CHAPTER 14
EMERGENCY PROJECT FOR NORTH DHAKA EAST

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14.1 Identification of Emergency Plan

The creation of new sewerage system requires a complete set of facilities, encompassing a sewer network, pump stations and sewage treatment plant, to attain the function of sewerage services with regardless to the magnitude of the required sewerage system. In other words, provision of considerable project implementation period and capital input is the destiny of the sewerage system project.

The North Dhaka Sewerage Master Plan has been established for the target year of 2020 and the feasibility study on the priority project was developed focusing on the core area of the North Dhaka East Sewerage Service Zone with a target year of 2005. In the case of the priority project, it will require a five-year implementation period and large-scale capital investment, starting from land acquisition and site preparation (using local budgetary resources), up through the construction of the sewerage facilities and the installation of the service connections (using foreign funding). The project benefits will appear from the beginning of 2006. However, uncertainty is involved at present, regarding the budgetary arrangements for both the local and foreign funding. Any delay regarding such arrangements will affect the implementation of the priority project.

On the other hand, water pollution in the Gulshan and Banani lakes is at a critical stage. The surrounding environment has deteriorated owing to the leakage of raw sewage (from damaged sections of the area's sewer lines) into Banani Lake and due to the overflow of sewage from clogged sewer lines and unserved areas into Gulshan Lake. The waters from these lakes are then flowing down to the Lakhya River, wherein a surface water intake facility of the Saidabad Water Treatment Plant is being constructed downstream. If immediate countermeasures are not taken to prevent further water pollution in the subject water bodies, serious influence on the Saidabad waterworks is anticipated.

In due consideration of the above mentioned situation, a possible immediate countermeasure was drawn up to utilise the existing sewerage facilities in South Dhaka (within their surplus capacity), until such time that the new sewerage system planned in the priority project can

start its services. Through these means, an early provision of sewerage services in the priority project area can be assured to prevent further water pollution in the Gulshan and Banani lakes.

The Emergency North Dhaka Sewerage Project is hereby identified as the immediate countermeasures to meet with the present conditions. This scheme is based on the fact that the Pagla Sewage Treatment Plant in South Dhaka is receiving about 40,000 cu.m/day, which is less than half of its daily average design sewage flow of 96,000 cu.m/day. As a result of the implementation of the emergency project, which entails the provision of proper sewerage facilities for the existing sewerage service area of the core area and the proposed sewerage service area (both located in the North Dhaka Sewerage Service Zone), as well as the treatment of this sewage at the Pagla Sewage Treatment Plant (until completion of the priority project), the following effects/benefits can be realised:

- Provision of sewerage service to unserved area at the earliest time possible,
- Effective utilisation of the existing sewerage facilities, and
- Early improvement of water pollution conditions in the Gulshan and Banani lakes.

14.2 Present Situation of South Dhaka Sewerage System

14.2.1 North Dhaka East Area

Please refer to Chapter 2.5, Conditions of Existing Sewerage Facilities.

14.2.2 South Dhaka Area

Prior to the commencement of the preliminary design of the emergency project, the existing sewerage facilities in South Dhaka, particularly the operating conditions of the pumping stations and the Asad Gate Trunk Main, were investigated and evaluated, as described below.

(1) Sewage pump stations

1) Composition of major pump stations

There are 13 major pump stations throughout the present service area of South Dhaka Sewerage System as listed below. The data of these pump stations were gathered from their operation records and from interviews with the pump operators.

1. Asad Gate L.S.	2. Tejgaon L.S.	3. Bashaboo L.S.
4. Sayedabad L.S.	5. Hazaribag L.S.	6. New Market L.S.
7. Mogbazar L.S.	8. P&T L.S.	9. Nawabganj L.S.
10. Azimpur L.S.	11. Medical College L.S.	12. Faridabad L.S.
13. Narinda P.S.		

The existing sewer network was subdivided into three groups in accordance with the sewage flow into trunk mains, namely the Asad Gate Trunk Main, the Hazaribag Trunk Main and the Nawabganj Trunk Main.

2) Flow balance between pump stations

The Sewage flow at each pump station was surveyed, in both the rainy and dry season, and exhibited in Figure 14.2.1. The survey results revealed the following facts:

- A decrease of sewage flow in dry season indicated the seepage of stormwater into the sewer lines.
- Sewage leakage from broken sewer lines was indicated at several locations.

The most significant imbalance of sewage flow in the dry season was observed between the Bashaboo I/S (6,350 cu.m/day) and the Saidabad I/S (1,035 cu.m/day) on the Asad Gate Trunk Main, wherein about 5,000 cu.m/day of sewage was lost by leakage.

(2) Installation conditions of the Asad Gate Trunk Main

Based on the aforementioned survey results, the Asad Gate Trunk Main was further investigated to confirm its installation conditions and surrounding environment. The survey results are exhibited in Figure 14.2.2. A colour marking of the route of the Asad Gate Trunk Main was prepared, as outlined below, in order to the reflect survey results.

Red: Trunk main is always submerged under water in Gulshan Lake and other swamps throughout the year. Access to the trunk main in these sections is limited to square-shaped manholes, which can be reached only by boat.

Yellow:Trunk main is submerged under water in Gulshan Lake and other swamps during the rainy season. Access to the trunk main is limited to a footpath along the trunk main.

Blue: Trunk main is laid under roads in residential areas and markets where maintenance vehicle can access and is not submerged under water.

Thus, major rehabilitation work of the trunk main in the sections marked with red or yellow is considered costly and difficult under the present conditions.

