114.32	112.20	117.00	115.00	2.00	2.12	0.63	178	0.80	0.716	172	
MB2	MB3	4,085	31,208	140	600	935	900	112.20	111.16	115.00	114.00	2.12	2.16	0.63	178	0.80	0.716	172	
MB3	HR5	13,518	44,726	200	700	810	1000	111.03	110.22	114.00	113.00	2.19	2.00	0.66	254	0.80	0.752	246	
Hardoi Road Trunk Sewer																			
HR1	HR2	135,083	135,083	545	1,200	2,400	2000	119.69	118.49	123.00	122.00	2.00	2.20	0.67	757	0.80	0.763	732	
HR2	HR3	54,817	189,900	767	1,400	1,510	2200	117.61	116.92	122.00	122.00	2.86	3.55	0.71	1,087	0.80	0.805	1,052	
HR3	HR4	20,695	268,563	1,085	1,600	675	2500	113.53	113.26	122.00	117.00	6.73	2.00	0.72	1,456	0.80	0.825	1,409	
HR4	HR5	20,695	289,258	1,168	1,600	675	2500	109.53	109.26	117.00	113.00	5.73	2.00	0.72	1,456	0.80	0.825	1,409	
HR5	HR6	7,466	341,450	1,379	1,600	560	2500	106.14	105.92	113.00	109.66	5.12	2.00	0.72	1,456	0.80	0.825	1,409	
HR6	Daulatganj STP	7,466	348,916	1,409	1,600	690	2500	102.86	102.58	109.66	106.32	5.06	2.00	0.72	1,456	0.80	0.825	1,409	
(CS-7A)	Daulatganj STP	61,362	61,362	248	800	351	1000	107.12	106.77	110.01	110.44	2.00	2.78	0.72	363	0.80	0.823	351	
Total flow to	Daulatganj STP	0	410,278	1,656															

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District II

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
Sarojni Nagar Sewer																			
SN0	SN1	105,262	105,262	425	1,000	3,050	1500	118.90	116.87	122.00	122.00	2.00	4.03	0.68	537	0.80	0.780	520	
SN1	Kwajapur STP	55,020	160,282	648	1,200	3,600	2000	116.67	114.87	122.00	120.00	4.02	3.82	0.67	757	0.80	0.763	732	
Chilawan-Garaura Sewer																			
SN2	Kwajapur STP	103,200	103,200	416	1,000	3,600	1500	119.30	116.90	123.00	120.00	2.60	2.00	0.68	537	0.80	0.780	520	
Trans Sharda Trunk Sewer																			
KN1	SN8	117,097	117,097	473	1,200	2,740	2000	119.69	118.32	123.00	123.00	2.00	3.37	0.67	757	0.80	0.763	732	
SN8	SN7	140,885	257,982	1,042	1,400	1,900	2200	118.12	117.25	123.00	123.00	3.35	4.21	0.71	1,087	0.80	0.805	1,052	
SN7	SN6	85,759	343,741	1,388	1,600	2,170	2500	117.05	116.18	123.00	122.00	4.21	4.08	0.72	1,456	0.80	0.825	1,409	
SN6	SN5	16,194	359,936	1,454	1,800	990	2500	115.98	115.59	122.00	121.00	4.07	3.46	0.78	1,993	0.80	0.893	1,929	
SN5	SN4	31,503	391,439	1,580	1,800	420	2500	115.59	115.42	121.00	121.00	3.46	3.63	0.78	1,993	0.80	0.893	1,929	
SN4	SN3	47,567	439,005	1,773	1,800	1,930	2500	115.42	114.65	121.00	119.00	3.63	2.40	0.78	1,993	0.80	0.893	1,929	
SN3	Kwajapur STP	160,908	599,913	2,421	2,000	1,050	2500	114.45	114.03	119.00	120.00	2.42	3.84	0.84	2,639	0.80	0.958	2,554	
Total flow to	Kwajapur STP		863,396	3,485															

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District III (1/2)

Node		Contributory Population		Design Flow	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative	(lps)				u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
Mohan Meakin PS	TGPS	179,912	179,912	727		3,100													Rising Main
Mahanagar Sewer																			
Lunia Purws PS	NN1	211,339	211,339	853		1,880													Rising Main
NN1	NN2	65,857	277,197	1,118	1,600	1,720	2500	109.95	109.26	114.00	113.00	2.31	2.00	0.72	1,456	0.80	0.825	1,409	
NN2	Kukrail No.2 PS	65,857	343,054	1,384	1,600	2,150	2500	109.26	108.40	113.00	113.00	2.00	2.86	0.72	1,456	0.80	0.825	1,409	
Trans Gomti Trunk Sewer (existing)																			
TT1	TT1A	14,495	14,495	78	900	300	2308	106.55	106.42	108.70	108.57	1.15	1.15	0.51	327	0.80	0.586	317	
TT1A	TT2	0	14,495	78	900	350	2333	106.42	106.27	108.57	109.67	1.15	2.40	0.51	325	0.80	0.583	315	
TT2	TT3	35,472	49,968	225	900	330	1650	106.27	106.07	109.67	109.67	2.40	2.60	0.61	387	0.80	0.693	374	
TT3	TT4	0	49,968	225	900	470	1516	106.07	105.76	109.67	109.56	2.60	2.80	0.63	403	0.80	0.723	390	
TT4	TT5	13,113	63,081	254	900	950	2568	105.76	105.39	109.56	108.94	2.80	2.55	0.49	310	0.80	0.555	300	
TT5	TGPS	0	63,081	254	900	40	1000	105.39	105.35	109.94	111.65	3.55	5.30	0.78	497	0.80	0.890	481	
(TS-17 area)	TGPS	50,826	50,826	205															
(TS-18 area)	TGPS	12,538	12,538	66															
PM1	PM2	6,362	6,362	33	500	950	700	108.78	107.42	112.00	110.00	2.64	2.00	0.63	124	0.80	0.719	120	
PM2	PM3 (To TGPS)	17,329	23,691	108	500	530	700	107.18	106.42	110.00	109.00	2.24	2.00	0.63	124	0.80	0.719	120	
Total flow to	TGPS	0	330,048	1,332															
TGPS	TG1	330,048	330,048	1,332															Rising Main
TG1	TG2	0	330,048	1,332															Rising Main
TG2	Kukrail No.1 PS	0	330,048	1,332															Rising Main
(TS-22A area)	Kukrail No.2 PS	15,909	15,909	87															
Kukrail Nala Interceptor Right Bank																			
KR3	Kukrail No.2 PS	19,546	19,546	105	500	1,170	700	110.42	108.75	113.00	113.00	2.00	3.67	0.63	124	0.80	0.719	120	
Kukrail No.2 PS	KC1	0	378,508			300													Rising Main

