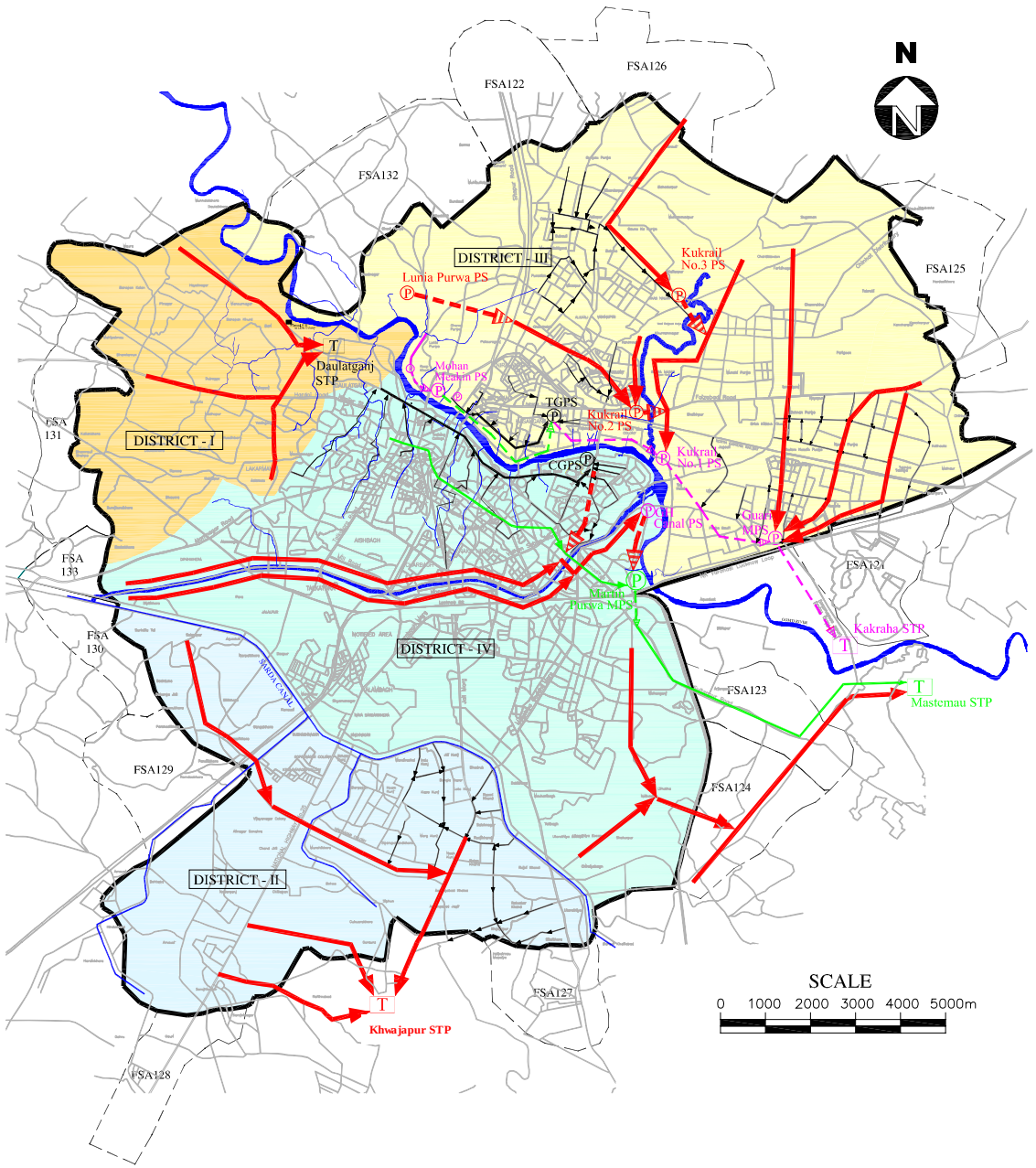


Proposed Collection & Treatment Capacity in year 2030

No.	Pumping Station	Status	Sewage Flow (MLD)	Remark
1	TGPS	Existing	50.98	+ Mohan Meakin
2	CGPS	Existing	50.20	
3	Lunia Purwa	Proposed	32.83	
4	Mohan Meakin	Sanction	27.73	
5	Kukrail No.1	Sanction	233.71	+ TGPS + Kukrail No.2 & No.3
6	Kukrail No.2	Proposed	58.75	+ Lunia Purwa
7	Kukrail No.3	Proposed	92.53	
8	Guari	Sanction	322.19	+ Kukrail No.1
9	GH Canal	Sanction	124.68	
10	Martin Purwa	Proposed	245.99	+ CG Relief sewer + CGPS + GH Canal