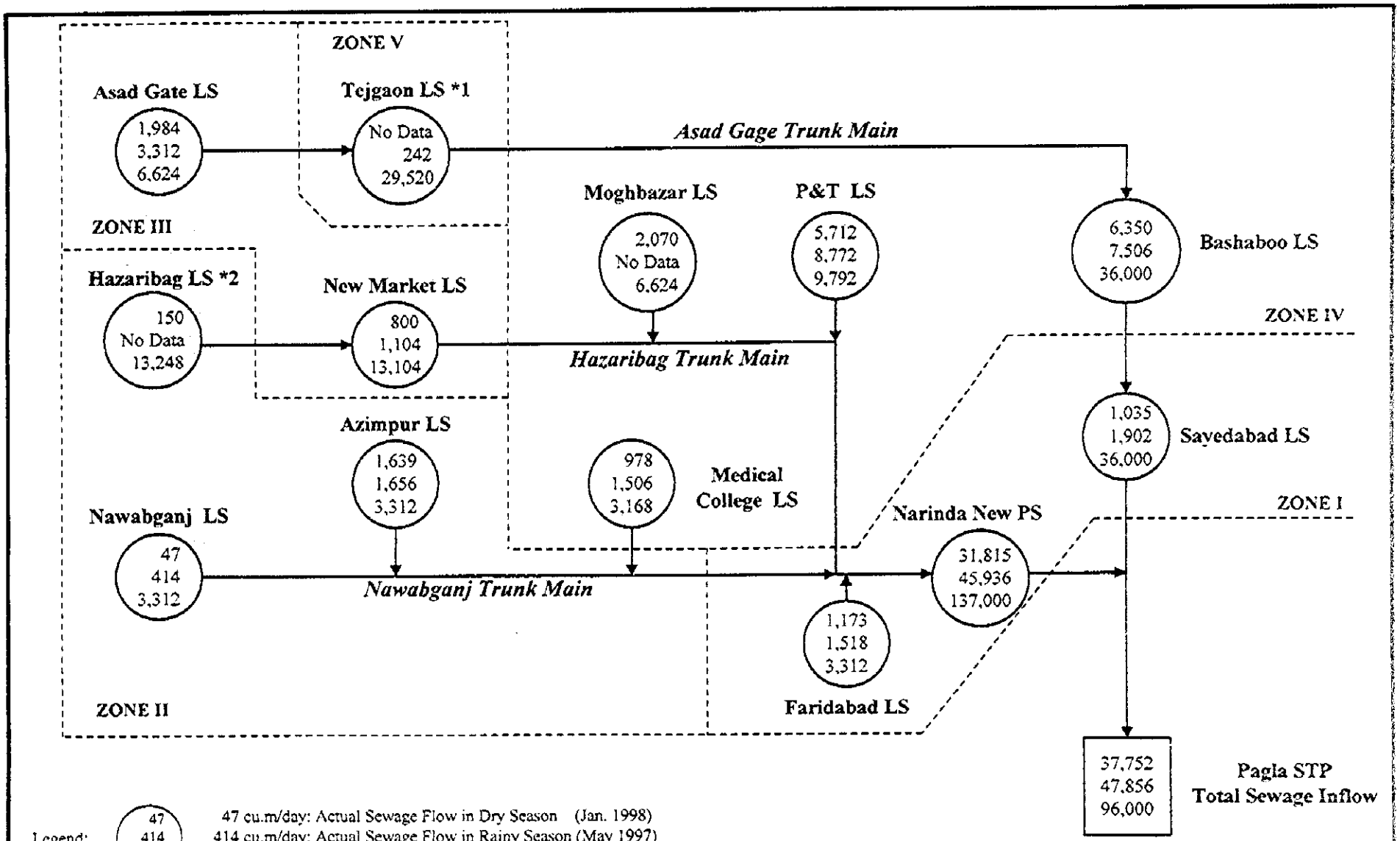
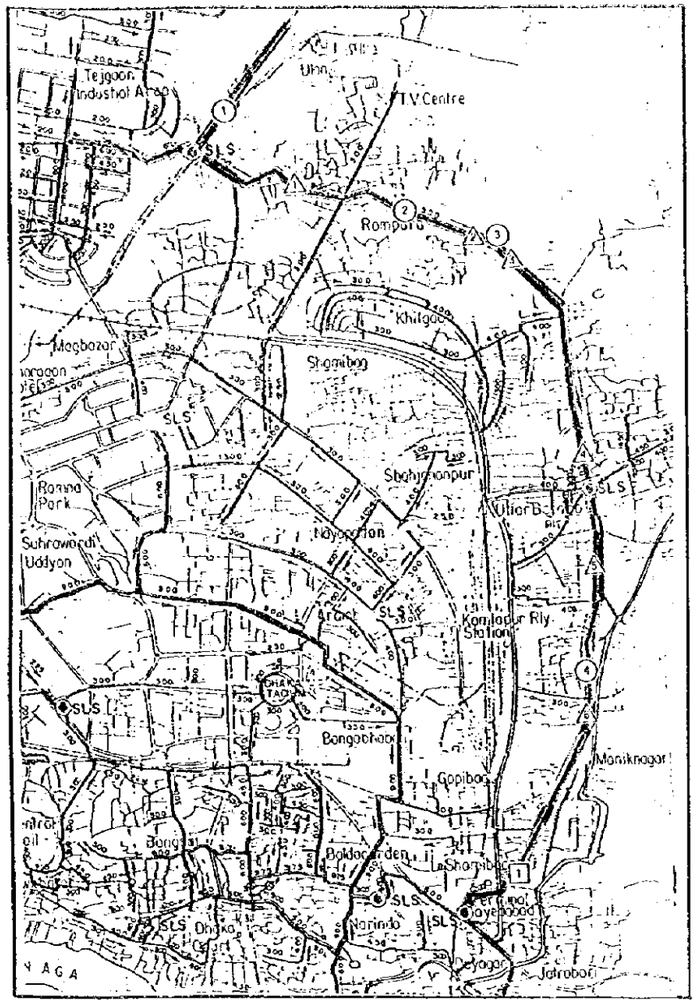
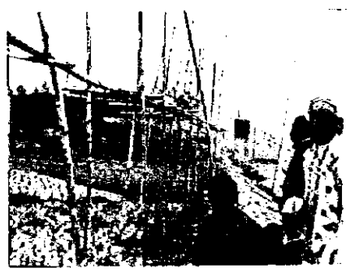
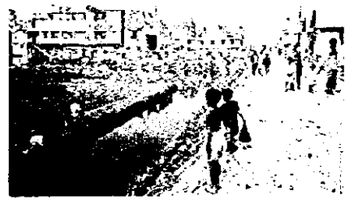


Figure 14.2.1
Schematic Diagram of Sewage Flow in South Dhaka

The Study on Sewerage System in North Dhaka







LEGEND

◉	SLS
▬	Submerged Through the Year
▭	Submerged during Rainy Season
▭	Installed under The Road
△	Leakages from Dameged Trunk Main
○	Site Condition of Trunk Main
□	Obstacles Accumulated in Manholes of Trunk Main

Figure 14.2.2

Present Conditions of Trunk Main

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(3) Clogging conditions

The clogged conditions of the trunk main were also investigated, as shown in Figure 14.2.2. The findings of these investigations were as follows:

- Large amounts of garbage of various kinds were observed at the grit chambers of pump stations and manholes.
- High water levels in manholes in comparison to the installed depth of the sewer lines.
- Considerable time passed before the dye reached the manholes downstream.