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District III (2/2)

Node		Contributory Population		Design Flow	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative	(lps)				u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
Kukrail Nala Interceptor Left Bank																			
KL1	KL1A	66,319	66,319	268	800	1,100	1000	113.11	112.01	116.00	116.00	2.00	3.10	0.72	363	0.80	0.823	351	
KL1A	KL2	596,362	662,681	2,675	2,200	600	2500	110.61	110.37	116.00	116.00	3.02	3.26	0.90	3,402	0.80	1.020	3,293	
KL2	KL3	44,846	707,527	2,855	2,200	1,000	2500	110.37	109.97	116.00	115.00	3.26	2.66	0.90	3,402	0.80	1.020	3,293	
KL3	KC1	0	707,527	2,855	2,200	1,280	2500	109.97	109.46	115.00	114.00	2.66	2.17	0.90	3,402	0.80	1.020	3,293	
KC1	Kukrail No.1 PS	470,786	1,178,313	4,757	2,200	1,150	1100	105.87	104.82	114.00	109.19	5.76	2.00	1.35	5,132	0.80	1.539	4,968	
Kukrail-Guari Sewer																			
Kukrail No.1 PS	Guari MPS	0	1,508,361	6,089	2200 x2	3,750	2500	104.82	103.32	109.19	109.00	2.00	3.31	0.90	6,804	0.80	1.020	6,587	
Vikas Nagar Sewer																0.80	0.000	-	
VN1	VN2	134,721	134,721	545	1,200	2,400	2000	117.69	116.49	121.00	120.00	2.00	2.20	0.67	757	0.80	0.763	732	
VN2	VN3	61,605	196,325	792	1,400	780	2200	112.82	112.47	120.00	116.00	5.65	2.00	0.71	1,087	0.80	0.805	1,052	
VN3	Kukrail No.3 PS	400,037	596,362	2,408	2,000	2,540	2500	110.85	109.83	116.00	114.00	2.98	2.00	0.84	2,639	0.80	0.958	2,554	
Kukrail No.3 PS	KL1A	0	596,362	2,408		700													Rising Main
Gomti Nagar Main Sewer																0.80	0.000	-	
GM1	GM2	80,117	80,117	324	800	830	1000	115.94	115.11	119.00	118.00	2.17	2.00	0.72	363	0.80	0.823	351	
GM2	GM3	47,827	127,944	518	1,000	720	1500	114.90	114.42	118.00	118.00	2.00	2.48	0.68	537	0.80	0.780	520	
GM3	GM4	42,908	170,852	614	1,200	1,350	2000	113.86	113.19	118.00	116.50	2.83	2.00	0.67	757	0.80	0.763	732	
GM4	GM5	0	170,852	614	1,200	1,120	2000	111.25	110.69	116.50	114.00	3.94	2.00	0.67	757	0.80	0.763	732	
GM5	Guari MPS	47,611	218,463	784	1,400	2,400	2200	106.75	105.66	114.00	109.19	5.72	2.00	0.7	1,087	0.80	0.805	1,052	
																0.80	0.000	-	
(TS-26 area)	Guari MPS	91,359	91,359	369	600	202	900	108.19	106.80	109.35	108.35	0.48	0.87	0.63	178	0.80	0.716	172	
Gomti Nagar No.1 Sewer																			
GN3	GN2	107,211	107,211	432	1,000	2,150	1500	113.33	111.90	117.00	115.00	2.57	2.00	0.68	537	0.80	0.780	520	
GN2	GN1	52,581	159,791	646	1,400	1,620	2200	106.82	106.08	115.00	113.00	6.65	5.39	0.71	1,087	0.80	0.805	1,052	
GN1	Guari MPS	44,471	204,263	824	1,600	2,450	2500	105.88	104.90	113.00	109.00	5.38	2.36	0.72	1,456	0.80	0.825	1,409	
																0.80	0.000	-	
Gomti Nagar No.2 Sewer																			
GN7	GN6	19,544	19,544	105	700	1,000	1000	108.41	107.41	115.00	114.00	5.81	5.81	0.66	254	0.80	0.752	246	
GN6	GN5	19,544	39,088	175	900	1,000	1500	107.21	106.54	114.00	113.00	5.79	5.46	0.64	405	0.80	0.726	392	
GN5	GN4	10,337	49,425	223	900	1,050	1500	106.54	105.84	113.00	110.00	5.46	3.16	0.64	405	0.80	0.726	392	
GN4	Guari MPS	7,814	57,239	232	1,400	2,400	2200	105.34	104.25	110.00	109.00	3.12	3.22	0.71	1,087	0.80	0.805	1,052	
																0.80	0.000	-	
Total flow to	Guari MPS	2,079,685	2,079,685	8,395															
																0.80	0.000	-	
Total flow to	Kakraha STP	124,345	2,204,030	8,897															