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

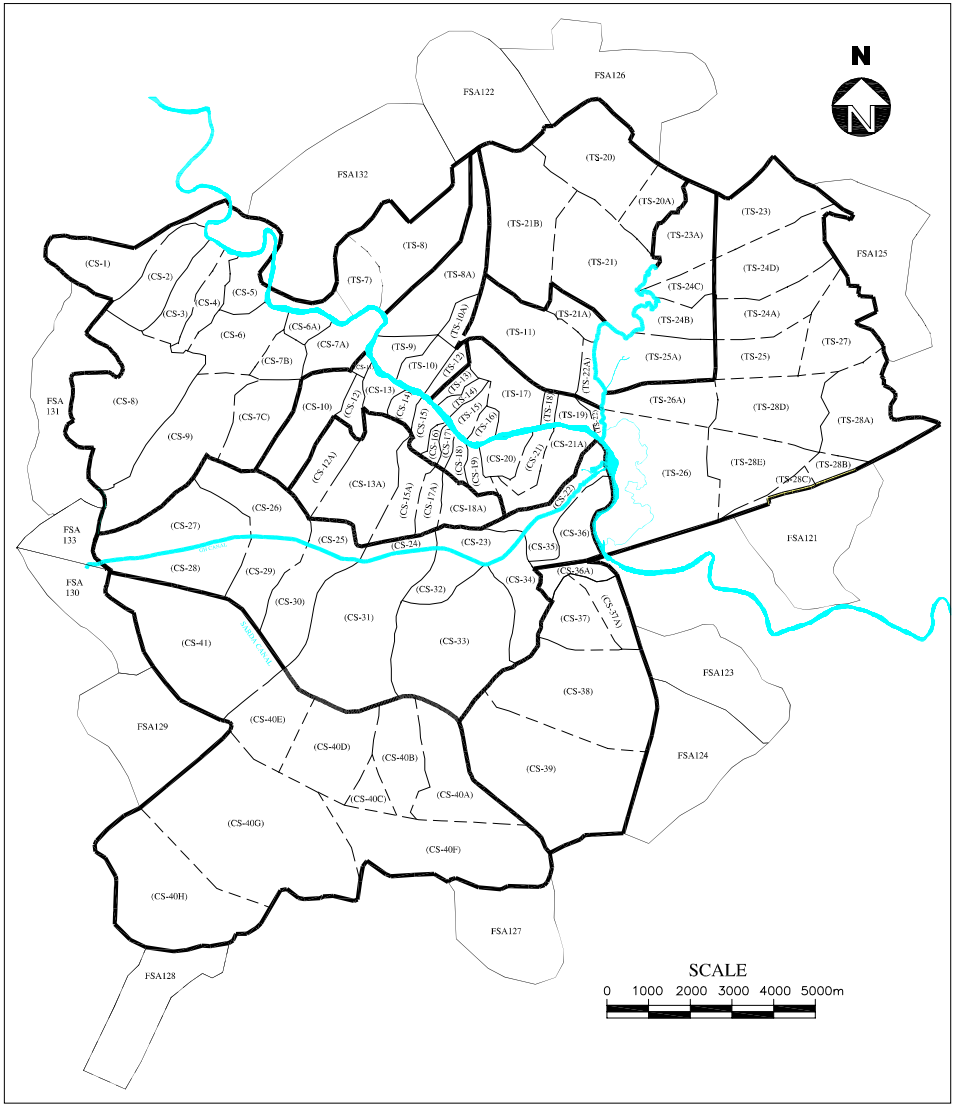
LEGEND

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

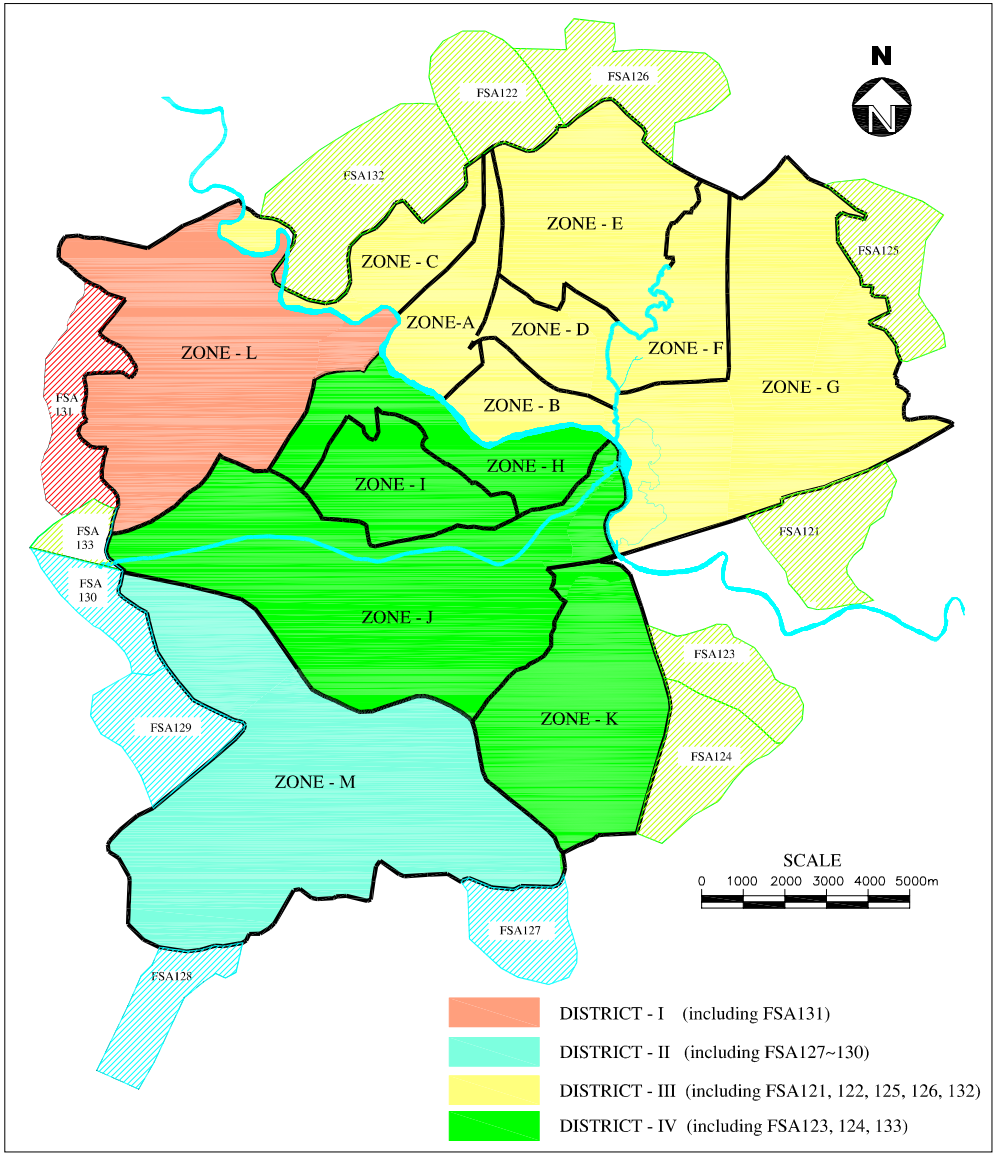
NOTE:

- Ⓟ T : Existing Facility
- Ⓟ T : Sanctioned Facility
- Ⓟ T : Proposed Facility (2015)
- Ⓟ T : Proposed Facility (2030)

JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO ENGINEERING CONSULTANTS CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD.	PROJECT THE STUDY ON WATER QUALITY MANAGEMENT PLAN FOR GANGA RIVER IN THE REPUBLIC OF INDIA	LOCATION LUCKNOW CITY	FIGURE 7.3 PROPOSED COLLECTION & TREATMENT CAPACITY YEAR 2030