The above-mentioned facts revealed that there were chronic clogging conditions in the trunk mains and the connecting sewer network. Critical conditions were observed including the following:

- The trunk main, starting from the Nawabganj L/S, is clogged by garbage and the pumped sewage has overflowed to nearby residential areas in the last six months.
- The trunk main, staring from Medical College L/S, has the same clogging conditions and pumped sewage has overflowed into the stormwater drainage system.

(4) Leaking conditions

Dye was thrown into strategic locations of the trunk main as a tracer to identify sewage leakage points. Visible leakage was found at several locations, such as sewage gushing out from swamps. Invisible leakage occurring under water was revealed by the dye.

(5) Overall conditions

Leaking points and their surrounding area are exposed to serious water pollution and foul odour, which were claimed by local residents.

As a whole, the sewer network in the Gulshan area and the Asad Gate Trunk Main, from the Tejgaon L/S up to the Saidabad L/S via the Bashaboo P/S, requires a thorough cleaning, but many sections of the trunk main are not accessible.

14.3 Preliminary Design

The focus points of the preliminary design for the emergency project to handle sewage generated in the existing service area and part of the new service area at the Pagla Sewage Treatment Plant are as follows:

(1) Selection of a new service area in the core area of North Dhaka East Sewerage Zone and the preliminary design of an additional sewer network

(2) Improvement of the existing sewer network in the core area of the North Dhaka East Sewerage Zone

(3) Relocation of the Asad Gate Trunk Main (mainly from the Tejigaon I/S to the Bashaboo I/S)

14.3.1 Selection of New Service Area and Preliminary Design of Additional Sewer Network

(1) Selection of new service area

The new sewerage service area (214 ha) can be divided into three sub-areas by local conditions:

- Joar Sahara,
- Baridhara, and
- Badda.

The target area for provision of the sewer network was selected based on the following criteria:

1) Technical suitability

a. The candidate area is served by the water supply service of DWASA.

b. The candidate area has appropriate road network to allow for installation of sewer network.

c. The candidate area has reasonable population density to realise the maximum extent of benefits over the investment.

2) Socio-economic suitability

The candidate area has a high potential suitability regarding the following matters:

a. Investment effect can be seen at the shortest time possible.

b. Potential beneficiaries/residents have shown willingness-to-pay and ability-to-pay for the sewerage service in terms of cost recovery.

c. Potential beneficiaries/residents have sufficient affordability to shoulder cost for installing service connections to the sewer network.

d. Potential beneficiaries/residents have willingness to participate to the implementation of sewerage system.

Through a comparative evaluation, the Baridhara area was selected as the target area for the provision of a new sewer network as shown in Table 14.3.1. Due attention was paid on technical suitability and cost recovery as well as socio-economic suitability.

Table 14.3.1 Comparative Evaluation of Candidate Areas

Selection Criteria	Joar Sahara	Baridhara	Badda
Technical Suitability			
1) Water supply coverage	Good	Good	Good
2) Road network	Poor	Good	Poor
3) Population density	Medium	Medium	Hight
Socio-economic Suitability			
1) Realisation of investment effects	Medium	Highest	Low
2) Cost recovery	Medium	Highest	Low
3) Financial affordability	High	Highest	Medium
4) Motivation	Moderate	Highest	Moderate
Overall Evaluation	2nd	1st	3rd

(2) Preliminary design of new sewer network

The sewer system of the Baridhara area is differed from that of the priority project in order to temporarily convey sewage up to the Pagla STP through the existing sewer network, as follows:

- Discharged sewage in the Baridhara area will be collected at one location.
- The collected sewage will be lifted by a manhole-pump and transmitted through a pressure pipe to the existing sewer network in the Gulshan area.
- When the North Dhaka East Sewage Treatment Plant starts operation in the future, a pressure pipe from the manhole-pump will be re-routed to the Uttara Trunk Main.

The sewer facility plan of the Baridhara area is shown in Figure 14.3.1 and the relating hydraulic calculations and longitudinal vertical cross-section of the sewer network are contained in Appendix 14.3.1.