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District IV (1/3)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
GH Canal Interceptor Left Bank																			
GL0	GL1	95,607	95,607	387	900	3,460	1500	111.21	108.91	116.36	114.05	4.15	4.15	0.64	405	0.80	0.726	392	
GL1	GL2	101,799	197,406	797	1,400	1,400	2200	108.41	107.77	114.05	113.12	4.11	3.82	0.71	1,087	0.80	0.805	1,052	
GL2	GL3	27,674	225,080	909	1,400	1,320	2200	107.77	107.17	113.12	112.24	3.82	3.54	0.71	1,087	0.80	0.805	1,052	
GL3	GL4	18,434	243,515	983	1,400	1,340	2200	107.17	106.56	112.24	110.85	3.54	2.76	0.71	1,087	0.80	0.805	1,052	
GL4	GL5	31,334	274,849	1,109	1,600	2,030	2500	106.36	105.55	110.85	106.80	2.75	(0.49)	0.72	1,456	0.80	0.825	1,409	
GL5	GL6	31,334	306,183	1,235	1,600	970	2500	105.55	*105.16*	106.80	106.11	(0.49)	(0.79)	0.72	1,456	0.80	0.825	1,409	
GL6	GR6	24,661	330,844	1,337	1,600	10	2500	105.16	105.16	106.11	106.11	(0.79)	(0.79)	0.72	1,456	0.80	0.825	1,409	
GH Canal Interceptor Right Bank																			
GR0	GR1	21,638	21,638	98	500	3,460	700	115.41	110.47	116.28	113.97	0.29	2.92	0.63	124	0.80	0.719	120	
GR1	GR2	34,494	56,132	227	700	1,340	1000	110.27	108.93	113.97	113.08	2.92	3.37	0.66	254	0.80	0.752	246	
GR2	GR3	50,973	107,105	432	1,000	1,260	1500	108.63	107.79	113.08	112.24	3.35	3.35	0.68	537	0.80	0.780	520	
GR3	GR4	220,092	327,197	1,321	1,600	1,480	2500	107.19	106.60	112.24	110.85	3.31	2.51	0.72	1,456	0.80	0.825	1,409	
GR4	GR5	57,854	385,050	1,555	1,800	2,050	2500	106.40	105.58	110.85	106.80	2.50	(0.73)	0.78	1,993	0.80	0.893	1,929	
GR5	GR6	50,870	435,920	1,760	1,800	1,050	2500	105.58	*105.16*	106.80	106.11	(0.73)	(1.00)	0.78	1,993	0.80	0.893	1,929	
GR6	**GH Canal PS**	14,308	**781,072**	**2,802**	2,200	2,000	2500	101.82	101.02	106.11	103.03	1.90	(0.38)	0.90	3,402	0.80	1.020	3,293	
(CS-36 area)	GH Canal PS	23,410	23,410	105															
GH Canal PS	Martin Purwa MPS	0	804,482	3,247															
New CIS Gomti Relief Sewer																			
CT1	CT2	177,411	177,411	716	1,200	668	2000	114.10	113.77	117.42	117.69	2.00	2.61	0.67	757	0.80	0.763	732	
CT2	CT3	82,003	259,415	1,046	1,400	493	2200	110.35	110.13	117.69	113.67	5.80	2.00	0.71	1,087	0.80	0.805	1,052	
CT3	CT4	0	259,415	1,046	1,400	360	2200	110.13	109.97	113.67	114.48	2.00	2.98	0.71	1,087	0.80	0.805	1,052	
CT4	CT5	95,742	355,157	1,433	1,800	28	2500	109.57	109.56	114.48	114.54	2.96	3.03	0.78	1,993	0.80	0.893	1,929	
CT5	CT6	0	355,157	1,433	1,800	934	2500	107.95	107.58	114.54	111.53	4.64	2.00	0.78	1,993	0.80	0.893	1,929	
CT6	CT7	42,057	397,214	1,604	1,800	48	2500	107.37	107.36	111.53	111.31	2.20	2.00	0.78	1,993	0.80	0.893	1,929	
CT7	CT8	61,719	458,933	1,852	1,800	1,069	2500	107.36	106.93	111.31	113.93	2.00	5.05	0.78	1,993	0.80	0.893	1,929	
CT8	CT9	0	458,933	1,852	1,800	1,127	2500	106.02	105.57	113.93	109.52	5.96	2.00	0.78	1,993	0.80	0.893	1,929	
CGPS	CT9	323,423	323,423	1,305															
CT9	**CT10**	0	**782,356**	**2,808**	2,200	664	2500	105.13	104.86	109.52	111.98	2.00	4.73	0.90	3,402	0.80	1.020	3,293	
CT10	**CT11**	0	**782,356**	**2,808**	2,200	1,533	2500	100.96	100.35	111.98	111.55	8.63	8.81	0.90	3,402	0.80	1.020	3,293	
CT11	**Martin Purwa MPS**	0	**782,356**	**2,808**	2,200	600	2500	100.35	100.11	111.55	111.55	8.81	9.05	0.90	3,402	0.80	1.020	3,293	
Martin Purwa MPS	**SR1**	0	**1,586,838**	**5,694**															

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District IV (2/3)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
(CS-36A area)	SR1	3,646	3,646	21															
(CS-37A area)	SR1	5,763	5,763	30															
Sultanpur Road Trunk Sewer																			
SR1	SR2	0	1,596,247	**5,728**	2000x2	500	1900	111.89	111.63	116.94	115.80	2.88	2.00	0.96	3,029	0.80	1.099	5,864	
SR2	SR3	0	1,596,247	**5,728**	2000x2	500	1900	111.63	111.36	115.80	117.57	2.00	4.03	0.96	3,029	0.80	1.099	5,864	
SR3	SR4	0	1,596,247	**5,728**	2000x2	500	1900	111.36	111.10	117.57	116.91	4.03	3.64	0.96	3,029	0.80	1.099	5,864	
SR4	SR5	0	1,596,247	**5,728**	2000x2	1,500	1900	111.04	110.26	116.91	114.43	3.69	2.00	0.96	3,029	0.80	1.099	5,864	
SR5	SR6	0	1,596,247	**5,728**	2000x2	500	1900	107.36	107.10	114.43	111.27	4.90	2.00	0.96	3,029	0.80	1.099	5,864	
SR6	SR7	0	1,596,247	**5,728**	2000x2	500	1900	107.10	106.83	111.27	113.95	2.00	4.95	0.96	3,029	0.80	1.099	5,864	
SR7	SR8	0	1,596,247	**5,728**	2000x2	500	1900	106.83	106.57	113.95	116.24	4.95	7.50	0.96	3,029	0.80	1.099	5,864	
SR8	SR9	0	1,596,247	**5,728**	2000x2	500	1900	106.57	106.31	116.24	117.37	7.50	8.89	0.96	3,029	0.80	1.099	5,864	
SR9	SR10	0	1,596,247	**5,728**	2000x2	980	1900	106.31	105.79	117.37	110.45	8.89	2.49	0.96	3,029	0.80	1.099	5,864	
SR10	Mastemau STP	0	1,596,247	**5,728**	2000x2	980	1900	104.29	103.78	110.45	107.95	3.98	2.00	0.96	3,029	0.80	1.099	5,864	
Shakurpur Sewer																			
SS1	LS3	107,761	107,761	434	1,000	2,580	1500	116.62	114.90	*120.00*	*118.00*	2.28	2.00	0.79	620	0.80	0.899	600	
Lilamatha Sewer																			
LS1	LS2	8,393	8,393	45	500	1,240	700	114.42	112.65	*117.00*	*117.50*	2.00	4.27	0.73	143	0.80	0.830	138	
LS2	LS3	34,726	43,119	193	700	2,470	1000	112.45	109.98	*117.50*	*118.00*	4.27	7.24	0.76	293	0.80	0.869	284	
LS3	GS2	0	150,880	610	1,200	2,170	2000	109.48	108.39	*118.00*	*118.00*	7.21	8.29	0.77	872	0.80	0.879	844	
Ghuswal Sewer																			
GS1	GS2	57,485	57,485	232	700	1,610	1000	115.22	113.61	*118.00*	*118.00*	2.00	3.61	0.76	293	0.80	0.869	284	
GS2	GS3	57,485	265,851	1,073	1,600	2,600	2500	107.99	106.95	*118.00*	*117.37*	8.27	8.68	0.84	1,681	0.80	0.953	1,627	
GS3	GS4	0	265,851	1,073	1,600	900	2500	106.95	106.59	*117.37*	*112.50*	8.68	4.17	0.84	1,681	0.80	0.953	1,627	
GS4	Mastemau STP	0	265,851	1,073	1,600	900	2500	104.57	104.21	*112.50*	*107.95*	6.20	2.00	0.84	1,681	0.80	0.953	1,627	
(FSA123 area)	Mastemau STP	84,889	84,889	342															
Total flow to	Mastemau STP	0	1,946,986	7,859															