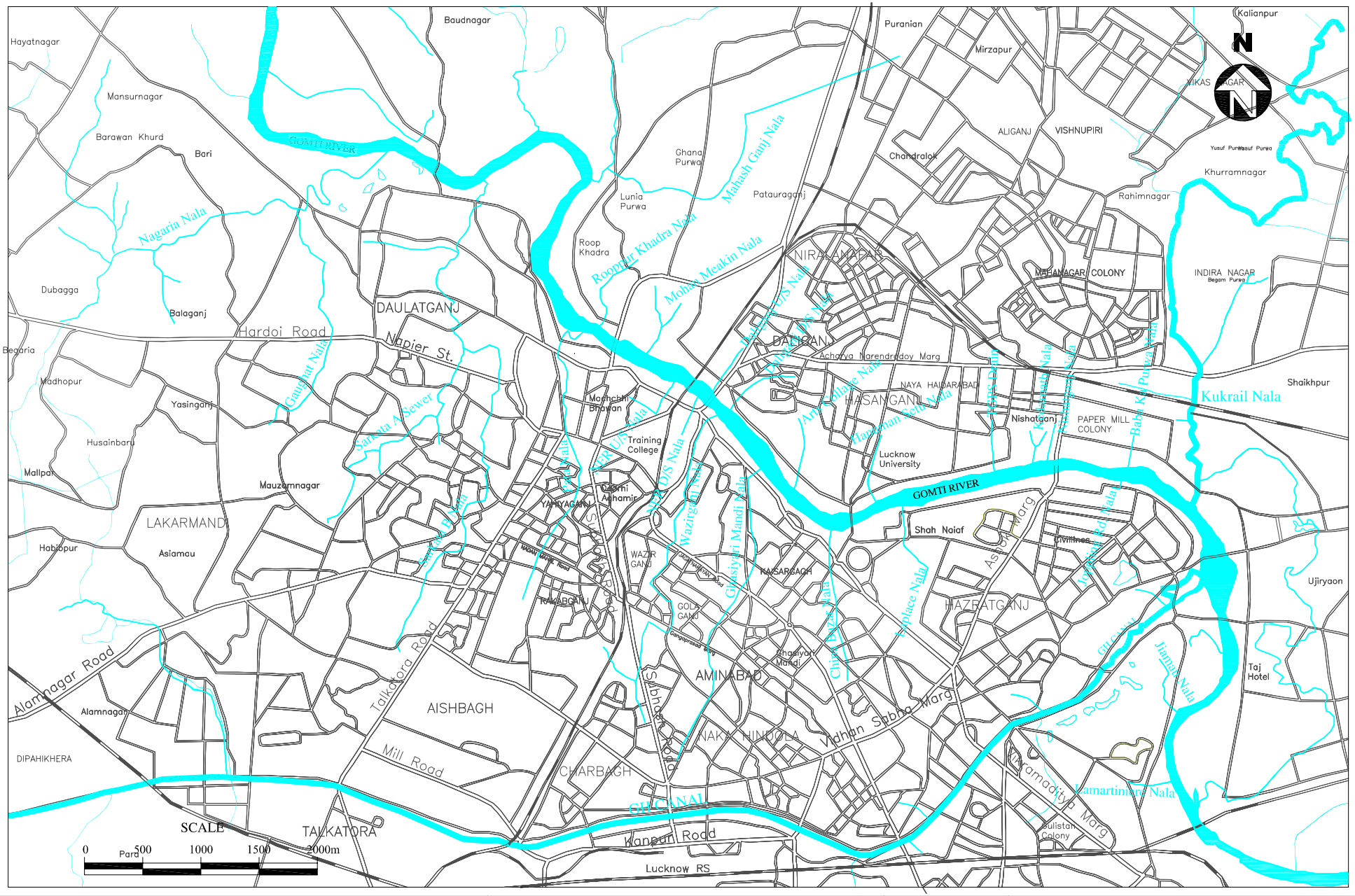


SEWER SUB-CATCHMENTS

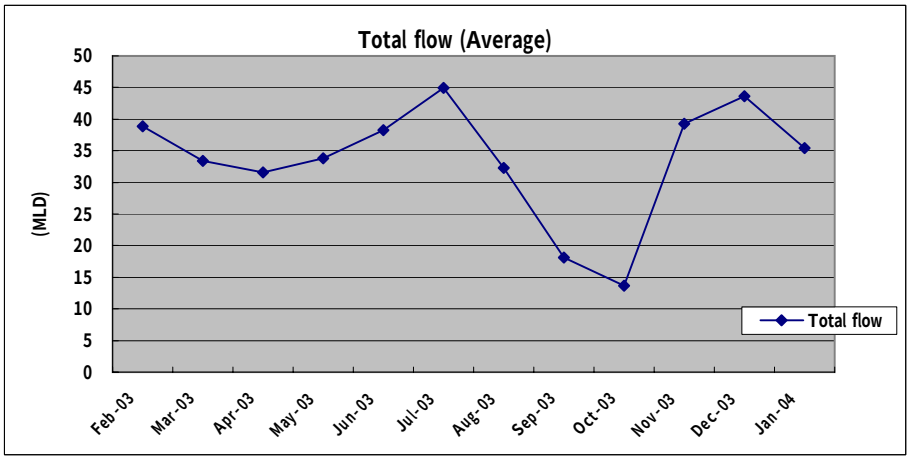


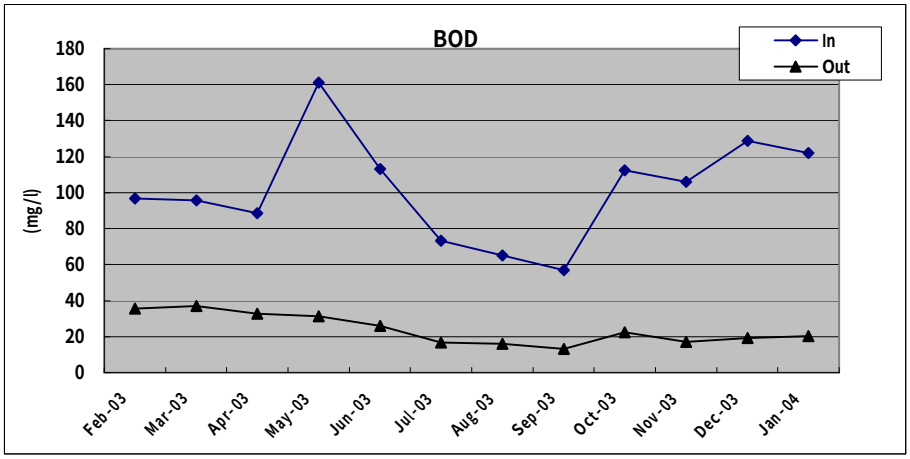
DISTRICTS & ZONES

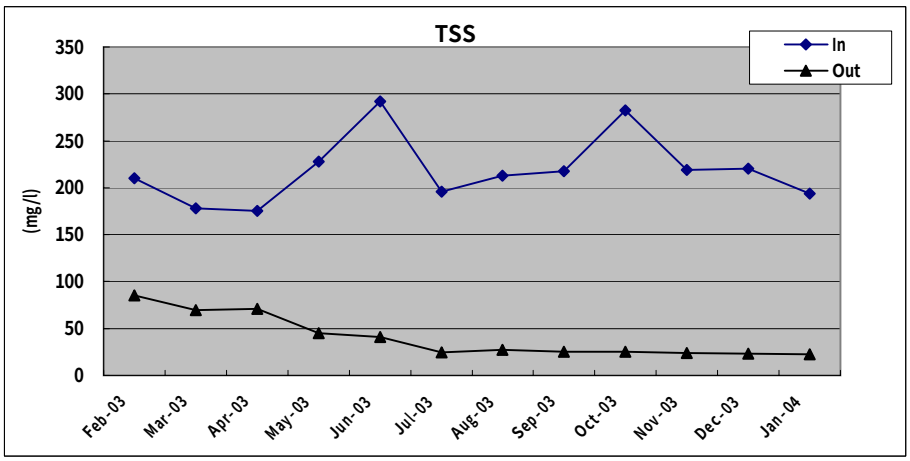
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO ENGINEERING CONSULTANTS CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD.	PROJECT THE STUDY ON WATER QUALITY MANAGEMENT PLAN FOR GANGA RIVER IN THE REPUBLIC OF INDIA	LOCATION LUCKNOW CITY	FIGURE 7.4 SEWER ZONES & SUB-CATCHMENTS MAP



JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO ENGINEERING CONSULTANTS CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD.	PROJECT THE STUDY ON WATER QUALITY MANAGEMENT PLAN FOR GANGA RIVER IN THE REPUBLIC OF INDIA	LOCATION LUCKNOW CITY	FIGURE 7.5 LOCATION MAP FOR NALAS







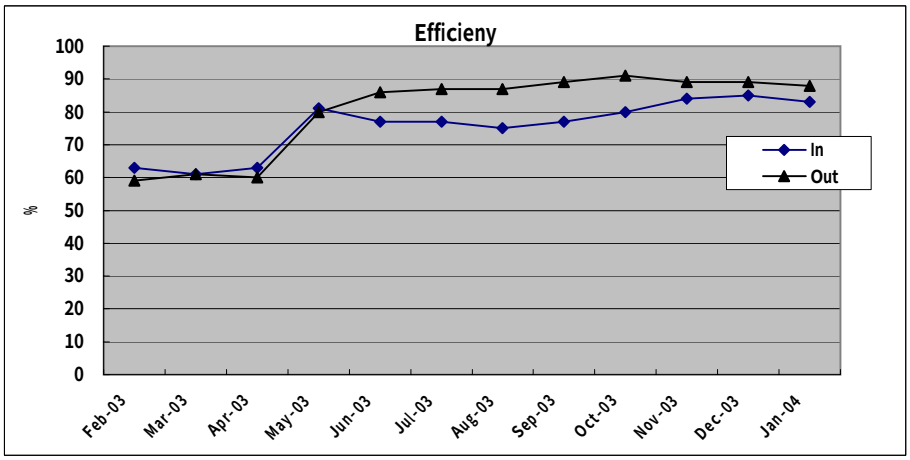


Figure 7.6 Daulat Ghanj STP : Average Monthly Data

CHAPTER 8

IMPLEMENTATION STRATEGY AND PHASING

CHAPTER 8 IMPLEMENTATION STRATEGY AND PHASING

A number of options were evaluated in Chapter 6 leading to the selection of a recommended plan. The details of the sewerage infrastructure, location, capacity, and type of treatment process were determined in Chapter 7. This section of the Master Plan identifies the implementation strategy and recommends priorities. It also identifies the required infrastructure components, along with implementation phases.

8.1 OVERALL STRATEGY

Sewerage will be developed gradually, with a series of interventions implemented in a phased approach. Although the time line to full build out cannot be predicted with any certainty, and may not happen within the 2030 planning horizon, it is assumed that all the improvements will take place within the planning horizon. The implementation of sewerage over the planning horizon has been divided into two stages:

- Stage I: immediate interventions required by 2015
- Stage II: continuing long-term development of sewerage 2016 to 2030

8.1.1 Stage I

The following Stage I projects have been identified as critical needs and should be implemented within one to five years following the adoption of the Master Plan:

- Augmentation of existing treatment works
- Construction of new treatment plants
- Interception of all drains and diversion to treatment
- Major trunk sewers and pumping stations required to service densely populated areas and convey sewage to treatment works
- Cleaning and rehabilitation of existing sewers
- Capacity building for project implementation organization
- Capacity building of O&M organizations for sewers and treatment plant
- Rehabilitation of existing trunk sewers to divert sewage to new treatment works
- The extension of trunk sewers in all areas of the city that do not have adequate sewerage infrastructure
- Improving branch sewers in existing sewered areas
- Development of branch sewers in formerly unserviced areas
- An on-going program of house connections to increase amount of wastewater collected and treated
- Removing informal connections of storm water drains to the sewer system
- Disconnecting informal connection of branch sewers to storm water drains.
- On-going capacity building for O&M organizations

8.1.2 Stage II

Stage-II: projects implemented beyond 2015 are required to service population growth in new areas. These projects will generally include:

- Additional trunk sewers in new growth areas
- Replacement of pumping equipments and/or augmentation of pumping capacity
- Augmentation of capacity at treatment plants to handle increased flows over the planning horizon.
- On-going program for development of branch sewers and improving house connections ratios.

8.2 TIMING FOR IMPLEMENTATION OF SEWERAGE COMPONENTS

District wise delineation of the sewerage scheme is presented in Chapter 7 Figure 7.2 for 2015 and Figure 7.3 for 2030. The overall scheme will consist of 4 separate sewerage Districts each with its own treatment plant.

8.2.1 Treatment Plants

Treatment plants for each District have been selected on the basis of cost comparisons and technology options for meeting required effluent standards. Capacities are for full build out conditions in 2030.

Table 8.1 Phase wise Implementation of Treatment Plant Capacity

(mld)

Treatment Plans	District	Status	2003	2015	2030
Daulatganj	I	E/A	42	56	56
LDA Colony (planned)	I		-	10	14
Khwajapur	II	P	-	-	135
Kakraha	III	S	-	345	345
Mastemau	IV	P	-	100	305
Total			42	511	855

Treatment Plans	District	Process	Effluent discharge	Disinfection
Daulatganj	I	FAB	Gomti River	Chlorination
LDA Colony (planned)		FAB	Gomti River	Chlorination
Khwajapur	II	UASB++	Sai River	Chlorination
Kakraha	III	UASB++	Gomti River	Chlorination
Mastemau	IV	UASB++	Gomti River	Chlorination

8.2.2 Collection System Components

Proposed trunk sewers, pumping stations and tentative alignments are presented in layout drawings B4 to B9 Appendix B. The drawings also identify tributary areas used to calculate hydraulic capacities of the pipes. A phase wise summary of required collection infrastructure improvements is presented in Table 8.2.