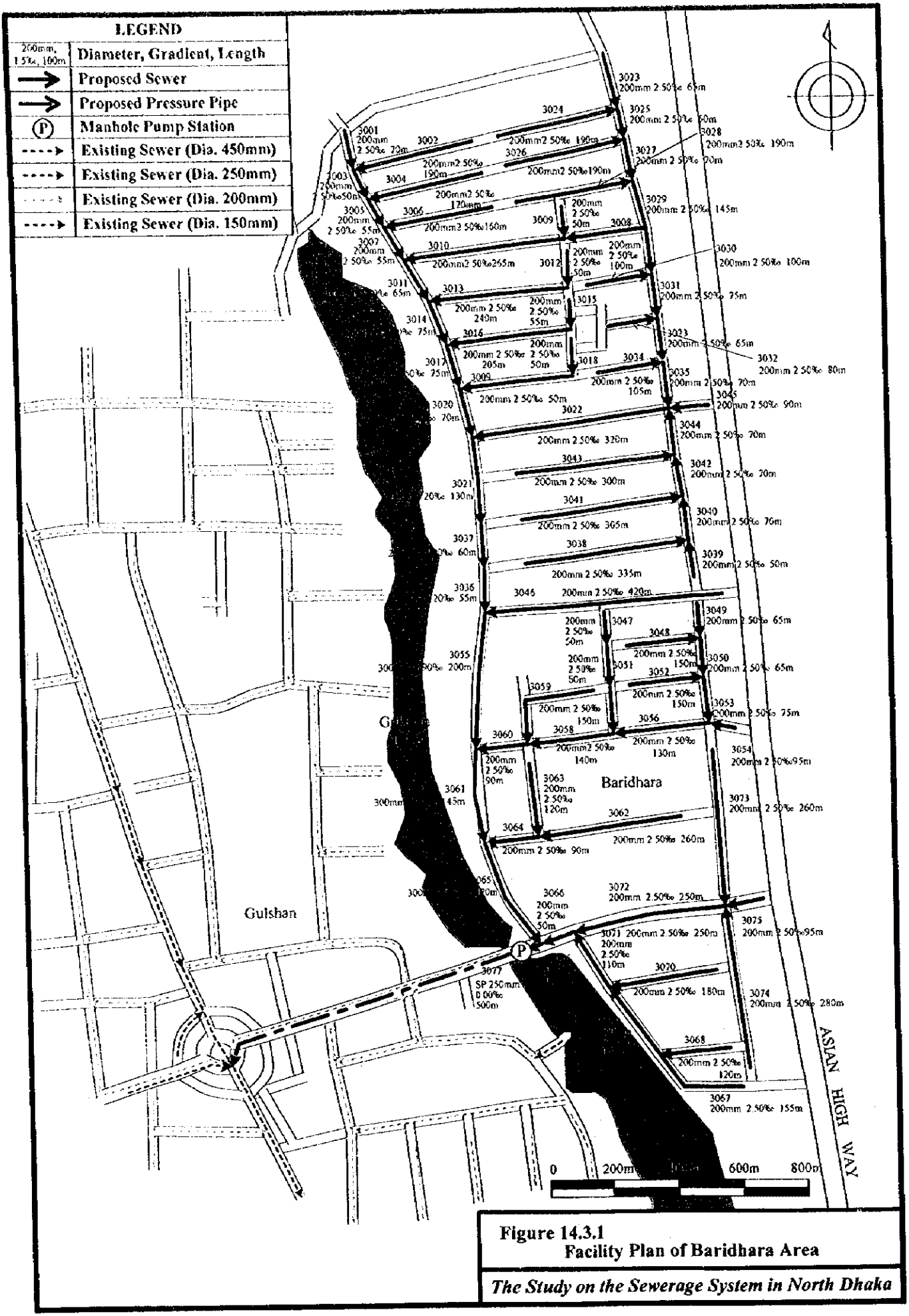

Figure 14.3.1
Facility Plan of Baridhara Area

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14.3.2 Improvement of Existing Sewer System in Core Area

In order to temporary accept sewage of the Baridhara area, the hydraulic capacity of the existing sewer network in the Gulshan area was evaluated using a computer-aided simulation, with the following preconditions:

- Temporary diversion of sewage flow from the Baridhara area will continue up to the end of 2005.
- The design population and per capita sewage flow in 2005 was applied. However, the design maximum daily flow was adopted in consideration for maximum economy and the temporary re-routing of the sewage flow.

Design parameters are as follows:

Design population density: 444.70 person/ha

Per capita sewage flow: 115 lpcd (design maximum daily flow)

In addition to the above, the sewerage service coverage was also considered to estimate the area's realistic sewage volume. Practically, the sewerage service coverage was estimated based on the current ratio of number of water supply connections and number of sewer connections, as shown in Appendix 14.3.1. The future sewerage service coverage was assumed considering that a 100% service coverage ratio will be achieved in the master plan target year of 2020. The trend of sewerage service coverage in every five-year period was estimated as shown in Table 14.3.2. The sewerage service coverage in 2005 was assumed at 44%.

Table 14.3.2 Sewerage Service Ratio

Unit: %

Area	1997	2000	2005	2010	2015	2020
North Dhaka	14.2	25	44	63	81	100
South Dhaka	44.8	52	64	76	88	100

Sewage flow from the Cantonment area is not considered in this estimate due to the uncertainty regarding the realisation of sewerage service.

Based on the above assumptions, a hydraulic simulation was carried out as contained in Appendix 14.3.3 and the sewer lines having insufficient hydraulic capacity are exhibited in Figure 14.3.2. Sewer lines having insufficient hydraulic capacity will have flow conditions of pressure pipe with increased hydraulic levels. These increases in water level are exhibited in Table 14.3.3. The total increase of the water level was estimated at 40 cm. Thus, sewage

overflow from manholes will not occur, since the earth cover of sewer lines is approximately 1.0 m deep.

Table 14.3.3 Estimated Increase of Water Level in Sewer Lines Having Insufficient Hydraulic Capacity

Sewer No.	Length	Sewage Flow	Material	Diameter	Gradient	Velocity	Hydraulic Gradient	Increase of Water Level
	(m)	(cu.m/sec)		(mm)	(‰)	(m/sec)	(‰)	(m)
1025	870	0.1103	VP	450	0.70	0.694	0.89	0.17
1035	780	0.1172	VP	450	0.70	0.737	1.00	0.23
Total								0.40

