JAPAN INTERNATIONAL COOPERATION AGENCY

DHAKA WATER SUPPLY AND
SEWERAGE AUTHORITY
THE PEOPLE'S REPUBLIC OF BANGLADESH

THE STUDY
ON
THE SEWERAGE SYSTEM
IN
NORTH DHAKA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

FINAL REPORT

SUMMARY

JULY 1998

NIPPON JOGESUIDO SEKKEI CO., LTD.

EXCHANGE RATE

MASTER PLAN	US$ 1.0 = Tk 43.732 = Yen 115.5 (As of July 1997)
FEASIBILITY STUDY	US$ 1.0 = Tk 43.333 = Yen 130.0 (As of January 1998)

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a study on the Sewerage System in North Dhaka and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team composed of individuals from Nippon Jogesuido Sekkei Co., Ltd and headed by Mr. Ikuo Miwa. The team visited Bangladesh three times between May 1997 and June 1998.

The team held discussions with the officials concerned of the Government of Bangladesh and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that the report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for the close cooperation that they extended to the team.

July 1998

Kimio Fujita, President
Japan International Cooperation Agency

July 1998

Mr. Kimio Fujita, President
Japan International Cooperation Agency
Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit herewith the Final Report for the Study on the Sewerage System in North Dhaka.

The Study was completed through discussions with the officials of the Government of Bangladesh and field investigations during three visits from May 1997 and June 1998 and the homework thereafter.

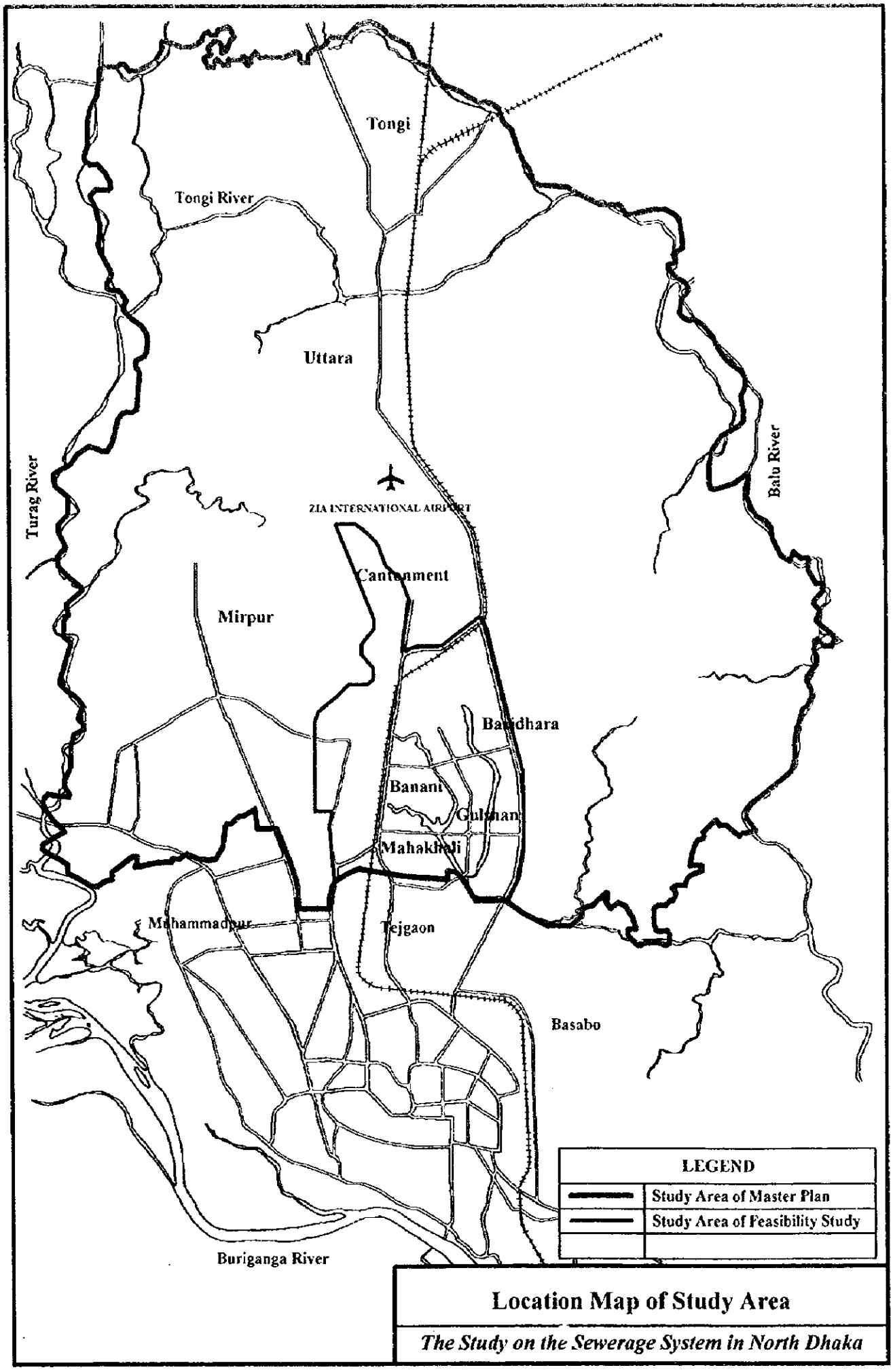
The Final Report consists of three volumes: 1) the Summary Report, which succinctly describes the study and its recommendations; 2) the Main Report, which covers the findings of the Master Plan and the Feasibility Study, as well as the proposed Emergency Project; and 3) the Supporting Report, which contains data upon which the Master Plan and the Feasibility Study are based.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Construction. We also would like to show our appreciation to the officials of the Dhaka Water Supply and Sewerage Authority, the JICA Bangladesh Office, and the Embassy of Japan in Bangladesh for their kind assistance throughout this Study.

Very truly yours,

美和或男

Ikuo Miwa, Team Leader
The Study on the
Sewerage System in North Dhaka



Location Map of Study Area

The Study on the Sewerage System in North Dhaka

EXECUTIVE SUMMARY

This study comprises two (2) parts: (1) North Dhaka Sewerage Master Plan and (2) Feasibility Study for Priority Project.

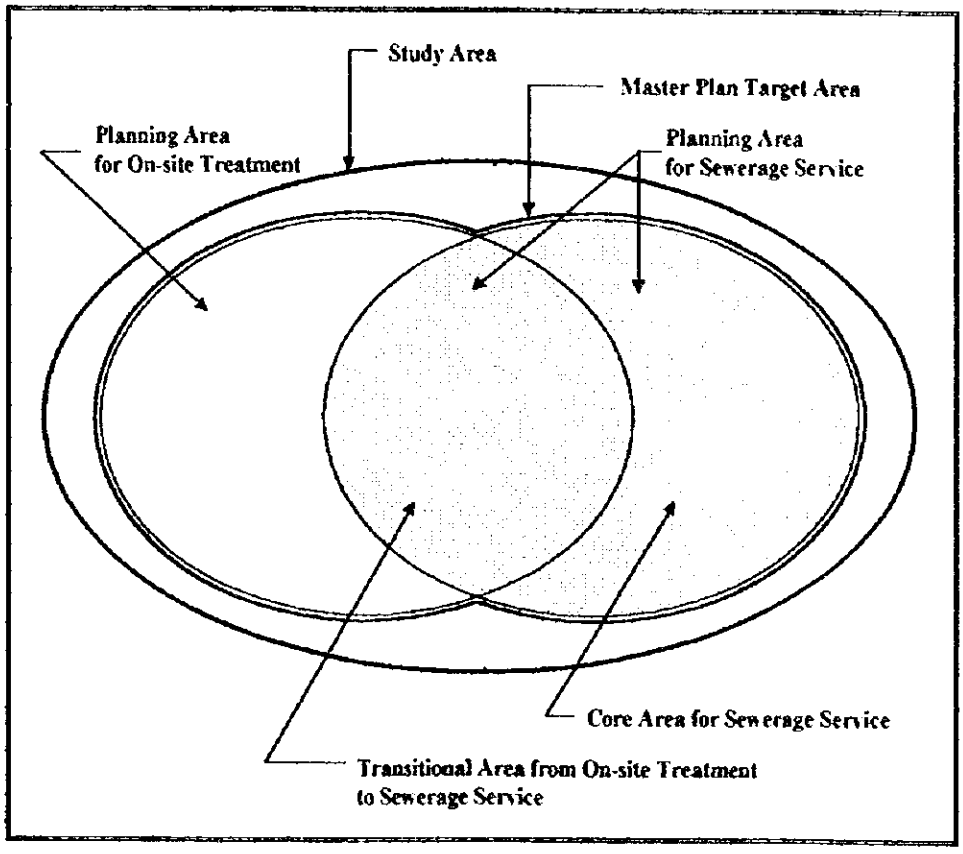
PART-I NORTH DHAKA SEWERAGE MASTER PLAN

1. Study Area: The Study Area covers North Dhaka including Tongi, Uttara, a part of Mirpur and Mohammadpur, Banani, Gulshan, Badda, Baridhara, the Cantonment, and adojoining areas.

2. Target Year: 2020

3. Classification of Study Area

   The Study Area is classified into planning area for sewerage service, transitional area from on-site treatment to sewerage service, and on-site treatment area based on the RAJUK's Dhaka Metropolitan Development Plan (DMDP) as shown in the following figure.



4. Determination of Sewerage Zone

The planning area of sewerage master plan is subdivided into four sewerage zones taking into account the geographical and administrative boundary in the Study Area as follows:

Tongi Sewerage Zone: Tongi Pourashava

Uttara Sewerage Zone: Uttara

North Dhaka East Sewerage Zone: Badda, Banani, Baridhara, Gulshan and Cantonment

North Dhaka West Sewerage Zone: Mirpur, Mohammadpur, Cantonment

5. Per Capita Sewage Flow by Year

Item	2000	F/S 2005	2010	2015	M/P 2020
Design Average Daily Flow	85	95	100	100	100
Design Maximum Daily Flow	105	115	125	125	125
Design Maximum Hourly Flow	135	145	160	160	160

6. Planned Population and Design Sewage Flow by Sewerage Service Area

Sewerage Service Area	Sewerage Zone	Item	Unit	Core Area	Transitional Area	Total	Cantonment Security	Total
Tongi	Tongi	Area	ha	151	892	1,043	0	1,043
		Population	person	39,000	265,000	304,000	0	304,000
		Q1	m3/day	3,900	26,500	30,400	0	30,400
		Q2	m3/day	4,875	33,125	38,000	0	38,000
		Q3	m3/day	6,240	42,400	48,640	0	48,640
North Dhaka East	Uttara	Area	ha	504	512	1,016	0	1,016
		Population	person	86,000	75,000	161,000	0	161,000
		Q1	m3/day	8,600	7,500	16,100	0	16,100
		Q2	m3/day	10,750	9,375	20,125	0	20,125
		Q3	m3/day	13,760	12,000	25,760	0	25,760
	North Dhaka East	Area	ha	868	1,371	2,239	1,090	3,329
		Population	person	487,000	314,000	801,000	83,000	884,000
		Q1	m3/day	48,700	31,400	80,100	8,300	88,400
		Q2	m3/day	60,875	39,250	100,125	10,375	110,500
		Q3	m3/day	77,920	50,240	128,160	13,280	141,440
	Total	Area	ha	1,372	1,883	3,255	1,090	4,345
		Population	person	573,000	389,000	962,000	83,000	1,045,000
		Q1	m3/day	57,300	38,900	96,200	8,300	104,500
		Q2	m3/day	71,625	48,625	120,250	10,375	130,625
		Q3	m3/day	91,680	62,240	153,920	13,280	167,200
North Dhaka West	North Dhaka West	Area	ha	789	1,677	2,466	130	2,596
		Population	person	438,000	1,184,000	1,622,000	10,000	1,632,000
		Q1	m3/day	43,800	118,400	162,200	1,000	163,200
		Q2	m3/day	54,750	148,000	202,750	1,250	204,000
		Q3	m3/day	70,080	189,440	259,520	1,600	261,120
Total		Area	ha	2,312	4,452	6,764	1,220	7,984
		Population	person	1,050,000	1,838,000	2,888,000	93,000	2,981,000
		Q1	m3/day	105,000	183,800	288,800	9,300	298,100
		Q2	m3/day	131,250	229,750	361,000	11,625	372,625
		Q3	m3/day	168,000	294,080	462,080	14,880	476,960

Note: Q1 - Design Average Daily Flow, Q2 - Design Maximum Deily Flow,
Q3 - Design Maximum Hourly Daily Flow

7. Project Cost and O&M Cost of Sewerage System

Project Cost of Sewerage system

Unit: Tk'000 and US$'000

Facilities	Tongi	Uttara	North Dhaka East	North Dhaka West	Total
1.Construction Cost					
Branch Sewer	426,764	415,716	843,306	949,520	2,635,306
Trunk Main	141,357	149,553	539,120	519,893	1,349,923
Pumping Station	294,520	81,493	898,318	1,171,420	2,445,751
Sewage Treatment Plan	646,157	0	1,663,590	2,340,602	4,650,349
Sub-total	1,508,798	646,762	3,944,334	4,981,435	11,081,329
Sub-total (including overhead)	1,810,558	776,114	4,733,201	5,977,722	13,297,595
2.Land Acquisition					
Land Cost for PS	3,030	1,320	30,325	6,905	41,580
Land Cost for STP	733,740	0	1,440,780	2,391,110	4,565,630
Sub-total	736,770	1,320	1,471,105	2,398,015	4,607,210
3.Engineering Service	54,317	23,283	141,996	179,332	398,928
4.Administration Cost	93,244	39,970	243,760	307,853	684,827
Total(1+2+3+4)	2,694,889	840,687	6,590,062	8,862,922	18,988,560
5.Physical Contingency	269,489	84,069	659,006	886,292	1,898,856
Grand Total	2,964,378 (US$67,785)	924,756 (US$21,145)	7,249,068 (US$165,761)	9,749,214 (US$222,930)	20,887,416 (US$477,623)

Note: Exchange Rate: US$1.00 = 43.732Taka (as of July 1997)
This project cost is not include the price contingency.

Operation and Maintenance Cost of Sewerage System

Unit: Tk'000/year and US$'000/year

Sewerage Facility	Tongi	Uttara	North Dhaka East	North Dhaka West	Total
Power Consumption					
Pumping Station	3,965	861	14,645	21,770	41,241
Sewage Treatment Plant	254	0	487	616	1,357
Personnel Expense	922	127	1,462	1,844	4,355
Total	5,141 (US$117)	988 (US$22)	16,594 (US$379)	24,230 (US$554)	46,953 (US$1,073)

Note: Exchange rate: US$1.00 = 43.73Taka (as of July 1997)

8. Sewage Treatment Plant

Location: North Dhaka East (120 ha), North Dhaka West (180 ha), Tongi (50 ha)

Treatment Method: Stabilisation Pond

Design Sewage Quality: Influent BOD 200 mg/L SS 200 mg/L

Effluent BOD 40 mg/L SS 100 mg/L

PART-II FEASIBILITY STUDY OF PRIORITY PROJECT

1. Study Area: North Dhaka East Sewerage Service Area covering North Dhaka East Sewerage Zone and Uttara Sewerage Zone

2. Target Year: 2005

3. Design Sewage Flow of North Dhaka East Sewerage Service Area

Phase	Target Year	Sewerage Zone	Item	Unit	Core Area	Cantonment	Sub-Total	Transitional Area	Total
M/P	2020	Uttara	Area	ha	504	0	504	512	1,016
			Population	person	86,000	0	86,000	75,000	161,000
			Q1	cu.m/day	8,600	0	8,600	7,500	16,100
			Q2	cu.m/day	10,750	0	10,750	9,375	20,125
			Q3	cu.m/day	13,760	0	13,760	12,000	25,760
		North Dhaka East	Area	ha	868	1,090	1,958	1,371	3,329
			Population	person	487,000	83,000	570,000	314,000	884,000
			Q1	cu.m/day	48,700	8,300	57,000	31,400	88,400
			Q2	cu.m/day	60,875	10,375	71,250	39,250	110,500
			Q3	cu.m/day	77,920	13,280	91,200	50,240	141,440
		Total	Area	ha	1,372	1,090	2,462	1,883	4,345
			Population	person	573,000	83,000	656,000	389,000	1,045,000
			Q1	cu.m/day	57,300	8,300	65,600	38,900	104,500
			Q2	cu.m/day	71,625	10,375	82,000	48,625	130,625
			Q3	cu.m/day	91,680	13,280	104,960	62,240	167,200
F/S	2005	Uttara	Area	ha	504	0	504	512	1,016
			Population	person	80,000	0	80,000	65,000	145,000
			Q1	cu.m/day	7,600	0	7,600	6,175	13,775
			Q2	cu.m/day	9,200	0	9,200	7,475	16,675
			Q3	cu.m/day	11,600	0	11,600	9,425	21,025
		North Dhaka East	Area	ha	868	1,090	1,958	1,371	3,329
			Population	person	386,000	70,000	456,000	236,000	692,000
			Q1	cu.m/day	36,670	6,650	43,320	22,420	65,740
			Q2	cu.m/day	44,390	8,050	52,440	27,140	79,580
			Q3	cu.m/day	55,970	10,150	66,120	34,220	100,340
		Total	Area	ha	1,372	1,090	2,462	1,883	4,345
			Population	person	466,000	70,000	536,000	301,000	837,000
			Q1	cu.m/day	44,270	6,650	50,920	28,595	79,515
			Q2	cu.m/day	53,590	8,050	61,640	34,615	96,255
			Q3	cu.m/day	67,570	10,150	77,720	43,645	121,365

Note: Q1 - Design Average Daily Flow, Q2 - Design Maximum Daily Flow,
Q3 - Design Maximum Hourly Daily Flow

4. Sewer System

Separate sewer system is introduced for the whole study area. Supplementary pipe is considered where the existing sewer lines do not have enough hydraulic capacity in the target year.