Table 8.2 Phase wise Implementation of Collection System Improvements

Implementation period		Pump stations	Trunk sewers/ Rising mains	Lateral and branch sewers
Stage I	By end of 2010	Major conveyance facilities ▪ Guari MPS (S) ▪ Kukrail no.1 (S) ▪ Daliganj no.1 (S) ▪ Mohan Meakin (S) ▪ GH Canal (S) ▪ Martin Purwa MPS Improve existing: ▪ TGPS (S) ▪ CGPS (S) Sanctioned nala tappings ▪ 3 PS on TG side ▪ 5 PS on CG side	Relief sewers: District IV ▪ CG relief sewer Trunk sewers: District IV: ▪ Sultanpur road trunk sewer New rising mains: District III: ▪ Guari MPS to Kakraha STP (S) ▪ TGPS to Kukrail no.1 (S) ▪ Kukrail no.1 to Guari MPS (S) ▪ Mohan Meakin to TGPS District IV: ▪ Martin Purwa MPS to Sultanpur road trunk sewer	District III District IV
	2011 to 2015	Major conveyance facilities ▪ Nil	▪ Nil	
Stage II	2016 to 2030	New pump station: ▪ Lunia Purwa PS ▪ Kukrail no.2 PS ▪ Kukrail no.3 PS	New trunk sewers: District I: ▪ Hardoi Road trunk sewer ▪ Musabagh sewer ▪ Lakarmandi sewer Districts II: ▪ Trans Sharda trunk sewer ▪ Chilawan-Garaura sewer ▪ Sarojni Nagar sewer District III : ▪ Vikas Nagar sewer ▪ Mahanagar sewer ▪ Kukrail nala interceptor left bank ▪ Kukrail nala interceptor right bank ▪ Gomti Nagar main sewer ▪ Gomti Nagar no.1 sewer ▪ Gomti Nagar no.2 sewer District IV: ▪ Lilamatha sewer ▪ Shakurpur sewer ▪ Ghuswal sewer ▪ GH canal interceptor Rising mains: District III: ▪ Lunia Purwa PS to Mahanagar sewer ▪ Kukrail no.2 PS to Kukrail nala interceptor left bank ▪ Kukrail no.3 PS to Kukrail nala interceptor left bank District IV: ▪ CGPS to CG Relief sewer ▪ GH Canal PS to Martin Purwa MPS	District I District II District III District IV

(S): sanctioned

(1) District I

At present the total wastewater load calculated on the basis of population in District I is about half the capacity of Daulatganj STP. However, it is noted that the STP is already receiving flows of 42 to 45 mld. This is because a significant amount of wastewater is being pumped from Sarkata and Pata nalas which collect wastewater from catchments in District IV. Therefore the FAB treatment plant at Daulatganj will need to be augmented by an increments of 14 mld to deal with anticipated increases in nala flows.

As sewerage improvements are implemented the flow of wastewater in the nalas will decrease and the amount of wastewater diverted from District IV to Daulatganj STP will decrease. In parallel with this, the population and sewage load in District I will increase. Therefore the balance of sewage coming to Daulatganj will continue to grow gradually to the projected ultimate flow of 56 mld.

(2) District II

Wastewater from this district is not directly discharging to Gomti and therefore considered a lesser priority from pollution control perspective.

(3) District III

The priority in District III is to intercept Kukrail nala and to relieve flows in the existing Trans-Gomti trunk sewer.

UPJN is in the process of implementing sanctioned projects to construct Kakraha STP, Guari MPS, Kukrail No.1 PS, and TG Pumping Station including the conveyance systems linking all four facilities. These facilities are located at the downstream end of the proposed wastewater collection system. Therefore they are the important foundation for future development of sewerage. The capacity of pumping stations, size of rising mains and outfall sewer proposed in the Master Plan are different, since catchment areas and populations have been reconfigured. UPJN should proceed as soon as possible with implementation of the sanctioned components. However the capacity of facilities and the size of pipes should be reviewed and increased if necessary to accommodate the future development of sewerage schemes as proposed in the Master Plan.

NRCD has sanctioned a larger capacity at Kukrail no.1 Pumping Station because it is tapping nala flows and it has been assumed that the nala flows will increase in the future because. Proposed sewerage improvements may take time to implement. Therefore in the interim period it will be necessary to implement the larger sanctioned capacity at Kukrail no.1. Pumps can be downsized at a later stage to match reduced flows if and when these begin to drop.

In parallel with the sanctioned projects to tap nalas, some effort is required to relieve flows in the Trans-Gomti trunk sewer before 2010. This will include the construction of a pumping station at Mohan Meakin nala and rising main from this pumping station to TG Pumping Station

(4) District IV

The priority in District IV is to relieve flows in the existing Cis Gomti trunk sewer to convey it to Mastemau Sewage Treatment Plant through Martin Purwa pumping station. When flows in the trunk sewer have been relieved, UPJN may implement sanctioned interception schemes to divert nala flows into the CGTS. .

Wastewater collected at CG Pump Station should be conveyed to the relief sewer as soon as possible to prevent pollution at the upstream of the Gomti barrage. UPJN has a sanctioned project to convey

sewage from CG Pumping Station across the Gomti River for treatment at Kakraha STP. This plan could also be implemented in the interim period until Mastemau STP is augmented.

UPJN is also in the process of implementing sanctioned projects to construct tapping facility for GH Canal, GH Canal Pumping Station and rising main across the Gomti River to convey sewage flow of GH Canal Pumping Station to Guari Main Pumping Station.

8.3 PRIORITY PROJECTS

The sewerage system is required to improve sanitary conditions in the city with the goal of removing wastewater from open drains and improving water quality in water bodies. In the beginning, priority should be given to developing sewerage in areas upstream of the Gomti Barrage and in the areas in proximity of the city.

Development of sewerage should then follow in the other directions with priority given to diverting sewage away from the river and improving services in the most densely populated areas. Finally sewerage should be implemented in new growth areas.

The timing of any sewerage development will depend on actual population growth and growth patterns. It is also essential that sewerage development be integrated with development of water supply. Installation of sewers in areas where water distribution is inadequate will lead to failure of the system. Delayed installation of sewers in areas that have adequate water supplies will lead to discharge of sewage to drains and pollution of the environment.

Priority projects are defined as projects that should be implemented as soon as possible to achieve pollution reduction targets.

Priority projects: selected for detailed investigations in subsequent studies are listed as follows:

1) Feasibility of proposed trunk sewers, rising mains and pump stations. Confirm and survey proposed alignments, confirm topography, location and invert levels of connecting lateral sewers. Confirm catchment areas, projected flows, determine size of pipes and develop profile drawings. If necessary adjust conceptual trunk sewer layout based on topographic surveys. Confirm sites of proposed pumping stations and develop preliminary designs.

<u>District III (Trans Gomti side)</u>

Rising main from Mohan Meakin PS to TG pumping station

2) <u>District IV (Cis Gomti side)</u>

Cis Gomti Relief Sewer
Sultanpur Road Trunk Sewer
Martin Purwa Main Pumping Station and rising main

3) Field survey of existing pumping stations: CGPS to determine the physical condition of existing mechanical, electrical equipments, rising mains and sumps. Identify repair or replacement needs. Determine future flows, required size of replacement pumps, sumps and new rising mains if required.

4) Inspect condition of existing TG and CG trunk sewers and prepare a plan with costs for rehabilitation.