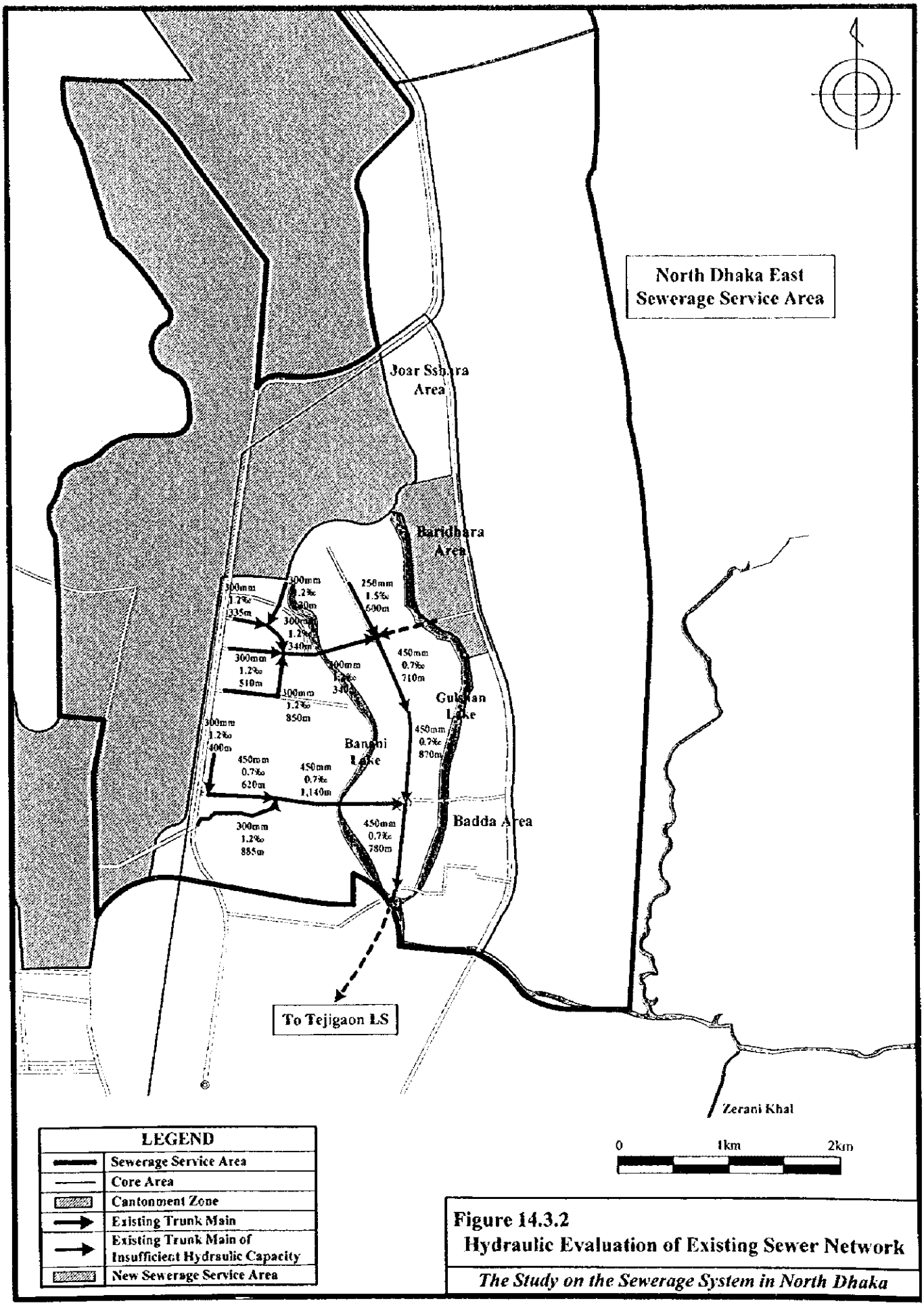

Figure 14.3.2
Hydraulic Evaluation of Existing Sewer Network

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14.3.3 Relocation of Existing Trunk Main in South Dhaka

(1) Principal approach

The existing Asad Gate Trunk Main has a lot of damage and clogging (as described in the foregoing subsection) and is not performing its principal purpose--to convey collected sewage to the Pagla Sewage Treatment Plant.

The function of the said existing trunk main shall be restored as a prerequisite to realise the temporary treatment of sewage to be collected from the existing and new service areas in the North Dhaka Sewerage Zone. The principal approaches of this restoration are described below.

1) The target section to restore the function of the Asad Gate Trunk Main shall be the area between the Tejgaon L/S.

2) The existing Asad Gate Trunk Main shall be relocated and installed under the road because of following reasons:
   a. The existing trunk main has already superannuated and is getting close to expiration of service life, since its more than 50 years of usage.
   b. The section of the trunk main submerged throughout the year makes it very difficult to conduct a damage survey and the rehabilitation/O&M of this section, even if restored/rehabilitated is practically impossible.
   c. Owing to extremely long distance between manholes, the cleaning of trunk main by means of water jetting equipment, etc. is almost impossible. Thus, additional manholes shall be provided to shorten the distance between manholes to ensure proper cleaning of the trunk main when the rehabilitation is taken up for the existing trunk main.

3) The new trunk main shall have a flow capacity equivalent to the existing trunk main.

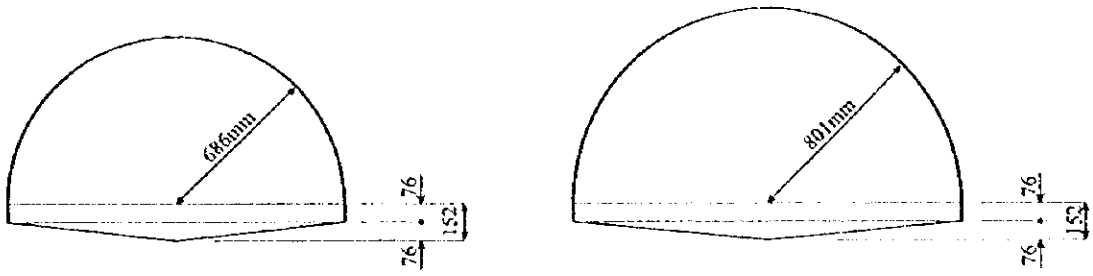
4) The existing pump stations in the target section of trunk main shall continue to be utilised.

5) The damaged parts of the existing trunk main, other than the section for relocation, shall be repaired by DWASA itself in a three-year period from 1998 with the use of 500 million Taka allocated by the national government.

(2) Hydraulic design of new trunk main

The hydraulic design of the existing Asad Gate Trunk Main is shown below, while vertical cross-section and hydraulic capacity are shown in Figure 14.3.3 and Table 14.3.4, respectively.