Table 7.3 Proposed Trunk Sewers: Hydraulic Calculation

District IV (3/3)

Node		Contributory Population		Design Flow (lps)	Size (mm)	Length (m)	Gradient	Invert level (m)		Ground level (m)		Covering (m)		Full pipe capacity		Design capacity			Remarks
From	To	Each	Cumulative					u/s	d/s	u/s	d/s	u/s	d/s	Velocity (m/s)	Discharge (l/s)	Depth ratio d/df	Velocity (m/s)	Discharge (l/s)	
CT51	**CT46**	**5,362**	**5,362**	**30**	**750**	**269**	**690**	**108.76**	**108.37**	**111.23**	**111.07**	**1.64**	**1.87**	**0.74**	**325**	**0.80**	**0.838**	**314**	**CG Trunk (CS11)**
SA5	SA4	79,969	79,969	322	450	1,995	607	115.74	112.45	117.69	114.65	**1.42**	**1.67**	0.56	89	0.80	0.635	86	Sarkata A Sewer
SA4	SA3	24,606	104,575	423	600	856	335	112.45	109.90	114.65	113.65	**1.52**	**3.07**	0.91	257	0.80	1.035	248	
SA3	SA2	14,763	119,338	482	750	460	460	109.90	108.90	113.65	110.62	**2.92**	**0.89**	0.90	397	0.80	1.025	384	
SA2	CT46	3,691	123,029	497	750	47	582	108.90	108.82	110.62	111.07	**0.89**	**1.42**	0.80	353	0.80	0.911	342	
CT46	**CT43**	**123,029**	**128,391**	**518**	**1,050**	**383**	**912**	**108.37**	**107.95**	**111.07**	**110.01**	**1.55**	**0.91**	**0.80**	**692**	**0.80**	**0.911**	**670**	**CG Trunk (CS10)**
SB3	SB2	31,360	31,360	140	1,050	1,557	654	110.81	108.43	114.91	110.59	**2.95**	**1.01**	0.94	817	0.80	1.076	791	Sarkata B Sewer
SB2	CT43	0	31,360	140	1,050	14	37	108.43	108.06	110.59	110.19	**1.01**	**0.98**	3.95	3,424	0.80	4.508	3,314	
CT43	**CT39A**	**31,360**	**159,751**	**646**	**1,400**	**351**	**2194**	**107.95**	**107.79**	**110.01**	**110.44**	**0.53**	**1.11**	**0.62**	**961**	**0.80**	**0.711**	**930**	**CG Trunk (CS12)**
P3	P2	20,536	20,536	93	900	860	691	110.14	108.89	113.49	110.34	**2.35**	**0.45**	0.83	527	0.80	0.945	511	Pata Sewer
P2	CT39A	0	20,536	93	900	17	340	108.89	108.84	110.34	110.59	**0.45**	**0.75**	1.18	751	0.80	1.346	727	
CT39A	**CT30A**	**20,536**	**180,287**	**727**	**1,500**	**1,159**	**2318**	**107.79**	**107.29**	**110.44**	**109.79**	**1.01**	**0.87**	**0.64**	**1,124**	**0.80**	**0.725**	**1,088**	**CG Trunk (CS13)**
Shahmina Rd. Sewer + NER U/S Drain	CT30A																		Shahmina Rd. Sewer + NER U/S Drain
CT30A	**CT29**	**12,674**	**192,961**	**779**	**1,650**	**77**	**1283**	**107.29**	**107.23**	**109.79**	**109.71**	**0.72**	**0.69**	**0.91**	**1,946**	**0.80**	**1.037**	**1,884**	**CG Trunk (CS14)**
NER D/S Drain	CT29																		NER D/S Drain
CT29	**CT27**	**0**	**192,961**	**779**	**1,650**	**428**	**1297**	**107.23**	**106.90**	**109.71**	**109.44**	**0.69**	**0.75**	**0.91**	**1,937**	**0.80**	**1.033**	**1,875**	**CG Trunk**
WG3	WG2	17,118	17,118	93	1,200	1,244	754	109.55	107.90	112.15	110.26	**1.29**	**1.04**	0.96	1,087	0.80	1.096	1,052	Wazirganj Sewer
WG2	CT27	0	17,118	93	1,200	46	148	107.90	107.59	110.26	109.88	**1.04**	**0.97**	2.17	2,450	0.80	2.469	2,371	
CT27	**CT25**	**17,118**	**210,079**	**848**	**1,800**	**503**	**1479**	**106.90**	**106.56**	109.88	110.28	**1.04**	**1.79**	**0.90**	**2,288**	**0.80**	**1.025**	**2,214**	**CG Trunk (CS15)**
Kutchary Rd.	CT25																		Kutchary Rd. Sewer
CT25	**CT22**	**13,222**	**223,301**	**902**	**1,800**	**667**	**1450**	**106.56**	**106.10**	**110.28**	**110.80**	**1.79**	**2.77**	**0.91**	**2,311**	**0.80**	**1.035**	**2,237**	**CG Trunk (CS16,17)**
G2	CT22	9,731	9,731	51	900	984	631	108.04	106.48	111.64	110.83	**2.60**	**3.35**	0.87	552	0.80	0.988	534	Ghasiyari Mandi Sewer
CT22	**CT20**	**9,731**	**233,032**	**941**	**1,950**	**281**	**1405**	**106.10**	**105.90**	**110.80**	**111.13**	**2.62**	**3.14**	**0.97**	**2,906**	**0.80**	**1.109**	**2,813**	**CG Trunk (CS18)**
China Bazar Drain	CT20																		China Bazar Drain
CT20	**CT17**	**12,653**	**245,685**	**992**	**2,100**	**516**	**1032**	**105.90**	**105.40**	**111.13**	**110.62**	**2.99**	**2.99**	**1.19**	**4,129**	**0.80**	**1.359**	**3,996**	**CG Trunk (CS19)**
Shahmina Rd. + Laplace Drain	CT17																		Shahmina Rd. + Laplace Drain
CT17	**CT8**	**17,629**	**263,314**	**1,062**	**2,100**	**1,165**	**4481**	**105.40**	**105.14**	**110.62**	**110.30**	**2.99**	**2.93**	**0.57**	**1,981**	**0.80**	**0.652**	**1,918**	**CG Trunk (CS20)**
Ashok Marg	CT8																		Ashok Marg Sewer
CT8	**CT1**	**17,496**	**280,810**	**1,134**	**2,100**	**1,371**	**4570**	**105.14**	**104.84**	**110.30**	**109.93**	**2.93**	**2.86**	**0.57**	**1,964**	**0.80**	**0.646**	**1,901**	**CG Trunk (CS21)**
CT1	CGPS	0	280,810	1,134	2,100	7	4567	104.84	104.84	109.93	109.93	**2.85**	**2.86**	0.57	1,964	0.80	0.646	1,901	CG Trunk (CS21A)
Wazir Hasan	CGPS	42,613	42,613	190	900	883	2453	105.20	104.84	110.45	109.93	**4.25**	**4.09**	0.44	280	0.80	0.502	271	CG Trunk (CS21A)
Total discharge to	**CGPS**	**17,496**	**323,423**	**1,305**															