Configuration of Sewer System

Area	Type of Flow	Material	Diameter (mm)	Length (m)
New Service Area	Gravity Flow	PVC	200	34,500
			250	445
		RC	900	1,095
			1,000	1,185
			1,100	1,750
			1,200	290
			1,500	1,660
		Sub-Total		40,925
	Pressurised Flow	Steel Pipe	1,100	4,400
	Total			45,325
Existing Service Area	Gravity Flow	PVC	300	725
			350	1,110
			400	1,455
		RC	700	710
			800	2,010
			1,100	800
		Sub-Total		6,810
	Pressurised Flow	Steel Pipe	900	1,340
	Total			8,150
Grand Total				53,475

5. Pump Station

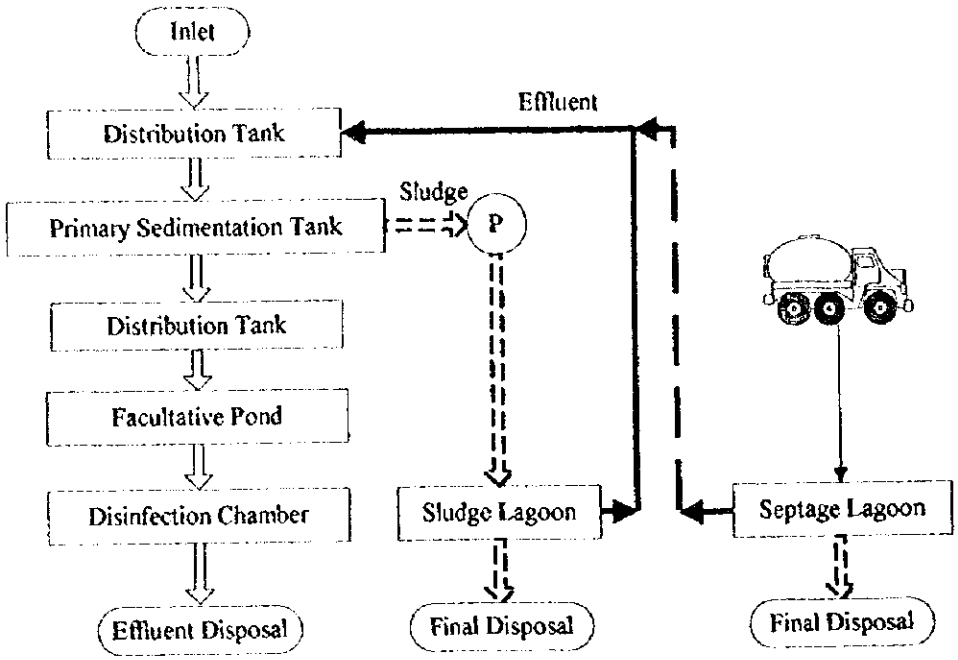
Name of Pump Station	Sewage Flow	M/P	F/S
Merul Pump Station	Q_1	104,500	43,320
	Q_2	130,625	52,440
	Q_3	167,200	66,120
Gulshan Pump Station	Q_1	43,699	33,242
	Q_2	54,624	40,240
	Q_3	69,918	50,738

Note: Q1 - Design Average Daily Flow, Q2 - Design Maximum Deily Flow,
Q3 - Design Maximum Hourly Daily Flow

In the Seasibility Study period, the Merul Pump Station and the Gulshan Pump Station will have about 40% and 73% of the design maximum hourly sewage flow of the Master Plan, respectively. In this regard, the civil and architectural facilities of the Merul Pump Station were designed to handle half of the whole capacity, while the Gulshan Pump Station was designed to handle whole scale of the Master Plan.

6. Sewage Treatment Plant

Preliminary engineering design of the sewage treatment plant was prepared with the following flow sheet which includes sludge treatment for septage collected from septic tanks.



7. Construction Cost and O&M Cost

Construction Cost of Sewerage System

Unit: Tk '000

Item	Currency Mode	Ratio (%)	Sewer	Pump Station	Sewage Treatment Plant	Total
Civil Work	Local	-	142,699	712	954,829	1,098,240
	Foreign	-	541,003	91,122	835,893	1,468,018
	Sub-Total	-	683,702	91,834	1,790,722	2,566,258
Mechanical & Electrical Work	Local	-	0	0	0	0
	Foreign	-	0	294,143	187,041	481,184
	Sub-Total	-	0	294,143	187,041	481,184
Direct Construction Cost	Local	-	142,699	712	954,829	1,098,240
	Foreign	-	541,003	385,265	1,022,934	1,949,202
	Total	-	683,702	385,977	1,977,763	3,047,442
Indirect Construction Cost (Overhead & Tax)	Local	15.0	21,404	106	143,224	164,734
	Foreign	20.0	108,200	77,053	204,586	389,839
	Total	-	129,604	77,159	347,810	554,573
Construction Cost	Local	-	164,103	818	1,098,053	1,262,974
	Foreign	-	649,203	462,318	1,227,520	2,339,041
	Grand Total	-	813,306 (US$18,768,744)	463,136 (US$10,687,836)	2,325,573 (US$53,667,482)	3,602,015 (US$83,124,062)

Note: Exchange Rate US$ 1.00 = 43.333 Tk (as of January 1998)

Operation and Maintenance Cost of Sewerage System

Unit: Tk '000

Item	Sewer	Pump Station	Sewage Treatment Plant	Total
Personnel Expense	1,200	1,855	1,659	4,714
Water Charges	0	7	3	10
Power Consumption	0	10,194	760	10,954
Fuel	2,640	688	54	3,382
Chemical	0	0	6,640	6,640
Repair Expanse	0	6,909	3,455	10,364
Total	3,840 (US$88,616)	19,653 (US$453,534)	12,571 (US$290,102)	36,064 (US$832,252)

Note: Exchange Rate US$ 1.00 = 43.333 Tk (as of January 1998)

8. Project Cost

Unit: Tk'000

Item	Currency Mode	Ratio (%)	Sewer	Pump Station	Sewage Treatment Plant	Total
Construction Cost	Local	-	164,103	818	1,098,053	1,262,974
	Foreign	-	649,203	462,318	1,227,520	2,339,041
	Sub-Total	-	813,306	463,136	2,325,573	3,602,015
Land Acquisition	Local	-	0	18,636	511,078	529,714
	Foreign	-	0	0	0	0
	Sub-Total	-	0	18,636	511,078	529,714
Engineering Service	Local	-	0	0	0	0
	Foreign	3.0	19,476	13,869	36,825	70,170
	Total	-	19,476	13,869	36,825	70,170
Administration Cost	Local	5.0	8,205	40	54,902	63,147
	Foreign	5.0	33,433	23,809	63,217	120,459
	Total	-	41,638	23,849	118,119	183,606
Custom Duty VAT	Local	100	23,315	0	0	23,315
	Foreign	100	145,211	294,143	244,856	684,210
	Total	-	168,526	294,143	244,856	707,525
Physical Contingency	Local	10.0	17,230	1,949	166,403	185,582
	Foreign	10.0	70,211	49,999	132,756	252,966
	Total	-	87,441	51,948	299,159	438,548
Grand Total	Local	-	212,853	21,443	1,830,436	2,064,732
	Foreign	-	917,534	844,138	1,705,174	3,466,846
	Grand Total	-	1,130,387 (US$26,086,054)	865,581 (US$19,975,099)	3,535,610 (US$81,591,627)	5,531,578 (US$127,652,780)

Note: Exchange Rate: US$ 1.00 = 43.333 Tk (as of January 1998)

SUMMARY REPORT

TABLE OF CONTENTS

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

CHAPTER 1 PROGRESS OF THE STUDY

Upon the arrival of the Study Team in Dhaka on May 7, 1997, a series of discussions was held with agencies/officials concerned pertaining to the study schedule, approach and methodology of the Study, appointment of counterpart personnel, and composition of the Study Team.

The Study Team, in close liaison and co-operation with DWASA, conducted a reconnaissance survey, data collection and preliminary engineering study to the establish planning fundamentals and prospective alternatives of the sewerage master plan for North Dhaka.

During the Stage 1 Field Work from May 7 up to August 2, 1997, various field investigations were carried out, such as:

- Questionnaire Survey for Residents' Awareness on Environmental Sanitation,
- Survey on the Quantity and Quality of Domestic and Industrial Wastewater,
- Examination of Septic and Sewerage Sludge,
- Initial Environmental Examination, and
- Topographic Survey.

As a preliminary step of the Study, a master plan target area for sanitation/sewerage service provision was identified and the boundary of planning area was delineated. The Dhaka Metropolitan Development Plan (hereinafter referred to as "DMDP"), developed and published by "Rajdhani Unnayan Kartripakkha" (Capital Development Authority, hereinafter referred to as "RAJUK") in May 1997, was thoroughly reviewed and reflected in the Study. Particularly, the policies and strategies taken up in the DMDP Structure Plan (1995-2015) were a major reference for further determining the target areas for on-site treatment and sewerage service.

Alternative configurations of the sewerage system were then prepared for further study to select the optimum plan. Some alternatives were added to include the domestic sewage to be generated in the Cantonment Security Zone (military installation) during the Stage 1 Domestic Work. In this respect, unit cost information was also collected from DWASA and local suppliers.

The findings and survey results obtained during the Stage 1 Field Work were incorporated in the Progress Report 1 and further developed to include the output of the subsequent domestic work.

As a result, the North Dhaka Sewerage Master Plan was developed and compiled as the Interim Report of the Study.

Progress Report 2 presented the findings and outcome of the Stage 2 Field Work in Bangladesh, which mainly focused on the Feasibility Study on the Priority Project (Core Area of North Dhaka East Sewerage Zone) undertaken by the Study Team during a 3.5 month period from November 7, 1997 until February 17, 1998.

The finalisation of the Feasibility Study took place during the successive period of the Study up to the end of March 1998 and the overall outcome together with the master plan was incorporated in the Draft Final Report. This Draft Final Report was submitted to DWASA in the beginning of June 1998 and presented at the 2nd Technology Transfer Seminar on June 17, 1998.

The Final Report was completed in mid-July in Japan. The Final Report incorporated the corrections and additions resulting from the review of the Draft Final Report. The Final Report was submitted to JICA for their review and was subsequently provided to DWASA in late July/early August 1998.

CHAPTER 2 EXISTING CONDITIONS IN THE STUDY AREA

As a result of the recent economic development and population increase, the Study Area has become the urban growth centre of Dhaka City, not only as a residential area, but also for new commercial establishments. Urban development, especially land development through the reclamation of swampy areas, has also triggered an acceleration of urbanisation and population growth, while the urban infrastructure is insufficient to meet with the increasing needs.

2.1 Physical Conditions

Most months show a maximum temperature of higher than 30°C and relative humidity usually exceeds 70% throughout the year. Rainfall averages 2,135 mm annually. The influence of the monsoons in Dhaka is relatively mild compared to the coastal area. Although rainfall in the winter season is negligible, relative humidity is still as high as about 70%. In this respect, the Study Area is considered to have generally hot and humid climatic conditions. The Study Area lies on flat alluvial deposits with difference of ground elevation of less than 10 m.

2.2 Water Supply

Most households and business establishments are served by the DWASA water supply system. The DWASA Management Information Report (hereinafter referred to as "MIR) for the month of April 1997 shows that a total of about 60,800 connections in the Study Area (MODS - Maintenance Operation Distribution Service; Zones IV & V) are served by DWASA.

Within the Study Area, the water production from 75 deep tube-wells in that period was recorded at about 279,000 cu.m/day, equivalent to about 4.6 cu.m/day/connection. In this respect, a considerable amount of technical and administrative losses is deemed involved in the present water supply system.

Water supply services are currently extended up to Uttara Model Town, while Tongi Pourashava has its own piped water supply system, which has been implemented by the Public Health Engineering Department (hereinafter referred to as the "PHED") of the Ministry of Local Government, Rural Development and Co-operatives (hereinafter referred to as "MLGRDC"). In Tongi Industrial Estate, most factories have their own deep well water sources.

2.3 Sewerage Service

Only a part of the Study Area is currently served by the existing sewerage system, including the wards of Gulshan, Banani and Mohammadpur. The total number of sewered customers in MODS Zone V is 3,667 connections (Zone IV is unserved by the sewerage system). This means that only 14% out of the 25,734 water supply service connections in Zone V are presently served by the sewerage system. In other words, the majority of households or establishments being unserved by the sewerage system are using septic tanks. Grey water and effluent of septic tanks are discharged into nearby drainage or open channels, resulting in the deterioration of the aquatic and living environments.

Even in the served area of the sewerage system, the sewage flow in the sewer lines was observed to be inadequate due to the accumulation of sediments and scum as well as other solid wastes discharged or dumped into the sewer lines. In addition, many pipes were damaged and numerous leaks were observed.

2.4 Water Pollution

The water bodies in the Study Area have become increasingly polluted as urban/industrial development has intensified. The rivers that surround Dhaka and the numerous ponds and lakes are the ultimate destination for all of the wastewater discharged in the city. The inadequate storm drainage system, weak environmental protection enforcement, poor solid waste management and the monsoon weather patterns have resulted a poor living environment.

The prevention of water pollution control in the Study Area is minimal, especially in the slum areas. Water is usually untreated at the pollution source and simply discharged into the various available watercourses such as the Tongi River, swampy areas, etc. It is then used by the lower income people without regard for health risk.

The Gulshan and Banani Lakes are presently receiving water bodies for untreated domestic and commercial wastewater due to the insufficient provision of sewerage and drainage facilities. The illegal dumping of solid wastes is another cause of water pollution and environmental degradation

Tongi Industrial Estate is a significant and complicated industrial pollution source. Factories of detergent, dry cell batteries, pharmaceuticals, chemical products, and textile dying are all discharging untreated wastewater into the Tongi River through nearby swamps. Tanneries, mostly small-scale, are another source of water pollution with wastewater containing chromium hexavalent. Under the DMDP, such tanneries are planned to be relocated outside of the Study Area.

During the Stage 2 Field Work of the Feasibility Study, the 2nd survey on sewage quality and quantity was carried out to obtain dry season data. The 1st survey was conducted in the Stage 1 Field Work in the rainy season (June to July, 1997). The 2nd survey focused on domestic sewage, influent and effluent of the Pagla Sewage Treatment Plant (hereinafter referred to as the Pagla STP"), and the rivers receiving treated effluent from the proposed STPs. The results of these analyses are shown below.