Section	Material	Diameter	Gradient
Upstream of Tejigaon I/S	Reinforced Concrete Pipe	600mm	1.1‰
Tejigaon I/S – Bashaboo I/S	EQ Brick Arch Pipe	36"	0.48‰
Bashaboo I/S – Saidabad I/S	EQ Brick Arch Pipe	48"	0‰



Cross-section of Trunk Main between Tejgaon LS and Bashaboo LS

Cross-section of Trunk Main between Bashaboo LS and Sayedabad LS

Figure 14.3.3 Cross-section of Existing Trunk Main

Table 14.3.4 Hydraulic Capacity of Existing Trunk Main

Section of Existing Trunk Main	Length	Cross-sectional Area	Wetted Perimeter	Hydraulic Mean Depth	Roughness Coefficient	Gradient	Flow Velocity	Flow Rate
	L (m)	*A* (sq.m)	*P* (m)	*R* (m)	*n* (-)	*I* (-)	*V* (m/sec)	*Q* (cu.m/sec)
Gulshan Area - Tejgaon LS	1,580	0.283	1.885	0.150	0.013	0.00110	0.720	0.204
Tejgaon LS - Bashaboo LS	3,720	0.896	3.688	0.243	0.015	0.00048	0.569	0.509
Bashaboo LS - Sayedabad LS	2,743	1.190	4.278	0.278	0.015	0.00111	0.947	1.127

The total length of new trunk main will be longer than the existing one, since the existing pump stations at Tejgaon, Bashaboo and Saidabad will be utilised continuously. In this connection, diameter and gradient of new trunk main will be determined to achieve the design flow capacity of the existing trunk main, because the invert levels of inlet and outlet pipes at existing pump stations shall be kept unchanged. The hydraulic design of new trunk main is shown in Table 14.3.5. The facility plan of the existing South Dhaka sewerage service area is

shown in Figure 14.3.4 and the longitudinal vertical cross-section of new trunk main is shown in Figure 14.3.5, respectively.

Table 14.3.5 Specification of New Trunk Main

Section of Existing Trunk Main	Required Flow Rate	Roughness Coefficient	Gradient	Diameter		Flow Velocity	Flow Rate	Length
				Required	Therefore			
	Q (cu.m/sec)	*n* (-)	*I* (-)	*D* (mm)		*V* (m/sec)	*Q* (cu.m/sec)	*L* (m)
Gulshan Area - Tejgaon LS	0.204	0.013	0.000665	659	700	0.621	0.239	2,615
Tejgaon LS - Bashaboo LS	0.509	0.013	0.00044	1005	1000	0.640	0.503	4,015
Bashaboo LS - Sayedabad LS	1.127	0.013	0.00081	1207	1200	0.981	1.110	3,370

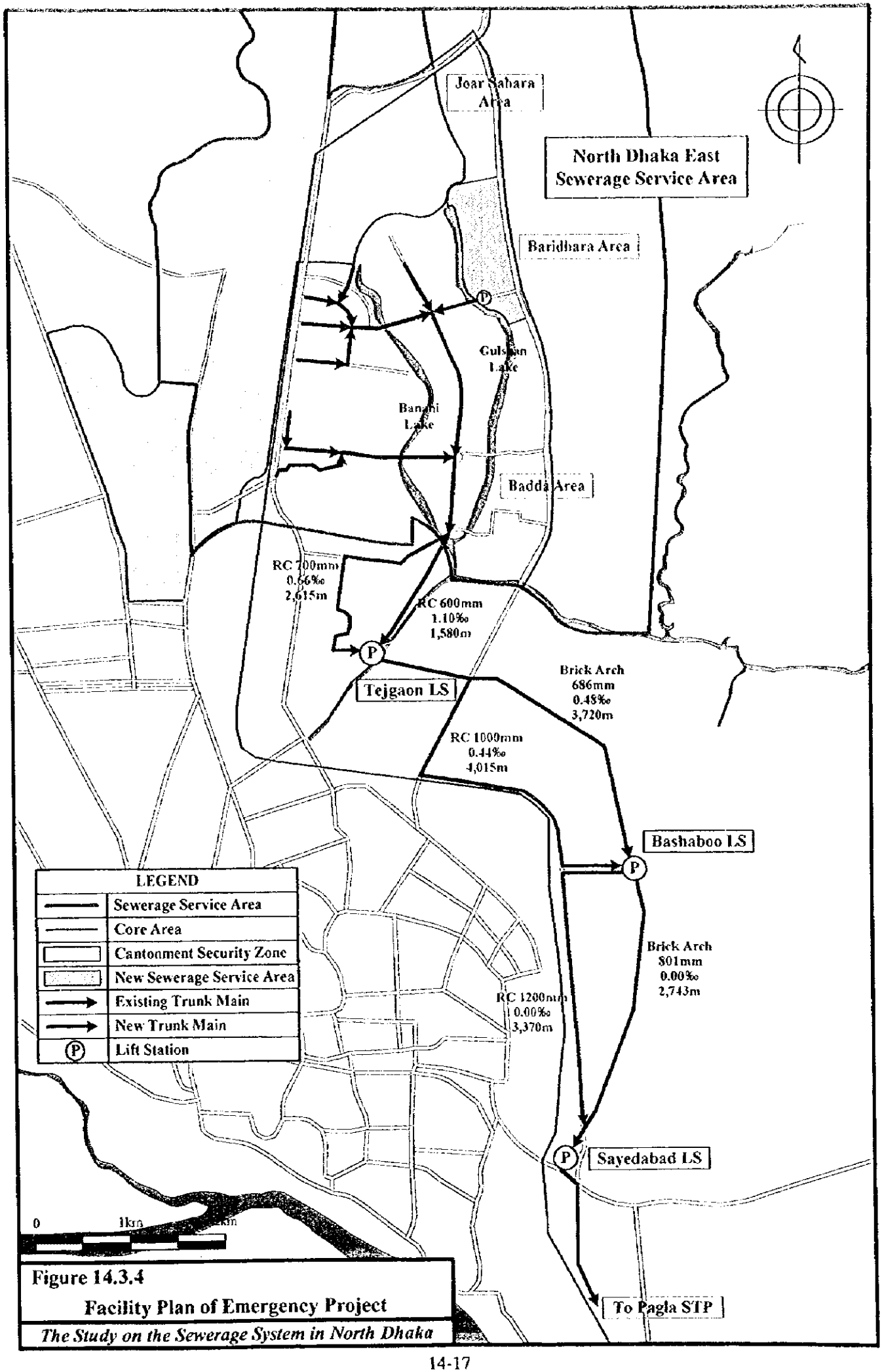
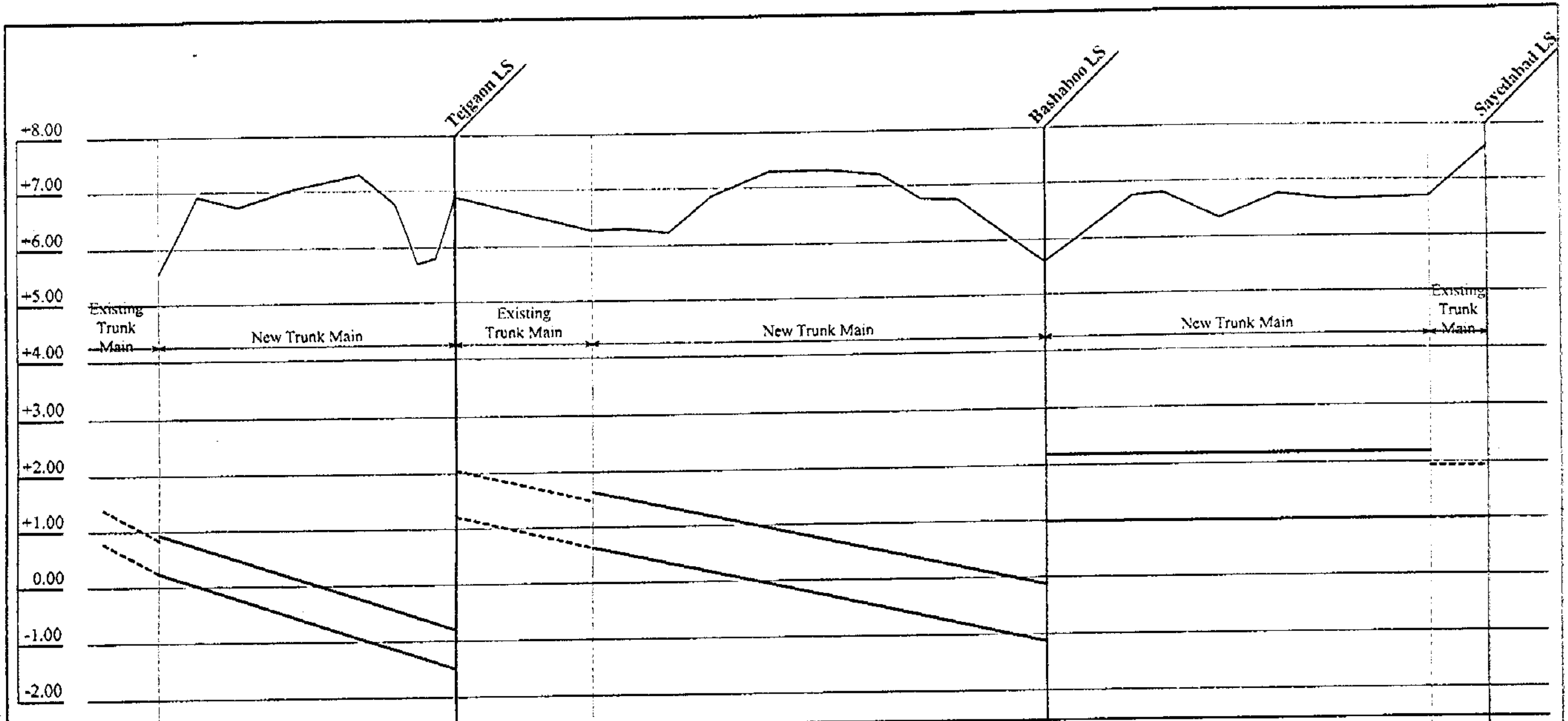