5) Feasibility of Mastemau treatment plant for District IV. Confirm and survey site, method of treatment, method of disposal of effluent and sludge. Develop preliminary design for STP including influent pumping station. Investigate feasibility of discharging to irrigation or wetlands.

CHAPTER 9

COST ESTIMATES

CHAPTER 9 COST ESTIMATES

9.1 CAPITAL COST ESTIMATE

9.1.1 General

The total estimated direct construction costs including a 20% physical contingency for planning level estimates and land acquisition are as follows:

(Crores)

	Stage I	Stage II	Total
Direct Cost	626.0	1,277.8	1,903.8
Physical Contingency (20%)	125.2	255.6	380.8
Land Acquisition	43.8	19.6	63.4
Total	795.0	1,553.0	2,348.0

Summary of direct cost is presented phase wise in Table 9.1 and the breakdown of component costs is represented in the form of a pie chart in Figure 9.1.

All costs are with 2003 base prices, in Indian Rupees. Taxes and duties vary depending on the equipment or material supplied therefore these are included in the unit costs.

The rates used for costing various components are based on the development of unit rates.

The estimate of investment costs has been worked out based on a phase wise implementation plan that corresponds to priorities and timeframes discussed in the report. The following costs have been included in estimated costs for project evaluation:

	Capital	O&M	Replacement
Existing facilities and sanctioned projects (GAP II)	X	O	O
Augmenting existing pump stations and treatment plants or replacing outdated equipment	O	O	O
Proposed master plan projects	O	O	O

X = not included O = included in cost estimate

The investment costs for Stage II (2016 to 2030) include an estimate of replacement costs for mechanical/electrical equipments installed during the first phase that will have reached the end of their useful life after 15 years (Table 9.9). The cost of sanctioned projects identified by UPJN in most recent DPRs has been adopted for calculating O&M and replacement costs of sanctioned facilities.

Total costs for the facilities identified in the master plan are comprised of the following items:

- Direct construction cost based on preliminary design of facilities (based on unit costs including taxes and duties) plus 10% for contractor's profit.
- Land acquisition cost
- Engineering cost: Add 15% of direct construction cost for design and construction supervision
- Administrative costs: Add 10% of direct construction cost for centage fees related to project preparation and supervision (refer Indo-Dutch project 4% preparation + 6% admin. during construction)
- Physical contingency: add 20% to the sum of direct construction cost

9.1.2 Capital Costs for Trunk Sewers and Manholes

The cost estimate for laying trunk sewers and laterals has been prepared on the basis of preliminary design for Master Plan.

The estimated costs include ancillary items like excavation, reinstatement of road surfaces, provision of protection works, closed timbering, and cost of bedding. The cost per linear meter of pipe includes the cost of manholes. The cost of new trunk sewers and laterals is presented in Table 9.2.

Total length of trunk sewers and laterals is approximately 59 km. The cost of trunk sewers and laterals is estimated at Rs. 3,929 million.

9.1.3 Capital Costs for Branch Sewers

The capital cost of branch sewers has been worked out on the basis of cost per unit length of 1,000 Rs/m (Jal Sansthan Allahabad) assuming 250 mm diameter concrete pipe. The average length of branch sewer per hectare is 385 m/ha. The average length of branch sewers is worked out from a review of sewer drawings for typical colonies and urban areas.

The estimated cost of branch sewers includes cost of manholes, road reinstatement and other ancillary works. The estimated cost of branch sewers is presented in Table 9.3

The total cost of branch sewers is worked out to be Rs. 10,379 million.

9.1.4 Capital Costs for House Connections

The number of house connections to be made during various project years has been assessed on the basis of number of dwellings calculated from census population and family size. The number of houses connected to the wastewater collection system will reach up to 80% by the end of Phase 2. The connection ratios at each phase have been identified in Section 6 “Planning Framework”.

The unit cost of house connections is taken as 7,750 Rs/connection. This unit cost is obtained from discussions with Jal Sansthan Allahabad and costs identified in Allahabad Sewerage Master Plan adjusted to 2003 cost base using wholesale price index. Costs for branch sewers are estimated for each District in Table 9.4.

9.1.5 Capital Costs for Sewage Pumping Stations

The total capital cost of pumping stations has two major components: civil works and electro-mechanical works. The cost of each has been worked out separately as shown in Table 9.5

The costs are worked out on the basis of cost per mld developed from a review of recent UPJN tenders and DPR cost estimates. The following formulae and costs are applied depending on the type of pump station:

	Civil works	Electro-mechanical	Electrical service
Submersible < 6 mld	y = 0.1073x + 2.7675	y = 1.0x	y = 0.8x
Submersible > 6 mld	y = 0.1679x + 1.3616	y = 0.3x	y = 0.8x
Centrifugal	y = 26.958Ln(x) - 80.598	y = 0.2462x + 5.0009	y = 25.0x

x: Design capacity in mld, y: Cost in Million Rs.

The electro-mechanical costs include the cost of diesel generators. The cost of electrical service entrance assumes 11 kV, and includes an average transmission line length of 5 km.

The cost of new pumping stations and upgrades to existing is estimated at Rs. 2,945 million.

9.1.6 Capital Costs for Rising Mains

The size and other details of rising mains have been worked out on the basis of preliminary design. All rising mains are estimated on the basis of unit cost per meter length for pre-stressed concrete pipe. Costs include installation, jointing, and testing, and connection to outfall sewer.

Cost details are provided in Table 9.6. The total length of new rising mains is 12 km and the estimated cost is Rs. 246 million.

9.1.7 Capital Costs for Treatment Plants

Capital costs of treatment plants have been worked out in Section 6 "Evaluation" for comparison and selection of treatment processes. Capital costs per unit mld are based on a review of treatment plants constructed under GAP and YAP presented in Supporting Report Vol. III-11. The estimated cost of treatment works is presented in Table 9.7. The total cost is Rs 1,348 million. The estimated cost includes treatment units along with piping, pumping, cost of laboratory, administrative building, electrical sub-station, site development and boundary walls. The cost of dual fuel engine generators is included for treatment processes that produce methane. Costs of land acquisition have been identified separately in Table 9.8.

9.2 ANNUAL O&M COSTS

Effective operation and maintenance is essential for the success of any sewerage system. Operation and maintenance involves the following major components:

- Operation, maintenance and monitoring personnel
- Parts, equipment and machinery
- Energy costs

Total O&M costs are summarized in Table 9.11.

Annual repair and maintenance costs at pumping stations are estimated as a percentage of capital costs using the following factors as adopted by UPJN:

Table 9.12 Unit Operation and Maintenance Costs

Sl.	Description of items	Economic life (years)	Annual repair and maintenance cost as % of capital cost
1	Civil structures	30	1.5
2	Pumps	15	3.0
3	Pipelines	30	0.25
4	Electrical	15	3.0
5	Diesel generators	15	3.0

Source: UPJN Detailed project reports, Allahabad and Lucknow

Energy costs for pumping stations are calculated on the basis of electricity required to operate the pumps as calculated from the discharge and pumping head. The cost of electricity is taken as Rs 3.1 per kwh from the rate schedule issued by U.P. Power Corporation, August 2003. Recurring costs (excluding staff) for pumping stations are presented in Table 9.13.