Table 2.1 Analysis Results of Public Water Bodies (1)

Sampling Point	Balu River			Lakhya River			Turag River					
							Upstream			Downstream		
Sampling Date	Jan. 1, 1998			Dec. 29, 1997			Dec. 31, 1997			Dec. 30, 1997		
Time	10:00	14:00	18:00	10:00	14:00	18:00	10:00	14:00	18:00	10:00	14:00	18:00
Atoms. Temp.	20.5	21	20	20	22	20	22	23	21	22	23	20.5
Sample Temp.	20	21	20	21	22.5	20.5	23	24.5	23	21	24	21.5
pH	8.2	8.3	8.0	8.2	8.3	8.3	8.2	8.3	8.2	8.1	8.1	8.8
BOD	25.4	29.6	24.3	22.1	25.3	29.6	20.8	11.7	16.9	25.6	18.2	31.9
COD	108	132	61	36	32	32	64	160	128	160	96	140
DO	5.86	6.23	6.02	5.78	5.37	5.66	7.47	6.78	6.27	5.02	5.73	5.52
SS	210	120	110	140	280	90	65	70	65	90	105	70
Chloride	8.7	7.8	8.9	9.2	12.8	10.1	12.6	11.7	13.8	12.6	11.7	13.8
T-N	6.44	5.51	7.02	7.71	8.20	6.70	8.50	8.65	5.16	6.18	7.90	7.33
T-P	7.0	6.8	6.6	3.5	4.0	3.0	3.0	2.0	2.5	2.5	3.2	3.0
Coliform Group Bacteria	$1.5x10^3$	$1.7x10^4$	$1.0x10^5$	$8.0x10^3$	$7.5x10^3$	$6.0x10^4$	$1.0x10^5$	$1.5x10^4$	$1.6x10^4$	$2.0x10^4$	$1.1x10^4$	$2.3x10^4$

Unit: mg/l, Temperature; °C Coliform Group Bacteria; No./100ml

Table 2.2 Analysis Results of Public Water Bodies (2)

Unit: mg/l

Sampling Point	Balu River			Lakhya River			Turag River					
							Upstream			Downstream		
Time	10.00	14.00	18.00	10.00	14.00	18.00	10.00	14.00	18.00	10.00	14.00	18.00
Cadmium (Cd)	0.08	0.07	0.08	0.08	0.03	0.08	0.05	0.04	0.05	0.03	0.05	0.07
Mercury (Hg)	0.02	0.01	0.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic (As)	0.02	0.01	0.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Lead (Pb)	0.25	0.34	0.23	0.12	0.18	0.23	0.30	0.25	0.30	0.28	0.31	0.30
Chromium (Cr)	0.02	0.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.01	0.01
Copper (Cu)	0.25	0.15	0.10	0.25	0.15	0.20	0.28	0.17	0.30	0.30	0.42	0.37
Zinc (Zn)	0.30	0.60	0.90	0.80	0.40	0.30	0.30	0.40	0.60	0.60	0.70	0.50
Nickel (Ni)	0.02	<.01	0.01	<.01	<.01	<.01	0.03	<.01	<.01	0.02	0.04	0.03

CHAPTER 3 EXISTING SEWERAGE SYSTEM IN SOUTH DHAKA

3.1 Overall Sewerage System

The present organisational set-up of DWASA is shown in Figure 3.1 and the administrative boundary of the MODS Zone Offices is shown in Figure 3.2. The major sewerage facilities in Dhaka City are summarised in Table 3.1.

Table 3.1 Outline of Existing Sewerage System

Item	Existing Quantity	Remarks
Sewer Line	624 km (531 km)	(93 km) of sewer line in Zone IV for Small-Bore System in not yet operated since the discharge pump station is not yet completed
Sewage Pump Station	1 No.	Narinda
Sewage Lift Station	19 Nos.	Bashaboo, Sayedabad, Faridabad, Azimpur, Nawabganj, Hazaribag, Asad Gate, New Market, Tejgaon, Banani, Mohakhali, Mogbazar, P & T, Medical College, Mothertek, Goran, and other three locations
Sewage Treatment Plant	1 No.	Pagla

3.2 Sewer System

3.2.1 Physical Conditions

The materials used for sewer lines are VC Pipe (Vitrified Clay Pipe), RC Pipe (Reinforced Concrete Pipe) and PVC Pipe (Polyvinyl Chloride Pipe) etc. Some sewer lines were constructed in early 1960's targeting a population of approximately 500,000 and are now experiencing capacity shortages due to the rapid population growth in the city, as shown in Table 3.2.

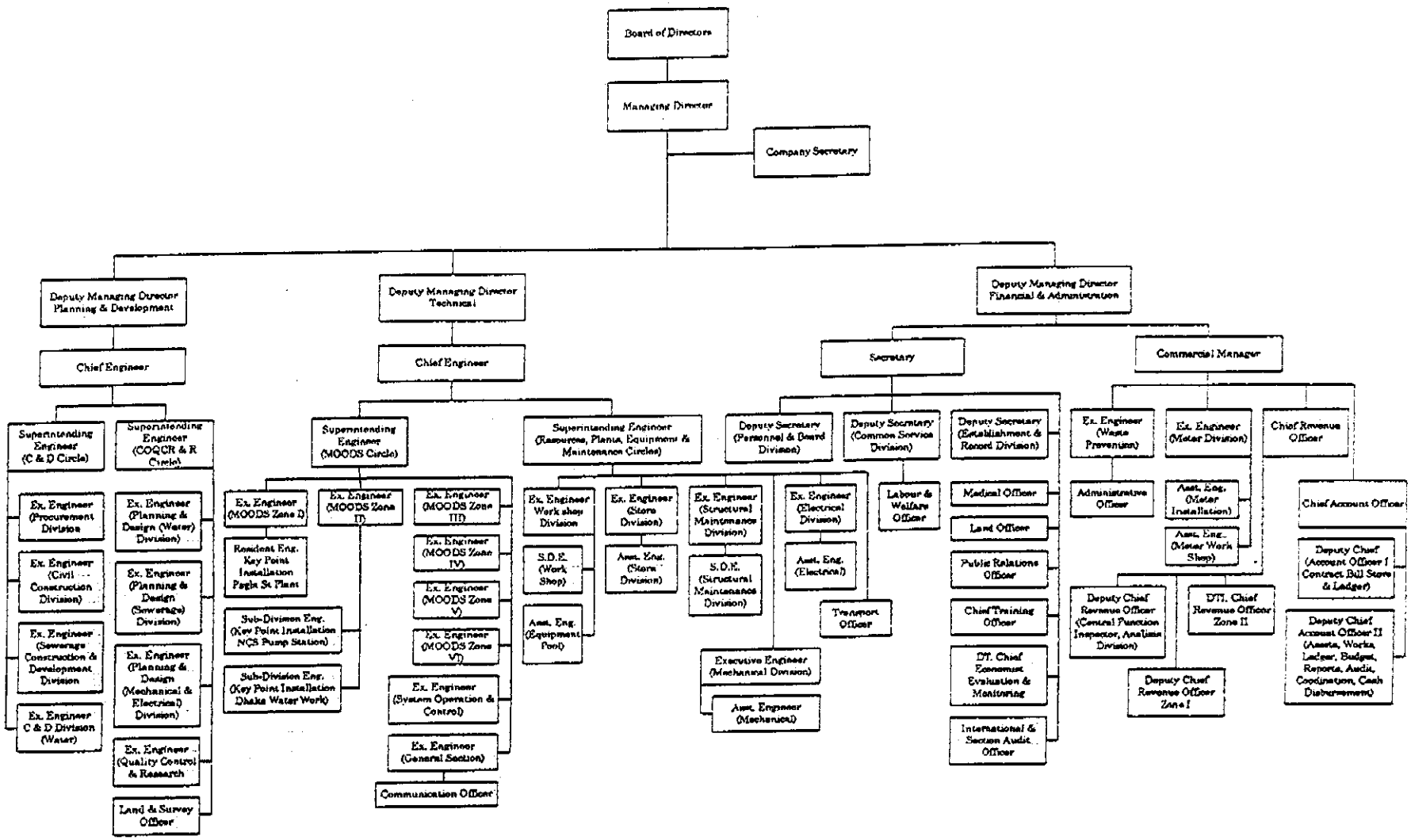


Figure 3.1
Proposed Organization Chart of DWASA

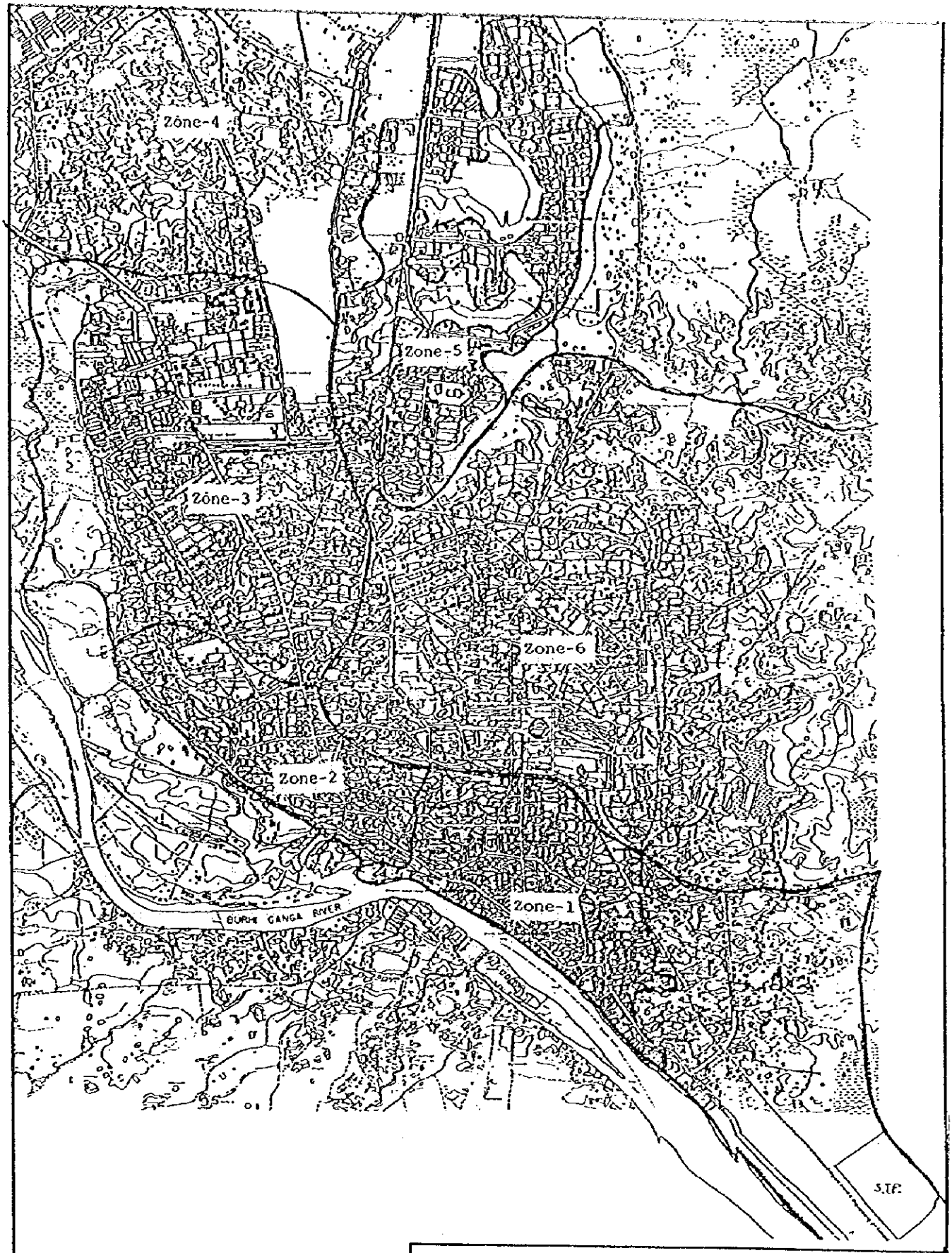


Figure 3.2
Water Supply and Sewerage System Zoninng

The Study on the Sewerage System in North Dhaka

Table 3.2 Outline of Existing Sewers in Six Zones

Zone	Total Length of Sewer	Present Status	Remarks
I	200 - 1,350mm L =150 km	Bad - 20 km	Needs repair
II	150 - 600mm L =110 km	Bad - 2.4 km	Needs repair
III	200 - 450mm L = 90 km	Bad - 3 km	Needs repair, Planned new sewer installation L = 15 km
IV	(L= 93 km)	-	Small-Bore System is not yet in operation
V	200 - 900mm L = 61 km	Good	
VI	150 - 900mm L =120 km	Bad - 10 km	Needs repair
Total	L= 624 km *(531 km)	Bad - 35.4 km	

Note: *excluding Zone IV

3.2.2 Practice of Operation and Maintenance

The sewers are mainly maintained by sewer inspectors, sewer mechanics and sewer cleaners. If citizens complain of any nuisance, for example flooding, sewage leakage, etc. to the complaint attendant of a Zone Office, a sewer inspector is dispatched to the problem site and, under his supervision, sewer mechanics and cleaners remove any sediments using hand-tools such as bamboo sticks. Sludge dewatering pumps and hydraulic jetting machines are also available. Aside from the above-mentioned emergency claims, an annual cleaning program is formulated every year and routine cleaning is also carried out by cleaning teams.

However, the public opinion regarding sewerage and dust is usually negative and some are disposing their waste into sewers through manholes, which consequently causes clogging and flooding. In addition, manhole covers, mainly made of cast iron, are lost to theft and waste piled beside the road flows into the open manholes on rainy days. Accordingly, public sanitation education is indispensable together with the replacement of the manhole covers.

Table 3.3 shows the number of O&M staff per one km of sewer in the six MODS Zones. O&M staff includes sewer inspectors, sewer cleaners and vacuum operators.

Table 3.3 Number of O & M Staff per 1 km of Sewer

Zone	Total Length of Sewer	Number of O & M Staff	Staff per 1 km of Sewer
I	150 km	47	0.31
II	110 km	43	0.39
III	90 km	25	0.28
IV	(93 km)	(5)	(0.05)
V	61 km	25	0.41
VI	120 km	30	0.25
		Average	0.32

3.3 Lift and Pump Stations

3.3.1 Physical Condition

There are 19 lift stations (hereinafter referred to as L/Ss) and one pump station (P/S) in South Dhaka. Their locations are shown is Figure 3.3. Under the last "Construction and Rehabilitation Project for the Sewerage of Dhaka City/JICA," 12 L/Ss and one P/S were rehabilitated. Their present status is summarised in Table 3.4. Three small L/Ss out of 19 L/Ss are not refered herein.

The existing facilities are generally in operational condition, however, malfunctioning facilities should be repaired immediately especially the pumps, starters, generators and electricity supply.

Further, the pumps are operated manually and the operating sewage level, the pump starting level, is inordinately high. This was observed at almost every L/S and P/S. This is because many of the water level indicators installed in wet wells were out-of-order and operators started the pumps only by their eye measurement of the sewage level in wet well. This might have hindered the smooth flow of sewage in upstream of the L/Ss and P/S. Thus, the water level indicator should be repaired immediately or some other measuring devices should be prepared.