Table 7.4 Lucknow: Exisiting and Sanctioned Pump Stations

Pump station	Status		Exisiting/Sanctioned pumps			Total installed	Allowable discharge (1)	Sump capacity	Rising mains	
			lpm	lps	Head (m)	lps	lps	m3	dia (inch)	Length (m)
CGPS	E	5	36,480	608	18	3,040	2,027	445	1200	990
G.H. Canal IPS	S	4	91,980	1,533	20	7,932	5,288	768	1400	3600
		2	54,000	900	15					
TGPS	E	5	4,320	72	18	360	240	74	900	1090
Mohan Meakin	S	3	4,920	82	24	7,380	4,920	46	400	800
		2	2,460	41	16					
Kukrail No.1	S	6	69,300	1,155	20	6,930	4,620	1,662	1800	4655
MPS at Guari	S	6	102,000	1,700	26	10,200	6,800	2,431	2100	4100

Note (1) : Allowable discharge is installed capacity less 50% reserved as standby.

Table 7.5 (1/3) Pump Station Design

Peak (pk) 2
Average (avg) 1
Non-peak (npk) 0.5

alternative III

Pump stations	Status	Installed capacity (lps)	Design discharge (lps)							
			2015				2030			
			pk x 1.5	pk	avg	npk	pk x 1.5	pk	avg	npk
CGPS	E	3,040	1,736	1,157	579	289	1,771	1,181	590	295
G.H. Canal IPS	S	7,932	3,715	2,477	1,238	619	4,340	2,894	1,447	723
Martin Purwa PS	P		2,951	1,968	984	492	8,542	5,694	2,847	1,424
Mohan Meakin	S	7,380	660	440	220	110	972	648	324	162
Lunia Purwa PS	P		417	278	139	69	1,146	764	382	191
TGPS	E	360	1,215	810	405	203	1,771	1,181	590	295
Kukrail No.1	S	6,930	6,250	4,167	2,083	1,042	8,125	5,417	2,708	1,354
Kukrail No.2	P		972	648	324	162	2,049	1,366	683	341
Kukrail No.3	P		1,701	1,134	567	284	3,229	2,153	1,076	538
MPS at Guari	S	10,200	11,597	7,731	3,866	1,933	11,215	7,477	3,738	1,869

Table 7.5 (2/3) Pump station design

Alternative III

	Proposed pumps												Proposed rising main		
Pump stations	2015						2030						static head	dia.	length
	Pk (lps)	Pk * 1.5	No.	lps	lpm	total (lps)	Pk (lps)	Pk * 1.5	No.	lps	lpm	total (lps)	(m)	mm	m
CGPS	1,157	1,736	6	290	17,400	1,740	1,181	1,771	6	300	18,000	1,800		1 x 1100	2,000
G.H. Canal IPS	2,477	3,715	12	310	18,600	3,720	2,894	4,340	12	370	22,200	4,440	9	1 x 1600	2,000
Martin Purwa PS	1,968	2,951	6	500	30,000	3,000	5,694	8,542	12	720	43,200	8,640		2 x 1600	890
Mohan Meakin	440	660	6	110	6,600	660	648	972	6	170	10,200	1,020	14	600	4,000
Lunia Purwa PS	278	417	6	70	4,200	420	764	1,146	6	200	12,000	1,200		2015:1x700 2030:2x700	2,380
TGPS	810	1,215	6	210	12,600	1,260	1,181	1,771	6	300	18,000	1,800		1 x 600	2,590
Kukrail No.1	4,167	6,250	12	530	31,800	6,360	5,417	8,125	12	680	40,800	8,160	15	1 x 1800	4,655
Kukrail No.2	648	972	6	180	10,800	1,080	1,366	2,049	6	350	21,000	2,100		2015:1x900 2030:2x900	300
Kukrail No.3	1,134	1,701	6	290	17,400	1,740	2,153	3,229	12	270	16,200	3,240		2015:1x1100 2030:2x1100	700
MPS at Guari	7,731	11,597	12	970	58,200	11,640	7,477	11,215	12	950	57,000	11,400	15	2 x 2100	4,100