Energy costs for treatment plants is worked out on the basis of unit consumption rates per mld identified in Supporting report B "Review of Gap and YAP treatment plants. Recurring costs for treatment plants are identified in Table 9.14.

9.2.1 Staff

The number of staff required for carrying out regular operational, preventive and corrective maintenance activities can be grouped into the following categories:

- Personnel for sewer maintenance
- Personnel for sewage pumping stations
- Personnel for operation and maintenance of sewage treatment works
- Personnel for process control

Staff requirements for pump stations and treatment plants are in accordance with directives issued for GAP projects by UP Ministry for Urban Development Annual recurring costs on staffing is based on the manpower required and salaries that have been given by UPJN Allahabad for 2002, and increased by 10% to bring them to 2003 base.

(1) Sewer Maintenance

Sewer maintenance generally involves regular inspection of all sewers, sewer cleaning operations, both preventive and corrective, and occasional repairs to manholes. Category and extent of personnel required for these activities have been worked out on the basis of quantity of work. Recommended personnel requirements for this component are presented in Table 9.15. A total of 5 crews are recommended for stage I, and 12 crews for stage II.

(2) Sewage Pumping Station

The personnel requirements for operation and maintenance of sewage pumping stations vary depending on the size of the station. Staff requirements for pump stations are presented in Table 9.16 in accordance with directives issued for GAP projects by UP Ministry for Urban Development

(3) Sewage Treatment Plants

The personnel requirements for operation and maintenance of treatment plants vary depending on the size of the station. Staff requirements for the STPs have been worked out according to the guidelines of UP Ministry for Urban Development for GAP project and presented in Table 9.17 to 9.20.

9.3 IMPLEMENTATION/COST SCHEDULE

The annual investment costs and recurring costs for implementing the Sewerage Master Plan are presented for each district in Table 9.21. The schedule of costs is based on the implementation schedule and priorities discussed in previous sections. The cost breakdown of projects identified for implementation during Stage I is listed in order of priority in Table 9.22.

CHAPTER 10

INITIAL ENVIRONMENTAL EXAMINATION (IEE) STUDY FOR LUCKNOW

CHAPTER 10 INITIAL ENVIRONMENTAL EXAMINATION (IEE) STUDY FOR LUCKNOW

10.1 OBJECTIVE OF THE IEE STUDY

IEE is a very important and useful planning tool for development projects/programs at early stage. Original formulation of any projects/programs may be modified, if significant negative impact is predicted by the IEE. According to the JICA Environmental Guidelines, IEE is defined as "an examination undertaken at the outset of the development project planning stage to determine the environmental impacts that may be created by the particular project based on existing information and data."

The IEE has the following two objectives:

(1) To evaluate whether EIA is necessary for the project and, if so, to define its contents, and (2) to examine from an environmental viewpoint, the measures for mitigating the impacts of the project, which requires environmental consideration but not a full-scale environmental impact assessment.

For the above objectives, the study on IEE was investigated (1) knowing the existing social and natural environmental conditions of the Study area, (2) identifying constraints and problems for the master plan projects/programs on the water quality management for Ganga River.

10.2 METHODOLOGY OF THE IEE STUDY

10.2.1 Procedure

There are three steps for the IEE as follows.
(a) Identify of master plan projects/programs for the IEE,
(b) Survey evaluation of environmental impact at the construction or rehabilitation and the operation stage by using an environmental impact checklist, and
(c) Output of evaluation.

10.2.2 Evaluation of Environmental Elements

An environmental impact matrix is used as a checklist of environmental effects. Environmental elements of impact matrix are based on JICA Guideline including JBIC Guideline. The major components are social issues, demographic issues, economic activity, institutional and custom related issues, health and sanitary issues, and cultural asset issues as social environment, and biological and ecological issues, soil resources, land resources, hydrology, water quality and temperature, pollution and landscape as natural environment.

10.3 SURVEY AREA

The survey area is four (4) cities of Lucknow, Kanpur, Allahabad and Varanasi. This part of the Report focuses on Lucknow.

10.4 PROJECTS FOR THE IEE STUDY

(a) District I

(1) Installation of Sewers
(2) Augmentation of Dalatganj STP

(b) District II

(3) Installation of Sewers

(4) Construction of Khwajapur STP

(c) District III

(5) Rehabilitation of TGPS
(6) Installation of Sewers
(7) Construction of Pumping Stations (IPS)

(d) District IV

(8) Rehabilitation of CGPS
(9) Installation of Sewers
(10) Construction of Martin Purwa SPS
(11) Construction of GH canal SPS
(12) Construction of Mastemau STP

10.5 EXISTING ENVIRONMENTAL CONDITIONS

The district Lucknow is geographically located at $26^0$30' N to $27^0$10' N latitude and $80^0$34' E to $81^0$12' E longitude. Lucknow is the capital city of the largest state of India, Uttar Pradesh and one of the important historical and commercial cities of northern India. Total population of the city according to 2001 census is 2,207,340 that resisters an annual growth rate of 2.46 % during the period of 1991-2001.

The climate of the city is subtropical monsoon type. The average maximum and minimum temperature of the year are 32.2℃ and 16.7℃ respectively. Lucknow experiences both very dry hot summer and very cold winter every year. Dust storm in summer and cold north winds in winter are common.

The city gets an annual average rainfall of the order of 1016mm out of which about 90 % of the rainfall occurs during the monsoon months i.e., June to September. The values of maximum and minimum rainfalls ever observed are 2143 mm in 1980 and 161.1 mm in 1952 respectively.

During the months of August the values of relative humidity goes as high as 86 % while the same goes down up to 20 % during the months of April. March, April and May are found as dry months. Large fluctuations in relative humidity are a very common phenomenon.

The major existing of environmental conditions are as following.

(1) Slums

Significant percentage of homeless population resides in a number of scattered slum areas in the city. The total number of recognized slum areas including the areas under Nehru Rojgar Yojana are about 260 and approximately 100,000 of people live in slum areas. The Lucknow Municipal Corporation (LMC) has provided some basic community facilities like Sulabh Complex, drinking water supply and power in identified slums.

(2) Important Historical Places

Lucknow is a historical city of Uttar Pradesh, it is famous for its old buildings of historical importance. Among them, the Imambara is very famous historical structure, others include Chota Imambara, Residency, Baradari etc.. Gomti Ghat, Bhool Bhulaiya, Zoo also attract thousands of peoples from home and abroad.

(3) Conservation and Development of Areas of Historical and Cultural Importance

Three zones in the city are identified as heritage zones. These are namely Qaisarbagh complex, Hussainabad complex and La Martineer complex.