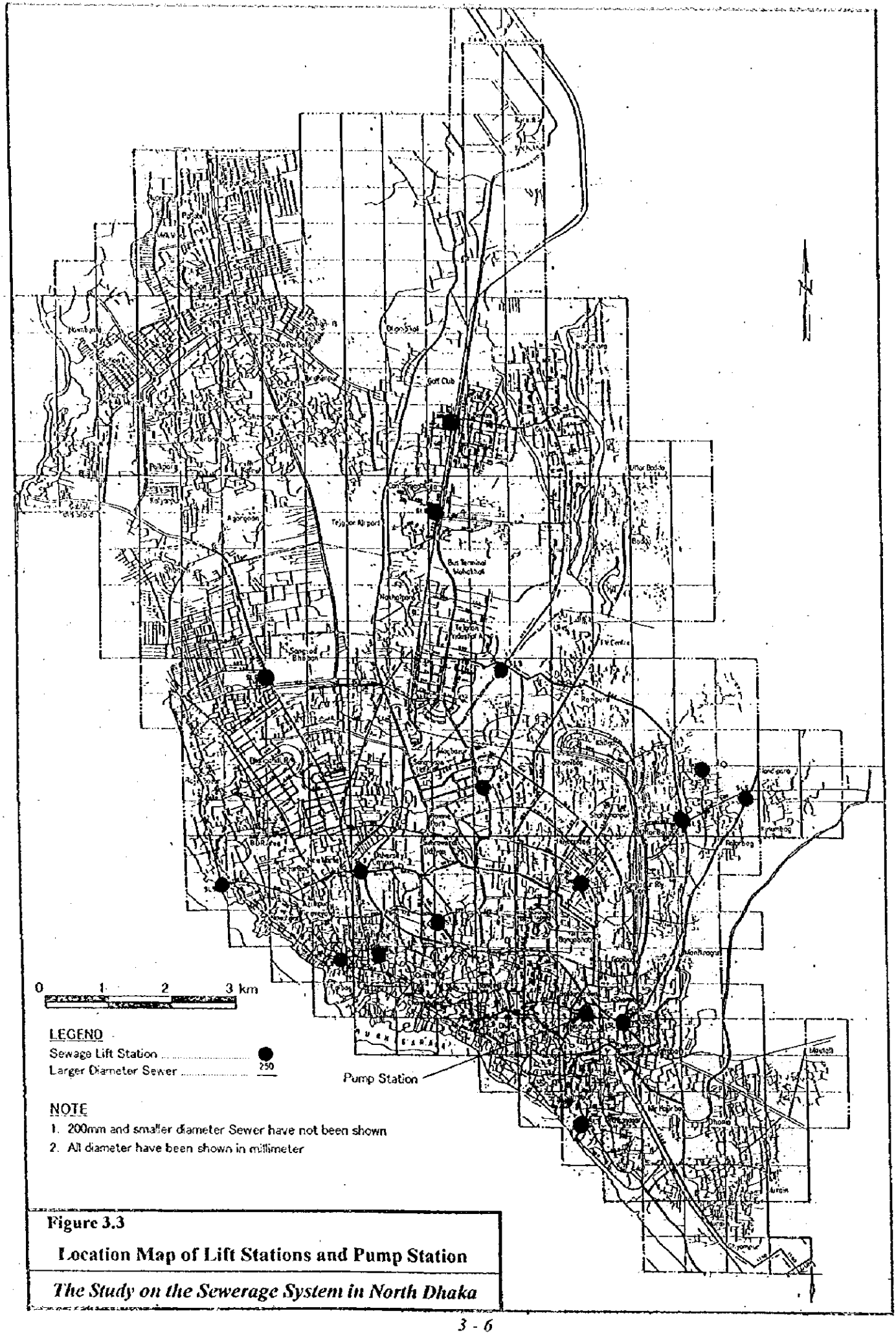


Figure 3.3

Location Map of Lift Stations and Pump Station

The Study on the Sewerage System in North Dhaka

Table 3.4 Present Status of Lift Stations and Pump Station

Zone	Name of Stations	Present Status
I	Narinda P/S (Old)	All six pumps are operational Vacuum pump should be repaired Not Operated due to the small incoming flow
	Narinda P/S (New)	Among seven pumps, five are operational Two pumps are under repair (impeller worn out, bearing damage) Vacuum pump should be repaired
	Bashaboo L/S	All five pumps are operational but one starter's magnetic contactor was burnt due to the voltage fluctuation Vacuum pump should be repaired Generator was burnt last July, 1993 due to short circuit
	Sayedabad L/S	All five pumps are operational Vacuum pump should be repaired
	Faridabad L/S	All two pumps are operational Battery for the generator should be recharged
II	Azimpur L/S	All two pumps are operational
	Nawabganj L/S	Among two, one pump was burnt on April, 1997 Battery of generator was damaged
	Hazaribag L/S	Last November, 1996, electricity was shut-down de to the damage of double fuse insulator and L/S is not operated The tannery's wastewater discharged into the pond nearby causing odour problems
III	Asad Gate L/S	Among three, one pump is under repair Vacuum pump should be repaired
	New Market L/S	Among four pumps, two are non-functioning due to shaft worn out Vacuum pump should be repaired
V	Tejgaon L/S	All five pumps are operational Vacuum pump should be repaired Seldom operated, since by-pass gate is open to allow the incoming sewage flow through by gravity
	Banani L/S	Running
	Mohakhali L/S	Among three pumps, No.2 pump is under repair (motor was burnt last 15 Jan., 1997)
VI	Mogbazar L/S	Among two sets of pump and starter, one set was burnt Battery of generator was damaged
	P & T L/S	All two pumps are operational
	Medical College L/S	All three pumps are operational but starter of No.1 pump is mal-functioning since the magnetic contactor was burnt
	Mothertek L/S	Running
	Goran L/S	Running

3.3.2 Practice of Operation and Maintenance

These L/Ss and P/S are operated by pump operators in three shifts. The duty time of each shift is as follows:

Shift 1 : 6:00 - 14:00
Shift 2 : 14:00 - 22:00
Shift 3 : 22:00 - 6:00

Operational activities are recorded in a logbook and it contains, pump operation duration, voltage, current and countermeasures taken in accidents, such as breakdown, malfunctioning, current shut down etc. Since L/Ss are not equipped with any telecommunication system, operators must inform an officer in Zone Office in case of an accident and that officer calls the maintenance team at the Narinda P/S.

3.3.3 Incoming Sewage Flow

The incoming sewage flow for each L/S and P/S was calculated by the pump operation time and the results are shown in Table 3.5 and Figure 3.4, respectively. These data were obtained through field surveys conducted in both the rainy season and dry season. It was clearly indicated that a considerable volume of sewage (about 5,600 cu.m/day) leaks from the trunk main between the Bashaboo L/S and theSaidabad L/S.

Table 3.5 Incoming Sewage Flow to Lift Stations and Pump Stations

Zone	Name of Station	Sewage Flow (cu.m /day)	Remarks
I	Narinda P/S (Old)	0	Not operated due to small incoming swage
	Narinda P/S (New)	45,936	Only No.1 pump is operated
	Bashaboo L/S	7,506	No.1, 2, 4, 5 pumps are operated
	Sayedabad L/S	1,920	No.4, 5 pumps are operated
	Faridabad L/S	1,518	No.1, 2 pumps are operated
II	Azimpur L/S	1,656	No.1, 2 pumps are operated
	Nawabganj L/S	414	No.2 pump is operated
	Hazaribag L/S	0	Not operated due to the electricity shut-down
III	Asad Gate L/S	3,312	No.1, 2 pumps are operated
	New Market L/S	1,104	No.3 pump is operated
V	Tejgaon L/S	0	By-pass gate is open and seldom operated
VI	Mogbazar L/S	Unknown	No record
	P & T L/S	8,772	No.1, 2 pumps are operated
	Medical College L/S	1,056	No.2, 3 pumps are operated

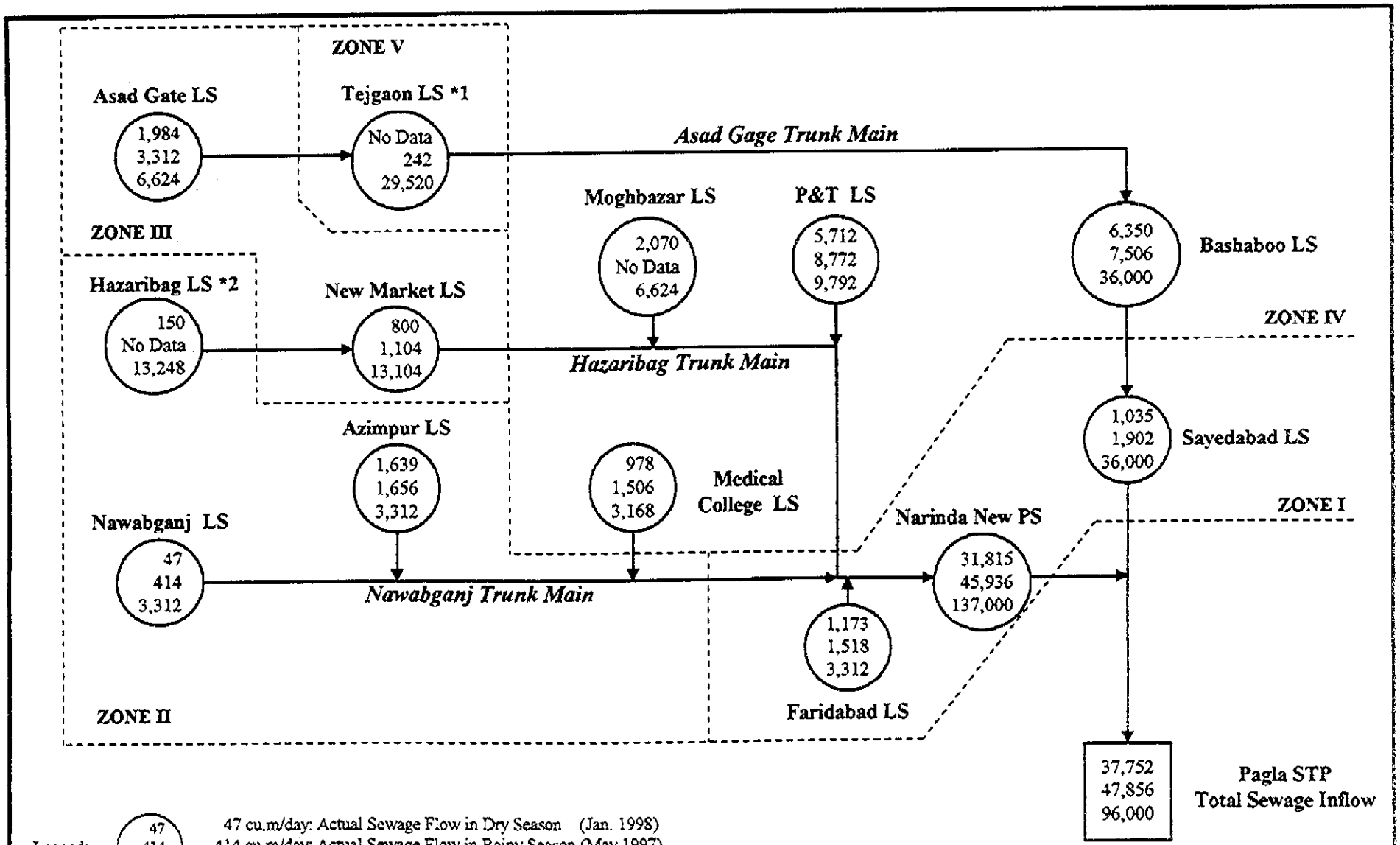


Figure 3.4
Schematic Plan for Lift Station and Pump Station and Pagla STP

The Study on Sewerage System in North Dhaka

These data were obtained through field investigations conducted in both the rainy season and dry season to grasp the operating conditions of the sewer network and pump stations. Comparing the discharged flow from Bashaboo (7,506 cu.m/day) and Sayedabad (1,920 cu.m/day), which are located along the Asad Gate Trunk Main, a large volume of sewage (5,586 cu.m/day) is believed to be leaked within the said section.

3.4 Sewerage Treatment Plant

3.4.1 Physical Condition

The Pagla STP was rehabilitated under a Japanese Grant Aid Project. The outline of the facilities are shown in Table 3.5 and the general plan and hydraulic plan of the STP are also shown in Figures 3.5 and 3.6, respectively.

Table 3.5 Outline of Pagla Sewage Treatment Plant

1. General

Name:	Pagla Sewage Treatment Plant
Location:	Dhaka City, Pagla District
Site Area:	110.5 ha (whole area) 87.7 ha (present site area)
Ground Level:	Present GL = +1.8 to +6.9 Design GL = +6.7 to +6.9
Land Use:	East - farming, West - railroad and industrial area, North - marsh, South - farming
Sewerage System:	Separate system
Treatment Method:	Sewage Treatment = primary sedimentation tank + facultative lagoon Sludge Treatment = sludge lagoon (digestion and drying)
Receiving Water Body:	Buriganga River H.W.L. = +6.7

Design Sewage Flow Rate

Unit: cu.m/day

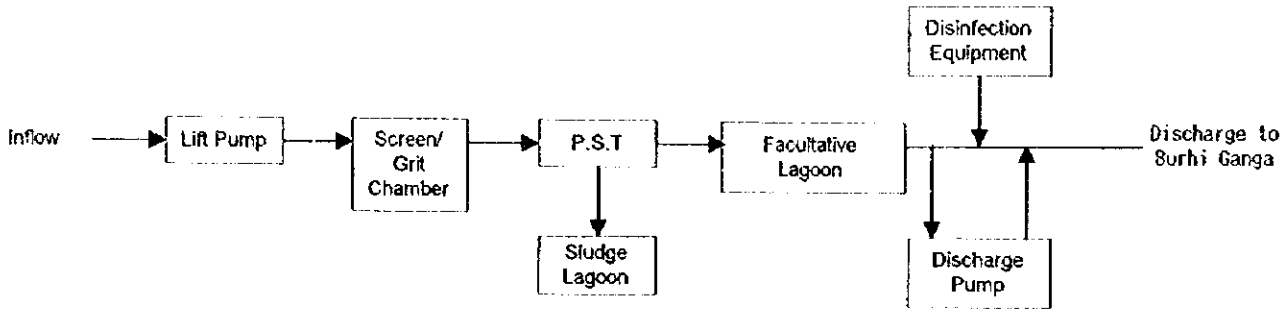
Sewage Flow	Whole Plan	Existing Facility
Daily Average	146,000	96,000
Daily Maximum	183,000	120,000
Hourly Maximum	232,000	120,000

Table 3.5 Outline of Pagla Sewage Treatment Plant (Continued)

Design Sewage Effluent Quality

Water Quality Parameter	Influent (mg/l)	Primary Sedimentation Tank		Facultative Lagoon		Total Removal Ratio (%)
		Removal Ratio (%)	Effluent (mg/l)	Removal Ratio (%)	Effluent (mg/l)	
BOD	200	40	120	59	50	75
SS	200	60	80	25	60	70

2. Treatment Flow



3. Outline of Major Facilities

Facility	Dimension	No. of Facility		Capacity
		Existing	Whole	
Inflow	Brick Arch Sewer Dia. Ø54" (Equ.) Slope 0.45% Sewer Pipe Invert Level +0.762 Sewer Dia. Ø1800 Slope 0.45% Invert Level +0.485	1 --	1 1	
Lift Pump	Screw Pump Ø1,600 x 41 m^3/min. x 3.8 m x 45 kW	3 (1)	5 (1)	
Grit Chamber	Horizontal Flow Type W 3.3 m x L 10.2 m x D 1.42 m	2	2	Surface Load: 3,600 m^3/m^2 x day
Primary Sedimentation Tank	Centrifloc Sludge Scraper Ø33 m x D 3.0 m	4	6	Detention Time: 2.02 hr. Overflow Rate: 35.7 m^3/m^2 x day Weir Loading: 293 m^3/m x day
Facultative Lagoon	Embanked Rectangular Pond Effective Depth: 2.0 m	42 ha	64.1 ha	Retention Days: 7 BOD Area Load: 343 kg BOD ha x day
Discharge Pump	Horizontal Centrifugal Pump Ø250mm x 4.55m^3/ min x 10.7 m Ø250mm x 11.36m^3/ min x 10.7 m Ø400mm x 31.82m^3/ min x 10.7 m	 2 2 3	 2 2 3	
Disinfection Equip.	Liquid Chlorine	1	1	Max. Dosing Rate: 3 mg/l
Sludge Lagoon	Embanked Rectangular Pond	3	3	Solid Load 75 kg/m3 x year
Discharge Pipe	Brick Arch Inflow Ø1,350 Inflow Ø1,500 Length 1,240 m	 1 1	 -- 2	Gravity flow only