Required installed capacity is 1.5 x projected peak flow

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Table 7.5 (3/3) Pump Sation Design

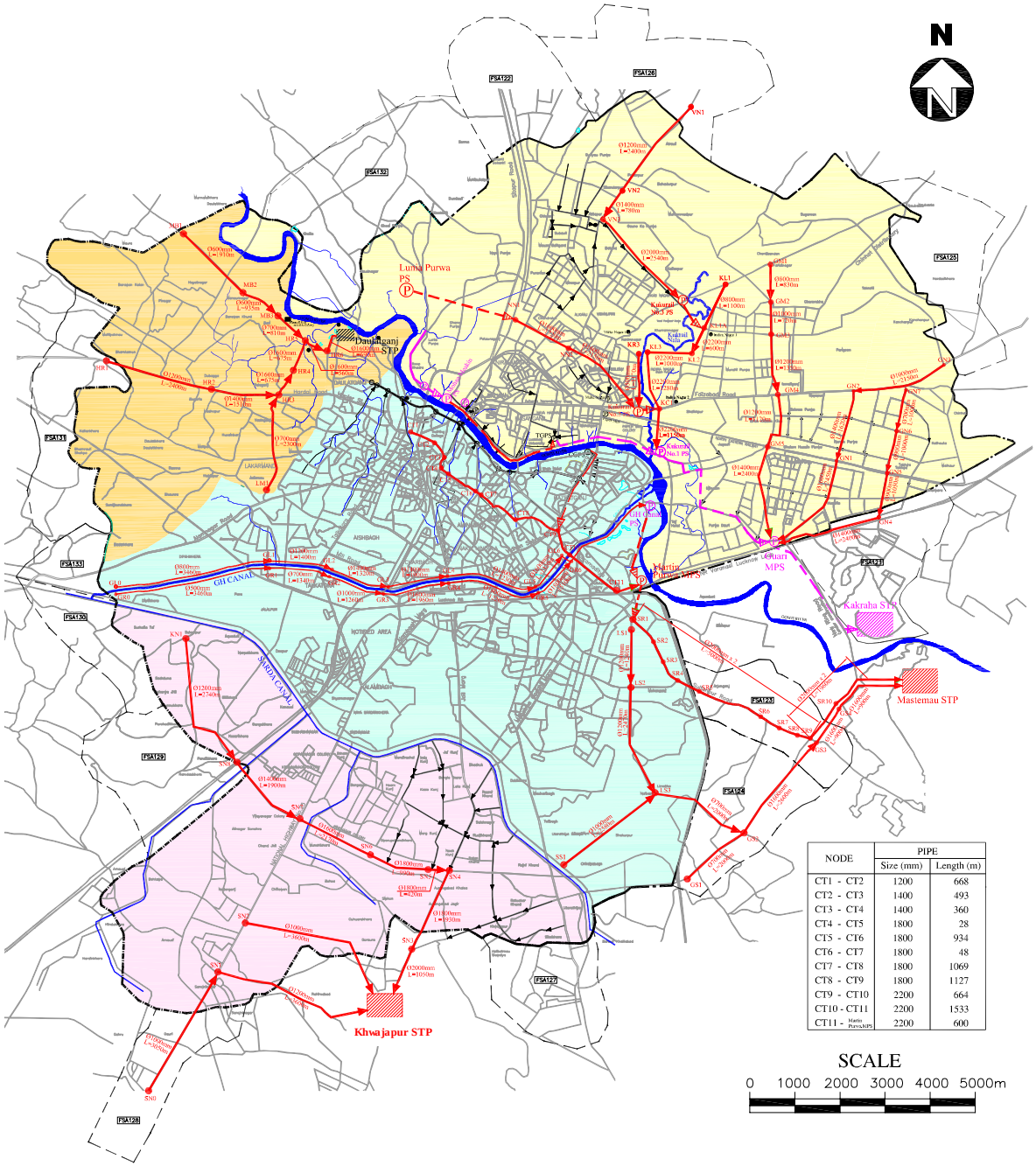
Pump station		Peak flows (lps)		Exisiting/ Sanctioned sump	Exisiting Sump Holding Time		Design Holding Time	Required sump capacity	
		2015	2030	m3	2015	2030	(min)	2015	2030
CGPS	E	1,157	1,181	445	6.41	6.28	5.0	347	354
TGPS	E	810	1,181	74	1.52	1.04	5.0	243	354
G.H. Canal IPS	S	2,477	2,894	768	5.17	4.42	5.0	743	868
Kukrail No.1	S	4,167	5,417	1662	6.65	5.11	5.0	1,250	1,625
MPS at Guari	S	7,731	7,477	2431	5.24	5.42	5.0	2,319	2,243
Mohan Meakin	P	440	648	46	1.74	1.18	5.0	132	194
Martin Purwa PS	P	1,968	5,694				5.0	590	1,708
Lunia Purwa PS	P	278	764				5.0	83	229
Kukrail No.2	P	648	1,366				5.0	194	410
Kukrail No.3	P	1,134	2,153				5.0	340	646