Figure 14.3.4

Facility Plan of Emergency Project

The Study on the Sewerage System in North Dhaka



Diameter	600mm		700mm		686mm		1000mm		1200mm		801mm	
Gradient	1.1‰		0.66‰		0.48‰		0.44‰		0.00‰		0.00‰	
Ground Level		5.54		6.89		6.28		5.60		6.69		7.60
Invert Elevation		0.240		-1.498 / 1.219		0.638		-1.125 / 0.990		0.990 / 0.990		0.990
Distance		0	2,615	2,615	1,210	3,825	4,015	7,840	3,370	11,210	510	11,720

Figure 14.3.5
New Trunk Main Profile

The Study on the Sewerage System in North Dhaka

14.4 Project Cost

Project cost of the emergency project is estimated as shown in Table 14.4.1, while the direct construction costs are contained in Appendix 14.4.1.

Table 14.4.1 Project Cost of Emergency Project

Item	Ratio (%)	Baridhara Area	South Dhaka Area	Total
Direct Construction Cost		56,890	573,364	630,254
Indirect Construction Cost	20	11,378	114,672	126,050
Construction Cost		68,268 US$1,575,427	688,036 US$15,877,875	756,304 US$17,453,302
Engineering Service	10	6,826	68,803	75,629
Administration Cost	5	3,754	37,841	41,595
Physical Contingency	10	7,884	79,468	87,352
Total	100	86,732 US$2,001,523	874,148 US$20,172,801	960,880 US$22,174,324

14.5 Project Evaluation

The emergency project is formulated to partially utilise the existing South Dhaka Sewerage System situated in the outside of Study Area. However, due to the absence of sewerage master plan of South Dhaka area at equivalent level with the North Dhaka area, there is a potential difficulty to evaluate magnitude of influence to be brought out by implementation of this emergency project to the existing South Dhaka Sewerage System. Particularly, the existing capacities of the Pagla Sewage Treatment Plant and the relevant pump stations shall be verified as to whether or not these sewerage facilities can temporarily accept the additional sewage flow from the North Dhaka Sewerage Service Area up to the year 2005.

In this subsection, design conditions of the existing South Dhaka Sewerage System are roughly evaluated to examine magnitude of the said influence.

14.5.1 Future Population in South Dhaka Sewerage Service Area

The future population in the South Dhaka Sewerage Service Area in the year 2020 was estimated in application of the same manner as adopted for the sewerage master planning of North Dhaka. The estimated future population is shown below and the basis of this estimation is contained in Appendix 14.5.1.

Target Year:	2020
Sewerage Service Area:	4,811 ha
Future Population:	3,706,000 persons

14.5.2 Future Sewage Flow

The design per capita sewage flow of the North Dhaka was used to estimate future sewage flow to each pump station in South Dhaka. This process is contained in Appendix 14.5.2.