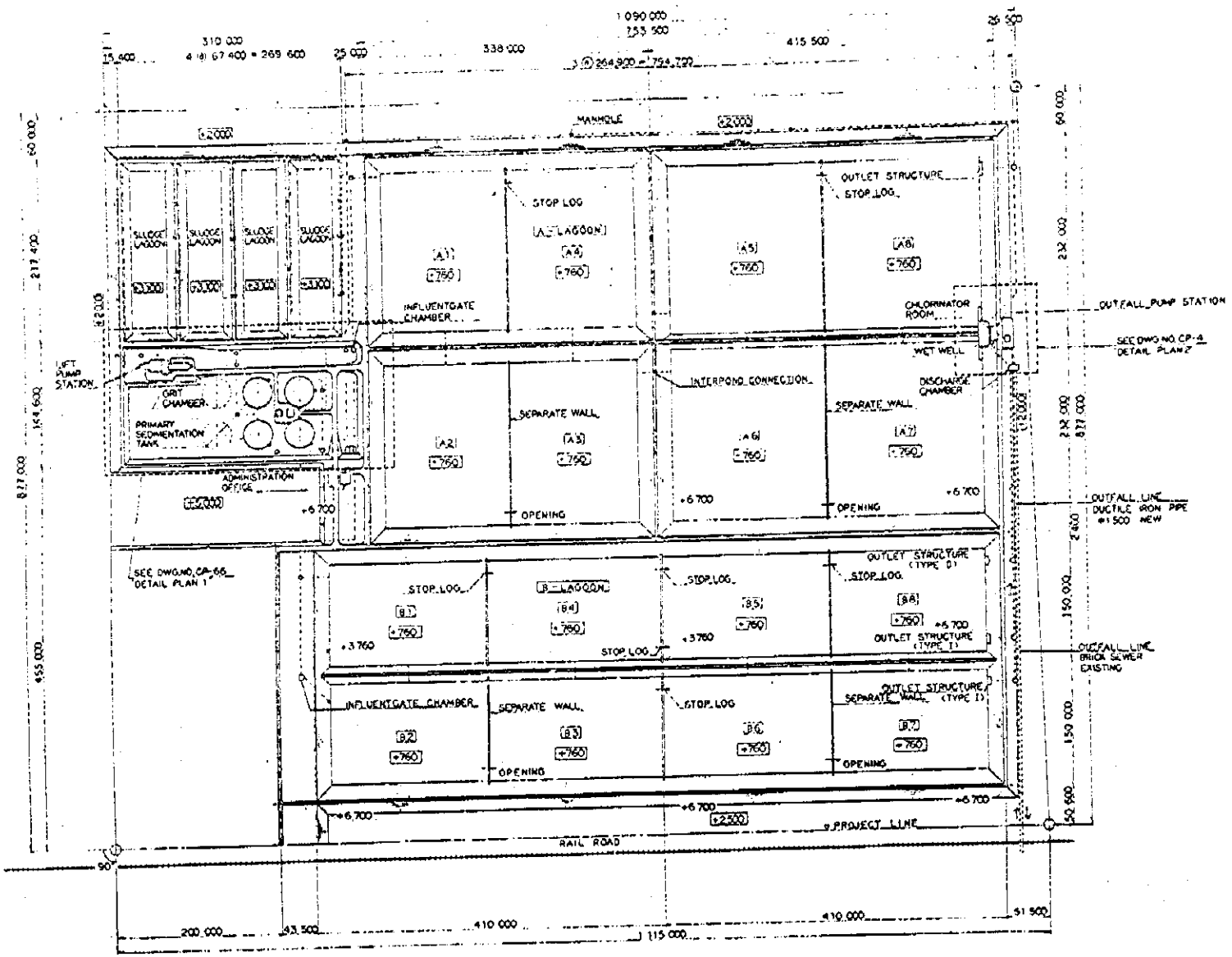


Figure 3.5 General Plan of Pagla STP

The Study on the Sewerage System in North Dhaka

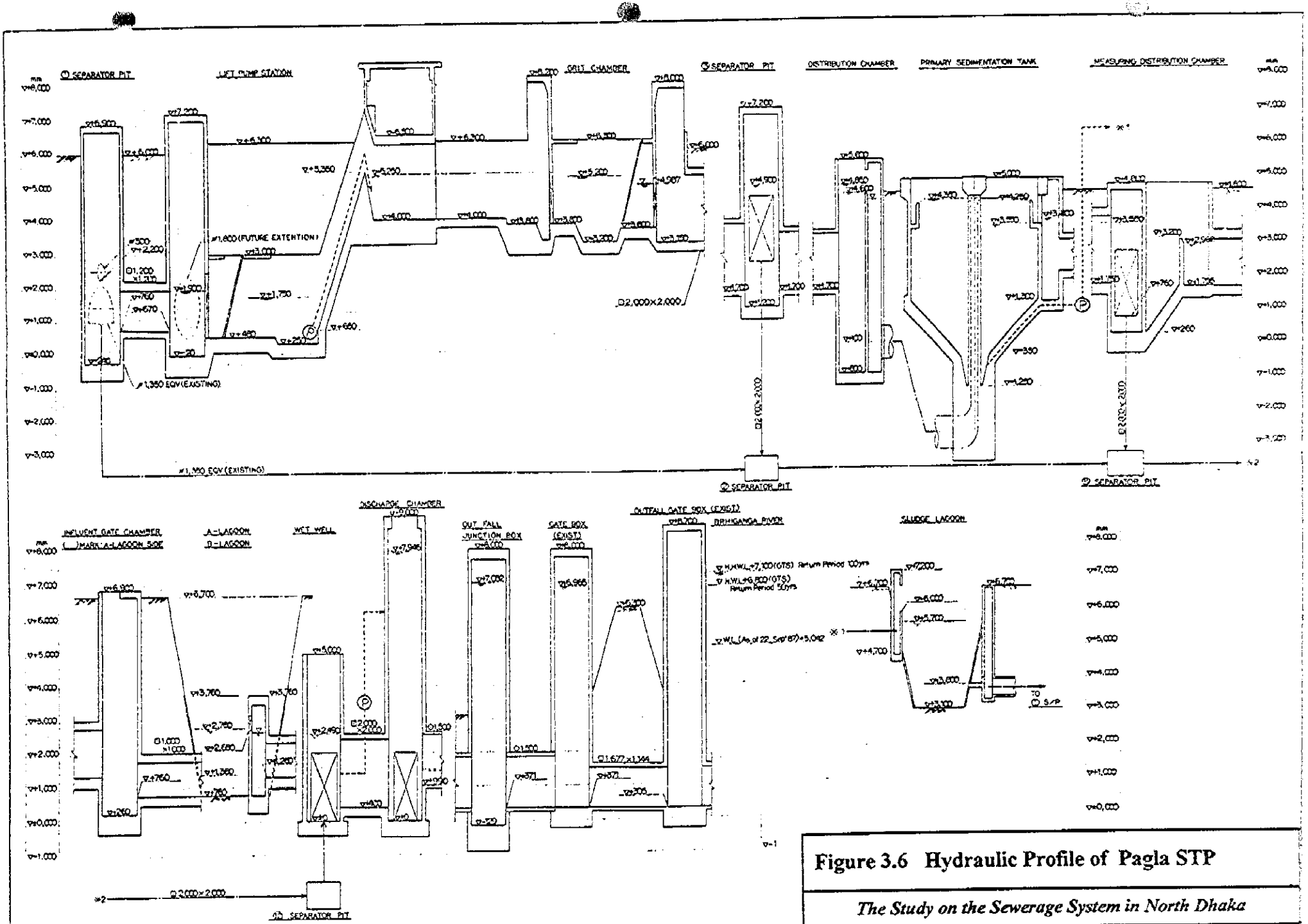


Figure 3.6 Hydraulic Profile of Pagla STP

The Study on the Sewerage System in North Dhaka

The present status of the facilities are shown below:

Table 3.6 Present Status of Pagla STP

Facility	Present Status
Lift Pump	All operational
Grit Chamber	Operational
Primary Sedimentation Tank	All operational
Facultative Lagoon	Operational
Discharge Pump	All operational
Disinfection Equipment	Chlorinator is now under repair Maintenance of chlorinator is under the jurisdiction of the Structure Maintenance Division in DWASA

Minor breakdowns can be repaired by the Pagla maintenance team. In a case of major repair, the Pagla staff will prepare an estimate and call the contractors registered in DWASA for the tender. The successful tenderer will undertake the repair work.

3.4.2 Practice of Operation and Maintenance

The plant is operated by three shifts and the staff composition is as follows:

Table 3.7 Staff Composition of Pagla STP

Position	No.	Position	No.
Executive Engineer	1	Driver	2
Subdivision Engineer	1	Utility Man	2
Sub-assistant Engineer	2	Gardener	1
Microbiologist	1	Office Cleaner	1
Sample Collector	1	Wireless Operator	1
Foreman	1	Generator Operator	2
Electrician	1	Treatment Plant Assistant	6
Cashier	1	Pump Operator	8
Typist & Clerk	1	Helper	8
Store Keeper	1	Sewer Cleaner	13
		Total	55

The monthly total expenditure and its breakdown as of the year 1996 is shown below. This includes that of the Narinda P/S and other L/Ss.

Table 3.8 Monthly Expenditure Breakdown for Pagla STP and Narinda P/S and L/S (1996)

Unit: Tk

Items	Jan.	Feb.	Mar.	Apr.	May	Jun.
Salary	295,938	223,380	212,340	287,512	220,135	207,223
O&M Costs	284,788	270,558	275,435	280,530	285,631	283,780
Spare Parts	5,700	6,000	7,000	3,000	8,000	9,000
Electricity	196,354	195,394	195,394	408,042	408,042	408,042
Others	20,000	20,000	20,000	20,000	20,000	20,000
Total	802,780	715,232	710,169	999,084	941,807	928,028

Items	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Salary	209,180	219,310	217,916	224,309	227,988	217,894	2,763,125
O&M Costs	290,195	278,290	279,355	278,780	286,996	275,855	3,370,193
Spare Parts	9,500	7,000	8,000	7,500	9,000	6,000	85,700
Electricity	496,291	463,947	463,947	242,045	242,045	256,973	3,976,515
Others	20,000	20,000	20,000	20,000	20,000	20,000	240,000
Total	1,025,166	988,547	989,218	772,634	786,029	776,722	10,435,533

3.4.3 Incoming Sewage Flow

Incoming sewage flow is measured at the measuring chamber at the upstream of Lagoon A and B on an everyday basis. Recorders calibrate the overflow depth by the measuring scale attached to the vertical wall beside the weir and calculate the incoming flow to each lagoon by a calculation chart. The monthly average flow for the last one-year (1996) was as follows:

Table 3.9 Monthly Average Incoming Sewage Flow at Pagla STP (1996)

Unit: cu.m3/day

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
Average Flow	40,505	38,359	42,840	42,625	47,657	57,702
Month	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Flow	53,245	51,672	46,890	42,904	38,167	34,903
				Annual Average		44,539

Considering the design capacity of the plant, 120,000 cu.m/day, the incoming sewage flow is only equivalent to 32.0% (minimum), 44.4% (maximum) and 37.1% (average). Thus, the existing facilities are in operation partially; they are: 1 No. of inlet screw pump (total 3 Nos.), 2 Nos. of primary sedimentation tank (total 4 Nos.), facultative lagoon (8 Nos.; all), discharge pump (operated depending on the water level of the receiving water body: the Buriganga River) and 1 No. of sludge lagoon (total 3 Nos.).

3.4.4 Treatment Performance

A laboratory room is located in the administration building. Samples are taken once a week at:

- Distribution Chamber
- Outlet Primary Sedimentation Tank
- Outlet of A and B Lagoon

A microbiologist analyses the SS and BOD_5 for each sample. However the BOD_5 meter was disabled last 20 October, 1995 and thus only SS is measured and recorded at present. Table 3.10 shows the existing water analysis equipment in the laboratory room in the Pagla STP.

Table 3.10 Existing Water Analysis Equipment in the Pagla Laboratory

Item	Type and Manufacturer	No.	Present Status
Digital DO/O Meter	Bionic Industry Co., Ltd. DO-715k	1 unit	Non-functional
pH Meter	Horiba	1 unit	Functional
Drying Oven	Yamato	1 unit	ditto
Incubator	Sanyo	1 unit	ditto
Vacuum Pump	Yamato	1 unit	ditto
Glassware	Yamato	1 set	

The monthly average BOD_5, SS and their removal rate in a one-year period, from November 1994 to October 1995, is shown below.

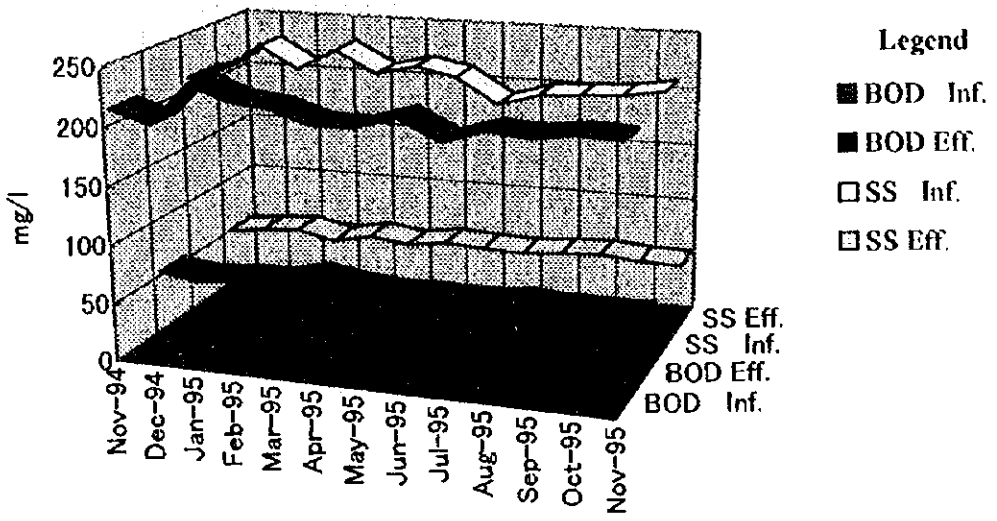
Table 3.11 Water Quality and Removal Rate of BOD_5 and SS

Item	BOD_5					SS				
Month/ Year	Inf.	P.S.T. Eff		F.L.	Overall R.R.	Inf.	P.S.T. Eff.		F.L.	Overall R.R.
	(mg/l)	(mg/l)	R.R. (%)	(mg/l)	(%)	(mg/l)	(mg/l)	R.R. (%)	(mg/l)	(%)
Nov. 96	213	116	45.5	53	75.1	211	106	49.8	51	75.8
Dec.	202	111	45.0	48	76.2	221	105	52.5	55	75.1
Jan. 97	238	128	46.2	51	78.5	243	111	54.3	58	76.1
Feb.	225	121	46.2	52	76.9	225	122	45.8	50	77.8
Mar.	222	122	45.0	60	73.0	243	126	48.1	58	76.1
Apr.	211	114	46.0	54	74.4	225	90	60.0	53	76.4
May	211	116	45.0	51	75.8	233	89	61.8	58	75.1
Jun.	222	121	45.5	52	76.6	226	92	59.3	56	75.2
Jul.	205	120	41.5	50	75.6	205	80	61.0	55	73.2
Aug.	216	124	42.6	55	74.5	215	84	60.9	58	73.0
Sep.	213	122	42.7	53	75.1	217	88	59.4	60	72.4
Oct.	218	120	45.0	53	75.7	219	85	61.2	57	74.0
Avg.	216	120	44.7	53	75.6	224	98	56.2	56	75.0

Note: Inf. = Influent, P.S.T. = Primary Sedimentation Tank, Eff. = Effluent, R.R. = Removal Rate, F.L. = Facultative Lagoon.

During the field survey of L/Ss in industrial areas, some industrial sewage was connected to the public sewerage system and other was discharged to the pond or channel nearby just as in the case of the Hazaribag L/S in MODS Zone II (please refer Appendix 3.3.1). Thus, incoming sewage to the Pagla STP was comprised of domestic/industrial sewage. Figure 3.7 shows the influent and effluent quality fluctuation through the year.

Figure 3.7 Influent & Effluent Water Quality Fluctuation



The treated sewage is discharged to the Buriganga River through a discharge trunk by gravity or by discharge pump, depending on the level of the river.