Table 7.8 Daulatganj STP : Average Monthly Inflow & Effluent Data

Date	Total flow	pH (-)		COD (mg/l)		DO (mg/l)		BOD (mg/l)		TSS (mg/l)		FC (MPN/100ml)		Efficiency %			Remarks
	MLD	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	BOD	TSS	MPN	
Feb-03	38.85	7.44	7.57	263	97	1.80	6.20	97	36	210	86	-	-	63	59	-	
Mar-03	33.44	7.51	7.71	308	117	1.56	6.13	96	37	178	69	-	-	61	61	-	
Apr-03	31.59	7.67	7.66	303	108	1.75	5.65	89	33	175	71	-	-	63	60	-	
May-03	33.85	-	-	-	-	-	-	161	31	228	45	-	-	81	80	-	
Jun-03	38.30	-	-	-	-	-	-	113	26	292	41	-	-	77	86	-	
Jul-03	44.97	-	-	-	-	-	-	73	17	195	25	-	-	77	87	-	
Aug-03	32.24	-	-	-	-	-	-	65	16	213	28	-	-	75	87	-	
Sep-03	18.10	-	-	-	-	-	-	57	13	218	25	-	-	77	89	-	
Oct-03	13.65	-	-	-	-	-	-	113	22	283	25	4.1E+06	800	80	91	99.98	
Nov-03	39.32	-	-	-	-	-	-	106	17	219	24	3.1E+06	717	84	89	99.98	
Dec-03	43.65	-	-	-	-	-	-	129	19	220	23	1.6E+06	700	85	89	99.96	
Jan-04	35.37	-	-	-	-	-	-	122	20	194	23	3.0E+06	735	83	88	99.98	
MAX	44.97	7.67	7.71	308	117	1.80	6.20	161	37	292	86	3.1E+06	735	77	71	99.98	
MIN	31.59	7.44	7.57	263	97	1.56	5.65	65	16	175	23	1.6E+06	700	75	87	99.96	
AVERAGE	37.16	7.54	7.65	291	107	1.70	5.99	105	25	212	43	2.6E+06	717	76	80	99.97	

Note; Max, Min, and Average are calculated by omiting data because the STP did not function during 23/9/2003 - 23/10/2003

SEWERAGE MASTER PLAN IN LUCKNOW CITY



NODE	PIPE	
	Size (mm)	Length (m)
CT1 - CT2	1200	668
CT2 - CT3	1400	493
CT3 - CT4	1400	360
CT4 - CT5	1800	28
CT5 - CT6	1800	934
CT6 - CT7	1800	48
CT7 - CT8	1800	1069
CT8 - CT9	1800	1127
CT9 - CT10	2200	664
CT10 - CT11	2200	1533
CT11 - Martin Purwa MPS	2200	600

DISTRICT (including FSA No.)	Population			Wastewater Generation (MLD)		
	2003	2015	2030	2003	2015	2030
DISTRICT - I (131)	169,099	252,388	410,279	19.44	34.13	63.59
DISTRICT - II (127~130)	281,373	484,791	863,395	32.31	65.49	133.83
DISTRICT - III (121, 122, 125, 126, 132)	870,028	1,379,160	2,204,029	99.88	185.93	341.62
DISTRICT - IV (123, 124, 133)	1,142,974	1,489,248	1,946,986	213.24	251.69	301.78
Total	2,463,474	3,605,587	5,424,689	364.87	537.24	840.82

No.	Pumping Station	Status	Sewage Flow (MLD)		Remark
			2015	2030	
1	TGPS	Existing	34.30	50.98	+ Mohan Meakin
2	CGPS	Existing	49.33	50.20	
3	Lunia Purwa	Proposed	12.01	32.83	
4	Mohan Meakin	Sanction	18.14	27.73	
5	Kukrail No.1	Sanction	179.11	233.71	(2015): + CGPS + TGPS + Kukrail Nala (2030): + TGPS + Kukrail No.2 & No.3
6	Kukrail No.2	Proposed	27.48	58.75	+ Lunia Purwa
7	Kukrail No.3	Proposed	49.25	92.53	
8	Guari	Sanction	320.54	322.19	(2015): + Kukrail No.1 + GH Canal (2030): + Kukrail No.1
9	GH Canal	Sanction	93.92	124.68	
10	Martin Purwa	Proposed	79.23	245.99	(2015): + CG Relief sewer (2030): + CG Relief sewer + CGPS + GH Canal

No.	Treatment Plant	Status	Capacity (MLD)		Remark
			2015	2030	
1	Daulatganj	Existing	56	56	District - I
2	LDA Colony	Sanction	10	14	District - I
3	Kakraha	Sanction	345	345	District - III
4	**Khwajapur**	Proposed	-	135	District - II
5	Mastemau	Proposed	100	305	District - IV
		Total	511	855	

District No.	Location	Name of Sewer
District - I	LM1 - HR3	LAKARMANDI SEWER
	MB1 - HR5	MUSABAGH SEWER
	HR1 - Daulatganj STP	HARDOI ROAD TRUNK SEWER
District - II	SN0 - **Khwajapur STP**	SAROJNI NIGAR SEWER
	SN2 - **Khwajapur STP**	CHILAWAN-GARAURA SEWER
	KN1 - **Khwajapur STP**	TRANS SHARDA TRUNK SEWER
District - III	NN1 - Kukrai No.2 PS	MAHANAGAR SEWER
	KR3 - Kukrail No.2 PS	KUKRAIL NALA INTERCEPTOR RIGHT BANK SEWER
	KL1 - Kukrail No.1 PS	KUKRAIL NALA INTERCEPTOR LEFT BANK SEWER
	GN3 - Guari MPS	GOMTI NAGAR NO.1 SEWER
	GN7 - Guari MPS	GOMTI NAGAR NO.2 SEWER
	GM1 - Guari MPS	GOMTI NAGAR MAIN SEWER
	VN1 - Kukrail No.3 PS	VIKAS NAGAR SEWER
District - IV	CT1 - Martin Purwa MPS	CIS GOMTI RELIEF SEWER
	GL0 - GL6	GH CANAL INTERCEPTOR LEFT BANK SEWER
	GR0 - GH Canal PS	GH CANAL INTERCEPTOR RIGHT BANK SEWER
	SR1 - Mastemau STP	SULTANPUR ROAD TRUNK SEWER
	SS1 - LS3	SHAKUPUR SEWER
	LS1 - GS2	LILAMATHA SEWER
	GS1 - Mastemau STP	GHUSWAL SEWER