The future sewage flow in the year 2005 was then estimated taking into account the sewerage service coverage and the leakage ratio of the sewage from the sewer network, in order to come up with a more realistic figure. The future sewerage service coverage referred to the estimated figures as presented in Table 14.3.2.

The sewage leakage ratio was estimated separately for the service area of the Saidabad L/S having heavy leakage at present and for the remaining service area of the Narinda P/S, based on the following formula:

Sewage Leakage Ratio = {(Sewage Flow) × (Sewerage Service Coverage) - (Pumped Sewage Volume)} ÷ {(Sewage Flow) × (Sewerage Service Coverage)}

The estimated sewage leakage ratio is shown in Table 14.5.1.

Table 14.5.1 Present Sewage Leakage Ratio

Area	Unit	Saidabad L.S.	Narinda P.S.
Sewage Flow	cu.m/day	72,240	124,946
Sewerage Service Coverage	%	44.8	44.8
Pumped Sewage volume	cu.m/day	1,469	38,876
Sewage Leakage Ratio	%	95	31

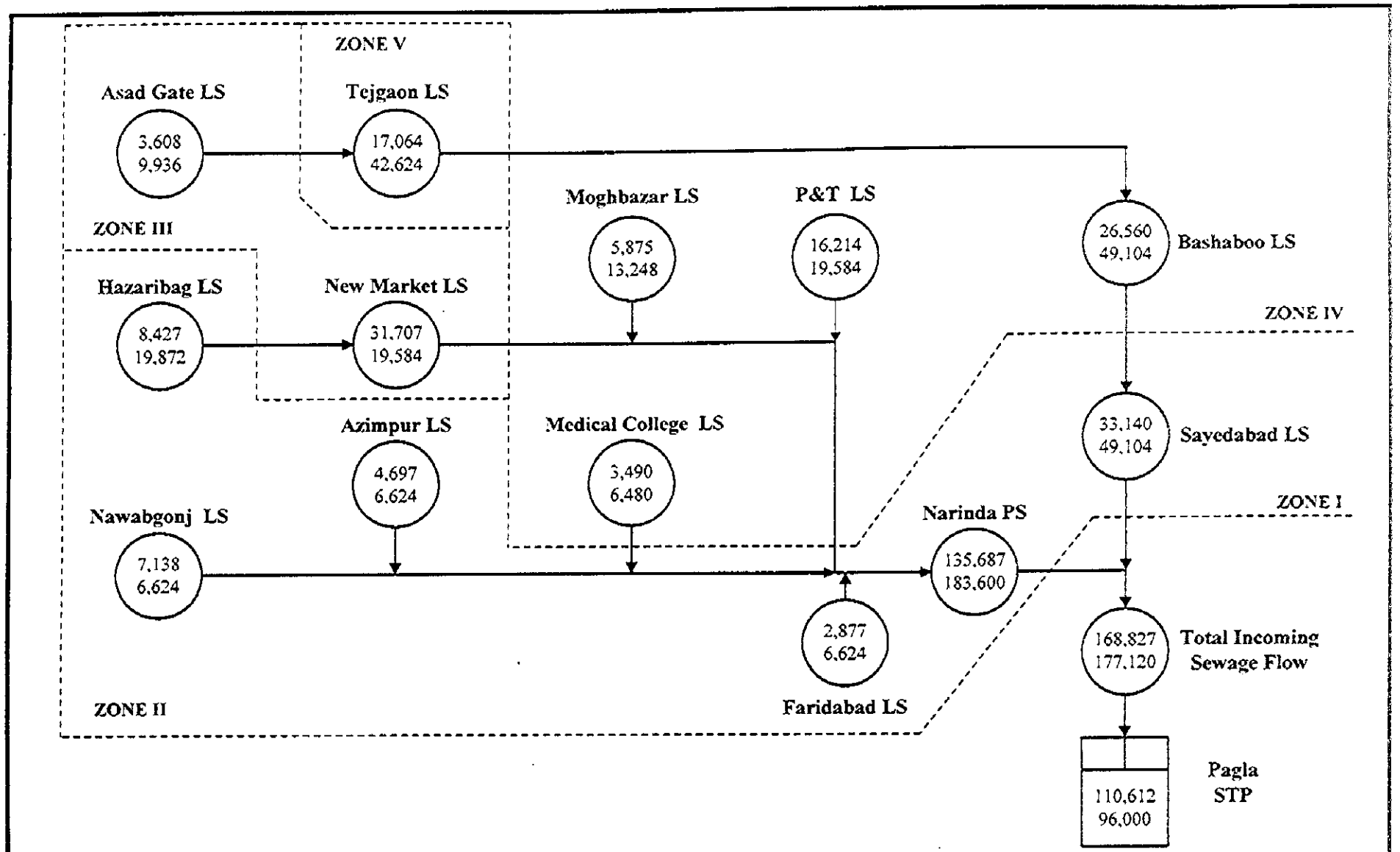
The future sewage leakage ratios are estimated as shown in table 14.5.1 assuming that it will be improved up to 20% in 2020.

Table 14.5.2 Sewerage Leakage Ratio

Pump Station	1997	2000	2005	2010	2015	2020
Saidabad L.S.	95.0	85	69	53	36	20
Narinda P.S.	31.0	30	27	25	22	20

The future sewage flow at relevant pump stations in 2005 reflecting sewerage service coverage and sewage leakage ratio is shown in Figure 14.5.1. The pumping capacities at the Tejgaon I/S, Bashaboo L/S and Saidabad L/S will have allowance to accept additional sewage flow from the North Dhaka East Sewerage Zone. The sewage flow at the New Market L/S and the Nawabganj L/S was estimated to exceed the present pump capacity. Although the estimated sewage inflow exceeds slightly the existing treatment capacity at about 15%, it is considered to be within the acceptable range of loading.

Thus, it is concluded that the proposed emergency project is technically feasible.



LEGEND: (414 / 828) 414 cu.m/day: Design Incoming Sewage Flow in 2005
828 cu.m/day: Total Present Pump Capacity

NOTE: Sewage flow of lift station is shown maximum hourly flow.
Sewage flow of Pagla STP is shown average daily flow.

Figure 14.5.1
Design Incoming Sewage Flow of Existing Lift Station (Year 2005)

The study on the Sewerage System in North Dhaka