As shown in Table 3.11, the average overall removal rate is 75.6% for BOD_5 and 75.0% for SS. Although the present treatment performance complies with the design removal rate, which is 75.0% for BOD_5 and 70.0% for SS, the effluent quality (BOD_5) exceeds the existing DOE effluent standards shown below.

Table 3.12 DOE Effluent Standards

Water Quality Index	Unit	Standard Value
BOD_5	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
SS	mg/l	100
Temperature	°C	30
Coliform	number/100 ml	1,000

The equipment of the laboratory should be improved immediately. Given the location of the plant and the budget restrictions, the water quality analysis cannot be covered by a private or governmental laboratory. Thus, the laboratory should be properly equipped at least for stable SS and BOD_5 measurement.

3.5 Central Store

The Central Store, belonging to the Store Division, is located just beside the Pagla STP. All purchased equipment or materials are transported here, checked, registered and then distributed to Zone Offices. In an area of 16.0 ha, there are three warehouses and one office building. Electrical and mechanical equipment is stored in warehouses and pipes, bends and valves are kept in open spaces without roofing. The staff composition is as follows:

Table 3.13 Staff Composition of Central Store

Position	No.	Position	No.
Executive Engineer	1	Generator Operator	1
Subdivision Engineer	1	Mechanic	1
Assistant Engineer	1	Gardener	5
Sub-assistant Engineer	4	Additional Pump Operator	5
Upper Divisional Assistant	2	Warehouse Man	3
Typist	6	Helper	6
Revenue Inspector	1	Utility Man	2
Driver	1	Office Cleaner	4
		Total	44

The monthly expenditure and its breakdown for the last year (1996) are shown below.

Table 3.14 Monthly Expenditure and Breakdown for Central Store

Unit: Tk

Items	Jan.	Feb.	Mar.	Apr.	May	Jun.
Salary	107,466	79,789	106,182	194,473	105,943	113,414
O&M Costs	15,207	64,514	10,496	63,935	15,138	171,298
Spare Parts	-	-	-	-	-	-
Electricity	34,518	28,069	28,069	28,069	28,069	28,069
Others	305	415	313	311	311	438
Total	157,476	172,787	145,060	286,788	149,506	313,219

Items	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Salary	111,440	115,124	115,807	117,318	114,885	117,186	1,399,007
O&M Costs	16,533	15,510	15,470	84,647	11,446	16,357	500,616
Spare Parts	-	-	-	-	-	-	-
Electricity	31,683	31,683	31,683	35,021	35,021	37,246	377,200
Others	321	238	174	468	630	694	4,618
Total	159,997	162,555	163,134	237,454	161,982	171,483	2,281,441

O&M cost includes the cost for fuel and building expansion and repair.

The stores warehouse over 400 categories of goods. At present, they are recorded manually and there might be serious trouble related to miswriting or miscalculation. For efficient store management, DWASA is planning to introduce a computer system. The Physical Inventory Report was completed on 30 June, 1996 and it contains the following information:

10 digit Code No. (for instance 1120602121)

- Name of material/equipment (for instance, material corresponding to the above Code No. is: 4 inch x 11.25 inch PVC Bend, B-Class)
- Date of Inventory
- Quantity as per book balance as of the end of the fiscal year S/A: Serviceable, U/S: Unserviceable, Total)
- Quantity received thereafter up to the date of the inventory (S/A, U/S)
- Total quantity on the inventory date (S/A, U/S, Total)
- Quantity issued upon the date of the end of the financial year (S/A, U/S)
- Balance quantity after the issue as on the inventory date (S/A, U/S)
- Actual found on the inventory date (S/A, U/S, Total)
- Shortage/exceeded for the last year (S/A, U/S, Total)
- Shortage/exceeded for the previous year (S/A, U/S, Total)

3.6 Workshop

The workshop, belonging to the Workshop Division of DWASA, is located besides the MODS Zone IV Office in Mirpur. Within an area of 5,000 sq.m, there is one garage, two office buildings, one roofed working space and one repair shop. The staff composition, a list of existing equipment and the repair record are shown below.

Table 3.15 Staff Composition of Workshop

Position	No.	Position	No.
Subdivision Engineer	2	Assistant Mechanic	2
Sub-assistant Engineer	6	Electrical Worker	2
Cashier	2	Assistant Electrical Worker	2
Typist	3	Machinist	2
Electrician	1	Assistant Machinist	2
Foreman	2	Welder	1
Store Keeper	1	Winder	1
Store Assistant	1	Assistant Winder	1
Mechanic	2	Helper	9
		Utility Man	1
		Total	43

Table 3.16 List of Existing Equipment

Items	No.	Items	No.
16 ft. - 0 in. Lathe	1	Grinder	2
6 ft. - 0 in. Lathe	1	Radial Drill	1
4 ft. - 0 in. Lathe	1	Hand Grinder	1
Power Hacksaw	1	Hand Drill	1
Metal Cutter	3	Welding Machine	3
Twist Drill	2	Air Compressor	1
Shaper	1	Hand Tool (set)	1

Table 3.17 Record of Repair Works (as of September, 1996)

Items	No.
Water Carrier	14
Generator	4
Machine Shop	25
Microbus	2
Pick-up	3
Car	17
Tempo	0

The workshop repairs vehicles, pumps, generators, etc. from the Zone Offices. The existing system is as follows: first, they check the condition of the machine and find out which part should be replaced; second, purchase the required spare parts in the parts shop in the city; third, repair the machine. However, this procedure takes a great deal of time and for more efficient repair work, they are requesting that DWASA construct a spare parts store. If the required part is available in that store, repair work can be finished in half the time as that required by the present system. The O&M budget for the last is shown below.

Table 3.18 O&M Budget for the Workshop (1996-1997)

Item	Cost (Tk)	Item	Cost (Tk)
Overtime	438,900	Office Maintenance	71,668
Transportation	11,400	Vehicle Maintenance	2,850,000
Labour	84,098	Fuel	617,000
Telephone	120,745	Other Expenses	900
Advertisement	-	Furniture	4,465
Printing and Stationary	219,451	Motor and Generator	4,090,000
		Total	8,509,127

CHAPTER 4 PAST AND ON-GOING PROJECTS RELATED TO SANITATION/SEWERAGE FACILITIES

The past and ongoing projects, which might be related in formulating the master plan for the North Dhaka Sewerage Development, are outlined below.

4.1 "Basic Design Study Report on the Sewerage Construction and Rehabilitation Project for Dhaka City", Japan International Cooperation Agency, February 1988

The study was conducted from September 1987 to February 1988. Consequently, the following lines were established to construct/rehabilitate/provide facilities/equipment (see Table 4.1) under the Japanese Grant-Aid Program which was commissioned to the Dhaka Water Supply and Sewerage Authority in March 1992.

4.2 "Water Treatment Plant at Demra and Other Works - Interim Report (Water Supply)", Camp Dresser & McKee International Inc. USA, et al., November 1989

Included as part of the DWASA IV Project was the design of a 450,000 cu.m/day Demra Water Treatment Plant. In addition to the initial works, the plant was to be arranged in a manner that would allow easy expansion to 910,000 cu.m/day at some future date.

4.3 "Water Treatment Plant at Demra and Other Works - Interim Report (Sewerage)", Camp Dresser & McKee International Inc. USA, et al., February 1990

A feasibility study was undertaken by RMP/Montgomery on behalf of the DWASA for a long-term plan through the year 2010 on water supply and sewerage system within the Dhaka metropolitan area. The final report of the study produced in 1981, recommended that in order to ease the crisis of safe water supply and sanitation problem in Dhaka City and adjoining areas, a priority programme consisting of critical water and sewerage elements from Phase 1 of their Long Term Plan Development (LTP) be started immediately.

Table 4.1 Facilities/Equipment Constructed/Rehabilitated/Provided

Item	Configurations/Specifications	Qty	Remarks
Pagla Sewage Treatment Plant			
Lift Pump	Screw Pump ϕ 1,600mm x 41m^3/d x 3.8mH x 45kw	3	One for standby
Grit Chamber	Parallel Flow 3.3mW x 10.2mL x 1.42mD	2	
Primary Sedimentation Tank	Center-Feed Circular w/ Sludge Scraper ϕ 33m x 3.0mD	4	
Facultative Lagoon	Rectangular Embankment Effective Water Depth : approx. 2.0m	14.8ha	
Disinfection Equipment	Chlorinator	1	
Sludge Lagoon	Rectangular Embankment 59.1mW x 169.1mL x 3.6mD	3	
Outfall Pipe	ϕ 1,500mm x approx. 1,240m	1	Existing one (54") is used, if the gravity drainage is possible
Administration Bldg.	Office, Electrical Room	1	Two-stories
Diesel Engine Generator	375KVA	2	Near admin. office and outfall pumping station, respectively
Lift and Pumping Station			
Hazaribag LS	Submergible Pump ϕ 200mm x 2.3m^3/d x 17mH x 22kw ϕ 200mm x 4.6m^3/d x 17mH x 30kw	2 2(1)	Replacement of pumps
Nawabganj LS	Submergible Pump ϕ 150mm x 2.3m^3/d x 9.2mH x 11kw	2(1)	ditto
Faridabad LS	Submergible Pump ϕ 150mm x 2.3m^3/d x 7mH x 7.5kw	2(1)	ditto
Old Narinda PS	Submergible Pump ϕ 300mm x 11.4m^3/d x 12.2mH x 37kw ϕ 400mm x 31.9m^3/d x 12.2mH x 85kw	2(1) 2(1)	ditto
Screen Chamber			All stations
Grit Chamber			New Narinda PS
Overhead Traveling Crane	10 metric tons	1	Old Narinda PS
Diesel Engine Generator		10	8 units : fixed type 2 units : non-fixed type
Submerged Motor Pump	2.3 - 4.6 m3/min	6	
Others			Vacuum pump, sump pump, control panel, level gauge, etc.
Replacement of Sewers			
Faridabad LS	ϕ 500mm x 1,500m		Discharge pipe
Faridabad LS	ϕ 16" x 400m		Discharge pipe
Asad Gate To Tejgaon LS	ϕ 24" x 150m		
Gulshan to Tejgaon LS	ϕ 24" x 100m		
Tejgaon to Swaminbag LS	ϕ 36" - 48" eqv. x 200m		
Old Narinda PS	ϕ 42" x 85m		Discharge side header pipe
New Narinda PS	Inlet Pipe, Sump Pit		

In compliance with this recommendation, the DWASA investigated the "Water Treatment at Demra and Other Works" project to meet the main objectives of the priority programme for sewerage, or to develop the sewage disposal system to meet the immediate need and to lay a firm foundation for future development.

4.4 "Updating Study on Storm Water Drainage System Improvement in Dhaka City", Japan International Co-operation Agency, February 1990

The Study on Storm Water Drainage System Improvement Project in Dhaka City was conducted in 1987 and consequently proposed a three-phased programme for drainage improvement for the City of Dhaka with a total area of 137.5 sq.km. The study urged the immediate implementation of the highest priority programme or Phase-1, which required Tk 2.61 billion and covered an area of 31.30 sq.km.

The ten drainage zones in the Phase-1 Programme as shown in Figure 4.1 were divided into categories with two different levels of priority. The zones with the highest priority were zones B, C, F and H that had a total area of 49.46 sq.km. Second priority zones are zones A, D, E, G, J and I with an area of 85.39 sq.km. In this new organization, Zone H was shifted to the highest priority from the second priority in the 1987 JICA study due to its rapid urbanization and the serious damage caused by the 1987 flood.

4.5 "Dhaka WASA IV Project - Saidabad Site Feasibility Study (Final Report)", Camp Dresser & Mckee International Inc. USA, et al., February 1992

Preparation of the detailed design of "the Water Treatment Plant at Demra and Other Works" for the DWASA IV Project commenced in April 1989. The work included 454,000 cu.m/day (100 IMGD) water treatment plant at Demra, increasing the capacity of the Pagla Sewage Treatment Plant by 90,000 cu.m/day (20 IMGD) and related pumping stations and pipelines. The project reached the Interim Report stage, including preliminary construction cost estimates.

The DWASA IV Project, as formulated, was considered unfeasible on financial grounds. The water supply and transmission (based on a 454,000 cu.m/day facility) were estimated to cost about US$ 270 million, and the sewerage component US$ 240 million, resulting in a total cost of about US$ 510 million.

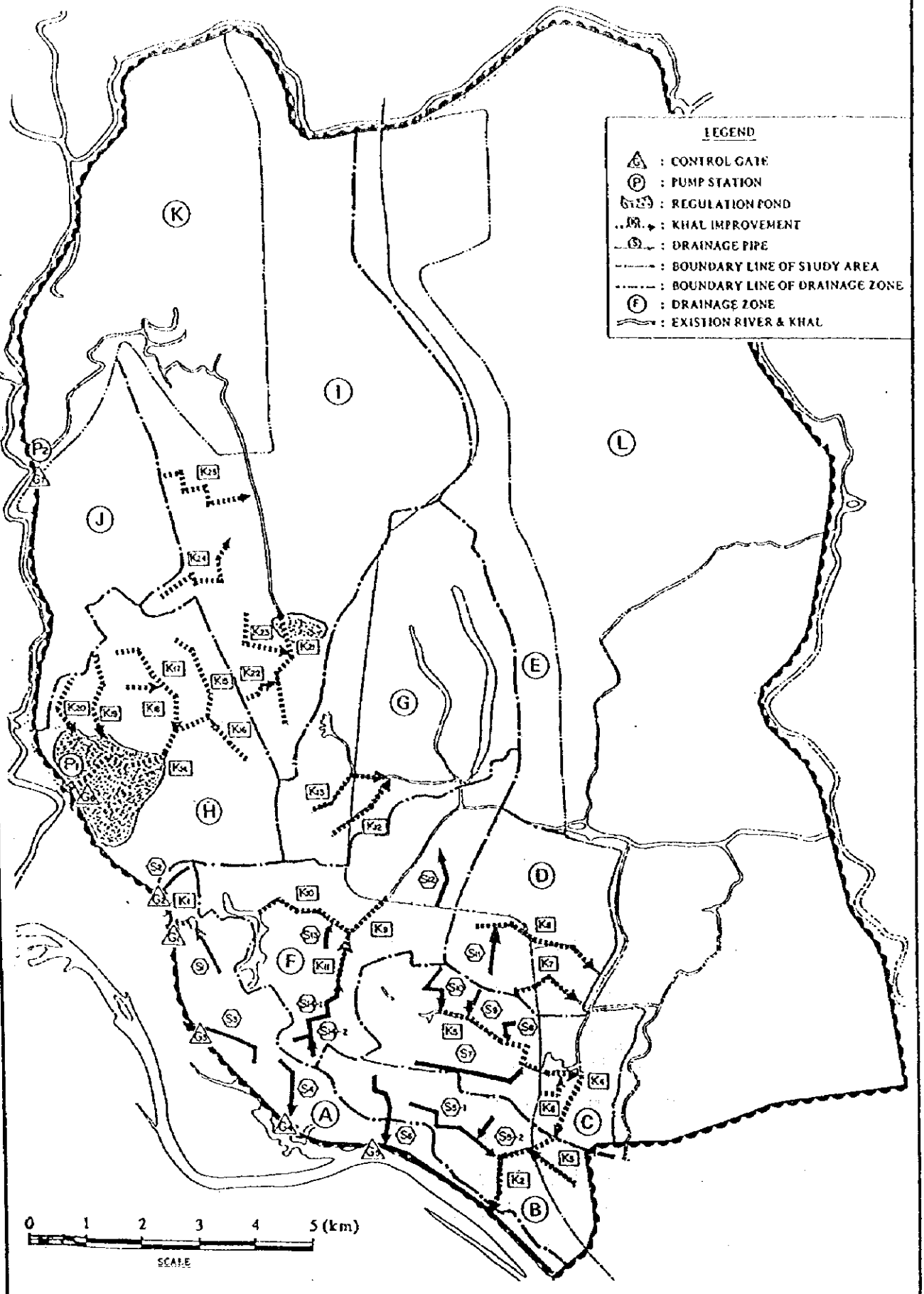


Figure 4.1

Proposed Facilities for Storm Water Drainage System Improvement

The Study on the Sewerage System in North Dhaka

Accordingly, the physical dimensions of the project needed to be re-identified within an envelope of affordable costs. The Ministry of Local Government and other Government of Bangladesh officials decided to review whether the Saidabad site might be appropriate for a surface water treatment plant of a smaller size than the one planned at Demra.