(4) Industrial Area

Lucknow is basically not an industrial city but there are 4 identified industrial areas where many large, medium and small scales industries have been clustered. These are Talkatora industrial area, Aishbagh industrial area, Sarojini Nagar industrial area and Amousi industrial area. As the Talkatora and Aishbagh are congested, of late the industries are growing at Amousi and Sarojini Nagar.

(5) Drainage

The Gomti River meanders through the heart of Lucknow. There are 26 significant nalas/drains in the city. But they are not systematically connected with sewerage. These drains discharge directly into the Gomti River. Out of these 26 nalas/drains, 14 are on the Cis side of the river and 12 are on the Trans side.

(6) Major Sewerage System

There is one Sewage Treatment Plant (STP) named as Daulatganj STP.

(7) Metals and Pesticides in Gomti

The concentration of metals was at non-traceable range during the monitoring conducted in 1996. But during 2000, the concentration in respect of iron and chromium at the upstream at raw water intake point and in the down streamside were considerably on higher side. It indicates that these metals are added to the river through the wastewater of drains.

Pesticides are present in the river water at abundance. Huge consumption of pesticides in agricultural fields at catchments areas upstream of Lucknow is finding their way to the river, as no manufacturing unit are there and the upstream areas are primarily agriculture based.

(8) Soils

There is narrow irregular loam line across the centre from Hardori up to the town of Malihabad. The west and centre of this pargana is built by stiffen loam with patches of usar. West and south side has light loam. North-western part has tarai Gomti. Western side has got undulating sand.

(9) Agriculture

The Lucknow district is divided in 8 blocks in respect of agricultural land, Kakori, Sarojni Nagar, Chinhat, Bakshi Ka Mau, Malihabad, Mohanlalganj and Gusaiganj. Agricultural land area is a total of 237,025 hectares. The major agricultural products are rice, wheat, maize, jwar etc. These areas are producing both the Rabi and Kharif crops. Besides other vegetables are also produced here. The main Rabi crops are wheat and mustard, and Kharif season crops are rice, maize and jwar.

Three types of fertilizers are being used in cultivation but low nitrogen content of the soil demand large amounts of nitrogenous fertilizer. Crop-wise quantities of fertilizers being used are depicted in the table below.

Crop type	Nitrogen based (MT/annum)	Phosphorous based (MT/annum)	Potassium based (MT/annum)
Rabi Crops	11,360	3,045	356
Kharif Crops	7,655	853	253

Solid Waste Management

The primary collection of the solid waste is taken care by the Department of Health and Sanitation of Lucknow Municipal Corporation. About 1500 MT (200 g to 500 g per capita) of garbage is generated every day within the Municipal Limits. The coverage through regular sweepers of Lucknow Nagar Nigam (LNN) is about 80 % of the city and the number of sweepers is about 4,100. Rubbish Removal and Maintenance Department carry out the transportation and disposal of solid waste.

Open Space

Open spaces with recreational facilities are Aminuddaula Park, Hazrat Mahal Park, Husainabad Park, Sarojini Naidu Park, and Victoria Park. Among the beautiful gardens the Banarasi Bagh, Company Bagh, Dilkusha Garden and the Botanical Garden are famous.

10.6 EVALUATION AND CONCLUSION OF THE IEE STUDY

The Ministry of Environment and Forests (MoEF) enforced the notification in January 1994 and amended it in May 1997, April 1997, January 2000, December 2000, August 2001 and November 2001 for conducting Environmental Impact Assessment (EIA) studies which are obligatory for the establishment of certain categories of industries specified in Schedule I. The Schedule I industries include 30 categories. The appraisal committees comprising experts, Governmental official and non-government organisations (NGOs) were set up by the MoEF to scrutinise various EIAs prepared for the establishment of such industries and projects. The appraisal committees would accord an environmental clearance to the project in consultation with MoEF after scrutinising the EIA report for the proposed project. Sewerage project is not included in these industries and does not require EIA study according to the Notification.

An Initial Environmental Examination (IEE) for the proposed project components in the Master Plan for the four cities was carried out by JICA Study Team based on a JICA guideline, to briefly identify the impacts of the facilities proposed in the Sewerage Master Plans on natural and social environment. The important environmental issues are identified and the impacts are ranked as (A) strong impact, (B) medium impact, (C) not fully known, and (blank) no major impact during the construction and operation stage.

The results of the IEE to Master Plan Projects that have been planned for Lucknow city are shown in Table 10.1. The major impacts identified for the proposed facilities are related to construction and operation of sewage treatment plants as given in table below.

Impact items	Phase	Spatial range	Time range	Range/ affected people
1. Land acquisition for construction of STP	Construction	Agricultural field	Long term	Farmers
2. Income loss of agriculture due to construction of STP in agricultural field	Construction	(Social issue)	Long term	Farmers
3. Landscape and land use change	Construction	Agricultural field	Long term	Nearby villagers
4. Sludge disposal from STP	Operation	Disposal sites	Long term	Disposal sites
5. Contamination of surface water and groundwater by discharging treated effluent and seepage from STP	Operation	River, irrigation canal and groundwater	Long term	Nearby villagers
6. Contamination of soil through application of treated water and dried sludge	Operation	Agricultural field	Long term	Farmers

The proposed projects are, however, in general, environmental mitigation projects by providing sewerage system to properly dispose of municipal sewage. Therefore, the projects themselves have preferable environmental impacts on the water environment and the public health of the residents.

Table 10.1 Possible Environmental Impact Matrix for IEE

Development Scheme \ Environmental Elements		Social Environment									Natural Environment								Pollution					
		Resettlement	Economic Activity	Traffic/Public Facilities	Split of Communities	Cultural Properties	Water Right/Right of Common	Public Health Condition	Solid Waste	Hazard	Topography and Geology	Soil Erosion	Groundwater	Hydrological Situation	Coastal Zone	Flora and Fauna	Local Meteorology	Landscape	Air Pollution	Water Pollution	Soil Contamination	Noise and Vibration	Ground Subsidence	Odour
Sewage Treatment Plant	**C**	B/C	B/C	C					C									B/C				C		
	O							C	C				B/C	C						B/C	B/C	C		C
Pumping Station	**C**	C		C																		C		
	O							C	C													C		
Installation of Main Trunk Sewer	**C**		C	C																		C		
	O																							
Rehabilitation of Existing Trunk sewer	**C**		C	C				C												C		C		C
	O																							

Remarks:

C: Indicates construction (rehabilitation) stage. **O**: Indicates operation stage.

A: Indicates that the development scheme is foreseen to have strong impact on the environmental element.

B: Indicates that the development scheme is foreseen to have some impact on the environmental element.

C: Indicates that the development scheme is foreseen to have minor impact on the environmental element

Balnk: indicates no impact