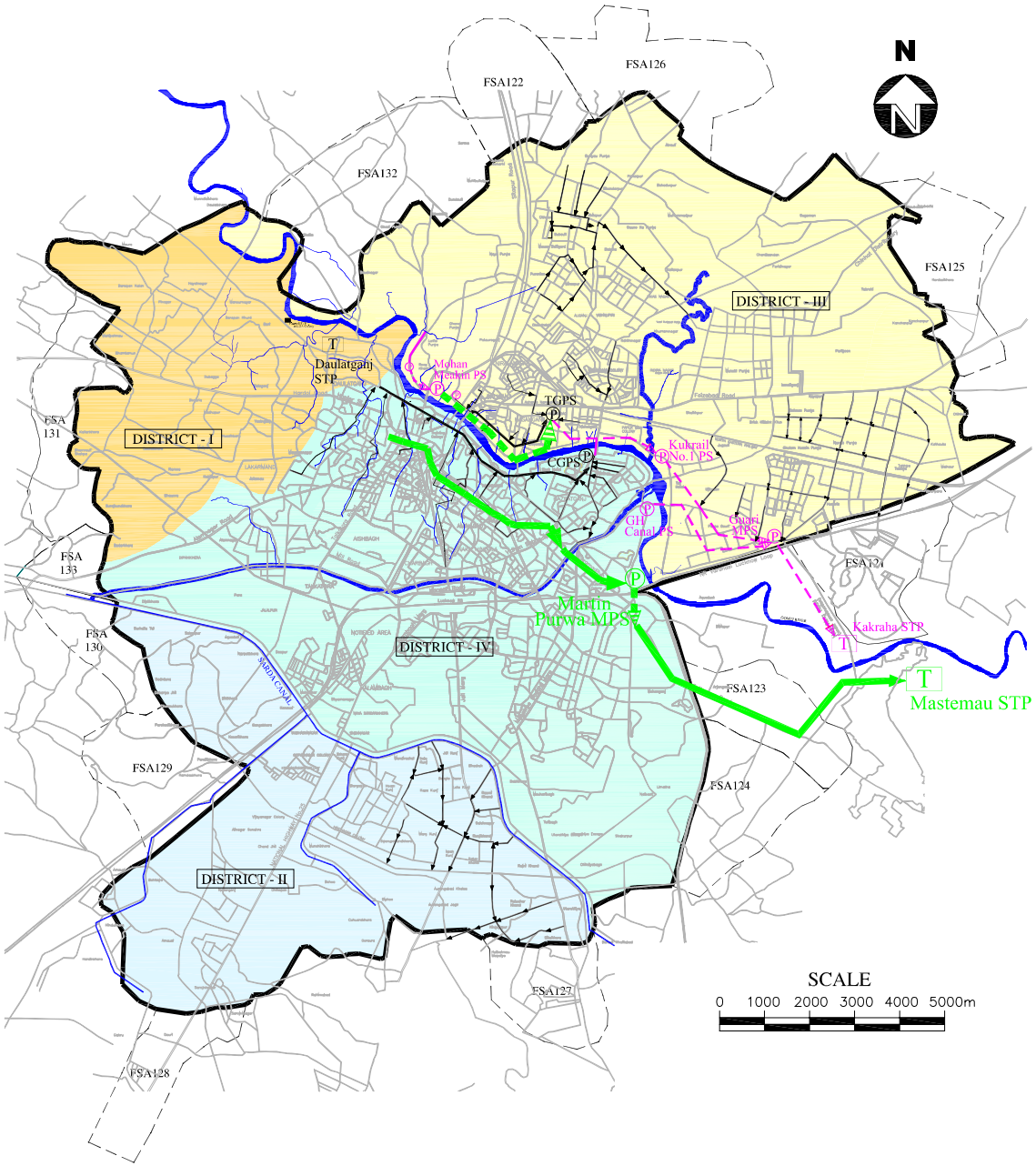
LEGEND
- Municipal Boundary
- Existing Sewer
- Existing SPS
- Existing STP
- Proposed Trunk Sewer
- Proposed Rising Main
- Proposed SPS
- Proposed STP
- FSA131 Feture Service area
- HR1 Node Number

NOTE:
- : Proposed Facility (2030)
- : Sanctioned Facility

- DISTRICT - I (including FSA131)
- DISTRICT - II (including FSA127~130)
- DISTRICT - III (including FSA121, 122, 125, 126, 132)
- DISTRICT - IV (including FSA123, 124, 133)

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO ENGINEERING CONSULTANTS CO., LTD.
CTI ENGINEERING INTERNATIONAL CO., LTD.

PROJECT	LOCATION	FIGURE 7.1
THE STUDY ON WATER QUALITY MANAGEMENT PLAN FOR GANGA RIVER IN THE REPUBLIC OF INDIA	LUCKNOW CITY	SEWERAGE MASTER PLAN



Proposed Collection & Treatment Capacity in year 2015

No.	Pumping Station	Status	Sewage Flow (MLD)	Remark
1	TGPS	Existing	34.30	+ Mohan Meakin
2	CGPS	Existing	49.33	
3	Mohan Meakin	Sanction	18.14	
4	Kukrail No.1	Sanction	179.11	+ CGPS + TGPS + Kukrail Nala
5	Guari	Sanction	320.54	+ Kukrail No.1 + GH Canal
6	GH Canal	Sanction	93.92	
7	Martin Purwa	Proposed	79.23	+ CG Relief sewer

No.	Treatment Plant	Status	Capacity (MLD)	Remark
1	Daulatganj	Existing	56	District - I
2	LDA Colony	Planned	10	District - I
3	Kakraha	Sanction	345	District - III
4	Mastemau	Proposed	100	District - IV
		Total	511	

LEGEND

- Municipal Boundary
- Sewer
- Rising Main
- Ⓟ Puming Station
- T Treatment Plant
- River/Nala/Canal
- FSA131 Feture Service area

NOTE:

- Ⓟ T : Existing Facility
- Ⓟ T : Sanctioned Facility
- Ⓟ T : Proposed Facility (2015)

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ENGINEERING CONSULTANTS CO., LTD.
CTI ENGINEERING INTERNATIONAL CO., LTD.

PROJECT	LOCATION	FIGURE 7.2
THE STUDY ON WATER QUALITY MANAGEMENT PLAN FOR GANGA RIVER IN THE REPUBLIC OF INDIA	LUCKNOW CITY	PROPOSED COLLECTION & TREATMENT CAPACITY YEAR 2015