The final engineering designs of the water supply and sewerage components were therefore suspended and an Addendum prepared to carry out a feasibility assessment of constructing a surface water treatment plant at Saidabad. If construction of a water treatment plant at Saidabad were found feasible then it would be assessed together with all other options.

As shown in Figure 4.2, the Saidabad site is located immediately adjacent to the eastern boundary of Dhaka City on a 55 acre parcel of land owned by DWASA. The site is very near to the transmission corridor from Demra to Jatrabari and also near to a canal (DND Canal) developed earlier by Bangladesh Water Development Board for an irrigation project which is not being used now since the poldered area is transforming into a city suburb. This canal could carry the raw water from Demra.

4.6 "Dhaka City Emergency Water Supply Project - Feasibility Study (Final Report) Main Report", BCEOM & Engineering and Planning Consultants Ltd. Bangladesh, May 1992

This plan subdivided the water supply service area into 36 zones and prepared projection of future population and water demand in the target year of 2020, as shown in Figure 4.3.

A plan for a new water treatment plant with 6 alternative locations was then prepared as shown in Figure 4.4; it was decided to take up the Saidabad site and the Friendship Bridge site.

Figure 4.5 shows the proposed long-term surface water development plan on the basis of least cost.

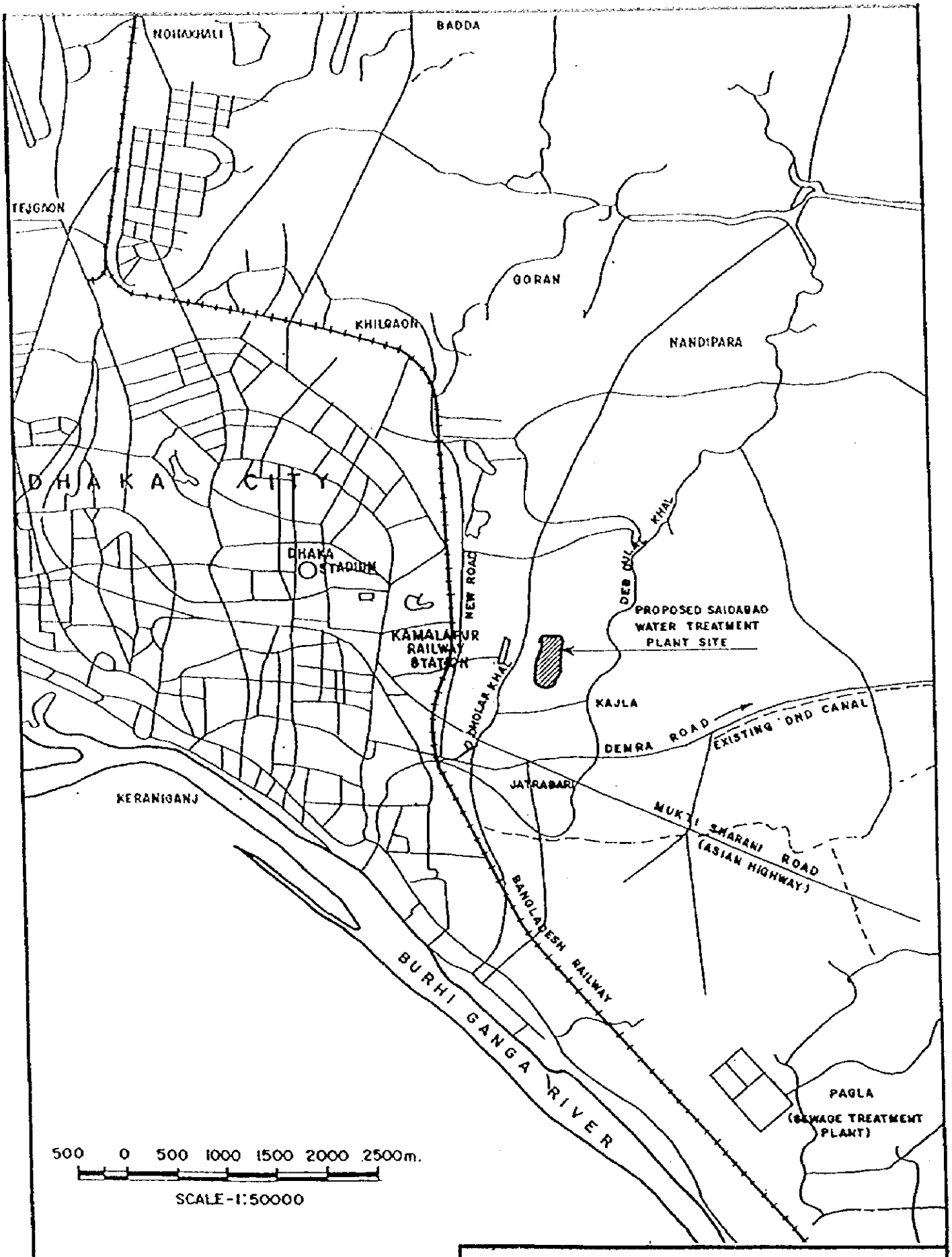


Figure 4.2
Location Plan of Saidabad Water Treatment Plant

The Study on the Sewerage System in North Dhaka

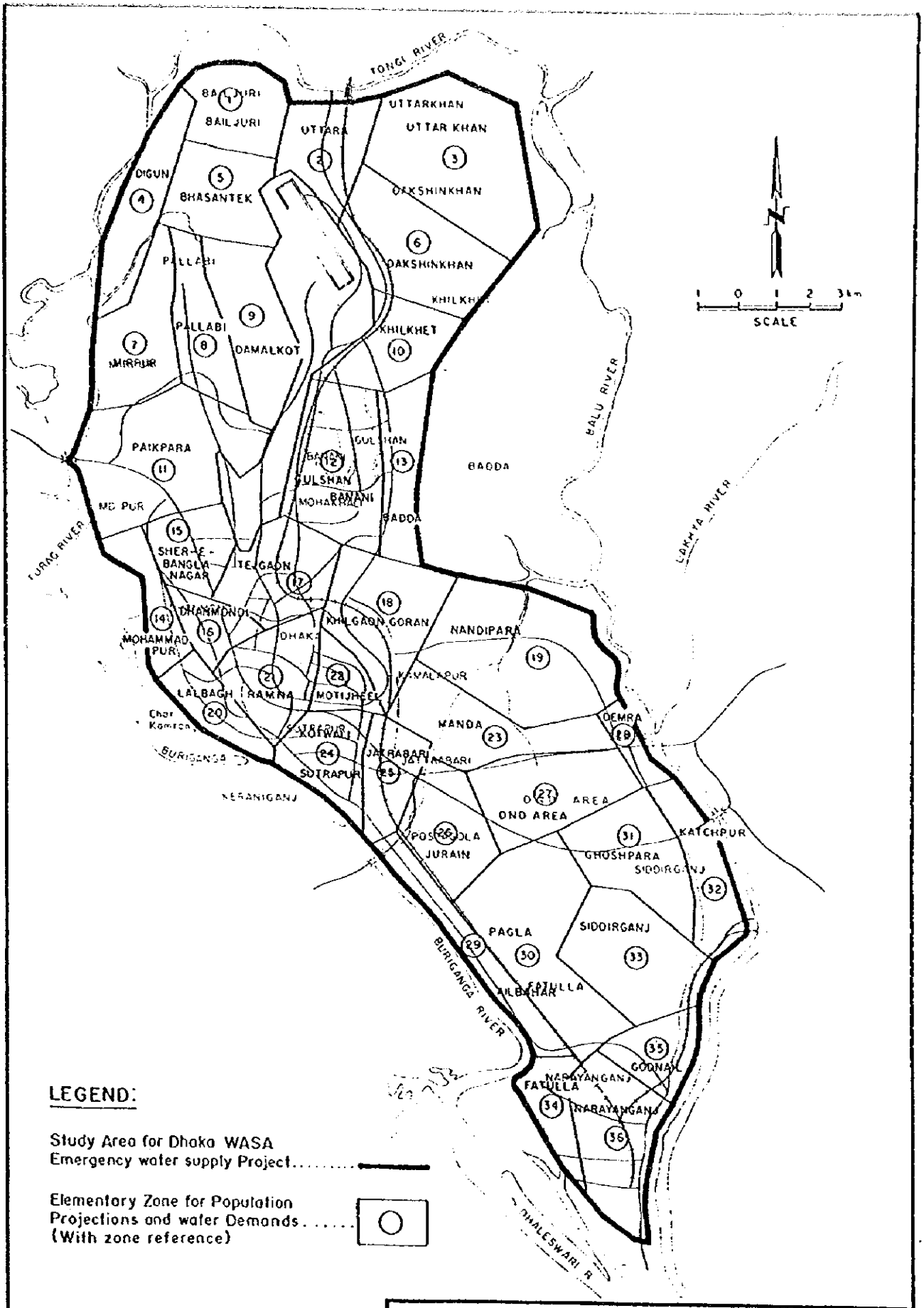


Figure 4.3
Study Area and Elementary Urban Zones

The Study on the Sewerage System in North Dhaka

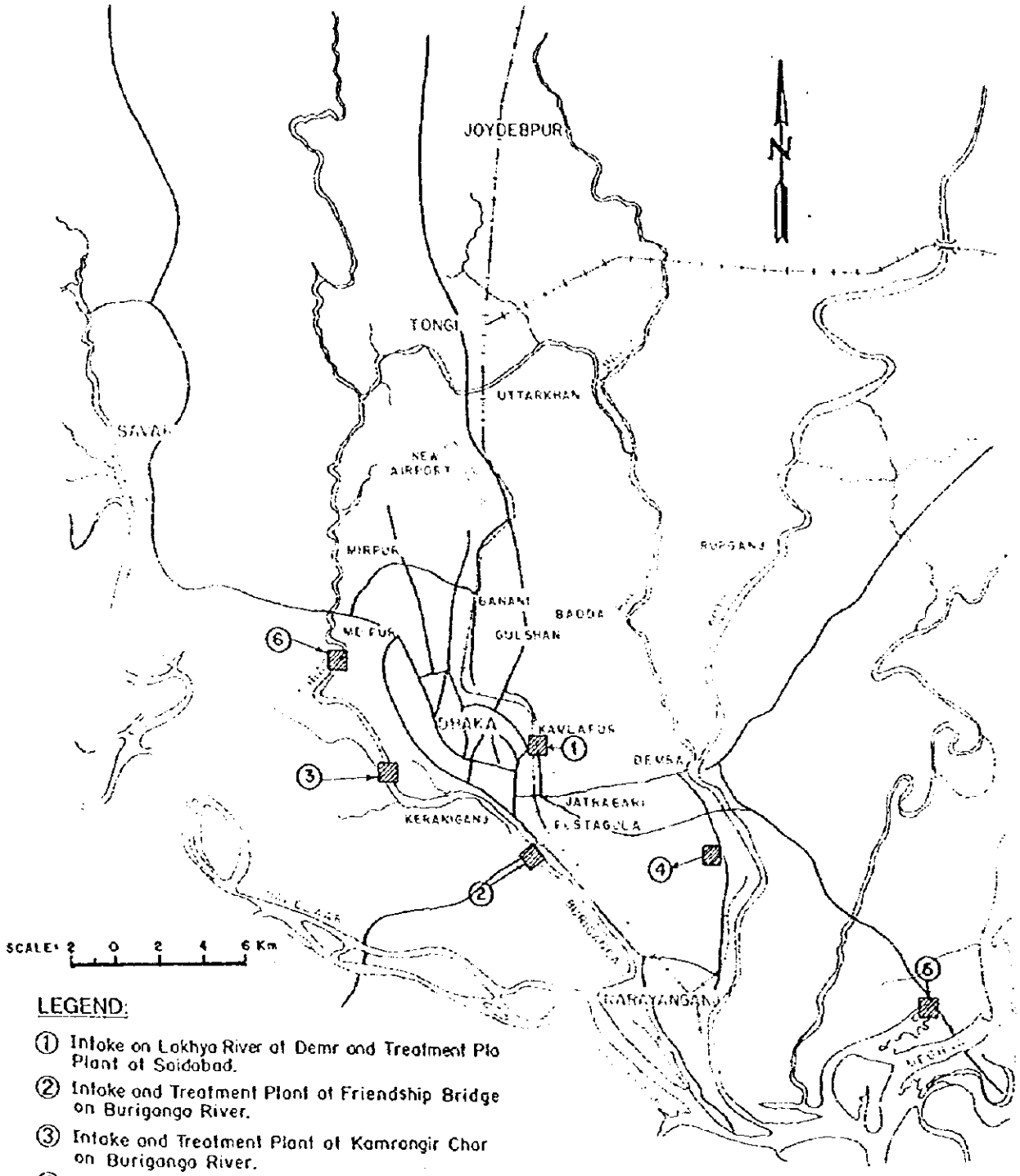
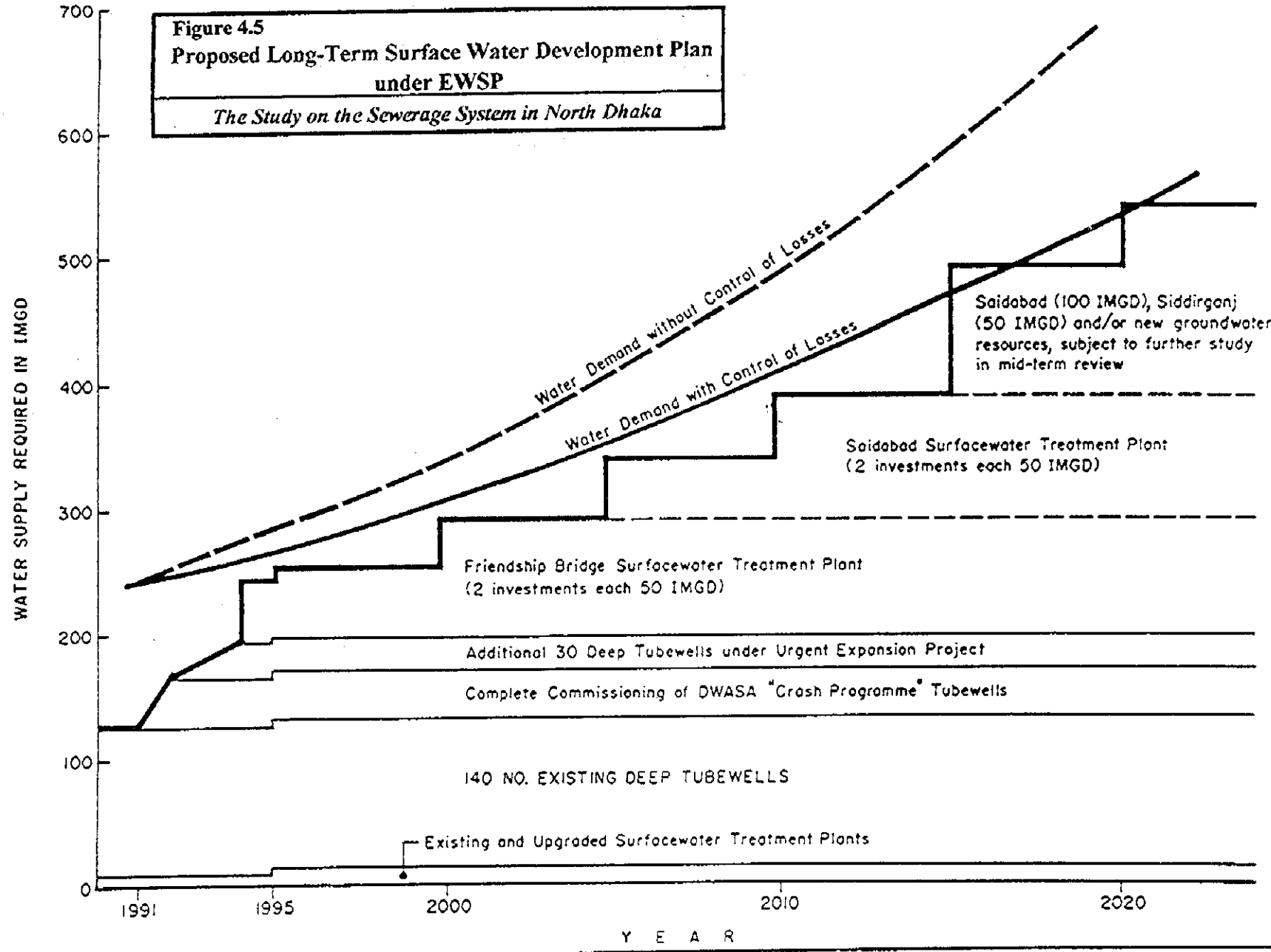


Figure 4.4
Potential Surface Water Intake Sites under EWSP

The Study on the Sewerage System in North Dhaka

Figure 4.5
Proposed Long-Term Surface Water Development Plan under EWSP

The Study on the Sewerage System in North Dhaka



4.7 Staff Appraisal Report (Report No. 13969-BD), "Bangladesh Fourth Dhaka Water Supply Project", The World Bank, November 1996

The Fourth Dhaka Water Supply Project (DWASA IV) consists of the following major components:

- Institutional reform program,
- Capacity additions and service extension,
- Loss reduction, sanitation and efficiency improvement activities, and
- Institutional development technical assistance.

The third component includes a sanitation program consisting of a study and preparation of a sanitation master plan for Dhaka for the period 1995-2010, and first stage investments in low cost sanitation and rehabilitation of selected sewerage systems assets. The term "sanitation" is defined here as a service: (a) for the collection and disposal of excreta and wastewater from domestic, commercial and industrial sources and (b) for the abatement of environmental pollution from such waste. The provision of this service entails the construction, operation and maintenance of a range of physical infrastructures, such as conventional sewerage, intermediate sewerage and various types of on-site sanitation systems. Its scope of work for consulting services is almost the same as that of the JICA Study except for the difference in the study area and some of the items to be studied.

CHAPTER 5 SEWERAGE MASTER PLAN

5.1 Planning Strategy

5.1.1 Dhaka Metropolitan Development Plan as Supreme Urban Development Plan

The RAJUK's DMDP Structure Plan (1995-2015) is primarily referred to, as the latest supreme plan for urban development of Dhaka City and its prospective suburban areas, in delineating the target area for the preparation of a master plan with a planning horizon of 2020 in this Study. The overview of the DMDP Structure Plan in its target year of 2015 is shown in Figure 5.1.

The DMDP Structure Plan provides policies of relevant sector developments, such as land use, economy, transportation and flood control, but no clear policy for provision of sanitation and sewerage service is included. Some policies relevant to sanitation/sewerage sector are picked up in the fields of pollution control and infrastructures from the DMDP Structure Plan.
A list of policies adopted in the DMDP is shown in Table 5.1.

5.1.2 Strategy for Sanitation/Sewerage Provision

(1) Coverage of master plan

The master plan for sanitation/sewerage service provision will be focused on the domestic wastewater and stormwater disposal will be excluded from the master plan activities, as stipulated in the Scope of Work for the Study and in consideration of presence of plans for flood control and stormwater disposal.

Target area for master planning is considered to coincide with the urban area boundary in 2015 as adopted in the DMDP Structure Plan. This means that the proposed urban area for 2015 under the said Structure Plan will remain unchanged through the future until the target year 2020 of this Study.

This strategic decision is based on the uncertainty of the long-term framework as admitted in the course of DMDP preparation and on the importance to maintain consistency with the supreme plan, the DMDP Structure Plan, within the reasonable time frame.

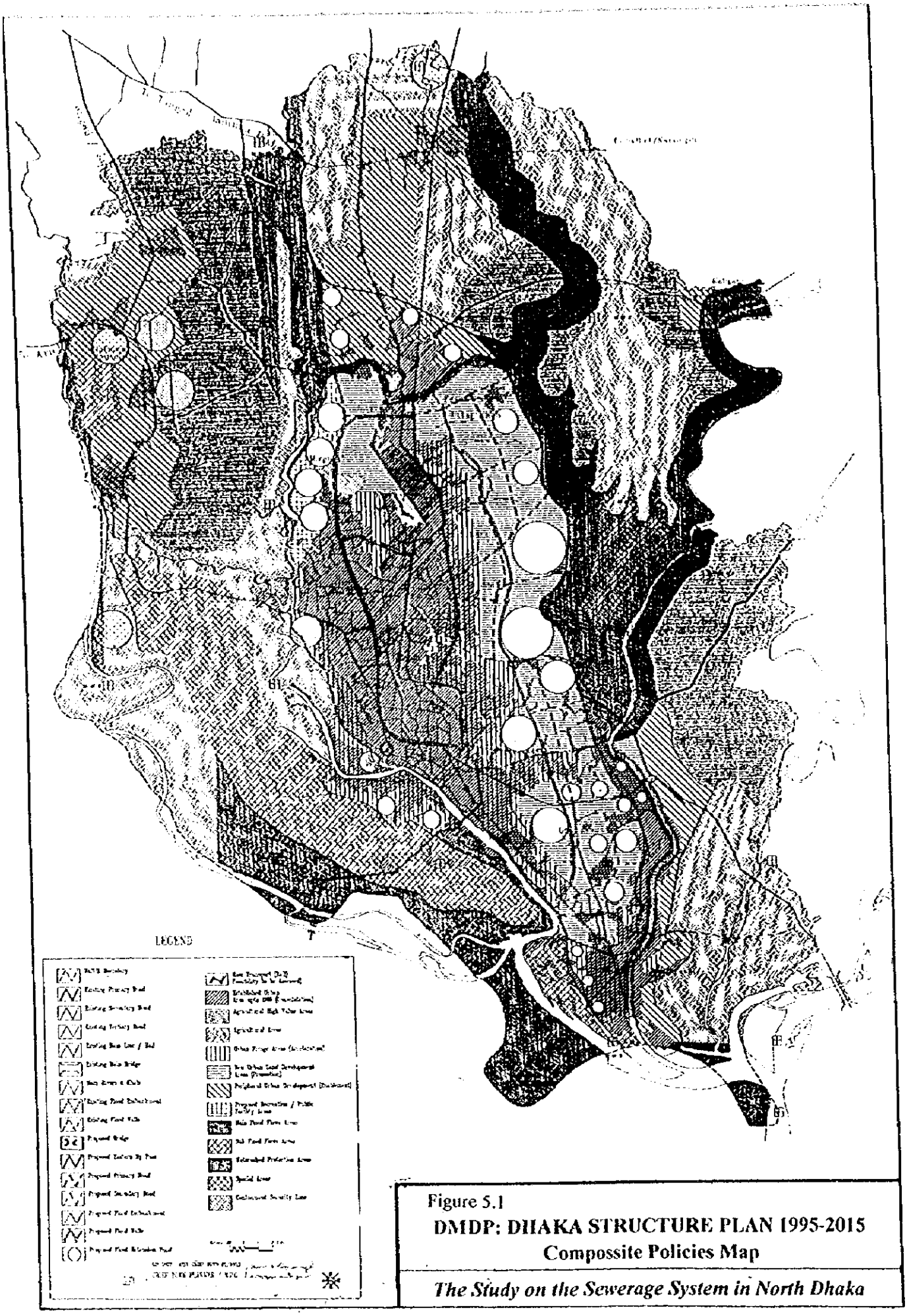


Figure 5.1

DMDP: DHAKA STRUCTURE PLAN 1995-2015

Compossite Policies Map

The Study on the Sewerage System in North Dhaka

Table 5.1 List of Policies Adopted in DMDP

Sector/Field		Policy (ID & Name)	
1.	**Rural and Special Area Policies**		
1.1	Areas of High Agricultural Value	RS/1	Areas of High Agricultural Value
1.2	Flood Control, Drainage and Irrigation Project Areas	RS/2	Flood Control, Drainage and Irrigation (FCD) Project Areas
1.3	Flood Plains, rivers and Water Bodies	RS/3	Flood-Flow Zones
		RS/4	River Pollution Control
		RS/5	Flood Retention Ponds
1.4	Special Areas	RS/6	Special Areas
2.	**Urban Area Policies**		
2.1	Established pre-1983 Urban Area	UA/1	Land Resource Optimisation
		UA/2	Infrastructure Consolidation
		UA/3	Community-Based Development Initiatives
		UA/4	Urban Neighbourhood Action Programs
2.2	Existing Near Urban Fringe	UA/5	Urban Fringe Development Acceleration
2.3	New Urban Land	UA/6	New Urban Land Growth Promotion
		UA/7	Infrastructure Initiatives
2.4	Peripheral Urban Development Areas	UA/8	Priority Peripheral Urban Development Areas (Tongi/Gazipur & Savar/Dhamsona)
3.	**Economic Development**		
3.1	Economic Development Manufacturing Industry	SE/1	Incentive
		SE/2	Industrial Estates, Tejgaon and Tongi
		SE/3	Foot-loose Industries
		SE/4	Polluting Industries
		SE/5	Informal Sector Activities
3.2	Public Administration	SE/6	Institutions and Public Administration
3.3	Commerce	SE/7	Dispersal of commercial Activity
		SE/8	Improved Access to and within the CBD (Central Business District)
3.4	Health and Hygiene	SE/9	Data Dissemination
3.5	Recreation and Open Space	SE/10	Augmenting City Open Space
		SE/11	Securing Future Open Space
4.	**Infrastructures**		
4.1	Road Development	IN/1	Eastern Bypass
		IN/2	Incremental Network Development
4.2	Development of Public Transport Service	IN/3	Bus Service
		IN/4	Commuter Rail Network
5.	**Flood Control and Drainage**		
5.1	Prioritisation of FCD Projects - Approach and Criteria	IN/5	Incremental Flood Protection

Another reason underlying this decision is that an expansion of water supply service to the future urban area of the DMDP Structure Plan is not yet in a visible state at this moment.

It shall be noted that, in view of the above, the target area of this master plan will be subject to periodical review and should be updated corresponding to the implementation progress of relevant infrastructure projects and the DMDP Urban Area Plan.

(2) Application of different service levels by area

There are several implications for provision of public sewerage service:

1) Cost and time requirement

An implementation of a sewerage system to achieve the proposed service coverage of the master plan generally requires a considerable period and a large amount of capital investment.

2) Accountability of executing agency

The attainment of sound accountability of the executing agency is predicated on a thorough restructuring of its institutional and financial set-up from the viewpoint of financial cash flow, debt service ratio, cost recovery, and human resource development.

3) Affordability of beneficiaries

Beneficiaries are belong to different income groups and financial affordability in connection with per capita water consumption and payment to water/sewerage service charges and they may stay at more or less similar situation during the master plan period.

4) Different states of urbanization by area

Although the DMDP Structure Plan has been issued as an overall guideline of policy and strategy, the Detailed Area Plan by Strategic Planning Zone are still at the stage of commencement and various legislative arrangements are subject to inter-agency coordination and approval by the Government. Meanwhile, the private sector continues investments of different magnitudes and in different fields.

When the above-mentioned circumstances and the size of master plan target area are taken into account, there will appear different states of urbanization with different population densities.

Although provision of sewerage service to the entire urban area is ideal, it is not realistic when the previously-mentioned implications are fully taken into account. An application of different service levels in different areas is therefore deemed as the most practical approach as an intermediate measure in terms of the realization and fulfillment of public sewerage service through the future.

(3) Exclusion of industrial wastewater from sewerage service

Within the master plan target area, there is the Tongi Industrial Estate, which is an integrated industrial complex mostly consisting of textile dying and poultry, followed by pharmaceuticals, dry battery cells, and synthetic detergents. None of these factories have wastewater treatment facilities and their untreated "colourful" wastewater is discharged into the Tongi River via swamp areas. This industrial estate is now subject to a thorough review of its management from the standpoint of operating procedures and cost effectiveness under Policy SE/2 of the DMDP Structure Plan.

Another typical polluting industry is the tannery industry, which discharges toxic wastewater containing chromium hexavalent. Most of tanneries are small-scale and area located in the Hazaribag area of Dhanmondhi in South Dhaka. These factories are subject to relocation to a site adjacent to the Dhaleswari River, south of Savar.

This master plan has introduced a categorization of target area as follows:

- Core area for sewerage service
- Transitional area from on-site treatment to sewerage service
- On-site treatment area

A conceptual diagram of sanitation/sewerage provision is drawn in Figure 5.2 and its itemized explanation of area categorization is provided in Table 5.2, respectively.

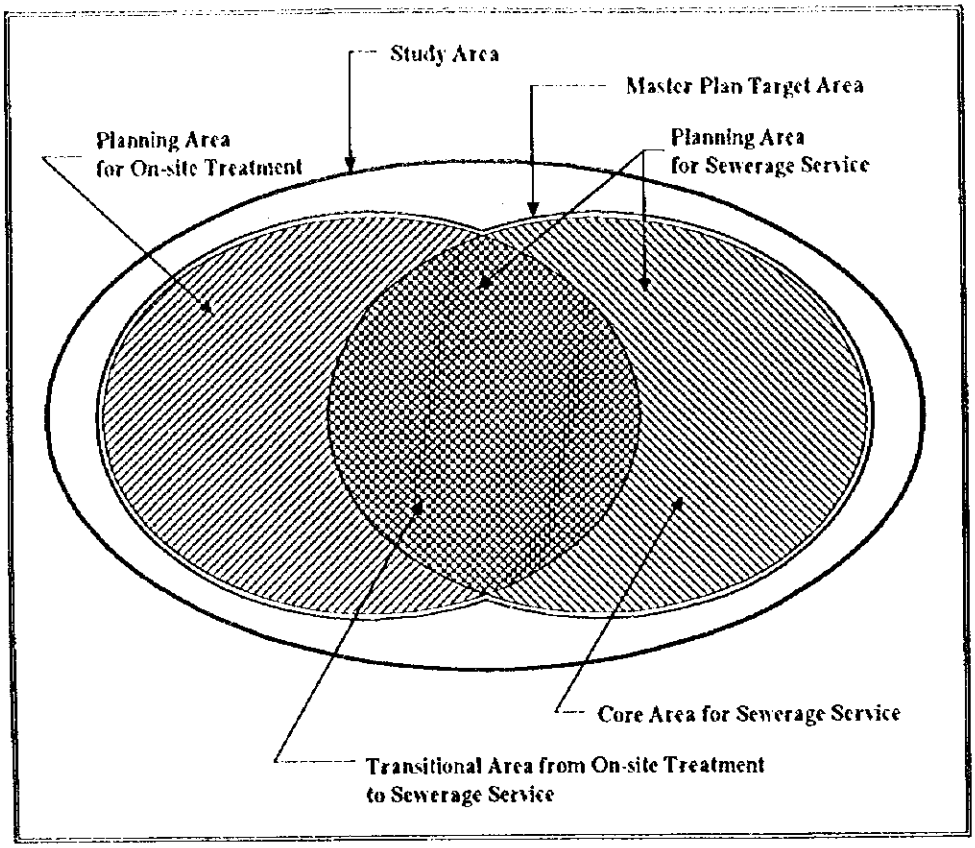


Figure 5.2 Conceptual Diagram of Sanitation/Sewerage Provision

Table 5.2 Explanation of Conceptual Diagram

Area	Description
Study Area (North Dhaka)	・Dhaka City (Uttara, Mirpur, Mohammadpur, Cantonment, Banani, Badda, Gulshan, Baridhara) ・Tongi Pourashava (Municipality)
Outside the Target Area For Master Plan	Areas outside of the Target Area for Master Plan are rivers, canals, swamps, agricultural area and open space.
Target Area for Master Plan	Master Plan area for sanitation/sewerage provision.
Planning Area for **Sewerage Service**	Areas where sewerage services will be provided by the target year of 2020 under this Master Plan.
Planning Area for **On-site Treatment**	Areas where the existing on-site treatment methods, i.e. septic tank, will be utilized through the future within this Master Plan framework.
Transitional Area from On-site Treatment to Sewerage Service	Areas where the sewage will be treated by sewerage system by shifting from the existing septic tank during the Master Plan period to 2020.
Core Area for Sewerage Service	Existing urbanized areas having relevant infrastructures (water supply and road network) for implementing sewerage project.